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Create Compelling Visualizations with Geographic Data and JMP® 9

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ABSTRACT

JMP 9 introduces exciting graphical support for geographic data. In this presentation, you learn how to use the built-in background maps in any plot of geographic data. You also see how to connect to a Web mapping service to display specialty maps like satellite images, radar images, or roadways. Because JMP 9 can plot geographic shapes based on place names, we demonstrate how to use the flexible architecture to create your own shape files to plot any location, like a floor plan or a campus. Lastly, we show how to convert SAS® map data sets for use in JMP.

INTRODUCTION

Some things are just better as pictures. Consider this description: “a series of nine paintings that depict nine stories from the Christian Bible's Book of Genesis.”¹ How does that strike you? Do you feel inspired?

What about when you see this?



Figure 1. The Ceiling of the Sistine Chapel²

A little more powerful, no? Kind of takes your breath away.

¹ White, David. “The Sistine Chapel.” <http://www.socialstudiesforkids.com/articles/worldhistory/sistinechapelceiling.htm>.

² Photograph of the Sistine Chapel courtesy of Patrick Landy, http://en.wikipedia.org/wiki/File:Sistine_chapel.jpg.

What about this: How do you feel when you look at this table?

Latitude	Longitude	Date	Wind speed
26.9	-89	08/28/21Z	145
27.2	-89.1	08/29/00Z	140
27.6	-89.4	08/29/03Z	140
27.9	-89.5	08/29/03Z	140
28.2	-89.6	08/29/07Z	135
28.8	-89.6	08/29/09Z	130
29.1	-89.6	08/29/11Z	125
29.7	-89.6	08/29/13Z	115
30.2	-89.6	08/29/15Z	110
30.8	-89.6	08/29/15Z	90

Table 1. Hurricane Tracking Data

On the other hand, this tells a real story:

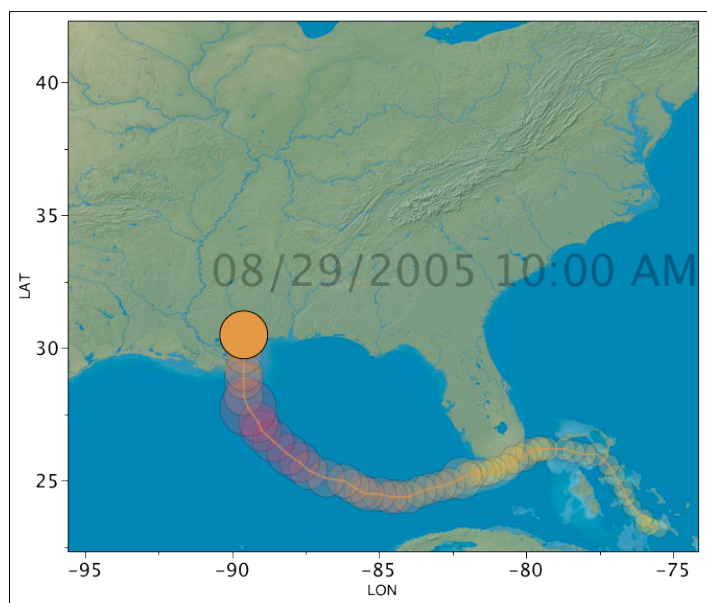


Figure 2. Hurricane Katrina making landfall

That's the strength of images. They evoke feelings and emotions by engaging parts of our brains that numbers and words can't.

JMP has transformed numbers into compelling images since the first version was released in 1989. JMP 9 brings this same power to geographic data: turning simple tables of numbers into captivating pictures that bring the story in your data to life.

BACKGROUND MAPS

In JMP 9 you can place a map image behind any graph of longitude and latitude. Simply plot longitude and latitude on the X and Y axes, and then right-click within the graph and choose **Background Map** from the pop-up menu.

