

Storm Mapping Tutorial

A step-by-step guide for using GIS to
create maps of weather conditions before, during,
and after hurricanes

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GIS Support Tutorial: Introduction

This tutorial provides guidance to those using ArcGIS for map production before, during, and after hurricanes. The National Oceanic and Atmospheric Administration's (NOAA) Coastal Services Center initially developed this GIS Support Tutorial for members of the Federal Emergency Management Agency (FEMA) and their contractors. However, it can be used by anyone wanting to create and display hurricane-related GIS data before, during, and after a storm.

Though this tutorial focuses on novice users of geographic information systems, or GIS, those users who have not taken the Environmental Systems Research Institute's (ESRI) *Introduction to ArcGIS I* course (or similar introductory ArcGIS training) should first familiarize themselves with basic GIS concepts and cartographic principles.

This tutorial provides guidance in the following ways:

- Discussion of where to find NOAA National Weather Service data and other related resources
- Basic direction on how to use ArcGIS for cartographic production
- Standard cartographic principles in designing specific presentation-quality maps



GIS Support Tutorial: Mapping Timeline

A general timeline is provided to show when each product may be created, but timing of products can be altered based on specific characteristics of an event.

Chapter/Product	Pre-Landfall			Landfall	Post-Landfall
	Day -3	Day -2	Day -1	Day 0	Day 1
1 6-Hour Quantitative Precipitation Forecast		✓	✓	✓	✓
2 Forecast Waveheight	✓	✓	✓	✓	
3 Forecast Windspeed	✓	✓	✓	✓	
4 120-Hour Quantitative Precipitation Forecast	✓	✓	✓	✓	✓
5 NOAA Hydrometeorological Prediction Center (HPC) Rainfall Forecast	✓	✓	✓	✓	✓
6 24-Hour Stage III Rainfall				✓	✓
7 Cumulative Rainfall - Stage III Multi-Sensor Precipitation Estimate				✓	✓
8 SLOSH Model Run - hypothetical (h), or real-time (r)	✓ h	✓ h	✓ r	✓ r	
9 6 Hour Flash Flood Guidance		✓	✓	✓	✓
10 120-Hour QPF / 6-Hour Flash Flood Guidance Difference		✓	✓	✓	✓
11 Stage III Rainfall / 6-Hour Flash Flood Guidance Difference				✓	✓
12 Significant River Flood Outlook	✓	✓	✓	✓	✓
13 Tropical Cyclone Wind Speed Probabilities	✓	✓	✓	✓	



GIS Support Tutorial: Requirements

To complete this tutorial, you will need the following tools:

- ArcGIS, ArcView version 8.x or higher with the Spatial Analyst extension

Contact Information

Environmental Systems Research Institute (ESRI)
www.esri.com

- HURREVAC

Contact Information

John F. Townsend
Sea Island Software Inc.
(843) 881-0593
www.hurrevac.com
support@hurrevac.com

- SLOSH Display Program

Contact Information

Arthur Taylor
Arthur.Taylor@noaa.gov
(301) 713-1613, x163
<http://slosh.nws.noaa.gov/>

Wilson (Wil) Shaffer
Wilson.Shaffer@noaa.gov
(301) 713-1613, x167

Continued on next page...



GIS Support Tutorial: Requirements

- ❑ National Digital Forecast Database (NDFD) GRIB2 Decoder

Contact Information

Arthur Taylor

Arthur.Taylor@noaa.gov

(301) 713-1613, x163

www.nws.noaa.gov/mdl/NDFD_GRIB2Decoder/howto.php

- ❑ A file decompression utility such as WinZip or PKZIP – This software allows you to extract compressed shapefiles that are used throughout the tutorial.

WinZip – www.winzip.com/downwzeval.htm

PKZIP – <http://nct.digitalriver.com/fulfill/0018.18>

- ❑ Adobe PDF – Finished maps are exported to .pdf format for easy exchange and printing. This software allows you to create these files.

www.adobe.com/products/acrobatpro/tryout.html

Other Resources

- ❑ NOAA Coastal Services Center Storm Info Web site – This site provides links to many of the data sources listed in the tutorial.

www.csc.noaa.gov/storm_info/guide.html

- ❑ FEMA's floodmaps.net – This site is for use by those actively engaged in flood hazard mapping, maintenance, and update. This site's Easy FTP page allows you to share large files with others.

www.floodmaps.net/eftp/



SLOSH Model Run

Purpose: This type of map presents the predicted amount of storm surge from a tropical cyclone event. The Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model is currently the primary tool used by the federal government to evaluate the threat from storm surge.

Source Data: SLOSH is a computerized model run by the National Weather Service to estimate storm surge heights from historical, hypothetical, or predicted hurricanes. The model creates its estimates by assessing the pressure, size, forward speed, track, and wind data from a storm. Graphical output from the model displays color-coded storm surge heights for a particular area. The calculations are applied to a specific locale's shoreline, incorporating the unique bay and river configurations, water depths, bridges, roads, and other physical features.

