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Mapping Political Economies over Time

A Primer of Regional Systems Theory and Methods for the Study of Historical Economies, Societies and Polities, and their Integration into the Modern World System

Exercise 3: Urban Systems in 19th Century China

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First Edition, 2017

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Exercise 3: Urban Systems in 19th Century China

Learning Objectives

1. Create density maps based on estimates of Chinese urban populations in the 19th Century, and compare with the Macroregional Systems Model of Agrarian China.
2. Identify all Cities in China with a population over 25,000 in relation to Navigable Waterways.

Files used in this exercise

Datasets referenced in this exercise may be downloaded from the Harvard Dataverse repository at <https://dataverse.harvard.edu/dataverse/mpe>. We suggest that instructors provide a shared directory for students to access these files on their local network. The basemap data layers are accessible through ESRI ArcGIS Online.

<u>File Name</u>	<u>Description</u>
1. Macroregions	Physiographic Macroregions of China
2. ChinaW-UrbanPops	Administrative Capitals of 19 th Century China
3. rivers	Major Rivers
4. China_NavRivers	Navigable Waterways of China
5. Coast1820	Coastline of China ca. 1820
6. Grandcanal	Grand Canal

Data sources

This exercise makes use of data developed by G. William Skinner and his research team at the University of California, Davis, including contributions from Lawrence Crissman, Griffith University/ACASIAN, now archived at the Harvard University Center for Geographic Analysis.

Mark Henderson and Merrick Lex Berman, ed.s (2016). Skinner Regional Systems Analysis Dataverse. Cambridge: Harvard University. <https://dataverse.harvard.edu/dataverse/hrs>.

Getting Started: Start ArcMap 10 and Save an ArcMap Project

This exercise shows examples from ArcMap version 10.5. If you're using a different version, or different GIS software, what you see on your screen may vary. We assume that you're familiar with the basic layout of your GIS software and are ready to try some new techniques.

To begin, start ArcMap and create a new ArcMap project. From the Menu Bar click on File / Save As, and name your ArcMap document **China-Lab3**.

Consult with your instructor to determine the best location to save your .mxd document file. Remember, the .mxd file is only an array of pointers to the actual GIS data files, which must also be present where you save your work for the file to correctly open again later.

I. Urban Population Densities in Macroregions

Although G. William Skinner first developed his regional systems approach for the study of China, we used examples from France to introduce the basic theoretical tenets and methods of Regional Systems Theory in Exercise 1. That is because there is a wealth of disaggregated census data for France from the early 19th century at the local (commune) level with which to model spatial aspects of how urbanization affected the economy and demography of the agrarian-based society.

Although there are no comparable, systematic datasets for 19th century China, Skinner mapped the outlines of the premodern economies of China based using a range of 19th and early 20th century data, mainly official gazetteers about the status of towns and cities in the imperial field administration. The initial presentation of this model in 1977 identified nine macroregional economies as of the 19th century (see Map 1). Skinner observed that, in contemporary China, all nine macroregions exhibited fully developed hierarchies of cities and regional systems. A century earlier, however, two of them, Manchuria and Yungui (Yun-Kwei), were merely emergent, their hierarchical relationships in flux. In fact, none of the capital cities of China in the 19th century with over 500,000 inhabitants are found in these two regions (see Map 2).



Map 1. Macroregions of Agrarian China, ca. 19th Century, from *The City in Late Imperial China* by G. William Skinner (1977).



Map 2. Capital Cities with an Estimated Median Population Greater than 500,000 ca. 1893 (according to the ChinaW Dataset).

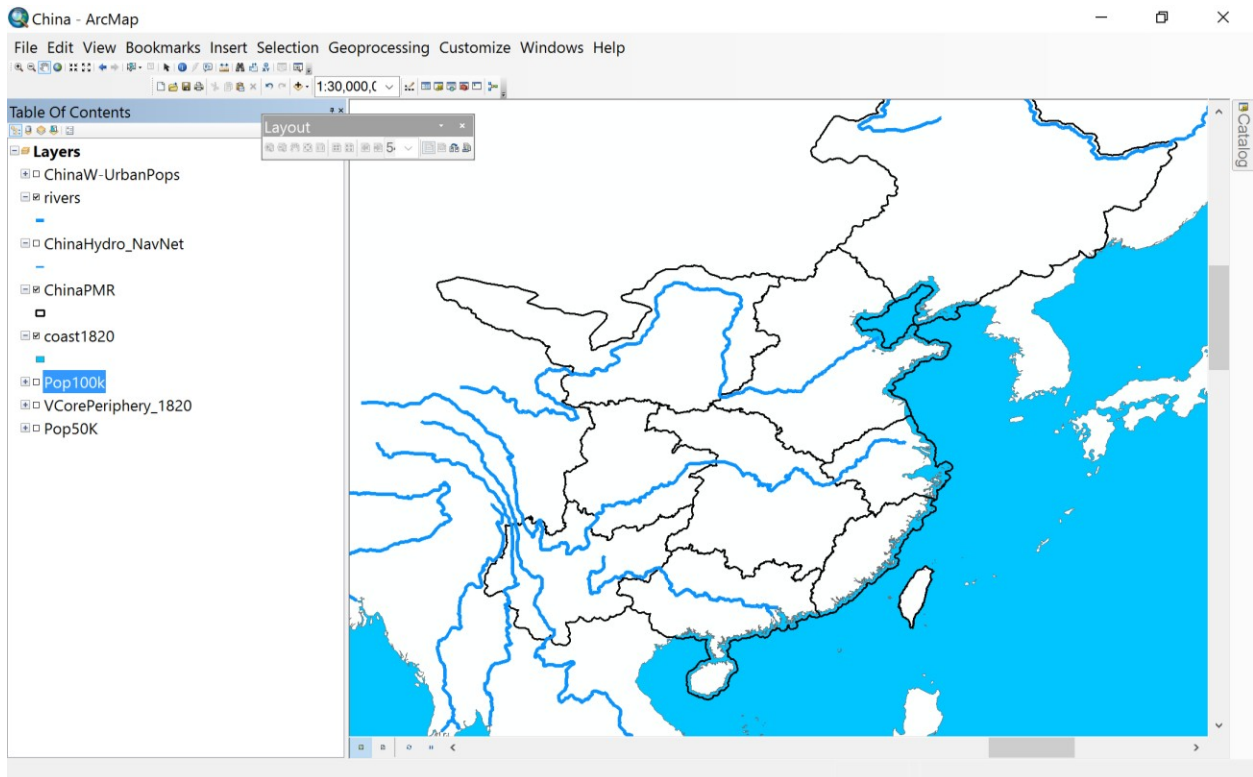
Regional Systems Theory posits that the relatively low cost of transport in cores and their denser transport net, led to the local economies of core areas becoming consistently more commercialized than those of peripheral areas, both in the sense that more commercial crops and handicrafts were produced for the market and in the sense that households were more dependent on the market for consumer goods. For these various reasons, then, there developed in each of the macroregions a reasonably discrete urban system, that is, a cluster of cities within which interurban transactions were concentrated and whose rural-urban transactions were largely confined within the region.

