User Guide to displaying GHRSST data using ESRI ArcGIS

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Updated: December 2008

Introduction

This User Guide should be read in conjunction with the GHRSST Data Access Tutorial, which describes the L2 and L4 data formats and how to access them.

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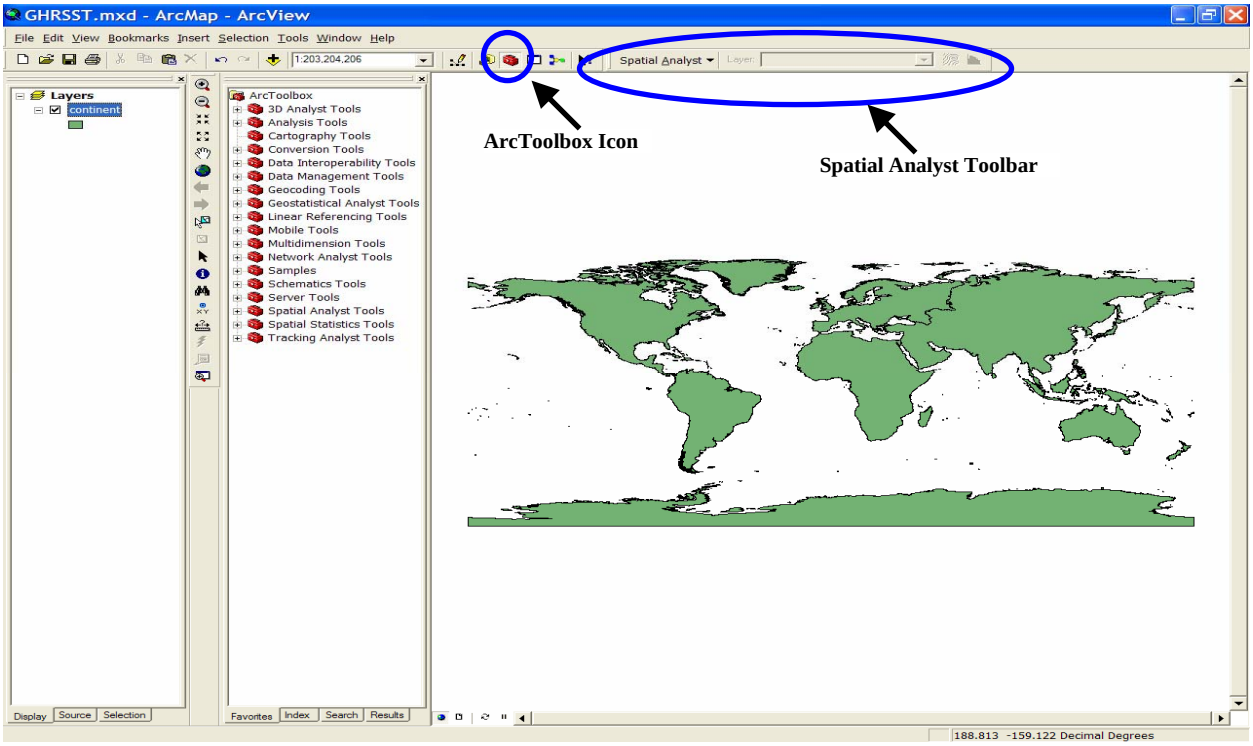
This Guide assumes the user has a licensed copy of ArcGIS (Version 9.3 Service Pack 1) Desktop ArcView and the ArcGIS (Version 9.3 Service Pack 1) Desktop Spatial Analyst Extension.

Getting Started

Open ArcView and add a background for navigation. Ensure the Spatial Analyst Toolbar and ArcToolbox are enabled.