Note: Since frequent updates are made to the SLOSH basins, it is highly recommended that you request the latest version of the SLOSH Display program before the beginning of each hurricane season. See the SLOSH contact information in the introduction of this tutorial. The latest version of the SLOSH Display program can now be downloaded at <http://slosh.nws.noaa.gov/sloshPub>. You will first visit the disclaimer page at <http://slosh.nws.noaa.gov/sloshPub/disclaim.php>. Follow the directions to get the user name and password for 2009. Then press **SLOSH Display web page**, which will ask for this user name and password. Read the information about the program and then follow the links to register and download. More information about the SLOSH program is found at www.nhc.noaa.gov/HAW2/english/surge/slosh.shtml and slosh.nws.noaa.gov.

The geographic coverage of the SLOSH model currently includes all of the U.S. East and Gulf coasts, as well as parts of Hawaii, Guam, Puerto Rico, and the Virgin Islands. With the SLOSH Display program, a user can generate and extract GIS shapefiles for various storm scenarios, which can be exported and used in a mapping environment such as ArcMap.

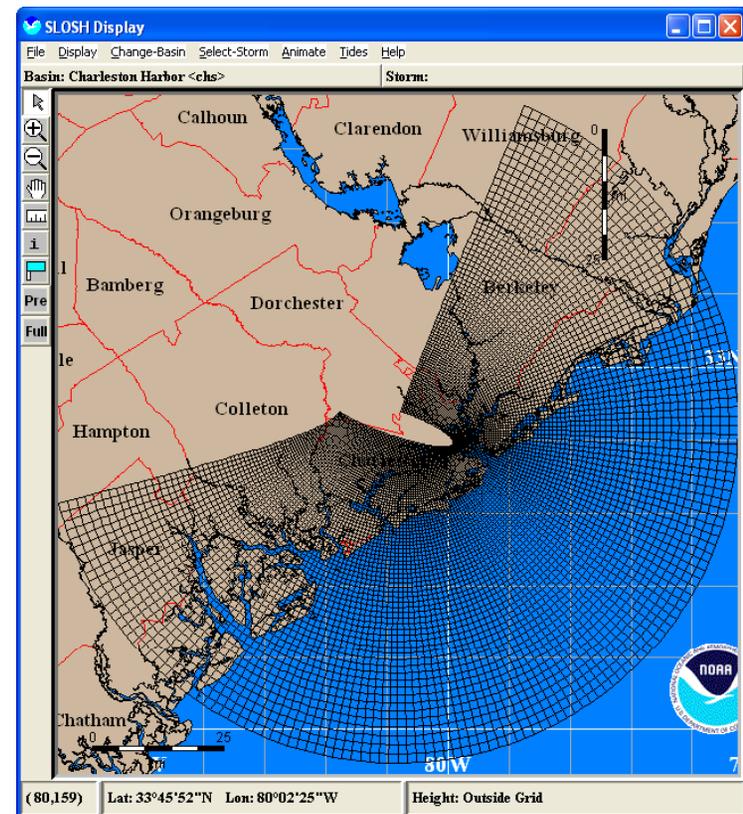


SLOSH Model Run

SLOSH Display Instructions: Install the current SLOSH Display Program that is distributed through the NOAA National Weather Service's (NWS) Meteorological Development Lab (MDL). Once installation is complete, click on **Start > Programs > SLOSH Package 1.46 > SLOSH Display**.

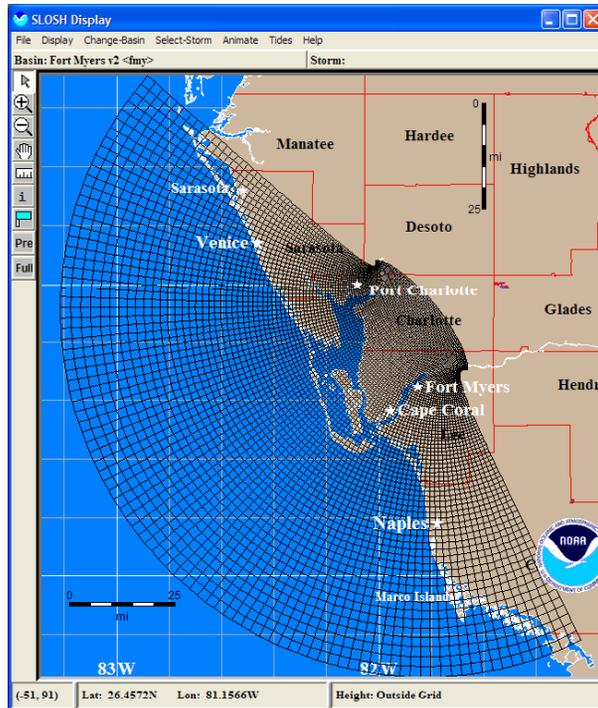
Once the program opens, click on the **Change Basin** menu and select **Change Basin**. Click on the basin that is forecast to be affected by the hurricane of concern. It may be necessary to step through this process for several adjoining basins because of forecast uncertainty.

Hurricane Wilma struck the southwestern Florida coast on October 24, 2005, as a Category 3 storm. For this tutorial, you will focus on this area.



SLOSH Model Run

SLOSH Display Instructions: The following map will appear. Select the basin of interest by clicking on the elliptical graph on the map. You should see the corresponding basin name selected on the left (efmy Fort Myers v2). Double-click on this name to change the appearance of the map.



The new basin appears for your study area.

SLOSH Model Run

SLOSH Display Instructions: After choosing a basin, click on the **Select Storm** menu and then on **Select Storm**. Once the dialog window appears, make sure the radio button for **MEOW** is selected. This will illustrate the “Maximum Envelope Of Winds” for the storm.