Unlike France, for which we had actual 1831 Census data for each commune, and thus could select all settlements with more than 2500 persons as an estimate of urban centers, there is no accurate Census data for all of China prior to the contemporary People's Republic of China period (1949-). Instead, we will assume that all towns and cities in China also served as administrative seats in the official dynastic field administration. Fortunately, research indicates that urban centers with more than about 2500 persons had administrative status in the 19th century.

In the case of China, Skinner compiled information about administrative capitals of the Qing period (1644-1911) from two China-wide gazetteers published in 1820 and 1893, in addition to numerous local gazetteers. These data were published as the ChinaW dataset, a GIS point file of urban centers with numerous socioeconomic and physical attributes. We can utilize these data to devise a methodology to test the validity of Skinner's Macroregional Systems Model of Agrarian China. If we map urban population densities in the 19th century, we should observe a correlation with the areas of each Macroregion.

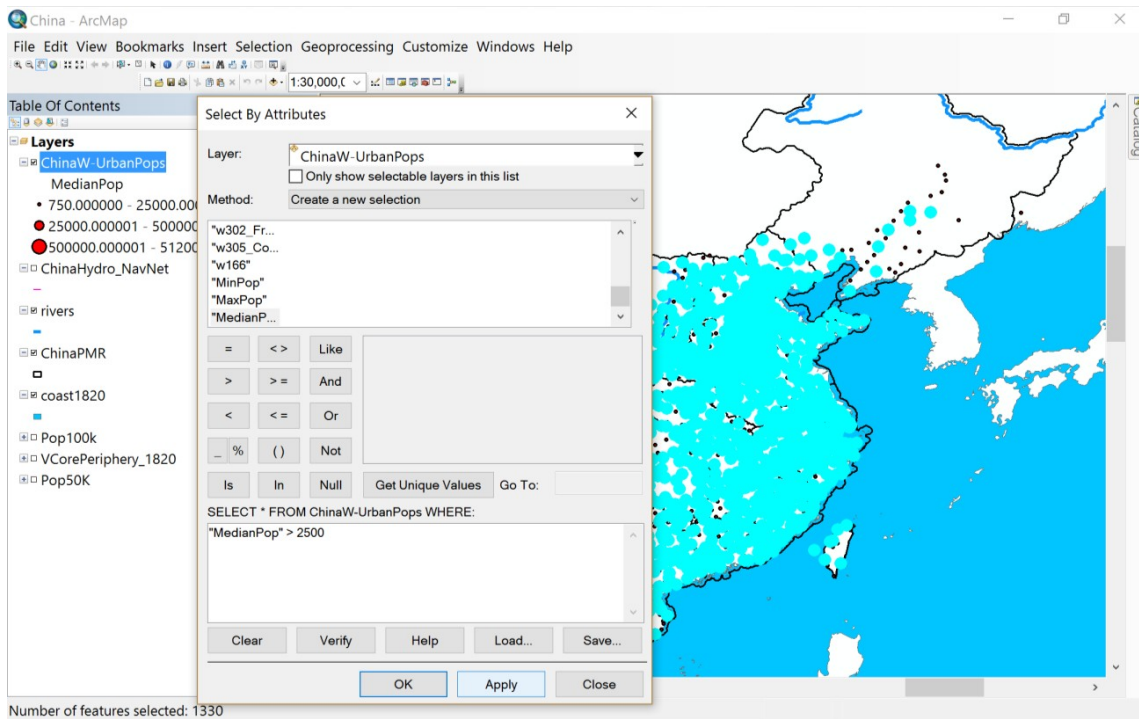
Step 2. Add base map layers

Add the shapefiles coast1820, rivers, and Physiographic Macroregions. Your map should look like this:

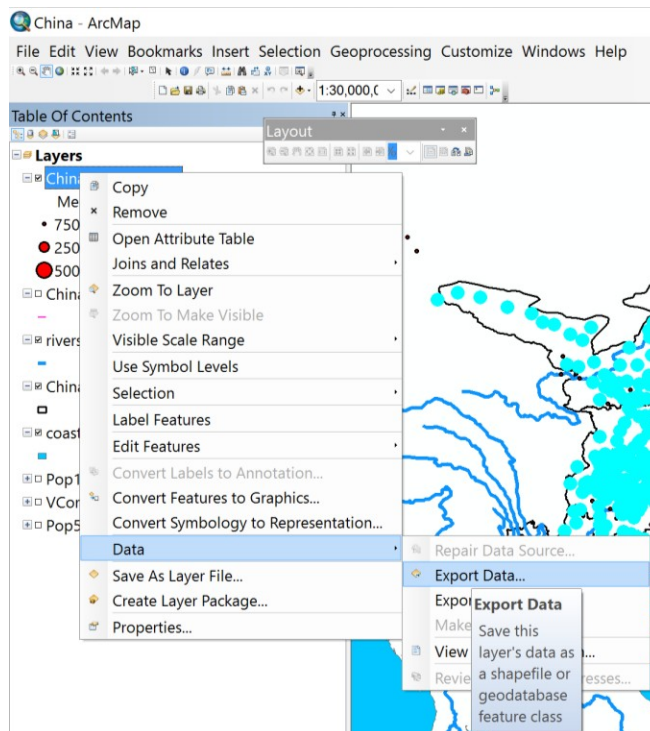


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Under Selection, choose Select By Attributes. Make sure your target layer is ChinaW-UrbanPops, and then double-click on the last variable MedianPop, then choose the Greater Than symbol (>), and after one space enter 2500. Click Apply, and the selected cities should be highlighted:

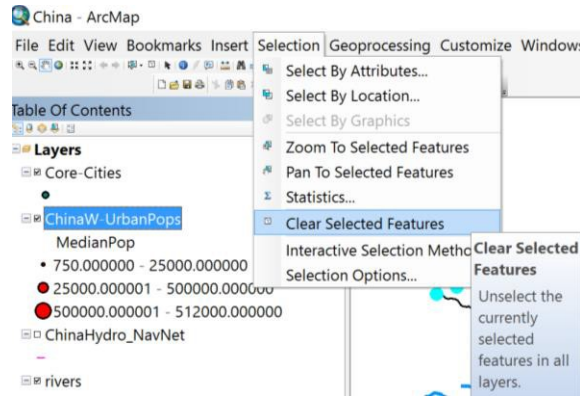


Next, right-click on ChinaW-UrbanPops and choose Data – Export Data. Make sure to save the file to your China folder, and change the default **Export_Output** name to **Core-Cities.shp**.



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Don't forget to Clear Selected Features under Selection, so that the cities over 2500 do not remain selected (remember, anything left selected may cause problems for you later).



Right-click on Core-Cities and open the attribute table. You should see there are 1,330 city records.

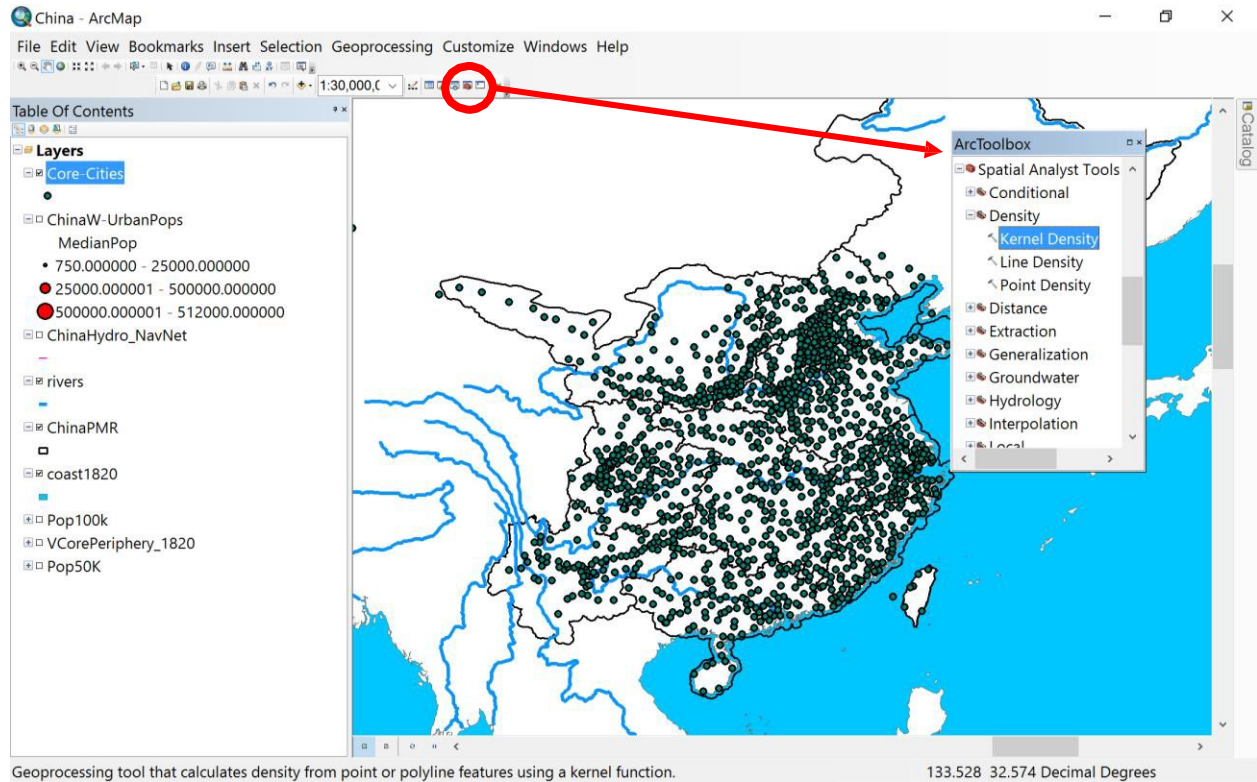
This is interesting, because for all of France in 1831 there were 1,475 Communes with more than 2,500 persons. Given that just one macroregion of China is roughly the size of France, this indicates that either France was much more urbanized than China in the 19th century, or that some of the Communes with more than 2,500 persons were rural and we made a mistake in assuming they all had urban centers. This problem shows how difficult it is to find comparable historical GIS data for different societies and civilizations—or how different the urban-rural population distributions of these two societies were.

