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CALIFORNIA SOLAR DATA MANUAL

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Many people outside the laboratory provided data and guidance for the manual. Of particular note are James Goodridge, Engineering Climatologist for the California Department of Water Resources, who shared his extensive knowledge of solar data and the climate of California; and Harold Bulk, Climatologist at the University of Arizona, who developed the solar zones.

The manual reflects, to a large extent, the comments made by the many people who took the time to carefully review earlier versions.

Finally, we thank Candace Voelker, Robert Hendrickson and other members of the Laboratory's Technical Information Department for their professional job of assembling the manual.

PREFACE

This solar data manual is aimed at the needs of designers, architects, engineers, homeowners, builders, and the growing number of ingenious and enthusiastic individuals through whose efforts the widespread use of the sun's energy will become a reality.

Because it contains the most reliable solar data presently available in the State of California, this manual provides the basic solar data needed to design residential or commercial heating systems, solar heated swimming pools, and solar air conditioning systems. Many other uses of the data are possible — for example, for agricultural applications. The data are provided in a variety of representations as an attempt to make them accessible and useful to the broadest possible audience. The design of passive solar heating and cooling systems is in its infancy, but might well revolutionize our approach to architecture and building construction in the near future. Statistical distributions showing the variability and patterns of the solar climate are presented in the hope of aiding such efforts.

This manual is not intended to show how to design a solar heating system for a home, or tell how many square meters of solar collector area are needed to heat a swimming pool. As the use of solar energy becomes more widespread, standard design criteria and "rules of thumb" will gradually emerge and will vastly simplify design procedures for standard applications. Until that time the solar designer must base decisions on computer simulations, simplified design procedures based on computer simulations (a guide to these is included in Section VIII), calculations based on simplifying assumptions, an awareness of the commercially available hardware options, common sense, and a knowledge of the requisite solar and weather parameters. This manual can supply only the latter.

CONTENTS

I. Introduction

California has relatively high population densities in generally sunny areas. This combination of people and sun creates a high potential for solar energy use. Solar-heated swimming pools are common, and many homes have been built or retrofitted for heating by the sun. However, the amount of energy involved is still quite small, when compared to the total energy use of the state. To facilitate widespread use of solar energy, it is important to provide potential users with a description of the solar energy resource. The *California Solar Data Manual* describes this resource through an assembly of existing and derived data.

Several types of solar data have been collected throughout California for varying periods of time and with various degrees of accuracy. These data were scrutinized for the manual and accepted or rejected on the basis of certain criteria. For some of the important solar data types there are no records. In these cases, the data were derived by the application of standard methods. All the data were then organized into graphical or tabular displays. The manual also contains relevant climatological data.

Each section of the manual elaborates on a different aspect of the solar resource description, and may be useful in determining the physical and economic advisability of a particular solar energy application, in optimizing an actual design, or in evaluating options about where to place collectors.

Section II presents the factors that determined the data contents of the manual. Estimates of errors in the data are provided, and the impact of these errors on solar design is discussed.

To facilitate organization of the data in a way most usable by readers, we have divided the state into 15 solar zones of roughly similar solar radiation conditions. These zones are illustrated in Section III, along with page references to the most relevant solar and climate data in Sections V and VI.

Section IV provides a guide to the data tables and graphs, which are then displayed in Sections V, VI, and VII.

One useful application of the various data is as input to simplified design methods to predict the performance and cost of solar energy systems for the heating and cooling of buildings. Section VIII gives a guide to these methods.

For the interested reader, Section IX briefly summarizes the nature of solar radiation as received at the surface of the earth. Section X describes the technique used to calculate unmeasured solar radiation quantities, given measurements of other solar quantities.

Appendix A is a solar radiation glossary, and Appendix B provides conversion factors between Engineering (English) and SI (metric) units. Appendix C contains a general bibliography, and Appendix D provides a supplementary list of specific references.

II. Availability and Quality of the Data

A. DATA AVAILABILITY

There are over 100 locations in California where solar data of one kind or another have been collected for varying periods. Although one might think that the state would be more than adequately covered by these sites, close examination has revealed that this is not the case. This section describes the types of data, collection instruments, and inadequacies in data records.

1. Solar Data

Solar energy is a general term that may be loosely defined as the radiated energy produced by the sun's thermonuclear reactions. Other more specific terms are useful for the practical implementation of solar devices. Total radiation on a horizontal surface is the amount of energy that falls on a horizontal plane at the earth's surface. This quantity has two components: direct beam and diffuse radiation. Direct beam radiation is the radiation that comes directly from the sun. Diffuse radiation is that which comes from the sky after the atmosphere has scattered the incoming solar rays.

a. TOTAL RADIATION ON A HORIZONTAL SURFACE

This quantity, sometimes called "insolation" or "global radiation," is the most frequently recorded solar measurement. Typically, this measurement is made with a pyranometer, which produces a voltage proportional to the temperature difference between a black surface heated by the sun and a cooler surface that is either shaded from the sun or painted white. A calibration constant is supplied with each instrument in order to convert the voltage to energy units (W/m^2 or Btu/ft^2h).

A similar instrument, the pyranograph (sometimes called an actinograph), uses a piece of metal that expands or contracts in proportion to the intensity of insolation, which can then be determined by a calibration constant. Many pyranograph measurements have been recorded in California, usually for short periods of time. Pyranographs, however, are generally considered less accurate than pyranometers.

A few places in the state have instruments that use solar cells. With such devices, radiation can be estimated from the amount of electricity produced.

A disadvantage with solar cells is that they only measure a part of the solar spectrum, usually the red and infrared portion.

Decisions on which data to include in the manual were based on three criteria. The first concerned the need for long-term data. Four or five years were considered adequate, because in this period of time, statistical averages can be calculated with reasonable certainty.

The second criterion concerned the type of instrument used to gather the solar data. Since there is some contention as to the relative quality of the various instruments, standard references on solar instrumentation were consulted and opinions from experts outside LBL were sought. In addition, on-site field inspections were conducted by LBL staff members for 24 solar measurement stations.

The third criterion dealt with the quality of the data record. Over the years, many solar-measuring instruments have suffered damage or deterioration, periodic recalibrations have sometimes been neglected, and recording systems have occasionally malfunctioned. Consequently, raw data records often contain errors. To deal with these instrumentation problems, a "clear-day" analysis was used. Application of the clear-day analysis is complicated (Martin et al., 1977), but a simplified description will explain the principle.

The original data were obtained in the form of daily radiation values measured by a pyranometer. Each daily quantity was then divided by the value a pyranometer would measure in the absence of the earth's atmosphere. This latter value, which can be observed at the edge of the atmosphere, is known as the extraterrestrial radiation (ETR). Daily pyranometer values divided by extraterrestrial radiation produce the quantity K_T. Clear days are those with the highest values of K_T.

After many K_T computations were performed, the behavior of clear-day values was studied. On the basis of this examination, decisions concerning the data were made. In some cases, the examination revealed that instrumentation had malfunctioned for periods of time, and data from these periods were discarded. In other cases, long-term deterioration in the instrumentation was observed. Data affected by long-term deterioration were treated by correction factors based on theoretical clear-day K_T values.

There is, unavoidably, some residual error in the adjusted data, as discussed in Section B below. However, this error is far less than that observed in much of the original data. Some pyranometers were discovered measuring values 15% too low, and others 20% too high.

After applying the three criteria, the solar-cell data were considered unusable. The pyranograph measurements were judged to be of rather poor quality, but were included in the manual when no other measurements were available for an area. The bulk of the pyranometer data was judged acceptable. However, a large fraction of the data required adjustment of the calibration constant by the clear-day approach. Out of the 100 possible sites, the solar-data tables in Section V have measurements from 19 locations in or close to California.

b. DIRECT BEAM (NORMAL INCIDENCE) RADIATION

Direct beam (normal incidence) radiation is the direct beam radiation that falls on a hypothetical surface that is always perpendicular (normal) to the direct incoming rays. This radiation can be measured by a pyrheliometer. The most commonly used pyrheliometer works much the same as a pyranometer, but has a long tube, called a collimator, that restricts the field of view of the instrument so that it "sees" only a small portion of the sky. The pyrheliometer must be mounted on a sun-tracking device so that the sun is always near the center of the field of view.

Few long-term pyrheliometer measurements are available in the U.S.; none are available in California. One reason is that, because of the sun-tracking devices, they are relatively expensive and require attention every few days. The data tables contain calculated values for the direct beam radiation made according to a technique described in Section X.

c. TOTAL RADIATION ON A TILTED SURFACE

Total radiation on a tilted surface is simply the direct, diffuse, and reflected radiation that falls on a surface tilted at some specified angle from the horizontal. Knowing this quantity is important since most solar applications that employ flat-plate collectors have the collectors tilted towards the south in order to maximize the energy received during the winter. As no long-term tilted-surface measurements exist for California, these data were also calculated by a technique outlined in Section X.

2. Climate Data

a. CLOUD COVER AND PERCENT POSSIBLE SUNSHINE

Cloud cover is an estimate, made by a trained observer, of the fraction of the sky covered by clouds. Percent possible sunshine is the percentage of time that the sun is shining during the period from sunrise to sunset.

This latter quantity is obtained from an instrument having a "sunshine switch" that is "on" whenever the solar radiation is above some threshold, usually defined as the amount of light necessary to cast a shadow.

Cloud cover and percent possible sunshine are sometimes used to estimate the amount of solar radiation when actual measurements are not available. Long-term averages of these quantities are published by the National Weather Service (NWS) for a number of places in California, and are included in the data tables. Long-term values of cloud cover are also available for many military bases in the state. But since these estimates are for day and night combined, they are probably not as strongly correlated with the solar radiation as are the NWS values. The military base values are given in the data tables when no other source of cloud cover data is available in the area.

LBL did not attempt to verify the quality of either the cloud cover or sunshine data.

b. WEATHER DATA

For 20 locations in or close to California the NWS has published summaries that provide climatological descriptions for the locations and long-term values for most of the important weather parameters. All the descriptions and many of these values have been included in the manual. Similar information for military bases is available through the Air Weather Service (AWS). These data are also included, except for bases very near the NWS locations.

A few basic types of data (average temperature, heating and cooling degree-days) are available for 203 locations and precipitation data for 349 locations from a climatological summary of California published by the NWS. A copy of this summary appears in Section VI.

B. SOLAR DATA ERRORS

The major contribution of this manual towards fulfilling California's solar data needs is the presentation of pyranometer measurements that have been analyzed and adjusted by the clear-day technique. LBL has also estimated the errors in these data and analyzed the consequences of designing solar energy systems with erroneous solar quantities.

1. Errors in the Total Horizontal Radiation

The clear day analysis effectively compensates for many of the error sources that afflict pyranometer measurements. The major remaining source of error is inherent in the clear day technique itself. For the data in this manual, adjustments to the calibration constant were based on summertime measurements when the skies are cloud-free for extended periods of time. But even under these conditions, the calibration cannot be set exactly; for summer months, it is estimated that the data are accurate to within ±5%.

In the spring, autumn and winter, other problems arise. One is that certain instruments may read differently for cold temperatures than for warm; another arises if the instrument does not properly account for the lower position of the sun in the sky during the winter. Based on the available literature and some practical experience with the instruments, LBL estimates that the error during the spring, autumn, and winter months increases to as much as ±10%.

2. Errors in the Direct Beam and Tilted-Surface Calculations

Because direct beam and tilted-surface radiation are calculated from total horizontal radiation data, they both suffer from errors inherent in the clear day analysis. In addition, there are uncertainties in the computational techniques, which compound the overall error in these values. Graphs included in Section V provide estimates for the possible error in the calculations, assuming the total horizontal radiation error to be ±5%. Since this number is probably low for the winter months, a good rule of thumb is to choose the greater of the estimate provided by the graph and ±10%.

C. CONSEQUENCES OF DATA ERRORS ON SYSTEM DESIGNS

Consider a solar energy system that is designed using data in error by a certain amount. What, then, will be the effect on the performance and cost of the system? LBL investigated this question for two hypothetical cases: a residence heated by flat-plate collectors, with a conventional back-up furnace; and a solar electric power plant (Berdahl, et al., 1977). The results of the two investigations were similar and are briefly summarized here for the solar heating case.

A computer program was used to study a design for a standard-sized residence with solar energy supplying from 50% to 70% of the heating load, depending on the area of the solar collector. The analysis was carried out for a heating load and long-term values of solar radiation characteristic of the climate of Davis. The analysis was then repeated for a climate like that of Los Angeles. The following results are essentially the same for both climates, and are considered applicable to any solar heating system in California that supplies between 50% and 70% of the heating load.

If the solar data overestimate the actual long-term solar radiation by a certain percentage, then the amount of usable solar energy that is collected will be less than anticipated by about half that percentage. For example, if the solar data are too high by 10%, the usable solar energy will be about 5% less than expected. These percentages are reflected in cost calculations over the lifetime of the solar heating system: one can expect to pay about 5% more than anticipated if the design data are 10% too high. Gross overestimates of the solar radiation may cause buildings to be equipped with solar systems when they should not be.

An inverse relationship holds for data that underestimate the actual long-term solar radiation. For example, if one uses solar data that are 20% lower than the actual radiation values, then the usable solar energy collected will be about 10% more than expected. This circumstance will also result in an annual cost about 10% lower than expected. Thus, underestimated solar data may deter construction of solar equipped buildings when such data indicate that there is not enough solar energy to make such a venture economically viable.

1. General Cost Impact of Errors in the Data

There is another more subtle effect caused by errors in the data. Suppose the solar system is designed to minimize costs (optimized) using erroneous numbers. Optimal performance will not be observed, and overall heating costs will then be higher than if the correct values of solar data had been used. This increased cost occurs regardless of whether the data are overestimated or underestimated. For an individual building the cost penalty turns out to be small (~0.5%) as long as the solar data are not in error by more than 10%.

III. Solar Zones

As discussed in Section II, there are only 19 solar measurement stations in or near California with data of acceptable record length and quality, so many sites of potential solar energy applications will be some distance from any of the stations. Unfortunately, there is no accepted procedure for using the values from one or more stations to determine the solar radiation at a distant location. The hills, valleys, mountains, and coast line of California make such a procedure quite difficult to derive.

To provide some guidance to the use of the solar data, California was divided into 15 "solar zones," which are depicted in the map on page 17 and shown in more detail on the maps on pages 18-33. Within each zone, a characteristic solar potential is expected to prevail. The division into zones was made by a climatologist (Bulk, 1977) on the basis of topography and atmospheric conditions related to solar radiation. The most important atmospheric condition was cloud cover, but such factors as fog and air-pollution levels were taken into account as well.

It must be emphasized that the solar zones are only approximate, as there were not enough accurate data to determine the exact boundaries. Furthermore, there will often be microclimates within a zone where the local solar radiation differs from that characteristic of the zone as a whole. For example, coastal radiation will vary from that immediately inland due to the influence of fog. Thus, the zones should be used as guides, together with the user's knowledge of local conditions.

The maps on page 17 and on pages 18-33 show the locations of the 19 measurement stations relative to the solar zones. Since the zone boundaries were chosen independently of these stations, it is not surprising that some zones have more than one station while others have none.

Users fortunate enough to have a solar application within one of the multi-station zones should, as a general rule, use the solar data from the nearest one. It is advisable, however, to consider for comparison purposes the data from the other stations within or close to the zone.

Users in a zone with one solar measurement location should normally use the corresponding data. Discretion is advised, particularly near zone boundaries that do not run along mountain ridges.

Care must also be taken in sparsely monitored zones that straddle large latitude intervals like zone 6. The user living in Ventura might question the suggestion to use data from the San Vicente reservoir for a solar energy application. In such an instance, the user might consider the data from Santa Maria, as well as from San Vicente.

Users living in zones devoid of solar data stations will be harder pressed in obtaining reliable data for solar energy applications. Except for those applications quite close to a measurement station, a good procedure is to consider the data from several stations. For example, a user in Red Bluff (zone 8) might be interested in using a simplified design method (see Section VIII) to estimate the optimal solar collector area for a home heating application. The user could try the data both for Davis (zone 10) and Medford (zone 7). The two results will likely bracket the estimate that would have been obtained, had data been available for Red Bluff.

The solar zones are not intended to indicate regions of similar climate. Although solar energy plays a significant role in determining the climatic conditions (temperature, precipitation, wind) of a given area, other factors, like topography, are also important. This is especially so for solar zones that circumscribe both mountain ranges and expansive valleys. Throughout such zones, the solar radiation will be roughly the same, whereas the climate will differ markedly between the highlands and valleys. The climate station sites are shown on the solar zone maps for the reader's reference, and each solar zone lists the nearby sources for both solar and climate data. However, the user is warned that the climatological data presented in Section V of this manual are not specific to the solar zones in which the stations are located. Use of these data, then, must be undertaken with discretion.

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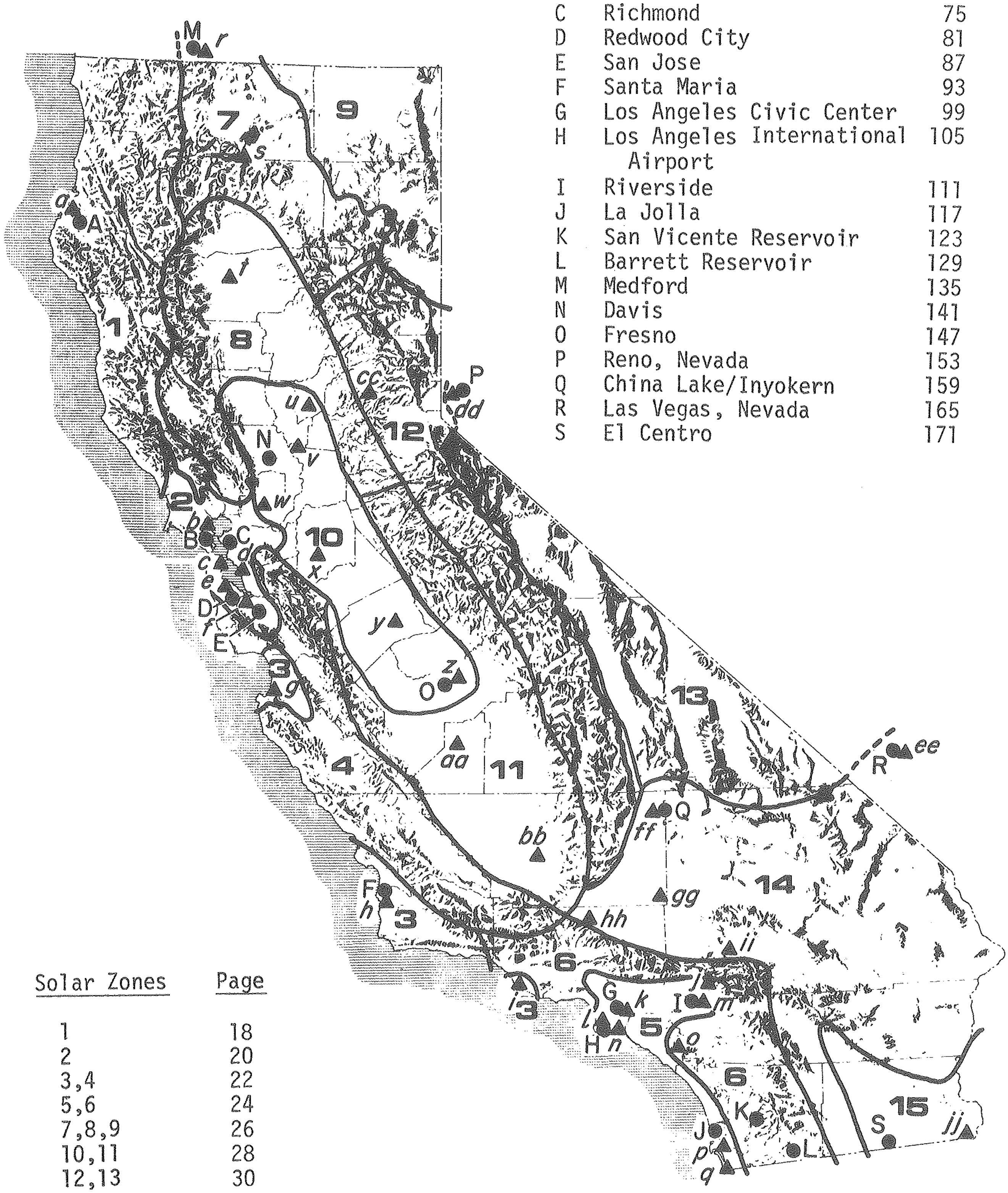

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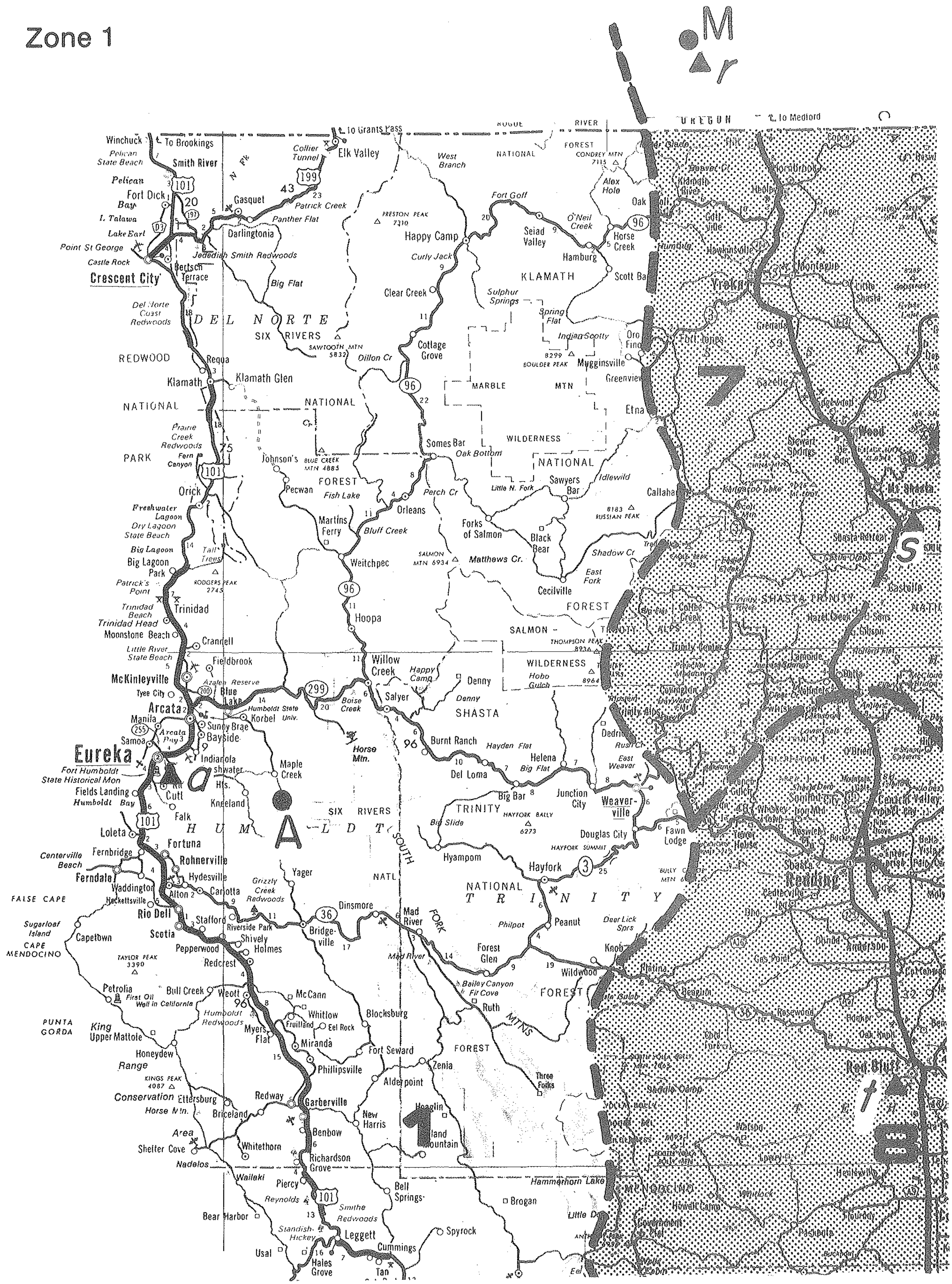
Zone 1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To Grants Pass
To Brookings
Winchuck
Pelican State Beach
Smith River
Pelican Bay
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Lake Earl
Point St George
Castle Rock
Crescent City
Gasquet
Patrick Creek
Panther Flat
Elk Valley
Collier Tunnel
Darlingtonia
Jedediah Smith Redwoods
Big Flat
DEL NORTE
SIX RIVERS
Happy Camp
Clear Creek
Seiad Valley
Hamburg
Horse Creek
Scott Bar
KLAMATH
Cottage Grove
Requa
Klamath
Klamath Glen
REDWOOD
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PARK
MARBLE
MTN
WILDERNESS
Somes Bar
Oak Bottom
Sawyers Bar
Orleans
Forks of Salmon
Orick
Weitchpec
Hoopa
Cecilville
Callahan
Etna
Big Lagoon
Trinidad
Moonstone Beach
Crandell
Fieldbrook
McKinleyville
Arcata
Blue Lake
Korbel
Willow Creek
Salyer
Denny
SHASTA
Burnt Ranch
Manila
Samoa
Eureka
Bayside
Maple Creek
Helena
Del Loma
Big Bar
Junction City
Weaverville
Douglas City
Hyampom
Hayfork
Fields Landing
Loleta
Fortuna
Fernbridge
Rohnerville
Hydesville
Ferndale
Carlotta
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Scotia
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Bridgeville
Mad River
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Blocksburg
Ruth
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Redway
Garberville
Alderpoint
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Richardson Grove
Piercy
Leggett
Cummings
Bear Harbor
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Anderson
Red Bluff
SHASTA-TRINITY
TRINITY
NATIONAL
FOREST

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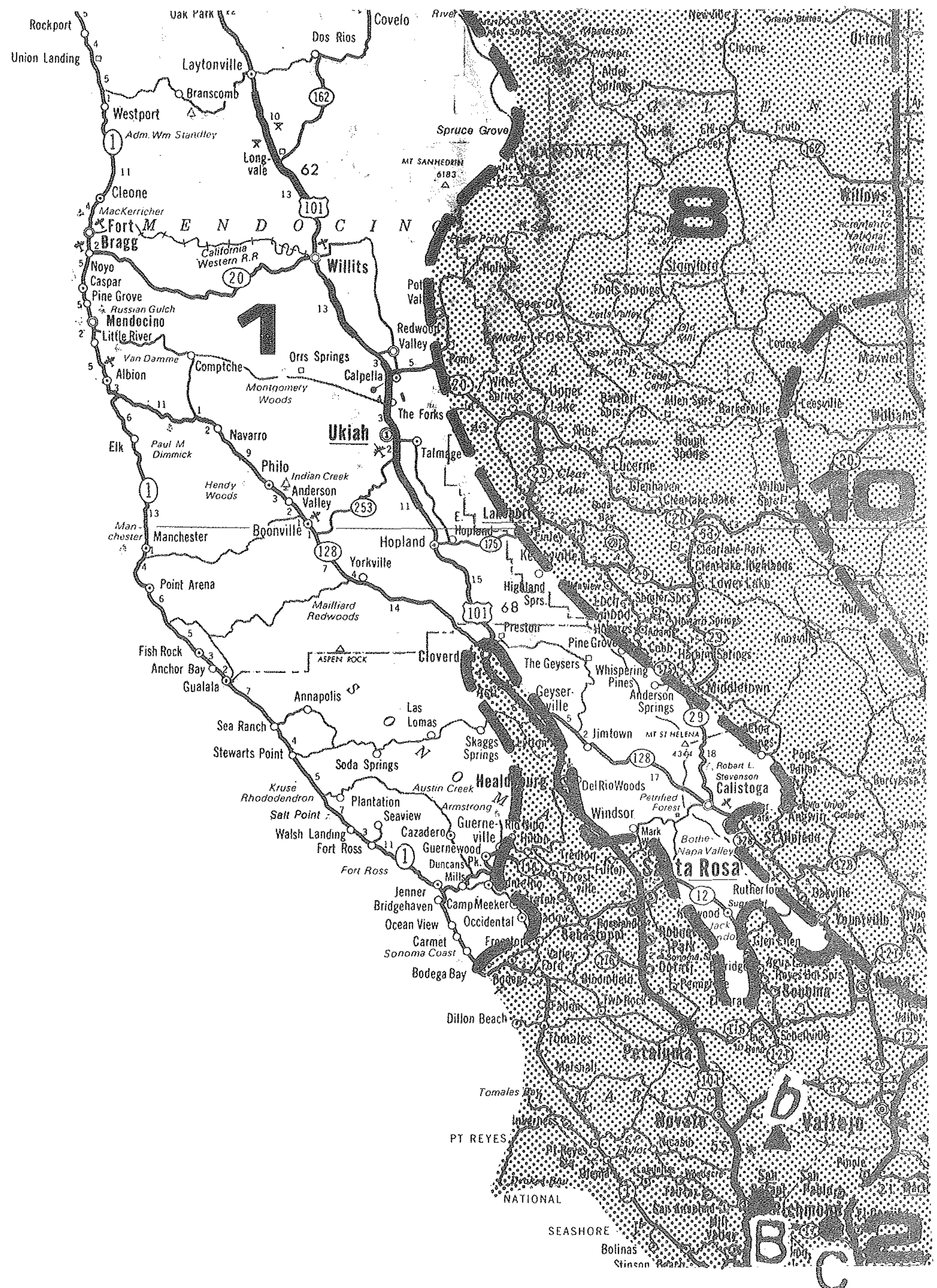

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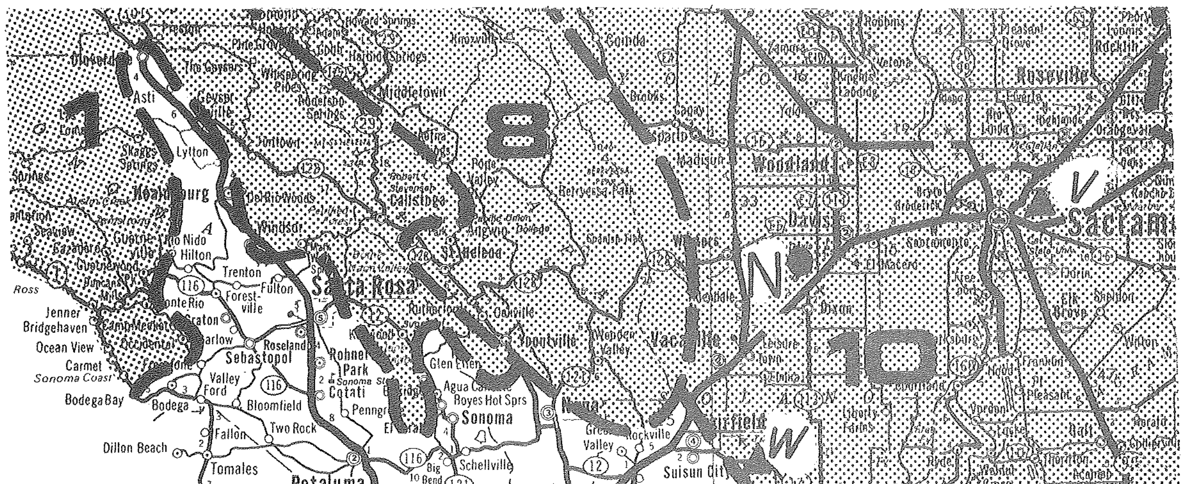
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Santa Clara
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Davis
Woodland
Roseville
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Napa
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Half Moon Bay
El Granada
San Gregorio
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Pigeon Pt.
Bodega Bay
Dillon Beach
Tomales
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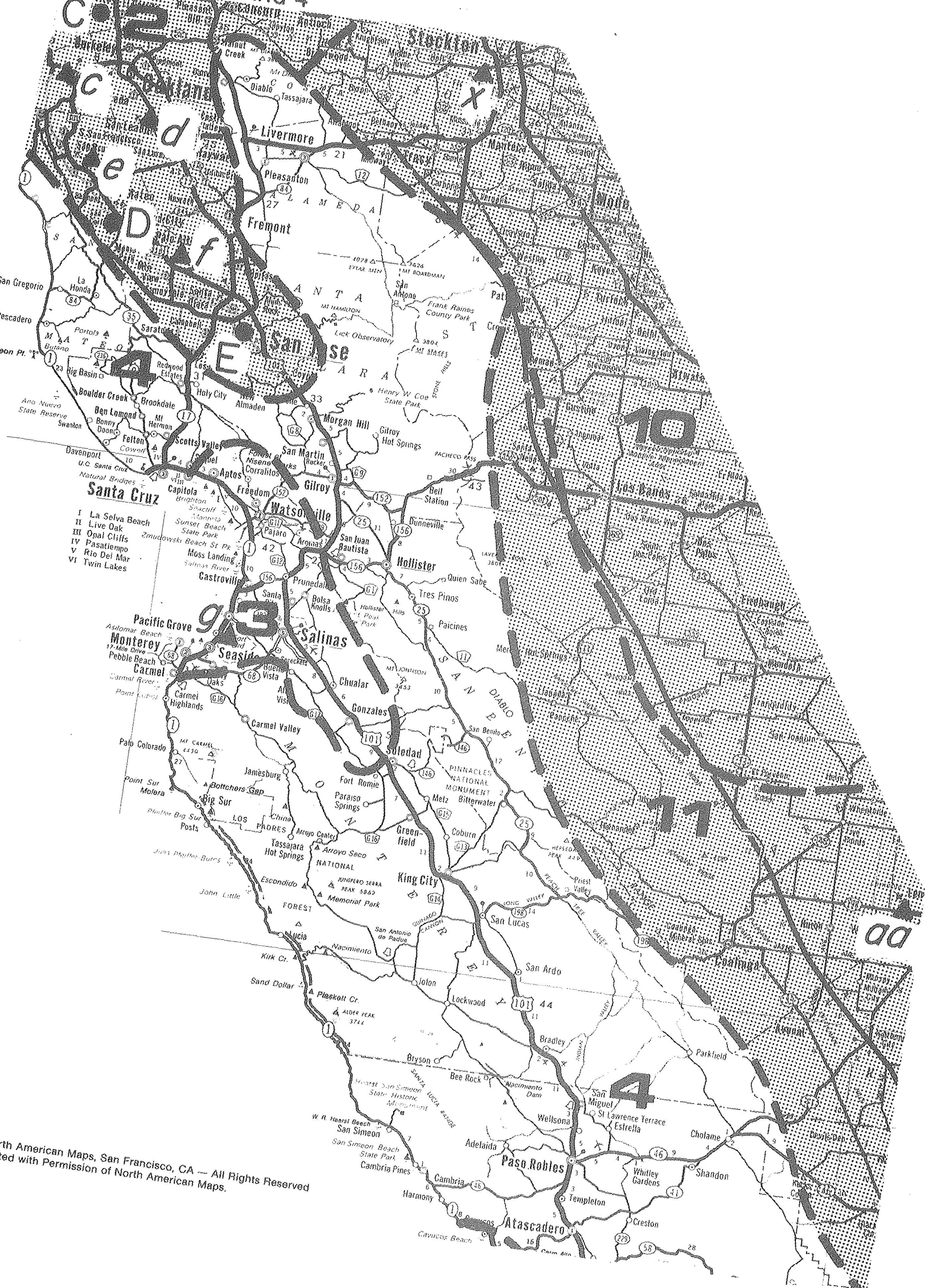
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Gilroy
Morgan Hill
San Martin
Gilroy Hot Springs
Hollister
San Juan Bautista
Castroville
Moss Landing
Prunedale
Salinas
Pacific Grove
Monterey
Pebble Beach
Carmel
Seaside
Carmel Highlands
Carmel Valley
Chualar
Gonzales
Soledad
Fort Romie
Paraiso Springs
Jamesburg
Palo Colorado
Big Sur
Posts
Tassajara Hot Springs
Greenfield
King City
Tres Pinos
Paicines
Bitterwater
Coburn
Priest Valley
San Lucas
San Ardo
Lockwood
Jolon
Lucia
Kirk Cr.
Sand Dollar
Bradley
Parkfield
Bryson
Bee Rock
San Miguel
Wellsona
Estrella
Cholame
Adelaida
Paso Robles
San Simeon
Cambria
Cambria Pines
Harmony
Templeton
Atascadero
Creston
Shandon
Whitley Gardens
Los Banos
Coalinga
Lick Observatory
Pinnacles National Monument
Arroyo Seco
Memorial Park
Salinas River
Zmudowski Beach St Pk
Henry W Coe State Park
Pacheco Pass
Bell Station
Dunneville
Quien Sabe
Holy City
Almaden
Redwood Estates
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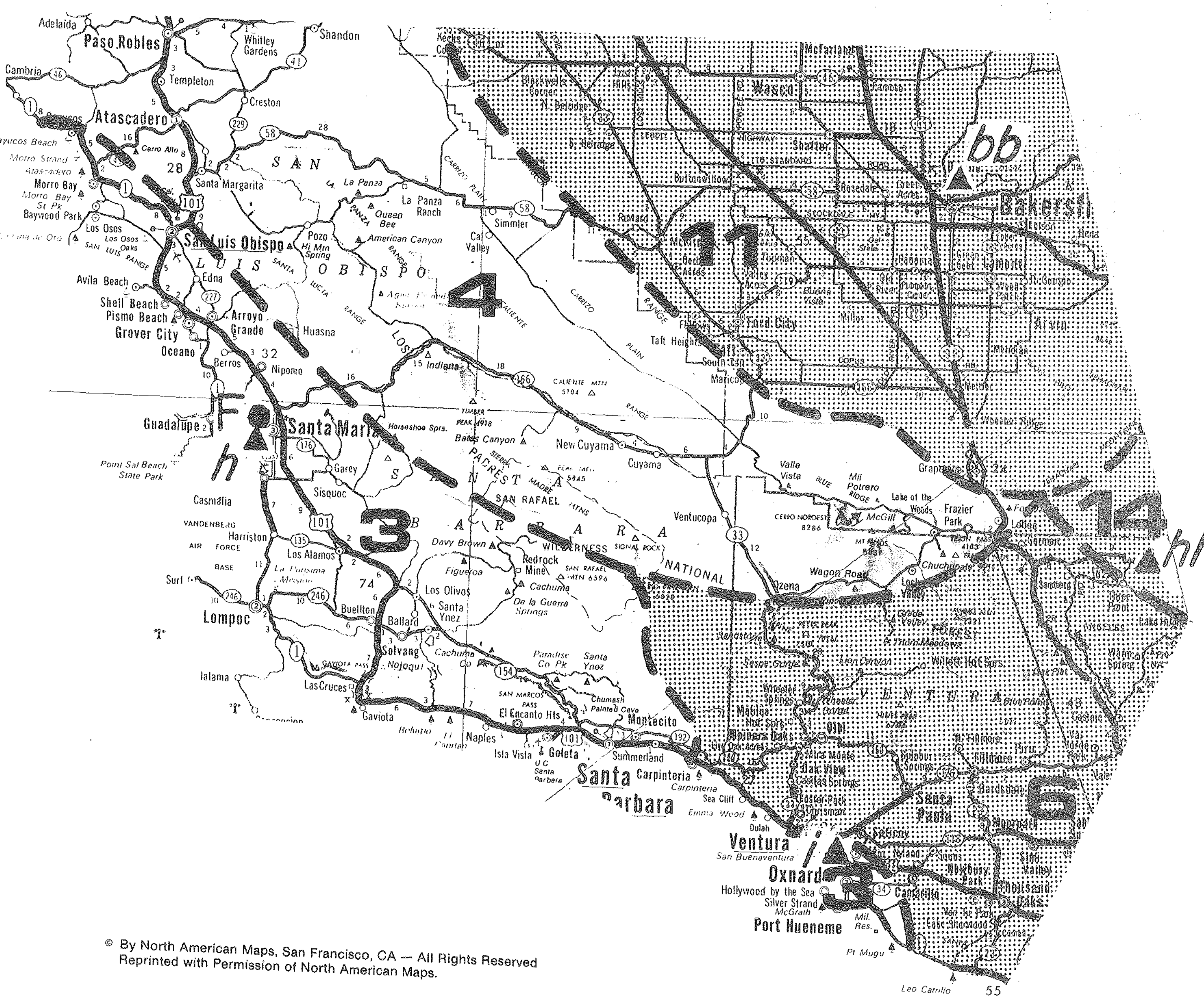

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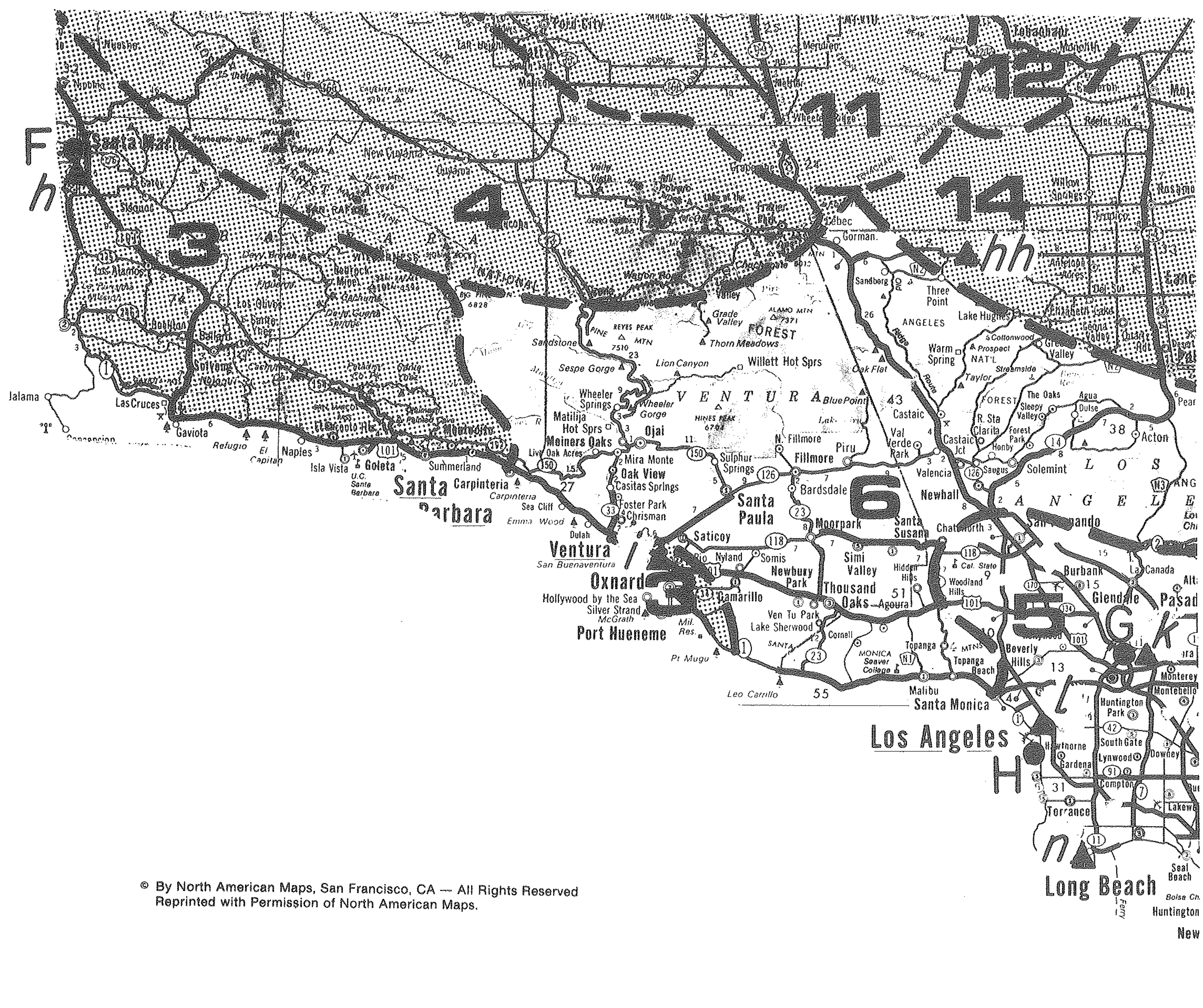

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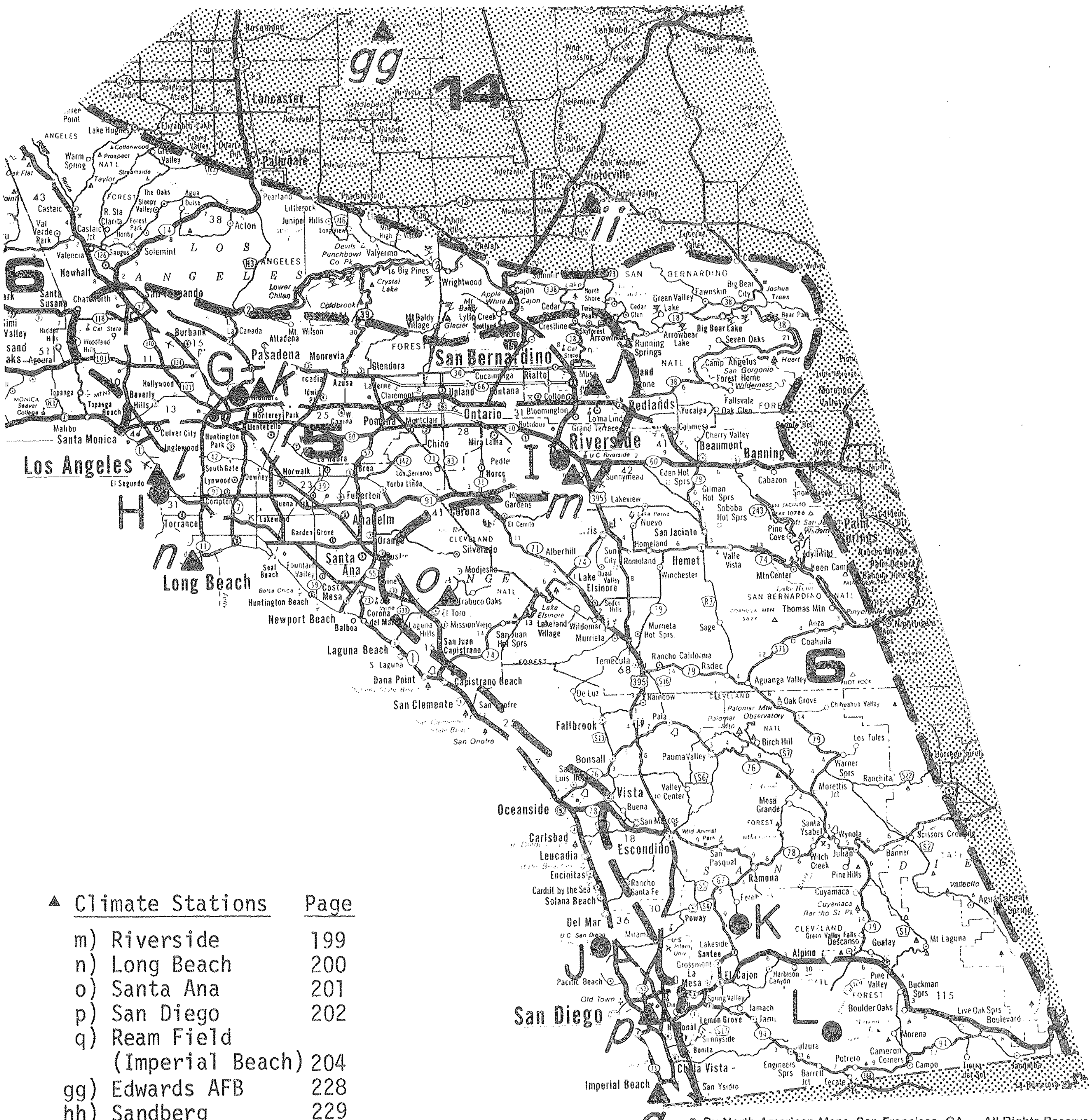
Camarillo
Fillmore
Ojai
Goleta
Carpinteria
Gaviota
Lompoc
Jalama
Newhall
Castaic
Saugus
Burbank
Glendale
Beverly Hills
Malibu
V E N T U R A
L O S A N G E L E S

Zones 5 and 6 (continued)

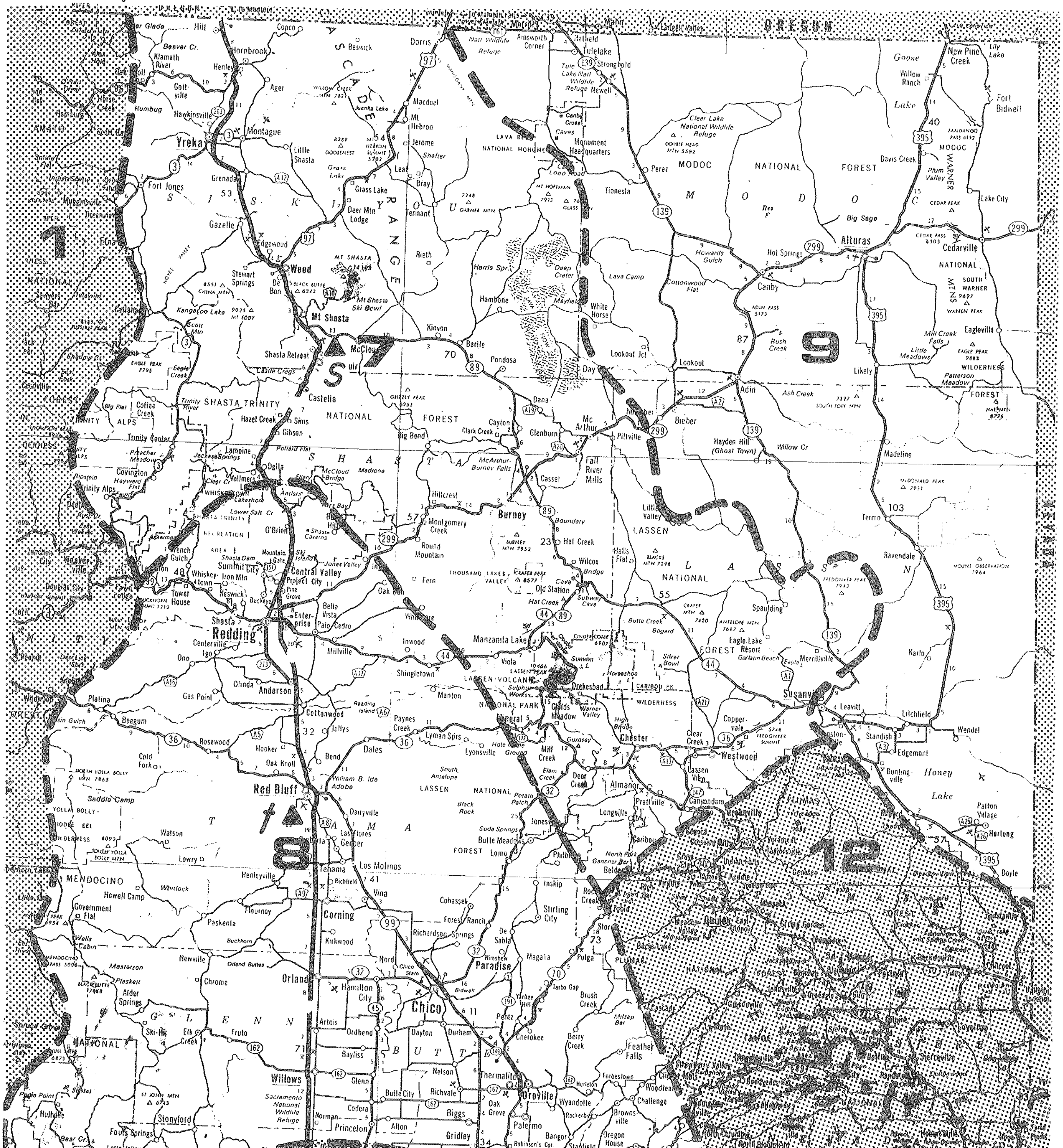
▲ Climate Stations	Page
h) Santa Maria	191
i) Oxnard	193
j) San Bernardino	194
k) Los Angeles Civic	195
l) Los Angeles Airport	197



▲ Climate Stations	Page
m) Riverside	199
n) Long Beach	200
o) Santa Ana	201
p) San Diego	202
q) Ream Field (Imperial Beach)	204
gg) Edwards AFB	228
hh) Sandberg	229
ii) Victorville	230

Zones 7, 8, and 9

• Solar Stations in Zone 7	Page	• Solar Stations in Zone 8
M Medford	135	none



Zones 7, 8, and 9 (continued)

• Solar Stations in Zone 9

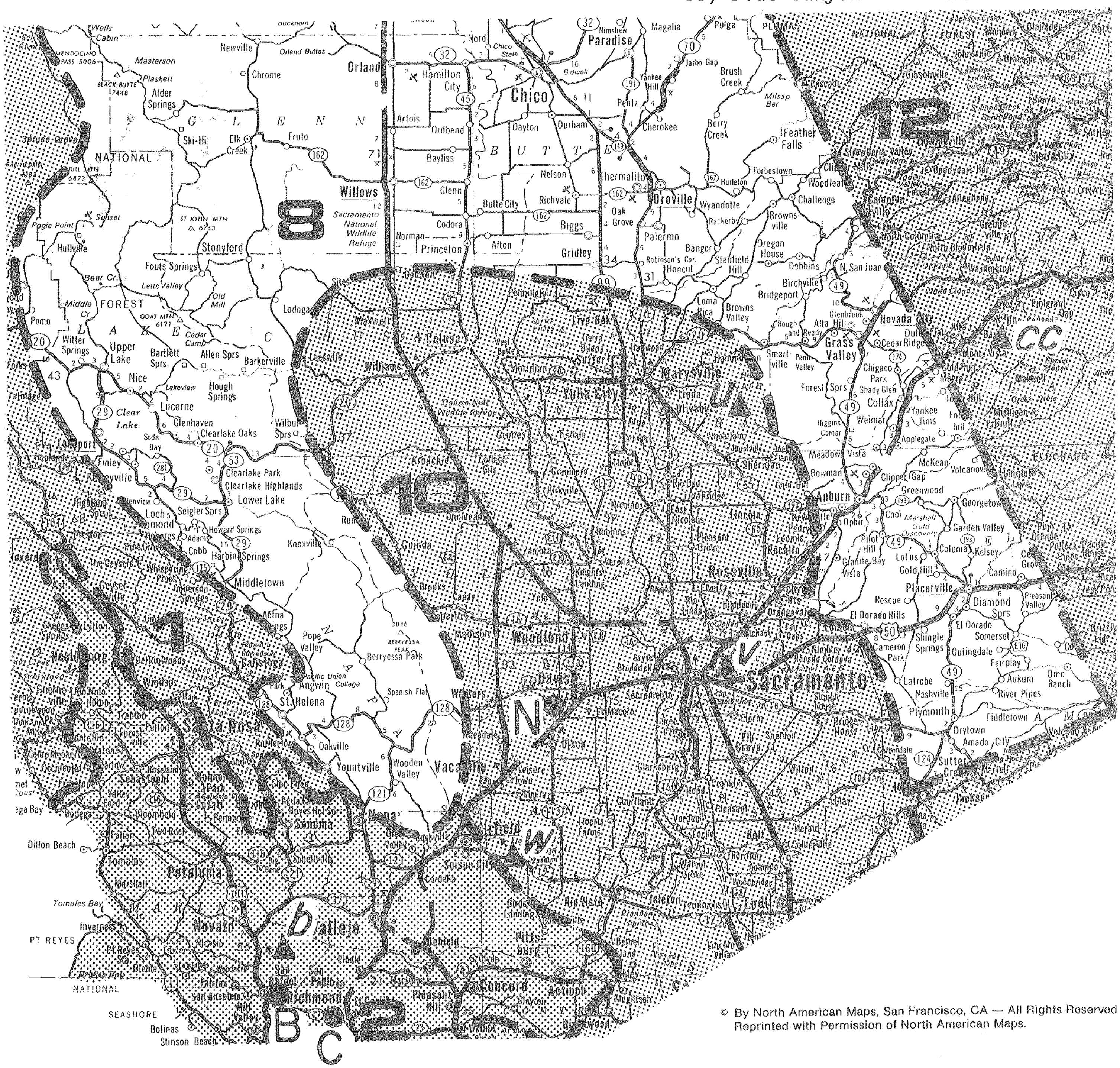
none

• Solar in Adjacent Zones

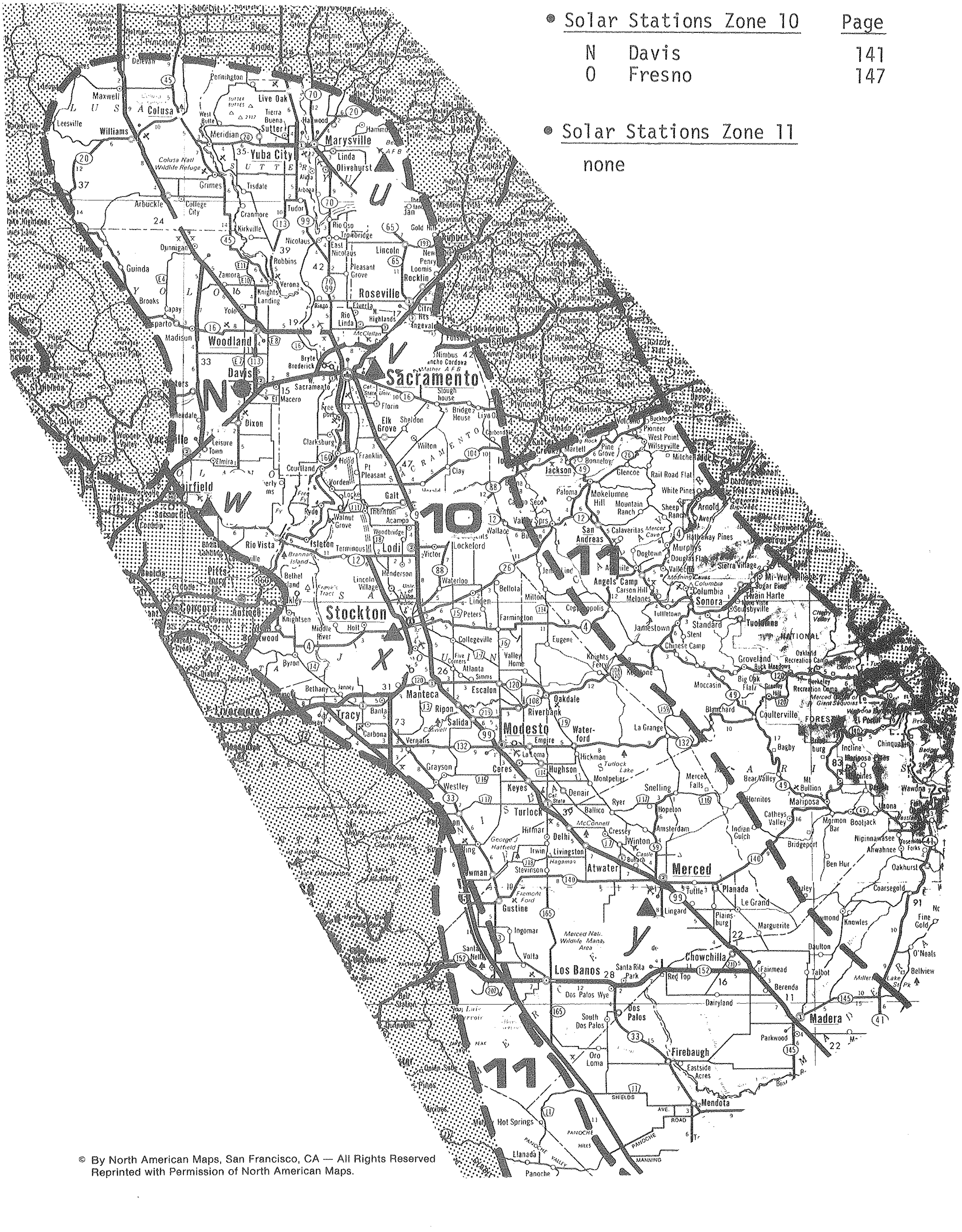
		Page
B	San Rafael	69
C	Richmond	75
N	Davis	141

▲ Climate Stations

Climate Stations	Page
b) San Rafael	181
r) Medford	205
s) Mt. Shasta	207
t) Red Bluff	208
u) Beale AFB	210
v) Sacramento	211
w) Fairfield	213
cc) Blue Canyon	222



Zones 10 and 11

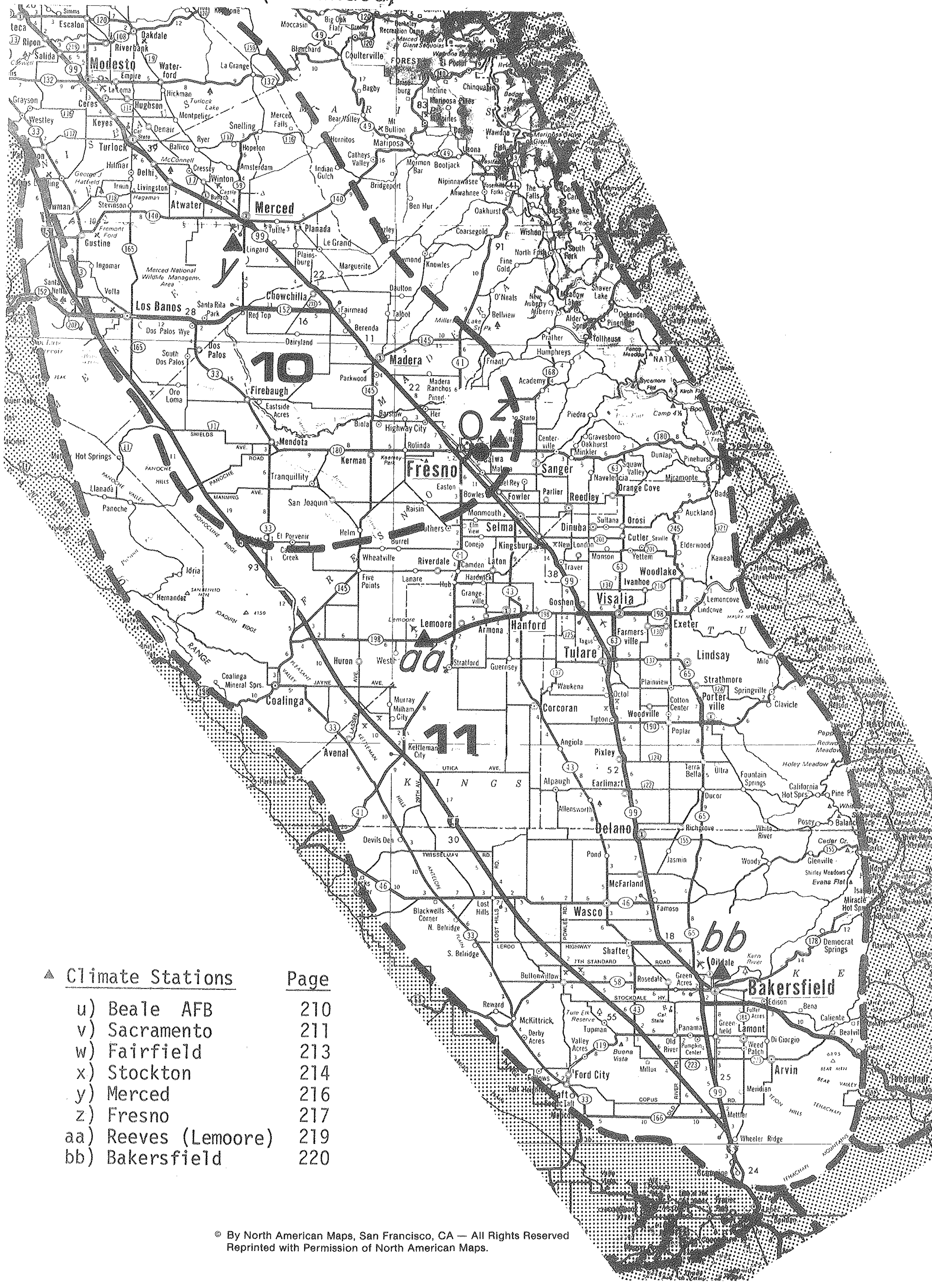


- Solar Stations Zone 10

		Page
N	Davis	141
O	Fresno	147

- Solar Stations Zone 11

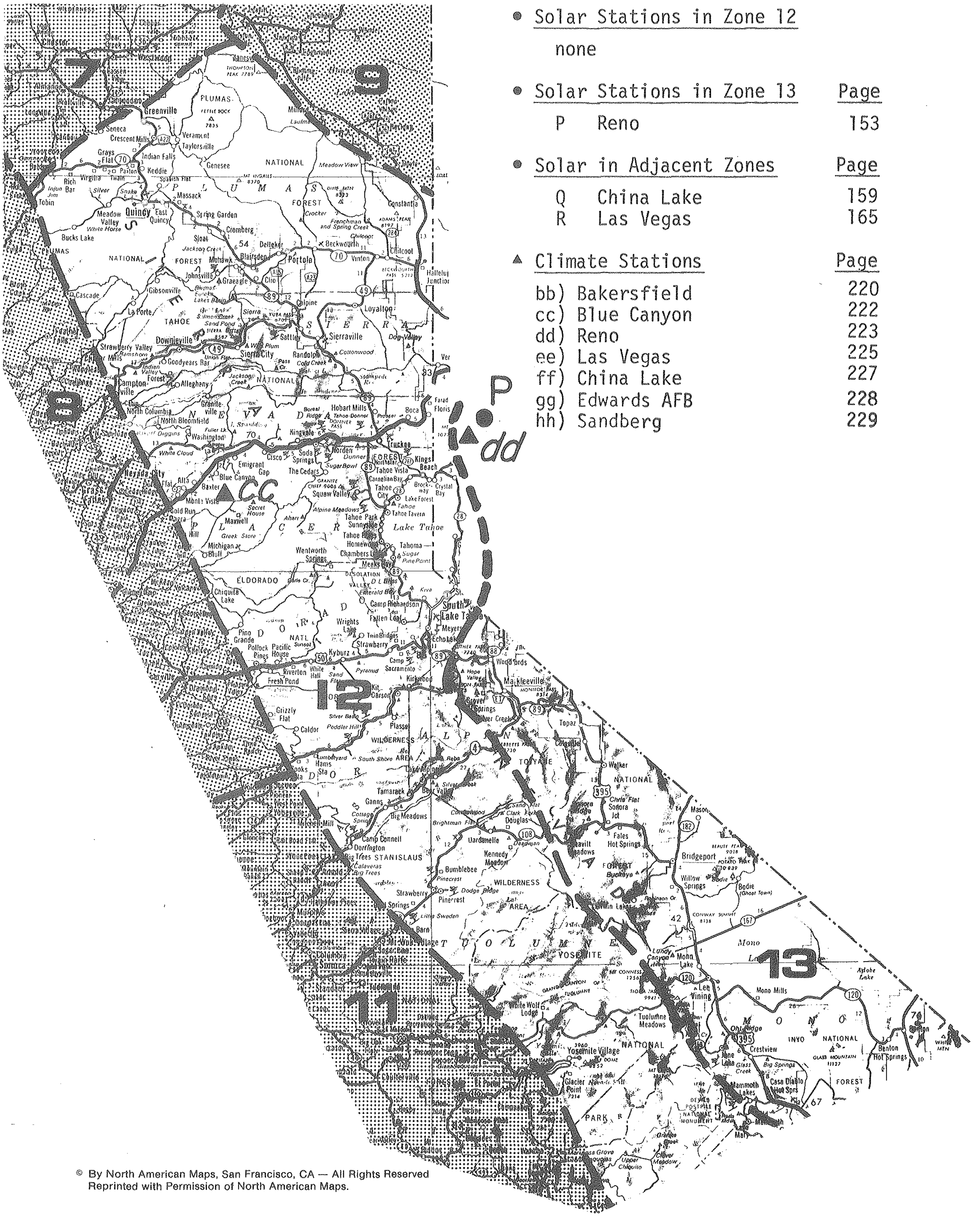
none



▲ Climate Stations

	Page
u) Beale AFB	210
v) Sacramento	211
w) Fairfield	213
x) Stockton	214
y) Merced	216
z) Fresno	217
aa) Reeves (Lemoore)	219
bb) Bakersfield	220

Zones 12 and 13



- **Solar Stations in Zone 12**

  none

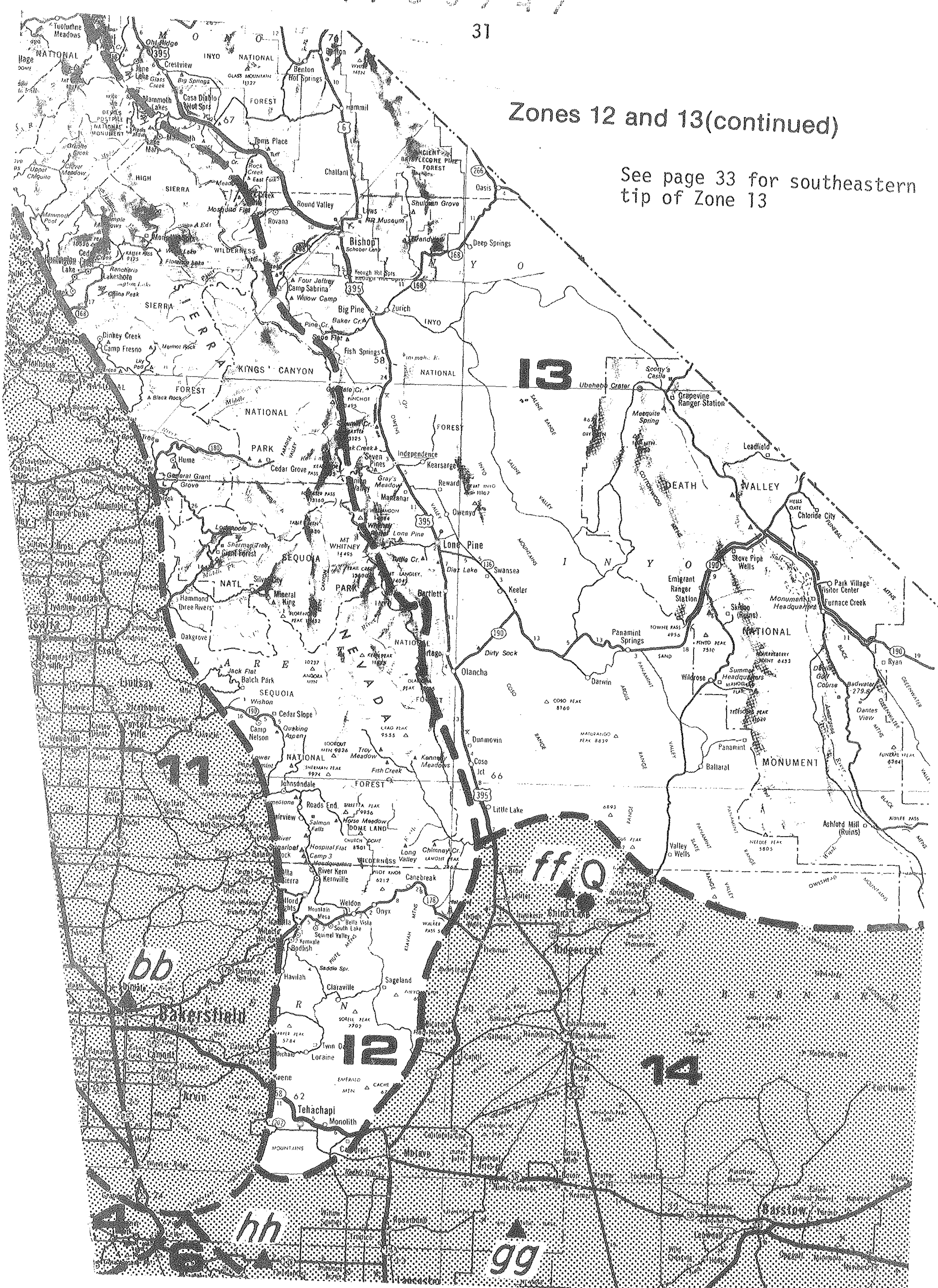
● Solar Stations in Zone 13		Page
P	Reno	153

● Solar in Adjacent Zones		Page
Q	China Lake	159
R	Las Vegas	165

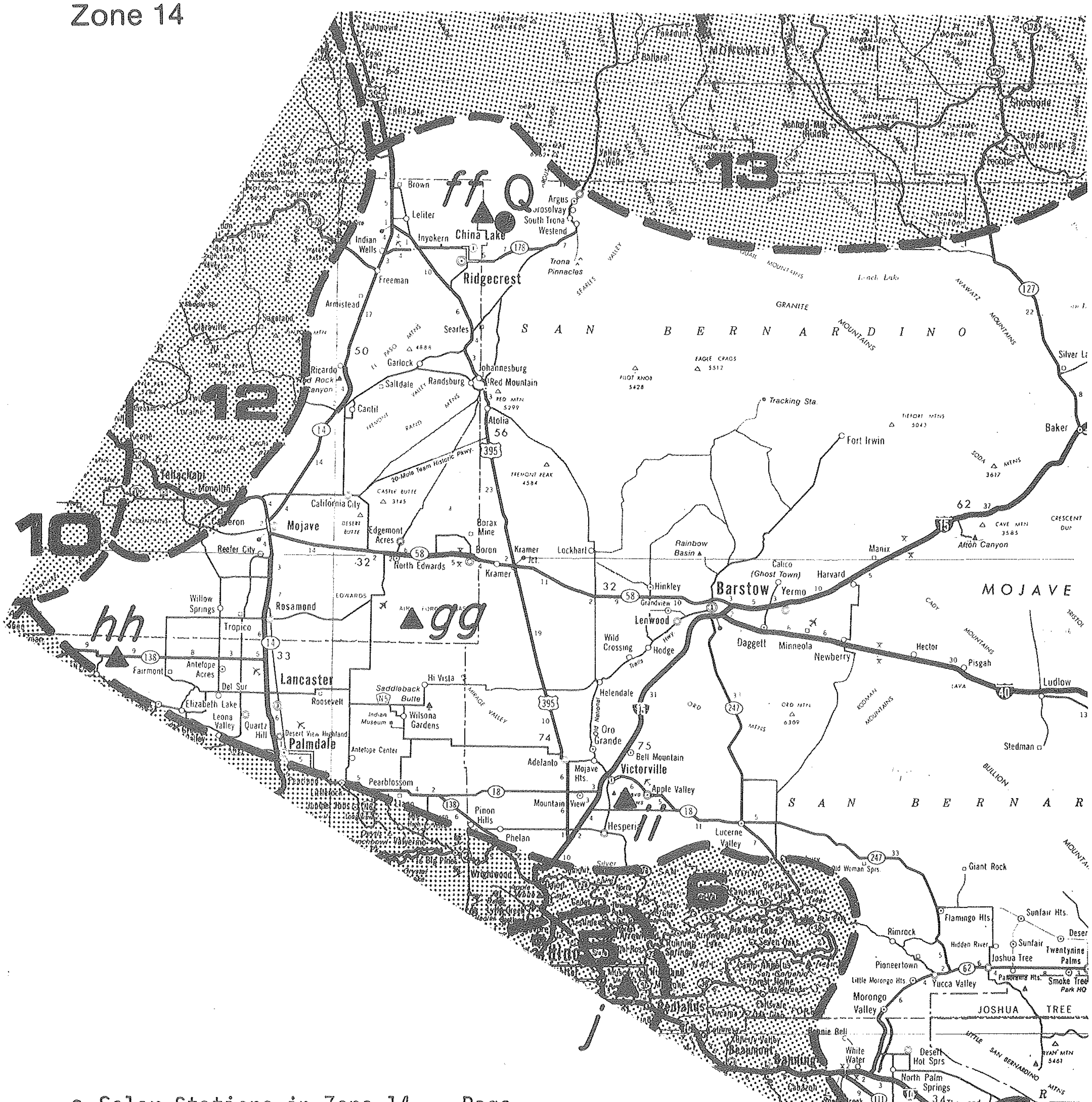
▲ Climate Stations	Page
bb) Bakersfield	220
cc) Blue Canyon	222
dd) Reno	223
ee) Las Vegas	225
ff) China Lake	227
gg) Edwards AFB	228
hh) Sandberg	229

Zones 12 and 13(continued)

See page 33 for southeastern tip of Zone 13



Zone 14



● Solar Stations in Zone 14 — Page

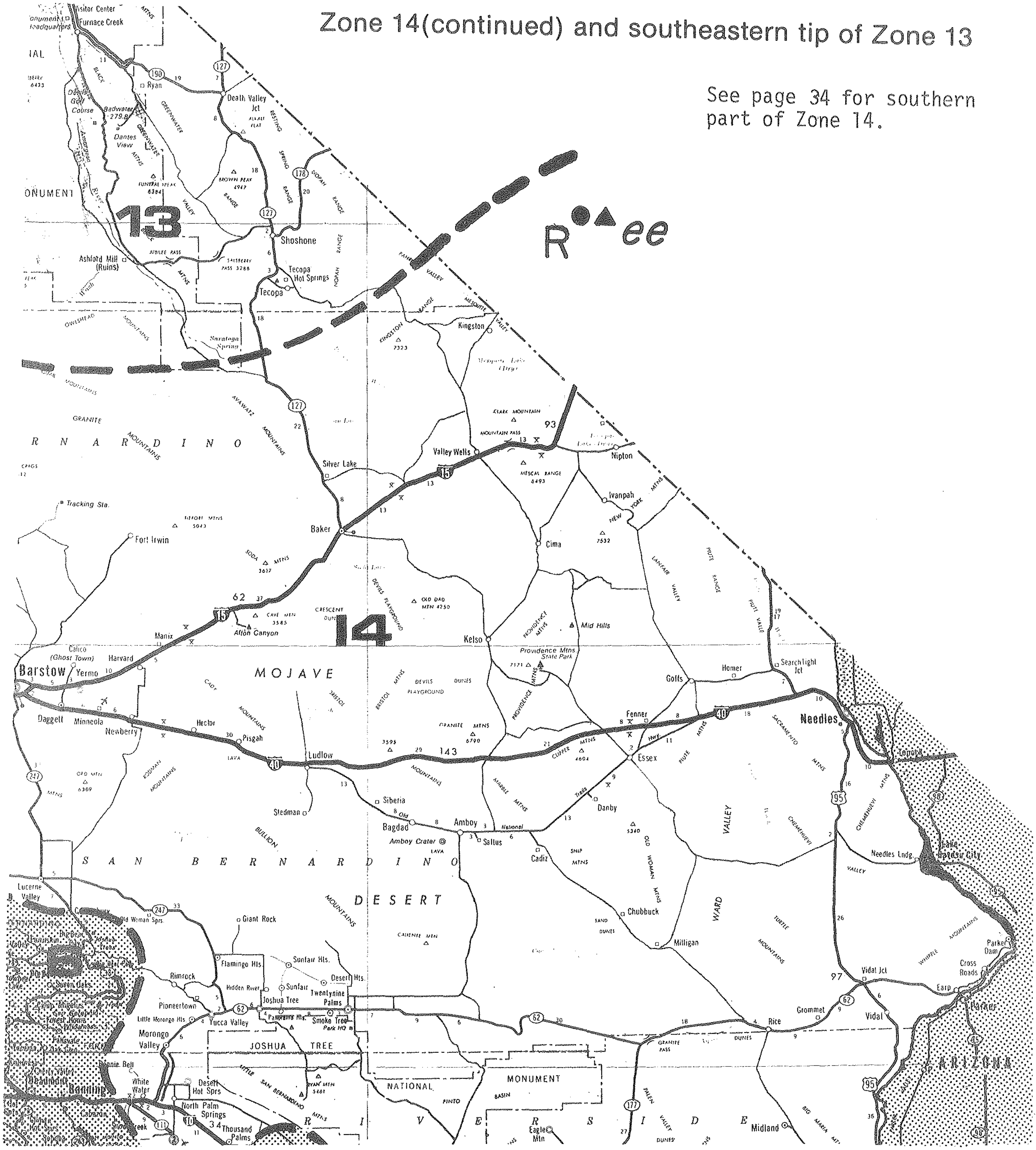
Q	China Lake (Inyokern)	159
R	Las Vegas	165

▲ Climate Stations — Page

ee)	Las Vegas	225
ff)	China Lake	227
gg)	Edwards AFB	228
hh)	Sandberg	229
ii)	Victorville	230

Zone 14(continued) and southeastern tip of Zone 13

See page 34 for southern part of Zone 14.



Zone 15 and southern part of Zone 14

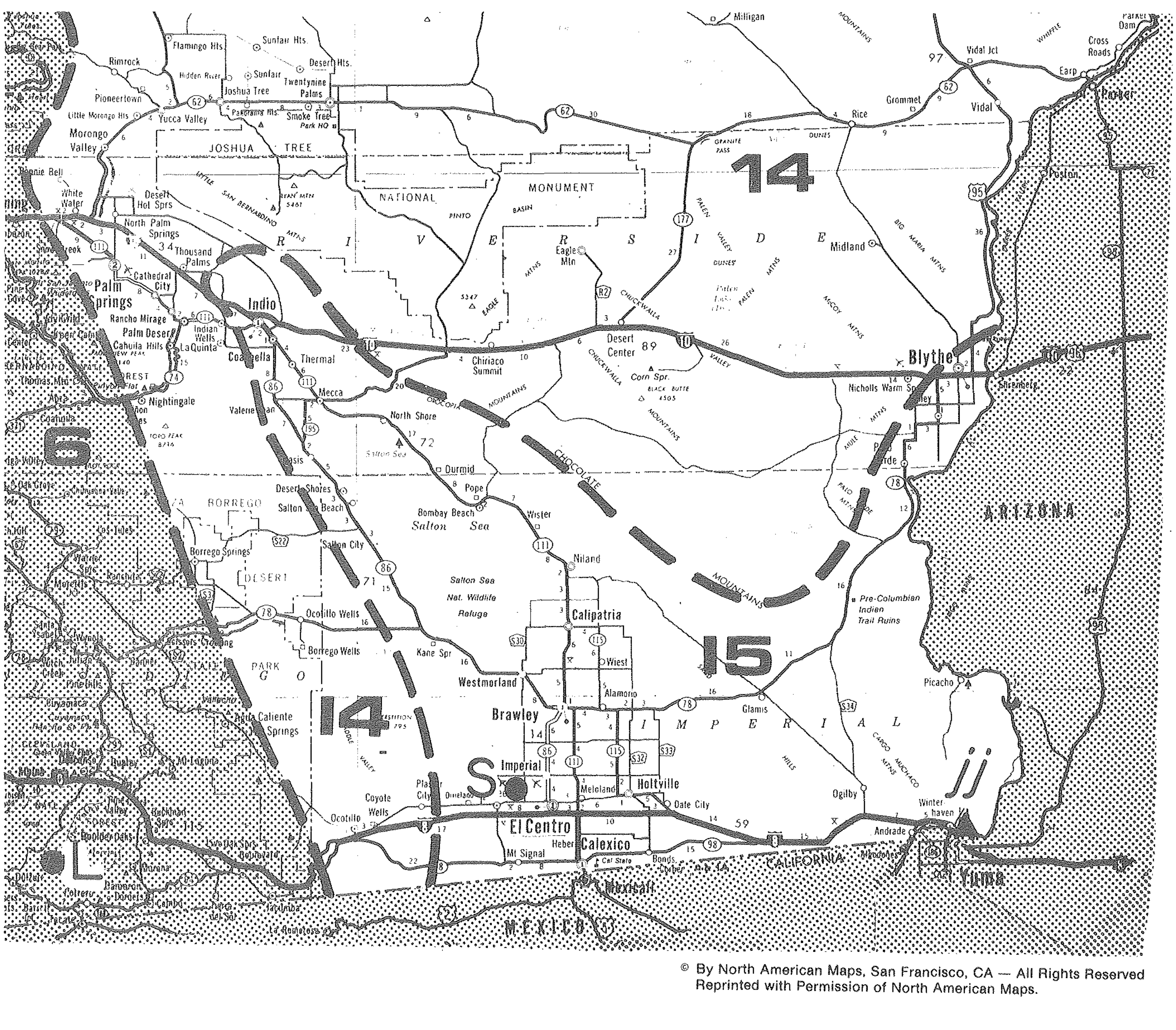
- Solar Stations in Zone 14

  see preceding two pages

● Solar Stations in Zone 15	Page
S El Centro	171

● Solar in Adjacent Zones	Page
L Barrett Reservoir	129

▲ Climate Stations	Page
jj Yuma	231



IV. Guide to the Data

The solar and climate data in the next three sections (V, VI, and VII) are explained in the following pages, along with instructions for their use. Sample exhibits are described in order of appearance in their respective sections.

Additional explanatory and resource material is given in Sections IX and X and is referred to where appropriate.

A. GUIDE TO SECTION V: SOLAR DATA

1. Exhibit 1. Monthly Solar Data

a. SOLAR RADIATION

Solar radiation data provide a measure of the energy that the earth receives from the sun. These data are broken down into two categories — horizontal surface and direct beam — each of which is useful in the design of solar systems. For maximum utility, the data are presented in both metric units, kWh/m^2 (kilowatt hours per square meter), and engineering units, $kBtu/ft^2$ (thousands of Btu's per square foot). Conversion to kilojoules, calories or langleys can be accomplished with the aid of conversion factors listed in Appendix B, p.309.

Exhibit 1.

Monthly Solar Data

Latitude: 36. 77° Longitude: 119.72° Elevation: 336'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	64	90	151	192	233	240	243	218	174	130	79	54	1868
direct beam (normal incidence)	95	126	195	229	273	279	285	262	224	186	122	79	2356
SOLAR RADIATION ($KBtu/ft^2$ per month)													
horizontal surface	20	29	48	61	74	76	77	69	55	41	25	17	592
direct beam (normal incidence)	30	40	62	73	86	88	90	83	71	59	39	25	746
PERCENT OF POSSIBLE SUNSHINE	50	66	79	85	89	94	96	96	95	88	67	46	82
MEAN CLOUD COVER (in tenths)	7	6	5	4	3	2	1	1	1	3	5	7	4
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.44	.52	.61	.65	.69	.70	.70	.69	.67	.61	.51	.40	.60

Recording interval: 1952-1975

Source of solar data: NWS, Eppley lightbulb pyranometer until 1974, Eppley PSP since 1974.

Horizontal Surface Radiation (also referred to as Total Horizontal Radiation) is the total radiation available on a flat plane at the earth's surface. This radiation is comprised of two components, Direct Beam Radiation and Diffuse Radiation. Direct Beam radiation is the energy that comes directly from the sun. Diffuse radiation is contributed by the sky after radiation coming from the sun is scattered by the atmosphere. The direct beam values presented in the tables are normal incidence values. This means that they give the direct solar beam radiation falling on a hypothetical surface that remains perpendicular to the direct solar beam. To envision this value, one might imagine the light falling through a long, narrow tube that tracks the sun. Direct beam (normal incidence) radiation was calculated from the total horizontal radiation according to the method outlined in Section X.

The lower value of horizontal surface radiation in the winter, as compared to the summer, results from the lower position of the sun in the sky, the shorter day, and the generally cloudier conditions. The direct beam (normal incidence) radiation is reduced mainly by the shorter day and cloudier conditions; the normal incidence orientation greatly reduces the influence of the lower position of the sun in the sky. Thus, the direct beam (normal incidence) radiation shows less winter-to-summer variation than the horizontal surface radiation.

EXAMPLE: Find solar radiation values for February.

Read across the table to the month of February and observe a value of 90 for the horizontal surface radiation and a value of 126 for the direct beam (normal incidence) radiation. Thus, 90 kWh/m^2 of total solar energy can be expected to fall on the earth's surface during the entire month. 126 kWh/m^2 of direct beam energy falls from the solar disk onto a perpendicular surface during this same period. The fact that the direct beam radiation is higher than the horizontal surface radiation may seem counter-intuitive. It must be kept in mind that direct beam radiation, as given in the exhibits, is the normal incidence value, and thus, as explained above, it is not particularly affected by the low position of the sun in the sky in February. On the other hand, the horizontal surface radiation is substantially reduced by this effect.

b. PERCENT POSSIBLE SUNSHINE AND MEAN CLOUD COVER

Percent Possible Sunshine and Mean Cloud Cover both provide measures of the extent to which the sky is clear or cloudy. Percent possible sunshine indicates the percentage of time during the daylight hours of the month that the sun shines. Mean cloud cover describes the average extent of cloudiness for the month. Continuing the example for the month of February, we observe that percent possible sunshine is 66% and mean cloud cover is 0.6. Thus during the daytime in February the sun can be expected to shine 66% of the time, and for the month an average of six-tenths of the sky will be covered by clouds. The apparent discrepancy between the two values can probably be accounted for by the fact that they measure different quantities. Percent possible sunshine provides a measurement of the time during the day in which the sun is bright enough to cast shadows. Mean cloud cover is an estimate of the spatial extent of cloud cover. It is sometimes possible to observe shadows when the sky is overcast, and thus a sky with a cloud cover of 1.0 might still correspond to a sunshine condition.

c. FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)

Extraterrestrial Radiation is the solar energy incident at the top of the earth's atmosphere. The fraction of extraterrestrial radiation (K_T) is the ratio of total horizontal radiation at the earth's surface to extraterrestrial radiation falling on a surface parallel to the ground. Calculated in this way, K_T essentially cancels out the effect of the position of the sun in the sky (low in winter, high in summer) and the length of the day. This fraction is therefore a good indicator of the general climatic conditions for any given month. For February, K_T is 0.52. Thus, 52% of the radiation impinging on the edge of the atmosphere finally makes it to the earth's surface; the remaining 48% is lost due to the atmosphere.

2. Exhibit 2. Monthly Total Horizontal Radiation

Exhibit 2 shows how the average monthly total horizontal radiation changes throughout the year. The maximum and minimum monthly values obtained during the recording interval are also presented as dashed lines on this graph. The range between these values demonstrates the effect of year-to-year weather fluctuations on the amount of available sunlight. The extraterrestrial radiation is indicated by a dotted line.

Exhibit 2

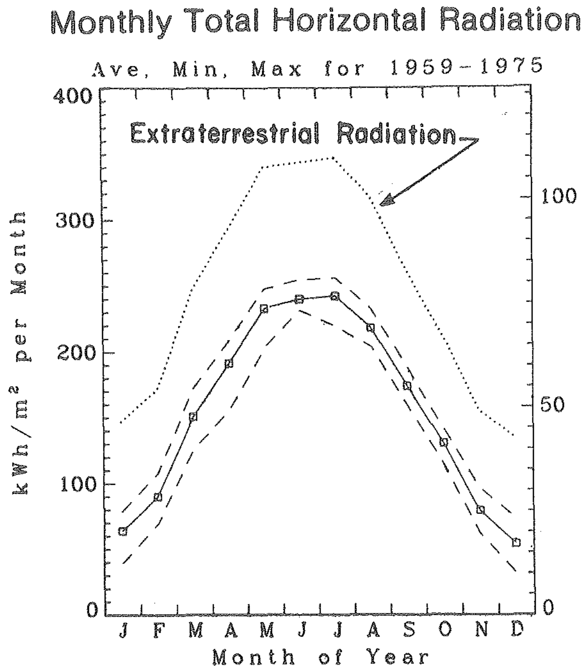
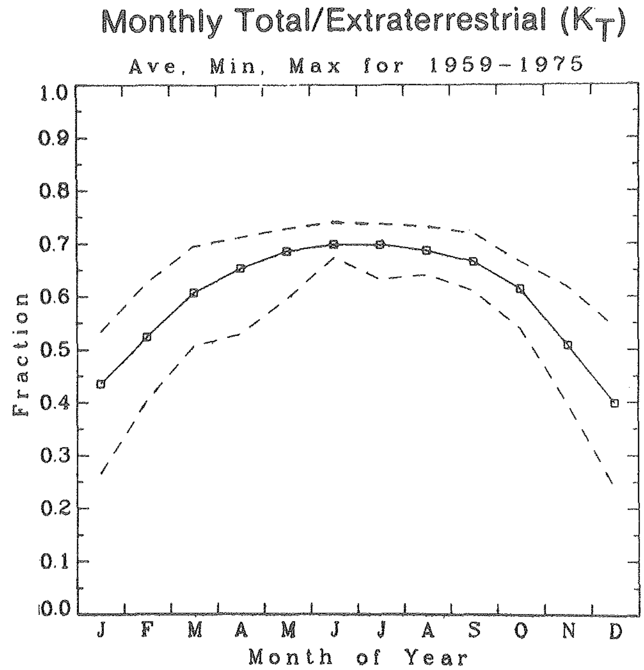


Exhibit 3



3. Exhibit 3. Monthly Total/Extraterrestrial (K_T)

Exhibit 3 depicts the yearly variation of K_T, the ratio of total horizontal radiation to extraterrestrial radiation. As discussed above, plotting the data in this manner nearly cancels out the effect of the changing position of the sun in the sky during the course of the year; the variation in K_T is then almost entirely due to weather conditions. A plot that is relatively flat (winter values about the same as summer values) indicates that the location has about the same amount of cloudiness during the winter as the summer. A peaked plot (summer values higher than winter) suggests a climate that is cloudier in winter than in summer. In this figure, the maximum and minimum values for K_T (dashed lines) indicate the high and low months of record.

4. Exhibit 4. Occurrences of Cloudy Days

Exhibit 4 shows the number of times that cloudy weather of a specified duration can be expected to occur. Such cloudy day statistics may be helpful in determining the optimal thermal storage size for certain applications. Two curves are presented: one for the entire year, and one for the period from October to March when heating might be necessary (heating season). For example, the graph indicates that one can reasonably expect five episodes of two consec-

Exhibit 4

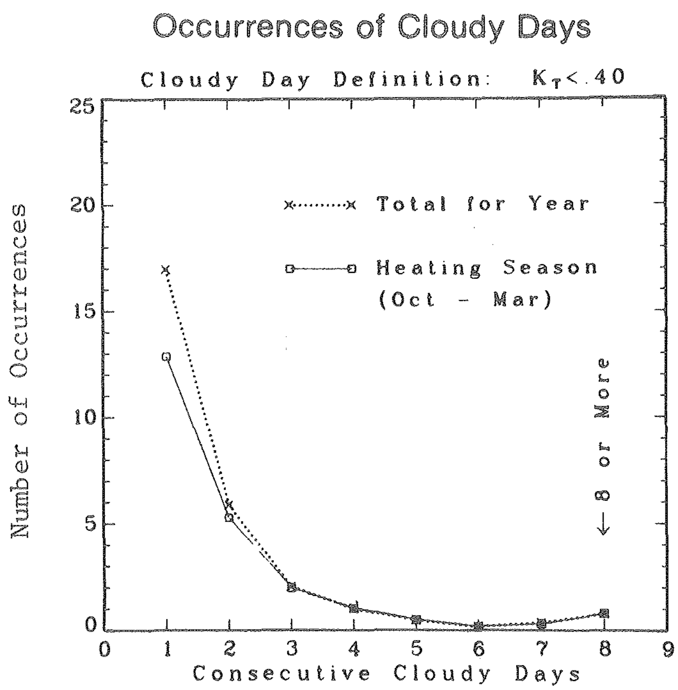
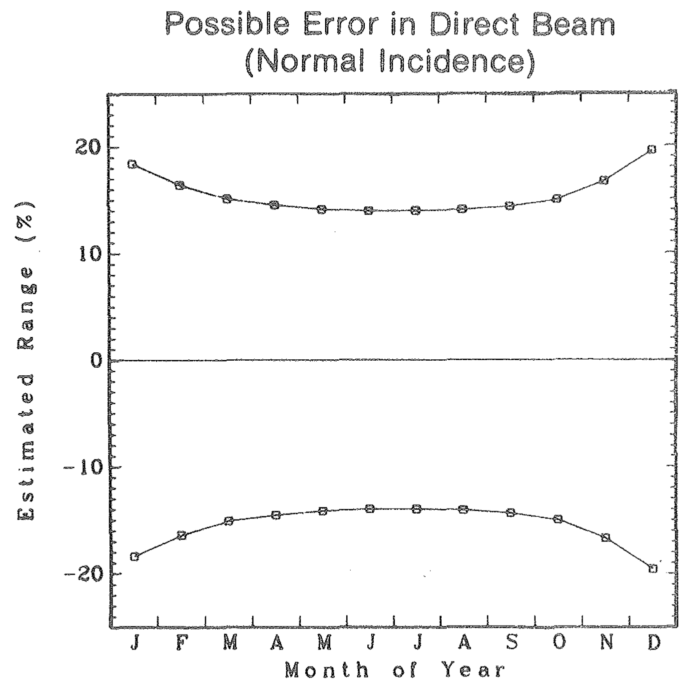


Exhibit 5



utive cloudy days during the heating season. If one needs to know how many times two or more cloudy days occur in a row, it is necessary to add the number of occurrences of two consecutive cloudy days plus the number of occurrences of three cloudy days plus the number of occurrences of four cloudy days, and so on. Continuing the above example, two or more consecutive cloudy days can be expected to occur ten times.

It should be noted that the definition of a cloudy day will vary somewhat from application to application. The definition chosen for this graph is that a day is cloudy when $K_T < 0.4$, which corresponds roughly to days during which 90% or more of the sky is covered with clouds.

5. Exhibit 5. Possible Error in Direct Beam (Normal Incidence)

Exhibit 5 provides an estimate of the range of uncertainty in the calculation of the direct beam (normal incidence) radiation tabulated in Exhibit 1. For example, the figure shows that for the month of December the actual amount of direct beam radiation could be 20% more or 20% less than the tabulated value. Section X describes how this range of uncertainty was estimated.

6. Exhibit 6 (a) and (b). Clear Day Plots for Solar Radiation

In Exhibits 6a and 6b radiation estimates for a very clear day are plotted against solar time (hours). Exhibit 6a presents direct beam (normal incidence) radiation, and Exhibit 6b, total horizontal radiation. In each figure, radiation values for the equinoxes (March 21 and September 21), the summer solstice (June 21), and the winter solstice (December 21) are plotted as separate curves. As might be expected, radiation is maximum in the summer, minimum in the winter, and intermediate during the spring and fall. These figures are useful for describing the maximum radiation values that can be expected at any hour during any time of the year.

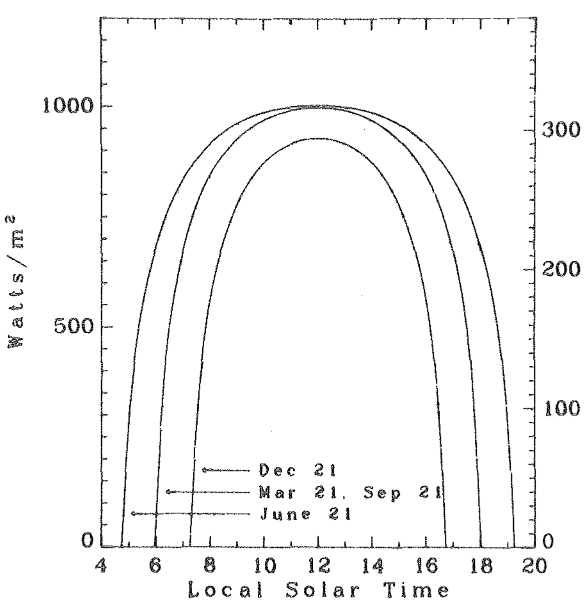
The vertical axis shows power density units or energy per unit area per unit time. The horizontal time axis is subdivided into hours of local solar time. Solar time is specific to a given location, and is calculated by assuming that the sun is most directly overhead at solar noon.

In a single time zone, all clocks measure one standard time (or daylight time) for convenience. This standard time corresponds approximately to the local solar time for the central meridian of a time zone. Local solar time is

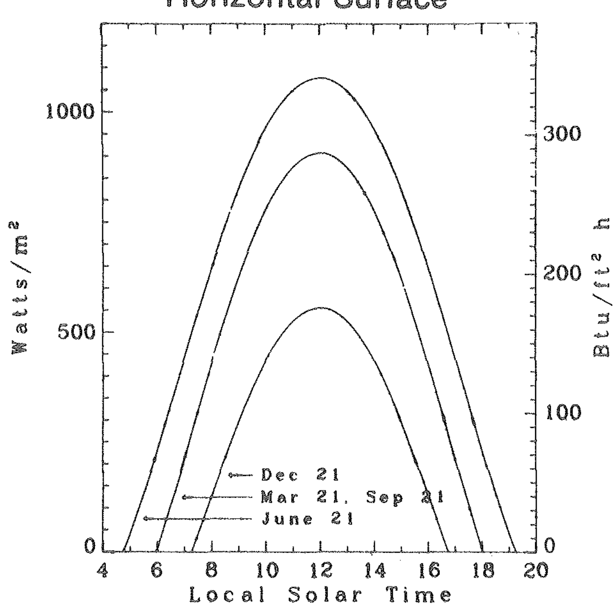
Exhibit 6.

Clear Day Plots for Solar Radiation

(a) Direct Beam (Normal Incidence)



(b) Total Radiation on a Horizontal Surface



more appropriate for solar energy applications because it derives from the exact position of the sun. The relationship between solar time and standard time is discussed in Section IX.

7. Exhibit 7 (a) and (b). Total Radiation on a Tilted Surface

Exhibits 7(a) and (b) present monthly values for total radiation on a tilted surface, which were calculated by a method given in Section X. This quantity is the sum of direct, diffuse, and reflected radiation that falls on a surface tilted from the horizontal, and is useful since flat-plate collectors are often tilted in order to maximize collection during the winter months. The two exhibits contain the same data, but metric units, kWh/m^2 (kilowatt hours per square meter), are used in 7(a) and engineering units, $kBtu/ft^2$ (thousands of Btu's per square foot), in 7(b).

The top section of each exhibit provides total radiation values that do not include reflected radiation. In the bottom section, reflection values are given for a typical grassy ground cover that scatters light in all directions, a behavior known as diffuse reflection. Some surfaces behave like a mirror

Exhibit 7

(a) Total Radiation on a Tilted Surface (Calculated Values) Metric Units (kWh/m^2)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
		DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)												
SOUTH	15	81	108	170	201	233	234	239	224	190	154	99	68	1999
SOUTH	30	93	119	178	198	219	215	221	216	195	168	113	79	2014
SOUTH	45	99	124	176	184	193	184	191	196	188	171	121	85	1912
SOUTH	60	100	121	164	159	156	144	152	164	170	165	121	86	1701
SOUTH	75	95	111	142	125	112	98	106	124	141	148	114	82	1397
SOUTH	90	84	94	111	85	65	51	57	78	105	123	100	73	1027
SE,SW	15	75	102	163	197	232	235	239	221	184	146	93	64	1951
SE,SW	30	82	109	167	193	220	219	224	213	186	153	101	70	1937
SE,SW	45	85	109	162	180	198	194	200	196	177	153	104	72	1830
SE,SW	60	83	103	149	159	169	162	168	170	160	143	101	71	1637
SE,SW	75	76	92	128	131	134	125	131	138	136	127	92	65	1375
SE,SW	90	65	77	102	99	96	87	93	102	106	104	78	56	1066
E,W	15	63	89	148	187	228	234	237	213	170	128	78	53	1826
E,W	30	60	84	140	176	213	219	221	200	161	121	74	51	1722
E,W	45	56	78	129	161	193	197	200	181	147	112	69	47	1570
E,W	60	51	70	114	141	168	170	173	158	130	100	62	43	1380
E,W	75	44	60	97	118	139	140	143	132	110	85	54	37	1159
E,W	90	36	49	78	93	109	109	112	104	87	69	44	30	919
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	1	1	1	1	1	1	1	0	0	0	6
ANY	30	1	1	2	3	3	3	3	3	2	2	1	1	25
ANY	45	2	3	4	6	7	7	7	6	5	4	2	2	55
ANY	60	3	5	8	10	12	12	12	11	9	7	4	3	93
ANY	75	5	7	11	14	17	18	18	16	13	10	6	4	139
ANY	90	6	9	15	19	23	24	24	22	17	13	8	5	187

(b) Total Radiation on a Tilted Surface (Calculated Values) Engineering Units (kBtu/ft^2)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
		DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)												
SOUTH	15	26	34	54	64	74	74	76	71	60	49	31	22	633
SOUTH	30	29	38	56	63	69	68	70	68	62	53	36	25	638
SOUTH	45	31	39	56	58	61	58	61	62	60	54	38	27	606
SOUTH	60	32	38	52	50	49	46	48	52	54	52	38	27	539
SOUTH	75	30	35	45	40	36	31	33	39	45	47	36	26	443
SOUTH	90	27	30	35	27	21	16	18	25	33	39	32	23	325
SE, SW	15	24	32	52	62	73	74	76	70	58	46	29	20	618
SE, SW	30	26	34	53	61	70	69	71	68	59	49	32	22	614
SE, SW	45	27	35	51	57	63	61	63	62	56	48	33	23	580
SE, SW	60	26	33	47	50	53	51	53	54	51	45	32	22	519
SE, SW	75	24	29	41	42	42	40	42	44	43	40	29	21	436
SE, SW	90	21	24	32	31	31	28	29	32	34	33	25	18	338
E, W	15	20	28	47	59	72	74	75	67	54	40	25	17	579
E, W	30	19	27	44	56	68	69	70	63	51	38	24	16	545
E, W	45	18	25	41	51	61	62	63	57	47	36	22	15	498
E, W	60	16	22	36	45	53	54	55	50	41	32	20	14	437
E, W	75	14	19	31	37	44	44	45	42	35	27	17	12	367
E, W	90	11	15	25	30	34	35	35	33	28	22	14	10	291
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	1	1	1	1	1	1	1	1	0	0	8
ANY	45	1	1	1	2	2	2	2	2	2	1	1	0	17
ANY	60	1	1	2	3	4	4	4	3	3	2	1	1	30
ANY	75	2	2	4	4	5	6	6	5	4	3	2	1	44
ANY	90	2	3	5	6	7	8	8	7	6	4	3	2	59

and reflect light directly (specular reflection). Others reflect some of the incoming light directly and some of it diffusely. Many surfaces, such as an asphalt highway, reflect light diffusely for most of the day, but when the sun is low enough in the sky, during morning and evening hours, they reflect more like a mirror. Though there are many types of behavior, the surfaces encountered in solar applications usually reflect light diffusely during most of the sun-light hours.

Because reflection is a function of ground cover, inclusion of this component in the total radiation calculation would have made the tables unwieldy. Given reflection values for a typical grassy ground cover, the interested reader can calculate reflection from many other surfaces by use of a reflectivity ratio. This is done by multiplying the appropriate radiation value in the bottom section by the ratio of the reflectivity (rho) of the ground cover in question to the typical grassy ground cover reflectivity (~0.2), that is, by rho/0.2. Liu and Jordan (1961) quote the following reflectivities.

Surface	Rho
Desert	0.24 - 0.28
Fields, various types	0.03 - 0.28
Forest, green	0.03 - 0.10
Grass, various conditions	0.14 - 0.37
Ground, bare	0.07 - 0.20
Mold, black	0.08 - 0.14
Sand, dry	0.18
Sand, wet	0.09
Snow or ice	0.46 - 0.86

Once calculated, reflection values for specific sites can then be added to the corresponding values from the top section, thereby producing composite values for total radiation on a tilted surface. Note, however, that reflection values are often a very small component of the total radiation. Thus, for reasonable estimates of the total radiation, the top section in each exhibit should suffice, except at the largest tilt angles.

A collector may face any direction and be tilted to any degree, and every position will have a characteristic incident radiation. An extreme case of positioning is the collector tilted vertically and facing east. In this position, all the direct beam and much of the diffuse radiation will cease at noon, and thus values for total radiation will be low. The first column at the far left of each exhibit gives the orientation, or the direction that the surface faces. The second column gives the angle of tilt for the surface. In the top section of each exhibit, five directions and six angles of tilt define 30 possible positions and their respective radiation values. Though there are an infinite number of collector positions, it is assumed that these are sufficient for most purposes. Radiation for intermediate values can be calculated by interpolation. It should be noted that in column one there are sometimes two orientation values per row (for example E,W) and one radiation value for both orientations. This results from the fact that the orientations are symmetric with respect to the sun's motion through the sky. In the bottom section of each exhibit, there is no restriction on the surface orientation because it is assumed that reflection is the same from every direction. However, reflection does differ with angle of tilt, and thus radiation values are given for the same six inclination angles used in the top section.

EXAMPLE: Find the monthly total radiation on a tilted surface for a collector oriented SW and inclined 25° from the horizontal. The month is February and the collector is located in a bare ground terrain.

First, determine total radiation on a tilted surface (minus reflection) by consulting the top section of one of the exhibits. As there is no value for a 25° tilt, it must be obtained by interpolation between the nearest higher and lower values: 15° and 30°. From exhibit 7(a) the radiation values for these tilt angles and a SW orientation are 102 kWh/m^2 and 109 kWh/m^2, respectively. Since 25° is 2/3 of the way between 15° and 30°, the corresponding radiation value will lie 2/3 of the way between 102 kWh/m^2 and 109 kWh/m^2. This value is 106.7 kWh/m^2.

Next, determine reflected radiation for normal grassy ground cover by consulting the bottom section of one of the exhibits. Once again, there is no value for a 25° tilt, so interpolation must be repeated. The radiation value 2/3 of the way between 0 kWh/m^2 and 1 kWh/m^2 is 0.7 kWh/m^2.

Then, calculate reflection for the specified ground cover. Obtain reflectivity for the ground cover in question and form the ratio, rho/0.2.

rho	=	0.12	Approximate reflectivity coefficient for bare ground from Liu and Jordan (1961).
rho/0.2 = (0.12/0.2)	=	0.6	Reflection adjustment factor (rho/0.2).
$(0.6) \times 0.7$ kWh/m^2	=	0.4 kWh/m^2	Reflection radiation from bare ground.

Finally, determine total radiation on the tilted surface by adding the calculated values.

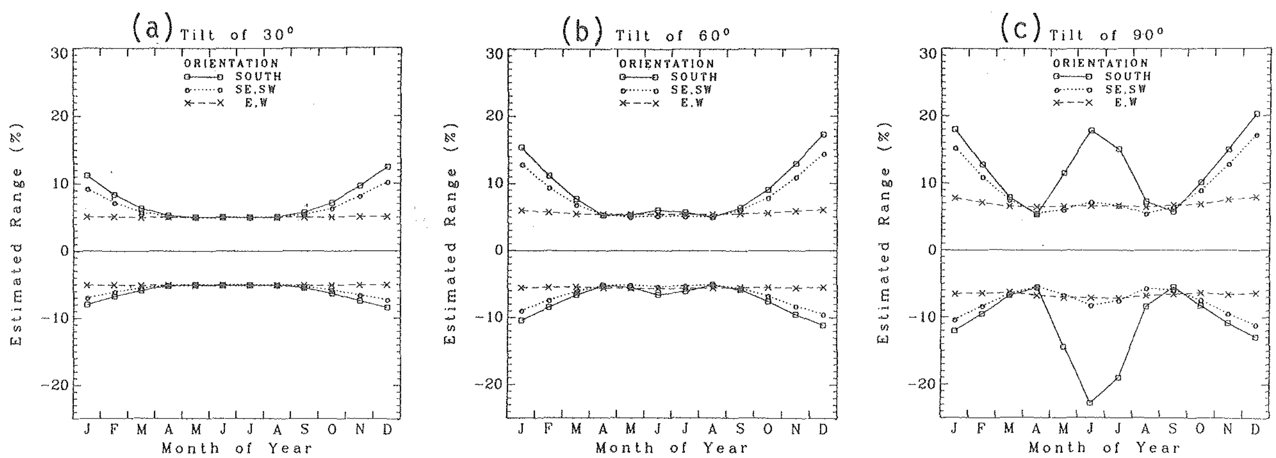
106.7 kWh/m^2	+	0.4 kWh/m^2	=	107.1 kWh/m^2
Total radiation on surface tilted 25° from horizontal (without reflection).		Reflection radiation from bare ground onto surface tilted 25°.		Total radiation on surface tilted 25° from horizontal (with reflection)

8. Exhibit 8 (a),(b) and (c). Possible Error in the Total Radiation on a Tilted Surface

Exhibit 8(a), (b) and (c) presents the estimated error of the calculated values for total radiation on a tilted surface. These error estimates are provided to help the user understand the uncertainties implicit in the data presented in Exhibit 7. The separate figures give information for various degrees of tilt (30°, 60°, 90°). Within each figure, the error for five different orientations is plotted: south, southeast (SE), southwest (SW), east and west. The SE and SW orientations both produce identical error estimates, as do the east and west orientations, because these two sets are symmetric with respect to the sun's daily motion through the sky.

Exhibit 8

Possible Error in the Total Radiation on a Tilted Surface



EXAMPLE: Find the possible error in February for the value of total radiation falling on a southward-facing collector tilted 30° from the horizontal.

First, consult Exhibit 8(a) and follow the south orientation line to February, where a double error value is observed. The data can be 8% higher or 7% lower than estimated. Next, refer to Exhibit 7(a), and find the estimated value for total radiation on a surface tilted 30° facing south. For February, this value is 119 kWh/m^2. Finally, use the error percentages to define a range for the radiation value:

$$(119\ \text{kWh/m}^2) \times 0.08 = 9.5\ \text{kWh/m}^2$$

$$(119\ \text{kWh/m}^2) \times 0.07 = 8.3\ \text{kWh/m}^2$$

$$119\ \text{kWh/m}^2 + 9.5\ \text{kWh/m} = 128.5\ \text{kWh/m}^2$$

$$119\ \text{kWh/m}^2 - 8.3\ \text{kWh/m} = 110.7\ \text{kWh/m}^2$$

Thus, for the month of February, the long-term average of radiation on a collector facing south and tilted 30° could lie anywhere between 110.7 kWh/m^2 to 128.5 kWh/m^2. Error values for tilt and orientation positions intermediate between those presented in the exhibits must be interpolated.

9. Exhibit 9. Direct Beam Conversion Factor from Horizontal to Tilted Surface

The calculation methods that were used to estimate the direct beam (normal incidence) and tilted-surface radiation include factors that convert the direct beam radiation on a horizontal surface to normal incidence or to tilted-surface values. These factors are difficult to calculate without a computer, and thus they are presented in Exhibit 9 to benefit the user who might want to perform a tilted-surface calculation for input data different from those used for the calculated values in Exhibit 7 or the normal incidence values in Exhibit 1.