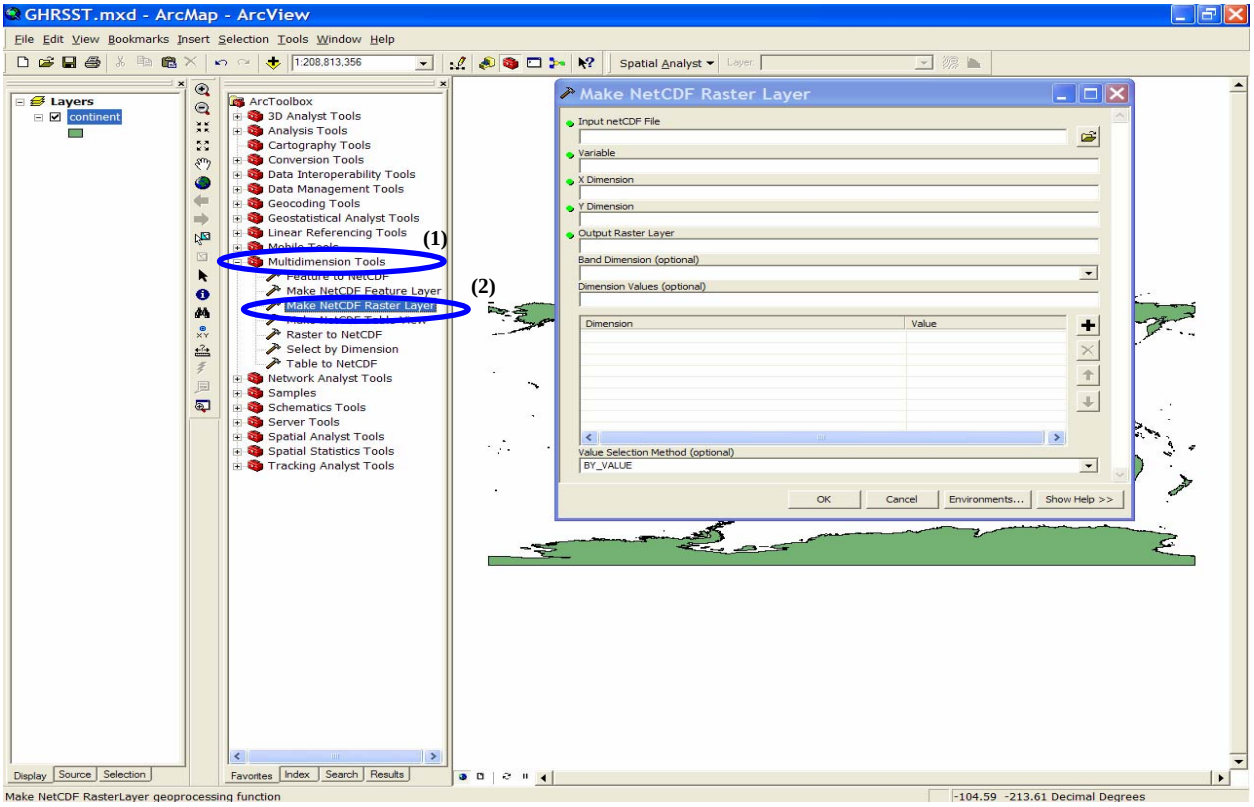


Displaying GHRSST netCDF data in ArcView requires the netCDF file to be local, so it must first be downloaded from either the GHRSST Global Data Assembly Center (GDAC) or the GHRSST Long Term Stewardship and Reanalysis Facility (LTSRF), via their http or ftp site, by following the instructions in the GHRSST Data Access Tutorial.

Displaying L4 Products

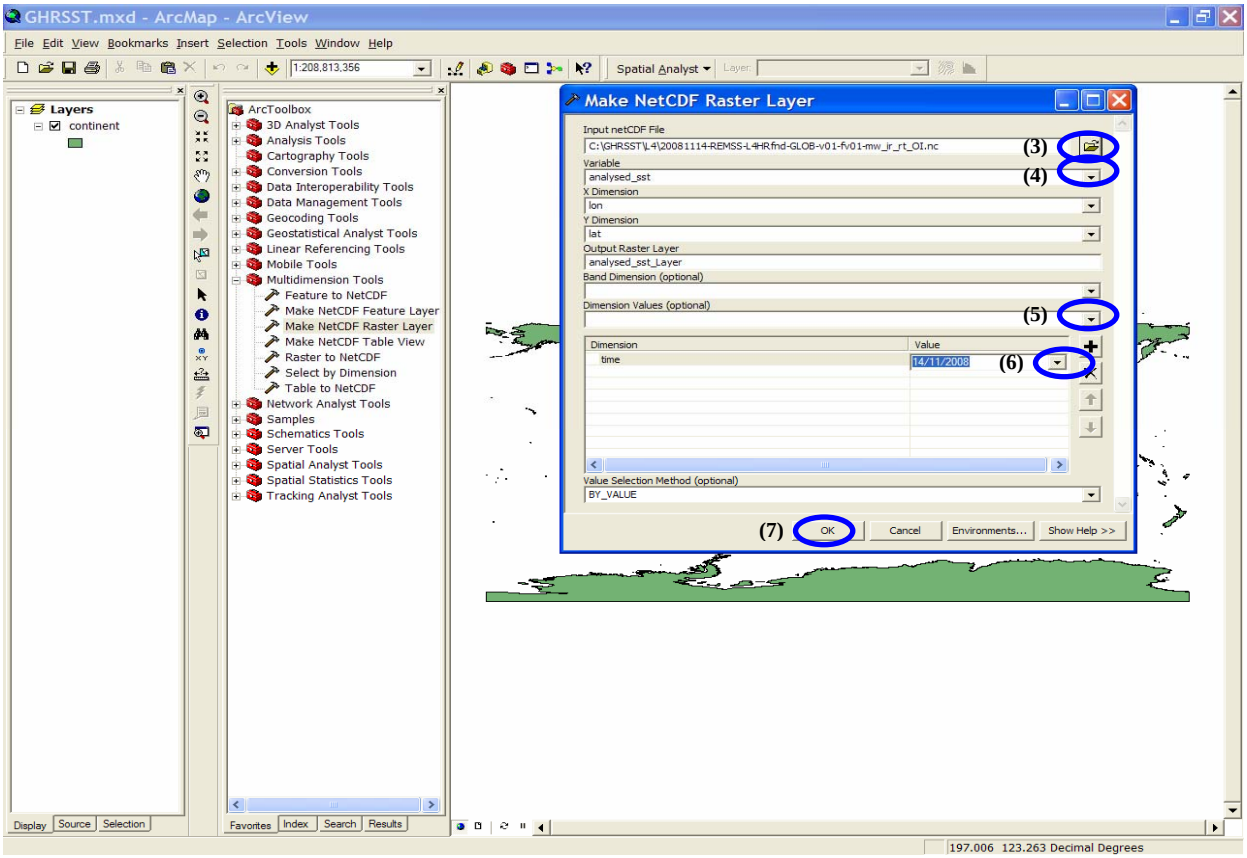
L4 products are post-processed using interpolation, and mapped onto a regular (equally spaced) grid, thus making them suitable for importing as a raster layer. Importing regularly gridded data is done through the ArcToolbox using the *Make NetCDF Raster Layer* tool from the *Multidimension Toolbox*.

