Title
The NCGIA Guide to Laboratory Materials - 1993 (93-10)

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National Center for Geographic Information and Analysis

The NCGIA Guide to Laboratory Materials - 1993

(The 1993 Update of NCGIA Report 91-20)

Edited by
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TABLE OF CONTENTS

This document is an updated version of NCGIA Technical Paper 91-20: The NCGIA Guide to GIS Laboratory Materials - 1991. This 1993 update includes approximately 40 pages of new or updated material, plus an appendix which contains a set of eight full-text GIS exercises. Much of the information described by the new material is available free-of-charge via anonymous FTP (File Transfer Protocol). Appendix D contains instructions on using FTP.

Appendix E contains eight full-text GIS exercises, which are set up to work with the OSU-MAP GIS package using some of the standard datasets provided with OSU-MAP. These exercises were provided by Dick Scott of Glassboro State College. The contributions to this document by Dick Scott and others are gratefully acknowledged.

Conventions of update entries:

The following are some characteristics of the new or updated information in this guide:

- The title of new or updated entries begins with an asterisk (*). These entries have been moved to the beginning of their section within the document.

- Courier font 10 point text constitutes information pulled directly from the Internet.

- Some entries may contain a field called "ED. NOTE:", which contains notes or comments by the Editor.

- When applicable, the "SOURCE" field will contain an FTP address. One or more. directories of interest will be listed in parentheses after the FTP address. For example, the following entry:

  SOURCE: Anonymous FTP at spectrum.xerox.com (/pub)

means that one logs in as "anonymous" to the FTP site "spectrum.xerox.com", and then changes to the directory "pub". Appendix D of this document contains instructions for using FTP-

- Under the FORMAT field: "Unix compressed" means files are compressed with the Unix "compress" command. These files are binary and their names end with the two characters ".Z". Use the Unix "uncompress" command to uncompress them, and be sure to download them as binary and not text.

Once again, thanks to everyone who contributed material to this Guide. If you would like to contribute something for the next update, see Appendix C.

Rusty Dodson
NCGIA Santa Barbara
September 2, 1993.

In the summer of 1990 the National Center for Geographic Information and Analysis completed the *NCGIA Core Curriculum in GIS*. The objective of the Core Curriculum, a 1000+ page, three volume document, is to encourage the rapid development of high quality courses in Geographic Information Systems (GIS). To achieve this objective, the NCGIA produced an extensive set of classroom teaching materials, including lecture notes, handouts, overheads, and slides. The document was completed in July, 1990 and is available from the NCGIA.

To support the classroom materials provided in the Core Curriculum volumes 1-3, the NCGIA has produced a series of resources designed to assist educators in establishing a GIS laboratory curriculum. The series is currently made up of four separate documents: two volumes of student laboratory exercises[1], a set of case studies on establishing GIS laboratory facilities[2], and this guide to GIS laboratory materials.

This document is a compendium of information pertaining to GIS laboratory education. Our objective is to provide resources which facilitate the establishment of a GIS laboratory curriculum. These resources include references to student exercises produced by the NCGIA, vendors, and other institutions; as well as aids for the creation of new exercises, including ideas for topics and sources of appropriate data.

We feel that the information in this guide will be immediately useful in improving the quality of GIS laboratory education. This guide includes material received prior to July, 1991. We wish to express our thanks to all those who responded by providing material for this first version, and who are named as contributors in the sections that follow. The contents of the 1991 edition are limited by the material received, and are inevitably somewhat uneven. However, we anticipate that this document will be updated when a sufficient amount of new material has been collected. It is hoped that readers will take part in the future development of this guide by sending any interesting materials to the NCGIA.

A generic format for submissions is included in an appendix at the end of this document. We encourage the development and submission of lab exercises which cover themes and topics not addressed in the current version of this guide.

Structure of the document

This materials guide is made up of several components:

GIS laboratory themes and topics

This section provides a conceptual framework for the identification of exercise topics and functions as an organizing structure for this sourcebook. Issues of fundamental importance to GIS are broken down into a set of topics around which laboratory exercises can be based. Each exercise entry in the body of the compendium is associated with one or more topics from this list.

The body

The body of this guide consists of three chapters of entries: lab exercises, data sets, and miscellaneous materials. Each entry contains a title as well as several descriptive items including price when available and information on subject matter, system requirements, student level, and how to obtain the materials. A description of the format used in organizing each entry is provided at the beginning of this section.

The exercise chapter contains references to published exercise sets and exercises which are available from their author or contributor. In addition, some entries in this chapter contain complete, immediately-usable exercises.

The data chapter describes data sets which may be useful in creating new exercises. These references pertain to data available from both vendors and private individuals, and are often in a ready format for one or more GIS packages.

The miscellaneous chapter contains information on items which do not fit into one of the previous two categories. Included are sources of educational software and other resources of interest to the GIS education community.

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[1] GIS Laboratory Exercises: Volumes I and 2; NCGIA Technical Papers #91-12 and #91-14. Both are described in the Exercise section of this document.

[2] *GIS Teaching Facilities: Six case studies on the acquisition and management of laboratories*; NCGIA Technical Paper #91-21. Described in the miscellaneous section of this document.

Appendices

Included in the appendices are an index to GIS software mentioned in the document, an extensive bibliography on GIS education, and a generic form for the submission of new material.

Indexes

This section contains a cross-referencing of the items in the body of the document by various subject groupings. The index should be helpful to those desiring a specific type of resource. For example, readers interested in materials which support a particular GIS package can find all pages in the guide that contain a reference to that software.

Disclaimer

Much of the information contained in this document has been submitted by individuals not affiliated with the NCGIA. While every effort has been made to ensure the usefulness and accuracy of the contents, please make sure that the material is appropriate for your particular pedagogic needs.

Since the objective of the Curriculum is to provide a basis for teaching the conceptual aspects of GIS, we have chosen to provide lab materials that will supplement the lectures by demonstrating important concepts and introducing real applications, rather than simply provide skills training in the use of one or more specific GIS packages. Of course, this task is made difficult by the nature of many current GIS software programs which require training before even simple analytical tasks can be conducted.

Therefore our approach to the development of lab materials is a very broad one, providing a range of support from general guidance on what topics might be appropriate to examples of specific lab exercises. Our design consists of four levels of detail. The top level describes the four major themes which we feel conceptually-oriented labs should address:

- The database as a representation of reality
- GIS as a management tool
- GIS investigates the world
- Implementation and design

Whether an instructor chooses to include labs which address all four of these themes in one course will depend on the department in which the courses are taught and the level of instruction. At the second level of detail, each of the themes is defined more precisely as a set of topics. Topics describe specific aspects of the themes that would be suitable for individual lab exercises. The next level, generic exercises, provides suggestions as to the kinds of datasets and related activities that could be used to demonstrate aspects of each topic. The final level, specific exercises, provides databases and detailed exercises which can be used directly in the classroom. At this level only, materials focus on specific GIS programs. In terms of the connection between Core Curriculum lecture materials and labs, we see that each exercise will be associated with one or more lecture topics while individual lectures may similarly be supported by a range of exercises.

THEMES AND TOPICS FOR LAB EXERCISES

By Michael F. Goodchild

THE DATABASE AS A REPRESENTATION OF REALITY

A spatial database is a discrete, digital representation of real geographical phenomena distributed over the earth's surface. The relationships between the database and reality are complex, but an understanding of them is an essential requirement for effective use of GIS technology.

Spatial primitives

Databases represent real spatial variation and features through the use of discrete primitive elements. Several different primitives are identified in current GISs, including pixels, cells, points, lines, arcs, areas, polygons and surfaces though many terms are synonymous or overlapping in definition with others.

Alternative data models

Geographical data is infinitely complex, but must be reduced to finite dimensions to fit within a digital storage device. For each type of spatial data, there are several alternative methods of discretization available, each with its own form of information loss, and each suitable for different kinds of analysis.

Scale and resolution

For geographical information, "the closer you look, the more you see". Scale and resolution define the level of spatial detail in the database, but need to be distinguished from each other and from related concepts of accuracy and precision.

Accuracy

Accuracy measures the relationship between the digital database and the true spatial distributions which it represents. A variety of methods can be used for determining accuracy, each with its own problems and limitations.

Spatial layers and objects

Some phenomena, such as elevation, are continuous and have values everywhere ("layers"), while others, for example telephone poles, are discrete objects and do not occur everywhere. However, both of these very different distributions may be represented in a database using the same set of primitives - in the case of elevation and poles as a set of points. It is important to distinguish between the properties and functionality of these different distributions. Many processes can be described through interactions between layers, and the combination of layers through overlay is a fundamental concept in GIS.

Multiple themes

A spatial database represents the complex, multithematic nature of geography through layers, coverages, classes of objects and other forms of data modeling. The definition of themes and their implementation in the data model is critical in its effect on the usefulness of the database in different applications.

Relationships

Three types of relationships can be defined in spatial databases: those which are necessary for the formation of complex objects from simple primitives; those. which are computable from the geometry and locations of the objects, such as proximity and connectedness; and relationships which are neither of these, such as those defined by ownership.

GIS AS A MANAGEMENT TOOL

In many applications, GIS is used to manage or maintain spatially distributed facilities and resources. GIS is an important tool in building spatial inventories and in making well-informed decisions about the locations or uses of these facilities and resources.

The information product

Because GIS is a complex software environment, it is often necessary to limit access to trained, technically qualified staff. Decision-makers work not with the system itself, but with products generated by the system, such as maps, charts, tables and lists. The functions of the system are used to process data into a form suitable for decision-making.

Queries

When the application requires relatively simple functions, it is cost-effective for decision-makers to be trained in using the system themselves. Car navigation systems, for example, can be used by drivers with minimal technical training.

Vehicle routing/scheduling

A major area of application of GIS is in determining routes and schedules for vehicles. Simple capabilities allow decisions to be made on optimal routes for emergency vehicles, delivery schedules for express mail, work schedules for utility repairmen, etc.

Central facilities

GIS is often used to study potential locations for central facilities, such as fire stations, retail stores, airports, campgrounds, schools etc. These applications rely on the ability of GIS to combine information from different layers, and to measure distance in meaningful ways.

Dividing the world

Many applications of GIS support decisions about how to divide the world, into trade areas, school service districts, sales territories, voting districts etc. Each of these applications uses similar functions of the GIS.

Resource management

GISs play important roles in the inventory, management and planning for development of spatially distributed resources such as timber and outdoor recreation areas.

The suitability of a site for various uses may depend on many factors, each of which can be conceptualized as a GIS layer. All GISs include the ability to superimpose layers, and thus combine factors into aggregate measures of suitability.

Multiple criteria

In controversial decisions, it is often necessary to deal with conflicting criteria. GIS must often be applied in cases where several criteria exist, and some objective means must be found to reconcile the resulting conflicts.

Spatial decision support systems

GISs exist to support decision-making. Effective decision support requires a flexible approach, in which the system helps the user not only to solve the problem, but also to define objectives in what is often a highly uncertain environment, and to explore the implications of different options.

The management environment

The effectiveness of GIS technology is often limited by the management environment in which it operates, and by political, economic and social concerns. To make good use of the capabilities of this technology, it is necessary to understand the institutional frameworks within which it must operate.

GIS INVESTIGATES THE WORLD

GIS is an important tool in scientific investigation, in those areas of science and social science that deal with geographical data. This theme explores the concepts underlying the application of GIS as a scientific tool, and its effectiveness as a means of investigating the world and its human and physical environments.

Exploring the world through a database

The success of GIS depends on whether it can provide the user with an accurate view of the world. What can the user learn about the world through the medium of a GIS? What are its limitations, and advantages with respect to more conventional media such as atlases, maps, texts and photographs?

Combining media

Recent developments in GIS technology allow the spatial database to be used as a means of access to other media, such as images stored on videodisk, and recorded sound. Each medium has its strengths and weaknesses.

Exploring cause/effect relationships

The ability to overlay layers in a GIS is a powerful way of discovering and exploring causal relationships. GIS can bring together environmental factors with patterns of disease, for example, and suggest correlations. But correlations can be spurious, and some understanding of cause/effect processes is needed to make sense of many patterns.

Geographical brushing

GIS offers many excellent and powerful tools for exploring geographical data. The brushing technique allows an area or variable to be examined selectively in order that the patterns and processes operating in regions can be identified visually.

Spatial dependence

This is the tendency for places which are close together to be more similar than places which are far apart. Almost all geographical distributions show some form of spatial dependence, but its strength can be an important factor in understanding the processes controlling the distribution.

GIS capabilities can be used to explore and display dynamic aspects of geographical distributions such as the diffusion of disease, the processes behind weather patterns or the effects of human migration, without the static constraints of conventional maps. Space/time data can be viewed and described in spatial and temporal cross-sections.

Modeling environmental processes

Research over the past several decades has led to the development of many useful models of environmental processes, in such areas as atmospheric circulation, hydrologic processes soil erosion. GIS can be used to input and pre-process data, to display the results, and to explore the effects of changing conditions.

Modeling socioeconomic processes

Just as in the modeling of environmental processes, GIS technology can also be used effectively to support social science research, including such areas as modeling of spatial interaction and regional economics. Again, the GIS can be used to input and pre-process data, to display the results, and to explore the effects of changing conditions.

IMPLEMENTATION AND DESIGN

This section includes aspects of the technical implementation and design of GIS. Many important concepts underlie the data structures and algorithms of current GISs, and the procedures used to define and develop GIS projects.

Map projections and coordinates

GIS designers have implemented many standard methods of describing locations on the curved surface of the earth. An understanding of the different characteristics of these options is important for planning both data input and the final product and in evaluating the accuracy of locational attributes.

Digitizing

The process of converting maps into digital records is labor-intensive, and effective preparation and processing techniques art needed to minimize its tedium and cost.

Data structures

Data structures are the digital implementation of data models, and require decisions to be made about record formats and coding systems. Any one data model may be implemented in many different data structures, and one data structure may implement more than one data model.

Data integration

The ability to integrate data from a variety of sources is a major advantage of GIS, but raises a host of issues if it is to be done effectively. Format, scale, data structure, projection, and date are examples of factors that may vary from one source to another and must somehow be reconciled.

Algorithms

Algorithms are the procedures used by the computer system to perform various operations on data. Some GIS processes, such as overlay and buffer zone generation, present complex and difficult problems to algorithm designers. An understanding of the algorithms used by specific GIS functions is often necessary to accurately interpret the results from complex operations.

Database design

Combining a knowledge of the proposed database contents and its applications with various principles of database design is important in the development of useful and meaningful databases.

Benchmark tests are used to confirm that a GIS can indeed perform the functions claimed, and can carry out the required volume of work within prescribed time limits.

Designing a product

Effective use of GIS, particularly in management applications, requires careful planning. This should include the identification of intended products, the data required to generate them and the functions that the system will have to be able to perform. Consideration of important cartographic principles is also important.

User interfaces

The practical value of a GIS is affected by the design of its user interface which is in turn affected by its anticipated audience and application. There are several different types currently available.

The headings used for both the laboratory exercises and the data sets are listed below with brief descriptions.

Lab Exercises

TITLE: The title of the exercise. The title may be the actual name or a statement that describes content.

CONTRIBUTOR: The individual(s) or organization that provided the exercise.

SOURCE: The contact from whom the exercise can be obtained. The information listed includes address, phone, FAX, and price when available. Prices are as current as possible, but should be confirmed.

NCGIA TOPIC: This relates an exercise to one or more corresponding topics from the list of laboratory themes/topics included in this volume.

APPLICATION AREA: A general discipline or field of study under which the exercise could be classified.

GEOGRAPHIC LOCATION: The location of the study area used in the exercise.

EDUCATIONAL ROLE: This item provides a general indication of the level of difficulty for students (i.e. Beginning/Intermediate/Advanced), or an indication of where the exercise may fit within a particular course.

COMPLETION TIME: An approximate amount of time required to complete the exercise.

HARDWARE/SOFTWARE: A description of the hardware and software needed to run the exercise.

DATA REQUIRED: A description of the data necessary to run the exercise.

GENERAL DESCRIPTION: A broad overview of the exercise. This may be used in addition to the previous headings to browse through this materials guide.

DETAILED DESCRIPTION: When appropriate, a more detailed description of the exercise will be found here. In some cases this item contains the complete text of the exercise.

Current as of: The most recent date of verification for the above information.

TITLE: The title of the data set. The title may be the actual name or a statement that describes content.

SOURCE: The contact from whom the data set can be obtained. The information listed includes address, phone, FAX, and price when available. Prices are as current as possible, but should be confirmed.

GEOGRAPHIC COVERAGE: The portion of the earth that is covered by the data set. The description below may provide more detailed information.

FORMAT: This lists any information available about system requirements, storage media, and data structure.

DESCRIPTION: This entry describes any pertinent and available information about the data set.

Current as of: The most recent date of verification for the above information.

EXERCISES

TITLE: *SpaceStat/Idrisi spatial analysis exercises

SOURCE: NCGIA/Geography Dept.
University of California
Santa Barbara, CA 93106-4060 (USA)
Phone: 805/893-8224 FAX: 805/893-8617
Internet: ncgiapub@ncgia.ucsb.edu

PRICE: $13.50

NCGIA TOPIC: Spatial dependence; analysis in space; modeling socioeconomic processes

APPLICATION AREA: Spatial econometrics; demographics; spatial regression analysis

GEOGRAPHIC LOCATION: Includes datasets of Africa and Columbus, Ohio. Can be used on any point or polygon based data in Idrisi format.

EDUCATIONAL ROLE: Intermediate undergraduate or introductory graduate level. Assumes some familiarity with statistics.

COMPLETION TIME: Each lab takes 1-2 hours.

HARDWARE/SOFTWARE: SpaceStat version 1.0 or higher, and Idrisi version 4.0 or higher. Spacestat is described in an entry in the miscellaneous section of this Guide.

DATA REQUIRED: See "Geographic Location" above.

GENERAL DESCRIPTION: This set of student exercises comprises NCGIA Technical Report 93-5: *Teaching introductory geographical data analysis with GIS: A laboratory guide for an integrated SpaceStat/Idrisi environment. Edited by Rusty Dodson, with a Preface by Luc Anselin.*

This report contains student laboratory exercises for an introductory course in spatial analysis, based on an integrated computing environment using the SpaceStat and Idrisi software packages. Topics include exploratory data analysis, spatial weight matrices, spatial autocorrelation, point pattern analysis, bivariate regression, spatial ANOVA, and trend surface regression. Includes a 70 page document with exercises and appendices plus a DOS diskette with datasets and SpaceStat/Idrisi linkage software.

CONTENTS:

Lab 0: Introduction to DOS
Lab 1: Introduction to Idrisi
Lab 2: Introduction to SpaceStat
Lab 3: Exploratory data analysis
Lab 4: Spatial weight matrices
Lab 5: Point pattern analysis
Lab 6: Spatial autocorrelation statistics
Lab 7: Regression analysis

TO ORDER: Send a check/money order made out to "U.C. Regents/NCGIA" to the above address.

Current as of: August, 1993.

TITLE *Getting Started in GIS: A workbook of computer based exercises

CONTRIBUTOR: Dr Mitchel Langford, Leicester University, UK

SOURCE: Mrs Jean Burgan
CVCP/USDU
Sheffield University, UK
Tel:0742 725248
Email: j.burgan@uk.ac.shef.pa
PRICE: £75

NCGIA TOPIC: Multiple themes; vehicle routing; suitability analysis; spatial decision support systems

APPLICATION AREA: Geography

GEOGRAPHIC LOCATION: Leicestershire, Midlands, UK

EDUCATIONAL ROLE: Beginning. Suitable for a wide range of teaching modes: Supervised practical; Self-paced learning; Distance learning

COMPLETION TIME: Approximately 1 hour per practical, 4 hours in total

HARDWARE/SOFTWARE: Uses the IDRISI raster GIS; MS-DOS/VGA/20+Mb Hard Disk

DATA REQUIRED: All data required are included in the package

GENERAL DESCRIPTION: Four "hands-on" sessions help to develop an understanding of basic concepts and techniques in GIS. Now sold to over 70 academic and commercial institutions. Contents:

Practical A: Introducing a simple GIS

- Familiarisation with IDRISI
- Concept of independent thematic coverages
- Overlay function introduced

Practical B: Manipulating and extracting information

- GIS as a spatial data storage and management system
- GIS as a decision support tool
- Extract summary statistics from individual coverages
- Answer questions using spatially linked thematic coverages

Practical C: Optimal routing

- Manipulation and analysis of point, line, area, and surface data
- Find the 'cheapest' route for a proposed pipeline by constructing a cost surface based on landcover and topography

Practical D: Site selection

- Track down the optimal site for a leisure centre
- The classic 'sieve mapping' approach

Current as of: July, 1993

TITLE *Moving On in GIS: Advanced computer based exercises

CONTRIBUTOR: Dr Mitchel Langford, Leicester University, UK

SOURCE: Mrs Jean Burgan
CVCP/USDU
Sheffield University, UK
Tel:0742 725248
Email: j.burgan@uk.ac.shef.pa
PRICE: £75

NCGIA TOPIC: Site selection; vehicle routing

APPLICATION AREA: Geography/Geology/Environmental Management

GEOGRAPHIC LOCATION: A proposed site for sand/gravel extraction in the UK. The data are from a real source but the exact location has been disguised to protect the supplier.

EDUCATIONAL ROLE: Intermediate.

HARDWARE/SOFTWARE: Uses the IDRISI raster GIS. Recommended configuration: MS-DOS; VGA; 12Mb Hard Disk space; 386SX + coprocessor, or better

DATA REQUIRED: All data required are included in the package.

GENERAL DESCRIPTION: Based upon real data, these exercises demonstrate the use of GIS as a planning support tool; providing the information and analyses necessary to complete a proposal document for sand and gravel quarrying to be submitted to the Local Planning Authority. Demonstrates many of the new features of IDRISI v4.0 including the use of command line parameters and IDRISI macros using DOS batch files. Contents:

Stage 1 & 2:

- Familiarisation with the study area
- An introduction to IDRISI macros
- Database completion (vector-to-raster conversions)

Stage 3 & 4

- Measuring areas of extraction and volumes of material extracted
- Site development analysis (plant location and transport routing)
- Analysis of site operating costs

Stage 5 & 6

- Visualisation of the worked site
- Pseudo-3D presentations
- Exhausted site reclamation for agricultural use
- Exhausted site reclamation for recreational use

Current as of: July, 1993

TITLE *Introduction to GIS: The Arc/Info method

CONTRIBUTOR: Bill Hickin, David Maguire, Alan Strachan

SOURCE: Midlands Regional Research Laboratory
Bennett Building
University of Leicester
LEICESTER, LE1 7RH
UK
Tel: 0533 523849
FAX: 0533 523854
Email: rrl@uk.ac.leicester
PRICE: £15

NCGIA TOPIC: Site selection; queries; resource management

APPLICATION AREA: General GIS / Geography

GEOGRAPHIC LOCATION: Various UK sites

EDUCATIONAL ROLE: Appropriate to businesses and agencies wishing to make staff more familiar with GIS, and to 2nd/3rd year undergraduates taking courses on GIS, Computer mapping, and geographical techniques.

COMPLETION TIME: About 18 hours in total

HARDWARE/SOFTWARE: PCArc/Info Starter Kit and ArcPlot modules, Version 3.4D(+); Colour VGA, 8Mb local/networked disk space + 700K for each used to allow them to save results

DATA REQUIRED: All included

GENERAL DESCRIPTION: This workbook and accomanying disks have been created for those wishing to learn about GIS basics in a short period of time. It provides hands-on experience of how GIS functionality can be used to address a range of real world issues. Contents:

Chpt 1. Introduction
Chpt 2. GIS in perspective
Chpt 3. Introducing ARC/INFO
Chpt 4. Cartography and databases
Chpt 5. Combining and querying health data
Chpt 6. Retail site suitability analysis
Chpt 7. Recreation and environmental management
Chpt 8. Review and conclusions

Current as of: July, 1993.

TITLE *Getting Started with ARC/INFO

CONTRIBUTOR: Alan Strachan, Bill Hickin, David Unwin, Kamie Kitmitto

SOURCE: Midlands Regional Research Laboratory
Bennett Building
University of Leicester
LEICESTER, LE1 7RH UK
Tel: 0533 523849
FAX: 0533 523854
Email: rrl@uk.ac.leicester
PRICE: £70-80

NCGIA TOPIC: Data integration; analysis in space; designing a product

APPLICATION AREA: Provides an integrated lecture and practical resource base for GIS educators and trainers.

GEOGRAPHIC LOCATION: UK examples used in associated exercises

EDUCATIONAL ROLE: Introductory.

COMPLETION TIME: Six 30 minute lectures; Six 1/2-to-1 hour exercises sessions.

HARDWARE/SOFTWARE: Access to Sun/UNIX version of ARC/INFO or pc ARC/INFO is required to run practicals.

DATA REQUIRED: All data for exercises included on MS-DOS disk or SUN Data Tape.

GENERAL DESCRIPTION: Materials produced as part of the Information Technology Training Initiative (ITTI) funded by the Information Systems Committee of the Higher Education Funding Council. These materials come as two complementary versions, one for Sun/Workstation Arc/Info, the other for PC/DOS Arc/Info. The objective is to introduce the Arc/Info GIS and to actively explore its core functionality and potential. Contents are as follows:

Modules:

- Introduction to GIS
- The System
- Data Input
- Managing Data
- Analysing Data
- Displaying Data
- The way forward

Exercises:

- The motorway game
- A quick tour of Arc/Info
- Getting spatial data into arc/info
- Getting attribute data into arc/info
- Geographical analyis
- Constructing a choropleth map

Current as of: July, 1993

TITLE *GIS awareness package

SOURCE: GeoData Institute
The University
Southampton, U.K. SO9 5NH
Phone: 44 (0703) 583565
FAX: 44 (0703) 592848
Email: j.h.ball@southampton.ac.uk (or @uk.ac.southampton)
PRICE: £30. Outside U.K. add £5.
Checks payable to: "University of Southampton"

APPLICATION AREA: General GIS information

GEOGRAPHIC LOCATION: United Kingdom

EDUCATIONAL ROLE: Introductory

COMPLETION TIME: 1.5 hours

HARDWARE/SOFTWARE: IBM compatible PC

DATA REQUIRED: Includes required booklet and 2 HD 3.5 inch diskettes.

GENERAL DESCRIPTION: A booklet plus a computer-guided presentation.

This package contains a booklet which covers in basic detail the fundamentals of GIS. Sections include:

- What is GIS?
- How is the real world represented within a GIS?
- What are the benefits of using GIS?
- What functionality is available within a GIS?
- What are the applications of GIS?

A PC-based presentation accompanies the booklet with numerous supporting images and diagrams. A further presentation is available on Modelling & Overlay analysis.

Current as of: July, 1993

TITLE: *Various published workbooks of exercises using IDRISI

CONTRIBUTOR: Lee Thomson
IDRISI Project Manager
Clark University

SOURCE: Available from various sources listed below.

NCGIA TOPIC: Many

APPLICATION AREA: Time series/change analysis; forestry; coastal processes; resource management; rural planning; agricultural management

GEOGRAPHIC LOCATION: Africa; Nakuru, Kenya; and others

EDUCATIONAL ROLE: Beginning/intermediate

COMPLETION TIME: Varies

HARDWARE/SOFTWARE: IDRISI, version 3.0 or higher

DATA REQUIRED: Workbooks include all necessary data.

GENERAL DESCRIPTION: These are several collections of GIS exercises written for IDRISI:

UNITAR Workbook Series

The United Nations Institute for Training and Research produces a workbook series titled Explorations in Geographic Information Systems Technology. These workbooks are meant to explore in some detail either the use of GIS in a certain application area or a set of GIS techniques or methodologies. A basic understanding of the principles of GIS is assumed.

The IDRISI Project develops and distributes these volumes on behalf of UNITAR. Current prices are $75 plus shipping per volume. For further information contact The IDRISI Project. Volumes 1 and 2 are currently available. Volumes 3 and 4 will be available in summer, 1993, and volumes 5 and 6 will be available in early 1994. A summary of the volumes follows:

Volume 1: Change and Time Series Analysis. The exercises focus on the following topics:

- Pairwise Comparisons: Quantitative Data
- Simple Differencing
- Thresholding
- Image Regression
- Image Ratioing
- Pairwise Comparisons: Qualitative Data
- Cross-tabulation
- Using the Kappa Index of Agreement
- Multiple Comparisons: Quantitative Data
- Principal Components Analysis
- Time Sequencing
- Time Profiling
- Change Vector Analysis
- Spatial Registration
- Change Vector Extraction

(Continued...)

Volume 2: Applications in Forestry. Case Study Exercises Include:

- General forest management and GIS: Locating Optimal Harvest Areas
- Habitat Analysis in Kootenay National Park, British Columbia, Canada
- Mapping Suitable Locations for Reforestation: Eucalyptus in Africa
- Gypsy Moth Defoliation of Forests in Northeastern North America
- Forest Management: Getting the Trees to the Mill
- Analyzing Deforestation and Soil Loss in Northern Thailand
- Monitoring Land Use in Rondonia, Brazil Using AVHRR and TM Imagery

Volume 3: Applications in Coastal Zone Research and Management. Case Study Exercises Include:

- Shrimp Habitat Inventory, Florida, USA
- Aquaculture Suitability Analysis, Gulf of Nicoya, Costa Rica
- Eelgrass Mapping from Low-Altitude Aerial Video Imagery, Massachusetts, USA
- Modeling Sea Level Rise and the Effects of Database Error, Rhode Island, USA
- Bathymetric Modeling from Satellite Imagery, Dominican Republic
- Change Analysis using Satellite Imagery, Dominican Republic
- Quantifying Beach Sand Erosion and Deposition, Adelaide, Australia
- Viewshed Analysis, Spain

Volume 4: GIS and Decision Making. Case Study Exercises Include:

- Risk Analysis -- Global Warming Sea Level Rise, Boston, Massachusetts, USA
- Error Evaluation, Bagmati Zone, Nepal
- Constraint Mapping, Bagmati Zone Nepal
- Multi-Criteria Evaluation, Nakuru, Kenya
- Multi-Objective Land Allocation, Kathmandu Valley, Nepal

Volume 5: GIS and Mountain Environments

This workbook will explore the special issues related to using GIS in Mountain Environments research and resource management.

Volume 6: Applications in Hazard Assessment and Management

This workbook will explore the use of GIS in identifying, assessing, and managing both natural and technological hazards.

Nakuru, Kenya Case Study

This includes a data set of Kenya's Nakuru province as well as exercises in resource management, agricultural management, and rural planning. (AVAILABLE JANUARY, 1992)

(Continued...)

The above items are or will be available from:

Nassrine Azimi UNITAR European Office Palais des Nations CH-1211 Geneva 10 Switzerland FAX: (41) 22-733-1383	or:	IDRISI Project Clark University 950 Main St. Worcester, MA 01610 USA Tel: 508/793-7526 FAX: 508/793-8824 Email: idrisi@vax.clarku.edu

International Geosphere/Biosphere Programme Global Change Database Africa Pilot Project

This is a workbook of four exercises which use the *GCDP Africa Database* (described in the data section of this document). Three of these exercises are original versions of exercises included in the document: *NCGIA GIS Laboratory Exercises, Volume 1*, which is referenced elsewhere in this Guide.

Available from:

Stan Ruttenberg
UCAR
PO Box 3000
Boulder, CO 80303
USA

IDRISI User's Guide and Tutorial Exercises

As taken from the manual, these exercises explore how to use IDRISI to do GIS, and how to do GIS with IDRISI. This workbook contains 16 exercises and is available for $35.00 from Clark University (address above). The Following is a Summary of the Exercises:

Introduction to IDRISI
1. The IDRISI Environment
2. Image Display I
3. Image Display II
4. Data and File Types

Raster GIS Analysis
5. Database Query
6. Surface Display
7. Map Algebra
8. Distance I / Context Operators
9. Distance II

Vector Display and Analysis
10. Vector / DBMS I: The Plot Utility
11. Vector / DBMS II: DBIDRIS

Remotely Sensed Image Processing
12. Image Processing I - Image Display
13. IP II : Unsupervised Classification
14. IP III: Principal Components
15. IP IV: Supervised Classification

Digital Cartographic Databases
16. Digital Cartographic Databases

Current as of: July, 1993

TITLE: NCGIA GIS Laboratory Exercises, Volume 1

CONTRIBUTOR: NCGIA - Santa Barbara

SOURCE: Available as Technical Paper #91-12 from the NCGIA:
NCGIA/Dept. of Geography
University of California
Santa Barbara, CA 93106-4060
NCGIA@NCGIA.UCSB.EDU NCGIA@VOODOO.BITNET
PRICE: $25.00; includes 2 HD 3.5" diskettes

NCGIA TOPIC: Many

APPLICATION AREA: Data exploration; suitability analysis; change detection; forest management; emergency planning; hydrological modeling.

GEOGRAPHIC LOCATION: The African continent; Maple Mountain, Ontario; London, Ontario; Goleta, California.

EDUCATIONAL ROLE: These exercises are designed to support the *NCGIA Core Curriculum Volume 1: Introduction to GIS*

COMPLETION TIME: Most exercises can be completed in 2-4 hours.

HARDWARE/SOFTWARE: All of the exercises require a PC with color monitor and mouse; five of the exercises require IDRISI; the remaining three exercises require pcARC/INFO.

DATA REQUIRED: All necessary data and digital versions of the exercise text are provided in compressed form on two 3.5" HD diskettes.

GENERAL DESCRIPTION:

GIS Laboratory Exercises, Volume 1, consists of a set of eight introductory level exercises which were designed to support the *NCGIA Core Curriculum Volume 1: Introduction to GIS.* The first five exercises use IDRISI software and the final three use pcARC/INFO. The following is a brief description of each exercise:

- Exploring Africa: an introduction to GIS
- Exploring the Data: a closer look at representations of reality in a GIS and data quality
- Suitability Analysis: finding sites for *Eucalyptus grandis* plantations in Africa
- Change Detection: investigating areas of potential deforestation and desertification in Africa
- Forest Management: finding leasable timber stands in Maple Mountain, Ontario
- Introduction to vector GIS: a first look at pcARC/INFO, using the Green Valley data set
- Emergency Planning: exploring the spatial patterns of fire alarms in London, Ontario
- Hydrological Modeling: investigating the hydrological impacts of commercial development near a coastal wetland

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Current as of: July, 1991

TITLE: NCGIA GIS Laboratory Exercises, Volume 2

CONTRIBUTOR: NCGIA

SOURCE: Available as Technical Paper 91-14 from the NCGIA:
NCGIA/Dept. of Geography
University of California
Santa Barbara, CA 93106-4060
NCGIA@NCGIA.UCSB.EDU NCGIA@VOODOO.BITNET
PRICE: $20.00; includes one HD 3.5" diskette

NCGIA TOPIC: Spatial primitives; data models; accuracy; map projections and coordinates; data structures; algorithms

APPLICATION AREA: Technical issues in GIS

GEOGRAPHIC LOCATION: Not applicable

EDUCATIONAL ROLE: These exercises are designed to support the *NCGIA Core Curriculum Volume 2: Technical Issues in GIS.*

COMPLETION TIME: Most exercises can be completed in 2-4 hours.

HARDWARE/SOFTWARE: All exercises require a PC. Five of the exercises use Microsoft Quickbasic, and two require pcARC/INFO. All necessary Quickbasic code is provided, and can be adapted to another version of BASIC or to another language entirely if desired.

DATA REQUIRED: All necessary source code and data, as well as digital versions of the exercise text, are provided on a single 3.5" HD diskette.

GENERAL DESCRIPTION:

GIS Laboratory Exercises, Volume 2, consists of a set of seven intermediate level exercises which were designed to support the *NCGIA Core Curriculum Volume 2: Technical Issues in GIS.* Some of the exercises involve running and writing programs in Microsoft Quickbasic, and two of the exercises require pcARC/INFO. The following is a brief description of each exercise:

- Coordinate Systems: coordinate conversion, distance calculation, automated map drawing (Quickbasic)
- Vector Data Structures 1: exploration and modification of algorithms--polygon area, point-in-polygon, line intersection (Quickbasic)
- Vector Data Structures 2: variations of topological overlay (pcARC/INFO)
- Raster Data Structures: run length encoding, Morton cell indexing (Quickbasic)
- Surface Modeling with DEMs and TINs: DEM interpolation and display, the TIN data structure (Quickbasic, pcARC/INFO)
- Kriging and the semivariogram: construction of the semivariogram, interpolation with kriging (Quickbasic)
- Uncertainty, fuzzy logic, and relational databases: using fuzzy logic to manipulate uncertainty in spatial data (pcARC/INFO optional)

Current as of: July, 1991

TITLE: Basic Cartographic Modeling in IDRISI

CONTRIBUTOR: Laurence W. Carstensen Jr.
Department of Geography
Virginia Tech
Blacksburg, VA 24061-0115
Internet: CARSTENS@VTVM1.CC.VT.EDU

SOURCE: Full text below

NCGIA TOPIC: Suitability analysis

APPLICATION AREA: Terrain Analysis, resource/habitat management, construction engineering

GEOGRAPHIC LOCATION: The students work in any geographic area they choose. Each project is unique.

EDUCATIONAL ROLE: These are the first experiences with IDRISI in the course. They build in degrees of difficulty as the students go through them.

COMPLETION TIME: The models and associated map production are completed in a 10 day period by groups of two to three students working together.

HARDWARE/SOFTWARE: These are run in IDRISI on PC-XT's at present. Clearly they will be much more palatable on 386 PC's, but will run on any IBM platform.

DATA REQUIRED: One image of elevation with at least 500 feet of relief, and one image with at least one light-duty road and 5 stands of forest.

GENERAL DESCRIPTION:

This project allows students to do some simple terrain analysis on an area of their own choosing. By using terrain as a basis, they need digitize only one coverage, and IDRISI generates all additional requirements. There are three parts to the project: 1) Solar Energy Generating Stations 2) Hugag Habitats - adapted from the original by Joseph Berry, and 3) Forest Fire towers and road building. Students begin by digitizing a 10,000 x 10,000 foot area from any topographic map of their choice. The area must have 500' of vertical relief, at least 1 light-duty or better road, and at least 5 separate stands of forest.

DETAILED DESCRIPTION:

Solar Energy

Determine the most suitable sites for ground based (not visible) solar power generation. These sites would have aspects facing into the SE-SW quadrant 135 - 225 degrees, and exhibit slopes approximately equal to the latitude at the center of your study area.

Hugag Habitat

(Hugags were invented by J.K. Berry) -- (The project has been adapted by me). Though the Hugag may not be native to your region, you are intrigued by its unusual nature, and decide to study your area for potential habitats. The following is known:

The Hugag is a strange beast that spends its entire life inside a single forest stand. Research has found that the creature prefers large stands and that it prefers stands that have more irregular shapes (non-circular are more interesting) to those that are dull and round. It is terrified of automobiles, therefore it never travels within 500 feet of a road! Large stands that are bounded by a road, or that contain a road are to be reduced in size by this effect. If a road crosses a stand, you must split it into two stands, because the road effectively reduces the habitat. Prepare a map of your study area that illustrates possible habitats for hugags. Your map will rank habitats according to the following requirements of the beast:

- Stand Size: weight of +.1 per acre

- Stand Irregularity: use 2 * the inverse of the value from the irregularity function. (NOTE: Use the IDRISI CRATIO module as the irregularity function.)

For example, for a stand of size 100 acres with a CRATIO value of 0.5, the weighting scheme would go like this: (100 x 0.1) + (1/0.5 * 2) = 10 + 4 = 14.

- Finally, female Hugags, because of their "kneeless" legs are able to lay their eggs safely only in special nests built on rather steep slopes (> 30 degrees). Eliminate all stands that do not have at least one "birthing cell" and produce a second display ranking those stands that are left, and the locations of the birthing cells.

Fire tower Siting

Your area is in need of fire protection and you wish to set up a ranger tower that will provide the best view of the entire area. You must locate the tower in the cell that provides a maximum view of the area, and may build it up to 300 feet tall if you need. (A shorter tower in a better location is better!). You should devise a system using IDRISI to assist you in determining the optimal viewing location. Trial-and-error is not good enough! Minimum height for the tower is 100 feet (to get above the trees). To show that you have selected a good site, calculate the percent of the total area that can be seen from your tower and the percent of the forested land that can be seen from your tower.

After the tower is located, you must locate the lowest cost access road from an existing road in the study area. The road will run up the gradient of each cell. Thus, in determining the cost of this road, slope (gradient) is the key factor (because you must use switchbacks inside steep cells), but so also is the presence of forests:

cost = slope * slope + 1000

Open land: no additional cost above that for slope. Forested land: 2 times the slope cost for clearing land. Prepare a map of the viewshed from your firetower by showing the viewed area over the elevation element. Similarly prepare a map of your road route showing both the existing roads, the access road, and the forest stands over the elevation element. Finally, determine the total cost to build the road to access the tower.

Current as of: June, 1991

TITLE: Siting of a Downhill Ski Area

CONTRIBUTOR: Laurence W. Carstensen Jr.
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Blacksburg, VA 24061-0115
Internet: CARSTENS@VTVM1.CC.VT.EDU

SOURCE: Full text below.