Like Exhibit 7, this Exhibit is divided into top and bottom sections. The top section contains factors whereby direct beam radiation on a horizontal

Exhibit 9

Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profiles

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.46	1.31	1.18	1.07	1.00	.97	.98	1.04	1.13	1.25	1.41	1.51
SOUTH	30	1.82	1.53	1.28	1.07	.94	.88	.90	1.01	1.18	1.42	1.72	1.92
SOUTH	45	2.06	1.65	1.30	1.00	.82	.74	.77	.91	1.16	1.50	1.92	2.20
SOUTH	60	2.16	1.66	1.22	.86	.65	.56	.59	.75	1.05	1.47	1.98	2.32
SOUTH	75	2.11	1.55	1.06	.66	.44	.35	.38	.55	.87	1.34	1.91	2.29
SOUTH	90	1.92	1.34	.83	.42	.21	.13	.16	.32	.64	1.12	1.71	2.11
SE,SW	15	1.32	1.21	1.12	1.05	1.00	.97	.98	1.02	1.09	1.17	1.28	1.35
SE,SW	30	1.55	1.35	1.18	1.04	.94	.90	.92	.99	1.11	1.27	1.48	1.61
SE,SW	45	1.68	1.40	1.16	.97	.85	.79	.82	.91	1.07	1.29	1.58	1.77
SE,SW	60	1.69	1.36	1.08	.86	.72	.65	.68	.79	.98	1.24	1.57	1.80
SE,SW	75	1.60	1.24	.94	.70	.56	.49	.52	.63	.83	1.10	1.47	1.72
SE,SW	90	1.40	1.04	.75	.52	.39	.33	.35	.46	.64	.91	1.27	1.52
E,W	15	.98	.98	.98	.97	.97	.97	.97	.97	.98	.98	.98	.98
E,W	30	.95	.94	.93	.92	.91	.90	.91	.91	.92	.93	.94	.95
E,W	45	.90	.87	.85	.83	.82	.81	.81	.82	.84	.86	.89	.90
E,W	60	.82	.79	.76	.73	.71	.70	.70	.72	.75	.77	.81	.83
E,W	75	.72	.68	.65	.61	.59	.57	.58	.60	.63	.67	.71	.73
E,W	90	.60	.56	.52	.48	.46	.44	.45	.47	.50	.54	.59	.61
NORMAL INCIDENCE		2.60	2.15	1.81	1.60	1.51	1.48	1.50	1.55	1.71	1.99	2.43	2.75

surface can be converted into direct beam radiation on a tilted surface. The bottom section, which is only one row of numbers, contains the factors used to convert direct beam radiation on a horizontal surface into direct beam (normal incidence) radiation.

In the top section, the factors are organized according to tilt angle and surface orientation in a manner like that used to present the total radiation on a tilted surface (Exhibit 7). In fact, the two left columns indicate the same orientation and tilt conditions. The bottom section requires no specification of orientation and tilt, due to the nature of direct beam (normal incidence) radiation.

For use of this table, the reader is referred to Section X, "Estimating Unmeasured Solar Radiation Quantities."

10. Exhibit 10 (a) and (b). Daily Solar Histograms

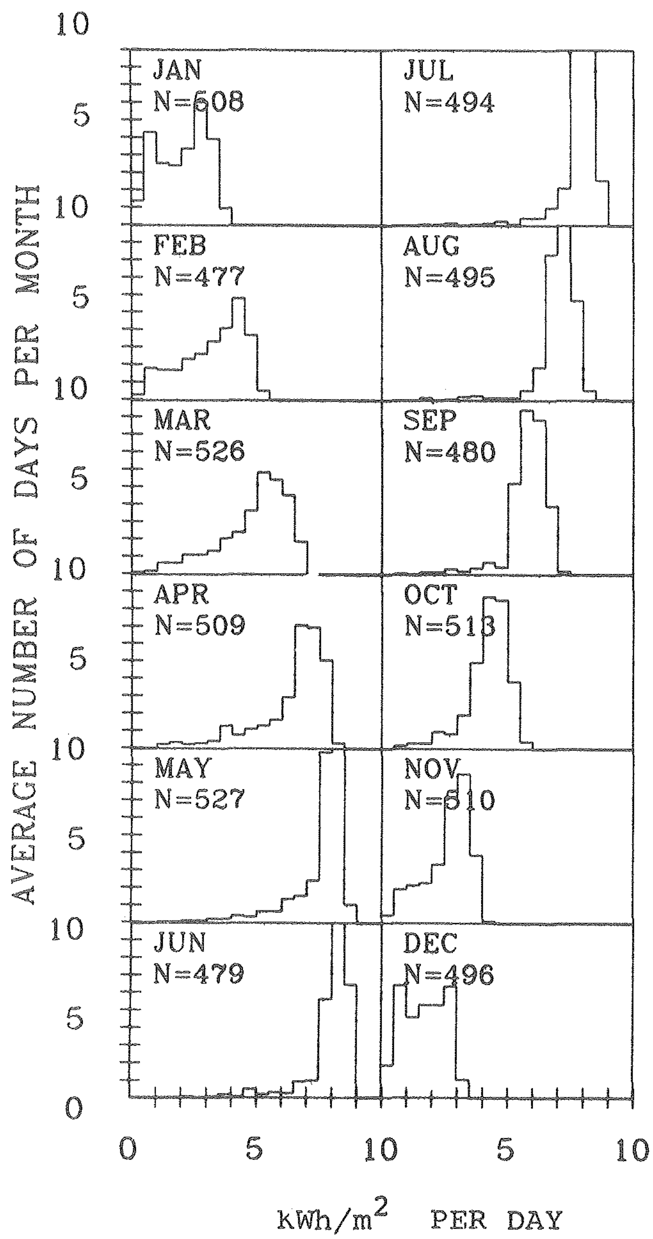
Exhibit 10(a) shows the number of days each month that the total radiation on a horizontal surface reaches various levels. Exhibit 10(b) presents similar information for the fraction of extraterrestrial radiation (K_T). Each histogram is comprised of data averaged over the years for which reliable information is available. The number N on both histograms is the actual number of daily values used to construct the histogram. It should be noted that the vertical axis values are average numbers of days that the radiation or fraction lies within a certain range and thus these values need not be integers. For the radiation histogram, the horizontal axis unit is 0.5 kWh/m^2, and in the fraction of extraterrestrial radiation histogram, 0.05 (dimensionless number).

EXAMPLE: Find the number of days in February that the daily radiation value lies between 4 kWh/m^2 and 4.5 kWh/m^2. Then determine the number of days in the month that the sun will produce at least 4 kWh/m^2 of radiation.

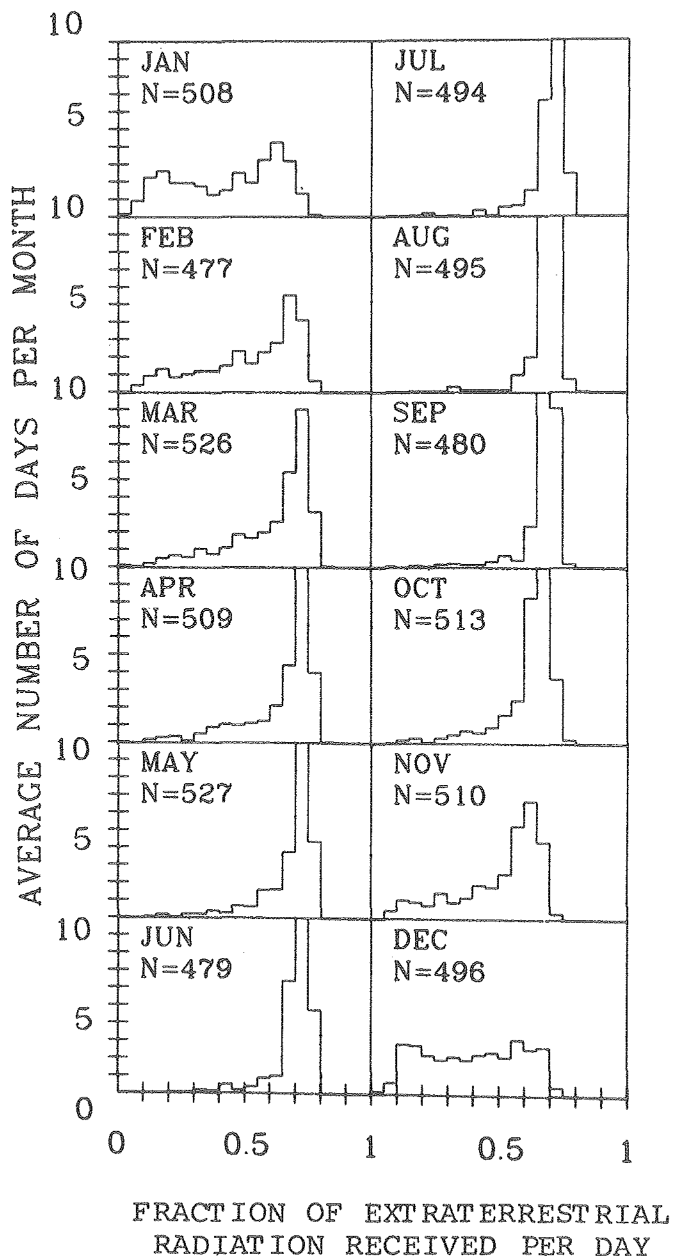
Locate 4 kWh/m^2 and 4.5 kWh/m^2 on the horizontal axis and observe the corresponding vertical axis value, 6.0 days. Thus, on an average of 6.0 days every February, the sun will produce between 4 kWh/m^2 and 4.5 kWh/m^2 of energy. To determine the number of days during which more than 4 kWh/m^2 of radiation will be produced, add the average day values for each 0.5 kWh/m^2 range above 4 kWh/m^2:

Exhibit 10

(a) Total Radiation Histogram



(b) Total/Extraterrestrial (K_T) Histogram



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

6.0 days	+	3.5 days	+	0.5 days	=	10 days
(4 - 4.5) kWh/m^2		(4.5 - 5.0) kWh/m^2		(5.0 - 5.5) kWh/m^2		

Thus, for the month of February, daily radiation values will exceed 4 kWh/m^2 on an average of 10 days. The fraction of extraterrestrial radiation (K_T) histogram can be used exactly like the radiation histogram.

B. GUIDE TO SECTION VI: CLIMATE DATA

This section contains tables of climate data for 36 weather stations in California. The data sources include both National Weather Service (NWS) and Air Weather Service (AWS) locations. The NWS narrative climate summaries are included with the corresponding tables. No such summaries exist for the AWS sites.

Following the tables are lists of mean temperatures and heating and cooling degree-day normals, along with the geographic coordinates of the 203 stations where these data were collected. Precipitation normals for 349 stations are also given, including the geographic locations for these sites.

11. Exhibit 11. Monthly Climatological Data

The data presented in this table are average values observed over many years of measurement. Most of the entries presented are self-explanatory. A possible exception is the 'Degree Days' category. Each degree that the mean daily temperature is above a specified temperature (65°F) is a cooling degree-day unit, and each degree of the daily mean below that temperature is a heating degree-day unit. Monthly values for both heating and cooling are the sums of the respective degree-day units for each day of the designated month.

Exhibit 11

Climatological Data for San Diego

Latitude: 32°44' Longitude: 117°10' Elevation: 13'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	55.2	56.7	58.1	60.7	63.3	65.5	69.6	71.4	69.9	66.1	60.8	56.7	62.9
average daily max/min	65/46	66/48	66/50	68/54	69/57	71/60	75/64	77/65	77/63	74/58	70/52	66/47	70/55
extreme max/min	86/31	85/38	85/39	91/44	91/48	90/51	92/57	90/58	111/56	107/43	97/38	88/36	111/31
DEGREE DAYS													
heating (base 65°F)	314	237	219	144	79	52	6	0	16	43	140	257	1507
cooling (base 65°F)	10	0	0	15	26	67	149	201	163	77	14	0	722
WIND													
Mean speed (mph)	5.6	6.3	7.2	7.6	7.6	7.5	7.1	7.0	6.7	6.3	5.7	5.5	6.7
Max. speed* (mph)	39	35	46	37	27	26	23	23	25	31	51	34	51
Prevailing direction	NE	WNW	WNW	WNW	WNW	SSW	WNW	WNW	NW	WNW	NE	NE	WNW
FREEZE DAYS PER MONTH	<0.5	0	0	0	0	0	0	0	0	0	0	0	<0.5
PRECIPITATION (in. water)													
average	1.88	1.48	1.55	0.81	0.15	0.05	0.01	0.07	0.13	0.34	1.25	1.73	9.45
max/min	6.26/T	5.31/0.00	5.89/T	3.58/T	0.95/0.00	0.38/0.00	0.13/0.00	0.87/0.00	1.90/0.00	2.90/0.00	5.82/0.00	7.60/0.03	7.60/0.00
RELATIVE HUMIDITY(%)													
4 AM	68	72	74	74	76	80	81	80	78	74	73	70	75
10 AM	54	56	59	58	64	69	69	67	65	58	57	55	61
4 PM	55	57	59	58	63	67	66	66	64	61	63	57	61
10 PM	68	71	72	71	74	78	79	78	77	73	73	70	74

*"fastest mile"; speed is fastest observed 1-minute value.

Source of climatological data: NWS climatic summary.

C. GUIDE TO SECTION VII: SKY CHARTS

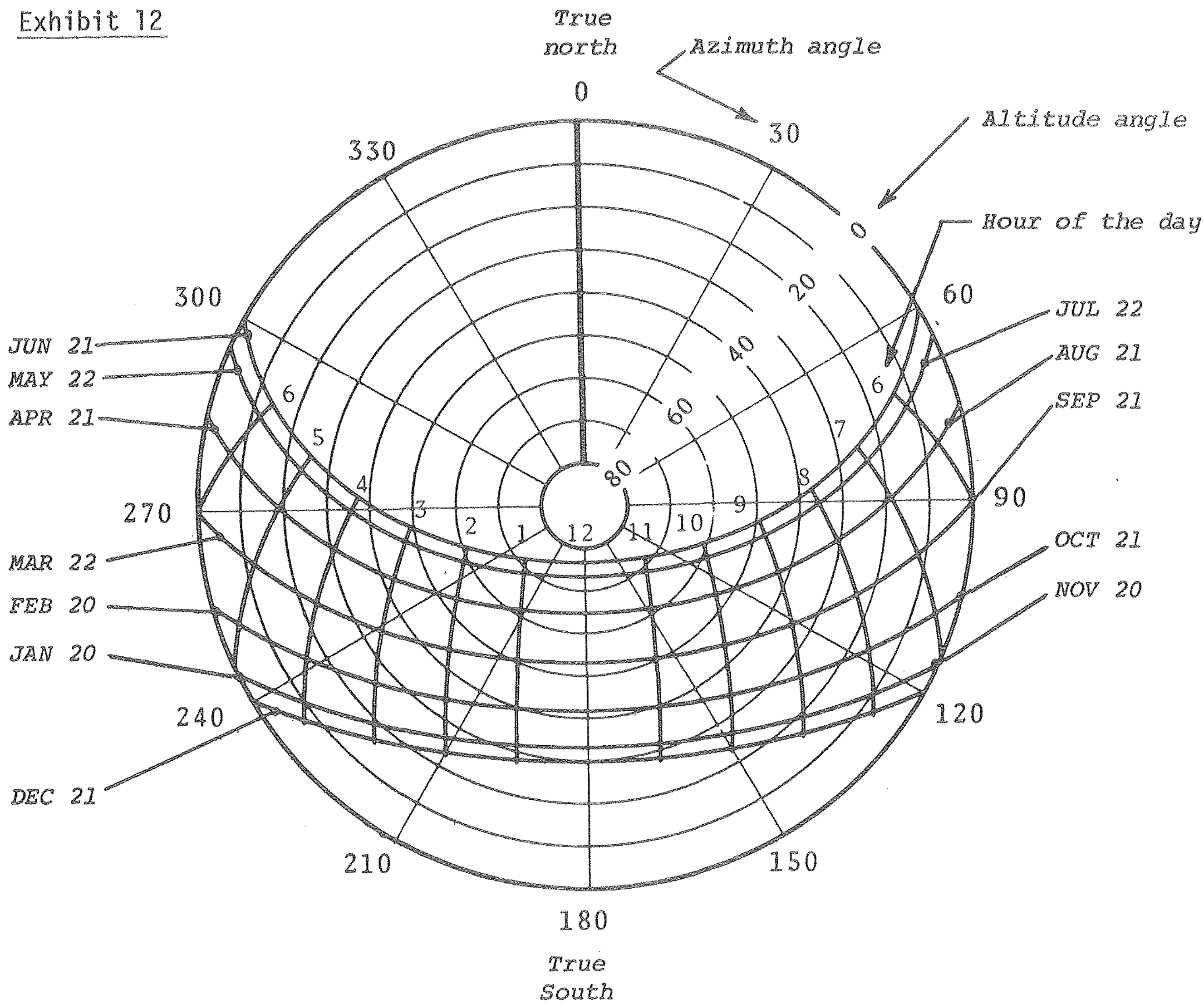
This section contains five sky charts, given for every two degrees of latitude in the state of California. (Latitude and longitude coordinates for over 350 weather stations in California are given in Section VI-b.)

12. Exhibit 12. Sky Chart

The sky chart is a plot that describes the relationship between time of the year, hour of the day, and position of the sun in the sky. The bowed curves that slope up at either end specify a time of year, or date. The vertical curves that intersect the date lines at approximately right angles indicate the time of day. The concentric circles each represent an altitude angle, and the radial lines represent an azimuth angle. One need only locate the date and

0 0 3 0 4 7 0 0 7 8 7

Exhibit 12



time to determine the azimuth and altitude angles which, when taken together, pinpoint the sun's position in the sky. The altitude angle measures the sun's height in degrees above the horizon, and the azimuth angle determines its angular distance, measured clockwise, from true north.

EXAMPLE: Find the altitude and azimuth angles of the sun on November 1 at 10 AM, solar time. (The procedure for converting from local standard time to solar time is given in Section IX.)

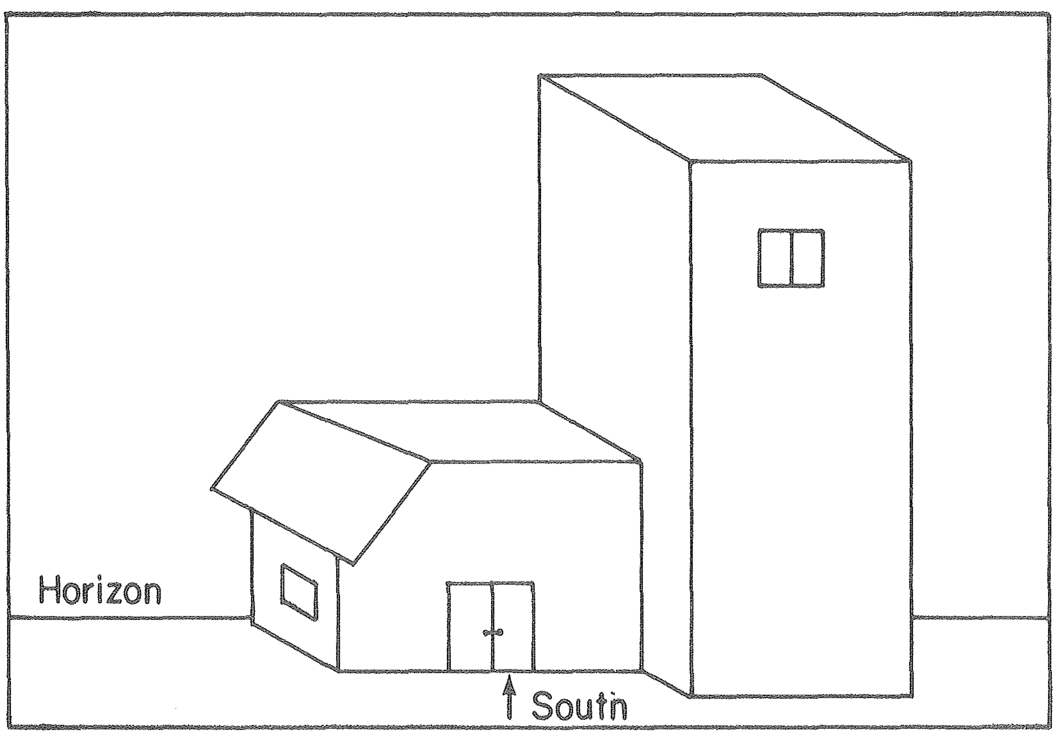
Using the sky chart shown, observe that October 21 is the closest date on the chart to November 1. Follow this line to the point where it intersects with the 10 AM curve. Since November 1 falls approximately 1/3 of the way between October

21 and November 20, move 1/3 the distance toward November 20 along the 10 AM curve. At this point, the altitude is 32° and the azimuth is 144°.

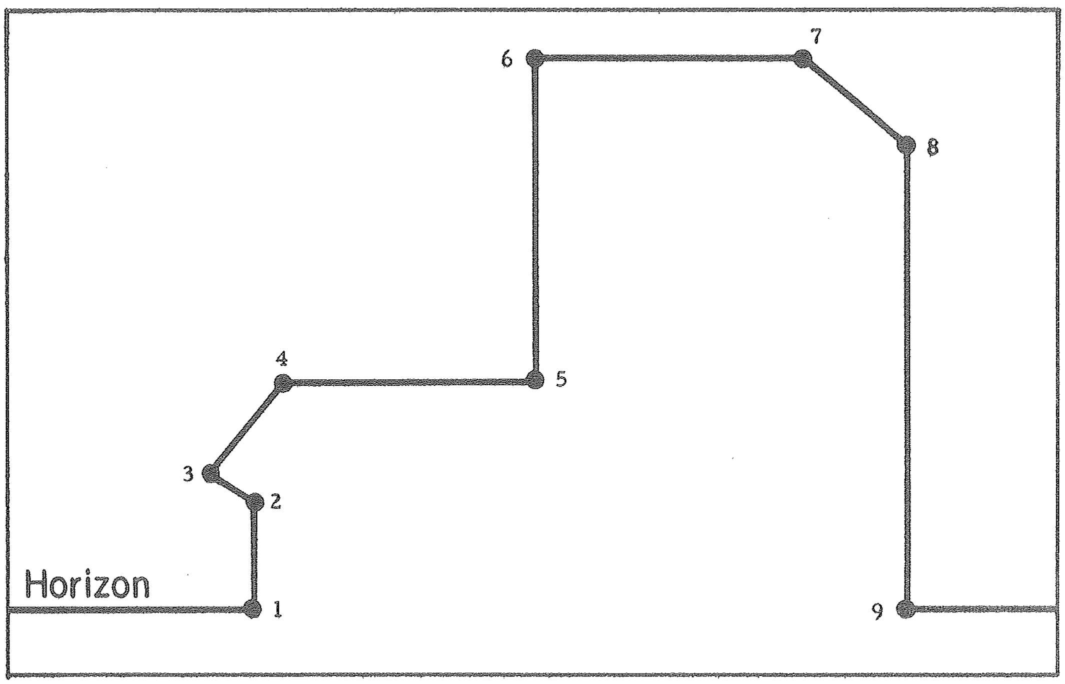
Thus, the sun is 32° above the horizon, and if an imaginary vertical line is dropped from the sun, its point of intersection on the horizon will lie 144° from the north (measured clockwise).

Sky charts are also useful for determining the extent to which obstructions such as buildings or trees will shade a solar collector. The procedure is to stand at the position of the collector and measure the altitudes and azimuths of all visible obstructions. The outlines of these obstructions can then be plotted on the sky chart for the particular locale. The collector will be shaded during any interval in which the sun's daily path passes through the outline of one of the obstructions.

EXAMPLE: Determine the extent to which a south-facing collector is blocked from the sun by a nearby building. From the collector, assume the southern horizon looks like this:



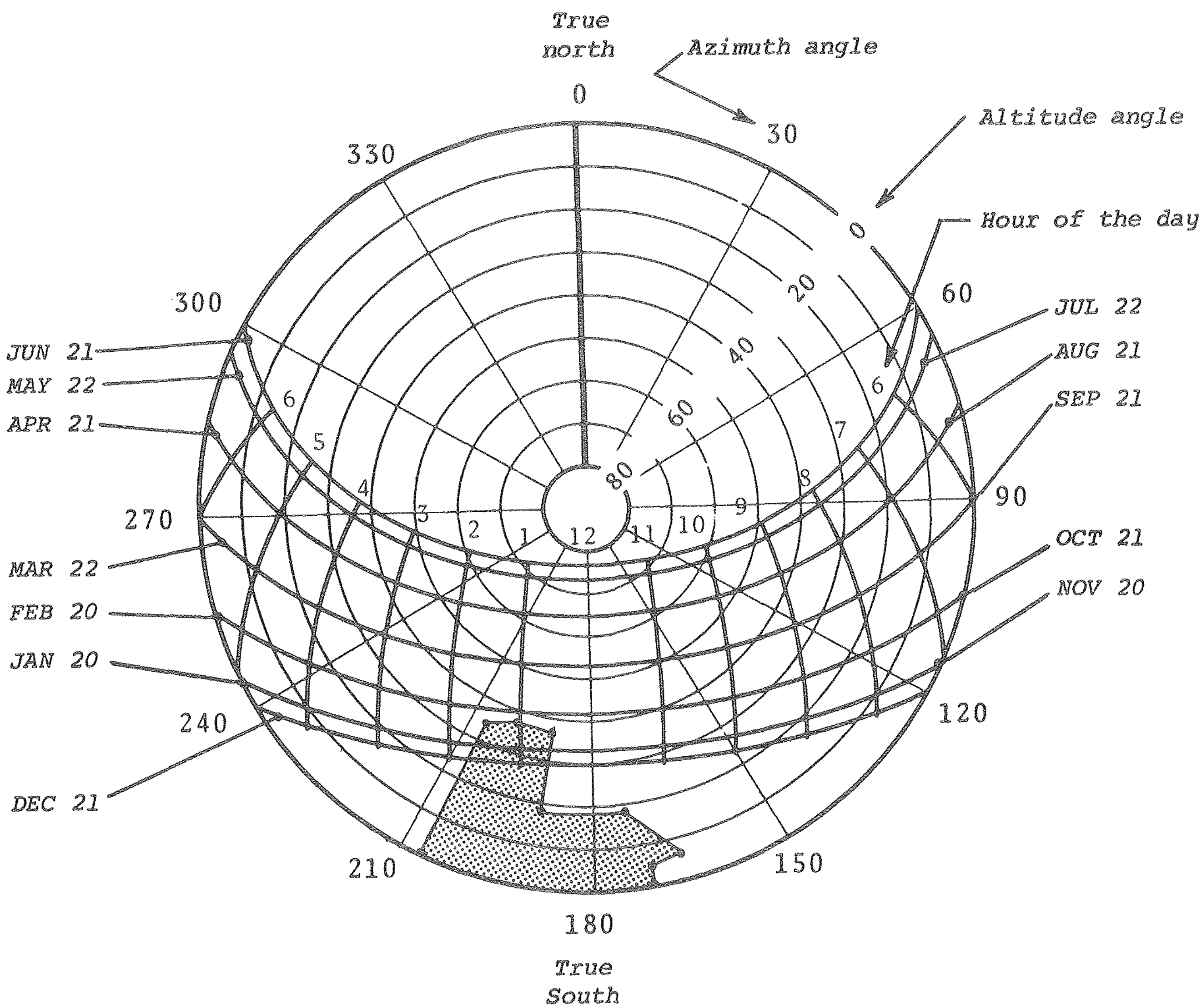
First, take altitude and azimuth angles for the part of the building's outline that stands above the horizon. Then plot these angles on the sky chart. The azimuth angles can be obtained with a magnetic compass. For measurement of the altitude angles, a protractor with a weighted string will suffice. One can take the coordinates for as many points on the outline as desired, although not that many are needed unless the structure is complex.



Suppose 9 points are considered adequate, and that the measured coordinates from the <u>position of the collector</u> are

Point	Azimuth	Altitude
1	170°	0°
2	170°	7°
3	165°	8°
4	175°	18°
5	191°	18°
6	191°	37°
7	199°	37°
8	207°	35°
9	207°	0°

Now, transfer these coordinates to the sky chart.



The shaded area on the sky chart corresponds to the outline of the structure. The cross-hatched area formed by the date and time curves defines all possible positions of the sun in the sky. The intersection of the shaded and cross-hatched areas determines the extent to which the structure blocks the sun. Thus, it is observed that from about November 1 to February 10, the sun is obstructed for some portion of the day. On December 21, the sun is blocked from approximately 12:35 to 1:45. By February 15, the period of time blocked has changed to approximately 12:30 to 1:30. It will be noted that in all instances, except for the summer and winter solstice, two dates are represented by the same horizontal curve; for example, October 21 and February 20. This is because on these two dates the earth's declination is identical, and the sun's motion through the sky appears the same for both cases.

The sky chart determines the sun's position in the sky, and thus inferences made concerning solar-energy obstruction pertain primarily to the direct beam component of the total radiation. Some diffuse and reflected energy will normally be present regardless of the obstruction.

V. Solar Data

The solar data in this section are arranged in order of their appearance on the solar zone maps (Section III).

(A) SOLAR DATA FOR BUTLER VALLEY RANCH

Nearby Climate Station - Eureka

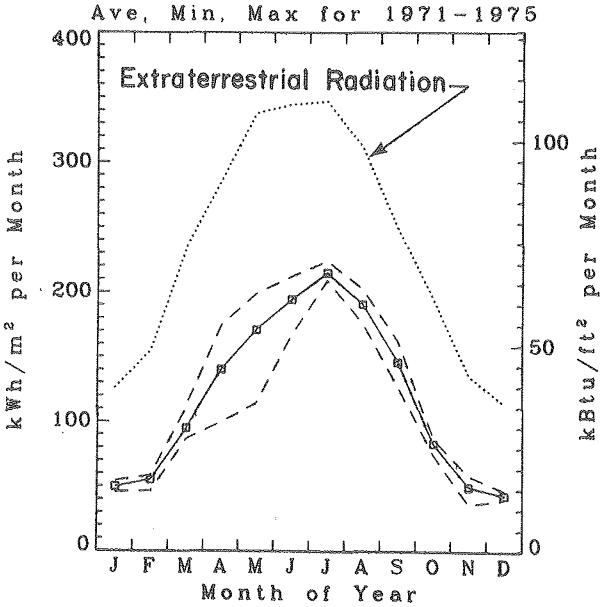
Monthly Solar Data, Butler Valley Ranch

	Latitude: 40.77°			Longitude: 123.90°			Elevation: 421'						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	50	55	95	140	171	194	215	190	146	83	50	43	1432
direct beam (normal incidence)	77	62	99	145	168	200	237	218	181	99	67	69	1623
SOLAR RADIATION (KBtu/ft^2 per month)													
horizontal surface	16	17	30	44	54	61	68	60	46	26	16	14	454
direct beam (normal incidence)	24	20	31	46	53	63	75	69	57	32	21	22	514
PERCENT OF POSSIBLE SUNSHINE*	42	46	50	55	55	57	52	47	53	49	42	40	50
MEAN CLOUD COVER (in tenths)*	7	7	7	7	7	6	7	7	6	6	7	7	7
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.39	.36	.41	.49	.51	.56	.62	.61	.58	.43	.37	.38	.48

Recording interval: 1971-1975
*Data for Eureka, 40° 48'N, 124°10' W, elevation 43'
Source of solar data: U.S. Army Corps of Engineers, pyranograph.

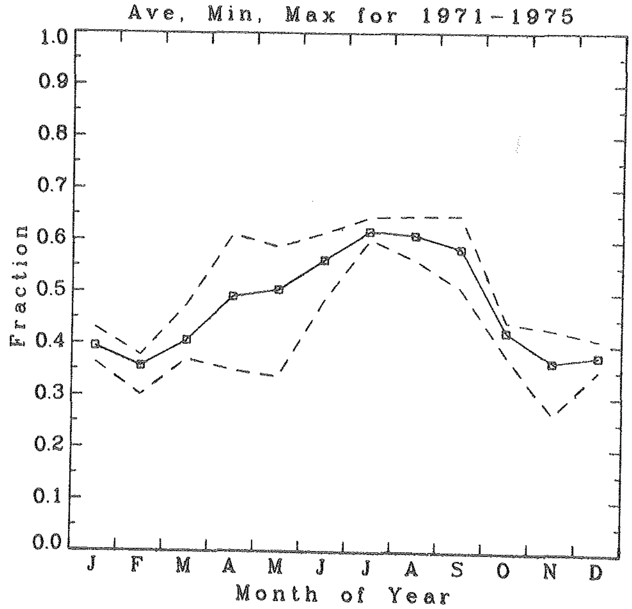
Monthly Total Horizontal Radiation Butler Valley Ranch

Ave, Min, Max for 1971-1975

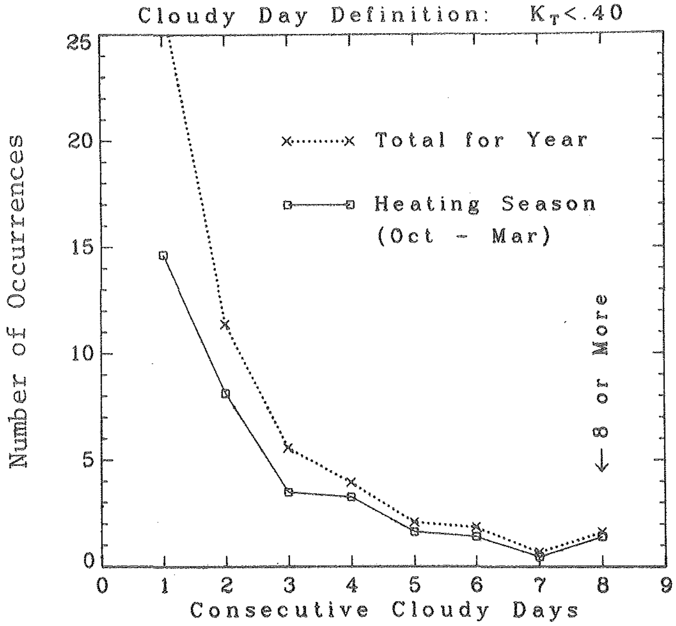


Monthly Total/Extraterrestrial (K_T) Butler Valley Ranch

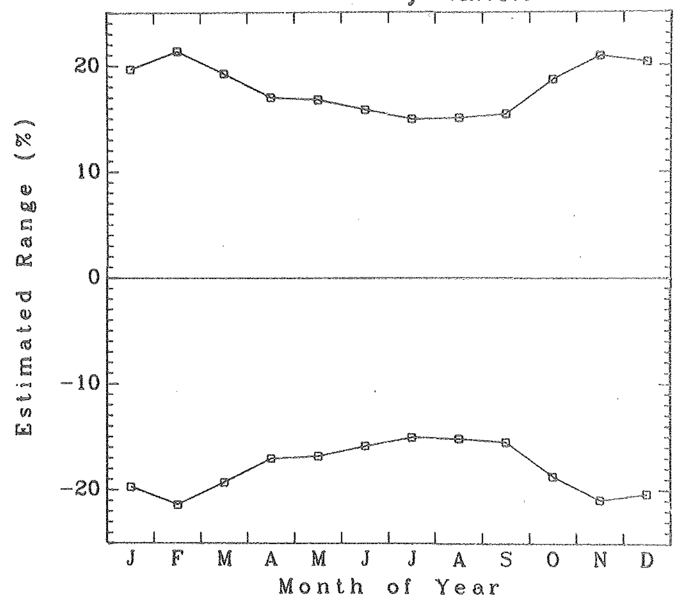
Ave, Min, Max for 1971-1975



Occurrences of Cloudy Days
Butler Valley Ranch

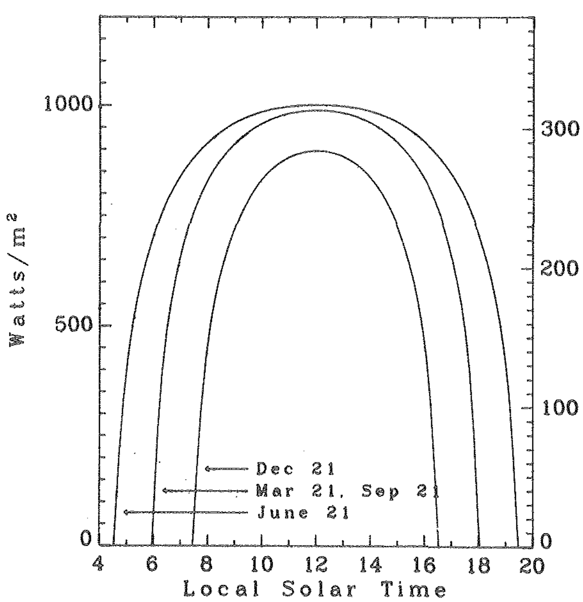


Possible Error in Direct Beam (Normal Incidence)
Butler Valley Ranch

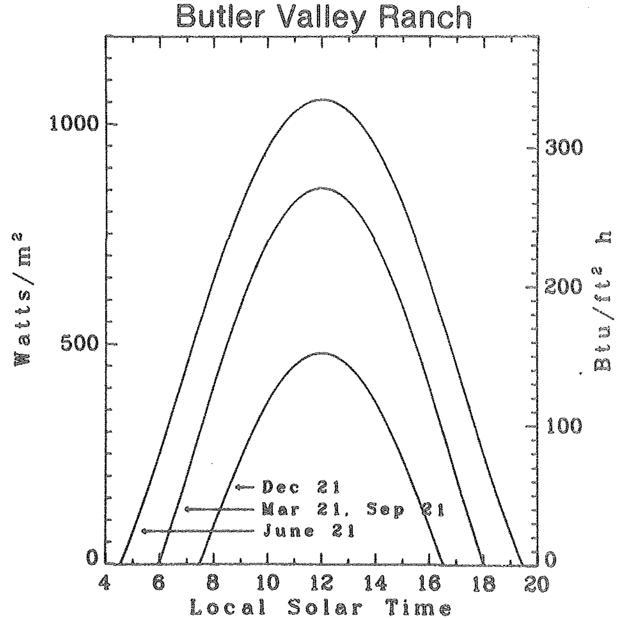


Clear Day Plots for Solar Radiation

Direct Beam (Normal Incidence)
Butler Valley Ranch



Total Radiation on a Horizontal Surface
Butler Valley Ranch



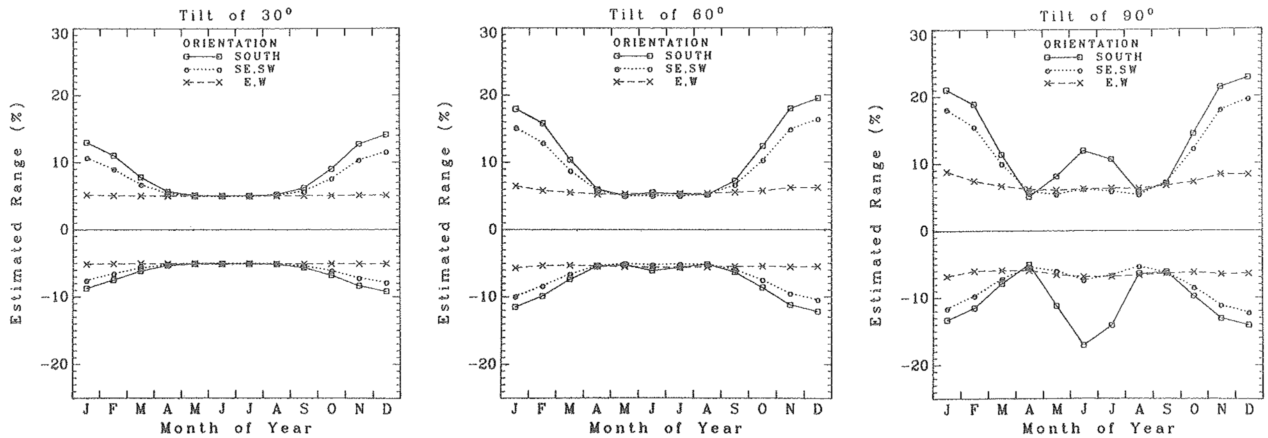
Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m^2)
Butler Valley Ranch

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
		DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)												
SOUTH	15	64	65	105	147	172	191	213	197	161	96	61	56	1529
SOUTH	30	74	70	110	146	164	178	201	193	167	104	70	66	1542
SOUTH	45	81	72	108	137	147	156	177	177	162	106	74	72	1471
SOUTH	60	82	70	101	121	123	127	145	152	149	102	74	74	1320
SOUTH	75	79	65	88	98	93	92	106	118	126	92	70	72	1100
SOUTH	90	71	55	71	71	61	56	64	80	97	78	62	65	831
SE,SW	15	60	61	102	145	171	191	213	194	156	92	58	52	1493
SE,SW	30	66	65	103	142	163	180	202	189	158	96	62	58	1485
SE,SW	45	69	64	100	134	149	162	182	176	152	95	64	61	1408
SE,SW	60	68	61	92	119	129	138	156	154	139	89	62	61	1267
SE,SW	75	63	55	80	100	104	109	124	127	119	79	57	57	1074
SE,SW	90	55	46	65	77	78	79	90	96	95	66	49	50	844
E,W	15	49	54	93	137	167	189	209	186	143	81	49	42	1401
E,W	30	47	52	89	130	157	178	197	175	135	78	47	41	1325
E,W	45	45	48	82	119	143	161	178	160	125	72	44	38	1214
E,W	60	40	43	73	105	125	140	155	140	111	64	40	35	1072
E,W	75	35	37	62	88	105	117	129	118	94	55	34	30	906
E,W	90	29	30	50	70	82	92	102	94	76	45	28	25	723
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	0	0	1	1	1	1	0	0	0	0	5
ANY	30	1	1	1	2	2	3	3	3	2	1	1	1	19
ANY	45	1	2	3	4	5	6	6	6	4	2	1	1	42
ANY	60	2	3	5	7	9	10	11	10	7	4	2	2	72
ANY	75	4	4	7	10	13	14	16	14	11	6	4	3	106
ANY	90	5	6	9	14	17	19	21	19	15	8	5	4	143

Total Radiation on a Tilted Surface (Calculated Values)
Engineering units (kBtu/ft^2)
Butler Valley Ranch

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
		DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)												
SOUTH	15	20	20	33	47	54	61	68	62	51	30	19	18	484
SOUTH	30	24	22	35	46	52	56	64	61	53	33	22	21	489
SOUTH	45	26	23	34	43	47	49	56	56	51	34	23	23	466
SOUTH	60	26	22	32	38	39	40	46	48	47	32	23	24	418
SOUTH	75	25	20	28	31	30	29	34	38	40	29	22	23	349
SOUTH	90	23	18	22	22	19	18	20	25	31	25	20	21	263
SE,SW	15	19	19	32	46	54	61	67	62	49	29	18	17	473
SE,SW	30	21	20	33	45	52	57	64	60	50	30	20	18	470
SE,SW	45	22	20	32	42	47	51	58	56	48	30	20	19	446
SE,SW	60	21	19	29	38	41	44	49	49	44	28	20	19	402
SE,SW	75	20	17	25	32	33	35	39	40	38	25	18	18	340
SE,SW	90	17	15	21	24	25	25	29	30	30	21	15	16	267
E,W	15	16	17	29	43	53	60	66	59	45	26	16	13	444
E,W	30	15	16	28	41	50	56	62	56	43	25	15	13	420
E,W	45	14	15	26	38	45	51	56	51	39	23	14	12	385
E,W	60	13	14	23	33	40	44	49	45	35	20	13	11	340
E,W	75	11	12	20	28	33	37	41	37	30	18	11	10	287
E,W	90	9	10	16	22	26	29	32	30	24	14	9	8	229
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	0	1	1	1	1	1	1	0	0	0	6
ANY	45	0	1	1	1	2	2	2	2	1	1	0	0	13
ANY	60	1	1	2	2	3	3	3	3	2	1	1	1	23
ANY	75	1	1	2	3	4	5	5	4	3	2	1	1	34
ANY	90	2	2	3	4	5	6	7	6	5	3	2	1	45

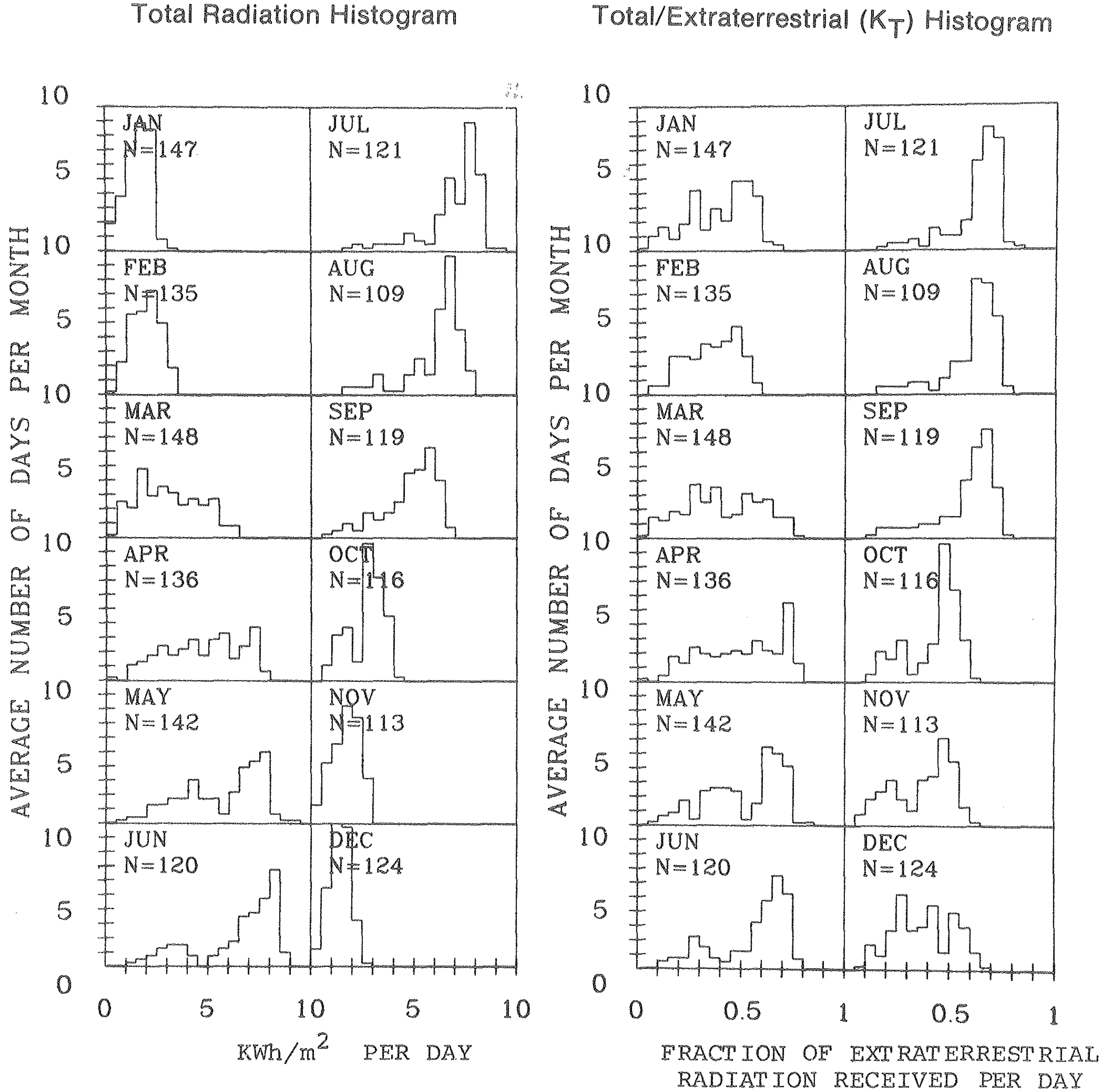
Possible Error in the Total Radiation on a Tilted Surface
Butler Valley Ranch



Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profiles
Butler Valley Ranch

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.55	1.36	1.21	1.09	1.02	.99	1.00	1.06	1.16	1.30	1.48	1.61
SOUTH	30	1.99	1.63	1.34	1.11	.97	.91	.94	1.04	1.23	1.51	1.86	2.11
SOUTH	45	2.29	1.79	1.38	1.06	.86	.78	.81	.96	1.23	1.61	2.12	2.47
SOUTH	60	2.44	1.83	1.33	.93	.70	.61	.64	.82	1.14	1.61	2.22	2.65
SOUTH	75	2.43	1.74	1.18	.74	.50	.40	.44	.62	.97	1.50	2.18	2.66
SOUTH	90	2.25	1.54	.96	.51	.27	.19	.22	.39	.74	1.28	1.99	2.49
SE, SW	15	1.38	1.25	1.14	1.06	1.01	.99	.99	1.04	1.11	1.20	1.33	1.42
SE, SW	30	1.67	1.42	1.22	1.07	.97	.93	.94	1.02	1.15	1.33	1.58	1.74
SE, SW	45	1.84	1.50	1.23	1.01	.88	.82	.85	.95	1.13	1.38	1.72	1.95
SE, SW	60	1.90	1.48	1.16	.91	.76	.69	.72	.83	1.04	1.34	1.74	2.03
SE, SW	75	1.82	1.37	1.03	.76	.60	.53	.56	.68	.90	1.22	1.66	1.97
SE, SW	90	1.63	1.18	.84	.58	.43	.36	.39	.51	.71	1.03	1.46	1.78
E, W	15	.99	.98	.98	.98	.97	.97	.97	.97	.98	.98	.98	.98
E, W	30	.96	.95	.93	.92	.91	.91	.91	.92	.93	.94	.96	.96
E, W	45	.93	.89	.87	.84	.83	.82	.82	.83	.86	.88	.91	.93
E, W	60	.86	.82	.78	.74	.72	.71	.71	.73	.76	.80	.85	.87
E, W	75	.77	.72	.67	.63	.60	.59	.59	.62	.65	.70	.75	.78
E, W	90	.65	.60	.55	.50	.47	.46	.46	.49	.53	.58	.63	.66
NORMAL INCIDENCE		2.91	2.33	1.92	1.66	1.55	1.52	1.53	1.61	1.79	2.14	2.70	3.12

Butler Valley Ranch



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

(B) SOLAR DATA FOR SAN RAFAEL

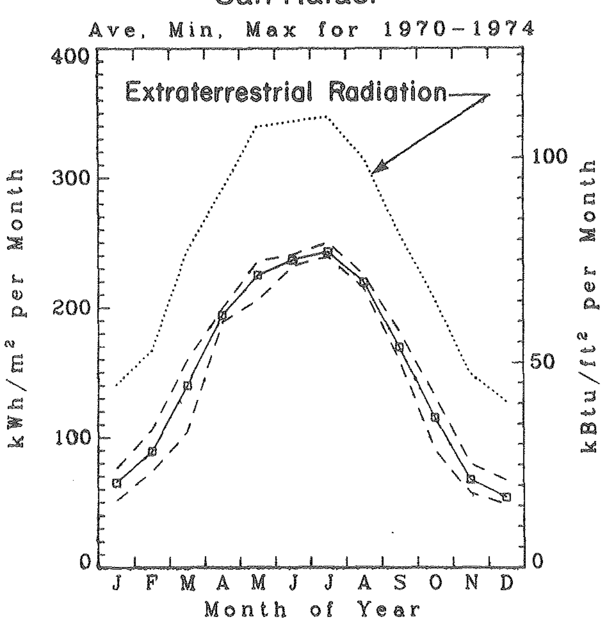
Nearby Climate Station - San Rafael

Monthly Solar Data, San Rafael

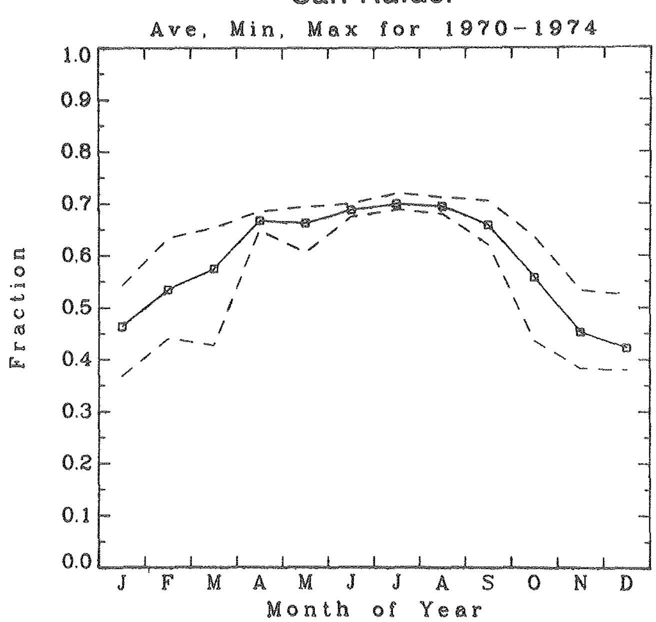
Latitude: 37.97° Longitude: 122.53° Elevation: 25'													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	65	89	140	194	225	237	243	220	170	115	68	54	1820
direct beam (normal incidence)	105	129	178	238	259	275	287	268	221	158	99	86	2302
SOLAR RADIATION (KBtu/ft^2 per month)													
horizontal surface	21	28	44	61	71	75	77	70	54	36	22	17	576
direct beam (normal incidence)	33	41	56	76	82	87	91	85	70	50	31	27	729
PERCENT OF POSSIBLE SUNSHINE*													
MEAN CLOUD COVER (in tenths)*	6	5	5	5	4	3	2	3	2	4	5	6	4
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.46	.53	.58	.67	.66	.69	.70	.70	.66	.56	.45	.42	.59

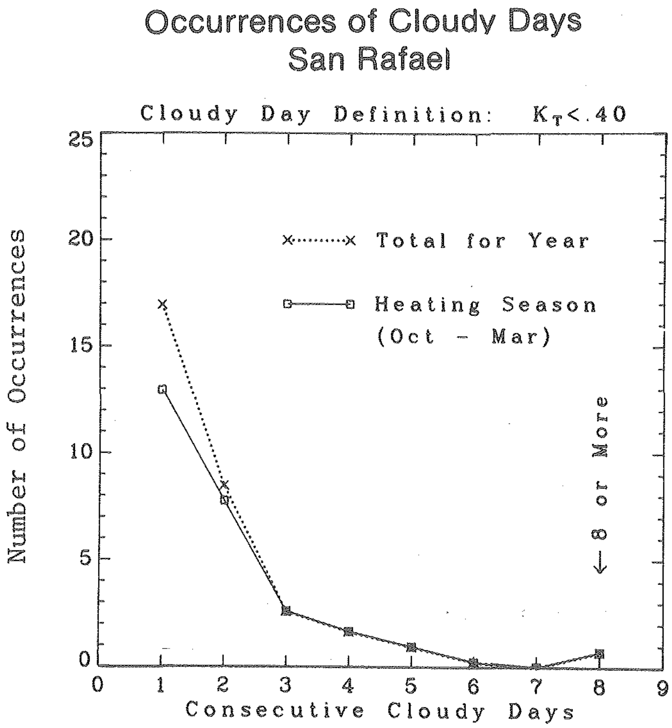
Recording interval: 1970-1974
Source of solar data: BAAPCD, Eppley lightbulb pyranometer.

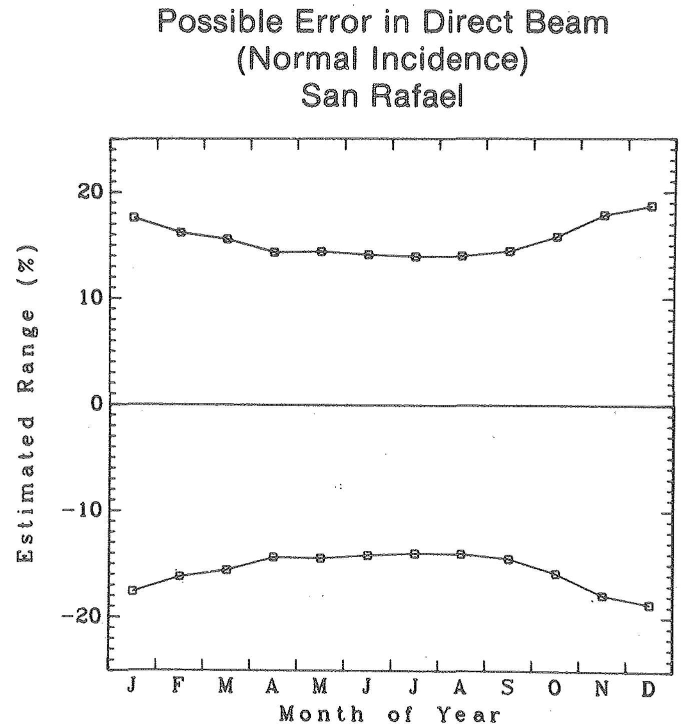
Monthly Total Horizontal Radiation San Rafael



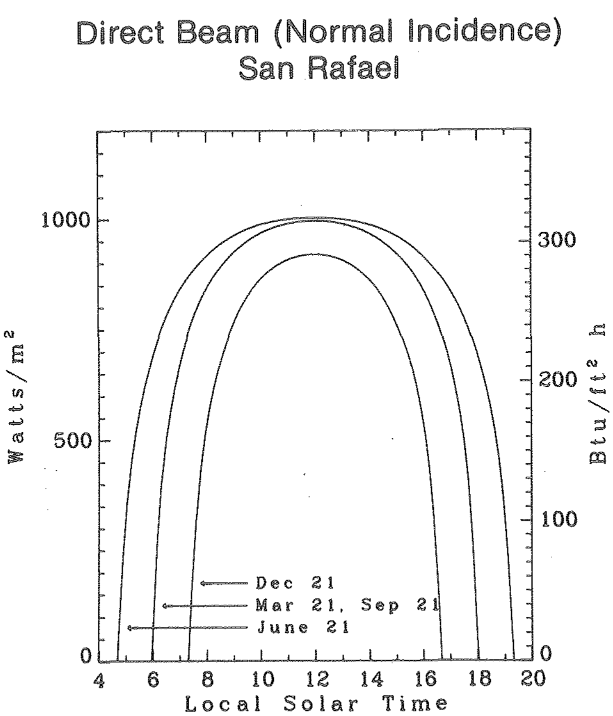
Monthly Total/Extraterrestrial (K_T) San Rafael

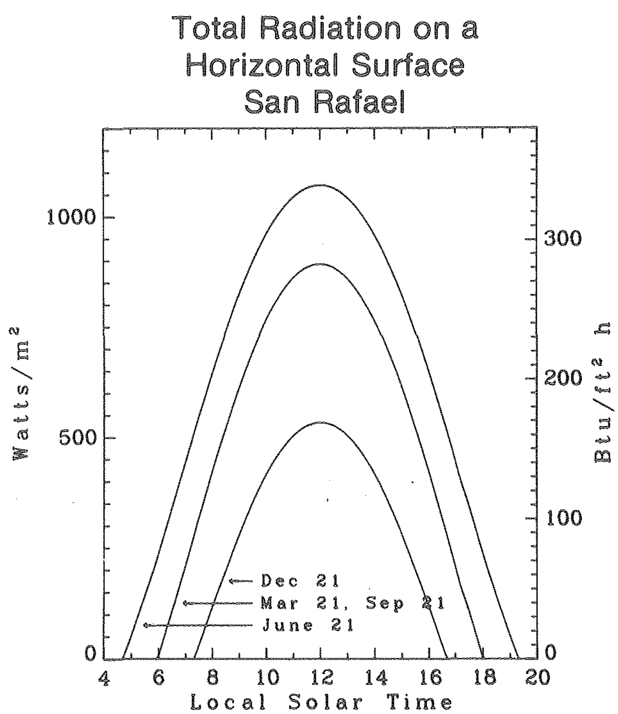






Clear Day Plots for Solar Radiation





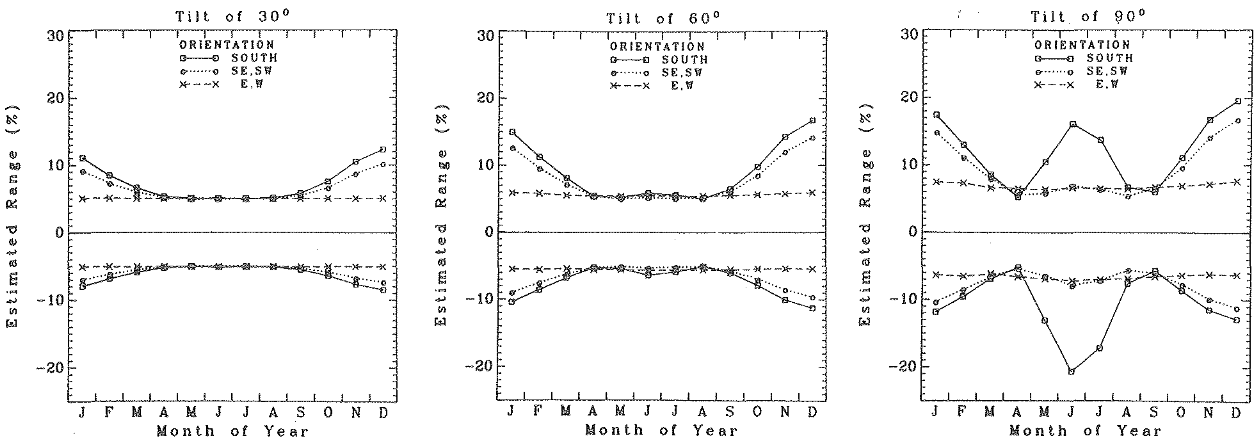
Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m²)
San Rafael

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
		DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)												
SOUTH	15	84	108	158	205	225	231	240	226	187	136	84	70	1955
SOUTH	30	98	120	166	203	213	213	223	220	192	148	96	82	1974
SOUTH	45	106	125	165	190	188	184	194	200	186	151	102	89	1880
SOUTH	60	107	123	154	165	154	145	155	169	169	146	102	91	1679
SOUTH	75	102	113	133	131	112	100	109	128	142	131	96	87	1386
SOUTH	90	91	97	106	90	67	54	61	82	106	109	85	79	1026
SE,SW	15	78	102	152	201	224	232	240	223	181	129	79	65	1906
SE,SW	30	86	109	156	198	213	217	226	216	182	135	86	72	1897
SE,SW	45	90	110	151	185	193	193	202	199	175	135	88	75	1796
SE,SW	60	88	105	139	164	165	162	171	173	159	127	85	74	1612
SE,SW	75	81	94	121	135	131	126	134	141	135	112	78	69	1358
SE,SW	90	70	79	97	103	95	89	95	105	106	92	66	60	1057
E,W	15	64	88	137	190	220	231	237	214	166	113	66	53	1780
E,W	30	62	84	130	179	206	216	222	201	157	108	64	51	1680
E,W	45	58	78	120	163	186	195	200	183	144	100	59	48	1534
E,W	60	52	70	107	143	162	169	174	160	127	89	53	43	1350
E,W	75	45	60	91	120	135	140	144	134	108	76	46	38	1136
E,W	90	37	49	73	95	106	109	112	105	86	62	38	31	903
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY PHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	0	1	1	1	1	1	1	0	0	0	6
ANY	30	1	1	2	3	3	3	3	3	2	2	1	1	24
ANY	45	2	3	4	6	7	7	7	6	5	3	2	2	53
ANY	60	3	4	7	10	11	12	12	11	8	6	3	3	91
ANY	75	5	7	10	14	17	18	18	16	13	9	5	4	135
ANY	90	7	9	14	19	23	24	24	22	17	12	7	5	182

Total Radiation on a Tilted Surface (Calculated Values)
Engineering Units (kBtu/ft²)
San Rafael

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
		DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)												
SOUTH	15	27	34	50	65	71	73	76	72	59	43	27	22	619
SOUTH	30	31	38	53	64	67	68	71	70	61	47	30	26	626
SOUTH	45	33	40	52	60	60	58	62	63	59	48	32	28	596
SOUTH	60	34	39	49	52	49	46	49	53	54	46	32	29	532
SOUTH	75	32	36	42	41	36	32	35	41	45	42	31	28	439
SOUTH	90	29	31	33	28	21	17	19	26	34	35	27	25	325
SE,SW	15	25	32	48	64	71	73	76	71	57	41	25	21	604
SE,SW	30	27	35	49	63	68	69	72	69	58	43	27	23	601
SE,SW	45	28	35	48	59	61	61	64	63	55	43	28	24	569
SE,SW	60	28	33	44	52	52	51	54	55	50	40	27	24	511
SE,SW	75	26	30	38	43	42	40	42	45	43	36	25	22	430
SE,SW	90	22	25	31	33	30	28	30	33	34	29	21	19	335
E,W	15	20	28	44	60	70	73	75	68	53	36	21	17	564
E,W	30	20	27	41	57	65	68	70	64	50	34	20	16	532
E,W	45	18	25	38	52	59	62	63	58	46	32	19	15	486
E,W	60	17	22	34	45	51	53	55	51	40	28	17	14	428
E,W	75	14	19	29	38	43	44	46	42	34	24	15	12	360
E,W	90	12	15	23	30	34	34	36	33	27	20	12	10	286
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	1	1	1	1	1	1	1	0	0	0	8
ANY	45	1	1	1	2	2	2	2	2	2	1	1	1	17
ANY	60	1	1	2	3	4	4	4	3	3	2	1	1	29
ANY	75	2	2	3	5	5	6	6	5	4	3	2	1	43
ANY	90	2	3	4	6	7	8	8	7	5	4	2	2	58

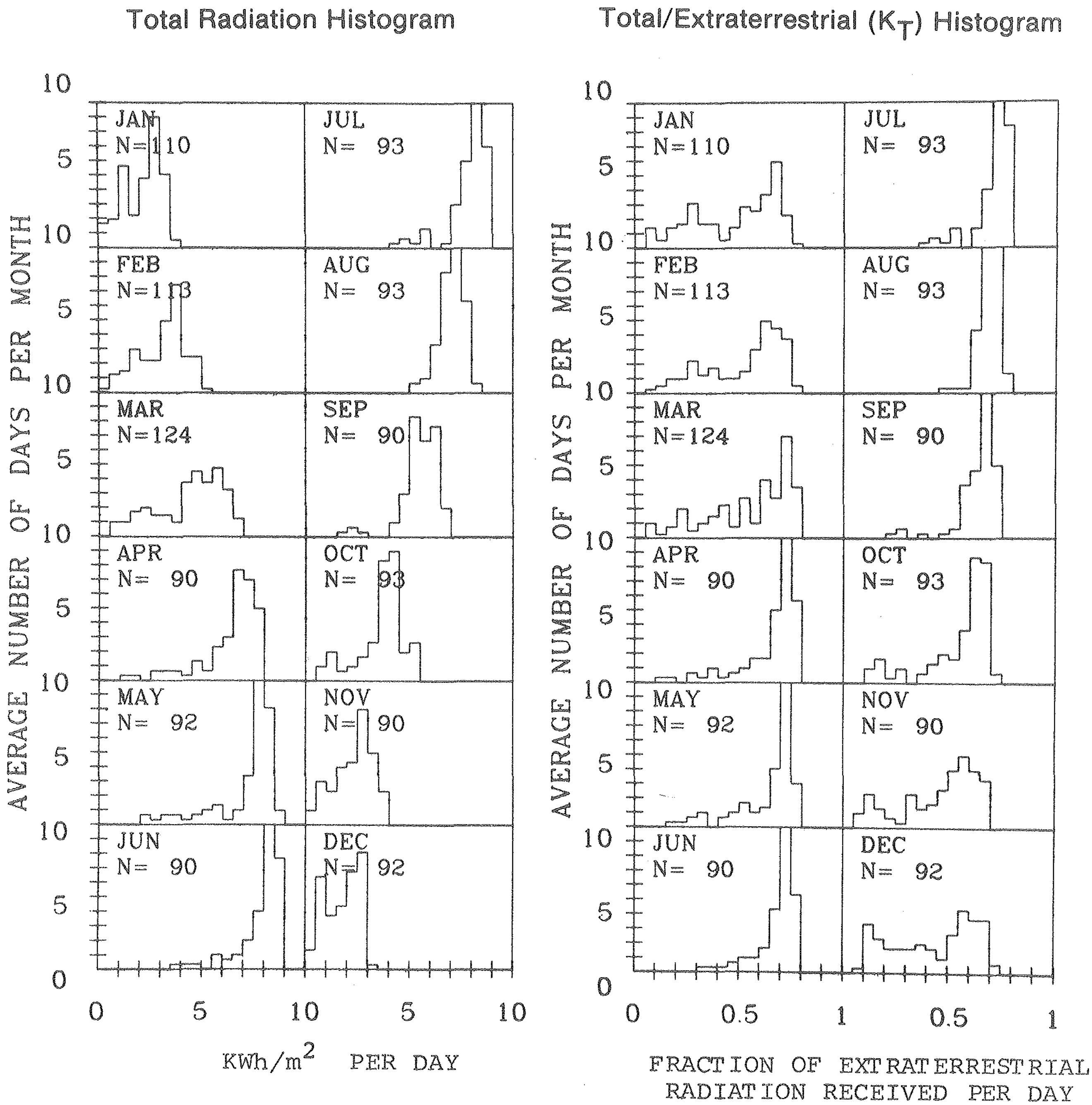
Possible Error in the Total Radiation on a Tilted Surface
San Rafael



Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profiles
San Rafael

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.48	1.33	1.19	1.08	1.01	.98	.99	1.04	1.14	1.27	1.43	1.54
SOUTH	30	1.87	1.56	1.30	1.08	.95	.89	.91	1.02	1.20	1.45	1.76	1.97
SOUTH	45	2.12	1.69	1.32	1.02	.83	.75	.78	.92	1.18	1.53	1.97	2.27
SOUTH	60	2.23	1.70	1.25	.88	.66	.57	.61	.77	1.08	1.51	2.04	2.41
SOUTH	75	2.19	1.60	1.10	.69	.46	.36	.40	.57	.90	1.38	1.98	2.39
SOUTH	90	2.00	1.39	.87	.45	.23	.15	.18	.34	.67	1.16	1.78	2.20
SE,SW	15	1.33	1.22	1.13	1.05	1.00	.98	.99	1.03	1.09	1.18	1.29	1.37
SE,SW	30	1.58	1.37	1.19	1.04	.95	.91	.93	1.00	1.12	1.29	1.50	1.65
SE,SW	45	1.72	1.43	1.18	.98	.86	.80	.82	.92	1.09	1.32	1.61	1.81
SE,SW	60	1.74	1.40	1.10	.87	.73	.66	.69	.80	1.00	1.27	1.62	1.86
SE,SW	75	1.65	1.28	.97	.72	.57	.50	.53	.64	.85	1.14	1.52	1.78
SE,SW	90	1.46	1.08	.78	.54	.40	.34	.36	.47	.66	.94	1.32	1.59
E,W	15	.98	.98	.98	.98	.97	.97	.97	.97	.98	.98	.98	.98
E,W	30	.95	.94	.93	.92	.91	.91	.91	.91	.92	.93	.94	.95
E,W	45	.90	.88	.86	.84	.82	.81	.82	.83	.85	.87	.89	.91
E,W	60	.83	.80	.76	.73	.71	.70	.71	.72	.75	.78	.82	.84
E,W	75	.73	.70	.65	.62	.59	.58	.58	.60	.64	.68	.72	.74
E,W	90	.61	.57	.53	.49	.46	.45	.45	.47	.51	.55	.59	.62
NORMAL INCIDENCE		2.67	2.19	1.84	1.62	1.52	1.50	1.51	1.56	1.73	2.03	2.49	2.84

San Rafael



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

(C) SOLAR DATA FOR RICHMOND

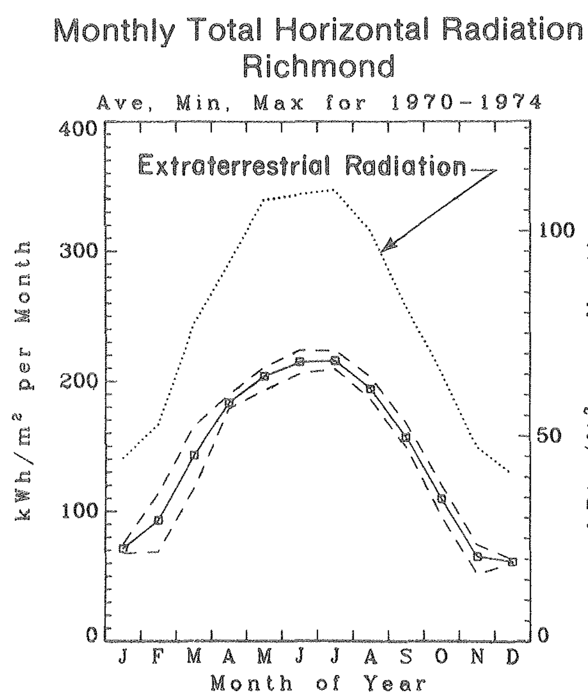
Nearby Climate Stations - San Rafael, Oakland

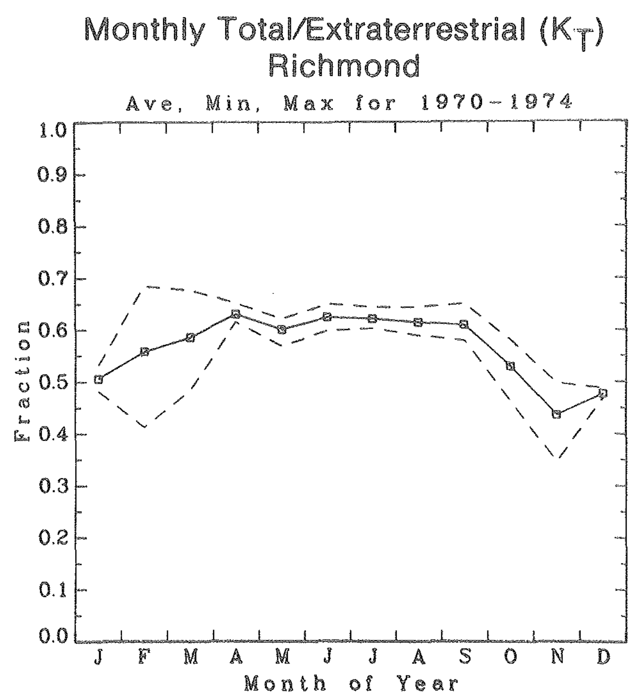
Monthly Solar Data, Richmond

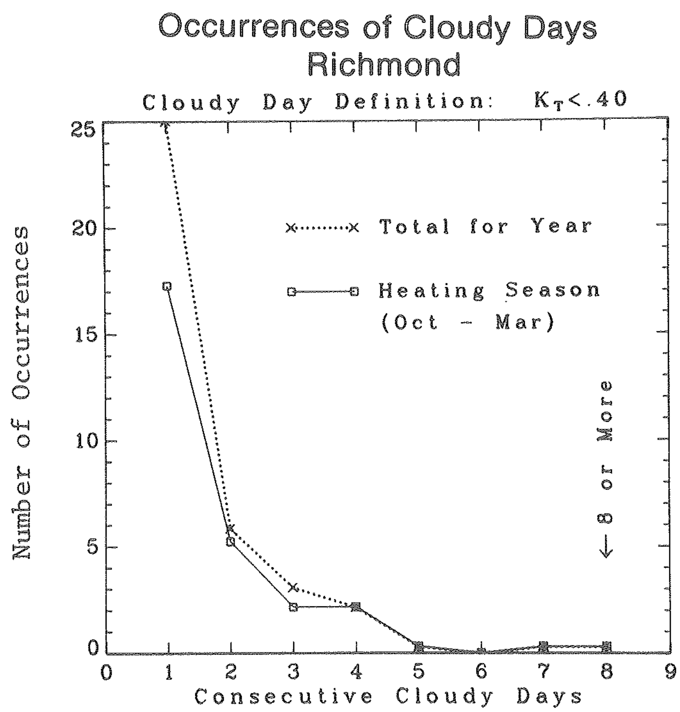
Latitude: 37.95° Longitude: 122.37° Elevation: 0	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	71	93	143	183	204	215	216	194	157	110	65	61	1712
direct beam (normal incidence)	121	138	183	217	220	233	235	218	194	145	93	106	2101
SOLAR RADIATION (KBtu/ft^2 per month)													
horizontal surface	22	29	45	58	65	68	68	62	50	35	21	19	542
direct beam (normal incidence)	38	44	58	69	70	74	74	69	61	46	29	34	666
PERCENT OF POSSIBLE SUNSHINE*													
MEAN CLOUD COVER (in tenths)*	6	6	6	5	5	4	4	4	3	4	6	6	5
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.51	.56	.59	.63	.60	.62	.62	.61	.61	.53	.44	.48	.57

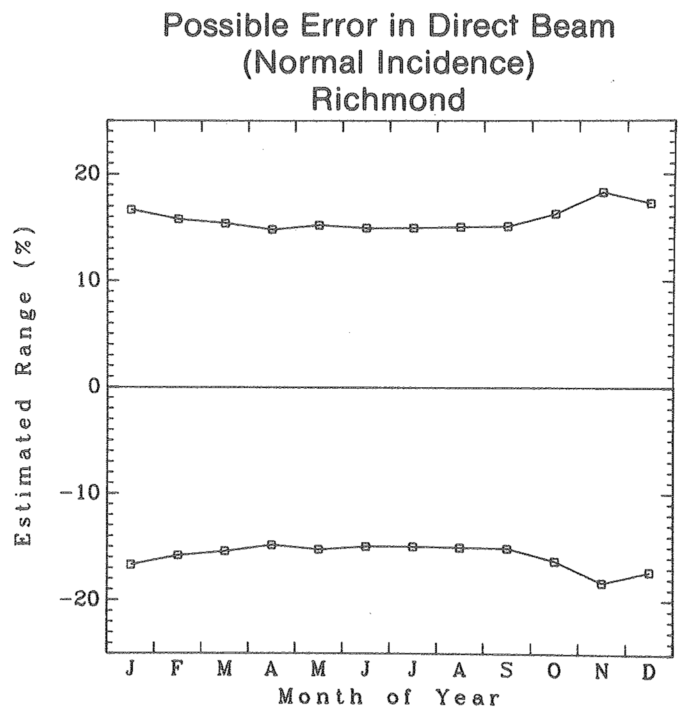
Recording interval: 1970-1974

*Data for Oakland 37° 44' N 122° 12' W, elevation 6'
Source of solar data: BAAPCD, Eppley lightbulb pyranometer.

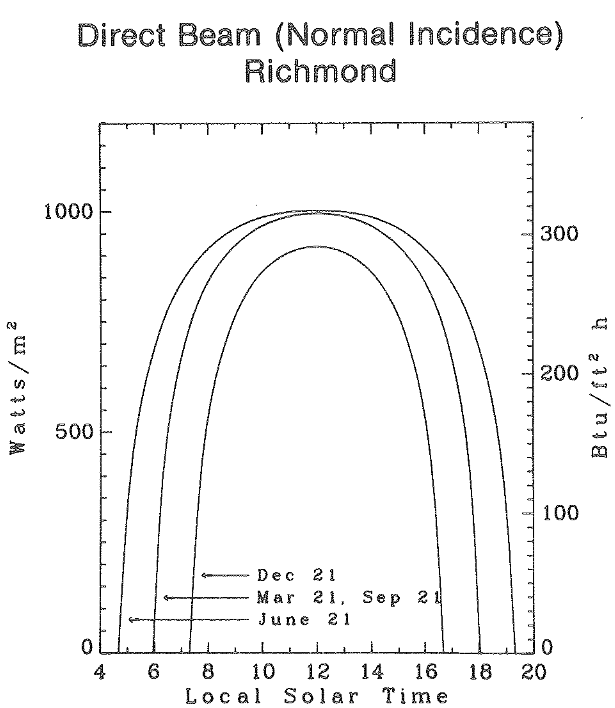


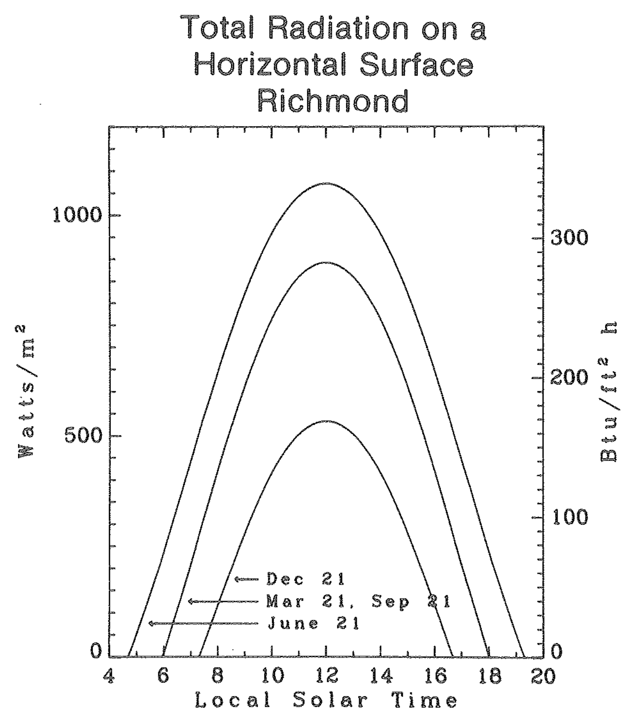






Clear Day Plots for Solar Radiation





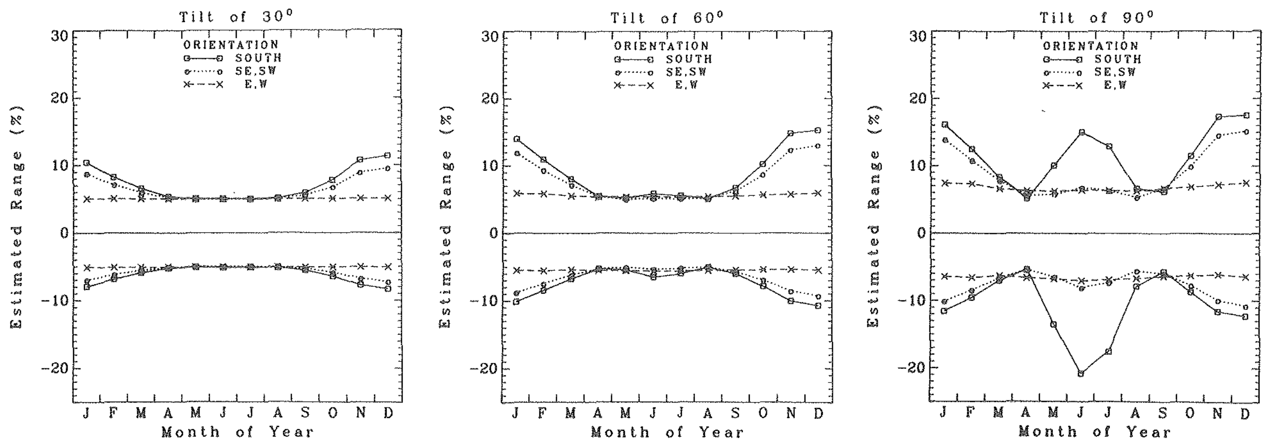
Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m^2)
Richmond

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
		DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)												
SOUTH	15	93	113	161	193	204	210	213	199	172	128	81	81	1848
SOUTH	30	109	127	170	191	193	194	198	193	176	139	92	96	1877
SOUTH	45	118	132	168	178	171	168	173	176	170	142	97	105	1799
SOUTH	60	121	130	157	155	140	133	140	149	154	136	97	108	1620
SOUTH	75	116	120	136	123	103	94	100	114	129	123	91	104	1353
SOUTH	90	104	103	108	85	63	53	58	74	97	102	80	94	1021
SE,SW	15	86	107	155	189	203	210	213	197	166	122	76	75	1799
SE,SW	30	96	115	159	186	193	197	200	190	168	128	82	84	1797
SE,SW	45	100	116	155	174	175	175	180	175	160	127	84	88	1709
SE,SW	60	99	111	143	154	150	148	152	153	145	119	81	87	1541
SE,SW	75	91	100	123	127	120	115	120	124	123	105	74	82	1306
SE,SW	90	79	83	99	97	87	82	86	93	97	86	63	71	1024
E,W	15	70	92	140	179	199	210	211	189	154	107	64	60	1675
E,W	30	67	88	133	169	187	196	197	178	145	102	61	58	1582
E,W	45	63	81	122	154	169	177	178	162	133	95	57	54	1447
E,W	60	57	73	109	135	148	154	155	142	118	84	51	49	1275
E,W	75	50	63	92	114	123	127	128	118	100	72	44	43	1074
E,W	90	41	51	74	90	96	99	100	93	80	58	36	35	855
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	0	1	1	1	1	1	1	0	0	0	6
ANY	30	1	1	2	2	3	3	3	3	2	1	1	1	23
ANY	45	2	3	4	5	6	6	6	6	5	3	2	2	50
ANY	60	4	5	7	9	10	11	11	10	8	5	3	3	86
ANY	75	5	7	11	14	15	16	16	14	12	8	5	5	127
ANY	90	7	9	14	18	20	21	22	19	16	11	7	6	171

Total Radiation on a Tilted Surface (Calculated Values)
Engineering Units ($kBtu/ft^2$)
Richmond

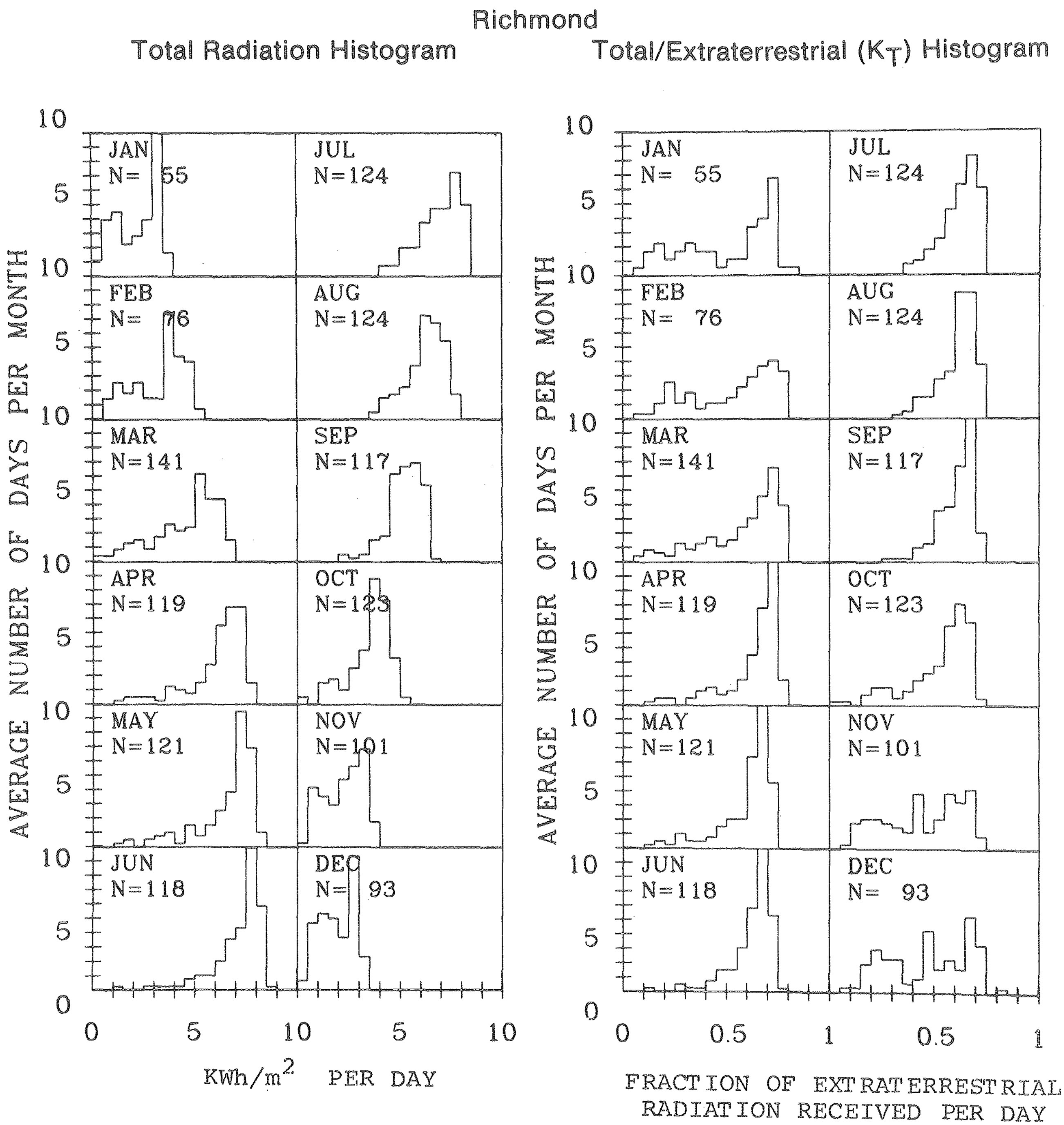
SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
		DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)												
SOUTH	15	29	36	51	61	65	67	67	63	54	41	26	26	585
SOUTH	30	35	40	54	61	61	61	63	61	56	44	29	30	595
SOUTH	45	38	42	53	56	54	53	55	56	54	45	31	33	570
SOUTH	60	38	41	50	49	44	42	44	47	49	43	31	34	513
SOUTH	75	37	38	43	39	33	30	32	36	41	39	29	33	429
SOUTH	90	33	33	34	27	20	17	18	24	31	32	25	30	324
SE,SW	15	27	34	49	60	64	67	67	62	53	39	24	24	570
SE,SW	30	30	36	50	59	61	62	63	60	53	40	26	27	569
SE,SW	45	32	37	49	55	55	56	57	55	51	40	27	28	541
SE,SW	60	31	35	45	49	47	47	48	48	46	38	26	28	488
SE,SW	75	29	32	39	40	38	37	38	39	39	33	23	26	414
SE,SW	90	25	26	31	31	28	26	27	29	31	27	20	23	325
E,W	15	22	29	44	57	63	66	67	60	49	34	20	19	531
E,W	30	21	28	42	54	59	62	63	56	46	32	19	18	501
E,W	45	20	26	39	49	54	56	56	51	42	30	18	17	458
E,W	60	18	23	34	43	47	49	49	45	37	27	16	16	404
E,W	75	16	20	29	36	39	40	41	37	32	23	14	14	340
E,W	90	13	16	24	29	31	31	32	30	25	19	11	11	271
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	1	1	1	1	1	1	1	0	0	0	7
ANY	45	1	1	1	2	2	2	2	2	1	1	1	1	16
ANY	60	1	1	2	3	3	3	3	3	2	2	1	1	27
ANY	75	2	2	3	4	5	5	5	5	4	3	2	1	40
ANY	90	2	3	5	6	6	7	7	6	5	3	2	2	54

Possible Error in the Total Radiation on a Tilted Surface
Richmond



Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profiles
Richmond

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.48	1.33	1.19	1.08	1.01	.98	.99	1.04	1.14	1.27	1.43	1.54
SOUTH	30	1.87	1.56	1.30	1.08	.95	.89	.91	1.02	1.20	1.45	1.76	1.97
SOUTH	45	2.12	1.69	1.32	1.02	.83	.75	.78	.92	1.18	1.53	1.97	2.26
SOUTH	60	2.23	1.70	1.25	.88	.66	.57	.61	.77	1.08	1.51	2.04	2.41
SOUTH	75	2.19	1.60	1.10	.69	.46	.36	.40	.57	.90	1.38	1.98	2.39
SOUTH	90	2.00	1.39	.87	.45	.23	.15	.18	.34	.66	1.16	1.78	2.20
SE,SW	15	1.33	1.22	1.13	1.05	1.00	.98	.99	1.03	1.09	1.18	1.29	1.37
SE,SW	30	1.58	1.37	1.19	1.04	.95	.91	.93	1.00	1.12	1.29	1.50	1.65
SE,SW	45	1.72	1.43	1.18	.98	.86	.80	.82	.92	1.09	1.32	1.61	1.81
SE,SW	60	1.74	1.40	1.10	.87	.73	.66	.69	.80	.99	1.27	1.61	1.86
SE,SW	75	1.65	1.28	.96	.72	.57	.50	.53	.64	.85	1.14	1.51	1.78
SE,SW	90	1.46	1.08	.78	.54	.40	.34	.36	.47	.66	.94	1.32	1.59
E,W	15	98	.98	.98	.98	.97	.97	.97	.97	.98	.98	.98	.98
E,W	30	.95	.94	.93	.92	.91	.91	.91	.91	.92	.93	.94	.95
E,W	45	.90	.88	.86	.84	.82	.81	.82	.83	.85	.87	.89	.91
E,W	60	.83	.80	.76	.73	.71	.70	.71	.72	.75	.78	.82	.84
E,W	75	.73	.70	.65	.62	.59	.58	.58	.60	.64	.67	.72	.74
E,W	90	.61	.57	.53	.49	.46	.45	.45	.47	.51	.55	.59	.62
NORMAL INCIDENCE		2.67	2.19	1.84	1.62	1.52	1.50	1.51	1.56	1.73	2.03	2.49	2.84



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

(D) SOLAR DATA FOR REDWOOD CITY

Nearby Climate Stations - San Francisco International Airport, Mountain View

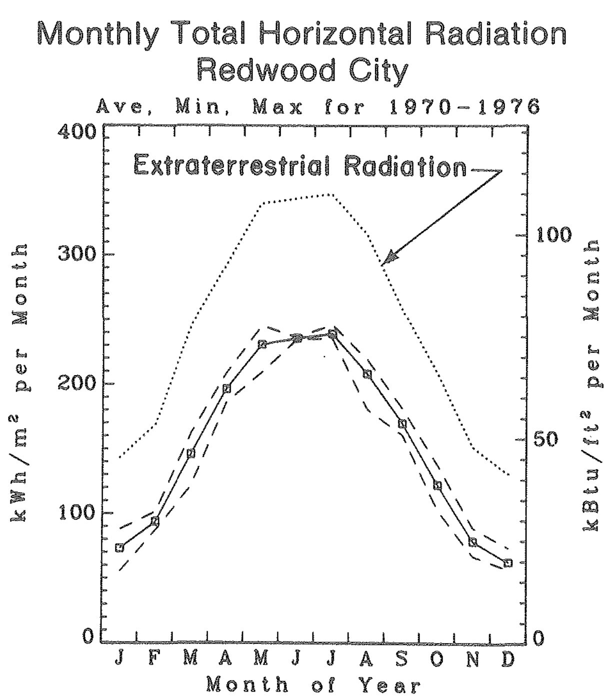
Monthly Solar Data, Redwood City

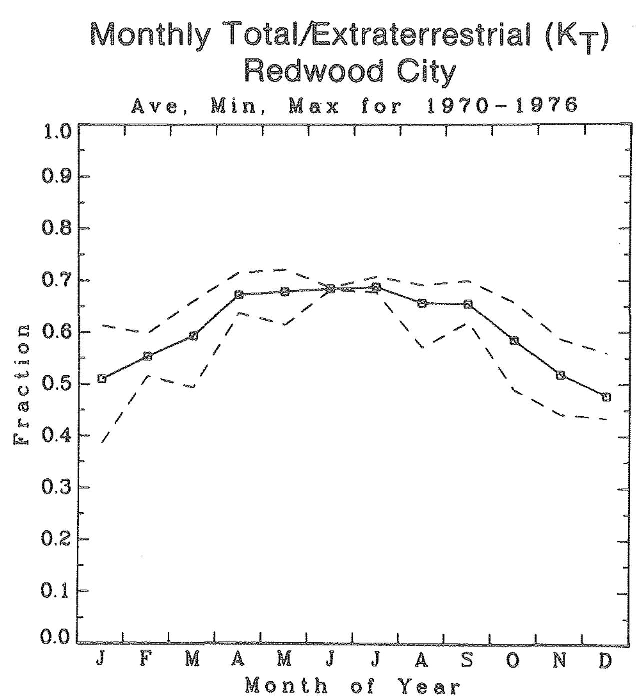
Latitude: 37.48° Longitude: 122.22° Elevation: 0	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	73	94	146	196	231	236	239	208	170	122	79	63	1857
direct beam (normal incidence)	123	137	187	241	269	272	278	244	219	172	125	107	2375
SOLAR RADIATION (KBtu/ft^2 per month)													
horizontal surface	23	30	46	62	73	75	76	66	54	39	25	20	589
direct beam (normal incidence)	39	43	59	76	85	86	88	77	69	54	40	34	752
PERCENT OF POSSIBLE SUNSHINE*													
MEAN CLOUD COVER (in tenths)*	6	6	5	5	4	4	3	3	3	4	5	6	4
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.51	.55	.59	.67	.68	.68	.69	.66	.66	.59	.52	.48	.61

*Data for Mountain View (Moffett Field) 37°25" 122°13' W, elevation 34'

Recording interval: 1970-1976

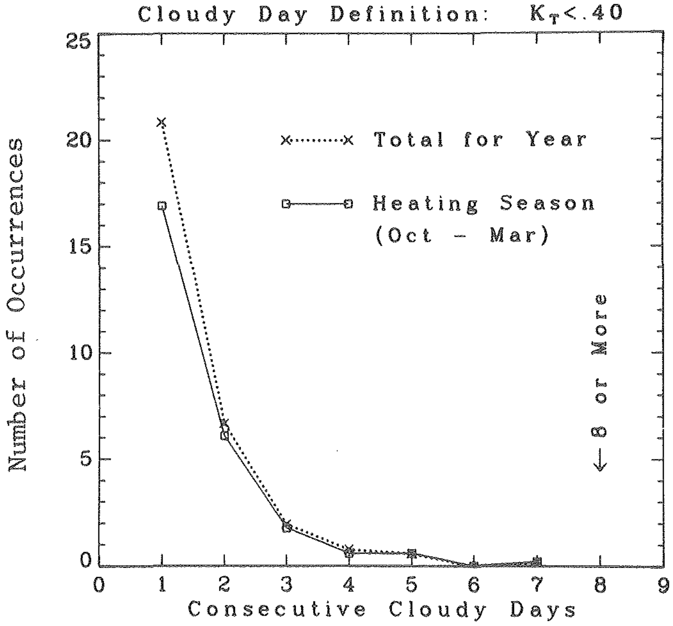
Source of solar data: BAAPCD, Eppley lightbulb pyranometer.



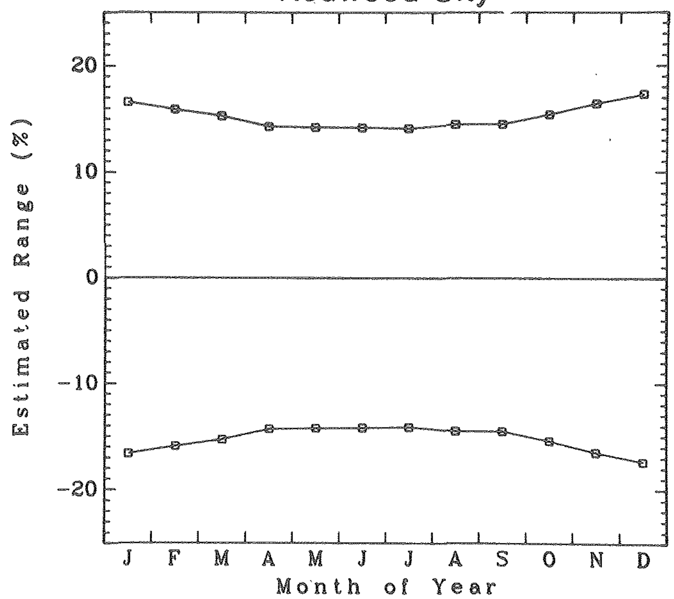


Occurrences of Cloudy Days
Redwood City

Cloudy Day Definition: $K_T<.40$

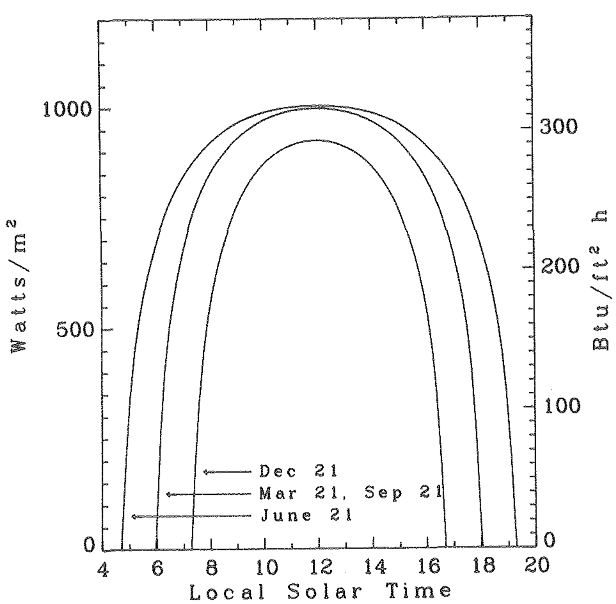


Possible Error in Direct Beam
(Normal Incidence)
Redwood City

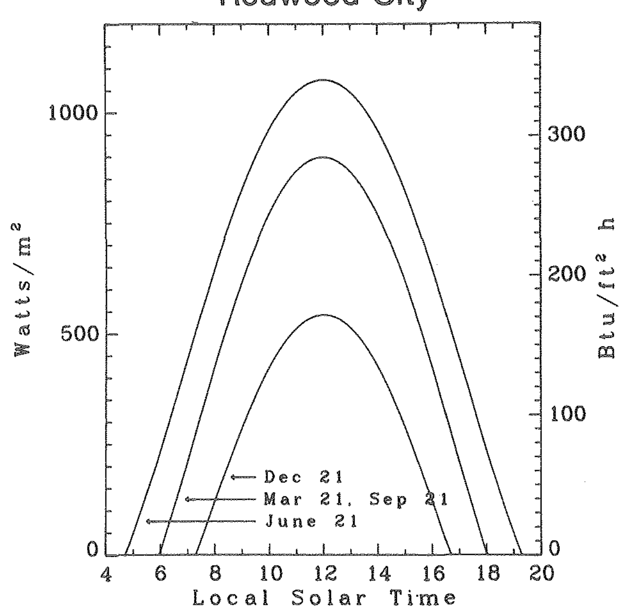


Clear Day Plots for Solar Radiation

Direct Beam (Normal Incidence)
Redwood City



Total Radiation on a Horizontal Surface
Redwood City



Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m²)
Redwood City

DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

SURFACE ORIENT- ATION	ANGLE OF TILT (DEGREES FROM HOR- IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	95	113	164	207	231	230	236	214	187	144	100	82	2002
SOUTH	30	111	126	173	205	218	212	219	207	192	157	115	97	2031
SOUTH	45	120	132	171	191	192	182	190	188	185	161	123	106	1942
SOUTH	60	123	129	160	165	156	143	152	158	168	155	124	109	1742
SOUTH	75	117	119	138	131	113	99	106	120	140	140	117	105	1445
SOUTH	90	105	102	109	89	66	53	59	77	105	116	103	95	1079
SE, SW	15	88	107	158	203	230	230	236	211	181	137	93	76	1949
SE, SW	30	98	114	162	199	218	215	222	204	182	144	102	85	1946
SE, SW	45	102	115	157	186	197	191	198	188	174	143	105	89	1847
SE, SW	60	100	110	145	165	168	160	167	163	158	135	102	89	1662
SE, SW	75	93	99	125	136	134	124	131	133	134	119	93	83	1403
SE, SW	90	80	82	100	103	97	87	93	99	105	98	80	72	1096
E, W	15	72	92	143	192	225	230	233	203	166	120	77	62	1815
E, W	30	69	88	136	181	211	215	218	191	157	114	74	59	1713
E, W	45	65	82	125	165	191	194	197	173	144	106	69	56	1565
E, W	60	58	73	111	145	166	168	171	152	127	94	62	50	1378
E, W	75	51	63	94	121	138	139	142	127	108	81	54	44	1159
E, W	90	41	51	75	96	108	108	110	100	86	65	44	36	921

GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)

SURFACE ORIENT- ATION	ANGLE OF TILT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ANY	15	0	0	0	1	1	1	1	1	1	0	0	0	6
ANY	30	1	1	2	3	3	3	3	3	2	2	1	1	25
ANY	45	2	3	4	6	7	7	7	6	5	4	2	2	54
ANY	60	4	5	7	10	12	12	12	10	9	6	4	3	93
ANY	75	5	7	11	15	17	17	18	15	13	9	6	5	138
ANY	90	7	9	15	20	23	24	24	21	17	12	8	6	186

Total Radiation on a Tilted Surface (Calculated Values)
Engineering Units (kBtu/ft²)
Redwood City

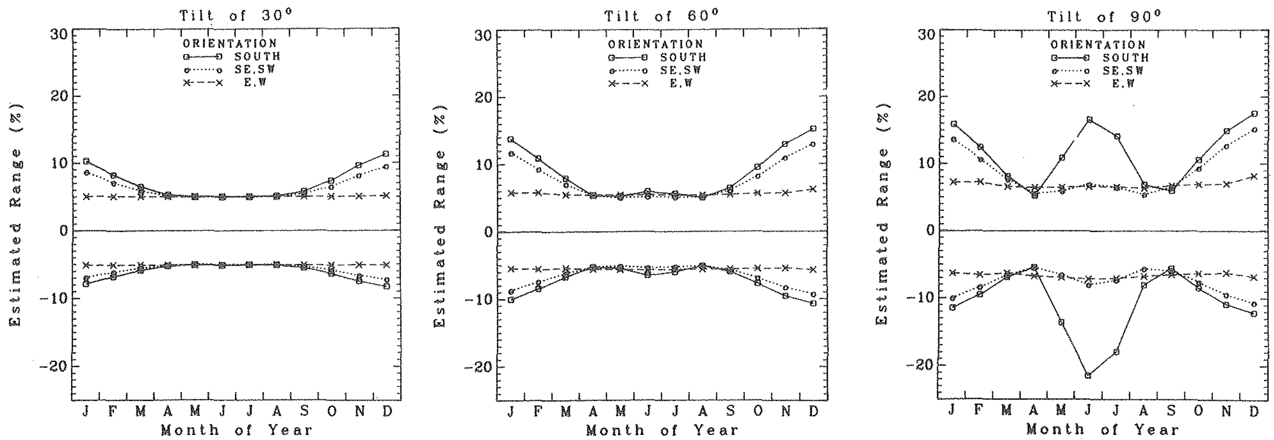
DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

SURFACE ORIENT- ATION	ANGLE OF TILT (DEGREES FROM HOR- IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	30	36	52	66	73	73	75	68	59	46	32	26	634
SOUTH	30	35	40	55	65	69	67	69	66	61	50	36	31	643
SOUTH	45	38	42	54	60	61	58	60	60	59	51	39	34	615
SOUTH	60	39	41	51	52	50	45	48	50	53	49	39	35	552
SOUTH	75	37	38	44	41	36	31	34	38	44	44	37	33	458
SOUTH	90	33	32	35	28	21	17	19	24	33	37	33	30	342
SE, SW	15	28	34	50	64	73	73	75	67	57	43	29	24	618
SE, SW	30	31	36	51	63	69	68	70	65	58	46	32	27	616
SE, SW	45	32	37	50	59	62	61	63	59	55	45	33	28	585
SE, SW	60	32	35	46	52	53	51	53	52	50	43	32	28	526
SE, SW	75	29	31	40	43	42	39	42	42	42	38	30	26	445
SE, SW	90	25	26	32	33	31	28	30	31	33	31	25	23	347
E, W	15	23	29	45	61	71	73	74	64	53	38	24	20	575
E, W	30	22	28	43	57	67	68	69	61	50	36	23	19	543
E, W	45	20	26	40	52	61	61	62	55	46	33	22	18	496
E, W	60	18	23	35	46	53	53	54	48	40	30	20	16	436
E, W	75	16	20	30	38	44	44	45	40	34	26	17	14	367
E, W	90	13	16	24	30	34	34	35	32	27	21	14	11	292

GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)

SURFACE ORIENT- ATION	ANGLE OF TILT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	1	1	1	1	1	1	1	1	0	0	8
ANY	45	1	1	1	2	2	2	2	2	2	1	1	1	17
ANY	60	1	1	2	3	4	4	4	3	3	2	1	1	29
ANY	75	2	2	3	5	5	6	6	5	4	3	2	1	44
ANY	90	2	3	5	6	7	7	8	7	5	4	2	2	59

Possible Error in the Total Radiation on a Tilted Surface
Redwood City

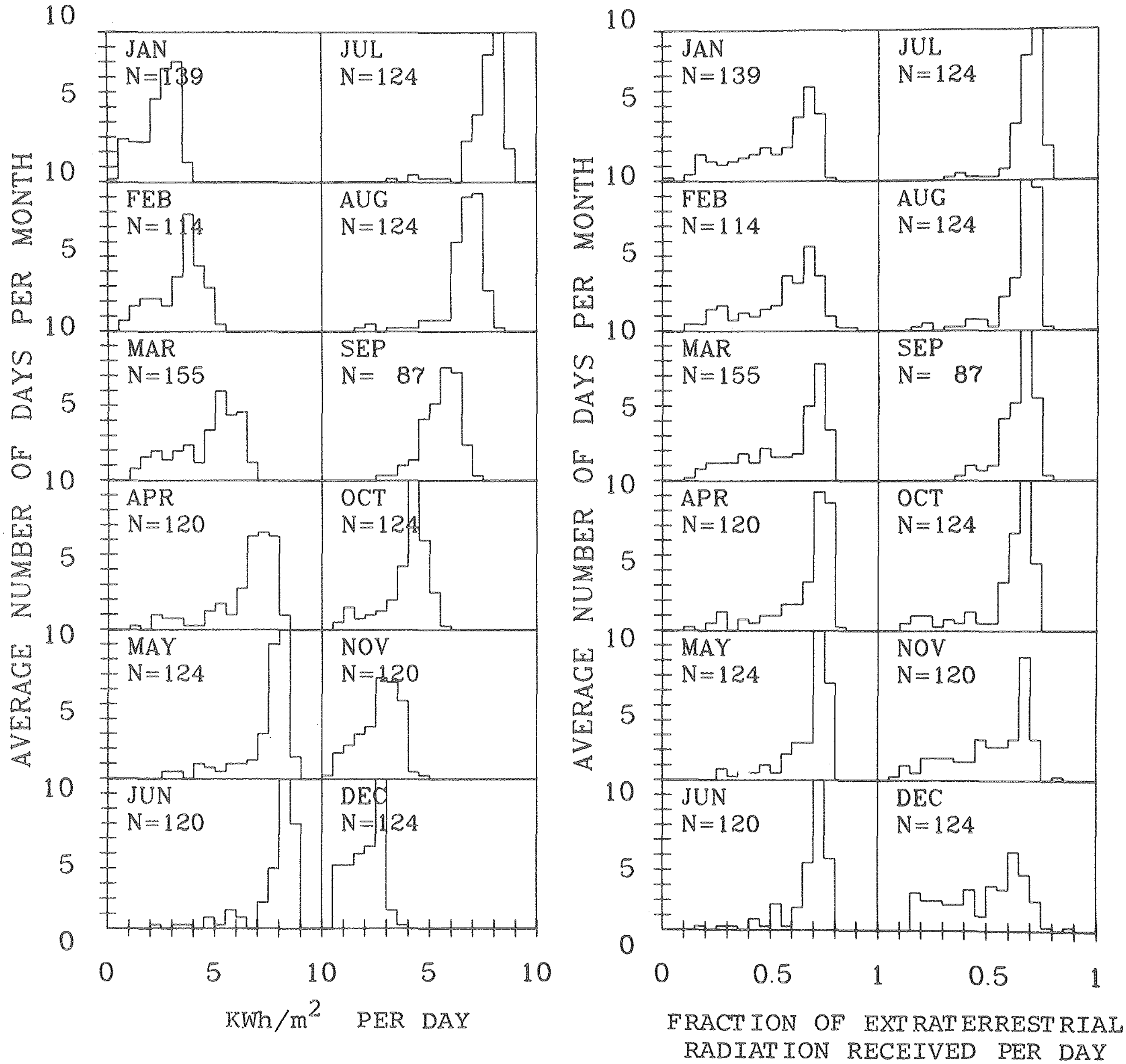


Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profiles
Redwood City

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.47	1.32	1.19	1.08	1.01	.97	.99	1.04	1.13	1.26	1.42	1.53
SOUTH	30	1.85	1.55	1.29	1.08	.95	.89	.91	1.01	1.19	1.44	1.74	1.95
SOUTH	45	2.09	1.68	1.31	1.01	.83	.75	.78	.92	1.17	1.52	1.95	2.24
SOUTH	60	2.20	1.69	1.24	.87	.66	.57	.60	.76	1.07	1.49	2.02	2.38
SOUTH	75	2.15	1.58	1.08	.68	.45	.36	.39	.56	.89	1.36	1.95	2.35
SOUTH	90	1.96	1.37	.85	.44	.22	.14	.17	.33	.65	1.14	1.75	2.17
SE,SW	15	1.33	1.22	1.13	1.05	1.00	.98	.99	1.02	1.09	1.18	1.29	1.36
SE,SW	30	1.56	1.36	1.18	1.04	.95	.91	.92	1.00	1.12	1.28	1.49	1.64
SE,SW	45	1.70	1.42	1.17	.98	.85	.80	.82	.92	1.08	1.31	1.59	1.80
SE,SW	60	1.72	1.38	1.10	.87	.72	.66	.68	.79	.99	1.25	1.59	1.84
SE,SW	75	1.63	1.26	.95	.71	.56	.50	.52	.64	.84	1.12	1.49	1.76
SE,SW	90	1.43	1.07	.77	.53	.39	.33	.36	.46	.66	.93	1.29	1.56
E,W	15	.98	.98	.98	.98	.97	.97	.97	.97	.98	.98	.98	.98
E,W	30	.95	.94	.93	.92	.91	.91	.91	.91	.92	.93	.94	.95
E,W	45	.90	.88	.85	.83	.82	.81	.81	.83	.84	.87	.89	.91
E,W	60	.82	.80	.76	.73	.71	.70	.70	.72	.75	.78	.81	.84
E,W	75	.72	.69	.65	.61	.59	.58	.58	.60	.63	.67	.71	.74
E,W	90	.60	.57	.52	.49	.46	.45	.45	.47	.51	.55	.59	.62
NORMAL INCIDENCE		2.63	2.18	1.83	1.61	1.52	1.49	1.50	1.56	1.72	2.02	2.47	2.81

Redwood City

Total Radiation Histogram — Total/Extraterrestrial (K_T) Histogram



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

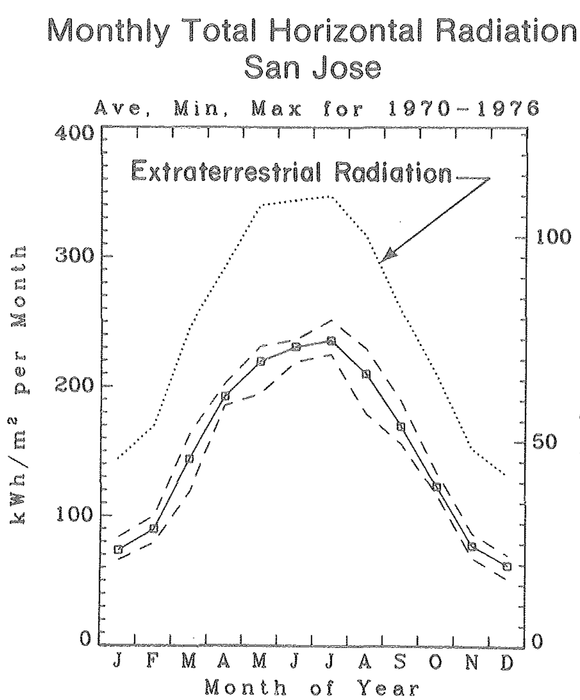
(E) SOLAR DATA FOR SAN JOSE

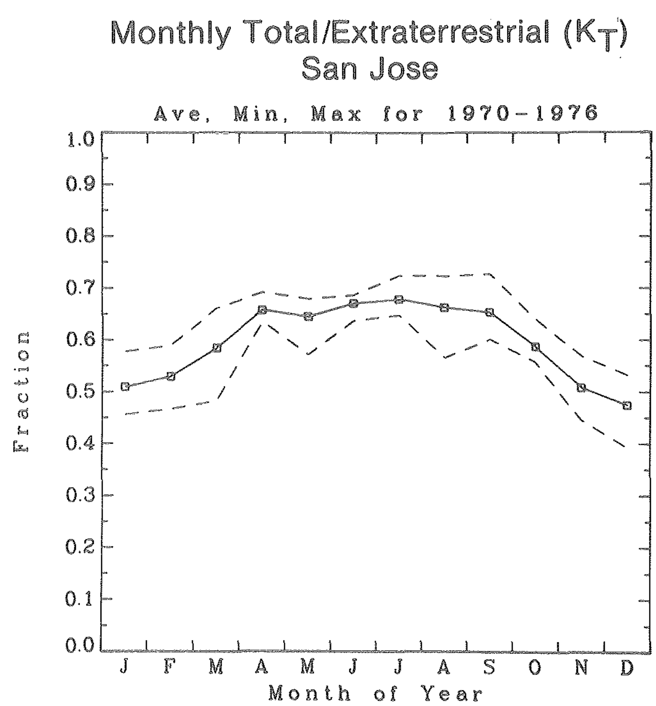
Nearby Climate Station - Mountain View

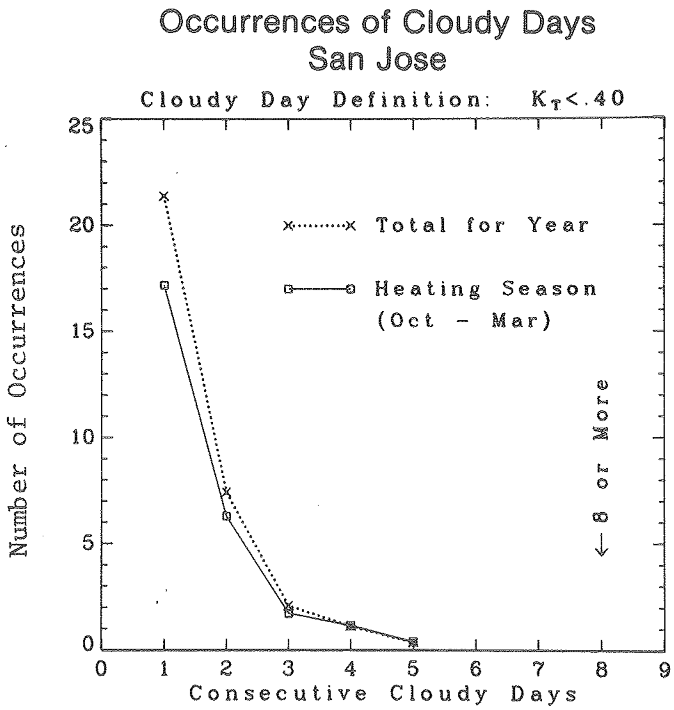
Monthly Solar Data, San Jose

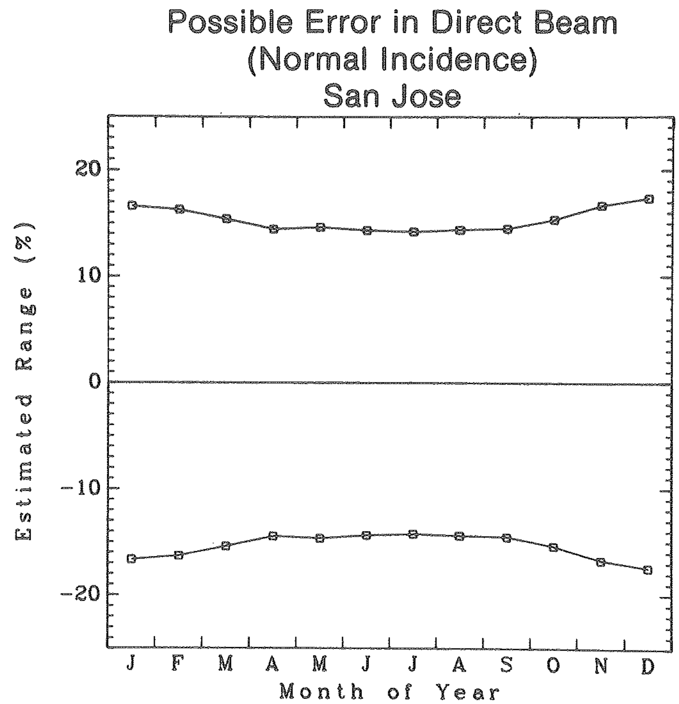
	Latitude: 37.33°			Longitude: 121.88°			Elevation: 0						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	74	90	144	192	219	231	236	210	170	123	78	63	1829
direct beam (normal incidence)	123	128	183	232	246	262	271	247	217	173	122	104	2310
SOLAR RADIATION (KBtu/ft^2 per month)													
horizontal surface	23	29	46	61	69	73	75	67	54	39	25	20	579
direct beam (normal incidence)	39	40	58	74	78	83	86	78	69	55	39	34	732
PERCENT OF POSSIBLE SUNSHINE*													
MEAN CLOUD COVER (in tenths)*	6	6	5	5	4	4	3	3	3	4	5	6	4
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.51	.53	.58	.66	.65	.67	.68	.66	.65	.59	.51	.47	.60

Recording interval: 1970-1976
*Data for Mountain View (Moffett Field) 37° 25', 122° 03' W, elevation 34'
Source of solar data: BAAPCD, Eppley lightbulb pyranometer.