To access the tool, open the *Multidimension Toolbox* (1) and double-click on *Make NetCDF Raster Layer* (2).

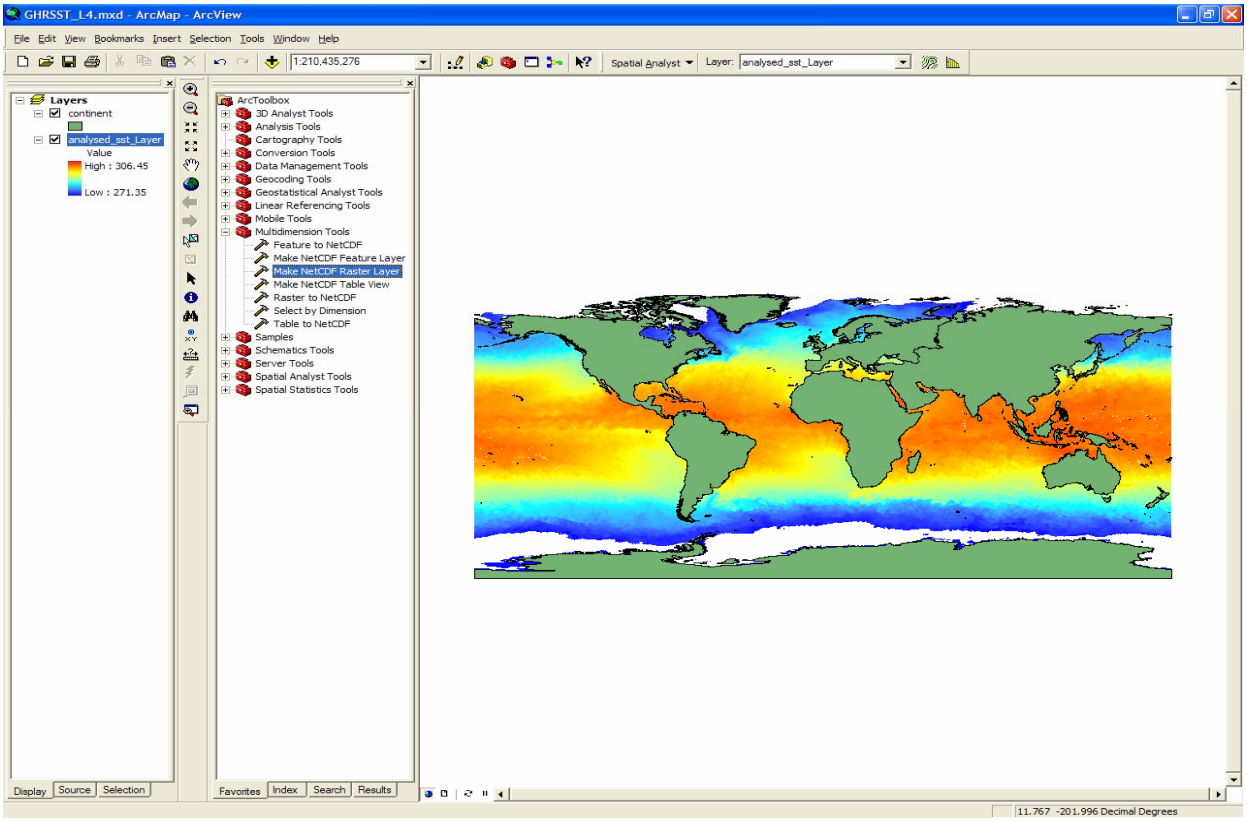


This will open the *Make NetCDF Raster Layer* dialogue box. Fill in the *Input netCDF File* field by navigating to the local folder (3) and file containing the L4 netCDF file. Double clicking the file name will fill the other mandatory fields with *Variable* = analysed_sst, *X Dimension* = lon, *Y Dimension* = lat and *Output Raster Layer* = analysed_sst_Layer. Use the drop down list icon (4) to select any other output variable. L4 products typically contain the SST analysis, analysis error and sea ice fraction.

L4 SST products will generally have only one date or date/time, however some sites may aggregate multiple analyses into a single file. If this occurs, the default date/time is the first one in the file. To select other timesteps click on the *Dimension Values* drop down list (5) and select *time*. This will add *time* to the list of dimensions. Finally, click under Value (6) to select the date/time to be displayed.



Click OK (7) and the analysed SST field of the netCDF file will be converted to a raster and displayed with a default palette.