NCGIA TOPIC: Relationships; resource management; modeling environmental processes; suitability analysis

APPLICATION AREA: Recreation resource management

GEOGRAPHIC LOCATION: Students' choice

EDUCATIONAL ROLE: Intermediate/advanced

COMPLETION TIME: Students worked in groups of 2-3 on this project for several days.

HARDWARE/SOFTWARE: IDRISI (a later version which has the REGRESS module)

DATA REQUIRED: Topographic map (from which elevation points are sampled); climatic data (gathered from published reports).

GENERAL DESCRIPTION:

This project allows students to do more sophisticated terrain analysis on an area of their own choosing. By using terrain as a basis, they need digitize only one coverage, and IDRISI generates all additional requirements. The objective of the project is to site a ski area on a 1:24,000 topographic quadrangle. Student must sample a quadrangle map to obtain a good point set, then the terrain is interpolated either by IDRISI, SURFER, or even by SYMAP. If not done by IDRISI, then some instructor-provided software is needed to reformat the data as an IDRISI image file.

DETAILED DESCRIPTION:

Collect data for the month of January for all climate stations within 100 miles of your topographic map. You need at least 10 stations, and they should occur over as wide a range of elevations as possible. These data are found in [your campus] library. Be sure to collect long term climatic norms, not data for only a single year. To model snow potential, collect:

- Average maximum daily temperature
- Average minimum daily temperature
- Average precipitation for the month
- The elevation at each recording station

Now we will use the data collected from the climate stations to estimate values over the entire study region. Compute a maximum daily temperature regression model for your region by estimating the temperature for every elevation in your study area. Following your instructor's directions, use the REGRESS module in IDRISI to compute a model which uses elevation (X) to predict the maximum daily temperature (Y).

Note the slope coefficient and the Y intercept values for the regression. The Y intercept value gives the temperature in your region at sea level. If, for example:

$$Y = -.005X + 31.5$$

then the temperature decreases (-sign) by 0.005 degrees F per foot of elevation change, and at sea level (X = 0), the temperature is predicted to be 31.5 degrees F. In IDRISI, use the results of this model with the SCALAR module to generate a maximum temperature image for your region. (ALSO, note the R-SQUARE value to determine how well your model predicts temperature.)

Compute a minimum temperature model in the same manner, and use this model to create a minimum temperature image for your region as you did above.

Next, run a regression of precipitation versus elevation to check on the R-SQUARE value. If it is strong enough to warrant use, then compute the model for precipitation in a similar manner. As it probably won't be a strong relationship, you may build a precipitation model using an assumed effect of elevation. You may assume that precipitation increases by 10% per 1000 feet of elevation increase.

$$Y = 0.0001(\text{mean station elev - cell elev}) * (\text{mean station precip.}) + \text{mean station precip.}$$

Create a snow cover map (totals in inches) by using the three basic images from above with the following assumptions:

SNOWFALL: each inch of precipitation is equal to 10" of nice fluffy powder if the maximum daily January temperature is less than 32 degrees; or is equal to 5" of snow if the minimum is below 32 degrees and the maximum is over 32 degrees; or no snow at all if the minimum is over 32 degrees.

MELTING: occurs if temperatures are above freezing. Because of solar radiation, aspect will affect the local daily average (MAX+MIN)/2 temperature:

ASPECTS	ALTER TEMPERATURE BY
0 - 45 degrees	-2 degrees F.
46 - 90 degrees	0 degrees F.
91 - 135 degrees	+1 degree F.
136 - 180 degrees	+3 degrees F.
181 - 270 degrees	+5 degrees F.
271 - 315 degrees	0 degree F.
316 - 360 degrees	-2 degrees F.

Melting occurs, if adjusted daily mean temperatures are above 32 degrees, at a rate of 0.5" per day per degree above 32 F. For example, a cell with an adjusted temperature of 35 degrees will lose 46.5" (3 degrees * 31 days * 0.5") of snow in the month due to melting; a cell with an adjusted maximum temperature of 32.6 degrees will lose 9.3" (0.6 degrees * 31 days * 0.5")

MACHINE SNOW: can help! You can install snowmaking machinery to assure more snowfall (though it is expensive), provided that the daily minimum temperature is below 32 degrees. You can make 5" of snow per night, or 15" of snow per entire day. You may make snow only at night if the maximum daily temperature is over 32 degrees, or all day long if the maximum is below 32 degrees. (You may want maps of snow cover both with and without snow making to indicate to the investors the real need for snowmaking.)

Using the snow cover model you have created, select one best site based upon ample snow (you decide what is enough), and the correct gradients. You will need a set of slopes ranging from 3 to 45 degrees in gradient.

Using the site you feel will be best suited for a ski area (disregard land ownership problems), digitize a small, local DEM of that site that will provide accuracy to 50 foot cells. Enter enough data points to be accurate at 50 feet and interpolate your proposed terrain using INTERPOL. Then, set up a second database and plan for the best locations of the following features:

- A mountain top lodge (preferably with a good view as determined by your topo sheet scale map)
- A parking lot for 100 cars or more (assume 200 sq. feet per car)

At least one slope in each of the following classes (if possible):

- ADVANCED - steepest portion is over 35 degrees
- INTERMEDIATE - steepest portion over 25 degrees, but less than 35 degrees
- BEGINNER - steepest portion under 25 degrees
- SCHOOL - steepest portion under 15 degrees
- Any other facilities you feel will be needed (lift lines, etc.)

NOTE: You may find the digitizing routine in COLOR helpful in locating ski slopes. Prepare a full set of maps to convince the committee of investors (the rest of the class) that the snow is plentiful, the lodge is scenic (might book up all summer too!) and that they should spend their money on this project. One map should show the entire resort layout over the elevation matrix. Include maps from both the databases.

Current as of: June, 1991

TITLE: Attribute Data and Relational Databases as GIS Components

CONTRIBUTOR: Laurence W. Carstensen Jr.
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SOURCE: Full text below. Locally-written software (source code) used in this exercise can be obtained from the contributor either directly through electronic mail or through the postal system, provided you send a blank floppy diskette.

NCGIA TOPIC: Data structures; data integration; suitability analysis

APPLICATION AREA: This project is open ended and students have gone in many different directions. It is an exercise in data integration, registration, digital data files, and creativity in suitability modelling at the county level. Similar projects could be devised around most any premise that makes use of several data sources. It makes very clear the role of the attributes in the RDBMS in making GIS models.

GEOGRAPHIC LOCATION: The students work in any geographic area they choose. Each project is unique.

EDUCATIONAL ROLE: This project is the final in the GIS class.

COMPLETION TIME: The models and associated map production are completed in a 4 week period by groups of two to three students working together.

HARDWARE/SOFTWARE: PC; IDRISI; dBase III+; programs written by the contributor

DATA REQUIRED: County boundaries for one US state, plus project-dependent attribute data (US Geodata's County-City Handbook contains over 200 variables). The basic data entry requirements take very little time if all the files and programs I use are available. The implementation of the additional data varies from group to group (Some use more than just interstates, some use national forests as amenities, universities, etc. Each of these has to be digitized from the highway map.) Still only 2-3 hours should be required.

GENERAL DESCRIPTION:

This project allows students to look for the best counties in which to locate a high-tech industry seeking "amenities." The project requires that students work in both IDRISI and in dBase III+ to complete the project. Data are brought together from several sources and must be registered together. Data sources are many!! I suggest that the project be altered to fit with whatever files are locally available at a given university. Some creativity is required in order to allow local resources to be used. Some of the software listed has been written by the contributor for the project. Comments in [] are warnings of requirements specific to local conditions, etc. at Virginia Tech.

DETAILED DESCRIPTION

This project makes evident the utility of a relational data base in conjunction with a GIS. It will also illustrate the use of data from several existing digital sources.

Data collection

NOTE: This section is highly site specific. It is included as an example of some data collection alternatives.

Select a state of interest that contains between 30 and 70 counties. The number of counties is not really a major issue, but this range should work well without a great deal of processing time. You need at least 30 counties to make the job interesting. Retrieve the counties from the DIMECO file using POLYVRT. (The state could be digitized as a last resort!). Use an ALBERS projection at a scale of 1 inch to 10 miles (1:633,600), and be certain that you note all projection parameters (standard parallels, origin location, central meridian)! Upload the resulting base data in CALFORM format to a floppy disk file. Use a high level (8-10) of generalization for this step as you will be rasterizing the file to a relatively coarse resolution.

Using the program CALLID.BAS [locally produced], convert the CALFORM file to an IDRISI vector file for use by your rasterization program.

Rasterize the file using DOCUMENT V, INITIAL, POLYRAS being sure to add at least one row and column around all four edges of the state to allow editing of the file later to add important features that are not in the state, but are near it.

Use your final program from computer cartography [may need a local substitute, or may be able to obtain the three points without the map. Here in the prerequisite course, the students have already written this code] to plot a copy of the base data directly from the CALFORM file. The scale is not significant. After you have a plot, determine the exact coordinates of three prominent points in the state outline (points you feel would be evident on any map of the state) and write their coordinates on the plot. These points should come from the lower left part of the map, the lower right portion, and from the upper right (approximately). This sheet will give you points for a three point orientation so you can digitize additional data for your database as needed.

Run the GETELEV program [locally written by the contributor] on your userid to obtain the needed elevation data for your state. The data are the latitude and longitude for every populated place in the state that contains an elevation value. These data are from the GNIS tape of populated places. Retrieve the data file from your minidisk to a floppy disk. These data will be used to create a terrain model of your state. If you wish, (as the locations are all populated places, which make for a poor sample), you may add data to the back of the file by determining additional latitudes, longitudes, and elevations from topographic maps. Remember that you are working with coarse data, so the model doesn't have to be too great!

The problem

Your assignment is to work with HIGH-TECH incorporated. Your state government has already agreed to massive tax incentives to get them to locate in the state. It is your job to assist them in deciding (at the county level) where to locate. The company has requested that you rank the counties in the state, and provide maps depicting the locations of desirable areas. As their management level employees are all highly paid, and their business is relatively mobile (it can locate anywhere it can get a phone line), their major concern is to live in an area of "high amenities" to keep their employees happy. They are not familiar with your state especially, and thus are not too specific as to the amenities you can offer, but they have mentioned that they consider:

- climate factors (a 4 season climate),
- terrain factors (interesting terrain), and
- proximity to water recreation (ocean, lake, major river)

to be amenities. In addition, they must have:

- reasonable proximity to an interstate highway,
- a relatively poorly-educated workforce (to pay lower wages), and
- reasonable county tax rates.

Determine the county rankings by looking at the data above, and at other variables you feel are significant to rating an area as having high amenities. You must produce a report using dBASE III+, and a set of maps that will illustrate your findings and your methodology

To complete this project, you will need to determine a strategy for determining the level of amenities. In this strategy, you will need to use IDRISI to determine certain of the attributes of county units, and you will use dBASE III+ to compute the scalings for each county and to print the final report. The DBIDRIS program in IDRISI will make the passing of data back and forth relatively painless. I also have several aids for you:

- dBASE III+ database files from the county-city databook. [available from US Geodata] You need only copy them to use them. As they contain well over 200 variables for each county, you should have more than enough data to load into your attribute files.
- A program called PROJECT to create an IDRISI file of data points for data you collect that have locations given as latitude, longitude pairs (such as climate data!) [this is a program written by the contributor to register lat, long data to the original DIMECO county data].
- A second version of the PROJECT program is called PROJGNIS, and is to be used with the elevation data you have collected. The file from GETELEV is already in the correct format. The only difference is that PROJGNIS allows a 12 character place name to appear after the data items [this is also a local program].
- A system for adding information to the database which is not available in latitude, longitude: Using the plot of your state on which you have located and marked three known points, you can use any map of your state and do a three point orient on the digitizer. The results are not as good as using latitude and longitude, but they are reasonable provided the cell size is several miles and maps are of reasonable accuracy!!. Errors will occur because of projection differences, but will not be significant for a relatively small area like a state. You can use MAPDIGID [local program to digitize on an ALTEK digitizer and get IDRISI .VEC files] to add information that is needed.
- Highway maps for each state depict water and interstates, etc.

Be prepared in lab to present your findings to the board of directors of HIGH-TECH (the rest of the class). You should have a completed printed report from dBASE III+ that ranks the counties according to suitability and maps to back up the results.

Current as of: June, 1991

TITLE: Locating Sawmills in Southern Thailand

CONTRIBUTOR: Dick Scott
Department of Geography and Anthropology
Glassboro State College
reprinted from the *Proceedings on the Third Workshop on GIS in Higher Education*, Ohio State University, June 8-10, 1990

SOURCE: Full text below

NCGIA TOPIC: Resource management; suitability analysis

APPLICATION AREA: Forestry; Urban/rural planning

GEOGRAPHIC LOCATION: Southern Thailand

EDUCATIONAL ROLE: Beginning to Intermediate, depending on the amount of supplementary instruction included

COMPLETION TIME: 1-2 hours

HARDWARE/SOFTWARE: OSU-MAP, small version, running on any suitable hardware platform

DATA REQUIRED: The Thai database, which is included with the OSU-MAP program

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GENERAL DESCRIPTION: This entry should be immediately useful to users of OSU-MAP, as it makes use of one of MAP's included databases. The following problem description could be used as it stands for intermediate students, or the instructor could add supplementary information to the exercise so that it could be completed by students less familiar with GIS concepts and the OSU-MAP package.

DETAILED DESCRIPTION:

Thailand is a developing nation that wants to follow a path of balanced economic growth. The region for which you work as a planner has a significant forest resource along with a scenic landscape. Your job is to identify sites that are suitable for locating sawmills and yet will not interfere with the scenic view of the countryside. Sawmill sites must meet the following constraints:

1) So that the harvested lumber can be transported easily, the site must be within 2.5 kilometers of the main roads. Here main roads are defined as one and two lane hard and loose roads.

2) The potential sites for sawmills must be located within areas that are covered with evergreen forest.

3) The sites for sawmills must not be visible from any point on the main road.

In solving this problem you will use the LANDUSE, ELEVATIO, and ROADS layers from the THAI database. In addition, you will need to use some or all of the following commands:

COLOR	SHADE
RENUMBER	LABEL
SPREAD	RADIATE

CROSS LIST
DESCRIBE

When you have completed the analysis, hand in a brief essay in which you explain the approach you took in solving the problem and describe the results obtained. In addition, hand in the following maps:

1) A map showing the main roads surrounded by the 2.5 kilometer corridor along with all areas of evergreen forest.

2) A map showing areas that are visible and invisible from the main roads.

3) A map showing the joint occurrence of sites that are within the corridor vegetated by evergreen forest, and invisible from the roadway.

Current as of: June, 1990

TITLE: The von Thünen Agricultural Land Use Model

CONTRIBUTOR: Robert Cromley
University of Connecticut
CROMLEY@UCONNVM.BITNET

SOURCE: Full text below

NCGIA TOPIC: Modeling socioeconomic processes

APPLICATION AREA: Agricultural location theory

GEOGRAPHIC LOCATION: Hypothetical

EDUCATIONAL ROLE: Intermediate/Advanced (as written)

COMPLETION TIME: A few hours

HARDWARE/SOFTWARE: Any raster GIS with the necessary functions

DATA REQUIRED: None

GENERAL DESCRIPTION:

This exercise was originally written to be used with IDRISI, however other raster systems should be capable for this task. As written, the exercise assumes a good amount of knowledge on both von Thünen's model and the workings of the GIS used to solve the problem. A bit more introduction and hand-holding would easily adapt this lab to an introductory level.

DETAILED DESCRIPTION:

For this exercise, you will use GIS and cartographic modeling techniques to solve a basic geographic model from agricultural location theory - the von Thünen Land Use Model. In this model, we will try to determine which agricultural activity should be found at each location on an isotropic plain. The activity that should occupy a parcel of land will be the one that generates the highest locational (or economic) rent. This rent value is determined by the following equation:

$$R = E(p - a) - Efk$$

where **R** is the locational rent at a given distance from the market; **E** is the yield per unit of land for a given activity; **p** is the market price per unit of product; **a** is the production cost per unit of product; **f** is the freight rate per unit-mile for a given activity; and **k** is the distance a parcel of land is from the market. Transport costs are incurred over an isotropic plain. The objective of this exercise is to determine which of three given crops (see the table below for each crop's parameters) should be grown at each pixel on the plain. It may be the case that at some locations none of the crops should be grown because the locational rent for all crops is negative. Set IDRISI so that the cell measurement units are miles (mi), and each cell measures one mile on a side. There are different ways to solve this problem using IDRISI but one alternative is given below.

Parameter	Crop I	Crop II	Crop III
E	5 tons	8 tons	20 tons
p	$2.08 per ton	$1.70	$0.63
a	$1.00 per ton	$1.10	$0.54
f	$0.01 per ton/mile	$0.005	$0.0005

One way to complete this exercise is to follow these steps:

1) Create a point location surface having 100 rows and 200 columns. The market should be located between rows 48-52 and columns 1-4. Use the INITIAL and UPDATE commands to create this surface.

2) In a series of steps, create a rent surface for each crop. (Hint: first plug your parameters into the rent formula and simplify--use the DISTANCE command to compute the distance from each pixel to the market. Next, use the SCALAR command to create the rent surface for each crop.)

3) Combine the three individual rent surfaces to form the maximum possible rent surface. Use the OVERLAY command to create this surface in a pairwise manner.

4) Identify the crop associated with the maximum rent at each location away from the market. Create a legend that identifies the land use at each location.

   Using the OVERLAY command, in sequence, subtract the rent surface of each crop from the maximum rent surface. This represents the opportunity cost associated with using a given crop rather that the crop generating the highest rent. Land where the opportunity cost is positive signifies a better land use can be found than the current crop and land where the opportunity cost is zero signifies that the current crop is the best land use for that area. The area having a value of zero is then reclassified and identified as being the corresponding crop. The individual crop layers can then be composited together using the OVERLAY command.

5) How many hectares are devoted to each crop? (Use the AREA command)

6) What is the total amount of unused land in hectares? (This is land that had a negative value in the maximum rent surface)

7) What is the total agricultural yield for each crop?

Other modifications to the basic model can be incorporated such as changes in the crop parameters and the addition of new markets and/or a road network.

Current as of: June, 1991

TITLE: Introduction to Cartographic Modeling--The Weber Model

CONTRIBUTOR: Robert Cromley
University of Connecticut
CROMLEY@UCONNVM.BITNET

SOURCE: Full text below

NCGIA TOPIC: Modeling socioeconomic processes

APPLICATION AREA: Industrial location theory

GEOGRAPHIC LOCATION: Hypothetical

EDUCATIONAL ROLE: Intermediate/Advanced (as written)

COMPLETION TIME: A few hours

HARDWARE/SOFTWARE: Any raster GIS with the necessary functions

DATA REQUIRED: None

GENERAL DESCRIPTION:

This exercise was originally written to be used with IDRISI, however other raster systems should be capable for this task. As written, the exercise assumes a good amount of knowledge on both Weber's model and the workings of the GIS used to solve the problem. A bit more introduction and hand-holding would easily adapt this lab to an introductory level.

DETAILED DESCRIPTION:

In this exercise, we will use GIS and cartographic modelling techniques to solve a basic geographic model from industrial location theory - The Weberian Least Cost Transport Site. We will try to ascertain the 'optimal' location of production that minimizes total transport costs over an isotropic plain. The total cost of production is assumed to be the sum of the costs of procuring raw material 1 (RM1) and raw material 2 (RM2) and distributing the finished product to market. In Weber's model transport costs are assumed to be a function of weight X distance.

Complete each of the following steps:

1) Create a point location surface having 300 rows and 500 columns for each raw material site and the market. RM1 should be located between rows 50-56 and columns 100-106; RM2 should be located between rows 240-243 and columns 110-114; the market should be located between rows 160-170 and columns 465-475.

2) Using a weight of 2 for RM1, 3 for RM2 and 2 for the market, calculate the three individual cost surfaces.

3) Combine the three individual surfaces to form the total transport cost surface. Where is the optimal location of production?

4) Use a weight of 2 for RM1, 2 for RM2 and 4 for the market (the case of pure inputs). Where is the optimal location of production?

5) Use a weight of 2 for RM1, 5 for RM2 and 2 for the market (the case of very gross raw materials). Where is the optimal location of production?

6) Using the weights in step 2, is it worth moving the production site from the MTP to a site located at row 150, column 300 where per unit labor costs are $50. cheaper (justify your answer)?

Save the final map for each final answer.

Current as of: July, 1991

TITLE: Market Area Analysis

CONTRIBUTOR: Robert Cromley
University of Connecticut
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SOURCE: Full text below

NCGIA TOPIC: Dividing the world; modeling socioeconomic processes

APPLICATION AREA: Marketing; economic geography

GEOGRAPHIC LOCATION: Hypothetical

EDUCATIONAL ROLE: Intermediate/Advanced (as written)

COMPLETION TIME: A few hours

HARDWARE/SOFTWARE: Any raster GIS with the necessary functions

DATA REQUIRED: None

GENERAL DESCRIPTION:

This exercise was originally written to be used with IDRISI, however other raster systems should be capable for this task. As written, the exercise assumes a good amount of knowledge on both market analysis and the workings of the GIS used to solve the problem. A bit more introduction and hand-holding would easily adapt this lab to an introductory level.

DETAILED DESCRIPTION:

In this exercise, you will use GIS and cartographic modelling techniques to determine the boundaries between central markets. The exercise illustrates the effects of spatial price funnels resulting from an f.o.b. (free-on-board) pricing system. Assuming that customers will purchase their products from the seller having the lowest spatial price, the market boundary between two sellers is where the spatial price of two sellers is equal. The spatial price for a seller is determined by the following equation:

$$SP = p - fk$$

where, **SP** is the spatial price of a certain commodity at a given distance from a seller; **p** is the market price per unit of product; **f** is the Transportation charge per unit-mile for a given product; and **k** is the distance a location is from the seller. Transport costs are incurred over an isotropic plain. The objective of this exercise is to determine the market areas associated with two sellers of a single homogeneous product. Assume that each pixel measures one mile on a side.

Parameter	Seller I	Seller II
p	\$20. per unit	\$20.
f	\$0.10 per unit-mile	\$0.10

To complete this exercise complete each of the following steps:

1) Create a point location surface having 100 rows and 200 columns. Seller #1 should be located at row 50, column 50 and Seller #2 should be located at row 50, column 150. (Use the INITIAL and UPDATE commands to create this surface.)

2) In a series of steps create a spatial price surface for each seller. (hint: first plug your parameters into the spatial price formula and simplify.)

   First, use the DISTANCE command to generate the distance each pixel is from an individual seller. Next, use the SCALAR command to create the spatial price surface for each seller.

3) Combine the two individual spatial price surfaces to form the minimum possible spatial price surface. Use the OVERLAY command to create this surface.

4) Identify the market area associated with the seller at each of the two locations. Create a legend that identifies the market area associated with each seller.

   Using the OVERLAY command, in sequence, subtract the spatial price surface of each seller from the minimum spatial price surface. This represents the oppor- tunity cost for each consumer associated with purchasing the product from a given seller rather than the sellers offering the lowest spatial price. Areas where the opportunity cost is negative indicate that a lower spatial price can be found than the current seller. The area having a value of zero signifies that the current seller is the best for that area. The area having a value of zero is then reclassified and identified as being the market area corresponding to the current seller. The individual market areas are then be composited together using the OVERLAY command.

5) How large are the market areas associated with each seller? (Use the AREA command.)

6) Assume that Seller #2 nows charges a market price of $25.00/unit. Repeat steps 2 to 5. What is the change in the shape of the market boundary between each seller?

7) Next assume that Seller #2 also charges a new transport rate of $0.30 per unit-mile. Repeat steps 2-5. What is the change in the shape of the market boundary between each seller?

TITLE: Using ARC/INFO to Teach Basic Concepts about Spatial Coordinates

CONTRIBUTOR: Gwen MacNairn
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380 New York Street
Redlands, CA 92373

SOURCE: Full text below

NCGIA TOPIC: Map projections and coordinates; accuracy

APPLICATION AREA: Computer cartography, map projections

GEOGRAPHIC LOCATION: None

EDUCATIONAL ROLE: Introductory/intermediate

COMPLETION TIME: A few hours

HARDWARE/SOFTWARE: ARC/INFO, running on any platform

DATA REQUIRED: AML code is provided below which creates the global world graticule and Tissot's indicatrixes which are used in the exercise.

GENERAL DESCRIPTION: This exercise illustrates the concepts involved with projecting spatial data onto a planar surface. A basic world graticule is created within an AML, and students project this dataset in various ways, focusing on the distortions and preservations of map properties associated with each projection used.

Current as of: June, 1991

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Using ARC/INFO to Teach Basic Concepts about Spatial Coordinates

Abstract: This paper was designed for the Higher Education User Group (HEUG) and stresses the value of learning about a particular process by examining the results. Due to limitations in time and money, it is recognized that a good exercise uses data already available, provides quick results and emphasizes cognitive conclusions rather than how to use GIS software. The topic being presented in the form of an exercise is how spatial attributes of a Tissot indicatrix can be used to illustrate properties of equal-area projections. The discussion exercises can be used by anyone and the hands-on exploration can be performed in a computer lab environment running the ARC/INFO software.

INTRODUCTION

Having a commercial GIS available in an academic classroom/computer lab environment is a relatively new phenomenon. It enables students to learn GIS technology and experiment with a particular application. These are important activities, but what about exploring basic concepts associated with spatial data?

Several ARC/INFO users involved in higher education have asked for some ideas to help create exercises for use in their GIS courses. To be most useful, the following criteria have been identified and used to create the exercises presented in this paper.

- The input data is readily available, you create it yourself.
- The results can be obtained quickly by using prepared projection files and an AML.
- The purpose is to better understand a concept rather than how to use ARC/INFO.

Choosing a topic that could be of use to everyone in the Higher Education User Group (HEUG) followed this progression:

- Technical issues in GIS
  - Coordinate systems and spatial coordinates
    - Maps display projected data
      - Projections distort spatial coordinates and measurements
        - Geographic analysis often requires area measurements
          - A GIS can be used to calculate areas
            - Equal-area projections
              - Create a Tissot indicatrix
                - Project it into two different equal-area projections
                  - Examine the results

As more universities acquire ARC/INFO, the ability to create and share common classroom exercises becomes a real possibility. Here is a beginning, an exercise reinforcing basic concepts that also fits into the NCGIA Core Curriculum (1989). You may use some of it, all of it, or expand on it in a way that can help your students better understand map projections, their properties and their units of measure.

BACKGROUND

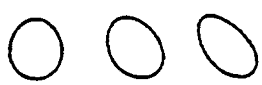
Properties of map projections

Before beginning, students should know that when spatial data is projected onto a planar surface, the following properties are distorted in some way, and that the amount of distortion varies between projections.

- Area
- Shape
- Distance
- Direction

Tissot Indicatrix

One way of associating properties of spatial data and how they are distorted with a variety of different map projections is to use a Tissot indicatrix. Tissot analyzed planar distortion when map data was projected using angular measurements (1881). A circle on the earth, called an indicatrix, can be projected onto a map. The results will be a circle for conformal projections and an ellipse for all others. The Tissot indicatrix can be used to indicate the the amount of distortion in angles and areas, as indicated in the table below.

Type of projection	Spatial results	Description
Conformal		Circular shape is maintained by increasing the area
Equal-Area		Area is maintained but the circles become elliptical

Projections

ARC/INFO provides a number of different projections, nine of which are equal-area. Listed below are the names of these projections, what kind of data they are generally used for and their ARC/INFO keyword used when performing the projection.

Equal-area projections used for global data:

• Eckert IV	• ECKERTIV
• Eckert IV	• ECKERTVI
• Hammer-Aitoff	• HAMMER-AITOFF
• McBryde-Thomas	• FLAT_POLAR_QUARTIC
• Mollweide	• MOLLWEIDE
• Sinusoidal	• SINUSOIDAL

Equal-area projections used for continents or data from even smaller regions:

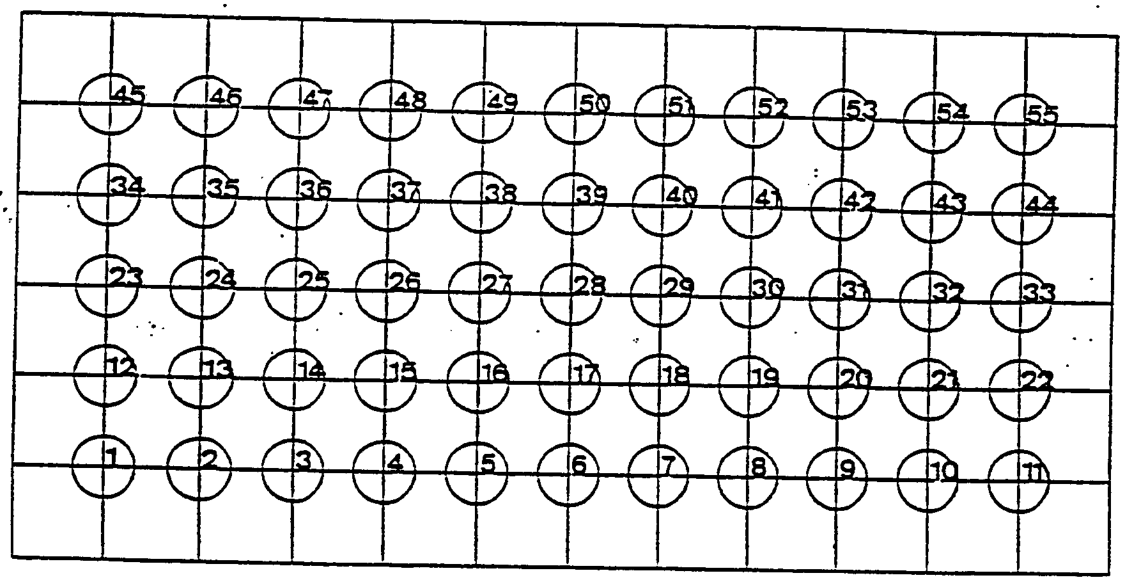
• Albers Equal-Area Conic	• ALBERS
• Cylindrical Equal-Area	• CYLINDRICAL
• Lambert Azimuthal Equal-Area	• LAMBERT_AZ

HOW TO USE

The exercise portion of this paper presents a series of spatial results and attributes, and then asks related questions. The best way to use this material, is after a lecture on map projections. The questions can be done in class or taken home – done in groups or individually. The answers should be accompanied by a group discussion. Although the exercises use only two Equal-area projections – SINUSOIDAL and ALBERS – interested students can choose to do more.

EXERCISE 1: Geographic units of measure - latitude and longitude

When displayed on a graphic screen, a Tissot indicatrix and a 30° graticule used for a global reference will look like this:



Data which you can create – a Tissot indicatrix and a global graticule

The polygon attributes as listed in the PAT will look like this:

$RECNO	AREA	PERIMETER	CIRCLE#	CIRCLE-ID
1	-17,190.680	3,451.319	1	0
2	312.558	62.751	2	45
3	312.558	62.751	3	46
4	312.558	62.751	4	47
5	312.558	62.751	5	48
6	312.558	62.751	6	49
7	312.558	62.751	7	50
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
53	312.558	62.751	53	8
54	312.558	62.751	54	9
55	312.558	62.751	55	10
56	312.558	62.751	56	11

Using the information in the polygon attribute table (PAT), answer the following questions. (Note: the number in the diagram corresponds to the CIRCLE-ID in the PAT.)

The area for each circular polygon is 312.558 square ____________________

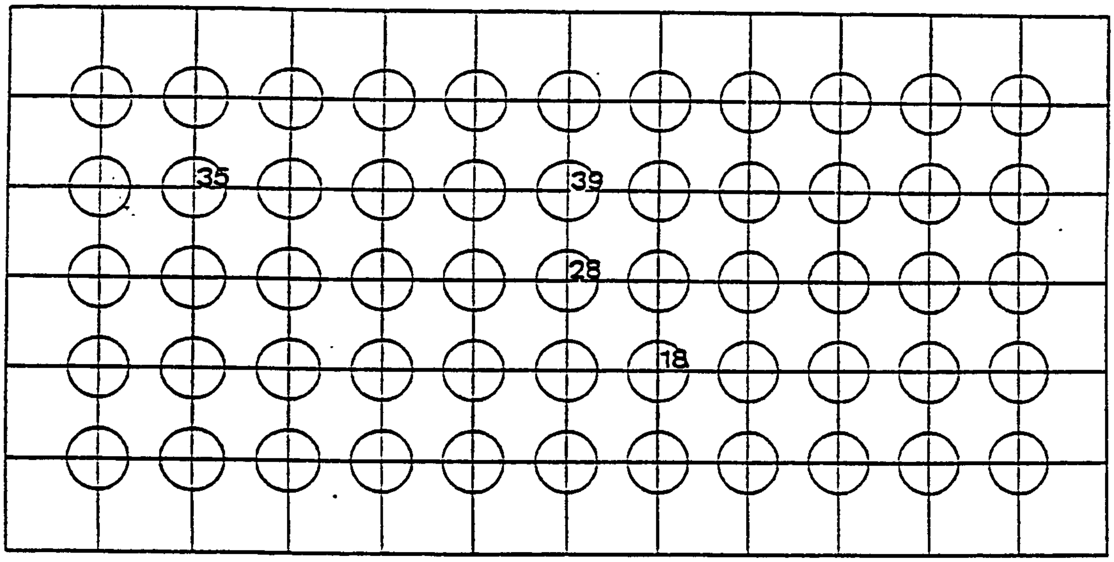
Is this a significant measurement ? ____________________

The central circle is located on the Greenwich Meridian (0°) and the Equator (0°).

The CIRCLE-ID for the central circle is ____________________

EXERCISE 2: Predicting spatial results for equal-area projections

When a Tissot indicatrix and corresponding graticule are displayed on a graphic screen at the same time, degrees of latitude and longitude are used like a coordinate system.



Starting data set - a Tissot Indicatrix and a global graticule

When this data is projected into an equal-area projection, which of the following statements describes what you would expect when examining the calculated values of area?

a) Since it is an equal-area projection, I would expect the area of all circles to be equal.

b) I would expect an equal-area projection to have limitations, with only the area of all circles along the same meridian to be equal.

c) I would expect an equal-area projection to have limitations, with only the area of all circles along the same parallel to be equal.

Now more specifically, using the CIRCLE-ID values, predict which of the following polygon records would list approximately the same values for area?

Circles along the same longitude (e.g., 28 = 39) ?____________________

Circles along the same latitude (e.g., 35 = 39) ? ____________________

Circles along corresponding parallels, North and South (e.g., 18 = 39) ?____________

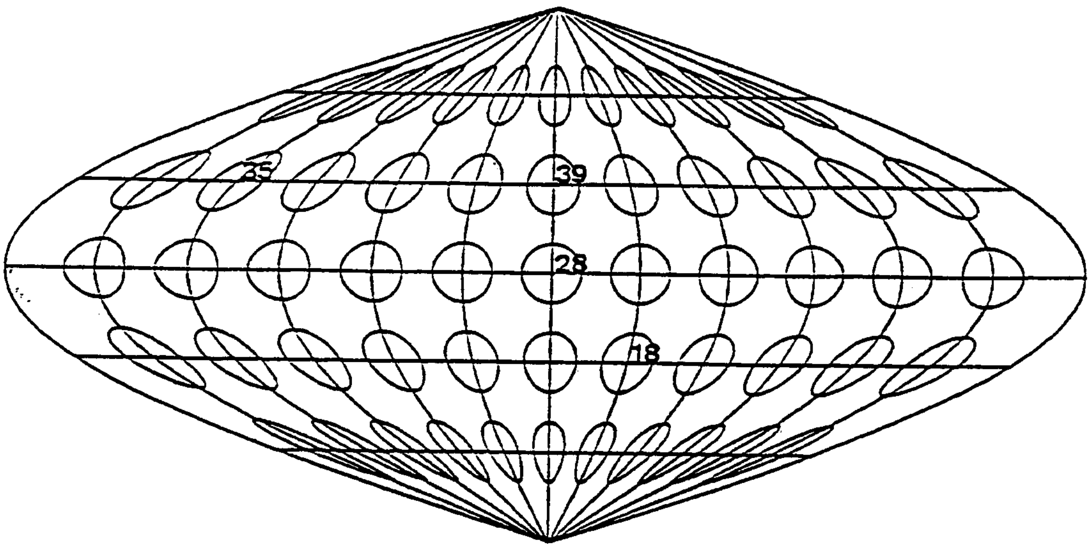
EXERCISE 3: Spatial data and equal-area projections

Questions to think about and then discuss. (Note: Use the diagrams on the next page.)

Describe general characteristics of equal-area projections.
(e.g., In equal-area projections, which areas are "equal"?)

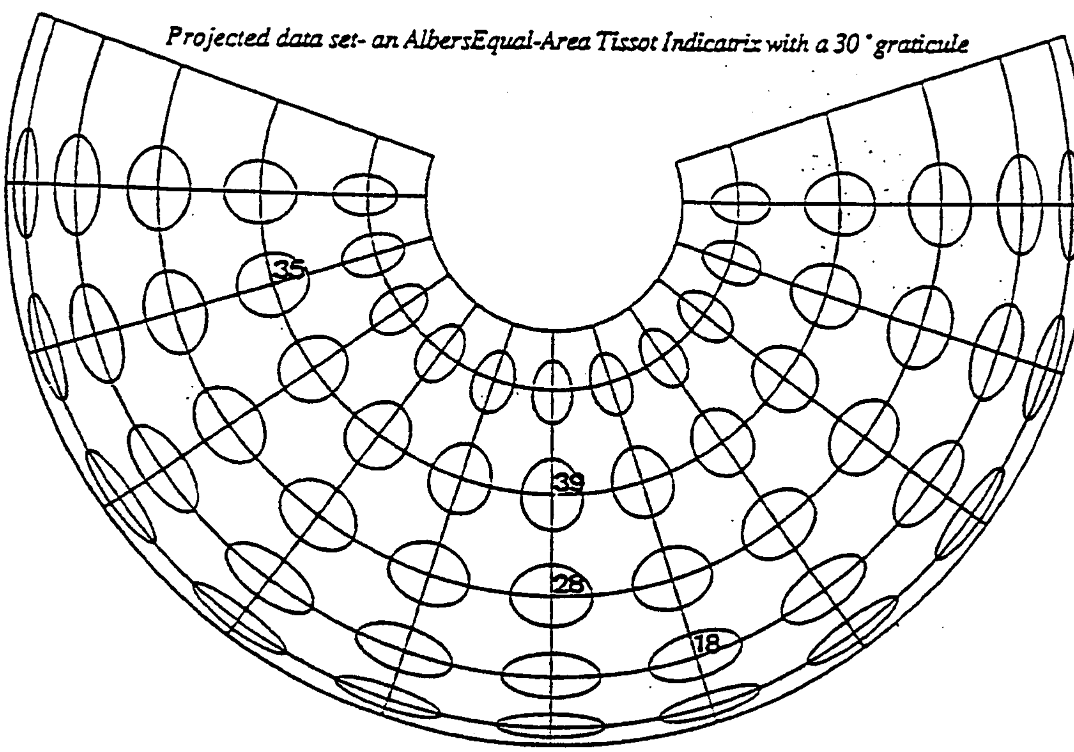
Discuss similarities and differences between the Sinusoidal and Albers equal-area projections. (e.g., Classify each as being cylindrical, pseudocylindrical, conic or azimuthal.)

Projected data set - a Sinusoidal Tissot Indicatrix with a 30° graticule



$RECNO	AREA	PERIMETER	CIRCSIN#	CIRCSIN-ID
14	3.341688E+12	7943647.000	14	35
18	3.341688E+12	6520722.000	18	39
29	3.858650E+12	6972313.000	29	28
41	3.341690E+12	6616127.000	41	18

Projected data set- an AlbersEqual-Area Tissot Indicatrix with a 30° graticule



$RECNO	AREA	PERIMETER	CIRCALB#	CIRCALB-ID
14	3.330325E+12	6504026.000	14	35
39	3.330324E+12	6504025.000	39	39
48	3.832914E+12	7077042.000	48	28
51	3.330327E+12	7292331.000	51	18

ANSWERS

Using the information in the PAT, answer the following questions:

The area for each circular polygon is 312.558 square ____________ *(degrees)*

Is this a significant measurement? ____________ *(no)*

The CIRCLE-ID for the central circle is ____________ *(28)*

Degrees measure angles not distances or areas. This makes an area measured in square degrees meaningless.

When this data is projected into an equal-area projection, which of the following statements describes what you would expect when examining the calculated values of area?

c) I would expect an equal-area projection to have limitations, with only the area of all circles along the same parallel to be equal.

Now more specifically, using the CIRCLE-ID values, predict which of the following polygon records would list approximately the same values for area?

Circles along the same longitude (e.g. 28 = 39)? ____________ *(no)*

Circles along the same latitude (e.g. 35 = 39)? ____________ *(yes)*

Circles along corresponding parallels, North and South (e.g. 18 = 39)? ____________ *(yes)*

EXERCISE 4: Hands-on exploration

Students who have ARC/INFO (Rev 4.0 or higher) can follow the script below, to reproduce the results for themselves. The script should be modified for students who are using PC ARC/INFO. This requires that you use an SML instead of an AML to generate the indicatrix. All other commands should be the same.