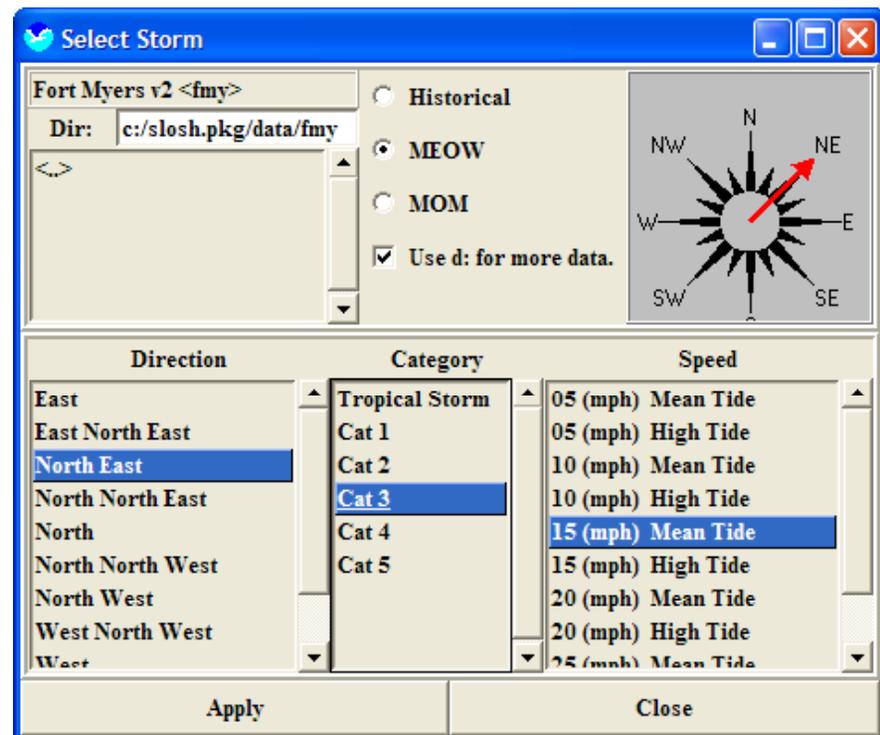
Under Direction, choose the direction in which the storm is forecast to be moving at the time of landfall. For this exercise, choose **North East**.

For Category, select the category or intensity that the storm is forecast to be at landfall. Select the next *highest* category if the storm is forecast to be on the cusp of one category and another. For this exercise, select **Cat 3**.

Finally, for Speed, select the closest speed at which the storm is forecast to be moving. Again, if necessary, round up if the storm is forecast to be moving at a speed somewhere in between the choices. For this exercise, select **15 Mean Tide (mph)**.

For some basins, various tide options are available. In an event, select the most appropriate tide by determining the tide height expected during the storm’s forecasted landfall. Predicted tides for a location can be found at tidesandcurrents.noaa.gov/.

Click **Apply** and then **Close**.



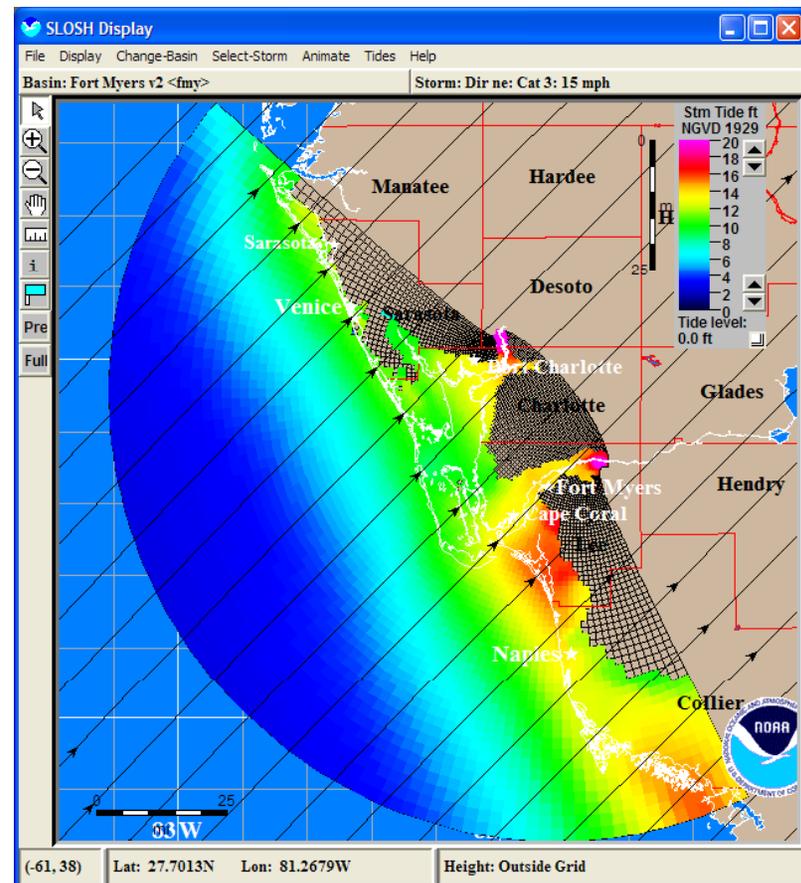
SLOSH Model Run

SLOSH Display Instructions: Once the surge heights are displayed in the map, click **File > Save to SHP**.