FID	Shape *	w1_ChinaW_	w2_Hanzi_n	w3_Pinyin_
0	Point	AH001	安庆府	Anqing Fu
1	Point	AH002	潜山县	Qianshan Xian
2	Point	AH003	宿松县	Susong Xian
3	Point	AH004	太湖县	Taihu Xian
4	Point	AH005	桐城县	Tongcheng Xian
5	Point	AH007	池州府	Chizhou Fu
6	Point	AH009	建德县	Jiande Xian
7	Point	AH010	青阳县	Qingyang Xian
8	Point	AH012	铜陵县	Tongling Xian
9	Point	AH013	滁州	Chu Zhou
10	Point	AH016	凤阳府	Fengyang Fu
11	Point	AH016.1	凤阳县*	Fengyang Xian*
12	Point	AH017	定远县	Dingyuan Xian
13	Point	AH018	凤台县*	Fengtai Xian*
14	Point	AH019	怀远县	Huaiyuan Xian
15	Point	AH020	灵璧县	Lingbi Xian
16	Point	AH021	寿州	Shou Zhou
17	Point	AH022	宿州	Su Zhou

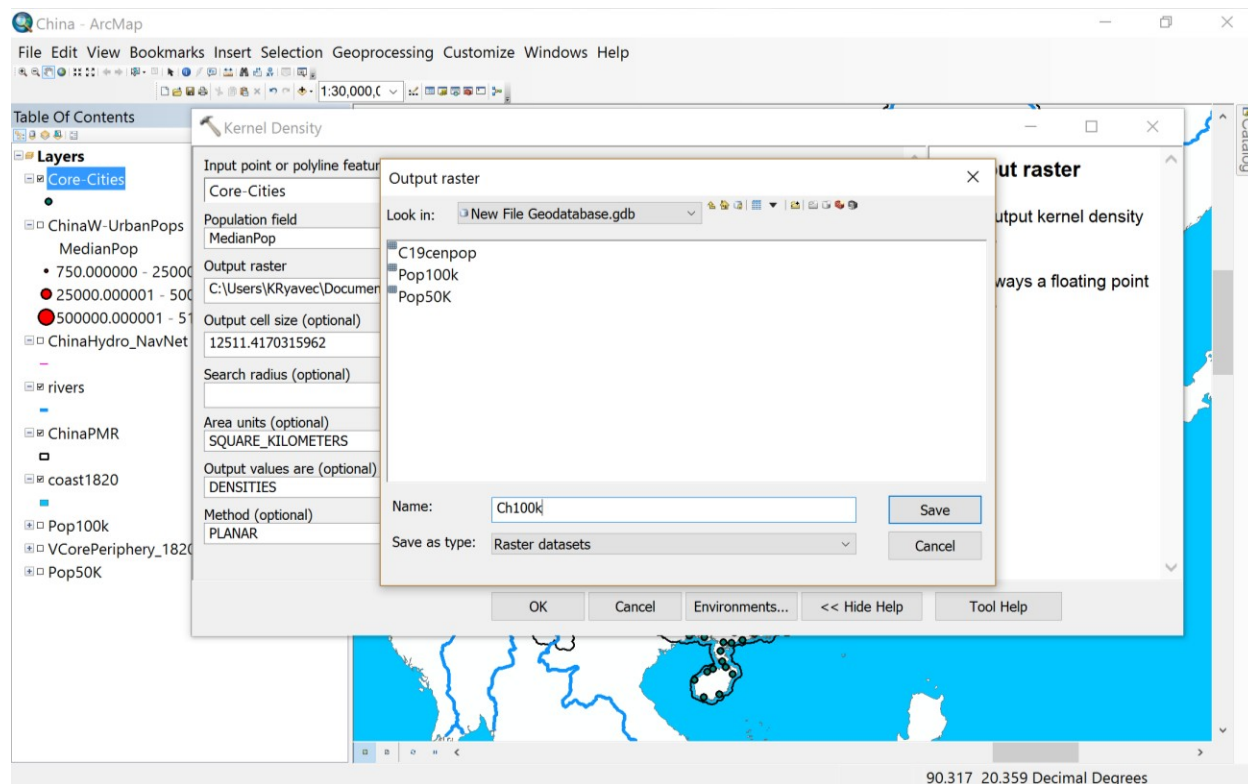
Table (0 out of 1330 Selected)

Step 5. Make a Kernel Density map of Urban Population

Click on the Toolbox Icon near the top of the screen, and when the Toolbox window opens, scroll down to Spatial Analyst Tools / Density / Kernel Density.