Prepare text files

Someone already familiar with what is required can make the text files necessary – an AML and some projection files. The AML will be used to create the Tissot indicatrix and the two projection files to project the indicatrix into two equal-area projections. Once written, these text files can be accessed with system pathnames. Writing the files in advance ensures that the spatial results can be generated and examined as quickly as possible.

CIRCLE.AML

```
/* ---------------------------------------------------------------
/*   Program: CIRCLE.AML
/*   Purpose: Creates a Tissot Indicatrix.
/*            Running this program at the Generate: prompt creates
/*            a total of 55 circles at 30 degree intervals.
/*            Intersections range from -150,-60 to 150,60. This will
/*            overlay a global graticule (-180,-90 to 180,90). These
/*            circles allow you to see various degrees of distortion
/*            when projected using different map projections.
/* ---------------------------------------------------------------
/* Called by:
/* Calls made:
/* ---------------------------------------------------------------
/* Arguments:
/*   Globals:
/*    Locals: id - the id for each circle
/*           xval - value of the x-coordinate
/*           yval - value of the y-coordinate
```

```
/* ------------------------------------------------------------
/*      Input:
/*     Output:
/* ------------------------------------------------------------
/*   Locals:   id - the id for each circle
/*           xval - value of the x-coordinate
/*           yval - value of the y-coordinate
/* ------------------------------------------------------------
/*   History: 5/5/90 - original coding - Gwen MacNairn
/* ------------------------------------------------------------
/*
/* Set initial variables
&s id = 0
&s yval = -60
/* Move from south to north
&do &until %yval% = 90
  &s xval = -150
  /* Move from west to east
  &do &until %xval% = 180
    /* Increment CIRCLE-ID
    &s id = %id% + 1
    /* Make circle using GENERATE format
    CIRCLES
    %id%,%xval%,%yval%,10
    END
    /* Increment longitude
    &s xval = %xval% + 30
  &end  /* &do
  /* Increment latitude
  &s yval = %yval% + 30
&end  /* &do
&return
/*------------------------------------------------------------
```

GEOALB.PRJ

```
INPUT
PROJECTION GEOGRAPHIC
UNITS DD
DENSIFY 0.5
PARAMETERS
OUTPUT
PROJECTION ALBERS
UNITS METERS
PARAMETERS
/* 1st standard parallel
30 00 00
/* 2nd standard parallel
45 00 00
/* Central meridian
00 00 00
/* Latitude of origin
00 00 00
/* False easting
0.0
/* False northing
0.0
END
```

GEOSIN.PRJ

```
INPUT
PROJECTION GEOGRAPHIC
UNITS DD
DENSIFY 0.5
PARAMETERS
OUTPUT
PROJECTION SINUSOIDAL
UNITS METERS
PARAMETERS
/* Radius of sphere
0.0
/* Central meridian
00 00 00
/* False easting
0.0
/* False northing
0.0
END
```

Generating your data

You will be creating your own data – a global graticule and a corresponding Tissot indicatrix geo-referenced to intersections on the graticule. First, generate the graticule. The units will be measured in decimal degrees and range from -180 to +180 in the x-axis, and from -90 to +90 in the y-axis. To illustrate the concepts, 30-degree grid cells are an adequate size (Snyder, 1989). To create the graticule, start the GENERATE program and specify these values. When finished, quit from the GENERATE program and BUILD the graticule as a POLYGON coverage.

```
Arc: GENERATE GRATICULE
(C) 1988, 1989 Environmental Systems Research Institute, Inc.
    All Rights Reserved Worldwide
GENERATE Version 5.0.1

Generate: GRID
Grid Origin Coordinate (X,Y): -180,-90
Y-Axis Coordinate (X,Y): -180,0
Cell Size (Width,Height): 30,30
Number of Rows, Columns: 6,12
Generate: QUIT

Externalling BND and TIC...

Arc: BUILD  GRATICULE  POLY
 Building polygons...
Arc:
```

Next, generate a Tissot indicatrix of circles, centered on every 30 degree-intersection of the graticule. To create the indicatrix, start the GENERATE program and then run the AML. When finished, quit from the GENERATE program and BUILD the indicatrix as a POLYGON coverage.

```
Arc: GENERATE  CIRCLE
(C) 1988, 1989 Environmental Systems Research Institute, Inc.
    All Rights Reserved Worldwide
GENERATE Version 5.0.1

Generate: &R CIRCLE
Enter Circles.
Terminate input by entering END
Enter Circles.
Terminate input by entering END
    :

Enter Circles.
Terminate input by entering END
Enter Circles.
Terminate input by entering END
Generate: QUIT

Externalling BND and TIC...

Arc: BUILD  CIRCLE  POLY
 Building polygons...
```

Project the global graticule and the Tissot indicatrix into a Sinusoidal coordinate system. The projection parameters have already been typed into a text file named GEOSIN.PRJ, so when running PROJECT specify this name as the {projection_file}.

```
Arc: PROJECT
Usage: PROJECT <COVER|FILE> <input> <output> {projection_file}
Arc: PROJECT  COVER  GRATICULE  GRATSIN  GEOSIN.PRJ
Arc: PROJECT  COVER  CIRCLE  CIRCSIN  GEOSIN.PRJ
Arc: BUILD  GRATSIN  POLY
 Building polygons...
Arc: BUILD  CIRCSIN  POLY
 Building polygons...
```

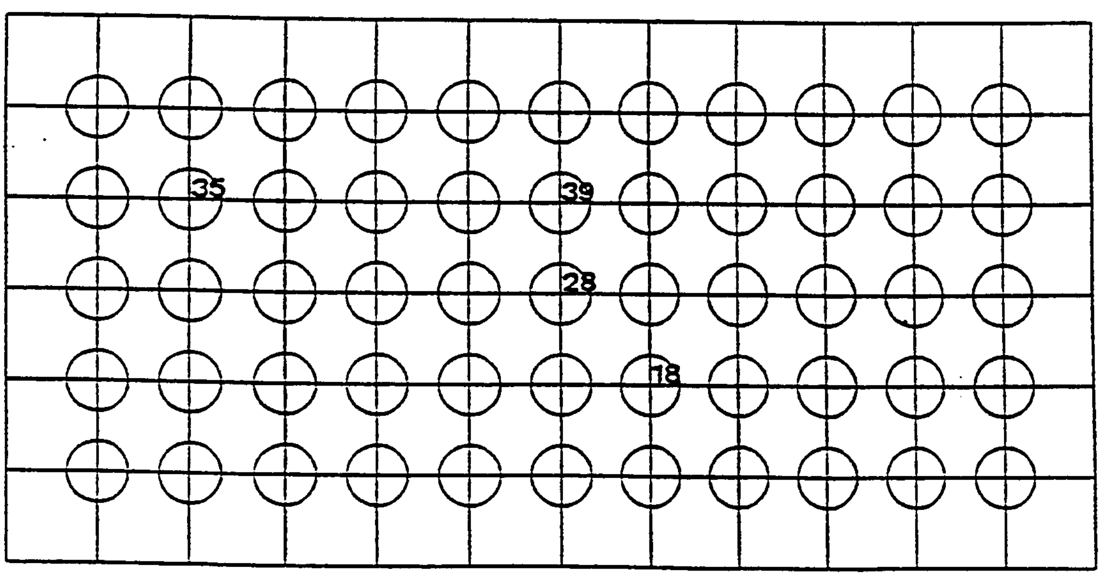
Next project the global graticule and the Tissot indicatrix into an Albers coordinate system. When running PROJECT specify GEOALB.PRJ as the {projection_file}.

```
Arc: PROJECT  COVER  GRATICULE  GRATALB  GEOALB.PRJ
Arc: PROJECT  COVER  CIRCLE  CIRCALB  GEOALB.PRJ
Arc: BUILD  GRATALB  POLY
 Building polygons...
Arc: BUILD  CIRCALB  POLY
 Building polygons...
```

Display data

A GIS allows you to display spatial data and query its attributes interactively. To generate a sense of the input data generated, first display the geographic graticule and then the Tissot indicatrix – on top of each other.

```
Arcplot: MAPEXTENT  GRATICULE
Arcplot: ARCLINES  GRATICULE 4
Arcplot: ARCLINES  CIRCLE  2
Arcplot: RESELECT  CIRCLE  POLY  CIRCLE-ID  IN  {18,28,35,39}
CIRCLE polys   : 4 of 56 selected.
Arcplot: POLYGONTEXT  CIRCLE  CIRCLE-ID
```



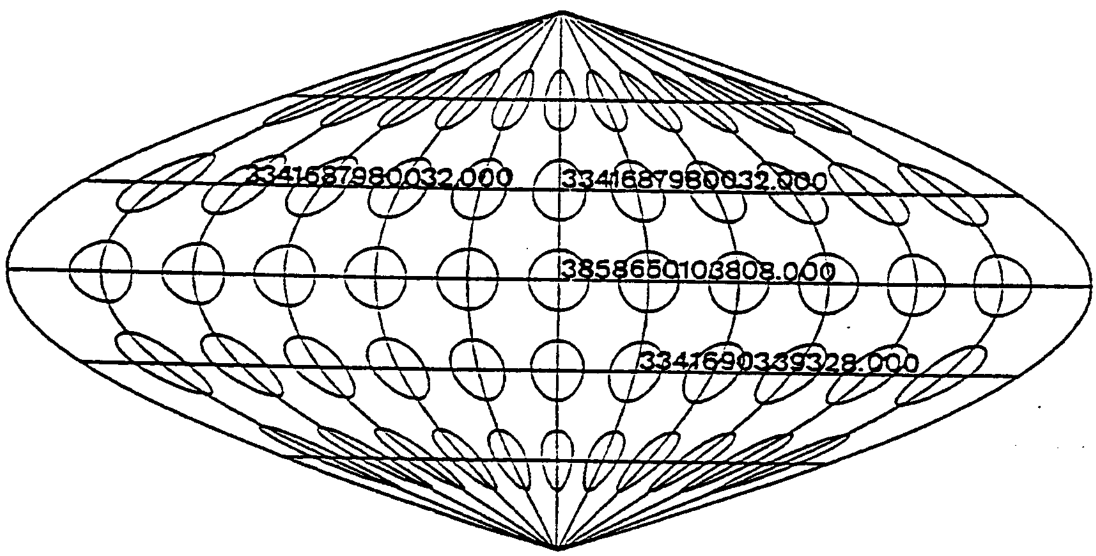
Generated data - a Tissot Indicatrix with a 30° global graticule

Records in the PAT for selected circles in the indicatrix will look like this:

```
Arcplot: LIST  CIRCLE  POLY
 $RECNO          AREA     PERIMETER CIRCLE# CIRCLE-ID
     14        312.558       62.751     14       35
     18        312.558       62.751     18       39
     29        312.558       62.751     29       28
     41        312.558       62.751     41       18
```

When displayed on a graphic screen, the Sinusoidal results will look like this:

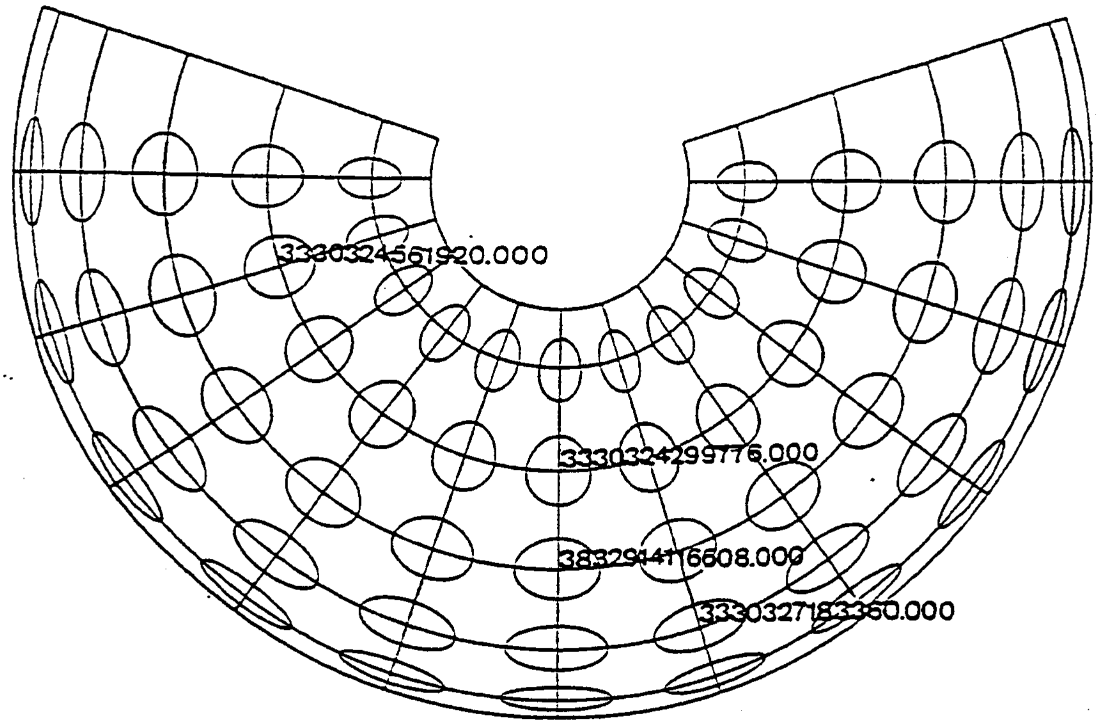
```
Arcplot: CLEAR
Arcplot: MAPEXTENT  GRATSIN
Arcplot: ARCLINES  GRATSIN 4
Arcplot: ARCLINES  CIRCSIN  2
Arcplot: RESELECT  CIRCSIN  POLY  CIRCSIN-ID  IN  {18,28,35,39}
CIRCSIN polys  : 4 of 56 selected.
Arcplot: POLYGONTEXT  CIRCSIN  AREA
```



Projected data set - a Sinusoidal Tissot Indicatrix with a 30° graticule

The Albers results will look like this:

```
Arcplot: CLEAR
Arcplot: MAPEXTENT  GRATALB
Arcplot: ARCLINES  GRATALB 4
Arcplot: ARCLINES  CIRCALB  2
Arcplot: RESELECT  CIRCALB  POLY  CIRCALB-ID  IN  {18,28,35,39}
CIRCALB polys  : 4 of 56 selected.
Arcplot: POLYGONTEXT  CIRCALB  AREA
```

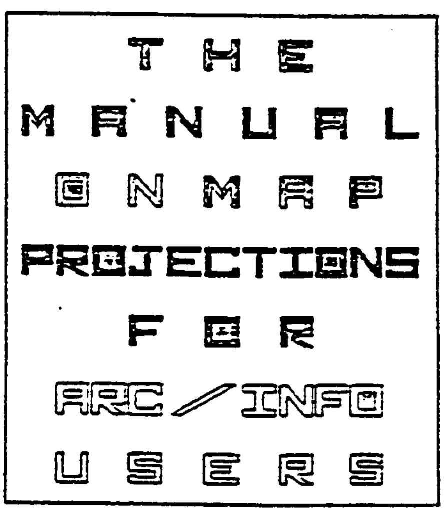


Projected data set -anAlbers Equal-Area Tissot Indicatrix with a 30° graticule

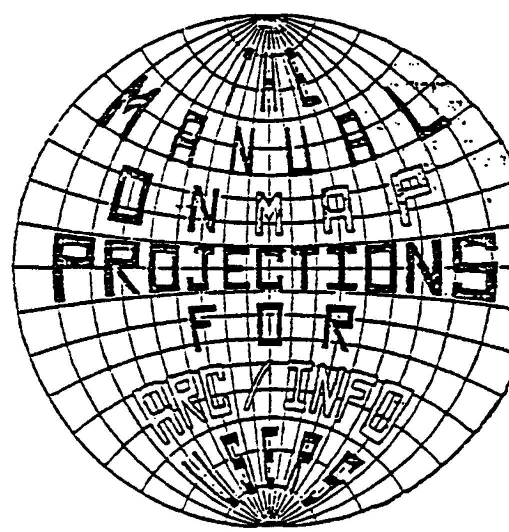
EXERCISE 5: Additional hands-on exploration

Interested students can do additional equal-area projections, or choose to investigate other kinds of map projections. A good choice would be to explore conformal projections.

An alternative activity would be to generate a coverage of block letters, using decimal degrees of latitude and longitude for the spatial coordinates. This kind of coverage can be projected into any global projection, in the same manner as with the indicatrix, to produce some very interesting results. This kind of exercise not only teaches you about projection distortions, but can also be used to create logos for maps or special publications.



Block letters – Geographic degrees



Letters and a graticule – Stereographic projection

CONCLUSIONS

First, all students working with geographic data should not leave their university programs without knowing that

- For length and area, degrees are not a meaningful unit of measure
- Latitude and longitude provide reference locations but are not a type of map projection

Secondly, when performing analysis, the single most important measurement is probably area. This explains why the equal-area projections are of particular interest. It is worth reinforcing the point that a database is not a static structure and that its spatial coordinates are not fixed. Once created, coordinate systems can be reprojected, if need be.

Finally, no set of exercises are perfect. Only by sharing exercises between each other, can an effective booklet of lab exercises be developed.

REFERENCES

ESRI, 1989. *AML Users Guide, ARCPLOT Users Guide* and *ARC/INFO Users Guide, Volume 2*. ESRI, 380 New York Street, Redlands, CA, 92373.

NCGIA, 1989. *Core Curriculum, Draft Version*. NCGIA, Department of Geography, University of California, Santa Barbara, CA, 93106.

Snyder, J.P. and P.M. Voxland, 1989. *An Album of Map Projections*. U.S. Geological Survey Professional Paper 1453, Washington D.C.

Tissot, A., 1881. *Memoire sur la representation des surfaces et les projections des cartes geographiques*. Gauthier Villars, Paris, France.

TITLE: The ITC ILWIS Case Study Exercises

CONTRIBUTOR: Dr. Carlos R. Valenzuela
International Institute for Aerospace Survey and Earth Sciences (ITC)
350 Boulevard 1945
P.O. Box 6
7500 AA Enschede
The Netherlands
Phone: 053-874-444
FAX: 053-874-400

SOURCE: Available from contributor

NCGIA TOPIC: Modeling environmental processes; resource management; exploring the world; exploring cause/effect relationships; data integration; suitability analysis

APPLICATION AREA: Remote sensing/GIS; engineering geology; geomorphology

GEOGRAPHIC LOCATION: Portugal/Spain; Golden, Colorado, USA; Mexico; Sumatra, Indonesia

EDUCATIONAL ROLE: Introductory-intermediate

COMPLETION TIME: Varied--each case study contains several exercises

HARDWARE/SOFTWARE: The Integrated Land and Watershed Information System (ILWIS), developed at the ITC

DATA REQUIRED: Data are included with the exercises. Data are also available separately on a cost recovery basis. These data are easily converted to ASCII or other formats for use in other GIS packages.

GENERAL DESCRIPTION:

These are four case study workbooks produced by the ITC for use with their ILWIS GIS/image processing package. Each workbook contains several individual exercises which train students on the ILWIS software as well as educate students on GIS and digital image processing techniques and principles. The four workbooks are as follows:

- **Remote Sensing/GIS for Geology Study Case**: This case study uses data from the Ossa Morena Zone (SE Portugal and SW Spain) to familiarize students with digital image processing and GIS data integration procedures.
- **Mexico Study Case**: These exercises develop land use/land cover classifications with an emphasis on gully erosion detection on an area near Mexico City.
- **Sumatra Study Case**: This case study uses ILWIS to assess potential coffee growing areas in the Komering basin of south Sumatra.
- **GIS in Engineering Geology and Applied Geomorphology**: This workbook analyzes natural hazards in the area of Golden, Colorado, USA, including rockfall, landsliding, flooding, presence of swelling clays, and mining subsidence.

Current as of: July, 1991

TITLE: Using GIS to site a landfill

CONTRIBUTOR: Bruce W. Meier
Dept. of Geography
Miami University
Oxford, Ohio 45056

SOURCE: Text and maps included below

NCGIA TOPIC: Suitability analysis

APPLICATION AREA: Urban/environmental systems

GEOGRAPHIC LOCATION: Hypothetical

EDUCATIONAL ROLE: Introductory--can be used with or without a computer.

COMPLETION TIME: A few hours

HARDWARE/SOFTWARE: Can be completed with nothing more than colored pencils, or can be adapted to practically any GIS package.

DATA REQUIRED: Five maps included herein

GENERAL DESCRIPTION:

This exercise was originally designed to be used without computers. Students use colored pencils to shade suitable areas and then manually overlay the various map layers. Used without a computer, this might make a good first exercise for students to complete before they have been introduced to the laboratory facilities.

Or, students can digitize the included maps (they aren't very complex) as an additional exercise and then perform the suitability analysis on the computer.

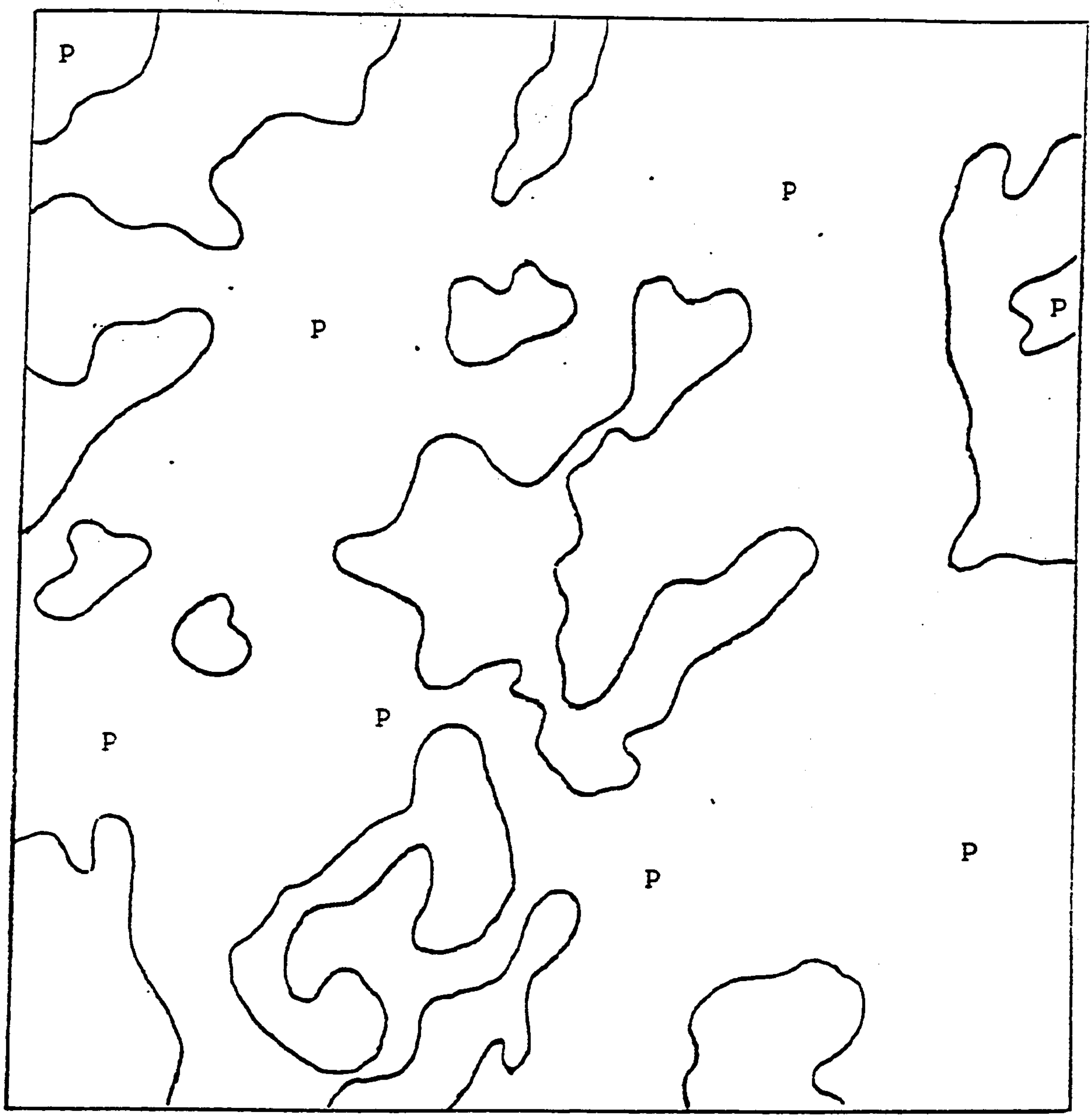
DETAILED DESCRIPTION:

The Problem: From a political point of view, no property owner wants a solid waste landfill to be located near his property, nor should a landfill be located where it is likely to have a serious impact on the environment. Yet, landfills have to be placed somewhere.

Using the information provided, locate land that appears to be suitable for a landfill site. Suitable areas should have the following characteristics: soils that aren't easily saturated, bedrock not within 10 feet of the surface, not floodprone, and not marsh. The minimum area for a landfill is one square centimeter (on the paper maps), and a suitable site must exist entirely within one land ownership parcel. Sites may be any shape so long as they meet the area criterion.

Prepare a final map showing all suitable areas and a list of properties on which a landfill could be sited.

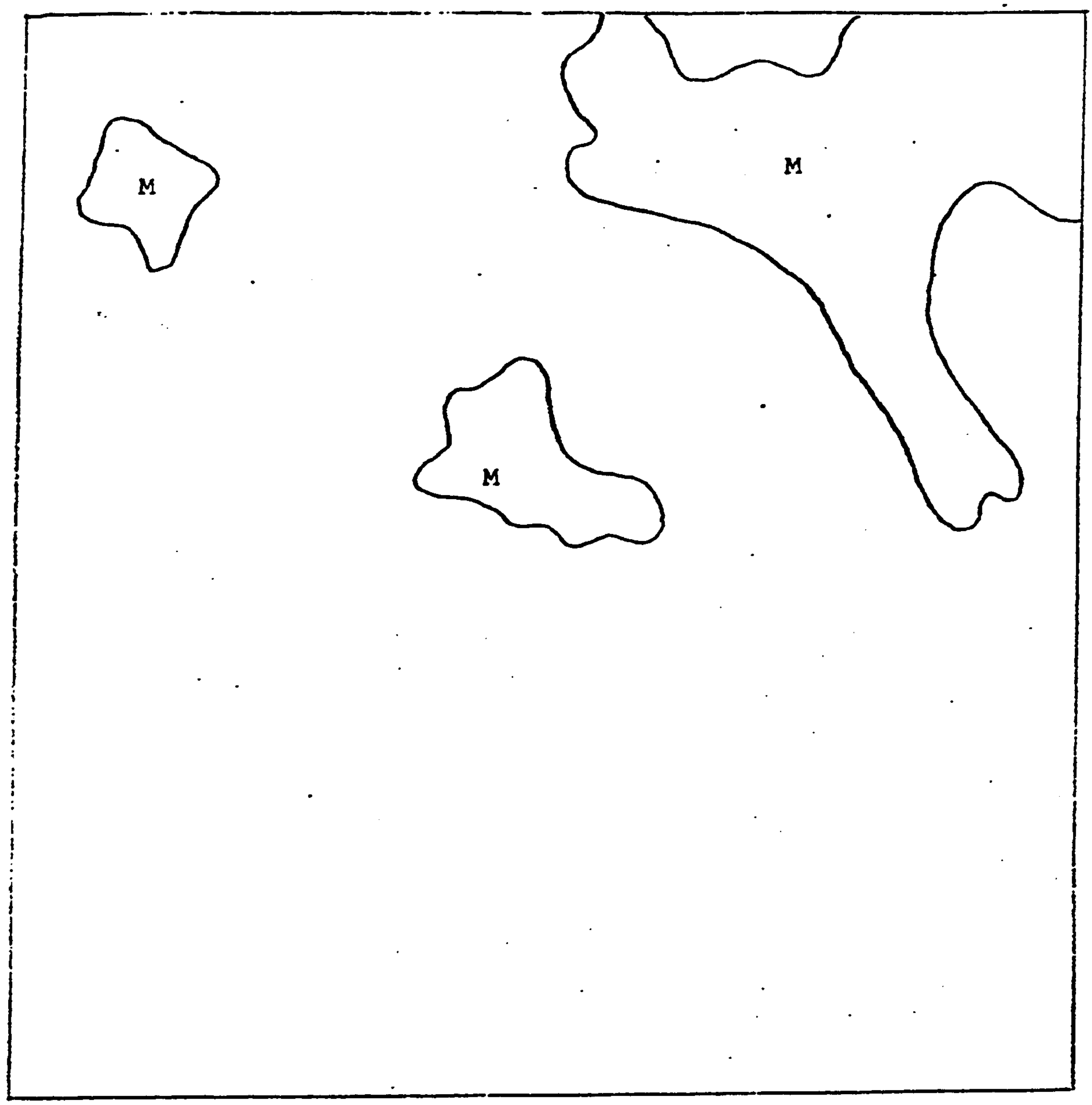
Current as of: March, 1991



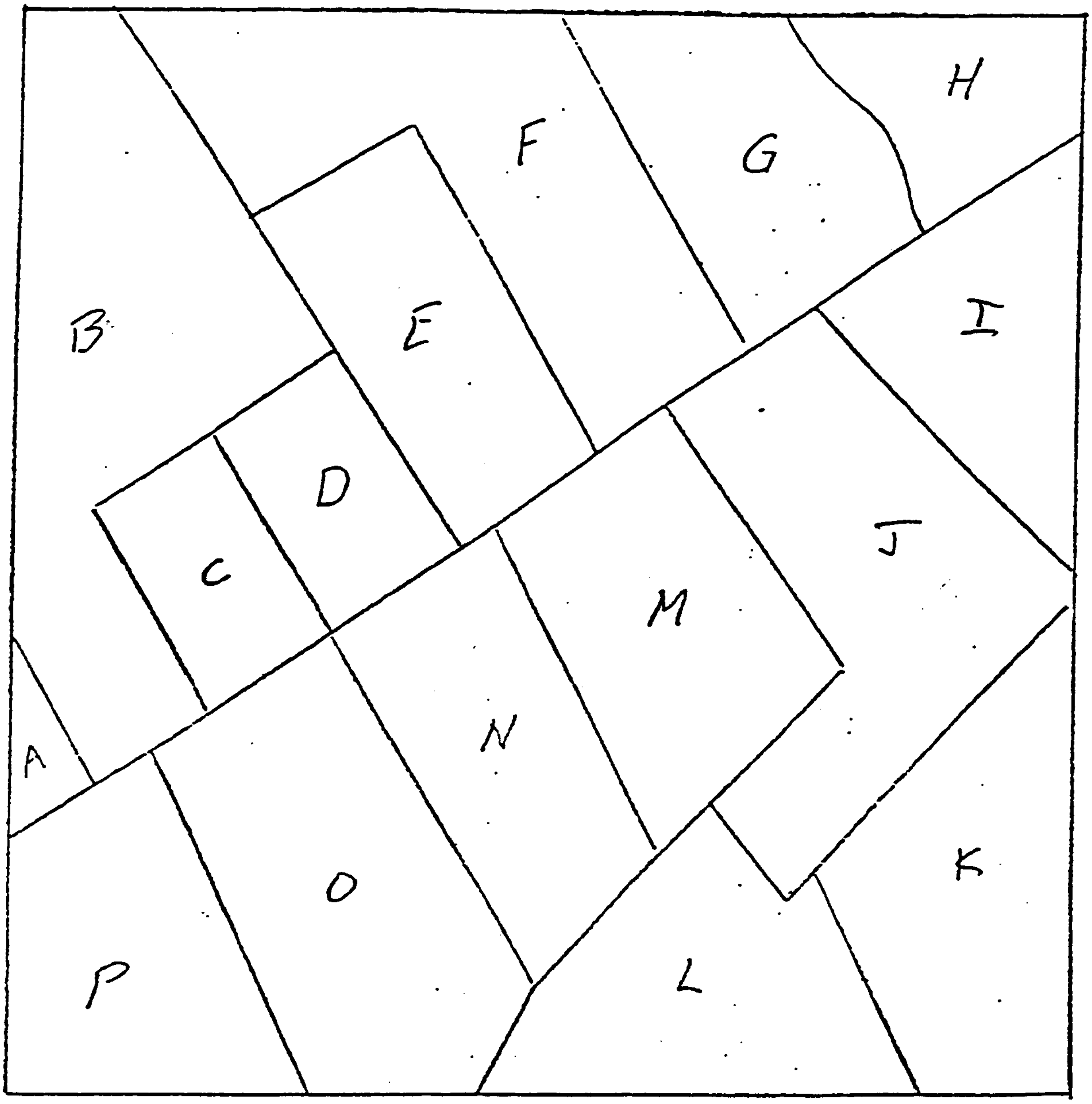
Permeable (easily saturated) Soils

Bedrock at the Surface or within 10 Feet of the Surface

Floodprone Land



Marsh



Legally Defined Parcels of Land

TITLE: Conceptual Snippets

CONTRIBUTOR: University of South Carolina
reprinted from the *Proceedings on the Third Workshop on GIS in Higher Education*, Ohio State University, June 8-10, 1990

SOURCE: Full text below

NCGIA TOPIC: Exploring the world through a database; suitability analysis; resource management; queries; spatial dependence

APPLICATION AREA: Urban/rural planning; spatial analysis

GEOGRAPHIC LOCATION: Anywhere

EDUCATIONAL ROLE: Introductory/intermediate

COMPLETION TIME: Varied

HARDWARE/SOFTWARE: These are conceptual, generic ideas to be adapted to your own equipment.

DATA REQUIRED: You must provide the necessary data

GENERAL DESCRIPTION:

These are short problem descriptions which may be used as they stand or which may be adapted, revised, and expanded.

DETAILED DESCRIPTION:

Resource management

- Timber companies are interested in locating large stands of forested lands for acquisition. Create a map of deciduous tree stands that are greater than 300 cells in size. Calculate and label the areas of these stands.

Suitability analysis

- The State Development Board is interested in attracting a type of industry that needs ready access to the interstate highways. In addition, local political concerns dictate that the large plants associated with this industry not be a visible blight upon the landscape. Determine all areas that are within 10 cells and are visible from major highways (divided and undivided).

- The slope of the terrain is often an important factor in site suitability analyses. The state's Department of Health and Environmental Conservation (DHEC) is interested in finding a new site for the storing of hazardous waste. Part of the criteria they are using for the site selection is the slope of the terrain between the waste site and the surface water bodies. Create a slope map and identify possible areas of concern. Rank these areas in order of their suitability as a hazardous waste site.

- A developer is looking at our county as a place for a large regional shopping center. The developer is convinced its location should be in the "rural/urban fringe". As well-trained geographers, we are aware that the "fringe" is characterized by diverse land use. Create a map of land use diversity for the county and identify areas of interest.

- A major brewery has decided to locate in our state. The criteria that the company is using to locate its facility include the following points. 1) The brewery must be located within 15 km of a town for a supply of labor. 2) It must be located within 75 km of an agricultural region to reduce the shipping cost of barley. 3) It must be located within 2 km of an interstate to expedite shipping of the finished product. 4) It has been decided that the land cover type best suited for this operation is mixed forest land due to its low per-acre purchase price. Determine what areas satisfy these criteria and map and rank them in order of their preferability.

Emergency planning

- The Federal Emergency Management Agency (FEMA) has decided to test the county's evacuation plan. The scenario which they are interested in is a rail car accident involving a tank car containing liquified natural gas. Identify a fire buffer zone around the rail line of approximately 2 kilometers and a blast damage zone of approximately 6 kilometers.

Terrain analysis

- Create a terrain "roughness" map for the county. Analyze this map to address the hypothesis: Terrain is rougher in higher elevations.

Current as of: June, 1991

TITLE: Three introductory GIS labs - St. Catharines, Ontario

CONTRIBUTOR: David Flack
Department of Geography
Brock University
St. Catharines, Ontario, Canada L2S 3A1
telephone: (416) 688-5550 ext.3489
email: ggsflack@brocku.ca

SOURCE: Available from contributor

NCGIA TOPIC: Spatial layers; multiple themes; suitability analysis; dividing the world

APPLICATION AREA: Geography/Urban Studies

GEOGRAPHIC LOCATION: St. Catharines, Ontario, Canada

EDUCATIONAL ROLE: Units 1 and 2 provide a basic introduction to IDRISI, and Unit 3 introduces GIS problem solving.

COMPLETION TIME: 2 - 3 hours for each of the three units

HARDWARE/SOFTWARE: PC/IDRISI 3.2

DATA REQUIRED: St. Catharine's dataset (described in the data section of this volume).

GENERAL DESCRIPTION:

Unit 1: Introduction to IDRISI, Part I

This exercise introduces the student to the list and describe commands, memory storage, the five methods of display, the area command and document. It is based largely on one image of St. Catharines showing the lake, river, and canal. Some vector files are included for overlay with the color command. The student is also provided with the opportunity to create new files of library and grocery store locations using manual keyboard entry. Questions are posed throughout to reinforce understanding of what is being done.

Unit 2: Introduction to IDRISI, Part II

This exercise introduces the student to the commands convert, histo, reclass, overlay, group and area. It is based on a landuse map of St. Catharines. The student is given enough direction to be able to create a buffer zone around the railway and then find the extent of residential landuse within that buffer for the purpose of emergency planning.

Unit 3: An Introductory Assignment in G.I.S.: City Planning

This assignment requires students to find residential areas that are 1.5 km from both a major grocery store and a library branch, as the first step in re-distributing urban amenities in St.Catharines. It is assumed that they have already been introduced to the necessary commands. The student must begin by creating the files for grocery stores and libraries through manual keyboard entry. The computer work is followed by questions concerning the applicability of the analysis, the underlying assumptions and possibilities for improvement. Each student then selects a third urban amenity to add to the analysis.

Current as of: June, 1991

TITLE: Propagating DEM Error by Simulation

CONTRIBUTOR: Peter F. Fisher
Kent State University
Kent, Ohio 44242
email: pfisher@kentvm.bitnet; pfisher@kentvm.kent.edu

SOURCE: Full text follows

NCGIA TOPIC: Accuracy

APPLICATION AREA: Any area concerned with error, specifically those using viewsheds or drainage basins. Forestry, landscape planning, military, etc.

GEOGRAPHIC LOCATION: Anywhere

EDUCATIONAL ROLE: I believe almost any level could use this, but the statistics and idea of error might make it more suitable for an intermediate or advanced level.

COMPLETION TIME: Software dependent. IDRISI: approx. 1 hour, OSU-MAP: approx. 20 minutes if you have a random field generator.

HARDWARE/SOFTWARE: I know IDRISI on a PC has the modules as standard for this but other packages may too.

DATA REQUIRED: One DEM.

DETAILED DESCRIPTION:

Using modules which I know to exist in IDRISI, and may occur in other packages, this exercise would be a full class project. A common DEM of any size and any area can be used. Each student will run RANDOM. This yields a random field with user specified Standard Deviation. This error field is added to the DEM, and then DRAINAGE or, better, VIEWSHED, is run for some viewpoint. The SD and viewpoint should be common to all students. All students will then run HISTO to yield the area of the drainage basin or the viewshed. With a class of any size, it is possible to ascertain a statistical significance level for the representativeness of the original viewshed or drainage basin, but the more students, the higher the significance (19 students give 0.05 significance - Monte Carlo Hypothesis testing). This is a direct application of error simulation to the accuracy of a derived product. It is also possible to generate a "fuzzy viewshed" as opposed to the normal "Boolean viewshed" by adding together all viewsheds in error simulated DEMs. Value 0 indicates a cell is definitely out of sight, while n (number of simulations) indicates it is most likely in view. Values between 0 and n indicate level of certainty of a cell being in view.

Current as of: June, 1991

TITLE: Understanding GIS, the ARC/INFO method

SOURCE: Environmental Systems Research Institute
380 New York Street
Redlands, CA USA 92373-9870
Phone: 714/793-2853 FAX: 714/793-5953

PRICE: Book only - $35.00 for students; $50.00 for others; Book plus database on diskettes or tape - $75.00

NCGIA TOPIC: Spatial primitives; spatial layers; the information product; queries; digitizing; database design

APPLICATION AREA: General hands-on training

GEOGRAPHIC LOCATION: Hypothetical

EDUCATIONAL ROLE: An Introduction to GIS and ARC/INFO concepts

COMPLETION TIME: Estimated time required to complete all ten lessons is 40 hours

HARDWARE/SOFTWARE: Versions of the book are available for either PC or workstation ARC/INFO. In addition to a hardware platform running ARC/INFO, a graphics monitor and a digitizing table are required.

DATA REQUIRED: Includes a database of a hypothetical area with the following coverages: coastline, land use, roads, sewer lines, soils, and streams.