If this option is not available in your version of the SLOSH Display Program, please contact one of these developers:

Arthur Taylor – (301) 713-1613, ext. 163 or
Arthur.Taylor@noaa.gov

Wilson (Wil) Shaffer – (301) 713-1613, ext. 167 or
Wilson.Shaffer@noaa.gov

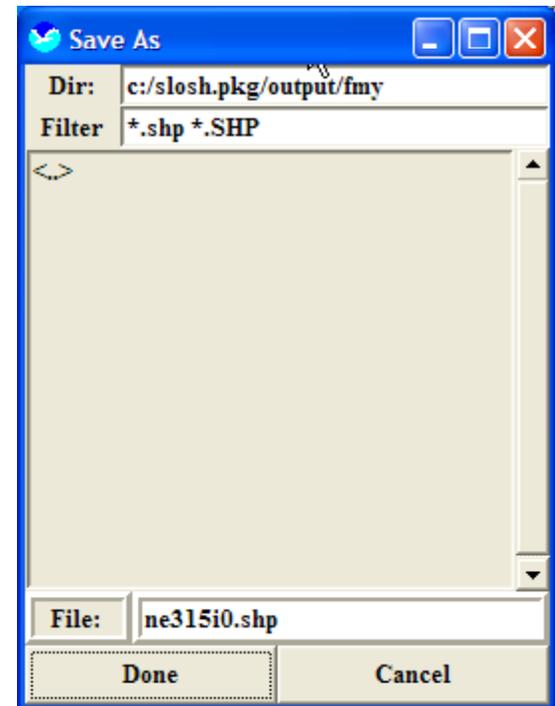
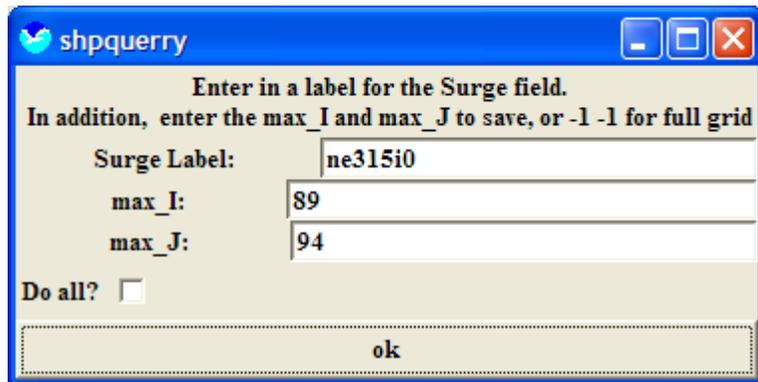


SLOSH Model Run

SLOSH Display Instructions: Once you select Save to SHP, the following dialog box will open.

You have the ability to change the directory that the data will be saved to. Simply click on the <..> in the grey area and navigate to a new location. For the purposes of this module, you will take the default location. Notice the naming convention that will be used for the shapefile; “ne315i0” represents a storm heading toward the northeast that strikes the shore as a Category 3 moving at 15 miles per hour.

Click on the **Done** button. The next dialog window will open. You should simply take the default values given in the display and click **OK**. The shapefile of the SLOSH data for this area will copy into the given folder.



SLOSH Model Run

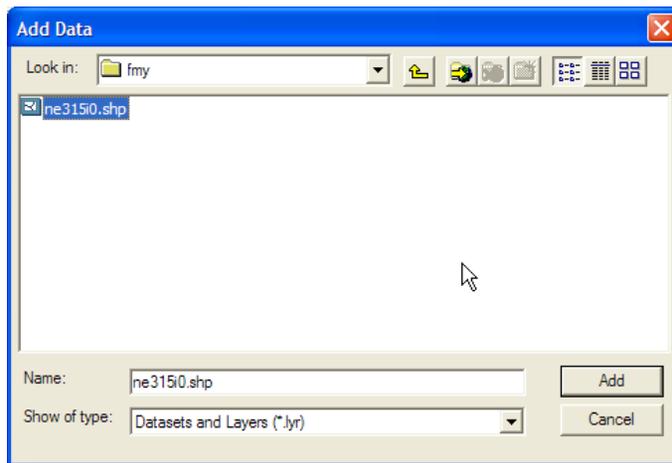
Download the data: Should you not have access to saving the SLOSH data as a shapefile, you can download the most recent shapefiles from <ftp://ftp.tpc.ncep.noaa.gov/surge/Latest/>.

This page will provide shapefiles that depict the latest SLOSH model runs. The formatting of the shapefiles follows the convention [letter of storm][advisory number]_[basin abbreviation].[file extension]. Download all the files (.shp, .shx, .dbf) for the latest advisory for each affected basin to your hard drive or network drive with the exception of the .rex and .gif files. A map will need to be created for each of the latest SLOSH model runs for each basin.