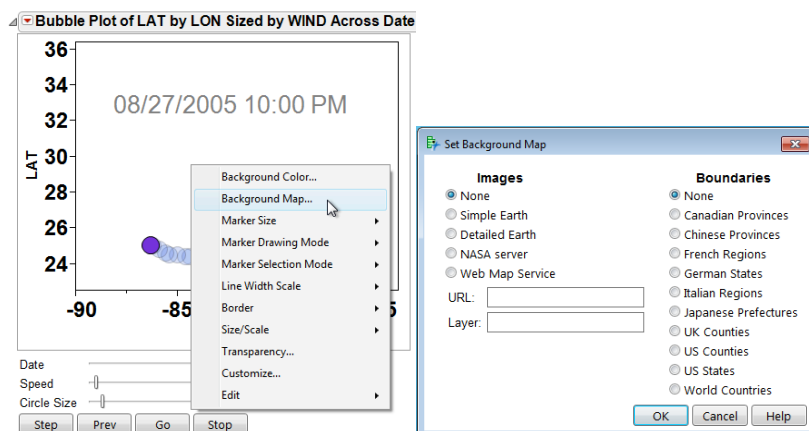


Figure 3. Right-click in Any Map of Latitude and Longitude and Add a Background Map

On the left of the dialog you can choose from two built-in map images, or you can connect to a Web mapping service to retrieve the background image. On the right side of the dialog you can choose to show political boundaries for a number of regions.

BUILT-IN MAPS

The image data for the built-in map, labeled “Simple Earth,” comes from Tom Patterson, <http://www.shaderelief.com>.

As its name suggests, Simple Earth is a relatively unadorned image of the earth’s geography. It does not show clouds or arctic ice, and it uses a green and brown color scheme for the land and a constant deep blue for water.

Detailed Earth has a softer color scheme than Simple Earth, lighter greens and browns for the land, as well as variation in the blue for the water. Detailed Earth is also slightly higher resolution than Simple Earth, which means that you can zoom into a graph further with Detailed Earth than with Simple Earth, before the quality of the background image begins to blur.

The image data for Detailed Earth comes from Natural Earth, which provides free vector and raster map data at <http://www.naturalearthdata.com>.

Since Detailed and Simple Earth are built into JMP, these options work any time, without a network connection.

However, these images might not be all that you want, or they might not be detailed at the resolution you need. If this is the case, and if you have an Internet connection, you can connect to a Web mapping service (WMS) to retrieve a map image that meets your needs.

A WMS uses a standard protocol to provide map images over the Internet. JMP includes connection information for one public WMS server from NASA.

The NASA server provides very-high-resolution images for the entire earth so you can zoom into small sections of your map.

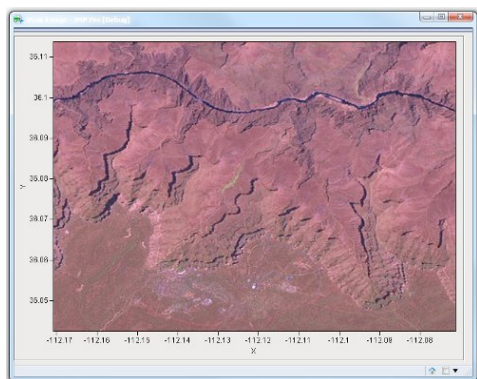


Figure 4. A High-Resolution Satellite Image from the NASA WMS Server

If you know the URL and layer name for another WMS server, you can enter them in the background map dialog. Most WMS servers support multiple layers to display different features, such as terrain, roads, or weather.

Figure 5 shows a map of the Starbucks locations around Cary, NC. This image comes from the WMS server at http://columbo.nrlssc.navy.mil/ogcwms/servlet/WMServlet/Wake_County_NC_Maps.wms:

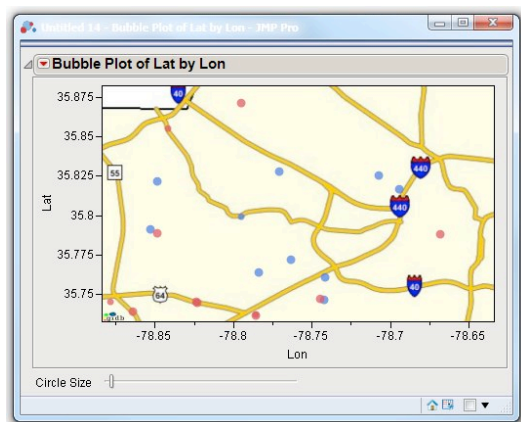


Figure 5. A Map Featuring Major Roadways from a Public WMS server

Finding WMS servers on the Internet is pretty easy with a Google search. Once you find one, though, you need to see the layers it supports. For this, one of our JMP developers has created an add-in for JMP: the WMS Explorer. You can download the WMS Explorer from <http://www.jmp.com/addins>.