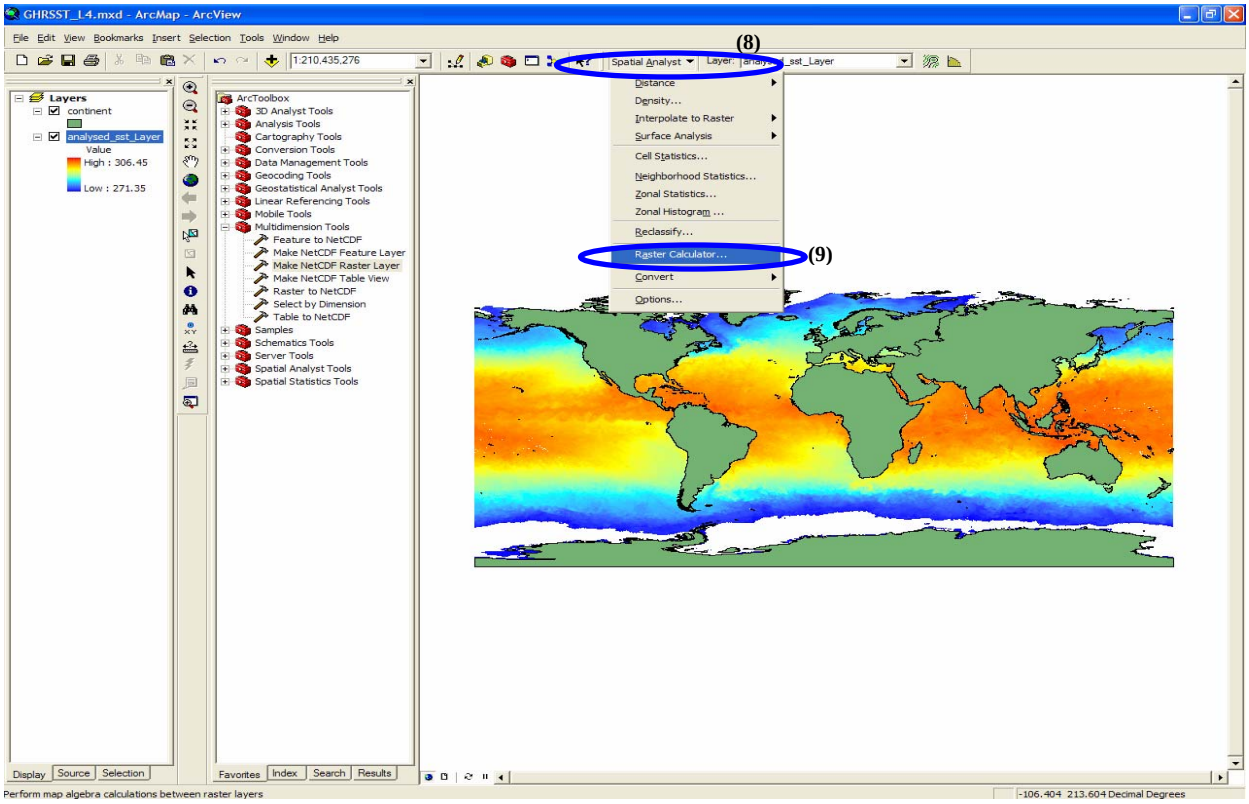


Note: Although the raster is displayed and listed in the Table of Contents, it exists in memory only. It must be saved to the local disk to be retained after the ArcView session is closed.