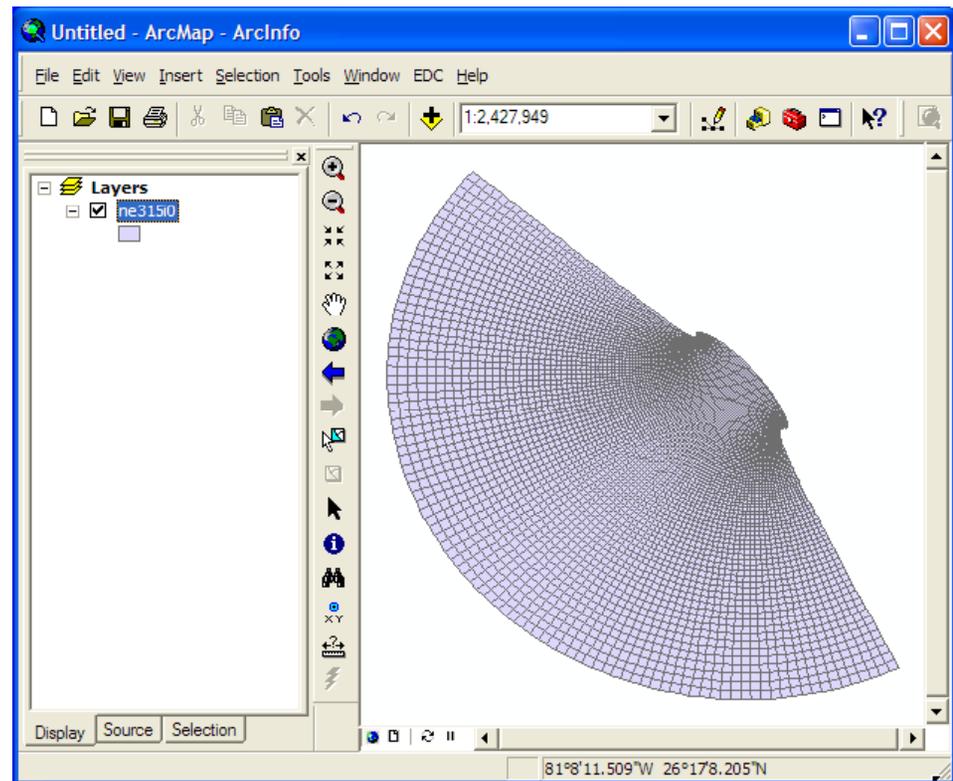


SLOSH Model Run

View the data: Add the layer by clicking on the **Add Data** button  found at the top of the ArcMap window. This brings up a dialog window that lets users browse to their data.

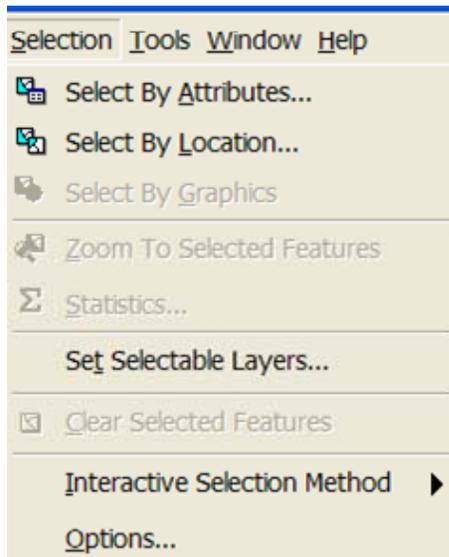


Select the SLOSH data that you want to work with and click **Add**. The layer now appears at the top of ArcMap's table of contents.

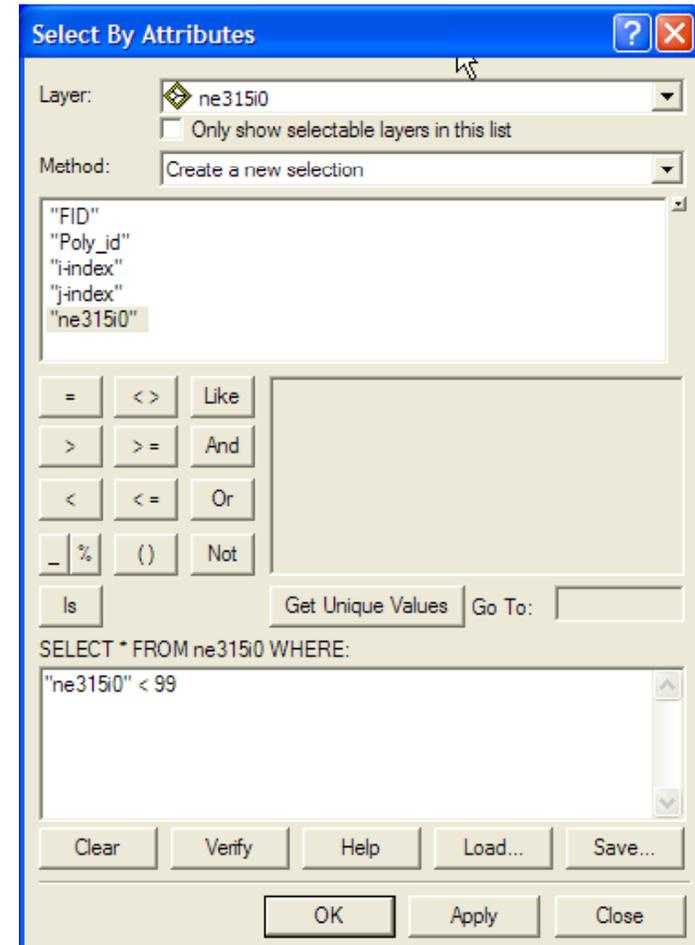


SLOSH Model Run

Work with the data: In ArcMap, go to the **Selection** pull-down menu and click on **Select by Attribute**.