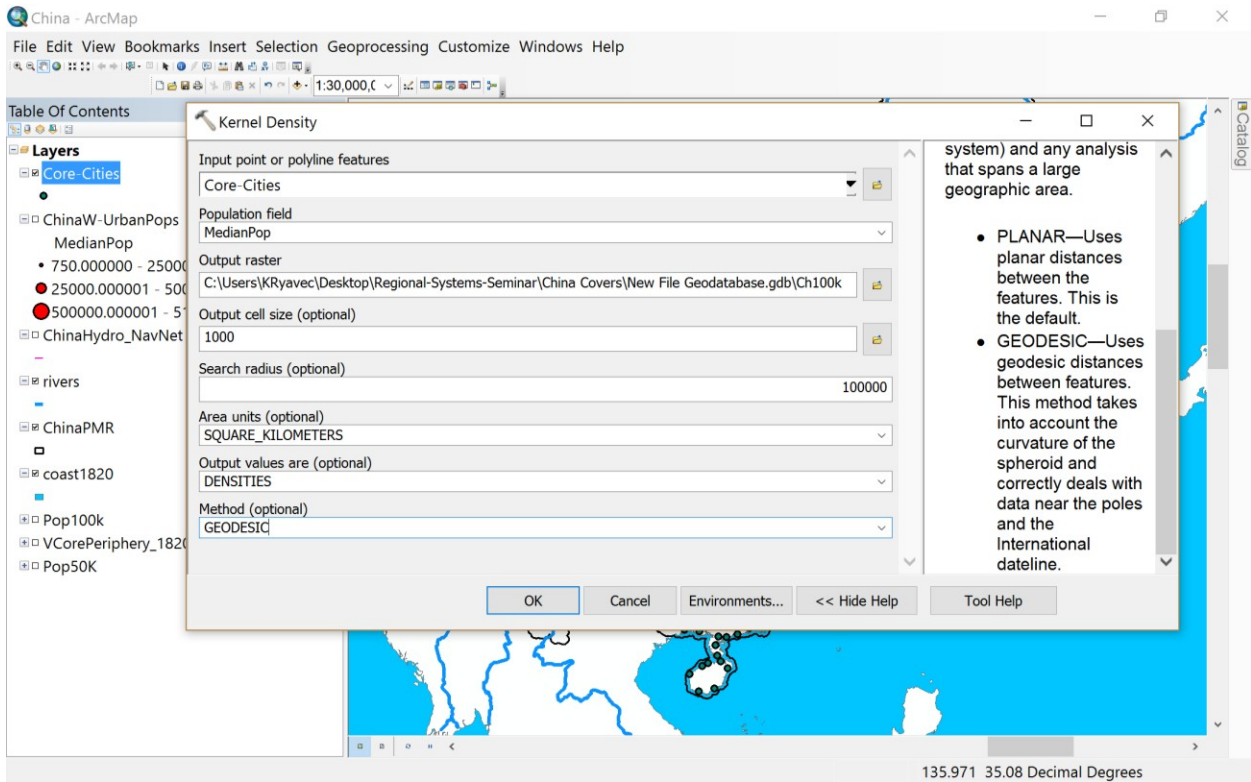


Double-click on the Kernel Density tool. When the input box opens, choose Core-Cities as the Input points. Under Population Field, choose MedianPop. For Output Raster, click on the small folder box to the right, and choose the icon to make a New File Geodatabase. The Output raster must be saved in a Geodatabase.gdb folder or it will not work. Also, since the name of the Output raster cannot have more than 8 characters, choose **Ch100k** for your output raster file name, then click Save.