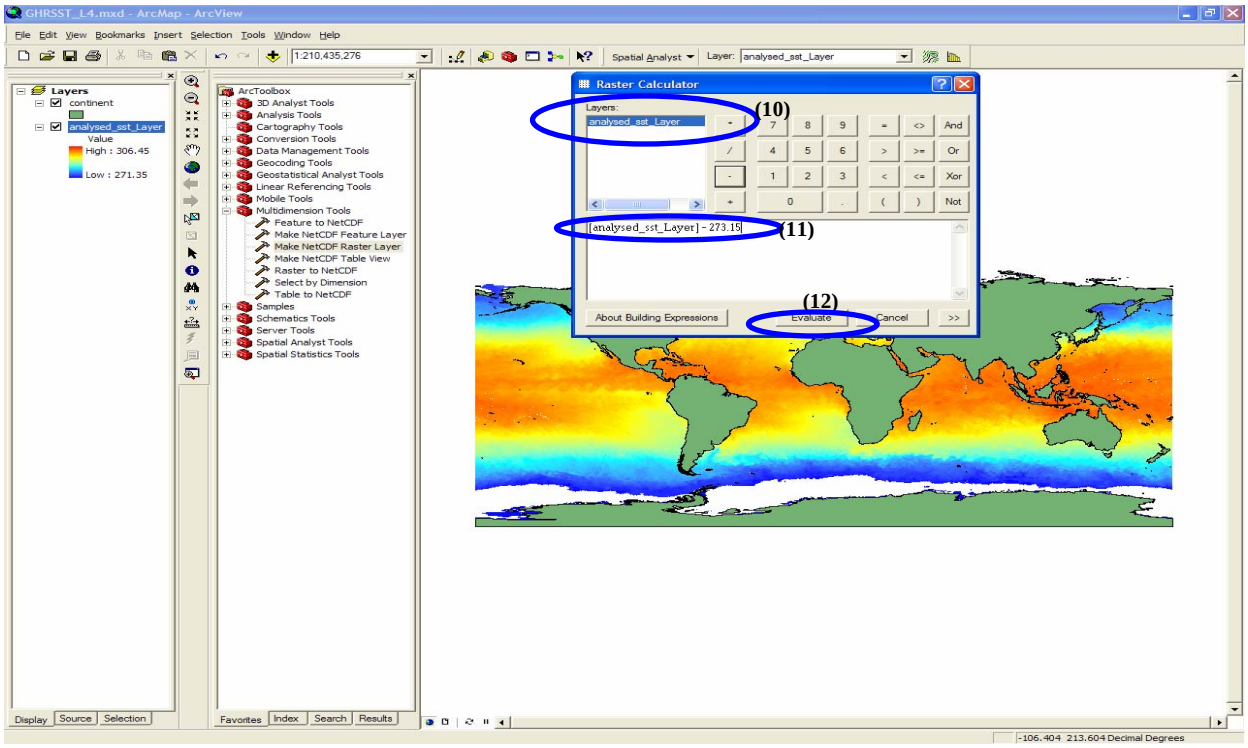
Customizing the L4 Gridded Display

Having successfully loaded a GHRSST L4 file into the ArcView display, some users might wish to customize the display by converting the temperature unit from Kelvin to either Celsius or Fahrenheit, and adding contours.

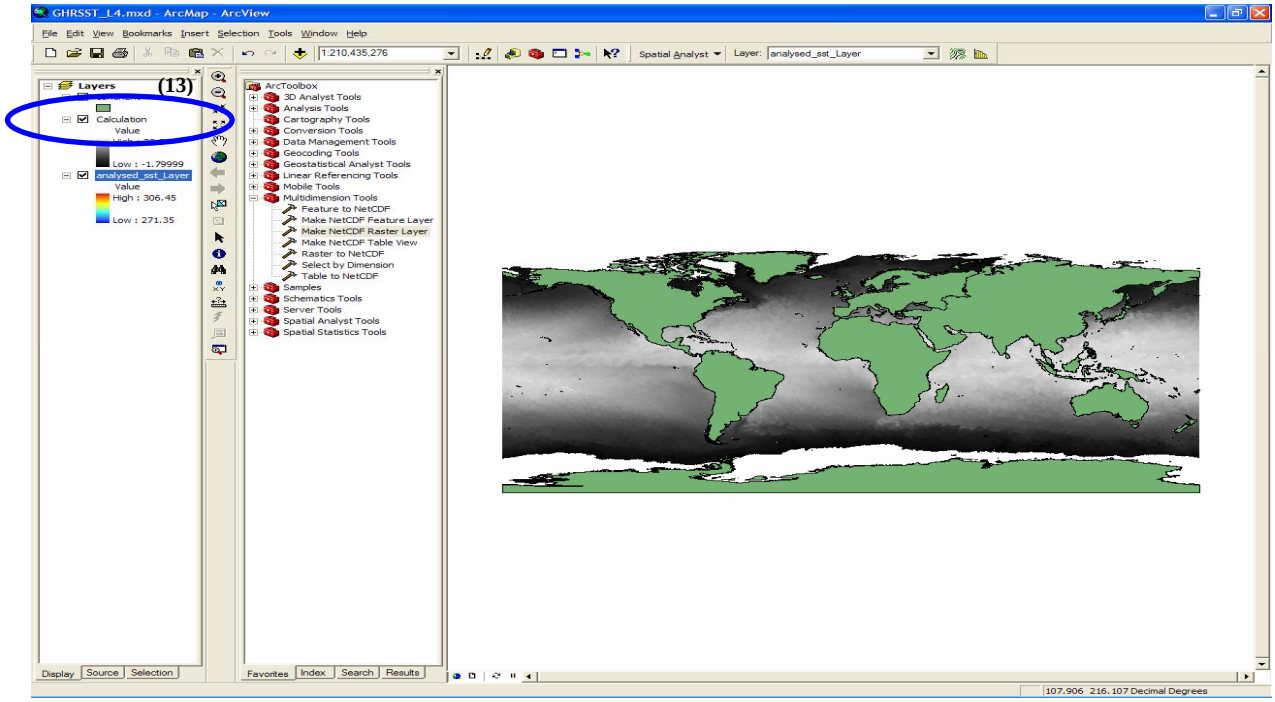
Converting Units. To convert raster values, the Spatial Analyst raster calculator is used. Select *Spatial Analyst* (8) and then *Raster Calculator* (9) from the drop down menu.