1. Set the Layer to the SLOSH data that you are working on.
2. Make sure the Method is set to **Create a new selection**.
3. Under Fields, double-click on the field with the same name as your layer.
4. Single-click on the less than operator (<).
5. In the expression box, type in the number **99** at the end of the expression.
6. Make sure the Select by Attributes dialog box looks like the one pictured here and click **OK**.



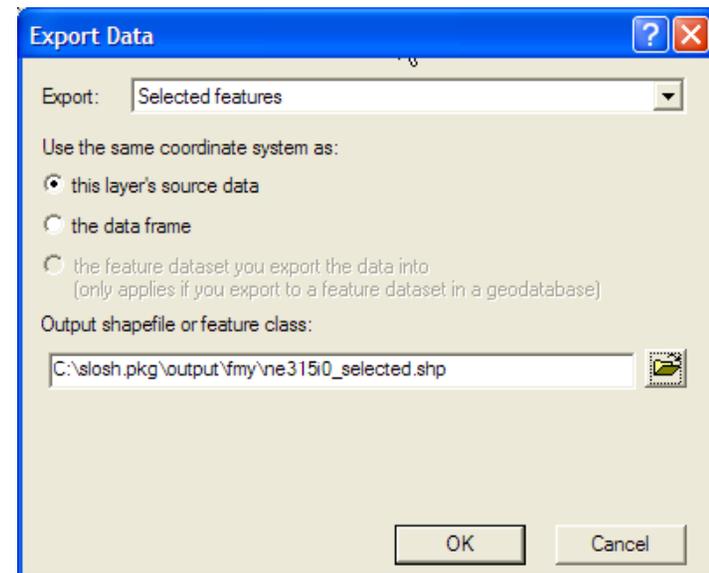
SLOSH Model Run

Add and symbolize the data: After the selection is made, right-click on the SLOSH layer and select the **Data** option from the context menu. From the Data menu select **Export**. Make sure **Selected features** is shown in the Export pull-down list. Use the same coordinate system as the layer's source data, and specify a name and location where you would like the new shapefile to be created. Click **OK**.

When asked if you want to add the exported data to the map as a layer, click **Yes**.

You have just created a new shapefile without the No Data value of 99.9 that was included in the original data downloaded from the National Hurricane Center.

Remove the original SLOSH data, leaving the layer you created in the last step.



SLOSH Model Run

Add and symbolize the data: Double-click on the new SLOSH data layer to open the Layer Properties dialog. Click on the **Symbology** tab.

In the Show menu, click on **Quantities**.

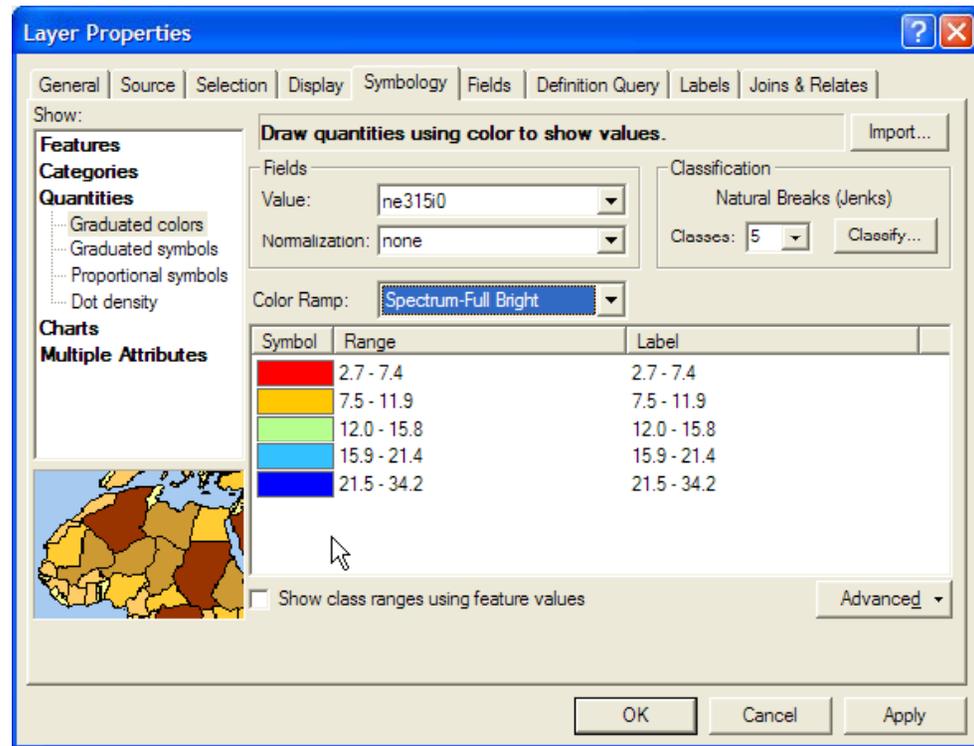
Under Quantities, make sure **Graduated colors** is selected.

Under Fields, change Value to the field that matches the name of your SLOSH layer.

You may get a dialog box that tells you that not all records are being used because the sample size is too small. Click **OK**.

