# CLIMATE GRAPHS LESSON

BACKGROUND

Many people are familiar with "climate graphs", in which a "dual purpose chart" is prepared for a given site using monthly temperature and precipitation data. The horizontal axis represents months of the year, a series of vertical bars represents monthly precipitation (with precipitation numbers shown along one Y-axis), and a "connect-the-dots" line represents monthly temperature (with temperature numbers shown along another Y-axis). Each site with good data can thus be shown in a single graph, and easily compared visually with other sites, in a rough but reasonable "apples-to-apples" comparison.

ArcView lacks (and thus ArcVoyager lacks) a sufficiently flexible charting tool to work this magic in a single chart. But ArcView (and thus ArcVoyager) is able to construct and display multiple charts relating to a single data set, and can thus be used to mimic climate graphs, given adequate data and computer display space. More importantly, the power of the computer makes it easy to mix and match and shuffle between such climate graphs, in a way that is not easy with paper versions.
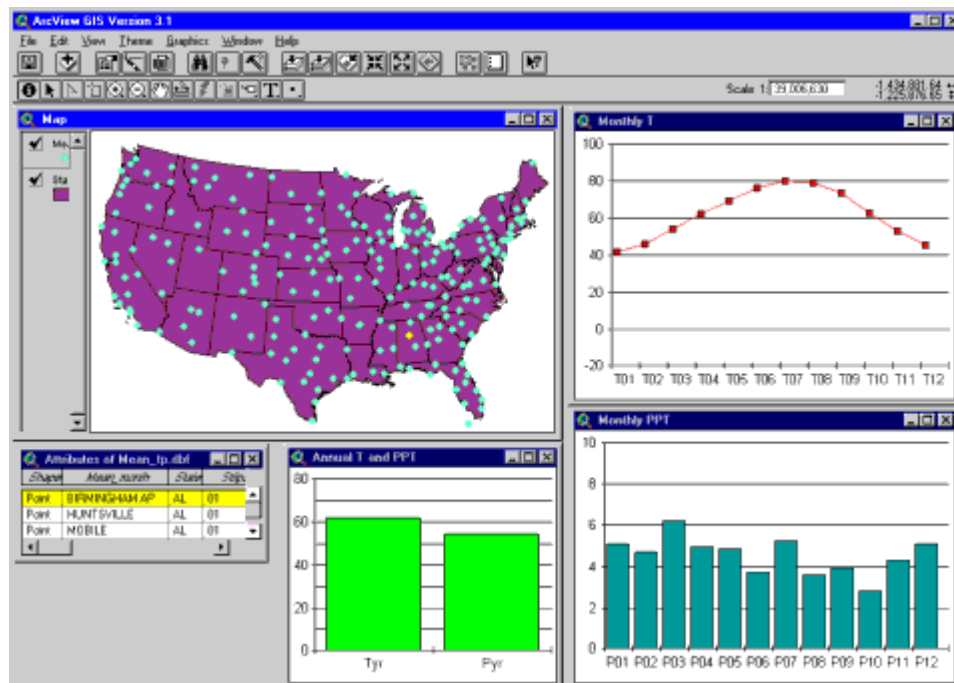
The following exercise asks users to construct three charts using monthly mean temperature and precipitation data from the United States. The data in this exercise are from National Oceanic and Atmospheric Administration (NOAA). The source data can be explored and the exercise enhanced by going to these sites on the World Wide Web and constructing additional data tables for exploration. This exercise will deal only with mean monthly and yearly temperature and precipitation from some 275 sites from the U.S. 50 states.

http://www.ncdc.noaa.gov/ol/climate/online/ccd/nrmlprcp.html - normal precipitation
http://www.ncdc.noaa.gov/ol/climate/online/ccd/meantemp.html - mean temp

http://www.ncdc.noaa.gov/ol/climate/online/ccd/mintemp.html - min temp
http://www.ncdc.noaa.gov/ol/climate/online/ccd/maxtemp.html - max temp
http://www.ncdc.noaa.gov/ol/climate/online/ccd/nrmhdd.html - heating degree days
http://www.ncdc.noaa.gov/ol/climate/online/ccd/nrmcdd.html - cooling degree days

SET-UP PROCEDURE

1. Construct a base map containing at least the US 50 states, preferably also with the rest of North America and an ocean layer for background. Set the projection to Albers. Within ArcVoyager or ArcVoyager Special Edition, this is pre-set in the North America map in Level III "Point Me."