The explorer lets you enter the URL for a WMS server and it will display a list of all the layers available on that server. You can select a layer to see what it looks like.

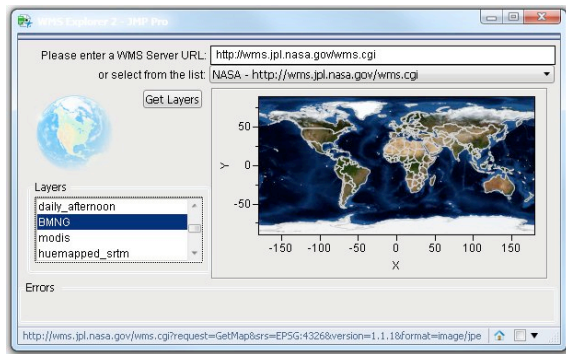


Figure 6. The WMS Explorer Add-in for JMP

The options on the right side of the Background map dialog let you overlay political boundaries on the graph, with or without a background image.

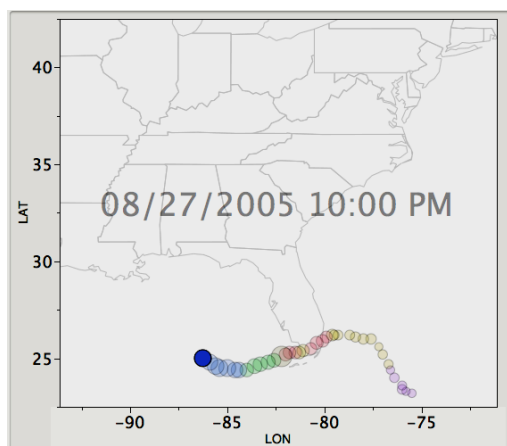


Figure 7. A JMP Graph with Political Boundaries

The political boundaries included with JMP are shown in the dialog, but this list can be extended with the addition of shape files, as discussed later.

CHOROPLETH MAPS

Sometimes you want to color geographic regions on a map to show statistical differences across geography. This kind of map is called a choropleth map. The Graph Builder platform in JMP 9 lets you quickly create this kind of map.

By dragging a column containing geographic place-names, like countries, states, or provinces, into the Shape role, you can create a map.

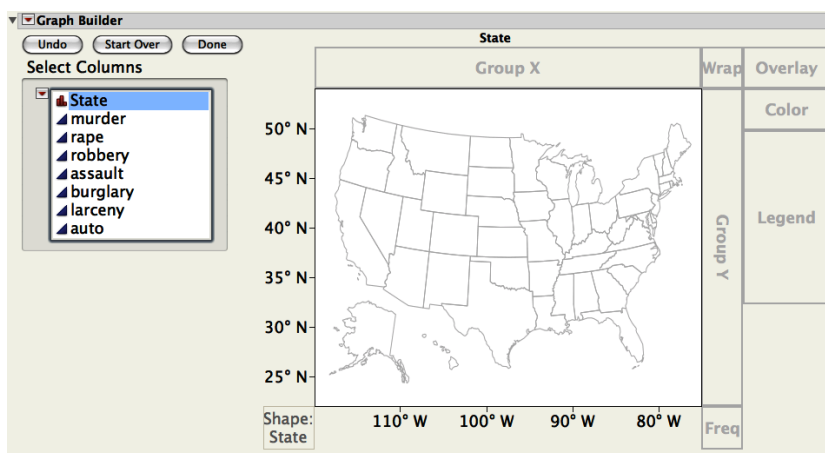


Figure 8. Dragging a Column of Place Names (U.S. State Names, in This Case) into the Shape Role in Graph Builder Gives a Map

Then drag a column to the Color role to color the map by that column.