Right-click on the Color Ramp. Click **Graphic View** from the available options. This changes the color ramp into a textual description of the color ramp.

Select the **Spectrum-Full Bright** color ramp.



SLOSH Model Run

Add and symbolize the data: Click on the **Symbol** header and select **Flip Symbols** so that higher amounts of inundation are assigned darker reds.

Click **Apply** to assign the new color ramp.

Click again on the **Symbol** header.

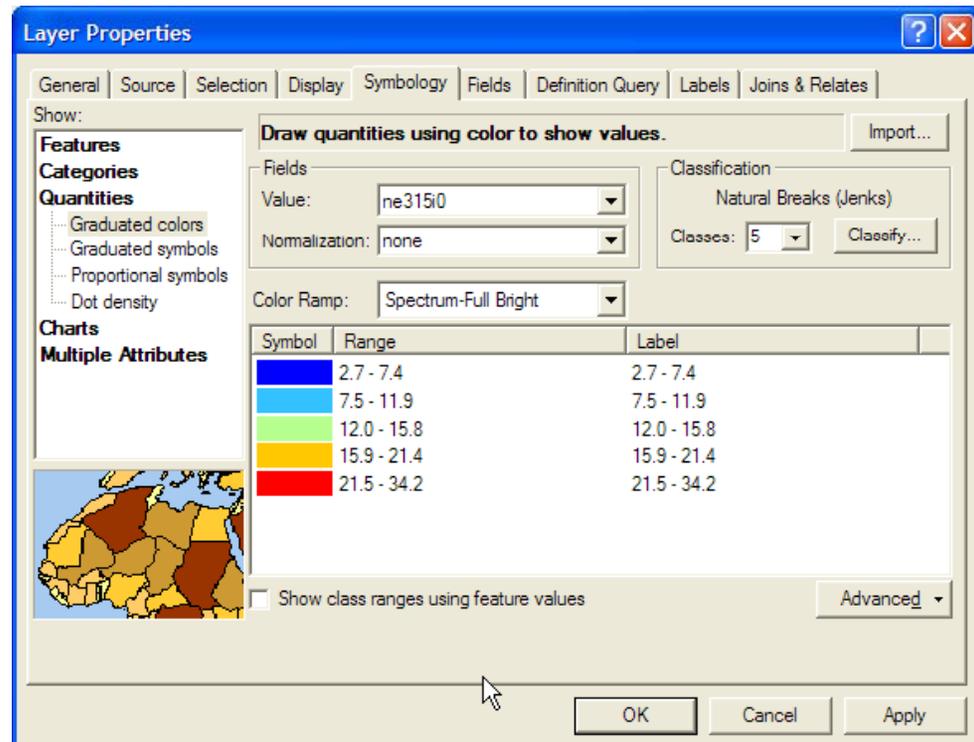
Select the **Properties for all Symbols** option.

In the Symbol Selector dialog box, under Options, click on the **Outline Color** pull-down menu and select **No Color**.

Click **OK** and **OK** again to close the Layer Properties box and apply all of the changes you have made to the symbology of the SLOSH data layer.

This will remove the outline around each polygon and make the SLOSH data appear more continuous.

Click **OK** to make these changes in the view.



SLOSH Model Run

Add and symbolize the data: You now have the SLOSH data symbolized in a meaningful way. You might want to add a state boundary layer for display purposes.

Click on the **Add Data** button and browse to the directory that houses your base layer shapefiles.

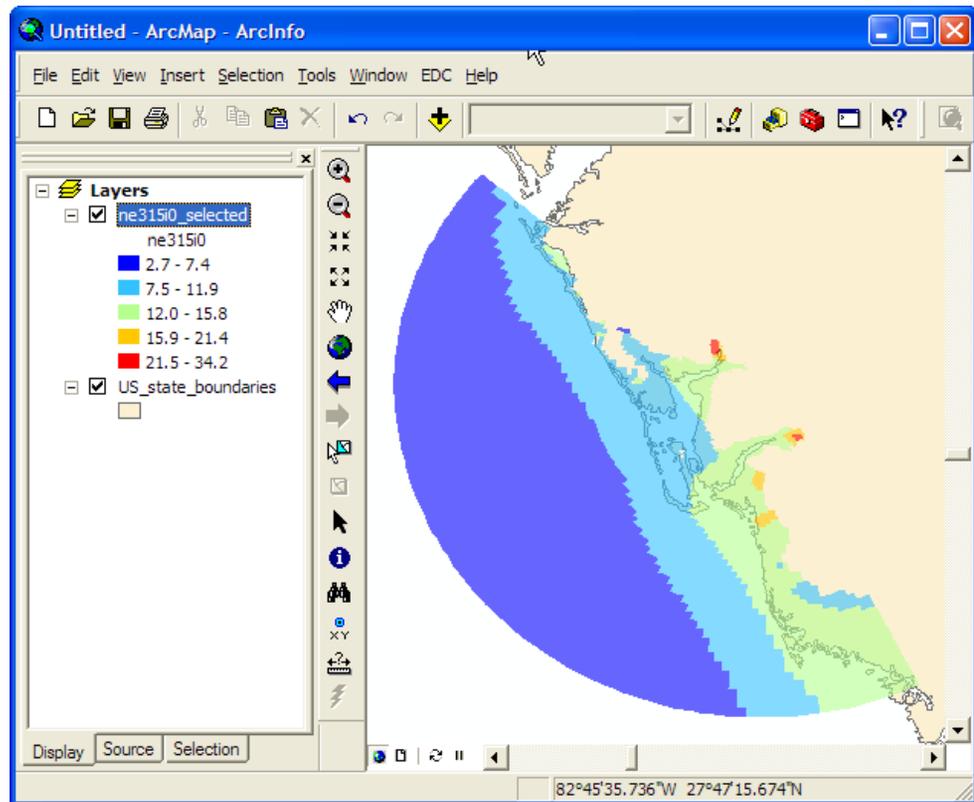
Add a states layer to your map.