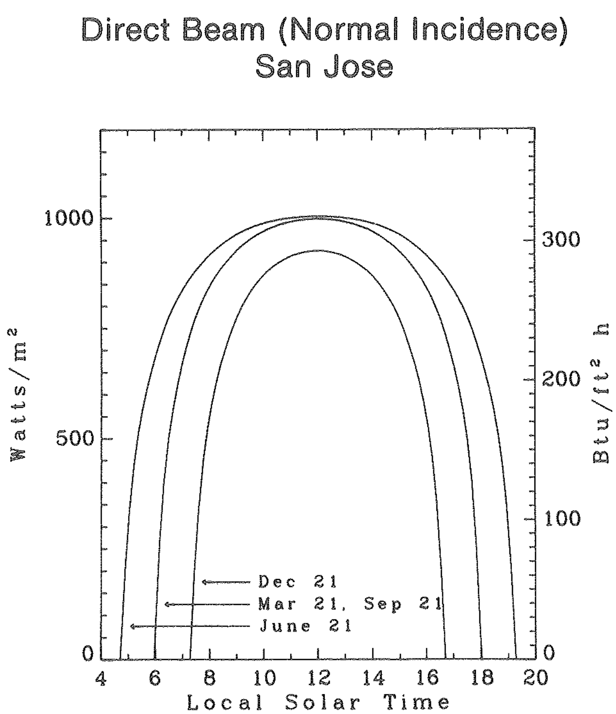


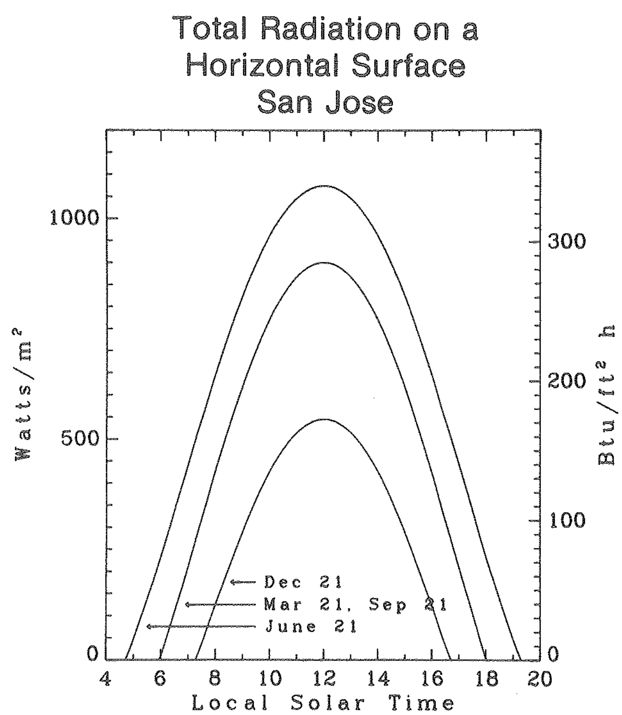






Clear Day Plots for Solar Radiation





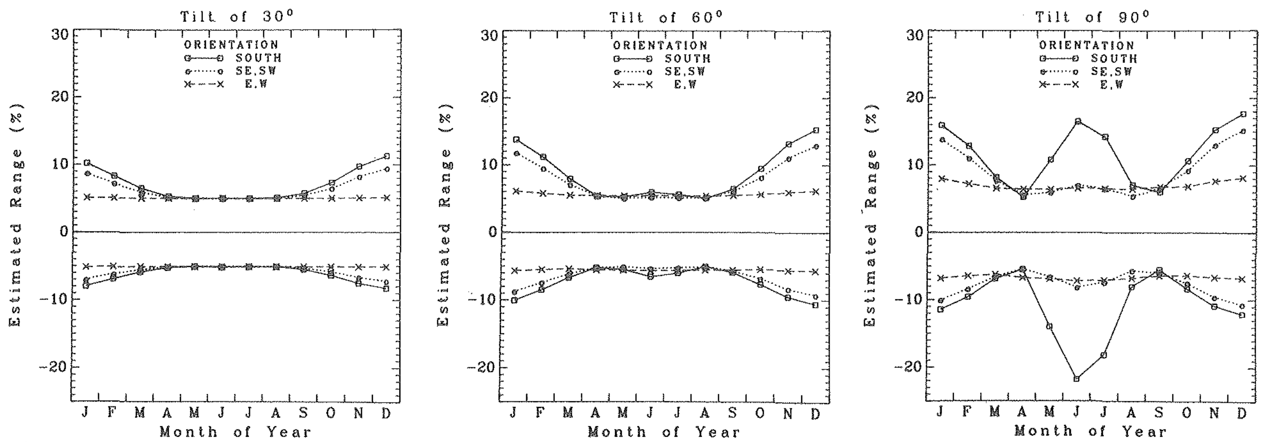
Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m^2)
San Jose

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
		DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)												
SOUTH	15	95	108	162	202	219	225	232	215	186	145	98	82	1970
SOUTH	30	111	120	170	200	206	207	216	208	191	158	112	97	1997
SOUTH	45	121	125	168	186	182	178	187	189	184	162	120	106	1909
SOUTH	60	123	122	157	161	149	140	149	159	167	156	120	108	1712
SOUTH	75	117	112	136	127	108	97	105	121	139	140	114	105	1421
SOUTH	90	105	96	107	87	64	53	59	77	104	116	100	94	1062
SE,SW	15	88	102	156	198	218	226	232	213	180	138	91	76	1918
SE,SW	30	98	109	159	195	207	211	218	206	181	145	100	85	1914
SE,SW	45	102	110	155	182	187	187	195	189	173	144	103	89	1817
SE,SW	60	101	104	142	161	160	157	165	164	157	135	100	88	1634
SE,SW	75	93	93	123	133	127	122	129	133	133	120	91	82	1380
SE,SW	90	80	78	98	101	92	86	92	99	104	98	78	71	1078
E,W	15	72	88	141	188	214	225	230	205	166	121	76	62	1788
E,W	30	69	84	134	177	201	210	215	193	157	115	73	59	1687
E,W	45	65	78	123	161	182	190	194	175	144	106	68	55	1541
E,W	60	59	70	109	142	158	164	168	153	127	95	61	50	1357
E,W	75	51	60	93	119	131	136	139	127	107	81	53	44	1142
E,W	90	42	49	74	94	103	106	109	100	86	66	43	36	907
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	0	1	1	1	1	1	1	0	0	0	6
ANY	30	1	1	2	3	3	3	3	3	2	2	1	1	24
ANY	45	2	3	4	6	6	7	7	6	5	4	2	2	54
ANY	60	4	4	7	10	11	12	12	10	8	6	4	3	91
ANY	75	5	7	11	14	16	17	17	16	13	9	6	5	136
ANY	90	7	9	14	19	22	23	24	21	17	12	8	6	183

Total Radiation on a Tilted Surface (Calculated Values)
Engineering Units ($kBtu/ft^2$)
San Jose

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
		DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)												
SOUTH	15	30	34	51	64	69	71	74	68	59	46	31	26	624
SOUTH	30	35	38	54	63	65	66	68	66	60	50	36	31	633
SOUTH	45	38	40	53	59	58	56	59	60	58	51	38	34	605
SOUTH	60	39	39	50	51	47	44	47	50	53	49	38	34	542
SOUTH	75	37	36	43	40	34	31	33	38	44	44	36	33	450
SOUTH	90	33	30	34	28	20	17	19	24	33	37	32	30	336
SE,SW	15	28	32	49	63	69	71	74	67	57	44	29	24	608
SE,SW	30	31	35	51	62	66	67	69	65	57	46	32	27	606
SE,SW	45	32	35	49	58	59	59	62	60	55	46	33	28	575
SE,SW	60	32	33	45	51	51	50	52	52	50	43	32	28	518
SE,SW	75	29	30	39	42	40	39	41	42	42	38	29	26	437
SE,SW	90	25	25	31	32	29	27	29	31	33	31	25	23	342
E,W	15	23	28	45	60	68	71	73	65	53	38	24	20	566
E,W	30	22	27	42	56	64	67	68	61	50	36	23	19	535
E,W	45	21	25	39	51	58	60	62	55	46	34	22	18	488
E,W	60	19	22	35	45	50	52	53	48	40	30	19	16	430
E,W	75	16	19	29	38	42	43	44	40	34	26	17	14	362
E,W	90	13	15	24	30	33	34	34	32	27	21	14	11	287
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	1	1	1	1	1	1	1	1	0	0	8
ANY	45	1	1	1	2	2	2	2	2	2	1	1	1	17
ANY	60	1	1	2	3	3	4	4	3	3	2	1	1	29
ANY	75	2	2	3	5	5	5	6	5	4	3	2	1	43
ANY	90	2	3	5	6	7	7	7	7	5	4	2	2	58

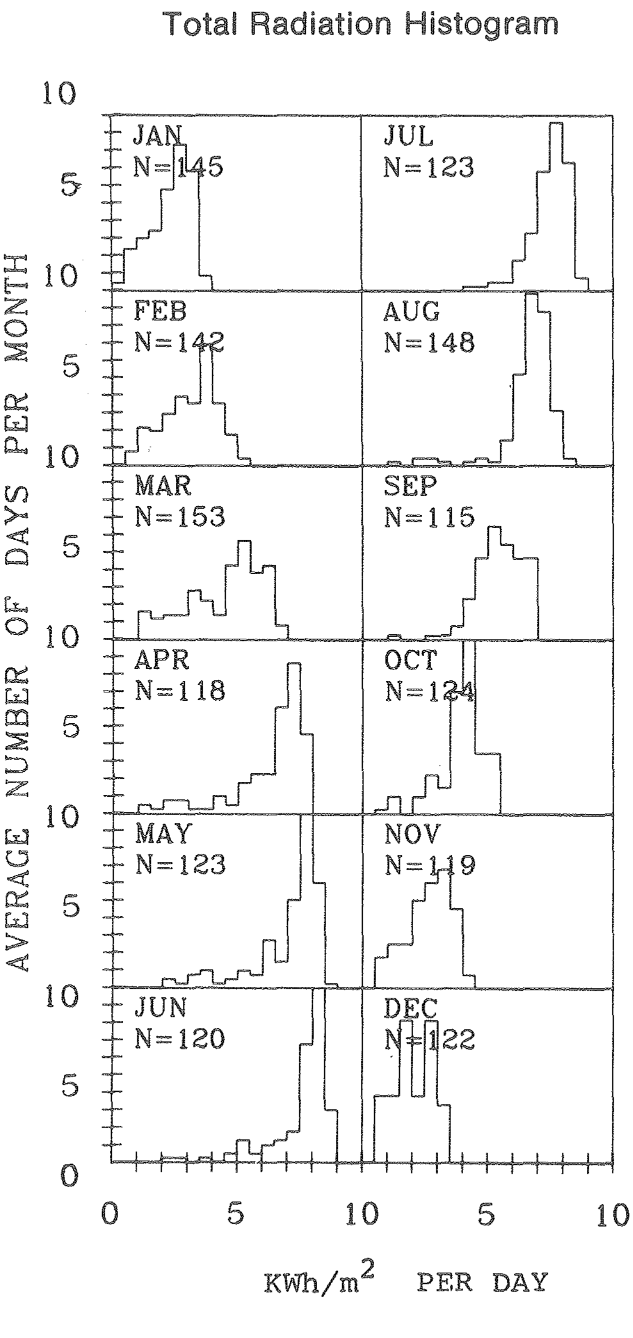
Possible Error in the Total Radiation on a Tilted Surface
San Jose

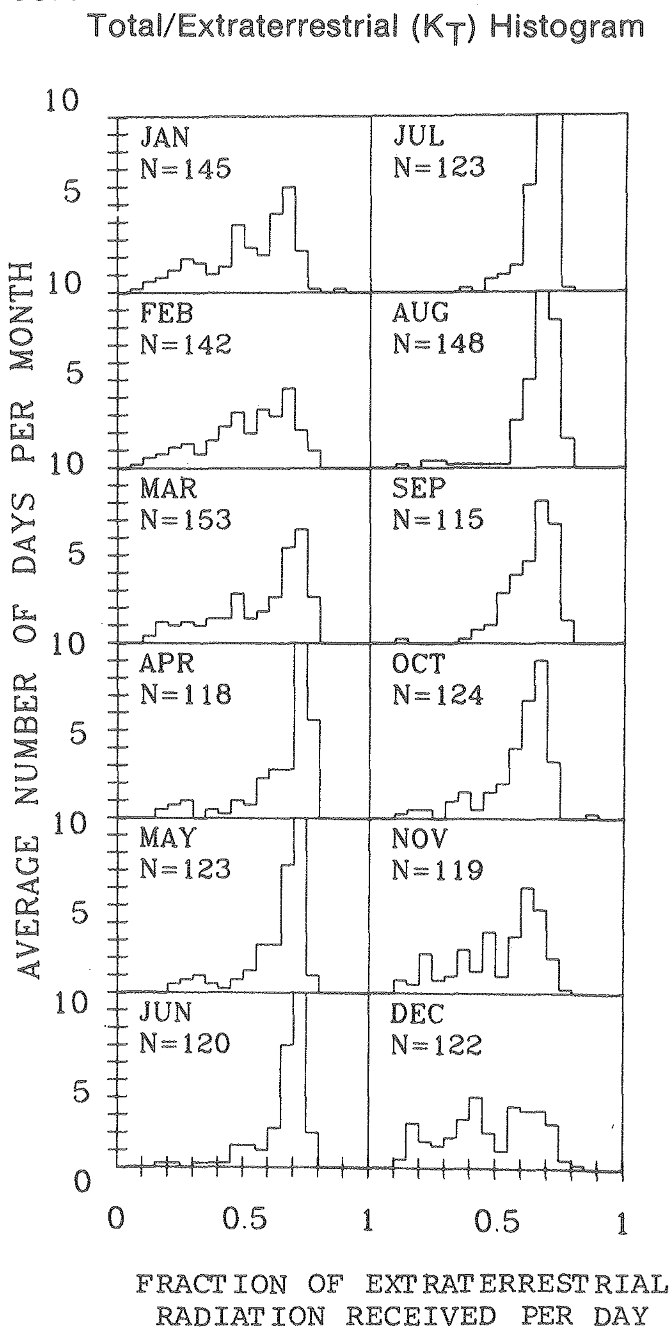


Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profile
San Jose

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.47	1.32	1.19	1.07	1.00	.97	.99	1.04	1.13	1.26	1.42	1.52
SOUTH	30	1.84	1.55	1.29	1.08	.94	.89	.91	1.01	1.19	1.43	1.74	1.94
SOUTH	45	2.09	1.67	1.31	1.01	.82	.75	.78	.92	1.17	1.51	1.94	2.23
SOUTH	60	2.19	1.68	1.23	.87	.65	.56	.60	.76	1.06	1.48	2.01	2.37
SOUTH	75	2.15	1.57	1.08	.67	.45	.35	.39	.56	.89	1.36	1.95	2.34
SOUTH	90	1.95	1.36	.85	.44	.22	.14	.17	.32	.65	1.14	1.75	2.15
SE, SW	15	1.33	1.22	1.12	1.05	1.00	.98	.99	1.02	1.09	1.18	1.29	1.36
SE, SW	30	1.56	1.36	1.18	1.04	.95	.91	.92	.99	1.12	1.28	1.49	1.63
SE, SW	45	1.70	1.41	1.17	.98	.85	.80	.82	.92	1.08	1.31	1.59	1.79
SE, SW	60	1.72	1.38	1.09	.86	.72	.66	.68	.79	.98	1.25	1.59	1.83
SE, SW	75	1.63	1.26	.95	.71	.56	.50	.52	.64	.84	1.12	1.49	1.75
SE, SW	90	1.43	1.06	.76	.53	.39	.33	.36	.46	.65	.93	1.29	1.56
E, W	15	.98	.98	.98	.98	.97	.97	.97	.97	.98	.98	.98	.98
E, W	30	.95	.94	.93	.92	.91	.91	.91	.91	.92	.93	.95	.95
E, W	45	.90	.88	.85	.83	.82	.81	.81	.83	.84	.87	.89	.91
E, W	60	.83	.79	.76	.73	.71	.70	.70	.72	.75	.78	.81	.84
E, W	75	.73	.69	.65	.61	.59	.58	.58	.60	.63	.67	.71	.74
E, W	90	.61	.57	.52	.49	.46	.45	.45	.47	.51	.55	.59	.62
NORMAL INCIDENCE		2.63	2.17	1.83	1.61	1.52	1.49	1.50	1.56	1.72	2.01	2.47	2.80

San Jose





These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

(F) SOLAR DATA FOR SANTA MARIA

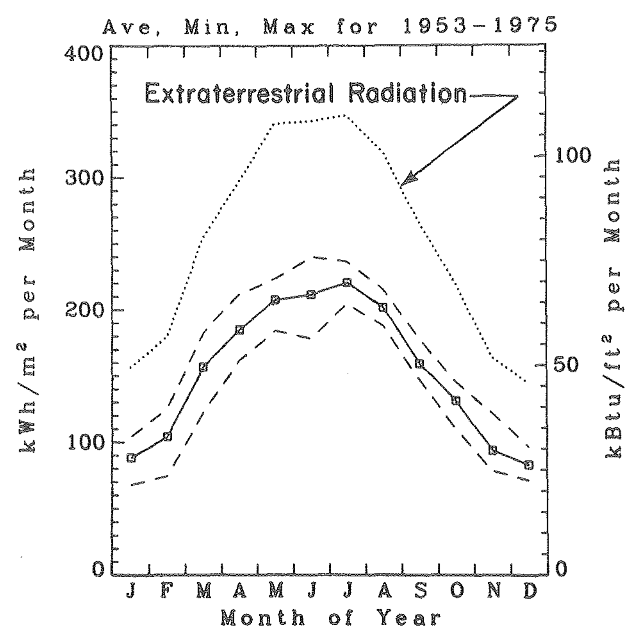
Nearby Climate Stations - Santa Maria, Oxnard

Monthly Solar Data, Santa Maria

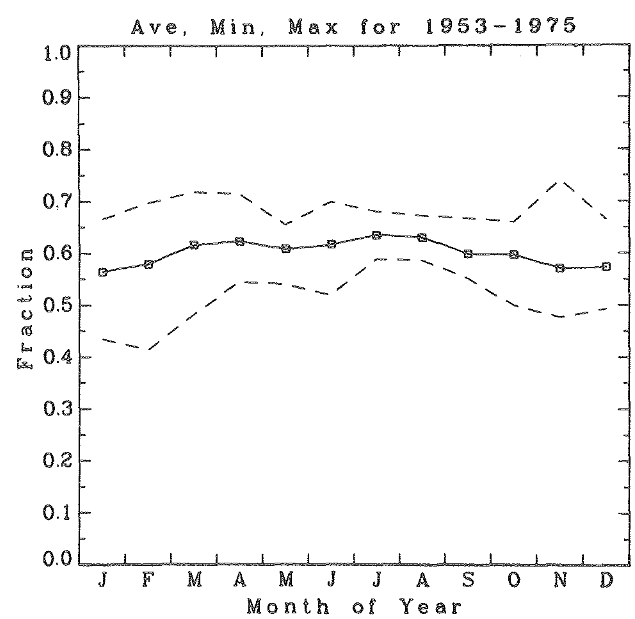
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Latitude: 34.93° Longitude: 120.42° Elevation: 234'													
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	89	104	157	185	207	212	221	202	159	131	94	83	1844
direct beam (normal incidence)	149	149	199	211	221	225	239	225	188	178	149	148	2282
SOLAR RADIATION (KBtu/ft^2 per month)													
horizontal surface	28	33	50	59	66	67	70	64	50	42	30	26	585
direct beam (normal incidence)	47	47	63	67	70	71	76	71	60	56	47	47	723
PERCENT OF POSSIBLE SUNSHINE*													
MEAN CLOUD COVER (in tenths)*	5	5	5	5	5	4	3	3	4	4	4	5	4
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.56	.58	.62	.62	.61	.62	.64	.63	.60	.60	.57	.57	.60

Recording interval: 1952-1975
Source of solar data: NWS, Eppley lightbulb pyranometer.

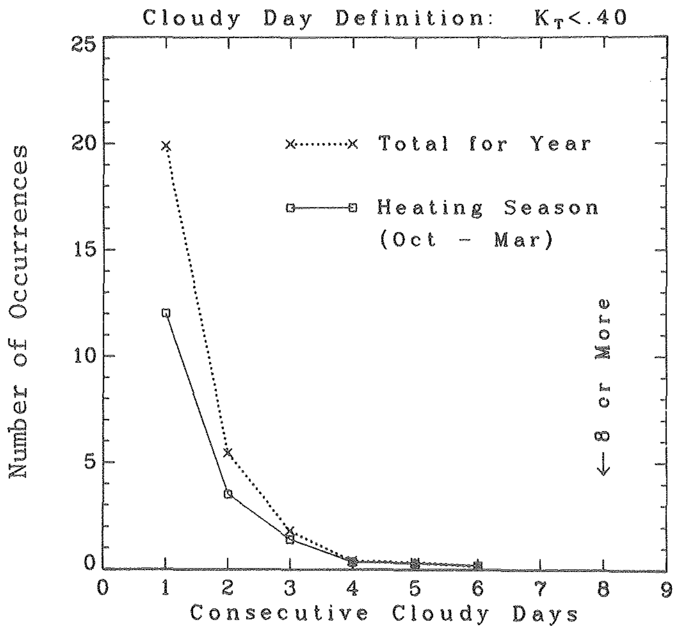
Monthly Total Horizontal Radiation Santa Maria



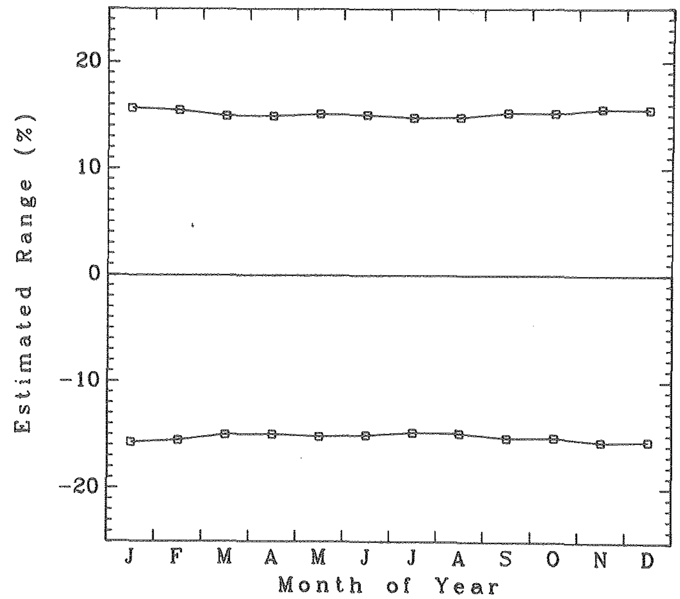
Monthly Total/Extraterrestrial (K_T) Santa Maria



Occurrences of Cloudy Days
Santa Maria

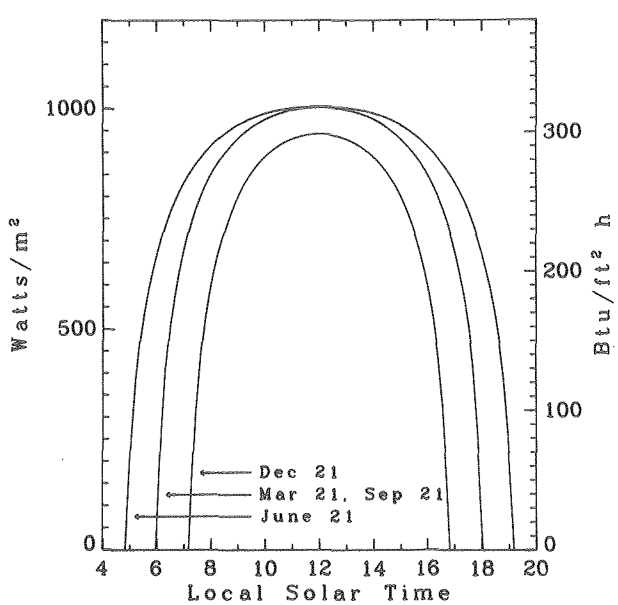


Possible Error in Direct Beam (Normal Incidence)
Santa Maria

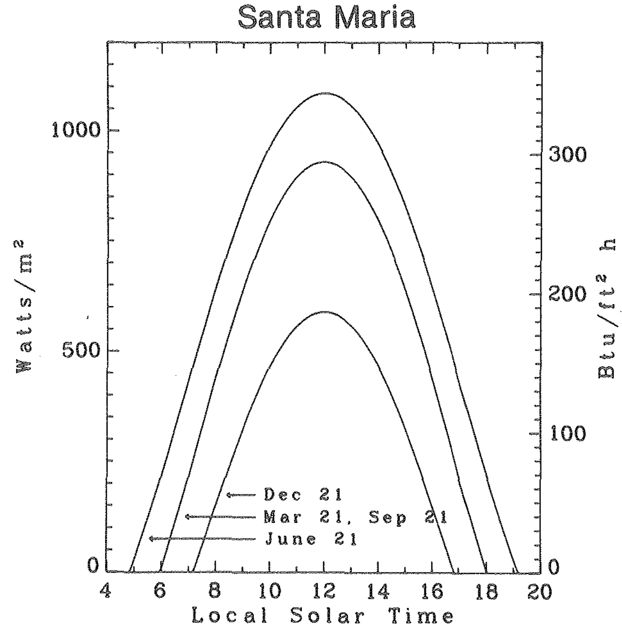


Clear Day Plots for Solar Radiation

Direct Beam (Normal Incidence)
Santa Maria



Total Radiation on a Horizontal Surface
Santa Maria



Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m²)
Santa Maria

DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

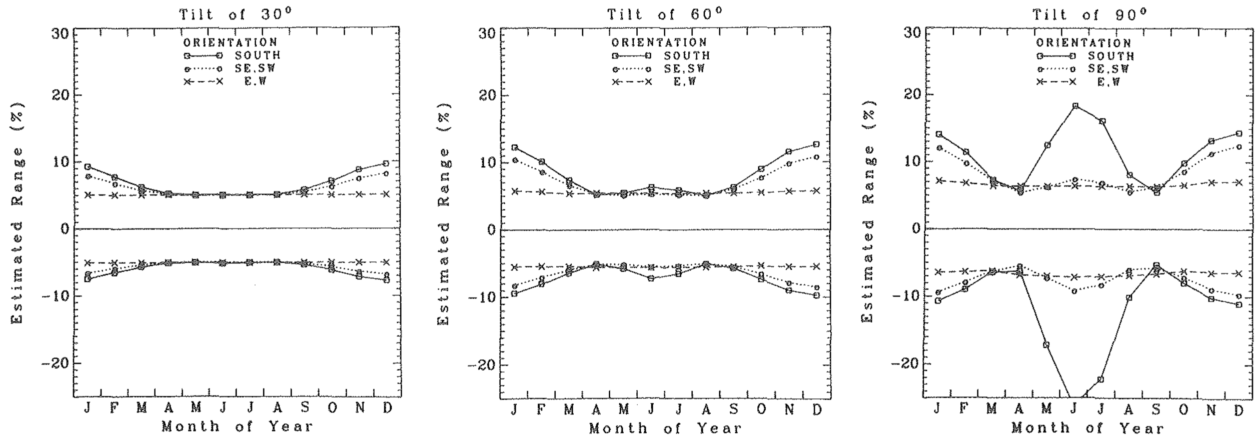
SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	114	125	175	192	206	205	216	205	172	152	118	109	1989
SOUTH	30	132	138	183	189	192	188	199	197	174	165	134	129	2019
SOUTH	45	143	142	180	174	169	160	172	177	166	167	143	141	1934
SOUTH	60	144	138	166	149	136	126	136	147	149	159	143	144	1738
SOUTH	75	137	126	142	116	98	86	94	110	123	142	134	138	1448
SOUTH	90	122	106	110	78	57	47	52	69	90	116	117	124	1088
SE,SW	15	106	118	169	189	205	206	216	203	167	145	110	101	1935
SE,SW	30	117	125	172	184	194	192	202	195	167	152	120	113	1931
SE,SW	45	121	125	166	171	174	169	180	178	158	150	123	118	1833
SE,SW	60	118	119	152	150	148	141	151	154	142	139	119	117	1648
SE,SW	75	109	105	130	123	117	109	118	124	119	122	108	108	1392
SE,SW	90	93	87	103	93	84	77	83	91	93	99	91	94	1088
E,W	15	87	102	154	181	202	206	215	197	156	128	92	81	1802
E,W	30	83	97	145	170	190	193	201	185	147	122	88	78	1699
E,W	45	77	90	133	155	171	174	181	167	134	112	82	73	1550
E,W	60	70	80	118	135	149	150	157	146	118	100	73	66	1361
E,W	75	60	68	99	113	123	124	130	121	99	85	63	57	1142
E,W	90	49	55	79	89	96	96	101	95	79	68	51	46	905
GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)														
ANY	15	0	0	1	1	1	1	1	1	1	0	0	0	6
ANY	30	1	1	2	2	3	3	3	3	2	2	1	1	25
ANY	45	3	3	5	5	6	6	6	6	5	4	3	2	54
ANY	60	4	5	8	9	10	11	11	10	8	7	5	4	92
ANY	75	7	8	12	14	15	16	16	15	12	10	7	6	137
ANY	90	9	10	16	18	21	21	22	20	16	13	9	8	184

Total Radiation on a Tilted Surface (Calculated Values)
Engineering Units (kBtu/ft²)
Santa Maria

DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	36	39	56	61	65	65	68	65	54	48	37	35	630
SOUTH	30	42	44	58	60	61	59	63	62	55	52	43	41	640
SOUTH	45	45	45	57	55	53	51	54	56	53	53	45	45	613
SOUTH	60	46	44	52	47	43	40	43	47	47	50	45	46	551
SOUTH	75	43	40	45	37	31	27	30	35	39	45	43	44	459
SOUTH	90	39	34	35	25	18	15	16	22	28	37	37	39	345
SE,SW	15	33	37	54	60	65	65	68	64	53	46	35	32	613
SE,SW	30	37	40	54	58	61	61	64	62	53	48	38	36	612
SE,SW	45	38	40	53	54	55	54	57	56	50	47	39	38	581
SE,SW	60	37	38	48	47	47	45	48	49	45	44	38	37	522
SE,SW	75	34	33	41	39	37	35	37	39	38	39	34	34	441
SE,SW	90	29	28	33	29	27	24	26	29	29	31	29	30	345
E,W	15	28	32	49	57	64	65	68	62	49	41	29	26	571
E,W	30	26	31	46	54	60	61	64	59	47	39	28	25	538
E,W	45	25	28	42	49	54	55	57	53	43	36	26	23	491
E,W	60	22	25	37	43	47	48	50	46	37	32	23	21	431
E,W	75	19	22	32	36	39	39	41	38	31	27	20	18	362
E,W	90	16	18	25	28	30	30	32	30	25	22	16	15	287
GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)														
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	1	1	1	1	1	1	1	1	0	0	8
ANY	45	1	1	1	2	2	2	2	2	1	1	1	1	17
ANY	60	1	2	2	3	3	3	3	3	3	2	1	1	29
ANY	75	2	2	4	4	5	5	5	5	4	3	2	2	43
ANY	90	3	3	5	6	7	7	7	6	5	4	3	3	58

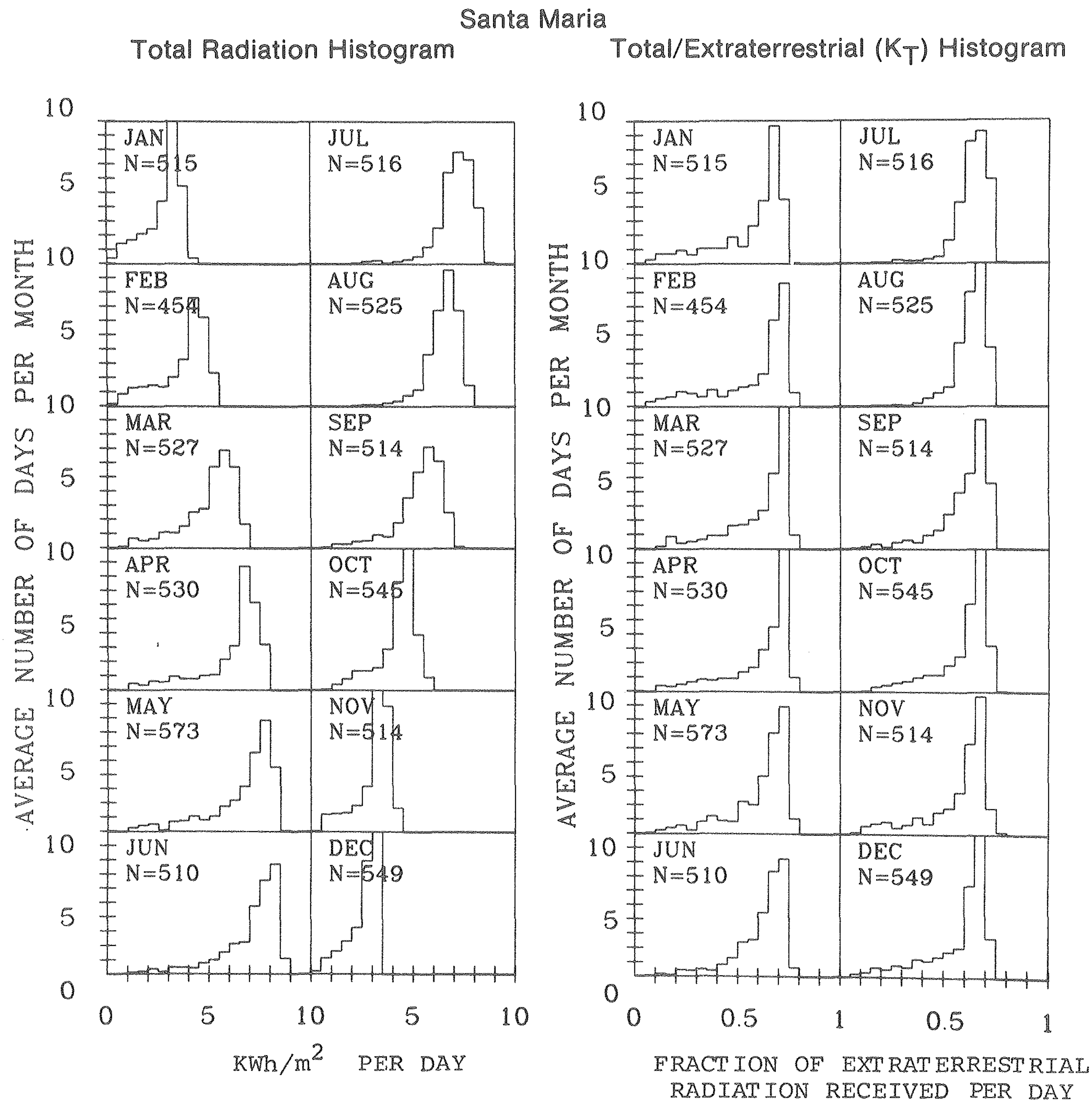
Possible Error in the Total Radiation on a Tilted Surface
Santa Maria



Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profiles
Santa Maria

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.43	1.29	1.17	1.06	.99	.96	.98	1.03	1.12	1.24	1.38	1.47
SOUTH	30	1.76	1.49	1.26	1.05	.93	.87	.89	.99	1.16	1.39	1.66	1.84
SOUTH	45	1.97	1.59	1.26	.97	.80	.72	.75	.89	1.12	1.45	1.84	2.09
SOUTH	60	2.05	1.59	1.17	.83	.62	.53	.57	.72	1.01	1.41	1.88	2.19
SOUTH	75	1.98	1.47	1.01	.63	.41	.32	.35	.52	.83	1.27	1.80	2.15
SOUTH	90	1.78	1.25	.78	.39	.19	.11	.14	.28	.59	1.05	1.60	1.95
SE,SW	15	1.29	1.20	1.11	1.04	.99	.97	.98	1.02	1.08	1.16	1.26	1.32
SE,SW	30	1.50	1.32	1.16	1.02	.93	.89	.91	.98	1.09	1.25	1.44	1.56
SE,SW	45	1.61	1.36	1.14	.95	.83	.78	.80	.89	1.05	1.26	1.52	1.69
SE,SW	60	1.61	1.31	1.05	.83	.70	.64	.66	.77	.95	1.19	1.50	1.71
SE,SW	75	1.51	1.18	.90	.68	.54	.47	.50	.61	.80	1.06	1.39	1.62
SE,SW	90	1.31	.99	.72	.50	.37	.31	.33	.44	.61	.86	1.19	1.42
E,W	15	.98	.98	.98	.97	.97	.97	.97	.97	.98	.98	.98	.98
E,W	30	.94	.93	.92	.91	.91	.90	.90	.91	.92	.93	.94	.94
E,W	45	.88	.87	.85	.83	.81	.81	.81	.82	.84	.86	.88	.89
E,W	60	.80	.78	.75	.72	.70	.69	.70	.71	.74	.76	.79	.81
E,W	75	.70	.67	.63	.60	.58	.57	.57	.59	.62	.65	.69	.71
E,W	90	.58	.54	.51	.48	.45	.44	.44	.46	.49	.53	.57	.59
NORMAL INCIDENCE		2.47	2.07	1.77	1.58	1.49	1.48	1.48	1.53	1.67	1.93	2.33	2.61

Santa Maria



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

(G) SOLAR DATA FOR LOS ANGELES (CIVIC CENTER)

Nearby Climate Station - Los Angeles (Civic Center)

Monthly Solar Data, Los Angeles (Civic Center)

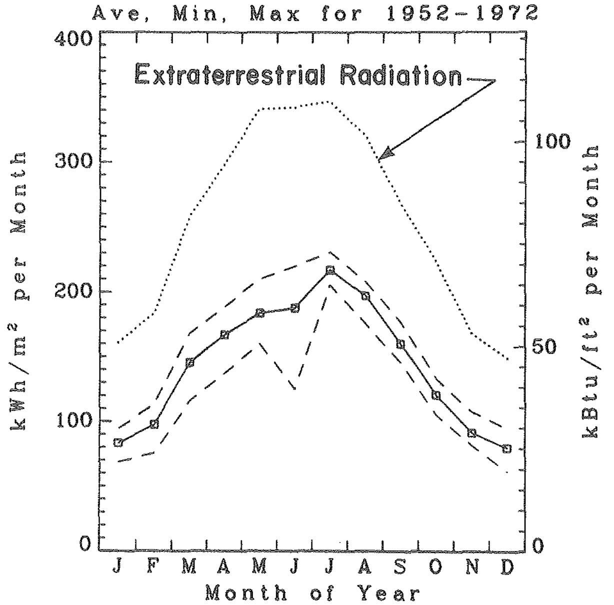
Latitude: 34.05° Longitude: 118.23° Elevation: 540'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	83	98	146	167	184	188	217	197	160	121	91	80	1732
direct beam (normal incidence)	130	130	173	177	180	184	232	215	186	151	137	134	2031
SOLAR RADIATION (KBtu/ft^2 per month)													
horizontal surface	26	31	46	53	58	60	69	62	51	38	29	25	549
direct beam (normal incidence)	41	41	55	56	57	58	74	68	59	48	44	42	644
PERCENT OF POSSIBLE SUNSHINE	69	72	73	70	66	65	82	83	79	73	74	71	73
MEAN CLOUD COVER (in tenths)	5	5	5	5	5	4	3	3	3	4	4	4	4
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.52	.53	.56	.56	.54	.55	.63	.61	.60	.54	.54	.53	.56

Recording interval: 1952-1974
Source of solar data: NWS, Eppley lightbulb pyranometer.

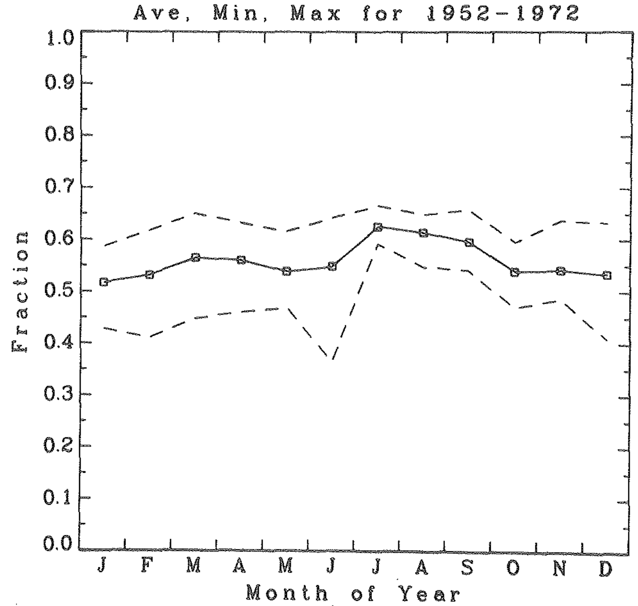
Monthly Total Horizontal Radiation Los Angeles (Civic Center)

Ave, Min, Max for 1952-1972

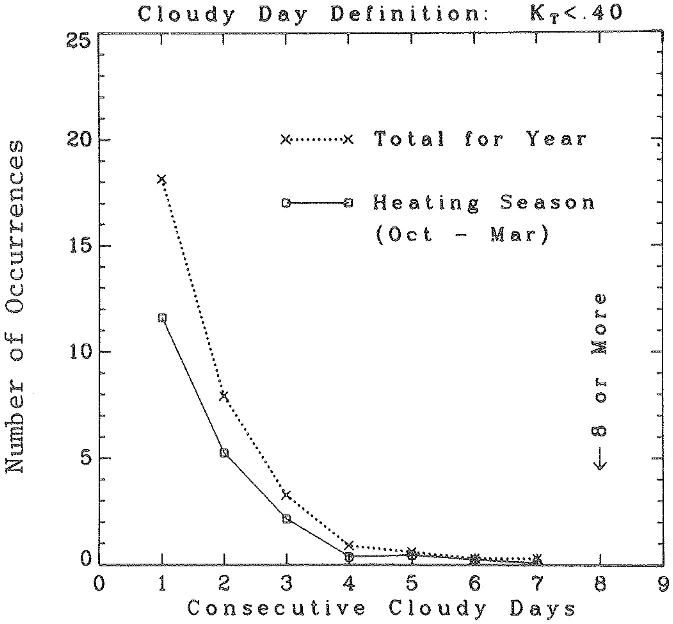


Monthly Total/Extraterrestrial (K_T) Los Angeles (Civic Center)

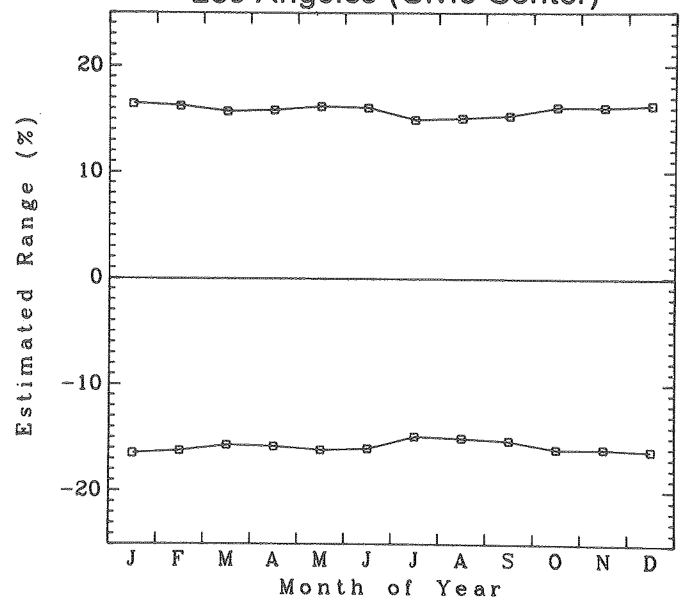
Ave, Min, Max for 1952-1972



Occurrences of Cloudy Days
Los Angeles (Civic Center)
Cloudy Day Definition: $K_T < .40$

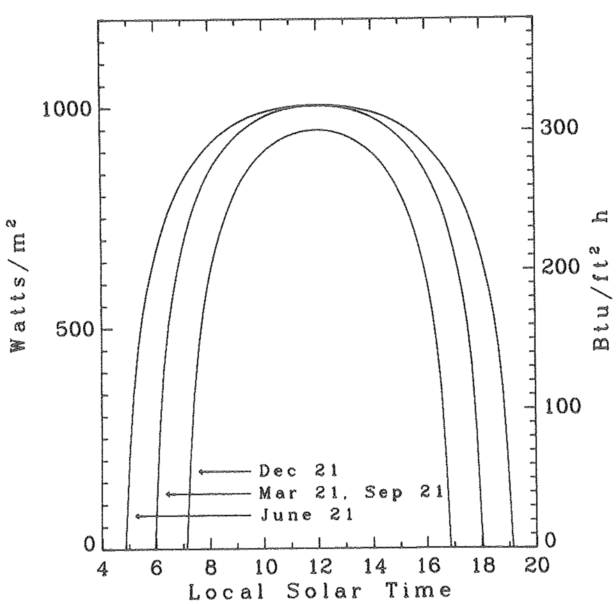


Possible Error in Direct Beam
(Normal Incidence)
Los Angeles (Civic Center)

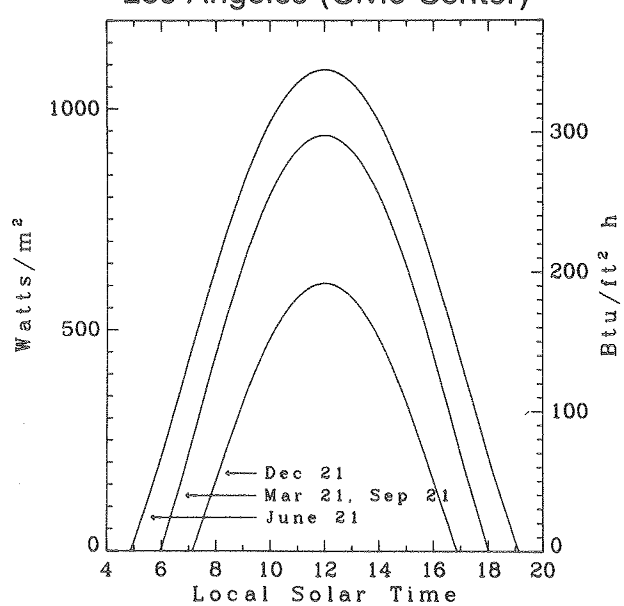


Clear Day Plots for Solar Radiation

Direct Beam (Normal Incidence)
Los Angeles (Civic Center)



Total Radiation on a
Horizontal Surface
Los Angeles (Civic Center)



Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m²)
Los Angeles (Civic Center)

DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	105	115	161	173	182	182	212	200	172	138	113	103	1854
SOUTH	30	121	126	167	168	170	166	195	191	174	148	128	120	1872
SOUTH	45	129	129	163	155	149	142	167	171	165	148	135	131	1784
SOUTH	60	129	124	149	132	121	112	132	142	147	140	134	133	1597
SOUTH	75	122	113	127	103	87	78	91	106	121	124	125	127	1325
SOUTH	90	108	94	98	69	52	44	50	66	88	101	109	113	992
SE,SW	15	98	109	155	170	181	183	212	198	168	132	106	96	1808
SE,SW	30	107	115	157	165	171	170	198	189	167	137	114	106	1796
SE,SW	45	110	114	151	153	153	150	176	173	158	134	117	110	1698
SE,SW	60	107	108	137	134	130	125	147	149	141	124	112	108	1522
SE,SW	75	98	95	117	109	103	98	115	120	118	108	101	100	1282
SE,SW	90	83	78	92	82	75	69	81	88	91	88	85	86	1000
E,W	15	82	96	142	163	179	183	212	192	156	118	89	78	1692
E,W	30	78	91	135	154	168	172	198	181	148	112	85	75	1595
E,W	45	73	84	123	140	152	155	178	163	135	103	79	70	1454
E,W	60	65	75	109	122	132	134	154	142	118	91	71	63	1275
E,W	75	56	63	92	102	109	110	127	118	99	77	61	54	1069
E,W	90	45	51	73	80	85	86	99	93	79	62	49	44	846

GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)

SURFACE ORIENT-ATION	ANGLE OF TILT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ANY	15	0	0	0	1	1	1	1	1	1	0	0	0	6
ANY	30	1	1	2	2	2	3	3	3	2	2	1	1	23
ANY	45	2	3	4	5	5	5	6	6	5	4	3	2	51
ANY	60	4	5	7	8	9	9	11	10	8	6	5	4	87
ANY	75	6	7	11	12	14	14	16	15	12	9	7	6	128
ANY	90	8	10	15	17	18	19	22	20	16	12	9	8	173

Total Radiation on a Tilted Surface (Calculated Values)
Engineering Units (kBtu/ft²)
Los Angeles (Civic Center)

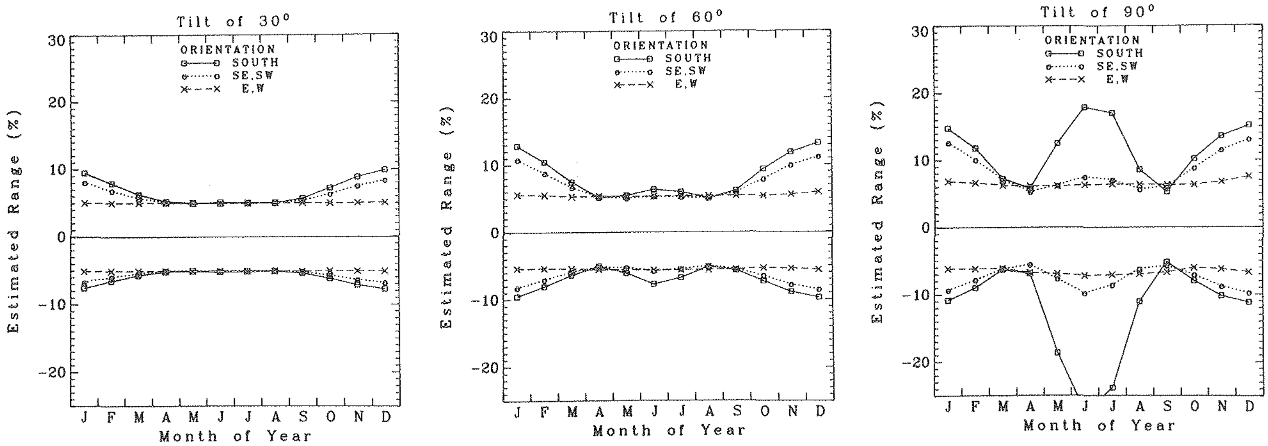
DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	33	36	51	55	58	58	67	63	54	44	36	33	587
SOUTH	30	38	40	53	53	54	53	62	60	55	47	41	38	593
SOUTH	45	41	41	52	49	47	45	53	54	52	47	43	41	565
SOUTH	60	41	39	47	42	38	36	42	45	47	45	43	42	506
SOUTH	75	39	36	40	33	28	25	29	34	38	39	40	40	420
SOUTH	90	34	30	31	22	17	14	16	21	28	32	35	36	314
SE,SW	15	31	35	49	54	57	58	67	63	53	42	34	30	573
SE,SW	30	34	36	50	52	54	54	63	60	53	43	36	34	569
SE,SW	45	35	36	48	48	49	48	56	55	50	42	37	35	538
SE,SW	60	34	34	43	42	41	40	47	47	45	39	36	34	482
SE,SW	75	31	30	37	35	33	31	36	38	37	34	32	32	406
SE,SW	90	26	25	29	26	24	22	26	28	29	28	27	27	317
E,W	15	26	30	45	52	57	58	67	61	50	37	28	25	536
E,W	30	25	29	43	49	53	54	63	57	47	35	27	24	505
E,W	45	23	27	39	44	48	49	56	52	43	33	25	22	461
E,W	60	21	24	34	39	42	42	49	45	37	29	22	20	404
E,W	75	18	20	29	32	35	35	40	37	31	24	19	17	339
E,W	90	14	16	23	25	27	27	31	29	25	20	16	14	268

GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)

SURFACE ORIENT-ATION	ANGLE OF TILT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	1	1	1	1	1	1	1	1	0	0	7
ANY	45	1	1	1	2	2	2	2	2	1	1	1	1	16
ANY	60	1	2	2	3	3	3	3	3	3	2	1	1	27
ANY	75	2	2	3	4	4	4	5	5	4	3	2	2	41
ANY	90	3	3	5	5	6	6	7	6	5	4	3	3	55

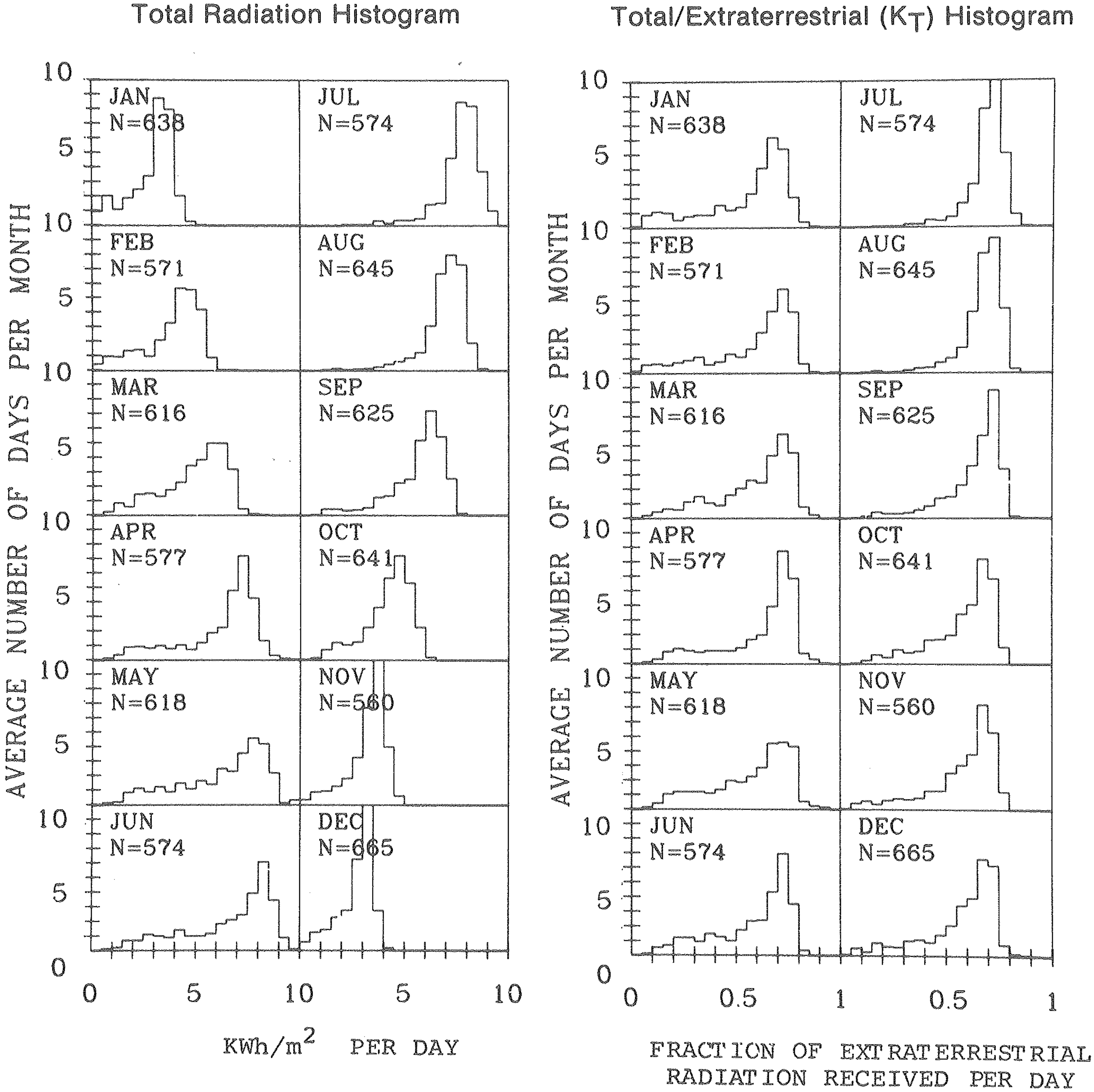
Possible Error in the Total Radiation on a Tilted Surface
Los Angeles (Civic Center)



Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profiles
Los Angeles (Civic Center)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.41	1.28	1.16	1.06	.99	.96	.97	1.03	1.11	1.23	1.37	1.46
SOUTH	30	1.73	1.47	1.24	1.04	.92	.86	.88	.98	1.15	1.37	1.64	1.81
SOUTH	45	1.93	1.57	1.24	.96	.79	.71	.74	.88	1.11	1.43	1.80	2.05
SOUTH	60	2.00	1.55	1.15	.81	.61	.52	.55	.71	.99	1.38	1.84	2.14
SOUTH	75	1.93	1.43	.99	.61	.40	.31	.34	.50	.81	1.24	1.75	2.09
SOUTH	90	1.73	1.22	.75	.37	.17	.10	.11	.27	.57	1.02	1.55	1.90
SE,SW	15	1.28	1.19	1.11	1.04	.99	.97	.98	1.01	1.07	1.15	1.25	1.31
SE,SW	30	1.48	1.31	1.15	1.02	.93	.89	.90	.97	1.09	1.24	1.42	1.54
SE,SW	45	1.58	1.34	1.12	.94	.83	.77	.79	.89	1.04	1.24	1.49	1.66
SE,SW	60	1.58	1.29	1.03	.82	.69	.63	.65	.76	.94	1.17	1.47	1.68
SE,SW	75	1.47	1.16	.89	.67	.53	.47	.49	.60	.78	1.04	1.36	1.58
SE,SW	90	1.27	.96	.70	.49	.36	.30	.33	.43	.60	.84	1.16	1.38
E,W	15	.98	.98	.98	.97	.97	.97	.97	.97	.98	.98	.98	.98
E,W	30	.94	.93	.92	.91	.91	.90	.90	.91	.92	.92	.93	.94
E,W	45	.88	.86	.84	.83	.81	.81	.81	.82	.84	.85	.87	.89
E,W	60	.80	.77	.75	.72	.70	.69	.70	.71	.73	.76	.79	.81
E,W	75	.69	.66	.63	.60	.58	.57	.57	.59	.62	.65	.68	.70
E,W	90	.57	.54	.50	.47	.45	.44	.44	.46	.49	.52	.56	.58
NORMAL INCIDENCE		2.42	2.04	1.75	1.57	1.49	1.47	1.48	1.53	1.66	1.90	2.28	2.56

Los Angeles (Civic Center)



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

(H) SOLAR DATA FOR LOS ANGELES (INTERNATIONAL AIRPORT)

Nearby Climate Stations - Los Angeles (International Airport), Long Beach

Monthly Solar Data, Los Angeles (International Airport)

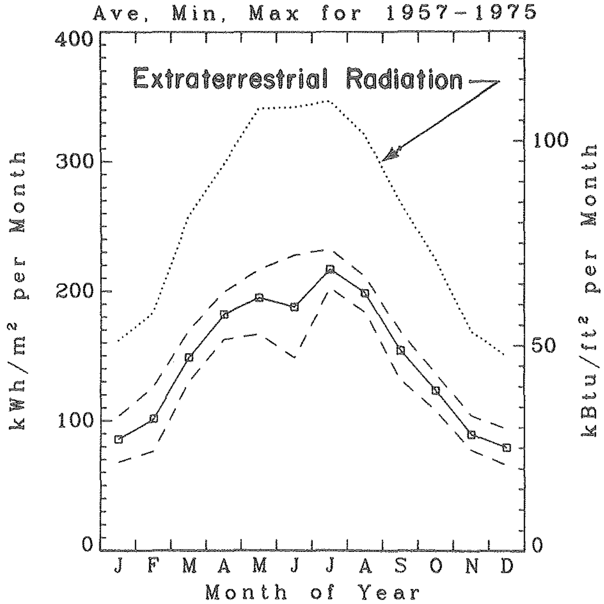
Latitude: 33.93° Longitude: 118.38° Elevation: 126'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	86	102	149	182	195	188	217	199	154	123	90	79	1764
direct beam (normal incidence)	135	138	179	204	199	184	232	218	175	157	133	133	2086
SOLAR RADIATION (KBtu/ft^2 per month)													
horizontal surface	27	32	47	58	62	60	69	63	49	39	29	25	559
direct beam (normal incidence)	43	44	57	65	63	58	74	69	56	50	42	42	661
PERCENT OF POSSIBLE SUNSHINE													
MEAN CLOUD COVER (in tenths)	5	5	5	5	5	5	4	4	4	4	5	5	5
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.53	.55	.58	.61	.57	.55	.63	.62	.57	.55	.53	.53	.57

Recording interval: 1951-1975
Source of solar data: NWS, Eppley lightbulb pyranometer.

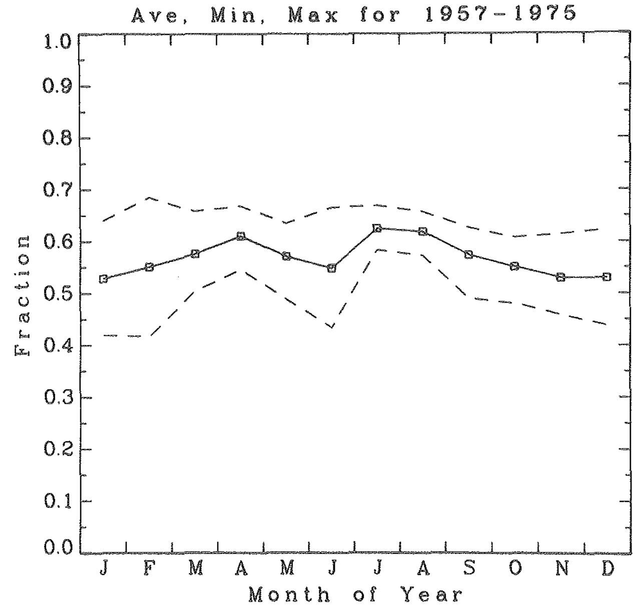
Monthly Total Horizontal Radiation Los Angeles (International Airport)

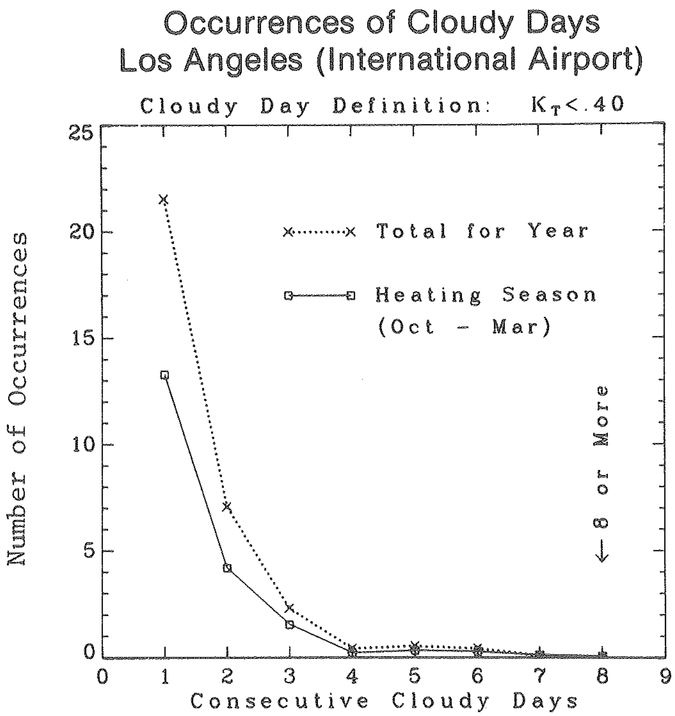
Ave, Min, Max for 1957-1975

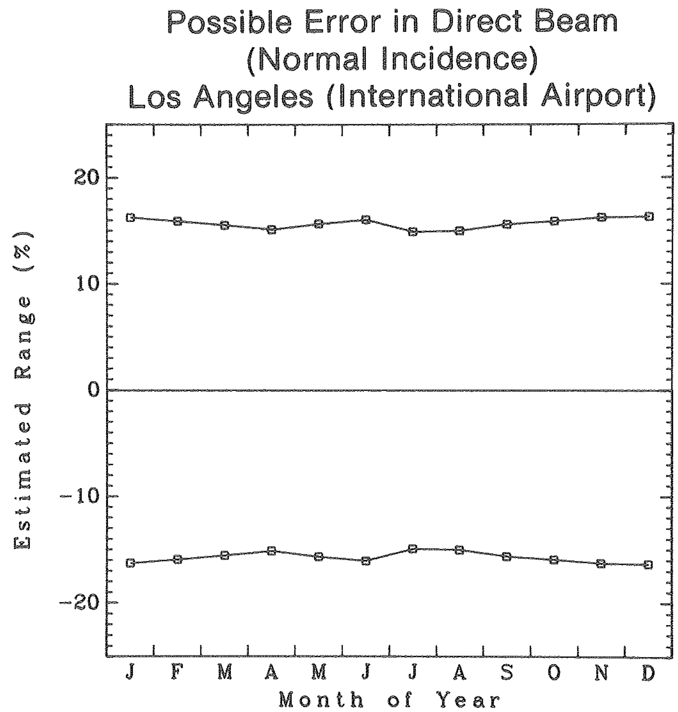


Monthly Total/Extraterrestrial (K_T) Los Angeles (International Airport)

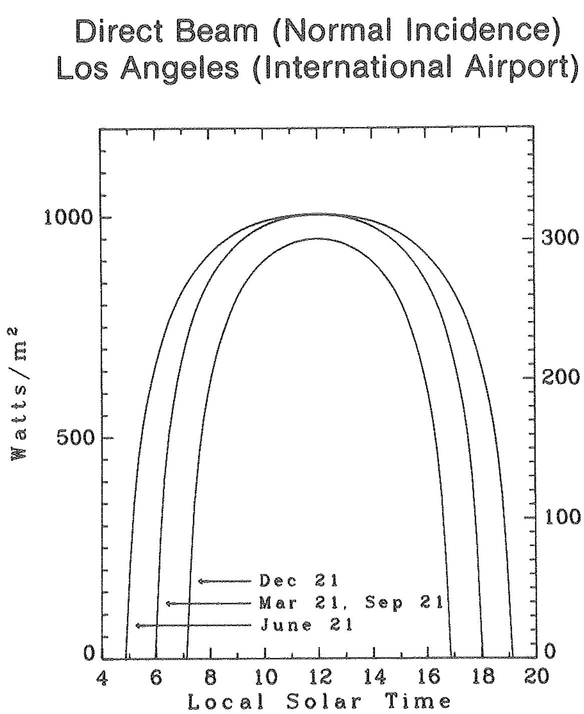
Ave, Min, Max for 1957-1975

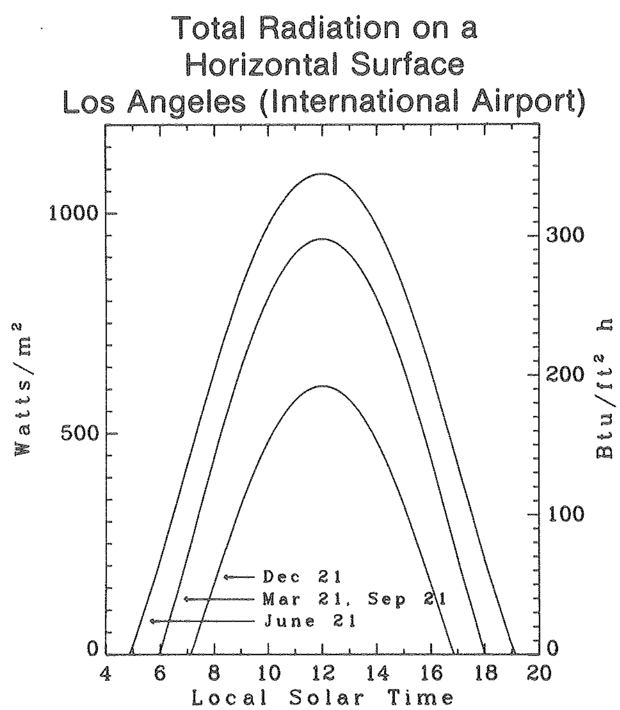






Clear Day Plots for Solar Radiation





Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m²)
Los Angeles (International Airport)

DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	108	120	164	189	193	182	212	201	165	142	110	102	1888
SOUTH	30	124	131	170	184	180	166	195	192	167	151	125	119	1906
SOUTH	45	133	135	166	169	157	142	167	172	159	152	132	129	1815
SOUTH	60	133	130	153	145	127	112	132	143	141	144	131	131	1622
SOUTH	75	126	118	130	112	91	78	91	107	116	128	122	125	1343
SOUTH	90	111	99	100	74	53	44	50	66	84	104	106	112	1002
SE,SW	15	101	114	159	186	192	183	212	199	161	135	104	95	1841
SE,SW	30	110	120	161	181	181	170	198	191	160	140	112	105	1829
SE,SW	45	114	119	155	167	162	150	176	174	151	137	114	109	1728
SE,SW	60	110	112	140	146	138	125	147	150	135	127	109	107	1548
SE,SW	75	101	100	120	119	109	97	114	120	113	111	99	99	1302
SE,SW	90	86	82	95	90	79	69	81	89	88	90	83	85	1014
E,W	15	84	99	146	178	190	183	212	194	151	121	88	78	1723
E,W	30	80	95	138	167	178	172	198	182	142	114	84	75	1624
E,W	45	74	87	126	152	161	155	178	165	130	105	77	69	1480
E,W	60	67	78	111	133	140	134	154	143	114	93	69	62	1298
E,W	75	57	66	94	111	116	110	127	119	96	79	59	54	1088
E,W	90	47	53	75	87	90	86	99	93	76	63	48	44	861

GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)

SURFACE ORIENT-ATION	ANGLE OF TILT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ANY	15	0	0	1	1	1	1	1	1	1	0	0	0	6
ANY	30	1	1	2	2	3	3	3	3	2	2	1	1	24
ANY	45	3	3	4	5	6	5	6	6	5	4	3	2	52
ANY	60	4	5	7	9	10	9	11	10	8	6	4	4	88
ANY	75	6	8	11	14	14	14	16	15	11	9	7	6	131
ANY	90	9	10	15	18	19	19	22	20	15	12	9	8	176

Total Radiation on a Tilted Surface (Calculated Values)
Engineering Units (kBtu/ft²)
Los Angeles (International Airport)

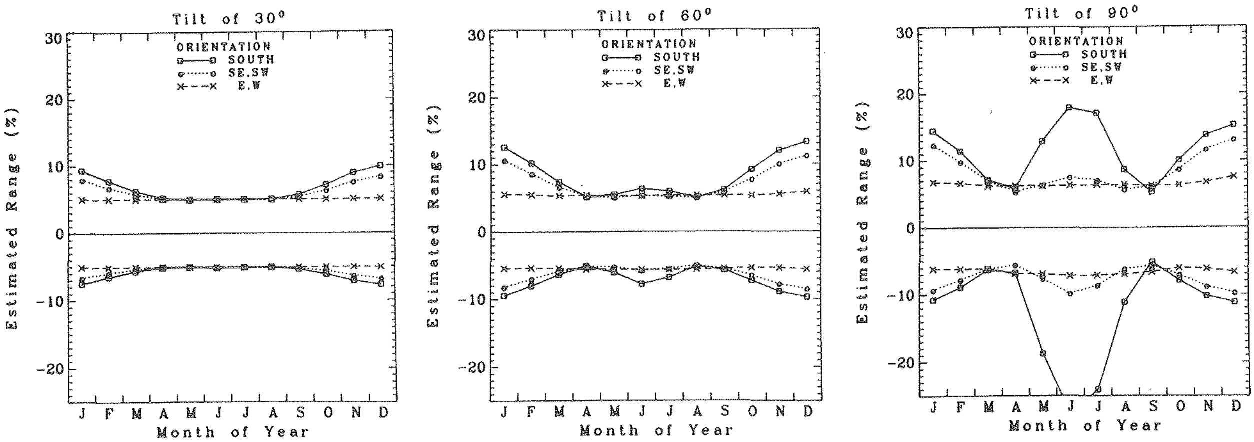
DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	34	38	52	60	61	58	67	64	52	45	35	32	598
SOUTH	30	39	42	54	58	57	53	62	61	53	48	40	38	604
SOUTH	45	42	43	53	54	50	45	53	55	50	48	42	41	575
SOUTH	60	42	41	48	46	40	35	42	45	45	46	41	42	514
SOUTH	75	40	37	41	36	29	25	29	34	37	40	39	40	426
SOUTH	90	35	31	32	23	17	14	16	21	27	33	33	35	318
SE,SW	15	32	36	50	59	61	58	67	63	51	43	33	30	583
SE,SW	30	35	38	51	57	57	54	63	60	51	44	35	33	579
SE,SW	45	36	38	49	53	51	48	56	55	48	44	36	35	548
SE,SW	60	35	36	45	46	44	40	47	47	43	40	35	34	490
SE,SW	75	32	32	38	38	34	31	36	38	36	35	31	31	413
SE,SW	90	27	26	30	28	25	22	26	28	28	28	26	27	321
E,W	15	27	32	46	56	60	58	67	61	48	38	28	25	546
E,W	30	25	30	44	53	56	54	63	58	45	36	27	24	515
E,W	45	24	28	40	48	51	49	56	52	41	33	25	22	469
E,W	60	21	25	35	42	44	42	49	45	36	30	22	20	411
E,W	75	18	21	30	35	37	35	40	38	30	25	19	17	345
E,W	90	15	17	24	28	29	27	31	30	24	20	15	14	273

GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)

SURFACE ORIENT-ATION	ANGLE OF TILT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	1	1	1	1	1	1	1	1	0	0	7
ANY	45	1	1	1	2	2	2	2	2	1	1	1	1	16
ANY	60	1	2	2	3	3	3	3	3	2	2	1	1	28
ANY	75	2	2	3	4	5	4	5	5	4	3	2	2	41
ANY	90	3	3	5	6	6	6	7	6	5	4	3	3	56

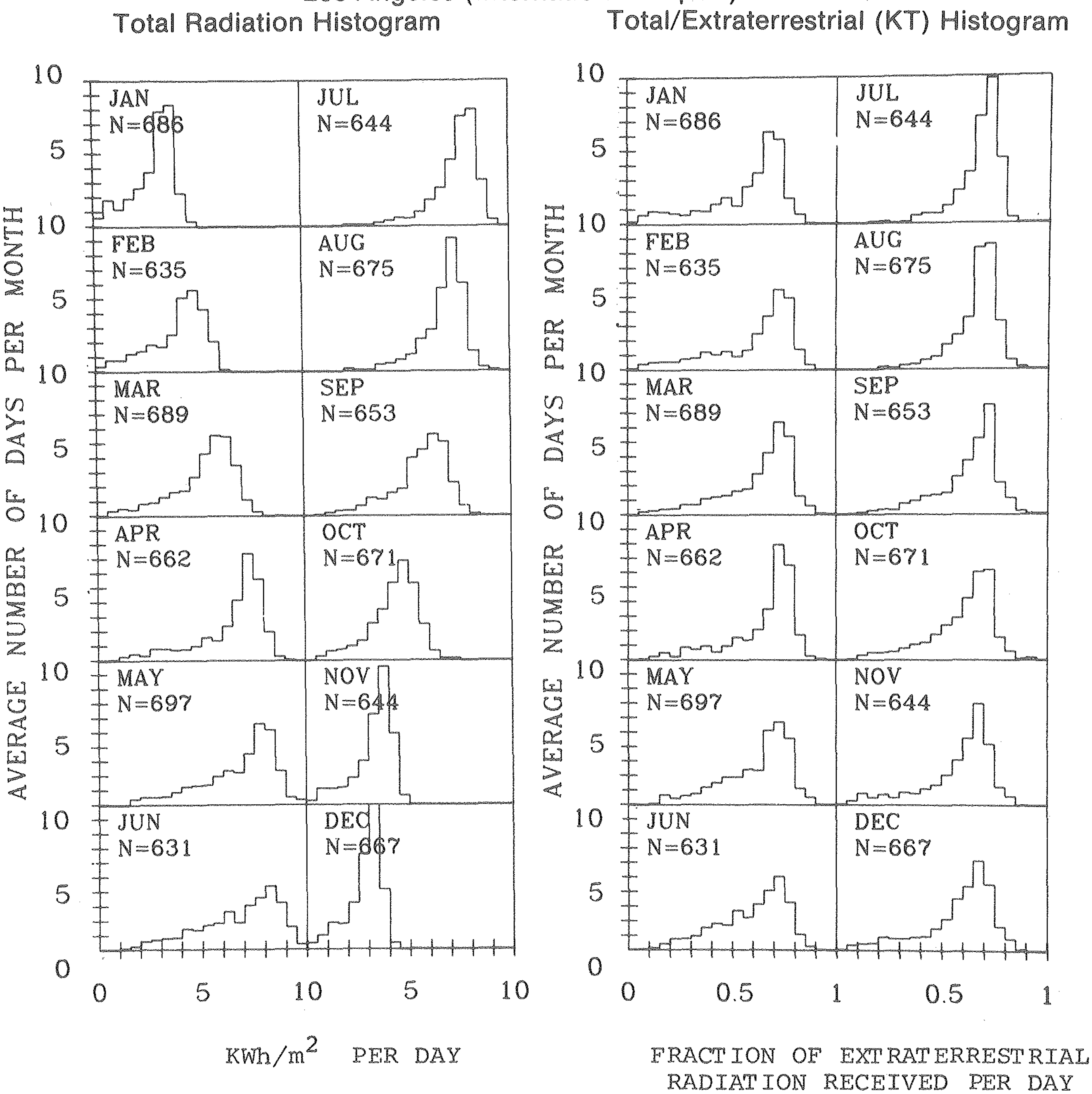
Possible Error in the Total Radiation on a Tilted Surface
Los Angeles (International Airport)



Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profiles
Los Angeles (International Airport)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.41	1.28	1.16	1.06	.99	.96	.97	1.02	1.11	1.23	1.36	1.45
SOUTH	30	1.73	1.47	1.24	1.04	.92	.86	.88	.98	1.15	1.37	1.64	1.81
SOUTH	45	1.92	1.56	1.24	.96	.79	.71	.74	.87	1.11	1.42	1.80	2.04
SOUTH	60	1.99	1.55	1.15	.81	.61	.52	.55	.71	.99	1.38	1.83	2.13
SOUTH	75	1.92	1.43	.98	.61	.39	.31	.34	.50	.81	1.24	1.75	2.08
SOUTH	90	1.72	1.21	.75	.37	.17	.10	.13	.27	.57	1.01	1.54	1.89
SE,SW	15	1.28	1.19	1.11	1.04	.99	.97	.98	1.01	1.07	1.15	1.25	1.31
SE,SW	30	1.48	1.30	1.15	1.01	.93	.89	.90	.97	1.09	1.23	1.42	1.54
SE,SW	45	1.58	1.34	1.12	.94	.82	.77	.79	.88	1.04	1.24	1.49	1.66
SE,SW	60	1.57	1.28	1.03	.82	.69	.63	.65	.76	.93	1.17	1.47	1.67
SE,SW	75	1.46	1.15	.89	.67	.53	.46	.49	.60	.78	1.03	1.35	1.57
SE,SW	90	1.26	.96	.70	.49	.36	.30	.33	.43	.60	.84	1.15	1.37
E,W	15	.98	.98	.98	.97	.97	.97	.97	.97	.98	.98	.98	.98
E,W	30	.94	.93	.92	.91	.91	.90	.90	.91	.92	.92	.93	.94
E,W	45	.88	.86	.84	.83	.81	.81	.81	.82	.84	.85	.87	.89
E,W	60	.79	.77	.74	.72	.70	.69	.70	.71	.73	.76	.79	.81
E,W	75	.69	.66	.63	.60	.58	.57	.57	.59	.62	.64	.68	.70
E,W	90	.57	.54	.50	.47	.45	.43	.44	.46	.49	.52	.55	.58
NORMAL INCIDENCE		2.41	2.03	1.75	1.57	1.49	1.47	1.48	1.52	1.66	1.90	2.27	2.55

Los Angeles (International Airport)



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

(I) SOLAR DATA FOR RIVERSIDE

Nearby Climate Stations - Riverside, San Bernardino

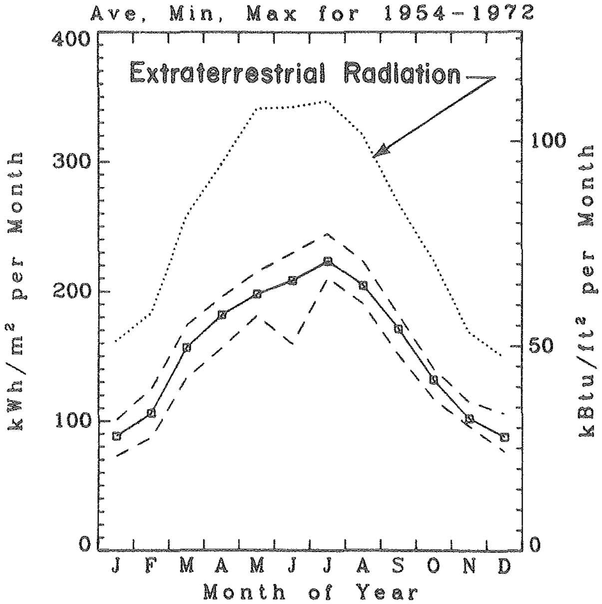
Monthly Solar Data, Riverside

Latitude: 33.97° Longitude: 117.33° Elevation: 1050'	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	88	106	157	182	198	209	224	205	171	132	102	88	1862
direct beam (normal incidence)	142	149	194	203	204	219	244	229	208	175	164	156	2290
SOLAR RADIATION (KBtu/ft^2 per month)													
horizontal surface	28	34	50	58	63	66	71	65	54	42	32	28	590
direct beam (normal incidence)	45	47	62	64	65	69	77	73	66	56	52	50	725
PERCENT OF POSSIBLE SUNSHINE													
MEAN CLOUD COVER (in tenths)*	4	5	5	5	4	3	2	2	2	3	4	4	4
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.55	.58	.61	.61	.58	.61	.64	.64	.64	.59	.60	.59	.60

*Data for March AFB 35°54'N, 117°15'W, Elevation 1543'
Recording interval: 1952-1975
Source of solar data: NWS, Eppley lightbulb pyranometer.

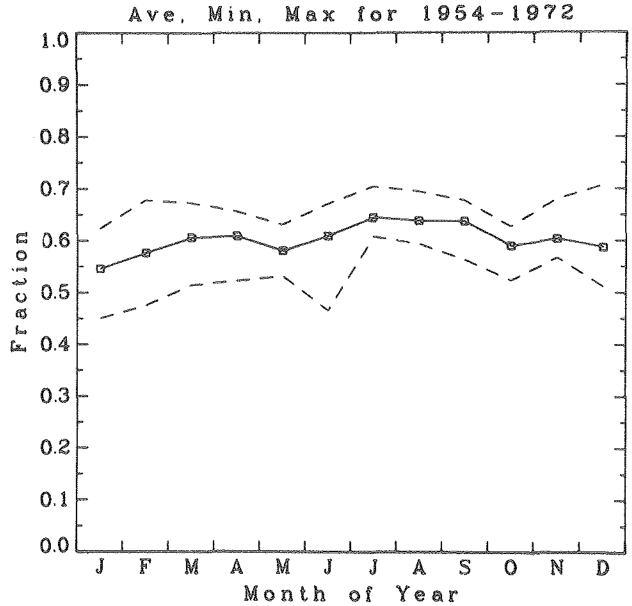
Monthly Total Horizontal Radiation Riverside

Ave, Min, Max for 1954-1972

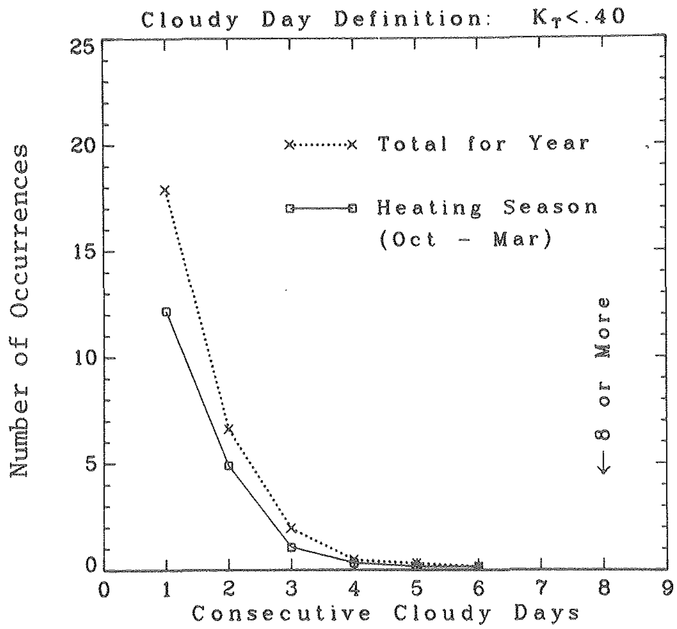


Monthly Total/Extraterrestrial (K_T) Riverside

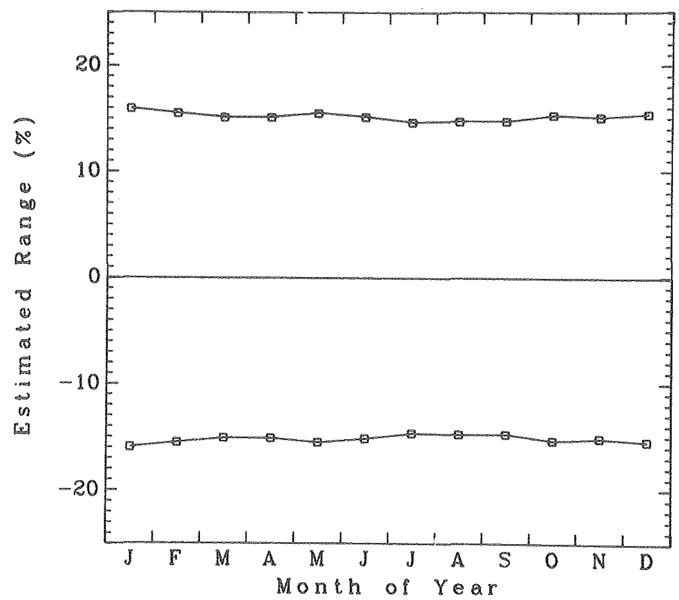
Ave, Min, Max for 1954-1972



Occurrences of Cloudy Days
Riverside

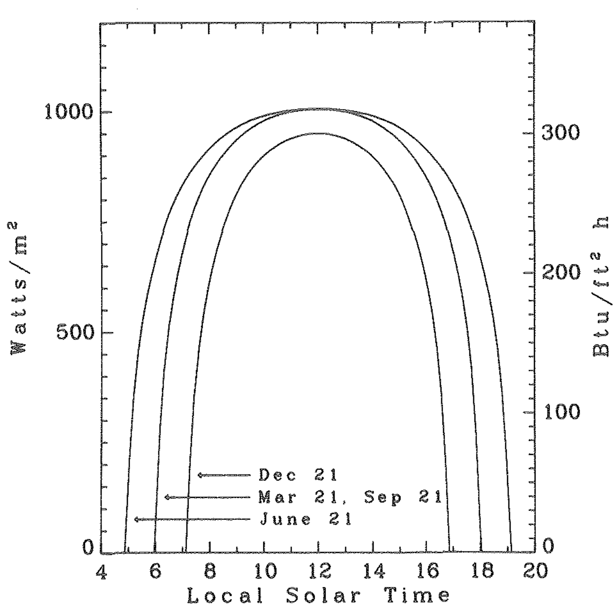


Possible Error in Direct Beam
(Normal Incidence)
Riverside

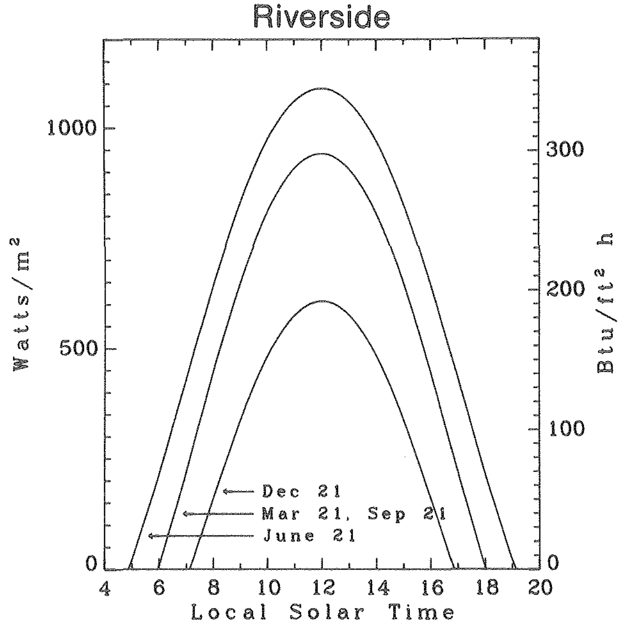


Clear Day Plots for Solar Radiation

Direct Beam (Normal Incidence)
Riverside



Total Radiation on a
Horizontal Surface
Riverside



Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m²)
Riverside

DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	112	126	174	188	196	202	218	208	185	152	128	115	2004
SOUTH	30	129	138	180	184	183	184	201	198	187	164	146	136	2031
SOUTH	45	138	143	177	169	160	157	172	178	178	165	155	148	1940
SOUTH	60	139	138	162	144	129	122	135	148	159	157	155	151	1740
SOUTH	75	132	125	138	112	92	83	93	110	130	139	145	144	1445
SOUTH	90	116	105	106	74	54	45	50	67	94	113	126	129	1081
SE,SW	15	104	119	168	186	196	203	219	206	180	146	120	107	1951
SE,SW	30	115	126	170	180	184	188	204	197	179	151	130	119	1944
SE,SW	45	118	126	164	167	165	166	181	179	169	149	133	124	1842
SE,SW	60	115	119	149	146	140	138	151	154	152	138	129	123	1653
SE,SW	75	105	105	127	119	111	107	118	124	127	121	117	113	1393
SE,SW	90	89	87	100	90	80	75	83	91	98	98	98	98	1086
E,W	15	87	104	153	178	193	204	218	200	167	129	100	86	1819
E,W	30	83	99	145	167	181	190	204	188	158	122	95	83	1715
E,W	45	77	91	132	152	164	171	184	170	144	113	88	77	1563
E,W	60	69	81	117	133	142	148	159	148	126	100	79	69	1371
E,W	75	59	69	99	111	117	122	131	123	106	85	68	60	1149
E,W	90	48	56	78	87	92	95	102	96	84	68	55	49	909

GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)

SURFACE ORIENT-ATION	ANGLE OF TILT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ANY	15	0	0	1	1	1	1	1	1	1	0	0	0	6
ANY	30	1	1	2	2	3	3	3	3	2	2	1	1	25
ANY	45	3	3	5	5	6	6	7	6	5	4	3	3	55
ANY	60	4	5	8	9	10	10	11	10	9	7	5	4	93
ANY	75	7	8	12	13	15	15	17	15	13	10	8	7	138
ANY	90	9	11	16	18	20	21	22	20	17	13	10	9	186

Total Radiation on a Tilted Surface (Calculated Values)
Engineering Units (kBtu/ft²)
Riverside

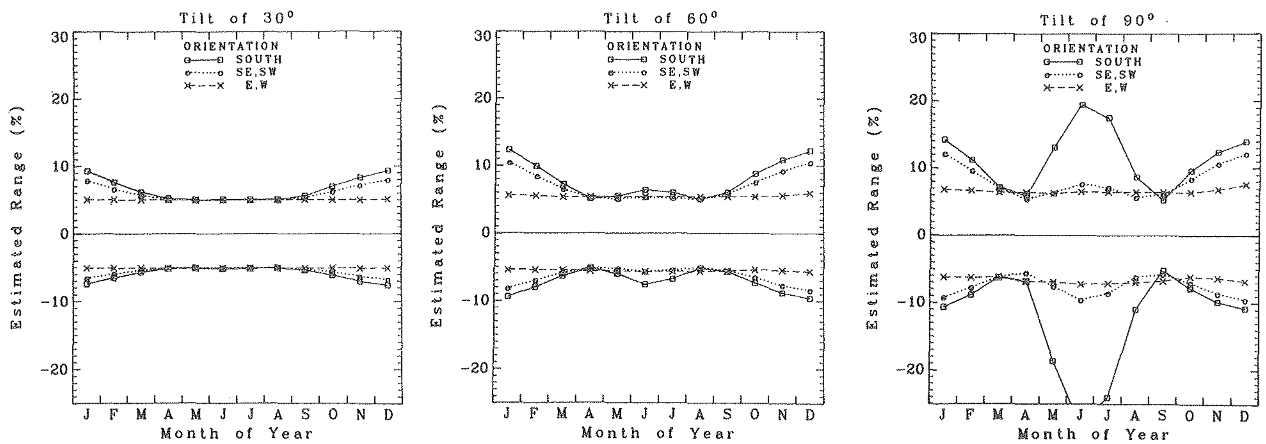
DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	36	40	55	60	62	64	69	66	59	48	41	37	635
SOUTH	30	41	44	57	58	58	58	64	63	59	52	46	43	643
SOUTH	45	44	45	56	54	51	50	55	56	56	52	49	47	615
SOUTH	60	44	44	51	46	41	39	43	47	50	50	49	48	551
SOUTH	75	42	40	44	35	29	26	29	35	41	44	46	46	458
SOUTH	90	37	33	34	23	17	14	16	21	30	36	40	41	342
SE,SW	15	33	38	53	59	62	64	69	65	57	46	38	34	618
SE,SW	30	36	40	54	57	58	60	65	62	57	48	41	38	616
SE,SW	45	37	40	52	53	52	53	57	57	54	47	42	39	584
SE,SW	60	36	38	47	46	44	44	48	49	48	44	41	39	524
SE,SW	75	33	33	40	38	35	34	37	39	40	38	37	36	441
SE,SW	90	28	27	32	28	25	24	26	29	31	31	31	31	344
E,W	15	27	33	49	56	61	65	69	63	53	41	32	27	576
E,W	30	26	31	46	53	57	60	65	59	50	39	30	26	543
E,W	45	24	29	42	48	52	54	58	54	46	36	28	24	495
E,W	60	22	26	37	42	45	47	50	47	40	32	25	22	434
E,W	75	19	22	31	35	37	39	41	39	34	27	21	19	364
E,W	90	15	18	25	28	29	30	32	30	27	21	17	15	288

GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)

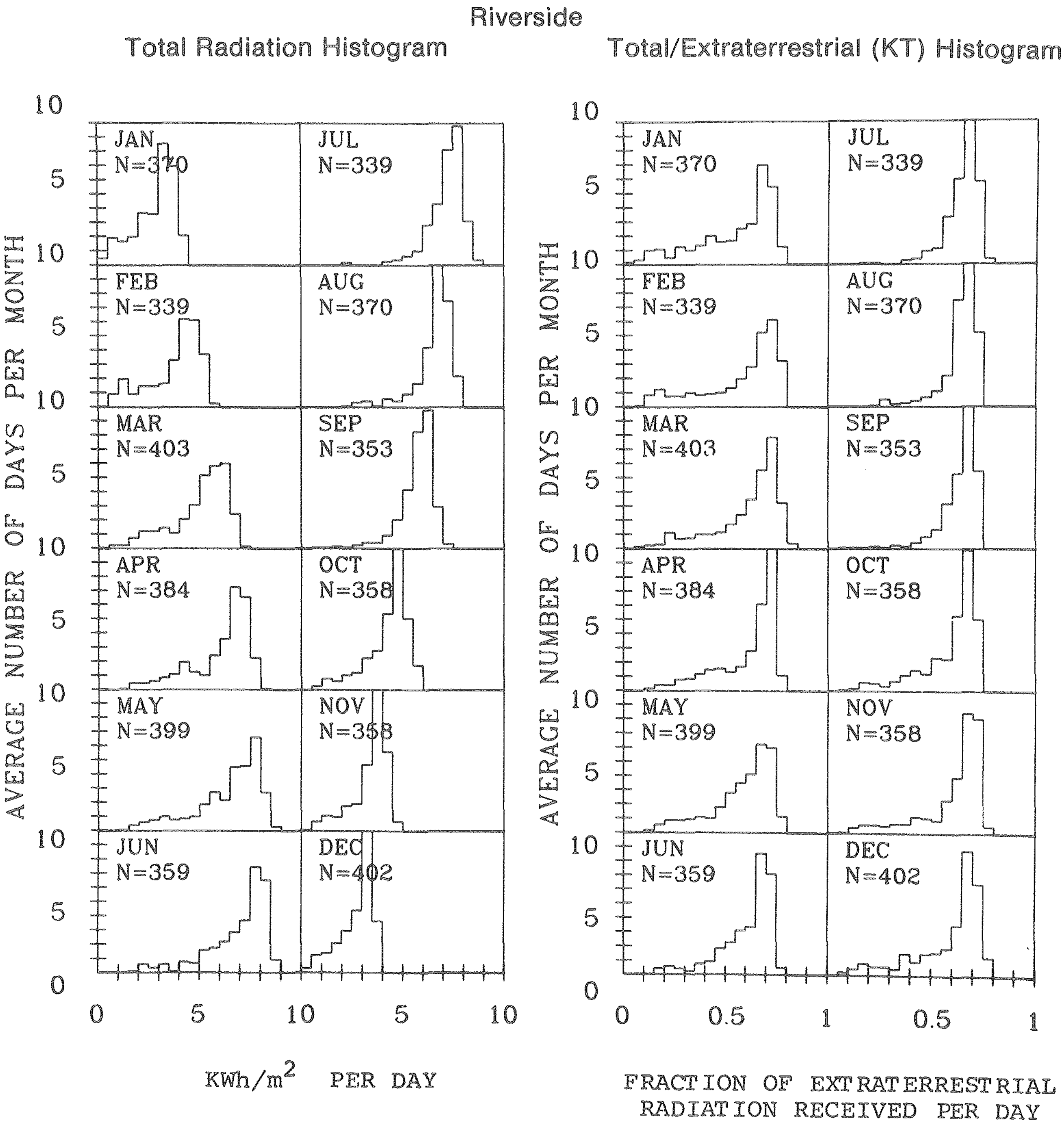
SURFACE ORIENT-ATION	ANGLE OF TILT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	1	1	1	1	1	1	1	1	0	0	8
ANY	45	1	1	1	2	2	2	2	2	2	1	1	1	17
ANY	60	1	2	2	3	3	3	4	3	3	2	2	1	29
ANY	75	2	2	4	4	5	5	5	5	4	3	2	2	44
ANY	90	3	3	5	6	6	7	7	6	5	4	3	3	59

Possible Error in the Total Radiation on a Tilted Surface
Riverside



Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profiles
Riverside

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.41	1.28	1.16	1.06	.99	.96	.97	1.03	1.11	1.23	1.37	1.46
SOUTH	30	1.73	1.47	1.24	1.04	.92	.86	.88	.98	1.15	1.37	1.64	1.81
SOUTH	45	1.92	1.56	1.24	.96	.79	.71	.74	.87	1.11	1.42	1.80	2.04
SOUTH	60	1.99	1.55	1.15	.81	.61	.52	.55	.71	.99	1.38	1.84	2.14
SOUTH	75	1.92	1.43	.99	.61	.39	.31	.34	.50	.81	1.24	1.75	2.08
SOUTH	90	1.72	1.21	.75	.37	.17	.10	.13	.27	.57	1.01	1.54	1.89
SE,SW	15	1.28	1.19	1.11	1.04	.99	.97	.98	1.01	1.07	1.15	1.25	1.31
SE,SW	30	1.48	1.30	1.15	1.02	.93	.89	.90	.97	1.09	1.24	1.42	1.54
SE,SW	45	1.58	1.34	1.12	.94	.82	.77	.79	.89	1.04	1.24	1.49	1.66
SE,SW	60	1.57	1.29	1.03	.82	.69	.63	.65	.76	.93	1.17	1.47	1.67
SE,SW	75	1.47	1.16	.89	.67	.53	.46	.49	.60	.78	1.03	1.35	1.57
SE,SW	90	1.27	.96	.70	.49	.36	.30	.33	.43	.60	.84	1.15	1.37
E,W	15	.98	.98	.98	.97	.97	.97	.97	.97	.98	.98	.98	.98
E,W	30	.94	.93	.92	.91	.91	.90	.90	.91	.92	.92	.93	.94
E,W	45	.88	.86	.84	.83	.81	.81	.81	.82	.84	.85	.87	.89
E,W	60	.79	.77	.74	.72	.70	.69	.70	.71	.73	.76	.79	.81
E,W	75	.69	.66	.63	.60	.58	.57	.57	.59	.62	.65	.68	.70
E,W	90	.57	.54	.50	.47	.45	.43	.44	.46	.49	.52	.56	.58
NORMAL INCIDENCE		2.41	2.03	1.75	1.57	1.49	1.47	1.48	1.53	1.66	1.90	2.27	2.55



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

(J) SOLAR DATA FOR LA JOLLA

Nearby Climate Stations - Imperial Beach, San Diego

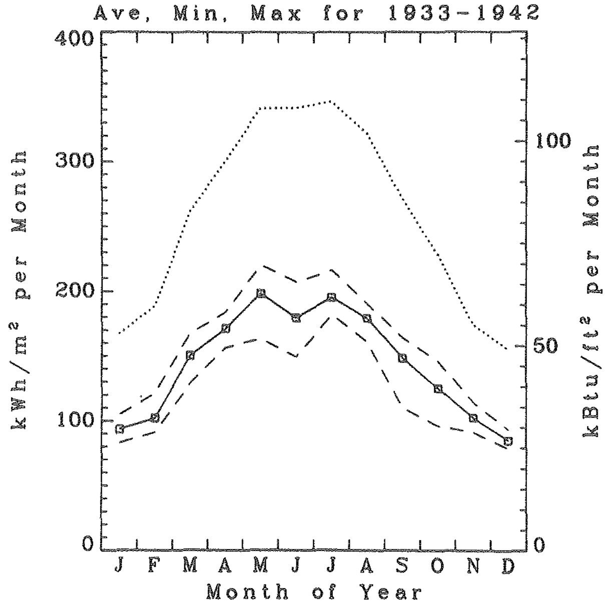
Monthly Solar Data, La Jolla

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Latitude: 32.83° Longitude: 117.25° Elevation: 85'													
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	94	102	150	171	198	180	195	179	148	125	102	85	1729
direct beam (normal incidence)	149	135	178	181	203	170	195	183	162	156	159	140	2010
SOLAR RADIATION (KBtu/ft^2 per month)													
horizontal surface	30	32	48	54	63	57	62	57	47	40	32	27	548
direct beam (normal incidence)	47	43	56	57	64	54	62	58	51	49	50	44	637
PERCENT OF POSSIBLE SUNSHINE*	71	72	70	65	58	56	68	69	68	67	73	71	67
MEAN CLOUD COVER (in tenths)*	5	5	5	5	6	6	5	4	4	4	4	5	5
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.56	.54	.57	.57	.58	.53	.56	.56	.55	.55	.59	.55	.56

Recording interval: 1929-1942
*Data for San Diego 32°44', 117°10' W, Elevation 13'
Source of solar data: Scripps Institute, Eppley lightbulb pyranometer.