2. Save the base project. (If using ArcVoyager Special Edition, saving is not an option.)

3. Add from "lsn_clim\data" the shapefile "meanmotp.shp" and turn the theme on.

4. Use the Legend Editor to change the symbol for the theme "Meanmotp.shp" to a bullseye symbol (right column, row 5), change the symbol size to 6, and choose bright red. Apply the changes.

5. Open the theme table for the theme "Meanmotp.shp"

6. Size the windows similar to the graphic above, so that the map occupies the upper left portion of the workspace and the table is visible below, and window edges are not overlapping.

7. Click once on the top row in the table, selecting the city of Birmingham, AL. The city should turn yellow in the table and yellow on the map (similar to the graphic above).

CREATE CHART #1

8. With the table as the active window and Birmingham as the only selected record, create a chart, and set the chart name as "Monthly PPT."

9. For items in the chart, add the twelve fields P01-P12 (representing precipitation by month). Click OK.

10. With the chart active, choose the menu items "Chart\Hide Title" and Chart\Hide Legend".

11. With the chart active, click the "Chart Element Properties" tool. Click once inside the chart in the numbers of the Y axis to open the "Chart Axis Properties" window. Change the settings to match this picture:
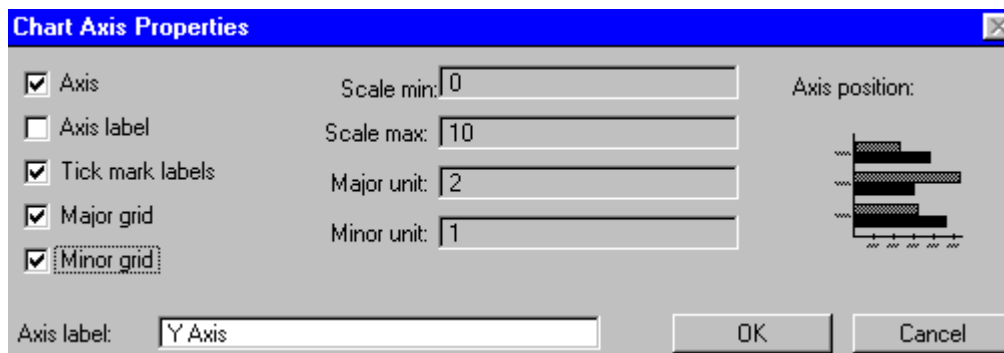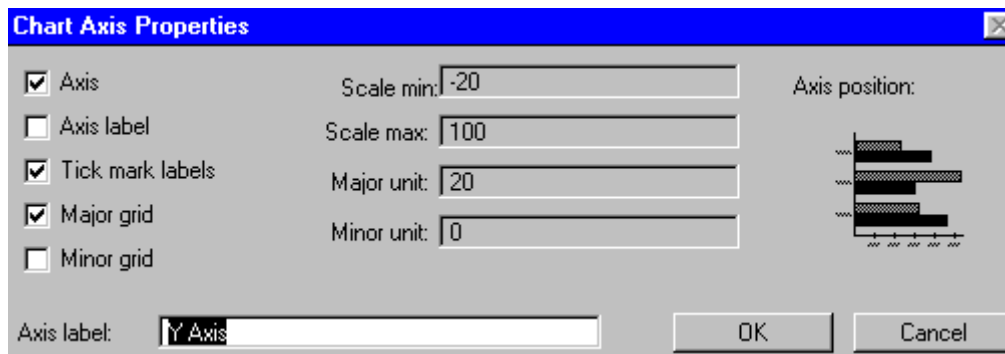

12. Click OK to engage the changes. Position the chart in the bottom right portion of the workspace, as shown in the graphic on the first page.