Make sure that the SLOSH layer is on top of the state layer.

Open the SLOSH Layer Properties and click on the **Display** tab.

Set the transparency level to **40%** and click **OK**.

Save the symbology of the SLOSH layer. Right-click on the layer, and select **Save As Layer File**. Browse to the SLOSH folder on your hard drive, and click **OK** to accept the default name of the new .lyr file.



SLOSH Model Run

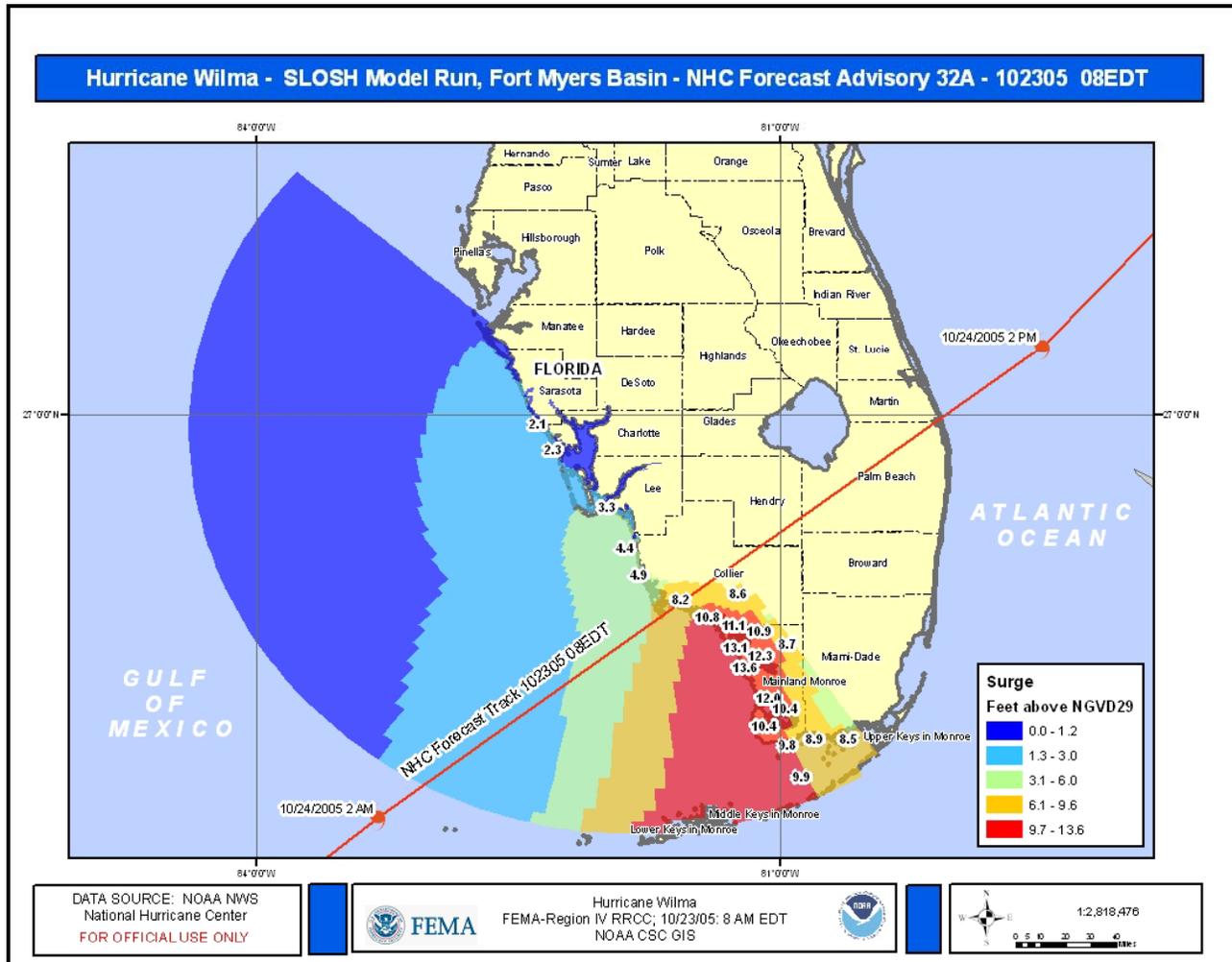
Add and symbolize the data: You now have symbolized SLOSH data and a state boundary displayed together.

At this point you are ready to begin making a map of your SLOSH data. Example maps that the NOAA Coastal Services Center has provided to members of FEMA in the past have been included for reference.

Refer to the “Basics of Cartography” chapter at the end of this manual for addition information.



SLOSH Model Run



SLOSH Model Run