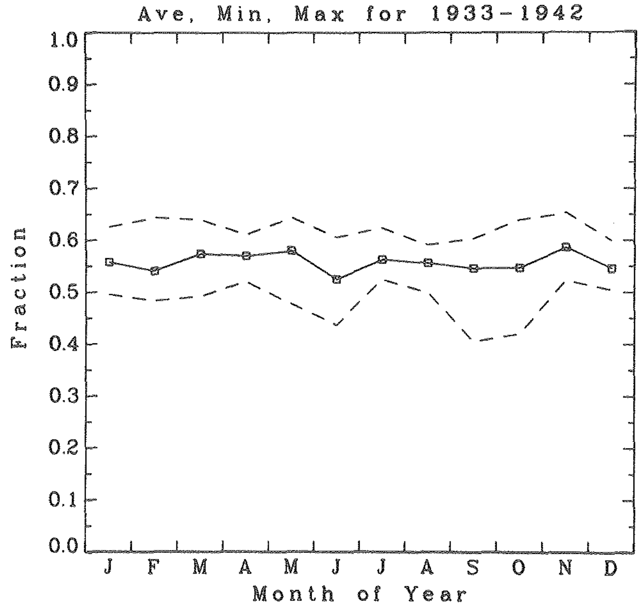
Monthly Total Horizontal Radiation
La Jolla

Ave, Min, Max for 1933-1942

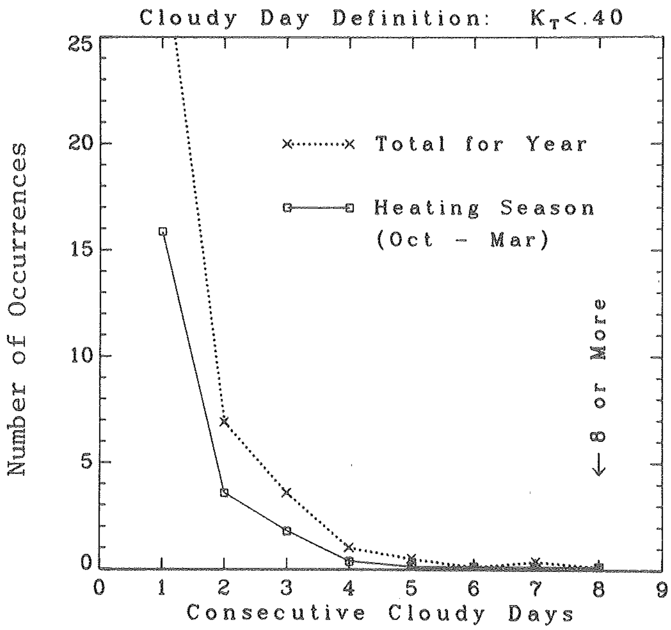


Monthly Total/Extraterrestrial (K_T)
La Jolla

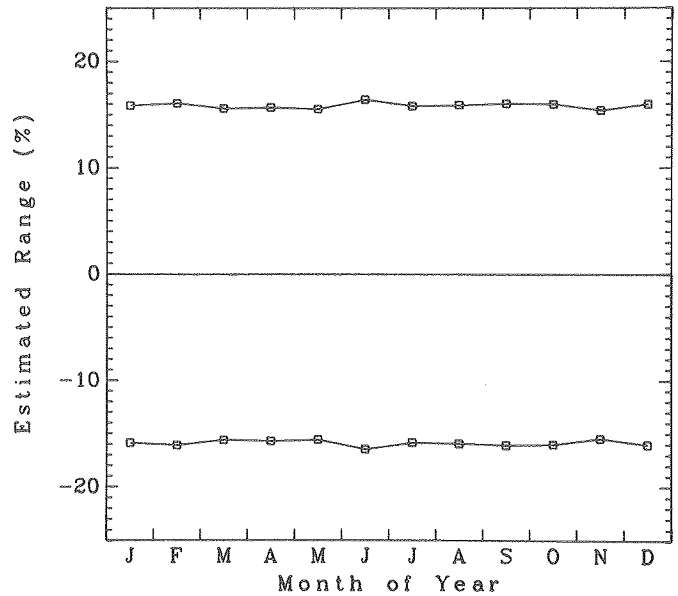
Ave, Min, Max for 1933-1942



Occurrences of Cloudy Days
La Jolla

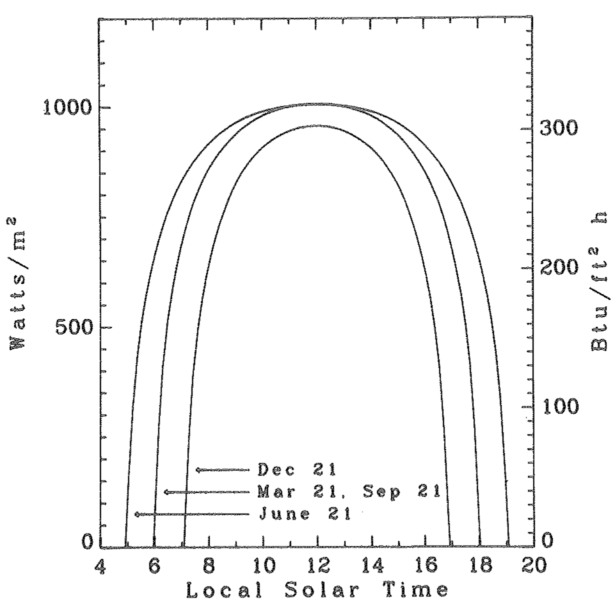


Possible Error in Direct Beam
(Normal Incidence)
La Jolla

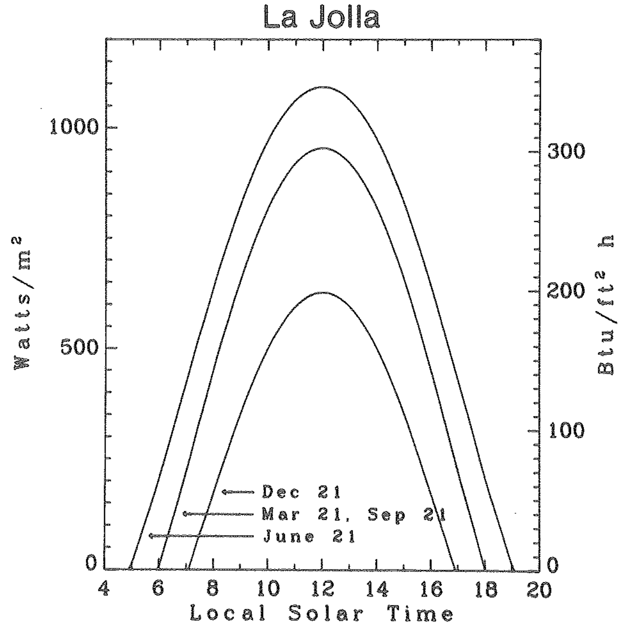


Clear Day Plots for Solar Radiation

Direct Beam (Normal Incidence)
La Jolla



Total Radiation on a
Horizontal Surface
La Jolla



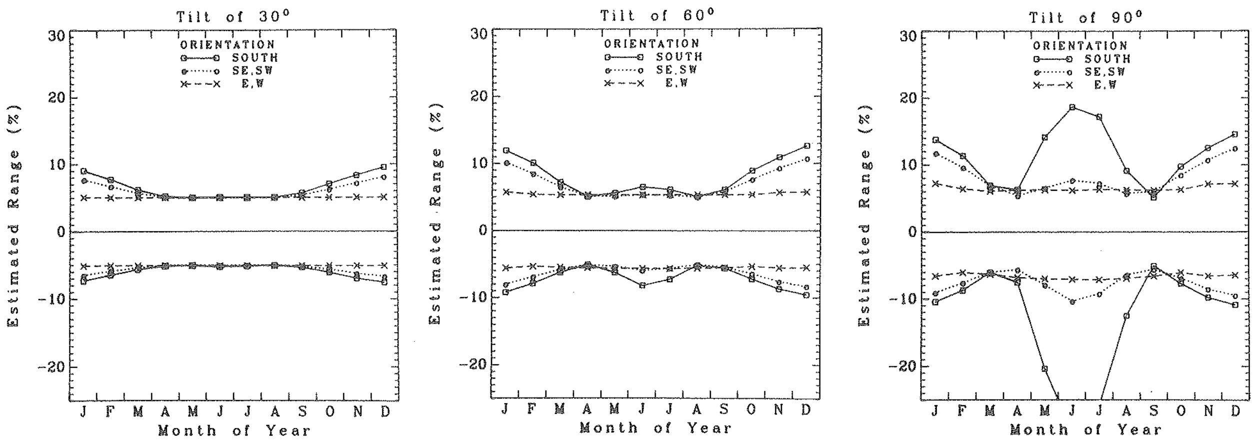
Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m²)
La Jolla

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
		DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)												
SOUTH	15	118	120	165	176	195	173	190	181	158	143	127	109	1855
SOUTH	30	135	130	171	171	182	158	175	172	159	152	144	127	1874
SOUTH	45	145	133	166	157	158	135	150	154	150	152	152	137	1788
SOUTH	60	145	128	152	133	127	106	118	127	133	143	151	138	1602
SOUTH	75	136	115	128	103	90	73	82	95	109	126	140	131	1331
SOUTH	90	120	96	98	68	52	41	46	59	78	102	121	117	999
SE,SW	15	110	114	160	174	195	174	191	179	154	137	119	101	1808
SE,SW	30	120	119	161	168	183	162	178	171	153	141	129	112	1797
SE,SW	45	124	118	155	155	164	143	158	156	144	137	131	116	1699
SE,SW	60	120	111	140	135	138	119	132	134	128	127	126	113	1523
SE,SW	75	109	98	119	110	109	92	103	107	107	110	114	104	1282
SE,SW	90	92	80	93	82	78	66	73	79	82	89	95	89	1000
E,W	15	92	100	147	167	193	175	191	175	145	122	100	83	1691
E,W	30	88	95	139	157	181	164	178	164	137	116	96	80	1594
E,W	45	81	87	127	143	163	148	161	149	125	106	88	74	1452
E,W	60	73	78	112	124	142	128	139	129	109	94	79	66	1273
E,W	75	62	66	94	104	117	105	115	107	92	79	68	57	1066
E,W	90	51	53	75	81	91	82	89	84	73	63	55	46	843
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	1	1	1	1	1	1	1	0	0	0	6
ANY	30	1	1	2	2	3	2	3	2	2	2	1	1	23
ANY	45	3	3	4	5	6	5	6	5	4	4	3	2	51
ANY	60	5	5	8	9	10	9	10	9	7	6	5	4	87
ANY	75	7	8	11	13	15	13	14	13	11	9	8	6	128
ANY	90	9	10	15	17	20	18	20	18	15	13	10	9	173

Total Radiation on a Tilted Surface (Calculated Values)
Engineering Units (kBtu/ft²)
La Jolla

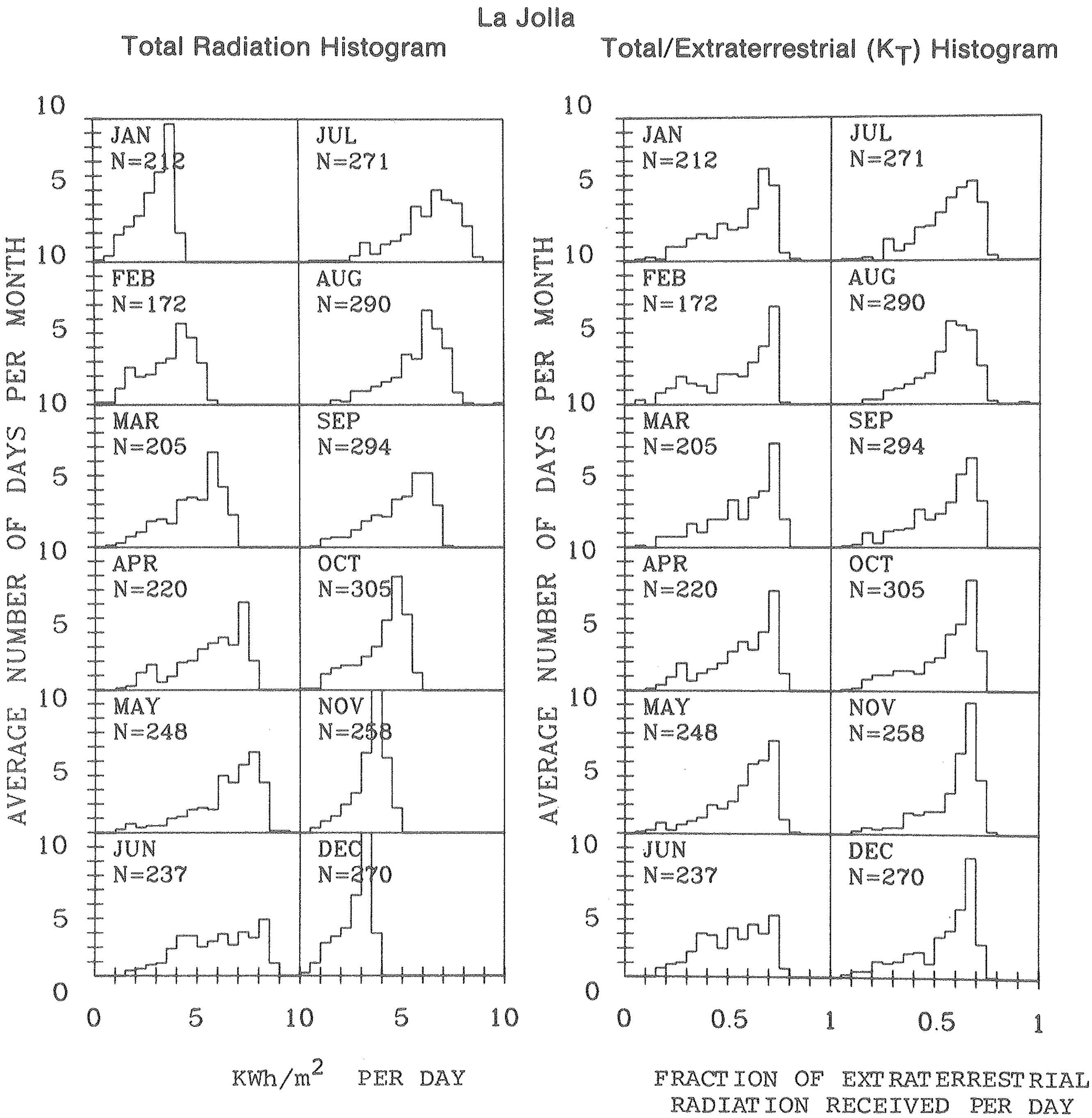
SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
		DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)												
SOUTH	15	37	38	52	56	62	55	60	57	50	45	40	35	588
SOUTH	30	43	41	54	54	58	50	55	54	50	48	46	40	594
SOUTH	45	46	42	53	50	50	43	48	49	48	48	48	43	566
SOUTH	60	46	41	48	42	40	34	38	40	42	45	48	44	508
SOUTH	75	43	37	41	33	29	23	26	30	34	40	44	42	422
SOUTH	90	38	30	31	22	16	13	15	19	25	32	38	37	316
SE,SW	15	35	36	51	55	62	55	60	57	49	43	38	32	573
SE,SW	30	38	38	51	53	58	51	56	54	48	45	41	35	569
SE,SW	45	39	37	49	49	52	45	50	49	46	44	41	37	538
SE,SW	60	38	35	44	43	44	36	42	42	41	40	40	36	482
SE,SW	75	35	31	38	35	35	29	33	34	34	35	36	33	406
SE,SW	90	29	25	30	26	25	21	23	25	26	28	30	28	317
E,W	15	29	32	47	53	61	55	60	55	46	39	32	26	536
E,W	30	28	30	44	50	57	52	57	52	43	37	30	25	505
E,W	45	26	28	40	45	52	47	51	47	40	34	28	23	460
E,W	60	23	25	35	39	45	40	44	41	35	30	25	21	403
E,W	75	20	21	30	33	37	33	36	34	29	25	21	18	338
E,W	90	16	17	24	26	29	26	28	27	23	20	17	15	267
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	1	1	1	1	1	1	1	1	0	0	7
ANY	45	1	1	1	2	2	2	2	2	1	1	1	1	16
ANY	60	1	2	2	3	3	3	3	3	2	2	2	1	27
ANY	75	2	2	4	4	5	4	5	4	3	3	2	2	41
ANY	90	3	3	5	5	6	6	6	6	5	4	3	3	55

Possible Error in the Total Radiation on a Tilted Surface
La Jolla



Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profiles
La Jolla

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.39	1.27	1.15	1.05	.99	.96	.97	1.02	1.11	1.22	1.35	1.43
SOUTH	30	1.69	1.45	1.23	1.03	.91	.85	.87	.97	1.14	1.35	1.61	1.77
SOUTH	45	1.88	1.53	1.22	.94	.77	.70	.73	.86	1.09	1.40	1.76	1.99
SOUTH	60	1.93	1.51	1.13	.79	.59	.50	.54	.69	.97	1.34	1.79	2.07
SOUTH	75	1.86	1.38	.96	.59	.38	.29	.32	.48	.78	1.20	1.69	2.01
SOUTH	90	1.66	1.17	.72	.35	.15	.08	.11	.25	.54	.97	1.49	1.81
SE,SW	15	1.27	1.18	1.10	1.03	.99	.96	.97	1.01	1.07	1.15	1.24	1.30
SE,SW	30	1.46	1.29	1.14	1.01	.92	.88	.90	.97	1.08	1.22	1.40	1.51
SE,SW	45	1.55	1.31	1.11	.93	.82	.76	.78	.87	1.03	1.22	1.46	1.62
SE,SW	60	1.54	1.26	1.01	.81	.68	.62	.64	.74	.92	1.15	1.44	1.62
SE,SW	75	1.43	1.12	.87	.65	.51	.45	.48	.58	.77	1.01	1.32	1.52
SE,SW	90	1.22	.93	.68	.47	.35	.29	.32	.41	.58	.81	1.12	1.32
E,W	15	.98	.98	.98	.97	.97	.97	.97	.97	.98	.98	.98	.98
E,W	30	.94	.93	.92	.91	.91	.90	.90	.91	.92	.92	.93	.94
E,W	45	.88	.86	.84	.82	.81	.81	.81	.82	.83	.85	.87	.88
E,W	60	.79	.76	.74	.72	.70	.69	.69	.71	.73	.75	.78	.80
E,W	75	.68	.65	.62	.59	.57	.56	.57	.59	.61	.64	.67	.69
E,W	90	.56	.53	.50	.46	.44	.43	.44	.46	.48	.51	.55	.57
NORMAL INCIDENCE		2.36	1.99	1.72	1.55	1.48	1.46	1.47	1.52	1.64	1.87	2.23	2.48



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

(K) SOLAR DATA FOR SAN VICENTE RESERVOIR

Nearby Climate Station - San Diego

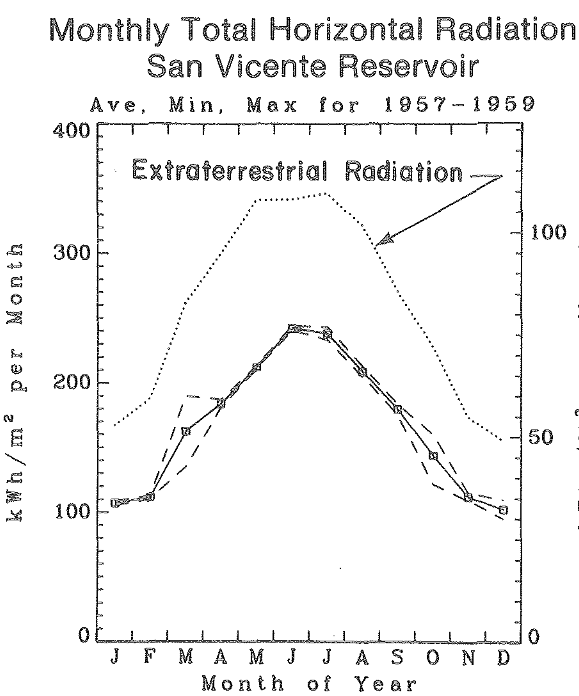
Monthly Solar Data, San Vicente Reservoir

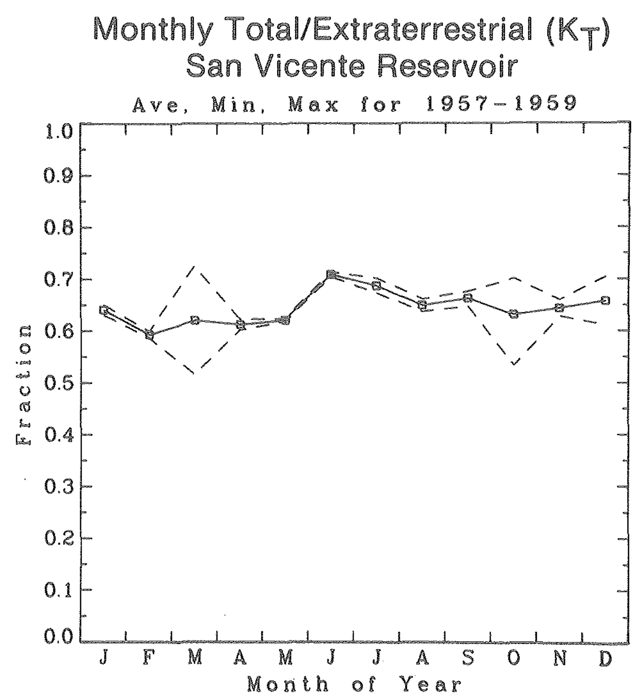
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Latitude: 32.92° Longitude: 116.92° Elevation: 660'													
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	107	112	162	184	212	242	238	209	180	144	112	102	2004
direct beam (normal incidence)	187	156	202	204	227	280	271	235	222	196	185	190	2557
SOLAR RADIATION (KBtu/ft^2 per month)													
horizontal surface	34	35	51	58	67	77	75	66	57	46	35	32	633
direct beam (normal incidence)	59	50	64	65	72	89	86	75	70	62	59	60	810
PERCENT OF POSSIBLE SUNSHINE*	71	72	70	65	58	56	68	69	68	67	73	71	67
MEAN CLOUD COVER (in tenths)*	5	5	5	5	6	6	5	4	4	4	4	5	5
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.64	.59	.62	.61	.62	.71	.69	.65	.66	.63	.64	.66	.64

*Data for San Diego 32° 44' N 117° 10' W. Elevation 13'

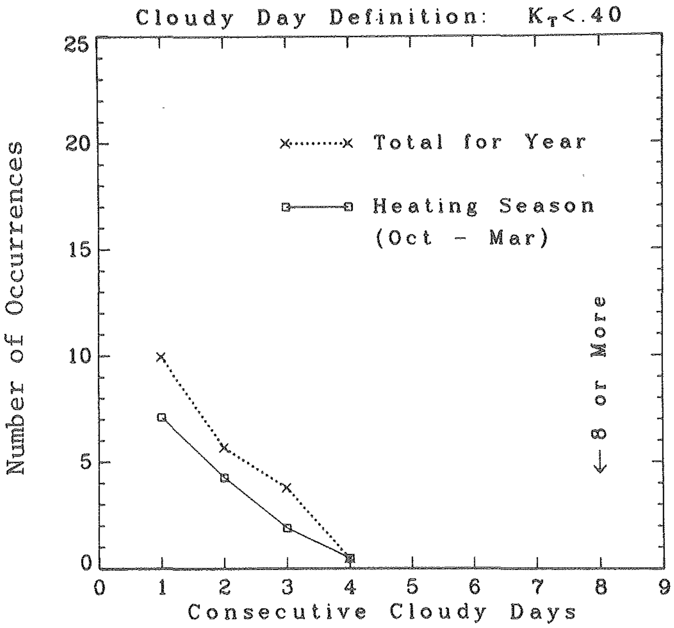
Recording interval: 1957-1959

Source of solar data: USGS, Eppley lightbulb pyranometer.

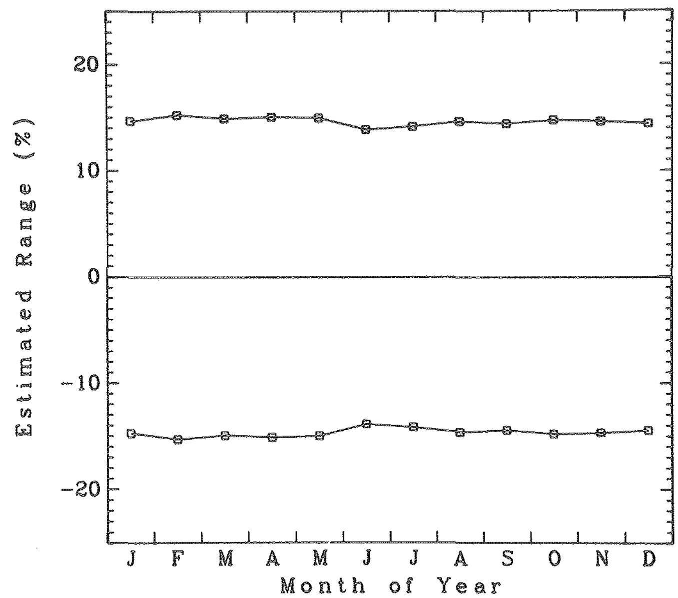




Occurrences of Cloudy Days
San Vicente Reservoir

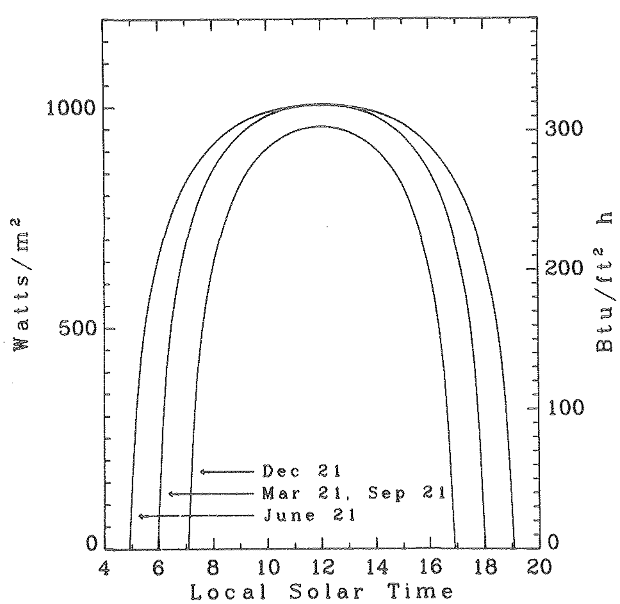


Possible Error in Direct Beam
(Normal Incidence)
San Vicente Reservoir

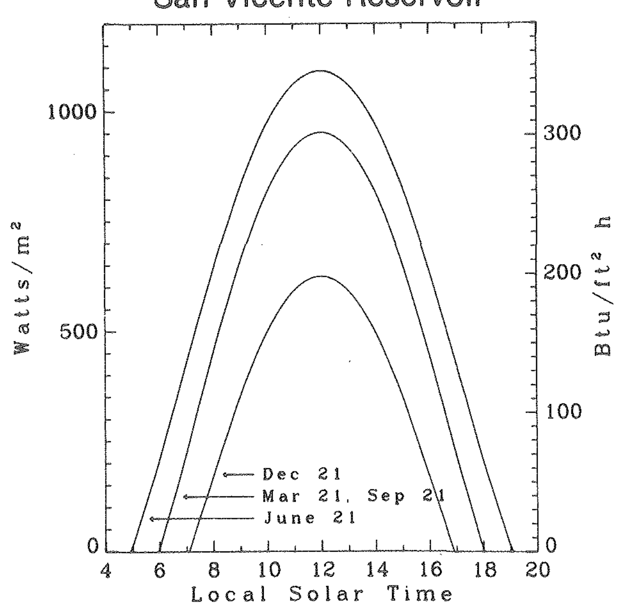


Clear Day Plots for Solar Radiation

Direct Beam (Normal Incidence)
San Vicente Reservoir



Total Radiation on a
Horizontal Surface
San Vicente Reservoir



Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m²)
San Vicente Reservoir

DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	138	132	180	190	209	233	231	211	194	166	141	135	2160
SOUTH	30	160	145	186	185	194	211	212	201	196	179	161	160	2189
SOUTH	45	173	149	182	169	169	177	180	180	186	180	171	174	2089
SOUTH	60	174	144	166	144	135	135	140	148	165	171	170	178	1869
SOUTH	75	165	130	141	111	95	88	94	109	134	151	159	170	1546
SOUTH	90	145	108	108	72	53	42	48	66	96	122	138	152	1150
SE, SW	15	128	125	174	187	209	234	232	209	189	159	131	125	2103
SE, SW	30	141	132	176	181	196	216	216	200	188	165	143	140	2094
SE, SW	45	146	132	168	167	175	189	191	182	177	162	146	146	1982
SE, SW	60	143	124	153	146	148	156	159	156	158	150	141	144	1776
SE, SW	75	131	109	130	119	116	119	122	125	132	131	128	133	1494
SE, SW	90	111	89	102	89	83	82	85	91	101	105	107	114	1161
E, W	15	105	109	159	180	207	236	232	204	176	141	110	100	1959
E, W	30	100	104	150	169	194	220	217	191	166	133	105	96	1844
E, W	45	93	96	137	153	175	198	195	173	151	122	97	89	1678
E, W	60	84	85	121	133	151	170	168	150	132	108	87	80	1470
E, W	75	72	72	102	111	125	139	139	125	111	92	74	69	1230
E, W	90	58	58	81	87	97	108	107	98	88	73	60	56	972

GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)

SURFACE ORIENT-ATION	ANGLE OF TILT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ANY	15	0	0	1	1	1	1	1	1	1	0	0	0	7
ANY	30	1	1	2	2	3	3	3	3	2	2	2	1	27
ANY	45	3	3	5	5	6	7	7	6	5	4	3	3	59
ANY	60	5	6	8	9	11	12	12	10	9	7	6	5	100
ANY	75	8	8	12	14	16	18	18	15	13	11	8	8	149
ANY	90	11	11	16	18	21	24	24	21	18	14	11	10	200

Total Radiation on a Tilted Surface (Calculated Values)
Engineering Units (kBtu/ft²)
San Vicente Reservoir

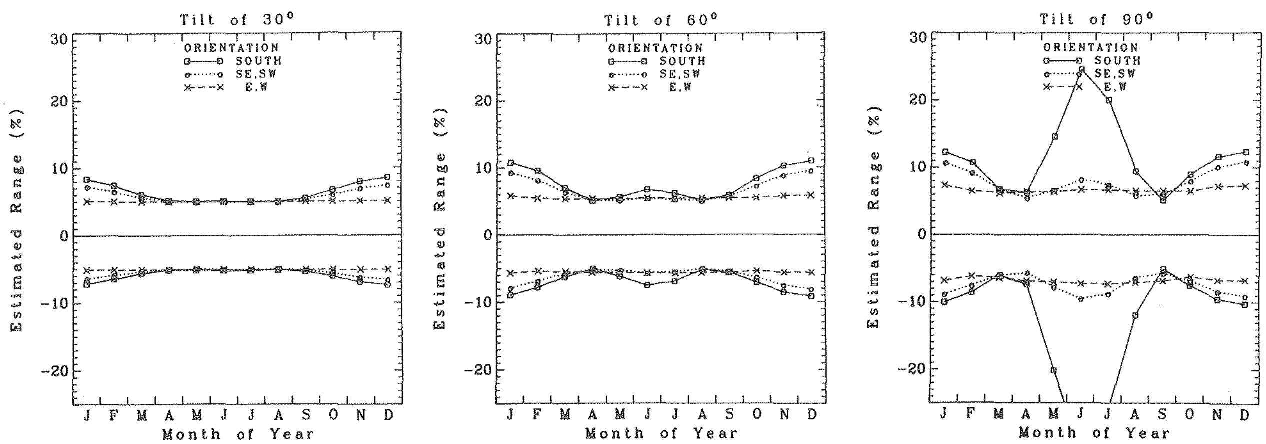
DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	44	42	57	60	66	74	73	67	61	53	45	43	684
SOUTH	30	51	46	59	59	62	67	67	64	62	57	51	51	693
SOUTH	45	55	47	58	54	54	56	57	57	59	57	54	55	662
SOUTH	60	55	45	53	46	43	43	44	47	52	54	54	56	592
SOUTH	75	52	41	45	35	30	28	30	35	43	48	50	54	490
SOUTH	90	46	34	34	23	17	13	15	21	30	39	44	48	364
SE, SW	15	41	40	55	59	66	74	74	66	60	50	42	39	666
SE, SW	30	45	42	56	57	62	69	68	63	59	52	45	44	663
SE, SW	45	46	42	53	53	56	60	60	58	56	51	46	46	628
SE, SW	60	45	39	48	46	47	49	50	49	50	48	45	46	563
SE, SW	75	41	35	41	38	37	38	39	40	42	41	40	42	473
SE, SW	90	35	28	32	28	26	26	27	29	32	33	34	36	368
E, W	15	33	35	50	57	66	75	74	65	56	45	35	32	621
E, W	30	32	33	48	53	61	70	69	61	52	42	33	30	584
E, W	45	30	30	43	48	55	63	62	55	48	39	31	28	532
E, W	60	27	27	38	42	48	54	53	48	42	34	27	25	466
E, W	75	23	23	32	35	40	44	44	40	35	29	24	22	390
E, W	90	19	18	26	28	31	34	34	31	28	23	19	18	308

GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)

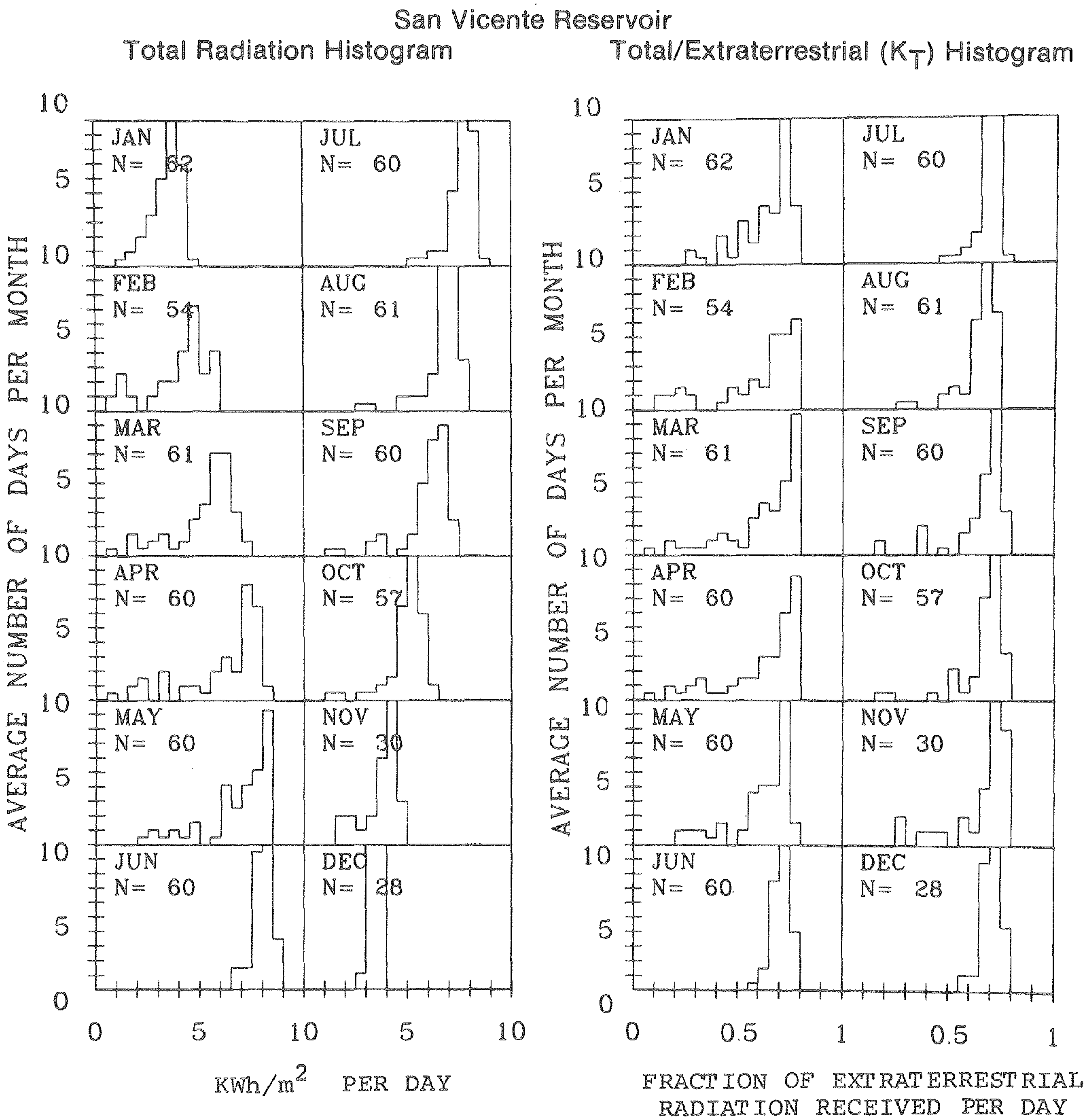
SURFACE ORIENT-ATION	ANGLE OF TILT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	1	1	1	1	1	1	1	1	0	0	9
ANY	45	1	1	2	2	2	2	2	2	2	1	1	1	19
ANY	60	2	2	3	3	3	4	4	3	3	2	2	2	32
ANY	75	3	3	4	4	5	6	6	5	4	3	3	2	47
ANY	90	3	4	5	6	7	8	8	7	6	5	4	3	64

Possible Error in the Total Radiation on a Tilted Surface
San Vicente Reservoir



Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profiles
San Vicente Reservoir

SURFACE ORIENT- ATION	ANGLE OF TILT (DEGREES FROM HOR- IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.40	1.27	1.15	1.05	.99	.96	.97	1.02	1.11	1.22	1.35	1.44
SOUTH	30	1.70	1.45	1.23	1.03	.91	.85	.88	.97	1.14	1.35	1.61	1.77
SOUTH	45	1.88	1.53	1.22	.95	.77	.70	.73	.86	1.09	1.40	1.76	1.99
SOUTH	60	1.94	1.51	1.13	.79	.59	.51	.54	.69	.97	1.35	1.79	2.07
SOUTH	75	1.86	1.39	.96	.59	.38	.29	.33	.48	.78	1.20	1.70	2.01
SOUTH	90	1.66	1.17	.72	.35	.16	.09	.11	.25	.54	.98	1.49	1.82
SE,SW	15	1.27	1.18	1.10	1.03	.99	.96	.97	1.01	1.07	1.15	1.24	1.30
SE,SW	30	1.46	1.29	1.14	1.01	.92	.88	.90	.97	1.08	1.22	1.40	1.51
SE,SW	45	1.55	1.31	1.11	.93	.82	.76	.78	.88	1.03	1.22	1.47	1.62
SE,SW	60	1.54	1.26	1.01	.81	.68	.62	.64	.74	.92	1.15	1.44	1.63
SE,SW	75	1.43	1.13	.87	.65	.52	.45	.48	.59	.77	1.01	1.32	1.52
SE,SW	90	1.23	.93	.68	.47	.35	.29	.32	.41	.58	.82	1.12	1.32
E,W	15	.98	.98	.98	.97	.97	.97	.97	.97	.98	.98	.98	.98
E,W	30	.94	.93	.92	.91	.91	.90	.90	.91	.92	.92	.93	.94
E,W	45	.88	.86	.84	.82	.81	.81	.81	.82	.83	.85	.87	.88
E,W	60	.79	.76	.74	.72	.70	.69	.69	.71	.73	.75	.78	.80
E,W	75	.69	.65	.62	.59	.57	.56	.57	.59	.61	.64	.67	.69
E,W	90	.56	.53	.50	.46	.44	.43	.44	.46	.48	.51	.55	.57
NORMAL INCIDENCE		2.36	2.00	1.72	1.55	1.48	1.46	1.47	1.52	1.64	1.87	2.23	2.48



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

(L) SOLAR DATA FOR BARRETT RESERVOIR

Nearby Climate Station - San Diego

Monthly Solar Data, Barrett Reservoir

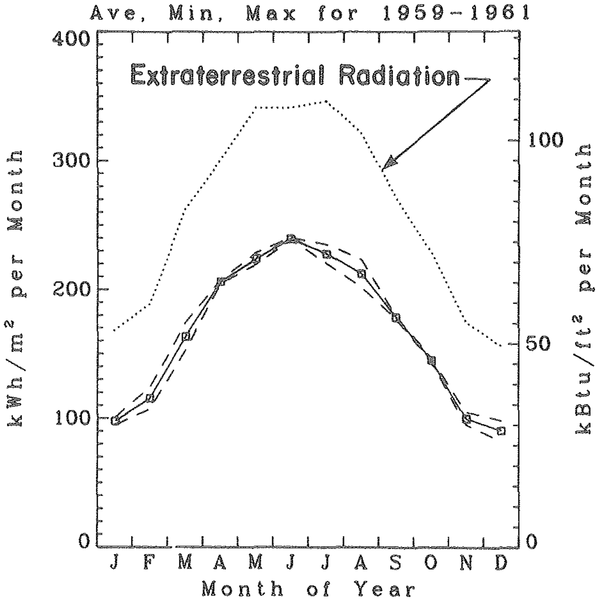
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Latitude: 32.68° Longitude: 116.67° Elevation: 1623'													
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	98	116	163	206	224	239	228	212	178	145	100	91	2000
direct beam (normal incidence)	159	164	203	247	249	275	251	241	218	198	151	154	2510
SOLAR RADIATION ($KBtu/ft^2$ per month)													
horizontal surface	31	37	52	65	71	76	72	67	56	46	32	29	634
direct beam (normal incidence)	50	52	64	78	79	87	80	76	69	63	48	49	795
PERCENT OF POSSIBLE SUNSHINE*	71	72	70	65	58	56	68	69	68	67	73	71	67
MEAN CLOUD COVER (in tenths)*	5	5	5	5	6	6	5	4	4	4	4	5	5
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.58	.61	.62	.69	.66	.70	.66	.66	.66	.63	.57	.58	.64

Recording interval: 1959-1961

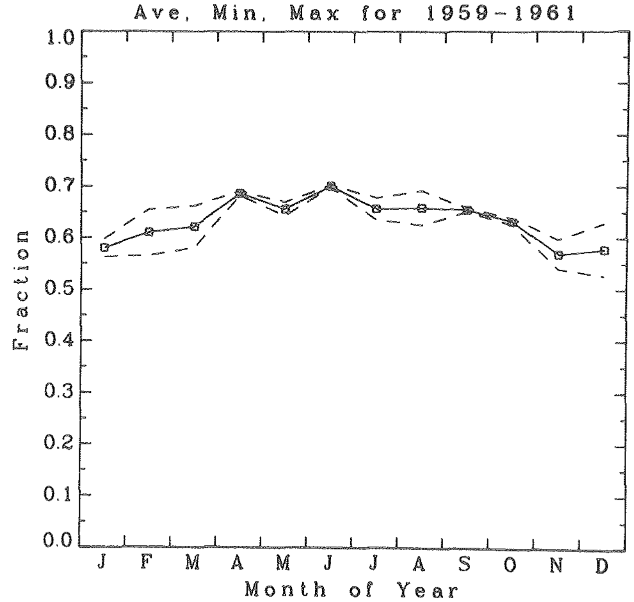
*Data for San Diego 32°44' N 117° 10' W, Elevation 13'

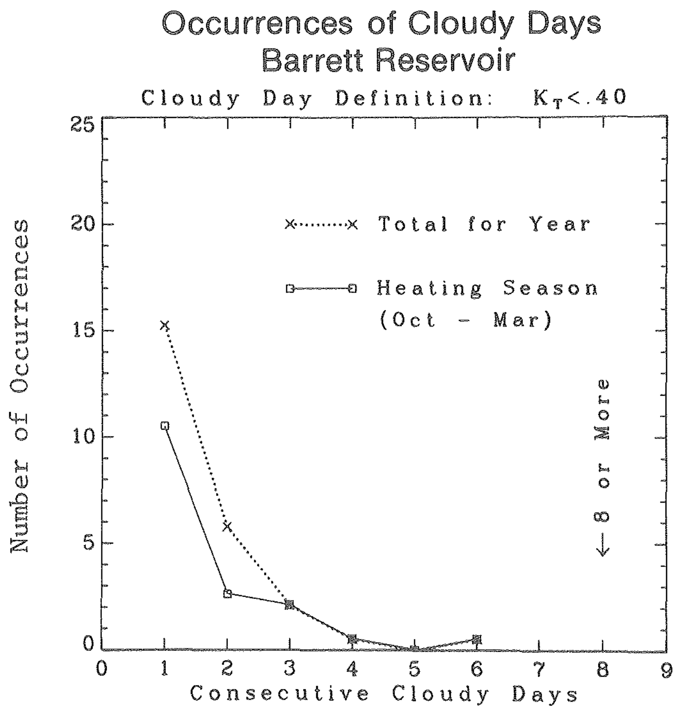
Source of solar data: USGS, Eppley lightbulb pyranometer.

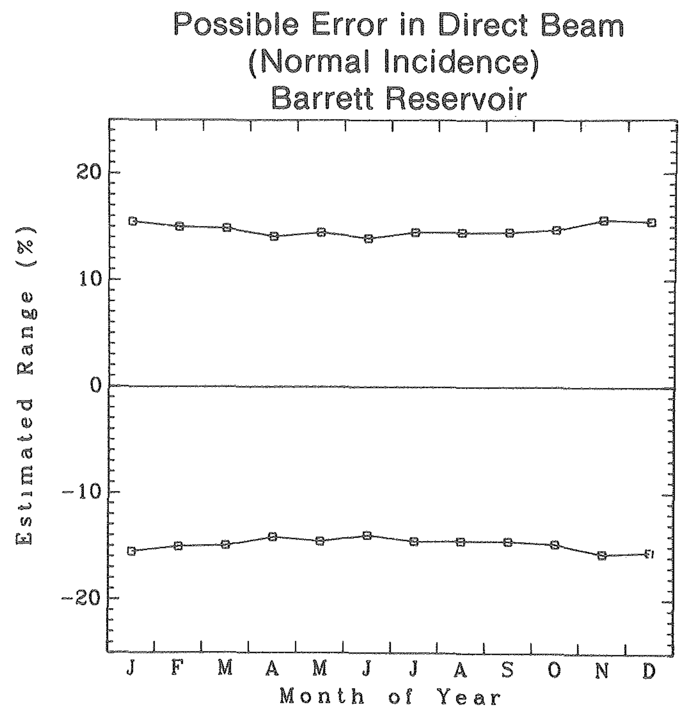
Monthly Total Horizontal Radiation
Barrett Reservoir
Ave, Min, Max for 1959-1961



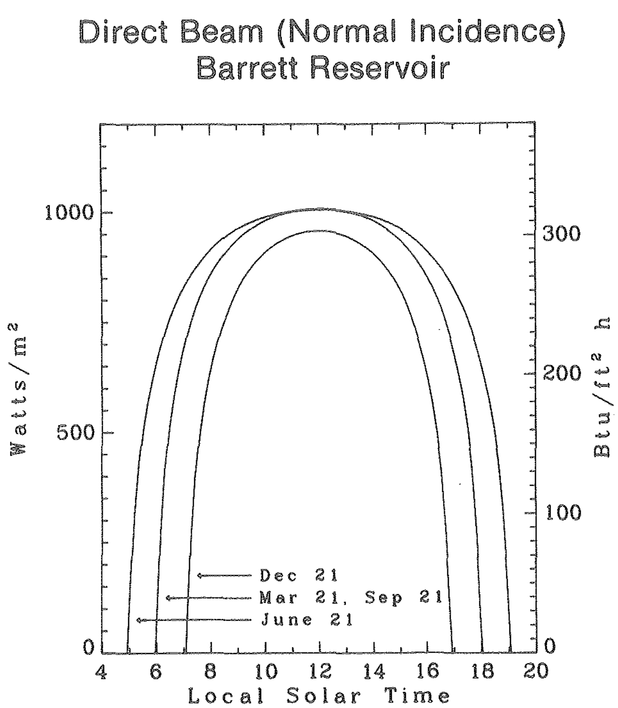
Monthly Total/Extraterrestrial (K_T)
Barrett Reservoir
Ave, Min, Max for 1959-1961

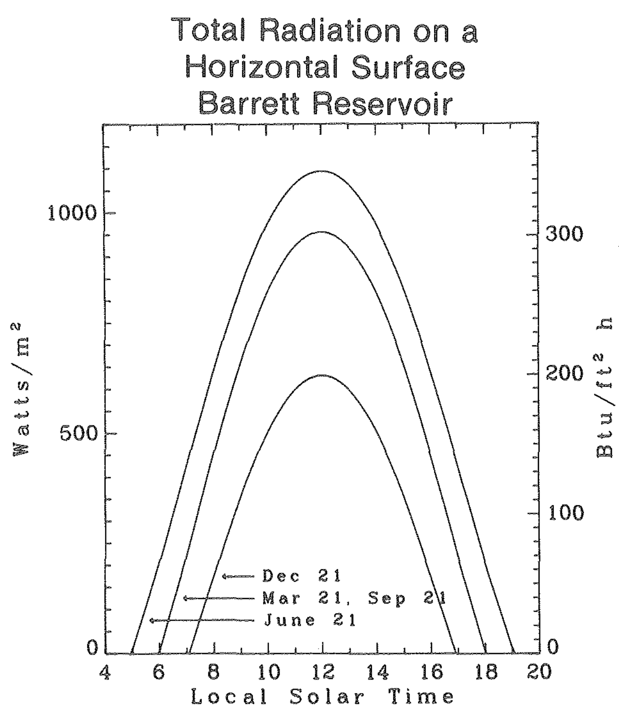






Clear Day Plots for Solar Radiation





Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m²)
Barrett Reservoir

DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

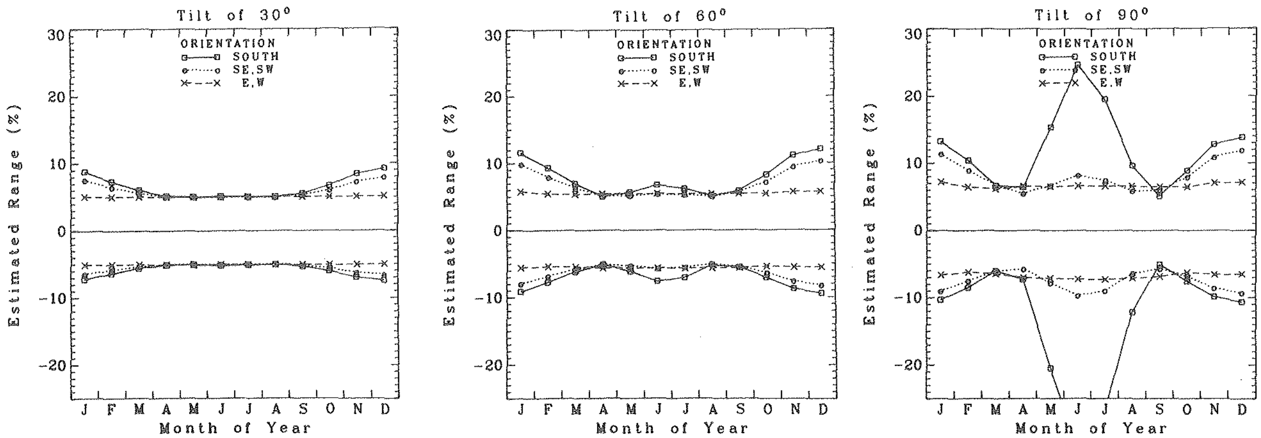
SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	124	137	180	214	221	230	221	215	192	167	123	117	2141
SOUTH	30	142	150	187	208	205	208	202	204	193	180	139	137	2156
SOUTH	45	152	154	182	190	178	175	173	182	183	181	146	148	2045
SOUTH	60	153	149	166	161	141	133	134	150	163	171	145	150	1816
SOUTH	75	144	135	141	123	98	87	91	110	132	151	135	143	1489
SOUTH	90	125	112	107	79	54	41	47	66	94	122	117	127	1092
SE, SW	15	115	130	174	210	221	232	222	213	187	160	115	109	2087
SE, SW	30	126	137	176	204	207	214	206	203	185	166	125	120	2070
SE, SW	45	130	136	169	188	185	187	182	184	175	162	127	125	1951
SE, SW	60	126	128	153	164	155	154	152	158	156	151	121	122	1741
SE, SW	75	115	113	130	133	122	117	117	126	130	131	109	112	1457
SE, SW	90	97	93	102	99	67	81	82	92	100	105	92	96	1126
E, W	15	96	113	160	201	219	233	222	207	174	142	98	89	1954
E, W	30	92	107	151	189	205	218	208	194	164	134	93	85	1839
E, W	45	85	99	138	171	184	195	187	176	149	123	86	79	1672
E, W	60	76	88	121	149	160	168	161	153	131	109	77	71	1463
E, W	75	65	75	102	124	132	138	133	127	110	92	66	61	1223
E, W	90	53	60	81	97	102	107	103	99	87	74	53	49	965
GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)														
ANY	15	0	0	1	1	1	1	1	1	1	0	0	0	7
ANY	30	1	2	2	3	3	3	3	3	2	2	1	1	27
ANY	45	3	3	5	6	7	7	7	6	5	4	3	3	59
ANY	60	5	6	8	10	11	12	11	11	9	7	5	5	100
ANY	75	7	9	12	15	17	18	17	16	13	11	7	7	148
ANY	90	10	12	16	21	22	24	23	21	18	14	10	9	200

Total Radiation on a Tilted Surface (Calculated Values)
Engineering Units (kBtu/ft²)
Barrett Reservoir

DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

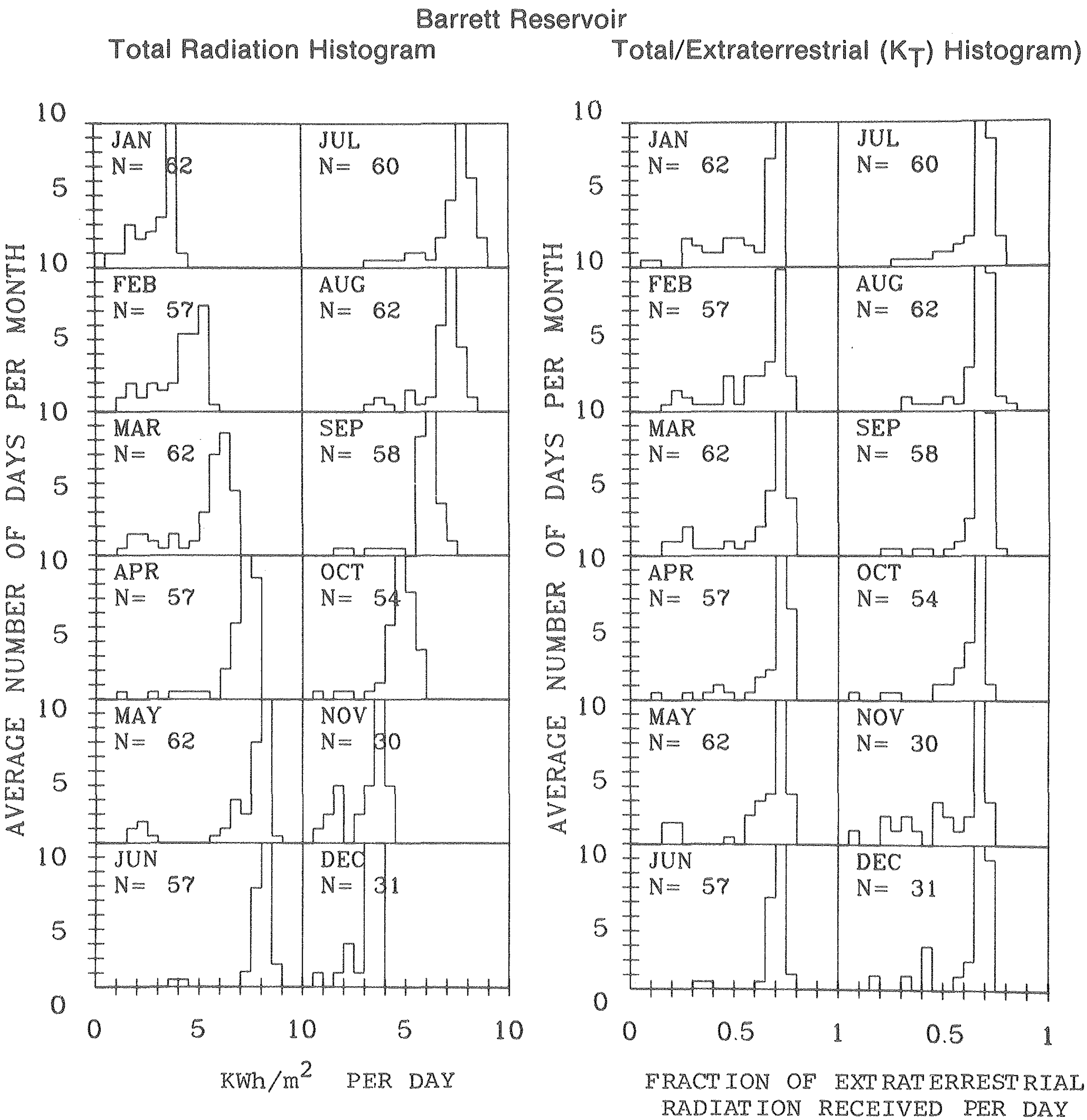
SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	39	43	57	68	70	73	70	68	61	53	39	37	678
SOUTH	30	45	48	59	66	65	66	64	65	61	57	44	43	683
SOUTH	45	48	49	58	60	56	55	55	58	58	57	46	47	648
SOUTH	60	48	47	53	51	45	42	43	47	52	54	46	47	575
SOUTH	75	46	43	45	39	31	27	29	35	42	48	43	45	472
SOUTH	90	40	36	34	25	17	13	15	21	30	39	37	40	346
SE, SW	15	37	41	55	67	70	73	70	67	59	51	37	34	661
SE, SW	30	40	43	56	65	66	68	65	64	59	52	39	38	656
SE, SW	45	41	43	54	60	59	59	58	58	55	51	40	40	618
SE, SW	60	40	41	49	52	49	49	48	50	49	48	38	39	551
SE, SW	75	36	36	41	42	39	37	37	40	41	42	35	36	461
SE, SW	90	31	29	32	31	27	26	26	29	32	33	29	30	357
E, W	15	30	36	51	64	69	74	70	66	55	45	31	28	619
E, W	30	29	34	48	60	65	69	66	62	52	42	30	27	583
E, W	45	27	31	44	54	58	62	59	56	47	39	27	25	530
E, W	60	24	28	38	47	51	53	51	48	41	34	24	22	464
E, W	75	21	24	32	39	42	44	42	40	35	29	21	19	387
E, W	90	17	19	26	31	32	34	33	31	27	23	17	16	306
GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)														
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	1	1	1	1	1	1	1	1	0	0	8
ANY	45	1	1	2	2	2	2	2	2	2	1	1	1	19
ANY	60	2	2	3	3	4	4	4	3	3	2	2	1	32
ANY	75	2	3	4	5	5	6	5	5	4	3	2	2	47
ANY	90	3	4	5	7	7	8	7	7	6	5	3	3	63

Possible Error in the Total Radiation on a Tilted Surface
Barrett Reservoir



Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profiles
Barrett Reservoir

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.39	1.27	1.15	1.05	.99	.96	.97	1.02	1.11	1.22	1.35	1.43
SOUTH	30	1.69	1.45	1.23	1.03	.91	.85	.87	.97	1.14	1.35	1.60	1.77
SOUTH	45	1.87	1.53	1.21	.94	.77	.70	.73	.86	1.09	1.39	1.75	1.98
SOUTH	60	1.93	1.50	1.12	.79	.59	.50	.54	.69	.97	1.34	1.78	2.06
SOUTH	75	1.85	1.38	.95	.59	.37	.29	.32	.48	.78	1.20	1.69	2.00
SOUTH	90	1.65	1.16	.72	.35	.15	.08	.11	.25	.54	.97	1.48	1.80
SE,SW	15	1.27	1.18	1.10	1.03	.98	.96	.97	1.01	1.07	1.14	1.24	1.30
SE,SW	30	1.45	1.29	1.14	1.01	.92	.88	.90	.96	1.08	1.22	1.39	1.51
SE,SW	45	1.54	1.31	1.10	.93	.81	.76	.78	.87	1.02	1.22	1.46	1.61
SE,SW	60	1.53	1.25	1.01	.81	.67	.61	.64	.74	.92	1.15	1.43	1.62
SE,SW	75	1.42	1.12	.86	.65	.51	.45	.48	.58	.76	1.00	1.31	1.51
SE,SW	90	1.22	.92	.67	.47	.35	.29	.31	.41	.58	.81	1.11	1.31
E,W	15	.98	.98	.98	.97	.97	.97	.97	.97	.98	.98	.98	.98
E,W	30	.94	.93	.92	.91	.91	.90	.90	.91	.92	.92	.93	.94
E,W	45	.87	.86	.84	.82	.81	.81	.81	.82	.83	.85	.87	.88
E,W	60	.79	.76	.74	.71	.70	.69	.69	.71	.73	.75	.78	.79
E,W	75	.68	.65	.62	.59	.57	.56	.57	.58	.61	.64	.67	.69
E,W	90	.56	.52	.49	.46	.44	.43	.44	.45	.48	.51	.55	.57
NORMAL INCIDENCE		2.35	1.99	1.72	1.55	1.48	1.46	1.47	1.51	1.64	1.87	2.22	2.47



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

(M) SOLAR DATA FOR MEDFORD, OREGON

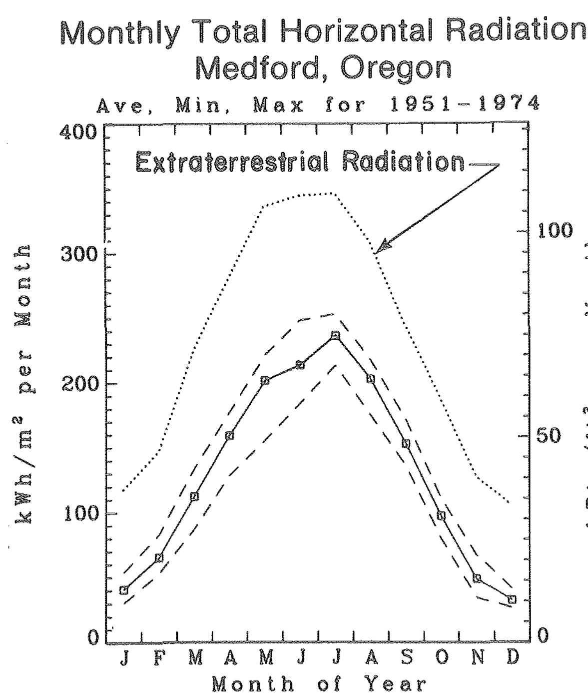
Nearby Climate Station - Medford

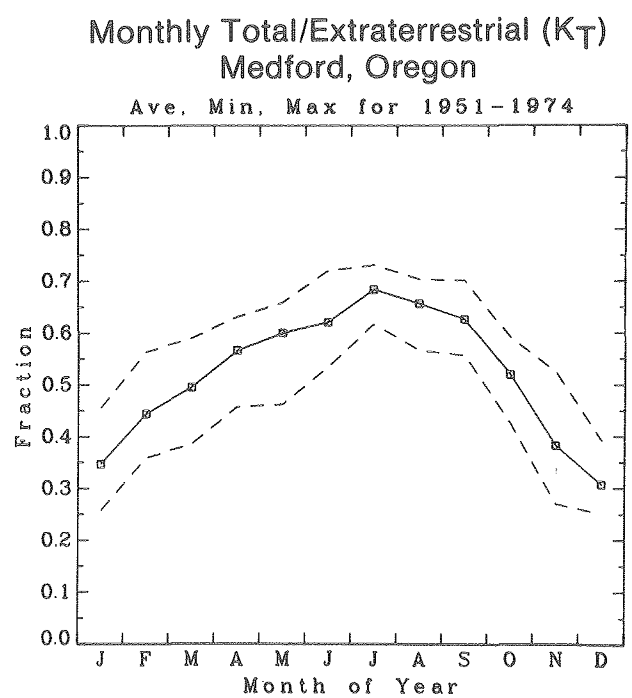
Monthly Solar Data, Medford, Oregon

	Latitude: 42.37°			Longitude: 122.87°			Elevation: 1321'						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	41	66	112	159	202	214	237	203	153	97	49	32	1565
direct beam (normal incidence)	59	92	138	183	224	237	282	247	203	138	71	44	1920
SOLAR RADIATION (KBtu/ft^2 per month)													
horizontal surface	13	21	36	50	64	68	75	64	49	31	16	10	496
direct beam (normal incidence)	19	29	44	58	71	75	89	78	64	44	22	14	608
PERCENT OF POSSIBLE SUNSHINE													
MEAN CLOUD COVER (in tenths)	8	8	7	7	6	5	2	2	3	6	8	9	6
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.35	.44	.49	.57	.60	.62	.68	.66	.63	.52	.38	.31	.52

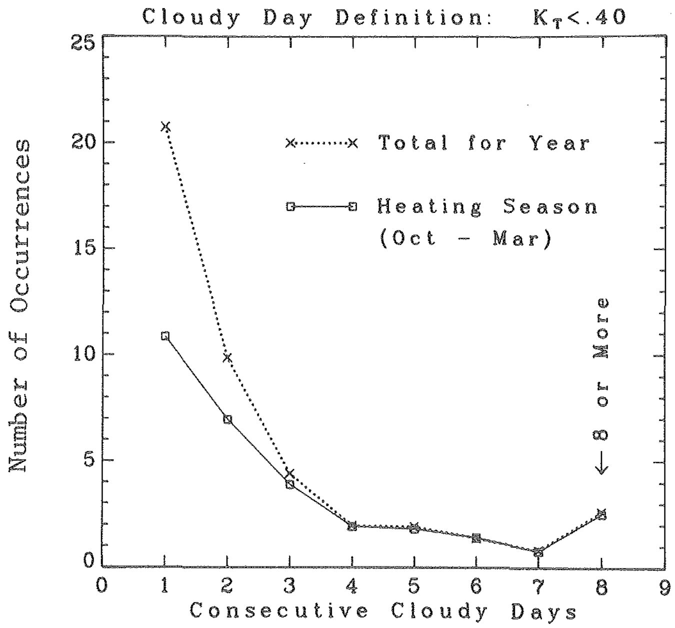
Recording interval: 1951-1974

Source of solar data: NWS, Eppley lightbulb pyranometer.

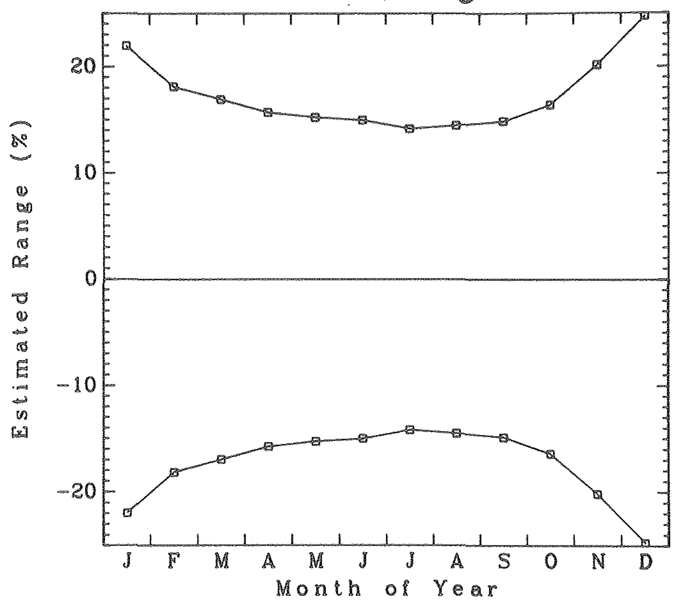




Occurrences of Cloudy Days
Medford, Oregon

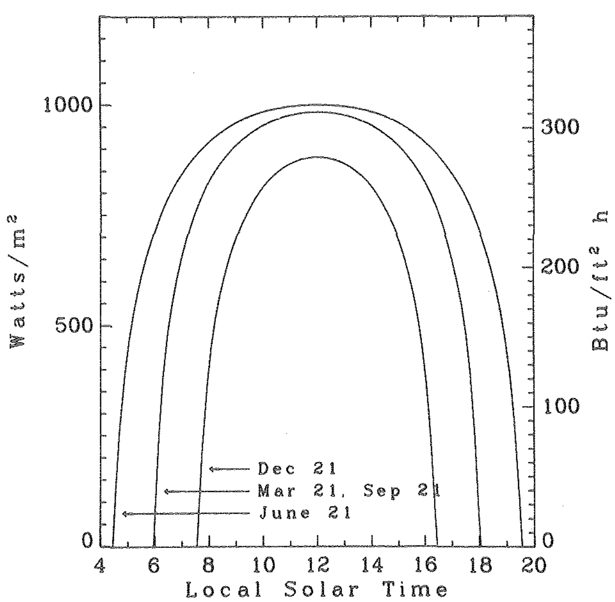


Possible Error in Direct Beam
(Normal Incidence)
Medford, Oregon

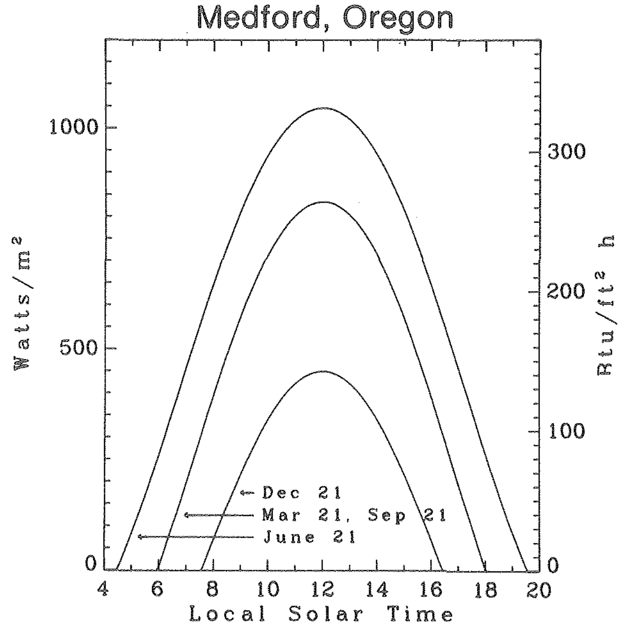


Clear Day Plots for Solar Radiation

Direct Beam (Normal Incidence)
Medford, Oregon



Total Radiation on a
Horizontal Surface
Medford, Oregon



Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m²)
Medford, Oregon

DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	52	80	128	169	204	212	237	212	171	117	62	41	1683
SOUTH	30	60	90	136	170	196	198	224	208	179	129	71	47	1707
SOUTH	45	65	94	136	160	176	174	198	193	176	134	76	51	1634
SOUTH	60	66	93	128	142	148	142	162	166	162	131	77	52	1470
SOUTH	75	63	87	113	116	112	103	119	131	139	120	73	50	1227
SOUTH	90	57	76	92	84	72	62	72	89	108	102	65	45	925
SE,SW	15	48	75	122	166	203	211	236	208	165	110	57	38	1641
SE,SW	30	53	81	126	164	195	200	224	204	168	117	63	42	1639
SE,SW	45	55	82	124	155	179	180	204	190	163	118	65	44	1560
SE,SW	60	55	79	115	139	155	153	174	168	150	113	64	43	1409
SE,SW	75	51	72	101	117	126	122	139	139	130	101	59	40	1196
SE,SW	90	44	61	82	91	93	88	101	105	104	85	51	35	941
E,W	15	40	64	110	156	197	209	231	198	150	96	48	32	1531
E,W	30	39	62	105	147	185	196	217	187	142	91	46	31	1449
E,W	45	37	58	97	135	169	177	197	171	131	85	43	29	1330
E,W	60	33	52	87	120	148	155	172	151	117	77	39	26	1177
E,W	75	29	45	75	101	124	129	143	127	100	66	34	23	997
E,W	90	24	37	61	81	98	101	113	101	81	54	28	19	798

GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)

SURFACE ORIENT-ATION	ANGLE OF TILT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ANY	15	0	0	0	1	1	1	1	1	1	0	0	0	5
ANY	30	1	1	2	2	3	3	3	3	2	1	1	0	21
ANY	45	1	2	3	5	6	6	7	6	4	3	1	1	46
ANY	60	2	3	6	8	10	11	12	10	8	5	2	2	78
ANY	75	3	5	8	12	15	16	18	15	11	7	4	2	116
ANY	90	4	7	11	16	20	21	24	20	15	10	5	3	157

Total Radiation on a Tilted Surface (Calculated Values)
Engineering Units (kBtu/ft²)
Medford, Oregon

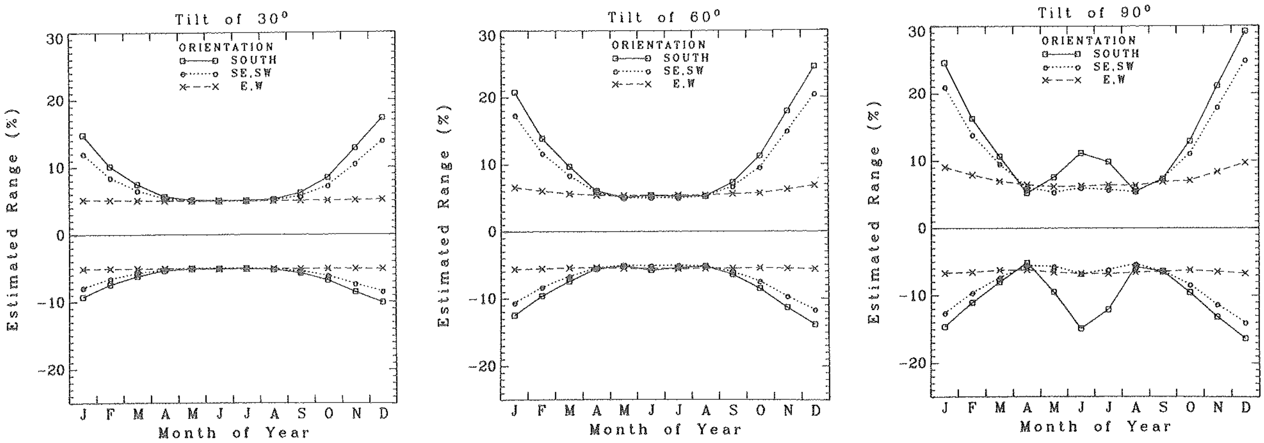
DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	16	25	40	54	65	67	75	67	54	37	19	13	533
SOUTH	30	19	28	43	54	62	63	71	66	57	41	22	15	541
SOUTH	45	21	30	43	51	56	55	63	61	56	42	24	16	518
SOUTH	60	21	30	41	45	47	45	51	53	51	41	24	16	466
SOUTH	75	20	28	36	37	36	33	38	41	44	38	23	16	389
SOUTH	90	18	24	29	27	23	20	23	28	34	32	21	14	293
SE,SW	15	15	24	39	52	64	67	75	66	52	35	18	12	520
SE,SW	30	17	26	40	52	62	63	71	65	53	37	20	13	519
SE,SW	45	18	26	39	49	57	57	64	60	52	37	21	14	494
SE,SW	60	17	25	37	44	49	49	55	53	48	36	20	14	446
SE,SW	75	16	23	32	37	40	39	44	44	41	32	19	13	379
SE,SW	90	14	19	26	29	30	28	32	33	33	27	16	11	298
E,W	15	13	20	35	49	62	66	73	63	47	30	15	10	485
E,W	30	12	20	33	47	59	62	69	59	45	29	15	10	459
E,W	45	12	18	31	43	53	56	62	54	42	27	14	9	421
E,W	60	11	17	28	38	47	49	54	48	37	24	13	8	373
E,W	75	9	14	24	32	39	41	45	40	32	21	11	7	316
E,W	90	8	12	19	26	31	32	36	32	26	17	9	6	253

GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)

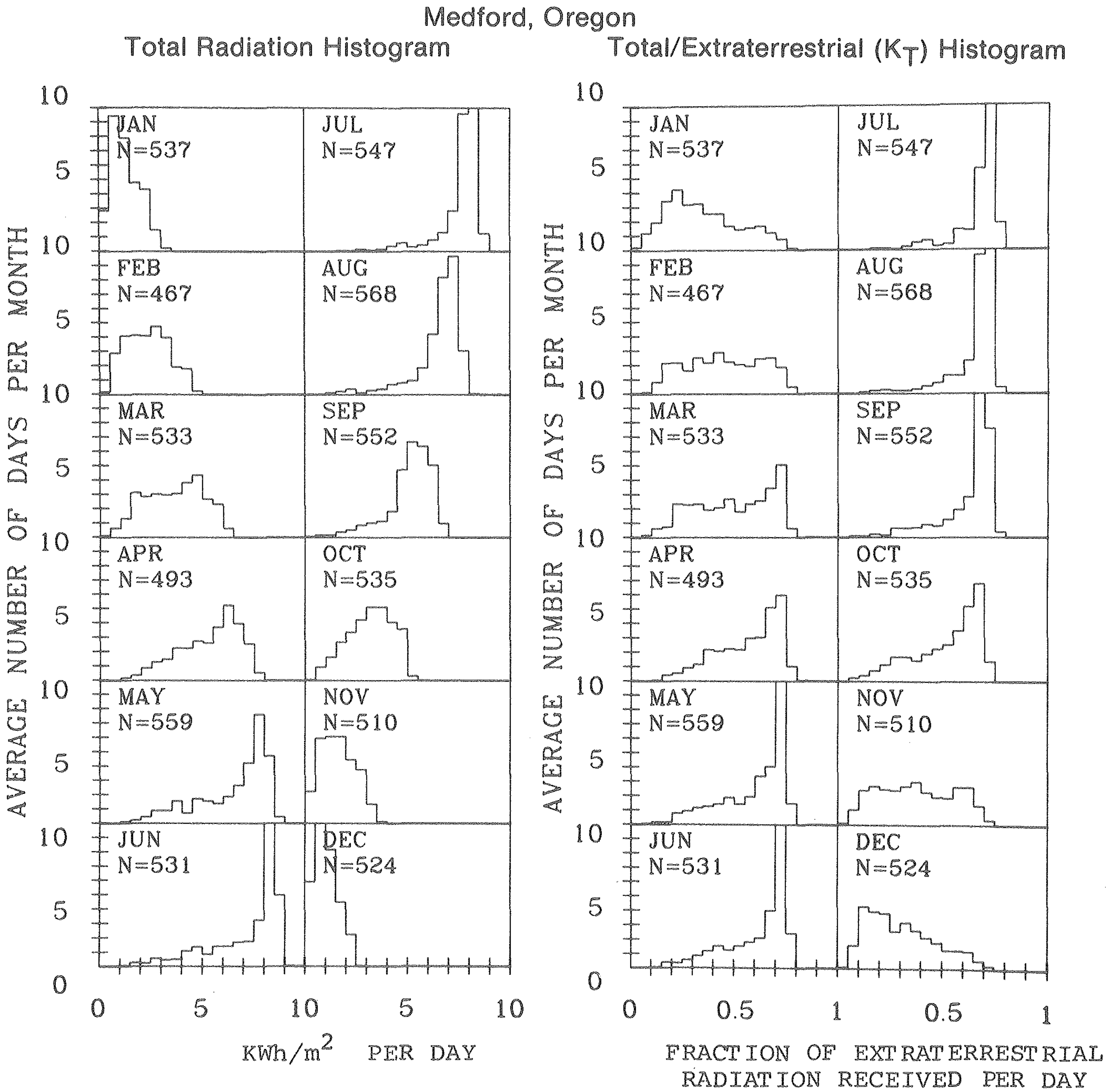
SURFACE ORIENT-ATION	ANGLE OF TILT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	0	1	1	1	1	1	1	0	0	0	7
ANY	45	0	1	1	1	2	2	2	2	1	1	0	0	15
ANY	60	1	1	2	3	3	3	4	3	2	2	1	1	25
ANY	75	1	2	3	4	5	5	6	5	4	2	1	1	37
ANY	90	1	2	4	5	6	7	8	6	5	3	2	1	50

Possible Error in the Total Radiation on a Tilted Surface
Medford, Oregon



Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profiles
Medford, Oregon

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.59	1.39	1.23	1.10	1.03	.99	1.00	1.06	1.17	1.32	1.51	1.66
SOUTH	30	2.07	1.68	1.37	1.13	.99	.92	.95	1.06	1.26	1.54	1.93	2.21
SOUTH	45	2.41	1.86	1.42	1.08	.88	.80	.83	.98	1.26	1.66	2.21	2.60
SOUTH	60	2.58	1.91	1.38	.96	.73	.63	.67	.84	1.18	1.67	2.34	2.82
SOUTH	75	2.58	1.83	1.24	.78	.53	.43	.46	.65	1.01	1.57	2.31	2.85
SOUTH	90	2.41	1.63	1.01	.54	.30	.21	.24	.42	.78	1.35	2.12	2.68
SE,SW	15	1.41	1.27	1.16	1.07	1.01	.99	1.00	1.04	1.11	1.22	1.35	1.46
SE,SW	30	1.72	1.45	1.24	1.08	.98	.93	.95	1.03	1.16	1.36	1.62	1.81
SE,SW	45	1.92	1.55	1.26	1.03	.90	.84	.86	.97	1.15	1.41	1.78	2.05
SE,SW	60	1.99	1.54	1.20	.93	.77	.70	.73	.85	1.07	1.38	1.82	2.15
SE,SW	75	1.93	1.44	1.07	.78	.62	.55	.57	.70	.93	1.27	1.74	2.10
SE,SW	90	1.74	1.24	.88	.60	.45	.38	.40	.53	.74	1.07	1.55	1.92
E,W	15	.99	.98	.98	.98	.97	.97	.97	.97	.98	.98	.98	.99
E,W	30	.97	.95	.94	.92	.91	.91	.91	.92	.93	.94	.96	.97
E,W	45	.94	.91	.87	.85	.83	.82	.82	.84	.86	.89	.92	.95
E,W	60	.88	.84	.79	.75	.73	.71	.72	.74	.77	.81	.86	.89
E,W	75	.79	.74	.69	.64	.61	.59	.60	.62	.66	.71	.77	.81
E,W	90	.67	.62	.56	.51	.48	.46	.47	.50	.54	.59	.65	.69
NORMAL INCIDENCE		3.06	2.42	1.97	1.69	1.57	1.53	1.55	1.63	1.83	2.20	2.82	3.30



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

(N) SOLAR DATA FOR DAVIS

Nearby Climate Stations - Fairfield, Sacramento

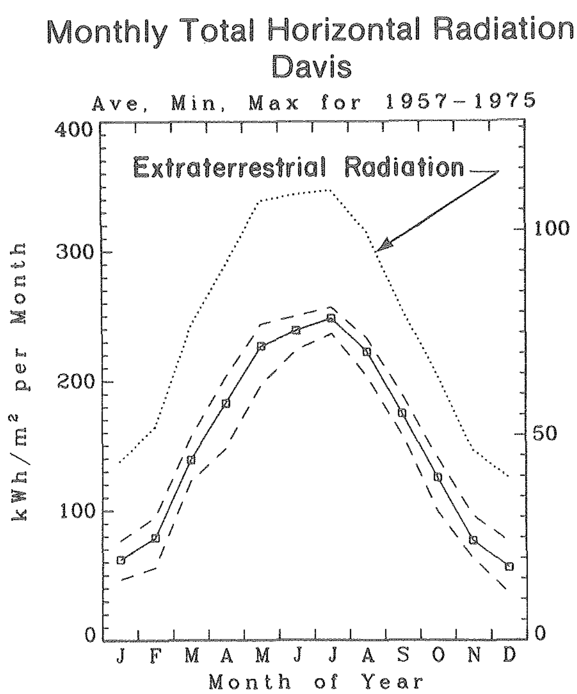
Monthly Solar Data, Davis

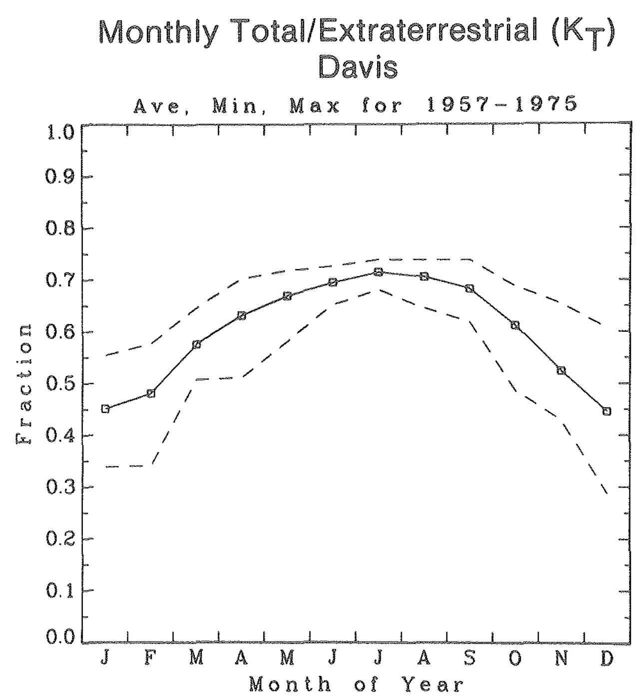
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Latitude: 38.53° Longitude: 121.75° Elevation: 50'													
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	62	79	139	183	227	239	248	222	175	125	77	56	1832
direct beam (normal incidence)	99	108	178	217	263	280	299	276	234	184	126	94	2358
SOLAR RADIATION (KBtu/ft^2 per month)													
horizontal surface	20	25	44	58	72	76	79	70	55	40	24	18	581
direct beam (normal incidence)	31	34	56	69	83	89	95	87	74	58	40	30	747
PERCENT OF POSSIBLE SUNSHINE*	45	61	70	80	86	95	97	96	94	84	64	46	79
MEAN CLOUD COVER (in tenths)*	7	6	6	5	4	2	1	1	2	3	6	7	4
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.45	.48	.58	.63	.67	.69	.71	.71	.68	.61	.52	.45	.60

Recording interval: 1952-1975

*Data for Sacramento 38°31'N 121°50'W, elevation 17'

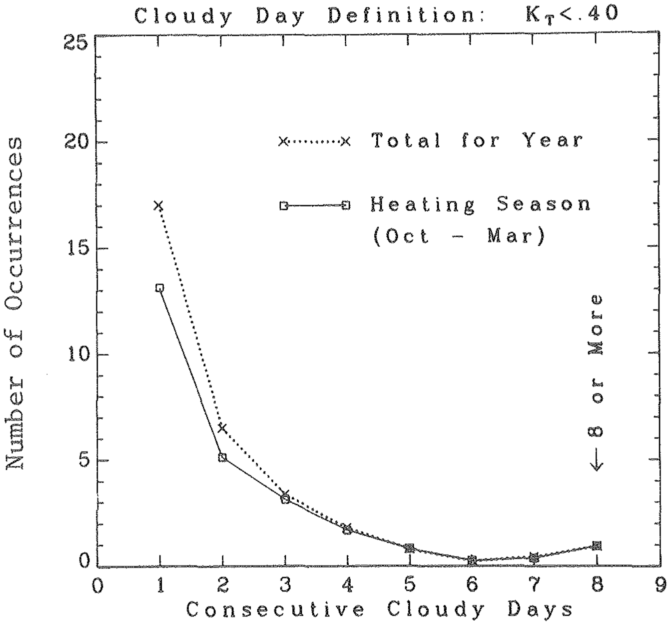
Source of solar data: NWS, Eppley lightbulb pyranometer.



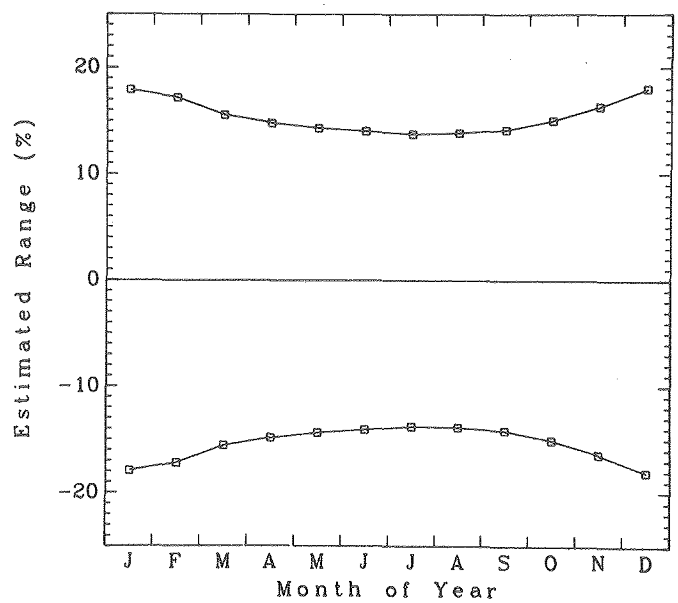


Occurrences of Cloudy Days
Davis

Cloudy Day Definition: K_T<.40

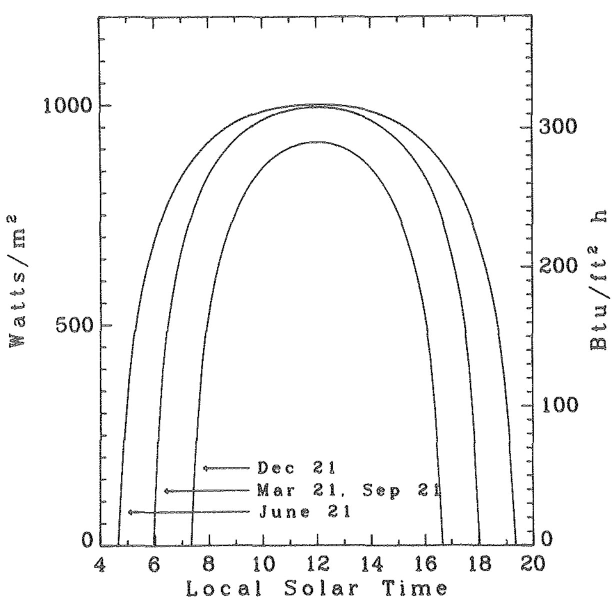


Possible Error in Direct Beam
(Normal Incidence)
Davis

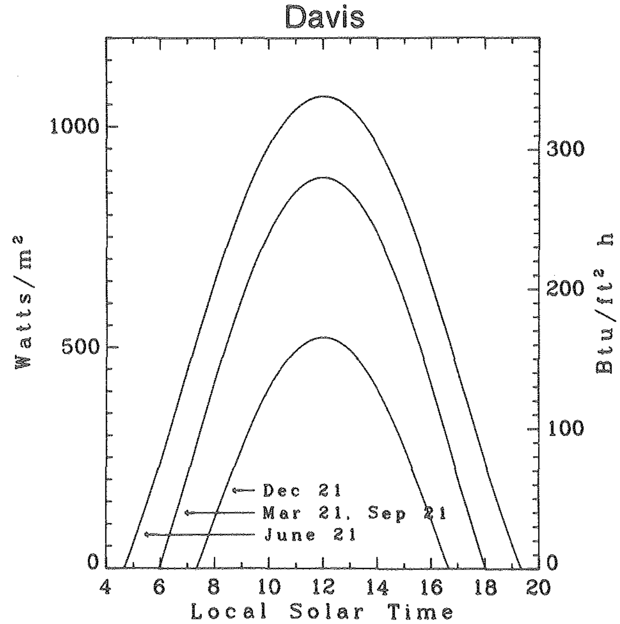


Clear Day Plots for Solar Radiation

Direct Beam (Normal Incidence)
Davis



Total Radiation on a
Horizontal Surface
Davis



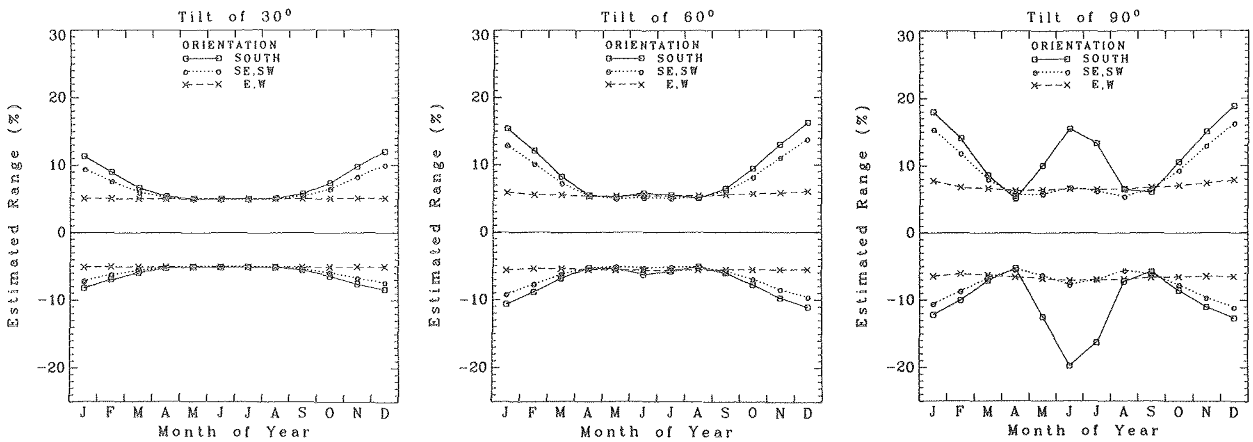
Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m^2)
Davis

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
		DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)												
SOUTH	15	80	95	157	193	228	234	246	230	193	149	98	74	1976
SOUTH	30	93	105	166	191	215	216	229	223	200	164	114	87	2003
SOUTH	45	101	109	165	179	191	186	199	204	194	169	123	95	1914
SOUTH	60	102	107	154	156	157	147	159	172	177	163	124	97	1716
SOUTH	75	98	98	134	124	114	102	112	131	148	148	118	94	1423
SOUTH	90	88	84	107	86	69	56	63	84	112	124	104	85	1061
SE,SW	15	74	90	151	189	226	234	245	226	187	141	91	68	1924
SE,SW	30	82	95	155	186	216	219	231	220	189	149	101	76	1920
SE,SW	45	86	96	151	174	195	195	207	203	182	149	104	80	1823
SE,SW	60	84	91	139	154	167	164	175	177	165	141	102	79	1640
SE,SW	75	78	82	121	128	133	128	137	144	141	126	94	74	1386
SE,SW	90	67	69	97	98	97	90	98	107	111	104	81	65	1082
E,W	15	61	78	136	179	221	233	242	217	171	123	75	55	1792
E,W	30	59	74	130	169	208	218	227	204	162	117	72	53	1691
E,W	45	55	69	119	154	188	197	205	185	148	108	68	50	1546
E,W	60	50	62	106	135	164	171	178	162	131	97	61	45	1362
E,W	75	43	53	90	114	136	141	147	135	111	83	53	39	1147
E,W	90	35	43	73	90	107	110	115	107	89	68	43	32	913
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	0	1	1	1	1	1	1	0	0	0	6
ANY	30	1	1	2	2	3	3	3	3	2	2	1	1	25
ANY	45	2	2	4	5	7	7	7	7	5	4	2	2	54
ANY	60	3	4	7	9	11	12	12	11	9	6	4	3	92
ANY	75	5	6	10	14	17	18	18	16	13	9	6	4	136
ANY	90	6	8	14	18	23	24	25	22	17	13	8	6	183

Total Radiation on a Tilted Surface (Calculated Values)
Engineering Units (kBtu/ft^2)
Davis

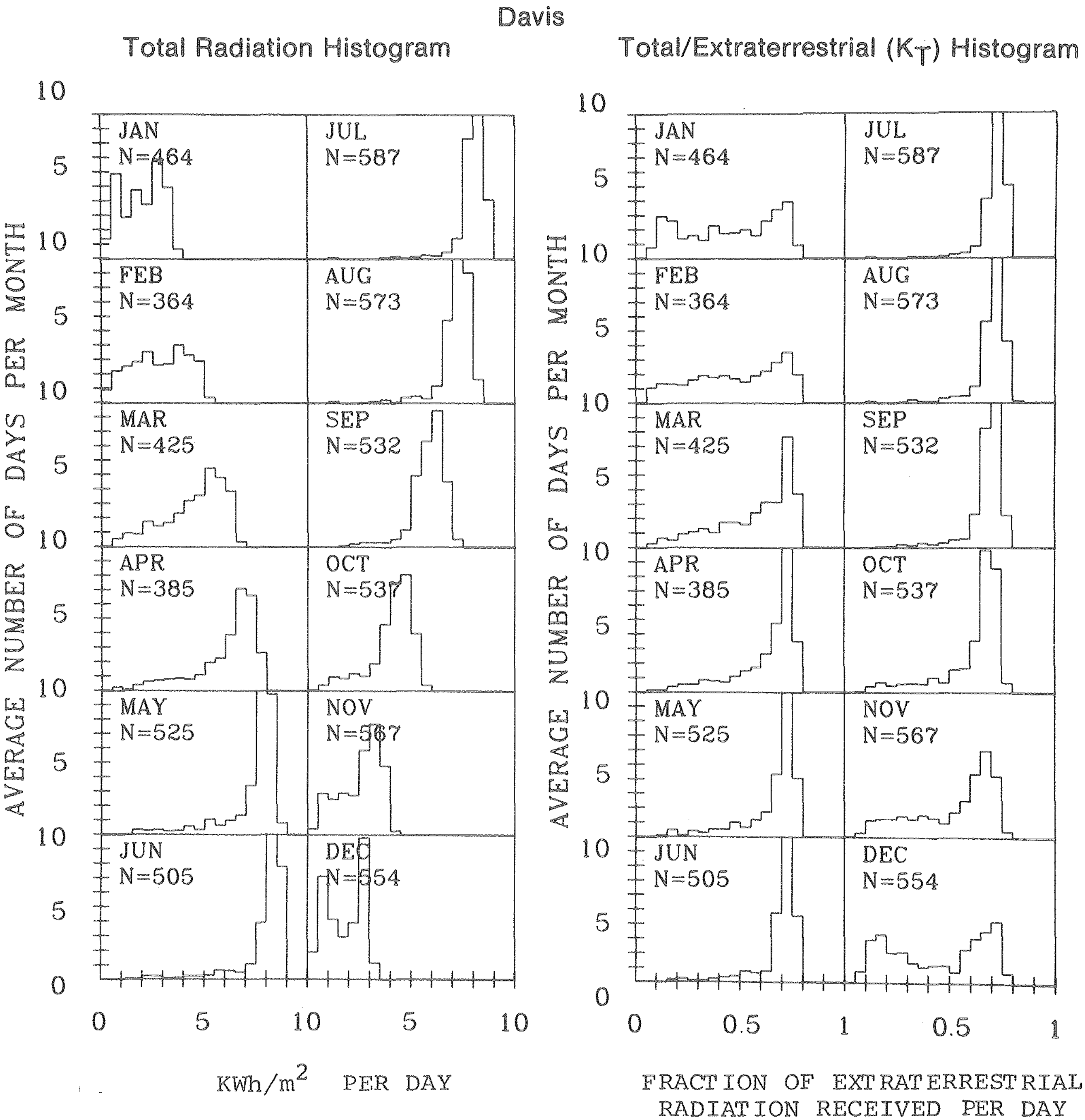
SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
		DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)												
SOUTH	15	25	30	50	61	72	74	78	73	61	47	31	23	626
SOUTH	30	30	33	53	61	68	68	72	71	63	52	36	28	635
SOUTH	45	32	35	52	57	61	59	63	64	61	53	39	30	606
SOUTH	60	32	34	49	49	50	47	51	55	56	52	39	31	544
SOUTH	75	31	31	42	39	36	32	36	42	47	47	37	30	451
SOUTH	90	28	27	34	27	22	18	20	27	35	39	33	27	336
SE,SW	15	24	28	48	60	72	74	78	72	59	45	29	22	609
SE,SW	30	26	30	49	59	68	70	73	70	60	47	32	24	608
SE,SW	45	27	30	48	55	62	62	66	64	58	47	33	25	578
SE,SW	60	27	29	44	49	53	52	55	56	52	45	32	25	520
SE,SW	75	25	26	38	41	42	41	44	46	45	40	30	23	439
SE,SW	90	21	22	31	31	31	29	31	34	35	33	26	20	343
E,W	15	19	25	43	57	70	74	77	69	54	39	24	17	568
E,W	30	19	24	41	53	66	69	72	65	51	37	23	17	536
E,W	45	17	22	38	49	60	62	65	59	47	34	21	16	490
E,W	60	16	20	34	43	52	54	56	51	42	31	19	14	432
E,W	75	14	17	29	36	43	45	47	43	35	26	17	12	364
E,W	90	11	14	23	29	34	35	36	34	28	21	14	10	289
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	1	1	1	1	1	1	1	1	0	0	8
ANY	45	1	1	1	2	2	2	2	2	2	1	1	1	17
ANY	60	1	1	2	3	4	4	4	4	3	2	1	1	29
ANY	75	1	2	3	4	5	6	6	5	4	3	2	1	43
ANY	90	2	3	4	6	7	8	8	7	6	4	2	2	58

Possible Error in the Total Radiation on a Tilted Surface
Davis



Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profiles
Davis

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.50	1.33	1.19	1.08	1.01	.98	.99	1.05	1.14	1.27	1.44	1.55
SOUTH	30	1.89	1.57	1.31	1.09	.95	.89	.92	1.02	1.21	1.46	1.78	1.99
SOUTH	45	2.16	1.71	1.33	1.02	.84	.76	.79	.93	1.19	1.55	2.00	2.30
SOUTH	60	2.27	1.73	1.27	.89	.67	.58	.61	.78	1.09	1.53	2.08	2.46
SOUTH	75	2.24	1.63	1.11	.70	.46	.37	.41	.58	.91	1.40	2.02	2.44
SOUTH	90	2.05	1.42	.89	.46	.24	.16	.19	.35	.68	1.19	1.82	2.26
SE,SW	15	1.34	1.23	1.13	1.05	1.00	.98	.99	1.03	1.09	1.18	1.30	1.38
SE,SW	30	1.59	1.38	1.20	1.05	.96	.91	.93	1.00	1.13	1.30	1.52	1.67
SE,SW	45	1.74	1.44	1.19	.99	.86	.81	.83	.93	1.10	1.33	1.63	1.84
SE,SW	60	1.77	1.41	1.12	.88	.73	.67	.69	.81	1.00	1.28	1.64	1.89
SE,SW	75	1.69	1.29	.98	.73	.57	.51	.53	.65	.86	1.15	1.54	1.82
SE,SW	90	1.49	1.10	.79	.55	.40	.34	.37	.48	.67	.96	1.34	1.62
E,W	15	.98	.98	.98	.98	.97	.97	.97	.97	.98	.98	.98	.98
E,W	30	.95	.94	.93	.92	.91	.91	.91	.91	.92	.93	.95	.96
E,W	45	.91	.88	.86	.84	.82	.81	.82	.83	.85	.87	.90	.91
E,W	60	.84	.80	.77	.74	.71	.70	.71	.72	.75	.79	.82	.84
E,W	75	.74	.70	.66	.62	.59	.58	.58	.60	.64	.68	.72	.75
E,W	90	.62	.57	.53	.49	.46	.45	.45	.48	.51	.56	.60	.63
NORMAL INCIDENCE		2.72	2.21	1.86	1.63	1.53	1.50	1.51	1.57	1.74	2.05	2.53	2.89



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

(O) SOLAR DATA FOR FRESNO

Nearby Climate Stations - Fresno, Merced, Lemoore (Reeves Field)

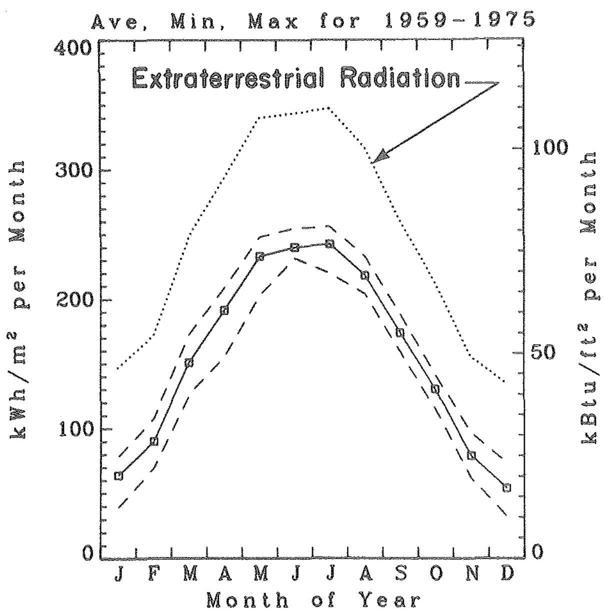
Monthly Solar Data, Fresno

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Latitude: 36. 77° Longitude: 119.72° Elevation: 336'													
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	64	90	151	192	233	240	243	218	174	130	79	54	1868
direct beam (normal incidence)	95	126	195	229	273	279	285	262	224	186	122	79	2356
SOLAR RADIATION (KBtu/ft^2 per month)													
horizontal surface	20	29	48	61	74	76	77	69	55	41	25	17	592
direct beam (normal incidence)	30	40	62	73	86	88	90	83	71	59	39	25	746
PERCENT OF POSSIBLE SUNSHINE	50	66	79	85	89	94	96	96	95	88	67	46	82
MEAN CLOUD COVER (in tenths)	7	6	5	4	3	2	1	1	1	3	5	7	4
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.44	.52	.61	.65	.69	.70	.70	.69	.67	.61	.51	.40	.60

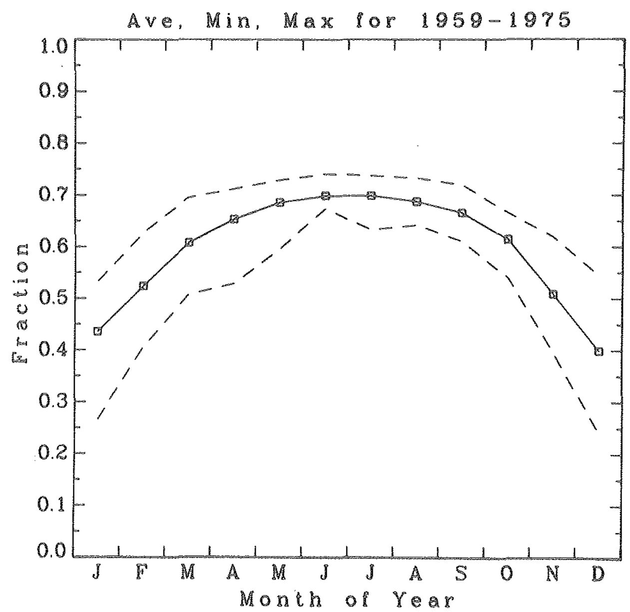
Recording interval: 1952-1975

Source of solar data: NWS, Eppley lightbulb pyranometer until 1974, Eppley PSP since 1974.