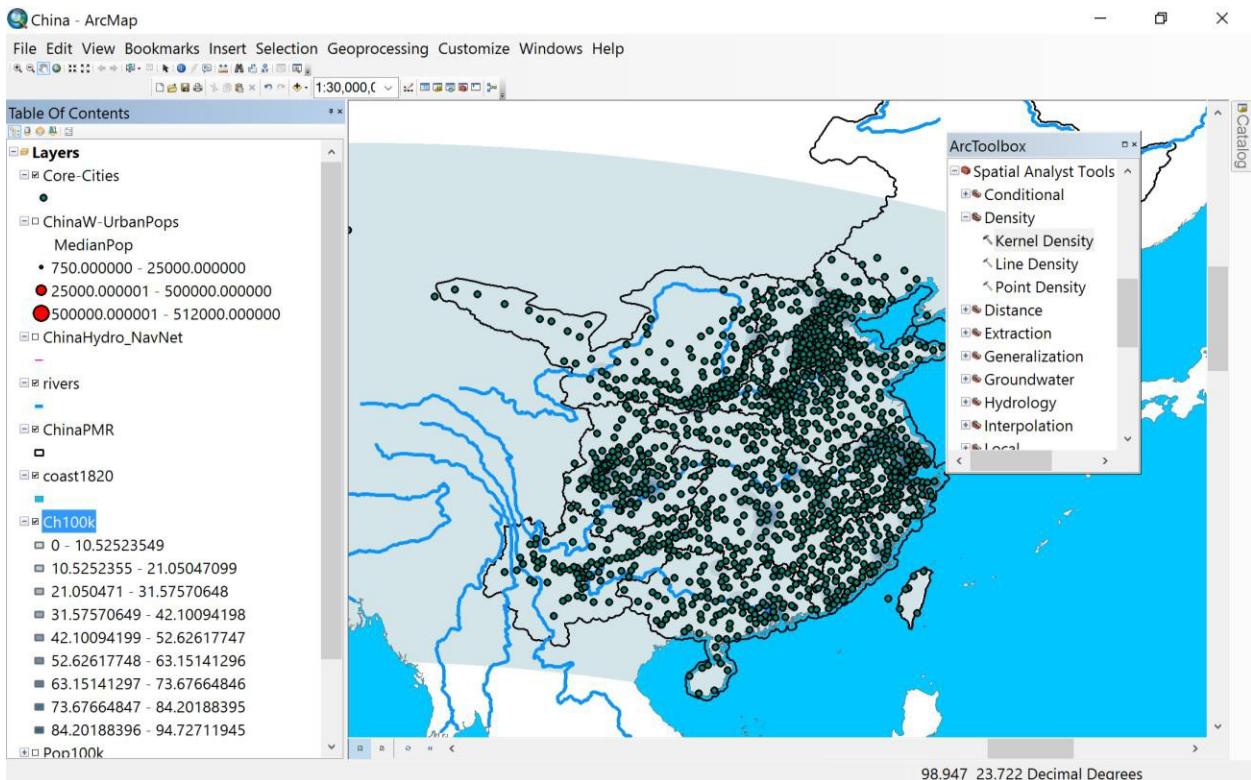


Next, backspace over the Output cell size and enter 1000 (for 1000 m or 1 km). Enter 100000 (100,000 m or 100 km) for the Search radius.

Choose Square Kilometers for the Area units, and Densities for the Output values, and Geodesic for the Method. Then click OK and wait for the operation to finish running.



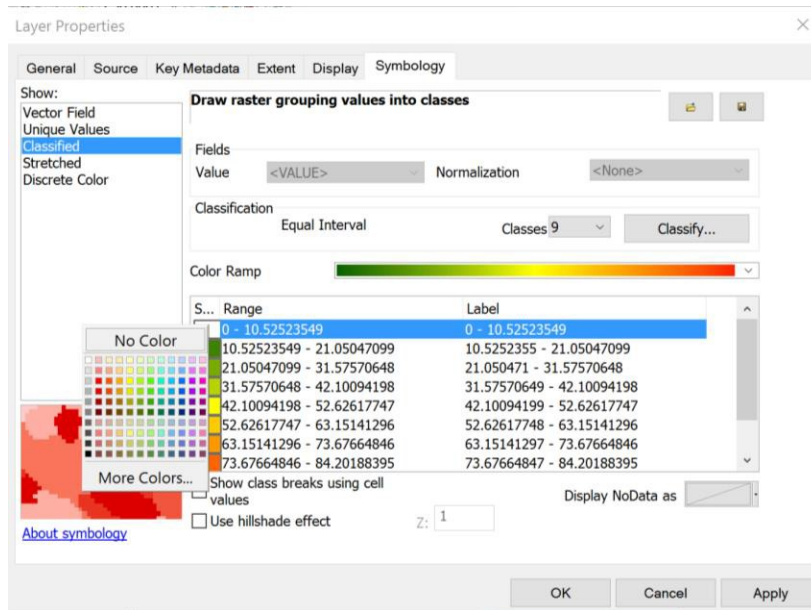
After a while this sort of image should open, note how the default extent is defined by the Cities we used as our Input points.



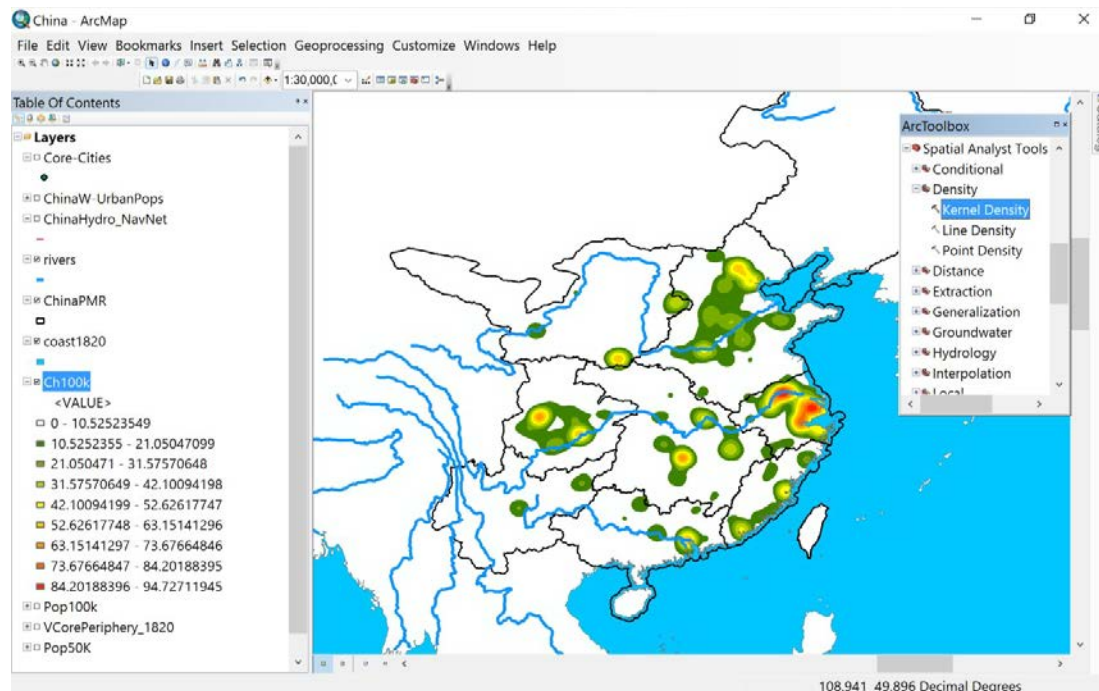
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To make our raster grid of Urban Population Densities more clear, right click on Ch100K and choose Layer Properties. Click on the Symbology tab, leave the default number of classes as 9, then choose Classified and select a color ramp you like, but make sure the colors logically convey Peripheral to Core values, such as shown below.