GENERAL DESCRIPTION: This 200+ page book provides a hands-on introduction to GIS technology in general and ARC/INFO specifically. The book is comprised of ten lessons (chapters) which are dedicated to specific tasks required to complete a GIS project. Each lesson builds on the skills learned in the previous lesson. Lesson titles are as follows:

1) Why GIS
2) Introduction to GIS and ARC/INFO
3) Starting your ARC/INFO project
4) Getting spatial data into ARC/INFO
5) Making spatial data usable
6) Getting attribute data into ARC/INFO
7) Managing the database
8) Performing geographic analysis
9) Presenting the results of the analysis
10) Customizing ARC/INFO

Current as of: 1990 Edition

TITLE: GIS Concepts Kit

CONTRIBUTOR: Bob Maher
Environmental Systems Research Institute (ESRI)
380 New York Avenue
Redlands, CA 92373

SOURCE: Available from:
Jeff Hecht
address as above
Phone: 714/793-2853 Ext. 1372
FAX: 714/793-5953

PRICE: $150.00

NCGIA TOPIC: Spatial primitives; accuracy; multiple themes; spatial layers and objects; relationships; queries; spatial decision support systems; database design

APPLICATION AREA: Exploratory introduction to GIS

GEOGRAPHIC LOCATION: Redlands, California

EDUCATIONAL ROLE: Introductory

COMPLETION TIME: 1-3 hours per exercise

HARDWARE/SOFTWARE: PC running pcARC/INFO Version 3.4D

DATA REQUIRED: Includes all necessary data, as well as a map atlas, USGS quad sheet, and a collection of aerial photographs

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GENERAL DESCRIPTION: The *GIS Concepts Kit* is ESRI's response to the demand for a structured set of lab exercises to support the NCGIA Core Curriculum lectures. These menu-driven exercises are based on the ARC/INFO data model and were developed in the Simple Macro Language (SML) using pcARC/INFO Rev 3.4D. The kit includes six labs as well as a tool kit of SML utilities which facilitate the development of additional exercises using a set of generic menus.

Six labs

The labs are designed to teach generic GIS concepts and procedures. The introductory labs deal with the perception of space and reality, and the problem of translating natural and cultural phenomena into objects in a spatial database. In subsequent labs, students explore the database using spatial and attribute queries. Throughout the labs, students use generic GIS tools to learn concepts, explore the database, and solve application problems. These tools are implemented with form menus. The titles of the labs are as follows:

- Lab 1: Exploring Redlands
- Lab 2: Defining space and spatial objects
- Lab 3: Measuring attributes
- Lab 4: Exploring the database
- Lab 5: Spatial analysis
- Lab 6: Tabular analysis

(Continued...)

The SML Developer's Tool Kit

This section includes a library of low level utilities, user interface tools, and documentation. This kit will enable interested faculty and students to develop additional lab exercises that build upon the generic GIS menus.

Current as of: July, 1991

TITLE: The Curriculum Development Toolkit

CONTRIBUTOR: Robert J. Rogerson
Institute for GIS in Education
also known as The Canadian Centre for GIS in Education
PO Box 3737, Station C
Ottawa, Ontario, Canada K1Y 4J8

SOURCE: Available from contributor. The Toolkit can be purchased individually for $150 US, but SPANS software is recommended.

NCGIA TOPIC: Various

APPLICATION AREA: The Toolkit contains examples from a wide range of disciplines which use GIS: Forestry, Urban Planning, Marketing, Sociology, Geology, Hydrology, Climatology, Agriculture, Geography, Entomology. Learning Units can be customized for any specific discipline and plans are underway to create a complete toolkit with examples from Earth Science alone.

GEOGRAPHIC LOCATION: Geographic locations used in the Toolkit are varied, with datasets, examples and case studies coming primarily from North America, but also from diverse locations in Europe, Africa and South America.

EDUCATIONAL ROLE: Student level is not defined. The exercises most obviously fit a middle-level college or university GIS course, but are being used in senior high school and in graduate studies: flexibility with respect to level is a characteristic of the materials.

COMPLETION TIME: Each of the Learning Units can be sped through within a single 50-minute class period, especially if the student is using them as self-learning exercises. Alternatively, each unit forms an adequate core for a 2 or 3 hour long laboratory. The Case Studies can form the core of projects which may extend over several laboratory periods.

HARDWARE/SOFTWARE: Hardware requirements vary depending on the operating system used:

DOS: 386 PC with math co-processor, VGA graphics, 40Mb HD minimum, 386 memory manager, second monochrome monitor

OS/2: 386 PC with math co-processor, VGA graphics, 80Mb HD minimum, mouse, 8Mb RAM

AIX: RS6000 workstation, minimum configuration: model 320, 32 Mb RAM, 2D graphics card, 320 Mb HD, mouse

SOFTWARE: In addition to the latest version of operating system software (although DOS 3.3 is acceptable for the DOS version), TYDAC's Spans GIS version 4.31 (for DOS) or version 5.2 (for OS/2 and AIX) should be acquired.

DATA REQUIRED: Datasets are provided with the Orientation, Learning Units and Case Studies, and are fully accessible to the user. They come from a diverse set of sources and are appropriate for a wide variety of applications.

GENERAL DESCRIPTION:

The Toolkit is a comprehensive collection of material to support GIS laboratory teaching, particularly, but not exclusevely, that based on TYDAC's SPANS GIS software.

The Curriculum Development Toolkit comprises four sections. The first consists of introductory background material which is generic GIS, outlining the concepts, techniques and types of applications which are common to GIS analysis. The Background Units are cross-referenced to the NCGIA Core Curriculum Volumes 1 to 3, as well as to other GIS textbooks.

The second section is of orientation units which describe how to use SPANS software and introduce the student to data structures, data types, setting up a study area and data input/output.

The third section is the core of the Toolkit, consisting of interactive, computer-based learning usits which take the student through the application of GIS techniques from examples of typical applications to specific instructions on performing an analysis. The interactive features of these units make them suitable for traditional laboratory-style training or for self-learning.

The fourth section is of case studies using real data sets. An appendix gives full instructions on customizing the Toolkit for specific users. For instance, a learning unit which contains an example of index overlay using an urban example can be changed to one using an agricultural example, or a forestry one, etc..

Current as of: June, 1991

TITLE: Desktop Mapping for Planning and Strategic Decision Making

CONTRIBUTOR: Strategic Mapping, Inc.
4030 Moorpark Ave., Suite 250
San Jose, CA 95117
Phone: 408/985-7400
FAX: 408/985-0859

SOURCE: Available from contributor. PRICE: Approximately $40.00

NCGIA TOPIC: Spatial decision support systems; modeling socioeconomic processes; suitability analysis; relationships; multiple themes; the information product; queries; dividing the world

APPLICATION AREA: Urban planning; marketing; retailing

GEOGRAPHIC LOCATION: Washington, D.C.; Oakland, CA; San Francisco, CA; Marin County, CA; Del Norte, TX

EDUCATIONAL ROLE: Beginning/intermediate/advanced

COMPLETION TIME: 1-3 hours per exercise

HARDWARE/SOFTWARE: Required: ATLAS*GRAPHICS (version 3.0) and ATLAS*DRAW running on an IBM PC-XT or AT compatible microcomputer. A color monitor is recommended. In addition, one exercise requires Lotus 1-2-3 and SPSS/PC+; and one exercise requires Lotus 1-2-3 and dBASE III PLUS.

DATA REQUIRED: All necessary data are provided on diskette.

GENERAL DESCRIPTION:

This 200 page manual includes a set of 10 case studies which introduce a problem, set forth the goals and the overall procedure of the analysis, and provide step-by-step instructions on how to create the appropriate maps and reports. While it is designed specifically for users of ATLAS*GRAPHICS and ATLAS*DRAW, the case studies may also be useful as conceptual material for further GIS exercise development. The following is a listing of each case study:

Thematic mapping

- Thematic mapping for sales area analysis
- Thematic mapping with two or more variables
- Relating data to alternative map features
- Presenting the results of cluster analysis

Geographic information systems

- Areal multipliers for trade area analysis
- Areal multipliers for freeway impact analysis
- Analyzing retail competition using gravity modeling
- Industrial site selection
- Land development planning
- Automating permit notification

Current as of: June, 1991

DATA SETS

TITLE *Slovene Carst Dataset (Slovenia)

SOURCE:

Zoran Stancic
University of Ljubljana
Dept. Of Archaeology
Askerceva 12
61000 Ljubljana
Slovenia
Tel: 38 61 262 571
TAX: 38 61 159 337
Email: zoran.stancic@uni-lj.ac.mail.yu
PRICE: Free if you send a 3.5" or 5.25" diskette.

GEOGRAPHIC COVERAGE: Slovene Carst area, a 400 square-kilometer area near the Italy/Slovenia border and the Italian town of Trieste. Raster images are 200x200, 100 meter cell size.

FORMAT: Idrisi vector and raster files. Data will be sent in ASCII file format.

DESCRIPTION:

This dataset contains the following themes:

- Digital elevation model
- Hydrography
- Geology
- Urban sites
- Archaeological sites

Current as of: July, 1993.

TITLE: *US GeoData Sampler

SOURCE: Earth Science Information Center (ESIC)
U.S. Geological Survey (USGS)
507 National Center
Reston, VA 22092
(703)860-6045
(800)USA-MAPS

Price: $25 on one tape or $75 on three tapes. See below.

GEOGRAPHIC COVERAGE: Seattle, Washington vicinity

FORMAT: File format: DLG, DEM, LULC, GNIS. Shipped on 9-track tapes, 1600 (three tapes) or 6250 bpi (one tape).

DESCRIPTION: This dataset includes a sampling of each of the four major types of digital data produced by the USGS: Digital line graph (DLG), Digital elevation model (DEM), Land use and land cover (LULC), and the Geographic Names Information System (GNIS). The data sampler consists of a set of digital files which cover the Seattle, Washington area. The included files are:

- 1:2,000,000 scale DLG for Northwestern states (WA, OR, ID)
- 1:250,000 scale LULC for Seattle, WA
- 1:100,000 scale DLG for Tacoma, WA
- 1:24,000 scale DLG for Tumwater, WA
- 1-degree DEM for Seattle, WA East
- 7.5-minute DEM for Tumwater, WA
- GNIS for WA

Current as of: August, 1993

TITLE *TELNET and modem access to NOAA earth systems data directory

SOURCE: Telnet to esdim1.nodc.noaa.gov (login: noaadir)
Also available via modem. See below.

GEOGRAPHIC COVERAGE: local to global, many scales

FORMAT: various

DESCRIPTION: This system provides access to NOAA's Environmental Services Data Directory. The Data Directory allows one to search for information about available datasets based on the following search criteria: DISCIPLINE; SUBDISCIPLINE; LOCATION; TIME COVERAGE; GEOGRAPHIC COVERAGE (lat,lon); SOURCE NAME (Spacecraft, Platform, ...); SENSOR NAME (instrument); CAMPAIGN/PROJECT; INVESTIGATOR; DATA CENTER.

In addition, this data directory provides access to the following additional environmental data systems: (NOTE: Brackets [...] denote future connections)

NOAA Systems:

1. NCDC - National Climatic Data Center

[2. NGDC - National Geophysical Data Center]

[3. NODC - National Oceanographic Data Center]

[4. NOAA Library]

Other Earth Science/Global Change Systems:

5. Canada's GCNet
6. CIESIN's gopher
7. CIESIN's Green Pages
8. ESA - European Space Agency

[9. FedWorld - Federal Government Information]

10. GCMD - Global Change Master Directory
11. GLIS - Global Land Information System
12. KuDA - Kuwait Data Archive
13. NASDA - Japanese Space Agency

Questions can be addressed to:
Gerald Barton, NOAA/NESDIS, (22) 66-4548
Internet: barton@esdim.noaa.gov OMNET: G.BARTON

To access the system by modem:

1. Use the settings: full duplex, 8 bits, no parity, one stop bit, 300 to 9600 baud (preferred terminal type is vt100)
2. Dial (202) 606-4666, (202) 606-5082 or (202) 606-5085
3. at "Xyplex>" prompt, type "c esdim1"
   (press <break> key several times if Xyplex> prompt does not appear)
4. at "Login:" prompt, type "noaadir"
5. at the end of your session, press the <break> key
6. at "Xyplex>" prompt, type "dis"
7. hang up your phone

Current as of: July, 1993

TITLE *Space shuttle photography on-line

SOURCE: Available via anonymous FTP on sseop.jsc.nasa.gov or 146.154.11.34
Also avialable via Telnet sseop.jsc.nasa.gov (User: photos Password: photos)
Also available via modem. See below.

GEOGRAPHIC COVERAGE: many locations on Earth plus some moon photos

FORMAT: Color (3 band) and BW (1 band) digital photographic images. Most are Targa format. A program for viewing Targa files on an IBM PC is available on-line as well.

DESCRIPTION: This information is excerpted from the "readme.txt" file obtained over FTP.

Welcome to the Space Shuttle Earth Observation Project's digital image collection. This account makes both hand-held color images of the earth as well as black and white ESC (electronic still camera) images available to the general public via Internet or modem.

All earth-looking hand-held photography is examined by cataloguers for the purpose of determining various facts about the pictures such as coordinates, country, prominent features, focal length of the camera lens, quality of exposure, percentage of cloud cover, tilt of the camera, whether photos are contiguous (stereo shots), and direction of the camera. This information is available via Internet at SSEOP.JSC.NASA.GOV or 146.154.11.34 username PHOTOS password PHOTOS or over the phone lines at (713)483-2500.

```
LOGGING ON TO THE SYSTEM USING A MODEM

COMMANDS                                NOTES
--------------------------------        ------------------------------------------
     You: ATDT 483-2500                 Or 1-713-483-2500 if long distance.
Computer: CONNECT                       Hit enter a couple or so times.
          ENTER NUMBER
     You: SN_VAX                        Case doesn't matter.
Computer: CALLING 63109                 The number varies.
          CALL COMPLETE                 Hit enter twice fast, then once.
          #
     You: J31X                          Not echoed, case doesn't matter.
Computer: Welcome to the Xyplex Terminal Server.
          Enter username>
     You: Anonymous                     or whatever.
Computer: Xyplex>
     You: C SSEOP                       The C is for connect.
Computer: Xyplex -010 Session 1 to SSEOP established
          Username:
     You: PHOTOS                        Case in these responses doesn't matter
Computer: Password:
     You: PHOTOS
```

A SAMPLE OF AVAILABLE SPACE SHUTTLE PHOTOGRAPHS:

Image	Date	Time	Alt	Orb	Center Point or *nadir point Lat	Lon	Description
ESC01002	03-25-92	4:24:28	159	11	27.0	53.0	Persian Gulf, IRAN
ESC01003	03-25-92	6:09:48	159	12	52.5	106.0	Lake Baikal, Russia
ESC01004	03-25-92	6:10:16	159	12	52.5	106.0	Lake Baikal, Russia
ESC01005	03-26-92	13:54:48	159	33	40.2	27.5	Mt. Armuteuk, NE Turkey
ESC01009	03-26-92	13:58:26	160	33	30.8	34.0	Mt. Geb Halal,Sinai,Egypt
ESC01010	03-26-92	13:58:50	160	33	31.2	34.3	Egypt/Israel/Gaza Strip

Image	Date	Time	Alt	Orb	Center Point or *nadir point Lat	Lon	Description
ESC01011	03-26-92	13:59:20	160	33	28.0	36.0	NW Saudi Arabia
ESC01012	03-26-92	13:59:44	160	33	28.2	36.8	Tabuk, Saudi Arabia
ESC01013	03-26-92	14:00:06	160	33	25.5	36.9	Hanak, Saudi Arabia
ESC01014	03-26-92	14:00:40	160	33	25.0	39.6	Near Medina, Saudi Arabia
ESC01015	03-26-92	14:01:12	160	33	22.1	41.5	Near As Suo, Saudi Arabia
ESC01016	03-26-92	14:02:12	161	33	20.5	42.7	Near Bishah, Saudi Arabia
ESC01017	03-26-92	14:02:52	161	33	17.5	44.5	Near Najran, Saudi Arabia
ESC01018	03-26-92	14:03:28	161	33	16.0	45.0	NE of Sana, Yemen
ESC01019	03-26-92	14:03:52	161	33	14.2	46.6	Near Habban, S. Yemen
ESC01020	03-26-92	14:04:14	161	33	15.2	48.3	Wadi Daw-ar', Yemen
ESC01021	03-26-92	14:04:50	161	33	16.0	49.0	Near Sayan, Yemen
ESC01022	03-26-92	14:05:16	161	33	10.7	50.2	Buuraha Cal, Somalia
ESC01023	03-26-92	14:05:38	161	33	10.4	50.6	Wadi Dhuudo, Somalia
ESC01025	03-26-92	15:11:26	158	34	53.0	-82.0	Akimiski Is. James Bay
ESC01026	03-26-92	15:11:52	158	34	53.8*	-79.3	Ice flow, James Bay
ESC01027	03-26-92	15:12:12	158	34	54.3*	-77.3	Ice flow, James Bay
ESC01028	03-26-92	15:12:42	158	34	55.0*	-74.2	Ice flow, James Bay
ESC01029	03-26-92	15:13:04	158	34	55.5*	-71.9	Ice flow, James Bay
ESC01030	03-26-92	15:14:20	158	34	56.6*	-63.4	Clouds, high oblique
ESC01031	03-26-92	15:15:16	158	34	57.1*	-57.0	Labrador Sea
ESC01032	03-26-92	21:29:28	159	38	34.3*	-83.2	City in SE U.S.
ESC01035	03-26-92	21:31:20	160	38	28.5	-80.5	Cape Canaveral, Florida
ESC01036	03-26-92	21:32:04	160	38	26.5	-77.1	Great Abaco Is., Bahamas
ESC01037	03-26-92	21:32:30	160	38	25.0	-76.4	Eleuthera
ESC02006	03-27-92	14:13:00	161	49	6.3	42.3	Wabe Shebele Wenz, Ethiopia
ESC02007	03-27-92	18:20:00	157	52	54.2	-120.1	Prince Rupert, B.C.
ESC02008	03-27-92	18:20:32	157	52	56.4	-125.0	Williston Lake, B.C.
ESC02011	03-27-92	18:22:08	157	52	57.1*	-110.2	Northern Saskatchewan
ESC02012	03-27-92	18:22:36	157	52	57.1*	-106.9	Northern Saskatchewan
ESC02013	03-27-92	18:22:58	157	52	57.1*	-104.3	Northern Saskatchewan
ESC02014	03-27-92	18:24:48	157	52	57.3	-92.0	Hudson Bay, Canada
ESC02015	03-27-92	18:25:48	157	52	52.8	-81.8	James Bay, Canada
ESC02016	03-27-92	18:26:40	158	52	52.6	-81.6	James Bay, Canada
ESC02017	03-27-92	18:27:20	158	52	52.6	-81.6	James Bay, Canada
ESC02019	03-27-92	20:19:42	161	53	-12.0	-39.0	Near Salvador, Brazil
ESC02020	03-27-92	21:23:22	157	54	56.5	-155.7	Tugidak Is. Alaska
ESC02021	03-27-92	21:24:14	157	54	57.7	-154.0	Uyak Bay,Kodiak Is.AK
ESC02022	03-27-92	21:27:20	158	54	54.2	131.7	Rose Point,Graham Is,BC
ESC02023	03-27-92	21:31:36	158	54	45.7	-105.3	Powder River, Wyoming
ESC02024	03-28-92	23:14:14	159	71	27.2*	-114.3	
ESC02025	03-28-92	23:14:58	160	71	24.8*	-112.5	
ESC02026	03-28-92	23:15:42	160	71	23.0	-109.9	Cabo San Lucas, Mexico
ESC02027	03-29-92	08:22:00	160	77	60.0	117.7	Labuk Bay, Borneo
ESC02033	03-29-92	12:47:08	159	80	28.0	35.8	Wadi in Al Hajaz,SaudiArabia
ESC02034	03-29-92	12:47:36	159	80	28.0	40.0	An Nafud Sand Sea,SaudiArabia
ESC02036	03-29-92	12:48:30	160	80	24.0	41.6	Near Wadi Agia,Saudi Arabia
ESC02038	03-29-92	12:49:48	160	80	20.0	45.0	Near As Sulay, SaudiArabia
ESC02039	03-29-92	12:50:18	160	80	18.0	45.0	Near Na Jran, Saudi Arabia
ESC02040	03-29-92	12:51:40	160	80	14.5	48.0	Wadi Najr, South Yemen
ESC03001	03-29-92	13:53:34	157	81	38.5	-106.0	Salida, Colorado
ESC03002	03-29-92	13:54:08	157	81	42.5	-104.5	Eastern Wyoming
ESC03003	03-29-92	13:54:34	157	81	43.2	-101.5	Patricia, South Dakota
ESC03005	03-29-92	13:56:12	157	81	47.5	-96.0	Mahnomen, Minnesota
ESC03006	03-29-92	13:56:32	157	81	47.5	-92.5	Mesabi Range,Virginia,MN
ESC03021	03-30-92	06:39:34	157	92	55.0	73.4	Omsk, Russia
ESC03022	03-30-92	06:40:32	156	92	55.4	78.3	Kubyshev, Russia
ESC03027	03-30-92	06:48:40	159	92	37.0*	114.9	South of Bejing, China
ESC03033	03-30-92	12:49:02	158	96	38.4	21.3	Bay of Mesologion, Greece
ESC03035	03-30-92	12:50:04	159	96	35.5	24.2	Akrotiri, Khana, Crete
ESC03036	03-30-92	12:51:42	159	96	32.3*	27.8	Just west of Alexandria, Egypt

Image	Date	Time	Alt	Orb	Center Point or *nadir point Lat	Lon	Description
ESC03037	03-30-92	12:52:02	159	96	31.3*	28.7	Alexandria, Egypt
ESC03038	03-30-92	12:52:20	159	96	29.2	-30.8	Faiyum depression, Egypt
ESC03039	03-30-92	12:52:40	159	96	29.2	-30.8	Faiyum depression, Egypt
ESC04002	03-30-92	12:56:26	160	96	14.0	41.0	Northern Ethopia
ESC04003	03-30-92	12:56:50	160	96	14.0	41.0	Northern Ethopia
ESC04004	03-30-92	12:57:14	160	96	14.0	41.0	Northern Ethopia
ESC04005	03-30-92	12:57:36	160	96	11.7	42.4	Lake Assal, Djibouti
ESC04007	03-30-92	12:59:40	161	96	6.0	49.0	Coast of Somalia
ESC04008	03-30-92	13:00:12	161	96	6.0	49.0	Coast of Somalia
ESC04009	03-31-92	00:44:32	156	104	54.3*	166.9	Kamchatka, Russia
ESC04011	03-31-92	14:45:00	160	113	-26.9	28.3	Val Dam, South Africa
ESC04012	03-31-92	14:46:02	160	113	-30.0	-31.0	Durbin, South Africa
ESC04019	03-31-92	17:20:50	156	115	49.2	-69.8	NW of St.LawerenceRiver
ESC04020	03-31-92	17:21:20	156	115	49.0	-69.0	N of St. Lawerence R.
ESC04023	03-31-92	21:57:08	157	118	33.0	-118.5	W. San Clemente Is.
ESC04027	03-31-92	23:15:22	154	119	57.1*	159.3	Kamchatka volcanoes
ESC04029	04-01-92	04:05:24	158	122	10.6*	167.3	Atoll, Marshall Islands
ESC04033	04-01-92	04:07:40	159	122	3.0*	171.7	Tarawa Islands
ESC04035	04-01-92	04:09:44	159	122	-3.9*	175.7	Atoll, Kingsmill Group
ESC05001	04-01-92	05:18:44	154	123	55.9	85.4	Yashkino, Russia
ESC05002	04-01-92	05:19:08	154	123	55.9	85.4	Yashkino, Russia
ESC05003	04-01-92	05:21:20	155	123	52.1*	98.9	Lake Baikal, Russia
ESC05004	04-01-92	05:22:22	155	123	50.0*	104.3	Lake Baikal, Russia
ESC05010	04-01-92	07:08:32	159	124	2.0*	126.5	Ocean Scene, Near Indonesia
ESC05020	04-01-92	08:31:16	157	125	26.9*	87.6	Himalaya mountains, Nepal
ESC05026	04-01-92	11:24:00	155	127	48.9*	15.2	Northeastern Austria
ESC05027	04-01-92	11:24:24	155	127	48.2	17.1	Bratslava, Czechoslavakia
ESC05028	04-01-92	11:24:50	155	127	48.1	16.9	Bratslava, Czechoslavakia
ESC05029	04-01-92	11:27:10	156	127	41.0	29.0	Istanbul, Turkey
ESC05030	04-01-92	11:27:46	156	127	40.0	31.7	Kabirmir River, Turkey
ESC05032	04-01-92	11:28:36	156	127	36.7*	32.9	Southern Turkey
ESC05033	04-01-92	11:29:14	157	127	34.9*	34.8	Cypress
ESC05034	04-01-92	11:29:50	157	127	33.0*	36.5	Ocean features in Med. Sea
ESC05036	04-01-92	11:30:44	157	127	30.3*	39.0	Saudi Arabia
ESC05038	04-01-92	11:31:32	157	127	27.8*	41.1	Saudi Arabia
ESC06001	04-01-92	11:34:50	158	127	17.1*	48.6	Airfield in South Yemen
ESC06003	04-01-92	11:35:40	158	127	14.4*	50.4	South Yemen
ESC06004	04-01-92	11:36:20	158	127	11.9	50.7	Alula, Somalia
ESC06005	04-01-92	11:36:46	159	127	12.2	52.1	ABD AL Kuri, South Yemen
ESC06006	04-01-92	11:37:10	159	127	10.5	51.2	Hafun, Somalia
ESC06007	04-01-92	11:37:52	159	127	7.0*	54.8	Ocean front east of Somalia
ESC06008	04-01-92	11:39:00	159	127	3.2*	57.0	Ocean scene, Indian Ocean
ESC06009	04-01-92	11:39:58	159	127	0.0*	58.8	Ocean scene, Indian Ocean
ESC06013	04-01-92	13:08:32	159	128	5.7*	32.6	Thunderstorms over Zaire
ESC06014	04-01-92	13:09:32	159	128	2.4*	34.5	Lake Victoria
ESC06015	04-01-92	13:10:02	159	128	0.7*	35.5	Lake Victoria
ESC06016	04-01-92	13:10:28	159	128	-0.8*	36.3	Lake Victoria
ESC06017	04-01-92	13:11:10	159	128	-3.1*	37.7	Speke Gulf
ESC06020	04-01-92	13:13:06	159	128	-10.5	40.4	Rio Rovuma
ESC06023	04-01-92	13:16:06	160	128	-19.5*	47.6	Betsiboka River, Madagascar
ESC06024	04-01-92	18:58:40	156	132	39.2	-87.2	White River Indiana
ESC06026	04-01-92	18:59:50	156	132	37.2*	-82.2	Southeastern United States
ESC06028	04-01-92	19:00:40	156	132	28.5	-80.5	Cape Canaveral, Florida
ESC06040	04-01-92	19:07:38	158	132	11.9*	-62.6	Ocean scene, Caribbean Sea

Current as of: July, 1993.

TITLE *ESRC on-line dataset information retrieval system

SOURCE:

Sheila Taylor, BIRON Training Officer
E-mail:sheil@uk.ac.essex
ESRC Data Archive, University of Essex
Wivenhoe Park, COLCHESTER, Essex CO4 3SQ, UK
Tel: +44 (206) 873226
FAX: +44 (206) 872003

ESRC Data Archive,
University of Essex,
Wivenhoe Park, Colchester, Essex CO4 3SQ, UK
Email: ARCHIVE@UK.AC.ESSEX
Tel: 0206 - 872001

GEOGRAPHIC COVERAGE: Ranges from small regions to entire countries

FORMAT: Varied

DESCRIPTION: This on-line data archive provides a bibliographic information retrieval system for locating information about datasets, using catalog and keywork searches. Most of the datasets referenced here are demographic/socioeconomic in nature. The dataset information is available over Internet via telnet, and through the JANET and NISS services.

Information about the data sets held in the ESRC Data Archives is easily available to anyone who has access to JANET. The Archives are situated on University of ESSEX Solbourne machine. Access is achieved using BIRON (Bibliographic Information Retrieval ONline). Data held in the Archive cover most areas of social and economic life. It comprises over three thousand datasets.

Accessing BIRON

via INTERNET: telnet dasun.essex.ac.uk or 155.245.96.2
via JANET: call essex.solb1 or 000049600400 from a PAD terminal
via the NISS Gateway: call niss from a PAD terminal, then select V-Archive Services on the Gateway main menu.

Login: **biron** Password: **norib**

Current as of: July, 1993

TITLE *Southampton City Greenways GIS Awareness Dataset

SOURCE: GeoData Institute
The University
Southampton, U.K. SO9 5NH
Phone: 44 (0703) 583565
FAX: 44 (0703) 592848
Email: j.h.ball@southampton.ac.uk (or @uk.ac.southampton)
PRICE: £20. Outside U.K. add £5.
Checks payable to: "University of Southampton"

GEOGRAPHIC COVERAGE: Southampton, Hampshire, U.K.

FORMAT: DXF files plus flat ASCII data files, delivered on one 3.5 inch HD DOS format diskette. Includes booklet of documentation.

DESCRIPTION: These two datasets are for new users implementing a GIS and for those wishing to demonstrate a range of applications using data from different geographical locations.

One dataset includes boundary data for 65 ecological units from an area within Southampton. Attribute data includes:

- Habitat type
- Land use and drainage
- Visual assessment
- A subjective measure of ecological quality

Another dataset provides Enumeration District boundaries for Southampton City with a range of associated population statistics including:

- OPCS ED code, ward code, district code, county code
- Male/female population and population density for a number of years

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Current as of: July, 1993

TITLE *U.S. street, boundary, and demographic data on CDROM

SOURCE: Wessex, Inc.
1015 Tower Rd.
Winnetka, IL 60093
Phone: 708/501-3662 or 800/892-6906
FAX: 708/501-3691
PRICE: $95-$495 per CD. See below.

GEOGRAPHIC COVERAGE: United States

FORMAT: CDROM, MapInfo format (Arc/Info format available October, 1993). Many other GIS formats to be released soon. See below.

DESCRIPTION: These datasets are divided into three categories: U.S. streets, U.S. boundaries, and U.S. demographics. The data are currently available in Mapinfo format (for DOS or Windows). Soon-to-be released GIS formats are Arc/Info, SPANS Map, AutoCad, GIS Plus/TransCad, and Atlas internal format. Contact the company for information about other software formats. The following is a description of each data category:

U.S. Streets - A four-CD set extracted from Census Bureau TIGER files. Contains all streets, highways, rivers, landmarks, and city/town boundaries. For metropolitan areas, street names and address ranges are supplied.

U.S. Boundaries - One CD extracted from Census Bureau TIGER files. Contains all county, MCD/CCD, place, census tract (1980 and 1990), and block group boundaries.

U.S. Demographics - One CD containing all variables from the Census Bureau's Summary Tape File 1A report. This includes data on age, race, sex, ethnicity, and housing. Data is included at the state, county, MCD/CCD, place, tract, and block group levels. Includes "Profiler Demographics Table Builder" software for building custom tables.

PRICES

US streets	$595.00
Single CD	$195.00
US boundaries	$495.00
US demographics	$95.00
Complete set	$995.00

Current as of: July, 1993

TITLE *DEM of San Francisco Bay area on FTP

SOURCE Anonymous FTP on walrus.wr.usgs.gov (/pub/data/dem)

GEOGRAPHIC COVERAGE: San Franciso Bay area, California, USA

FORMAT: USGS DEM format. Unix compressed. Horizontal resolution: 3 arc-seconds.

DESCRIPTION: These DEMs reside on a USGS FTP site in Palo Alto, California.

```
filename      lat.range    long.range    location
--------      ---------    ----------    --------
sf24.dem.Z  38.0   37.0 -123.0 -122.0 SAN FRANCISCO CA
sj13.dem.Z  38.0   37.0 -122.0 -121.0 SAN JOSE      CA
sx24.dem.Z  37.0   36.0 -123.0 -122.0 SANTA CRUZ    CA
zp13.dem.Z  37.0   36.0 -122.0 -121.0 MONTEREY      CA
```

The data have a horizontal resolution of 3.0 X 3.0 seconds of lat/long degrees. The data have a vertical resolution of 1.0 meters. Each file has been compressed with the Unix "compress" command.

Current as of: July, 1993

TITLE *US county boundaries and names on FTP

SOURCE: For US counties of the 48 states in one Arc/Info coverage:
Anonymous FTP on csdokokl.cr.usgs.gov (/pub/gis_data)
Filename: uscounties.e00.Z

For US counties by state (one Arc/Info coverage per state):
Anonymous FTP on dis2qvarsa.er.usgs.gov (/state100)
Filenames: listed by US postal abbreviation

GEOGRAPHIC COVERAGE: County boundaries of the USA.

FORMAT: Arc/Info export files, Unix compressed. Contains county names and FIPS codes.

DESCRIPTION: This entry describes two FTP sources for US county boundaries, county names, and state and county FIPS codes. Both of these FTP sites contain data in Unix-compressed Arc/Info export format. The first site, csdokokl.cr.usgs.gov, contains only a single file of all counties for the 48 contiguous US. The projection parameters for this dataset are included in the INFO file "uscounties.doc", which is available after the "uscounties.e00.Z" file is imported to Arc/Info.

The second site, dis2qvarsa.er.usgs.gov, contains an individual county dataset for each of the 50 US states. The map projection parameters for these files are available over FTP as the files "prj.48states", "prj.ak", and "prj.hi".

ED. NOTE: I downloaded data from both of these FTP sites and noticed the following: On the csdokokl.cr.usgs.gov site, there is an attribute error in the "uscounties" coverage: Cache county, Utah (FIPS# 49005) occurs twice (as two polygons). The larger polygon should be Box Elder county (FIPS# 49003).

On the dis2qvarsa.er.usgs.gov site, I imported and displayed the California county dataset in Arc/Info. The coastlines appear to be buffered by approximately 7 km. That is, the coastline arcs in the coverage are located 7 km from where the "true" coastlines should be. I spoke with someone familiar with the data and he told me that the coastal buffer phenomenon is due to the fact that these datasets are derived from TIGER data, and that TIGER files store coastal boundaries in this manner.

Current as of: July, 1993

TITLE *30 arc-second DEM data via tape or FTP

SOURCE: Anonymous FTP on 152.61.192.70 (/pub/30ASCDWDEM) or see below:
Customer Services
EROS Data Center
Sioux Falls, SD 57198 USA
(605)594-6151; FAX (605)594-6589
PRICE: $70.00 per tape copy. Also available on anonymous FTP until December 31, 1993.

GEOGRAPHIC COVERAGE: Haiti, Dominican Republic, Puerto Rico, Madagascar. Africa is in production.

FORMAT: 30 arc-second grid resolution DEM. Coordinate system is Lat/Lon. File format: 16-bit straight raster image. Tape format: 9-track, 1600 or 6250 bpi.

DESCRIPTION: The EROS Data Center has recently produced a 30 Arc-Second DCW Digital Elevation Model. What follows is an exact copy of the Product announcement:

This dataset provides 30 by 30 arc-second digital elevation data produced from the Defense Mapping Agency's (DMA) 1:1,000,000 Digital Chart of the World (DCW) contour and hydrology data. The EROS Data Center's DEM project includes generation of 30 arc-second data for the entire world that will be distributed on CD-ROM as major geographic regions are completed. Production is underway for the continent of Africa. Two areas, Madagascar and Haiti, are complete and available for distribution.

Current as of: June, 1993

TITLE *DEM data catalog (many sources)

SOURCE: Various. Some FTP.

GEOGRAPHIC COVERAGE: Various: ranges from small local areas to global coverage.

FORMAT: Various

DESCRIPTION: The following catalog of DEM data is posted regularly to the GIS-L discussion list by Bruce Gittings of the University of Edinburgh. To quote:

"Attached is the latest version of the Catalogue of Digital Elevation Data which I have been accumulating. Any corrections/additions to this list are always welcome via e-mail, and regular re-posting will occur. I'm afraid it is still not a very extensive list and there have been few updates since the last version. Please send me any details you have, even if based on hearsay--other people will undoubtedly fill out the details. Any clues are useful.

"I am most grateful to the many individuals who have contributed. I will not acknowledge individual names because some wish to maintain their anonymity.

"Regards,

Bruce Gittings
Dept. of Geography, Univ. of Edinburgh
Drummond Street, Edinburgh, EH8 9XP, Scotland
E-mail: BRUCE@GEOVAX.ED.AC.UK"

```
CATALOGUE OF DIGITAL ELEVATION DATA                LAST UPDATED: 07-AUG-1993
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The following list is compiled on these basis of my own information and the
contributions of several helpful readers of GIS-L.  I WOULD BE VERY GRATEFUL
FOR ANY CORRECTIONS/ADDITIONS WHICH YOU CAN BE SURE WILL BE OF BENEFIT TO THE
COMMUNITY.

Please read the disclaimer at the end of this message (if it is missing, then
this posting is incomplete).
```

REG	NAME/SUPPLR	SCALE/RESOLUTION	VACm	FORMAT	SIZE	COST / FTP SITE	NOTE
WOR	DCW	1:1M as 1000ft Cont & Elev Poly	?	VPF	600MB	#200	(1)
WOR	Nat Geophys. Data Center	FNOC Elev, Terrn & Surf. Charact. as 10 min Grid	9	2 Byte Integers	28MB	On CD - see note Via FTP from ?	(5)
WOR	Nat Geophys. Data Center	ETOPO5 5 min DEM	9/1	2 Byte Integers	18.5MB	On CD - see note Via FTP from ?	(5)
WOR	Defense Map. Agency	90m / 30m DEM	?	DTED 1	?MB per 1x1 degree tile	Partial Release only of 90m data	(6)
WOR	Global GRASS	4'48" Raster Various Files	?	GRASS?	?	$300 (npd)	(8)
WOR	Dig. Bathym. Database	5' Raster Cells	?	?	?	Low (!)	(9)
WOR	GEBCO	1:10M Bathymetry	?	MGD77	?	?	(10)
EC	Bartholomews	1:1M Contours/ Bathymetery	?	A/INFO	?	? (npd)	(2)
AUS	AUSLIG	Highest Pnt Grid	?	?	?	? (npd)	(12)

REG	NAME/SUPPLR	SCALE/RESOLUTION	VACm	FORMAT	SIZE	COST / FTP SITE	NOTE
AUS	AUSLIG	Irregular Spot Heights	?	?	?	AU$100 / 1:250K sheet (npd)	(12)
AUS	AUSLIG	18" Grid of above	?	?	?	AU$150 / 1:100K sheet (npd)	(12)
AUS	AGSO	6' Grid	?	?	?	AU$750 (npd)	(13)
CHI	SIIASA	Contours	?	A/INFO + I/G MGE		? (npd)	(14)
FRA	IGN	98m DEM (from 1:50K maps)	?	?	?	$1000/sht	(11)
GER	Hessen Province	40m grid or irreg. points	?	ASCII		$200/km.sq. (npd)	(15)
IRE	Bartholomews	1:500K Contours	?	A/INFO	?	? (npd)	(2)
JPN	SIIASA	Contours	?	A/INFO + I/G MGE		? (npd)	(14)
SAF	CDSLI	200/400m DEM	?	NES	?	? (npd)	(7)
UK	Ordnance Survey	1:50000 DEM	?	NTF-L4	748KB per 20x20km tile	#30 p.a. (npd)	(4)
UK	OS	1:50000 Contours	?	NTF-L1	~1.5MB per 20x20km tile	#30 p.a. (npd)	
UK	OS	1:10000 Contours	?	NTF-L1		Special Order (npd)	
UK	Bartholomews	1:250K Contours	?	A/INFO	~? Whole UK	~#3500 p.a.	(2)
USA	USGS 1 Deg	~93m (3sec) DEM	<61	DEM	~940 x 3MB	$40 or less	(3)
USA	USGS 30'	~62m (2sec) DEM	?	DEM	?	(All this USGS	
USA	USGS 15'	~62 x 93m DEM	?	DEM	?	data same price)	
USA	USGS 7.5'	30m DEM	<15	DEM	~55,000x2MB	Many are avail at spectrum.xerox.com	

NB. REG = Region
WOR = World
AUS = Australia
CHI = China
FRA = France
VACm= Vertical Accuracy in Metres
EC = European Community
GER = Germany
IRE = Ireland
JPN = Japan
SAF = South Africa

' = Minute
" = Second
= Pounds (UK)
$ = US Dollars
AU$ = Australian Dollars
p.a. = per annum (ie. licence fee)
(npd)= Not public domain - ie. commercial product, restricted use, not available via FTP.
Where used above, "DEM" means a regular gridded array of point heights.

NOTES

(1) Digital Chart of the World (DCW) may be purchased from:

UK/Europe: Chadwyck-Healey Ltd.
Cambridge Place
Cambridge CB2 1NR
United Kingdom
Tel (0223) 311479
FAX (0223) 66440

US: USGS Open-File Section
Box 25286
Denver, CO 80225
Tel (303) 236-7476
FAX ?

The DCW database is based on the Vector Product Format (Military Standard - MILSTD 60006) and the Vector Relational Format (VRF) of the International Digital Geographic Exchange Standard (DIGEST). DCW is described by Military Specification (MIL-D-89009). Both MILSTD 60006 and MIL-D-89009 are available from:

Standardization Document Order Desk
Building 40, 700 Robbins Avenue
Philadelphia, PA 19111-5094

(2) Bartholomews are at:

12 Duncan Street
Edinburgh
United Kingdom

Tel 031 667 9341
FAX 031 662 4282

Discounts to educational establishments are normally available. In the UK and Eire this data is available from CHEST (at the University of Manchester Computing Centre) at very low prices.