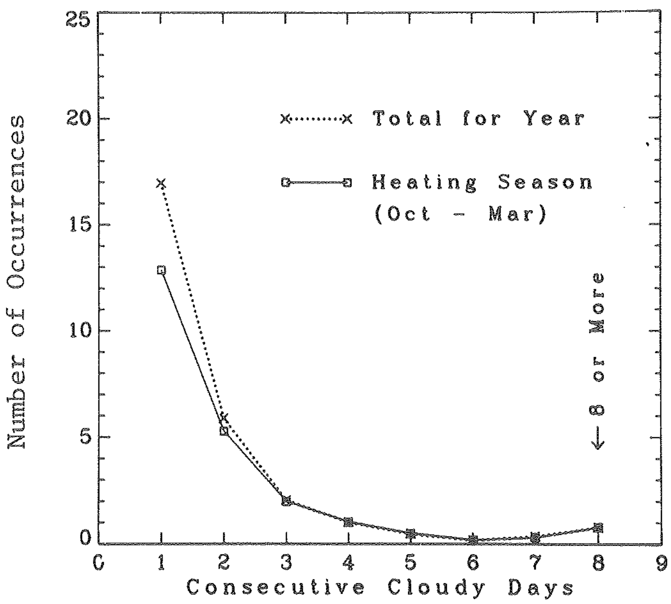
Monthly Total Horizontal Radiation Fresno



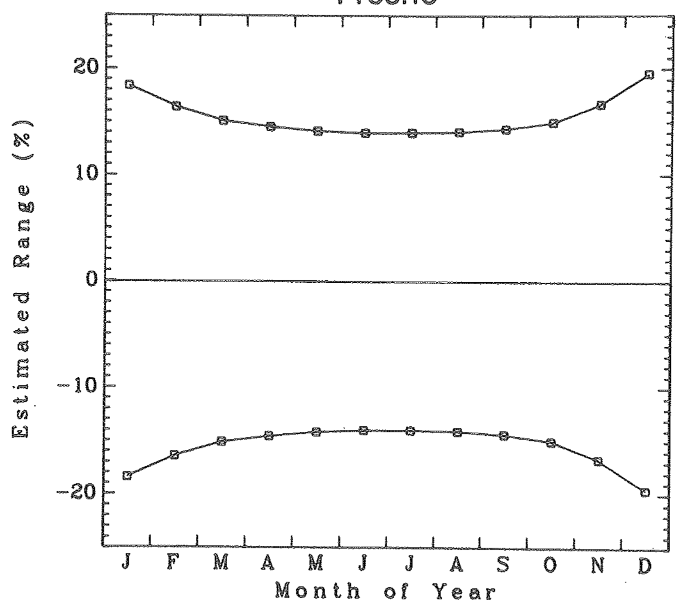
Monthly Total/Extraterrestrial (K_T) Fresno



Occurrences of Cloudy Days
Fresno

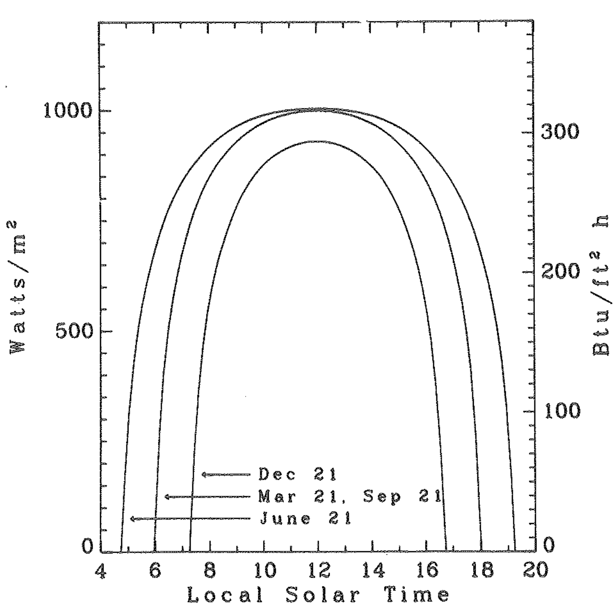


Possible Error in Direct Beam
(Normal Incidence)
Fresno

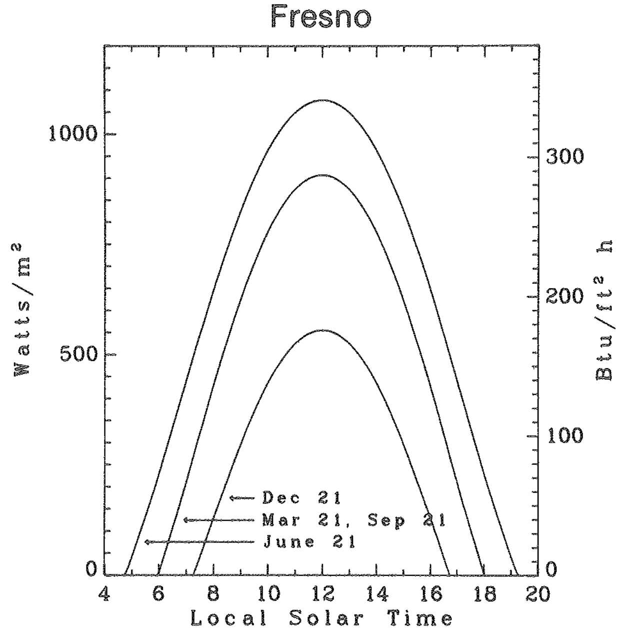


Clear Day Plots for Solar Radiation

Direct Beam (Normal Incidence)
Fresno



Total Radiation on a
Horizontal Surface
Fresno



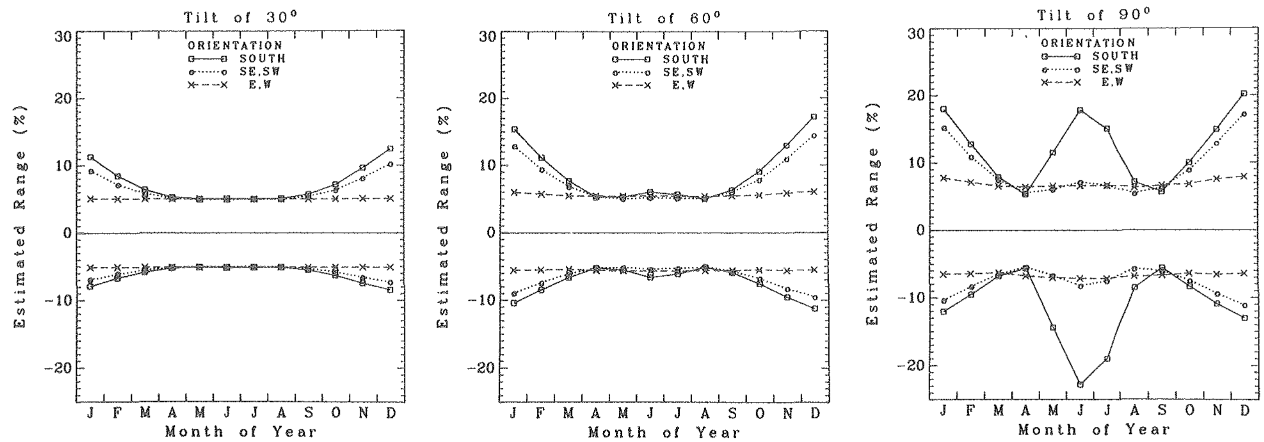
Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m²)
Fresno

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
		DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)												
SOUTH	15	81	108	170	201	233	234	239	224	190	154	99	68	1999
SOUTH	30	93	119	178	198	219	215	221	216	195	168	113	79	2014
SOUTH	45	99	124	176	184	193	184	191	196	188	171	121	85	1912
SOUTH	60	100	121	164	159	156	144	152	164	170	165	121	86	1701
SOUTH	75	95	111	142	125	112	98	106	124	141	148	114	82	1397
SOUTH	90	84	94	111	85	65	51	57	78	105	123	100	73	1027
SE, SW	15	75	102	163	197	232	235	239	221	184	146	93	64	1951
SE, SW	30	82	109	167	193	220	219	224	213	186	153	101	70	1937
SE, SW	45	85	109	162	180	198	194	200	196	177	153	104	72	1830
SE, SW	60	83	103	149	159	169	162	168	170	160	143	101	71	1637
SE, SW	75	76	92	128	131	134	125	131	138	136	127	92	65	1375
SE, SW	90	65	77	102	99	96	87	93	102	106	104	78	56	1066
E, W	15	63	89	148	187	228	234	237	213	170	128	78	53	1826
E, W	30	60	84	140	176	213	219	221	200	161	121	74	51	1722
E, W	45	56	78	129	161	193	197	200	181	147	112	69	47	1570
E, W	60	51	70	114	141	168	170	173	158	130	100	62	43	1380
E, W	75	44	60	97	118	139	140	143	132	110	85	54	37	1159
E, W	90	36	49	78	93	109	109	112	104	87	69	44	30	919
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	1	1	1	1	1	1	1	0	0	0	6
ANY	30	1	1	2	3	3	3	3	3	2	2	1	1	25
ANY	45	2	3	4	6	7	7	7	6	5	4	2	2	55
ANY	60	3	5	8	10	12	12	12	11	9	7	4	3	93
ANY	75	5	7	11	14	17	18	18	16	13	10	6	4	139
ANY	90	6	9	15	19	23	24	24	22	17	13	8	5	187

Total Radiation on a Tilted Surface (Calculated Values)
Engineering Units (kBtu/ft²)
Fresno

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
		DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)												
SOUTH	15	26	34	54	64	74	74	76	71	60	49	31	22	633
SOUTH	30	29	38	56	63	69	68	70	68	62	53	36	25	638
SOUTH	45	31	39	56	58	61	58	61	62	60	54	38	27	606
SOUTH	60	32	38	52	50	49	46	48	52	54	52	38	27	539
SOUTH	75	30	35	45	40	36	31	33	39	45	47	36	26	443
SOUTH	90	27	30	35	27	21	16	18	25	33	39	32	23	325
SE, SW	15	24	32	52	62	73	74	76	70	58	46	29	20	618
SE, SW	30	26	34	53	61	70	69	71	68	59	49	32	22	614
SE, SW	45	27	35	51	57	63	61	63	62	56	48	33	23	580
SE, SW	60	26	33	47	50	53	51	53	54	51	45	32	22	519
SE, SW	75	24	29	41	42	42	40	42	44	43	40	29	21	436
SE, SW	90	21	24	32	31	31	28	29	32	34	33	25	18	338
E, W	15	20	28	47	59	72	74	75	67	54	40	25	17	579
E, W	30	19	27	44	56	68	69	70	63	51	38	24	16	545
E, W	45	18	25	41	51	61	62	63	57	47	36	22	15	498
E, W	60	16	22	36	45	53	54	55	50	41	32	20	14	437
E, W	75	14	19	31	37	44	44	45	42	35	27	17	12	367
E, W	90	11	15	25	30	34	35	35	33	28	22	14	10	291
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	1	1	1	1	1	1	1	1	0	0	8
ANY	45	1	1	1	2	2	2	2	2	2	1	1	0	17
ANY	60	1	1	2	3	4	4	4	3	3	2	1	1	30
ANY	75	2	2	4	4	5	6	6	5	4	3	2	1	44
ANY	90	2	3	5	6	7	8	8	7	6	4	3	2	59

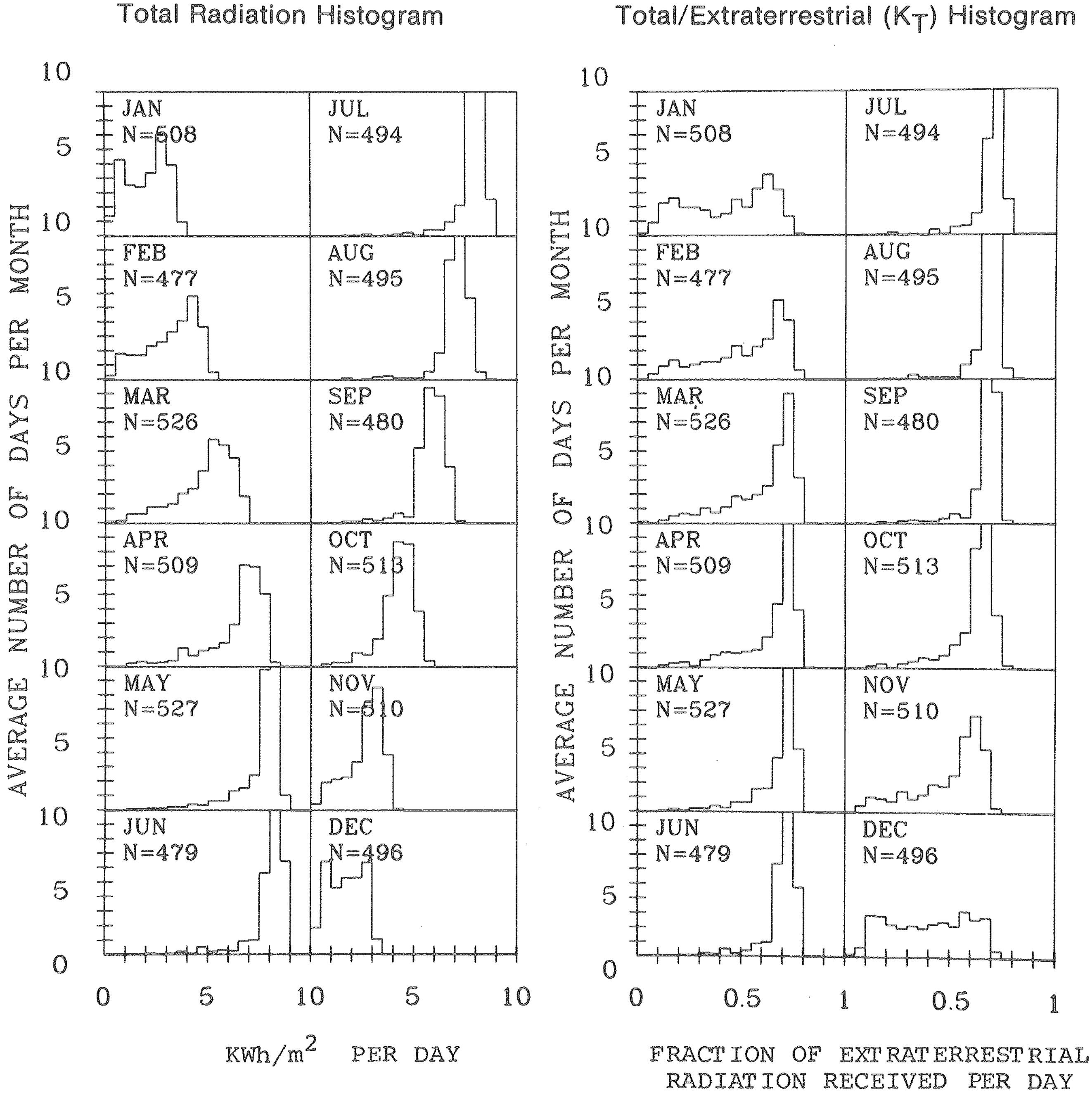
Possible Error in the Total Radiation on a Tilted Surface
Fresno



Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Normal Solar Profiles
Fresno

SURFACE ORIENT- ATION	ANGLE OF TILT (DEGREES FROM HOR- IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.46	1.31	1.18	1.07	1.00	.97	.98	1.04	1.13	1.25	1.41	1.51
SOUTH	30	1.82	1.53	1.28	1.07	.94	.88	.90	1.01	1.18	1.42	1.72	1.92
SOUTH	45	2.06	1.65	1.30	1.00	.82	.74	.77	.91	1.16	1.50	1.92	2.20
SOUTH	60	2.16	1.66	1.22	.86	.65	.56	.59	.75	1.05	1.47	1.98	2.32
SOUTH	75	2.11	1.55	1.06	.66	.44	.35	.38	.55	.87	1.34	1.91	2.29
SOUTH	90	1.92	1.34	.83	.42	.21	.13	.16	.32	.64	1.12	1.71	2.11
SE,SW	15	1.32	1.21	1.12	1.05	1.00	.97	.98	1.02	1.09	1.17	1.28	1.35
SE,SW	30	1.55	1.35	1.18	1.04	.94	.90	.92	.99	1.11	1.27	1.48	1.61
SE,SW	45	1.68	1.40	1.16	.97	.85	.79	.82	.91	1.07	1.29	1.58	1.77
SE,SW	60	1.69	1.36	1.08	.86	.72	.65	.68	.79	.98	1.24	1.57	1.80
SE,SW	75	1.60	1.24	.94	.70	.56	.49	.52	.63	.83	1.10	1.47	1.72
SE,SW	90	1.40	1.04	.75	.52	.39	.33	.35	.46	.64	.91	1.27	1.52
E,W	15	.98	.98	.98	.97	.97	.97	.97	.97	.98	.98	.98	.98
E,W	30	.95	.94	.93	.92	.91	.90	.91	.91	.92	.93	.94	.95
E,W	45	.90	.87	.85	.83	.82	.81	.81	.82	.84	.86	.89	.90
E,W	60	.82	.79	.76	.73	.71	.70	.70	.72	.75	.77	.81	.83
E,W	75	.72	.68	.65	.61	.59	.57	.58	.60	.63	.67	.71	.73
E,W	90	.60	.56	.52	.48	.46	.44	.45	.47	.50	.54	.59	.61
NORMAL INCIDENCE		2.60	2.15	1.81	1.60	1.51	1.48	1.50	1.55	1.71	1.99	2.43	2.75

Fresno



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

(P) SOLAR DATA FOR RENO, NEVADA

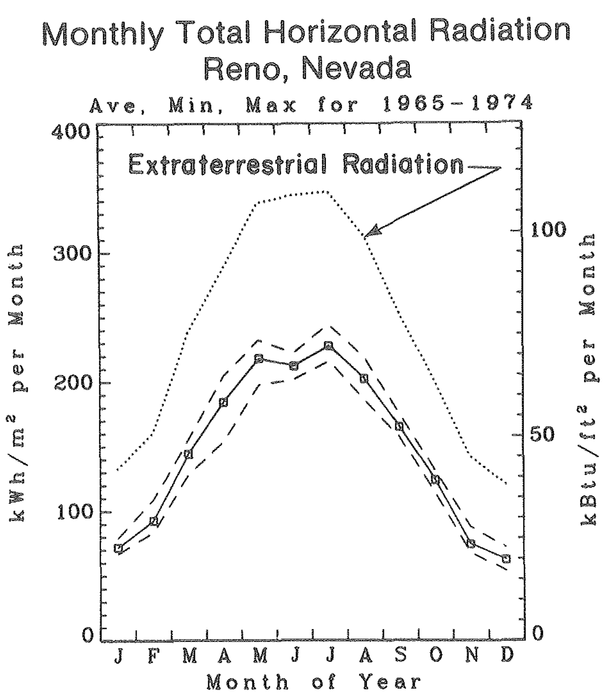
Nearby Climate Station - Reno

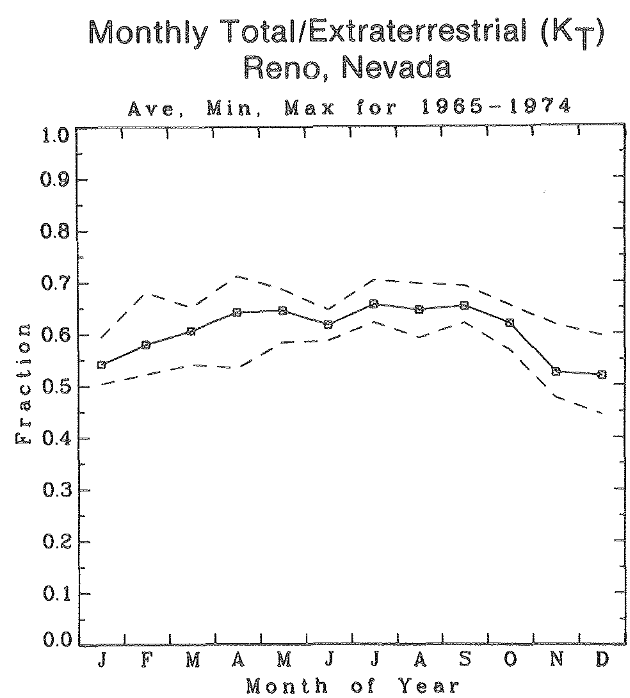
Monthly Solar Data, Reno, Nevada

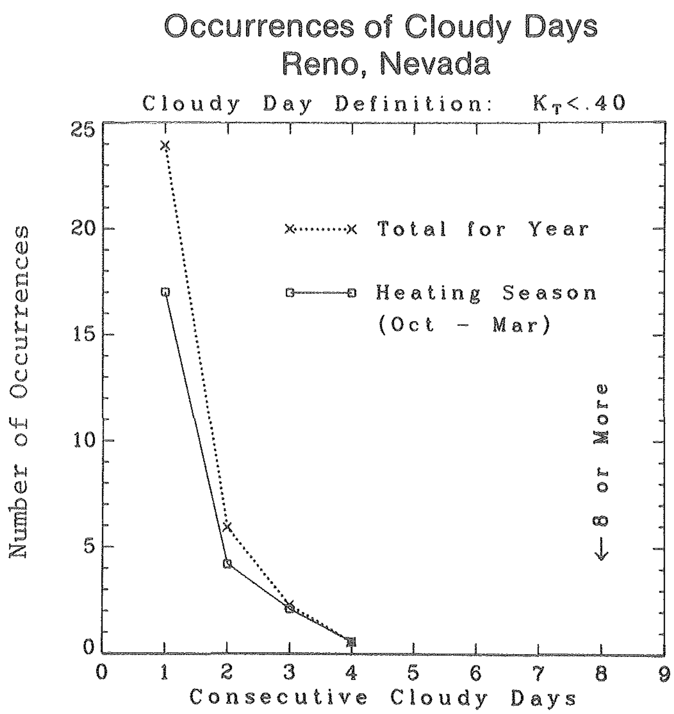
Latitude: 39.5° Longitude: 119.78° Elevation: 4400'

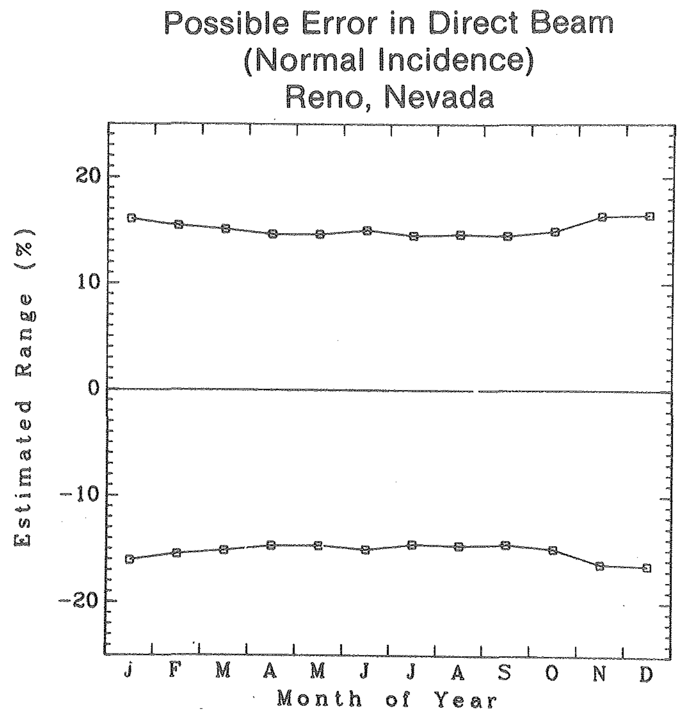
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	72	93	144	185	219	213	228	203	165	124	75	63	1784
direct beam (normal incidence)	134	146	193	224	249	230	260	239	218	187	126	120	2325
SOLAR RADIATION (KBtu/ft^2 per month)													
horizontal surface	23	29	46	59	69	68	72	64	52	39	24	20	566
direct beam (normal incidence)	42	46	61	71	79	73	82	76	69	59	40	38	737
PERCENT OF POSSIBLE SUNSHINE	66	68	74	80	81	85	92	93	92	83	70	63	80
MEAN CLOUD COVER (in tenths)	6	6	6	6	5	4	2	2	2	4	6	6	5
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.54	.58	.61	.64	.65	.62	.66	.65	.65	.62	.52	.52	.61

Source of solar data: NWS, Eppley lightbulb pyranometer

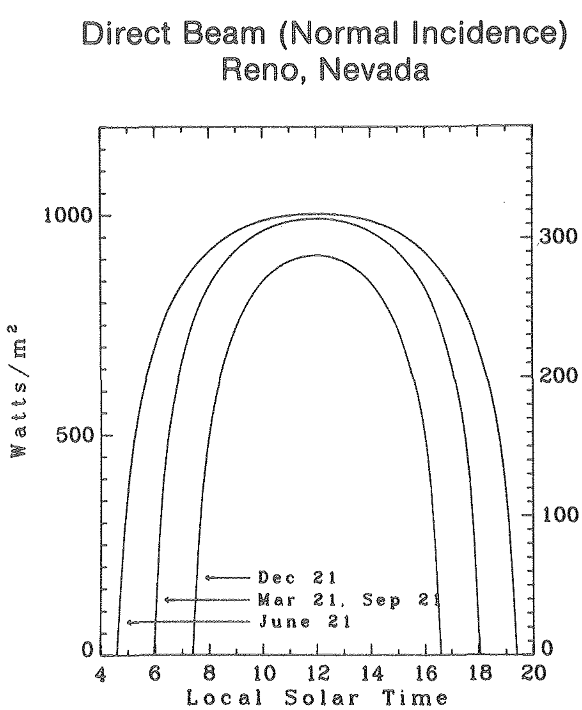


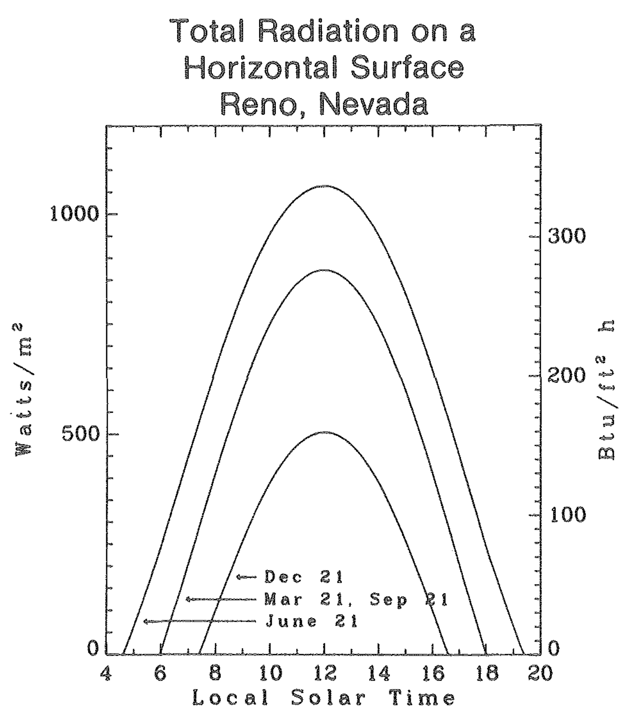






Clear Day Plots for Solar Radiation





Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m^2)
Reno, Nevada

DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	96	115	165	196	220	209	226	209	183	149	96	85	1949
SOUTH	30	115	130	175	195	209	194	212	204	190	165	112	103	2002
SOUTH	45	126	137	175	183	186	169	186	187	185	170	121	115	1938
SOUTH	60	130	135	164	160	153	135	150	159	168	166	123	119	1764
SOUTH	75	126	126	144	128	113	96	108	123	142	151	117	116	1491
SOUTH	90	114	109	115	90	70	56	63	81	108	127	105	106	1143
SE,SW	15	89	108	158	191	218	209	226	207	177	141	89	78	1890
SE,SW	30	100	116	163	189	208	196	213	201	179	150	99	89	1904
SE,SW	45	106	119	160	178	189	175	192	186	173	150	103	95	1826
SE,SW	60	105	114	148	158	163	148	163	162	157	143	101	95	1659
SE,SW	75	98	103	129	131	130	117	129	133	135	127	93	90	1417
SE,SW	90	86	87	104	101	95	83	93	100	106	106	80	79	1121
E,W	15	71	91	142	181	213	207	223	198	162	122	73	62	1744
E,W	30	68	87	135	170	200	194	209	186	153	116	70	59	1649
E,W	45	64	82	124	156	181	176	189	170	141	108	66	56	1512
E,W	60	59	73	111	137	158	153	164	149	125	97	60	51	1337
E,W	75	51	63	94	115	132	127	137	125	106	83	52	45	1131
E,W	90	42	52	76	92	104	99	107	99	85	68	43	37	904

GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)

SURFACE ORIENT-ATION	ANGLE OF TILT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ANY	15	0	0	0	1	1	1	1	1	1	0	0	0	6
ANY	30	1	1	2	2	3	3	3	3	2	2	1	1	24
ANY	45	2	3	4	5	6	6	7	6	5	4	2	2	52
ANY	60	4	5	7	9	11	11	11	10	8	6	4	3	89
ANY	75	5	7	11	14	16	16	17	15	12	9	6	5	132
ANY	90	7	9	14	18	22	21	23	20	17	12	7	6	178

Total Radiation on a Tilted Surface (Calculated Values)
Engineering Units ($kBtu/ft^2$)
Reno, Nevada

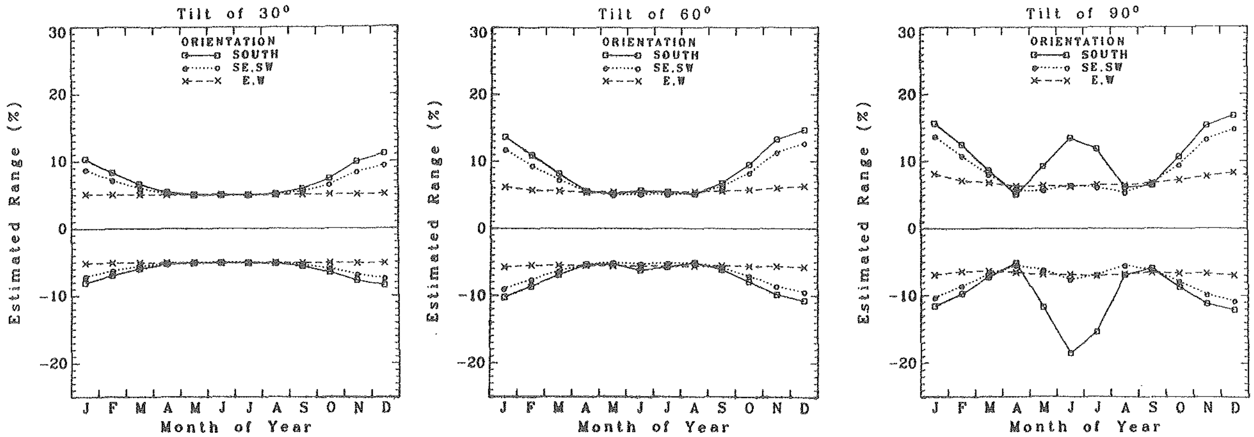
DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	31	36	52	62	70	66	72	66	58	47	30	27	617
SOUTH	30	36	41	55	62	66	61	67	65	60	52	35	33	634
SOUTH	45	40	43	55	58	59	53	59	59	58	54	38	36	614
SOUTH	60	41	43	52	51	49	43	48	50	53	53	39	38	559
SOUTH	75	40	40	46	41	36	31	34	39	45	48	37	37	472
SOUTH	90	36	34	36	28	22	18	20	26	34	40	33	34	362
SE,SW	15	28	34	50	61	69	66	72	65	56	45	28	25	599
SE,SW	30	32	37	52	60	66	62	68	64	57	47	31	28	603
SE,SW	45	34	38	51	56	60	56	61	59	55	48	33	30	578
SE,SW	60	33	36	47	50	52	47	52	51	50	45	32	30	525
SE,SW	75	31	33	41	42	41	37	41	42	43	40	30	29	449
SE,SW	90	27	28	33	32	30	26	29	32	34	33	25	25	355
E,W	15	22	29	45	57	68	66	71	63	51	39	23	19	552
E,W	30	22	28	43	54	63	62	66	59	49	37	22	19	523
E,W	45	20	26	39	49	57	56	60	54	45	34	21	18	479
E,W	60	19	23	35	43	50	48	52	47	40	31	19	16	424
E,W	75	16	20	30	37	42	40	43	40	34	26	16	14	358
E,W	90	13	16	24	29	33	31	34	31	27	21	14	12	286

GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)

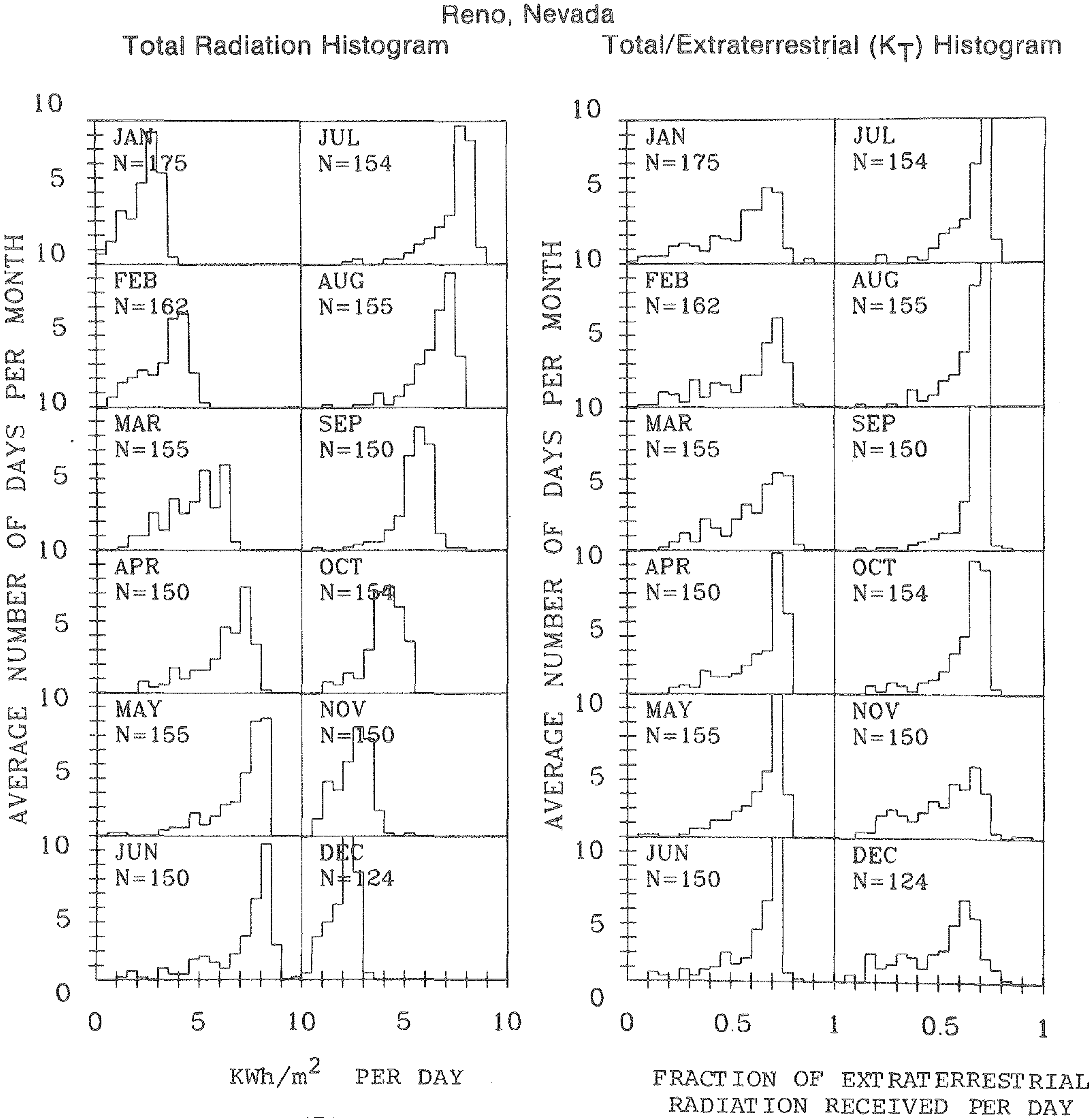
SURFACE ORIENT-ATION	ANGLE OF TILT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	1	1	1	1	1	1	1	1	0	0	8
ANY	45	1	1	1	2	2	2	2	2	2	1	1	1	17
ANY	60	1	1	2	3	3	3	4	3	3	2	1	1	28
ANY	75	2	2	3	4	5	5	5	5	4	3	2	1	42
ANY	90	2	3	5	6	7	7	7	6	5	4	2	2	56

Possible Error in the Total Radiation on a Tilted Surface
Reno, Nevada



Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profiles
Reno, Nevada

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.52	1.35	1.20	1.09	1.01	.98	.99	1.05	1.15	1.28	1.46	1.58
SOUTH	30	1.93	1.60	1.32	1.10	.96	.90	.93	1.03	1.22	1.48	1.81	2.04
SOUTH	45	2.22	1.75	1.35	1.04	.85	.77	.80	.94	1.20	1.57	2.05	2.37
SOUTH	60	2.35	1.77	1.29	.91	.68	.59	.63	.80	1.11	1.56	2.14	2.54
SOUTH	75	2.32	1.68	1.14	.72	.48	.38	.42	.60	.94	1.44	2.09	2.53
SOUTH	90	2.13	1.47	.92	.48	.25	.17	.20	.36	.70	1.23	1.89	2.36
SE,SW	15	1.36	1.24	1.14	1.06	1.00	.98	.99	1.03	1.10	1.19	1.31	1.40
SE,SW	30	1.62	1.40	1.21	1.06	.96	.92	.94	1.01	1.14	1.31	1.54	1.70
SE,SW	45	1.78	1.46	1.21	1.00	.87	.81	.84	.94	1.11	1.35	1.67	1.89
SE,SW	60	1.82	1.44	1.14	.89	.74	.68	.70	.82	1.02	1.31	1.68	1.95
SE,SW	75	1.74	1.33	1.00	.74	.59	.52	.54	.67	.88	1.18	1.59	1.89
SE,SW	90	1.55	1.13	.81	.56	.41	.35	.38	.49	.69	.99	1.39	1.69
E,W	15	.98	.98	.98	.98	.97	.97	.97	.97	.98	.98	.98	.98
E,W	30	.96	.94	.93	.92	.91	.91	.91	.91	.92	.94	.95	.96
E,W	45	.91	.89	.86	.84	.82	.81	.82	.83	.85	.88	.90	.92
E,W	60	.85	.81	.77	.74	.72	.70	.71	.73	.76	.79	.83	.86
E,W	75	.75	.71	.66	.62	.59	.58	.59	.61	.65	.69	.73	.77
E,W	90	.63	.58	.54	.50	.47	.45	.46	.48	.52	.56	.61	.65
NORMAL INCIDENCE		2.80	2.26	1.88	1.64	1.54	1.51	1.52	1.59	1.76	2.09	2.60	2.99



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

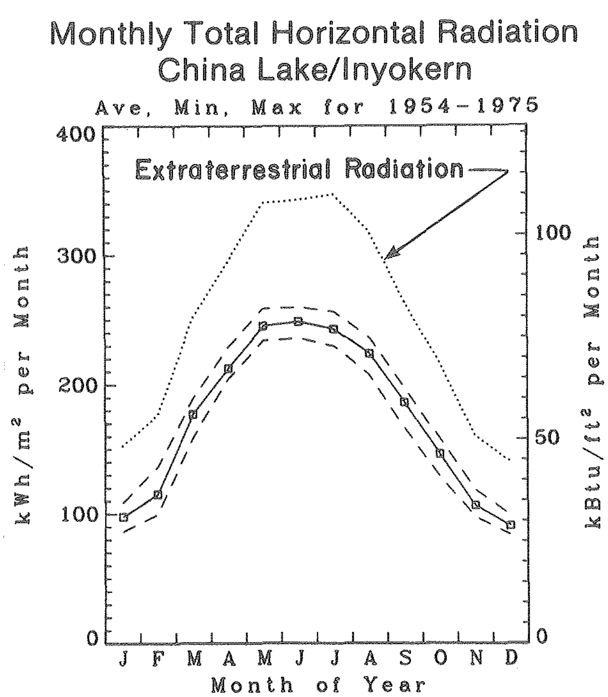
(Q) SOLAR DATA FOR CHINA LAKE/INYOKERN

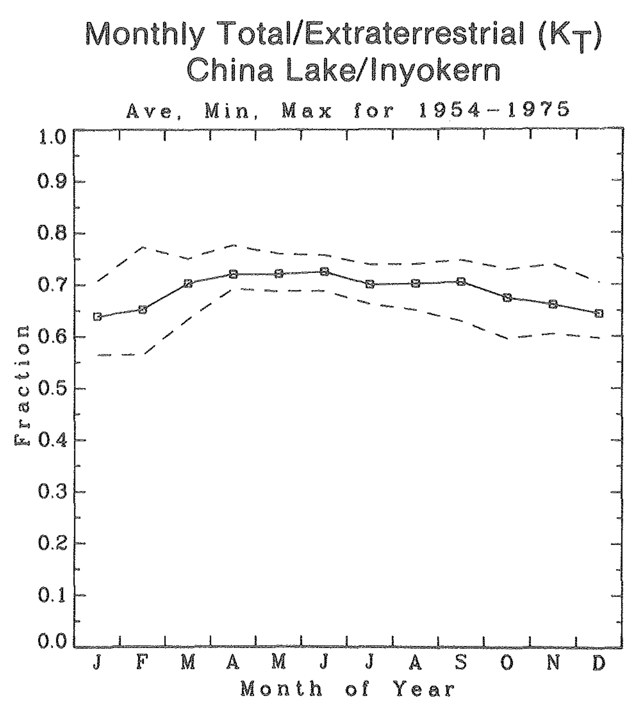
Nearby Climate Stations - China Lake, Edwards AFB, Bakersfield, Victorville, Sandberg

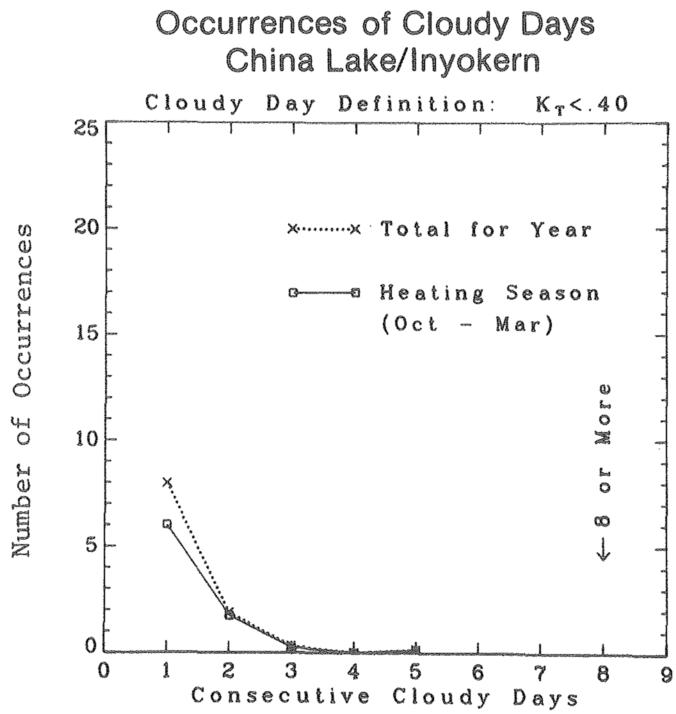
Monthly Solar Data, China Lake/Inyokern

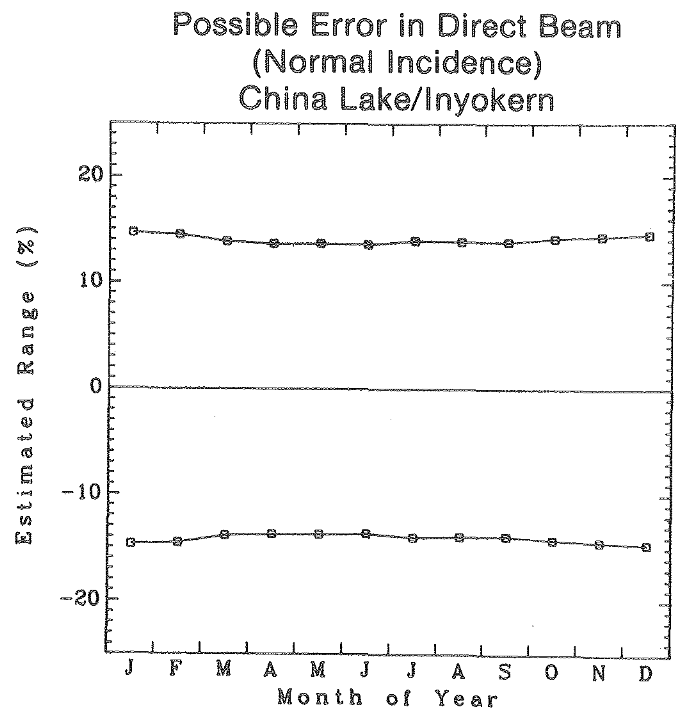
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Latitude: Longitude: Elevation:													
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	98	115	177	213	246	249	243	224	186	146	106	91	2094
direct beam (normal incidence)	182	181	249	272	297	297	285	272	248	218	190	179	2870
SOLAR RADIATION (KBtu/ft^2 per month)													
horizontal surface	31	36	56	68	78	79	77	71	59	46	34	29	664
direct beam (normal incidence)	58	57	79	86	94	94	90	86	78	69	60	57	909
PERCENT OF POSSIBLE SUNSHINE	n/a												
MEAN CLOUD COVER (in tenths)	4	4	3	3	3	1	2	1	1	2	3	3	3
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.64	.65	.70	.72	.72	.73	.70	.70	.70	.67	.66	.64	.69

Source of solar data: NWS 1952-1971; Naval Weapons Center 1971-1975; Eppley lightbulb pyranometer.

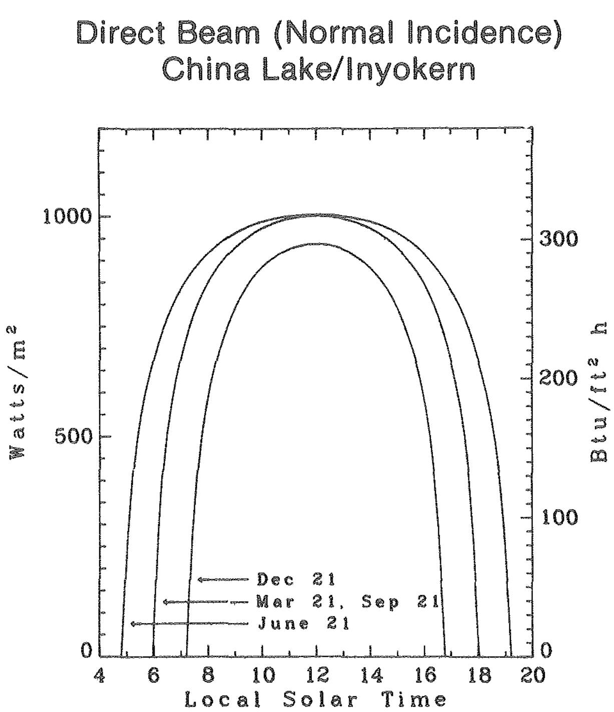


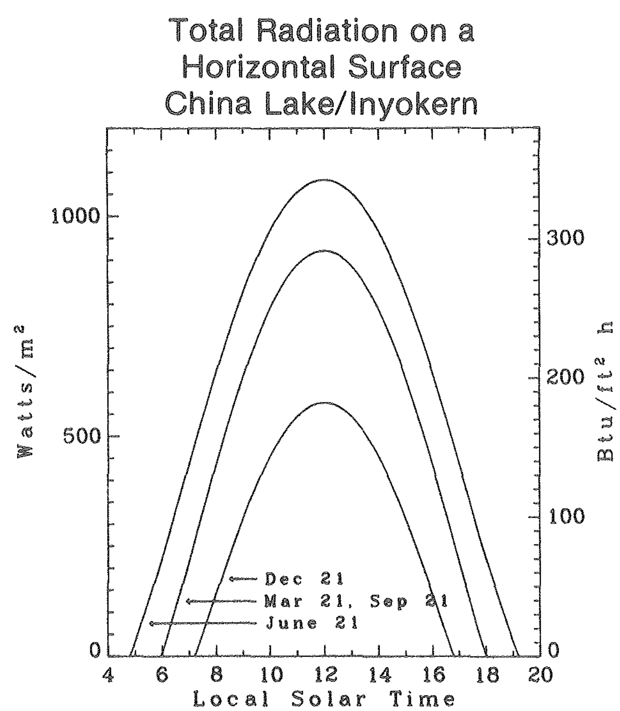






Clear Day Plots for Solar Radiation





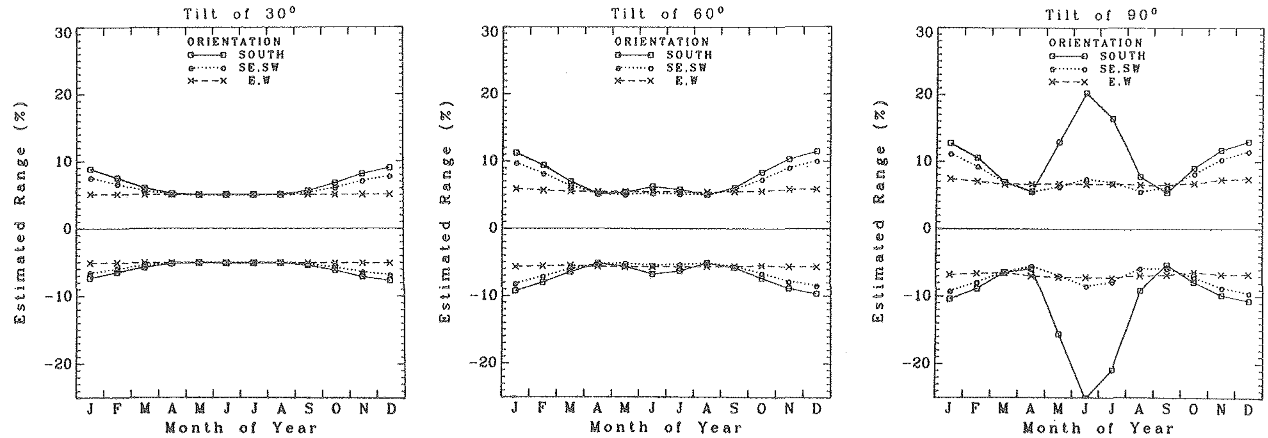
Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m^2)
China Lake/Inyokern

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
		DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)												
SOUTH	15	129	141	201	224	244	242	238	229	204	173	137	123	2285
SOUTH	30	153	157	212	220	229	221	220	220	209	189	160	148	2337
SOUTH	45	167	164	210	204	200	187	190	199	201	193	172	163	2249
SOUTH	60	170	161	195	175	161	145	149	166	180	186	174	168	2029
SOUTH	75	163	148	168	136	113	97	103	123	149	166	164	163	1693
SOUTH	90	145	125	130	90	63	48	55	76	109	137	145	147	1270
SE,SW	15	119	132	193	219	244	243	239	226	198	164	127	113	2217
SE,SW	30	134	142	198	215	230	225	223	218	198	173	141	128	2225
SE,SW	45	140	143	192	200	207	199	199	200	189	172	146	136	2122
SE,SW	60	138	137	177	176	175	165	167	172	170	161	142	135	1915
SE,SW	75	128	122	152	144	138	127	130	139	144	142	130	126	1621
SE,SW	90	110	101	121	108	98	88	91	102	112	116	111	110	1268
E,W	15	96	113	173	208	240	243	237	219	182	143	104	89	2048
E,W	30	92	108	164	196	224	227	222	205	172	136	100	86	1931
E,W	45	86	100	151	178	203	204	200	186	157	125	93	80	1762
E,W	60	78	89	133	156	176	176	173	162	138	112	84	73	1550
E,W	75	67	77	113	130	146	145	143	135	117	95	72	63	1302
E,W	90	55	62	90	103	114	112	111	106	93	77	59	52	1033
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	1	1	1	1	1	1	1	0	0	0	7
ANY	30	1	2	2	3	3	3	3	3	2	2	1	1	28
ANY	45	3	3	5	6	7	7	7	7	5	4	3	3	61
ANY	60	5	6	9	11	12	12	12	11	9	7	5	5	105
ANY	75	7	9	13	16	18	18	18	17	14	11	8	7	155
ANY	90	10	12	18	21	25	25	24	22	19	15	11	9	210

Total Radiation on a Tilted Surface (Calculated Values)
Engineering Units (kBtu/ft^2)
China Lake/Inyokern

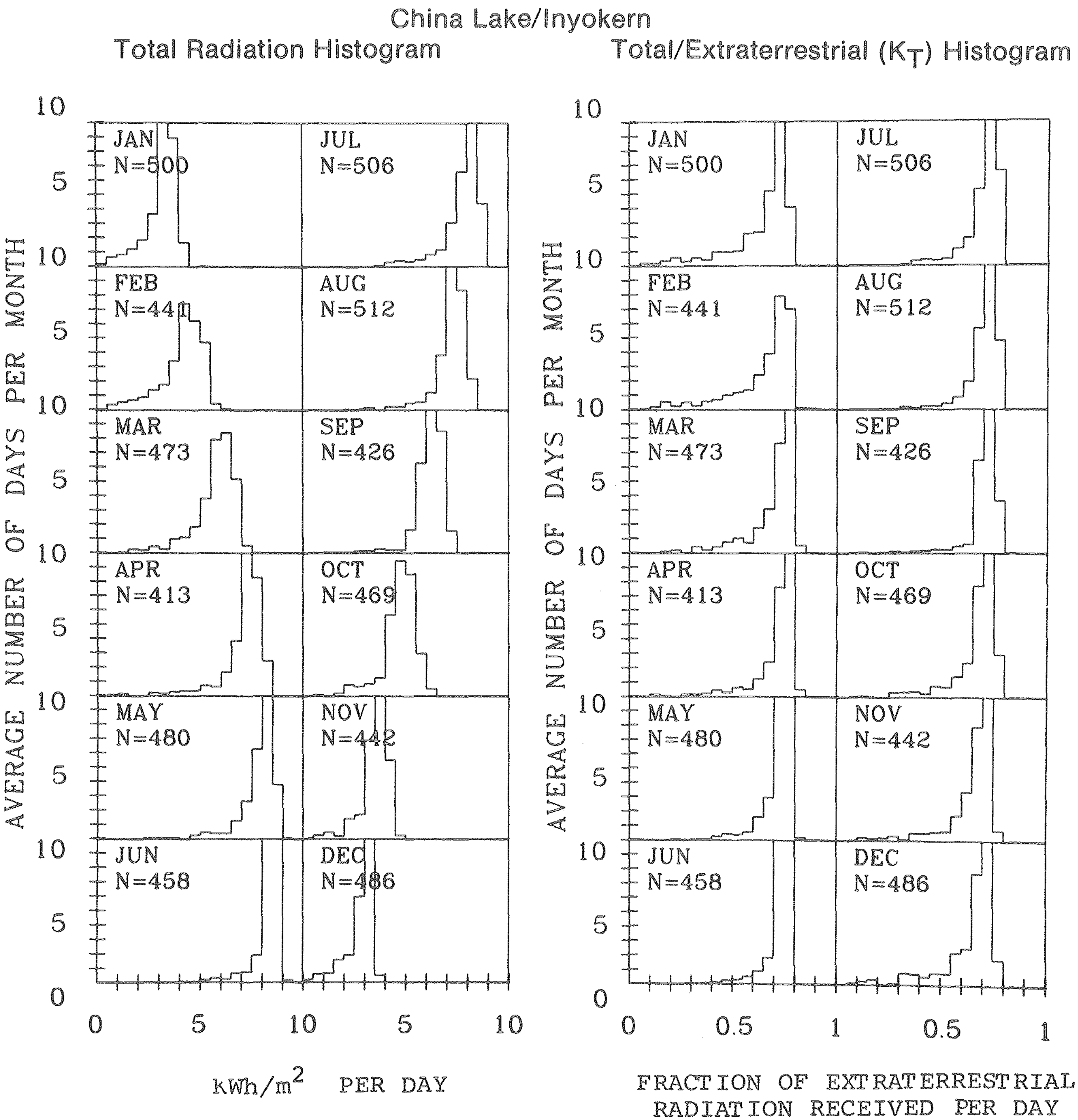
SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
		DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)												
SOUTH	15	41	45	64	71	77	77	76	73	65	55	43	39	724
SOUTH	30	48	50	67	70	73	70	70	70	66	60	51	47	740
SOUTH	45	53	52	66	65	63	59	60	63	64	61	55	52	713
SOUTH	60	54	51	62	55	51	46	47	52	57	59	55	53	643
SOUTH	75	52	47	53	43	36	31	32	39	47	53	52	52	536
SOUTH	90	46	40	41	28	20	15	17	24	35	43	46	47	402
SE,SW	15	38	42	61	69	77	77	76	72	63	52	40	36	702
SE,SW	30	42	45	63	68	73	71	71	69	63	55	45	41	705
SE,SW	45	44	45	61	63	66	63	63	63	60	54	46	43	672
SE,SW	60	44	43	56	56	56	52	53	55	54	51	45	43	607
SE,SW	75	40	39	48	46	44	40	41	44	46	45	41	40	514
SE,SW	90	35	32	38	34	31	28	29	32	35	37	35	35	402
E,W	15	30	36	55	66	76	77	75	69	58	45	33	28	649
E,W	30	29	34	52	62	71	72	70	65	54	43	32	27	612
E,W	45	27	32	48	56	64	65	63	59	50	40	29	25	558
E,W	60	25	28	42	49	56	56	55	51	44	35	27	23	491
E,W	75	21	24	36	41	46	46	45	43	37	30	23	20	413
E,W	90	17	20	29	33	36	36	35	34	29	24	19	16	327
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	1	1	1	1	1	1	1	1	0	0	9
ANY	45	1	1	2	2	2	2	2	2	2	1	1	1	19
ANY	60	2	2	3	3	4	4	4	4	3	2	2	1	33
ANY	75	2	3	4	5	6	6	6	5	4	3	2	2	49
ANY	90	3	4	6	7	8	8	8	7	6	5	3	3	66

Possible Error in the Total Radiation on a Tilted Surface China Lake/Inyokern



Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profiles China Lake/Inyokern

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.44	1.30	1.17	1.07	1.00	.97	.98	1.03	1.12	1.24	1.39	1.49
SOUTH	30	1.78	1.51	1.27	1.06	.93	.87	.90	1.00	1.17	1.40	1.69	1.87
SOUTH	45	2.00	1.62	1.27	.98	.81	.73	.76	.90	1.14	1.47	1.87	2.13
SOUTH	60	2.09	1.61	1.19	.84	.63	.54	.58	.74	1.03	1.43	1.92	2.24
SOUTH	75	2.03	1.50	1.03	.64	.42	.33	.36	.53	.85	1.30	1.84	2.20
SOUTH	90	1.83	1.28	.80	.40	.20	.12	.15	.30	.61	1.07	1.64	2.01
SE,SW	15	1.30	1.20	1.12	1.04	.99	.97	.98	1.02	1.08	1.16	1.27	1.33
SE,SW	30	1.52	1.33	1.17	1.03	.94	.90	.91	.98	1.10	1.26	1.45	1.58
SE,SW	45	1.64	1.37	1.15	.96	.84	.78	.81	.90	1.06	1.27	1.54	1.72
SE,SW	60	1.64	1.33	1.06	.84	.70	.64	.67	.77	.96	1.21	1.53	1.75
SE,SW	75	1.54	1.20	.92	.69	.54	.48	.51	.62	.81	1.08	1.42	1.66
SE,SW	90	1.35	1.01	.73	.51	.38	.32	.34	.44	.63	.88	1.22	1.46
E,W	15	.98	.98	.98	.97	.97	.97	.97	.97	.98	.98	.98	.98
E,W	30	.94	.93	.92	.91	.91	.90	.91	.91	.92	.93	.94	.95
E,W	45	.89	.87	.85	.83	.82	.81	.81	.82	.84	.86	.88	.89
E,W	60	.81	.78	.75	.73	.71	.70	.70	.72	.74	.77	.80	.82
E,W	75	.71	.67	.64	.61	.58	.57	.58	.59	.62	.66	.70	.72
E,W	90	.59	.55	.51	.48	.45	.44	.45	.46	.50	.53	.57	.60
NORMAL INCIDENCE		2.52	2.10	1.78	1.59	1.51	1.48	1.49	1.54	1.69	1.95	2.37	2.66



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

(R) SOLAR DATA FOR LAS VEGAS, NEVADA

Nearby Climate Station - Las Vegas

Monthly Solar Data, Las Vegas, Nevada

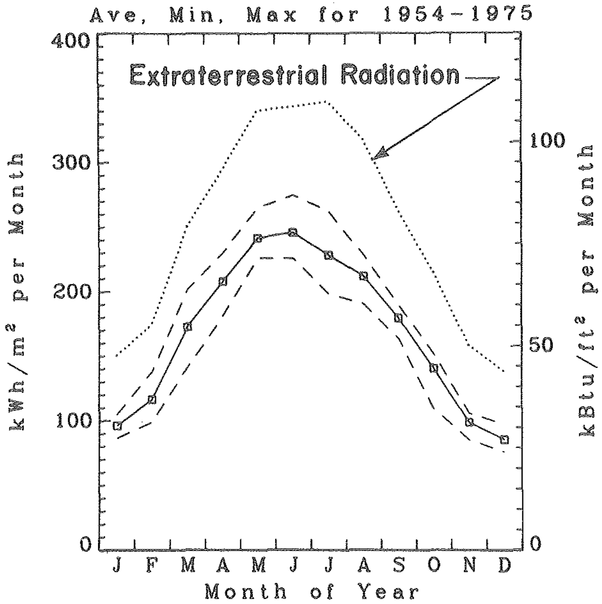
Latitude: 36° 08'   Longitude: 115° 17'   Elevation: 2188'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	96	117	173	208	242	246	228	212	180	140	99	85	2026
direct beam (normal incidence)	180	187	241	262	289	291	255	248	234	206	170	165	2728
SOLAR RADIATION (KBtu/ft^2 per month)													
horizontal surface	30	37	55	66	77	78	72	67	57	44	31	27	642
direct beam (normal incidence)	57	59	76	83	92	92	81	78	74	65	54	52	864
PERCENT OF POSSIBLE SUNSHINE	78	81	83	86	88	93	87	88	92	86	81	78	86
MEAN CLOUD COVER (in tenths)	5	5	5	4	3	2	3	3	2	3	4	4	3
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.64	.67	.69	.71	.71	.72	.66	.67	.68	.65	.62	.62	.67

Source of solar data: NWS; Eppley lightbulb pyranometer until 1973; Eppley PSP since 1973; recording interval 1952-1975.

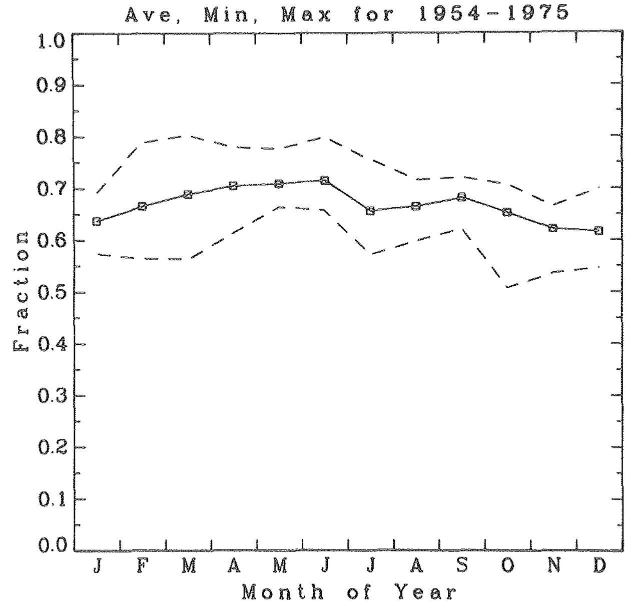
Monthly Total Horizontal Radiation Las Vegas, Nevada

Ave, Min, Max for 1954-1975



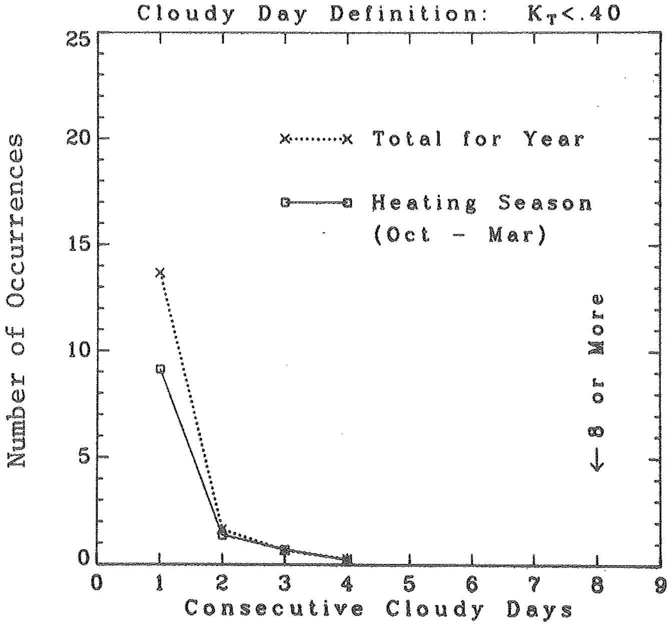
Monthly Total/Extraterrestrial (K_T) Las Vegas, Nevada

Ave, Min, Max for 1954-1975

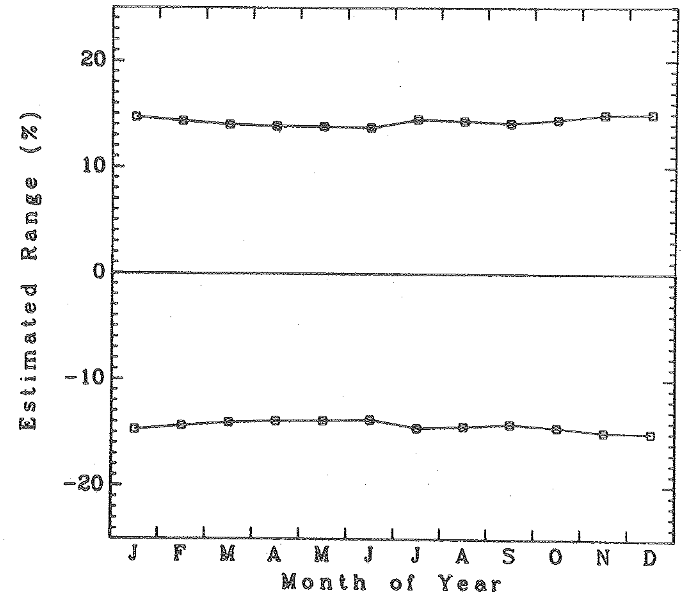


Occurrences of Cloudy Days
Las Vegas, Nevada

Cloudy Day Definition: $K_T < .40$

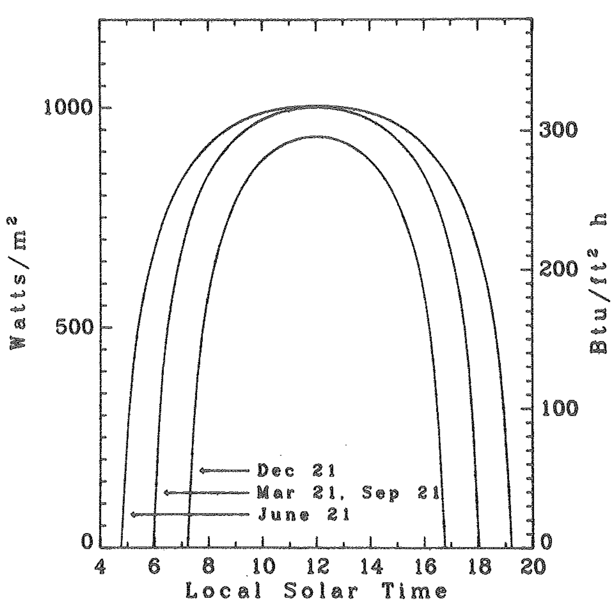


Possible Error in Direct Beam
(Normal Incidence)
Las Vegas, Nevada

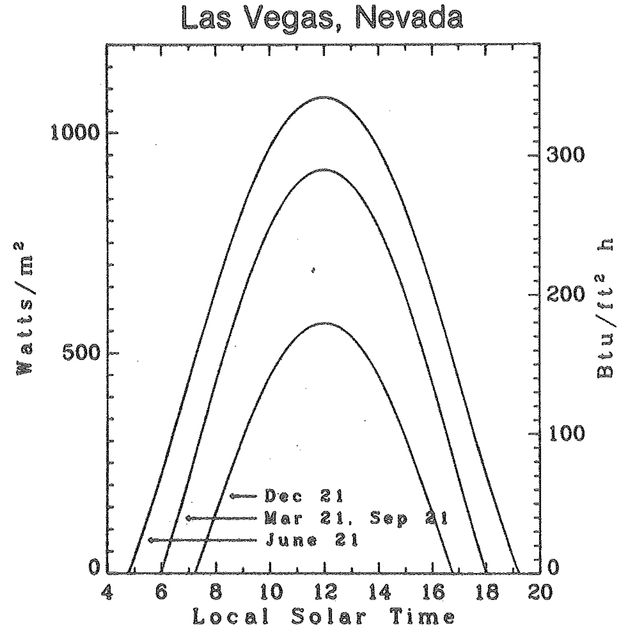


Clear Day Plots for Solar Radiation

Direct Beam (Normal Incidence)
Las Vegas, Nevada



Total Radiation on a
Horizontal Surface
Las Vegas, Nevada



Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m²)
Las Vegas, Nevada

DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

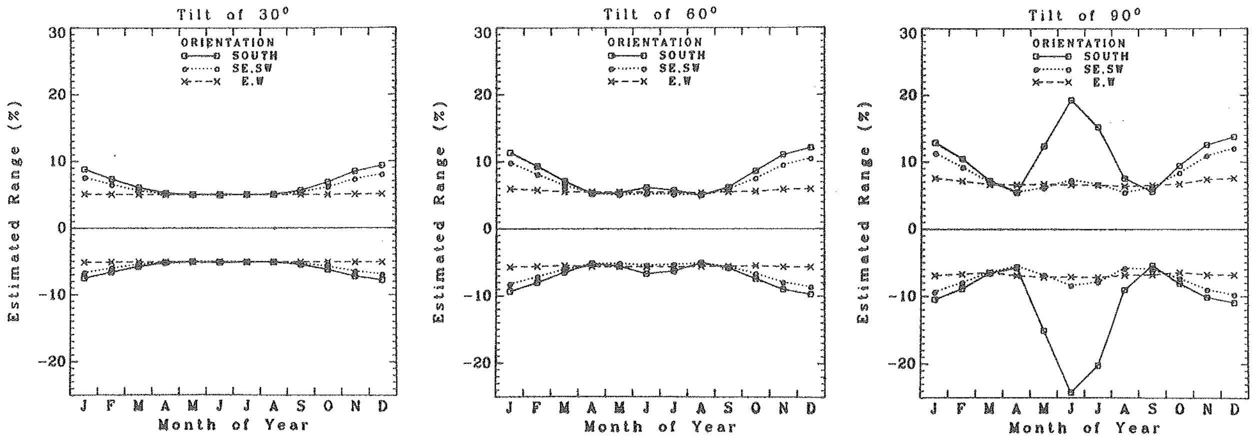
SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	128	143	196	218	241	239	224	217	196	166	126	115	2209
SOUTH	30	151	160	207	216	226	218	207	209	201	181	147	138	2261
SOUTH	45	165	168	205	200	198	186	179	188	193	185	158	153	2179
SOUTH	60	169	165	190	172	159	145	142	158	174	178	159	157	1969
SOUTH	75	162	152	164	134	113	97	99	119	144	160	150	152	1647
SOUTH	90	145	129	128	89	64	49	55	74	106	132	132	138	1242
SE, SW	15	118	134	188	214	240	240	224	214	190	157	118	106	2143
SE, SW	30	132	145	193	210	227	223	210	206	191	166	130	120	2152
SE, SW	45	139	146	188	196	204	197	187	189	182	165	134	127	2054
SE, SW	60	137	140	173	172	173	164	158	164	164	155	131	126	1856
SE, SW	75	127	125	149	141	137	126	123	132	139	136	120	118	1574
SE, SW	90	109	104	118	106	98	88	88	98	108	111	102	103	1234
E, W	15	95	114	169	203	236	240	223	207	175	138	97	84	1979
E, W	30	91	109	160	191	221	224	208	194	166	131	93	81	1868
E, W	45	85	101	147	174	199	201	188	176	151	121	86	76	1706
E, W	60	77	91	130	152	173	174	163	154	134	107	78	69	1501
E, W	75	67	78	110	127	143	143	135	128	113	92	67	60	1263
E, W	90	55	63	88	101	112	111	105	101	90	74	55	49	1003
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	1	1	1	1	1	1	1	0	0	0	7
ANY	30	1	2	2	3	3	3	3	3	2	2	1	1	27
ANY	45	3	3	5	6	7	7	7	6	5	4	3	3	59
ANY	60	5	6	9	10	12	12	11	11	9	7	5	4	101
ANY	75	7	9	13	15	18	18	17	16	13	10	7	6	150
ANY	90	10	12	17	21	24	25	23	21	18	14	10	9	203

Total Radiation on a Tilted Surface (Calculated Values)
Engineering Units (kBtu/ft²)
Las Vegas, Nevada

DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

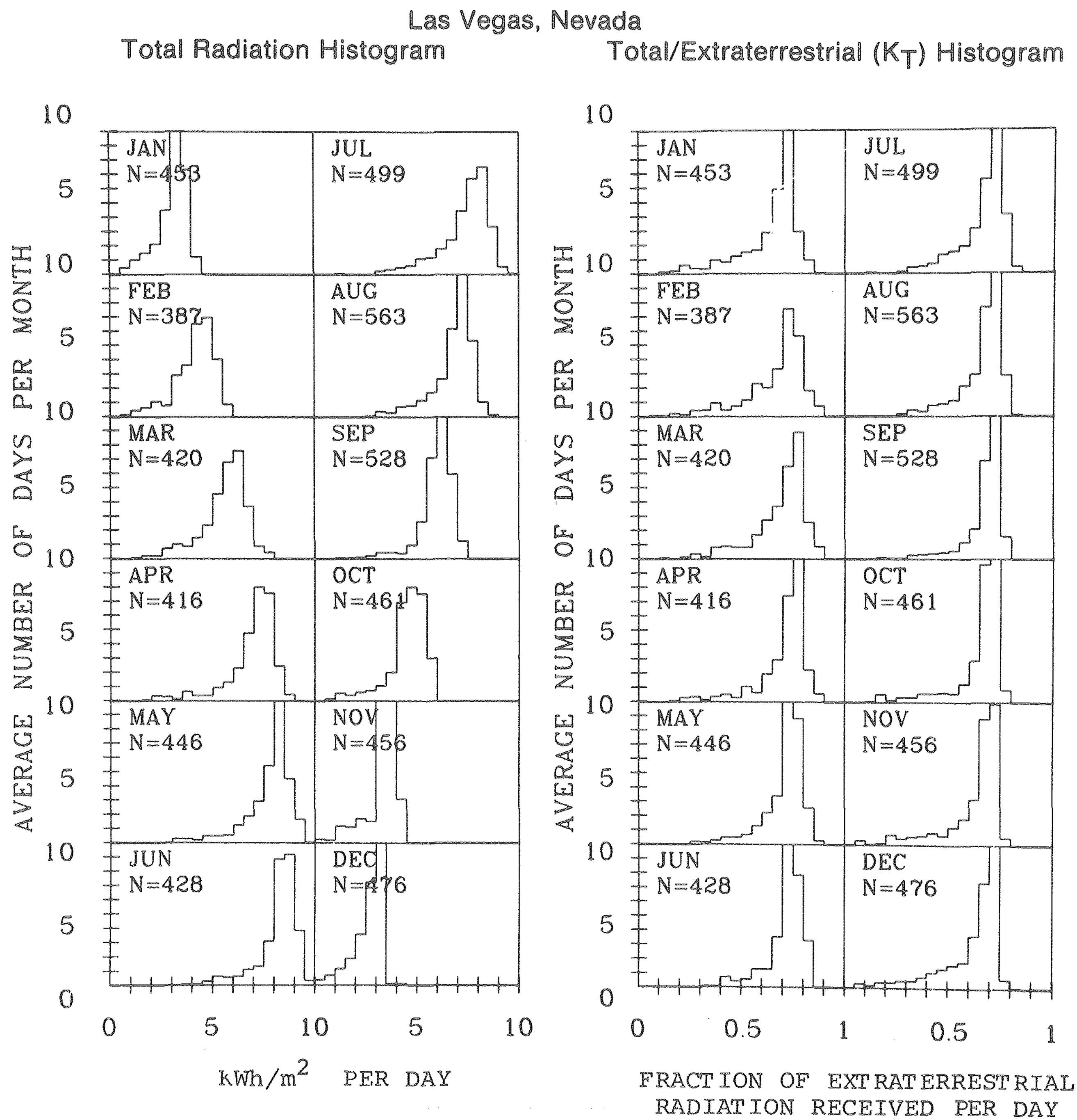
SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	40	45	62	69	76	76	71	69	62	53	40	37	700
SOUTH	30	48	51	66	68	72	69	66	66	64	57	46	44	716
SOUTH	45	52	53	65	63	63	59	57	60	61	59	50	48	690
SOUTH	60	53	52	60	54	51	46	45	50	55	56	50	50	624
SOUTH	75	51	48	52	43	36	31	32	38	46	51	48	48	522
SOUTH	90	46	41	41	28	20	16	17	24	34	42	42	44	394
SE, SW	15	37	43	60	68	76	76	71	68	60	50	37	34	679
SE, SW	30	42	46	61	67	72	71	67	65	61	52	41	38	682
SE, SW	45	44	46	59	62	65	62	59	60	58	52	42	40	651
SE, SW	60	43	44	55	55	55	52	50	52	52	49	41	40	588
SE, SW	75	40	40	47	45	43	40	39	42	44	43	38	37	499
SE, SW	90	35	33	37	34	31	28	28	31	34	35	32	33	391
E, W	15	30	36	54	64	75	76	71	66	56	44	31	27	627
E, W	30	29	35	51	61	70	71	66	62	52	41	29	26	592
E, W	45	27	32	47	55	63	64	60	56	48	38	27	24	540
E, W	60	24	29	41	48	55	55	52	49	42	34	25	22	476
E, W	75	21	25	35	40	45	45	43	41	36	29	21	19	400
E, W	90	17	20	28	32	35	35	33	32	28	23	17	16	318
		GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)												
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	0	1	1	1	1	1	1	1	1	0	0	9
ANY	45	1	1	2	2	2	2	2	2	2	1	1	1	19
ANY	60	2	2	3	3	4	4	4	3	3	2	2	1	32
ANY	75	2	3	4	5	6	6	5	5	4	3	2	2	48
ANY	90	3	4	5	7	8	8	7	7	6	4	3	3	64

Possible Error in the Total Radiation on a Tilted Surface
Las Vegas, Nevada



Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profiles
Las Vegas, Nevada

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.45	1.30	1.18	1.07	1.00	.97	.98	1.03	1.13	1.25	1.40	1.50
SOUTH	30	1.80	1.52	1.27	1.06	.93	.88	.90	1.00	1.17	1.41	1.70	1.89
SOUTH	45	2.03	1.63	1.28	.99	.81	.73	.76	.90	1.14	1.48	1.89	2.15
SOUTH	60	2.12	1.63	1.20	.85	.64	.55	.58	.74	1.04	1.44	1.94	2.27
SOUTH	75	2.06	1.52	1.04	.65	.43	.34	.37	.54	.86	1.31	1.87	2.24
SOUTH	90	1.87	1.30	.81	.41	.20	.13	.15	.30	.62	1.09	1.67	2.05
SE,SW	15	1.31	1.21	1.12	1.04	.99	.97	.98	1.02	1.08	1.17	1.27	1.34
SE,SW	30	1.53	1.34	1.17	1.03	.94	.90	.92	.99	1.10	1.26	1.46	1.59
SE,SW	45	1.65	1.38	1.15	.96	.84	.79	.81	.90	1.06	1.28	1.55	1.74
SE,SW	60	1.66	1.34	1.07	.85	.71	.65	.67	.78	.97	1.22	1.55	1.77
SE,SW	75	1.56	1.22	.93	.69	.55	.48	.51	.62	.82	1.09	1.44	1.68
SE,SW	90	1.37	1.02	.74	.52	.38	.32	.34	.45	.63	.89	1.24	1.48
E,W	15	.98	.98	.98	.97	.97	.97	.97	.97	.98	.98	.98	.98
E,W	30	.95	.94	.92	.92	.91	.90	.91	.91	.92	.93	.94	.95
E,W	45	.89	.87	.85	.83	.82	.81	.81	.82	.84	.86	.88	.90
E,W	60	.82	.79	.75	.73	.71	.70	.70	.72	.74	.77	.80	.82
E,W	75	.71	.68	.64	.61	.58	.57	.58	.60	.63	.66	.70	.72
E,W	90	.59	.55	.51	.48	.45	.44	.45	.47	.50	.54	.58	.60
NORMAL INCIDENCE		2.55	2.12	1.79	1.59	1.51	1.48	1.49	1.55	1.69	1.97	2.39	2.70



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

(S) SOLAR DATA FOR EL CENTRO

Nearby Climate Station - Yuma

Monthly Solar Data, El Centro

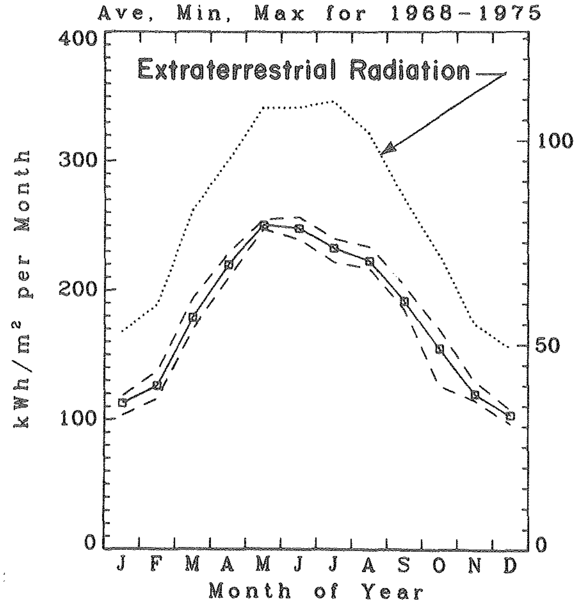
Latitude: 32.8° Longitude: 115.67° Elevation: 12'	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
SOLAR RADIATION (kWh/m^2 per month)													
horizontal surface	112	126	179	220	250	248	232	223	192	155	120	103	2160
direct beam (normal incidence)	201	190	237	276	302	292	260	262	247	221	206	192	2888
SOLAR RADIATION (KBtu/ft^2 per month)													
horizontal surface	36	40	57	70	79	79	74	71	61	49	38	33	685
direct beam (normal incidence)	64	60	75	88	96	93	82	83	78	70	65	61	915
PERCENT OF POSSIBLE SUNSHINE*	85	88	91	94	96	97	90	91	94	92	86	82	91
MEAN CLOUD COVER (in tenths)*	4	4	4	2	2	1	3	2	1	2	3	4	3
FRACTION OF EXTRATERRESTRIAL RADIATION (K_T)	.67	.67	.68	.73	.73	.73	.67	.69	.71	.68	.69	.66	.69

*Data for Yuma, Ariz. 32° 40' N, 114° 36' W, elevation 194'

Source of solar data: NWS, Eppley lightbulb pyranometer until 1974, Eppley PSP since 1974; recording interval 1952-1975.

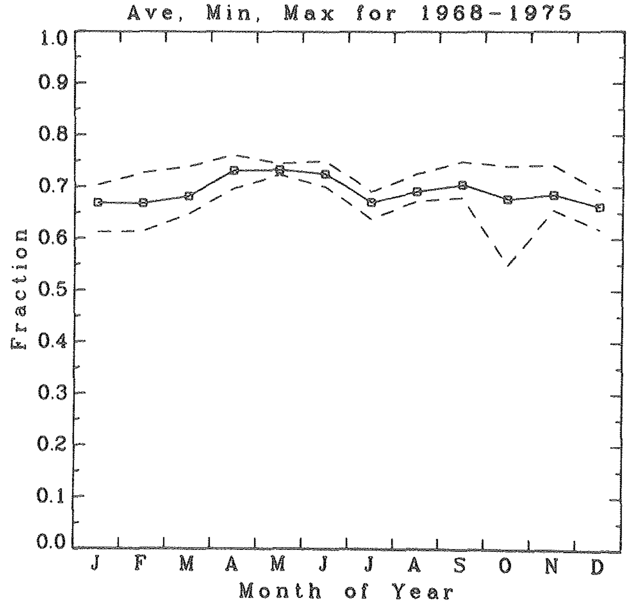
Monthly Total Horizontal Radiation El Centro

Ave, Min, Max for 1968-1975

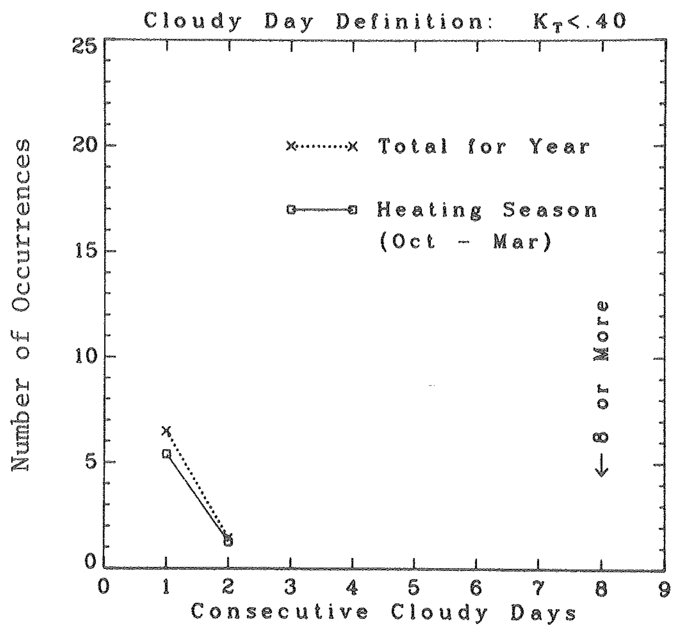


Monthly Total/Exterrestrial (K_T) El Centro

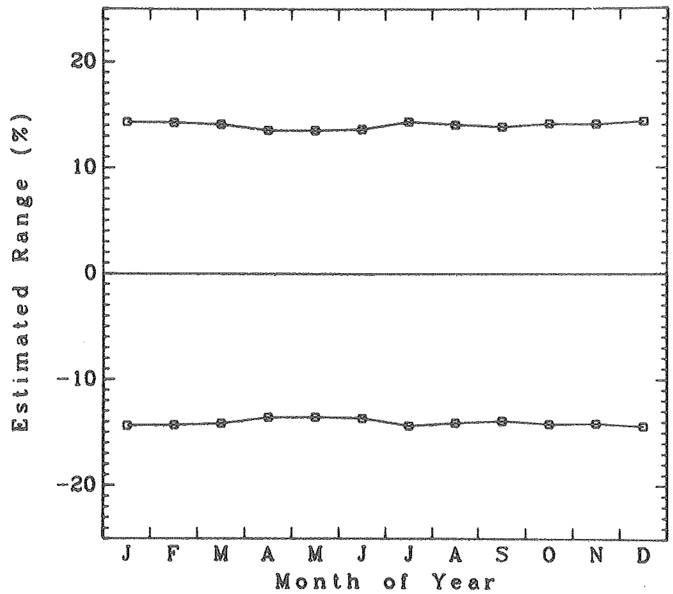
Ave, Min, Max for 1968-1975



Occurrences of Cloudy Days
El Centro

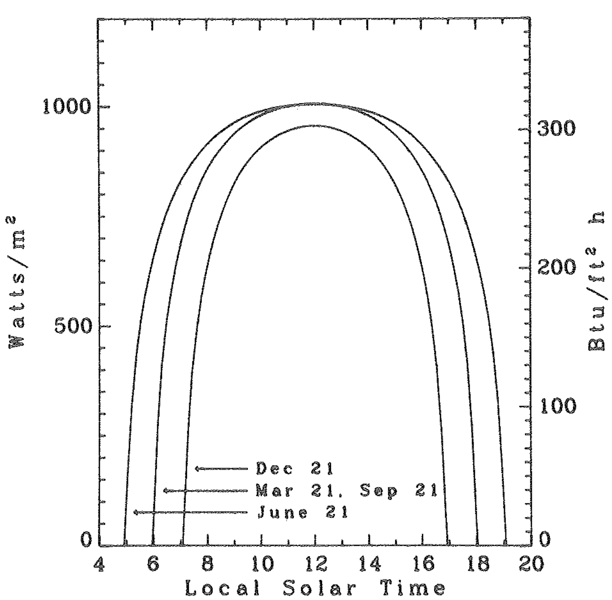


Possible Error in Direct Beam (Normal Incidence)
El Centro

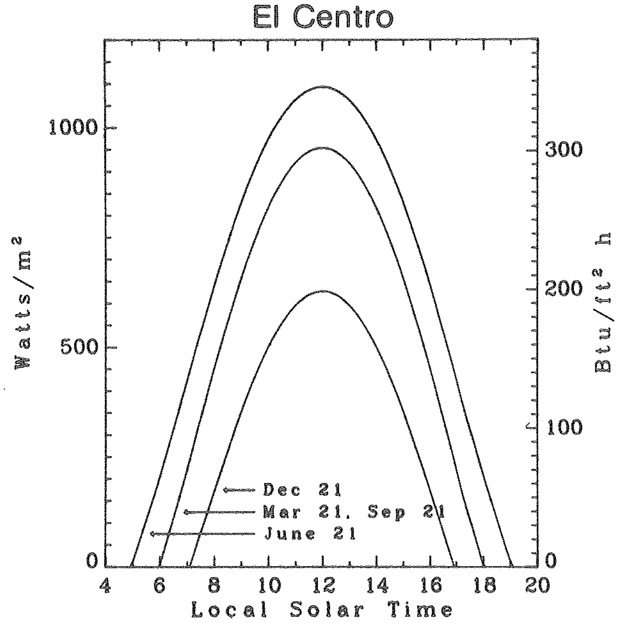


Clear Day Plots for Solar Radiation

Direct Beam (Normal Incidence)
El Centro



Total Radiation on a Horizontal Surface
El Centro



Total Radiation on a Tilted Surface (Calculated Values)
Metric Units (kWh/m²)
El Centro

DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	145	151	199	228	247	238	226	225	207	180	151	136	2335
SOUTH	30	170	167	207	223	228	215	207	215	210	194	174	161	2370
SOUTH	45	183	172	203	204	197	180	176	191	199	196	186	176	2264
SOUTH	60	185	167	186	172	155	137	137	157	177	186	185	180	2024
SOUTH	75	175	152	157	131	106	88	92	115	144	165	173	172	1670
SOUTH	90	155	127	120	83	55	41	47	68	102	133	151	153	1234
SE,SW	15	135	143	192	225	246	240	227	223	201	171	141	126	2270
SE,SW	30	149	152	195	218	231	221	211	213	200	179	154	141	2265
SE,SW	45	155	152	187	201	206	193	186	194	189	176	158	148	2145
SE,SW	60	151	143	170	175	173	159	155	166	169	163	153	145	1922
SE,SW	75	138	127	145	142	134	121	120	132	141	142	139	134	1615
SE,SW	90	118	104	114	105	94	83	84	96	108	115	117	115	1252
E,W	15	110	123	175	214	244	241	227	217	187	151	117	101	2109
E,W	30	105	117	165	201	228	225	212	204	176	143	112	97	1985
E,W	45	98	108	151	182	205	202	191	184	160	131	103	90	1805
E,W	60	88	96	133	159	177	174	164	160	141	116	93	81	1581
E,W	75	75	82	112	132	146	142	135	133	118	98	79	70	1322
E,W	90	61	66	89	103	113	110	105	104	93	79	64	57	1044

GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)

SURFACE ORIENT-ATION	ANGLE OF TILT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ANY	15	0	0	1	1	1	1	1	1	1	1	0	0	7
ANY	30	2	2	2	3	3	3	3	3	3	2	2	1	29
ANY	45	3	4	5	6	7	7	7	7	6	5	4	3	63
ANY	60	6	6	9	11	13	12	12	11	10	8	6	5	108
ANY	75	8	9	13	16	19	18	17	17	14	11	9	8	160
ANY	90	11	13	18	22	25	25	23	22	19	15	12	10	216

Total Radiation on a Tilted Surface (Calculated Values)
Engineering Units (kBtu/ft²)
El Centro

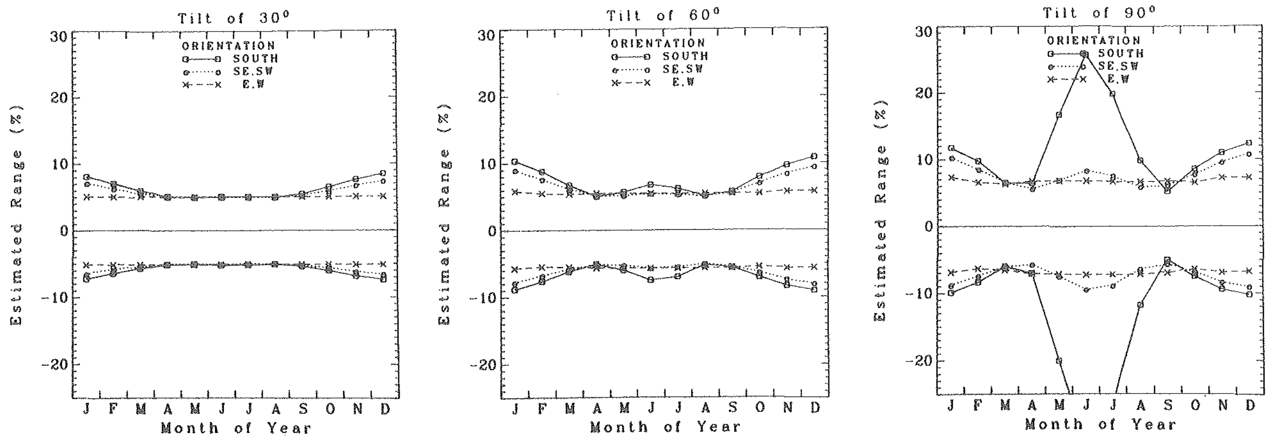
DIRECT BEAM + DIFFUSE (GROUND REFLECTION EXCLUDED)

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SOUTH	15	46	48	63	72	78	75	72	71	66	57	48	43	740
SOUTH	30	54	53	66	71	72	68	65	68	66	62	55	51	751
SOUTH	45	58	55	64	65	62	57	56	61	63	62	59	56	717
SOUTH	60	59	53	59	55	49	43	43	50	56	59	59	57	641
SOUTH	75	56	48	50	42	34	28	29	36	46	52	55	54	529
SOUTH	90	49	40	38	26	17	13	15	21	32	42	48	49	391
SE,SW	15	43	45	61	71	78	76	72	71	64	54	45	40	719
SE,SW	30	47	48	62	69	73	70	67	68	64	57	49	45	717
SE,SW	45	49	48	59	64	65	61	59	61	60	56	50	47	680
SE,SW	60	48	45	54	55	55	50	49	53	54	52	49	46	609
SE,SW	75	44	40	46	45	42	38	38	42	45	45	44	43	512
SE,SW	90	37	33	36	33	30	26	27	31	34	36	37	37	397
E,W	15	35	39	55	68	77	76	72	69	59	48	37	32	668
E,W	30	33	37	52	64	72	71	67	65	56	45	35	31	629
E,W	45	31	34	48	58	65	64	60	58	51	42	33	29	572
E,W	60	28	30	42	50	56	55	52	51	45	37	29	26	501
E,W	75	24	26	35	42	46	45	43	42	37	31	25	22	419
E,W	90	19	21	28	33	36	35	33	33	30	25	20	18	331

GROUND REFLECTION FOR REFLECTIVITY = .2 (MULTIPLY BY RHO/.2 FOR REFLECTIVITY = RHO)

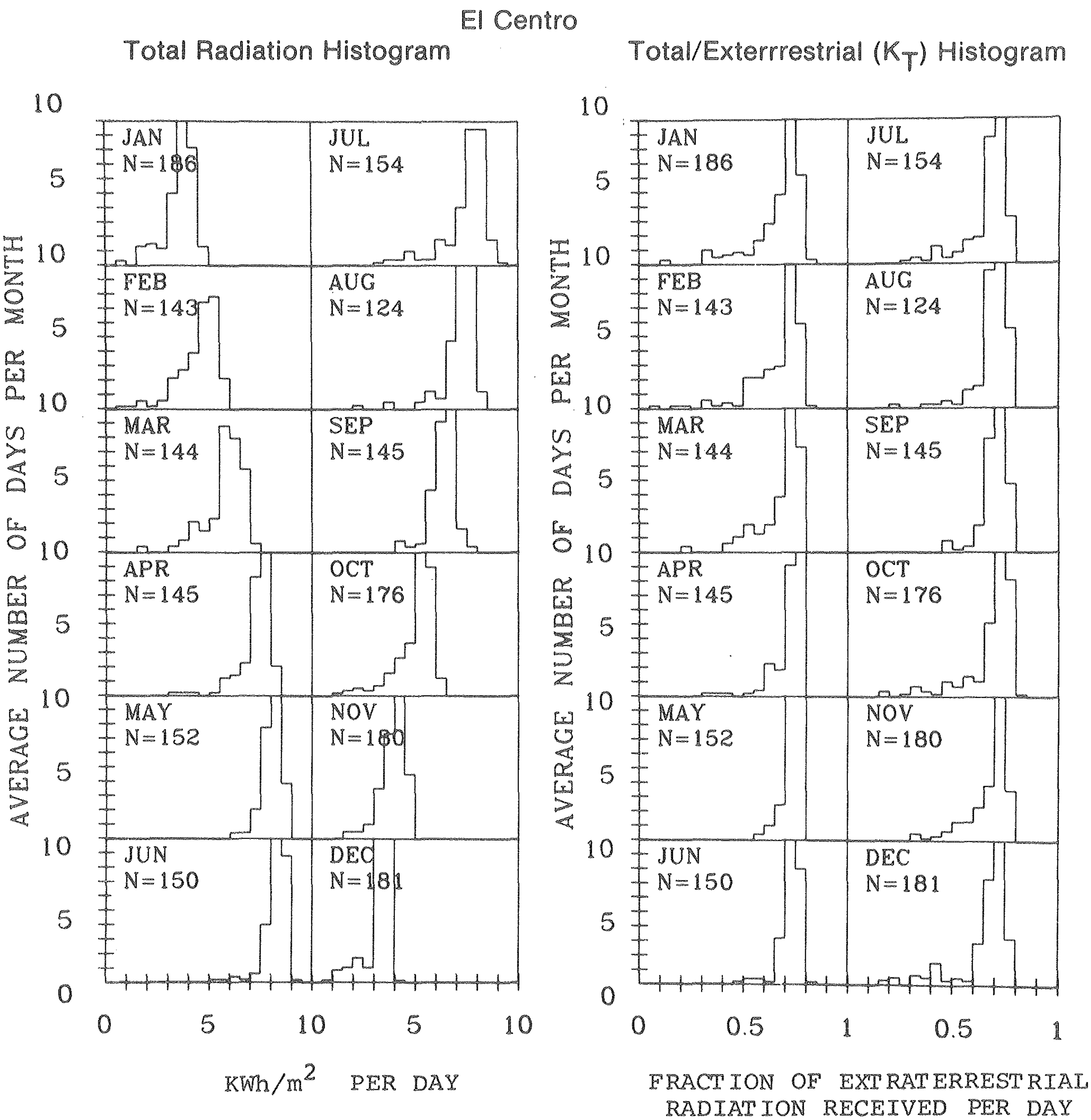
SURFACE ORIENT-ATION	ANGLE OF TILT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ANY	15	0	0	0	0	0	0	0	0	0	0	0	0	2
ANY	30	0	1	1	1	1	1	1	1	1	1	1	0	9
ANY	45	1	1	2	2	2	2	2	2	2	1	1	1	20
ANY	60	2	2	3	3	4	4	4	4	3	2	2	2	34
ANY	75	3	3	4	5	6	6	5	5	4	4	3	2	51
ANY	90	4	4	6	7	8	8	7	7	6	5	4	3	68

Possible Error in the Total Radiation on a Tilted Surface
El Centro



Factor to Convert Direct Beam Radiation on a Horizontal Surface to Direct Beam on a Tilted Surface, Calculated using Nominal Solar Profile
El Centro

SURFACE ORIENT-ATION	ANGLE OF TILT (DEGREES FROM HOR-IZONTAL)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SOUTH	15	1.39	1.27	1.15	1.05	.99	.96	.97	1.02	1.11	1.22	1.35	1.43
SOUTH	30	1.69	1.45	1.23	1.03	.91	.85	.87	.97	1.14	1.35	1.61	1.77
SOUTH	45	1.88	1.53	1.22	.94	.77	.70	.73	.86	1.09	1.39	1.76	1.99
SOUTH	60	1.93	1.51	1.12	.79	.59	.50	.54	.69	.97	1.34	1.79	2.07
SOUTH	75	1.86	1.38	.96	.59	.38	.29	.32	.48	.78	1.20	1.69	2.00
SOUTH	90	1.65	1.16	.72	.35	.15	.08	.11	.25	.54	.97	1.48	1.81
SE,SW	15	1.27	1.18	1.10	1.03	.99	.96	.97	1.01	1.07	1.15	1.24	1.30
SE,SW	30	1.46	1.29	1.14	1.01	.92	.88	.90	.97	1.08	1.22	1.40	1.51
SE,SW	45	1.55	1.31	1.11	.93	.82	.76	.78	.87	1.02	1.22	1.46	1.62
SE,SW	60	1.53	1.26	1.01	.81	.68	.62	.64	.74	.92	1.15	1.44	1.62
SE,SW	75	1.42	1.12	.86	.65	.51	.45	.48	.58	.77	1.01	1.32	1.52
SE,SW	90	1.22	.93	.68	.47	.35	.29	.32	.41	.58	.81	1.12	1.32
E,W	15	.98	.98	.98	.97	.97	.97	.97	.97	.98	.98	.98	.98
E,W	30	.94	.93	.92	.91	.91	.90	.90	.91	.92	.92	.93	.94
E,W	45	.87	.86	.84	.82	.81	.81	.81	.82	.83	.85	.87	.88
E,W	60	.79	.76	.74	.72	.70	.69	.69	.71	.73	.75	.78	.80
E,W	75	.68	.65	.62	.59	.57	.56	.57	.59	.61	.64	.67	.69
E,W	90	.56	.53	.50	.46	.44	.43	.44	.45	.48	.51	.55	.57
NORMAL INCIDENCE		2.36	1.99	1.72	1.55	1.48	1.46	1.47	1.51	1.64	1.86	2.23	2.47



These histograms show the average number of days per month that the daily total solar radiation on a horizontal surface and the fraction of extraterrestrial radiation reach various levels. Each histogram represents data from a single month averaged over the years for which reliable data are available. The number (N) on each histogram is the actual number of daily values evaluated for that month.

VI. Climate Data

This section is divided into two parts. The first contains the climate tables, and the second contains limited climate data stations.

A. CLIMATE TABLES

To permit readers to consider climate information from several stations nearest a particular solar data station, the climate tables are arranged in the same order in which they are mentioned in the solar zones.

*Indicates a NWS Narrative Summary follows.

a) EUREKA

Climatological Data for Eureka

Latitude: 40°48' Longitude: 124°10' Elevation: 43'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	47.3	48.4	48.3	49.7	52.5	55.2	56.3	57.0	56.6	54.4	51.7	48.6	52.2
average daily max/min	54/41	54/42	54/43	55/44	57/48	60/51	60/52	61/53	62/51	60/48	58/46	55/43	58/47
extreme max/min	75/25	85/27	78/29	79/32	84/36	85/41	76/45	82/44	85/41	82/32	77/29	77/21	85/21
DEGREE DAYS													
heating (base 65°F)	549	464	518	459	388	294	270	248	252	329	399	508	4679
cooling (base 65°F)	0	0	0	0	0	0	0	0	0	0	0	0	0
WIND													
Mean speed (mph)	6.9	7.2	7.6	8.0	7.9	7.4	6.8	5.8	5.5	5.6	6.0	6.4	6.8
Max. speed* (mph)	54	48	48	49	40	39	35	34	44	56	43	56	56
Prevailing direction	SE	SE	N	N	N	N	N	NW	N	N	SE	SE	N
FREEZE DAYS PER MONTH	2	1	<0.5	<0.5	0	0	0	0	0	<0.5	<0.5	1	5
PRECIPITATION (in. water)													
average	7.42	5.15	4.83	2.95	2.11	0.66	0.14	0.27	0.65	3.23	5.77	6.58	39.76
max/min	13.9/1.63	13.9/0.50	14.0/0.07	10.7/0.31	6.05/0.03	2.57/0.00	1.34/0.00	1.98/0.00	3.56/0.00	13.0/0.00	16.6/T	12.9/1.17	16.6/0.00
RELATIVE HUMIDITY(%) 4 AM, 10 AM, 4 PM, 10 PM	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*"fastest mile"; speed is fastest observed 1-minute value.
Source of climatological data: NWS climatic summary.

Narrative Climatological Summary for Eureka

Humboldt Bay is 1/4 mile north and 1 mile west of the station. There are no hills in Eureka of any consequence. The land slopes upward gently from the Bay towards the Coast Range, which begins about 3 miles east of the station and reaches the top of its first ridge approximately 10 miles to the east. The average elevation of the ridge is about 2000 feet. This ridge extends in a semicircle from a point 20 miles north of Eureka to a point 25 miles south.

The climate of Eureka being completely maritime, high humidity prevails the entire year, which is divided into the "rainy" season and the "dry" season. The rainy season begins in October and continues through April. About 90% of the year's precipitation falls during this period. The dry season extends from May through September and is marked by considerable fog or low cloudiness.

Usually, however, the fog clears in the late forenoon with the early afternoons generally sunny.

Temperatures are moderate during the entire year. Although the highest temperature ever recorded was 85°, and the lowest 20°, the usual range is from a low of about 35° to a high of about 75°. The daily range of temperature averages from about 9° in the summer months to 13° in the winter months, and is occasionally not over 2° to 3°. (Source: NWS)

b) SAN RAFAEL

Climatological Data for San Rafael (Hamilton AFB)

Latitude: 38°04' Longitude: 122°30' Elevation: 14'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	47	51	53	56	60	64	66	66	66	61	53	48	57
average daily max/min	54/39	59/42	62/43	67/45	71/48	77/51	79/52	79/52	79/52	73/49	63/43	55/40	68/46
extreme max/min	77/23	75/25	81/30	89/30	102/36	106/42	102/44	102/44	104/40	96/34	83/28	73/26	106/23
DEGREE DAYS†													
heating (base 65°F)	580	414	391	275	170	72	31	44	47	153	357	543	3077
cooling (base 65°F)	0	0	0	5	6	48	68	72	68	13	0	0	280
WIND													
Mean speed (mph)	6	6	6	6	7	7	6	6	5	5	5	6	6
Max. speed* (mph)	64	86	48	56	52	47	37	53	53	74	61	61	86
Prevailing direction	E	NW	NW	NW	NW	NW	SE	SE	SE	NW	NW	E	NW
FREEZE DAYS PER MONTH	7	3	1	<0.5	0	0	0	0	0	0	1	4	16
PRECIPITATION (in. water)													
average	5.7	4.6	3.2	1.8	0.5	0.2	T	T	0.2	1.7	2.9	5.2	26.0
max	3.6	3.2	2.3	2.8	0.8	1.8	T	0.1	2.3	3.9	3.3	3.9	3.9
RELATIVE HUMIDITY(%)													
4 AM	89	86	84	85	85	83	87	87	84	83	85	89	86
1 PM	73	67	60	58	55	52	53	54	51	55	63	73	60

* Peak gust speed.

† Data for Kentfield 37°57'N 122°33' W, Elevation 120'

Source of climatological data: AWS climatic summary.

c) SAN FRANCISCO (FEDERAL OFFICE BUILDING)

Climatological Data for San Francisco (Federal Office Building)

Latitude: 37°47' Longitude: 122°25' Elevation: 52'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	50.9	53.4	54.3	55.3	56.7	58.7	58.5	59.4	62.2	61.4	57.4	52.0	56.7
average daily max/min	56/46	59/48	60/49	61/49	63/51	65/53	64/53	65/54	69/56	68/55	63/52	57/47	62/51
extreme max/min	79/30	75/36	83/38	86/40	93/44	101/47	92/47	96/48	101/48	94/45	86/41	76/30	101/30
DEGREE DAYS													
heating (base 65°F)	437	325	332	291	257	194	202	177	102	127	233	403	3080
cooling (base 65°F)	0	0	0	0	0	5	0	0	18	16	0	0	39
WIND													
Mean speed (mph)	6.7	7.5	8.5	9.5	10.4	10.9	11.2	10.5	9.1	7.6	6.3	6.5	8.7
Max. speed* (mph)	47	47	44	38	38	40	38	34	32	43	41	45	47
Prevailing direction	N	W	W	W	W	W	W	W	W	W	W	N	W
FREEZE DAYS PER MONTH	<0.5	0	0	0	0	0	0	0	0	0	0	<0.5	<0.5
PRECIPITATION (in. water)													
average	4.51	2.97	2.77	1.63	0.54	0.17	0.01	0.05	0.17	1.06	2.60	4.18	20.66
max/min	10.7/1.00	8.49/0.04	8.22/0.12	5.47/T	3.19/T	1.42/0.00	0.62/0.00	0.49/0.00	2.06/0.00	5.51/T	7.80/T	11.5/0.18	11.5/0.00
RELATIVE HUMIDITY(%)													
4 AM	81	83	81	82	89	89	92	93	87	81	82	80	85
10 AM	72	70	61	59	65	70	73	73	64	62	69	71	67
4 PM	63	63	61	61	68	72	74	73	66	60	63	63	66
10 PM	76	78	76	80	86	88	90	90	82	74	76	74	81

*"fastest mile"; speed is fastest observed 1-minute value.

Source of climatological data: NWS climatic summary.

Narrative Climatological Summary for San Francisco (Federal Office Building)

San Francisco's unique location at the northern end of a narrow peninsula that separates San Francisco Bay from the Pacific Ocean and forms the southern shore of the Golden Gate — the only sea-level entrance through the Coastal Mountains into the Great Valley — causes San Francisco to be known as the air conditioned City, with cool pleasant summers and mild winters. Flowers bloom throughout the year, and warm clothing is needed in every month.

Sea fogs, and the low stratus cloudiness associated with them, constitute another striking characteristic of San Francisco's climate. In the summertime, the temperature of the Pacific Ocean is unusually low near the coast and atmospheric pressure relatively high, while the interior of California is characterized by the opposite in both elements. This tends strongly to intensify the landward movement of air and to make the prevailing westerly winds brisk and persistent, especially during the period from May to August. The fog or low-lying stratus cloudiness off the coast is carried inland by strong westerly winds during the afternoon or night and evaporated during the subsequent forenoon. Notwithstanding the occurrence of these stratus clouds, the sun shines on an average of 66% of the daylight hours in downtown San Francisco.

As a result of the steady sweep of air from the Pacific, there are few extremes of heat or cold. During the entire period of temperature records in San Francisco, temperatures have risen to 90° or higher on an average of only once a year and dropped below freezing less than once a year. As a rule, abnormally warm or cool periods last only a few days.

The diurnal land- and sea-breeze characteristic of many coastal regions does not prevail here. Winds from the land are extremely rare, and it is during these infrequent and brief interludes in the normal west wind of the warm months that the occasional hot days occur.

Pronounced wet and dry seasons are another characteristic of this climate. On the average, 84% of the total annual precipitation falls during the five-month period, November to March, leaving only 16% for the remaining seven months of the year. Measurable amounts of precipitation fall on less than 70 days a year.

There are wide contrasts in climate within short distances in the San Francisco Bay area, some of which are described briefly for the Peninsula in the Local Climatological Data for San Francisco Airport, and for the East Bay area in the Oakland Airport Local Climatological Data. Moreover, even within the city of San Francisco there are differences in climate, the most obvious being the greater frequency and duration of fog or low cloudiness along the western or Pacific coastal side of the City.

The nearby communities in Marin County, lying just to the north across the Golden Gate and sheltered from the prevailing ocean winds by the fairly high peaks and ridges of the Coast Range, enjoy generally warmer and sunnier weather than San Francisco. Their climate is further modified by proximity to San Francisco and San Pablo Bays to the east. In general, temperatures increase from south to north, with correspondingly greater daily ranges, and also increase slightly with distance from the bays. Daily maximum temperatures for July average 16° warmer at San Rafael and 18° warmer at Kentfield than at San Francisco. As in San Francisco, there are well-defined wet and dry seasons, but rainfall amounts are strongly influenced by the topography of the Coast Range. Annual average rainfall varies from 26 inches at Hamilton Field to about 40 inches at San Rafael and 49 inches at Kentfield. During the summer stratus season, low overcast frequently covers the entire area during the early morning hours, but clearing begins early in the forenoon, especially in the more northern portions of the County. Wind direction is a critical factor in the occurrence of late afternoon and evening fogs or clouds in the Sausalito and Belvedere areas on the north side of the Golden Gate. Fog with winds from a direction slightly north of west seldom affects these areas, but ocean fog usually reaches them when the wind is a few points south of west. This fog extends less frequently to more northern communities of the County.

The climate of the coastal strip from Half Moon Bay to the south, to Bolinas Bay to the north, is characterized by cool, foggy summers and mild winters. July and August are the foggiest months, but even then there is often some midday clearing. Rainfall along the coastal strip averages slightly more than at San Francisco. (Source: NWS)

d) OAKLAND

Climatological Data for Oakland

Latitude: 37°44' Longitude: 122°12' Elevation: 6'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	48.6	51.9	53.7	56.1	58.9	61.9	63.1	63.5	64.5	61.1	55.3	49.9	57.4
average daily max/min	55/43	58/46	60/47	63/49	65/52	69/55	70/56	70/57	72/57	69/53	62/49	56/44	64/51
extreme max/min	74/32	74/37	82/35	88/39	98/43	94/50	99/52	89/50	96/49	89/42	78/37	73/26	99/26
DEGREE DAYS													
heating (base 65°F)	508	367	350	270	193	114	80	74	59	135	291	468	2909
cooling (base 65°F)	0	0	0	0	0	21	21	28	44	14	0	0	128
WIND													
Mean speed (mph)	6.7	7.3	9.0	9.5	10.0	10.0	9.3	9.0	7.8	6.8	6.3	6.5	8.2
Max. speed* (mph)	46	49	45	35	38	42	28	29	33	43	46	48	49
Prevailing direction	SE	W	W	W	W	W	WNW	WNW	WNW	WNW	WNW	E	W
FREEZE DAYS PER MONTH	<0.5	0	0	0	0	0	0	0	0	0	0	1	1
PRECIPITATION (in. water)													
average	4.03	2.83	2.32	1.58	0.55	0.14	0.01	0.03	0.18	1.08	2.37	3.57	18.69
max/min	8.90/0.65	8.85/0.02	5.69/0.04	4.60/T	3.42/T	1.21/0.00	0.80/0.00	0.34/0.00	3.27/0.00	8.56/T	7.42/0.00	11.3/0.28	11.3/0.00
RELATIVE HUMIDITY(%)													
4 AM	83	81	80	80	83	85	87	87	83	80	82	82	83
10 AM	77	75	72	68	71	74	76	76	73	72	75	75	74
4 PM	72	69	66	63	65	68	68	68	64	64	69	71	67
10 PM	80	79	76	76	79	82	84	84	80	77	78	80	79

*"fastest mile"; speed is fastest observed 1-minute value.

Source of climatological data: NWS climatic summary.

Narrative Climatological Summary for Oakland

The climate of Oakland has three outstanding features; mild year-round temperatures; low overcast, clearing by noon with almost no rain during the summer; and copious rains during the winter.

Located on the east shore of San Francisco Bay, Oakland enjoys a climate more equable than would be expected if only latitude were considered. Because of the prevailing westerly winds from the Pacific, where temperature varies very little between winter and summer, winters are mild and summers are cool. On an average of about 4 days a year, when northeasterly winds have overcome the prevailing westerly wind, daytime temperatures may reach into the nineties, and on rare occasions (6 times since 1928) temperatures of 100° or higher have been recorded. Although during the winter about 6 days with minimum temperatures of 32° or below can be expected, some flowers are usually in bloom, and hardy shrubs seldom are damaged. The average date of the last freeze in the spring is February 3, but freezing temperatures have been reported as late as April 6. The average date of the first freeze in the fall is December 12, although temperatures of 32° or lower have been observed as early as November 4.

Since 1928 the total annual rainfall has ranged from a low of 8.34 inches in 1929 to a high of 29.54 inches in 1941. About 90% of the annual total rainfall is received in the six months, November through April. During the 100-day period, June 15 - September 22, the normal rainfall is only 0.07 inch. In spite of the almost rainless summers, however, cooling sea breezes, morning overcast and rather high relative humidity prevent any semblance of a desert climate.

Separating Oakland both geographically and climatically from its neighboring communities to the north and east, is a range of hills 700 to 1900 feet in height, roughly paralleling the Bay shore and lying about 4 miles inland. East of these hills, summers are normally free of fog, have low humidities, and afternoon temperatures 15° to 25° higher than Oakland. In Antioch, for instance, the mean daily maximum temperature for July, the warmest month, is 92°; in Walnut Creek 86°, and in Livermore 88°. In winter, local variations in temperature are not so apparent, with the entire East Bay area registering daily high and low temperatures comparable to those of Oakland.

The broad valleys of Contra Costa County and southern Alameda County are subject to nighttime and early morning radiation-type fogs in the winter, particularly after a period of rain when skies are clear and the air damp and still. These fogs occur with a frequency somewhat greater than Oakland's average of 18 days per year, and the persistency of the fogs is a bit greater, with little or no clearing on some days.

As in Oakland, summers in the nearby communities are almost rainless, with most of the precipitation falling during the October through April period. Although rain normally occurs no more frequently than in Oakland, average annual amounts vary considerably from place to place, with the greatest amounts occurring in the hilly area just north and east of Oakland. A 6-year record at Orinda (Bowman) indicates an annual total of more than 27 inches; Berkeley receives on an average more than 23 inches; and Walnut Creek more than 19 inches. Farther north along the shores of Suisun Bay, and to the south in southern Alameda County, rainfall amounts drop off rapidly; annual totals at Martinez averaging 13.97 inches, Antioch 12.53 inches, Livermore 14.55 inches, and Newark 13.64 inches. (Source: NWS)

e) SAN FRANCISCO (INTERNATIONAL AIRPORT)

Climatological Data for San Francisco (International Airport)

Latitude: 37°37' Longitude: 122°23' Elevation: 8 '

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	48.3	51.2	53.0	55.3	58.3	61.6	62.5	63.0	64.1	61.0	55.3	49.7	56.9
average daily max/min	55/41	59/44	61/45	64/47	67/50	70/53	71/54	72/54	74/55	70/52	63/47	57/43	65/49
extreme max/min	71/29	72/35	79/31	85/38	94/48	106/45	98/48	98/49	103/45	95/39	85/35	72/24	106/24
DEGREE DAYS													
heating (base 65°F)	518	386	372	291	210	120	93	84	66	137	291	474	3042
cooling (base 65°F)	0	0	0	0	0	18	16	22	39	13	0	0	108
WIND													
Mean speed (mph)	7.1	8.5	10.3	12.1	13.1	13.9	13.6	12.8	11.0	9.2	7.2	6.8	10.5
Max. speed* (mph)	58	52	40	46	41	44	38	36	38	44	47	47	58
Prevailing direction	WNW	WNW	WNW	WNW	W	W	NW	NW	NW	WNW	WNW	WNW	WNW
FREEZE DAYS PER MONTH	2	0	<0.5	0	0	0	0	0	0	0	0	1	3
PRECIPITATION (in. water)													
average	4.37	3.04	2.54	1.59	0.41	0.13	0.01	0.03	0.16	0.98	2.29	3.98	19.53
max/min	10.4/0.31	9.52/T	9.01/T	6.36/T	3.81/T	0.86/0.0	0.23/0.0	0.29/T	2.30/T	7.30/T	7.94/0.0	12.3/0.21	12.3/0.0
RELATIVE HUMIDITY(%)													
4 AM	86	84	81	82	85	86	88	88	84	81	84	86	84
10 AM	79	75	70	65	65	65	66	67	66	68	74	78	70
4 PM	67	65	63	60	61	60	61	62	59	59	65	69	62
10 PM	81	79	77	78	80	81	83	84	79	76	78	81	80

*"fastest mile"; speed is fastest observed 1-minute value.
Source of climatological data: NWS climatic summary.

Narrative Climatological Summary for San Francisco (International Airport)

The station is located in the Terminal Building of the San Francisco International Airport, which is on flat filled tideland on the west shore of San Francisco Bay. The bay borders the airport from the north to the south-southeast. San Bruno Mountain, 5 miles to the north-northwest, rises to 1300 feet. A north-south trending ridge of Coastal Mountains, 4 miles to the west, varies in elevation from 700 to 1900 feet, being highest southward along the peninsula. The Pacific Ocean west of the ridge is 6 miles from the airport. A broad gap to the northwest of the station, between San Bruno Mountain and the Coastal Mountains, allows a strong flow of marine air over the station and this feature exercises a dominant control over the local climate.

San Francisco Airport and nearby towns of San Bruno and South San Francisco enjoy a marine-type climate characterized by mild and moderately wet winters and by dry, cool summers. Winter rains (December through March) account for about three-fourths of the average annual rainfall, and measurable precipitation occurs on an average of 10 days per month during this period. However, there are frequent dry periods lasting well over a week. Severe winter storms with gale winds and heavy rains occur only occasionally. Thunderstorms average two a year and may occur in any month, but are usually very mild.

The daily and annual range in temperature is small. A few frosty mornings occur during the winter but the temperature seldom drops below freezing. Winter temperatures generally rise to the high fifties in the early afternoon.

The summer weather is dominated by a cool sea breeze resulting in an average summer wind speed of nearly 15 mph. Winds are light in the early morning but normally reach 20 to 25 mph in the afternoon.

A sea fog, arriving over the station during the late evening or night as a low stratified cloud, is another persistent feature of the summer weather. This "high" fog, occasionally producing drizzle or mist, usually disappears during the late forenoon. Despite the morning overcast, summer days are remarkably sunny. On the average a total of only 15 days during the 4 months from June through September are classified as cloudy.

Daytime temperatures are held down both by the morning low overcast and the afternoon strengthening sea breeze, resulting in daily maximum readings averaging under 70° from May through August. However, during these months occasional "hot" spells, lasting a few days, are experienced without the usual "high" fog and sea breeze. September, when the sea breeze becomes less pronounced, is the warmest month with an average maximum of 72°. Minimum temperatures during the summer are near 51°.

Southward along the peninsula east of the Coastal Mountains summers are warmer and less windy, due to the diminishing influence of the sea breeze. However, areas adjacent to a pass or saddle in the Coastal Mountains are usually cooler and more windy than areas protected by higher ridges. Thus, the highly populated area from Millbrae to Palo Alto enjoys a modified Mediterranean-type climate. The winters are much the same as for the San Francisco Airport, but protected spots, as for example, Woodside, are 5° to 10° colder than the airport on clear, calm nights. The summers are sunny and warm. For instance, San Mateo's average daily maximum temperature in summer is above 76° and Palo Alto, farther south, is even warmer and less windy than the peninsula communities to its north. The low overcast often occurs in the southern peninsula area for a few hours in the morning, but persists longer and comes in earlier in the northern section. Summer nights on the peninsula are comfortably cool, with minimum temperatures averaging in the low fifties.

The coastside of the peninsula area, containing relatively sparse and small agricultural communities, has a more exclusive marine-type climate. In summer, due to the greater persistence of fog and low overcast, the daily temperature range is less, with daytime temperatures lower than those experienced east of the Coastal Mountains. The winter months are generally free of fog and during this period due to the more direct, moderating influence of the Pacific Ocean, nighttime temperatures do not drop as low as those on the east side. The additional orographic lifting provided by the Coastal Mountains produces somewhat heavier rainfall amounts along the coastal strip and adjacent mountain area than on the east side of the peninsula. (Source: NWS)

f) MOUNTAIN VIEW (MOFFETT FIELD NAS)

Climatological Data for Mountain View (Moffett Field AFB)

Latitude: 37°25' Longitude: 122 03' Elevation: 34'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	48	52	53	57	59	64	65	65	65	61	55	50	58
average daily max	56	60	62	66	68	73	73	73	75	71	64	57	67
average daily min	40	43	44	47	50	54	56	56	55	51	46	42	49
extreme max	76	75	83	87	98	104	95	96	96	92	87	76	104
extreme min	21	26	30	32	38	43	45	47	41	33	29	27	21
DEGREE DAYS †													
heating (base 65°F)	549	400	378	271	164	74	34	33	57	149	342	518	2969
cooling (base 65°F)	0	0	0	0	9	47	65	58	57	0	0	0	236
WIND													
Mean speed (mph)	6	6	7	7	7	8	7	7	6	6	5	6	6
Max. speed* (mph)	64	64	51	49	44	46	35	36	38	55	53	62	64
Prevailing direction	SE	SE	NNW	NNW	NNW	NNW	NNW	NNW	NNW	NNW	NNW	SE	NNW
FREEZE DAYS PER MONTH	4	1	<0.5	<0.5	0	0	0	0	0	0	1	2	8
PRECIPITATION (in. water)													
average	2.9	1.9	1.9	1.1	0.4	0.1	T	T	0.2	0.6	1.7	2.5	13.3
max/min	2.3	1.5	1.3	1.2	0.7	0.4	0.3	0.2	2.0	2.5	2.8	2.2	2.8
RELATIVE HUMIDITY(%)													
4 AM	85	85	82	83	83	83	86	86	82	81	84	86	84
1 PM	66	63	58	57	58	58	62	61	55	54	60	67	60

* Peak gust speed.
† Data for Palo Alto Jr. Museum 37°24'N 122° 08'W Elevation 25'
Source of climatological data: AWS climatic summary.

The area is primarily agricultural, with vegetable and other produce crops thriving successfully the year round. Minimum temperatures of 32°F or slightly lower occur, on the average, about 23 times during the winter months and necessitate the rotation of crops to the hardier varieties during this season. Precipitation, particularly during the summer months, is insufficient for some crops and is supplemented by irrigation from subterranean water reserves. High humidity and moderate temperatures, however, substantially limit the irrigation requirement.

The rainfall season, typical of the mid-California coast, is in the winter. About three-fourths of the total annual rainfall occurs from December through March in connection with Pacific cold fronts and storm centers passing inland. During the remainder of the year, and particularly from June to October, the northward displacement and intensification of the semipermanent Pacific anticyclone produces a circulation resulting in little or no precipitation here. Thunderstorms are rare.