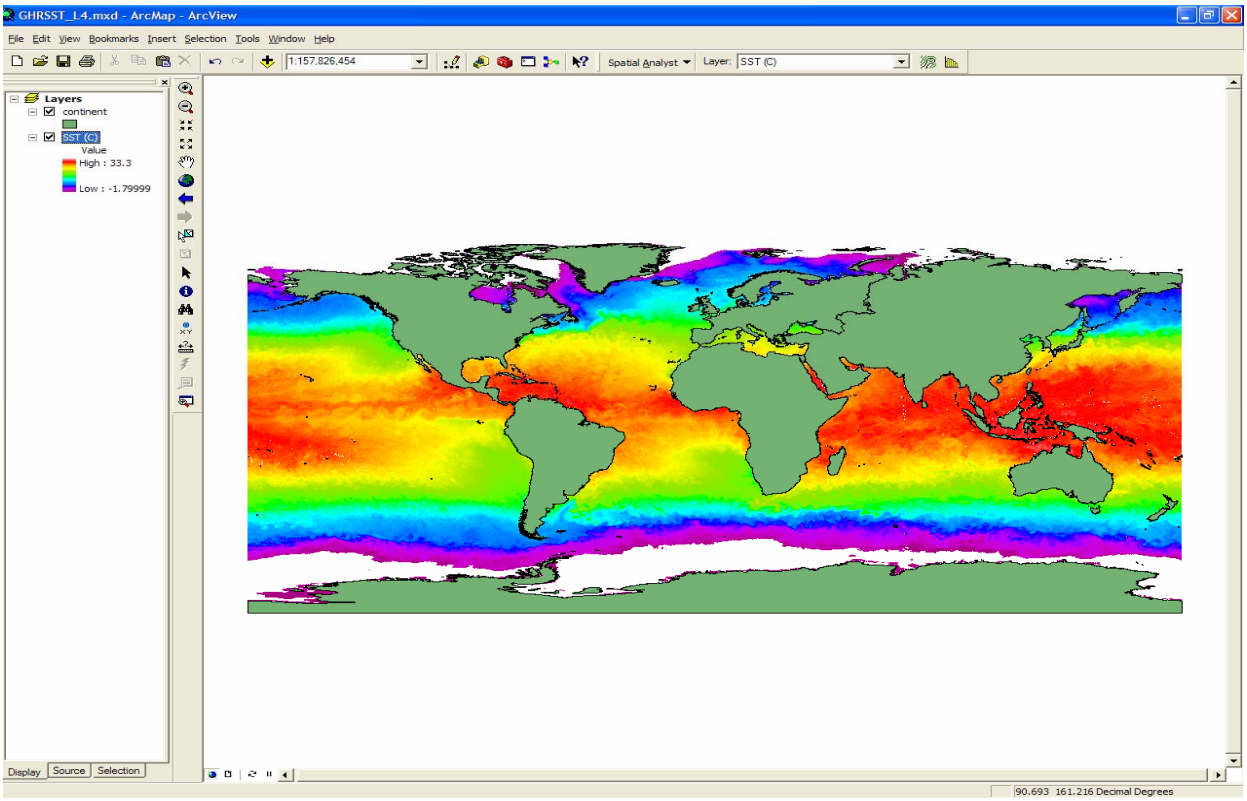


To convert to Celsius, double click the source raster layer (10), then use either the calculator keypad or your keyboard to enter the formula (11).