(3) United States Geological Survey (the US national mapping agency) are at:

Earth Science Information Center
US Geological Survey
507 National Center
Reston, VA 22092

Tel 1-800-USA-MAPS
(Continental US Only)
(703) 860-6045/6336 (Others)
FAX 1-703-648-5548/5939

(4) Ordnance Survey (the UK national mapping agency) are at:

Romsey Road
Maybush
Southampton S09 4DH

Tel (0703) 792300
FAX (0703) 792324

NTF is the UK National Transfer Format (now incorporated within British Standard BS7567).

(5) See the entry in this NCGIA guide under "Global ecosystems data on CDROM". -Ed.

(6) This is military data. Only some of the 90m data has been released and I understand that release has been suspended due to "sensitivity" of some components of the data-set. Further enquiries to:

The Director
DMA Combat Support Center
ATTN: PMA
Washington, DC 20315-0010, USA

Tel (301) 227-2495

They can supply "Digital Sample Set #1" which consists of eight cells of Digital Terrain Elevation Data Level 1 (DTED 1) for 43 N to 45 N 113W to 109W on 1600 or 6250 bpi, 9 track, 1/2" mag tape. Cost $600. This includes a copy of the DMA Product Specification.

(7) CDSLI is the Chief Directorate of Surveys and Land Information (Private Bag X10, Mowbray, 7705, South Africa). NES is the South African National Exchange Standard, copies of which are also available from CDSLI.

200m DEMs exist for about half the country (the more interesting areas), 400m DEMs exist for the rest of the country (the flat bits). CDSLI are starting to produce 50 metre DEMs as well. Each DEM covers a quarter-degree square (to match the 1:50 000 national mapping series). They are on the Gauss Conformal projection on the Clarke 1880 (modified) ellipsoid.

(8) See the entry in this NCGIA Guide under "Global GRASS CDROMS". -Ed.

(9) For the Digital Bathymetric Data Base, contact:

Francis Marchant
US Naval Oceanographic Office
Stennis Space Centre
Mississippi, 39522-5001 USA

Tel: (601) 688 4327

(10) General Bathymetric Chart of the Oceans (GEBCO), contains individually adjusted vector ship track data. Its coverage is more or less global (they may still be digitising the South Atlantic). Contact:

Peter Hunter, GEBCO Editor
Institute of Oceanographic Sciences (Deacon Laboratory)
Brook Road, Wormley, Surrey, SU8 5UB
E-mail: cart@ibma.nerc-wormley.ac.uk

(11) The Institut Geographique National (IGN) are the French national mapping agency and are located at:

Institut Geographique National — Tel: ?
Service des Ventes et Editions (Sales and Services) — FAX: ?
107 Rue la Boetie
75008, Paris France

(12) Australian Data is available from the Australian Survey and Land Information Group (AUSLIG). There are three products; M7 are Critical Aeronautical Heights which represent the highest point in each 30'x30' quad, M8 are Spot heights (ie. an irregular grid) and M9 represents an 18" grid (gridded from M8 using an Hutchinson Algorithm). Both M8 and M9 have incomplete coverage of the country. AUSLIG are located at:

PO Box 2, — Tel: ?
Belconnen, ACT 2616, — FAX: ?
Australia.

(13) The Australian Geological Survey Organisation (AGSO - formerly BMR) provide a 6' grid of the whole country. AGSO are at:

GPO Box 378, — Tel: ?
Canberra, ACT 2601, — FAX: ?
Australia.

(14) Spatial Information Infrastructure for Asian Studies in Australia (SIIASA) is a consortium of 12 Australian universities lead by Griffith University.

The aim of the SIIASA project is to establish Geographical Information System (GIS) databases covering all of Asia, defined very broadly to encompass the Near East, the Pacific Islands (possibly including Papua New Guinea), and the ex-Soviet Central Asian Republics and asiatic Russia in addition to South, Southeast, and East Asian Countries.

The China Geographical Information System Project, established at Griffith in 1989, is the pilot project for the SIIASA databases. Its 1:1,000,000 vectorised map of the People's Republic of China is nearing completion, and amounts to nearly half a gigabyte of data. In addition to dense hydrology, detailed transport routes, and thousands of cities and towns, it includes an elaborate set of land use polygons covering the entire PRC. The source for data on contours in meters presently only covers around a third of the country. County-level administrative boundaries for the entire country, which will be used initially for the spatial analysis of 1990 census materials, are being extended back to October, 1949.

Apart from China and Japan, the base map for the SIIASA spatial databases will be the 1:1m Digital Chart of the World, to which local administrative boundaries for various time periods will be added in order to analyse census and other attribute data. Larger scale spatial data will be incorporated where available and needed to service regional research interests. For further information and to access the data contact:

Dr. Lawrence W. Crissman,
Asian and International Studies,
Griffith University,
Nathan, QLD 4111

Tel (07) 875-7285
FAX (07) 875-5111
E-mail CRISSMAN@ASIAN.GU.EDU.AU

Australia

(15) For the Hessen Province (Bundesland Hessen) of Germany the 'Landesvermessungsamt' provides a DEM. Its either a 40m grid or unprocessed irregular data with an accurate down to 2m. Its price is about some hundred DM per Km^2. You may order it on 3 1/2" disc or tape in tabular ASCII-Format from:

Hessen Landesvermessungsamt, Tel: +49 611 535-0
Scharperstrasse 4,
Postfach 3249,
6200 Wiesbaden 1, Germany.

Other DEM-Data may be obtained from:

Inst. fur Angew. Geodasie, Tel: +49 69 6333-1
Richard-Strauss-Allee 11,
6000 Frankfurt am Maine 70,
Germany.

DISCLAIMER

The University of Edinburgh and I [Bruce Gittings -Ed.] accept no responsibility for any errors in this list, nor do we endorse any of the data sets listed above in any way. I have no further information beyond that listed above, and am unable to help in either obtaining further details or acquiring the data themselves so please don't bombard me with e-mail requesting same.

Current as of: August, 1993.

TITLE *Nitrate 3-D dataset on FTP

SOURCE: Anonymous FTP at pasture.ecn.purdue.edu (/pub/mccauley/data)
Files: nitrate.README, nitrate.tar
PRICE: free on FTP

GEOGRAPHIC COVERAGE: an 800x700 m cotton field located approx. 40 km west of Bryan, Texas.

FORMAT: Flat ASCII files (GRASS sites file format), stored in a Unix tar archive. Sampling resolution is 100 m for five depths and 50 m for one depth.

DESCRIPTION: This dataset contains point samples of antecedent nitrate concentrations in parts-per-million (ppm), for a small cotton field in texas. The field was sampled at 6 depths. The shallowest depth (0-6 inches) was sampled over a 50 m grid (195 observations); and the other five depths were sampled over a 100 m grid (42 observations). A 100 m resolution grid of soil type is also included.

Data notes: To extract files from the archive file "nitrate.tar", type:

tar xf nitrate.tar

at the Unix prompt. This will make a directory called ./nitrate with the following files:

```
nitrate.006       nitrate sampled at depth 0-6 inches
nitrate.012             "     6-12
nitrate.018             "     12-18
nitrate.024             "     18-24
nitrate.030             "     24-30
nitrate.036             "     30-36
soils             soil type (100m grid)
resolution.ps.Z   Unix-compressed Postscript file containing a
                  draft paper of an application using this dataset
```

Current as of: July, 1993

TITLE *1990 Conterminous U.S. AVHRR Bi-Weekly Composites on CDROM

SOURCE: Customer Services
EROS Data Center
Sioux Falls, SD 57198
U.S.A.
phone: (605)594-6151
PRICE: Each disc in the 5 CD-ROM set is $32 ($U.S.)

GEOGRAPHIC COVERAGE: the 48 contiguous United States

Area of Coverage:
Lower Left W 125 deg N 24 deg
Upper Left W 125 deg N 50 deg
Upper Right W 66 deg N 48 deg
Lower Right W 75 deg N 23 deg

Dates of Coverage:
Disc 1: March 2 - April 26, 1990
Disc 2: April 27 - June 21, 1990
Disc 3: June 22 - August 16, 1990
Disc 4: August 17 - October 11, 1990
Disc 5: October 12 - October 25, 1990
November 9 - November 22, 1990
December 7 - December 20, 1990

FORMAT: ISO-9660 formatted CD-ROM discs; approx. 1km grid cell resolution.

DESCRIPTION: CD-ROM Contents:

- Bi-weekly composite satellite images of NOAA-11 Advanced Very High Resolution Radiometer (AVHRR) Local Area Coverage (LAC) data for bands 1-5 afternoon acquired coverage
- Normalized difference vegetation index images for each of the 19 composite images
- Satellite and solar azimuth and relative zenith data for each image pixel
- Miscellaneous state, county, climatic, and ecological region raster polygons and linework for the entire conterminous United States.

IMDISP, a PC-DOS compatible display software package, is provided on an accompanying floppy disk. The CD-ROM also contains IMDISP and Land Analysis System (LAS) label files for each image on the disk.

Hardware Needs: A CD-ROM reader with the software drivers that read ISO-9660 formatted CD-ROM discs. For MS-DOS PC's this would equate to a CD-ROM drive with Microsoft extensions at version 2.1 or higher. Similar hardware/software capabilities exist for Apple MacIntosh and SUN computer systems.

Current as of: January, 1992.

TITLE *DEM/DLG/TIGER etc. data exchange via FTP (spectrum.xerox.com)

SOURCE: Anonymous FTP at spectrum.xerox.com (/pub/map)

GEOGRAPHIC COVERAGE: various locations in USA

FORMAT: USGS DEM, USGS DLG, US Census TIGER, others; Most are Unix compressed

---

DESCRIPTION: This FTP directory hierarchy is for exchanging digital geographic data. Data may be downloaded as in any anonymous FTP site. In addition, public-domain or copyright-free datasets may be contributed to the data exchange by placing them, via FTP, in the /pub/map/incoming directory. Before doing this, get and read the /pub/map/incoming/README-IN file.

The names and contents of the directories below /pub/map are as follows:

incoming	- the place to put files that you want to contribute
dem	- USGS Digital Elevation Model files
dlg	- USGS Digital Line Graph files
gnis	- USGS Geographic Names Information System
land.use	- USGS land use data
tiger	- US Bureau of Census street maps from 1990
tiger-precensus	- US Bureau of Census street maps, beta version
source	- general purpose utility software/information
cia	- data derived from US CIA World Data Bank II

ED. NOTE: The following information comes from an FTP session by the Editor in July, 1993:

TIGER DATA - CONTENTS OF THE FILE /PUB/MAP/TIGER/INDEX-TIGER

```
Filename            description
--------            -----------
ca-orange           California, Orange County
ca-riverside        California, Riverside County
ca-san-francisco    California, San Francisco County
ca-san-mateo        California, San Mateo County
ca-santa-clara      California, Santa Clara County
ca-shasta           California, Shasta County
dc-washington       District of Columbia
md-prince-george    Maryland, Prince George's County
ny-monroe           New York State, Monroe County
ny-new-york         New York State, New York County--Manhattan
ny-tompkins         New York State, Tompkins County
```

GEOGRAPHIC NAMES DATA - CONTENTS OF THE FILE /PUB/MAP/GNIS/README-GNIS:

```
These files represent the USGS-Geographic Names Information System File for Populated
Places.  This is a special run of the GNIS system.  It includes for many places an
elevation and 1980 population count.  The format of the file is as follows:

Field             bytes
-----             -----
Place name         1 - 49
PPL               50 - 52
```

FIPS county 1	61 - 65
Fips county 2	66 - 70
Latitude	74 - 80
Longitude	81 - 88
Elevation	95 - 103
Population 1980	104 - 113
Map ID #s	114 - 132

This file is compressed two ways: (1) Filename: pplagaz.Z - unix "compress" [Lempell-Ziv] and (2) Filename: pplagaz.zip - the ZIP format (used on PCs). Take your choice. For full information on the file and its format see GEOGRAPHIC NAMES INFORMATION SYSTEM, DATA USERS GUIDE 6, Published by the USGS Reston Va. 1987.

USGS LAND USE DATA - CONTENTS OF THE FILE /PUB/MAP/LAND.USE/INDEX-LAND

# file name	comments
N0306010	<DENVER,CO. 1:250,000 QUAD LAND USE MAP 50 >
N0306020	< DENVER,CO. 1:250,000 QUAD POLITICAL MAP 50 >
N0306030	< DENVER,CO. 1:250,000 QUAD CENSUS MAP 50 >
N0306040	<DENVER,CO. 1:250,000 QUAD HYDRO MAP 50 >

DLG DATA - CONTENTS OF THE FILE /PUB/MAP/DLG/1:24,000/INDEX-DLG-24K

The /pub/map/dlg directory contains directories called "1:24,000", "1:63,360", "1:100,000", and "1:2,000,000". The index from the "1:24,000" directory is included below.

file name	place name	year	scale	lat	long	category(s)
M.OV01.N0003687.dlg.Z	INDIAN HILLS	1971	1:24000	39.50	-105.25	PUB LAND SURVEYS
M.OV01.N0004456.dlg.Z	PLATTE CANYON	1965	1:24000	39.37	-105.25	PUB LAND SURVEYS
M.OV01.N0004457.dlg.Z	KASSLER	1965	1:24000	39.37	-105.12	PUB LAND SURVEYS
M.OV01.N0009174.dlg.Z	LITTLETON, CO.	1965	1:24000	39.50	-105.12	PUB LAND SURVEYS
M.OV01.N0011228.dlg.Z	LITTLETON, CO.	1965	1:24000	39.50	-105.12	HYDROGRAPHY
M.OV01.N0024006.dlg.Z	PLATTE CANYON, CO	1965	1:24000	39.37	-105.25	PIPE & TRANS LINES
M.OV01.N0024007.dlg.Z	PLATTE CANYON, CO	1965	1:24000	39.37	-105.25	ROADS AND TRAILS
M.OV01.N0024008.dlg.Z	PLATTE CANYON, CO	1965	1:24000	39.37	-105.25	RAILROADS
M.OV01.N0024651.dlg.Z	PLATTE CANYON, CO	1965	1:24000	39.37	-105.25	HYDROGRAPHY
M.OV01.N0024964.dlg.Z	INDIAN HILLS, CO	1965	1:24000	39.50	-105.25	PIPE & TRANS LINES
M.OV01.N0024965.dlg.Z	INDIAN HILLS, CO	1965	1:24000	39.50	-105.25	ROADS AND TRAILS
M.OV01.N0024966.dlg.Z	INDIAN HILLS, CO	1965	1:24000	39.50	-105.25	RAILROADS
M.OV01.N0024967.dlg.Z	KASSLER, CO	1965	1:24000	39.37	-105.12	HYDROGRAPHY
M.OV01.N0024968.dlg.Z	KASSLER, CO	1965	1:24000	39.37	-105.12	PIPE & TRANS LINES
M.OV01.N0024969.dlg.Z	KASSLER, CO	1965	1:24000	39.37	-105.12	ROADS AND TRAILS
M.OV01.N0024970.dlg.Z	KASSLER, CO	1965	1:24000	39.37	-105.12	RAILROADS
M.OV01.N0025551.dlg.Z	INDIAN HILLS, CO	1965	1:24000	39.50	-105.25	HYDROGRAPHY
M.OV01.N0028200.dlg.Z	LITTLETON, CO	1965	1:24000	39.50	-105.12	PIPE & TRANS LINES
M.OV01.N0028201.dlg.Z	LITTLETON, CO	1965	1:24000	39.50	-105.12	ROADS AND TRAILS
M.OV01.N0028202.dlg.Z	LITTLETON, CO	1965	1:24000	39.50	-105.12	RAILROADS
M.OV01.N0047481.dlg.Z	INDIAN HILLS, CO	1965	1:24000	39.50	-105.25	NON-VEG FEATURES
M.OV01.N0047482.dlg.Z	LITTLETON, CO	1965	1:24000	39.50	-105.12	NON-VEG FEATURES
M.OV01.N0047511.dlg.Z	INDIAN HILLS, CO	1965	1:24000	39.50	-105.25	SURVEY CONTROL
M.OV01.N0047512.dlg.Z	LITTLETON, CO	1965	1:24000	39.50	-105.12	SURVEY CONTROL
M.OV01.N0050673.dlg.Z	INDIAN HILLS, CO	1965	1:24000	39.50	-105.25	VEG SURFACE COVER
M.OV01.N0050674.dlg.Z	LITTLETON, CO	1965	1:24000	39.50	-105.12	VEG SURFACE COVER
M.OV02.N0003687.dlg.Z	INDIAN HILLS	1971	1:24000	39.50	-105.25	BOUNDARIES (24&25)

file name	place name	year	scale	lat	long	category(s)
M.OV02.N0004456.dlg.Z	PLATTE CANYON	1965	1:24000	39.37	-105.25	BOUNDARIES (24&25)
M.OV02.N0004457.dlg.Z	KASSLER	1965	1:24000	39.37	-105.12	BOUNDARIES (24&25)
M.OV02.N0009174.dlg.Z	LITTLETON, CO.	1965	1:24000	39.50	-105.12	BOUNDARIES (24&25)
M.OV02.N0011228.dlg.Z	LITTLETON, CO.	1965	1:24000	39.50	-105.12	RAILROADS
M.OV03.N0011228.dlg.Z	LITTLETON, CO.	1965	1:24000	39.50	-105.12	PIPE & TRANS LINES
ashby.dlg.Z	ASHBY GAP, VA	1970	1:24000	39.00	-78.00	HYPSOGRAPHY
baton.dlg.Z	BATON ROUGE W, LA	1963	1:24000	30.37	-91.25	HYPSOGRAPHY
belle.dlg.Z	BELLE CREEK SW, MT-WY	1970	1:24000	45.00	-105.25	HYPSOGRAPHY
black.dlg.Z	BLACK EARTH, WI	1962	1:24000	43.12	-89.75	HYPSOGRAPHY
blue.dlg.Z	BLUEMONT, VA	1970	1:24000	39.00	-77.87	HYPSOGRAPHY
bount.dlg.Z	BOUNTIFUL PEAK, UT	1952	1:24000	40.87	-111.87	HYPSOGRAPHY
camas.dlg.Z	CAMAS, WA-OR	1961	1:24000	45.50	-122.50	HYPSOGRAPHY
cannon.dlg.Z	CANNONVILLE, UT	1966	1:24000	37.50	-112.12	HYPSOGRAPHY
crater.dlg.Z	CRATER LAKE WEST, OR	1985	1:24000	42.87	-122.25	HYPSOGRAPHY
downey.dlg.Z	DOWNEY CANYON, OR	1969	1:24000	43.00	-117.25	HYPSOGRAPHY
drink.dlg.Z	DRINKWATER LAKE, CA	1986	1:24000	35.37	-116.62	HYPSOGRAPHY
eastst.dlg.Z	EAST STROUDSBURG, PA	1944	1:24000	41.00	-75.25	HYPSOGRAPHY
eloise.dlg.Z	ELOISE, FL	1955	1:24000	27.87	-81.75	HYPSOGRAPHY
elyunq.dlg.Z	EL YUNQUE, PR	1967	1:20000	18.25	-65.87	HYPSOGRAPHY
entriken.dlg.Z	ENTRIKEN, PA	1963	1:24000	40.25	-78.25	HYPSOGRAPHY
fort.dlg.Z	FORT IRWIN, CA	1986	1:24000	35.25	-116.75	HYPSOGRAPHY
hogans.dlg.Z	HOGANSBURG, NY-ON-PQ	1964	1:24000	44.87	-74.75	HYPSOGRAPHY
honolulu.dlg.Z	HONOLULU, HI	1983	1:24000	21.25	-157.90	HYPSOGRAPHY
jabez.dlg.Z	JABEZ, KY	1978	1:24000	36.87	-85.00	HYPSOGRAPHY
jackson.dlg.Z	JACKSON, SC-GA	1965	1:24000	33.25	-81.87	HYPSOGRAPHY
lahond.dlg.Z	LA HONDA, CA	1961	1:24000	37.25	-122.37	HYPSOGRAPHY
madison.dlg.Z	MADISON, WV	1962	1:24000	38.00	-81.87	HYPSOGRAPHY
mccall.dlg.Z	MC CALL, ID	1973	1:24000	44.87	-116.12	HYPSOGRAPHY
moorh.dlg.Z	MOORHEAD, IA	1971	1:24000	41.87	-95.87	HYPSOGRAPHY
newbrit.dlg.Z	NEW BRITAIN, CT	1966	1:24000	41.62	-72.87	HYPSOGRAPHY
newph.dlg.Z	NEW PHILADELPHIA, OH	1962	1:24000	40.37	-81.50	HYPSOGRAPHY
ozark.dlg.Z	OZARK, MO	1970	1:24000	37.00	-93.25	HYPSOGRAPHY
phantom.dlg.Z	PHANTOM RANCH, AZ	1988	1:24000	36.00	-112.12	HYPSOGRAPHY
saxton.dlg.Z	SAXTON, PA	1968	1:24000	40.12	-78.25	HYPSOGRAPHY
smith.dlg.Z	SMITH TANK, TX	1962	1:24000	33.37	-101.12	HYPSOGRAPHY

DEM DATA - CONTENTS OF THE FILE /PUB/MAP/DEM/INDEX-DEM

```
#                                  DEM  planimetric       plan.   elev.  # of   resolution
# file name                        level reference   zone units   units  sides   x    y    z comments
#--------------------------------  ----- ----------- ---- ------- -----  -----  ----------- --------
M.N0008572.dem.Z                   DEM-1 UTM           13 meters  meters     4  30   30    1 <INDIAN HILLS CO>
M.N0008573.dem.Z                   DEM-1 UTM           13 meters  meters     4  30   30    1 <LITTLETON CO>
M.N0012041.dem.Z                   DEM-1 UTM           13 meters  meters     4  30   30    1 <PLATTE CANYON CO>
M.N0019250.dem.Z                   DEM-1 UTM           13 meters  meters     4  30   30    1 <KASSLER CO>
alma.dem.Z                         DEM-1 UTM           13 meters  meters     4  30   30    1 <ALMA,CO PIKE,CO>
anchor.dem.Z                       DEM-2 UTM            6 meters  feet       4  60   60    1 <ANCHORAGE, AK>
annandale.dem.Z                    DEM-1 UTM           18 meters  meters     4  30   30    1 <ANNANDALE VIRGINIA>
ashby.dem.Z                        DEM-2 UTM           18 meters  feet       4  30   30    1 <ASHBY GAP,VA>
belle.dem.Z                        DEM-2 UTM           13 meters  feet       4  30   30    1 <BELLE CREEK SW MT>
bh7.dem.Z                          DEM-1 UTM           11 meters  meters     4  30   30    1 <BEVERLY HILLS, CA>
blue.dem.Z                         DEM-2 UTM           18 meters  feet       4  30   30    1 <BLUEMONT,VA>
bount.dem.Z                        DEM-2 UTM           12 meters  feet       4  30   30    1 <BOUNTIFUL PEAK, UT>
brothers.dem.Z                     DEM-1 UTM           10 meters  meters     4  30   30    1 <THE BROTHERS SE WA>
buffalo-w.dem.Z                    DEM-1 geographic     0 arc-sec meters     4   3    3    1 <BUFFALO NY,PA>
camas.dem.Z                        DEM-2 UTM           10 meters  feet       4  30   30    1 <WA-OR PORTLAND>
carlsbad-caverns-west-sw.dem.Z     DEM-1 UTM           13 meters  meters     4  30   30    1 <CARLSBAD CVRNS NM>
carlsbad-e.dem.Z                   DEM-1 geographic     0 arc-sec meters     4   3    3    1 <CARLSBAD E NM,TX>
chapelhill.dem.Z                   DEM-1 UTM           17 meters  meters     4  30   30    1 <CHAPEL HILL NC>
crater.dem.Z                       DEM-2 UTM           10 meters  feet       4  30   30    1 <CRATER LAKE OR>
denver.dem.Z                       DEM-1 UTM           15 meters  meters     4  30   30    1 <DENVER AR>
el-paso-gap-sw.dem.Z               DEM-1 UTM           13 meters  meters     4  30   30    1 <EL PASO GAP,SW NM>
el-paso-gap.dem.Z                  DEM-1 UTM           13 meters  meters     4  30   30    1 <EL PASO GAP, NM>
eloise.dem.Z                       DEM-2 UTM           17 meters  feet       4  30   30    1 <ELOISE FL>
emory-peak-e.dem.Z                 DEM-1 geographic     0 arc-sec meters     4   3    3    1 <EMORY PEAK E TX>
emory-peak-w.dem.Z                 DEM-1 geographic     0 arc-sec meters     4   3    3    1 <EMORY PEAK W TX>
ennisne.dem.Z                      DEM-1 UTM           12 meters  meters     4  30   30    1 <ENNIS (S),NE MT>
ennissw.dem.Z                      DEM-1 UTM           12 meters  meters     4  30   30    1 <ENNIS (S),SW MT>
entriken.dem.Z                     DEM-2 UTM           17 meters  feet       4  30   30    1 <ENTRIKEN, PA>
fairfax.dem.Z                      DEM-1 UTM           18 meters  meters     4  30   30    1 <FAIRFAX VA>
fallsch.dem.Z                      DEM-1 UTM           18 meters  meters     4  30   30    1 <FALLS CHURCH VA>
fort.dem.Z                         DEM-2 UTM           11 meters  feet       4  30   30    1 <FORT IRWIN, CA>
gaithersburg.dem.Z                 DEM-1 UTM           18 meters  meters     4  30   30    1 <GAITHERSBURG,MD>
germantown.dem.Z                   DEM-1 UTM           18 meters  meters     4  30   30    1 <GERMANTOWN,MD>
guadalupe-pass.dem.Z               DEM-1 UTM           13 meters  meters     4  30   30    1 <GUADALUPE PASS, TX>
helens1.dem                        DEM-1 UTM           10 meters  meters     4  30   30    1 <MT ST HELENS NW>
helens2.dem                        DEM-1 UTM           10 meters  meters     4  30   30    1 <MT ST HELENS NW>
herndon.dem.Z                      DEM-1 UTM           18 meters  meters     4  30   30    1 <HERNDON VA>
hogans.dem.Z                       DEM-2 UTM           18 meters  meters     4  30   30    1 <HOGANSBURG, NY>
honolulu.dem.Z                     DEM-2 UTM            4 meters  feet       4  30   30    1 <HONOLULU, HI>
independence-spring.dem.Z          DEM-1 UTM           13 meters  meters     4  30   30    1 <INDEP. SP., TX>
jabez.dem.Z                        DEM-2 UTM           16 meters  meters     4  30   30    1 <JABEZ, KY>
```

# file name	DEM level	planimetric reference	zone	plan. units	elev. units	# of sides	resolution x	y	z	comments
jackson.dem.Z	DEM-1	UTM	17	meters	meters	4	30	30	1	<JACKSON SC-GA>
jensen-ridge.dem.Z	DEM-1	UTM	12	meters	meters	4	30	30	1	<JENSEN RIDGE, UT>
kensington.dem.Z	DEM-1	UTM	18	meters	meters	4	30	30	1	<KENSINGTON,MD>
madison.dem.Z	DEM-1	UTM	17	meters	meters	4	30	30	1	<MADISON WV>
manassas.dem.Z	DEM-1	UTM	18	meters	meters	4	30	30	1	<MANASSAS,VA>
n0009338.dem.Z	DEM-1	UTM	12	meters	meters	4	30	30	1	<FT DOUGLAS ,UT>
newbrit.dem.Z	DEM-1	UTM	18	meters	meters	4	30	30	1	<NEW BRITAIN CO>
patterson-hills.dem.Z	DEM-1	UTM	13	meters	meters	4	30	30	1	<PATTERSON HLLS, TX>
phantom.dem.Z	DEM-2	UTM	12	meters	meters	4	30	30	1	<PHANTOM RANCH, AZ>
poolesville.dem.Z	DEM-1	UTM	18	meters	meters	4	30	30	1	<POOLESVILLE,MD>
presidio-e.dem.Z	DEM-1	geographic	0	arc-sec	meters	4	3	3	1	<PRESIDIO - E TX>
rockville.dem.Z	DEM-1	UTM	18	meters	meters	4	30	30	1	<ROCKVILLE MD>
sandyspr.dem.Z	DEM-1	UTM	18	meters	meters	4	30	30	1	<SANDY SPRING,MD>
saxton.dem.Z	DEM-2	UTM	17	meters	feet	4	30	30	1	<SAXTON, PA>
seneca.dem.Z	DEM-1	UTM	18	meters	meters	4	30	30	1	<SENECA MD>
sf24.dem.Z	DEM-1	geographic	0	arc-sec	meters	4	3	3	1	<SAN FRANCISCO CA>
sj13.dem.Z	DEM-1	geographic	0	arc-sec	meters	4	3	3	1	<SAN JOSECA>
slaton.dem.Z	DEM-2	UTM	14	meters	feet	4	30	30	1	<SLATON, TX >
sterling.dem.Z	DEM-1	UTM	18	meters	meters	4	30	30	1	<STERLING,VA>
sx24.dem.Z	DEM-1	geographic	0	arc-sec	meters	4	3	3	1	<SANTA CRUZ CA>
temp.dem.Z	DEM-1	UTM	12	meters	meters	4	30	30	1	<ENNIS (S),NE MT>
tiefort.dem.Z	DEM-2	UTM	11	meters	feet	4	30	30	1	<TIEFORT MTS, CA>
tumwater.dem.Z	DEM-2	UTM	10	meters	meters	4	30	30	1	<TUMWATER, WA>
van-horn-e.dem.Z	DEM-1	geographic	0	arc-sec	meters	4	3	3	1	<VAN HORN - E TX>
vienna.dem.Z	DEM-1	UTM	18	meters	meters	4	30	30	1	<VIENNA VA>
virginia.dem.Z	DEM-2	UTM	15	meters	meters	4	30	30	1	<VIRGINIA, MN>
wash.dem.Z	DEM-1	UTM	18	meters	meters	4	30	30	1	<WASH DC>
west_point.dem.Z	DEM-1	UTM	18	meters	meters	4	30	30	1	<WEST POINT, NY.>
westofdl.dem.Z	DEM-2	UTM	11	meters	feet	4	30	30	1	<DRINKWATER LK, CA>
zp13.dem.Z	DEM-1	geographic	0	arc-sec	meters	4	3	3	1	<MONTEREY CA>

Current as of: July, 1993

TITLE *Global ecosystems data on CDROM

SOURCE: National Geophysical Data Center (NGDC)
NOAA, E/GC1, Dept. 891
325 Broadway
Boulder, CO 80303 U.S.A.
FAX: (303) 497-6513
Internet: info@mail.ngdc.noaa.gov
PRICE: $101.00, includes 300+ pages of documentation and visualization/browsing software.

GEOGRAPHIC COVERAGE: Global

FORMAT: ISO 9660 CDROM standard; variable raster resolution from 2 arc-degrees to 2 arc-minutes; some vector boundary data; Idrisi and GRASS format examples.

DESCRIPTION: The CDROM includes selected data on the global environment, such as ecosystems, land use, wetlands, vegetation (including satellite-derived vegation index), climate, topography, and soils. These data are on a range of compatibile grids, from 2 degrees to 2 minutes. Vector data for coastlines and other features are also provided. The NGDC plans to provide periodic updates and enhancements to the disk. The CD-ROM format is readable on IBM-DOS compatible machines, Apple Macintoshes, UNIX workstations, and other computers that support the ISO 9660 standard. The data are completely within the public domain.

Software is included to browse, visualize, and select appropriate portions of the database for your work. Primarily, however, the database is designed to interface with many statistical, image analysis, and geographic information systems. Data and sample setups are provided in two highly accessible geographic information systems, GRASS and IDRISI, to show how they can be used in other GISs. The structure of the database has demonstrated its adaptability by passing several tests by software vendors for quick and easy importation into their systems.

The price for the CDROM incuding 300+ pages of documentation is $101 (product number 1016-A27-001). Orders MUST be prepaid and those from outside the U.S. must include an additional $10 handling fee. The NGDC will take Amex, Visa, and MasterCard in a FAXed order showing expiration date, card number, telephone number, and your signature. Order from the above address.

A related product from the NGDC is the "Experimental calibrated GVIs on CDROM (product number 1084-A27-001 for CRDOM; 1084-B07-CUS for 9-track tape). This dataset consists of AVHRR Global Vegetation Index data, either bi-weekly or monthly for the period April 1985 through December 1991. The price, including browsing/visualization software, is $71 for CDROM and $106 per 9-track tape. Contact NGDC above for details.

Current as of: July, 1993

TITLE *Idrisi dataset of Baltic Sea area

SOURCE: GRID-Arendal
P.O.Box 1602
N-4801 Arendal, Norway
Phone: +47-41-35650 FAX: +47-41-35050
E-mail: GRID@GRIDA.NO (INTERNET)
PRICE: Free to "eastern" institutions; US $20 for "Western" institutions

GEOGRAPHIC COVERAGE: The Nordic countries and Baltic Sea drainage basin

FORMAT: Idrisi raster and vector; on diskette.

DESCRIPTION: GRID-Arendal, one of the nodes in the United Nations Environment Programme (UNEP)'s Global Resource Information Database (GRID) network has now prepared a batch of GIS data sets in IDRISI format for distribution to non-commercial institutions. Their main use will presumably be for educational GIS purposes.

The data sets have all been extracted from the global data sets of GRID (which originally were compiled by a wide variety of institutions), and cover the Nordic countries and the Baltic Sea drainage basin, or more specifically the region delineated by the following coordinates: 4-40 degrees E, 48-72 degrees N. The data sets will mainly be distributed on diskettes, accompanied by a data description document. "Western" institutions have to pay US$ 20 for handling and media costs, while "Eastern" institutions will receive these data sets entirely free-of-charge. The data sets represented are:

1 Holdridge Life Zones under present/doubled atmospheric CO_2-levels
2 Olson Major Ecosystem Complexes
3 Matthews Predominant Vegetation Type
4 Monthly Global Vegetation Index data for 1983, 86 and 89
5 FAO/UNESCO Soil Types
6 Zobler Generalized FAO/UNESCO Soil Units
7 NOAA/NGDC ETOPO5 Digital Elevation/ Bathymetry Model
8 Leemans & Cramer Monthly Mean Precipitation (1930-1960)
9 Leemans & Cramer Monthly Mean Cloudiness (1930-1960)
10 Leemans & Cramer Monthly Mean Temperature (1930-1960)
11 Matthews Seasonal Albedo
12 Matthews Methane emissions from animals
13 World Database II Coastlines, Islands and Lakes (vector)
14 World Databank II Rivers (vector)
15 Matthews Wetlands
16 World Databank II International Boundaries (vector)
17 World Databank II National Boundaries (vector)
18 World Databank II Railroads (vector)
19 Matthews Cultivation Intensity

Current as of: October, 1992

TITLE *Global GRASS data on CDROM

SOURCE: Cook College Remote Sensing Center
Global Dataset Project
Box 231, College Farm Road
Rutgers University
New Brunswick, NJ 08903 USA
Phone: 908/932-9631 FAX: 908/932-8644
PRICE: approx. $300 per CDROM, or 3 for $750. See below.

GEOGRAPHIC COVERAGE: Global.

FORMAT: GRASS GIS format (flat uncompressed raster), on CDROM. Grid cell size is 4'48".

DESCRIPTION: Contents and prices for the 3 available CDROMs are listed below:

CD1:
```
Surface albedo for Jan/Apr/Jul/Oct
Aspect
Continents/islands, continental shelf
Coral reef, greenturtle, marine otter, zooplankton distribution
Primary/secondary cover/vegetation types
Highest/medium/lowest biomass productivity
Fisheries, phytoplankton productivity
Ocean floor biomass, ocean productivity, ocean temperature
Many soil themes
Elevation, shaded relief
AVHRR vegetation production monthly for 1984-88 (45 months)
Others
```

CD2:
```
12 monthly temperature (degrees F) files
12 monthly precipitation (inches) files
12 monthly cloud cover (percentage) files
1 bathymetry file
1 visual earth - shaded image
5 continent scale watershed files
1 soil elements file
1 soil formations file
1 ridge systems file
1 rivers file
1 shaded relief map (improved since CD1)
1 major mountains of the world file
1 percent urbanized file
1 four year vegetation average (AVHRR) file
```

CD3:
```
53 weekly vegetation productivity files
(each file is a composition of approx. 7 AVHRR NVI images)
```

Ordering information: (order from the above address)

Prices:
- CD1: US$375.00; CD2: US$300.00; CD3: US$250.00
- All three can be obtained for $750.00.
- Outside US add $10.00 for shipping & handling
- US Federal agencies discount 25% of total
- Please make check, money order or P.O. payable to:
  Rutgers, The State University

Current as of: July, 1993

TITLE *National disease data over FTP

SOURCE: FTP to lib.stat.cmu.edu, login as statlib, enter your email address as the password, go to /disease. Also available over electronic mail. See below.

GEOGRAPHIC COVERAGE: USA, by state and county

FORMAT: Flat ASCII files. Georeferenced by state and county FIPS code.

DESCRIPTION: The American Statistical Association (ASA) Section on Statistical Graphics sponsored a special exposition entitled "Statistics in Public Health Surveillance", as a poster session at the August 1991 Joint Statistical Meetings in Atlanta. Its purpose was to provide a forum for ASA members to present innovative graphical and analytic techniques for addressing questions of importance to public health control and prevention efforts. For the exposition, everyone was given access to the following data files concerning tuberculosis and mumps incidence in the US.

ED. NOTE: The mumps-by-county data file (mumps_yc below), has so many missing data observations that for any given year less than 100 of the 3,000+ US counties has a known mumps count. The tuberculosis file (tb) includes attributes of age, sex, race, and ethnicity for 11,338 individual cases of TB, referenced by state FIPS code. The rest of the files contain disease counts for a state or county over a time series of years or months. The README file contains detailed information on each data file. Excerpts from the README file are included below:

Excerpts from the README file in /disease:

```
The following is a quick inventory of the files and their sizes:

   BYTES        LINES        FILE NAME        Contents
   -----        -----        ---------        --------
   16541          326        README           text (this file)
   38151         3141        census_70        county populations, 1970
   38294         3137        census_80        county populations, 1980
   57207         3141        fips_70          state & county codes, 1970
   57051         3137        fips_80          state & county codes, 1980
  112651        10342        mumps_ms         mumps cases by month & state
   83476         7000        mumps_yc         mumps cases by year & county
   26235         1606        mumps_ys         mumps cases by year & state
    3079           60        notice           text (call for presentations)
     650           54        start            when states started reporting
  201556        11338        tb               tuberculosis cases
  ------        -----
  634891        43282        TOTAL
```

To get the data via anonymous FTP:

```
ftp to lib.stat.cmu.edu, login as statlib, enter your email address as the password, go
to ./disease.
Additional datasets are in ./datasets and ./jasadata
```

To get the data via electronic mail:

```
Obtain the README file by sending an email letter to
statlib@temper.stat.cmu.edu containing the single line
"send README from disease".

If you were unable to get the README file from statlib in this manner,
then there may be some sort of problem with the way your mail address
makes it through the network.  Statlib is run by a computer program that is
```

sometimes unable to figure out how to reply to your mail. If you have requested the README file and haven't gotten it, then don't try to request anything else. Instead, send a mail message to statlib-request@temper.stat.cmu.edu, requesting assistance.

After scanning through the information below, if you decide you want the entire data collection to try your hand at analyzing it, here are instructions for getting it.

If you request the entire disease data set you will receive a lot of mail. Please make sure that your system can accept about a megabyte of mail. Some computer systems have only a limited amount of disk space allocated for incoming mail. If this could be a problem on your machine, please check first with the system administrator, or obtain the disease data in smaller chunks.

Please be patient when you request that data. Some parts of the data may arrive quite quickly, while other parts may take much longer to arrive. There are many reasons why mail can be delayed, ranging from temporary network problems, to intermediary computers being unavailable. So please wait up to a day before you reissue a request to statlib.

1) If you are on a UNIX system, you can get the rest of the data as a self-unbundling shar archive by sending another email letter to statlib@temper.stat.cmu.edu containing the single line "send shar from disease". It will come in several pieces, with easy instructions for reassembling them.

1a) If you have the uudecode and uncompress commands on your system, you can ask the statlib server to "send shar.uu from disease" to retrieve a uuencoded, compressed version of the shar file. When you receive the pieces of this file, put them together, execute uudecode on the resulting file, and then uncompress the result of the uudecode operation. This ends up sending about 320K characters as opposed to the 660K characters occupied by the entire shar file.

2) If you do not have access to a UNIX system, send another email letter to statlib@temper.stat.cmu.edu containing the lines

```
send census_70 from disease
send census_80 from disease
send fips_70 from disease
send fips_80 from disease
send mumps_ms from disease
send mumps_yc from disease
send mumps_ys from disease
send start from disease
send tb from disease
```

The data will be sent to you in a number of email letters that you will have to hand edit to trim away the mail headers and recreate the data files.

Current as of: July, 1993

TITLE: Public Domain Data Sources

SOURCE: This is a cross reference to an entry entitled *Public Domain Software for the PC* which can be found in the Miscellaneous section of this document. See that entry for information on obtaining the following data sets.