During most days, clear, sunshiny afternoons prevail. But under the influence of the Pacific anticyclone, considerable advectional and radiational cooling results in the almost nightly occurrence of low stratus clouds — the California stratus — and often of early-morning radiational fog. Both clouds and fog, however, are generally dissipated before noon.

The unequal daytime solar heating over land and ocean, in conjunction with the Pacific "high," gives rise to a consistent and prevailing westerly sea breeze during most afternoons, the winds generally decreasing to a calm by sundown. Thus the two factors of nighttime stratus and daytime sea breezes effectively combine to maintain relatively cool days and warm nights with little diurnal change. (Source: NWS)

i) OXNARD (OXNARD AFB)

Climatological Data for Oxnard (Oxnard AFB)

Latitude: 34°13' Longitude: 119°05' Elevation: 94'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	53	54	54	57	59	62	66	67	66	63	57	55	60
average daily max/min	64/41	65/43	65/43	67/46	68/49	71/53	75/57	76/57	76/55	74/51	69/45	67/43	70/49
extreme max/min	87/25	89/30	89/30	97/31	95/36	101/42	94/45	96/46	105/43	101/35	97/31	93/27	105/25
DEGREE DAYS†													
heating (base 65°F)	351	297	304	242	180	116	68	51	56	109	202	310	2286
cooling (base 65°F)	0	6	0	0	0	14	74	69	53	38	10	0	264
WIND													
Mean speed (mph)	6	6	6	6	6	5	5	5	5	5	6	7	5
Max. speed* (mph)	54	51	49	41	41	26	25	24	37	51	58	52	58
Prevailing direction	ENE	ENE	WSW	WSW	WSW	WSW	WSW	WSW	WSW	WSW	ENE	ENE	WSW
FREEZE DAYS PER MONTH	2	1	<0.5	<0.5	0	0	0	0	0	0	<0.5	1	4
PRECIPITATION (in. water)													
average	2.5	2.7	1.4	1.3	0.1	0.1	T	T	0.1	0.1	1.9	1.5	11.7
max/min	4.2	4.2	2.0	2.0	0.4	0.6	T	0.1	0.6	0.5	1.7	2.2	4.2
RELATIVE HUMIDITY(%)													
4 AM	71	77	82	87	88	90	91	91	89	82	75	66	82
1 PM	50	51	56	57	58	62	62	63	59	54	51	47	56

* Peak gust speed.
† Data for Oxnard 34°12'N 119°11'W Elevation 49'
Source of climatological data: AWS climatic summary.

j) SAN BERNARDINO (NORTON AFB)

Climatological Data for San Bernardino (Norton AFB)

Latitude: 34°06' Longitude: 117°14' Elevation: 1166'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	51	53	55	61	65	70	77	77	75	66	57	52	64
average daily max/min	63/38	66/40	68/42	74/47	78/51	85/55	94/60	94/60	91/58	81/51	71/43	65/39	78/49
extreme max/min	86/20	87/26	89/26	99/32	100/36	112/42	109/47	110/46	113/42	105/35	93/27	85/25	113/20
DEGREE DAYS†													
heating (base 65°F)	403	311	283	167	65	22	0	0	13	52	206	369	1891
cooling (base 65°F)	0	9	7	35	72	193	409	409	301	108	14	0	1557
WIND													
Mean speed (mph)	5	5	5	5	5	5	5	5	3	3	3	3	5
Max. speed* (mph)	79	63	54	54	46	55	45	64	69	66	59	74	79
Prevailing direction	E	E	SW	SW	WSW	WSW	WSW	WSW	WSW	WSW	E	E	WSW
FREEZE DAYS PER MONTH	7	4	2	<0.5	0	0	0	0	0	0	1	4	18
PRECIPITATION (in. water)													
average	2.1	1.9	1.7	1.3	0.4	0.1	0.1	0.1	0.4	0.4	1.4	1.7	11.6
max/min	4.0	1.9	1.5	1.6	1.2	0.5	0.3	0.9	1.9	0.9	2.0	2.4	4.0
RELATIVE HUMIDITY(%)													
4 AM	74	77	80	82	83	82	77	77	74	74	71	72	77
1 PM	42	41	43	41	41	37	28	30	31	34	36	41	37

* Peak gust speed.

† Data for San Bernardino County Hospital 34°08'N 117°16'W, Elevation 1125'

Source of climatological data: AWS climatic summary.

k) LOS ANGELES (CIVIC CENTER)

Climatological Data for Los Angeles (Civic Center)

Latitude: 34°03' Longitude: 118°14' Elevation: 270'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	56.7	58.1	59.2	61.7	64.7	68.0	73.2	74.1	72.7	68.4	62.7	58.1	64.8
average daily max/min	67/47	68/49	69/50	71/53	73/56	77/60	83/64	84/64	83/63	78/59	73/52	68/48	74/55
extreme max/min	95/28	91/34	94/38	99/39	102/46	106/50	103/54	103/53	110/51	104/41	100/39	89/32	110/28
DEGREE DAYS													
heating (base 65°F)	268	207	190	124	60	25	0	0	5	35	113	218	1245
cooling (base 65°F)	10	14	10	25	51	115	258	282	236	140	44	0	1185
WIND													
Mean speed (mph)	6.8	6.9	7.0	6.6	6.3	5.7	5.4	5.3	5.3	5.7	6.4	6.6	6.2
Max. speed* (mph)	49	40	47	40	39	32	21	24	27	48	42	44	49
Prevailing direction	NE	W	W	W	W	W	W	W	W	W	W	NE	W
FREEZE DAYS PER MONTH	<0.5	0	0	0	0	0	0	0	0	0	0	<0.5	<0.5
PRECIPITATION (in. water)													
average	3.00	2.77	2.19	1.27	0.13	0.03	0.00	0.04	0.17	0.27	2.02	2.16	14.05
max/min	14.9/0.00	12.4/T	8.14/0.00	6.02/0.00	1.43/0.00	0.32/0.00	0.03/0.00	0.39/0.00	1.80/0.00	1.53/0.00	9.68/0.00	6.57/T	14.9/0.00
RELATIVE HUMIDITY(%)													
4 AM	63	71	74	78	81	85	84	84	78	76	61	62	75
10 AM	51	54	52	53	56	59	54	56	52	55	45	45	53
4 PM	50	52	52	54	55	56	53	55	54	56	49	50	53
10 PM	67	70	72	74	75	78	79	79	76	74	62	62	72

*"fastest mile"; speed is fastest observed 1-minute value.

Source of climatological data: NWS climatic summary.

Narrative Climatological Summary for Los Angeles (Civic Center)

The climate of Los Angeles is normally pleasant and mild through the year. The Pacific Ocean is the primary moderating influence, but coastal mountain ranges lying along the north and east sides of the Los Angeles coastal basin act as a buffer against extremes of summer heat and winter cold occurring in desert and plateau regions in the interior. A variable balance between mild sea breezes, and either hot or cold winds from the interior, results in some variety in weather conditions, but temperature and humidity are usually well within the limits of human comfort. An important, and somewhat unusual, aspect of the climate of the Los Angeles metropolitan area, is the pronounced difference in temperature, humidity, cloudiness, fog, rain, and sunshine over fairly short distances.

These differences are closely related to the distance from and elevation above the Pacific Ocean. Both high and low temperatures become more extreme and the average relative humidity becomes lower as one goes inland and up foothill slopes. On the coast and in the lower coastal plain, average daily temperature ranges are about 15° in summer and 20° in winter, but in foothill and inland valley communities these ranges increase to about 30° in summer and 25° in winter. Relative humidity is frequently high near the coast, but may be quite low along the foothills. During periods of high temperatures, the relative humidity is usually below normal so that discomfort is rare, except for infrequent periods when high temperatures and high humidities occur together.

Like other Pacific Coast areas, most rainfall comes during the winter with nearly 85% of the annual total occurring from November through March, while summers are practically rainless. As in many semiarid regions, there is a marked variability in monthly and seasonal totals. Annual precipitation may range from less than a third of the normal value to nearly three times normal, while some customarily rainy months may be either completely rainless, or receive from three to four times the average for the month. Precipitation generally increases with distance from the ocean from a yearly total of around 12 inches in coastal sections to the south of the City up to over 20 inches in foothill areas. Destructive flash floods occasionally develop in and below some mountain canyons. Snow is often visible on nearby mountains in the winter, but is extremely rare in the coastal basin. Thunderstorms are infrequent.

Prevailing winds are from the west during the spring, summer, and early autumn, with northeasterly wind predominating the remainder of the year. Average wind speeds are rather low. At times, the lack of air movement, combined with a frequent and persistent temperature inversion, is associated with concentrations of air pollution in the Los Angeles coastal basin and some adjacent areas. In fall, winter, and early spring months, occasional foehn-like descending (Santa Ana) winds come from the northeast over ridges and through passes in the coastal mountains. These Santa Ana winds may pick up considerable amounts of dust and reach speeds of 35 to 50 mph in north and east sections of the City, with higher speeds in outlying areas to the north and east, but rarely reach coastal portions of the City.

Sunshine, fog, and clouds depend a great deal on topography and distance from the ocean. Low clouds are common at night and in the morning along the coast during spring and summer, but form later and clear earlier near the foothills so that average annual cloudiness and fog frequencies are greatest near the ocean, and sunshine totals are highest on the inland side of the City. The sun shines about 75% of daytime hours at the Civic Center. Light fog may accompany the usual night and morning low clouds, but dense fog is more likely to occur during night and early morning hours of the winter months. (Source: NWS)

I) LOS ANGELES (INTERNATIONAL AIRPORT)

Climatological Data for Los Angeles (International Airport)

Latitude: 33°56' Longitude: 118°24' Elevation: 97'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	54.5	55.6	56.5	58.8	61.9	64.5	68.5	69.5	68.7	65.2	60.5	56.9	61.7
average daily max/min	64/45	64/47	64/49	66/52	68/55	70/59	75/62	76/63	76/62	73/58	70/51	67/47	69/54
extreme max/min	87/30	92/37	88/39	95/43	96/45	92/50	92/55	91/58	110/55	106/43	101/38	88/32	110/30
DEGREE DAYS													
heating (base 65°F)	331	270	267	195	114	71	19	15	23	77	158	267	1819
cooling (base 65°F)	5	7	0	9	17	56	127	154	134	83	23	0	615
WIND													
Mean speed (mph)	6.7	7.3	8.0	8.4	8.2	7.8	7.6	7.5	7.1	6.8	6.6	6.6	7.4
Max. speed* (mph)	48	57	62	59	45	32	29	33	28	46	55	49	62
Prevailing direction	W	W	W	WSW	WSW	WSW	WSW	WSW	WSW	W	W	W	W
FREEZE DAYS PER MONTH	<0.5	0	0	0	0	0	0	0	0	0	0	<0.5	<0.5
PRECIPITATION (in. water)													
average	2.52	2.32	1.71	1.10	0.08	0.03	0.01	0.02	0.07	0.22	1.76	2.39	11.59
max/min	9.60/0.00	11.1/T	5.98/0.00	4.52/0.00	0.56/0.00	0.29/0.00	0.15/0.00	0.30/0.00	4.39/0.00	2.34/0.00	7.92/0.00	6.57/T	11.1/0.00
RELATIVE HUMIDITY(%)													
4 AM	68	73	78	79	82	85	86	85	83	79	75	70	79
10 AM	54	58	61	60	65	70	68	68	65	58	58	55	62
4 PM	59	62	66	63	66	68	68	69	67	64	64	61	65
10 PM	69	71	75	76	79	83	83	83	81	77	74	70	76

*"fastest mile"; speed is fastest observed 1-minute value.
Source of climatological data: NWS climatic summary.

Narrative Climatological Summary for Los Angeles (International Airport)

Predominating influences on the climate of the Los Angeles International Airport are the Pacific Ocean, 3 miles to the west; the southern California coastal mountain ranges that line the inland side of the coastal plain surrounding the airport, and the large-scale weather patterns that allow Pacific storm paths to extend as far south as the Los Angeles area only during late fall, winter, and early spring. Marine air covers the coastal plain most of the year, but air from the interior reaches the coast at times, especially during the fall and winter months. The coast ranges act as a buffer to the more extreme conditions of the interior. Pronounced differences in temperature, humidity, cloudiness, fog, sunshine, and rain occur over fairly short distances on the coastal plains and the adjoining foothills due to the local topography and the decreased marine effect further inland. In general, temperature ranges are least and humidity highest close to the coast, while precipitation increases with elevation on the foothills.

The most characteristic feature of the climate of the coastal plain around the station is the night and morning low cloudiness and sunny afternoons, which prevail during the spring and summer months and occur often during the remainder of the year. Combined with the westerly sea breeze at Los Angeles International Airport, the coastal low cloudiness is associated with mild temperatures throughout the year. Daily temperature range is usually less than 15° in spring and summer but increases to around 20° in fall and winter. Hot weather is not frequent at any season along the coast, although readings have exceeded 85° at the airport occasionally in every month of the year when air from the interior reached the coast. When high temperatures do occur the humidity is almost always low so that discomfort is unusual. Nighttime temperatures are generally cool but minimum temperatures below 40° are rare and periods of over 10 years have passed with no readings below freezing at the airport. Prevailing daytime winds are from the west, but night and early morning breezes are usually light and from the east and northeast. Strongest winds observed at the station have been from the west and north following winter storms. At times during the fall, winter, and spring, gusty dry northeasterly "Santa Ana" winds blow over southern California mountains and through passes to the coast, but very rarely reach Los Angeles International Airport. The extremely dry air and the dust clouds associated with them can be expected at the station several times each year, however.

Precipitation occurs mainly in the winter. Measurable rain may fall on an average of about one day in four from late October into early April, but in three years out of four traces or less are reported for the entire months of July and August. Thunderstorms do not occur often near the coast, but showers and thunderstorms are observed over the coastal ranges at times during the summer when moist air from the south and southeast invades southern California. Annual rainfall at Los Angeles International Airport is somewhat less than that recorded on the Palos Verdes Hills rising to an elevation of near 1500 feet on a peninsula 12 miles to the south, and on the Hollywood Hills and Santa Monica Mountains which extend east-west 12 miles north of the station with peaks reaching to near 2000 feet. Traces of snow have fallen at Los Angeles International Airport only a few times, melting as they fell. Snow is visible on mountains from 30 to 100 miles to the east and northeast, however, at times every winter.

Visibility at Los Angeles International Airport is frequently restricted by haze, fog, or smoke. Low visibilities are favored by a layer of moist marine air with warm dry air above. Lowest visibilities usually occur with weak winds, but at times a moderate afternoon sea breeze will bring a fog bank ashore and over the airport. Light fog occurs at some time nearly every month, but heavy fog is observed least during the summer and can be expected on about one night or early morning in four during the winter. (Source: NWS)

m) RIVERSIDE (MARCH AFB)

Climatological Data for Riverside (March AFB)

Latitude: 33°54' Longitude: 117°15' Elevation: 1543'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	51	52	55	59	64	70	76	77	74	66	58	53	63
average daily max/min	62/39	64/40	67/42	72/46	77/50	84/55	92/60	92/61	89/58	80/51	71/44	66/40	76/49
extreme max/min	85/18	87/22	92/27	97/32	103/36	110/43	109/48	107/47	110/44	103/36	93/26	90/23	110/18
DEGREE DAYS†													
heating (base 65°F)	406	312	283	168	74	22	0	0	5	62	212	375	1919
cooling (base 65°F)	6	7	7	27	68	160	341	347	257	96	8	0	1324
WIND													
Mean speed (mph)	5	5	6	6	6	6	6	6	5	5	5	5	6
Max. speed* (mph)	53	49	47	44	39	45	49	40	45	45	46	56	56
Prevailing direction	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NE	NW
FREEZE DAYS PER MONTH	6	3	1	<0.5	0	0	0	0	0	0	1	3	14
PRECIPITATION (in. water)													
average	1.8	1.6	1.4	1.0	0.1	T	T	0.1	0.3	0.3	1.0	1.5	9.1
max/min	3.1	1.6	1.8	1.6	0.5	0.2	0.2	1.3	1.9	0.8	2.1	2.7	3.1
RELATIVE HUMIDITY(%)													
4 AM	73	78	82	85	84	83	74	75	74	76	71	71	77
1 PM	39	41	42	41	39	36	28	29	30	32	34	38	36

* Peak gust speed.
† Data for Riverside Fire Station #3, 33°57'N 117°23'N, Elevation 840'
Source of climatological data: AWS climatic summary.

n) LONG BEACH

Climatological Data for Long Beach

Latitude: 33°49' Longitude: 118°09' Elevation: 25'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	54.2	55.5	57.2	60.6	64.1	67.3	72.2	73.3	71.8	66.9	60.6	55.5	63.3
average daily max/min	65/43	66/45	68/47	71/51	74/54	77/58	83/62	84/63	83/60	78/56	73/48	67/44	74/53
extreme max/min	89/25	91/33	88/33	99/38	103/40	108/47	100/51	105/56	110/50	111/39	101/35	85/31	111/25
DEGREE DAYS													
heating (base 65°F)	339	273	247	148	71	23	0	0	7	48	155	295	1606
cooling (base 65°F)	0	7	0	16	43	92	226	260	211	107	23	0	985
WIND													
Mean speed (mph)	5.6	6.2	7.0	7.5	7.3	7.0	6.7	6.5	6.1	5.9	5.7	5.3	6.4
Max. speed* (mph)	37	40	35	44	30	21	23	23	23	37	35	39	44
Prevailing direction	WNW	W	W	W	S	S	WNW	WNW	WNW	WNW	WNW	WNW	WNW
FREEZE DAYS PER MONTH	<0.5	0	0	0	0	0	0	0	0	0	0	<0.5	1
PRECIPITATION (in. water)													
average	2.26	2.16	1.50	0.89	0.07	0.04	0.00	0.02	0.09	0.19	1.38	1.65	10.25
max/min	11.2/0.00	7.88/0.00	4.20/0.00	4.42/T	0.67/0.00	0.52/0.00	0.05/0.00	0.22/0.00	1.31/0.00	2.08/0.00	6.05/T	5.98/T	11.2/0.00
RELATIVE HUMIDITY(%)													
4 AM	72	76	77	78	79	81	80	80	81	80	78	76	78
10 AM	57	60	60	56	61	64	61	60	60	57	59	60	60
4 PM	51	52	54	49	54	56	52	52	54	52	54	53	53
10 PM	70	72	72	71	75	76	75	75	76	75	74	73	74

*"fastest mile"; speed is fastest observed 1-minute value.
Source of climatological data: NWS climatic summary.

o) SANTA ANA (EL TORO MCAS)

Climatological Data for Santa Ana (El Toro MCAS)

Latitude: 33°40' Longitude: 117°44' Elevation: 383'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	54	55	56	59	62	66	71	72	71	66	60	56	63
average daily max/min	64/44	65/45	66/46	69/49	72/52	76/56	82/60	82/61	82/59	77/55	71/49	66/46	73/52
extreme max/min	93/25	88/30	88/32	101/33	101/39	103/44	103/48	102/47	116/44	108/38	97/35	93/30	116/25
DEGREE DAYS†													
heating (base 65°F)	372	298	279	177	94	38	0	0	9	64	195	341	1867
cooling (base 65°F)	0	7	0	9	29	77	181	209	165	70	12	0	759
WIND													
Mean speed (mph)	6	6	6	6	6	6	6	6	6	6	6	6	6
Max. speed* (mph)	67	75	61	53	55	33	54	41	49	52	72	69	75
Prevailing direction	E	E	W	W	W	W	W	W	W	W	E	E	W
FREEZE DAYS PER MONTH	1	<0.5	<0.5	0	0	0	0	0	0	0	0	<0.5	1
PRECIPITATION (in. water)													
average	2.4	1.8	1.9	1.3	0.2	0.1	T	0.1	0.2	0.3	1.5	1.9	11.7
max/min	5.2	2.1	2.5	2.2	0.5	0.3	0.3	0.7	1.2	0.7	2.8	2.4	5.2
RELATIVE HUMIDITY(%)													
4 AM	70	74	81	85	86	88	88	83	83	79	70	69	80
1 PM	52	53	55	55	55	56	52	53	51	51	48	51	53

* Peak gust speed.
† Data for Tustin Irvine Ranch 33°44'N 117°47'W, Elevation 118'
Source of climatological data: AWS climatic summary.

p) SAN DIEGO

Climatological Data for San Diego

Latitude: 32°44' Longitude: 117°10' Elevation: 13'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	55.2	56.7	58.1	60.7	63.3	65.5	69.6	71.4	69.9	66.1	60.8	56.7	62.9
average daily max/min	65/46	66/48	66/50	68/54	69/57	71/60	75/64	77/65	77/63	74/58	70/52	66/47	70/55
extreme max/min	86/31	85/38	85/39	91/44	91/48	90/51	92/57	90/58	111/56	107/43	97/38	88/36	111/31
DEGREE DAYS													
heating (base 65°F)	314	237	219	144	79	52	6	0	16	43	140	257	1507
cooling (base 65°F)	10	0	0	15	26	67	149	201	163	77	14	0	722
WIND													
Mean speed (mph)	5.6	6.3	7.2	7.6	7.6	7.5	7.1	7.0	6.7	6.3	5.7	5.5	6.7
Max. speed* (mph)	39	35	46	37	27	26	23	23	25	31	51	34	51
Prevailing direction	NE	WNW	WNW	WNW	WNW	SSW	WNW	WNW	NW	WNW	NE	NE	WNW
FREEZE DAYS PER MONTH	<0.5	0	0	0	0	0	0	0	0	0	0	0	<0.5
PRECIPITATION (in. water)													
average	1.88	1.48	1.55	0.81	0.15	0.05	0.01	0.07	0.13	0.34	1.25	1.73	9.45
max/min	6.26/T	5.31/0.00	5.89/T	3.58/T	0.95/0.00	0.38/0.00	0.13/0.00	0.87/0.00	1.90/0.00	2.90/0.00	5.82/0.00	7.60/0.03	7.60/0.00
RELATIVE HUMIDITY(%)													
4 AM	68	72	74	74	76	80	81	80	78	74	73	70	75
10 AM	54	56	59	58	64	69	69	67	65	58	57	55	61
4 PM	55	57	59	58	63	67	66	66	64	61	63	57	61
10 PM	68	71	72	71	74	78	79	78	77	73	73	70	74

*"fastest mile"; speed is fastest observed 1-minute value.
Source of climatological data: NWS climatic summary.

Narrative Climatological Summary for San Diego

The city of San Diego is located on San Diego Bay in the southwest corner of southern California. The prevailing winds and weather are tempered by the Pacific Ocean, with the result that summers are cool and winters warm in comparison with other places along the same general latitude. Temperatures freezing or below have occurred only eleven times at the station since the record began in 1871, but hot weather (90°F or above) is more frequent.

Dry easterly winds sometimes blow in the vicinity for several days at a time, bringing temperatures in the nineties, and at times even in the hundreds, in the eastern sections of the City and outlying suburbs. At the National Weather Service station itself, however, there have been only 15 days on which 100° or higher was reached.

As these hot winds are predominant in the fall, highest temperatures occur in the months of September and October. Records show that 62% of the days with 90° or higher have occurred in these two months. High temperatures are almost invariably accompanied by very low relative humidities, which often drop below 20% and occasionally below 10%.

A marked feature of the climate is the wide variation in temperature within short distances. In nearby valleys daytimes are much warmer in summer and nights noticeably cooler in winter, and freezing occurs much more frequently than in the City. Although records show unusually small daily temperature ranges, averaging only about 15° between the highest and lowest readings, a few miles inland these ranges increase to 30° or more.

Strong winds and gales are infrequent in the region, and in San Diego harbor (which is landlocked) velocities over 30 mph occur only about once each year on the average.

The seasonal rainfall is near 10 inches in the City, but increases with elevation and distance from the coast, and in the mountains to the north and east the average is between 20 and 40 inches, depending on slope and elevation. Most of the precipitation falls in winter, except in the mountains where there is an occasional thundershower. Eighty-five percent of the rainfall occurs from November through March, but wide variations take place in monthly and seasonal totals. Irrigation is extensively practiced, not only during the long dry summers and autumns, but also in years with deficient rainfall. Infrequent measurable amounts of hail occur in San Diego, but only twice has snow been observed at the Weather Service Office location. The first occurrence was on January 10, 1949. Light snow, mixed with rain, melted as it fell. On December 13, 1967, snow pellets (or graupel) fell between 7:30 and 8:50 a.m. A trace was recorded, and remained on the ground for about 5 minutes before melting. Some nearby areas within 5 miles of the station received larger amounts of snow, both in pellet and flake form. In some locations amounts up to or slightly exceeding a half-inch fell, and remained on the ground for an hour or more.

As on the rest of the Pacific Coast, a dominant characteristic of spring and summer is the nighttime and early morning cloudiness. Low clouds form regularly, and frequently extend inland over the coastal valleys and foothills, but they usually dissipate during the morning and the afternoons are generally clear.

Considerable fog occurs along the coast, but the amount decreases with distance inland. The fall and winter months are usually the foggiest. Thunderstorms are rare, averaging about three a year in the City. Visibilities are good as a rule. The sunshine is plentiful for a marine location, with a marked increase toward the interior. (Source: NWS)

q) REAM FIELD (IMPERIAL BEACH NAS)

Climatological Data for Ream Field (Imperial Beach NAS)

Latitude: 32°34' Longitude: 117°07' Elevation: 33'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	55	55	57	59	62	64	68	70	68	65	59	55	61
average daily max/min	64/45	63/47	64/49	65/52	67/56	68/59	72/63	74/65	74/62	72/57	68/50	64/46	68/54
extreme max/min	83/27	83/35	84/35	88/42	92/44	89/48	84/53	85/56	108/52	105/43	98/36	85/31	108/27
DEGREE DAYS†													
heating (base 65°F)	384	314	304	216	144	81	27	13	38	94	209	338	2162
cooling (base 65°F)	0	0	0	0	0	15	76	115	95	32	0	0	333
WIND													
Mean speed (mph)	7	7	7	8	7	7	6	6	6	6	7	7	7
Max. speed* (mph)	55	44	41	55	32	31	31	30	35	38	59	46	59
Prevailing direction	E	E	W	W	W	W	W	W	W	W	E	E	W
FREEZE DAYS PER MONTH	<0.5	0	0	0	0	0	0	0	0	0	0	<0.5	<0.5
PRECIPITATION (in. water)													
average	1.5	1.1	1.0	1.1	0.2	0.1	T	T	0.2	0.3	1.4	1.1	8.0
max	1.6	1.1	1.6	1.2	0.5	0.4	0.1	0.1	1.1	0.6	1.9	1.4	1.9
RELATIVE HUMIDITY(%)													
4 AM	77	82	84	86	84	87	88	87	86	83	79	78	83
1 PM	61	64	67	68	68	71	73	72	71	69	63	61	67

* Peak gust speed.
† Data for Chula Vista 32°36'N 117°06'W, Elevation 9'
Source of climatological data: AWS climatic summary.

r) MEDFORD, OREGON

Climatological Data for Medford, Oregon

Latitude: 42°22' Longitude: 122°52' Elevation: 1298'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	36.6	41.3	44.8	50.2	57.3	64.3	71.7	70.4	64.4	53.4	43.5	37.7	53.0
average daily max/min	44/29	52/31	57/33	64/37	72/43	79/49	90/54	88/53	82/47	67/39	53/34	44/31	66/40
extreme max/min	70/0	77/10	81/21	88/24	98/28	109/34	108/38	109/39	106/31	94/18	75/14	72/-6	109/-6
DEGREE DAYS													
heating (base 65°F)	880	664	626	444	250	94	11	21	89	360	645	846	4930
cooling (base 65°F)	0	0	0	0	11	73	218	189	71	0	0	0	562
WIND													
Mean speed (mph)	4.2	4.4	5.3	5.8	5.7	5.9	5.7	5.3	4.5	3.7	3.5	3.6	4.8
Max. speed* (mph)	50	46	55	35	38	33	44	48	32	40	38	44	55
Prevailing direction	SSE	S	NNW	WNW	WNW	WNW	WNW	WNW	WNW	S	N	N	WNW
FREEZE DAYS PER MONTH	20	17	14	9	1	0	0	0	<0.5	5	9	15	90
PRECIPITATION (in. water)													
average	3.54	2.15	1.64	1.00	1.44	0.89	0.25	0.33	0.56	2.05	3.10	3.69	20.64
max/min	6.67/0.51	5.37/0.21	5.54/0.29	3.07/0.16	4.58/0.07	3.49/0.00	1.63/0.00	1.52/0.00	2.31/0.00	9.16/T	8.62/0.01	12.7/0.74	12.7/0.00
RELATIVE HUMIDITY(%)													
4 AM	89	87	85	83	82	78	73	74	76	86	91	88	83
10 AM	87	83	70	62	56	46	44	47	50	71	87	87	66
4 PM	73	58	49	44	38	33	26	26	27	45	69	75	47
10 PM	87	81	74	69	64	59	50	53	58	77	87	86	70

*"fastest mile"; speed is fastest observed 1-minute value.

Source of climatological data: NWS climatic summary.

Narrative Climatological Summary for Medford, Oregon

Medford is located in a mountain valley formed by the famous Rogue River and one of its tributaries, Bear Creek. The major portion of the valley ranges in elevation from 1300 to 1400 feet. Mountains surround the valley on all sides; to the east the Cascades, ranging from 4000 to 9500 feet; to the south the Siskiyous, ranging from 3000 to 7600 feet; and to the west and north, the Coast Range and Umpqua Divide, ranging from 3500 to 5500 feet above sea level. The valley's outlet to the ocean 80 miles westward is the narrow canyon of the Rogue River.

Medford has a moderate climate of marked seasonal characteristics. Late fall, winter, and early spring months are damp, cloudy, and cool under the influence of marine air. Late spring, summer, and early fall are warm, dry, and sunny due to the dry continental nature of the prevailing winds aloft that cross this area.

The rain shadow afforded by the Siskiyous and Coast Range results in a relatively light annual rainfall, most of which falls during the winter season. Scanty summertime rainfall is brought by thunderstorm activity, which affects the mountains to the south and east for the most part, but occasionally spreads over the valley. Snowfall is quite heavy in the surrounding mountains during the winter providing excellent skiing, as well as adequate irrigation water storage, which is necessary for production of most commercial crops during the dry summer. Valley snowfall is light; individual accumulations of snow seldom last more than 24 hours, and present little hindrance to transportation on the valley's floor.

Few extremes of temperature occur. In wintertime, the average daily minimum temperature dips slightly below freezing during December and January. On only rare occasions since records began in 1911 have minimums dropped below zero. The first occasion and lowest temperature, 10° below zero, occurred at the City Park Cooperative Observatory on December 13, 1919. The second, 3° below zero, occurred on January 11, 1930 at the Medford Airport and the third, 6° below zero, on December 8, 9 and 10, 1972, followed by 3° below zero on the 11th. The 1972 cold spell was unusually prolonged with a record four consecutive days of minimum temperatures below zero. High temperatures in the summer months average slightly below 90°, with extremes occasionally climbing to or slightly above the 100° mark. High temperatures are always accompanied by low humidity, and hot days give way to cool nights as cool air drains down the mountain slopes into the valley. The average length of the growing season is 170 days, from April 30 to October 17. Latest date of 32° or lower in the spring is June 12, and the earliest date of 32° or lower in the fall is September 13. Longest growing season on record was 203 days in 1944.

Winds are normally very light in the valley, prevailing from the south in the winter, and from the northwest the remainder of the year. Highest velocities are reached when a well-developed storm off the northern California coast causes a foehn or chinook wind off the Siskiyou Mountains to the south; speeds to 50 mph are common, and gusts to 70 mph have been felt occasionally. Summer thunderstorms afford gusty winds to 40 or 50 mph which may come from any direction.

Fog often fills the lower portion of the valley during the winter and early spring months, when rapid clearing of the sky after a storm allows nocturnal cooling of the entrapped, moist air to the saturation point. Duration of the fog is seldom more than 3 days; usually only 1 or 2 days. Smoke sources are the numerous sawmill refuse burners throughout the area. Smoke occasionally reduces visibility to 1 to 3 miles under stable conditions in the morning hours. (Source: NWS)

s) MOUNT SHASTA

Climatological Data for Mount Shasta

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Latitude: 41°19' Longitude: 122°19' Elevation: 3544'													
TEMPERATURE(°F)													
average monthly	33.6	37.8	40.4	46.3	53.3	60.0	67.8	66.0	61.2	51.4	41.7	35.5	49.6
average daily max/min	42/25	47/28	51/30	59/34	67/40	74/46	85/51	83/49	78/45	65/38	52/32	44/27	62/37
extreme max/min	65/-2	71/1	80/11	84/14	91/21	96/25	100/31	103/34	103/25	92/19	80/14	72/-5	103/-5
DEGREE DAYS													
heating (base 65°F)	973	762	763	561	371	178	37	64	145	422	699	915	5890
cooling (base 65°F)	0	0	0	0	8	28	124	95	31	0	0	0	286
WIND Mean speed (mph) Max. speed* (mph) Prevailing direction	None	None	None	None	None	None	None	None	None	None	None	None	None
FREEZE DAYS PER MONTH	26	21	21	13	3	<0.5	<0.5	0	1	6	18	25	135
PRECIPITATION (in. water)													
average	6.65	5.61	4.03	3.05	1.87	1.08	0.32	0.31	0.69	2.54	5.09	6.25	37.49
max/min	14.8/0.49	17.6/0.21	11.9/0.29	9.67/0.13	5.28/0.01	3.25/0.00	1.77/0.00	2.47/0.00	6.83/T	13.9/T	17.2/T	17.5/0.40	17.6/0.00
RELATIVE HUMIDITY(%)													
4 AM	80	78	77	72	70	71	69	67	60	71	83	85	74
10 AM	75	70	62	54	51	49	40	40	43	54	70	75	57
4 PM	69	61	53	43	41	37	29	28	32	47	64	70	48
10 PM	79	77	71	63	56	54	49	48	50	66	81	83	65

*"fastest mile"; speed is fastest observed 1-minute value.

Source of climatological data: NWS climatic summary.

t) RED BLUFF

Climatological Data for Red Bluff

Latitude: 40°09' Longitude: 122°15' Elevation: 342'	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	45.2	50.0	53.2	59.5	67.4	75.5	82.3	79.9	75.3	65.0	53.7	46.4	62.8
average daily max/min	54/37	60/40	64/43	72/47	81/54	89/62	98/67	96/64	91/60	78/52	64/43	55/38	75/51
extreme max/min	79/20	83/23	92/26	98/31	108/35	114/42	119/52	118/52	114/42	104/32	93/27	81/20	119/20
DEGREE DAYS													
heating (base 65°F)	614	420	366	218	64	8	0	0	0	82	339	577	2688
cooling (base 65°F)	0	0	0	53	139	323	536	462	309	82	0	0	1904
WIND													
Mean speed (mph)	9.1	9.3	9.9	9.6	9.2	9.3	8.0	7.6	7.9	8.4	8.6	8.5	8.8
Max. speed* (mph)	59	61	63	50	46	38	38	30	50	68	56	60	68
Prevailing direction	SSE	SSE	SSE	SSE	SSE	SSE	SSE	SSE	SSE	NW	NW	NW	SSE
FREEZE DAYS PER MONTH	10	3	1	<0.5	0	0	0	0	0	<0.5	1	7	22
PRECIPITATION (in. water)													
average	4.48	3.17	2.51	1.79	0.98	0.47	0.04	0.18	0.31	1.17	3.05	3.91	22.06
max/min	8.63/0.39	11.4/0.02	8.33/0.01	5.79/0.05	4.04/0.0	1.26/0.0	0.69/0.0	1.56/0.0	2.47/0.0	4.30/T	8.42/T	10.1/T	11.4/0.0
RELATIVE HUMIDITY(%)													
4 AM	81	79	74	68	64	55	50	52	51	62	75	82	66
10 AM	72	66	57	46	40	35	30	32	33	44	61	73	49
4 PM	59	51	44	35	29	23	18	19	21	32	51	62	37
10 PM	78	73	67	58	51	41	37	39	41	54	70	78	57

*"fastest mile"; speed is fastest observed 1-minute value.
Source of climatological data: NWS climatic summary.

Narrative Climatological Summary for Red Bluff

Red Bluff is located in the northern end of the Sacramento Valley, which is the northern half of the Great Central Valley of California. Mountains surround the City on three sides, forming a huge horseshoe. The Coastal Range is located about 30 miles to the west, the Sierra Nevada system about 40 miles to the east, and the Cascade Range about 50 miles to the northeast and north, completing the horseshoe. The western portion of the valley floor is composed mostly of rolling hills with a growth of scrub oak in areas that have not been cultivated, but considerable acreage has been planted to grains with the remainder in demand for winter grazing for large herds of cattle and sheep.

The Sacramento River, the flow of which is maintained by the Great Shasta Reservoir, courses through the eastern portion of the valley in a north-south direction, through fertile orchard and grain lands. At the present time no great amount of the river water is used for irrigation in the north end of the valley. Climatic conditions in the Red Bluff area apparently are not influenced by the Sacramento River, but drainage from the western slopes of Mt. Lassen, Mt. Shasta, and the Trinity Alps definitely have a marked influence on climatic conditions in the area, especially in orchard districts in the eastern portion of the valley.

Precipitation is confined mostly to rain during the winter and spring months, when the Pacific storms cross the area. The Coastal Range of mountains to the west, however, remove a great portion of the moisture from air masses moving eastward, usually resulting in lighter precipitation over the valley floor. Snowfall is infrequent and usually very light in amount. Precipitation during the late spring and summer months is confined to occasional thunderstorm activity and is quite light in amount.

Temperatures are highest during the months of June through September, when daytime readings very frequently surpass the 100° mark; however, nighttime temperatures during this period are nearly always comfortable. Winter months see the nighttime temperatures drop below the freezing mark frequently. Minimum temperatures are watched very closely during the late winter and early spring months by agricultural interests, as marginal temperatures frequently occur during the early development stages of almond and peach crops, as well as in early field crops.

Sunshine, which averages 77% of possible during the year, reaches its maximum during the long nearly cloudless summer and autumn days with 90 to 95% of possible sunshine recorded. These warm days with low relative humidity are ideal for fruit drying and curing other agricultural products of the area.

Wind movement is usually light and the direction is normally parallel with the valley. Strongest wind movement generally occurs during the winter months, in conjunction with storm areas moving through the Pacific Northwest, with highest velocities generally from the south. Summer and early fall winds are either southerly in direction, with a cooling effect, or northerly and warm and very dry, with a desiccating effect during the late summer.
(Source: NWS)

u) BEALE AFB

Climatological Data for Beale AFB

Latitude: 39°07' Longitude: 121°26' Elevation: 123'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	44	50	53	58	65	74	80	77	73	65	53	46	62
average daily max/min	51/36	59/41	63/42	69/46	77/52	89/59	96/63	93/61	88/58	78/52	63/43	53/38	74/49
extreme max/min	74/22	79/28	83/26	87/34	97/38	111/44	109/52	105/50	109/48	97/36	81/29	72/24	111/22
DEGREE DAYS†													
heating (base 65°F)	605	406	335	186	58	9	0	0	0	76	333	577	2585
cooling (base 65°F)	0	0	0	42	107	261	428	369	255	58	0	0	1520
WIND													
Mean speed (mph)	6	7	7	7	7	7	6	6	6	6	6	5	6
Max. speed* (mph)	55	44	46	39	39	37	32	35	46	53	55	55	55
Prevailing direction	S	S	SSE	S	S	S	S	S	S	S	S	S	S
FREEZE DAYS PER MONTH	11	3	2	0	0	0	0	0	0	0	2	7	25
PRECIPITATION (in. water)													
average	3.7	4.0	2.8	2.2	0.7	0.1	T	T	0.4	2.2	3.1	2.3	21.5
max/min	2.5	3.5	2.5	2.1	1.0	0.2	T	T	2.0	5.5	3.2	1.8	5.5
RELATIVE HUMIDITY(%)													
4 AM	87	84	80	80	74	67	59	61	64	69	79	85	74
1 PM	69	60	52	47	38	31	27	28	31	39	55	70	46

*Peak gust speed

† Data for Marysville 39°09'N 121°35' W. Elevation 60'

Source of climatological data: AWS climatic summary.

v) SACRAMENTO

Climatological Data for Sacramento

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Latitude: 38°31' Longitude: 121°30' Elevation: 17'													
TEMPERATURE(°F)													
average monthly	45.1	49.8	53.0	58.3	64.3	70.5	75.2	74.1	71.5	63.3	53.0	45.8	60.3
average daily max/min	53/37	59/40	64/42	71/45	79/50	86/55	93/58	91/57	88/55	77/50	64/42	53/38	73/47
extreme max/min	69/23	76/26	86/26	92/32	102/36	115/41	114/49	108/49	108/43	101/36	87/26	72/20	115/20
DEGREE DAYS													
heating (base 65°F)	617	426	372	227	120	20	0	0	5	101	360	595	2843
cooling (base 65°F)	0	0	0	26	98	185	316	286	200	48	0	0	1159
WIND													
Mean speed (mph)	8.0	8.0	9.0	9.1	9.4	10.0	9.2	8.7	7.9	6.9	6.5	7.2	8.3
Max. speed* (mph)	60	51	66	45	35	47	36	38	42	68	70	70	70
Prevailing direction	SE	SSE	SW	SW	SW	SW	SSW	SW	SW	SW	NNW	SSE	SW
FREEZE DAYS PER MONTH	8	1	1	<0.5	0	0	0	0	0	0	1	6	17
PRECIPITATION (in. water)													
average	3.73	2.68	2.17	1.54	0.51	0.10	0.01	0.05	0.19	0.99	2.13	3.12	17.22
max/min	8.50/0.38	8.77/0.15	5.62/0.14	4.76/0.0	3.13/T	0.63/0.0	0.79/0.0	0.65/0.0	1.61/0.0	7.51/0.0	7.41/0.02	12.6/0.17	12.6/0.0
RELATIVE HUMIDITY(%)													
4 AM	90	87	83	80	81	79	76	76	76	79	86	90	82
10 AM	86	79	68	58	52	48	48	49	50	58	77	86	63
4 PM	71	61	52	43	37	32	28	28	31	40	61	73	46
10 PM	86	81	76	72	71	65	61	62	64	69	81	87	73

*"fastest mile"; speed is fastest observed 1-minute value.

Source of climatological data: NWS climatic summary.

Narrative Climatological Summary for Sacramento

The lower Sacramento Valley, where Sacramento is located, enjoys a mild climate and abundance of sunshine most of the year. Cloudless skies prevail during the summer and largely in the spring and autumn. The summers are remarkably dry, with warm days and pleasant nights. In the "rainy season" (November - March) over three-fourths of the total annual precipitation falls, yet rain in measurable amounts occurs only on about 9 days monthly during the period. Mountains surround the valley to the west, north, and east. The Sierra Nevada snow fields are only 70 miles east of Sacramento and usually provide a plentiful supply of water in the valley streams during the dry season. Because of the shielding influence of the high mountains around the valley, winter storms reach valley districts in modified form. However, torrential rain and heavy snow frequently fall on the western Sierra slopes and the southern Cascades. As a result, flood conditions occasionally occur along the Sacramento River and its tributaries. Excessive rainfall and damaging windstorms are rare in the valley.

Prevailing winds at Sacramento are southerly every month except November, when they are northerly. This is due to the north-south direction of the valley and the deflecting effect of the towering Sierra Ranges on the prevailing oceanic winds which move through the Carquinez Straits at the junction of the Sacramento and San Joaquin Rivers. No other tidewater gap exists in the coastal mountains to admit marine air into the Sacramento or the San Joaquin Valley. Occasionally a steep northerly barometric pressure gradient develops and air is forced over the Siskiyou Mountains to the north, warmed with descent, and reaches the valley floor as a warm, dry, north wind. These occasionally disagreeable winds, known as "northers" in the valley, are the counterpart of the well-known "chinook" winds of the Rocky Mountains, and they, or modifications of them, produce the pronounced heat waves in summer. Fortunately, they are of infrequent occurrence and are usually followed within two or three days by the normally cool southerly breezes, especially at night. Summer nights in the lower Sacramento Valley are, with few exceptions, cool and invigorating, the result of a prevailing oceanic influence. While it is true that "northers" cause dry, hot weather for brief periods during the summer, it is equally true they are the modifications of cold waves in the winter. Winter northers, with only a few exceptions, are comparatively warm, drying winds.

As is well known, relative humidity has a marked influence on the reactions of plants and animals to temperature. The extremely low relative humidity that accompanies high temperatures in this valley should be considered when comparing temperatures here with those of cities in more humid regions.

Thunderstorms are few in number, usually mild in character, and occur mainly in the spring. Snow falls so rarely, and in such small amounts, that its occurrence may be disregarded as a climatic feature. Heavy fog occurs mostly in midwinter, never in summer, and seldom in spring or autumn. Light and moderate fog are more frequent, and may come anytime during the wet, cold season. The fog is usually the radiational cooling type, and confined to the early morning hours. An occasional winter fog, under stagnant atmospheric conditions, may continue for several days. (Source: NWS)

w) FAIRFIELD (TRAVIS AFB)

Climatological Data for Fairfield (Travis AFB)

	Latitude:			Longitude:				Elevation:					
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	46	51	54	59	62	68	72	71	71	64	55	47	60
average daily max/min	53/38	59/42	63/44	69/48	73/51	81/55	86/57	85/57	84/57	76/52	64/45	54/40	71/49
extreme max/min	78/21	76/29	82/32	95/30	98/39	110/45	108/50	109/49	110/45	101/35	88/30	76/23	110/21
DEGREE DAYS†													
heating (base 65°F)	620	426	366	234	87	23	0	0	0	107	357	592	2812
cooling (base 65°F)	0	0	0	30	68	197	332	292	200	54	0	0	1173
WIND													
Mean speed (mph)	6	7	8	10	11	13	15	13	11	8	5	5	8
Max. speed* (mph)	50	57	50	46	39	41	39	39	39	44	47	43	57
Prevailing direction	N	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	N	SW
FREEZE DAYS PER MONTH	7	2	1	1	0	0	0	0	0	0	1	1	13
PRECIPITATION (in. water)													
average	3.0	2.9	2.0	1.1	0.4	0.1	T	T	0.2	1.1	1.8	3.1	15.7
max/min	2.0	2.6	1.5	1.8	1.0	0.8	T	0.1	2.8	3.0	2.0	2.2	3.0
RELATIVE HUMIDITY(%)													
4 AM	86	83	80	81	80	78	80	82	77	78	81	87	81
1 PM	69	61	53	50	47	42	39	39	37	43	56	69	50

*Peak gust speed.

† Data for Fairfield 38° 22' N 121° 57' W, Elevation 105'

Source of climatological data: AWS climatic brief.

x) STOCKTON

Climatological Data for Stockton

Latitude: 37° 54'	Longitude: 121°15	Elevation: 22'											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	44.6	49.1	52.7	58.6	65.2	71.8	76.7	75.3	72.1	63.5	52.9	45.6	60.7
average daily max/min	53/36	59/39	65/41	72/45	80/50	88/55	95/59	93/58	89/55	78/49	64/42	53/38	74/47
extreme max/min	67/19	73/25	87/27	93/32	103/38	111/45	114/52	109/50	105/45	98/33	84/26	71/21	114/19
DEGREE DAYS													
heating (base 65°F)	632	445	381	214	67	15	0	0	0	88	363	601	2806
cooling (base 65°F)	0	0	0	22	73	219	363	323	217	42	0	0	1259
WIND													
Mean speed (mph)	6.7	7.0	7.6	8.1	9.1	9.1	8.1	7.6	7.0	6.3	5.7	6.2	7.4
Max. speed* (mph)	46	39	39	35	33	31	26	28	33	36	40	44	46
Prevailing direction	SE	SE	W	W	W	W	WNW	WNW	W	W	W	SE	W
FREEZE DAYS PER MONTH	9	3	1	<0.5	0	0	0	0	0	0	2	8	24
PRECIPITATION (in. water)													
average	2.91	2.11	1.96	1.37	0.42	0.07	0.01	0.03	0.17	0.72	1.72	2.68	14.17
max/min	7.06/0.18	6.00/0.05	5.60/T	3.55/0.00	1.91/T	0.66/0.00	0.61/0.00	0.81/0.00	3.00/0.00	2.97/T	6.22/T	8.05/0.04	8.05/0.00
RELATIVE HUMIDITY(%)													
4 AM	90	88	83	78	73	69	65	66	67	74	85	91	77
10 AM	87	81	67	54	46	43	41	43	46	56	77	87	61
4 PM	70	62	51	40	33	29	26	27	29	38	60	74	45
10 PM	86	82	75	69	61	56	50	51	56	64	80	87	68

*"fastest mile"; speed is fastest observed 1-minute value.
Source of climatological data: NWS climatic summary.

Narrative Climatological Summary for Stockton

Stockton, the county seat of San Joaquin County, is located near the center of the Great Central Valley of California, on the southeast corner of the broad delta formed by the confluence of the San Joaquin and Sacramento Rivers. The surrounding terrain is flat, irrigated farm- and orchard-land, near sea level, with the rivers and canals of the delta controlled by a system of levees.

Approximately 25 miles east and northeast of Stockton lie the foothills of the Sierra Nevada, rising gradually to an elevation of about 1000 feet. Beyond the foothills, the mountains rise abruptly to the crest of the Sierra, at a distance of about 75 miles, with some peaks here exceeding 9000 feet in elevation. On a few days during the year, when atmospheric conditions are favorable, the "downslope" effect of a north or northeast wind can bring unseasonably dry weather to the delta area; but on the whole the Sierra Nevada has little or no effect on the weather of San Joaquin County. The Sierra Nevada does affect the area, however, to the extent that the entire economy of the Great Valley depends upon the underground water supplies and rivers, which are fed in summer by the melting snows that have piled up during the winter on the windward (western) slopes of the mountains.

To the west and southwest, the Coast Range, with peaks above 2000 feet, forms a barrier separating the Great Valley from the marine air that dominates the climate of the coastal communities. Several gaps in the Coast Range in the San Francisco Bay Area, however, permit the passage inland of a sea breeze, which fans out into the delta and has a moderating effect on summer heat, with the result that Stockton enjoys slightly cooler summer days than communities in the upper San Joaquin and Sacramento Valleys.

Stockton's climate is characterized in summer by warm, dry days and relatively cool nights, with clear skies and no rainfall; and in winter by mild temperatures and relatively light rains, with frequent heavy fogs.

The annual rainfall averages near 14 inches, with 90% of this precipitation falling in the winter-half year, i.e., November through April. Thunderstorms are infrequent, occurring on 3 or 4 days a year, generally in the spring, and occasionally in summer, although rainfall with summer thunderstorms is negligible. Measurable rain can be expected on about 52 days a year, and rain exceeding 0.50 inch on about 9 days a year. Since the Pacific storms that bring rainfall to this area are associated with above-freezing temperatures at sea-level elevations, snowfall is practically unknown in the Stockton area.

In summer, temperatures exceeding 100° can be expected on 6 days in July, and about 15 days during the entire summer. During these hot afternoons the air is extremely dry, with relative humidities running generally less than 20%. Even on these hot days, however, temperatures will fall into the low sixties at night. In winter the nighttime temperature on clear nights will fall to, or slightly below, freezing, and will rise in the afternoon into the low fifties.

In late autumn and early winter, clear still nights give rise to the formation of dense fogs, which normally settle in during the night and burn off sometime during the day. In December and January, the so-called fog season, under stagnant atmospheric conditions the fog may last for as long as 4 or 5 weeks, with only brief and temporary periods of clearing. (Source: NWS)

y) MERCED (CASTLE AFB)

Climatological Data for Merced (Castle AFB)

Latitude: 37° 23' Longitude: 120° 34' Elevation: 198'													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	45	50	54	61	66	73	79	77	73	65	54	46	62
average daily max/min	53/37	60/40	65/43	73/48	80/52	88/58	95/63	92/61	88/58	78/51	64/43	53/39	74/49
extreme max/min	75/20	77/25	86/27	97/34	105/37	112/43	111/50	107/50	106/42	99/32	89/29	72/25	112/20
DEGREE DAYS †													
heating (base 65°F)	617	426	347	189	49	8	0	0	0	100	366	595	2697
cooling (base 65°F)	0	0	0	30	93	233	412	353	222	50	0	0	1393
WIND													
Mean speed (mph)	6	6	7	8	8	9	9	8	7	6	5	5	7
Max. speed* (mph)	59	62	56	48	49	46	35	33	48	49	43	54	62
Prevailing direction	SE	SE	NNW	NNW	NW	NW	NW	NW	NW	NW	NW	SE	NW
FREEZE DAYS PER MONTH	9	4	1	0	0	0	0	0	0	<0.5	1	6	21
PRECIPITATION (in. water)													
average	2.0	1.7	1.5	1.3	0.5	0.1	T	T	0.1	0.5	1.3	1.8	10.8
max/min	1.9	1.7	1.7	1.5	1.4	0.4	T	0.2	1.3	1.2	1.1	1.5	1.9
RELATIVE HUMIDITY(%)													
4 AM	90	87	83	79	75	68	62	64	69	75	84	89	77
1 PM	70	61	51	43	36	31	28	29	33	39	55	71	46

*Peak gust speed.

† Data for Merced Fire Station 2, 37°18' N 120°29' W. Elevation 169'

Source of climatological data: AWS climatic summary.

z) FRESNO

Climatological Data for Fresno

Latitude: 36° 46' Longitude: 119° 43' Elevation: 328'	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	45.3	49.9	53.9	60.3	67.4	73.9	80.6	78.3	73.8	64.2	53.5	45.8	62.3
average daily max/min	55/36	61/39	67/41	74/46	83/52	90/58	98/63	96/61	91/57	80/49	66/41	55/37	76/48
extreme max/min	75/22	76/25	90/26	95/32	104/36	110/45	111/52	108/49	105/41	96/27	88/26	71/21	111/21
DEGREE DAYS													
heating (base 65°F)	611	423	344	182	51	9	0	0	0	90	345	595	2650
cooling (base 65°F)	0	0	0	41	125	276	484	412	267	66	0	0	1671
WIND													
Mean speed (mph)	5.4	5.7	6.7	7.2	7.9	8.0	7.1	6.5	5.9	5.3	4.8	5.0	6.3
Max. speed* (mph)	32	38	41	36	38	34	25	31	29	40	29	43	43
Prevailing direction	SE	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	SE	NW
FREEZE DAYS PER MONTH	9	5	1	<0.5	0	0	0	0	0	<0.5	3	10	28
PRECIPITATION (in. water)													
average	1.84	1.72	1.62	1.24	0.32	0.06	0.00	0.02	0.07	0.42	1.22	1.71	10.24
max/min	8.56/0.37	5.97/T	5.79/0.00	4.41/0.02	1.56/T	0.60/0.00	0.04/0.00	0.25/0.00	0.92/0.00	1.54/0.00	3.50/0.00	6.73/0.07	8.56/0.00
RELATIVE HUMIDITY(%)													
4 AM	92	91	87	83	74	68	64	69	75	79	88	94	80
10 AM	85	77	64	52	43	40	39	42	45	52	74	87	58
4 PM	68	56	46	35	25	24	23	25	28	35	57	73	41
10 PM	89	84	76	64	50	46	42	47	54	67	84	91	66

*"fastest mile"; speed is fastest observed 1-minute value.

Source of climatological data: NWS climatic summary.

Narrative Climatological Summary for Fresno

Fresno is located about midway and toward the eastern edge of the San Joaquin Valley, which is oriented northwest to southeast and has a length of about 225 miles and an average width of about 50 miles. The terrain around Fresno itself is generally level with an abrupt upward slope about 15 miles eastward to the foothills of the Sierra Nevadas. The main Sierra Nevada Range is located about 50 miles to the east and extends from 12,000 to more than 14,000 feet in elevation. About 45 miles west of Fresno lie the foothills of the Coastal Range.

The climate of Fresno is dry — mild in winter and hot in summer, and nearly nine-tenths of the year's precipitation falls in the six months from November to April.

Thanks to clear skies during the summer and the comparative isolation of the San Joaquin Valley from marine effects, the normal daily temperature advances to a high of 99° during the latter part of July. The daily maximum temperature during the warmest month has ranged from 76° to 115°. Low relative humidities and some wind movement substantially lower the sensible temperature during periods of high readings. Even on the warmest days, the high rate of evaporation of perspiration from the body and the constant movement of air combine to keep the skin temperature much below the air temperature. Sunstroke is practically unknown. Humidity readings of 15% are common on summer afternoons, and readings as low as 8% have been recorded. In contrast to this, humidity readings average 90% during the morning hours of December and January.

Winds flow with the major axis of the San Joaquin Valley; as the Valley is oriented from the northwest to southeast, the winds are generally from one of these directions with northwest prevailing most of the time. This feature is especially beneficial since, during the warmest months, the northwest winds increase during the evenings as a result of heating or thermal effects that have occurred during the day. These refreshing breezes and the normally large temperature variation of about 35° between the highest and lowest readings of the day result in comfortable evening and night temperatures generally.

Winter temperatures are usually mild but during infrequent cold spells minimum readings occasionally drop below freezing. Heavy frost occurs almost every year, and the first heavy frost in the autumn usually occurs during the last week in November. The last frost in the spring is early in March; however, one year in five will have the last heavy frost after the first of April. The average growing season in this area is 291 days.

The mean annual precipitation is less than 11 inches, with 67% falling from December through March and 95% falling from October through April. Although the heaviest rain recorded at Fresno for short periods occurred in June, usually any rainfall during the summer is very light. On an average, over 40 rainy days are experienced each year. Although light amounts have fallen, snow is a rare occurrence in Fresno.

Fresno enjoys a very high percentage of sunshine, receiving more than 80% of the possible amounts during all but the four months of November, December, January and February. Reduction of sunshine during these months is caused by fog and short periods of stormy weather. During foggy periods, sometimes of nearly two weeks duration, winter fog reduces sunshine to a minimum. This fog frequently lifts to a few hundred feet above the surface of the Valley and presents the appearance of a heavy, solid cloud layer.

Spring and autumn are very enjoyable seasons in Fresno, with clear skies, light rainfall and winds, and mild temperatures. (Source: NWS)

aa) REEVES FIELD (LEMOORE NAS)

Climatological Data for Reeves Field (Lemoore NAS)

Latitude: 36°20' Longitude: 119°57' Elevation: 247'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	43	50	54	60	68	74	81	80	73	65	53	44	62
average daily max/min	53/33	61/39	68/39	75/44	85/50	91/56	100/62	98/62	90/55	81/48	65/41	52/36	77/47
extreme max/min	69/14	78/24	89/23	99/30	104/34	111/43	111/47	112/48	105/41	101/30	87/22	77/18	112/14
DEGREE DAYS†													
heating (base 65°F)	620	423	338	178	46	9	0	0	0	104	372	605	2695
cooling (base 65°F)	0	0	0	40	114	267	453	381	236	61	0	0	1552
WIND													
Mean speed (mph)	3	5	6	6	7	7	7	6	6	5	3	3	6
Max. speed* (mph)	38	49	41	37	32	37	30	31	37	40	35	38	49
Prevailing direction	NNW	NNW	NNW	NNW	NNW	NNW	NNW	NNW	NNW	WNW	NNW	SSE	NNW
FREEZE DAYS PER MONTH	15	7	5	1	0	0	0	0	0	<0.5	5	11	44
PRECIPITATION (in. water)													
average	1.4	1.4	0.8	0.7	0.2	0.1	T	T	0.1	0.4	1.1	1.0	7.2
max ‡ / min	1.3	1.4	0.6	0.5	0.5	0.4	0.1	0.1	0.3	0.8	0.9	0.7	1.4
RELATIVE HUMIDITY(%)													
4 AM	85	84	78	72	63	62	51	57	63	64	79	86	70
1 PM	66	61	44	35	26	26	21	24	29	33	56	70	41

*Peak gust speed.
†Data for Hanford 36°20'N 119°40'W, Elevation 242'
‡Max in 24 hours.
Source of climatological data: AWS climatic summary.

bb) BAKERSFIELD

Climatological Data for Bakersfield

Latitude: 35° 25' Longitude: 119° 03' Elevation: 475'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	47.5	52.4	56.6	62.7	69.8	76.9	83.9	81.6	76.6	66.9	56.0	47.9	64.9
average daily max/min	58/37	63/41	69/45	76/50	84/56	92/62	99/69	97/67	91/62	81/53	68/44	57/38	78/52
extreme max/min	79/24	80/27	92/31	98/38	107/41	111/48	113/56	111/57	108/49	98/29	90/30	75/25	113/24
DEGREE DAYS													
heating (base 65°F)	543	353	266	140	22	0	0	0	0	55	276	530	2185
cooling (base 65°F)	0	0	6	71	171	362	586	515	348	114	6	0	2179
WIND													
Mean speed (mph)	5.2	5.7	6.6	7.2	8.0	8.0	7.2	6.8	6.2	5.6	5.1	4.9	6.4
Max. speed* (mph)	35	44	38	40	38	41	25	30	30	31	30	35	44
Prevailing direction	NW	ENE	NW	NW	NW	NW	NW	NW	WNW	NW	ENE	ENE	NW
FREEZE DAYS PER MONTH	5	1	<0.5	0	0	0	0	0	0	<0.5	<0.5	5	12
PRECIPITATION (in. water)													
average	0.96	1.03	0.83	0.85	0.19	0.06	0.02	0.01	0.08	0.26	0.69	0.74	5.72
max/min	2.87/T	4.42/0.03	4.61/T	2.65/0.0	2.39/0.0	1.11/0.0	0.30/0.0	0.17/0.0	0.83/0.0	1.82/0.0	3.04/0.0	1.80/T	4.61/0.0
RELATIVE HUMIDITY(%)													
4 AM	83	77	70	64	55	51	47	51	55	63	76	85	65
10 AM	75	65	54	45	37	35	32	34	39	46	65	77	50
4 PM	61	49	40	32	24	23	20	22	26	33	50	64	37
10 PM	78	69	60	52	39	36	33	36	42	52	70	80	54

*"fastest mile"; speed is fastest observed 1-minute value.

Source of climatological data: NWS climatic summary.

Narrative Climatological Summary for Bakersfield

Bakersfield, situated in the extreme south end of the great San Joaquin Valley, is partially surrounded by a horseshoe-shaped rim of mountains with an open side to the northwest and the crest at an average distance of 40 miles.

The Sierra Nevadas to the northeast, shut out most of the cold air that flows southward over the continent during winter. They also catch and store snow, which provides irrigation water for use during the dry months. The Tehachapi Mountains, forming the southern boundary, act as an obstruction to northwest wind, causing heavier precipitation on the windward slopes, high wind velocity over the ridges and, at times, prevailing cloudiness in the south end of the valley after skies have cleared elsewhere. To the west are the Coast Ranges, and the ocean shore lies at a distance of 75 to 100 miles.

Because of the nature of the surrounding topography, there are large climatic variations within relatively short distances. These zones of variation may be classified as Valley, Mountain, and Desert areas. The overall climate, however, is warm and semi-arid. There is only one wet season during the year, as 90% of all precipitation falls from October through April, inclusive. Snow in the valley is infrequent, with only a trace occurring in about one year out of seven. Thunderstorms also seldom occur in the valley.

Summers are cloudless, hot and dry. The average length of the growing season is 265 days; the valley area is suitable for Mediterranean and specialized types of agriculture. Cotton, potatoes, grapes, and cattle are the principal agricultual products. There are considerable amounts of deciduous fruits, citrus, grain and various vegetables. There are actually more than 90 farm crops grown commercially. Certain crops are planted or harvested every month of the year. Severe freezes seldom occur and there are occasional years with no frost at all in certain warm areas.

Winters are mild and semi-arid, yet fairly humid. December and January are characterized by frequent fog, mostly nocturnal, which prevails when marine air is trapped in the valley by a high pressure system. In extreme cases this fog may last continuously for two or three weeks. Its depth is usually less than 3000 feet and the same condition that produces it also causes clear skies with mild temperatures in the surrounding mountain and desert areas.

Another local characteristic is the occasionally warm, dry, southeast chinook wind that spills through the Tehachapi Pass during winter. This wind usually attains velocities of 30 to 40 miles an hour, sometimes reaching as high as 60 miles an hour. Its path is approximately 30 miles wide and the stream flows in a curving course around the south end of the valley, turning northward and rising; it is seldom manifest on the floor of the valley for a distance of more than 50 miles.

During summer months, northwest sea breezes frequent the Bakersfield area about twice weekly. When above normal temperatures prevail for several days, the gradient builds up sufficiently to draw in cooler air from the coastal section. During prolonged periods of drought, this later afternoon breeze may carry varying amounts of dust, and thermal instability sometimes causes it to rise as high as 7000 feet. (Source: NWS)

cc) BLUE CANYON

Climatological Data for Blue Canyon

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Latitude: 39° 17' Longitude: 120° 42' Elevation: 5280'													
TEMPERATURE(°F)													
average monthly	36.4	37.4	38.0	43.9	51.3	59.1	68.1	66.8	62.9	54.0	44.5	39.1	50.1
average daily max/min	43/30	44/31	45/31	52/36	60/43	68/50	78/59	76/57	73/53	63/45	52/37	46/33	58/42
extreme max/min	71/5	73/6	72/9	78/17	86/21	92/28	95/40	94/35	93/27	85/17	78/13	75/3	95/3
DEGREE DAYS													
heating (base 65°F)	887	773	837	633	425	197	27	58	108	341	615	803	5704
cooling (base 65°F)	0	0	0	0	0	20	123	114	45	0	0	0	302
WIND													
Mean speed (mph)	10.7	10.2	9.9	8.1	8.2	8.0	7.1	7.3	8.0	9.1	9.1	8.7	8.7
Max. speed* (mph)	67	76	67	50	37	49	32	30	49	70	54	51	76
Prevailing direction													
FREEZE DAYS PER MONTH	19	17	19	12	4	1	0	0	<0.5	3	11	16	102
PRECIPITATION (in. water)													
average	13.7	9.42	8.55	5.47	3.14	0.99	0.10	0.27	0.52	4.14	9.04	12.3	67.6
max/min	33.9/2.55	23.2/0.82	18.7/1.86	16.6/0.35	10.9/0.12	3.06/0.00	5.86/0.00	3.10/0.00	3.78/0.00	22.3/0.00	28.4/T	45.1/1.11	45.1/0.00
RELATIVE HUMIDITY(%)													
4 AM 10 AM 4 PM 10 PM	60	59	61	52	48	42	33	32	34	42	52	56	48

*"fastest mile"; speed is fastest observed 1-minute value.

Source of climatological data: NWS climatic summary.

Narrative Climatological Summary for Blue Canyon

The area in which Blue Canyon is located lies on the western slope of the Sierra Nevadas. The climate is primarily that of a mountainous region, in this instance modified by the proximity of the Great Interior Valley of California.

The average annual temperature for the area is about 50°. The average low temperature in the winter season is about 29°, the coldest months being January, February, and March. The average high temperature during the summer is about 76°, July, August, and September being the warmest months. The extremes of temperature during the year are from near zero to the low nineties.

Annual precipitation is moderately heavy with the season beginning in October and ending in May or early June. The months of maximum precipitation are December, January, and February. The average annual precipitation is about 66 inches. During the winter months most of the precipitation is in the form of snow, which usually stays on the ground continuously from late October until early May. The average annual snowfall is about 245 inches.

The area is normally blanketed in heavy fog during winter storms.

Few high winds occur except during severe storms. During the summer season the normal wind is from the southwest in the daytime and from the east or northeast during the nighttime hours. This day-to-night change in wind is brought about by the great daytime heating in the Interior Valley which causes upslope winds, and the nighttime cooling which causes downslope winds to occur. The effect of these winds is to give the area relatively cool days and warm nights as compared to the Interior Valley.

The climate of the area is generally mild, except during the winter storms when blizzard conditions prevail. (Source: NWS)

dd) RENO, NEVADA

Climatological Data for Reno, Nevada

Latitude: 39°30' Longitude: 119°47' Elevation: 4404'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	31.9	37.1	40.3	46.8	54.6	61.5	69.3	66.9	60.2	50.3	40.1	33.0	49.4
average daily max/min	45/18	51/23	56/25	64/30	72/37	80/43	91/47	89/45	82/39	70/31	56/24	46/20	67/32
extreme max/min	70/-11	74/0	83/0	88/15	95/18	100/29	103/33	103/29	96/20	91/8	76/5	70/-16	103/-16
DEGREE DAYS													
heating (base 65°F)	1026	781	766	546	328	145	17	50	168	456	747	992	6022
cooling (base 65°F)	0	0	0	0	6	40	150	109	24	0	0	0	329
WIND													
Mean speed (mph)	6.0	6.1	7.6	8.0	7.6	7.2	6.6	6.2	5.4	5.3	5.3	5.1	6.4
Max. speed* (mph)	80	66	80	48	48	46	44	43	42	50	52	68	80
Prevailing direction	S	S	WNW	WNW	WNW	WNW	WNW	WNW	WNW	WNW	S	SW	WNW
FREEZE DAYS PER MONTH	27	25	26	22	7	1	0	<0.5	7	21	24	29	189
PRECIPITATION (in. water)													
average	1.21	0.86	0.70	0.47	0.66	0.40	0.26	0.22	0.23	0.42	0.68	1.09	7.20
max/min	4.13/T	3.69/T	2.02/0.03	2.04/T	2.89/T	1.31/0.00	1.06/0.00	1.65/0.00	1.02/0.00	2.14/T	2.04/0.00	5.25/0.01	5.25/0.00
RELATIVE HUMIDITY(%)													
4 AM	74	71	67	65	66	69	67	70	70	72	74	75	70
10 AM	66	57	46	38	33	34	29	31	34	41	57	66	44
4 PM	50	38	32	28	25	24	19	20	21	27	42	53	32
10 PM	69	61	54	49	44	43	38	41	47	56	66	70	53

*"fastest mile"; speed is fastest observed 1-minute value.

Source of climatological data: NWS climatic summary.

Narrative Climatological Summary for Reno, Nevada

At an elevation of 4400 feet above mean sea level, Reno is located at the west edge of Truckee Meadows in a semiarid plateau lying in the lee of the Sierra Nevada Mountain Range. To the west, the Sierras rise to elevations of 9,000 to 11,000 feet, and hills to the eastward reach 6,000 to 7,000 feet. The Truckee River, flowing from the Sierras eastward through Reno, drains into Pyramid Lake to the northeast.

While temperatures on the whole are mild, the daily range between maximum and minimum is considerable, often exceeding 45°. Even when afternoon maxima reach the upper nineties, a light wrap is needed shortly after sunset. Nights with minimum temperature over 60° are rare. Afternoon temperatures in mid-winter are moderate, and on an average only about 10 days a year fail to reach a temperature above freezing.

More than half the city's precipitation, falling largely as mixed rain and snow, occurs from December to March. Although there is an average of about 25 inches of snow a year, it is seldom that snow lies on the ground for more than 3 to 4 days at a time. Summer rain comes mainly as brief thundershowers in the middle and late afternoons. While precipitation is scarce, abundant water is available from the high-altitude reservoirs in the Sierra Nevada, where precipitation is heavy.

Humidity is very low during the summer months, and moderately low during the winter. Fogs are rare, and are usually confined to the early morning hours of mid-winter. Sunshine is abundant throughout the year. (Source: NWS)

ee) LAS VEGAS, NEVADA

Climatological Data for Las Vegas, Nevada

	Latitude: 36° 05'			Longitude: 115° 10'			Elevation: 2162'						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	44.2	49.1	54.8	63.8	73.3	82.3	89.6	87.4	80.1	67.1	53.3	45.2	65.8
average daily max/min	56/33	61/37	68/42	78/50	88/59	97/67	104/75	102/73	95/65	81/53	66/41	57/34	79/52
extreme max/min	77/8	82/19	91/23	96/31	108/40	115/51	116/62	113/56	107/46	99/26	85/26	74/15	116/8
DEGREE DAYS													
heating (base 65°F)	645	451	324	126	10	0	0	0	0	74	357	614	2601
cooling (base 65°F)	0	6	8	90	268	519	763	694	453	139	6	0	2946
WIND													
Mean speed (mph)	7.1	8.2	9.7	10.9	10.8	10.7	9.9	9.3	8.7	7.9	7.1	7.0	8.9
Max. speed* (mph)	52	54	52	48	52	46	64	55	54	52	46	54	64
Prevailing direction	W	SW	SW	SW	SW	SW	SW	SW	SW	WSW	W	W	SW
FREEZE DAYS PER MONTH	17	6	2	<0.5	0	0	0	0	0	<0.5	2	13	41
PRECIPITATION (in. water)													
average	0.45	0.30	0.33	0.27	0.10	0.09	0.44	0.49	0.27	0.22	0.43	0.37	3.76
max/min	2.4/T	1.6/0.0	1.8/0.0	2.4/0.0	1.0/0.0	0.8/0.0	1.6/0.0	2.6/0.0	1.6/0.0	1.1/0.0	2.2/0.0	1.4/0.0	2.6/0.0
RELATIVE HUMIDITY(%)													
4 AM	52	47	41	34	31	26	29	35	32	37	48	55	39
10 AM	39	34	28	21	18	16	19	23	22	25	34	41	27
4 PM	29	25	20	15	12	11	14	17	16	19	28	33	20
10 PM	46	40	33	26	22	17	22	26	25	31	42	49	32

*"fastest mile"; speed is fastest observed 1-minute value.

Source of climatological data: NWS climatic summary.

Narrative Climatological Summary for Las Vegas, Nevada

Las Vegas is situated near the center of a broad desert valley, which is almost surrounded by mountains ranging from 2,000 to 10,000 feet higher than the floor of the valley. This Vegas Valley, comprising about 600 square miles, runs from northwest to southeast, and slopes gradually upward on each side towards the surrounding mountains. Weather observations are taken at McCarran Airport, 7 miles south of downtown Las Vegas, and about 5 miles southwest and 300 feet higher than the lower portions of the valley. Since mountains encircle the valley, drainage winds are usually downslope toward the center, or lowest portion of the valley. This condition also affects minimum temperatures, which in lower portions of the valley can be from 15° to 25° colder than recorded at the airport on clear, calm nights. The four seasons are well defined. Summers are typically "desert" with maximum temperatures usually in the 100° plus bracket. The proximity of the mountains contributes materially to the relatively cool summer nights, with the majority of the minimums between 70° and 75°. There is a period of about two weeks almost every summer when warm, moist, tropical air predominates weather conditions in this area, and causes scattered thundershowers, occasionally quite severe, together with higher than average humidity. Although maximum temperatures are much lower during this humid period, minimum temperatures are higher than usual and many natives consider this the most unpleasant weather of the year. Soil erosion, especially near the mountains and foothills surrounding the valley, is evidence that these summer thundershowers have in the past on occasion developed into "cloudburst" proportions. Aside from this short humid period, summers are not as uncomfortable as indicated by the daytime maxima, because of the prevailing low humidity. Winters, on the whole, are mild and pleasant. Daytime temperatures average near 60°, and with mostly clear skies and warm sunshine, there is little decrease in outdoor activities. Winter minimum temperatures average 3° above freezing. The spring and fall seasons are generally considered most ideal, although rather sharp temperature transients occur during these months. There are only a few days during the spring and fall months when outdoor activities are affected in any degree by the weather.

The Sierra Nevada Mountains of California and the Spring Mountains immediately west of the Vegas Valley, the latter rising to elevations over 10,000 feet above the valley floor, act as effective barriers to moisture-laden storms moving eastward from the Pacific Ocean. It is mainly these barriers that result in a minimum of dark overcast and rainy days. Rainy days average less than one in June to three per month in the winter months. Snow rarely falls in this valley and it usually melts as it falls, or shortly thereafter. Two notable exceptions occurred: During January 1949, 16.7 inches of snowfall were recorded and in January 1974, 13.4 inches fell and the maximum depth on the ground was 8 inches. January 1949 will be remembered because of relatively heavy snows over the far southwest, which extended to the southern California coastline.

Strong winds, associated with major storms, usually reach this valley from the southwest or through the pass from the northwest. Winds over 50 mph are infrequent but, when they do occur, are probably the most provoking of the elements experienced in the Vegas Valley, because of the blowing dust and sand associated with these stronger winds. (Source: NWS)

ff) CHINA LAKE/INYOKERN

Climatological Data for China Lake/Inyokern

Latitude: 35° 41' Longitude: 117° 41' Elevation: 2293'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	44	50	55	64	71	80	87	85	78	67	53	45	65
average daily max/min	57/30	63/36	68/41	78/49	85/56	95/65	102/72	100/69	94/62	82/51	68/38	59/31	79/50
extreme max/min	77/6	81/14	86/22	97/28	107/38	114/42	113/55	110/53	110/40	100/32	86/20	75/8	114/6
DEGREE DAYS†													
heating (base 65°F)	614	392	267	127	10	0	0	0	0	43	316	601	2370
cooling (base 65°F)	0	0	10	115	262	483	741	682	450	145	0	0	2888
WIND													
Mean speed (mph)	7	8	10	10	10	10	9	9	8	7	6	6	8
Max. speed* (mph)	77	79	81	74	82	77	60	58	69	68	67	71	82
Prevailing direction	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW
FREEZE DAYS PER MONTH	19	9	4	<0.5	0	0	0	0	0	<0.5	7	19	58
PRECIPITATION (in. water)													
average	0.5	0.4	0.2	0.1	0.1	T	T	0.1	0.3	0.1	0.3	0.4	2.5
max/min	0.9	0.9	0.9	0.9	1.0	0.3	0.2	0.6	0.9	0.8	1.0	0.9	1.0
RELATIVE HUMIDITY(%)													
4 AM	63	59	52	46	42	36	32	35	38	45	55	65	47
1 PM	37	32	26	21	18	15	15	16	17	21	30	37	24

* Peak gust speed.

† Data for Trona 35° 47' N 117° 23' W, Elevation 1695'
Source of climatic data: AWS climatic brief.

gg) EDWARDS AFB

Climatological Data for Edwards AFB

Latitude: 34° 55' Longitude: 117° 54' Elevation: 2302'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	44	48	52	59	66	74	83	81	74	63	51	44	62
average daily max/min	57/30	61/34	66/38	73/44	81/51	90/58	99/66	97/64	91/57	79/47	66/36	57/30	76/46
extreme max/min	83/4	80/14	87/19	97/27	105/32	112/41	113/50	112/47	109/34	99/20	85/13	84/7	113/4
DEGREE DAYS*													
heating (base 65°F)	620	459	400	245	84	29	0	0	7	113	380	592	2929
cooling (base 65°F)	0	0	0	44	90	260	502	459	286	78	5	0	1724
WIND													
Mean speed (mph)	7	8	10	12	13	13	12	10	8	7	7	6	9
Max. speed† (mph)	59	67	74	58	62	59	51	60	75	75	55	58	75
Prevailing direction	W	SW	WSW	SW	SW	SW	SW	SW	SW	SW	SW	W	SW
FREEZE DAYS PER MONTH	20	12	6	1	<0.5	0	0	0	0	1	10	21	71
PRECIPITATION (in. water)													
average	0.8	0.8	0.5	0.3	T	T	T	0.1	0.1	0.2	0.6	0.7	4.1
max/min	3.3/0.0	4.4/0.0	2.3/0.0	1.5/0.0	0.3/0.0	0.3/0.0	0.4/0.0	1.0/0.0	1.1/0.0	1.7/0.0	3.5/0.0	3.7/0.0	4.4/0.0
RELATIVE HUMIDITY(%)													
4 AM	71	69	66	64	59	52	42	45	50	55	63	71	59
1 PM	40	36	32	27	24	20	17	17	19	24	34	42	28

†Peak gust speed.

* Data for Palmdale 34° 44' N 118° 06' W, Elevation 2596'

Source of climatological data: AWS climatic summary.

hh) SANDBERG

Climatological Data for Sandberg

Latitude: 34° 45' Longitude: 118° 44' Elevation: 4517'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	40.2	42.2	43.6	49.2	55.7	64.0	74.0	73.0	68.9	58.8	48.3	41.9	55.0
average daily max/min	46/34	49/35	52/36	58/40	66/46	75/53	85/63	84/62	79/59	68/50	55/41	48/36	64/46
extreme max/min	71/3	72/13	80/15	85/22	94/26	99/30	102/40	102/40	98/35	89/21	80/21	72/11	102/3
DEGREE DAYS													
heating (base 65°F)	769	638	663	474	288	116	7	10	33	212	501	716	4427
cooling (base 65°F)	0	0	0	0	0	86	286	258	150	20	0	0	800
WIND													
Mean speed (mph)	17.0	16.4	16.7	16.4	15.9	15.1	12.8	12.6	12.9	14.9	16.1	16.4	15.3
Max. speed* (mph)	64	77	74	64	59	64	46	40	45	53	62	53	77
Prevailing direction	ENE	N	NNW	NNW	NNW	NNW	NNW	NNW	NNW	NNW	ENE	ENE	NNW
FREEZE DAYS PER MONTH	13	11	11	6	2	<0.5	0	0	0	1	5	11	59
PRECIPITATION (in. water)													
average	2.15	2.45	1.33	1.12	0.25	0.03	0.03	0.06	0.21	0.34	2.05	1.95	11.97
max/min	10.6/0.0	11.4/0.02	6.18/0.0	4.11/0.0	1.13/0.0	0.54/0.0	0.49/0.0	0.65/0.0	3.40/0.0	3.55/0.0	9.80/0.0	10.3/T	11.4/0.0
RELATIVE HUMIDITY(%)													
4 AM	51	56	65	67	64	58	42	45	47	55	57	62	56
10 AM	56	57	57	52	46	36	26	27	30	39	47	54	44
4 PM	56	50	52	50	47	38	28	29	33	42	50	59	44
10 PM	58	56	63	62	59	51	38	41	45	52	55	63	54

*"fastest mile"; speed is fastest observed 1-minute value.

Source of climatological data: NWS climatic summary.

Narrative Climatological Summary for Sandberg

The station is located on a bare mountain-top on the range of mountains between the coastal valleys north of Los Angeles and the southern end of the San Joaquin Valley. The climate is comparatively dry and windy.

The rainfall season is from the middle of October to the latter part of April and most of the year's precipitation occurs during December, January and February, generally in the form of snow. The summer months are generally dry and it is not unusual for the months of June to August to be completely without precipitation.

During the winter months upslope winds cause fog and cloud caps to form at the station and on the tops of the surrounding mountains approximately 15% of the time.

Temperatures are fairly moderate, although considerable sub-freezing temperatures are experienced during the winter months. Summertime readings are not exceptionally high and rarely reach or exceed 100°F. The summer temperatures are moderated by the almost constant winds that blow in this vicinity, generally from a northerly direction at an average speed of 15-16 mph.

The winter months are exceptionally windy. During these months high winds are experienced frequently for many days at a time. (Source: NWS)

ii) VICTORVILLE (GEORGE AFB)

Climatological Data for Victorville (George AFB)

Latitude: 34° 35' Longitude: 117° 23' Elevation: 2885'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	45	48	52	59	65	73	81	80	75	65	52	47	62
average daily max	57	60	64	72	79	88	96	95	90	79	65	59	75
average daily min	33	36	39	45	50	58	66	64	59	50	39	34	48
extreme max	80	79	85	94	100	110	108	106	107	95	85	86	110
extreme min	9	18	24	31	35	41	50	49	38	31	20	17	9
DEGREE DAYS †													
heating (base 65°F)	688	512	446	250	101	25	0	0	13	156	444	660	3295
cooling (base 65°F)	0	0	0	19	77	217	434	403	220	57	6	0	1433
WIND													
Mean speed (mph)	8	9	10	10	10	10	8	8	8	8	8	7	9
Max. speed* (mph)	62	52	71	56	53	87	58	45	44	51	59	64	87
Prevailing direction	SSE	W	W	W	S	S	S	S	S	SSE	SSE	SSE	S
FREEZE DAYS PER MONTH	14	9	5	1	0	0	0	0	0	<0.5	5	12	46
PRECIPITATION (in. water)													
average	0.9	0.6	0.5	0.3	0.1	T	0.1	0.2	0.2	0.2	0.4	0.6	4.1
max/min	1.7	1.9	1.1	0.4	0.3	0.1	0.7	0.5	1.4	0.6	1.6	1.5	1.9
RELATIVE HUMIDITY(%)													
4 AM	65	64	63	62	58	51	40	45	48	53	61	63	56
1 PM	36	33	30	26	22	18	16	18	19	24	30	34	26

*Peak gust speed.

† Data for Victorville Pump Plant 34° 32' N 117° 18' W, Elevation 2858'

Source of climatological data: AWS climatic summary.

jj) YUMA, ARIZONA

Climatological Data for Yuma, Arizona

Latitude: 32° 40' Longitude: 114° 36' Elevation: 194'

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
TEMPERATURE(°F)													
average monthly	55.4	59.4	63.9	71.2	78.7	85.8	93.7	92.8	87.1	75.9	63.5	56.3	73.7
average daily max/min	67/43	73/46	78/50	86/57	93/64	101/71	106/81	104/81	100/74	90/62	77/51	68/44	87/60
extreme max/min	88/24	89/31	98/34	102/42	109/46	116/56	115/70	116/63	114/53	104/35	94/33	83/27	116/24
DEGREE DAYS													
heating (base 65°F)	308	192	97	24	0	0	0	0	0	5	108	276	1010
cooling (base 65°F)	10	37	62	210	425	624	890	862	663	343	63	6	4195
WIND													
Mean speed (mph)	7.4	7.4	7.8	8.4	8.3	8.5	9.5	8.9	7.1	6.5	6.8	7.2	7.8
Max. speed* (mph)	41	50	43	47	38	42	52	60	42	47	47	47	60
Prevailing direction	N	N	WNW	W	WNW	SSE	SSE	SSE	SSE	N	N	N	N
FREEZE DAYS PER MONTH	1	<0.5	0	0	0	0	0	0	0	0	0	1	2
PRECIPITATION (in. water)													
average	0.38	0.27	0.21	0.11	0.03	0.00	0.18	0.44	0.22	0.27	0.22	0.34	2.67
max/min	1.29/T	1.82/0.00	0.95/0.00	1.20/0.00	0.37/0.00	0.27/0.00	1.07/T	1.31/0.00	2.47/0.00	2.68/0.00	1.66/0.00	1.67/0.00	2.68/0.00
RELATIVE HUMIDITY(%)													
4 AM	55	55	54	47	44	44	50	57	57	53	57	60	53
10 AM	38	34	30	24	23	23	33	35	34	31	35	41	32
4 PM	27	23	21	17	15	14	23	25	23	22	27	32	22
10 AM	46	44	42	34	32	31	39	43	44	43	48	52	41

*"fastest mile"; speed is fastest observed 1-minute value.

Source of climatological data: NWS climatic summary.

Narrative Climatological Summary for Yuma, Arizona

The climate of Yuma is definitely a desert product. During the winters, home heating is necessary from late October until the 10th of April; but work or play can be conducted comfortably out-of-doors from about 10 a.m. to 5 p.m. during the winter, which is a period of mostly clear skies and abundant sunshine. Frosts are not uncommon in the nearby valleys and must be expected occasionally on higher lands.

In the period from November 1 to April 1 there are, on the average, 16 daylight hours with rain, a little more than three a month. There are places in the world where more rain has fallen in a single year than has fallen at Yuma during the past 90 years.

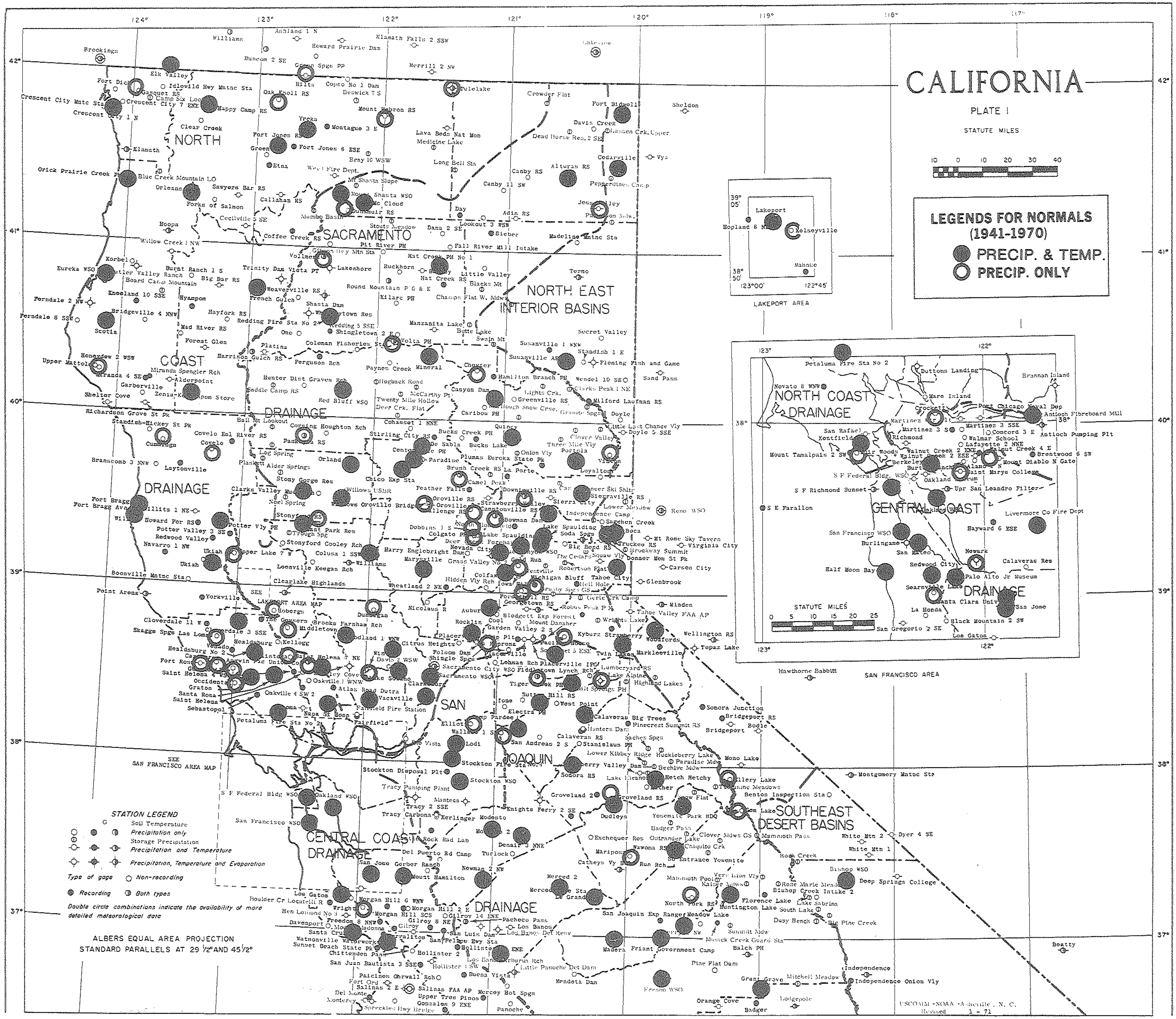
The sun does not shine all of every day, but comes nearer to doing so at Yuma than any other place in the United States for which we have records. Even in December and January the lower Colorado River Valley averages better than eight hours of sunshine a day.

The summers in this country are long and hot. Afternoon temperatures reach 100°, on the average, from June 10 to September 20, and 105° from July 2 to August 14. An extreme of 120° has been reached four times and the absolute high of 123° was registered on September 1, 1950.

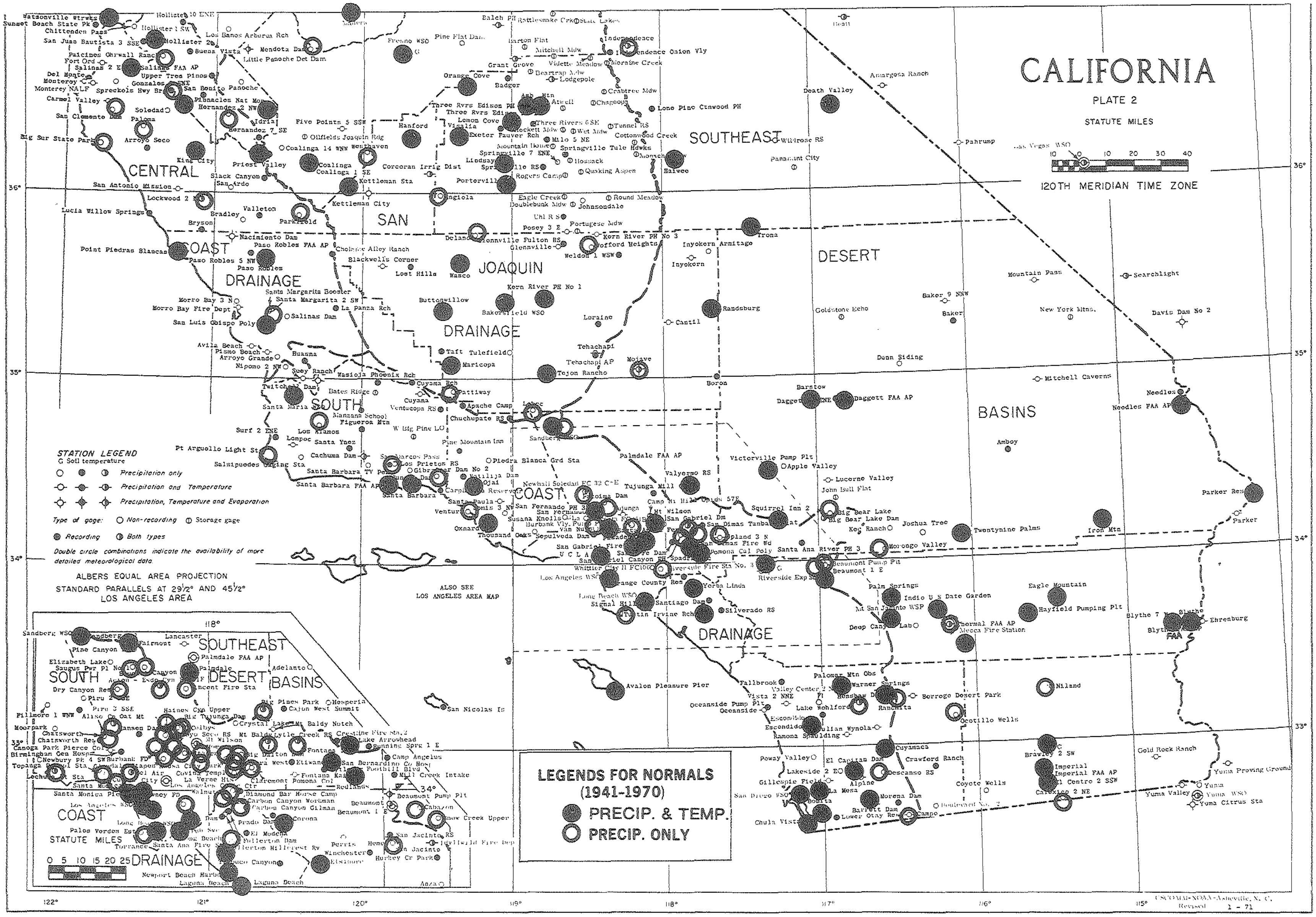
The hot air, ballooning upwards, draws in moisture-laden air from the Gulf of Lower California. Water content of the air from mid-July to mid-September is higher than might be expected over a desert area. This condition results from the relative nearness to the Gulf of Lower California. Evaporative coolers are very effective for cooling purposes during all the months except July, August, and September, during which months the wet-bulb temperatures are frequently between 75° and 80° — a condition that makes the ordinary water cooler somewhat ineffective. (Source: NWS)

B. LIMITED CLIMATE DATA STATIONS

Certain basic climate information is recorded in many places in California, indicated on the following map. Mean temperature, and heating and cooling degree-day normals are collected at 203 locations, whose geographic coordinates are given on page 254. Precipitation normals are recorded at 349 sites. Geographic coordinates for these stations follow the precipitation list.



CALIFORNIA
PLATE I
STATUTE MILES
LEGENDS FOR NORMALS (1941-1970)
PRECIP. & TEMP.
PRECIP. ONLY
NORTH COAST DRAINAGE
SACRAMENTO DRAINAGE
NORTH EAST INTERIOR BASINS
SAN JOAQUIN DRAINAGE
CENTRAL COAST DRAINAGE
SOUTHEAST DESERT BASINS
LAKEPORT AREA
SAN FRANCISCO AREA
STATION LEGEND
Soil Temperature
Precipitation only
Storage Precipitation
Precipitation and Temperature
Precipitation, Temperature and Evaporation
Type of gage
Non-recording
Recording
Both types
Double circle combinations indicate the availability of more detailed meteorological data
ALBERS EQUAL AREA PROJECTION
STANDARD PARALLELS AT 29 1/2° AND 45 1/2°


CALIFORNIA
PLATE 2
STATUTE MILES
120TH MERIDIAN TIME ZONE
CENTRAL COAST DRAINAGE
SAN JOAQUIN DRAINAGE
SOUTHEAST DESERT BASINS
SOUTH COAST DRAINAGE
STATION LEGEND
G Soil temperature
Precipitation only
Precipitation and Temperature
Precipitation, Temperature and Evaporation
Type of gage: Non-recording Storage gage
Recording Both types
Double circle combinations indicate the availability of more detailed meteorological data.
ALBERS EQUAL AREA PROJECTION
STANDARD PARALLELS AT 29½° AND 45½°
LOS ANGELES AREA
ALSO SEE LOS ANGELES AREA MAP
LEGENDS FOR NORMALS (1941-1970)
PRECIP. & TEMP.
PRECIP. ONLY

CLIMATOGRAPHY OF CALIFORNIA*

Monthly Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1941-70

PREFACE

The climatological normals presented here are based on records for the 30-year period 1941-70, inclusive. Data are presented in the order shown in the title. Units used are °F for temperature and inches for precipitation. Heating and cooling degree day normals are derived from the monthly normal temperatures (base 65°F) using the technique developed by Thom.[1,2] Degree day normals also have been computed to other bases and may be obtained at cost from the National Climatic Center, Asheville, North Carolina 28801.

1. Normals for National Weather Service Offices and Principal Climatological Stations

A normal of a climatological element is the arithmetic mean for a specific period of record which estimates the true mean of the element at the current exposure of the meteorological instrument measuring the element. The true mean is the mean of all possible observations (population) at the current exposure. It is from this population that future observations will come, not from values in the past record. The true mean can never be known exactly, but must be estimated from a sample of the past record. The normals presented here are estimates of the true mean obtained from the 30-year sample record 1941-70.

If no exposure changes have occurred at a station, the normal is estimated by simply averaging the 30 values from the 1941-70 record. Since it is next to impossible to maintain a multi-purpose network of meteorological stations without having exposure changes, it is first necessary to identify and evaluate these changes and then make adjustments for them if necessary.

After periods of heterogeneity have been determined, adjustments are applied to remove the heterogeneities introduced into the mean. This is done by comparing the record at the base station, for which the normal is desired, to the record

*Adapted from "Climatography of the United States No. 81 (by state)," National Climate Center, Federal Building, Asheville, North Carolina 28801.

at a supplementary station with a homogeneous period which covers the heterogeneous period at the base station. The difference method is applied to the monthly average maximum and minimum temperature and the ratio method to the monthly total precipitation.[3] A weighted average of the various partial means of the adjusted and unadjusted record is then prepared to give the normal.

2. Normals for Substations

Normals for substations were computed somewhat differently than those for the National Weather Service first-order stations. Monthly substation normals are the simple arithmetic averages of the monthly values of temperature and precipitation for the period 1941-70. They were computed only for substations active during the entire period. No attempt was made to adjust for minor changes in location of the observing site, or for changes in the time of observation. Normals were not computed for substations which moved a significant distance during the 1941-70 period (more than 5 miles horizontally, or 100 feet vertically). Missing values in the data series were estimated up to a maximum of 18 consecutive temperature values and 24 consecutive precipitation values. Annual substation normals are the averages of the monthly temperature normals and the sums of the 12 monthly precipitation normals.

Individual station values (by year-month) of average temperature and total precipitation for the 1941-70 period are available at the National Climatic Center, Asheville, North Carolina, and may be obtained in either hard copy or magnetic tape for the cost of duplication. In addition, monthly extremes of precipitation and temperature are included along with the standard deviation of monthly temperatures. The National Climatic Center also prepares special studies of climatological elements to specifications provided by the requesting agency or person. The cost of providing such services is borne by the requestor.

3. References

[1]Thom, H. C. S., "The Rational Relationship Between Heating Degree Days and Temperature," Monthly Weather Review, Vol. 82 No. 1 (January 1954).

[2]Thom, H. C. S., "Normal Degree Days Above Any Base by the Universal Truncation Coefficient," Monthly Weather Review, Vol. 94 No. 7 (July 1966).

[3]Barger, G. L., editor, "Climatology at Work," U.S. Weather Bureau, Washington, D.C. (1960).

4. Notes

a. TABLE CONTENT

Precipitation normals less than 0.005 inch are shown as zero. Monthly normals for February are based on a 28-day month.

b. STATION NAMES

Figures and letters following the station name indicate a rural location, and refer to the distance and direction of the station from the nearest post office. WSO, WSMO and WSFO denote a Weather Service Office, a Meteorological Observatory, and a Forecast Office, respectively. Station elevations are in feet above mean sea level. "R" or a "6" denotes a recording gauge. "//" indicates a wind shield is affixed to the gauge.

c. MAPS

Maps show the names and locations of stations in operation during the period considered (1941-70). No attempt was made to show current names and locations.

d. DEGREE DAY NORMALS

The usual arithmetical procedures were not applied to obtain the heating and cooling degree day data because of numerous heterogeneities in the records at most stations due to instrument changes and relocations. The rational conversion formulae developed by Thom (Refs. 1 and 2) allow the properly adjusted mean temperature normals to be converted to degree day normals with uniform consistency. In some cases this procedure will yield degree day values that are unexpected. These cases are not statistically significant (a relatively low number of degree days) and occur when the standard deviations are computed from a mixed distribution as frequently occurs during the transition months.