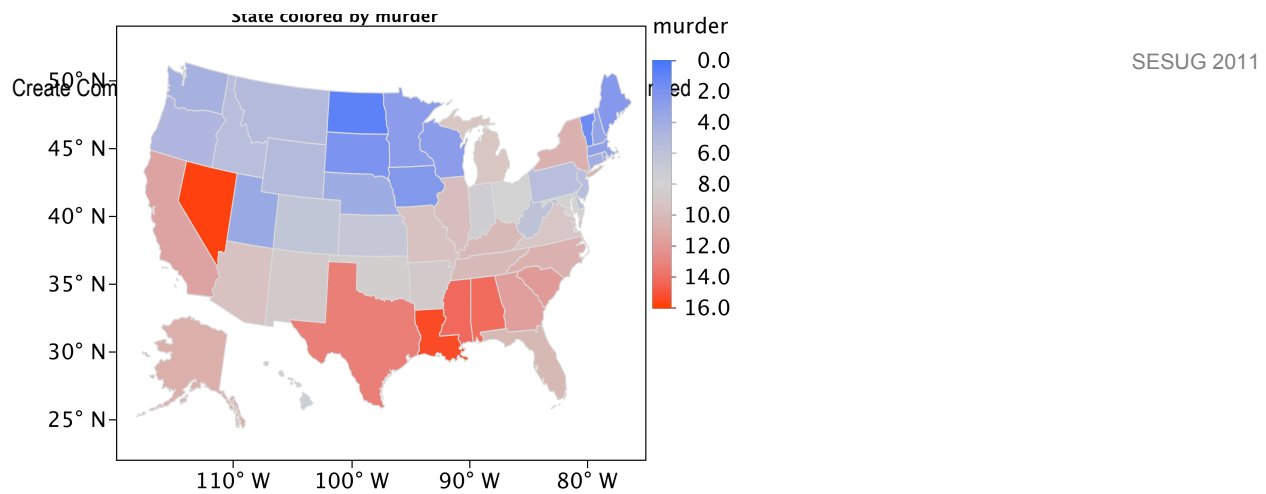


Figure 9. A Choropleth Map Created by Dragging a Column to the Color Role in Graph Builder

THE MAGIC

How does the Graph Builder know about place names and shapes? It's all done with pairs of data tables installed with JMP. Each pair consists of a -Name file and a -XY file. These files provide a mapping between the place names and the XY coordinates of the polygons that describe their shape.

JMP includes map files for:

- world countries
- states and counties in the United States
- first-level divisions for Canada, China, the United Kingdom, France, Italy, Japan, and Germany

Here's an excerpt of the map data for the United Kingdom:

Shape	Part	X	Y
1	2174	1	3.983° 55.461°
2	2174	1	4.094° 55.396°
3	2174	1	4.135° 55.284°
4	2174	1	4.297° 55.308°

Shape ID	Name	Type
1	2174 East Ayrshire	Unitary District
2	2175 East Dunbartonshire	Unitary District
3	2176 East Renfrewshire	Unitary District
4	2177 Glasgow	Unitary District (city)
5	2178 Inverclyde	Unitary District
6	2179 North Ayrshire	Unitary District
7	2180 North Lanarkshire	Unitary District
8	2181 Renfrewshire	Unitary District
9	2182 South Ayrshire	Unitary District
10	2183 South Lanarkshire	Unitary District
11	2184 West Dunbartonshire	Unitary District
12	2185 Aberdeen	Unitary District (city)
13	2186 Aberdeenshire	Unitary District
14	2187 Moray	Unitary District
15	2188 Falkirk	Unitary District
16	2190 Stirling	Unitary District
17	2191 Clackmannanshire	Unitary District
18	2193 Perthshire and Kinross	Unitary District
19	2194 Angus	Unitary District
20	2195 Dundee	Unitary District (city)
21	2196 Fife	Unitary District
22	2197 East Lothian	Unitary District
23	2198 Edinburgh	Unitary District (city)
24	2199 Midlothian	Unitary District

When you drag a column to the shape role, JMP searches the columns in the -Name data tables to find a match for the values in the column that you used. When it finds a match, it then uses the -XY data table to draw the map in the graph.