GEOGRAPHIC COVERAGE: Varied - mostly USA

FORMAT: Various, but all are DOS PC-oriented

DESCRIPTION: The following items were extracted from an entry in this document's Miscellaneous Resources section. They are available either free via electronic mail or for a nominal fee (approx. $1 per diskette) through the US Postal System. Included are interesting sources of both locational and attribute data:

- US County database - includes name, county seat, FIPS, lat/lon, date of creation, ICPSR code. $1.00
- Landsat image processing system - includes three scenes; supports MSS & TM; requires EGA graphics (by S. Loomer). $4.00
- Census Bureau state & metro area data book sampler. $1.00
- Census Bureau county & city data book 1988 sampler containing files which can be extracted into other DBMS packages. $1.00
- World Data Bank II - CIA data set and mapping program (PASCAL). $5.00
- Africa boundary files - Atlas format (by R. Martin). $1.00
- TinyTIGER - display any Precensus TIGER file; requires EGA & HD 5.25 (by F. Broome). Not available electronically. $1.00
- Census Bureau 1988 City-County Data Book (8 HD 5.25" disks). Not available electronically. $10.00
- USGS/GNIS Populated Places file; includes place names, coordinates, elevation, and population; expanded size: 9Mb. Not available electronically. $2.00

Current as of: June, 1991

TITLE: MundoCart/CD World Cartographic Database

SOURCE: Chadwyck-Healey Inc.
1101 King Street
Alexandria, VA 22314
(703)683-4890
(800)752-0515
Fax: (703)683-7589

PRICE: Single user licenses
$14,800 Complete set
$2,750 1st Regional subset
$2,220 each additional subset
Educational discounts available

GEOGRAPHIC COVERAGE: Global coverage and regional subsets (Africa, Antarctica, Australasia, Europe, North America, South America, North Asia, South Asia)

FORMAT: These datasets come on CD-ROM together with installation software on 1.44Mb or 1.2Mb floppy disks. Hardware requirements include an IBM PC AT (286) or better, 640K RAM, math co-processor, hard disk drive, high density floppy drive, mouse, MS-DOS version 3.2 or higher, EGA or VGA monitor, and CD-ROM drive. The database is topologically structured.

DESCRIPTION:

Mundocart/CD is a digital cartographic database of the entire world which is accessed by specialized retrieval software. It can be used to produce seamless maps for all parts of the world at scales ranging from 1:250,000 to 1:150,000,000. The data base includes 500,000 separate features and 60,000 names of places and features. Features included are coastlines, international and selected administrative boundaries, major city and town outlines, rivers, lakes, and canals. The source for these digitized coverages were the 1:1,000,000 Operational Navigation Charts put out by the U.S. Defense Mapping Agency. There is an option to buy the data in regional subsets rather than the complete global coverage. MundoCart/CD is compatible for export to vector and raster software packages as well as dBASE III. It contains a provision for the import of ASCII files containing long/lat coordinates.

Current as of: July 1991

TITLE: The World Climate Disc

SOURCE:

Chadwyck-Healey Inc.
1101 King Street
Alexandria, VA 22314
(703)683-4890
(800)752-0515
Fax: (703)683-7589

PRICE: $800

GEOGRAPHIC COVERAGE: global coverage on a 5° by 5° grid

FORMAT: CD-ROM (includes retrieval software)

DESCRIPTION:

This global data set contains three climatic indicators: monthly mean temperature from 2500 stations, monthly total precipitation from 5000 stations, and sea-level pressure statistics from 1873 through 1990. The data have been put in a derived gridded format of 5° by 5° boxes. The sea-pressure data set, however, is 5° by 10°. The included retrieval and mapping software allows for the creation of maps and graphs for the various variables over time.

Current as of: July 1991

TITLE: The World Weather Disc

SOURCE: WeatherDisc Associates Inc.
4584 NE 89th.
Seattle, WA 98115

PRICE: $295

GEOGRAPHIC COVERAGE: six global data sets; eleven data sets for the USA

FORMAT: CD-ROM

DESCRIPTION:

The data sets on this CD total about 600Mbytes. The data describe the climate today as well as that over the past few centuries. Seven of the data sets which are expected to be in greater demand come with software for accessing the data. The other data sets must be accessed with user provided software.

Current as of: Spring 1991 (from CTICG newsletter)

TITLE: Landsat MSS data

SOURCE: EOSAT
Customer Service Dept.
4700 Forbes Blvd.
Lanham, MD 20706
(800)344-9933
Fax (301)552-5476
(prefer fax for orders)

PRICE: $1000 per 4 band scene; $200 if scene is at least 2 years old

GEOGRAPHIC COVERAGE: Worldwide coverage; one scene is 170km N-S by 185km E-W; scenes are indexed by long/lat location (preferably providing range of long/lat)

FORMAT: Scenes are provided on magnetic tape in MSS format. Options are 1600bpi or 6250bpi, corrected or uncorrected, and band interleaved or band sequential.

DESCRIPTION:

EOSAT is the federally designated distributor of Landsat MSS data. The Landsat satellite Multi-Spectral Scanner collects data in four spectral bands. All four bands are included for each scene. Photographic representations of the data can also be purchased in black & white and color for one band or for a composite of the bands.

Current as of: July 1991

TITLE: World Resources Data Diskette

SOURCE:

World Resources Institute Publications
P.O. Box 4852
Hampden Station
Baltimore MD 21211
(301)338-6963

Price: $89.95 plus $3 postage and handling for data diskette and book; $17.95 plus $3 postage and handling for World Resource book only

GEOGRAPHIC COVERAGE: Global data for 147 countries

FORMAT: Available on 3.5" and 5.25" HD diskettes; IBM compatible

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DESCRIPTION:

The **World Resources Data Diskette 1990-1991** provides economic, population, natural resources, and environmental data for 147 countries. The data set contains over 300 indicators for these countries. Accompanying the diskettes is the **World Resource 1990-1991: A Guide to the Global Environment**. This 383-page volume is produced in conjunction with the United Nations Environment Programme and the U.N. Development Programme. It contains an assessment of the world's natural resource base including interpretive analysis of the global data listed in the book (and found on the diskettes).

Current as of: 1991

TITLE: ECODISC Educational CD-ROM

SOURCE:

ESM Ltd
Duke Street
Wisbech, Cambridgeshire
PE13 2AE United Kingdom

Price: £150 + VAT(17.5%)

GEOGRAPHIC COVERAGE: A British Nature Reserve (Slapton Ley Devon)

FORMAT: CD-ROM with HyperCard interface for use on Macintosh computers

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DESCRIPTION:

This is an educational data set appropriate for instruction in ecology or biogeography. It provides data which represents the biotic resource of a nature reserve. This allows for simulation in which students are able to examine the flora and fauna of the Reserve, experiment with different management strategies, and make projections on population trends for species. The data provide a number of views of the reserve to the student such as information on expert's studies, walks through the reserve, a selective sampling of flora, etc.

Current as of: Spring 1991 (CTICG newsletter)

TITLE: Global Change Database Project: Pilot Project for Africa

SOURCE:

GCDP Africa
World Data Center A for Solid Earth Geophysics
U.S. National Geophysical Data Center
325 Broadway
Boulder, CO 80303 USA
Phone: 303/497-6125 FAX: 303/497-6513

PRICE: $151.00; includes 300+ pages of documentation, exercise manual.

GEOGRAPHIC COVERAGE: The African continent

FORMAT: The database is distributed on high-density diskettes as a compressed archive of IDRISI binary format image and vector files. The entire uncompressed database occupies approximately 42 Megabytes of disk space.

DESCRIPTION: Product number 1085-A25-001

This database was developed by the US NOAA National Geophysical Data Center, in cooperation with the International Geosphere-Biosphere Program. The objective of this project is to facilitate global change research by making databases such as this one widely available. From an educational perspective, this data set constitutes a large and diverse source of GIS data which can be used for teaching.

The database consists of raster images which measure 480 columns by 438 rows. The images range from 1-degree to 10 arc-minute resolution. The following is a list of some data themes included in the Global Change Database for Africa:

- AVHRR normalized vegetation index (uncalibrated monthly averages for 45 months)
- Percent water and urban cover
- Elevation and bathymetry
- Ecosystem classes
- Average monthly precipitation and temperature
- Soil type (various sources/classifications)
- Landuse and landcover classes (various sources/classifications)
- Average annual windspeed
- Desertification hazard
- Vector files including coastlines, country boundaries, rivers, and lakes

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Current as of: July, 1993

TITLE: OSU-MAP Databases

SOURCE: Included with the OSU-MAP program

GEOGRAPHIC COVERAGE: Massachusetts, Ohio, Ontario, Maine, South Carolina, Costa Rica, Panama, Thailand

FORMAT: ASCII, in .DAT format for easy input to OSU-MAP

DESCRIPTION:

These databases are included with the OSU-MAP package, and make up a large, diverse set of study areas with which to develop laboratory exercises and applications. The following is a listing of the general geographic area and associated layers of each database.

Study area	Layers
Brown's Pond, Massachusetts	altitude, contours, steepness, aspect, water bodies, roads, buildings
Franklin County, Ohio	bedrock, glacial geology, political boundaries, geological limitations to development, agricultural land, landuse, soils, watersheds
Maple Mountain, Ontario	watersheds, shoreline, forest classes, forest species, ungulate classes, recreation classes
Montville Township, Ohio	political boundaries, landuse, soils, ground water, land productivity, sand and gravel, erosion loss, flooding
Onawa Lake, Maine	transportation, forest type, point features, water bodies, inoperable and available land, Appalachian Trail/Mountain Club
West Panama Canal	landuse, elevation, roads
Southern Thailand	landuse, elevation, soils, hydrology, transportation, political boundaries, settlements
Fairfield County, South Carolina	landuse, elevation, political boundaries, census county divisions, transportation, hydrography, soils
Ohio	State county boundaries, population density
La Selva, Costa Rica	political boundaries, cities/farms, roads, lakes, rivers, canals, forest cover, railroads, managed area boundaries, critical plant/animal species, elevation, visibility from major roads and cities/farms
Petersham County, Massachusetts	altitude, land cover, buildings, water, roads; (The Brown's Pond database is a subset of this database.)

Current as of: September, 1989 (OSU-MAP Version 3.0)

TITLE: USGS Digital Cartographic and Geographic Data

SOURCE: National Cartographic Information Center
U.S. Geological Survey
507 National Center
Reston, VA 22092
(703)860-6045 (800)USA-MAPS

Price: $40 for one file, $20 for each additional file. CD-ROMs are $32.

GEOGRAPHIC COVERAGE: The United States

FORMAT: Data are available on magnetic tape; some 1:1M and 1:2M data are on CD

DESCRIPTION:

There are three general types of data available: elevation data, geographic names information, and planimetric data. Detailed information on these various data sets is provided by the National Cartographic Information Center. A brief synopsis of the available data sets is found below.

- **Elevation Data:** Digital Elevation Models (DEMs) are available in coverages corresponding to the 7.5-minute USGS topographic quadrangle series. There also is DEM data from the Defense Mapping Agency in 1° x 2°(1:250,000 scale) sections.

- **Geographic Names Information:** This consists of four data bases available in text, microfiche, or magnetic tape format. The National Geographic Names Data Base is a computerized file of place and feature names in the U.S.. The USGS Topographic Maps Data Base gives descriptive information on every published or planned 7.5-minute quad map. It also describes all of the USGS topographic maps at scales of 1:100,000 and 1:250,000. The Generic Data Base gives general information on the features listed in the Geographic Names Data Base. About 1,100 types of features are described and cross-referenced with general categories in this data base. The fourth data base, The Board on Geographic Names, provides information on the decisions made by the Domestic Names Committee of the U.S. Board over the years.

- **Planimetric Data:** This is a collection of Digital Line Graph (DLG) data available at various scales. DLGs are available in three formats. One DLG format uses the 7.5 and 15-minute quadrangle series. Line features include political boundaries, transportation networks, drainage systems, or U.S. Public Land Survey System boundaries. These DLGs are stored with long/lat coordinates. A second DLG format is based on 1:2,000,000-scale maps. The line features of these files include political boundaries, hydrography, and transportation, and are also stored as geographic coordinates. The third type of DLG available consists of land use/land cover data sets created by overlaying 1:250,000 and 1:100,000-scale thematic maps. These DLGs provide information on various land uses. This digital data sets have been stored in both vector and raster formats available as ASCII or IBM binary. These thematic data are registered by UTM coordinates. All of the DLGs are topologically structured.

Current as of: July 1991

TITLE: Geophysics of North America

SOURCE:
National Geophysical Data Center
NOAA, E/GC1, Dept. 720
325 Broadway
Boulder, Colorado 80303-3328 U.S.A.
(303)497-6419
Fax:(303)497-6513

Price: $580 (plus $10 handling charge)

GEOGRAPHIC COVERAGE: North America; bathymetry of surrounding water bodies

FORMAT: CD-ROM data for PCs with EGA color graphics

DESCRIPTION:

This is a CD-ROM containing geophysical data on North America including topography, magnetics, gravity, earthquake seismicity, crustal stress, and thermal aspect. Access software on floppy disk comes with the CD. The software provides pop-up window menus and on-line help to aid in retrieving data from the CD.

Data Summary:

- TOPOGRAPHY - 5-minute gridded elevation and bathymetry values; 30-second gridded file for conterminous U.S. and its coastal waters
- GRAVITY - free-air and Bouguer anomalies on 6-km and 2.5-minute grids; isostatic, free-air, and Bouguer anomalies for conterminous U.S. on 4-km and 2.5-minute grids
- MAGNETIC - anomaly data on 2-km and 2.5-minute grids; MAGSAT satellite-derived anomalies on 2-degree and 10-minute grids (up to 50° north lat.)
- SATELLITE IMAGERY - 10-minute grid AVHRR data for several popular wavelengths, including vegetation index
- POINT DATA - earthquakes (1534-1985); crustal stress; thermal aspects
- BOUNDARIES - country, state, and province boundaries; U.S. county boundaries; software allows display of long. and lat. grids

Most of this data set can also be found in an inexpensive, display-only format on the USGS JEDI CD-ROM. See the entry in this section entitled *USGS JEDI Educational CD-ROM.* A wide range of additional geophysical data is available from the NGDC at the above address.

Current as of: July 1991

TITLE: USGS JEDI Educational CD-ROM

SOURCE: Nimbus Information Systems
JEDI
SR629, Guildford Farms
Ruckersville, VI 22968
(804)985-1100

Price: $31 plus $3.50 shipping and handling for 3-CDs and accompanying workbook

GEOGRAPHIC COVERAGE: Varies

FORMAT: 3 CD-ROMs with IMDIS software for data display and analysis on a PC

DESCRIPTION:

JEDI is the result of a Joint Educational Initiative between the USGS, NOAA, NASA, and more recently the Geology Department of the University of Maryland. It provides a potpourri of data. The disk includes most of the USGS Geophysics of North America database (see data entry in this document), selected Landsat scenes, AVHRR data for Yellowstone National Park, SLAR data, TOMS data, vegetation change analysis, ocean temperature and salinity analysis, Voyager data, and others. It is meant as an educational disk for use by educators at the primary, secondary, and university levels. The included analysis software, IMDIS, was made by Planetary Data Systems at JPL. It displays the data, computes histograms, and performs other analyses. The 2GB of raw data on the disks can be manipulated but cannot be output. The disk set comes with a 102-page workbook of activities. This wide assortment of data sources would provide students with a good introduction to digital data.

Current as of: July 1991

TITLE: National Highway Planning Network

SOURCE:

Steve Lewis
Federal Highway Administration
Room 3320, HPP 22
400 7th St., SW
Washington, D.C. 20590
(202)366-9223

Price: No charge, user provides tape or floppy disks

GEOGRAPHIC COVERAGE: United States major highways

FORMAT: Available in ASCII on magnetic tape or 6 HD 5.25" (or 3.5") floppy disks

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DESCRIPTION:

The National Highway Planning Network (NHPN) is a 17MB database of major highways in the United States. This growing database presently contains 390,000 miles of highways. Attribute data include the following: route name, number, type, length, heading, urban, one way, median, access control, number of lanes, traffic restriction, toll roads, truck routes, tunnels, pavement type, administrative class, and functional class.

The locations and attributes of these roads are at various levels of accuracy. This uncertainty is a reflection of source materials, but the information is being continually updated to increase accuracy. Presently these updates are not passed on to those who have received the NHPN. The Federal Highway Administration is looking for a commercial distributor of the data. This might create a situation for easy data update, but it will probably mean that there will be a charge for the data. The current data distribution mode only requires that the interested party provide the medium on which to copy the data.

Current as of: July 1991

TITLE: EtakMap Transportation Networks

SOURCE:

Etak, Inc.
1430 O'Brien Drive
Menlo Park, CA 94025
Phone: (415)328-3825
Fax: (415)328-3128

Price: varies according to type of platform (i.e. PC vs Workstation) and by county information content level; Example prices are $1000 for a PC version or $4000 for Workstation version of a class 3 county (most counties are class 3); Los Angeles county which is one of only 2 class 1 counties goes for $5,000 PC and $17,000 Workstation

GEOGRAPHIC COVERAGE: Many US counties and 100 major metropolitan areas; about 100 European metropolitan areas

FORMAT: Data is similar in format to DIME and TIGER files. It is shipped on 9-track magnetic tape or DCL tape. Data is in an interchange format that can be read by ARC/INFO, AutoCAD, IGDS, ATLAS*GIS, INFO-MAP, and others. A compressed format is also available which works exclusively with ETAK software products.

DESCRIPTION:

EtakMap are US transportation network datasets based on TIGER and DIME files. There are also datasets for European urban areas. Key attributes and features are roads, road names, road class, address, zip, city names, railroads, shorelines, political and statistical boundaries, and some census information. The census demographic information is not supported by EtakMap, though often some will remain. All features have been digitized from 1:24,000 USGS quads.

Current as of: July 1991

TITLE: National Environmental Data Referral Service

SOURCE:

NEDRES Program Office
Assessment and Information Services Center
NOAA/NESDRES (E/AIX3)
3300 Whitehaven St., N.W.
Washington, D.C. 20235
(202)634-7722

PRICE: NEDRES operates on a cost recovery basis. Charges are based on computer connect time, telecommunications, and records printed.

GEOGRAPHIC COVERAGE: Varies

FORMAT: The NEDRES data base can be accessed electronically with a modem.

DESCRIPTION: The NEDRES database is a computer-searchable catalog and index of environmental data. It contains descriptions of environmental data files, published data sources, data file documentation references, and organizations that make environmental data available. There are over 13,000 entries. Types of data sets described are climatological and meteorological, oceanographic, geophysical and geological, hydrological and limnological, and geographic. Geographic data sets overviewed include geodetic, cartographic, and land use. Each entry lists many parameters describing the data set such as title, data collection methods, time frame of data collection, size of data set, and geographic area covered by the data set.

Current as of: July 1991

TITLE: USA Digital Terrain Data

SOURCE:

Young Minds Inc.
308W State St., Suite 2B
Redlands, CA 92373
(714)335-1350
FAX: (714)798-0488

Price: $3000 (2-CD set)
(special university price - $1950)

GEOGRAPHIC COVERAGE: USA

FORMAT: 9 Gbytes data on 2 CD-ROMs; including retrieval software for MS-DOS and UNIX operating systems

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DESCRIPTION:

These CDs contain 3 Arc-second Digital Terrain Data for the United States. They were compiled from original Defense Mapping Agency/US Geological Survey DEM data. This company also offers other CD products including software for CD-ROM data disk creation (CD-ROM formatter).

Current as of: July 1991

TITLE: NOAA Digital Shoreline Data

SOURCE:

Graphics Manager (N/CG221A)
Charting and Geodetic Services
National Ocean Service, NOAA
6001 Executive Boulevard
Rockville, MD 20852
(301)443-8563

Price: Contact person above

GEOGRAPHIC COVERAGE: Shoreline for conterminous United States, Puerto Rico, U.S. Virgin Islands, Hawaii, and part of Alaska

FORMAT: Available in part or whole on 9-track magnetic tape

DESCRIPTION:

This coordinate data represents the shoreline as collected from the largest scale nautical chart coverage published for a given area. It is available either as varied large-scale or uniform 1:250,000 small-scale data sets. The small-scale coordinate data are derived from the large-scale digitized data. A brochure with additional information is available from the source address listed above. Also available from the Charting and Geodetic Services is Digital Aids to Navigation data. This provides a digital record of buoys, landmarks, and the like.

Current as of: March 1989

TITLE: United States Census TIGER/Line Files

SOURCE:

Customer Services
Data User Services Division
Bureau of the Census
Washington, DC 20233
Phone: (301)763-4100
Fax: (301)763-4794

Price: For 9-track tapes;
$200 for first county ordered
$25 for each additional county
For CD-ROM;
$250 per disc
Documentation for files is $5

GEOGRAPHIC COVERAGE: The entire United States, Puerto Rico, the Virgin Islands of the United States, Guam, American Samoa, the Northern Mariana Islands, and the other Pacific territories for which the U.S. Census Bureau assists in the census taking process.

FORMAT: Available on 9-track magnetic tape or CD-ROM. 9-track tapes can be ordered in ASCII or EBCDIC, and with 1600bpi or 6250bpi. Tapes are ordered by the county. CD-ROMs contain whole states (except California and Texas which require multiple discs). Some discs contain multiple states.

DESCRIPTION:

The TIGER File or TIGER data base contains digital data for all 1990 census map features (such as roads, railroads, and rivers), feature names and classification codes, alternate feature names, the associated 1980 and 1990 census geographic area codes and FIPS (Federal Information Processing Standard) codes, such as those for census tracts, blocks, cities and townships, and within metropolitan areas, address ranges and ZIP Codes for streets. TIGER/Line Files are available for each county. The average size of a county file is 6 megabytes. The state average is 400 megabytes. The TIGER/Line file allows for the combination of its geographic and cartographic data with other statistical information obtained from the census or elsewhere.

The census only provides the data files. User application software is available from the commercial sector. Many companies have developed software that use and enhance the TIGER/Line files. The Census Bureau will provide a list of companies providing this software.

Current as of: July 1990

TITLE: *NCGIA/US Census Multiple Representations Data Set: Lee County, Florida

SOURCE: Anonymous FTP at ncgia.ucsb.edu (/pub/data/lee.county)
NCGIA
Department of Geography
University of California
Santa Barbara, CA 93106-4060
Phone: 805/893-8224
FAX: 805/893-8617
email: ncgiapub@ncgia.ucsb.edu

PRICE: Approx. $20 for 7 HD 3.5" diskettes. Contact NCGIA for details.

GEOGRAPHIC COVERAGE: Lee County, Florida

FORMAT: The FTP version of this dataset consists of Unix-compressed Arc/Info export files. The data are also available from the NCGIA in TIGER prototype format on seven HD 3.5" DOS diskettes. The total size of the uncompressed dataset is approximately 45 megabytes.

DESCRIPTION:

This is a multi-scale, multi-agency database which was developed for use in teaching and research, primarily in the subject area of multiple representations. The dataset consists of vector data from various sources covering all of Lee County, Florida and surrounding areas. The components of the database are as follows:

- Tiger/Line Data: Various data products from the US Census Bureau, including the entire TIGER file for Lee County.
- USGS Digital Line Graph (DLG) Data
- USGS Land Use/Land Cover Data
- National Ocean Service (NOS) Shoreline Data

Documentation for this data set is included in the NCGIA Technical Paper 90-4: *NCGIA/US Census Multiple Representations Data Set Project--Technical Report on Pilot Project: Lee County, Florida*, May, 1990. An abridged version of this document is available in digital form with the FTP data.

Current as of: August, 1993.

TITLE: Census Data for UK, US, and Other Countries

SOURCE:

Chadwyck-Healey Inc.
1101 King Street
Alexandria, VA 22314
(703)683-4890
(800)752-0515
Fax: (703)683-7589

Price: Supermap - $4,500; Supermap US - $3,850

GEOGRAPHIC COVERAGE: Small area statistics for England, Scotland, and Wales; United States; (France, Italy, Hong Kong, and New Zealand)

FORMAT: CD-ROMs including mapping and presentational software running in Microsoft Windows 3.0. Supermap requires a PC with at least 1Mb RAM, hard drive, high density floppy drive, EGA or VGA monitor, mouse, and CD-ROM drive. It also requires MS-DOS version 3.3 or higher and windows 3.0.

DESCRIPTION:

Chadwyck-Healey offers the following CD-ROM data sets:

- **Supermap** - Three CDs contain the 1981 Small Area Statistic census data with boundary mapping to the ward level in England and Wales and to postcode sector in Scotland. Included software allows creation of tables, choropleth maps, charts, histograms, and scattergrams. Software also provides the ability to export data into ASCII and other formats

- **Supermap US** - US version of supermap contains the complete data set for population and housing in the 1980 US Census. It includes data down to the enumeration district and block group level

- **Other Countries** - Contact the UK office given below for more information:

  Paul Holroyd
  Chadwyck-Healey Ltd.
  Cambridge Place
  Cambridge CB2 1NR
  United Kingdom
  Phone: (0223)311479
  Fax: (0223)66440

Current as of: July 1991

TITLE: United States Census Catalog and Guide - 1991

SOURCE: To order ask for Stock #003-024-07271-8

Send a check (payable: Superintendent of Documents) to:
Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

or Call Superintendent of Documents for VISA or MASTERCARD order: (202)783-3238

for more information call the Census Bureau

GEOGRAPHIC COVERAGE: United States

FORMAT: Catalog listing products in various formats including all digital products

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DESCRIPTION:

This is the primary resource for information on census products. It includes indices, lists of sources, forms, and additional information about the census.

Current as of: July 1991

TITLE: Sherbrooke, Canada Geomatic Data

SOURCE: Canada Centre for Geomatics, EMR
(Sherbrooke Data Set)
2144 King St., West, Suite 010
Sherbrooke, Quebec, J1J 2E8, CANADA
Fax: (819)564-5698

GEOGRAPHIC COVERAGE: Sherbrooke area of Quebec

FORMAT: digital plus hardcopy maps of topography

DESCRIPTION:

Data for Sherbrooke includes digital topographic data, digital elevation models, SPOT and Landsat imagery, and hardcopy topographic maps. This data was compliled as a test set by the Canada Centre for Geomatics and The Canada Centre for Remote Sensing.

Current as of: Fall 1990

TITLE: Canadian Census Geography

SOURCE:

Marketing and Client Liaison
Statistics Canada, Geography Division
Jean Talon Building, 3rd Floor
Tunney's Pasture
Ottawa, Ontario
K1A 0T6
CANADA
(613)951-3889
Fax: (613)951-0569

Price: Varies according to area requested.
Examples: An AMF for Calgary is $2,563 Canadian Dollars; AMFs for all Canada is $95,000 CD; A census subdivision CARTLIB for all of Canada is $5,460 CD; A PNMF for all Canada is $500 CD

GEOGRAPHIC COVERAGE: Whole or part of Canada

FORMAT: These data are compatible with many GIS packages including: ARC/INFO, Grass, AtlasGIS, AtlasGraphics, GIMMS, MapInfo, and Map Analyst. Files are available on magnetic tape or diskette. Check with Statistics Canada for specific information.

DESCRIPTION:

The government agency, Statistics Canada, is the repository for maps and digital files containing boundaries and features used to define statistical areas in the Canadian Census. A detailed information package on products can be obtained from the address listed above. Below are short descriptions of three of the digital products.

- **Area Master Files (AMF)** - This contains a logical representation of all streets and other features such as railroad tracks, rivers and municipal boundaries for a given geographic area (usually a municipality). An AMF geographically references every street, address range, block-face, and centroid coordinate in the coverage area. AMFs are available for most urban centers with a population of 50,000 or more.

- **Cartographic Boundary Files (CARTLIBs)** - CARTLIBs are digital cartographic libraries of the boundaries and related features of various geostatistical areas. CARTLIBs can be used in conjunction with computer mapping programs as a basis for mapping statistical data.

- **Place Name Master File (PNMF)** - The PNMF lists census divisions, census subdivisions, and unincorporated places for which population was reported by the census. Information on the PNMF includes Standard Geographical Classification codes, census codes, type of place, lat/long, census map number, and population.

Current as of: July 1991

TITLE: EMR-Canada Digital Atlas and Topographic Data Base

SOURCE: For National Atlas:

Client Services Officer
National Atlas Information Service
615 Booth Street, Room 650
Ottawa, Ontario
K1A 0E9 CANADA
(613)992-3892

For Topographic Data Base maps:

Digital Mapping Information
615 Booth Street, Room 406
Ottawa, Ontario
K1A 0E9 CANADA
(613)995-0314
FAX: (613)995-6001

GEOGRAPHIC COVERAGE: Canada

FORMAT: Cartographic information is available in ARC Export or SIF and as ASCII text files, in geographic or Lambert Conformal Conic coordinates; names information is in ASCII text file format. Data can be transferred to 1/2" and 1/4" magnetic tape or to diskettes for small files.

DESCRIPTION:

The EMR (Energy, Mines, and Resources) Canada has two types of digital cartographic data available:

- **National Atlas Data Base** - The National Atlas Information Service is converting many of its 1:2M and 1:7.5M scale base maps into digital format. Each map includes drainage, boundaries, transportation networks, Indian reserves, parks, populated places, and other selected features. Thematic data from the 5th Edition National Atlas will be available and added as required. There is also a data base of geographical names available. It lists names of over 450,000 populated places and geographic features.

- **National Topographic Data Base** - The digital storage of Canada's topographic data is being carried out in two ways. Digital stereo-compilation at a scale of 1:50,000 is taking place for areas of Canada with high population density, major transportation routes, and developing regions of strategic importance. The second method, scanning of existing topographic maps, is being done for the rest of Canada at scales of 1:50,000 and 1:250,000. The 1:250,000 scanning is complete. The 1:50,000 scanning and stereo-compilation are slated for completion by the year 2000. Presently 597 stereo-compiled files and 179 scanned files are available.

Current as of: July 1991

TITLE: Alberta Digital Maps

SOURCE:

Provincial Mapping Section
Land Information Services Division
Alberta Forestry, Lands and Wildlife
4949 - 94B Avenue N.W.
Edmonton, Alberta T6B 2T5
CANADA
(403)427-6467

or send for the Digital Products Catalogue:

Maps Alberta
2nd Floor, 9945 -108 Street N.W.
Edmonton, Alberta T6B 2T5
CANADA
(403)427-3520

GEOGRAPHIC COVERAGE: Alberta Canada

FORMAT: Files are available in Intergraph Design System (IGTS) format, Intergraph Standard Interchange Format (ISIF), and in the Canadian Council on Geomatics Interchange Format (CCOGIF). Data can be sent on magnetic tape, 5.25" diskettes, and 3.5" diskettes (both DOS and Mac format).

DESCRIPTION:

Maps are available at various scales with varying feature content. The following are the available base maps:

- **1:2,000,000 Digital Base** - covers entire province; includes township grid, hydrography, primary highways, geo-administrative boundaries, and place names
- **1:1,000,000 Digital Base** - one file covers entire province; may be purchased by feature class; includes geo-administrative boundaries, Alberta Township System, hydrography, and transportation network
- **1:750,000 Digital Base** - same as 1:1,000,000
- **1:250,000 Digital Base** - same as 1:1,000,000 except 50 files are need to cover the province
- **1:20,000 Provincial Digital Base** - 70% of province mapped in three types of files: position files (geo-coded features), representation files (features adjusted for presentation), and digital elevation models; may be purchased by feature class; includes geo-administrative boundaries, Alberta Township System, hydrography, transportation network, and contours
- **1:20,000 City Digital Bases** - data for sixteen cities to supplement Provincial maps; includes geo-administrative boundaries, Alberta Township System, hydrography, and transportation network

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Current as of: December 1990

TITLE: St. Catharines, Ontario, Canada

CONTRIBUTOR: David Flack
Department of Geography
Brock University
St. Catharines, Ontario, Canada L2S 3A1
telephone: (416) 688-5550 ext.3489
email: ggsflack@brocku.ca

SOURCE: Available from contributor

GEOGRAPHIC COVERAGE: St. Catharines, Ontario, Canada

FORMAT: IDRISI-ASCII

DESCRIPTION:

This data set is associated with exercises described in the exercise section of this document under the title *Three Introductory Labs - St. Catherines, Ontario.*

- **Raster** (300 rows by 200 columns, 40 m cells)

  1. Water: Lake Ontario, Twelve Mile Creek and Welland Canal (60K)
  2. Landuse: Residential, Commercial, Industrial, Parks, Water, Regional Roads, Freeways, Railway(60K)

- **Vector**

  1. Roads (2K)
  2. Industrial (2K)
  3. Residential (9K)
  4. Commercial (3K)
  5. Water (2K)
  6. Parks (5K)
  7. Schools (1K)

All files were digitized from N.T.S. 1:50,000 map 30M/3. Note that last three vector files are optional with respect to the associated exercises.

Current as of: June, 1991

MISCELLANEOUS RESOURCES

TITLE *GIS Survival Guide

SOURCE: GeoData Institute
The University
Southampton, U.K. SO9 5NH
Phone: 44 (0703) 583565
FAX: 44 (0703) 592848
Email: j.h.ball@southampton.ac.uk (or @uk.ac.southampton)
PRICE: £6. Outside U.K. add £3.
Checks payable to: "University of Southampton"

APPLICATION AREA: General GIS information

EDUCATIONAL ROLE: For those needing to decide on investment/implementation strategies for GIS

GENERAL DESCRIPTION:

This booklet is aimed to be an introduction for first-time GIS users and buyers who need more than a trade leaflet but less than a textbook. The 41 pages produced in two colors emphasize the process of designing, selecting, purchasing, and implementing a system. The booklet is a very useful starting point for an organization contemplating buying a GIS, with sections on:

- GIS: the basics
- GIS system architecture
- GIS technical specification
- Data
- GIS applications
- GIS project design
- Management implications of GIS
- Investment desision
- GIS system selection

Current as of: July, 1993

TITLE *SpaceStat: software for statistical analysis of spatial data

SOURCE: NCGIA/Geography Department
University of California
Santa Barbara, CA 93106-4060
Phone: (805)893-8224
Fax: (805)893-8617
Internet: ncgiapub@ncgia.ucsb.edu

Price: Non-profit and academic sites: $250.00; for-profit sites: $500.00. Contact NCGIA for more details.

HARDWARE/SOFTWARE: IBM PC 386/486 or compatible, math coprocessor, at least 4 megabytes RAM.

DETAILED DESCRIPTION: SPACESTAT: NCGIA SOFTWARE S-92-1

SpaceStat is a software package for the analysis of spatial data, developed by Luc Anselin and distributed by the U.S. National Center for Geographic Information and Analysis (NCGIA) at the University of California, Santa Barbara. The software is written and compiled in the well known matrix language Gauss386 (version 3.0, from Aptech Systems, Inc.) and runs on IBM PS/2 and compatible machines with a 386 (with math coprocessor) or 486 cpu, and at least 4 megabytes of RAM (more is preferable). It is provided with a Gauss386 Runtime module for those users who do not have access to Gauss.

SpaceStat includes a large number of utilities to transform data from ascii into the format used by Gauss, to carry out spatial data transformations, construct spatial weights matrices (including linkages with a GIS) and distance matrices, and to transform and manipulate spatial weights matrices. However, its main emphasis is on descriptive statistics of spatial association (Moran's I, Geary's c, QAP, join counts, Getis-Ord G, multivariate spatial association) and spatial regression analysis. The latter includes facilities to easily implement specialized regression models, such as trend surface models, models with spatial regimes, spatial expansion models and spatial analysis of variance. A wide range of estimation methods are supported, including ordinary least squares (with diagnostics for spatial autocorrelation), maximum likelihood estimation of models with a spatial lag or a spatially autocorrelated error term, estimators for heteroskedastic models, and instrumental variables and bootstrap approaches.

At this point in time, SpaceStat does not yet include facilities for graphics, but this will be added in a future release. However, the software contains a mechanism to link with a number of GIS packages for visual display. This link is currently furthest developed for Idrisi.

SpaceStat is continually being refined, updated and expanded and interested persons are invited to contact Luc Anselin at NCGIA about features they would like to see implemented. SpaceStat is currently distributed with a tutorial/manual and several example data sets. NCGIA also has three recent technical reports that illustrate the use of SpaceStat in the context of the integration of spatial data analysis with GIS: "Spatial data analysis with GIS: an introduction to application in the social sciences" (NCGIA Technical Report 92-10, by Luc Anselin); "Teaching introductory geographical data analysis and GIS: a laboratory guide for an integrated SpaceStat/Idrisi environment" (NCGIA Technical Report 93-5, edited by Rusty Dodson); and "Spatial data analysis and GIS: interfacing GIS and econometric software" (NCGIA Technical Report 93-7, by Luc Anselin, Sheri Hudak and Rusty Dodson).

Current as of: August, 1993

TITLE *AAG Microcomputer Specialty Group software and data library

SOURCE: AAG Microcomputer Specialty Group. See below.
PRICE: Most items are $1.00

HARDWARE/SOFTWARE: IBM PC, Macintosh

GENERAL DESCRIPTION: This entry describes a multitude of public-domain datasets and software, much of which is relevant to GIS education.

FORMAT: distributed on diskette. One library is IBM PC format and one is Macintosh.

DETAILED DESCRIPTION: The AAG Microcomputer Specialty Group maintains a library of public domain software. This library is divided into two parts: IBM/compatible and Macintosh. Lists of software for each may be obtained at the following addresses:

IBM
Robert Sechrist
Dept. of Geography
Indiana Univ. of PA
Indiana, PA 15705
voice: (412) 357-2251
FAX: (412) 357-3768

Macintosh
Nancy Hultquist
Dept. of Geography
Central Washington Univ.
Ellensburg, WA 98926
(509) 963-1188

Ordering Procedure for IBM software: Identify desired software by number, total your costs and send check or M.O. for IBM software to Robert Sechrist. Make checks payable to "AAG-MSG" in United States funds drawn on a United States Bank. Note that orders cannot be accepted without pre-payment or purchase order. Do not submit orders over the net.

Individuals interested in contributing software, data files, or exercises should send them to the appropriate contact. The AAG-MSG is dedicated to providing low cost educational materials to geographers.

IBM SOFTWARE HOLDINGS (software number listed in **bold**)

G1 US County Database - Includes county name, county seat, FIPS latitude, longitude, date of creation, ICPSR code. ($1.00)
G2 Digital Terrain Analysis - Uses DTED for line of sight, 3-D oblique, slope categorization, & tinted elevation maps. ($1.00)
G3 Weather & Climate - Several related programs to create weather, classify climates (by R. Sechrist), and draw climatographs (by S. Loomer and others). ($1.00)
G4 Landsat (by S. Loomer) - Image processing system (requires EGA). ($1.00)
G5 UDMS-GIS (by V. Robinson & C. Heively)- Simple GIS system. ($3.00)
G6 Cartographic Utilities - Programs to facilitate digital cart. Includes Theissen Polygon, Point-in-Poly, Degrees to decimal. ($1.00)
G7 Barchan Sand Dune (by P. Fisher) - Simulate sand dune motion (requires math chip). ($1.00)
G8 Mortality Analysis (by United Nations) - Demographic package creates Halley Life Tables. ($3.00)
G9 MicroDEM (by P. Guth) - Digital Elevation Model Analysis. ($3.00)
G10 Statistical Consultant (by R. Sechrist) - Expert system that selects statistical tests and routines for data analysis. ($1.00)
G11 Habitat Evaluation Procedures & Suitability Index. ($3.00)
G12 Iterative Proportional Fitting (by A. Krmenec & R. Sechrist). ($1.00)
G13 Census Bureau 1987 State & Metro Area Data Book Sampler. ($1.00)
G14 Population Pyramid (by D. Noonan). ($1.00)
G15 Spatial Autocorrelation Classroom Exercise (by D. Griffith). ($1.00)

G16 FMAPDIGT (by T. Fang) - Converts field data onto a plotted map. ($1.00)
G17 Census Bureau 1988 County & City Data Book Sampler. ($1.00)
G18 Census Bureau 1983 County & City Data Book State Files. ($2.00)
G19 PC-Mapro (by F. Gossette) - Map projection software (about 20 projections supported), project & display on screen. ($2.00)
G20 Streets - Street mapping program, street navigation system. ($1.00)
G21 Daylight Mapper - Shows areas of daylight for any date and time. Show equinoxes, solstices, and progressions of terminator. ($1.00)
G22 Optimal Routing Exercise (by P. Fisher) - Class exercise to show students routing algorithms and path selections. ($1.00)
G23 Soil Taxonomy (by P. Fisher) - Expert system to classify soil. ($1.00)
G24 MicroCAM (by S. Loomer) - Map projection and thematic mapping. ($6.00) Printed MicroCAM manuals are available for $12.00 each. Order the MicroCAM interaface G40 too!
G25 Astronomy - Stellar & planetary mapping ($2.00)
G26 World Data Bank II - CIA data set and mapping program. ($5.00)
G27 Highway Interchange Development Model (by H. Moon & Lindquist) - Land use planning for new highway interchanges. ($1.00)
G28 Map Analysis Package (by D. Tomlin). ($1.00)
G29 Project Management - Includes PERT and CPM methods. ($1.00)
G30 Site Analysis & Selection (by Kim & Han). ($2.00)
G31 Africa National Boundary Files (by R. Martin) - Atlas format. ($2.00)
G32 Black Magic - Hypertext program. ($3.00)
G33 TinyTIGER (by F. Broome) - Display TIGER file & other TIGER programs (requires EGA) ($1.00)
G34 ANGLESTAT - Spatial statistics (by A. Krmenec). ($1.00)
G35 Center (by P. Fisher) - Point pattern analysis. ($1.00)
G36 Mapran (by P. Fisher) - Random choropleth mapping. ($1.00)
G37 SurveySoft - Surveyor's toolkit, field traverse, coordinate geometry. ($1.00)
G38 Image 3-D - 3-D CAD program ($2.00)
G39 USGS - GNIS Populated Places - File includes place names, coordinates, elevation, and population (9 meg). ($2.00)
G40 MicroCAM Interface (by Anderson, Rohweder, & Brook) - Program to generate MicroCAM command files (see G24). ($3.00)
G41 Epidemic (by R. Sechrist) - Spatial diffusion simulation. ($1.00)
G42 GEO-EAS - Environmental Protection Agency environmental analysis package. ($3.00)
G43 MicroMSI - Microcomputer Multi- Special Imagery analysis program. (AAG-MSG Award Winner) ($4.00)
G44 States - Educational learning game about the 50 states. ($1.00)
G45 Terra*Time & Distance - Tracks the local time around the globe. ($1.00)
G46 QuickMap Computerized Atlas - Custom map generator, etc. ($1.00)
G47 Save the Planet Database - On global warming and ozone depletion. ($1.00)
G48 AtlUS - Interactive U.S. atlas and gazetteer. ($1.00)
G49 What's In The Box? - PC hardware tutorial. ($1.00)
G50 Agricultural - Programs and information for ag planning. ($1.00)
G51 Digitize-PC - (by S. Sulyatski) Digitizer driver software for most digitizers (AAG-MSG Award Winner) ($1.00)
G52 ViSDA - (by Qin Tang) Time series choropleth mapping. See changes in spatial distributions over time. ($1.00)
G53 Atlas*GIS Exercises (by R. Sechrist) Municipal GIS files & tutorial exercises for Atlas*GIS ($1.00)
G54 TIGER Support (by F. Broome & R. Oblinsky) Support programs for manipulating TIGER files ($1.00)
G55 Pycnophylactic Interpolation & Geog. Data Reaggregation (by W. Tobler) Spatial data manipulation ($1.00)
G56 MAPIT (by Allison Software) Choropleth Mapping System ($1.00).