CREATE CHART #2

13. Make the table "Attributes of Meanmotp.shp" the active window, and keep Birmingham as the only selected site. Create a new chart and set the chart name as "Monthly T"

14. For items in the chart, add the twelve fields T01-T12 (representing monthly temperatures). Click OK.

15. Change the chart type by choosing the menu item "Gallery\Line" and selecting the top right style.

16. With the chart active, choose the menu items "Chart\Hide Title" and "Chart\Hide Legend".

17. With the chart active, click the "Chart Element Properties" tool. Click once inside the chart in the numbers of the Y axis to open the "Chart Axis Properties" window. Change the settings to match this picture:

18. Click OK to engage the changes. Position the chart in the top right portion of the workspace, as shown in the graphic on the first page.

CREATE CHART #3

19. Make the table "Attributes of Meanmotp.shp" the active window, and keep Birmingham as the only selected site. Create a new chart and set the chart name as "Annual T and PPT".

20. For items in the chart, add the two fields "PYR" and "TYR" (representing annual mean precipitation and temperature). Click OK.

21. With the chart active, choose the menu items "Chart\Hide Title" and "Chart\Hide Legend".

22. With the chart active, click the "Chart Element Properties" tool. Click once inside the chart in the numbers of the Y axis to open the "Chart Axis Properties" window. Change the settings to match this picture:
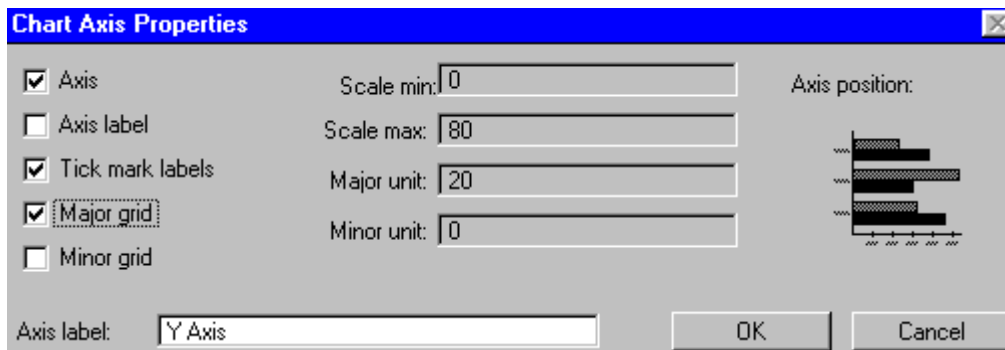
23. Click OK to engage the changes. Position the chart in the lower left of the workspace, as shown in the graphic on the first page.

EXPLORE THE DATA

24. Save your project. (If you are using ArcVoyager Special Edition, saving is not an option.)

25. Back in the map, click once on the theme "Meanmotp.shp" to make it the active theme. Choose the "Select Features" tool. (In ArcVoyager or ArcVoyager Special Edition, click and hold on the "Select Features" tool, then select the top choice.) You can now select individual cities in the map, one by one, and see how each city's climate varies. Each chart will show the same city.

26. If you aim at a city but miss, the charts will "un-select" the current feature, will assume you want to select all features, and will indicate "Too much data. Please select fewer rows." Just click on a city and hit it.

27. You can select more than one city at a time by holding down the shift key as you select additional cities. The colors in the charts will not be color coded by individual cities. However, the color for an individual city may change as you add another city. The best way to define which city is which is to make the "Annual T and PPT" chart active, click on the "Identify" tool, and click on one color bar in that chart. The corresponding items in the map, table, and charts will flash, and the Identify window will indicate what city it is.

28. Hawaii has cities which go "off the charts" in some months. If you are going to explore cities in Hawaii, you may want to go back to the "Chart Element Properties" and change the maximum precipitation of the "Monthly PPT" (use 24) and "Annual T and PPT" (use 160).

EXTEND THE LESSON

29. There is a significant relationship between landforms and some of these climate patterns. You may want to add elevation data to your map. There are fast-drawing elevation data available as shapefiles at this address on the ESRI Schools and Libraries website:

http://www.esri.com/industries/k-12/material.html#MDat13

You can download these compressed files, uncompress them, and use their pre-constructed legends. (Add the theme, double-click to engage the legend editor, hit the LOAD button, and navigate to the source of the data. Each shapefile contains a legend using the same name as the shapefile.)

30. There is also a significant relationship between climate patterns and agricultural activity. Users of ArcVoyager and ArcVoyager Special Edition can duplicate this same procedure within the US Agriculture project contained within ArcVoyager.