5. Mean Temperatures (National Weather Service)

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ALDERPOINT	44.7	48.7	50.9	55.1	60.3	65.5	71.8	71.3	67.8	59.7	51.3	45.7	57.7
ALTURAS RANGER STATION	28.6	34.0	38.1	44.5	52.1	58.8	65.8	63.8	57.8	48.4	38.7	31.8	46.8
ANTIOCH FIBREBOARD ML	45.7	50.5	53.8	59.1	64.4	70.1	73.4	72.3	70.7	63.7	53.8	46.8	60.4
ASH MOUNTAIN	46.5	49.7	52.3	58.1	65.4	74.0	82.8	81.3	76.2	66.2	55.2	47.6	62.8
AUBERRY 1 NW	43.4	46.1	48.8	54.8	62.4	69.7	78.5	76.7	71.8	61.6	51.2	44.7	59.2
AUBURN	44.9	48.4	50.9	56.3	62.5	69.8	77.4	75.8	72.1	63.3	53.3	46.1	60.1
AVALON PLEASURE PIER	54.0	54.6	55.5	57.7	60.1	62.3	65.6	67.0	66.1	63.4	58.9	55.2	60.0
BAKERSFIELD WSO	47.5	52.4	56.6	62.7	69.8	76.9	83.9	81.6	76.6	66.9	56.0	47.8	64.9
BARRETT DAM	48.3	50.2	52.4	57.1	62.0	67.4	75.6	75.9	72.0	63.8	55.5	49.8	60.8
BARSTOW	45.7	50.3	54.7	62.0	69.8	77.5	84.9	83.0	76.7	65.7	53.6	46.1	64.2
BEAUMONT 1 E	47.9	49.3	51.0	55.9	61.4	67.9	76.4	76.1	72.2	63.8	55.3	49.7	60.6
BERKELEY	49.3	52.2	53.6	55.6	58.2	61.0	61.6	62.2	63.6	61.2	55.9	50.6	57.1
BISHOP WSO	37.1	41.6	46.3	54.4	62.2	69.7	76.6	74.1	67.5	57.2	45.7	38.8	55.9
BLUE CANYON WSO	36.4	37.4	38.0	43.9	51.3	59.1	68.1	66.8	62.9	54.0	44.5	39.1	50.1
BLYTHE	53.0	57.8	62.7	70.3	77.6	84.8	92.1	91.2	85.3	73.7	60.9	53.4	71.9
BLYTHE FAA AIRPORT	53.5	58.5	63.6	71.6	79.5	87.4	94.7	93.3	87.6	75.7	62.4	54.3	73.5
BOCA	24.0	27.3	31.7	39.7	47.0	53.5	60.2	58.1	52.9	44.8	35.6	27.6	41.9
BONITA	53.7	54.9	56.2	59.4	62.4	64.9	69.3	70.7	69.4	64.8	59.3	54.6	61.6
BOWMAN DAM	35.5	36.7	38.0	43.6	50.6	58.6	66.8	65.7	62.0	53.0	43.3	37.7	49.3
BRAWLEY 2 SW	53.9	58.2	62.9	70.2	77.3	84.6	92.0	91.4	86.4	75.3	62.8	55.0	72.5
BROOKS FARNHAM RANCH	44.6	48.7	51.9	57.1	64.2	71.5	76.9	75.0	71.4	62.8	52.5	45.6	60.2
BURBANK VALLEY PMP PLT	53.7	55.6	57.4	60.7	64.1	67.9	74.2	74.6	72.7	66.5	60.0	54.8	63.5
BUTTONWILLOW	44.9	50.0	55.0	61.7	68.8	75.7	82.4	80.2	74.8	64.8	53.4	45.6	63.1
CALAVERAS BIG TREES	36.8	38.2	39.7	44.8	51.9	59.5	67.5	65.7	61.4	52.7	43.8	38.5	50.0
CAMP PARDEE	45.2	49.2	52.2	57.6	64.1	71.3	78.3	76.7	73.3	64.6	54.3	46.6	61.1
CANYON DAM	29.3	32.7	36.3	43.4	51.0	58.1	65.7	63.9	58.8	48.8	38.2	31.5	46.5
CEDARVILLE	29.8	34.8	39.1	46.9	54.4	61.5	72.0	69.8	61.8	50.3	39.2	32.1	49.3
CENTERVILLE PH	45.2	49.0	52.0	57.6	64.4	71.6	78.3	76.5	72.8	63.2	52.8	46.0	60.8
CHICO EXPERIMENT STA	44.7	49.2	52.4	58.2	65.4	72.6	78.3	76.2	72.4	63.1	52.6	45.5	60.9
CHULA VISTA	52.6	53.8	55.2	57.8	60.5	62.8	66.6	68.3	66.9	63.0	58.2	54.1	60.0
CLAREMONT POMONA COL	51.8	53.5	55.0	58.7	62.7	67.1	74.0	74.3	72.5	65.9	58.8	53.1	62.3
CLARKSBURG	44.2	49.0	52.6	57.9	63.5	69.1	73.1	72.3	70.0	62.0	52.0	45.2	59.2
CLOVERDALE 3 SSE	47.0	50.7	53.0	57.4	62.7	68.7	72.4	71.6	70.0	63.1	54.7	48.1	60.0
COALINGA	45.9	50.3	53.8	60.0	67.3	74.2	81.4	79.3	74.1	64.6	53.9	46.6	62.6
COLFAX	44.1	46.7	48.7	54.5	61.3	69.1	77.5	75.7	71.5	61.5	51.7	45.7	59.0
COLUSA 1 SSW	44.7	49.7	53.2	59.2	66.2	72.9	77.8	75.7	72.2	63.0	52.5	45.5	61.1
CORONA	52.6	54.3	56.0	60.0	64.3	68.6	74.6	74.9	72.3	65.7	58.8	53.6	63.0
CRESCENT CITY 1 N	46.8	48.1	48.4	50.2	53.5	56.7	58.3	58.8	58.6	55.3	51.3	48.1	52.8
CULVER CITY	55.3	56.4	57.4	59.3	61.7	64.3	68.3	69.5	68.5	65.6	60.9	56.7	62.0
CUYAMACA	39.1	41.0	43.0	48.6	54.4	61.6	70.3	69.5	64.7	55.2	46.3	40.8	52.8
DAGGETT FAA AIRPORT	47.3	52.0	56.7	64.3	72.3	80.1	87.3	85.5	79.2	68.1	55.5	48.0	66.4
DAVIS 2 WSW EXP FARM	45.0	49.6	52.8	58.2	64.3	70.6	74.6	73.1	71.0	63.1	53.2	46.0	60.1
DEATH VALLEY	52.0	59.1	66.9	76.4	85.3	93.8	101.6	99.2	80.9	77.4	62.1	52.4	76.4
DEER CREEK POWER HOUSE	34.2	37.7	41.1	46.6	53.3	59.7	66.4	64.8	61.2	52.0	41.5	35.2	49.5
DENAIR 3 NNE	44.9	49.5	53.1	58.9	65.2	71.3	76.3	74.3	70.8	62.5	52.4	45.4	60.4
DE SABLA	41.2	43.6	45.6	51.2	57.6	65.2	72.5	70.8	67.3	58.2	48.4	42.7	55.4
DUDLEYS	39.1	41.7	43.2	48.3	54.7	61.1	68.8	67.3	63.1	54.5	46.0	40.5	52.4
EAGLE MOUNTAIN	53.8	58.2	62.6	71.0	79.0	87.1	93.6	91.9	86.7	75.8	63.1	55.4	73.2
EAST PARK RESERVOIR	43.0	46.8	49.4	54.9	62.3	70.3	76.9	74.7	70.3	61.0	50.9	44.5	58.8
EL CAPITAN DAM	54.4	55.8	57.2	60.9	64.9	69.0	75.5	76.3	74.6	68.4	61.6	56.1	64.6
EL CENTRO 2 SSW	53.6	57.8	62.4	69.5	76.9	84.4	91.6	90.9	85.6	74.6	62.1	54.4	72.0
ELECTRA POWER HOUSE	45.8	49.5	52.2	57.5	64.1	70.9	77.4	75.7	71.9	63.3	53.6	46.7	60.7
ELK VALLEY	37.5	41.1	43.7	48.4	54.4	60.4	66.0	64.6	59.7	51.0	43.5	38.9	50.8
ELSINORE	50.6	52.9	54.9	59.7	64.8	70.7	78.4	78.4	74.6	66.3	57.4	51.8	63.4
ESCONDIDO	51.6	53.2	55.2	59.1	62.9	66.9	72.6	73.5	71.1	64.5	57.7	52.7	61.8
EUREKA WSO	47.3	48.4	48.3	49.7	52.5	55.2	56.3	57.0	56.6	54.4	51.7	48.6	52.2
FAIRMONT	44.2	46.8	49.0	55.0	61.4	69.3	78.9	78.0	73.3	63.5	52.4	45.8	59.8
FORT BIDWELL	29.8	35.0	39.3	46.1	53.3	59.5	67.1	65.7	59.4	50.3	39.3	32.4	48.1
FORT BRAGG	47.9	48.9	49.4	50.8	53.5	55.9	56.5	57.0	57.4	55.5	52.5	49.1	52.9
FORT BRAGG AVIATION	47.5	48.6	48.8	49.8	52.4	54.7	55.4	56.0	56.2	54.4	51.5	48.5	52.0
FORT JONES RANGER STA	33.2	39.0	42.8	48.3	55.3	62.2	69.6	67.8	61.4	51.4	41.4	34.8	50.6
FRESNO WSO	45.3	49.9	53.9	60.3	67.4	73.9	80.6	78.3	73.8	64.2	53.5	45.8	62.3
FRIANT GOVERNMENT CAMP	45.3	49.8	52.9	59.0	66.5	73.7	81.1	78.9	74.1	65.1	54.4	46.2	62.3
GRANT GROVE	33.2	33.6	34.5	39.5	46.4	54.1	62.6	61.3	57.0	49.1	40.5	35.3	45.6
GRATON	45.4	49.0	51.0	54.4	58.5	63.3	65.5	65.4	64.4	59.2	52.0	46.2	56.2
HAIWEE	40.3	44.4	48.8	56.9	64.9	73.2	80.4	78.5	72.3	61.6	49.1	41.5	59.3
HALF MOON BAY	49.9	51.0	51.3	52.4	54.6	56.6	57.6	58.2	58.9	57.1	54.5	51.1	54.4
HANFORD	45.0	49.9	54.1	60.4	67.2	73.6	79.6	77.3	72.7	63.6	52.6	45.5	61.8
HAPPY CAMP RANGER STA	38.3	43.8	47.5	53.3	60.3	66.8	73.9	72.1	66.7	56.4	46.3	40.2	55.5
HAT CREEK PH NO 1	33.7	38.2	42.1	48.6	55.8	62.3	68.8	66.3	61.1	52.0	41.8	35.1	50.5
HAYFIELD PUMPING PLANT	51.6	55.3	59.3	67.1	74.3	81.8	89.7	88.4	82.6	71.8	60.4	52.9	69.6
HEALDSBURG	47.0	51.1	53.5	57.4	62.3	67.5	69.8	69.8	68.6	62.6	54.4	48.0	59.3
HETCH HETCHY	37.9	41.1	43.5	49.5	55.9	62.6	70.8	69.8	65.6	56.8	46.3	39.4	53.3
HOLLISTER 1 SW	48.7	52.1	54.0	57.1	60.2	63.9	66.5	66.5	66.7	62.1	55.0	49.6	58.5
HUNTINGTON LAKE	31.1	31.1	32.0	37.2	44.2	52.2	60.6	58.7	55.4	47.2	39.0	33.5	43.6

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STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
IDRIA	45.5	47.8	49.9	55.7	62.9	70.8	79.3	77.6	72.9	63.2	53.1	47.2	60.5
IMPERIAL	54.8	59.0	63.3	70.4	77.5	84.8	91.6	91.0	86.1	75.3	63.2	55.8	72.7
INDIO U S DATE GARDEN	54.3	58.9	63.7	71.5	78.5	85.8	91.8	90.8	86.0	75.7	63.3	55.5	73.0
IRON MOUNTAIN	52.9	57.6	62.5	71.1	79.5	87.8	94.6	92.8	87.0	75.3	62.4	54.3	73.2
KENTFIELD	46.3	50.2	52.4	56.0	59.7	64.2	66.2	65.9	65.7	60.5	53.1	47.5	57.3
KERN RIVER PH NO 1	49.5	54.0	57.8	63.8	71.3	78.8	87.0	85.2	80.4	70.1	58.9	50.2	67.3
KETTLEMAN STATION	47.3	52.2	56.3	62.5	69.6	77.0	84.5	82.5	77.6	68.1	56.7	47.9	65.2
KING CITY	48.8	51.7	53.6	57.1	61.3	65.2	67.6	67.2	66.7	61.9	54.7	49.5	58.8
LAGUNA BEACH	52.6	54.1	55.1	57.6	60.7	63.3	67.1	68.3	66.9	62.8	58.3	53.5	60.0
LAKE ARROWHEAD	37.6	39.8	42.4	47.4	53.7	60.7	69.1	68.4	64.3	54.9	44.5	39.0	51.8
LAKEPORT	42.3	46.0	48.5	53.8	60.1	66.8	73.4	72.0	68.0	58.9	49.3	43.7	56.9
LAKE SPAULDING	34.3	36.3	37.6	42.7	49.8	56.9	63.5	61.8	59.0	51.0	41.5	36.3	47.6
LA MESA	53.9	55.0	56.2	59.2	62.4	65.4	71.0	72.1	70.9	66.0	60.4	55.4	62.3
LE GRAND	45.3	50.0	53.4	59.3	66.0	72.5	78.5	76.5	72.5	63.9	53.0	46.0	61.4
LEMON COVE	46.2	51.1	55.2	61.7	68.5	75.1	81.6	79.2	74.4	65.2	54.4	46.5	63.3
LINDSAY	45.6	50.0	53.8	60.4	67.2	73.6	80.1	77.7	73.0	63.9	53.4	46.2	62.1
LIVERMORE COUNTY F D	45.6	48.9	51.5	56.1	61.0	66.4	71.3	70.8	69.3	62.3	53.0	46.8	58.6
LODI	44.9	49.4	52.7	58.0	63.5	69.1	73.1	71.7	69.2	61.6	52.2	45.7	59.3
LONG BEACH PUB SVC	55.9	57.3	58.4	60.7	63.5	66.4	71.1	72.3	70.9	66.7	61.6	57.2	63.5
LONG BEACH WSO	54.2	55.5	57.2	60.6	64.1	67.3	72.2	73.3	71.8	66.9	60.6	55.5	63.3
LOS ANGELES WSO INTL	54.5	55.6	56.5	58.8	61.9	64.5	68.5	69.5	68.7	65.2	60.5	56.0	61.7
LOS ANGELES CIVIC CTR	56.7	58.1	59.2	61.7	64.7	68.0	73.2	74.1	72.7	68.4	62.7	58.1	64.8
LOS BANOS	45.4	50.5	54.5	60.3	66.3	72.6	78.4	76.7	72.9	64.0	53.4	46.2	61.8
LOS GATOS	47.7	50.5	53.0	56.8	61.3	66.0	69.5	68.9	67.8	61.8	54.2	48.7	58.9
MADERA	45.3	50.2	54.3	60.4	67.2	73.7	80.2	77.8	73.3	64.4	53.6	46.1	62.2
MARICOPA	47.3	52.4	57.1	63.4	70.8	78.1	85.4	83.5	77.9	68.0	56.3	47.9	65.7
MARYSVILLE	45.5	50.5	54.2	60.2	66.6	73.4	78.8	76.9	73.5	64.4	53.9	46.4	62.0
MC CLOUD	33.9	37.1	39.9	45.9	53.1	59.6	66.5	64.4	59.8	51.0	41.9	35.9	49.1
MECCA FIRE STATION	53.7	58.2	63.0	70.7	77.5	83.7	90.5	89.8	84.8	74.3	62.4	54.7	71.9
MERCED FIRE STATION 2	45.1	49.8	53.8	59.7	66.4	72.5	78.3	76.4	72.3	63.4	52.8	45.8	61.4
MINERAL	31.1	33.4	35.5	41.1	48.1	55.1	62.4	60.9	57.3	48.4	39.1	33.3	45.5
MODESTO	45.1	49.9	53.7	59.2	65.1	71.0	76.3	74.4	71.0	62.8	52.6	45.6	60.6
MOUNT HAMILTON	40.9	41.7	42.0	47.3	53.6	60.7	70.9	69.4	65.7	57.4	48.4	43.2	53.4
MOUNT SHASTA WSO	33.6	37.8	40.4	46.3	53.3	60.0	67.8	66.0	61.2	51.4	41.7	35.5	48.6
MOUNT WILSON FC 338	42.5	42.7	43.6	48.9	55.2	63.0	71.6	70.8	67.3	58.6	49.8	44.6	54.9
NAPA STATE HOSPITAL	47.4	51.2	53.1	56.3	60.6	65.0	67.3	67.2	67.2	62.2	54.7	48.7	58.4
NEEDLES FAA AIRPORT	51.6	56.5	61.6	70.4	79.6	88.3	95.4	93.3	86.9	74.3	60.7	52.7	72.6
NEVADA CITY	38.6	41.1	43.6	49.3	55.9	62.6	69.5	67.6	63.1	53.9	45.3	40.0	52.5
NEWMAN 2 NW	45.5	50.6	54.9	60.7	67.0	73.2	78.2	76.0	72.4	64.3	53.7	46.0	61.9
NEWPORT BEACH HARBOR	54.0	55.1	56.2	58.3	61.0	63.6	66.8	68.0	66.8	63.4	59.1	55.1	60.6
OAKLAND WSO	48.6	51.9	53.7	56.1	58.9	61.9	63.1	63.5	64.5	61.1	55.3	48.9	57.4
OJAI	51.0	53.0	55.1	59.1	62.6	66.7	73.3	73.3	71.1	64.8	57.7	52.2	61.7
ORANGE COVE	45.5	49.8	53.5	59.7	66.9	73.4	80.0	78.1	73.6	64.4	54.1	46.2	62.1
ORICK PRAIRIE CREEK PK	43.8	46.5	47.2	49.3	52.9	56.4	58.7	59.4	58.8	54.5	49.2	45.0	51.8
ORLAND	44.4	49.2	52.7	59.1	66.5	73.8	79.1	76.8	73.0	63.7	52.9	45.5	61.4
ORLEANS	41.6	46.5	49.6	54.6	60.4	66.2	73.1	72.1	67.8	57.9	48.7	43.1	56.8
OXNARD	53.8	54.6	55.2	57.1	59.3	61.6	65.2	65.6	64.9	62.7	58.6	55.0	59.5
PALMDALE	45.0	48.6	52.1	58.3	65.2	72.7	81.2	79.8	74.3	63.9	52.5	45.9	61.6
PALM SPRINGS	54.3	58.4	62.2	68.3	75.9	82.9	90.8	89.5	84.2	74.3	62.5	55.0	71.6
PALO ALTO JR MUSEUM	47.3	50.7	52.8	56.1	60.0	64.1	66.0	65.8	65.0	60.3	53.6	48.3	57.5
PALOMAR MT OBSERVATORY	43.1	43.9	45.0	50.6	56.8	64.2	72.5	72.0	68.6	59.8	50.7	45.2	56.0
PARKER RESERVOIR	52.8	57.8	63.1	71.6	80.2	88.4	95.2	93.9	88.4	76.8	62.7	54.3	73.8
PASADENA	54.2	55.8	57.2	60.4	63.6	67.4	73.8	74.5	72.9	67.0	60.4	55.5	63.6
PASO ROBLES	46.7	50.2	52.7	57.0	61.6	66.7	71.6	71.2	68.3	61.3	52.8	47.3	59.0
PETALUMA FIRE STA 2	46.9	50.5	52.3	55.1	59.1	63.9	66.7	67.0	66.8	61.7	53.9	47.9	57.7
PINNACLES NAT MONUMENT	46.9	49.4	51.3	55.8	61.2	67.3	73.5	72.7	70.1	62.6	54.0	48.2	59.4
PLACERVILLE	40.4	43.6	46.8	52.4	58.8	66.1	73.5	71.6	66.8	57.3	47.3	41.6	55.5
POINT PIEDRAS BLANCAS	52.1	52.2	52.0	52.1	53.5	55.0	56.4	56.8	57.7	57.1	55.8	53.3	54.5
POMONA CAL POLY	50.8	53.1	55.1	59.2	63.2	67.7	74.4	74.5	72.1	65.3	57.4	51.7	62.0
PORTERVILLE	46.2	51.0	55.1	61.2	67.8	74.3	81.0	78.8	74.1	65.2	54.6	46.8	63.0
PORTOLA	28.4	33.0	36.7	43.1	50.2	56.6	62.9	60.9	56.7	48.0	38.7	31.8	45.7
POTTER VALLEY PH	44.7	48.3	50.4	54.8	60.7	67.1	73.6	72.4	69.0	60.7	51.5	45.7	58.2
PRIEST VALLEY	41.2	43.8	45.9	50.9	56.7	63.6	70.9	69.2	65.0	56.7	47.8	42.5	54.5
QUINCY	33.7	38.0	41.9	47.6	54.6	61.2	66.3	64.0	59.7	51.2	41.8	35.3	48.6
RANDSBURG	44.4	47.9	51.3	59.1	67.5	75.8	84.0	82.0	75.8	65.2	52.9	45.7	62.6
RED BLUFF WSO	45.2	50.0	53.2	59.5	67.4	75.5	82.3	79.9	75.3	65.0	53.7	46.4	62.8
REDDING FIRE STA NO 2	46.1	50.7	53.9	60.3	67.8	75.6	83.1	80.6	76.1	65.7	54.3	47.2	63.5
REDLANDS	51.5	53.5	55.5	60.0	64.4	69.8	77.3	77.1	73.9	66.0	58.2	52.6	63.3
REDWOOD CITY	48.4	51.6	53.9	57.3	61.3	65.6	68.2	67.8	67.0	61.6	54.8	49.6	58.9
RIVERSIDE FIRE STA. #3	52.1	54.1	56.1	60.3	64.8	69.6	76.0	76.1	73.4	66.1	58.2	52.9	63.3
ROCKLIN	43.6	47.7	50.9	56.5	63.6	70.9	77.4	75.7	71.6	62.1	51.6	44.6	59.7
SACRAMENTO WSO	45.1	49.8	53.0	58.3	64.3	70.5	75.2	74.1	71.5	63.3	53.0	45.8	60.3
SAINT HELENA	45.8	49.7	51.9	56.4	61.6	67.1	70.8	70.2	68.0	61.3	53.1	47.1	58.6
SALINAS FAA AP	50.0	52.0	53.0	55.3	58.1	60.6	61.9	62.4	63.6	61.1	56.0	51.2	57.1
SAN BERNARDINO CO HOSP	52.0	54.2	56.1	60.6	65.2	70.7	78.2	78.2	74.6	66.8	58.6	53.1	64.0

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SANDBERG WSO	40.2	42.2	43.6	49.2	55.7	64.0	74.0	73.0	68.9	58.8	48.3	41.9	55.0
SAN DIEGO WSO	55.2	56.7	58.1	60.7	63.3	65.5	69.6	71.4	69.9	66.1	60.8	56.7	62.9
SAN FERNANDO	54.2	55.4	56.7	60.5	63.9	68.0	74.5	74.6	72.6	66.6	60.8	55.5	63.6
SAN FRANCISCO WSO	48.3	51.2	53.0	55.3	58.3	61.6	62.5	63.0	64.1	61.0	55.3	49.7	56.9
S F FEDERAL BLDG WSO	50.9	53.4	54.3	55.3	56.7	58.7	58.5	59.4	62.2	61.4	57.4	52.0	56.7
SAN GABRIEL FIRE DEPT	54.0	55.8	57.5	60.9	64.4	68.3	74.1	74.7	72.7	67.1	60.2	55.3	63.8
SAN JACINTO	49.3	51.4	53.7	58.8	64.4	70.2	77.7	77.5	73.6	64.9	55.9	50.4	62.3
SAN JOSE	49.5	52.5	54.6	57.8	61.7	65.7	68.4	68.1	67.7	62.7	55.8	50.3	59.6
SAN LUIS OBISPO POLY	51.9	53.5	54.3	56.5	58.6	61.7	64.7	64.9	65.3	63.4	58.5	53.5	58.9
SAN MATEO	49.5	52.4	54.1	56.7	59.8	63.2	65.0	65.3	65.5	61.9	55.7	50.6	58.3
SANTA ANA FIRE STATION	54.2	55.8	57.4	60.3	63.7	66.9	71.7	72.7	71.4	66.5	60.3	55.4	63.0
SANTA BARBARA	53.2	54.6	55.9	58.4	60.6	63.1	66.6	67.5	66.8	63.4	58.6	54.5	60.3
SANTA BARBARA FAA AP	51.6	53.3	54.7	57.3	59.7	62.0	65.1	65.7	65.0	61.6	57.0	52.8	58.8
SANTA CLARA UNIVERSITY	48.6	51.9	54.2	57.6	61.6	65.5	68.1	67.9	67.2	62.1	54.9	49.5	59.1
SANTA CRUZ	48.8	51.0	52.4	54.7	58.0	61.0	62.7	63.0	63.4	60.0	54.5	49.9	56.6
SANTA MARIA WSO	50.5	52.0	52.8	54.9	57.1	59.6	62.1	62.3	62.6	60.4	56.1	51.8	56.9
SANTA MONICA PIER	55.5	56.1	56.7	58.5	60.7	63.3	66.3	67.5	66.4	63.8	60.3	56.9	61.0
SANTA ROSA	46.1	50.0	51.9	55.5	59.7	64.4	66.8	67.0	66.4	61.1	53.2	47.2	57.4
SCOTIA	47.1	49.1	49.4	51.5	55.0	58.4	60.4	61.3	60.6	57.2	52.7	48.2	54.2
SIERRAVILLE RANGER STA	29.1	33.0	37.3	44.0	51.0	57.6	64.0	62.1	57.7	49.0	38.5	31.4	46.2
SONORA RS	43.9	46.9	49.2	54.8	61.4	68.7	77.0	75.4	70.9	61.7	51.5	45.0	58.9
SO ENTRANCE YOSEMITE	36.7	38.1	39.5	44.7	51.7	59.0	66.7	65.5	61.2	52.8	43.8	38.5	49.9
SQUIRREL INN 2	38.7	40.0	41.6	46.7	53.1	60.8	69.3	68.6	64.7	55.6	45.7	40.3	52.1
STOCKTON WSO	44.6	49.1	52.7	58.6	65.2	71.8	76.7	75.3	72.1	63.5	52.9	45.6	60.7
STOCKTON FIRE STA NO 4	44.5	49.2	52.9	58.1	63.8	69.7	74.1	72.6	69.6	62.0	52.3	45.5	59.5
STONY GORGE RESERVOIR	43.7	47.8	50.7	56.3	64.2	72.1	78.9	76.9	72.4	62.4	51.8	45.1	60.2
SUSANVILLE AIRPORT	29.9	35.0	39.7	46.6	54.2	61.4	69.2	67.0	60.9	50.4	39.5	31.7	48.8
TAHOE CITY	28.2	29.6	32.0	38.1	45.4	52.6	60.7	59.6	54.0	45.2	35.9	30.5	42.7
TEJON RANCHO	46.2	50.4	54.4	60.7	67.6	75.0	82.3	80.2	75.5	65.6	54.7	47.1	63.3
THREE RVRS EDISON PH 2	46.3	50.1	53.5	59.2	65.9	73.0	80.5	78.7	73.8	64.2	53.9	47.2	62.2
TIGER CREEK PH	42.2	45.6	48.0	53.2	59.5	66.3	74.3	73.2	69.4	60.3	49.9	42.8	57.1
TORRANCE	54.2	55.5	56.4	59.0	61.8	64.6	68.4	69.3	68.2	65.0	59.9	55.5	61.5
TRONA	45.2	51.0	56.7	64.6	73.1	81.1	88.9	87.0	80.0	68.3	54.6	45.6	66.3
TRUCKEE RANGER STATION	26.0	28.7	32.0	38.9	46.4	53.5	61.3	59.7	55.0	45.8	35.3	27.8	42.5
TUSTIN IRVINE RANCH	53.0	54.6	56.1	59.4	62.9	66.3	70.7	71.6	70.2	65.2	58.9	54.0	61.9
TWENTYNINE PALMS	48.6	52.9	57.3	65.2	73.3	81.2	88.5	86.8	80.4	69.2	57.0	49.6	67.5
TWIN LAKES	25.8	26.9	28.2	33.8	40.7	48.0	55.7	54.6	51.0	42.8	34.2	28.4	39.2
UKIAH	46.0	49.8	51.7	56.1	61.6	67.6	73.7	72.7	69.7	61.5	52.7	47.0	59.2
U C L A	56.9	57.7	58.0	59.9	62.0	64.3	68.6	69.6	69.1	66.5	62.7	58.6	62.8
VACAVILLE	45.0	49.8	53.2	58.2	64.4	70.8	75.7	74.3	71.5	63.3	53.1	45.9	60.4
VALYERMO RANGER STA	41.6	44.6	47.3	53.5	60.3	67.5	75.2	73.9	68.7	59.0	48.8	42.5	56.9
VICTORVILLE PUMP PLANT	42.8	46.7	50.6	57.3	64.2	71.4	79.0	78.0	71.9	61.8	50.4	43.7	59.8
VISALIA	46.2	51.3	55.7	61.9	68.4	75.0	81.3	79.2	74.6	65.5	54.9	46.8	63.4
WARNER SPRINGS	44.7	46.4	48.0	52.7	58.3	64.8	73.0	72.8	68.3	59.8	51.4	46.3	57.2
WASCO	45.4	50.6	55.5	61.8	68.9	75.9	82.6	80.4	75.3	65.5	54.3	46.5	63.6
WATSONVILLE WATERWORKS	48.4	50.7	52.0	54.5	56.9	59.5	60.7	60.8	61.7	59.3	54.4	49.6	55.7
WEAVERVILLE RANGER STA	36.5	41.3	44.1	50.0	57.1	63.7	70.8	69.0	64.1	54.3	44.3	37.9	52.8
WILLOWS	44.5	49.2	52.7	58.8	66.0	73.0	78.1	76.0	72.9	64.1	53.2	45.6	61.2
WOODFORDS	32.6	35.9	38.7	45.3	52.9	60.6	69.3	67.7	61.5	51.9	41.4	34.9	49.4
WOODLAND 1 WNW	45.4	50.4	54.0	59.7	66.1	72.5	76.9	75.3	72.6	64.2	53.9	46.4	61.5
YORBA LINDA	54.3	55.6	56.9	60.2	64.1	67.6	73.2	73.6	71.9	66.5	60.7	55.5	63.3
YOSEMITE PARK HEADQTRS	36.8	41.1	44.7	50.9	57.4	64.3	71.9	70.7	66.1	56.3	44.7	37.2	53.5
YREKA	33.9	38.9	42.6	48.8	56.3	63.4	71.9	70.0	63.9	53.0	42.1	35.6	51.7

6. Precipitation Normals (National Weather Service)

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ACTON-ESDO CYN FC261F	1.82	1.78	1.55	0.87	0.18	0.04	0.07	0.12	0.15	0.35	1.44	1.58	10.15
ALDERPOINT	10.90	7.43	6.15	3.83	1.84	0.55	0.05	0.34	0.52	3.82	7.22	10.02	52.67
ALISO CN OAT MT FC 446	4.82	4.14	3.26	2.32	0.36	0.07	0.01	0.12	0.14	0.57	3.25	3.44	22.50
ALTADENA	4.36	4.16	3.06	2.05	0.31	0.16	0.02	0.06	0.18	0.49	2.95	3.04	20.86
ALTURAS RANGER STATION	1.71	1.25	1.19	1.00	1.49	1.34	0.29	0.41	0.33	1.08	1.52	1.65	13.27
ANGIOLA	1.28	1.27	1.12	0.86	0.19	0.08	0.01	0.02	0.08	0.26	0.83	1.12	7.13
ANGWIN PAC UNION COL	9.23	6.50	4.61	3.03	0.85	0.39	0.02	0.13	0.31	2.46	4.90	8.03	40.46
ANTIOCH FIBREBOARD ML	2.92	2.12	1.74	1.20	0.40	0.12	0.01	0.05	0.13	0.74	1.67	2.57	13.67
ARROYO SECO RS FC 508D	4.54	4.43	3.17	2.06	0.38	0.17	0.02	0.09	0.22	0.56	3.14	3.28	22.06
ASH MOUNTAIN	4.51	4.08	4.00	3.17	0.86	0.24	0.06	0.05	0.25	0.79	3.02	4.56	25.69
AUBERRY 1 NW	4.09	3.97	3.55	2.76	0.82	0.14	0.03	0.03	0.28	0.89	3.03	4.35	24.14
AUBURN	7.16	5.19	5.02	3.30	1.36	0.38	0.01	0.07	0.30	2.10	4.71	6.20	35.80
AVALON PLEASURE PIER	2.37	2.40	1.75	1.12	0.13	0.03	0.01	0.00	0.11	0.41	1.65	1.94	11.92
AZUSA CITY PARK FC143B	3.83	3.39	3.03	1.87	0.25	0.11	0.02	0.06	0.20	0.40	2.40	2.89	18.45
BAKERSFIELD WSO R	0.96	1.03	0.83	0.85	0.19	0.06	0.02	0.01	0.08	0.26	0.69	0.74	5.72
BARRETT DAM	2.89	2.51	2.71	1.77	0.46	0.05	0.08	0.19	0.19	0.49	1.70	2.61	15.65
BARSTOW	0.63	0.49	0.52	0.24	0.04	0.04	0.32	0.30	0.24	0.26	0.48	0.57	4.13
BEAUMONT	2.89	2.67	2.67	1.77	0.44	0.09	0.17	0.27	0.33	0.66	1.99	2.54	16.49
BEAUMONT PUMPING PLANT	3.36	2.99	3.08	2.07	0.66	0.22	0.26	0.34	0.44	0.78	2.18	2.77	19.15
BEAUMONT 1 E	2.84	2.76	2.59	1.65	0.41	0.09	0.20	0.23	0.30	0.60	1.97	2.49	16.13
BEL AIR FC-10A	4.11	3.49	2.53	1.59	0.11	0.04	0.01	0.04	0.08	0.33	2.56	2.72	17.6[illegible]
BERKELEY	5.04	3.38	2.95	1.85	0.64	0.19	0.01	0.07	0.20	1.29	2.91	4.57	23.20
BIG BEAR LAKE DAM //	5.88	5.23	5.59	3.58	0.81	0.06	0.73	0.68	0.61	1.04	4.68	5.82	34.71
BIG DALTON DAM FC223BE	5.04	4.33	3.82	2.64	0.52	0.21	0.02	0.07	0.28	0.73	3.09	3.92	24.67
BIG PINES PARK FC 83B	4.67	4.74	3.37	2.36	0.37	0.06	0.31	0.54	0.51	0.86	3.34	3.92	25.05
BIG SUR STATE PARK	8.91	7.01	5.65	3.71	0.97	0.18	0.01	0.02	0.38	1.89	5.00	7.74	41.47
BIG TUJUNGA DAM FC46DE	5.48	5.46	3.75	2.52	0.37	0.04	0.02	0.13	0.21	0.55	3.71	3.77	26.01
BISHOP WSO R	1.20	1.06	0.43	0.41	0.27	0.09	0.17	0.10	0.10	0.26	0.58	1.05	5.72
BLUE CANYON WSO //R	13.66	9.42	8.55	5.47	3.14	0.99	0.10	0.27	0.52	4.14	9.04	12.28	67.58
BLYTHE	0.48	0.24	0.42	0.15	0.02	0.03	0.15	0.82	0.20	0.30	0.26	0.43	3.50
BLYTHE FAA AIRPORT	0.45	0.19	0.27	0.18	0.01	0.03	0.28	0.66	0.27	0.26	0.20	0.37	3.17
BOCA	4.34	2.84	2.49	1.56	1.23	0.80	0.35	0.41	0.37	1.36	2.65	3.89	22.29
BONITA	1.92	1.52	1.81	0.95	0.24	0.05	0.02	0.07	0.14	0.35	1.36	1.83	10.26
BOUQUET CANYON	3.15	3.01	2.46	1.75	0.26	0.06	0.04	0.07	0.16	0.46	2.28	2.55	16.25
BOWMAN DAM	12.80	9.08	8.75	5.32	3.46	1.27	0.15	0.49	0.58	4.32	9.05	12.16	67.43
BRAWLEY 2 SW	0.37	0.17	0.19	0.06	0.00	0.01	0.06	0.36	0.21	0.14	0.17	0.41	2.15
BREA CITY	2.91	2.60	2.27	1.32	0.21	0.05	0.03	0.05	0.13	0.28	1.82	2.27	13.84
BROOKS FARNHAM RANCH	4.46	3.31	2.40	1.51	0.46	0.23	0.01	0.06	0.20	1.15	2.45	4.05	20.29
BRUSH CREEK RS	15.25	11.01	8.67	5.81	2.74	1.04	0.04	0.23	0.67	4.52	8.99	13.17	72.14
BURBANK FD FC226 B	3.43	3.31	2.29	1.50	0.19	0.04	0.01	0.05	0.19	0.33	2.25	2.42	16.01
BURBANK VALLEY PMP PLT	3.15	3.09	2.16	1.37	0.17	0.05	0.01	0.05	0.12	0.36	2.14	2.22	14.89
BUTTONWILLOW	0.92	0.86	0.70	0.61	0.22	0.03	0.03	0.00	0.08	0.23	0.58	0.66	5.02
CABAZON	2.01	2.26	1.91	1.11	0.22	0.01	0.25	0.50	0.29	0.46	1.57	2.02	12.61
CALAVERAS BIG TREES	10.60	8.24	7.99	5.25	2.22	0.64	0.06	0.13	0.51	2.78	6.79	10.17	55.38
CALEXICO 2 NE	0.38	0.17	0.17	0.06	0.01	0.02	0.09	0.33	0.22	0.22	0.19	0.47	2.33
CALISTOGA	8.35	6.26	4.45	2.87	0.85	0.35	0.01	0.13	0.30	2.24	4.54	7.30	37.75
CAMPO	2.42	2.30	2.45	1.49	0.39	0.05	0.34	0.44	0.26	0.50	1.46	2.33	14.43
CAMP PARDEE	3.85	2.91	3.17	2.25	0.80	0.20	0.01	0.04	0.18	1.15	2.80	3.50	20.86
CAMPTONVILLE RS	12.34	8.66	7.46	5.11	2.55	0.82	0.02	0.18	0.46	3.66	7.79	11.64	60.69
CANYON DAM	8.17	5.93	4.83	3.01	1.74	0.89	0.18	0.22	0.45	2.45	5.01	7.09	39.97
CAZADERO	17.39	11.60	8.79	6.08	2.00	0.66	0.02	0.37	0.67	4.88	9.47	13.91	75.84
CEDARVILLE	1.82	1.31	1.18	0.97	1.15	1.11	0.33	0.29	0.31	1.27	1.69	2.77	14.20
CENTERVILLE PH	9.26	6.84	5.36	3.95	1.41	0.61	0.01	0.13	0.35	2.54	5.58	7.90	43.94
CHALLENGE RANGER STA	14.17	10.61	8.74	5.63	2.40	0.75	0.03	0.14	0.51	3.75	8.30	12.87	67.90
CHATSWORTH FC24F	3.41	3.19	2.30	1.58	0.16	0.02	0.00	0.11	0.06	0.32	2.44	2.55	16.14
CHESTER	6.70	5.20	3.85	2.41	1.58	1.07	0.25	0.26	0.51	2.12	4.47	5.84	34.26
CHICO EXPERIMENT STA	5.58	4.01	3.09	2.43	0.94	0.46	0.01	0.13	0.27	1.67	3.32	4.81	26.72
CHULA VISTA	1.64	1.27	1.55	0.91	0.17	0.05	0.02	0.07	0.12	0.35	1.18	1.57	8.90
CLAREMONT POMONA COL	3.35	3.02	2.80	1.62	0.23	0.07	0.04	0.06	0.19	0.41	2.12	2.73	16.64
CLARKSBURG	3.74	2.72	2.07	1.56	0.45	0.11	0.01	0.03	0.18	1.02	2.09	3.07	17.05
CLOVERDALE 3 SSE	9.64	6.77	4.92	3.30	0.89	0.39	0.03	0.15	0.32	2.82	5.61	8.67	43.51
COALINGA	1.38	1.47	1.02	0.68	0.25	0.03	0.02	0.01	0.08	0.26	0.87	1.22	7.29
COLBYS FC 53 D	5.48	5.76	3.61	2.57	0.32	0.04	0.06	0.20	0.28	0.63	4.00	4.07	27.00
COLFAX	10.00	7.11	6.70	4.36	1.86	0.61	0.02	0.11	0.33	2.85	6.43	8.92	49.40
COLGATE POWER HOUSE	8.46	6.07	5.35	3.68	1.66	0.48	0.01	0.11	0.29	2.55	5.07	7.22	40.95
COLUSA 1 SSW	3.15	2.59	1.87	1.35	0.53	0.24	0.03	0.08	0.16	1.00	2.01	3.02	16.03
CORONA	2.37	2.17	1.71	1.06	0.19	0.02	0.04	0.06	0.19	0.29	1.40	1.83	11.41
COVELO	9.65	5.96	4.87	2.74	1.28	0.65	0.05	0.33	0.51	2.67	5.65	8.54	42.80
COVINA TEMPLE FC 193 B	3.34	3.02	2.64	1.68	0.22	0.05	0.03	0.05	0.17	0.44	2.13	2.73	16.50
CRESCENT CITY 1 N	12.62	9.07	7.96	5.04	4.03	1.38	0.64	0.77	1.51	6.16	10.55	11.33	71.06
CROCKETT	4.08	2.84	2.35	1.57	0.46	0.16	0.01	0.03	0.12	1.12	2.30	3.72	18.76
CULVER CITY	2.97	2.49	1.99	1.29	0.09	0.03	0.00	0.05	0.07	0.29	2.06	2.13	13.46
CUMMINGS	15.68	9.88	8.25	4.78	2.51	0.66	0.05	0.36	0.57	4.98	10.11	14.41	72.24
CUYAMACA	5.59	5.41	6.13	3.66	1.10	0.15	0.51	0.52	0.58	1.03	3.54	5.22	33.44
DAGGETT FAA AIRPORT	0.51	0.36	0.39	0.27	0.05	0.03	0.27	0.57	0.32	0.28	0.35	0.48	3.88

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
DAVIS 2 WSW EXP FARM	3.88	2.78	1.95	1.50	0.51	0.16	0.01	0.03	0.16	1.04	2.04	3.21	17.28
DEATH VALLEY	0.20	0.31	0.14	0.16	0.06	0.03	0.14	0.11	0.10	0.07	0.29	0.21	1.82
DEER CREEK POWER HOUSE	14.35	10.49	9.25	6.07	3.00	0.94	0.05	0.20	0.49	3.99	9.17	13.22	71.22
DELANO	1.29	1.18	1.09	1.03	0.22	0.09	0.00	0.01	0.11	0.21	0.93	0.93	7.10
DENAIR 3 NNE	2.32	1.91	1.79	1.43	0.42	0.08	0.01	0.03	0.13	0.58	1.58	2.03	12.31
DE SABLA	13.19	10.03	8.01	5.63	2.40	1.07	0.03	0.20	0.61	4.12	8.86	11.86	66.01
DESCANSO RANGER STA	3.94	3.42	4.17	2.73	0.83	0.11	0.24	0.42	0.30	0.74	2.32	3.56	22.78
DOBBINS COLGATE FOREBY	8.68	6.24	5.45	3.69	1.78	0.51	0.02	0.13	0.31	2.68	5.59	7.86	42.94
DOWNEY FD FC107C	2.89	2.65	2.17	1.36	0.14	0.02	0.02	0.05	0.10	0.25	1.82	2.17	13.74
DOWNIEVILLE RANGER STA	12.87	9.74	8.16	5.39	3.15	0.98	0.12	0.25	0.62	3.82	8.49	12.22	65.91
DRY CANYON RESERVOIR	2.39	2.31	2.01	1.34	0.30	0.04	0.02	0.07	0.11	0.35	1.77	1.86	12.67
DUDLEYS	7.05	5.87	5.74	3.87	1.28	0.44	0.03	0.05	0.37	1.65	5 05	6.90	38.30
DUNNIGAN	3.34	2.76	1.97	1.44	0.41	0.20	0.00	0.04	0.20	1.02	2.04	3.20	16.62
DUNSMUIR RANGER STA	12.05	8.64	6.58	4.38	2.47	1.35	0.28	0.42	0.79	3.87	8.22	10.56	59.61
EAGLE MOUNTAIN	0.40	0.17	0.25	0.12	0.02	0.00	0.24	0.44	0.29	0.21	0.22	0.43	2.79
EAST PARK RESERVOIR	4.36	3.18	2.08	1.46	0/50	0.36	0.02	0.14	0.25	1.21	2.30	3.86	19.72
EL CAPITAN DAM	2.70	2.40	2.67	1.62	0.44	0.10	0.03	0.18	0.15	0.55	1.64	2.37	14.85
EL CENTRO 2 SSW	0.40	0.20	0.19	0.08	0.00	0.01	0.10	0.37	0.10	0.23	0.21	0.41	2.30
ELECTRA POWER HOUSE	5.60	4.36	4.43	3.17	1.20	0.33	0.02	0.06	0.19	1.64	4.00	5.22	30.22
ELK VALLEY	16.47	10.18	9.39	4.89	3.40	1.19	0.33	0.58	1.19	6.52	12.59	15.88	82.61
ELLERY LAKE	3.94	2.68	2.51	1.87	0.98	0.56	0.64	0.53	0.66	1.14	2.81	3.97	22.39
ELLIOTT	3.36	2.55	2.53	1.79	0.59	0.16	0.01	0.03	0.22	0.83	2.24	3.15	17.46
ELSINORE	2.20	1.92	1.65	0.86	0.13	0.02	0.03	0.12	0.17	0.28	1.41	1.95	10.74
ESCONDIDO	2.64	2.21	2.46	1.36	0.28	0.09	0.03	0.14	0.17	0.46	1.82	2.39	14.05
EUREKA WSO R	7.42	5.15	4.83	2.95	2.11	0.66	0.14	0.27	0.65	3.23	5.77	6.58	39.76
FAIRMONT	3.19	2.87	2.17	1.44	0.27	0.03	0.03	0.06	0.21	0.33	2.32	2.44	15.36
FIDDLETOWN LYNCH RANCH	6.85	5.28	5.28	3.78	1.45	0.43	0.01	0.07	0.24	2.08	4.80	6.41	36.68
FORESTHILL RANGER STA	10.46	7.55	7.23	4.50	2.20	0.63	0.02	0.14	0.36	2.89	6.97	9.57	52.52
FORT BIDWELL	2.41	1.81	1.39	1.04	1.21	1.16	0.31	0.35	0.39	1.21	1.86	2.43	15.67
FORT BRAGG	7.69	5.62	5.09	3.06	1.35	0.55	0.06	0.27	0.39	2.96	5.52	7.34	39.90
FORT BRAGG AVIATION	8.10	5.66	4.96	3.04	1.37	0.51	0.05	0.25	0.35	2.97	5.56	7.17	39.99
FORT JONES RANGER STA	4.60	2.53	1.75	0.99	1.01	0.80	0.34	0.43	0.36	1.62	3.02	4.37	21.82
FORT ROSS	8.58	6.09	4.91	3.29	1.27	0.53	0.05	0.22	0.46	2.78	5.14	7.23	40.55
FRESNO WSO R	1.84	1.72	1.62	1.24	0.32	0.06	0.00	0.02	0.07	0.42	1.22	1.71	10.24
FRIANT GOVERNMENT CAMP	2.36	2.16	2.05	1.61	0.48	0.09	0.01	0.00	0.18	0.63	1.69	2.36	13.62
FULLERTON HILLCREST RV	2.78	2.53	2.18	1.23	0.15	0.04	0.03	0.06	0.17	0.27	1.82	2.10	13.36
GASQUET RANGER STATION	17.73	12.10	11.01	6.34	4.62	1.00	0.44	0.66	1.57	7.46	14.06	16.62	93.61
GEM LAKE	3.53	2.74	2.33	1.67	0.95	0.40	0.49	0.55	0.56	0.98	2.64	3.49	20.33
GLENDALE STAPEN FC295G	3.68	3.41	2.49	1.55	0.18	0.04	0.01	0.04	0.17	0.31	2.48	2.48	16.84
GLENDORA WEST FC 185	4.08	3.63	3.17	2.01	0.33	0.13	0.02	0.05	0.22	0.49	2.54	3.15	19.82
GOLD RUN	11.87	7.90	7.74	4.88	2.33	0.79	0.03	0.15	0.43	3.13	7.48	10.33	57.06
GRANT GROVE	7.83	7.16	6.78	4.81	1.55	0.39	0.06	0.08	0.52	1.46	5.14	7.56	43.34
GRATON	9.86	6.40	4.85	3.25	0.94	0.36	0.03	0.17	0.35	2.58	5.34	8.20	42.33
GROVELAND RANGER STA	7.08	5.78	5.45	3.83	1.28	0.37	0.04	0.06	0.38	1.62	4.86	6.73	37.48
GUERNEVILLE	10.97	7.59	5.76	3.89	1.14	0.37	0.02	0.19	0.36	2.85	5.98	8.40	48.52
HAINES CYN LOWER FC364	4.83	4.83	3.40	2.46	0.49	0.11	0.02	0.12	0.25	0.54	3.54	3.50	24.09
HAINES CYN UPPER FC367	5.53	5.42	3.87	2.81	0.58	0.12	0.02	0.13	0.26	0.71	4.18	4.02	27.66
HAIWEE	1.08	1.16	0.62	0.50	0.14	0.07	0.24	0.25	0.18	0.35	0.81	1.09	6.50
HALF MOON BAY	5.12	3.65	3.25	2.14	0.70	0.28	0.05	0.11	0.28	1.44	2.82	4.66	24.60
HANFORD	1.43	1.38	1.23	0.87	0.25	0.04	0.01	0.01	0.08	0.30	0.96	1.28	7.84
HAPPY CAMP RANGER STA	12.13	7.32	6.09	2.91	2.00	0.92	0.43	0.35	0.69	4.33	8.52	11.24	56.93
HAT CREEK PH NO 1	3.16	2.55	1.98	1.36	1.25	1.01	0.23	0.27	0.40	1.30	2.19	3.28	18.98
HAYFIELD PUMPING PLANT	0.47	0.20	0.26	0.10	0.03	0.02	0.26	0.40	0.16	0.28	0.28	0.45	2.91
HEALDSBURG	9.86	6.72	4.70	3.23	0.89	0.37	0.02	0.19	0.35	2.52	5.41	8.09	42.35
HEMET	1.87	1.75	1.78	1.19	0.20	0.03	0.12	0.23	0.35	0.46	1.30	1.60	10.88
HENSHAW DAM	4.23	3.73	3.89	2.33	0.53	0.07	0.17	0.48	0.26	0.70	2.57	3.69	22.65
HERNANDEZ 2 NW	3.09	2.99	2.39	1.64	0.33	0.08	0.03	0.02	0.17	0.58	1.92	2.87	16.11
HETCH HETCHY	5.85	4.81	4.89	3.52	1.87	0.86	0.12	0.26	0.47	1.76	4.67	6.27	35.35
HILTS	4.25	2.57	1.77	0.94	1.11	0.83	0.29	0.41	0.42	1.90	3.11	4.34	21.94
HOBERGS	12.47	9.32	6.84	4.51	1.46	0.51	0.02	0.22	0.48	3.27	7.03	11.33	57.46
HOEGEES FC 60 A	7.37	6.96	5.13	3.66	0.60	0.20	0.04	0.09	0.27	0.84	4.81	5.72	35.79
HOLLISTER 1 SW	2.62	2.16	1.83	1.26	0.32	0.06	0.02	0.03	0.17	0.53	1.67	2.58	13.27
IDRIA	2.88	2.81	2.55	1.55	0.31	0.05	0.03	0.01	0.13	0.48	1.76	2.62	15.18
IMPERIAL	0.37	0.22	0.20	0.10	0.01	0.00	0.07	0.35	0.18	0.19	0.22	0.44	2.35
INDEPENDENCE	1.19	0.89	0.28	0.34	0.13	0.06	0.15	0.13	0.15	0.22	0.69	1.20	5.43
INDIO U S DATE GARDEN	0.46	0.21	0.29	0.11	0.02	0.00	0.14	0.40	0.23	0.21	0.41	0.52	3.00
IOWA HILL	10.19	7.36	6.98	4.60	2.51	0.63	0.02	0.12	0.39	2.95	6.75	9.22	51.72
IRON MOUNTAIN	0.48	0.20	0.26	0.17	0.02	0.00	0.25	0.42	0.18	0.35	0.22	0.38	2.93
JESS VALLEY	1.85	1.71	1.69	1.65	2.25	1.93	0.34	0.47	0.55	1.37	1.81	2.05	17.87
JUNCAL DAM	6.73	5.66	3.84	2.73	0.31	0.06	0.01	0.00	0.22	0.49	3.76	4.38	28.18
KELSEYVILLE	5.75	4.03	2.99	1.94	0.64	0.30	0.03	0.10	0.24	1.59	3.24	5.42	26.27
KENTFIELD	11.37	7.60	5.66	3.42	1.08	0.39	0.01	0.11	0.31	2.89	5.69	10.08	48.61
KERN RIVER PH NO 1	1.70	1.87	1.50	1.55	0.38	0.07	0.01	0.02	0.14	0.45	1.21	1.53	10.51
KETTLEMAN STATION	1.17	1.26	0.88	0.67	0.26	0.03	0.02	0.04	0.05	0.21	0.68	0.85	6.12
KING CITY	2.18	1.94	1.56	1.00	0.21	0.02	0.00	0.01	0.09	0.32	1.15	1.90	10.39

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
LA CRESCENTA FC 251 B	5.03	4.63	3.19	2.20	0.41	0.12	0.01	0.08	0.22	0.57	3.20	3.51	23.17
LAGUNA BEACH	2.28	2.27	1.76	1.23	0.20	0.10	0.01	0.02	0.16	0.33	1.58	1.81	11.75
LAKE ARROWHEAD	8.14	7.62	6.20	4.11	1.00	0.11	0.16	0.44	0.55	1.22	5.36	6.64	41.55
LAKEPORT	6.87	4.33	3.29	2.20	0.70	0.34	0.03	0.14	0.18	1.90	3.82	6.10	29.90
LAKE SPAULDING	13.50	9.60	9.11	5.85	3.38	1.13	0.17	0.33	0.56	4.31	8.96	12.65	69.55
LA MESA	2.23	1.86	2.08	1.09	0.28	0.08	0.03	0.10	0.15	0.42	1.56	2.07	11.95
LA VERNE HTS FC 560 C	3.53	3.26	2.82	1.80	0.31	0.08	0.03	0.07	0.20	0.44	2.33	2.93	17.80
LEBEC	2.15	2.66	2.10	1.44	0.42	0.03	0.04	0.04	0.19	0.39	1.80	1.93	13.19
LECHUZA PT STA FC 352B	5.15	4.14	3.32	2.07	0.26	0.07	0.01	0.04	0.10	0.37	3.22	3.46	22.21
LE GRAND	2.32	2.08	1.88	1.44	0.45	0.07	0.00	0.01	0.09	0.57	1.72	2.34	12.87
LEMON COVE	2.41	2.20	1.85	1.57	0.48	0.13	0.01	0.02	0.18	0.55	1.61	2.31	13.32
LINDSAY	2.00	1.86	1.67	1.37	0.43	0.06	0.02	0.03	0.15	0.38	1.44	1.85	11.26
LIVERMORE COUNTY F D	2.94	2.26	1.87	1.33	0.46	0.12	0.02	0.03	0.12	0.64	1.97	2.74	14.50
LOCKWOOD 2 N	2.73	2.57	2.05	1.29	0.27	0.03	0.01	0.02	0.11	0.44	1.56	2.85	13.93
LODI	3.24	2.34	2.22	1.58	0.51	0.13	0.02	0.03	0.21	0.92	2.12	3.02	16.34
LONG BEACH PUB SVC	2.73	2.59	1.88	1.13	0.10	0.04	0.00	0.02	0.11	0.21	1.73	1.92	12.46
LONG BEACH WSO	2.26	2.16	1.50	0.89	0.07	0.04	0.00	0.02	0.09	0.19	1.38	1.65	10.25
LOS ALAMOS	2.89	2.79	2.58	1.65	0.26	0.02	0.03	0.02	0.11	0.44	1.71	2.44	14.94
LOS ANGELES WSO R	2.52	2.32	1.71	1.10	0.08	0.03	0.01	0.02	0.07	0.22	1.76	1.75	11.59
LOS ANGELES CIVIC CTR R	3.00	2.77	2.19	1.27	0.13	0.03	0 00	0.04	0.17	0.27	2.02	2.16	14.05
LOS BANOS	1.58	1.48	1.18	0.97	0.30	0.03	0.01	0.01	0.16	0.53	1.16	1.49	8.90
LOS GATOS	6.00	4.70	3.80	2.36	0.60	0.07	0.01	0.02	0.20	1.36	3.25	5.37	27.74
LOS PRIETOS RANGER STA	4.67	4.28	3.29	2.33	0.29	0.04	0.02	0.01	0.10	0.43	2.91	3.55	21.92
LYTLE CREEK RANGER STA	7.42	6.07	5.26	3.26	0.52	0.08	0.07	0.06	0.22	0.77	4.57	5.09	33.39
MADERA	1.84	1.69	1.50	1.41	0.44	0.07	0.02	0.02	0.09	0.44	1.35	1.83	10.70
MARICOPA	0.95	0.99	0.71	0.74	0.21	0.02	0.00	0.01	0.13	0.26	0.71	0.74	5.47
MARIPOSA	5.24	4.79	4.49	3.04	1.05	0.25	0.02	0.01	0.33	1.27	4.03	5.50	30.02
MARYSVILLE	4.34	3.38	2.44	1.92	0.60	0.23	0.01	0.06	0.22	1.44	2.71	3.62	20.87
MC CLOUD	10.04	7.78	5.76	4.12	2.50	1.38	0.25	0.39	0.77	3.62	7.16	9.00	52.77
MECCA FIRE STATION	0.45	0.21	0.23	0.07	0.03	0.00	0.14	0.45	0.19	0.25	0.30	0.44	2.76
MENDOTA DAM	1.27	1.25	1.11	0.94	0.30	0.04	0.01	0.00	0.10	0.34	0.90	1.28	7.54
MERCED FIRE STATION 2	2.24	1.92	1.74	1.41	0.45	0.07	0.01	0.02	0.11	0.55	1.61	2.09	12.22
MIDDLETOWN	10.85	7.52	5.32	3.60	1.00	0.35	0.01	0.15	0.31	2.63	5.53	9.56	46.83
MINERAL	10.08	7.32	6.07	4.26	2.61	1.63	0.09	0.47	0.86	4.41	7.16	9.56	54.52
MODESTO	2.15	1.81	1.64	1.36	0.38	0.07	0.02	0.04	0.16	0.62	1.52	2.10	11.87
MOJAVE	1.02	1.01	0.89	0.37	0.04	0.03	0.06	0.04	0.16	0.20	0.90	1.05	5.77
MORONGO VALLEY	1.90	1.08	1.03	0.46	0.07	0.01	0.37	0.32	0.29	0.30	1.04	1.41	8.28
MT BALDY FC 85G	6.70	6.06	4.61	3.26	0.56	0.11	0.10	0.15	0.44	0.97	4.49	5.43	32.88
MOUNT HAMILTON	4.46	4.05	3.51	2.36	0.79	0.22	0.01	0.03	0.08	1.11	3.25	4.83	24.70
MOUNT HEBRON RS	1.47	1.20	0.88	0.87	1.10	0.99	0.37	0.35	0.50	1.05	1.60	2.03	12.41
MOUNT SHASTA WSO //R	6.65	5.61	4.03	3.05	1.87	1.08	0.32	0.31	0.69	2.54	5.09	6.25	37.49
MOUNT WILSON FC 338 B //	6.35	6.06	4.69	3.17	0.45	0.09	0.04	0.11	0.29	0.89	4.64	4.90	31.68
MUIR WOODS	8.37	5.53	4.40	2.75	1.08	0.43	0.01	0.14	0.30	2.06	4.73	7.54	37.34
NAPA STATE HOSPITAL	5.35	3.72	3.08	1.98	0.66	0.26	0.01	0.08	0.19	1.58	2.99	4.90	24.80
NEEDLES FAA AIRPORT	0.49	0.32	0.38	0.28	0.05	0.01	0.36	0.72	0.28	0.34	0.35	0.48	4.06
NEVADA CITY	11.20	8.49	7.33	4.84	2.20	0.60	0.04	0.12	0.46	3.02	6.93	10.29	55.52
NEWARK	3.27	2.29	2.03	1.28	0.44	0.11	0.02	0.04	0.14	0.66	1.90	2.77	14.95
NEWHALL SOLEDAD FC32CE	3.67	3.64	2.52	1.74	0.22	0.03	0.02	0.04	0.09	0.36	2.60	2.62	17.55
NEWMAN 2 NW	2.09	1.85	1.39	1.16	0.31	0.05	0.01	0.02	0.12	0.48	1.37	1.82	10.67
NEWPORT BEACH HARBOR	2.09	2.16	1.61	1.29	0.15	0.05	0.01	0.03	0.15	0.26	1.53	1.75	11.08
NILAND	0.33	0.22	0.20	0.09	0.00	0.00	0.15	0.30	0.15	0.17	0.23	0.42	2.26
NORTH FORK RANGER STA	5.97	5.24	4.88	3.60	1.35	0.30	0.05	0.02	0.37	1.23	4.22	6.23	33.46
OAK KNOLL RANGER STA	5.04	2.89	2.26	1.28	1.11	0.76	0.32	0.40	0.45	2.06	3.36	5.17	25.10
OAKLAND WSO R	4.03	2.83	2.32	1.58	0.55	0.14	0.01	0.03	0.18	1.08	2.37	3.57	18.69
OCCIDENTAL	12.26	8.19	6.21	4.11	1.44	0.60	0.03	0.28	0.51	3.38	6.72	10.35	54.08
OCOTILLO WELLS	0.43	0.34	0.41	0.19	0.03	0.01	0.13	0.45	0.18	0.32	0.32	0.64	3.45
OJAI	4.63	4.17	2.98	2.08	0.31	0.04	0.02	0.01	0.16	0.39	2.74	3.24	20.77
ORANGE COVE	2.30	2.08	1.80	1.43	0.38	0.07	0.01	0.01	0.12	0.49	1.46	2.25	12.40
ORICK PRAIRIE CREEK PK	13.06	8.96	8.50	4.85	3.71	1.24	0.36	0.67	1.16	5.56	10.05	11.99	70.11
ORLAND	4.09	3.09	2.25	1.63	0.54	0.39	0.04	0.16	0.29	1.05	2.61	3.63	19.77
ORLEANS	10.83	6.69	5.88	3.09	2.32	0.79	0.19	0.35	0.71	4.03	7.99	10.41	53.28
OROVILLE BRIDGE	5.86	4.33	3.55	2.52	0.98	0.39	0.01	0.09	0.30	1.73	3.67	4.96	28.39
OXNARD	3.13	2.75	2.18	1.36	0.10	0.04	0.01	0.01	0.06	0.27	1.87	2.47	14.25
PACIFIC HOUSE	9.55	7.12	7.05	4.87	2.46	0.82	0.04	0.18	0.34	2.88	6.77	9.31	51.39
PACOIMA DAM FC 33 A&E	4.00	3.48	2.95	2.04	0.37	0.12	0.02	0.12	0.26	0.53	2.63	2.87	19.39
PAICINES OHRWALL RANCH	3.02	2.60	2.21	1.44	0.41	0.04	0.02	0.04	0.17	0.58	1.85	3.10	15.48
PALMDALE	1.48	1.37	1.18	0.65	0.09	0.02	0.05	0.15	0.15	0.32	1.09	1.32	7.87
PALM SPRINGS	1.13	0.66	0.63	0.24	0.04	0.00	0.24	0.24	0.26	0.20	0.68	1.01	5.33
PALO ALTO JR MUSEUM	3.32	2.32	1.99	1.28	0.43	0.06	0.02	0.02	0.13	0.63	1.95	3.22	15.37
PALOMA	5.04	4.29	3.44	2.11	0.51	0.08	0.02	0.03	0.11	0.69	2.48	4.14	22.94
PALOMAR MT OBSERVATORY	4.85	4.65	4.70	2.51	0.40	0.07	0.36	0.47	0.38	0.79	3.07	4.56	26.81
PALOS VERDES EST FC43D	2.31	2.26	1.67	1.02	0.09	0.04	0.00	0.00	0.08	0.24	1.63	1.74	11.08
PARKER RESERVOIR	0.55	0.40	0.57	0.28	0.04	0.02	0.30	0.53	0.39	0.30	0.42	0.55	4.35
PARKFIELD	2.96	2.94	2.39	1.57	0.36	0.02	0.03	0.00	0.16	0.41	1.78	2.81	15.43
PASADENA	4.01	3.81	2.68	1.83	0.29	0.10	0.01	0.06	0.16	0.44	2.68	2.83	18.90

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
PASKENTA RANGER STA	4.67	3.77	2.73	2.03	0.78	0.59	0.07	0.16	0.22	1.30	2.94	4.22	23.48
PASO ROBLES	3.02	2.56	1.89	1.44	0.27	0.02	0.05	0.02	0.11	0.42	1.61	2.64	14.17
PATTIWAY	1.54	1.83	1.51	1.26	0.27	0.03	0.02	0.03	0.24	0.42	1.15	1.24	9.54
PETALUMA FIRE STA 2	5.71	3.90	3.00	1.98	0.43	0.23	0.01	0.06	0.15	1.34	3.10	4.78	24.69
PINNACLES NAT MONUMENT	3.02	2.91	2.56	1.57	0.36	0.06	0.03	0.02	0.11	0.57	1.77	2.83	15.81
PLACERVILLE	7.83	5.60	5.81	3.78	1.65	0.41	0.02	0.09	0.26	2.12	5.18	7.04	39.79
PT ARGUELLO LIGHT STA	2.57	2.52	2.27	1.48	0.21	0.04	0.03	0.01	0.06	0.71	1.56	2.32	13.78
POINT PIEDRAS BLANCAS	4.23	3.80	3.13	1.80	0.42	0.04	0.02	0.04	0.09	0.81	2.24	3.73	20.35
POMONA CAL POLY	3.39	2.93	2.74	1.60	0.25	0.05	0.02	0.05	0.19	0.42	2.10	2.71	16.45
PORTERVILLE	1.95	1.73	1.62	1.30	0.39	0.06	0.02	0.01	0.13	0.42	1.35	1.71	10.69
PORTOLA	4.25	3.00	2.46	1.51	1.17	0.76	0.39	0.22	0.23	1.39	2.74	4.00	22.12
POTTER VALLEY PH	10.24	6.47	5.08	3.07	1.39	0.49	0.05	0.20	0.47	2.84	6.11	9.25	45.66
PRIEST VALLEY	3.84	3.69	3.12	1.99	0.47	0.04	0.05	0.01	0.16	0.60	2.36	3.58	19.91
QUINCY	8.64	6.33	5.04	3.37	1.79	0.89	0.13	0.26	0.46	2.71	5.28	7.57	42.47
RANCHITA	1.94	1.81	2.16	1.14	0.30	0.04	0.77	0.95	0.36	0.61	1.43	2.28	13.89
RANDSBURG.	1.11	1.05	0.64	0.45	0.04	0.02	0.09	0.22	0.16	0.23	0.70	0.94	5.65
RED BLUFF WSO R	4.48	3.17	2.51	1.79	0.98	0.47	0.04	0.18	0.31	1.17	3.05	3.91	22.06
REDDING FIRE STA NO 2	8.38	5.87	4.56	3.09	1.64	1.07	0.06	0.26	0.56	2.28	5.35	7.43	40.55
REDLANDS	2.32	2.05	2.07	1.34	0.34	0.08	0.08	0.14	0.30	0.46	1.55	1.98	12.71
REDWOOD CITY	4.52	3.12	2.43	1.53	0.46	0.09	0.02	0.02	0.17	0.92	2.34	4.08	19.70
REPRESA	4.24	3.29	3.04	2.02	0.92	0.21	0.00	0.05	0.19	1.23	2.89	3.57	21.75
RIVERSIDE FIRE STA. #3	1.81	1.75	1.53	1.04	0.21	0.03	0.08	0.10	0.21	0.30	1.17	1.69	9.92
ROCKLIN	4.71	3.61	3.16	2.09	0.74	0.21	0.00	0.04	0.20	1.30	2.98	3.85	22.89
SACRAMENTO WSO R	3.73	2.66	2.17	1.54	0.51	0.10	0.01	0.05	0.19	0.99	2.13	3.12	17.22
SAINT HELENA	8.30	5.60	4.08	2.59	0.73	0.29	0.03	0.11	0.24	2.11	4.27	7.05	35.40
SAINT MARYS COLLEGE	6.20	4.34	3.52	2.37	0.82	0.20	0.02	0.05	0.20	1.67	3.58	5.58	28.55
SALINAS FAA AP	2.77	2.30	1.94	1.35	0.31	0.08	0.02	0.04	0.21	0.53	1.58	2.68	13.81
SALT SPRINGS PWR HOUSE	8.53	6.27	6.17	4.20	2.33	0.76	0.09	0.22	0.61	2.26	5.79	8.17	45.40
SAN BERNARDINO CO HOSP	3.11	2.88	2.45	1.62	0.45	0.11	0.04	0.20	0.31	0.51	1.83	2.60	16.11
SAN CLEMENTE DAM	4.56	3.98	3.19	2.02	0.45	0.09	0.01	0.03	0.18	0.72	2.39	4.12	21.75
SANDBERG PTL FC1308	2.70	3.21	2.11	1.65	0.35	0.04	0.03	0.10	0.22	0.38	2.46	2.19	15.44
SANDBERG WSO //R	2.15	2.45	1.33	1.12	0.25	0.03	0.03	0.06	0.21	0.34	2.05	1.95	11.97
SAN DIEGO WSO R	1.88	1.48	1.55	0.81	0.15	0.05	0.01	0.07	0.13	0.34	1.25	1.73	9.45
SAN DIMAS FIRE WD FC95	3.61	3.23	2.76	1.78	0.25	0.09	0.03	0.07	0.18	0.43	2.24	2.75	17.42
SAN FERNANDO	3.39	3.08	2.52	1.66	0.21	0.06	0.02	0.04	0.12	0.37	2.21	2.44	16.12
SAN FRANCISCO WSO R	4.37	3.04	2.54	1.59	0.41	0.13	0.01	0.03	0.16	0.98	2.29	3.98	19.53
S F FEDERAL BLDG. WSO R	4.51	2.97	2.77	1.63	0.54	0.17	0.01	0.05	0.17	1.06	2.60	4.18	20.66
SAN GABRIEL CANYON PH	4.55	3.93	3.36	2.08	0.38	0.17	0.02	0.07	0.21	0.49	2.69	3.35	21.30
SAN GABRIEL DM FC425BE	6.07	5.18	4.01	2.64	0.41	0.09	0.02	0.05	0.20	0.73	3.60	4.48	27.48
SAN GABRIEL FIRE DEPT	3.79	3.24	2.69	1.65	0.16	0.06	0.01	0.06	0.16	0.39	2.28	2.63	17.12
SAN JACINTO	2.00	1.92	1.96	1.18	0.24	0.04	0.12	0.23	0.31	0.52	1.41	1.75	11.68
SAN JOSE R	2.81	2.21	1.96	1.22	0.35	0.08	0.01	0.08	0.13	0.64	1.66	2.50	13.65
SAN LUIS OBISPO POLY	4.60	4.02	3.25	2.26	0.34	0.05	0.04	0.01	0.15	0.69	2.56	3.95	21.92
SAN MATEO	4.24	2.85	2.47	1.58	0.54	0.12	0.04	0.03	0.16	1.08	2.51	3.89	19.51
SANTA ANA FIRE STATION	2.63	2.45	2.01	1.32	0.18	0.03	0.02	0.04	0.12	0.26	1.70	2.16	12.92
SANTA ANITA FERN FC432	6.21	5.96	4.47	3.17	0.45	0.14	0.06	0.07	0.29	0.81	4.18	4.84	30.65
SANTA BARBARA	3.94	3.41	2.61	1.80	0.27	0.07	0.03	0.01	0.07	0.38	2.16	2.66	17.41
SANTA BARBARA FAA AP	3.47	3.02	2.39	1.54	0.18	0.03	0.04	0.01	0.07	0.35	1.94	2.49	15.53
SANTA CLARA UNIVERSITY	2.92	2.27	2.02	1.28	0.35	0.05	0.01	0.04	0.13	0.64	1.73	2.71	14.15
SANTA CRUZ	6.73	5.26	4.16	2.52	0.81	0.20	0.02	0.07	0.24	1.27	3.81	6.28	31.37
SANTA MARGARITA 2 SW	6.42	5.59	4.78	3.12	0.60	0.08	0.05	0.01	0.22	1.06	3.85	6.02	31.80
SANTA MARIA WSO R	2.25	2.40	1.98	1.31	0.19	0.04	0.03	0.02	0.10	0.52	1.36	2.05	12.25
SANTA MONICA	2.99	2.84	2.10	1.29	0.09	0.03	0.03	0.06	0.08	0.29	2.04	2.29	14.13
SANTA MONICA PIER	2.52	2.47	1.87	1.07	0.06	0.01	0.03	0.04	0.08	0.26	1.86	2.09	12.36
SANTA ROSA	6.80	4.52	3.70	2.58	0.73	0.32	0.01	0.13	0.27	1.87	3.74	5.87	30.54
SAUGUS PWR PL NO 1	3.35	3.18	2.77	1.82	0.40	0.07	0.03	0.05	0.19	0.46	2.50	2.83	17.65
SCOTIA	9.78	7.47	6.14	3.53	1.78	0.66	0.05	0.23	0.53	3.50	7.43	9.26	50.36
SEARSVILLE LAKE	6.02	4.12	3.90	2.45	0.70	0.11	0.01	0.04	0.25	1.38	3.54	5.85	28.37
SIERRAVILLE RANGER STA//	5.31	3.83	2.85	1.70	1.35	0.67	0.29	0.25	0.39	2.14	3.62	4.89	27.29
SIGNAL HILL FC 415	2.35	2.37	1.79	1.08	0.10	0.05	0.00	0.02	0.11	0.20	1.64	1.75	11.46
SKAGGS SPGS LAS LOMAS	13.34	9.79	7.23	4.68	1.59	0.61	0.04	0.28	0.44	4.05	7.71	12.08	61.84
SNOW CREEK UPPER	2.35	1.87	1.69	0.94	0.12	0.02	0.32	0.53	0.34	0.50	1.66	2.18	12.52
SONORA RS	5.69	4.88	4.92	3.19	1.19	0.33	0.03	0.05	0.35	1.49	4.21	5.61	31.94
SO ENTRANCE YOSEMITE	8.23	7.09	6.39	4.50	1.80	0.56	0.08	0.07	0.57	2.03	6.33	8.14	45.79
SPRECKELS HWY BRIDGE	2.78	2.37	2.11	1.32	0.36	0.08	0.02	0.02	0.20	0.47	1.55	2.75	14.03
SQUIRREL INN 2	7.55	7.16	6.17	4.18	1.00	0.14	0.13	0.30	0.61	1.20	4.96	6.23	39.63
STOCKTON WSO	2.81	2.11	1.86	1.37	0.42	0.07	0.01	0.03	0.17	0.72	1.72	2.68	14.17
STOCKTON FIRE STA NO 4	2.96	2.29	2.00	1.45	0.47	0.11	0.01	0.02	0.17	0.68	1.86	2.71	14.73
STONYFORD RANGER STA	4.73	3.57	2.32	1.60	0.53	0.40	0.02	0.15	0.22	1.29	2.55	4.31	21.69
STONY GORGE RESERVOIR	4.24	3.18	2.20	1.59	0.59	0.45	0.02	0.14	0.19	1.12	2.41	3.76	19.89
SUSANVILLE AIRPORT	2.78	1.99	1.26	0.73	0.77	0.77	0.23	0.15	0.32	1.15	1.70	2.64	14.49
TAHOE CITY	6.78	4.59	3.92	2.33	1.43	0.66	0.25	0.29	0.42	1.97	4.10	6.39	33.13
TEJON RANCHO	1.70	1.85	1.78	1.70	0.49	0.07	0.01	0.05	0.17	0.51	1.34	1.55	11.22
THERMAL FAA AIRPORT	0.36	0.22	0.26	0.06	0.02	0.00	0.14	0.33	0.12	0.21	0.33	0.47	2.54
THREE RVRS EDISON PH 2	3.94	3.38	3.15	2.55	0.79	0.19	0.02	0.04	0.20	0.67	2.48	3.71	21.12

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
TIGER CREEK PH	8.94	6.74	6.61	4.53	1.97	0.60	0.05	0.12	0.36	2.44	6.05	8.51	46.92
TOPANGA PATROL STA FC6	5.80	4.63	3.45	2.11	0.20	0.03	0.02	0.07	0.09	0.36	3.28	3.76	23.80
TORRANCE	2.74	2.56	1.73	1.06	0.08	0.02	0.00	0.01	0.10	0.18	1.79	1.84	12.21
TRONA	0.71	0.70	0.44	0.22	0.04	0.06	0.19	0.15	0.13	0.13	0.52	0.40	3.69
TRUCKEE RANGER STATION	6.67	4.53	4.00	2.45	1.49	0.73	0.35	0.30	0.37	1.84	3.95	6.14	32.82
TULELAKE //R	1.15	1.00	0.84	0.67	1.28	1.16	0.24	0.34	0.42	0.97	1.28	1.56	10.91
TURLOCK	2.23	1.83	1.67	1.35	0.33	0.05	0.01	0.02	0.12	0.56	1.49	1.91	11.57
TUSTIN IRVINE RANCH	2.40	2.22	1.82	1.34	0.18	0.03	0.01	0.03	0.17	0.30	1.56	1.89	12.05
TWENTYNINE PALMS	0.43	0.19	0.25	0.12	0.05	0.02	0.52	0.69	0.33	0.46	0.31	0.42	3.79
TWIN LAKES	9.56	6.82	6.90	4.64	2.62	1.23	0.61	0.72	0.73	2.56	6.13	8.59	51.13
UKIAH	8.56	5.83	4.38	2.72	0.98	0.33	0.05	0.14	0.26	2.17	4.99	8.02	38.43
UNION OIL STEARNS ABS	3.05	2.62	2.22	1.36	0.23	0.05	0.01	0.05	0.13	0.38	1.78	2.34	14.22
U C L A	3.65	3.27	2.51	1.52	0.15	0.04	0.01	0.06	0.09	0.33	2.36	2.49	16.48
UPLAND 3 N	4.08	3.65	3.18	2.01	0.43	0.10	0.05	0.05	0.24	0.61	2.47	3.24	20.11
UPPER LAKE 7 W	8.82	6.32	5.13	3.21	1.16	0.49	0.03	0.21	0.27	2.41	5.51	7.92	41.48
UPPER MATTOLE	16.82	11.98	9.34	5.78	2.97	0.71	0.16	0.45	0.79	6.01	11.43	14.88	81.32
VACAVILLE	6.12	4.10	2.79	1.95	0.54	0.14	0.01	0.02	0.29	1.45	2.98	5.17	25.56
VALYERMO RANGER STA	1.88	2.04	1.15	0.75	0.12	0.00	0.22	0.25	0.21	0..38	1.33	1.50	9.83
VAN NUYS FC 15A	3.28	3.07	2.22	1.51	0.17	0.03	0.01	0.09	0.10	0.30	2.18	2.32	15.28
VENTURA	2.84	2.59	2.30	1.29	0.14	0.04	0.01	0.00	0.04	0.26	1.87	2.18	13.56
VICTORVILLE PUMP PLANT	0.86	0.81	0.69	0.44	0.07	0.03	0.10	0.18	0.22	0.25	0.67	0.74	5.06
VINCENT FIRE STA FC128	1.53	1.49	1.17	0.68	0.11	0.03	0.10	0.26	0.16	0.34	1.20	1.34	8.42
VINTON	2.45	1.67	1.34	0.90	0.97	0.72	0.31	0.24	0.28	0.97	1.67	2.23	13.75
VISALIA	1.77	1.68	1.39	1.16	0.31	0.05	0.01	0.01	0.09	0.36	1.14	1.56	9.53
VOLLMERS	13.05	10.71	7.59	5.63	2.89	1.53	0.17	0.47	0.91	4.61	9.73	11.70	68.99
VOLTA POWER HOUSE	5.92	4.54	3.84	3.22	2.13	1.10	0.08	0.31	0.52	2.10	4.75	5.71	34.22
WALLACE 1 SE	3.80	2.84	3.12	2.16	0.65	0.16	0.01	0.04	0.18	0.91	2.63	3.40	19.90
WALNUT CREEK 2 ESE	4.57	3.22	2.54	1.67	0.60	0.12	0.01	0.03	0.14	1.15	2.59	4.15	20.79
WALNUT PTL STA FC102C	3.24	2.83	2.48	1.51	0.21	0.05	0.02	0.04	0.17	0.30	1.93	2.45	15.23
WARNER SPRINGS	2.46	2.29	2.34	1.39	0.32	0.05	0.52	1.00	0.33	0.55	1.65	2.17	15.07
WASCO	1.12	1.18	0.92	0.85	0.23	0.07	0.02	0.00	0.07	0.21	0.70	0.81	6.18
WATSONVILLE WATERWORKS	4.47	3.62	2.92	1.90	0.45	0.11	0.02	0.04	0.26	0.90	2.67	4.34	21.70
WEAVERVILLE RANGER STA	8.18	5.31	3.85	2.33	1.51	0.82	0.15	0.36	0.49	2.63	5.52	7.46	38.61
WESTHAVEN	1.20	1.29	0.98	0.74	0.26	0.07	0.02	0.00	0.06	0.29	0.76	0.97	6.64
WHITTIER CTY H FC 106C	2.94	2.76	2.25	1.40	0.17	0.02	0.01	0.04	0.13	0.28	1.79	2.16	13.95
WILLOWS	3.72	2.88	1.98	1.50	0.53	0.36	0.01	0.14	0.22	0.98	2.34	3.28	17.94
WINTERS	4.75	3.32	2.30	1.60	0.44	0.18	0.01	0.03	0.19	1.03	2.37	4.03	20.25
WOFFORD HEIGHTS	2.36	1.92	1.49	0.84	0.17	0.05	0.06	0.20	0.14	0.26	1.16	2.05	10.70
WOODFORDS	3.92	2.40	2.01	1.25	0.93	0.51	0.49	0.45	0.57	1.28	2.92	3.96	20.69
WOODLAND 1 WNW	3.69	2.77	2.07	1.54	0.49	0.15	0.00	0.04	0.18	0.88	2.12	3.25	17.28
WRIGHTS	10.06	7.56	5.97	3.88	1.20	0.30	0.02	0.07	0.41	2.41	5.73	8.80	46.41
YORBA LINDA	2.89	2.62	2.24	1.35	0.21	0.03	0.02	0.08	0.20	0.29	1.80	2.31	14.04
YOSEMITE PARK HEADQTRS	6.51	5.53	5.10	3.50	1.55	0.56	0.27	0.16	0.50	1.60	4.91	6.95	37.14
YREKA	3.52	2.07	1.43	0.87	0.98	0.90	0.31	0.56	0.41	1.48	2.38	3.92	18.83

7. Heating Degree Day Normals

STATION	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANNUAL
ALDERPOINT	10	8	31	177	411	598	629	456	437	307	165	61	3290
ALTURAS RANGER STATION	64	106	230	515	789	1026	1128	868	834	615	400	210	6785
ANTIOCH FIBREBOARD ML	0	0	7	76	333	561	598	406	347	200	76	23	2627
ASH MOUNTAIN	0	0	0	74	303	539	574	428	394	250	92	19	2673
AUBERRY 1 NW	0	0	10	144	414	629	670	529	502	318	141	47	3405
AUBURN	0	6	9	114	354	586	623	465	437	285	133	35	3047
AVALON PLEASURE PIER	61	46	60	107	192	304	345	291	295	225	166	100	2192
BAKERSFIELD WSO	0	0	0	55	276	530	543	353	266	140	22	0	2185
BARRETT DAM	0	0	19	88	291	471	518	414	391	247	127	40	2616
BARSTOW	0	0	0	88	342	586	598	416	326	164	27	0	2547
BEAUMONT 1 E	0	6	15	118	304	474	530	445	434	284	144	47	2801
BERKELEY	118	100	77	125	276	446	487	358	353	282	214	137	2973
BISHOP WSO	0	5	44	256	579	809	865	655	580	337	145	38	4313
BLUE CANYON WSO	27	58	108	341	615	803	887	773	837	633	425	187	5704
BLYTHE	0	0	0	9	150	360	377	228	114	32	0	0	1270
BLYTHE FAA AIRPORT	0	0	0	9	122	336	363	215	106	33	0	0	1184
BOCA	162	225	363	626	882	1159	1271	1056	1032	759	558	345	8438
BONITA	12	9	23	73	176	322	350	288	273	181	99	58	1864
BOWMAN DAM	40	72	128	383	651	846	915	792	837	642	452	224	5982
BRAWLEY 2 SW	0	0	0	7	116	314	350	212	118	43	0	0	1161
BROOKS FARNHAM RANCH	0	8	16	117	375	601	632	456	406	259	105	13	2988
BURBANK VALLEY PMP PLT	0	0	9	53	168	320	356	273	247	159	80	36	1701
BUTTONWILLOW	0	0	0	83	348	601	623	420	310	158	28	6	2578
CALAVERAS BIG TREES	61	67	138	386	636	822	874	750	784	606	411	201	5736
CAMP PARDEE	0	0	0	81	324	570	614	442	397	246	87	22	2783
CANYON DAM	58	89	204	502	804	1039	1107	904	890	648	434	222	6901
CEDARVILLE	9	33	158	461	774	1020	1097	846	803	548	341	165	6255
CENTERVILLE PH	0	0	6	106	366	589	614	448	403	248	100	15	2895
CHICO EXPERIMENT STA	0	0	6	103	372	605	629	442	391	228	76	13	2865
CHULA VISTA	27	13	38	84	209	338	384	314	304	216	144	81	2162
CLAREMONT POMONA COL	0	0	15	70	203	369	415	329	315	209	102	44	2071
CLARKSBURG	0	0	10	122	390	614	645	448	384	238	87	23	2971
CLOVERDALE 3 SSE	0	0	11	100	312	524	558	400	372	254	108	27	2666
COALINGA	0	0	0	86	333	570	592	412	347	191	52	9	2592
COLFAX	0	11	14	164	404	598	648	512	505	346	177	62	3441
COLUSA 1 SSW	0	0	7	99	375	605	629	420	366	212	56	11	2780
CORONA	0	0	8	64	201	353	390	308	285	173	68	25	1875
CRESCENT CITY 1 N	213	198	195	301	411	524	564	473	515	444	357	249	4445
CULVER CITY	23	15	24	70	147	262	309	252	242	181	119	67	1711
CUYAMACA	15	23	77	310	561	750	803	672	682	492	337	155	4877
DAGGETT FAA AIRPORT	0	0	0	57	296	527	549	371	271	118	14	0	2203
DAVIS 2 WSW EXP FARM	0	0	8	87	354	589	620	431	378	230	82	19	2819
DEATH VALLEY	0	0	0	0	123	381	403	185	76	17	0	0	1205
DEER CREEK POWER HOUSE	59	75	139	403	705	924	955	764	741	552	367	179	5863
DENAIR 3 NNE	0	0	9	108	378	608	623	434	369	208	66	13	2816
DE SABLA	0	16	41	232	498	691	738	599	601	426	249	94	4185
DUDLEYS	32	51	107	331	570	760	803	652	676	501	324	152	4959
EAGLE MOUNTAIN	0	0	0	10	126	305	358	221	134	38	0	0	1192
EAST PARK RESERVOIR	0	0	12	150	423	636	682	510	484	319	137	25	3378
EL CAPITAN DAM	0	0	5	40	149	282	338	269	251	154	59	22	1569
EL CENTRO 2 SSW	0	0	0	5	131	329	360	223	126	42	0	0	1216
ELECTRA POWER HOUSE	0	0	7	95	342	567	595	434	397	246	98	15	2796
ELK VALLEY	68	90	175	434	645	809	853	669	660	498	332	171	5404
ELSINORE	0	0	0	65	230	409	446	343	318	189	77	16	2101
ESCONDIDO	0	0	6	79	226	381	415	335	304	190	97	44	2077
EUREKA WSO	270	248	252	328	399	508	549	465	518	459	388	294	4678
FAIRMONT	0	0	10	135	386	595	645	510	496	324	164	62	3327
FORT BIDWELL	30	58	188	456	771	1011	1097	840	797	567	367	183	6365
FORT BRAGG	264	248	228	295	375	493	530	451	484	426	357	273	4424
FORT BRAGG AVIATION	298	279	264	328	405	512	543	459	502	456	381	309	4747
FORT JONES RANGER STA	16	41	145	422	708	936	986	720	688	501	308	135	5614
FRESNO WSO	0	0	0	90	345	595	611	423	344	182	51	9	2650
FRIANT GOVERNMENT CAMP	0	0	0	72	323	583	611	426	375	213	73	7	2683
GRANT GROVE	129	152	246	493	735	921	986	879	946	765	577	334	7163
GRATON	41	42	64	185	390	583	608	448	434	321	204	93	3413
HAIWEE	0	0	7	149	477	729	766	577	502	274	94	15	3590
HALF MOON BAY	229	216	186	245	315	431	468	392	425	378	322	252	3859
HANFORD	0	0	0	104	372	605	620	423	338	178	46	9	2695
HAPPY CAMP RANGER STA	5	10	43	270	561	769	828	594	543	359	183	54	4219
HAT CREEK PH NO 1	29	50	147	403	696	927	970	750	710	492	296	111	5581
HAYFIELD PUMPING PLANT	0	0	0	23	170	375	422	289	203	79	7	0	1568
HEALDSBURG	8	15	19	109	318	527	558	389	357	246	111	43	2700
HETCH HETCHY	12	20	63	267	561	784	840	669	667	476	296	132	4787
HOLLISTER 1 SW	45	25	42	118	303	477	505	361	341	252	165	91	2725
HUNTINGTON LAKE	158	177	284	552	780	977	1051	849	1023	834	645	390	7830

STATION	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANNUAL
IDRIA	0	7	5	141	367	552	605	479	468	312	147	45	3128
IMPERIAL	0	0	0	6	118	288	325	195	105	23	0	0	1060
INDIO U S DATE GARDEN	0	0	0	6	118	300	341	208	115	31	0	0	1118
IRON MOUNTAIN	0	0	0	9	137	337	384	234	133	38	0	0	1272
KENTFIELD	31	44	47	153	357	543	580	414	381	275	170	72	3077
KERN RIVER PH NO 1	0	0	0	31	207	459	481	311	233	140	23	6	1891
KETTLEMAN STATION	0	0	0	48	260	530	549	358	276	152	32	10	2215
KING CITY	19	28	28	131	312	481	502	372	353	247	135	47	2655
LAGUNA BEACH	36	23	43	106	217	357	384	308	310	228	156	93	2262
LAKE ARROWHEAD	29	27	89	326	615	806	848	706	701	528	359	165	5200
LAKEPORT	12	16	28	186	471	660	704	532	512	345	177	63	3716
LAKE SPAULDING	93	141	182	434	705	890	952	804	849	669	471	252	6452
LA MESA	7	6	17	70	161	303	353	290	281	187	107	53	1835
LE GRAND	0	0	0	85	360	589	611	420	360	186	52	7	2680
LEMON COVE	0	0	0	71	318	574	583	389	304	162	38	7	2446
LINDSAY	0	0	0	91	348	583	601	420	347	175	47	7	2619
LIVERMORE COUNTY F D	6	12	17	118	360	564	601	451	419	277	151	59	3035
LODI	7	19	16	129	384	598	623	437	381	228	89	35	2956
LONG BEACH PUB SVC	0	0	10	58	135	242	290	224	213	143	82	32	1429
LONG BEACH WSO	0	0	7	48	155	295	339	273	247	148	71	23	1606
LOS ANGELES WSO INTL	19	15	23	77	158	279	331	270	267	195	114	71	1819
LOS ANGELES CIVIC CTR	0	0	5	35	113	218	268	207	190	124	60	25	1245
LOS BANOS	0	0	0	75	348	583	608	406	326	179	48	11	2584
LOS GATOS	23	20	20	126	324	505	536	408	372	262	138	62	2794
MADERA	0	0	0	83	342	586	611	414	332	177	47	12	2604
MARICOPA	0	0	0	40	268	530	549	353	251	146	19	6	2162
MARYSVILLE	0	0	0	76	333	577	605	406	335	186	58	9	2585
MC CLOUD	55	88	177	434	693	902	964	781	778	573	375	187	6007
MECCA FIRE STATION	0	0	0	0	124	319	357	217	115	33	0	0	1165
MERCED FIRE STATION 2	0	0	0	100	366	595	617	426	347	189	48	8	2697
MINERAL	120	162	240	515	777	983	1051	885	915	717	524	303	7192
MODESTO	0	0	6	104	372	601	617	423	350	202	75	17	2767
MOUNT HAMILTON	38	67	77	272	506	676	747	652	713	544	368	208	4868
MOUNT SHASTA WSO	37	64	145	422	699	915	973	762	763	561	371	178	5890
MOUNT WILSON FC 338	11	12	64	246	465	632	698	624	663	498	324	157	4394
NAPA STATE HOSPITAL	15	17	27	110	309	505	546	386	369	270	151	64	2769
NEEDLES FAA AIRPORT	0	0	0	10	163	381	421	261	150	42	0	0	1428
NEVADA CITY	15	38	104	344	591	775	818	669	663	471	290	121	4900
NEWMAN 2 NW	0	0	8	86	339	589	605	403	313	179	58	10	2590
NEWPORT BEACH HARBOR	28	9	27	86	183	307	341	277	276	206	134	74	1948
OAKLAND WSO	80	74	59	135	281	468	508	367	350	270	193	114	2909
OJAI	0	0	11	74	229	397	434	341	310	187	100	48	2142
ORANGE COVE	0	0	0	94	327	583	605	426	357	195	55	10	2652
ORICK PRAIRIE CREEK PK	198	176	189	326	474	620	657	518	552	471	375	258	4814
ORLAND	0	0	5	95	363	605	639	442	381	221	70	9	2830
ORLEANS	11	17	36	225	489	678	725	518	477	321	161	69	3728
OXNARD	68	51	56	109	202	310	351	297	304	242	180	116	2286
PALMDALE	0	0	7	113	380	592	620	459	400	245	84	29	2929
PALM SPRINGS	0	0	0	12	161	310	341	224	141	51	0	0	1240
PALO ALTO JR MUSEUM	34	33	57	149	342	518	548	400	378	271	164	74	2969
PALOMAR MT OBSERVATORY	7	9	38	214	436	614	679	591	620	445	274	111	4038
PARKER RESERVOIR	0	0	0	8	135	336	384	229	125	33	0	0	1250
PASADENA	0	0	10	53	163	289	343	272	254	169	85	46	1694
PASO ROBLES	10	10	24	141	366	549	567	414	381	252	126	50	2890
PETALUMA FIRE STA 2	18	19	23	115	333	530	561	406	394	300	189	78	2966
PINNACLES NAT MONUMENT	9	12	16	114	334	521	561	437	425	291	144	56	2920
PLACERVILLE	8	17	46	246	531	725	763	594	564	386	207	74	4161
POINT PIEDRAS BLANCAS	267	258	223	249	276	363	400	358	403	387	357	300	3841
POMONA CAL POLY	0	0	8	85	244	412	440	340	313	194	94	36	2166
PORTERVILLE	0	0	0	72	316	564	583	392	310	170	45	11	2463
PORTOLA	102	156	259	527	789	1029	1104	896	877	657	459	256	7111
POTTER VALLEY PH	12	7	16	148	405	598	629	468	453	320	163	56	3276
PRIEST VALLEY	27	56	74	266	516	698	738	594	592	423	265	119	4368
QUINCY	69	112	179	428	686	921	970	756	716	522	331	152	5852
RANDSBURG	0	0	0	108	374	598	639	479	435	240	62	11	2946
RED BLUFF WSO	0	0	0	82	339	577	614	420	366	218	64	8	2688
REDDING FIRE STA NO 2	0	0	0	90	325	552	586	400	349	218	76	14	2610
REDLANDS	0	0	7	82	219	384	423	330	303	189	80	35	2052
REDWOOD CITY	15	13	23	118	306	477	515	375	344	239	124	47	2596
RIVERSIDE FIRE STA. #3	0	0	5	62	212	375	406	312	283	168	74	22	1919
ROCKLIN	0	0	8	119	402	632	663	484	437	269	108	21	3143
SACRAMENTO WSO	0	0	5	101	360	595	617	426	372	227	120	20	2843
SAINT HELENA	0	0	14	131	357	555	582	428	406	273	126	36	2918
SALINAS FAA AP	102	86	72	136	275	428	465	364	372	296	214	139	2959
SAN BERNARDINO CO HOSP	0	0	13	52	206	369	403	311	283	187	65	22	1891

STATION	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANNUAL
SANDBERG WSO	7	10	33	212	501	716	769	638	663	474	288	116	4427
SAN DIEGO WSO	6	0	16	43	140	257	314	237	218	144	79	52	1507
SAN FERNANDO	5	6	12	65	175	307	351	290	273	170	98	48	1800
SAN FRANCISCO WSO	93	84	66	137	291	474	518	386	372	291	210	120	3042
S F FEDERAL BLDG WSO	202	177	102	127	233	403	437	325	332	281	257	194	3080
SAN GABRIEL FIRE DEPT	0	0	5	43	166	304	347	269	244	149	67	24	1618
SAN JACINTO	0	0	6	94	282	453	487	385	354	211	81	23	2376
SAN JOSE	12	15	13	90	276	456	481	350	322	228	123	50	2416
SAN LUIS OBISPO POLY	62	52	45	101	211	357	406	326	332	263	201	116	2472
SAN MATEO	42	47	41	123	279	446	481	353	338	254	166	85	2655
SANTA ANA FIRE STATION	0	0	8	62	170	302	345	273	249	161	76	30	1675
SANTA BARBARA	43	21	32	81	200	330	371	298	286	206	146	86	2110
SANTA BARBARA FAA AP	61	43	55	128	240	378	415	328	319	233	168	102	2470
SANTA CLARA UNIVERSITY	14	17	21	107	303	481	508	367	335	231	127	55	2566
SANTA CRUZ	88	83	80	164	315	468	502	382	391	309	218	128	3139
SANTA MARIA WSO	112	102	94	159	270	409	450	364	378	303	245	167	3053
SANTA MONICA PIER	64	19	34	84	162	257	302	255	263	205	157	99	1901
SANTA ROSA	20	22	33	134	354	552	586	420	406	289	171	78	3065
SCOTIA	150	125	143	246	369	521	555	445	484	405	310	201	3954
SIERRAVILLE RANGER STA	88	130	232	496	795	1042	1113	896	859	630	438	234	6953
SONORA RS	0	6	15	148	405	620	654	507	480	326	155	54	3380
SO ENTRANCE YOSEMITE	49	84	141	383	636	822	877	753	791	609	417	213	5775
SQUIRREL INN 2	21	30	103	313	579	766	815	700	725	556	377	180	5175
STOCKTON WSO	0	0	0	88	363	601	632	445	381	214	67	15	2806
STOCKTON FIRE STA NO 4	0	0	10	112	381	605	636	442	375	224	77	25	2887
STONY GORGE RESERVOIR	0	0	6	124	396	617	660	482	443	283	100	13	3124
SUSANVILLE AIRPORT	30	58	159	453	765	1032	1088	840	784	552	342	145	6248
TAHOE CITY	148	185	330	614	873	1070	1141	891	1023	807	608	372	8162
TEJON RANCHO	0	0	0	81	313	555	583	409	333	187	49	16	2526
THREE RVRS EDISON PH 2	0	0	0	102	338	552	580	417	357	210	71	15	2642
TIGER CREEK PH	0	11	17	176	453	688	707	543	527	366	196	73	3757
TORRANCE	23	19	28	76	171	295	340	274	269	193	115	56	1859
TRONA	0	0	0	43	316	601	614	392	267	127	10	0	2370
TRUCKEE RANGER STATION	137	175	304	595	891	1153	1209	1016	1023	783	577	345	8208
TUSTIN IRVINE RANCH	0	0	9	64	195	341	372	298	279	177	94	38	1867
TWENTYNINE PALMS	0	0	0	38	254	477	514	349	254	113	8	0	2006
TWIN LAKES	294	328	420	688	924	1135	1215	1067	1141	936	753	510	9411
UKIAH	0	7	12	131	369	558	589	426	412	285	141	47	2977
U C L A	23	15	27	66	117	215	270	222	227	170	122	62	1536
VACAVILLE	0	0	0	107	357	592	620	426	366	234	87	23	2812
VALYERMO RANGER STA	0	5	39	202	486	698	725	571	549	358	177	60	3870
VICTORVILLE PUMP PLANT	0	0	13	156	444	660	688	512	446	250	101	25	3295
VISALIA	0	0	0	71	307	564	583	384	288	156	33	0	2386
WARNER SPRINGS	8	11	36	189	408	580	629	521	527	373	218	91	3591
WASCO	0	0	0	77	327	574	608	403	299	156	31	0	2475
WATSONVILLE WATERWORKS	138	137	112	182	318	477	515	400	403	315	251	170	3418
WEAVERVILLE RANGER STA	17	22	90	335	621	840	884	664	648	456	256	102	4935
WILLOWS	0	0	0	87	354	601	636	442	381	222	72	12	2807
WOODFORDS	15	46	135	412	708	933	998	815	815	591	384	172	6024
WOODLAND 1 WNW	0	0	7	78	333	577	608	409	341	200	65	7	2626
YORBA LINDA	0	0	8	61	155	298	340	271	258	167	78	34	1671
YOSEMITE PARK HEADQTRS	10	17	56	279	609	862	874	669	629	433	249	113	4800
YREKA	12	25	105	376	687	911	964	731	694	486	283	119	5393

8. Cooling Degree Day Normals

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
ALDERPOINT	0	0	0	10	19	76	221	204	115	13	0	0	658
ALTURAS RANGER STATION	0	0	0	0	0	24	89	68	14	0	0	0	195
ANTIOCH FIBREBOARD ML	0	0	0	23	57	176	260	226	178	36	0	0	956
ASH MOUNTAIN	0	0	0	43	104	289	552	505	336	112	9	0	1950
AUBERRY 1 NW	0	0	0	16	60	188	419	367	214	38	0	0	1302
AUBURN	0	0	0	24	56	182	384	344	222	61	0	0	1273
AVALON PLEASURE PIER	0	0	0	6	14	19	80	108	93	58	9	0	387
BAKERSFIELD WSO	0	0	6	71	171	362	586	515	348	114	6	0	2179
BARRETT DAM	0	0	0	10	34	112	329	338	229	61	6	0	1119
BARSTOW	0	0	6	74	176	380	617	558	351	110	0	0	2272
BEAUMONT 1 E	0	5	0	11	32	134	353	350	231	81	13	0	1210
BERKELEY	0	0	0	0	0	17	13	13	35	8	0	0	86
BISHOP WSO	0	0	0	19	58	179	360	287	119	15	0	0	1037
BLUE CANYON WSO	0	0	0	0	0	20	123	114	45	0	0	0	302
BLYTHE	0	27	43	191	391	594	840	812	609	278	27	0	3812
BLYTHE FAA AIRPORT	6	33	62	231	450	672	921	877	678	341	44	0	4315
BOCA	0	0	0	0	0	0	13	11	0	0	0	0	24
BONITA	0	0	0	13	18	55	146	186	155	67	5	0	645
BOWMAN DAM	0	0	0	0	6	32	96	94	38	11	0	0	277
BRAWLEY 2 SW	6	21	54	199	385	588	837	818	642	327	50	0	3927
BROOKS FARNHAM RANCH	0	0	0	22	81	208	369	318	208	49	0	0	1255
BURBANK VALLEY PMP PLT	5	10	12	30	52	123	289	301	240	99	18	0	1179
BUTTONWILLOW	0	0	0	59	150	327	539	471	294	77	0	0	1917
CALAVERAS BIG TREES	0	0	0	0	0	36	139	89	30	0	0	0	294
CAMP PARDEE	0	0	0	24	70	211	412	363	252	69	0	0	1401
CANYON DAM	0	0	0	0	0	15	80	55	18	0	0	0	168
CEDARVILLE	0	0	0	5	12	60	226	182	62	5	0	0	552
CENTERVILLE PH	0	0	0	26	82	213	412	357	240	50	0	0	1380
CHICO EXPERIMENT STA	0	0	0	24	89	241	412	347	228	44	0	0	1385
CHULA VISTA	0	0	0	0	0	15	76	115	95	32	0	0	333
CLAREMONT POMONA COL	6	7	5	20	31	107	283	288	240	98	17	0	1102
CLARKSBURG	0	0	0	25	50	146	251	229	160	29	0	0	890
CLOVERDALE 3 SSE	0	0	0	26	37	138	234	205	161	41	0	0	842
COALINGA	0	0	0	41	123	285	508	443	276	73	0	0'	1749
COLFAX	0	0	0	31	62	185	388	342	209	55	5	0	1277
COLUSA 1 SSW	0	0	0	38	93	248	397	332	223	37	0	0	1368
CORONA	5	8	6	23	46	133	298	307	227	86	15	0	1154
CRESCENT CITY 1 N	0	0	0	0	0	0	0	7	0	0	0	0	7
CULVER CITY	8	11	6	10	17	46	126	154	129	89	24	0	620
CUYAMACA	0	0	0	0	8	53	178	162	68	6	0	0	476
DAGGETT FAA AIRPORT	0	7	14	97	241	453	691	636	426	153	11	0	2729
DAVIS 2 WSW EXP FARM	0	0	0	26	71	187	298	254	189	38	0	0	1063
DEATH VALLEY	0	30	135	359	629	864	1135	1060	777	384	36	0	5409
DEER CREEK POWER HOUSE	0	0	0	0	0	20	102	68	25	0	0	0	215
DENAIR 3 NNE	0	0	0	25	73	202	350	288	183	31	0	0	1152
DE SABLA	0	0	0	12	19	100	237	186	110	21	0	0	695
DUDLEYS	0	0	0	0	0	35	150	123	50	5	0	0	363
EAGLE MOUNTAIN	11	31	59	218	434	663	887	834	651	344	69	7	4208
EAST PARK RESERVOIR	0	0	0	16	53	184	369	304	171	26	0	0	1123
EL CAPITAN DAM	9	11	9	31	56	142	326	350	293	145	47	6	1425
EL CENTRO 2 SSW	6	22	45	177	369	582	825	803	618	303	44	0	3794
ELECTRA POWER HOUSE	0	0	0	21	70	192	384	332	214	42	0	0	1255
ELK VALLEY	0	0	0	0	0	33	99	77	16	0	0	0	225
ELSINORE	0	0	0	30	71	187	415	415	292	105	10	0	1525
ESCONDIDO	0	0	0	13	32	101	238	264	188	63	7	0	907
EUREKA WSO	0	0	0	0	0	0	0	0	0	0	0	0	0
FAIRMONT	0	0	0	24	52	191	431	403	259	88	8	0	1456
FORT BIDWELL	0	0	0	0	0	18	95	80	20	0	0	0	213
FORT BRAGG	0	0	0	0	0	0	0	0	0	0	0	0	0
FORT BRAGG AVIATION	0	0	0	0	0	0	0	0	0	0	0	0	0
FORT JONES RANGER STA	0	0	0	0	8	51	159	128	37	0	0	0	383
FRESNO WSO	0	0	0	41	125	276	484	412	267	66	0	0	1671
FRIANT GOVERNMENT CAMP	0	0	0	33	119	268	499	431	276	75	5	0	1706
GRANT GROVE	0	0	0	0	0	7	55	37	6	0	0	0	105
GRATON	0	0	0	0	0	42	57	54	46	5	0	0	204
HAIWEE	0	0	0	31	90	261	477	419	226	44	0	0	1548
HALF MOON BAY	0	0	0	0	0	0	0	5	0	0	0	0	5
HANFORD	0	0	0	40	114	267	453	381	236	61	0	0	1552
HAPPY CAMP RANGER STA	0	0	0	8	37	108	281	230	94	0	0	0	758
HAT CREEK PH NO 1	0	0	0	0	10	30	147	90	30	0	0	0	307
HAYFIELD PUMPING PLANT	6	17	26	142	295	504	766	725	528	234	32	0	3275
HEALDSBURG	0	0	0	18	28	118	157	164	127	35	0	0	647
HETCH HETCHY	0	0	0	11	14	60	192	168	81	13	0	0	539
HOLLISTER 1 SW	0	0	0	15	17	58	91	72	93	28	0	0	374
HUNTINGTON LAKE	0	0	0	0	0	6	22	13	6	0	0	0	47

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
IDRIA	0	0	0	33	82	219	443	397	242	85	10	0	1511
IMPERIAL	9	27	52	185	388	594	825	806	633	326	64	0	3909
INDIO U S DATE GARDEN	10	38	75	226	419	624	831	800	630	337	67	5	4062
IRON MOUNTAIN	9	27	55	221	450	684	918	862	660	328	59	5	4278
KENTFIELD	0	0	0	5	6	48	68	72	68	13	0	0	280
KERN RIVER PH NO 1	0	0	13	107	218	420	682	626	462	189	24	0	2741
KETTLEMAN STATION	0	0	7	77	175	370	605	543	378	144	11	0	2310
KING CITY	0	0	0	10	20	53	99	97	79	35	0	0	393
LAGUNA BEACH	0	0	0	6	23	42	101	126	100	38	16	0	452
LAKE ARROWHEAD	0	0	0	0	9	36	156	133	68	13	0	0	415
LAKEPORT	0	0	0	9	25	117	272	233	118	7	0	0	781
LAKE SPAULDING	0	0	0	0	0	9	46	42	12	0	0	0	109
LA MESA	8	10	8	13	26	65	193	226	194	101	23	5	873
LE GRAND	0	0	0	25	83	232	419	357	229	51	0	0	1396
LEMON COVE	0	0	0	63	147	310	515	440	285	77	0	0	1837
LINDSAY	0	0	0	37	115	265	468	394	243	57	0	0	1579
LIVERMORE COUNTY F D	0	0	0	10	27	101	202	192	146	35	0	0	713
LODI	0	0	0	18	53	158	258	227	142	24	0	0	880
LONG BEACH PUB SVC	8	9	9	14	36	74	184	230	187	111	33	0	905
LONG BEACH WSO	0	7	0	16	43	92	226	260	211	107	23	0	985
LOS ANGELES WSO INTL	5	7	0	9	17	56	127	154	134	83	23	0	615
LOS ANGELES CIVIC CTR	10	14	10	25	51	115	258	282	236	140	44	0	1185
LOS BANOS	0	0	0	38	89	239	415	363	237	44	0	0	1425
LOS GATOS	0	0	0	16	23	92	162	141	104	27	0	0	565
MADERA	0	0	0	39	115	273	471	397	252	65	0	0	1612
MARICOPA	0	0	6	98	199	399	632	574	387	133	7	0	2435
MARYSVILLE	0	0	0	42	107	261	428	369	255	58	0	0	1520
MC CLOUD	0	0	0	0	6	25	102	69	21	0	0	0	223
MECCA FIRE STATION	7	27	53	204	388	561	781	769	594	293	46	0	3733
MERCED FIRE STATION 2	0	0	0	30	93	233	412	353	222	50	0	0	1393
MINERAL	0	0	0	0	0	6	40	35	9	0	0	0	90
MODESTO	0	0	0	28	78	197	350	296	186	36	0	0	1171
MOUNT HAMILTON	0	0	0	13	15	79	221	203	98	37	8	0	674
MOUNT SHASTA WSO	0	0	0	0	8	28	124	95	31	0	0	0	286
MOUNT WILSON FC 338	0	0	0	15	21	97	216	192	133	48	9	0	731
NAPA STATE HOSPITAL	0	0	0	9	14	64	86	85	93	23	0	0	374
NEEDLES FAA AIRPORT	5	23	44	204	453	699	942	877	657	299	34	0	4237
NEVADA CITY	0	0	0	0	8	49	154	120	47	0	0	0	378
NEWMAN 2 NW	0	0	0	50	120	256	409	341	230	64	0	0	1470
NEWPORT BEACH HARBOR	0	0	0	0	10	32	84	102	81	37	6	0	352
OAKLAND WSO	0	0	0	0	0	21	21	28	44	14	0	0	128
OJAI	0	5	0	20	26	100	262	261	194	68	10	0	946
ORANGE COVE	0	0	0	36	114	262	465	406	261	76	0	0	1620
ORICK PRAIRIE CREEK PK	0	0	0	0	0	0	0	0	0	0	0	0	0
ORLAND	0	0	0	44	116	273	437	366	245	55	0	0	1536
ORLEANS	0	0	0	9	18	105	262	237	120	5	0	0	756
OXNARD	0	6	0	0	0	14	74	68	53	38	10	0	264
PALMDALE	0	0	0	44	90	260	502	459	286	78	5	0	1724
PALM SPRINGS	10	39	54	180	338	537	800	760	576	301	86	0	3681
PALO ALTO JR MUSEUM	0	0	0	0	9	47	65	58	57	0	0	0	236
PALOMAR MT OBSERVATORY	0	0	0	13	20	87	239	226	147	53	7	0	792
PARKER RESERVOIR	6	27	66	231	471	702	936	896	702	373	66	0	4476
PASADENA	8	14	12	31	42	118	277	298	247	115	25	0	1187
PASO ROBLES	0	0	0	12	20	101	215	202	123	26	0	0	699
PETALUMA FIRE STA 2	0	0	0	0	6	45	71	81	77	13	0	0	293
PINNACLES NAT MONUMENT	0	0	0	15	26	125	273	251	169	39	0	0	898
PLACERVILLE	0	0	0	8	15	107	271	222	100	8	0	0	731
POINT PIEDRAS BLANCAS	0	0	0	0	0	0	0	0	0	0	0	0	0
POMONA CAL POLY	0	7	6	20	38	117	281	299	221	94	16	0	1109
PORTERVILLE	0	0	0	56	132	290	486	428	273	79	0	0	1754
PORTOLA	0	0	0	0	0	0	37	29	10	0	0	0	76
POTTER VALLEY PH	0	0	0	14	29	119	278	237	136	16	0	0	830
PRIEST VALLEY	0	0	0	0	8	77	210	186	74	9	0	0	564
QUINCY	0	0	0	0	8	38	110	81	20	0	0	0	257
RANDSBURG	0	0	10	83	140	335	589	527	324	114	11	0	2113
RED BLUFF WSO	0	0	0	53	139	323	536	462	309	82	0	0	1904
REDDING FIRE STA NO 2	0	0	0	77	162	332	561	484	333	111	0	0	2060
REDLANDS	0	8	9	38	61	179	381	380	274	113	15	0	1459
REDWOOD CITY	0	0	0	8	9	65	114	100	83	13	0	0	392
RIVERSIDE FIRE STA. #3	6	7	7	27	68	160	341	347	257	96	8	0	1324
ROCKLIN	0	0	0	14	65	198	384	332	206	28	0	0	1228
SACRAMENTO WSO	0	0	0	26	98	185	316	286	200	48	0	0	1159
SAINT HELENA	0	0	0	15	21	99	182	166	104	17	0	0	604
SALINAS FAA AP	0	0	0	0	0	7	6	16	30	15	0	0	74
SAN BERNARDINO CO HOSP	0	9	7	35	72	193	409	409	301	108	14	0	1557

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SANDBERG WSO	0	0	0	0	0	86	286	258	150	20	0	0	800
SAN DIEGO WSO	10	0	0	15	26	67	149	201	163	77	14	0	722
SAN FERNANDO	17	21	15	35	64	138	300	304	240	115	48	12	1310
SAN FRANCISCO WSO	0	0	0	0	0	18	16	22	38	13	0	0	108
S F FEDERAL BLDG WSO	0	0	0	0	0	5	0	0	18	16	0	0	39
SAN GABRIEL FIRE DEPT	6	11	11	26	48	123	282	301	236	108	22	0	1175
SAN JACINTO	0	0	0	25	63	179	394	388	264	81	9	0	1413
SAN JOSE	0	0	0	12	20	71	117	111	94	19	0	0	444
SAN LUIS OBISPO POLY	0	0	0	8	0	17	52	48	54	51	16	0	246
SAN MATEO	0	0	0	0	5	31	42	57	56	27	0	0	218
SANTA ANA FIRE STATION	10	16	13	20	36	87	210	242	200	109	29	0	972
SANTA BARBARA	5	6	0	8	10	28	93	99	86	42	8	0	386
SANTA BARBARA FAA AP	0	0	0	0	0	12	64	65	55	22	0	0	218
SANTA CLARA UNIVERSITY	0	0	0	9	21	70	110	106	87	17	0	0	420
SANTA CRUZ	0	0	0	0	0	8	17	21	32	9	0	0	87
SANTA MARIA WSO	0	0	0	0	0	5	22	18	22	17	0	0	84
SANTA MONICA PIER	8	6	6	10	24	48	104	96	76	47	21	6	452
SANTA ROSA	0	0	0	0	7	60	76	84	75	13	0	0	315
SCOTIA	0	0	0	0	0	0	8	10	11	0	0	0	29
SIERRAVILLE RANGER STA	0	0	0	0	0	12	57	41	13	0	0	0	123
SONORA RS	0	0	0	20	44	165	372	329	192	46	0	0	1168
SO ENTRANCE YOSEMITE	0	0	0	0	0	33	101	98	27	0	0	0	260
SQUIRREL INN 2	0	0	0	7	8	64	154	141	94	22	0	0	490
STOCKTON WSO	0	0	0	22	73	219	363	323	217	42	0	0	1259
STOCKTON FIRE STA NO 4	0	0	0	17	40	166	282	239	148	19	0	0	911
STONY GORGE RESERVOIR	0	0	0	22	76	226	431	369	228	43	0	0	1395
SUSANVILLE AIRPORT	0	0	0	0	7	37	161	120	36	0	0	0	361
TAHOE CITY	0	0	0	0	0	0	14	18	0	0	0	0	32
TEJON RANCHO	0	0	0	58	130	316	536	471	315	100	0	0	1926
THREE RVRS EDISON PH 2	0	0	0	36	99	255	481	425	268	77	0	0	1641
TIGER CREEK PH	0	0	0	12	26	112	293	265	149	30	0	0	887
TORRANCE	0	8	0	13	15	44	128	152	124	76	18	0	578
TRONA	0	0	10	115	262	483	741	682	450	145	0	0	2888
TRUCKEE RANGER STATION	0	0	0	0	0	0	22	11	0	0	0	0	33
TUSTIN IRVINE RANCH	0	7	0	9	29	77	181	209	165	70	12	0	759
TWENTYNINE PALMS	5	9	15	119	265	486	729	676	462	168	14	0	2948
TWIN LAKES	0	0	0	0	0	0	6	6	0	0	0	0	12
UKIAH	0	0	0	18	36	125	274	245	153	23	0	0	874
U C L A	19	18	10	17	29	41	135	158	150	113	48	16	754
VACAVILLE	0	0	0	30	68	197	332	292	200	54	0	0	1173
VALYERMO RANGER STA	0	0	0	13	31	135	320	281	150	16	0	0	946
VICTORVILLE PUMP PLANT	0	0	0	19	77	217	434	403	220	57	6	0	1433
VISALIA	0	0	0	63	139	304	505	440	288	86	0	0	1825
WARNER SPRINGS	0	0	0	0	10	85	256	253	135	28	0	0	767
WASCO	0	0	0	60	152	332	546	477	309	92	6	0	1974
WATSONVILLE WATERWORKS	0	0	0	0	0	5	0	7	13	0	0	0	25
WEAVERVILLE RANGER STA	0	0	0	6	12	63	187	146	63	0	0	0	487
WILLOWS	0	0	0	36	103	252	406	341	240	59	0	0	1437
WOODFORDS	0	0	0	0	9	40	149	129	30	6	0	0	363
WOODLAND 1 WNW	0	0	0	41	89	232	369	319	235	54	0	0	1349
YORBA LINDA	8	8	7	23	50	112	254	271	215	108	26	0	1082
YOSEMITE PARK HEADQTRS	0	0	0	10	13	92	224	193	89	10	0	0	631
YREKA	0	0	0	0	13	71	226	180	72	0	0	0	562

9. Location and Elevation of Temperature Stations

STATION	DIV	NAME	LAT	LONG	ELEV
04 0088	01	ALDERPOINT	N4010	W12337	460
04 0161	02	ALTURAS RANGER STATION	N4130	W12033	4400
04 0227	05	ANTIOCH FIBREBOARD ML	N3801	W12146	28
04 0343	05	ASH MOUNTAIN	N3629	W11850	1708
04 0379	05	AUBERRY 1 NW	N3705	W11930	2140
04 0383	02	AUBURN	N3854	W12104	1292
04 0395	06	AVALON PLEASURE PIER	N3321	W11819	25
04 0442	05	BAKERSFIELD WSO	N3525	W11903	475
04 0514	06	BARRETT DAM	N3241	W11640	1623
04 0519	07	BARSTOW	N3454	W11702	2162
04 0609	07	BEAUMONT 1 E	N3356	W11658	2605
04 0693	04	BERKELEY	N3752	W12215	345
04 0822	07	BISHOP WSO	N3722	W11822	4108
04 0897	02	BLUE CANYON WSO	N3917	W12042	5280
04 0924	07	BLYTHE	N3337	W11436	268
04 0927	07	BLYTHE FAA AIRPORT	N3337	W11443	395
04 0931	03	BOCA	N3923	W12006	5575
04 0968	06	BONITA	N3240	W11702	105
04 1018	02	BOWMAN DAM	N3927	W12039	5347
04 1048	07	BRAWLEY 2 SW	N3257	W11533	- 100
04 1112	02	BROOKS FARNHAM RANCH	N3846	W12209	294
04 1194	06	BURBANK VALLEY PMP PLT	N3411	W11821	655
04 1244	05	BUTTONWILLOW	N3524	W11928	269
04 1277	05	CALAVERAS BIG TREES	N3817	W12019	4696
04 1428	05	CAMP PARDEE	N3815	W12051	658
04 1497	02	CANYON DAM	N4010	W12105	4555
04 1614	03	CEDARVILLE	N4132	W12010	4670
04 1624	02	CENTERVILLE PH	N3947	W12140	522
04 1715	02	CHICO EXPERIMENT STA	N3942	W12147	205
04 1758	06	CHULA VISTA	N3236	W11706	9
04 1779	06	CLAREMONT POMONA COL	N3406	W11743	1201
04 1784	02	CLARKSBURG	N3825	W12132	14
04 1838	01	CLOVERDALE 3 SSE	N3846	W12259	320
04 1864	05	COALINGA	N3609	W12021	671
04 1912	02	COLFAX	N3906	W12057	2418
04 1948	02	COLUSA 1 SSW	N3912	W12201	60
04 2031	06	CORONA	N3352	W11734	710
04 2147	01	CRESCENT CITY 1 N	N4146	W12412	40
04 2214	06	CULVER CITY	N3401	W11824	106
04 2239	06	CUYAMACA	N3259	W11635	4650
04 2257	07	DAGGETT FAA AIRPORT	N3452	W11647	1915
04 2294	02	DAVIS 2 WSW EXP FARM	N3832	W12146	60
04 2319	07	DEATH VALLEY	N3628	W11652	- 194
04 2334	02	DEER CREEK POWER HOUSE	N3918	W12051	3700
04 2389	05	DENAIR 3 NNE	N3734	W12047	137
04 2402	02	DE SABLA	N3952	W12137	2713
04 2539	05	DUDLEYS	N3745	W12006	3000
04 2598	07	EAGLE MOUNTAIN	N3348	W11527	973
04 2640	02	EAST PARK RESERVOIR	N3922	W12231	1205
04 2709	06	EL CAPITAN DAM	N3253	W11649	600
04 2713	07	EL CENTRO 2 SSW	N3246	W11534	- 30
04 2728	05	ELECTRA POWER HOUSE	N3820	W12040	715
04 2749	01	ELK VALLEY	N4200	W12343	1705
04 2805	06	ELSINORE	N3340	W11720	1285
04 2862	06	ESCONDIDO	N3307	W11705	660
04 2910	01	EUREKA WSO	N4048	W12410	43
04 2941	07	FAIRMONT	N3442	W11826	3060
04 3157	03	FORT BIDWELL	N4151	W12008	4498
04 3161	01	FORT BRAGG	N3927	W12348	80
04 3164	01	FORT BRAGG AVIATION	N3924	W12349	61
04 3182	01	FORT JONES RANGER STA	N4136	W12251	2725
04 3257	05	FRESNO WSO	N3646	W11943	328
04 3261	05	FRIANT GOVERNMENT CAMP	N3659	W11943	410
04 3551	05	GRANT GROVE	N3644	W11858	6600
04 3578	01	GRATON	N3826	W12252	200
04 3710	07	HAIWEE	N3608	W11757	3825
04 3714	04	HALF MOON BAY	N3728	W12226	60
04 3747	05	HANFORD	N3620	W11940	242
04 3761	01	HAPPY CAMP RANGER STA	N4148	W12322	1150
04 3824	02	HAT CREEK PH NO 1	N4056	W12133	3015
04 3855	07	HAYFIELD PUMPING PLANT	N3342	W11538	1370
04 3875	01	HEALDSBURG	N3837	W12252	102
04 3939	05	HETCH HETCHY	N3757	W11947	3870
04 4022	04	HOLLISTER 1 SW	N3650	W12125	279
04 4176	05	HUNTINGTON LAKE	N3714	W11913	7020
04 4204	05	IDRIA	N3625	W12040	2650
04 4223	07	IMPERIAL	N3251	W11534	- 64
04 4259	07	INDIO U S DATE GARDEN	N3344	W11615	11
04 4297	07	IRON MOUNTAIN	N3408	W11508	922
04 4500	01	KENTFIELD	N3757	W12233	120
04 4520	05	KERN RIVER PH NO 1	N3528	W11847	970
04 4536	05	KETTLEMAN STATION	N3604	W12005	508
04 4555	04	KING CITY	N3612	W12108	320
04 4647	06	LAGUNA BEACH	N3333	W11747	35
04 4671	07	LAKE ARROWHEAD	N3415	W11711	5205
04 4701	02	LAKEPORT	N3902	W12255	1347
04 4713	02	LAKE SPAULDING	N3919	W12038	5156
04 4735	06	LA MESA	N3246	W11701	530
04 4884	05	LE GRAND	N3714	W12015	255
04 4890	05	LEMON COVE	N3623	W11902	513
04 4957	05	LINDSAY	N3611	W11904	395
04 4997	04	LIVERMORE COUNTY F D	N3740	W12146	490
04 5032	05	LODI	N3807	W12117	40
04 5080	06	LONG BEACH PUB SVC	N3347	W11812	10
04 5085	06	LONG BEACH WSO	N3349	W11809	34
04 5114	06	LOS ANGELES WSO INTL	N3356	W11824	105
04 5115	06	LOS ANGELES CIVIC CTR	N3403	W11814	270
04 5118	05	LOS BANOS	N3703	W12052	120
04 5123	04	LOS GATOS	N3714	W12158	365
04 5233	05	MADERA	N3658	W12004	268
04 5338	05	MARICOPA	N3505	W11923	675
04 5385	02	MARYSVILLE	N3909	W12135	60
04 5449	02	MC CLOUD	N4116	W12208	3300
04 5502	07	MECCA FIRE STATION	N3334	W11604	- 180
04 5532	05	MERCED FIRE STATION 2	N3718	W12029	169
04 5679	02	MINERAL	N4021	W12136	4911
04 5738	05	MODESTO	N3739	W12100	91
04 5933	04	MOUNT HAMILTON	N3720	W12139	4206
04 5983	02	MOUNT SHASTA WSO	N4119	W12219	3544
04 6006	06	MOUNT WILSON FC 338	N3414	W11804	5709
04 6074	01	NAPA STATE HOSPITAL	N3817	W12216	60
04 6118	07	NEEDLES FAA AIRPORT	N3446	W11437	913
04 6136	02	NEVADA CITY	N3916	W12101	2520
04 6168	05	NEWMAN 2 NW	N3721	W12103	108
04 6175	06	NEWPORT BEACH HARBOR	N3336	W11753	10
04 6335	04	OAKLAND WSO	N3744	W12212	6
04 6399	06	OJAI	N3427	W11915	750
04 6476	05	ORANGE COVE	N3637	W11918	431
04 6498	01	ORICK PRAIRIE CREEK PK	N4122	W12401	161
04 6506	02	ORLAND	N3945	W12212	254
04 6508	01	ORLEANS	N4118	W12332	403
04 6569	06	OXNARD	N3412	W11911	49
04 6624	07	PALMDALE	N3435	W11806	2596
04 6635	07	PALM SPRINGS	N3349	W11632	411
04 6646	04	PALO ALTO JR MUSEUM	N3727	W12208	25
04 6657	06	PALOMAR MT OBSERVATORY	N3321	W11652	5545
04 6699	07	PARKER RESERVOIR	N3417	W11410	738
04 6719	06	PASADENA	N3409	W11809	864
04 6730	04	PASO ROBLES	N3538	W12041	700
04 6826	01	PETALUMA FIRE STA 2	N3814	W12238	16
04 6926	04	PINNACLES NAT MONUMENT	N3629	W12111	1307
04 6960	02	PLACERVILLE	N3844	W12048	1890
04 7024	04	POINT PIEDRAS BLANCAS	N3540	W12117	59
04 7050	06	POMONA CAL POLY	N3404	W11749	740
04 7077	05	PORTERVILLE	N3604	W11901	393
04 7085	02	PORTOLA	N3948	W12028	4838
04 7109	01	POTTER VALLEY PH	N3922	W12308	1015
04 7150	04	PRIEST VALLEY	N3611	W12042	2300
04 7195	02	QUINCY	N3956	W12056	3409
04 7253	07	RANDSBURG	N3522	W11739	3570
04 7292	02	RED BLUFF WSO	N4009	W12215	342
04 7296	02	REDDING FIRE STA NO 2	N4035	W12224	580
04 7306	06	REDLANDS	N3403	W11711	1318
04 7339	04	REDWOOD CITY	N3729	W12214	31
04 7470	06	RIVERSIDE FIRE STA. #3	N3357	W11723	840
04 7516	02	ROCKLIN	N3848	W12114	242
04 7630	02	SACRAMENTO WSO	N3831	W12130	17
04 7643	01	SAINT HELENA	N3830	W12228	225
04 7669	04	SALINAS FAA AP	N3640	W12136	75
04 7723	06	SAN BERNARDINO CO HOSP	N3408	W11716	1125
04 7735	06	SANDBERG WSO	N3445	W11844	4517
04 7740	06	SAN DIEGO WSO	N3244	W11710	13
04 7759	06	SAN FERNANDO	N3417	W11828	965
04 7769	04	SAN FRANCISCO WSO	N3737	W12223	8
04 7772	04	S F FEDERAL BLDG WSO	N3747	W12225	52
04 7785	06	SAN GABRIEL FIRE DEPT	N3406	W11806	450
04 7810	06	SAN JACINTO	N3347	W11658	1535
04 7821	04	SAN JOSE	N3721	W12154	67
04 7851	04	SAN LUIS OBISPO POLY	N3518	W12040	320
04 7864	04	SAN MATEO	N3732	W12218	21
04 7888	06	SANTA ANA FIRE STATION	N3345	W11752	115
04 7902	06	SANTA BARBARA	N3425	W11941	5
04 7905	06	SANTA BARBARA FAA AP	N3426	W11950	9
04 7912	04	SANTA CLARA UNIVERSITY	N3721	W12156	88
04 7916	04	SANTA CRUZ	N3659	W12201	125