Current as of: June, 1993

TITLE *Map projection tutorial software for Macintosh on FTP

SOURCE Anonymous FTP on walrus.wr.usgs.gov (/pub/mac)
Filenames: map_projections.README, map_projections.hqx

Also available by on diskette from:
U.S. Geological Survey Books and Open-File Reports Sales
P.O. 25425
Denver, CO. 80225
(303) 236-7476

APPLICATION AREA: Map projections for thematic maps

HARDWARE/SOFTWARE: Apple Macintosh Plus, Classic, SE, or II; Hypercard 2.0.

GENERAL DESCRIPTION: The following information comes from the map_projections.README file:

map_projections.hqx: 1.7 Mb

The purpose of this HyperCard guide is to describe a few of the common map projections that can be used to present thematic data. This description of map projections enables a compiler of thematic data to select a map projection that will portray the data effectively, and it allows the map reader to identify the map projection so that there is a mutual understanding as to how to obtain information from the thematic map. In regional mapping, the choice of a map projection is usually based on convention or availability rather than on how well the map projection portrays a particular set of data. The best projection for portraying thematic data about people, countries, agriculture, geology, and so on (all areal phenomena) is a map projection that preserves areal relationships.

Many map projections are derived on a developable surface (see glossary, page 4) producing a basic grid system of longitude and latitude known as the earth's graticule. From the graticule, a map projection can be defined. In this manual, four main types of map projections are described. Projections onto (1) Planes (Azimuthal), (2) Cones, (3) Cylinders, and (4) a miscellaneous category. Each of these main types has some variations, and this guide will show some of these variations. Eighteen map projections commonly used to present thematic data are briefly described and illustrated. Also included are several examples of the map projections used by the U. S. Geological Survey for thematic maps. This guide consists of descriptive material only and does not contain a program for creating map projections.

Requirements for the diskette version of this report are: Apple Computer, Inc., HyperCard 2.0 software (not supplied) and Apple Macintosh Plus, Classic, SE, or II. The date of this Open-File Report is 10/04/1991. OF91-533-A, paper copy, 92p. OF91-533 -B, 3.5-in. HD Macintosh diskette.

To order this report on diskette, contact: U. S. Geological Survey Books and Open-File Reports Sales, P.O. 25425 Denver, CO. 80225, or call (303) 236-7476.

Current as of: July, 1993

TITLE: *Computer-based learning modules using Marine/Coastal image data

CONTRIBUTOR: Dirk G. Troost
United Nations Educational, Scientific, and Cultural Organization (UNESCO)
Training and Education in the Marine Science Programme (TREDMAR)
1, rue Miollis
75015 Paris, FRANCE
Tel: 33 1 4568 3971
FAX: 33 1 4783 5940

PRICE: Free.

APPLICATION AREA: Marine remote sensing, oceanography

GEOGRAPHIC LOCATION: Coastal areas around the world

EDUCATIONAL ROLE: Undergraduate university level

HARDWARE/SOFTWARE: DOS-compatible PC, EGA or VGA

DATA REQUIRED: All included

GENERAL DESCRIPTION:

Contains twenty-two lessons in three stand-alone modules written by scientists from around the world on a variety of marine and coastal phenomena: local, regional, and basin-wide.

Current as of: August, 1993.

TITLE: GIS WORLD's *GIS Sourcebook*

SOURCE:

GIS WORLD
P.O. Box 8090
Fort Collins, CO USA 80526
Phone: 303/223-4848
FAX: 303/223-5700

PRICE: (1990 edition)
$59.95 for subscribers to GIS WORLD
$119.95 for all others

GENERAL DESCRIPTION:

Published annually by GIS WORLD, Inc., this 375-page sourcebook contains a wide range of information of general interest to GIS users and educators. In addition to articles on applications, technology, and education, the *GIS Sourcebook* includes the following components:

- **Software Survey**: A detailed chart depicting general characteristics and functional capabilities of nearly 100 GIS packages. This item is also available separately as a poster-sized wall chart ($34.95).
- **GIS Industry Directories**: An index of approximately 200 GIS-related industries, as well as separate directories of consulting, digitizing, and scanning services.
- **Spatial Data Sources**: Detailed articles on selected data sources as well as an index to miscellaneous data sources.
- **Appendices**: Upcoming GIS events; list of acronyms; book reviews; glossary

Current as of: August, 1990

TITLE: GIST! II: The Geographical Information Systems Tutor, Version 2

SOURCE: AVAILABLE SEPTEMBER 1, 1991 FROM:

GIS WORLD, Inc.
P.O. Box 8090
Fort Collins, CO 80526
Phone: 303/223-4848
FAX: 303/223-5700

PRICE: Approximately $150.00

EDUCATIONAL ROLE: Introductory/intermediate

HARDWARE/SOFTWARE: GIST runs on a Macintosh with 1 Mb RAM and either two 800k disk drives or a hard disk. Hypercard software is also required.

GENERAL DESCRIPTION: GIST is an interactive tutorial which introduces important concepts in automated mapping, spatial theory, and geographical analysis. Using the point-and-click browsing capabilities of the Macintosh Hypercard system, GIST employs graphics and animation to present a wide range of topics including:

- Data capture
- Data structures
- Spatial data editing
- Restructuring
- Attribute and spatial searches (including Boolean logic)
- Manipulation of maps (including map projections)
- Spatial abstraction
- Data integration

In addition, GIST contains a GIS bibliography and a directory of commercial GIS packages with information on data structures, attribute storage, and hardware/software requirements of each system.

GIST was written by Jonathan Raper and Nick Green at the Department of Geography, Birkbeck College, 7-15 Gresse St., London, England W1P 1PA, phone: (01) 631 6577. A software review of GIST can be found in the May, 1991 *Professional Geographer*, 43(2), 235. Related articles by Raper can also be found in the bibliography appendix of this document.

Current as of: May, 1991

TITLE: NCGIA GIS Laboratory Facility Study

CONTRIBUTORS: Dr. Greg Elmes, West Virginia University
Dr. Peter Keller, University of Victoria
Dr. Susan Macey, Southwest Texas State University
Dr. Richard Scott, Glassboro State College
Dr. William Smith, Central Washington University
Dr. Richard Wright, San Diego State University

SOURCE: NCGIA/Geography Department
3510 Phelps Hall
University of California
Santa Barbara, CA 93106-4060
Phone: (805)893-8224
Fax: (805)893-8617

Price: $27.00
Available as an NCGIA Technical Paper (#91-21)

GENERAL DESCRIPTION: This is an NCGIA report entitled *GIS Teaching Facilities: Six case studies on the acquisition and management of laboratories.* The report provides valuable insight for anyone desiring to establish a laboratory facility for use in GIS courses. It includes 6 narrative case studies which review the acquisition and management of computer labs established primarily for teaching GIS. The case studies outline the procedures followed and include discussion of supporting documents, budgets proposed and realized, hardware and software configurations, and laboratory management schemes.

Available as of: September 1991

TITLE: VT/GIS - The von Thünen GIS Tutorial

CONTRIBUTOR: Rusty Dodson
NCGIA/Dept. of Geography
University of California
Santa Barbara, CA 93106-4060
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Phone: 805/893-8224 FAX: 805/893-8617

SOURCE: NCGIA technical paper 91-27

PRICE: $15.50

NCGIA TOPIC: Modeling socioeconomic processes

APPLICATION AREA: Agricultural location theory

GEOGRAPHIC LOCATION: Hypothetical

EDUCATIONAL ROLE: For beginning/intermediate students in economic geography

COMPLETION TIME: Several hours

HARDWARE/SOFTWARE: An IBM PC or compatible, with a color monitor and a MicroSoft-compatible mouse

DATA REQUIRED: Includes one 3.5" HD diskette with all necessary software and documentation.

GENERAL DESCRIPTION: VT/GIS is an educational software package developed with two main objectives: first, to investigate the possibility of using a commercially-available GIS package to develop an automated tutorial of a classic model from location theory; and second, to provide students with an interactive environment in which to investigate the results of a spatially-relaxed von Thünen model. The package consists of a linked set of DOS batch files, C programs, and IDRISI analytical and display modules, and includes an introductory paper, a user's manual, and two student exercises.

DETAILED DESCRIPTION: This simple package allows students to set up an environment which relaxes many of von Thünen's original simplifying spatial assumptions. By allowing for variable transportation costs and yield potential over space as well as multiple markets, the VT/GIS package takes advantage of GIS technology in illustrating complex spatial relationships.

The package is designed to teach agricultural location theory rather than GIS concepts per se. Students use the mouse to on-screen digitize points (markets), lines (railroads), and polygons (lake barriers and regions of variable fertility). VT/GIS then calculates the model and displays the resulting pattern of three-crop land use as both a "flat" map and as a three-dimensional land rent surface. At this point any of the model parameters may be changed and the model recalculated.

VT/GIS utilizes a menu/submenu interface in which the user types in the number or letter of the desired function. It is not fast - some operations take several minutes to process a 100 by 100 grid. Nevertheless, the package is a useful educational tool providing a colorful, interactive environment for computing a spatially-relaxed model from classical location theory.

Current as of: July, 1991

APPENDIX A
Index to GIS software mentioned in this document

The following is a listing of the GIS software products mentioned in this document, along with a contact for obtaining the software and, when available, a price. Prices cited are as current as possible, but of course subject to change.

ARC/INFO
ESRI
Environmental Systems Research Institute
380 New York Street
Redlands, CA 92373-9870
Phone: 714/793-2853
FAX: 714/793-5953

ATLAS*DRAW; ATLAS*GRAPHICS; ATLAS*GIS
Strategic Mapping, Inc.
4030 Moorpark Ave., Suite 250
San Jose, CA 95117
Phone: 408/985-7400
FAX: 408/985-0859
PRICE: Approximately $2,500 for one copy of ATLAS*GIS

AutoCAD
Autodesk, Inc.
2320 Marinship Way
Sausalito, CA 94965
Phone: 800/445-5415 Ext. 23
PRICE: Approximately $3,500

Geo/SQL GIS
Generation 5 Technology, Inc.
575 Park Street
Regina, Saskatchewan, S4N 5B2 Canada
Phone: 306/721-2362
FAX: 306/721-2474

GRASS
Grass Information Center
US Army Construction Engineering
Research Lab
P.O. Box 4005
Champaign, Illinois 61824-4005
(217)373-7220
FAX: (217)373-7222

IDRISI
The IDRISI Project
Graduate school of Geography
Clark University
950 Main Street
Worcester, MA 01610 USA
Phone: 508/793-7526
FAX: 508/793-8881
PRICE: $200 per academic license; $100 per student license

ILWIS
ITC, ILWIS Marketing Department
350, Boulevard 1945
P.O. Box 6, 7500 AA Enschede
The Netherlands
Phone: 31/53-874217 or 874337
FAX: 31/53-874400
PRICE: 7,500= Dfl. for the first software license, less for subsequent licenses

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INFO-MAP
Claymore Services Limited
Station House, Whimple
Exeter, Devon EX5 2QJ
United Kingdom
0404-823097
FAX: 0404-823030
PRICE: £995

MapInfo
MapInfo Corp.
Hendrick Hudson Bldg. 200 Broadway
Troy, New York 12180
(518)274-8673
FAX: (518)274-0510
PRICE: $995

OSU-MAP
OSU-MAP-for-the-PC
Department of Geography
The Ohio State University
Columbus, Ohio 43210-1361
Phone: 614/292-2514
FAX: 614/292-6213
PRICE: $95 per academic or student copy; $195 per non-academic copy

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pcARC/INFO
ESRI
Environmental Systems Research Institute
380 New York Street
Redlands, CA 92373-9870
Phone: 714/793-2853
FAX: 714/793-5953

SPANS
TYDAC Technologies, Inc.
Suite 310
1600 Carling Avenue
Ottawa, Ontario, Canada K1Z 8R7

Or:
1655 North Fort Myer Drive, Suite 320
Arlington, Virginia 22209
Phone: 703/522-0773
FAX: 703/522-5189
PRICE: $2,500 US for the first copy (research license), and $750 US for subsequent copies (educational licenses)

APPENDIX B
Bibliography on teaching GIS

by Karen K. Kemp and Rustin F. Dodson

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APPENDIX C
Format for future submissions

For future editions of this guide, we encourage the submission of any interesting exercises or descriptions of useful data sets or other educational materials of interest to GIS educators. For laboratory exercises we will include, if appropriate, the text of an entire exercise. Otherwise, we will include summary information and, when applicable, details on how to obtain the complete text and associated data. In the case of data sets and software products, only printed summary information can be included as we are unable to act as a clearinghouse and distributor of digital products. Send contributions to:

Electronic submissions

ncgiapub@ncgia.ucsb.edu
ncgiapub@voodoo.bitnet

Hardcopy submissions

Attention: Lab Materials Guide
NCGIA/Dept. of Geography
University of California
Santa Barbara, CA 93106-4060

The following is a guideline for the types of summary information in which we are most interested.

Summary format for lab exercises

TITLE:
CONTRIBUTOR:
SOURCE:
APPLICATION AREA:
GEOGRAPHIC LOCATION:
EDUCATIONAL ROLE:
COMPLETION TIME:
HARDWARE/SOFTWARE:
DATA REQUIRED:
GENERAL DESCRIPTION:
DETAILED DESCRIPTION:

Format for data sets

TITLE:
SOURCE:
GEOGRAPHIC COVERAGE:
FORMAT:
DESCRIPTION:

Miscellaneous resources

Items in this category will vary considerably. Please include any of the above headings which are appropriate as well as any additional information that may be relevant.

APPENDIX D
How to use anonymous FTP

File Transfer Protocol (FTP) is a means for moving files across a network between different computers. Normally, to use FTP one needs password-level access to both the sending and the receiving computer. *Anonymous FTP*, on the other hand, allows any user to copy files from a remote computer by providing the user with restricted access and file permissions. The following is a minimal set of instructions and commands necessary for using anonymous FTP on a Unix-based computer. These instructions show you how to log into the NCGIA's anonymous FTP system and get a file which is a digital version of this Lab Guide. The FTP site is "ncgia.ucsb.edu", the directory of interest is "pub/tech-reports/text", and the file of interest is "91-20.txt". Below, the commands you need to type are listed in **bold** text:

1) Log into the FTP site: type "anonymous" as your user name, and type your email address as your password. (You can actually type anything at all for the password--the email address is just a convention.) Note that the Unix prompt changes to "ftp>".

```
% ftp ncgia.ucsb.edu
     login: anonymous
     password: <your_email_address>  [you won't see it]
```

2) Change to the directory of interest. Also, you can browse any other directories you see by using the "cd", "ls", and "dir" commands.

```
ftp> cd pub/tech-reports/text
ftp> ls  [verify that the file you want to copy is here]
```

3) Use the "get" command to copy a file from the remote computer to your computer. The file will be copied to the directory you were in when you started the FTP session in step 1 above.

   Note that the file in this example is a text file, so the default FTP settings should work fine. If you copy a binary file, you need to first type the FTP command "binary" to set binary file transfer mode.

```
ftp> get 91-20.txt
```

   Another useful command for copying files is "mget" (many get). This command allows you to use the "?" and "*" wildcard characters to copy many files at once. FTP will prompt you for a "y" or "n" in response to each file it is about to copy. If you don't want these prompts, type the FTP command "prompt" before you issue the "mget" command. This will turn off the interactive FTP mode. Typing "prompt" again will turn it back on.

4) To quit FTP, type "quit"

```
ftp> quit
```

(Continued...)

A summary of some useful FTP commands:

FTP command	Function
get	Copies a file from the remote computer to the current directory of the local computer.
mget	Copies many files at once. Wildcards "?" and "*" may be used.
prompt	Toggles the interactive mode on or off. When on, "mget" prompts for each file.
ascii	Sets ASCII file transfer mode. This is the default.
binary	Sets binary file transfer mode.
lcd <dir>	Changes the current directory on the local computer to <dir>. Any files copied will now go to <dir>.
cd <dir>	Change the remote directory to <dir>.
ls	Lists the files in the current remote directory.
dir	A verbose version of "ls". Gives file sizes and other information.
quit	Quit FTP.

Pointers for using anonymous FTP

- When obtaining files over FTP, **always** get and read the README file from the current directory. This file will contain important information about the files. The README filename may differ slightly, e.g. READ.ME, readme, Read.me, etc.
- Filenames ending with ".Z" are Unix compressed, and are binary. Remember to transfer them using FTP binary mode.

APPENDIX E
Eight full-text exercises using OSU-MAP
By Dick Scott

PREFACE TO THE OSU-MAP EXERCISES

This set of exercises was written and provided by Dick Scott of the department of Geography and Anthropology at Glassboro State College. Aside from minor editing, the only change to the text was the removal of the OSU-MAP command syntax listings. You might want to provide your students with printouts of the appropriate command syntax, or show your students how to obtain and interpret the syntax information directly from the OSU-MAP software.

These exercises use the THAI, MAINE, and BROWN's Pond datasets, which are included as standard datasets of the OSU-MAP package. Information on obtaining OSU-MAP can be found in Appendix A.

Titles of OSU-MAP exercises

EXERCISE 1: OSU-MAP Visibility Analysis:
EXERCISE 2: OSU-MAP Visibility Analysis: Exciting Conclusion
EXERCISE 3: OSU-MAP Logical AND and Logical OR Analysis
EXERCISE 4: OSU-MAP Network Analysis Functions
Using the Find, Spread, and Drain Commands in Network Analysis
EXERCISE 5: Minimum Distance Roads
EXERCISE 6: Medical Facility Trade Areas
EXERCISE 7: Ski Area Site Analysis
EXERCISE 8: Introduction to GIS: Project Final

EXERCISE 1: OSU-MAP VISIBILITY ANALYSIS:

Introduction

This workshop introduces you to some of the analytical capabilities of OSU-MAP. To add interest and also to begin to get you oriented to the notion of GIS problem solving, I will introduce the commands required to carry out an analysis in which you are to determine suitable locations for cellular telephone towers. At the outset you will be given a list of constraints with which you have to deal. Your task is to find a solution to the problem.

The constraints of the problem are:

1) You must build five or fewer towers.

2) The maximum height of the towers is 40 meters.

3) The towers must be located on land and the slope of the land must be greater than two percent and less than nineteen percent.

4) The towers must be positioned such that all locations on all single and double lane roads are visible from at least one tower. Moreover, you must attempt to achieve maximum visibility for all locations within one and one-half kilometers of such roads.

Note that you may take advantage of the local terrain in order to increase the effective height of a tower, but you should keep in mind that higher locations may also be steeper. In selecting a higher location make sure that your site has acceptable slope.

To carry out this analysis you will work with the Thai database. The only layers you need for this analysis are: 1) landuse, 2) roads, and 3) elevatio. All other layers needed to complete the analysis are calculated from these three.

Creating the Slope Map

The first thing you need to do is use the elevation data to create a slope map. To do this you use the DIFFERENTIATE command:

```
DIF ELEVATIO For SLOPE
```

Having created the slope map, you will probably want to take a quick look at it. To do this use the COLOR command.

Re-classing the Slope Map to Fit Constraint Classes

The next step in the analysis is to create a layer that divides cell slopes into three classes: 1) too flat for construction [poor drainage], 2) acceptable for tower construction, and 3) too steep for construction [high cost]. To do this you first use the DESCRIBE command to examine the range of values present in the SLOPE layer. Next, you use the RENUMBER command to create the required classes. Finally, you use the LABEL command to provide legend descriptions for the new layer.

The DESCRIBE command provides you with summary information on a layer of the database. The summary includes a listing of every value taken on by one or more cells and the frequency of occurrence of each of those values. The command to create statistical summary of SLOPE:

```
DEscribe SLOPE
```

The text box will display the information about SLOPE. Specifically, you will notice that slope values range from zero to about fifty percent. You will use this information in re-classing the map with the RENUMBER command. The RENUMBER command creates a new layer in the database. In this new layer the data values in the existing layer will be replaced by values you specify in the command. Here we use the command to reduce a large number of slope values to three classes.

Command to RENUMBER SLOPE as per requirements of slope constraints defined in problem statement and create new layer called SLP-OK:

```
RENUmber SLOPE For SLP-OK A 1 To 0 TH 2 A 2 To 3 TH 19 A 3 To 20 TH 50
```

The new layer, SLP-OK has three categories: 1) cell values of one have slopes less than three percent, 2) cell values of two have slopes ranging from three to nineteen percent, 3) cell values of three have slopes ranging from twenty to fifty percent. From the standpoint of our analysis these categories are: too flat, good slope, and too steep. We can use the LABEL command to place descriptive labels in the legend box for SLP-OK. Command to LABEL SLP-OK:

```
LABEL SLP-OK
      1   Too Flat <R>
      2   Good Slope <R>
      3   Too Steep <R>
      -1  <R>
```

Re-classing Landuse to Create Two Classes: Land and Water

Because one locational constraint is that the towers must be located on land, you need to create a layer that divides the study area into two categories: land and water. To do this you will use a layer called LANDUSE along with the following commands: COLOR, DESCRIBE, RENUMBER, AND LABEL.

The first thing you might wish to do is take a look at the LANDUSE layer. To do this you use the COLOR command. You could use SHADE, but if you have color why not use it:

```
COLor LANDUSE
```

Next, you will need to inspect the numeric values the program is using for each of the landuse categories. To do this you use the DESCRIBE command: `DEscribe LANDUSE`

At this point note the range of values and the value used to signify water. Specifically, water has the value 0, while all other categories describing uses of the land surface range in value from one through fourteen.

You are now ready to use the RENUMBER command in order to create a new layer that has two classes: one for water bodies and one for land areas. The name of the new layer will be H2O. Here is the command you will use to create H2O:

```
RENUmberLANDUSE For H2O A 4 To 0 A 7 To 1 TH 14
```

This statement creates a layer called H2O in which water bodies are assigned the value 4 and all land areas are assigned the value 7.

At this point you will want to use the LABEL command to identify the categories on the new layer, H2O. Here is how you do it:

```
LABEL H2O
      4   Water <R>
      7   Land <R>
      -1  <R>
```

Of course, now you will want to see the result of your work. Use the COLOR command to display H2O:
`COLor H2O`

You have now created two new layers: one specifies those places that have acceptable slope in the land surface; whereas the other outlines the areas of land and water within the study area. You are now ready to use a new command, CROSS, that enables you to overlay SLP-OK and H2O.

Using Cross to Overlay Map Layers

You will use the CROSS command to produce a map of all areas that are not in the water and have acceptable slope values. This might seem a strange operation on the face of it, but the results might illustrate one of the inherent shortcomings of the raster approach to GIS.

The CROSS command overlays a first layer with a second layer to create a new layer. The command allows you to assign a value in the new layer to indicate the joint occurrence of a value you specify for layer one and a value you specify for layer two. In the new layer the program will assign the new cell value to all cells that have the joint values you specified for layer one and for layer two. Be patient, this is a little confusing at first, but you will quickly get the hang of it. For example, you could tell the computer to assign the value one in the new layer to all cells that had the value 10 in layer one and the value 15 in layer two.

Before you use this command, unless you are familiar with the values in the two layers you will be crossing, you should use the DESCRIBE command to get a listing of the data values occurring in each of the two layers.

Following is a table that can help you in constructing the CROSS command. The margins of the table have the values for layer #1 down the left column and the values for layer #2 across the top. The numbers in the body of the table represent the cell value assignments for the new layer in the event of the joint occurrence of the data values listed in the margins.

Water & Land versus Slope Class

		H2O	
		04	07
SLP-OK		Water	Land
01	Flat	1	2
02	OK	1	3
03	Steep	1	4

The CROSS command built from the relationships displayed in the table is:

```
CRoss SLP-OK With H2O For SLP&H2O Assigning 1 To 1 4 To 2 4 To 3 4 /
      Assigning 2 To 1 7 Assigning 3 To 2 7 A 4 To 3 7
```

The statement specifies that the program will create an new layer called SLP&H2O by crossing SLP-OK with H2O. In the new layer the value 1 will be assigned to the following joint occurrences of cell values in SLP-OK and H2O: 1 and 4, 2 and 4, 3 and 4; the value 2 will be assigned to the joint occurrence of 1 and 7; the value 3 to the occurrence of 2 and 7 and the value 4 to 3 and 7.

At this point you will want to use LABEL to specify the legend for the new map. The required LABEL command is:

```
LABEL SLP&H2O
      1   Water<R>
      2   Land: Too Flat<R>
      3   Land: GOOD SLOPE <R>
      4   Land: Too Steep <R>
      -1  <R> To end labels
```

Creating an Elevation Class Map for Crossing with the Slope and Water Map

One way to approach finding a good site for the towers is to look at suitable sites that are higher in elevation. Generally, a tower at higher elevation will be able to "see" more than one at lower elevations in the same region. Here we will use some familiar commands, COLOR, DESCRIBE, RENUMBER, and LABEL, in order to create an elevation class map. After creating this map, we will cross it with the SLP&H2O layer to look for sites that are acceptable in slope and at higher elevations. These should make good potential sites for locating the towers.

First let's take a look at the layer, ELEVATIO. We use the COLOR command:

```
COLOR ELEVATIO
```

Next, examine the range of values in ELEVATIO by using the DESCRIBE command:

```
DEscribe ELEVATIO
```

At this point you should make a note of the range of elevation values so that you can use RENUMBER to make a map with a smaller number of classes. A smaller number of classes will help you avoid information overload and will allow you to cross elevation with slope in a reasonable manner.

Now renumber the elevation layer. The RENUMBER command that I used is:

```
RENUmber ELEVATIO For eLV-CLS Assigning 0 To 0 TH 1 A 1 To 2 TH 40 /
      A 2 To 41 TH 100 A 3 To 101 TH 200 A 4 To 201 TH 800
```

Here you can use LABEL to place descriptions of the legend of ELV-CLS. The command to do this is:

```
LABEL ELV-CLS
      0   0 to 1<R>
      1   2 to 40<R>
      2   41 to 100<R>
      3   101 to 200<R>
      4   201 to 800<R>
      -1  <R>
```

To see the results of your handiwork, use COLOR. The command is:

```
COLor ELV-CLS
```

Crossing Elevation Class with Slope and Water Class to See Potential Sites

At this point you are ready to create a layer that you will use in selecting trial sites for the towers. To do this you will use the CROSS command to create a new layer that shows the joint occurrence of slope values and elevation values. Of course, you are looking for places that are at higher elevation and yet have acceptable slope.

The first thing you need to do is examine the values for each of the layers with which you will be working [unless you remember them]. The DESCRIBE command is the one for this:

```
DEscribe ELV-CLS
DEscribe SLP&H2O
```

These commands will enable you to examine the values present in each layer.

Next, you will want to build a table so that you can carry out the crossing operation accurately and easily.

			SLP&H2O		
		01	02	03	04
			Too	Good	Too
ELV-CLS		Water	Flat	Slope	Steep
[0]	0-1	1	2	3	8
[1]	2-40	1	2	4	8
[2]	41-100	1	2	5	8
[3]	101-200	1	2	6	8
[4]	201-800	1	2	7	8

The required CROSS command is:

```
CRoss ELV-CLS With SLP&H2O For POT-SITE Assigning 1 To 0 1 To 1 1 /
      To 2 1 To 3 1 To 4 1 A 2 To 0 2 To 1 2 To 2 2 To 3 2 To 4 2 /
      A 3 To 0 3 A 4 To 1 3 A 5 To 2 3 A 6 To 3 3 A 7 To 4 3 /
      A 8 To 0 4 To 1 4 To 2 4 To 3 4 To 4 4
```

Be careful, if you make an error that the program detects, then you will have to type the entire command over. What is worse is making an error that the program does not detect!!

At this point you should label POT-SITE so that you will be better able to interpret the different symbols:

```
LABEL POT-SITE
      1   Water<R>
      2   Land: Too Flat<R>
      3   OK SL < 2 <R>
      4   OK-SL 2-40<R>
      5   OK-SL 41-100<R>
      6   OK-SL 101-200<R>
      7   OK-SL 201-800<R>
      8   Too Steep<R>
      -1  <R>
```

This would be a good time to color POT-SITE so that you can get a sense of where the best sites might be. Our next task will be to create the road map and associated corridor, select five trial viewpoints, and run the viewshed analysis. Finally, we will overlay the viewshed on the corridor to ascertain whether or not we have been successful in locating the towers. Tune in next week for the exciting finish.

EXERCISE 2: OSU-MAP VISIBILITY ANALYSIS: EXCITING CONCLUSION

This workshop is a continuation of the cellular telephone tower locational problem. As you may recall, I outlined the following constraints which you must consider in selecting sites for the cellular telephone towers:

1) You must build five or fewer towers.

2) The maximum height of the towers is 40 meters.

3) The towers must be located on land and the slope of the land must be greater than two percent and less than nineteen percent.

4) The towers must be positioned such that all locations on all single and double lane roads are visible from at least one tower. Moreover, you must attempt to achieve maximum visibility for all locations within one and one-half kilometers of such roads.

As before, you will continue to work with the Thai database, using the landuse, elevation, and roads layers, plus layers you calculate within OSU-MAP. To begin, load the OSU-MAP program and set up the Thai database.

Before we get started, let's take a moment to review what we have done to this point. In our previous session, knowing that slope of the land surface was one of the constraints with which we had to deal, we began by using the DIFFERENTIATE function on the layer ELEVATIO to calculate a slope map. After calculating slope, we used the RENUMBER command to divide the slope values into classes that represent the ranges specified in the constraints.

The constraints also require that the towers be located on land. To separate land areas from water bodies, we used the RENUMBER function on the LANDUSE layer to create a layer with just two classes: land and water.

Next, you used the CROSS function to overlay the re-classed slope map with the re-classed landuse map. The resulting map depicts those land areas that have acceptable slope. If you compare the original slope map with the land and water map you might notice that in some places the water seems to be in violation of some fundamental physical laws.

The next step in the process is to create an elevation class map. This map shows, at a glance, the areas of higher and lower elevation within the study area. You use CROSS to overlay the previously combined land and water and slope class map with the elevation class map. The resulting map enables you to identify sites that are higher in elevation and acceptable in slope. These are the places you will want to try as potential sites for the towers. Now on with the story.

Selecting Main Roads from the Road Network

If you are going to determine visibility for locations on and near main roads, then you will need a map depicting the locations of the those roads. ROADS, one of the layers in the Thai database contains information on the transportation network. From this layer you need to extract the classes that indicate the locations of all one and two lane roads. To do this you will use the COLOR, DESCRIBE, and RENUMBER commands. To see the ROADS layer issue the COLOR command:

```
COLOr ROADS
```

Now that you have seen the road network, you need to see which numeric values the program is using to code the different features in the network [e.g., 11 for two lane roads] so that you can use RENUMBER to put all one and two lane roads in a single class and all other network features into the background. To display the codes used to represent the features displayed on the ROADS layer type:

```
DEscribe ROADS
```

In the text box the computer will display the numeric value assigned to each feature of the network.

Notice that the builders of this database used the values 11 through 14 to represent one and two lane roads of various types. All other values represent portions of the network in which we have no interest. Here you will use the RENUMBER command to create a new layer that depicts the one and two lane roads as a single class and puts all other information on the layer into the background. The command to do this is:

```
RENUmber ROADS For PHON-RD Assign 0 To 0 TH 4   A 7 To 11 TH 14
```

If you want to see the new layer, then use the COLOR command to take a look.

Creating a One and One-half Kilometer Buffer Around the Roads

The next step in our analysis is to build a buffer of 1.5 kilometers around the roads. Recall that we wish all locations within 1.5 km of the roads to be visible from the towers. To be able to determine the visibility or invisibility status of all cells within 1.5 km of the roads, we must know where they are. To locate these places we use the SPREAD command.

SPREAD measures the shortest distance from a specified region to all cells that are within a specified maximum distance of that region. The SPREAD command has a number of modifiers that enable you to carry out rather complex calculations. For example, you can include an absolute barrier layer. Spreading is impossible through absolute barriers. The SPREAD command will detect the presence of an absolute barrier within the barrier layer whenever there is a downward trend in that layer. In addition to absolute barriers, you may also specify friction layers. The cost of movement to a friction cell is equal to the cost of moving into the cell times the friction cost stored for the cell. For now we will use SPREAD to calculate a buffer around the roads.

For now, you are going to use a very simple SPREAD command to build a buffer of 1.5 km around the layer, PHON-RD. Since each cell in the Thai database is 500 meters on a side, you need a buffer of three cells. Given the conventions of the SPREAD command, you will need to SPREAD PHON-RD to four cells. Here is the command to do just that:

```
SPRead PHON-RD To 4 For BUFFER
```

This command creates a buffer of three cells around non-zero values in PHON-RD and saves the results in a layer called BUFFER. In BUFFER the program assigns the value zero to cells that contain roads. Cells for which the nearest road is within one cell get the value one. Cells for which the nearest road is within two cells get the value two and so on.

You might want to take a quick look at the buffer you have drawn around the roads. To do this issue the command:

```
COLor BUFFER
```

At this point you want to use the RENUMBER command on BUFFER to create a layer in which the roads appear as one class, the buffer around the roads as another class, and everything else appears as a third class. Remembering the values the program assigned when it created BUFFER, you can use the following RENUMBER command to create the corridor. If you forget the values the program assigned to BUFFER, then you can use the DESCRIBE command to examine the values present of that layer. The RENUMBER command is:

```
RENUmber BUFFER For CORRIDOR Assigning 1 To 4 A 7 To 0 A 8 To 1 TH 3
```

The command creates a new layer, CORRIDOR, in which roads have the value 7, cells within the buffer have the value 8, and everything else has the value 1.

This would be a good place to use LABEL to provide legend descriptions for the classes in CORRIDOR. The command is:

```
LABEL CORRIDOR
      1   Outside Corridor<R>
      7   Roads<R>
      8   Corridor<R>
      -1  <R>
```

To see the CORRIDOR layer, color it.

Crossing CORRIDOR with POT-SITE

You are now almost ready to begin the process of selecting trial sites for the towers. To do this you need to be able to see the location of the corridor and the location of potential sites that fit the slope, and land constraints and have higher elevation levels. To be able to make intelligent choices for trial sites, we will have to cross two layers: CORRIDOR and POT-SITE. As is the case generally, the syntax for this CROSS command is complex, so be careful in making your entry.

The margins of the following table list the values that occur in the two input layers. The values in the body of the table are those the program will assign in the new layer in the event of the joint occurrence of marginal value pairs in the input layers.

	POT-SITE							
CORRIDOR	[1] H2O	[2] Too Flat	[3] LT 2	[4] 2-40	[5] 41-100	[6] 101-200	[7] 201-800	[8] Too Steep
[1] Outside	9	0	3	4	5	6	7	8
[7] Road	9	2	2	2	2	2	2	2
[8] Corridor	9	1	3	4	5	6	7	8

The CROSS command required to create this layer is:

```
CRoss CORRIDOR With POT-SITE For TST-SITE A 9 To 1 1 To 7 1 To 8 1  /
      A 0 To 1 2 A 1 To 8 2 A 2 To 7 2 TH 8 A 3 To 1 3 To 8 3  /
      A 4 To 1 4 To 8 4 A 5 To 1 5 To 8 5 A 6 To 1 6 To 8 6 A 7 To 1 7 To 8 7 /
      A 8 To 1 8 To 8 8
```

At this point you should use the LABEL command to put legend descriptions on the new layer, TST-SITE. The command to do this:

```
LABEL TST-SITE
      0   OSC Too Flat<R>
      1   ISC Too Flat<R>
      2   ROAD<R>
      3   EL LT 2<R>
      4   EL GT 2-40<R>
      5   EL 41-100<R>
      6   EL 101-200<R>
```

```
7    EL 201-800<R>
8    Too Steep<R>
9    Water<R>
-1   <R>
```

NOTE: All legend entries that begin with "EL" represent places that are of acceptable slope. The numbers following the letters signify the range of elevation values for that class. OSC means "outside corridor"; ISC means "inside corridor."

To see the map of the corridor with the overlay of slope classes and elevation: `COLor TST-SITE`.

Selecting Potential Tower Sites by Using FIND

To make an initial selection of tower sites you will use the FIND command on TST-SITE to select likely tower locations. As you select each tower site, you will save the location of the cell containing the site to a layer called TOWERS. The FIND command is used to perform interactive editing of the cell values in any layer. You can also use it to copy the cell values of the layer you are "FINDING" on to the corresponding cells of the new layer. Here you will use both the edit and copy functions of FIND. Here is how you use the FIND command to create the layer with potential tower sites:

```
FINd On TST-SITE For TOWERS
```

Use the procedures outlined in the syntax description for FIND to select five cells to serve as initial sites. To do this move the crosshair to a site that looks good to you [i.e., slope is good, elevation high, good vantage point for corridor, not in road], press the Page Down key, assign the value 15 to the cell by typing "15 " and pressing the Enter key. The reason for the value 15 is that it is not a real value for any class on the layer and so it will stand out. Now with the crosshair in the same place copy this value to the layer TOWER <new layer> by pressing the Insert key. After you have used this procedure to select five sites for towers, exit the command by pressing the End key. If you wish to save the edits you have made on the <inmap> then press the Insert key. If you wish only to transfer values to the <newmap> then press any key but the Insert key.

At this point color TOWERS to confirm that you have been successful in creating the layer.

Calculating the View from TOWERS

Finally, you are ready to see what can be seen from the sites you have selected for the towers. The command you use to do this is RADIATE. In essence RADIATE enables you to specify a set of cell locations as <seedpoints> from which viewing takes place. One major source of obstructions to viewing is the <surface layer> over which the viewing takes place. In this case the <surface layer> is elevation above sea level. You can also specify how far above the <surface layer> the <seed points> are located. This is known as <platform height>. In this case the towers may be as much as forty meters in height above the <surface layer>. The viewing will radiate to a <viewshed distance> specified by you.

The RADIATE command we want uses the following options:

<seed point layer>	=	TOWERS
<platform height>	=	40
<viewshed distance>	=	150
<surface layer>	=	ELEVATIO
<new layer>	=	PHN-VIEW

The command is: (This may take a while.)

```
RAdiate TOWERS At 40 To 150 OVer ELEVATIO For PHN-VIEW
```

After the computer finishes calculating the viewshed, you might want to take a look at it. To do this color PHN-VIEW. Notice that on the screen you can see the locations of the towers [cell value = 2], the areas that are visible from the towers [cell value = 1], and the areas that are invisible from the towers [cell value = 0].