Last, click on the lowest density periphery value and select 'No Color', because most of the map surface in the default extent area is covered by the lowest density values. To solve this problem, it would be necessary to clip the Ch100k grid by the outer boundary of Agrarian China as defined by the ChinaPMR polygon shapefile of the macroregions. Thus simply choosing 'No Color' for the farthest periphery is an easy way to solve this problem.



Your final map of Urban Population Densities should look something like this:



Study again Skinner's initial map of the Macroregions of 19th century China, and also the estimated core areas. How do your findings compare?



MAP 1. PHYSIOGRAPHIC MACROREGIONS OF AGRARIAN CHINA IN RELATION TO MAJOR RIVERS, WITH REGIONAL CORES INDICATED BY SHADING

II. Major Urban Centers in Relation to Navigable Waterways

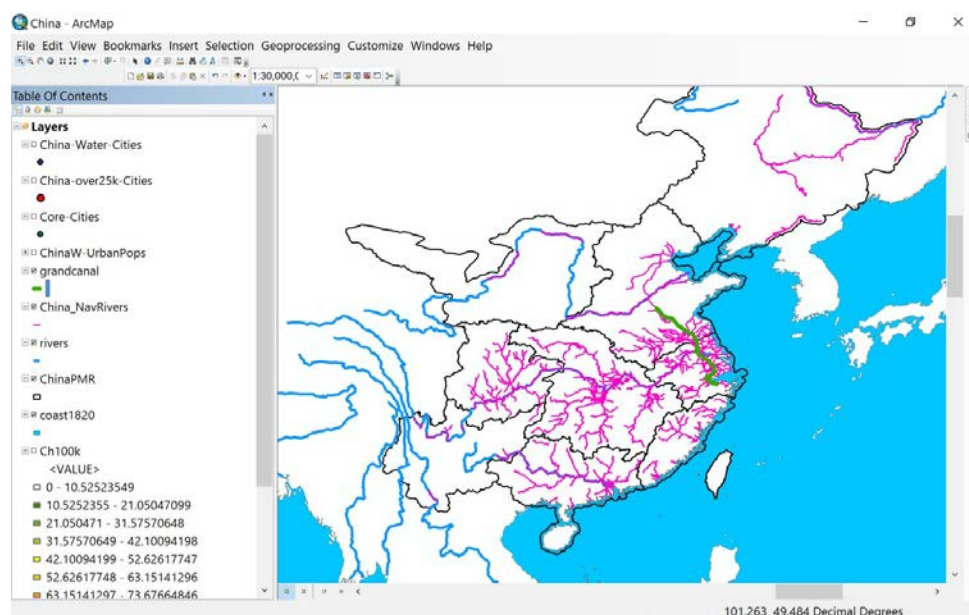
One of the main tenets of Regional Systems Theory holds that regional cores had major transport advantages vis-a-vis peripheral areas. Trade between the centrally located cities of one region and those of another was minimized by the high cost of unmechanized transport, the great distances involved, and the more rugged terrain that characterized most portions of the regional peripheries. Because of the low unit cost of water transport as against land transport, navigable waterways dominated traffic flows in all regions of Agrarian China except Yungui (the Yunnan-Guizhou Plateau in Southwest China) and the Northwest; and even where rivers were unnavigable their valleys typically afforded the most efficient overland routes. Thus the transport network of each region climaxed in these lowland cores, where most of the transport nodes were situated. River systems aside, the less rugged terrain of the core areas made it relatively inexpensive to build roads and canals.

We can utilize the best available GIS data on the Navigable Waterways of China¹ to study the extent to which the largest Chinese cities of the 19th century were located on navigable waterways. For a better comparison with our earlier similar exercise on France, we will also use 25,000 as the population cut-off level. We must assume that the navigable waterways of China in the 19th century matched those of a century later for want of better data.

¹China_NavRivers.shp contains arcs representing sections of rivers in contemporary China that are navigable. The river sections are not named. Derived from the "Navigable Waterways of China," compiled by Lawrence Crissman with Mark Henderson and Michele Ladenson, based on the *1:1 Million Land Use Map of China* (1990).

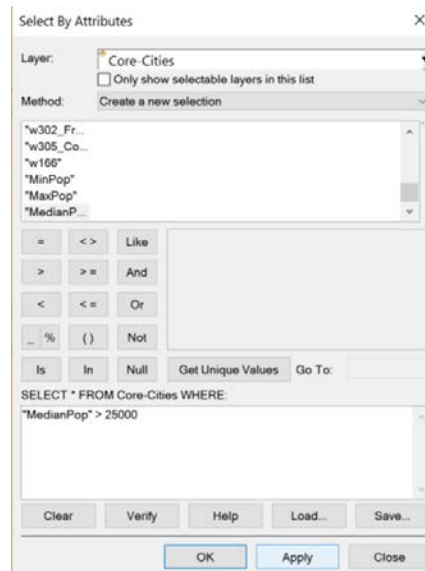
Step 6. Select Cities with Median Populations Greater than 25,000

First, open the rivers, ChinaPMR, and coast1820, then open the China_NavRivers and symbolize the lines so they are distinguishable from the major rivers. Also, open the grandcanal (it is shown in the thick green line below for reference). Note how the Grand Canal crossed the macroregional boundary between the Lower Yangzi and North China. And while the Yangzi river is navigable from the Pacific to the Sichuan Basin (i.e. Upper Yangzi macroregion), only certain stretches of the Yellow river are navigable.