STATION	DIV	NAME	LAT	LONG	ELEV
04 7946	06	SANTA MARIA WSO	N3454	W12027	236
04 7953	06	SANTA MONICA PIER	N3400	W11830	15
04 7965	01	SANTA ROSA	N3827	W12242	167
04 8045	01	SCOTIA	N4029	W12406	139
04 8218	02	SIERRAVILLE RANGER STA	N3935	W12022	4975
04 8353	05	SONORA RS	N3759	W12023	1749
04 8380	05	SO ENTRANCE YOSEMITE	N3730	W11938	5120
04 8479	07	SQUIRREL INN 2	N3414	W11714	5680
04 8558	05	STOCKTON WSO	N3754	W12115	22
04 8560	05	STOCKTON FIRE STA NO 4	N3800	W12119	12
04 8587	02	STONY GORGE RESERVOIR	N3935	W12232	791
04 8702	03	SUSANVILLE AIRPORT	N4023	W12034	4148
04 8758	03	TAHOE CITY	N3910	W12008	6230
04 8839	05	TEJON RANCHO	N3502	W11845	1425
04 8914	05	THREE RVRS EDISON PH 2	N3628	W11853	950
04 8928	05	TIGER CREEK PH	N3827	W12029	2355
04 8973	06	TORRANCE	N3348	W11820	110
04 9035	07	TRONA	N3547	W11723	1695
04 9043	03	TRUCKEE RANGER STATION	N3920	W12011	5995
04 9087	06	TUSTIN IRVINE RANCH	N3344	W11747	118
04 9099	07	TWENTYNINE PALMS	N3408	W11602	1975
04 9105	02	TWIN LAKES	N3842	W12002	7829
04 9122	01	UKIAH	N3909	W12312	623
04 9152	06	U C L A	N3404	W11827	430
04 9200	02	VACAVILLE	N3822	W12157	105
04 9251	07	VALYERMO RANGER STA	N3427	W11751	3705
04 9325	07	VICTORVILLE PUMP PLANT	N3432	W11718	2858
04 9367	05	VISALIA	N3620	W11918	325
04 9447	06	WARNER SPRINGS	N3317	W11638	3180
04 9452	05	WASCO	N3536	W11920	333
04 9473	04	WATSONVILLE WATERWORKS	N3656	W12146	95
04 9490	01	WEAVERVILLE RANGER STA	N4044	W12256	2050
04 9699	02	WILLOWS	N3932	W12212	140
04 9775	03	WOODFORDS	N3847	W11949	5671
04 9781	02	WOODLAND 1 WNW	N3841	W12148	69
04 9847	06	YORBA LINDA	N3353	W11749	350
04 9855	05	YOSEMITE PARK HEADQTRS	N3745	W11935	3970
04 9866	01	YREKA	N4143	W12238	2625

10. Location and Elevation of Precipitation Stations

STATION	DIV	NAME	LAT	LONG	ELEV
04 0014	06	ACTON-ESDO CYN FC261F	N3430	W11816	2960
04 0088	01	ALDERPOINT	N4010	W12337	460
04 0115	06	ALISO CN OAT MT FC 446	N3419	W11833	2367
04 0144	06	ALTADENA	N3411	W11808	1127
04 0161	02	ALTURAS RANGER STATION	N4130	W12033	4400
04 0204	05	ANGIOLA	N3559	W11929	205
04 0212	01	ANGWIN PAC UNION COL	N3834	W12226	1815
04 0227	05	ANTIOCH FIBREBOARD ML	N3801	W12146	28
04 0327	06	ARROYO SECO RS FC 508D	N3413	W11810	1220
04 0343	05	ASH MOUNTAIN	N3629	W11850	1708
04 0379	05	AUBERRY 1 NW	N3705	W11930	2140
04 0383	02	AUBURN	N3854	W12104	1292
04 0395	06	AVALON PLEASURE PIER	N3321	W11819	25
04 0410	06	AZUSA CITY PARK FC143B	N3408	W11754	610
04 0442	05	BAKERSFIELD WSO R	N3525	W11903	475
04 0514	06	BARRETT DAM	N3241	W11640	1623
04 0519	07	BARSTOW	N3454	W11702	2162
04 0606	06	BEAUMONT	N3356	W11658	2613
04 0607	06	BEAUMONT PUMPING PLANT	N3359	W11658	3045
04 0609	07	BEAUMONT 1 E	N3356	W11658	2605
04 0619	06	BEL AIR FC-10A	N3405	W11827	540
04 0693	04	BERKELEY	N3752	W12215	345
04 0742	06	BIG BEAR LAKE DAM //	N3414	W11658	6815
04 0758	06	BIG DALTON DAM FC223BE	N3410	W11749	1575
04 0779	07	BIG PINES PARK FC 83B	N3423	W11741	6862
04 0790	04	BIG SUR STATE PARK	N3615	W12147	235
04 0798	06	BIG TUJUNGA DAM FC46DE	N3418	W11811	2317
04 0822	07	BISHOP WSO R	N3722	W11822	4108
04 0897	02	BLUE CANYON WSO //R	N3917	W12042	5280
04 0924	07	BLYTHE	N3337	W11436	268
04 0927	07	BLYTHE FAA AIRPORT	N3337	W11443	395
04 0931	03	BOCA	N3923	W12006	5575
04 0968	06	BONITA	N3240	W11702	105
04 1013	06	BOUQUET CANYON	N3435	W11822	3055
04 1018	02	BOWMAN DAM	N3927	W12039	5347
04 1048	07	BRAWLEY 2 SW	N3257	W11533	-100
04 1056	06	BREA CITY	N3356	W11754	383
04 1112	02	BROOKS FARNHAM RANCH	N3846	W12209	294
04 1130	02	BRUSH CREEK RS	N3941	W12120	3560
04 1192	06	BURBANK FD FC226 B	N3411	W11818	680
04 1194	06	BURBANK VALLEY PMP PLT	N3411	W11821	655
04 1244	05	BUTTONWILLOW	N3524	W11928	269
04 1250	07	CABAZON	N3355	W11647	1800
04 1277	05	CALAVERAS BIG TREES	N3817	W12019	4696
04 1288	07	CALEXICO 2 NE	N3241	W11528	12
04 1312	01	CALISTOGA	N3835	W12235	364
04 1424	06	CAMPO	N3237	W11628	2630
04 1428	05	CAMP PARDEE	N3815	W12051	658
04 1462	02	CAMPTONVILLE RS	N3927	W12103	2755
04 1497	02	CANYON DAM	N4010	W12105	4555
04 1602	01	CAZADERO	N3832	W12308	1055
04 1614	03	CEDARVILLE	N4132	W12010	4670
04 1624	02	CENTERVILLE PH	N3947	W12140	522
04 1653	02	CHALLENGE RANGER STA	N3929	W12113	2560
04 1680	06	CHATSWORTH FC24F	N3415	W11836	948
04 1700	02	CHESTER	N4018	W12114	4525
04 1715	02	CHICO EXPERIMENT STA	N3942	W12147	205
04 1758	06	CHULA VISTA	N3236	W11706	9
04 1779	06	CLAREMONT POMONA COL	N3406	W11743	1201
04 1784	02	CLARKSBURG	N3825	W12132	14
04 1838	01	CLOVERDALE 3 SSE	N3846	W12259	320
04 1864	05	COALINGA	N3609	W12021	671
04 1896	06	COLBYS FC 53 D	N3418	W11807	3675
04 1912	02	COLFAX	N3906	W12057	2418
04 1916	02	COLGATE POWER HOUSE	N3920	W12111	595
04 1948	02	COLUSA 1 SSW	N3912	W12201	60
04 2031	06	CORONA	N3352	W11734	710
04 2081	01	COVELO	N3947	W12315	1385
04 2090	06	COVINA TEMPLE FC 193 B	N3405	W11752	575
04 2147	01	CRESCENT CITY 1 N	N4146	W12412	40
04 2177	04	CROCKETT	N3802	W12213	9
04 2214	06	CULVER CITY	N3401	W11824	106
04 2218	01	CUMMINGS	N3950	W12338	1285
04 2239	06	CUYAMACA	N3259	W11635	4650
04 2257	07	DAGGETT FAA AIRPORT	N3452	W11647	1915
04 2294	02	DAVIS 2 WSW EXP FARM	N3832	W12146	60
04 2319	07	DEATH VALLEY	N3628	W11652	-194
04 2334	02	DEER CREEK POWER HOUSE	N3918	W12051	3700
04 2346	05	DELANO	N3547	W11915	323
04 2389	05	DENAIR 3 NNE	N3734	W12047	137
04 2402	02	DE SABLA	N3952	W12137	2713
04 2406	06	DESCANSO RANGER STA	N3251	W11637	3500
04 2458	02	DOBBINS COLGATE FOREBY	N3920	W12112	1550
04 2494	06	DOWNEY FD FC107C	N3356	W11808	116
04 2500	02	DOWNIEVILLE RANGER STA	N3934	W12050	2895
04 2516	06	DRY CANYON RESERVOIR	N3429	W11632	1455
04 2539	05	DUDLEYS	N3745	W12006	3000
04 2568	02	DUNNIGAN	N3853	W12158	60
04 2572	02	DUNSMUIR RANGER STA	N4113	W12216	2420
04 2598	07	EAGLE MOUNTAIN	N3348	W11527	973
04 2640	02	EAST PARK RESERVOIR	N3922	W12231	1205
04 2709	06	EL CAPITAN DAM	N3253	W11649	600
04 2713	07	EL CENTRO 2 SSW	N3246	W11534	-30
04 2728	05	ELECTRA POWER HOUSE	N3820	W12040	715
04 2749	01	ELK VALLEY	N4200	W12343	1705
04 2756	03	ELLERY LAKE //	N3756	W11914	9645
04 2760	05	ELLIOTT	N3814	W12112	92
04 2805	06	ELSINORE	N3340	W11720	1285
04 2862	06	ESCONDIDO	N3307	W11705	660
04 2910	01	EUREKA WSO R	N4048	W12410	43
04 2941	07	FAIRMONT	N3442	W11826	3060
04 3038	05	FIDDLETOWN LYNCH RANCH	N3832	W12042	2140
04 3134	02	FORESTHILL RANGER STA	N3901	W12051	3015
04 3157	03	FORT BIDWELL	N4151	W12008	4498
04 3161	01	FORT BRAGG	N3927	W12348	80
04 3164	01	FORT BRAGG AVIATION	N3924	W12349	61
04 3182	01	FORT JONES RANGER STA	N4136	W12251	2725
04 3191	01	FORT ROSS	N3831	W12315	116
04 3257	05	FRESNO WSO R	N3646	W11943	328
04 3261	05	FRIANT GOVERNMENT CAMP	N3659	W11943	410
04 3288	06	FULLERTON HILLCREST RV	N3353	W11755	330
04 3357	01	GASQUET RANGER STATION	N4152	W12358	384
04 3369	03	GEM LAKE	N3745	W11908	8970
04 3450	06	GLENDALE STAPEN FC295G	N3409	W11816	530
04 3452	06	GLENDORA WEST FC 185	N3408	W11752	822
04 3491	02	GOLD RUN	N3910	W12052	3320
04 3551	05	GRANT GROVE	N3644	W11858	6600
04 3578	01	GRATON	N3826	W12252	200
04 3672	05	GROVELAND RANGER STA	N3749	W12006	3145
04 3683	01	GUERNEVILLE	N3830	W12300	145
04 3703	06	HAINES CYN LOWER FC364	N3416	W11816	2450
04 3704	06	HAINES CYN UPPER FC367	N3416	W11815	3440
04 3710	07	HAIWEE	N3608	W11757	3825
04 3714	04	HALF MOON BAY	N3728	W12226	60
04 3747	05	HANFORD	N3620	W11940	242
04 3761	01	HAPPY CAMP RANGER STA	N4148	W12322	1150
04 3824	02	HAT CREEK PH NO 1	N4056	W12133	3015
04 3855	07	HAYFIELD PUMPING PLANT	N3342	W11538	1370
04 3875	01	HEALDSBURG	N3837	W12252	102
04 3896	06	HEMET	N3345	W11657	1655
04 3914	06	HENSHAW DAM	N3314	W11646	2700
04 3925	04	HERNANDEZ 2 NW	N3625	W12055	2160
04 3939	05	HETCH HETCHY	N3757	W11947	3870
04 3987	01	HILTS	N4200	W12238	2900
04 4010	02	HOBERGS	N3851	W12243	2960
04 4017	06	HOEGEES FC 60 A	N3413	W11802	2650
04 4022	04	HOLLISTER 1 SW	N3650	W12125	279
04 4204	05	IDRIA	N3625	W12040	2650
04 4223	07	IMPERIAL	N3251	W11534	-64
04 4232	07	INDEPENDENCE	N3648	W11812	3950
04 4259	07	INDIO U S DATE GARDEN	N3344	W11615	11
04 4288	02	IOWA HILL	N3905	W12050	3056
04 4297	07	IRON MOUNTAIN	N3408	W11508	922
04 4374	02	JESS VALLEY	N4116	W12018	5300
04 4422	06	JUNCAL DAM	N3429	W11930	2075
04 4488	02	KELSEYVILLE	N3859	W12250	1385
04 4500	01	KENTFIELD	N3757	W12233	120
04 4520	05	KERN RIVER PH NO 1	N3528	W11847	970
04 4536	05	KETTLEMAN STATION	N3604	W12005	508
04 4555	04	KING CITY	N3612	W12108	320
04 4628	06	LA CRESCENTA FC 251 B	N3413	W11814	1565
04 4647	06	LAGUNA BEACH	N3333	W11747	35
04 4671	07	LAKE ARROWHEAD	N3415	W11711	5205
04 4701	02	LAKEPORT	N3902	W12255	1347
04 4713	02	LAKE SPAULDING	N3919	W12038	5156
04 4735	06	LA MESA	N3246	W11701	530
04 4840	06	LA VERNE HTS FC 560 C	N3407	W11745	1210
04 4863	05	LEBEC	N3450	W11852	3585
04 4867	06	LECHUZA PT STA FC 352B	N3405	W11853	1600
04 4884	05	LE GRAND	N3714	W12015	255
04 4890	05	LEMON COVE	N3623	W11902	513
04 4957	05	LINDSAY	N3611	W11904	395
04 4997	04	LIVERMORE COUNTY F D	N3740	W12146	490
04 5017	04	LOCKWOOD 2 N	N3558	W12105	1104
04 5032	05	LODI	N3807	W12117	40
04 5080	06	LONG BEACH PUB SVC	N3347	W11812	10
04 5085	06	LONG BEACH WSO	N3349	W11809	34
04 5107	06	LOS ALAMOS	N3445	W12017	565
04 5114	06	LOS ANGELES WSO R	N3356	W11824	105
04 5115	06	LOS ANGELES CIVIC CTR R	N3403	W11814	270

STATION	DIV	NAME	LAT	LONG	ELEV
04 5118	05	LOS BANOS	N3703	W12052	120
04 5123	04	LOS GATOS	N3714	W12158	365
04 5147	06	LOS PRIETOS RANGER STA	N3433	W11947	1024
04 5218	06	LYTLE CREEK RANGER STA	N3414	W11729	2730
04 5233	05	MADERA	N3658	W12004	268
04 5338	05	MARICOPA	N3505	W11923	675
04 5346	05	MARIPOSA	N3729	W11958	2011
04 5385	02	MARYSVILLE	N3909	W12135	60
04 5449	02	MC CLOUD	N4116	W12208	3300
04 5502	07	MECCA FIRE STATION	N3334	W11604	- 180
04 5528	05	MENDOTA DAM	N3647	W12022	166
04 5532	05	MERCED FIRE STATION 2	N3718	W12029	169
04 5598	02	MIDDLETOWN	N3845	W12237	1122
04 5679	02	MINERAL	N4021	W12136	4911
04 5738	05	MODESTO	N3739	W12100	91
04 5756	07	MOJAVE	N3503	W11810	2735
04 5863	07	MORONGO VALLEY	N3402	W11635	2560
04 5900	06	MT BALDY FC 85G	N3414	W11739	4275
04 5933	04	MOUNT HAMILTON	N3720	W12139	4206
04 5941	01	MOUNT HEBRON RS	N4147	W12202	4250
04 5983	02	MOUNT SHASTA WSO //R	N4119	W12219	3544
04 6006	06	MOUNT WILSON FC 338 B //	N3414	W11804	5709
04 6027	01	MUIR WOODS	N3754	W12234	225
04 6074	01	NAPA STATE HOSPITAL	N3817	W12216	60
04 6118	07	NEEDLES FAA AIRPORT	N3446	W11437	913
04 6136	02	NEVADA CITY	N3916	W12101	2520
04 6144	04	NEWARK	N3731	W12202	10
04 6162	06	NEWHALL SOLEDAD FC32CE	N3423	W11832	1243
04 6168	05	NEWMAN 2 NW	N3721	W12103	108
04 6175	06	NEWPORT BEACH HARBOR	N3336	W11753	10
04 6197	07	NILAND	N3317	W11531	- 55
04 6252	05	NORTH FORK RANGER STA	N3714	W11930	2630
04 6328	01	OAK KNOLL RANGER STA	N4150	W12251	1963
04 6335	04	OAKLAND WSO R	N3744	W12212	6
04 6370	01	OCCIDENTAL	N3825	W12258	960
04 6383	07	OCOTILLO WELLS	N3309	W11608	180
04 6399	06	OJAI	N3427	W11915	750
04 6476	05	ORANGE COVE	N3637	W11918	431
04 6498	01	ORICK PRAIRIE CREEK PK	N4122	W12401	161
04 6506	02	ORLAND	N3945	W12212	254
04 6508	01	ORLEANS	N4118	W12332	403
04 6525	02	OROVILLE BRIDGE	N3931	W12134	165
04 6569	06	OXNARD	N3412	W11911	49
04 6597	02	PACIFIC HOUSE	N3845	W12030	3440
04 6602	06	PACOIMA DAM FC 33 A E	N3420	W11824	1500
04 6610	04	PAICINES OHRWALL RANCH	N3644	W12122	950
04 6624	07	PALMDALE	N3435	W11806	2596
04 6635	07	PALM SPRINGS	N3349	W11632	411
04 6646	04	PALO ALTO JR MUSEUM	N3727	W12208	25
04 6650	04	PALOMA	N3621	W12130	1835
04 6657	06	PALOMAR MT OBSERVATORY	N3321	W11652	5545
04 6663	06	PALOS VERDES EST FC43D	N3348	W11823	216
04 6699	07	PARKER RESERVOIR	N3417	W11410	738
04 6703	04	PARKFIELD	N3553	W12026	1482
04 6719	06	PASADENA	N3409	W11809	864
04 6726	02	PASKENTA RANGER STA	N3953	W12232	755
04 6730	04	PASO ROBLES	N3538	W12041	700
04 6754	05	PATTIWAY	N3456	W11923	3868
04 6826	01	PETALUMA FIRE STA 2	N3814	W12238	16
04 6926	04	PINNACLES NAT MONUMENT	N3629	W12111	1307
04 6960	02	PLACERVILLE	N3844	W12048	1890
04 7016	06	PT ARGUELLO LIGHT STA	N3434	W12040	76
04 7024	04	POINT PIEDRAS BLANCAS	N3540	W12117	59
04 7050	06	POMONA CAL POLY	N3404	W11749	740
04 7077	05	PORTERVILLE	N3604	W11901	393
04 7085	02	PORTOLA	N3948	W12028	4838
04 7109	01	POTTER VALLEY PH	N3922	W12308	1015
04 7150	04	PRIEST VALLEY	N3611	W12042	2300
04 7195	02	QUINCY	N3956	W12056	3409
04 7244	06	RANCHITA	N3314	W11632	4110
04 7253	07	RANDSBURG	N3522	W11739	3570
04 7292	02	RED BLUFF WSO R	N4009	W12215	342
04 7296	02	REDDING FIRE STA NO 2	N4035	W12224	580
04 7306	06	REDLANDS	N3403	W11711	1318
04 7339	04	REDWOOD CITY	N3729	W12214	31
04 7370	02	REPRESA	N3842	W12110	295
04 7470	06	RIVERSIDE FIRE STA. #3	N3357	W11723	840
04 7516	02	ROCKLIN	N3848	W12114	242
04 7630	02	SACRAMENTO WSO R	N3831	W12130	17
04 7643	01	SAINT HELENA	N3830	W12228	225
04 7661	04	SAINT MARYS COLLEGE	N3750	W12206	623
04 7669	04	SALINAS FAA AP	N3640	W12136	75
04 7689	05	SALT SPRINGS PWR HOUSE	N3830	W12013	3700
04 7723	06	SAN BERNARDINO CO HOSP	N3408	W11716	1125
04 7731	04	SAN CLEMENTE DAM	N3626	W12142	600
04 7734	06	SANDBERG PTL FC130B	N3445	W11843	4025
04 7735	06	SANDBERG WSO //R	N3445	W11844	4517
04 7740	06	SAN DIEGO WSO R	N3244	W11710	13
04 7749	06	SAN DIMAS FIRE WD FC95	N3406	W11748	955
04 7759	06	SAN FERNANDO	N3417	W11828	965
04 7769	04	SAN FRANCISCO WSO R	N3737	W12223	8
04 7772	04	S F FEDERAL BLDG. WSO R	N3747	W12225	52
04 7776	06	SAN GABRIEL CANYON PH	N3409	W11754	744
04 7779	06	SAN GABRIEL DM FC425BE	N3412	W11752	1481
04 7785	06	SAN GABRIEL FIRE DEPT	N3406	W11806	450
04 7810	06	SAN JACINTO	N3347	W11658	1535
04 7821	04	SAN JOSE R	N3721	W12154	67
04 7851	04	SAN LUIS OBISPO POLY	N3518	W12040	320
04 7864	04	SAN MATEO	N3732	W12218	21
04 7888	06	SANTA ANA FIRE STATION	N3345	W11752	115
04 7897	06	SANTA ANITA FERN FC432	N3413	W11801	2035
04 7902	06	SANTA BARBARA	N3425	W11941	5
04 7905	06	SANTA BARBARA FAA AP	N3426	W11950	9
04 7912	04	SANTA CLARA UNIVERSITY	N3721	W12156	88
04 7916	04	SANTA CRUZ	N3659	W12201	125
04 7930	04	SANTA MARGARITA 2 SW	N3522	W12038	1200
04 7946	06	SANTA MARIA WSO R	N3454	W12027	236
04 7950	06	SANTA MONICA	N3401	W11829	64
04 7953	06	SANTA MONICA PIER	N3400	W11830	15
04 7965	01	SANTA ROSA	N3827	W12242	167
04 8014	06	SAUGUS PWR PL NO 1	N3435	W11827	2105
04 8045	01	SCOTIA	N4029	W12406	139
04 8068	04	SEARSVILLE LAKE	N3724	W12214	350
04 8218	02	SIERRAVILLE RANGER STA//	N3935	W12022	4975
04 8230	06	SIGNAL HILL FC 415	N3348	W11810	100
04 8272	01	SKAGGS SPGS LAS LOMAS	N3841	W12308	1930
04 8317	07	SNOW CREEK UPPER	N3352	W11641	1940
04 8353	05	SONORA RS	N3759	W12023	1749
04 8380	05	SO ENTRANCE YOSEMITE	N3730	W11938	5120
04 8446	04	SPRECKELS HWY BRIDGE	N3636	W12141	60
04 8479	07	SQUIRREL INN 2	N3414	W11714	5680
04 8558	05	STOCKTON WSO	N3754	W12115	22
04 8560	05	STOCKTON FIRE STA NO 4	N3800	W12119	12
04 8580	02	STONYFORD RANGER STA	N3923	W12233	1168
04 8587	02	STONY GORGE RESERVOIR	N3935	W12232	791
04 8702	03	SUSANVILLE AIRPORT	N4023	W12034	4148
04 8758	03	TAHOE CITY	N3910	W12008	6230
04 8839	05	TEJON RANCHO	N3502	W11845	1425
04 8892	07	THERMAL FAA AIRPORT	N3338	W11610	120
04 8914	05	THREE RVRS EDISON PH 2	N3628	W11853	950
04 8928	05	TIGER CREEK PH	N3827	W12029	2355
04 8967	06	TOPANGA PATROL STA FC6	N3405	W11836	745
04 8973	06	TORRANCE	N3348	W11820	110
04 9035	07	TRONA	N3547	W11723	1695
04 9043	03	TRUCKEE RANGER STATION	N3920	W12011	5995
04 9053	01	TULELAKE //R	N4158	W12128	4035
04 9073	05	TURLOCK	N3729	W12051	115
04 9087	06	TUSTIN IRVINE RANCH	N3344	W11747	118
04 9099	07	TWENTYNINE PALMS	N3408	W11602	1975
04 9105	02	TWIN LAKES	N3842	W12002	7829
04 9122	01	UKIAH	N3909	W12312	623
04 9138	06	UNION OIL STEARNS ABS	N3356	W11752	710
04 9152	06	U C L A	N3404	W11827	430
04 9158	06	UPLAND 3 N	N3408	W11739	1605
04 9167	02	UPPER LAKE 7 W	N3911	W12302	1524
04 9177	01	UPPER MATTOLE	N4015	W12411	255
04 9200	02	VACAVILLE	N3822	W12157	105
04 9251	07	VALYERMO RANGER STA	N3427	W11751	3705
04 9260	06	VAN NUYS FC 15A	N3411	W11827	695
04 9285	06	VENTURA	N3417	W11917	105
04 9325	07	VICTORVILLE PUMP PLANT	N3432	W11718	2858
04 9345	06	VINCENT FIRE STA FC12D	N3429	W11808	3135
04 9351	02	VINTON	N3949	W12011	4950
04 9367	05	VISALIA	N3620	W11918	325
04 9386	02	VOLLMERS	N4057	W12227	1335
04 9390	02	VOLTA POWER HOUSE	N4028	W12152	2200
04 9418	05	WALLACE 1 SE	N3811	W12058	214
04 9423	04	WALNUT CREEK 2 ESE	N3753	W12202	245
04 9431	06	WALNUT PTL STA FC102C	N3400	W11752	488
04 9447	06	WARNER SPRINGS	N3317	W11638	3180
04 9452	05	WASCO	N3536	W11920	333
04 9473	04	WATSONVILLE WATERWORKS	N3656	W12146	95
04 9490	01	WEAVERVILLE RANGER STA	N4044	W12256	2050
04 9560	05	WESTHAVEN	N3613	W11959	285
04 9660	06	WHITTIER CTY H FC 106C	N3358	W11802	340
04 9699	02	WILLOWS	N3932	W12212	140
04 9742	02	WINTERS	N3832	W12158	135
04 9754	05	WOFFORD HEIGHTS	N3543	W11827	2730
04 9775	03	WOODFORDS	N3847	W11949	5671
04 9781	02	WOODLAND 1 WNW	N3841	W12148	69
04 9814	04	WRIGHTS	N3708	W12157	1600
04 9847	06	YORBA LINDA	N3353	W11749	350
04 9855	05	YOSEMITE PARK HEADQTRS	N3745	W11935	3970
04 9866	01	YREKA	N4143	W12238	2625

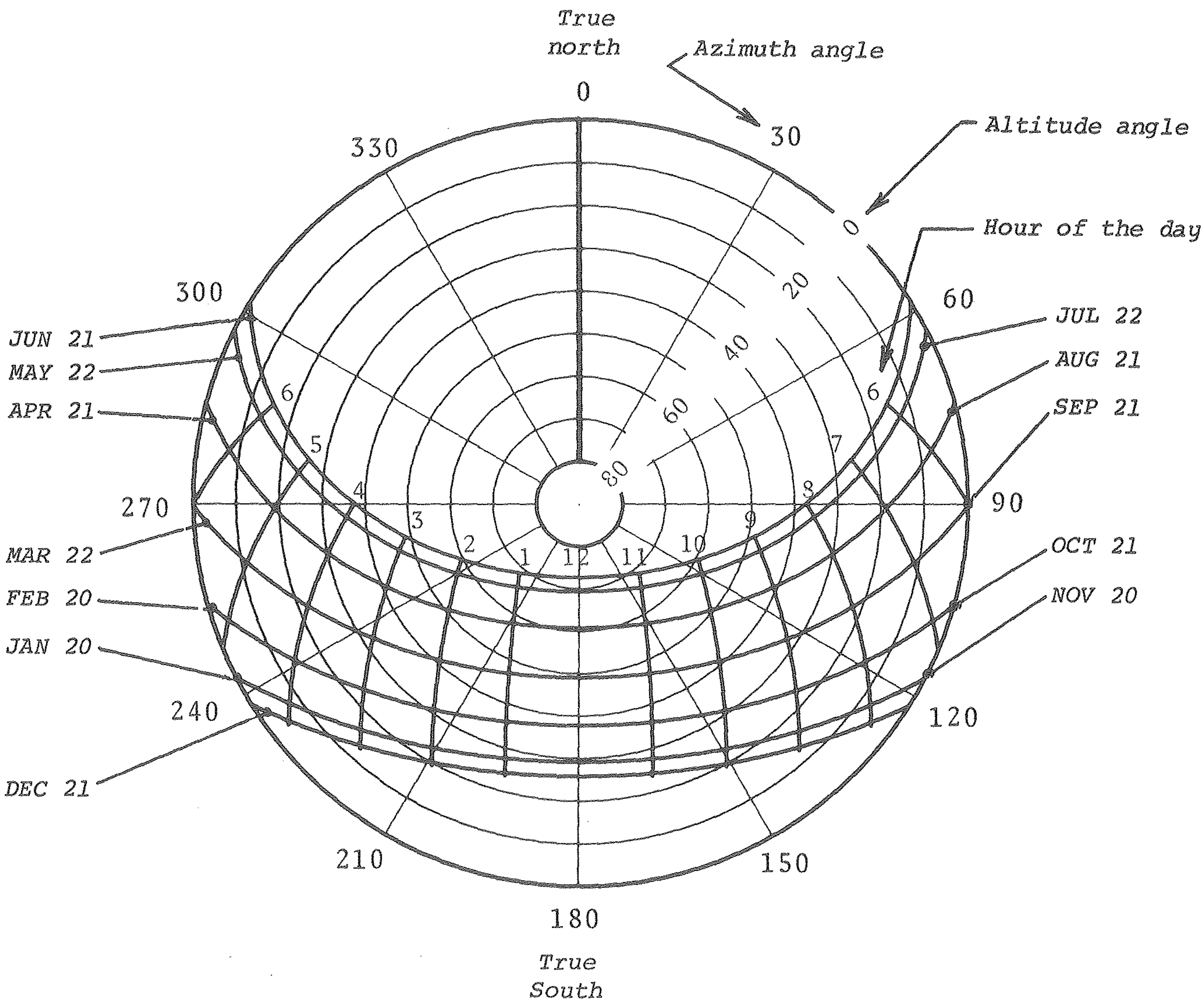
VII. Sky Charts

This section contains five sky charts, ranging in latitude from 41° (approximately the California-Oregon border) to 33° (approximately the California-Mexico border).

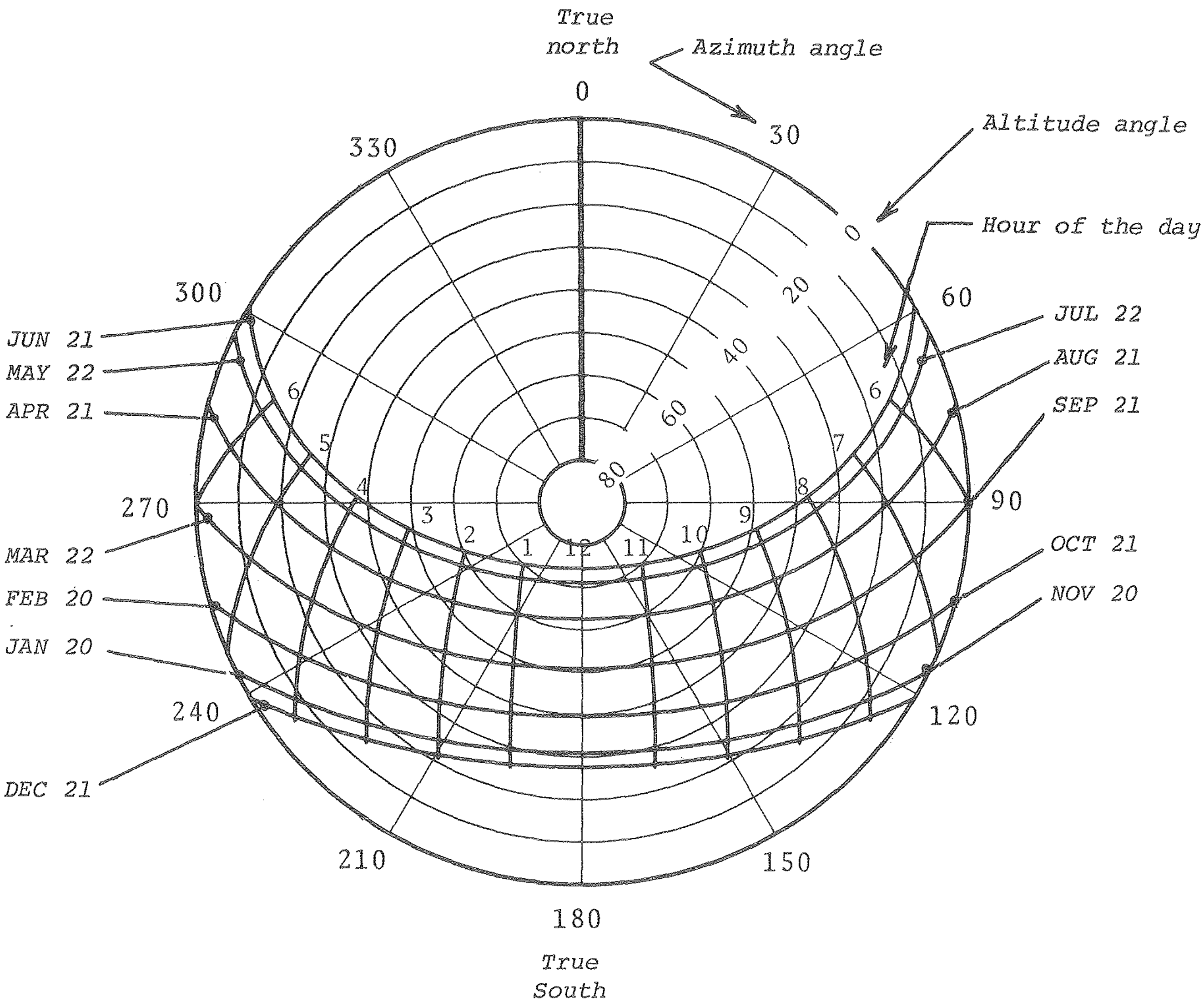
Users should pick the sky chart closest in latitude to that of their location. Latitude values for over 350 weather stations in California are given in Section VI-B.

A guide to the use of sky charts is given in Section IV.

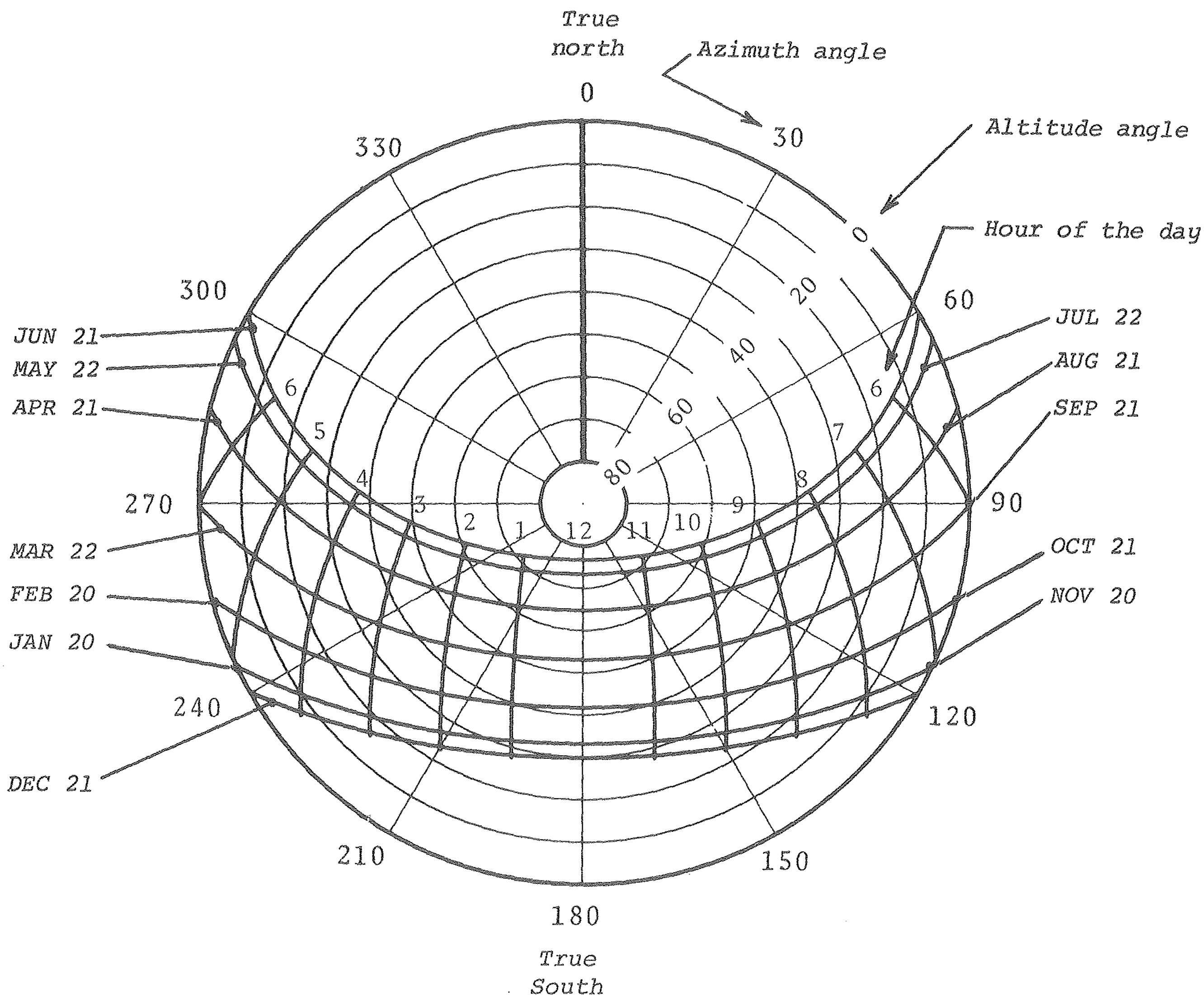
A. 41° LATITUDE



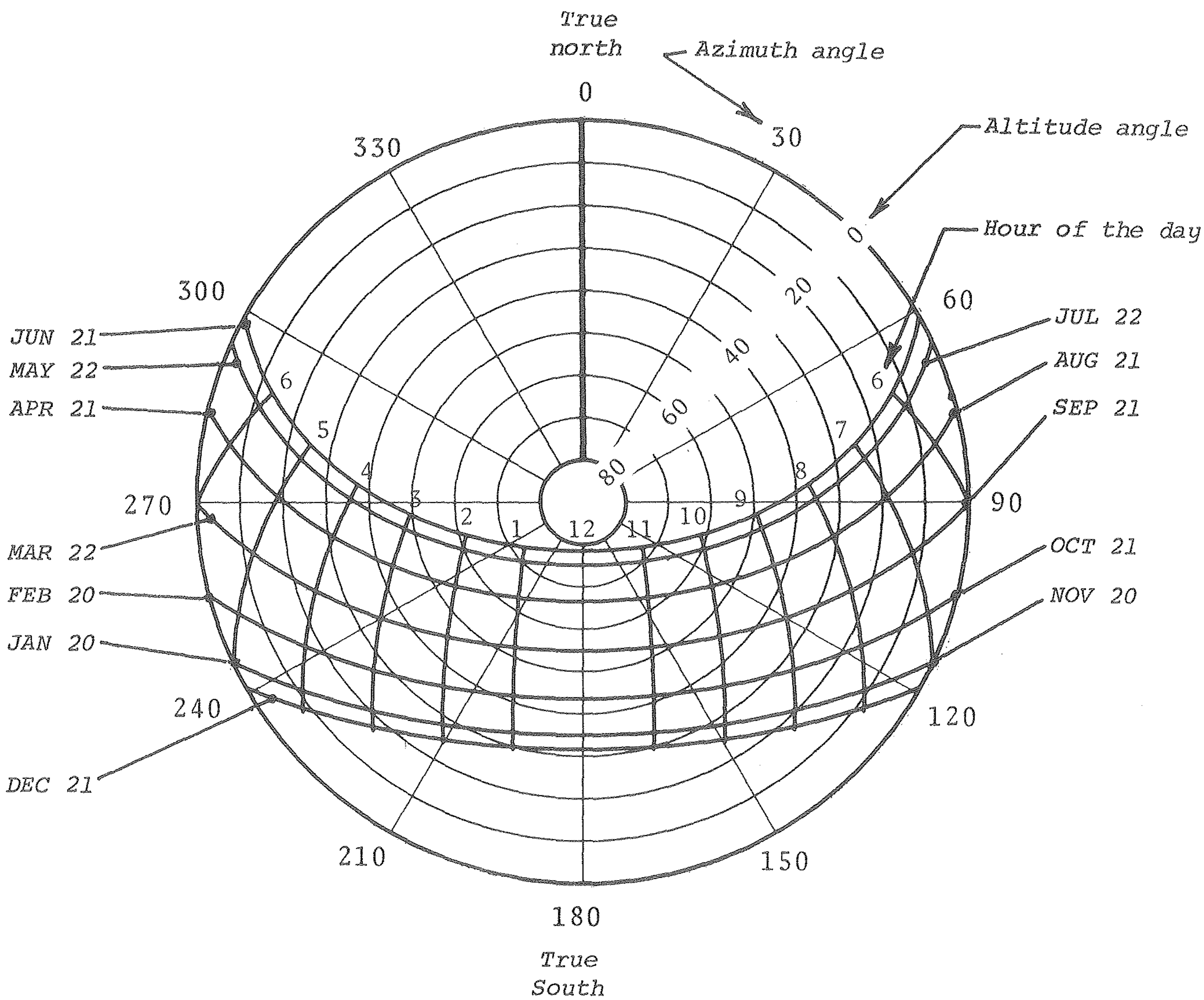
B. 39° LATITUDE



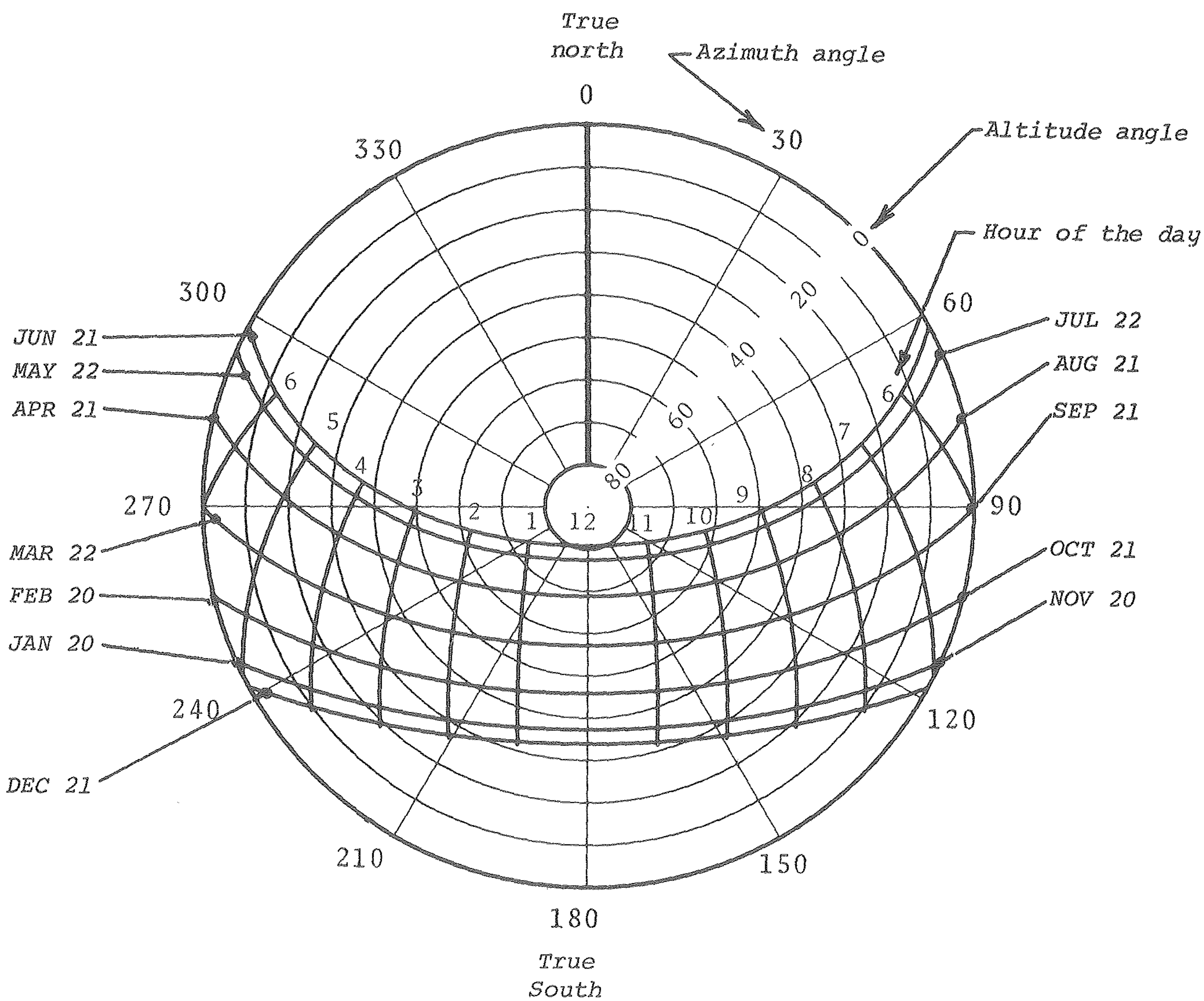
C. 37° LATITUDE



D. 35° LATITUDE



E. 33° LATITUDE



VIII. Guide to Simplified Performance and Cost Methods

A. INTRODUCTION TO TYPES OF METHODS

There are two general methods for evaluating the performance and costs of solar energy systems for buildings. One type involves sophisticated computer simulations that require detailed specifications of the system (collectors, storage tanks, building construction, etc.) as well as hourly solar and weather data. The other type is simplified, using less detailed specifications of the system, and monthly solar and weather data, such as those supplied by this manual. The simplified methods are usually intended for small, standard buildings, such as a home with roof-mounted collectors, storage tank, and forced-air heating system. The detailed simulation methods are more expensive and laborious, but they yield more reliable results. Their use may be warranted for large buildings, building complexes, and any novel system that cannot be handled by a simplified method. Both methods are presented here to aid the potential user in choosing a method that best matches his or her application, computational skill and knowledge.

Although the hourly data requirements of the detailed simulation methods are beyond the scope of this manual, two such methods are briefly discussed below for reference. A number of simplified methods are also discussed. Finally, for each simplified method, a more detailed breakdown is given of the range of applicability, input to be supplied by the user, and the resulting output. All of the methods listed are available to the general public.

B. DETAILED COMPUTER SIMULATION METHODS

1. TRNSYS

This computer program, developed by the University of Wisconsin with NSF and ERDA support, has been extensively used for several years. The best reference to the program is the operating manual (Klein et al., 1976); the basic processes are described by Duffie and Beckman (1974). TRNSYS is geared to performance calculations of multicomponent systems. Costs are not treated.

2. Cal-ERDA

This program is being developed by collaboration between Lawrence Berkeley Laboratory, Consultants Computation Bureau, Argonne National Laboratory, Los Alamos Scientific Laboratory, National Bureau of Standards, and Construction Engineering Research Laboratory, with support from the State of California and ERDA (hence the name). The program features a special language that facilitates the user's description of the building. Performance and cost evaluations can be made. The principal motivation for Cal-ERDA was energy conservation in buildings, but active solar systems (roof-mounted collectors) can be treated. The best source of information is the user's manual (Cal-ERDA Group, 1977).

C. SIMPLIFIED METHODS

These methods use monthly solar and weather data that have been averaged over several years (sometimes called "long-term" or historic data), such as are provided in this manual. The methods then predict the average (or long-term) performance of the user's solar energy system. Even if the methods were exact, the actual performance for any given month or year will usually differ from the prediction. Also, if solar or weather data for a short period of time are used, the long-term prediction will usually be in error.

The "performance" of a solar energy system refers to the fraction of the building's heating load or cooling load that will be supplied by solar energy over the long term. The most important factor that determines the performance (for a given load and reasonable tilt angle of the collector) is the area of the collector. All the methods described here provide a means of determining the relationship between performance and collector area. Most of the methods also allow the user to investigate the performance for different tilt angles, types of collector, storage tank volume, etc. Many of the methods provide a formula to calculate costs (for example, life-cycle costs) for a given performance. The computer-based methods can "optimize" the system by determining the collector area that will minimize costs. (This optimization may be done by hand for some of the other methods.)

The summaries presented below are based almost entirely on the referenced material. LBL has used some of the methods but has not tested any of them against either detailed simulations or real buildings.

1. University of Wisconsin Method (F-chart)

This method is based on a performance chart (the f-chart) that allows the user to determine the fraction f of the heating load provided by solar energy for a given collector area. The f-chart is applied after the user has specified the space heating and domestic hot-water load, certain parameters of the collecting system (for example, collector efficiency), the monthly total solar radiation, and the monthly mean temperature and heating degree days.

The f-chart method was developed from detailed considerations of solar heating systems for buildings by Klein, Beckman and Duffie (1976). The actual parameters of the chart were generated empirically from some 300 detailed simulations based on TRNSYS.

There are at least four different approaches to the use of f-chart:

a. ORIGINAL PAPERS

The basic method and its application to liquid systems is described by Klein, Beckman and Duffie (1976). An extension of the method to air systems is also given by the same authors (1977). The first paper includes a prescription for calculating the dollars saved annually by using a solar system rather than a conventional system. The prescription also explains how to determine the collector area that maximizes the savings. The application of f-chart using these papers is not completely straightforward, and requires a good knowledge of solar energy fundamentals and a good grasp of mathematics. Most users will find the other approaches more convenient.

b. FCHART - THE UNIVERSITY OF WISCONSIN INTERACTIVE SOLAR HEATING DESIGN PROGRAM

FCHART is an interactive computer program version of the method as it is presented in the original papers. The program is accompanied by some descriptive material, but a knowledge of solar energy fundamentals is still helpful. However, the program handles all the calculations and provides pre-set (default) values for all the various input parameters. The user need only change those parameters that are different for the user's system. Solar and weather data are built into the program for 100 locations (7 in California), but LBL recommends using the values in this data manual for applications in California. At the option of the user, FCHART will perform a life-cycle cost analysis and determine the collector area that minimizes the costs.

c. SOLAR HEATING OF BUILDINGS AND DOMESTIC HOT WATER

This report contains an approach to f-chart developed by Beck and Field (1976) for the Naval Facilities Engineering Command. Methods are provided to estimate the yearly value of fuel saved, the "present worth" of 15 years of fuel savings, and the cost of solar energy systems. Worksheets and step-by-step instructions are given to guide the user in preparing the input to performance and cost analysis. The report presents descriptive and numerical information concerning many aspects of solar energy systems, including types of flat-plate collectors, collector heat losses, selective surfaces, storage methods, maintenance, temperature rise through collectors, and architectural considerations. Two complete examples are also given: one for a residence and the other for a dental dispensary. Though the report contains tables of solar radiation (no weather data) for 52 locations (7 in California), LBL recommends using the solar and weather data in this manual.

d. INTERMEDIATE MINIMUM PROPERTY STANDARDS FOR SOLAR HEATING AND DOMESTIC HOT-WATER SYSTEMS

This document, prepared by the National Bureau of Standards for HUD (NBS/HUD, 1976), gives a step-by-step approach to using f-chart. The space-heating step requires reference to another HUD report, but otherwise, the approach is largely self-contained. Though there is no cost analysis, the document contains a wealth of descriptive and numerical information. Topics include safety considerations, corrosion, material lifetimes, seismic and hail load, condensation in collectors, absorptive coatings, storage methods, ducts and pipes, heat transfer fluids, and sealing compounds. In addition, a complete example for a residence is given.

Solar data and mean temperatures (but not degree-days) are presented for 80 locations (6 in California). LBL recommends the use of the solar and weather data in this manual.

2. Los Alamos Scientific Laboratory (LASL) Method

The basic idea of this method is similar to that of f-chart. An "x-factor" is defined that relates the fraction of the heating load supplied by solar energy to the collector area (Balcomb and Hedstrom, 1976). The parameters of the x-factor were determined empirically by a detailed simulation analysis of 25 U.S. and Canadian cities. The factor applies to air or liquid heating systems using flat-plate collectors.

In contrast to the f-chart, the x-factor has the parameters of a "standard" solar energy system built in. As a consequence, the LASL method is generally easier to apply than f-chart. On the other hand, the LASL method (with some exceptions, see below) cannot be used to examine the performance as a function of collector efficiency, tilt angle, and storage capacity per unit collector area. Another difference is that the LASL method only calculates the fraction of the annual load supplied by solar energy. F-chart can be used for either the monthly or annual fraction.

To use this method, it is necessary to specify the building's heating load in Btu's per degree-day, the monthly total radiation, and the monthly total degree-days. There are at least two approaches to the Los Alamos method:

a. ORIGINAL PAPER

This method, and a step-by-step explanation of its application, are described by Balcomb and Hedstrom (1976). The paper presents a quantity called "LC," which has been calculated from solar and weather data, along with the x-factor. Once the user has specified the heating load in Btu's per degree-day, the tabulated values of LC can be used to calculate in a very simple way the required collector area for 25%, 50%, and 75% of the annual load to be supplied by solar. A cost analysis is not included.

The knowledgeable solar-energy user should not have any difficulty using either LC or the x-factor as presented in the paper. However, the following approach is much more informative and somewhat more versatile.

b. ERDA'S PACIFIC REGIONAL SOLAR HEATING HANDBOOK

This handbook was prepared for ERDA, San Francisco Operations Office by LASL (ERDA-SAN/LASL, 1976). The step-by-step approach in the handbook is essentially the same as in the original paper. LC (now called the Load-Collector ratio) is tabulated for 18 cities in the Pacific region. Six of these cities (Santa Maria and Fresno in California) had hourly solar data available and are given special attention. The Load-Collector ratios are calculated from detailed simulations rather than the x-factor. Graphs show how the solar fraction depends on many design considerations such as collector type (single vs double glazing), orientation, tilt, and storage capacity. Strictly speaking, the graphs only apply to the six special cities. However, they can be used to judge the significance of variations in design for most locations. LBL recommends using the Load-Collector ratios for these special cities, but the data in this manual and the x-factor for other locations.

The handbook includes a "cost of solar heat" analysis that computes the cost per million Btu of the energy supplied by solar. A graph is given that can be used to estimate the "breakeven" point in solar-energy usage (in $\$/ft^2$ of collector) for various assumptions about future fuel costs. The handbook contains descriptive material on many aspects of heating systems. It also has short sections on domestic hot-water heating, swimming-pool heaters, and passive systems.

3. Martin Marietta Method (SOLCOST)

SOLCOST is a computer program developed by Martin Marietta (Denver) for ERDA. Connolly et al. (1976) have given a technical description of the method, but its application requires the computer program and the user's manual (Martin Marietta, 1977). SOLCOST has received some, but not extensive, verification.

SOLCOST differs from f-chart and the LASL method in that it performs a detailed simulation for an "average day" for each month. According to Connolly et al. (1976), "this approach provides an accurate solution while keeping computer costs to a reasonable value." SOLCOST is more versatile than the other methods. It is designed to handle hot-water systems, absorption cycle air conditioners, solar-assisted heat pumps, and some passive features, as well as air and liquid space-heating systems. A variety of methods can be used to specify the load, ranging from monthly fuel bills to transient simulations. Collectors may be evacuated tubes, or one- or two-axis concentrators, in addition to flat plates.

The weather data required are minimum and maximum temperatures, heating degree days and (for cooling only) minimum and maximum relative humidity. The solar data are percent possible sunshine (PP) and "clearness number." The program uses a recipe to compute the solar radiation for a clear day (Q_{clear})

and for a cloudy day (Q_{cloud}). It then forms the sum

$$Q_{average\ day} = PP \cdot Q_{clear} + (1 - PP) \cdot Q_{cloud}$$

The only location-dependent ingredient in Q_{clear} or Q_{cloud} is the clearness number, which is related to the average atmospheric transmission on clear days. This number is generally not available experimentally; as a default the program uses the contour map of Threlkeld and Jordan (1974). The weather and solar data are built into the program for 124 cities (7 in California). LBL recommends using the built-in values for these cities, but the values in this manual for other locations. In either case, use the built-in value for clearness number.

The program will perform a life-cycle cost analysis relative to a reference (conventional) system. At the user's option, the program will compute the collector area that minimizes this cost.

Users with a good knowledge of solar energy fundamentals should not have any particular difficulty applying SOLCOST. The user's manual provides standard forms to help structure the input to the program. The forms must then be converted to punched cards by someone familiar with computer input formats. (A keypunch operator would usually not be able to do this conversion.) Most of the input parameters have pre-set (default) values and only those that are different for the user's applications need be changed.

D. SUMMARY OF SIMPLIFIED METHODS

A concise summary of the three simplified methods is given on the following pages. Important aspects of solar-system design and analysis are referenced by letters to one or more of the approaches. In this way, a user with a particular design, data set, computational expertise and need, can find the approach most suitable to his or her objectives.

E. UNIVERSITY OF WISCONSIN METHOD (F-CHART)

Computation level:	Hand calculator with trig functions.	(a)
	Interactive computer program.	(b)
	Hand calculator.	(c,d)
Units:	Metric (a); Engineering (c,d); Either system (b).	
Solar system types:	Liquid flat plate collector, heat exchanger to storage tank, w/wo domestic hot water.	(a,b,c,d)
or:	Air flat plate collector, pebble bed storage, w/wo domestic hot water.	(a,b,c,d)
Solar data needed:	Monthly total radiation on tilted surface.	(a,c,d)
or:	Monthly total radiation on horizontal surface and tilt calculation.	(a,b,c,d)
Tilt calculation:	Equation for any tilt angle, south orientation.	(a)
	Built-in for any tilt angle, south orientation.	(b)
	Graph for latitude +10°, south orientation.	(c)
	Tables for latitude, latitude ± 15°, vertical, south orientation.	(d)
Weather data needed:	Monthly average ambient temperature and degree days.	(a,b,c,d)
System parameters:	Slope and intercept of collector efficiency curve.	(a,b,c,d)
	Effectiveness of collector-tank heat exchanger.	(a,b,c,d)*
	Various heat capacity flow rates.	(a,b,c,d)*
	Storage tank volume per unit collector area.	(a,b,c,d)
Space heating input:	Building load in energy units per month.	(a,b,c,d)
or:	Constant characterizing the load in units of energy per degree-day.	(a,b,c,d)
Hot water input:	Domestic hot water load in energy units.	(a,b,c,d)
or:	Constants characterizing the demand, water main temperature, minimum acceptable temperature.	(a,b,c,d)
Cost analysis:	"Annual Dollar Savings" based on $/m² of collector (installed), fixed costs, $/unit capacity storage, annual charge on capital investment, auxiliary fuel costs.	(a)
	"Life-cycle" based on collector area dependent costs; fixed costs; down payment, interest, term of mortgage, discount rate; insurance and maintenance; present cost of fuel and rate of increase.	(b)
	"Dollar Value of Fuel Saved" based on cost of fuel and furnace efficiency.	(c)
	"Present Worth of 15 Years of Fuel Saved" based on inflation rate and discount rate (estimates provided).	(c)
	"Cost of Solar System" based on cost/ft² of collector, storage, auxiliary heating installed, miscellaneous, and contractor fees.	(c)

(a) Original papers; Klein, Beckman and Duffie (1976 and 1977).
(b) Interactive computer program; FCHART (1976).
(c) Solar Heating of Buildings and Domestic Hot Water; Beck and Field (1976).
(d) Intermediate Minimum Property Standards for Solar Heating ....; NBS/HUD (1976).
* These parameters can often be ignored. They are used in a correction factor that is 1.0 for systems without heat exchangers and very close to 1.0 for efficient systems with exchangers.

F. LOS ALAMOS SCIENTIFIC LABORATORY METHOD (LASL)

Computation level:	Hand calculator for LC (Load-Collector ratio) approach.	(a,b)
	Hand calculator with trig functions for X-factor.	(a,b)
Units:	Engineering	(a,b)
Solar system types:	Liquid flat plate collector, heat exchanger to storage tank, w/wo domestic hot water, forced air heat.	(a,b)
or:	Air flat plate collector, rock bed storage, w/wo domestic hot water, forced air heat.	(a,b)
Solar data needed:	Monthly total radiation on tilted surface.	(a,b)
	Monthly total radiation on horizontal surface and tilt calculation.	(a,b)
Tilt calculation:	Equation for latitude +10^o, south orientation.	(a,b)
Weather data needed:	Monthly degree days.	(a,b)
System parameters:	For basic method (any location); none.	(a,b)
	For six special cities with hourly solar data graphs show liquid system performance dependence on: type of collector (single vs. double glazing, selective surface); collector orientation, tilt, cover glass transmissivity, surface absorptance and emittance, coolant flow rate, heat transfer coefficient, back insulation, and heat capacity; distribution pipe insulation, heat exchanger effectiveness; thermal storage heat capacity and heat losses; design water temperature.	(b)
	For air systems, graphs show dependence on: collector heat transfer effectiveness; air flow rate, thermal storage capacity, and rock bed temperature distribution.	(b)
Space heating input:	Building load in Btu per degree-day.	(a,b)
Hot water input:	Estimated load.	(a,b)
Cost analysis:	"Cost of Solar Heat" in dollars per million Btu's based on: system installation cost/ft^2; annual capital fixed charge rate; and annual operating, maintenance and repair cost.	(b)
	"Break-Even Point" in dollars per ft^2 of collector based on: alternate energy cost and forecasted annual increase; and useful solar energy delivered per ft^2 of collector.	

(a) Original paper; Balcomb and Hedstrom (1976).

(b) ERDA's Pacific Regional Solar Heating Handbook; ERDA-SAN/LASL (1976).

G. MARTIN MARIETTA METHOD (SOLCOST)

Computation level:	Batch process computer program.
Units:	Engineering.
Solar system types:	Space and domestic hot-water heating systems with air or liquid collectors.
or:	Absorption cycle air conditioning.
or:	Solar assisted heat pumps.
or:	Systems with some passive features.
Collector types:	Flat plate, evacuated tube, one- or two-axis trackers.
Solar data needed:	Percent possible sunshine and clearness number (default value of clearness number supplied by program from contour map).
Tilt calculation:	Built in for any tilt and orientation.
Weather data needed:	Minimum/maximum temperature. Heating degree-days. Min/max relative humidity (solar cooling only).
System parameters:	Collector efficiency parameters from efficiency curve. Storage capacity per collector area (liquid systems only). Fuel type, efficiency of auxiliary heat source. COP for solar assisted heat pump (heat pump application only). Various flags to specify collector type.
Heat/cool input:	Building Load in energy units.
or:	Monthly fuel bills and description of existing HVAC system (retrofit only).
or:	Building dimensions for buildings meeting ASHRAE standard 90-75.
or:	UA (U-factor) in Btu/hr-^{o}F.
or:	Detailed specification of building for steady-state calculation.
or:	Detailed specification for transient calculation. (Recommended by the authors for buildings with passive features.)
Hot water input:	Hot water load in energy units.
Cost analysis:	"Life cycle" relative to a reference system. The following types of information are used: Reference System: initial installed cost and maintenance. Solar System: fixed cost, installed cost per unit collector area, liquid storage installed cost per gallon, maintenance cost. Finance/Tax Data: scenario indicator (residence, business, non-profit), loan interest rate, loan term, loan down payment, insurance, property tax rate, income tax rate, various depreciation factors for businesses. Fuel Costs: dollars per unit; escalation rate; heat content per unit for any of natural gas, electricity, fuel oil, LPG, coal.

Note: All entries referenced to SOLCOST User's Guide; Martin Marietta (1977).

IX. General Solar Information

A. SOLAR SPECTRUM

The surface of the sun radiates at an effective blackbody temperature of 5800° K. The peak power output occurs in the yellow-green region of the visible spectrum and extends to longer (infrared) and shorter (ultraviolet) wavelengths. The uppermost solid curve in Fig. 1 shows the solar spectrum

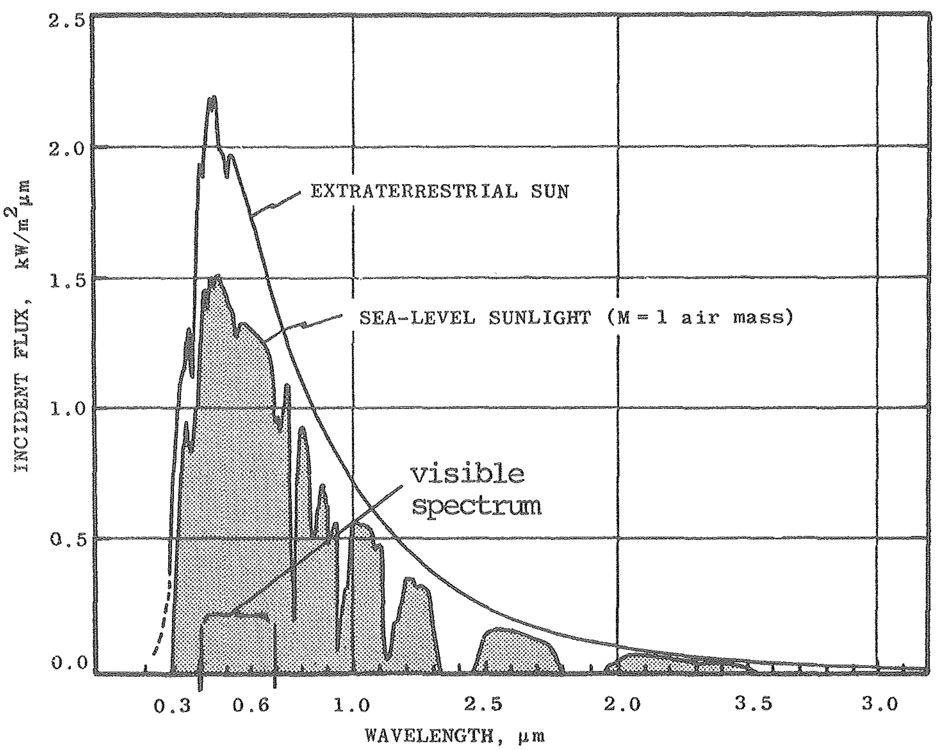


Fig. 1. Solar spectrum outside the earth's atmosphere (upper curve) and at sea level (lower curve), for the sun directly overhead (1 air mass).

outside the earth's atmosphere. The atmosphere absorbs and scatters some of the radiation incident from the sun, so that the solar spectrum received at the earth's surface is modified as shown by the lower curve in Fig. 1. On a clear day the degree of attenuation depends on the air mass ("thickness" of the atmosphere), the amount of water vapor, dust particles, ozone and other molecules present. This attenuation is due to a number of different physical processes and is highly dependent on the wavelength of the light.

When the sun is directly overhead, the radiation from it penetrates through a minimum thickness of the atmosphere. If the observer is located at sea level and the sun is directly overhead, the vertical penetration distance is referred to as air mass 1. As the sun moves away from overhead, towards the horizon, solar radiation penetrates an increasingly thick atmosphere (air mass 2, etc.). If the earth had no atmosphere, the sun would appear at full brightness immediately after sunrise and the brightness would remain the same throughout the day.

The effect of the atmosphere on the energy delivered by the sun (summed over all wavelengths) is illustrated in Fig. 2, a very clear day profile of the direct beam radiation (the part of the solar radiation that has not been scattered or absorbed by the atmosphere). The solar radiation that is scattered by the atmosphere is known as the diffuse component. The rounding of the curve before and after noon is due to the air mass effect. Curves like this, presented in the manual for each of California's solar data stations, show an upper limit to the amount of direct beam solar radiation that can be collected at any time of the day at various seasons of the year.

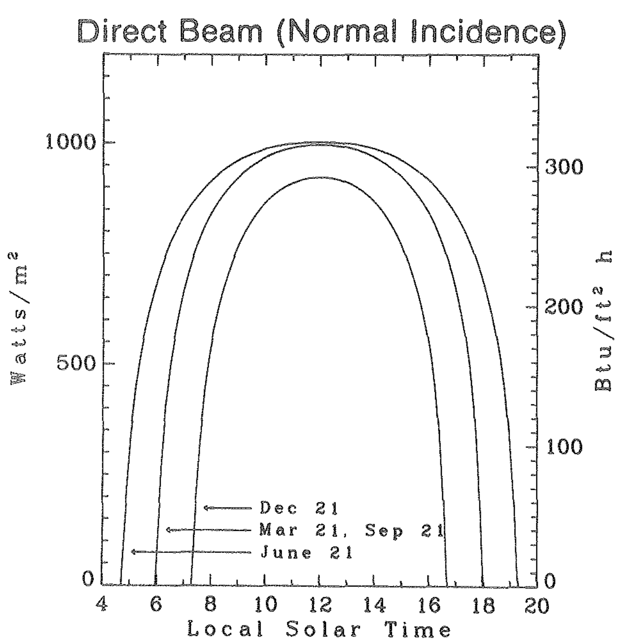


Fig. 2. Example of direct beam radiation intensity as a function of the time of day. In the absence of the earth's atmosphere the intensity would rise abruptly to a constant value (approx. 1370 W/m^2) and remain there throughout the day.

A second type of curve presented in the manual depicts daily variation of the total (direct beam plus diffuse) solar radiation on a horizontal surface (Fig. 3).

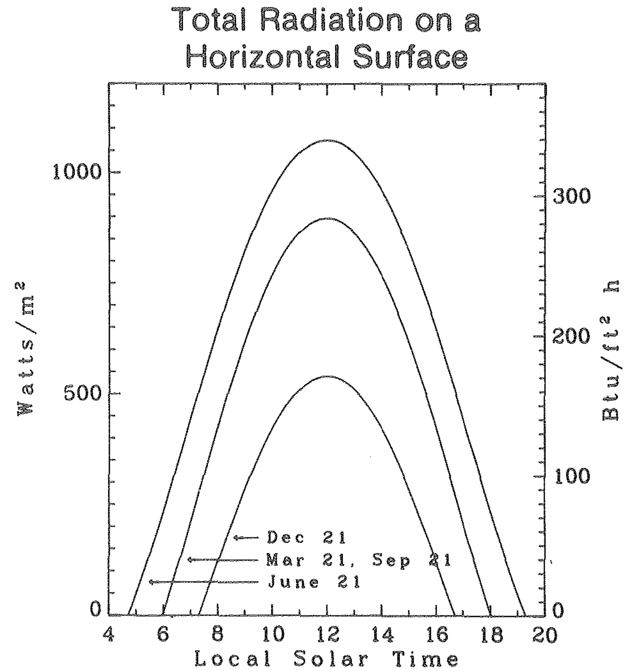


Fig. 3. Example of total solar radiation on a horizontal surface as a function of the time of day.

This curve differs from the curve of Fig. 2 in two respects: (a) the diffuse component of the radiation is added to the direct beam component; and (b) the receiving surface does not track the sun and thus, the direct beam component is reduced from the normal incidence value.

B. THE SOLAR CONSTANT

The amount of solar energy received per unit time per unit area on a surface normal to the sun at the mean distance of the earth from the sun and outside the earth's atmosphere is called the "solar constant." The presently accepted value for the solar constant (Duncan et al., 1977) is:

$$1367\ W/m^2 \qquad \text{or} \qquad 434\ Btu/ft^2 - h$$

This represents the amount of solar energy received just above the earth's atmosphere at the mean earth-sun distance. The eccentricity of the earth's elliptical orbit causes the sun-earth distance to vary by ±1.7% from the mean value, and thus, the actual amount of radiation just above the atmosphere will fluctuate somewhat throughout the year. The extraterrestrial radiation at any time of the year can be well approximated by the formula:

$$H_0 = 1367 + 45 \cos \left[\frac{360°}{365} n\right] , \qquad (1)$$

where H_0 is expressed in W/m^2 and n is the number of the day of the year.

C. SOLAR TIME AND STANDARD TIME

The displays and sky charts presented in this manual use solar (also called "local apparent") time so that they will be valid over the entire state. Therefore, a procedure is included below for the conversion from solar time to Pacific Standard Time (clock time). The difference for the state between the two kinds of time does not exceed 30 minutes.

In California, time measured on a properly set clock is Pacific Standard Time (PST), or Pacific Daylight Time (PDT), which is advanced one hour from PST (PDT = PST + 1 hour). The Pacific Standard Time zone is centered on the 120° W meridian, which passes through Lake Tahoe and slightly to the west of Fresno and Santa Barbara.

Solar time is a local phenomenon, determined such that solar noon occurs when the sun is most nearly overhead during the day. Thus two observers, displaced east and west of one another, would measure different solar times at the same PST. Since it takes the sun 4 minutes to pass through each degree of longitude, the time difference in minutes corresponding to an observer's longitude L_{local} with respect to the central meridian of the Pacific Time zone is $4 \cdot (L_{local} - 120^{\circ})$. The difference in solar time between the extreme eastern and western borders of California is 41 minutes, which corresponds to a maximum longitude difference of 10.3°.

An additional correction, referred to as the equation of time (E), must be made when converting from PST to Solar Time. The equation of time correction must be made because (a) the earth's orbit around the sun is elliptical rather than circular, and (b) the earth's axis is tilted with respect to its plane of motion about the sun (the ecliptic). The equation of time is plotted in Fig. 4.

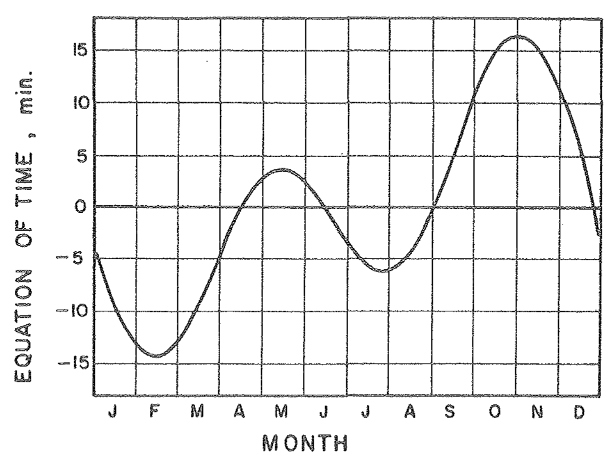


Fig. 4. Equation of time (E).

The formula to be used in converting from solar time to Pacific Standard Time is:

$$PST = SOLAR\ TIME - E + 4 \cdot (L_{local} - 120°) \ . \qquad (2)$$

EXAMPLE: Find the corresponding solar time when it is 9:35 AM PST in long Beach (L_{local} = 118°W) on 1 November.

Use Eq. 2 and Fig. 4:

$$SOLAR\ TIME = PST + E - 4 \cdot (L_{local} - 120°)$$
$$= 9{:}35 + 17m - 4 \cdot (118 - 120)$$
$$= 9{:}35 + 17m + 8m$$
$$= 10{:}00\ AM$$

D. LOCATION OF THE SUN IN THE SKY

For most solar energy applications, it is desirable to know the sun's position at different times of the day and year. This is especially true in systems that use focusing collectors that track the sun. For systems that use flat plate collectors, knowledge of the sun's position is also helpful in order to set tilt angles optimized for latitude, climate conditions, and load characteristics. The angles used to describe the position of the sun are illustrated in Fig. 5.

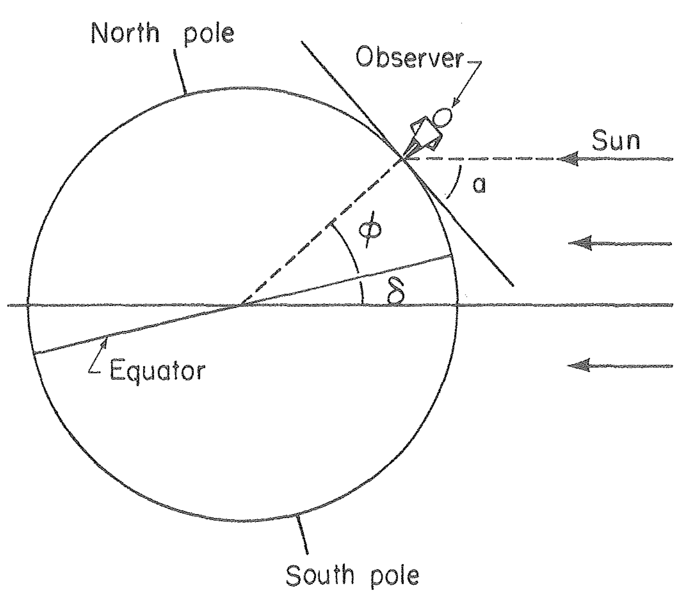


Fig. 5. This diagram shows the observer's latitude Φ and the solar declination δ . The "altitude" of the sun $\underline{a}$ is the angle to the sun as measured from the observer's horizontal plane.

The angle between the earth-sun line and the plane of the equator is the solar declination (δ), which changes throughout the year as described by the equation:

$$\sin \delta = (\sin 23.45^\circ)\sin\left[\frac{360^\circ}{365}(284 + n)\right] , \qquad (3)$$

where n is the number of the day in the year. This relationship is plotted in Fig. 6.

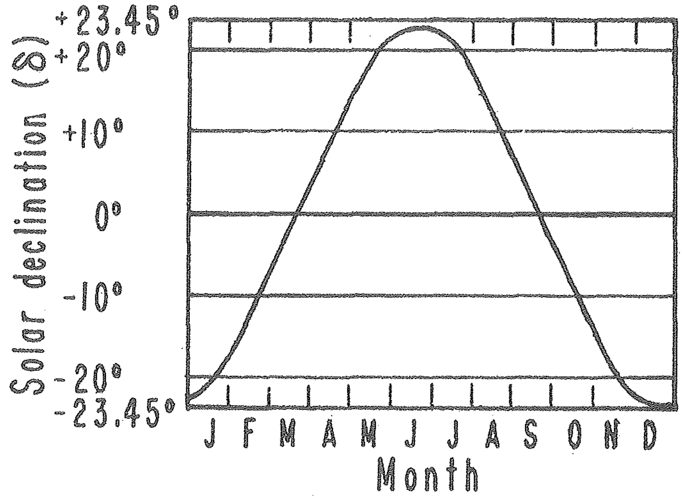


Fig. 6. Solar declination as a function of the time of year.

Solar altitude (a) and azimuth (α) are angular coordinates in the local frame of the observer. The altitude of an object (sun, star, etc.) is the angular distance to it as measured from the horizontal plane of the observer. The azimuth angle is measured in a clockwise direction on the observer's horizontal plane with the zero point due north. Note that this definition agrees with the standard compass convention, but differs from that used by some solar-energy texts. An observer can describe the sun's position at any time by indicating its altitude (a) and its azimuth (α). These quantities are related to the latitude (Φ) and declination (δ) by the formulas:

$$\sin a = \sin \Phi \sin \delta + \cos \Phi \cos \delta \cos \omega ,$$
$$\sin \alpha = -\cos \delta \sin \omega / \cos a . \qquad (4)$$

Here ω is the local hour angle that measures the rotation of the earth. At solar noon $\omega = 0$ and the sun is most directly overhead. The angle ω is positive in the afternoon and negative in the morning. The earth rotates through the angle of $\Delta\omega = 15^\circ$ each hour.

The transformation of latitude, declination, and hour angle into local altitude and azimuth coordinates of Eq. (4) can be plotted graphically in a variety of ways. The method used in this data manual is a polar plot as shown in Fig. 7. Five such plots are included in the manual, one for every 2° of latitude through the state. Examples that illustrate sky chart applications are given in Section IV.

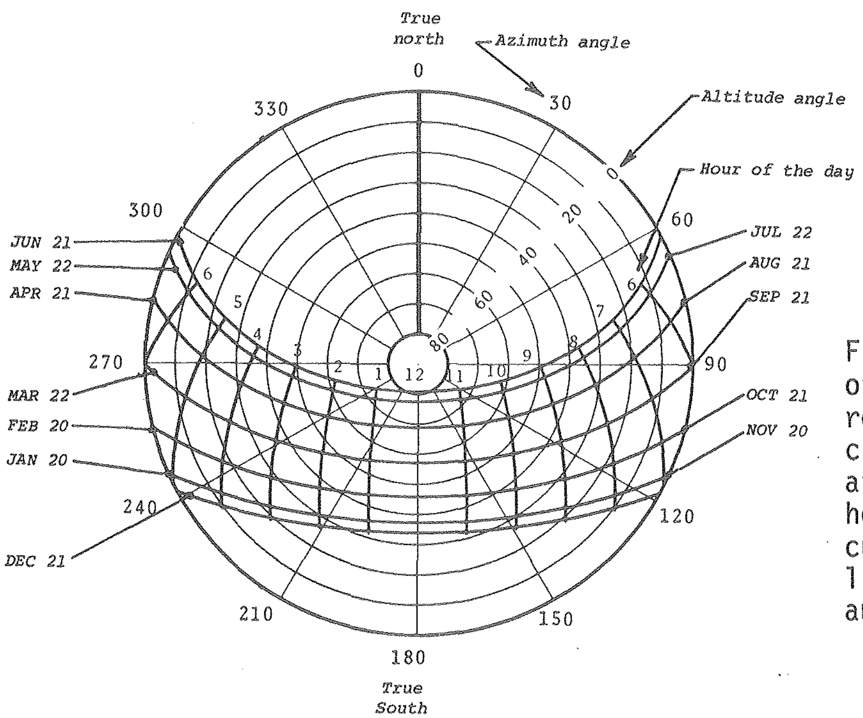


Fig. 7. Sky chart. Lines of equal altitude are represented as concentric circles with the zenith at the center and the horizon as the outer circumference. The radial lines measure the azimuth angle.

E. USEFUL RELATIONSHIPS

The instantaneous direct-beam solar radiation incident on a flat surface is

$$I^{beam} = I_n^{beam} \cdot \cos\theta \;, \qquad (5)$$

where I_n^{beam} is the instantaneous direct beam (normal incidence) solar radiation (W/m^2).

θ is the angle between the beam direction and the normal to the surface.

θ_h will refer to a horizontal surface.

θ_t will refer to a tilted surface.

The following expression relates the angle θ_h to the latitude Φ, declination δ and the local hour angle ω for a horizontal surface*:

* θ_h is the complement of the altitude angle, a, given by Eq.(4). That is, $\theta_h = 90° - a$.

$$\cos \theta_h = \sin \Phi \sin \delta + \cos \Phi \cos \delta \cos \omega . \quad (6)$$

The hour angle for sunrise (and sunset) ω_s can be obtained by setting $\cos \theta_h = 0$ in Eq. (6):

$$\cos \omega_s = - \tan \Phi \tan \delta . \quad (7)$$

The length of the day in hours is then

$$T_d = \frac{2}{15} \omega_s , \quad (8)$$

where ω_s is expressed in degrees.

This relationship is plotted graphically in Fig. 8 for three locations in California. The sunrise and sunset time scales on this figure are plotted in solar time. In order to find these times in PST it is necessary to apply the correction of Eq. (2).

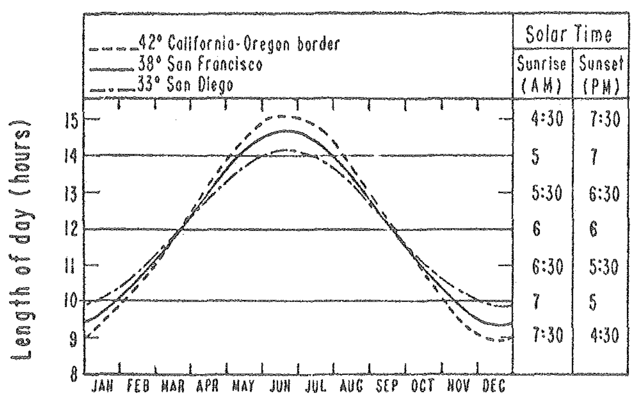


Fig. 8. Length of day and times of sunrise and sunset for three latitudes.

Equation (6) can be generalized to apply to a surface of arbitrary tilt and azimuthal orientation:

$$\cos \theta_t = (\sin \Phi \cos \lambda + \cos \Phi \sin \lambda \cos \alpha)\sin \delta$$
$$+ (\cos \Phi \cos \lambda - \sin \Phi \sin \lambda \cos \alpha)\cos \delta \cos \omega \quad (9)$$
$$- \sin \lambda \sin \alpha \cos \delta \sin \omega ,$$

where λ = tilt angle from horizontal ($\lambda = 90^{\circ}$ for vertical surfaces), and

α = azimuth angle measured clockwise by a north-facing observer

(α = 90° for east orientation,
= 180° for south orientation,
= 270° for west orientation) .

This equation can be easily reduced to a simpler form for two practical cases.

1. Case 1: South-Facing Surface, Any Tilt

$$\cos \theta_{t,\mathrm{South}} = \sin(\Phi-\lambda)\sin\delta + \cos(\Phi-\lambda)\cos\delta\cos\omega \ . \qquad (10)$$

During the summer half of the year "sunrise" for the surface will be later (and "sunset" earlier) than given by Eq. (7) and Fig. 8. The rule for obtaining the sunrise hour angle is:

for $\delta > 0$ (March 22 - Sept. 21),

use $\cos\omega_s = -\tan(\Phi-\lambda)\tan\delta$; (11)

and for $\delta < 0$ (Sept. 22 - March 21),

use Eq. (7).

EXAMPLE: Calculate the hours per day that a collector tilted south at the local latitude + 10° ($\lambda = \phi + 10°$) will see direct beam sunlight on the summer solstice ($\delta = 23.45°$). Equation (11) for $\delta > 0$ is used to obtain the hour angle:

$$\cos(\omega_s) = -\tan(-10°)\tan(23.45°)$$

$$\omega_s = \arccos(0.08) = 85.6° \ .$$

Using Equation (8), the answer is

$$T_d = \frac{2}{15}\omega_s = 11.4 \text{ hours} \ .$$

2. Case 2: Vertical Surface, East or West Orientation

In this case, Eq. (9) reduces to:

$$\cos\theta_{\mathrm{Vertical,East}} = -\cos\delta\sin\omega$$
$$\cos\theta_{\mathrm{Vertical,West}} = +\cos\delta\sin\omega \qquad (12)$$

Of course, for these surfaces the "day" is half as long as given by Eq. (7) and Fig. 8.

For other cases, Eq. (9) cannot be easily reduced to a simple form and approximate solutions must be obtained by numerical techniques.

X. ESTIMATING UNMEASURED SOLAR RADIATION QUANTITIES

A. NEED FOR ESTIMATION METHODS

Solar energy applications for heating and cooling of buildings typically use flat collectors tilted at various angles with respect to the horizontal plane. In this type of application, the solar data necessary for design are values of the total radiation incident on a flat surface tilted at the angle of the collector. Proposed solar electric plants would use focusing systems that collect only the light coming directly from the sun. In addition, focusing collectors are a possible means of providing electricity and heat to commercial and industrial complexes. In the design of these plants, direct beam radiation would be the most important solar data input.

Unfortunately, in the state of California there are measurements for neither direct beam radiation nor total radiation on tilted surfaces. In fact, these two data types are rarely collected anywhere on a long-term basis. As a result, a number of techniques have been developed for estimating their values based on the measurement of another quantity. Some techniques use the total radiation on a horizontal surface (measured by a pyranometer), and others use the percent possible sunshine (measured by a sunshine switch). For California there are more locations with pyranometer data than sunshine data. Thus, the technique selected to calculate the monthly values in the data tables (Section V) uses the total radiation on a horizontal surface. The approach is based on that of Liu and Jordan (1960, 1961, 1963). Essentially the same technique is used in f-chart (Klein, Beckman and Duffie, 1976), one of the simplified solar design methods discussed in Section VIII.

The remainder of this section will present an outline of the estimation technique, so that the user of the data tables might have some appreciation for the assumptions and uncertainties involved. The user interested in further details should consult the above references.

B. GENERAL FRAMEWORK

The daily or monthly value of total radiation on a horizontal surface has two components:

$$E_h^{total} = E_h^{beam} + E_h^{diffuse} , \qquad (13)$$

where E_h^{beam} is the direct beam radiation incident on the horizontal surface, and $E_h^{diffuse}$ is the diffuse skylight incident on the same surface. A similar equation holds for a surface tilted with respect to the horizontal,

$$E_t^{total} = E_t^{beam} + E_t^{diffuse} + E_t^{reflect} , \qquad (14)$$

where $E_t^{reflect}$ is the light reflected onto the tilted surface by the surroundings.

Focusing collectors use E_n^{beam}, the direct beam radiation on a surface kept normal to the beam, whereas flat collectors use E_t^{total}, the total radiation incident on a surface which is tilted.

Estimating E_t^{total} or E_n^{beam} requires two steps. The first step is to separate the total radiation on a horizontal surface into its diffuse and direct beam components, $E_h^{diffuse}$ and E_h^{beam}. The second step is to convert these components into the desired quantities.

$$E_n^{beam} = E_h^{beam} \cdot R_n^{beam} \qquad (15)$$

and

$$E_t^{total} = (E_h^{beam} \cdot R_t^{beam}) + (E_h^{diffuse} \cdot R_t^{diffuse}) + (E_h^{total} \cdot R_t^{reflect}) , \qquad (16)$$

where in each case R is the appropriate conversion factor. These two steps will now be considered in more detail.

C. ESTIMATING DIRECT BEAM AND DIFFUSE COMPONENTS OF TOTAL HORIZONTAL RADIATION

The estimation method was developed by Liu and Jordan (1960), based on 10 years of simultaneous measurements of total and diffuse radiation at Blue Hill, Massachusetts. They found a correlation between L_D and K_T, where

$$L_D = \frac{E_h^{diffuse}}{E_h^{total}} = \text{ratio } \frac{\text{diffuse radiation on horizontal surface}}{\text{total radiation on horizontal surface}}$$

and

$$K_T = \frac{E_h^{total}}{E_h^{ETR}} = \text{ratio } \frac{\text{total radiation on horizontal surface}}{\text{extraterrestrial radiation on horiz. surface}} .$$

E_h^{ETR} can be readily calculated from a knowledge of the solar constant and the geometry of the earth-sun system. E_h^{ETR} then nearly cancels out the effect on E_h^{total} of the position of the sun in the sky (low in winter, high in summer) and the earth-sun distance (closer in winter than in summer). Consequently, the variation in K_T is nearly all due to the weather. Typical daily values are

K_T	$= 1$	if the earth had no atmosphere
	~ 0.8	very clear day
	$\sim 0.3 - 0.6$	broken clouds
	~ 0.1	heavy overcast

Long-term monthly values for K_T are included in the data tables. Typical values are

K_T	~ 0.7	clear month over the long term
	~ 0.35	cloudy month over the long term

For a given value of K_T, Liu and Jordan found that the value of L_D is about the same regardless of the time of year. A mathematical description of the relationship between monthly values of L_D and K_T has been given by Klein, Beckman and Duffie (1976). This description was used to produce the values that are given in the data exhibits (1, 7(a) and (b)). For the purpose of understanding the relationship between L_D and K_T, the correlation can be approximated by

$$L_D = 1 - \frac{K_T}{0.85}$$

This agrees with the observation that for very overcast skies ($K_T \sim 0.1$) nearly all the total radiation is diffuse ($L_D \sim 1$). Similarly, for very clear skies ($K_T \sim 0.8$) very little of the total radiation will be diffuse ($L_D \sim 0.1$).

Once K_T and L_D are determined:

$$E_h^{diffuse} = L_D \cdot E_h^{total} \tag{17}$$

$$E_h^{beam} = (1 - L_D) \cdot E_h^{total} \tag{18}$$

D. CALCULATING THE DIRECT BEAM RADIATION AT NORMAL INCIDENCE

The method described above can be used to estimate E_h^{beam}, the direct beam radiation on a horizontal surface. To determine E_n^{beam}, the direct beam incident on a surface normal to the beam, we recall from Eq. (15) that

$$E_n^{beam} = E_h^{beam} \; R_n^{beam} \quad ,$$

or from Eq. (18) above,

$$E_n^{beam} = (1 - L_D) \cdot E_h^{total} \cdot R_n^{beam} \quad , \qquad (19)$$

where

E_h^{total} = measured value of total radiation on a horizontal surface;

L_D = ratio of diffuse to total radiation from the method of Liu and Jordan;

R_n^{beam} = factor to convert the direct beam radiation from a horizontal surface to a surface normal to the sun.

The next step for computing the normal incident quantity (E_n^{beam}) is to determine R_n^{beam} in Eq. (15), which can be rewritten as

$$R_n^{beam} = E_n^{beam} / E_h^{beam} \quad .$$

Let I_n^{beam} be the instantaneous direct beam (normal incidence) radiation as would be measured by a pyrheliometer. As discussed in Section IX, the instantaneous value on a horizontal surface is then

$$I_h^{beam} = I_n^{beam} \cdot \cos \theta_h$$

where $\cos \theta_h$ is given by Eq. (6). The daily values are related to the instantaneous ones by integrating over time,

$$E_n^{beam} = \int_{sunrise}^{sunset} I_n^{beam} \, dt \quad , \qquad E_h^{beam} = \int_{sunrise}^{sunset} I_n^{beam} \cdot \cos \theta_h \, dt \quad . \qquad (20)$$

These expressions then give

$$R_n^{beam} = \frac{E_n^{beam}}{E_h^{beam}} = \frac{\int_{sunrise}^{sunset} I_n^{beam}\, dt}{\int_{sunrise}^{sunset} I_n^{beam} \cos\theta_h\, dt} , \tag{21}$$

where the sunrise and sunset times can be obtained from Eqs. (7) and (8) in Section IX.

At first glance, this step appears to offer little progress since there are no long-term measurements for I_n^{beam} in California. If there were, Eq. (20) could be used to calculate E_n^{beam} and this whole estimation procedure could be eliminated. However, an approximate value can be obtained for R_n^{beam} by virtue of the fact that the appearance of I_n^{beam} in both the numerator and denominator cancels out the absolute magnitude of this term. Only the shape of the solar profile (relative intensity with respect to time of day) matters, and fortunately, the result is not particularly sensitive to the exact shape chosen.

For the data tables in Section V, R_n^{beam} was calculated by numerical integration techniques for the 15th of each month. Clear day solar profiles of the type shown in Fig. 2 of Section IX were used for the integrations. The shape of the profiles (but not the magnitude) should be a reasonable approximation of the long-term average, except where long-term weather patterns for a given month are correlated with the time of day.

Since R_n^{beam} is difficult to calculate except with a computer, values of this factor are given in Section V, in the last row of the table of conversion factors for each location. The interested user can then insert other values of E_h^{total} and L_D into Eq. (19).

E. CALCULATING THE TOTAL RADIATION ON A TILTED SURFACE

Equations (14), (16), (17), and (18) can be combined to yield

$$E_t^{total} = E_h^{total} \cdot [(1 - L_D) \cdot R_t^{beam} + L_D \cdot R_t^{diffuse} + R_t^{reflect}] , \tag{22}$$

with

$$R_t^{beam} = E_t^{beam} / E_h^{beam}$$

$$R_t^{diffuse} = E_t^{diffuse} / E_h^{diffuse}$$

$$R_t^{reflect} = E_t^{reflect} / E_h^{total} \quad .$$

Each of these conversion factors will be considered in turn.

1. Direct Beam Conversion Factor (R_t^{beam})

The procedure for calculating total radiation on a tilted surface is similar to that for the direct beam (normal incidence). Note that on a tilted surface, sunrise and sunset times are different from what they are on a horizontal surface, and to account for this the integral notation is modified slightly (sunrise' and sunset').

$$E_t^{beam} = \int_{sunrise'}^{sunset'} I_n^{beam} \cdot \cos \theta_t \, dt$$

where θ_t is given by Eq. (9), Section IX.

We then have

$$R_t^{beam} = \frac{\int_{sunrise'}^{sunset'} I_n^{beam} \cdot \cos \theta_t \, dt}{\int_{sunrise}^{sunset} I_n^{beam} \cdot \cos \theta_h \, dt} \quad . \qquad (23)$$

The values of R_t^{beam} for the data tables (Section V) were then computed using the same numerical scheme used to calculate the direct beam conversion factor, R_n^{beam}.

2. Diffuse Conversion Factor ($R_t^{diffuse}$)

The amount of diffuse radiation collected by a tilted surface depends on the angular distribution of the diffuse light across the sky. On clear days the sky will be brightest near the sun, while on cloudy or overcast days the sky will be more uniformly bright. Average conditions are essentially unknown, but there are two simple assumptions that cover the limiting cases.

The first assumption is that all diffuse radiation originates from near the sun. In this case it is approximately true that

$$R_t^{diffuse} = R_t^{beam} \tag{24}$$

The second assumption is that the diffuse radiation is isotropic (the sky is uniformly bright). In this case

$$R_t^{diffuse} = (1 + \cos \lambda) / 2 , \tag{25}$$

where λ is the tilt angle of the surface.

In accordance with common practice, the second assumption was used to calculate the conversion factor, $R_t^{diffuse}$, for the data tables in Section V.

3. Reflection Conversion Factor ($R_t^{reflect}$)

The light reflected onto a tilted surface depends crucially upon the nature of the surroundings. Grass, nearby buildings, snow, water, and sand, to mention a few common surface types, all reflect light differently. The only simple assumption is that the surroundings are a diffuse reflector of infinite extent and uniform reflectivity. A large grassy area would be approximately described by this assumption. The conversion factor is then

$$R_t^{reflect} = \rho(1 - \cos \lambda) / 2 , \tag{26}$$

where ρ is the ground reflectivity coefficient and λ the tilt angle. Typical values of the reflectivity coefficient are $\rho = 0.2$ for ordinary ground cover and $\rho = 0.7$ for snow. Because Eq. (26) is only valid for diffuse reflectors and the surface reflectivity varies from application to application, the values for E_t^{total} in the data tables were calculated for

$$E_t^{reflect} = 0 .$$

Supplementary tables are given for $E_t^{reflect}$ with $\rho = 0.2$ (typical grassy ground cover). $E_t^{reflect}$ can be calculated for other ρ values by use of the following relationship:

$$E_t^{reflect} \text{ (calculated)} = \left(\frac{\rho}{0.2}\right) \cdot E_t^{reflect} \text{ (tabulated)} \quad . \qquad (27)$$

Various reflectivity values and the procedure for using them are given on page 45.

F. ESTIMATE OF UNCERTAINTY IN CALCULATION

The method of Liu and Jordan is widely used, but has been tested against only a small number of actual measurements of the radiation received by a tilted surface. The data tables include graphs that show LBL's estimates of the range of uncertainty of the calculations. Four sources of uncertainty were considered.

1. Error in L_D

The original data used by Liu and Jordan to establish the relationship between L_D and K_T have a spread about the nominal correlation curve. Also, a recent study indicates that the correlation depends somewhat on geographic location (Ruth and Chant, 1976). Based on this information, the error in L_D was estimated to be

$$\Delta L_D = \pm 0.1$$

for all values of K_T.

The error in L_D proved to be the dominant source of uncertainty in the direct beam (normal incidence) calculation [Eq. (19)]. For the total radiation on a tilted surface [Eq. (22)] the effect varied from being quite important for south-facing surfaces during the winter, to being negligible during the summer months for tilt angles less than 60°.

2. Error in R_n^{beam} and R_t^{beam}

For the numbers in the data tables, a nominal clear-day solar profile was assumed. The uncertainty in this assumption was investigated by repeating the calculations for two alternative profiles. One was relatively higher in the morning and afternoon than the nominal profile; the other relatively lower. The error estimate for each value of R_n^{beam} or R_t^{beam} was taken as

$$\Delta R^{beam} = \pm \left| (R^{beam})_{nominal} - (R^{beam})_{alternate} \right|$$

for whichever alternate value was the most different from the nominal value. The errors were typically 1 to 2%, with a maximum of about 5% for vertical surfaces facing east or west. The resulting errors in the direct beam (normal incidence) and tilted surface radiation were of about the same size.

3. Uncertainty in Isotropic Assumption

Following general practice, the numbers in the table were calculated for the assumption that the diffuse radiation is isotropic. The sensitivity of the numbers to this assumption was tested by repeating the calculations for the alternative case that some fraction of the diffuse radiation comes from near the sun. Let

$$f_s = \text{fraction of diffuse from near the sun} .$$

The conversion factor then becomes:

$$R_t^{diffuse} = [(1 - f_s)\cdot(1 + \cos \lambda)/2 + f_s \cdot R_t^{beam}]$$

A reasonable upper limit was judged to be:

$$f_s = 0.2 \quad \text{(20\% of diffuse from near the sun)} .$$

The calculation proved to be rather sensitive to the value chosen for f_s for south-facing surfaces during winter months. The effect is to increase the predicted amount of total radiation. The uncertainty associated with not knowing the real value of f_s is thus rather important because the effect is biggest during the heating season.

During summer months variations in f_s are not important except for very steep surfaces (tilted greater than 60°). In this case, lower values of total radiation are predicted.

The uncertainty introduced by varying f_s is not a random error, but rather a systematic shift towards higher (in winter) or lower (in summer) values for the total radiation. The error graphs included with the data tables have this shift taken into account. As a result, the graphs show (for winter months) a larger positive uncertainty than a negative one.

4. Error in the Total Horizontal Radiation

The estimated direct beam (normal incidence) radiation and total radiation for a tilted surface can never be more accurate than the primary ingredient, the total horizontal radiation. For the purpose of the graphs in Section V it was estimated that the uncertainty in E_h^{total} is given by:

$$\Delta E_h^{total} = \pm 0.05 \cdot E_h^{total} \quad ;$$

i.e., a 5% error.

These four contributions (L_D, R^{beam}, f_s, E_h^{total}) to the error in the calculated solar radiation values have been combined to produce the error graphs in Section V, Exhibits 5, 8(a), (b), and (c).

XI. Appendices

APPENDIX A - SOLAR RADIATION GLOSSARY

TERM	*DEFINITION*
Actinograph	See Pyranograph.
Black and White Pyranometer	A thermopile pyranometer manufactured by Eppley Laboratory, Inc. that is intermediate in quality between a PSP and a Light Bulb Pyranometer.
Blackbody	An idealized body or surface that absorbs all radiation, of any wavelength, which strikes it. When a blackbody is heated, it emits radiation with a characteristic spectrum described by Planck's law.
Cavity Radiometer	A type of pyrheliometer with a black cavity as the radiation absorber. These instruments provide the most accurate measure currently available of the Direct Beam (normal incidence) radiation.
Cloud Cover	A measure of the fraction of the sky covered with clouds. A human observer rates the cover on a scale from 0 (no cover) to 10 (completely overcast).
Cooling Degree Days	Each degree that the mean daily temperature is above 65°F is called a cooling degree-day unit. The monthly value of cooling degree days is then the sum of the degree-day units for the days in the month. Cooling degree days are not a particularly good measure of a building's cooling requirements since they do not include relative humidity effects.
Declination Angle (δ)	Consider a person standing on the equator at solar noon. The solar declination is then the angle between the sun and local vertical. The angle varies from -23.45° at the winter solstice to +23.45° at the summer solstice, where a positive angle means that the sun is to the north of the equator.
Direct Beam	The solar radiation coming directly from the sun.
Direct Beam (normal incidence)	The direct beam radiation incident upon a surface held normal (perpendicular) to the beam. This surface must be rotated as the sun moves across the sky. Measured by a pyrheliometer.

Diffuse Radiation	The light incident upon a surface from the sky, as opposed to directly from the sun. This light was originally from the sun, but was scattered by clouds, air molecules, dust, etc. May be measured by a shadow-band pyranometer or by an ordinary pyranometer and pyrheliometer in combination.
Extraterrestrial Radiation	The solar radiation received at the top of the atmosphere.
Global Radiation	Same as Total Horizontal Radiation.
Heating Degree Days	Each degree that the mean daily temperature is <u>below</u> 65°F is called a heating degree-day unit. The monthly value is then the sum of the degree-day units for the days in the month. Degree days are a fairly good measure of a building's heating requirements, for buildings of conventional construction.
Hour angle	An angle that describes the number of hours that the sun is away from Solar Noon (see Section IX). Each hour corresponds to 15° of angle; positive values in the afternoon.
Insolation	Strictly speaking, the Total Horizontal Radiation. The term is often used more loosely, however, to refer to all types of solar radiation.
Isotropic	Uniformly distributed. When applied to Diffuse Radiation, refers to the assumption that (except for the sun itself) the sky is uniformly bright.
K_T	The ratio of Total Horizontal Radiation to Extraterrestrial Radiation on a horizontal surface (see Section IV or IX).
Light-Bulb Pyranometer	See 180° Pyrheliometer.
NIP	For Normal-Incidence Pyrheliometer. A commonly used pyrheliometer manufactured by Eppley Laboratory, Inc. The sensor is a thermopile. A black surface is the radiation absorber.
Percent Possible Sunshine	The percent of the time between sunrise and sunset that the sun is shining (not obscured by clouds). Measured by a Sunshine Switch.

PSP — For Precision Spectral Pyranometer. An advanced type of thermopile pyranometer manufactured by Eppley Laboratory, Inc. The "spectral" refers to the potential use of the instrument with a colored filter to measure a portion of the solar spectrum.

Pyranograph — A type of pyranometer in which a bimetallic strip senses the temperature difference between a black surface and a white or reflecting surface. These instruments are not as accurate as thermopile pyranometers.

Pyranometer — An instrument used to measure Total Radiation. Usually mounted horizontally, but sometimes tilted.

Pyranometer (Thermopile type) — A pyranometer with a black radiation-absorbing surface. A thermopile senses the temperature difference between this hot surface and a cooler surface that is either painted white or shaded from the sun.

Pyrheliometer — An instrument used to measure the Direct Beam (normal incidence) radiation. A collimator (long tube) shields the sensor from most of the diffuse sky light. Must be mounted on a sun-tracking mechanism.

180° Pyrheliometer — Archaic name for a thermopile pyranometer manufactured by Eppley Laboratory, Inc. The instrument looks like a light bulb. It is no longer manufactured. Modern pyranometers are generally considered superior.

Shadow-Band Pyranometer — A pyranometer with a metal strip that shades the sensor from the direct beam radiation. Used to measure the diffuse radiation.

Sky Chart — A graph used to locate the position of the sun in the sky for any hour of the day, for any day of the year (see Sections IV and IX).

Solar Constant — A measure of the radiation received from the sun at the top of the earth's atmosphere. See Section IX.

Solar Noon — Refers to 12:00 noon in a time system (Solar Time) in which the sun is most directly overhead at noon.

Solar Time — A time system in which the sun is at its highest point in the sky at noon. Section IX gives the relationship between Solar Time and Pacific Standard Time.

Sun Chart	See Sky Chart.
Sunshine Hours	The number of hours during some time period (day, month, year) that the sun was shining (not obscured by clouds). Measured by a Sunshine Switch.
Sunshine Switch	A device that is "on" when the sun is shining and "off" when the sun is obscured by clouds or at night. The device has a threshold so that, roughly, it will be on when the sun is bright enough to cast a shadow. Sunshine Hours and Percent Possible Sunshine are both derived from the measurements.
Thermopile	A series of thermocouples. A higher temperature at one end and a lower temperature at the other generates an electrical voltage. Many common solar instruments use a thermopile.
Total Horizontal Radiation	Total (direct + diffuse) radiation incident upon a horizontal surface. Measured by a pyranometer.

APPENDIX B - CONVERSION FACTORS

	From	*To*	*Multiply by*
TIME:	years	hours	8760
	years	seconds	3.16×10^{7}
	days	seconds	86,400
LENGTH:	meters	feet	3.2808
	meters	inches	39.3701
	km	miles	0.62137
ENERGY:	kWh	Btu	3410.08
		kJ	3600
		kcal	859.326
		erg	3.6×10^{13}
	Btu	kWh	2.928×10^{-4}
		kJ	1.0548
		kcal	0.251996
		erg	1.0548×10^{10}
		therm	10^{-5}
		quad	10^{-15}
POWER:	kW	Btu/h	3414.43
		Btu/min	56.8253
		cal/min	1.43197×10^{4}
		cal/sec	238.662
		kcal/h	859.2
		hp	1.3410
	Btu/h	kW	2.931×10^{-4}
		Btu/min	0.01667
		cal/min	4.1999
		cal/sec	0.0700
		kcal/h	0.251996
		hp	3.9275×10^{-4}

	From	*To*	*Multiply by*
AREA:	m^2	ft^2	10.7639
	m^2	in^2	1550
	km^2	$mile^2$	0.3861
	km^2	acres	247.105
ENERGY DENSITY:	kWh/m^2	Btu/ft^2	316.815
		kJ/m^2	3600
		J/cm^2	360
		cal/cm^2 (langley)	85.933
	Btu/ft^2	kWh/m^2	3.1517×10^{-3}
		kJ/m^2	11.3538
		J/cm^2	1.13538
		cal/cm^2 (langley)	0.27125
POWER DENSITY:	kW/m^2	Btu/ft^2-h	317.21
		kJ/m^2-h	3600
		W/cm^2	0.1
		langley/sec	0.23901
		langley/min	14.3406
	Btu/ft^2-h	W/m^2	3.1524
		kJ/m^2-h	11.348
		W/cm^2	3.1524×10^{-4}
		langley/sec	7.5347×10^{-5}
		langley/min	4.5208×10^{-3}

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