Overlaying CORRIDOR with PHN-VIEW

The only remaining step is to use CROSS to overlay CORRIDOR with PHN-VIEW. The resulting map will show clearly those areas within the corridor that are visible and invisible. The following table shows the values for each class in the two layers:

	CORRIDOR		
PHN-VIEW	[1] Outside Corridor	[7] On Road	[8] Inside Corridor
[0] Invisible	0	1	2
[1] Visible	0	3	4
[2] Towers	7	7	7

The required CROSS command is:

```
CROSS PHN-VIEW With CORRIDOR For FINAL Assign 0 To 0 1 To 1 1 /
      A 1 To 0 7 A 2 To 0 8 A 3 To 1 7 A 4 To 1 8 A 7 To 2 1 TH 8
```

You are now ready to see the final result [you hope] of your analysis. Before you go any further, let's use LABEL so that you will be able to make an intelligent interpretation of the map legend. Here is the LABEL command you need:

```
LABEL FINAL
      0   Outside Corridor<R>
      1   Invis on Road<R>
      2   Invis on Corrid <R>
      3   Visib on Road<R>
      4   Visib on Corrid<R>
      7   Towers<R>
      -1  <R>
```

Note that if you have been successful, then the values one and two will not exist on the FINAL layer. Now take a look by issuing this command:

```
COLor FINAL
```

If you have located the towers successfully, then all locations on the road will be in the visible class, and nearly all on the corridor will be in the visible class. If some road cells are invisible, then there will be dead spots for telephone transmission. If there are invisible cells on the road, then you will need to go back and re-select trial tower sites [page 6 of this exercise] and try again.

EXERCISE 3: OSU-MAP LOGICAL AND AND LOGICAL OR ANALYSIS

This workshop introduces you to some additional analytical functions of the OSU-MAP raster GIS. By the end of the workshop you will learn:

1) to use the MULTIPLY command to carry out logical "AND" analysis.

2) to use the ADD command to carry out logical "OR" analysis.

Once again we will be using the THAI data base. To begin the workshop, sign on to the network and run OSU- MAP in the usual fashion. If you do not remember how to do this ask me for assistance or refer to the earlier handouts.

Logical AND Analysis

If you want to know the location of cells in which two or more conditions hold simultaneously, then you should carry out a logical AND analysis. For instance, if you are a disaster planner and for flood planning and evacuation purposes want to know which cells have both roads and streams, then you could find out by performing a logical AND analysis. To demonstrate this kind of analysis we will follow this example. We begin by displaying two layers: 1) HYDRO and 2) ROADS. Next you use the RENUMBER command on the HYDRO layer to assign all cells that have streams or lakes the value "1" and all other cells the value "0." After you complete this step you will use RENUMBER on the ROADS layer to assign all cells with important roads the value "1" and all other cells the value "0." At this point you are ready to use the MULTIPLY command to carry out the AND analysis. To do this you multiply the renumbered HYDRO layer times the renumbered ROADS layer. The resulting layer will have the value "1" for all cells that have both a road and a stream and "0" for all other cells including those that have a road but not a stream, those that have a stream but not a road, and those that have neither a road nor a stream.

The first thing that you will need to do is to take a look at the two layers you will be working with in doing the AND. To do this you use the COLOR command:

```
COLor HYDRO <Enter>
COLor ROADS <Enter>
```

Issuing the COLOR command will allow you to examine the spatial pattern of the hydrologic features and transportation system of the study area. After looking at the two layers you will need to determine the values used to signify various features on each of the two layers. To do this you use the DESCRIBE command:

```
DEscribe HYDRO <Enter>
```

The text box will display the values used to code the different hydrological features. Note the values used, because you will be renumbering this layer to create a derived layer. Follow any directions at the bottom of the text box.

```
DEscribe ROADS <Enter>
```

The text box will display the values used to code the different features of the transportation system. Note the values used, because you will be renumbering this layer to create a derived layer. Follow any directions at the bottom of the text box.

Now that you know the values used as codes for the HYDRO and ROADS layers, you are ready to renumber each of the layers. For the HYDRO layer use the RENUMBER command to create a new layer called STREAMS that has just two values: "1" for cells containing hydrological features, "0" for all other cells. For the ROADS layer use RENUMBER to create a new layer called NET that has just two values: "1" for all cells that contain one or two lane roads of hard or loose pavement, "0" for all other cells. To do this issue the following commands:

```
RENUmber HYDRO Assigning 1 To 2 TH 5 For STREAM <Enter>
```

This command assigns the value of "1" to all cells that have any kind of hydrologic feature such asstreams or lakes.

```
RENUmber ROADS Assigning 0 To 2 TH 4  A 1 To 11 TH 14 For NET
```

This command assign the value "1" to cells containing more important roads and the value "0" to all othercells.

To carry out the next step you need to learn to use a new command, MULTIPLY. This command generates a new layer from a set of existing layers. The values of the cells in the new layer are the product of the values of corresponding cells of the existing layers listed in the command. The command to carry out the multiplication needed for the AND analysis is:

```
MUltiply STREAM By NET For ANDMAP <Enter>
```

The layer, ANDMAP, will have a value of "1" for all cells in which there is a hydrologic feature and a transport net feature. All other cells will have the value "0". To view the location of cells that have both types of features use the COLOR command:

```
COLor ANDMAP <Enter>
```

Logical OR Analysis

Sometimes you need to know if either one condition or another exists in each of the cells of a set of layers. For example, if you were selecting a site for a facility and you wished to avoid locations that are too steep or too swampy, then you might wish to know the location of all cells that are greater than twenty percent in slope OR that have mangrove forest or swamp as the predominant landuse. To get a sense of the data with which you will be working, begin by coloring the LANDUSE layer [which contains information on predominant landuse of each cell] and the SLOPE layer [created by DIFFERENTIATING ELEVATIO]. Next you use the DESCRIBE command to examine the value codes used to represent each of the categories of the LANDUSE layer and the value range of the SLOPE layer. Using the information you obtained from the DESCRIBE command use RENUMBER to create two new layers. The first layer you create from LANDUSE by assigning 0 to all uses except mangrove forest and swamp and by assigning the value 1 to the uses mangrove forest and swamp. The second layer you create from SLOPE by assigning 0 to all slopes of 0 through 19 percent and by assigning the value 1 to all slopes greater than 19 percent. Next add the two new layers together to create the layer used in doing the OR analysis.

Let's begin by taking a look at the LANDUSE and SLOPE layers. To do this we use the COLOR command:

```
COLor LANDUSE <Enter>
COLor SLOPE <Enter>
```

Next you will want to see the values used to signify the various landuse categories and the range of slope values present in the SLOPE layer. Pay special attention to the values used for the classes: Mangrove Forest and Swamp. The DESCRIBE commands you need are:

```
DEscribe LANDUSE <Enter>
```

Make a note of the numeric values used to signify each of the landuse classes.

```
DEscribe SLOPE <Enter>
```

Make a note of the minimum and maximum slope values.

You are now ready to use the RENUMBER command with the LANDUSE and SLOPE layers to create two new layers. In the first new layer you will assign all cells in the LANDUSE layer that contain mangrove forest or swamp the value "1." Assign all other cells the value "0." In the second new layer you will assign all cells in the SLOPE layer that have a percent slope of 20 or more the value "1" and all other cells the value "0." Here are the two RENUMBER commands that you will issue in order to accomplish this:

```
RENUmber LANDUSE Assigning 1 To 11 To 13   A 0 To 1 TH 10 To 12 To 14  /
      For MAN-SMP<Enter>
```

Here you have assigned the value 1 to all cells that contain mangrove forest or swamp and the value 0 to all other cells.

```
RENUmber SLOPE Assigning 1 To 20 TH 49   A 0 To 0 TH 19 For SLP-OR<Enter>
```

This statement assigns the value 1 to all cells in which slope is 20 percent or more and the value 0 to all cells in which slope is less than 20.

You are now ready to use the ADD command in order to identify all cells that contain the landuses mangrove forest or swamp or that have a slope of 20 percent or more. The ADD command creates a new layer in which each cell has as a value the sum of the values of corresponding cells in the existing layers.

The ADD command you will use here is:

```
ADd SLP-OR To MAN-SMP For OR-MAP <Enter>
```

In the resulting layer all cells that have non-zero values have either a slope of 20 percent or more OR havethe landuse mangrove forest or swamp, OR have both of these conditions. In fact, the value of the cellwill indicate the number of conditions met. All other cells have a zero value.

To see the result of your OR analysis use the COLOR command to display the layer, OR-MAP:

```
COLor OR-MAP <Enter>
```

Note that all cells that have non-zero values: 1) have slope of 20 or more percent, or 2) have predominant landuse of mangrove forest or swamp, or 3) have both conditions. Cells that have zero values meet none of the conditions.

EXERCISE 4: OSU-MAP NETWORK ANALYSIS FUNCTIONS

Using the Find, Spread, and Drain Commands in Network Analysis

This workshop introduces you to some more advanced applications of the SPREAD command and introduces a new command, DRAIN. Used together these commands can approximate some of the network analysis functions often found in vector mode GIS software. By the end of this workshop you will learn:

1) to use the SPREAD command to measure distances from a <region layer> cell. In this instance you will be measuring distance of each cell in the layer from the location of the nearest <region layer> cell while taking into account the effect of barrier cells. Barrier cells represent obstacles that must be circumvented.

2) to use the DRAIN command to find the shortest path from a set of starting points to the lowest point [or smallest value] on a surface layer. DRAIN and SPREAD work together in carrying out this analysis: SPREAD measures distances, taking into account the effect of barriers, from an origin point [i.e., low point or smallest value] to all other cells; DRAIN determines the path or paths of minimum distance from a set of these "other" cells to the low point.

I should point out that Raster GIS are not ideally suited to carry out network analysis problems such as those involving finding the shortest circuit through a network, or the shortest network path between two points. However, OSU-MAP can do some network analysis. To give you some of the flavor of this kind of locational problem, you will use SPREAD and DRAIN to find optimal paths.

The problem you will be working on concerns the location of pathways to connect a set of four parks that you will be locating in your region in Thailand. Three of these parks will be located inland toward the western part of the region, whereas the fourth will be located near the beach at the western edge of the lake. Tourists come to the waterfront park by boat and either spend the day at the beach or hike to any of the three inland parks. In locating the parks you must observe the following constraints:

1) one park must be on the lake and the other three must be inland, and

2) no park can be on settled land.

In locating the pathways that connect each of the inland parks to the beach front park, the constraints are:

1) no pathway can pass through settled areas, and

2) each path is as short as it can be without violating the first constraint of not passing through settled areas.

In solving this problem you will use the LANDUSE and the SETTLEMN layers from the THAI data base. You will use the LANDUSE layer to determine the position of the beach front park. To locate the three inland parks you will select sites toward the western portion of the region that are on unsettled land. To determine the location of unsettled land, you use the layer, SETTLEMN, which simply divides the region into cells that have settlements and those that do not.

The first step is to select locations for the three inland parks. To do this you use the FIND command on the SETTLEMN layer. You will select three sites that are in cells that have no settlements, assign a value of eight to each of the cells, and store the locations and values of those sites in a layer called PARKS. The second step is to select a location for the waterfront park. For this operation you use the FIND command to select a site on the western side of the lake. Assign the value "1" to the location of this cell and store it in a layer called BEACH.

Third, you will use the SPREAD command to construct a layer that contains a set of distance zones around the single cell that has the value of one in the BEACH layer. In its simple form the SPREAD command calculates the shortest distance from all of the cells in a <region layer> to all other cells up to a maximum distance you specify. The value stored for a cell is its distance, in number of cells, to the closest cell in the <region layer>. In previous exercises you used a simple form of this command to build a buffer.

Here you will calculate more complex distance zones. These distance zones will be constructed using a <barrier layer>. The distance value stored for each cell will represent the distance of the shortest path, not passing pass through any cell in the <barrier layer>, between the cell and the nearest cell in the <region layer>.

Fourth, you will use the DRAIN command to find the shortest path from the cells containing the inland parks, the locations of which are stored in the PARKS layer, to the waterfront park. The result of this operation is a layer that shows the shortest path not passing through settled areas from each inland park to the beach park. This layer, of course, constitutes your solution to the problem.

Finally, you will use the CROSS or the COVER command to overlay layers containing the locations of the parks, the locations of the paths, the settled and unsettled areas, and the water. After you label it, you will then make a hard copy of this layer. This "mini" exercise will serve to demonstrate that you have completed the workshop. The first task you must complete is to select the sites for the three inland parks. To do this you use FIND on the layer SETTLEMN.

For the present problem, you want to select three sites, use FINd to assign the value eight to each of the sites, and transfer those cell locations and values to the <new layer> called PARKS. To do this issue the following FIND command:

```
FINd On SETTLEMN For PARKS <Enter>
```

You want to select sites that are in unsettled cells to the west of the region. Use the crosshair to move to the cells you wish to select and then follow the instructions outlined above to assign the value eight [8] to each cell and transfer those values to the PARKS layer. In my test of this procedure I used the following cell locations:

Row	Column	Value
50	10	8
72	1	8
97	4	8

After you complete the FIND operation for the three inland parks, you should confirm that you have been successful in creating the new layer, PARKS. To do this issue the following command:

```
COLor PARKS <Enter>
```

Your second step in solving this problem is to select a site for the beach park. Remember the cell must be located on the waterfront. You will use the following procedure to make sure that the site you select is on the waterfront and is on currently unsettled land: 1) RENUMBER LANDUSE assigning all uses except water the value zero and assigning water a positive value [4]; 2) COVER the RENUMBERED LANDUSE layer with SETTLEMN so that you can identify the sites that are vacant and on the waterfront; and 3) at this point use FIND to select the site of the beach park. Assign the cell you select for the site a value of one.

Begin by creating a layer that has nothing on it but the location of water. To do this use RENUMBER on LANDUSE:

```
RENUmber LANDUSE A 0 To 1 TH 14 A 4 To 0 For TMP <Enter>
```

Now you will use the COVer Command to create a layer that will combine TMP [which shows where the waterfront is] with SETTLEMN [which shows where the vacant land is] in order to discover where the potential sites for the beach front park are located. The required COVer command is:

```
COVer TMP With SETTLEMN For SITE <Enter>
```

You are now ready to use FINd to select a site for the waterfront park. You will FINd on the layer SITE to create the layer BEACH. The constraint is that the location has to be on the waterfront and on unsettled land. The required command is:

```
FINd On SITE For BEACH <Enter>
```

You want to select a cell that is on the waterfront and not settled. In my trial of this exercise I selected the following cell location and assigned the value"one" for BEACH:

Row	Column	Value
47	47	1

After you complete the FIND operation for the waterfront park, you should confirm that you have been successful in creating the new layer, BEACH. To do this issue the following command:

```
COLor BEACH <Enter>
```

The third step in solving the problem is to carry out the SPREAD operation. In a simple SPREAD operation distance is measured by building concentric rings of cells around the cell or cells in the region layer. A cell that abuts a region layer cell is assigned the value one. A cell that has one cell between it and a region layer cell is assigned the value two, and so on out to the maximum distance of the SPREAD. In all cases the value assigned to a cell is equal to the number of cells one would have to move through to get to the nearest region layer cell. Here you are going to use SPREAD with a barrier layer. In this case as the program measures distance from region layer cells it proceeds outward as before, but at the time of each distance assignment the program checks to see if any cells to be assigned a distance have a lower value on the barrier layer than the current cell's barrier layer value. If a cell has a lower value on the barrier layer than that of the current cell, then a distance assignment is not made: a SPREAD can not pass through a barrier.

In the case of encountering a barrier the SPREAD operation will continue to the next non-barrier cell. Upon encountering a barrier, distance measurement will cease to take place in a straight line. Rather, the distances measured will be the shortest distance from the cell to the nearest contiguous region layer cell following a path that avoids barrier cells. Thus, SPREAD measures the shortest distance around the barrier.

How does the program know that it has encountered a barrier? As the flow proceeds outward from the all of the region layer cells that have non-zero values, the program constantly checks the barrier layer value of the current cell from which the SPREAD is proceeding against the barrier layer values of adjoining cells. If the barrier layer value of an adjoining cell is less than the barrier layer value of the current cell, then the SPREAD can not proceed to the adjoining cell.

Note that if you use the DOWNHILL option then a barrier exists when an adjoining cell on the barrier layer has a value that is greater than the value of the current cell on the barrier layer.

One of the layers in the THAI database is SETTLEMN. You are going to SPREAD from the cell that has the value equal to one on the BEACH layer to create a surface on which each cell value is the distance of the shortest path from that cell to the beach park site following a path that does not enter cells in which there are settlements [i.e., following a path that avoids settled area barriers].

To begin the SPRead operation, take a look at the layer SETTLEMN by displaying it with the COLOR command:

```
COLor SETTLEMN <Enter>
```

To see the values that the program uses to represent settled and unsettled areas use the DESCRIBE command:

```
DEscribe SETTLEMN <Enter>
```

You are now ready to issue the SPREAD command. You want to SPREAD BEACH to a distance of 80 over the SETTLEMN layer [barrier layer]. Since on SETTLEMN the cells that you want to serve as barriers have larger values than the cells through which you wish to SPREAD, you will use the DOWNHILL option. The layer you create is called WILDNESS. Here is the command:

```
SPRead BEACH To 80 Over SETTLEMN Downhill For WILDNESS <Enter>
```

This may take a while to calculate. To see the result of the SPREAD operation you should use COLOR to display WILDNESS:

```
COLor WILDNESS <Enter>
```

The layer you just displayed, WILDNESS, will now be used as an input to the DRAIN command.

The fourth step in solving the problem is to use DRAIN to find the shortest path from the inland parks to the waterfront park. The DRAIN command defines a downhill path over a surface from specified starting points. The downhill path proceeds until it reaches a "pit" in the surface. At every step along the way the path taken is the steepest downhill route. If two routes are of equal steepness, then the path splits and follows along both routes.

DRAIN requires two input layers: one layer that contains isolated starting cells and nothing else and a second layer that contains values representing the surface over which the drain operation will take place.

Non-zero values in the starting cell layer represent amounts of flow. DRAIN assigns that amount of flow to each cell in the steepest downhill path. If there is a split in the path as a result of equal downhill slope, then the flow is halved and assigned equally to each path. If two paths converge, then the flow if the two paths is summed to create a new larger flow.

For present purposes you should note that the steepest downhill path is also the shortest downhill path. Here you are going to DRAIN the PARKS layer over the WILDNESS layer. Now remember that the WILDNESS layer has a pit [i.e., lowest point] at the site of the beach park. All other cell values on the WILDNESS layer specify distances to the beach park site following paths that avoid settled areas. If you construct paths that begin at the site of each inland park and follow the steepest downhill path, then you will have defined the shortest route avoiding settled areas from the inland parks to the beach.

The DRAIN command you will use here is:

```
DRAin PARKS Over WILDNESS For TRAILS <Enter>
```

After the computer finishes its calculations, you will want to examine the location of the trails. To do this COLOR TRAILS:

```
COLor TRAILS <Enter>
```

The TRAILS layer specifies the shortest path you can take from each of the inland parks to the beach park while avoiding settled areas.

The final step is to present the results of your analysis. To confirm that the paths do not pass through settled cells, create a layer that shows the settled areas and the paths together.

To demonstrate that you have completed this workshop, hand in a map that shows the following:

1. the settled and unsettled areas,
2. the locations of the four parks
3. the paths connecting the inland parks from the waterfront park,
4. the water area.

EXERCISE 5: MINIMUM DISTANCE ROADS

This workshop introduces you to still more analytical function of OSU-MAP. Here you will learn some new ways to apply several commands with which you are already familiar. The commands that you will learn to apply in new contexts are:

1) SPREAD

2) DRAIN

Thailand is a developing country with limited resources. Success in economic development requires the existence of sufficient infrastructure to facilitate commerce. The infrastructure in and of itself, of course, produces nothing. Thus, to maximize development, planners should attempt to construct maximally efficient facilities at minimum cost. One important element of any system of infrastructure is the transportation system. In the present problem, you are given a road network, the location of five remote villages, and the location of a city. The government of Thailand is interested in increasing the accessibility of the city to the villages in the surrounding countryside by constructing high quality paved roads. You are required to find the shortest route that connects the villages to the city. The routes must follow existing roads. In solving this problem you will learn to apply the SPREAD and DRAIN commands in a new context.

Minimum Distance Roads

The first step for this problem is to create a layer that depicts the location of the city and of the villages. The layer containing this information is called SETTLEMN. You should begin by coloring SETTLEMN:

```
COLor SETTLEMN
```

You want to keep the classes that contain information on the location of the city and other dense settlements and get rid of the class that depicts the location of sparse settlements. First you must use DESCRIBE to find out which numeric values the program is using to represent each class:

```
DESCribe SETTLEMN
```

You will see the following numeric codes:

No Settlement	0
Sparse Settlement	1
Dense Settlement	2
City	3

Next you will use the RENUMBER command to create the new layer that has two classes, one for the city and another for the dense settlements:

```
RENUmber SETTLEMN For TOWN A 0 To 1 A 7 To 2 A 8 To 3
```

This statement removes that sparse settlement class from the layer and assigns different values to the two remaining classes, which are then stored in a layer named TOWN. Now let's label the new layer, TOWN:

```
LABEL TOWN
      7   Villages <R>
      8   City <R>
      -1  <R>
```

You are now ready to use the layer, ROADS, to create a new layer that you will use in the SPREAD and DRAIN operations. To begin let's see what the layer looks like:

```
COLor ROADS
```

Because we are trying to decide where new improved roads will be located, we will keep all parts of the transportation net for consideration except for footpaths. To do this we need to create a new layer that removes footpaths and places all other network features into a single class. First, determine the numeric codes for each class:

```
DESCribe ROADS
```

Note the following values:

No Road	0
Fair Weather Road	2
Cart Tracks	3
Footpath, trail	4
2-Lane Hard Road	11
1-Lane Hard Road	12
2-Lane Loose Road	13
1-Lane Loose Road	14

Second, remove the class for footpaths and assign all other network elements to a single class:

```
RENUmber ROADS For MAIN Assigning 0 To 4 A 12 To 2 TH 3 A 12 To 11 TH 14
```

Now, label MAIN:

```
LABEL MAIN
      12  Roads <R>
      -1  <R>
```

To confirm that you have created the road network layer successfully, color MAIN:

```
COLor MAIN
```

You will be using SPREAD and DRAIN to find the shortest route from each of five villages to the city. Not all villages are connected to the city by the network. Thus, before selecting villages from which to drain you must confirm that the village is located on the road network. To make this confirmation you will use CROSS to combine MAIN with TOWN.

The marginal values of following table depict the current values for classes in each of the two layers. The numbers in the body of the table indicate the values to be assigned in the new layer for cells that contain the marginal values in the old layers.

			TOWN	
		NEITHER	VILLAGE	CITY
MAIN		[0]	[7]	[8]
NO ROAD	[0]	0	7	8
MAIN ROAD	[12]	12	9	10

The CROSS command is:

```
CRoss MAIN With TOWN For TOWNNET A 7 To 0 7 A 8 To 0 8  /
      A 12 To 12 0 A 9 To 12 7 A 10 To 12 8
```

Before viewing TOWNNET, use LABEL to assign legend descriptions:

```
LABEL TOWNNET
      7   Vill no Road <R>
      9   Vill with Road <R>
      10  City with Road <R>
      12  Road <R>
      -1  <R>
```

Now take a look at the result of the CROSS operation:

```
COLor TOWNNET
```

At this point you are ready to create the layer containing just one non-zero cell. This cell, which will serve as the <region layer> in SPREAD, specifies the location of the city from which you will measure distance along the road net. To create the region layer you will use FIND on TOWNNET:

```
FINd On TOWNNET For START
```

Move the cursor to Row 18, Column 17. Press the Insert key, press the End key, and then press Insert one more time. You will save a single non-zero cell in the new layer START. This cell will have a value of 10, which is the value that TOWNNET uses for cells classified as "City with Road."

To confirm that you have been successful in creating the START layer, color START:

```
COLor START
```

When you use DRAIN to find the shortest distance you will need to specify a set of cells from which to drain the network. The layer that contains these points is called the <start cell layer>. To create this layer you use FIND on TOWNNET:

```
FINd On TOWNNET For POINTS
```

Move the cursor, using the Arrow keys, to each of five cells that represent the class, "Village with Road." At the cell press the Insert key to transfer the value of that cell to the new layer. After you have selected five cells, press the End key and then the Insert key. When I carried out this exercise I used the following five Row-Column locations:

Row	Column	Value
92	78	9
79	51	9
94	36	9
60	52	9
3	1	9

Of course, you are encouraged to experiment with other cell locations, but be careful to make certain that each cell you select is a village with road cell [value = nine] and that the road system at that point connects to the city cells [value = ten on TOWNNET].

To ensure that you have succeeded in creating the new layer, POINTS, containing the cell locations of the drain start cells, use color to draw POINTS:

```
COLor POINTS
```

You now must use spread to measure distances along the road net from the city. To do this you use the SPREAD command to create a layer in which the value of each cell is its distance from the city. For this command use the following layers:

Region Layer	START
Barrier Layer	MAIN
New Layer	DIST

The SPREAD command is:

```
SPRead START To 200 Over MAIN For DIST
```

The spread detects a barrier whenever the trend of the barrier layer is downward. Since the barrier layer is MAIN, for which cells containing a road have the value 12 and all other cells have the value 0, this means that the spread proceeds only along the road net because any location not on the road has a value less than the cells that are on the road.

The spread is carried out to a distance of 200, because the spread is not in a straight line, but rather follows all of the twists and turns of the road net.

To see the new layer, DIST, color it:

```
COLor DIST
```

Now you are ready to use DRAIN to find the shortest route from the five villages to the city. Remember that the DRAIN operation begins at each of the start points and proceeds down the steepest path until it finds either a pit or the lowest point on the surface layer. Because the surface layer represents distances from each cell to the start cell [i.e., the city], then following the steepest path [i.e., path of most rapid change in distance] will result in a definition of the shortest path. The DRAIN command is:

```
DRAIn POINTS Over DIST For PATH
```

Take a look at the PATH layer:

```
COLor PATH
```

At this point issue the DESCRIBE command to examine the values the DRAIN operation generated in the new layer, PATH:

```
DEscribe PATH
```

Note the range of values that the DRAIn operation assigned, as you will use this range in renumbering PATH so that all cells along the shortest paths have the same value. In checking the range you will notice a fairly regular increase in distances up until some point and then a jump in value to 200. Do not count 200 as the maximum value. Rather, use the next largest value [e.g., 50].

The RENUMBER command:

```
RENUmber PATH For PATH Assigning 11 To 1 TH 50
```

If you found a different second largest value use it.

To see the shortest route from each village to the city in comparison with the road net as a whole, use CROSS to create a layer that shows the shortest paths along with the remainder of the road net.

You will recall that the layer, MAIN, contains the highway net. Each cell containing an element of the net has the value 12, all other cells have the value zero. For PATH all cells that are on the shortest path have the value 11, all other cells have the value zero. The required CROSS command is:

```
CRoss PATH With MAIN For ROUTE A 12 To 0 12 A 8 To 11 12
```

Let's just go ahead and label the new layer, ROUTE:

```
LABEL ROUTE
      8   Shortest Path <R>
      12  Roads <R>
      -1  <R>
```

Now you are ready to see how the shortest path looks along with the rest of the road network. To see the result of your analysis, COLOR ROUTE:

```
COLor ROUTE
```

You can either COLOR ROUTE on the plotter or SHADE ROUTE and print it on the printer.

EXERCISE 6: MEDICAL FACILITY TRADE AREAS

Access to medical services is an important element in any successful development program. This workshop requires you to define minimum distance service area regions to two villages that house medical clinics, again using the THAI database. You are to measure distance over the road system and then create a layer in which each road is identified by a color indicating which village is closest. For this problem you will use the following commands:

1. MINIMIZE
2. SLICE
3. SUBTRACT
4. COVER

The second problem involves finding the breakpoint for travel to two medical facilities, each of which is located in a village. You will begin by using SPREAD to measure distance from the first village along the road net. These distances are stored in a layer called DIST1. Next you measure distance from a second village and store the result in a layer called DIST2. You will then use the MINIMIZE command to find the distance from each cell to the nearest medical center [note that this step is not strictly necessary to defining the trade areas]. After generating the two layers that measure distance to each of the villages respectively, you subtract these layers from each other to create a new layer that contains the difference in distance. Some of the differences will be negative numbers, others will be positive numbers. Renumber the difference layer so that all negative values receive a single value [e.g., 2] and all positive values receive a different single value [e.g., 4]. The resulting layer shows all cells that are closer to village one in one color and all cells that are closer to village two in another color.

To begin you need to specify the location of the first village in which a medical center is located. To do this begin by coloring TOWNNET in order to get the lay of the land and examine the classes in this layer:

```
COL TOWNNET
```

Now use FIND to specify the location of the village that has the first medical center:

```
FINd On TOWNNET For SITE1
```

Row	Column	Value
84	63	9

Use Insert to transfer the value of the cell to layer SITE1, press END, and then INSERT. Use COLOR to check your work:

```
COLor SITE1
```

Repeat this process for the second village that contains a medical center:

```
FINd On TOWNNET For SITE2
```

Row	Column	Value
53	29	9

Use Insert to transfer the value of the cell to layer SITE2, press END, and then INSERT. Use COLOR to check your work:

```
COLor SITE2
```

Now create the layer that has as its cell values distances along the road from the first village to each road cell:

```
SPRead SITE1 To 200 Over MAIN For DIST1
```

MAIN is the barrier layer, which contains the location of the road net over which the distances will be measured. Use COLOR to check your work:

```
COLor DIST1
```

Next create the layer that has as its cell values distances along the road from the second village to each road cell:

```
SPRead SITE2 To 200 Over MAIN For DIST2
```

MAIN is the barrier layer, which contains the location of the road net over which the distances will be measured. Use COLOR to check your work:

```
COLor DIST2
```

You are now ready to use the MINIMIZE command to create a layer in which each cell will have as a value the distance to the nearest village medical facility. The MINIMIZE command generates a new layer from two or more existing layers. The cell values for each cell of the new layer represent the minimum value of all the corresponding cells of the input or existing layers. The required MINIMIZE command is:

```
MINimize DIST1 Versus DIST2 For MINDIS
```

MINDIS cell values represent the distance to the nearest village medical facility.

If you color the MINDIS layer it will be difficult to read because it has so many classes. To reduce the number of classes for a ratio variable, you should use the SLICE command. SLICE generates a new layer from an existing layer. The classes in the new layer represent equal width intervals of the existing layer.

Before you carry out SLICE you should DESCRIBE MINDIS so that you can see what the range of values is. Use the maximum value as the upper limit for SLICE. Note that the value you are looking for is not 200, but the next larger value.

```
DEscribe MINDIS
```

Note the range of values, not including the maximum value of 200. The data value 200 represents the maximum distance to which the spread took place, occurs only outside the road net and should be renumbered to 0 so it is placed in the background. Let's do the RENUMBER now:

```
RENUmber MINDIS For MINDIS A 0 To 200
```

Now do the SLICE:

```
SLIce MINDIS Into 10 FRom 1 Thru 85 For MINCLS
```

You can color MINCLS to see the pattern of distance classes, but the map will not contain the locations of the villages. To insert the location of the villages you will use the COVER command. The COVER command allows you to overlay a set of two or more existing layers to create a new layer. You can understand COVER by imagining that you have placed a set of maps of existing layers on top of each other. As you look down through the stack, cells that have the value zero are transparent. All cells that have non-zero values are opaque. Thus as you look down through the stack of maps the cell value you see at any location is equal to the value of the first non-zero cell at that location in the stack. The output layer's cell values consist of the first non-zero value encountered as one looks down through the stack. Clearly, the output layer's cell values will depend very much on the order in which the maps are stacked. If a cell has zero values all the way through the stack, then the value of that cell remains zero.

The first layer listed is at the bottom of the stack. Others are piled on top of the first layer in the order listed. You view the stack from the top. A cell value in the output layer equals the cell value of the first non-zero cell one sees when looking down through the stack.

First you will create a layer that combines the locations of the two villages. These locations were stored in the layers SITE1 and SITE2. The COVER command is:

```
COVer SITE1 With SITE2 For ALL
```

Renumber ALL so that the village location will stand out:

```
RENUmber ALL A 12 To 9 For ALL
```

Now you combine MINCLS with ALL to create a composite layer:

```
COVer MINCLS With ALL For MINCLS
```

Take a look:

```
COLor MINCLS
```

Now you can see the locations of the villages along with the distance classes.

The final step in this analysis is to create a layer that shows to which medical facility each of the cells is closest. Notice that the MINCLS map depicts distance to the nearest clinic, but does not tell you which clinic is nearest. To find which clinic is nearest to each cell we subtract the two distance layers: one measuring distance to SITE1 the other measuring distance to SITE2. In this subtraction cells that are equidistant will be equal to 0. Cells closer to one site will have positive values, while cells closer to the other site will have negative values.

The SUBTRACT command creates a new layer from existing layers. Cell values of the new layer are determined by the following formula:

Layer1 - (Layer2 + Layer3 + ...)

The SUBTRACT command you need to issue is:

```
SUBtract DIST1 Minus DIST2 For DIFF
```

Now DESCRIBE DIFF:

```
DEscribe DIFF
```

Note the range of values in the layer. Pay particular attention to the range ofpositive and negative values.

At this point you will RENUMBER DIFF assigning a single value to all cells that have negative values and another value to all cells that have positive values.

```
RENUmber DIFF For DIFF A 2 To -74 TH -1 A 4 To 1 TH 74
```

Take a look:

```
COlor DIFF
```

You still need to combine the locations of the villages [ALL] with the layer that contains the trade areas [DIFF]. To do this use CROSS. The following table depicts the data required to construct the CROSS command.

		DIFF		
		OUT-SIDE	TRADE NO. 1	AREA NO. 2
ALL		[0]	[2]	[4]
NO TOWN	[0]	0	2	4
TOWN	[12]	12	12	12

```
CROss ALL With DIFF For NEWDIFF A 2 To 0 2 A 4 To 0 4  /
      A 12 To 12 0 TH 4
```

Take a look:

```
COLor NEWDIFF
```

To demonstrate that you have completed this workshop and mastered the material covered, make a copy of the final map by using the COLOR on plotter command or the SHADE command and write a brief description of the process that you went through to produce the map.

EXERCISE 7: SKI AREA SITE ANALYSIS

At long last you have completed your internship as a planner in Thailand. In the process you gained much expertise in GIS analysis, but earned very little money. You are now ready to return home to the United States where you are going to open a consulting firm specializing in locating suitable sites for you favorite activity, namely snow skiing. Like most children of the 1980s boom times you hope to make the big bucks. Your first client is Enviro-ski, a company that claims to build ski areas that respect the environment. As your first assignment, Forest Hacker, CEO of Enviro-ski, wants you to find a suitable ski area site within a small region in the state of Maine.

The area in which you will be working is 6.25 miles north to south and 5.5 miles east to west. The data base that you will be working with [MAINE.MAP] has 125 rows and 110 columns. Each cell in the data base covers an area 264 by 264 feet in size.

The data layers you have available are:

1. ROADS which contains the locations of major roads and railroads

2. TOPO which contains the elevation in feet of each cell in the data base

3. WATER which contains a variety of hydrologic information

Your job is to locate a suitable ski area site within the region. You have to deal with the following locational and environmental constraints:

1. The slope of the land in all cells within the ski area must be greater than 15 percent and less than 75 percent.

2. All cells within the ski area must have a slope aspect of either north, northeast, or east. This will help to extend the ski season by avoiding direct sun rays during warmer times of the day.

3. No part of the ski area may be within 500 feet of open or wooded wetlands. You have to have at least one constraint to justify your name.

4. The minimum size of the set of contiguous cells meeting constraints numbers one, two, and three must be at least one square mile. Remember that each cell is 264 feet by 264 feet and that there are 5280 linear feet in a mile.

5. Some part of the ski area must be within .3 miles of a lake, pond, or stream. This is to ensure that you have access to an adequate supply of water for snow making. It will be even better if the water source passes through the ski area.

6. Some part of the ski area must be within .25 miles of a road. This will ensure that there will be access to the site without building too much private road.

7. The difference between the maximum and minimum elevation on the site should be at least 1000 feet. Hint: save this for the end as a check.

Your job is to develop a procedure that will enable you to identify the one plot of land that fulfills all of the constraints. Before you will be able to accomplish that task, however, you must do some reading about a few OSU-MAP commands with which you are not yet familiar. These commands are:

1. ORIENT
2. CLUMP
3. SIZE

A primer describing the function and syntax of these commands accompanies this exercise.

Your contract with Enviro-ski requires that you produce the following GIS products:

1. A written step-by-step summary of the procedure you used in solving the problem. This summary should include a listing of constraints along with a narrative of the procedure.

2. A map that shows the following:

   a. the location of the roads

   b. the location of all water features [this is in essence the layer WATER]

   c. the location of the ski area site

3. An indication of the exact vertical drop between the highest and lowest cell on the site of the ski area.

PRIMER ON NEW OSU-MAP COMMANDS FOR SKI AREA PROBLEM

This primer serves to introduce you to three new OSU-MAP commands. These commands are:

1. ORIENT
2. CLUMP
3. SIZE

Orient

The ORIENT command provides a local neighborhood operation that calculates the aspect of a slope from a layer of elevation values. Before I explain how to use the command, I need to explain the concept of aspect. Imagine that you are standing on a slope near the top of a ski run. As you survey the beautiful surrounding alpine scene, you become overwhelmed by a curiosity concerning the aspect of the slope. To determine aspect: face in the direction in which the slope is steepest, reach in your jacket pocket and pull out your compass, and then determine the compass direction you are facing when looking down in the direction of the steepest slope. That direction is the aspect of the slope at the point you are standing.

You should note that you can use ORIENT to calculate aspect on any layer of interval or ratio values. For instance, you could use the command to determine the most rapid direction of change in a surface made up of income values of each cell.

To see how this command works, load the MAINE data base and issue the following command:

```
ORient TOPO For ASPECT
COLor ASPECT
DESCribe ASPECT
```

In the output layer, ASPECT, the program assigns each cell a value of 1 through 9 depending on the aspect of the slope in that cell.

Clump

To understand the CLump command you need to recall the distinction between a class and a zone. You will recall that a class consists of all of the cells in a layer that have the same value. Thus, on a landuse map all cells that have the landuse, open space, represent a class. A zone consists of a set of contiguous cells that have the same value. Thus, on a landuse map the class, open space, may consist of several zones, each of which represents a set of contiguous cells in which the landuse is open space.

CLump is an extended neighborhood operation that serves to identify each of the zones in a layer. Clump has several options that enable you to specify an exact or a "fuzzy" definition of "contiguous." By default two cells are contiguous only if they share an edge. One option is to expand the definition of contiguous to include cells that touch diagonally. With this option cells that share an edge or touch at the corners are considered to be contiguous. Incidentally, for our problem, this is the definition of contiguous we will use. A final option [Distance] provides a "fuzzy" definition of contiguous. With this option cells that fall within a specified distance are considered to be contiguous and hence a part of the same zone.

Size

SIZe is a zonal operator that specifies the size, in number of cells, of each zone in an input layer. In the output layer the cell values specify the size of the zone of which the cell is a member. For instance, if a cell is a member of a zone in which there are four cells, then the value of that cell in the output layer is 4.

Note that the use of the SIZe command in conjunction with the Clump command enables you to measure the area of each zone in a layer. CLump identifies the zones; SIZe measures the size of each zone in number of cells. Remember that for solving many problems you will need to convert numbers of cells to area measurements in acres, square miles or kilometers.

EXERCISE 8: INTRODUCTION TO GIS: PROJECT FINAL

You are a GIS analyst for the Brown's Pond Township Planning Commission. The town needs to expand its economic base to include the harvesting of a significant stand of second growth timber. However, the township planners want to make certain that visual blight and environmental harm resulting from the timber harvest are minimized. Your job is to identify locations in the Brown's Pond area [Massachusetts] that are suitable for logging. After you complete the analysis you are to prepare a report that explains the procedures you used and presents the results of the study.

You are given the following information about the Brown's Pond data base. The cell size is 200 feet by 200 feet. The data base contains the following layers:

1. Altitude
2. Buildings
3. Roads
4. Trees
5. Water

The planning commission sets forth the following criteria for areas [cells] to meet in order to be considered suitable for logging:

1. The forest cover is classified as hardwood or mixed woods.
2. The cell is greater than 400 feet from any road.
3. The cell is greater than 200 feet from any structure [house or public building] or cemetery.
4. The cell is greater than 400 feet from any stream, wet-land or pond.
5. The slope of the land in the cell is less than 20 percent.
6. The cell is not visible from any point along the primary roads.

Include the following maps in your report [inasmuch as possible with OSU-MAP all maps should follow good cartographic convention for color selection and other design elements].

1. A map that shows the location of the timber resource that is hardwood or mixed woods [use shade, pick distinctive symbols for each class].
2. A map that shows all of the features to be buffered along with the areas that fall within the boundaries of the buffers.
3. A map that shows all of the forest areas that fall outside the buffered area [you may combine this with map 2 if you can create a design that is easy to read].
4. A map that depicts all of the cells that are [color this map on the plotter]:

   a) Forest area, outside all buffers, on acceptable slope and invisible from the main roads.

   b) Forest area, outside all buffers, on acceptable slope and visible from the main roads.

Your written report should provide a detailed summary of the procedure you used in solving the problem along with your recommendations.