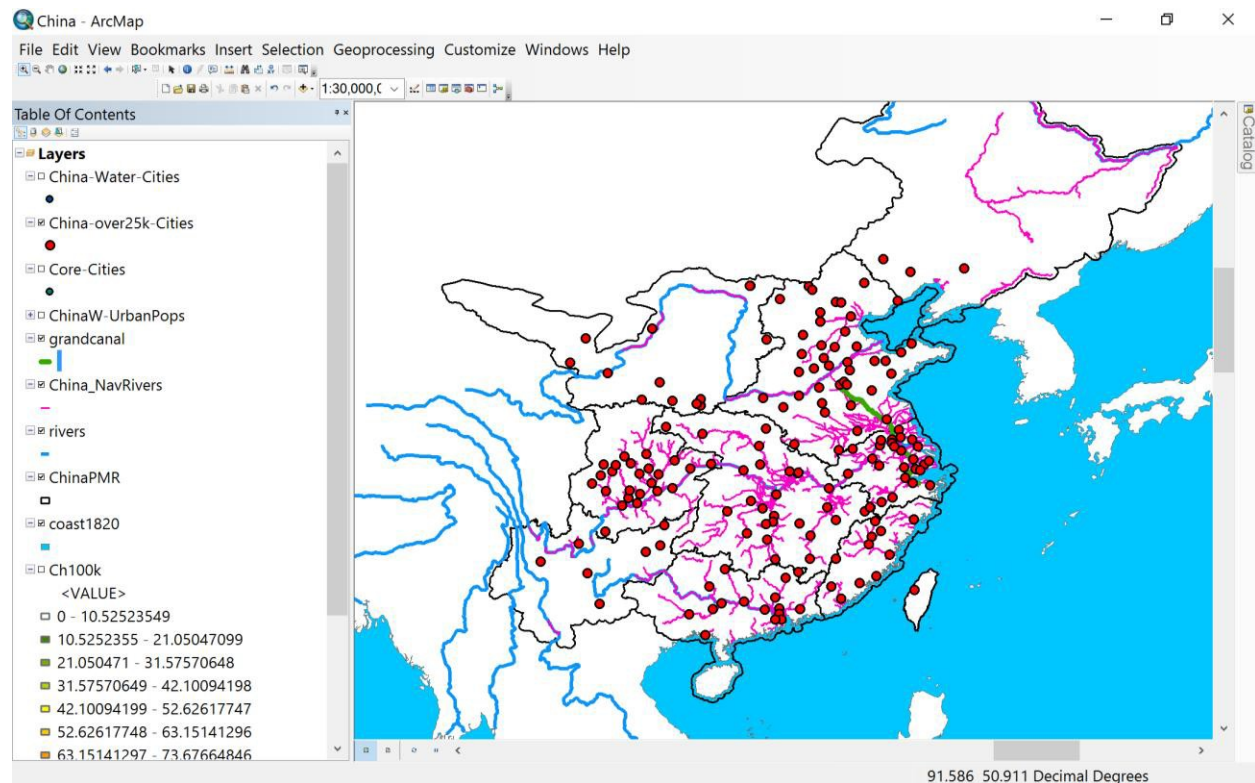
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Under Selection, choose Select By Attributes. For Layer select Core-Cities, then double-click on MedianP and choose the > symbol, then after one space enter 25000. Click Apply, note the selected cities are highlighted, then close this window.



Right-Click on Core-Cities and under Data go to Export Data, then save the selection to a new shapefile, name it China-over25k-Cities.shp, and make sure you save it in your China folder. Then remember to Clear Selected Features (from the Selection menu).

Your resulting map should look like this:



Step 7. Identify Cities with Populations Greater than 25,000 Located on Navigable Waterways

Under Selection, choose Select By Location. For Selection method, choose 'select features from'. Then select China-over25k-Cities as the Target layer. For Source layer, choose China_NavRivers. For the Spatial selection method for target layer feature(s), choose 'are within a distance of the source layer feature', and enter 12.0 Miles. Click Apply.

Select By Location

Select features from one or more target layers based on their location in relation to the features in the source layer.

Selection method:
select features from

Target layer(s):

- China-over25k-Cities
- Core-Cities
- ChinaW-UrbanPops
- grandcanal
- China_NavRivers
- rivers
- ChinaPMR
- coast1820
- VCorePeriphery_1820

Only show selectable layers in this list

Source layer:
China_NavRivers

Use selected features (0 features selected)

Spatial selection method for target layer feature(s):
are within a distance of the source layer feature

Apply a search distance
12.0 Miles

[About select by location](#) OK Apply Close

Use the process for saving selected points to a new shapefile you learned in previous steps. Name the new shapefile **China-WaterCities**.

Add China-WaterCities to your map, then color these points Blue, while leaving all the Cities over 25,000 colored Red underneath. Notice a few cities on the Pacific coast should also be considered along navigable waterways, but we did not append the coastline to our Source layer. Otherwise, it is clear that most of the large cities without access to navigable waterways were in North China, Manchuria, Northwest China, and Southwest China (Yungui). But it is possible some 19th century canals either fell out of use, or were missed by the contemporary navigable waterways database