You can add your own map files to JMP. You can make shapes for floors of building, warehouse locations, campuses, or anything else that you can describe with names and polygons.

To add your own map files, you'll need two things: a series of XY coordinates for the vertices of the polygons that describe the shape, and a set of names for each polygon. There are two common sources for data like this: ESRI shapefiles and SAS/GRAPH map data sets.

ESRI Shapefiles

ESRI shapefiles are actually a set of three files:

- a main file (.shp)
- an index file (.shx)
- a dBase table (.dbf)

The main file contains a Shape column to uniquely identify each geographic region, a Part column to indicate discontinuous regions, and the XY coordinates (in latitude/longitude degrees).

The dBase table has an ID column that maps to the Shape column in the main file, plus any number of columns that provide common names or values to refer to the regions.

JMP does not require the index file.

To convert an ESRI shapefile to a JMP map file:

1. Open the .shp file in JMP.
2. Make sure that the Shape column is the first column in the .shp file.
3. Save the .shp file as a JMP data table to the Maps folder with a name that ends in -XY.jmp.
4. Open the .dbf file.
5. Add a Shape column as the first column in the table. This column should be the row numbers from 1 to n, the number of rows in the data table.
6. Assign the Map Role column property to any column that you will use for place names in the Shape role of Graph Builder. To do this, right click at the top of the column and choose Column Properties ► Map Role. Then choose Shape Name Definition from the drop-down box in the property definition.
7. Save the table as a JMP data table with a name that matches the earlier table and that ends in -Name.jmp.

JMP looks for these files in two locations. One location is shared by all users on a machine. This location is:

Windows:

```
C:\Program Files\SAS\JMP\9\Maps
```

Mac:

```
/Library/Application Support/JMP/9/Maps
```

The other location is specific for an individual user:

Windows XP:

```
<user-name>\Local Settings\Application Data\SAS\JMP\Maps
```

Windows Vista:

```
<user-name>\AppData\Local\SAS\JMP\Maps
```

Macintosh:

```
<user-name>/Library/Application Support/JMP/Maps
```

SAS/GRAPH® Map Data Sets

SAS/GRAPH software includes a number of map data sets that can be converted for use as shape files with JMP. These data sets are in the MAPS library. They come as a pair of data sets just as they do with JMP. The traditional map data sets contain the XY coordinate data. The feature table contains the common place names.

You'll need to convert both of these files to JMP data tables for use with JMP.

Most of the traditional map data sets have unprojected latitude and longitude variables in radians that can be used with JMP once they've been converted to degrees and the longitude variable has been adjusted for projection. Here's a DATA step that shows the conversion process for the Belize data set.

```
data WORK.BELIZE;
  keep id segment x y;
  rename segment=Part;
  set maps.belize;
  if x NE .;
  if y NE .;
  y=lat*(180/constant('pi'));
  x=-long*(180/constant('pi'));
run;
```

You can now import the converted file and save it as Belize-XY.jmp.

The next step is to import the matching feature data set—in this case, MAPS.BELIZE2. After importing the feature data set, you'll need to move the ID column to the first position in the data table. Then assign the Map Role column property to the columns that you will use for place names in the Shape role of Graph Builder. To do this, right-click at the top of the column and choose **Column Properties ► Map Role**. Then choose **Shape Name Definition** from the drop-down box in the property definition. For MAPS.BELIZE2, you'll do this for the IDNAME column.

Now save the feature data table as Belize-Name.jmp.

Boundaries

When you add shape files to the built-in locations in JMP, they are available not only for the Graph Builder platform, but also for the Boundaries option in the Background Map dialog. In this way, you can add more political boundaries for use with background maps.

CUSTOM SHAPES

You might want to create choropleth maps of other non-geographic regions (for example, a floor of an office building). JMP supports this as well. Add the two shape files for your non-geographic space just as shown above.

You'll need XY coordinates in any units. If you don't have XY coordinates, but you do have a graphic image of the space, you can use the Custom Map Creator add-in for JMP. With this add-in, you can trace the outlines of the space and it will create the -XY and -Name files for you. You can download this add-in from <http://www.jmp.com/addins>.

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