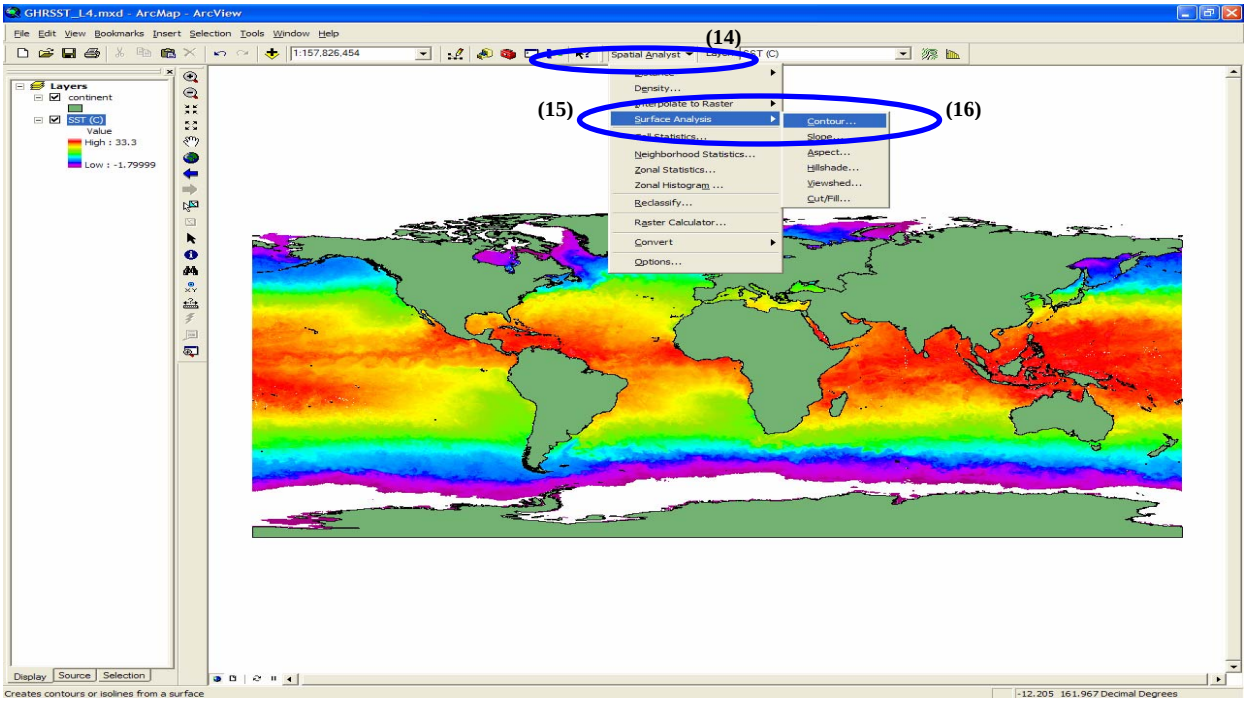


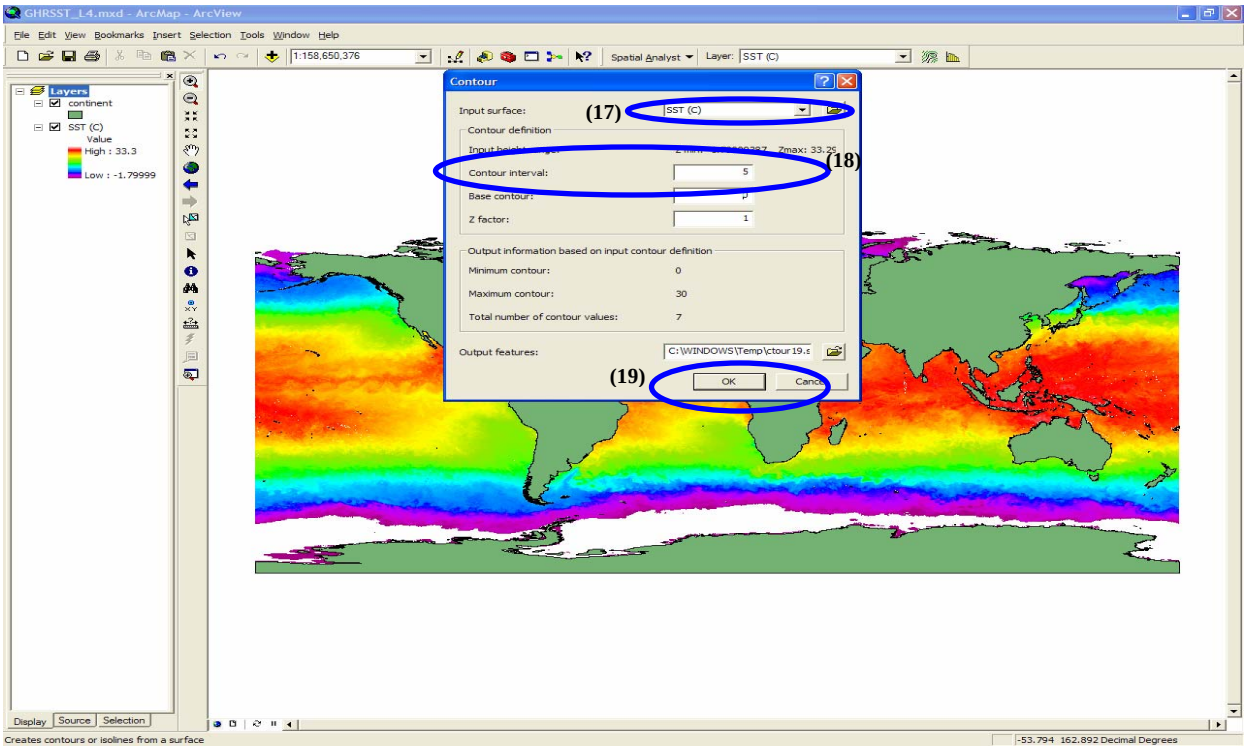
Click *Evaluate* (12) to perform the calculation. The new raster will be added to the *Table of Contents* (13). Rename the field, delete the original raster and apply a new palette as required.



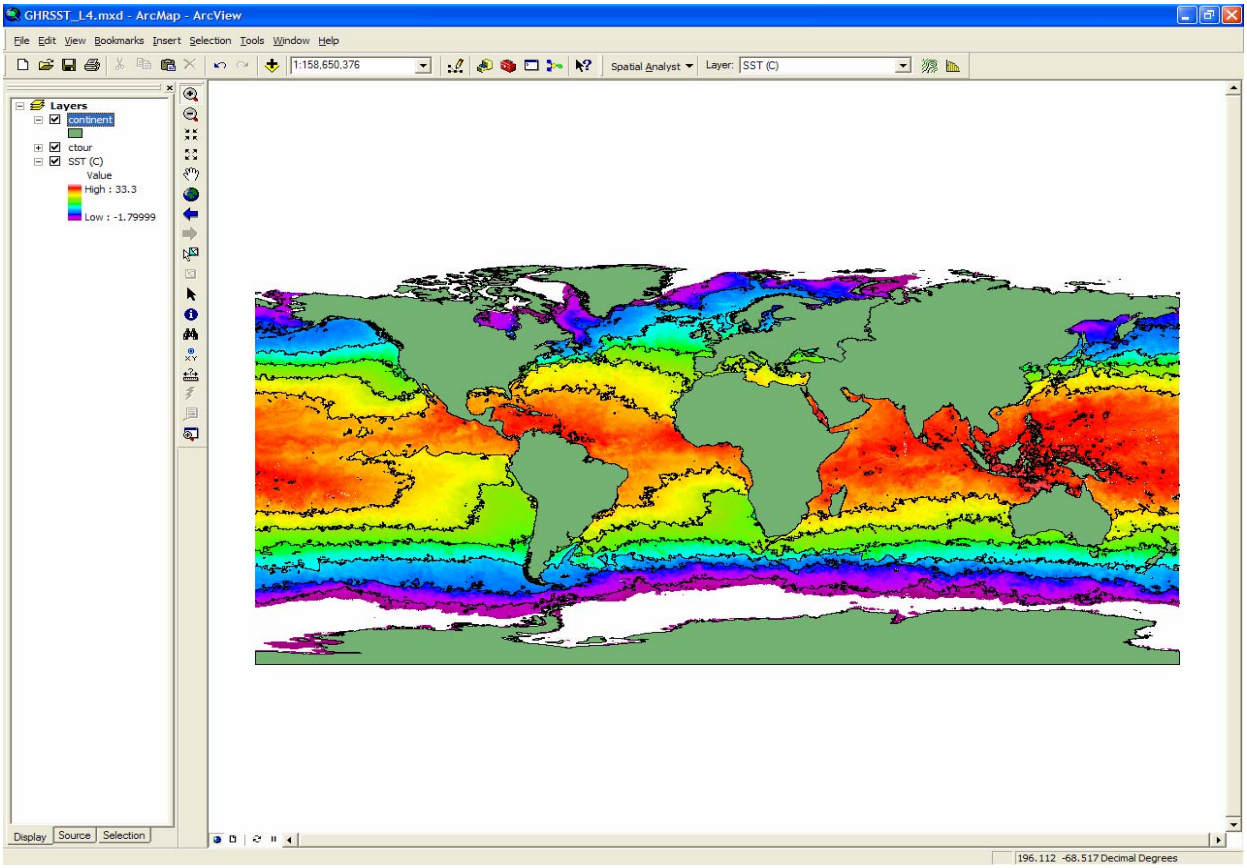


<u>Adding Contours.</u> To add contours, the *Spatial Analyst* toolbar is again used. Select *Spatial Analyst* (14), *Surface Analysis* (15) and *Contour* (16), the raster (17) and contour interval (18) and click OK (19)





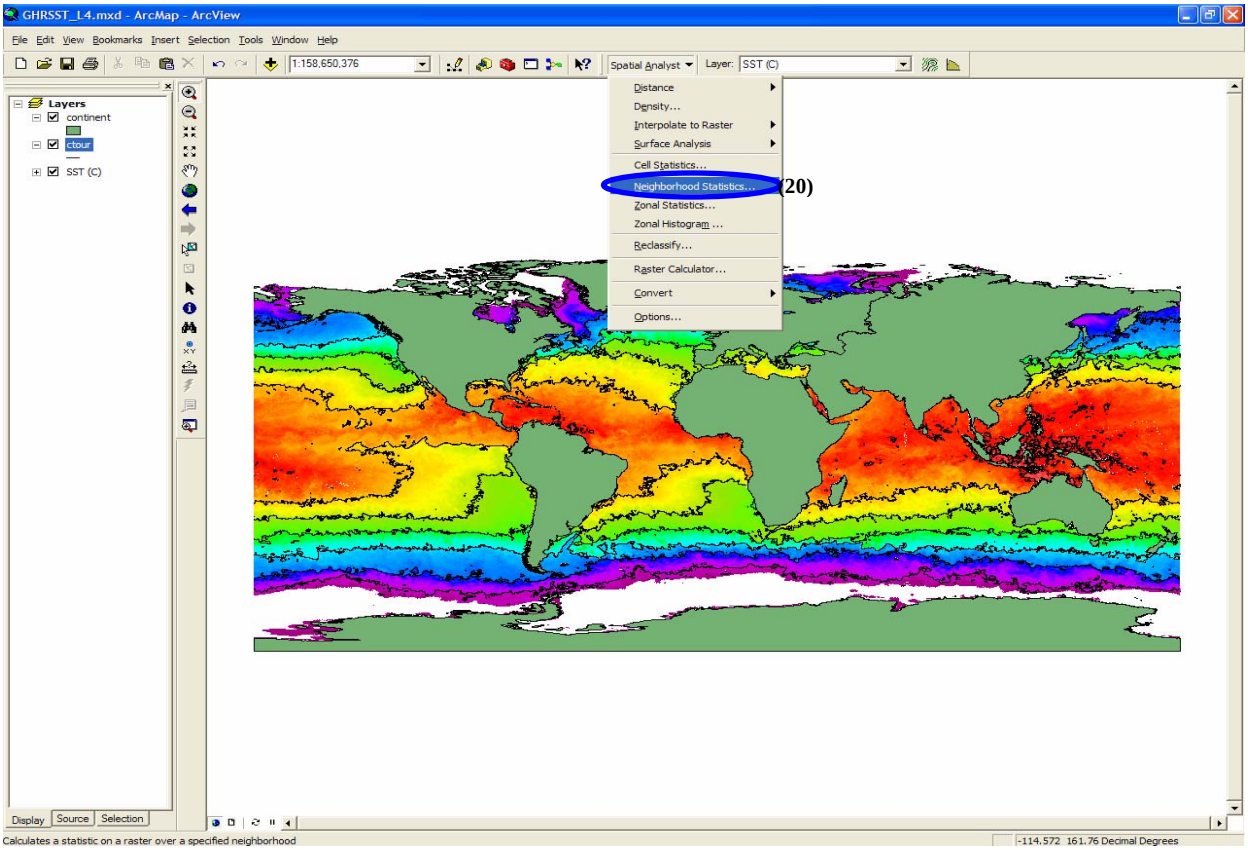
to generate the contours. Intervals of 5, 2 and 1 degree respectively are recommended as initial values at global, regional and local scales.

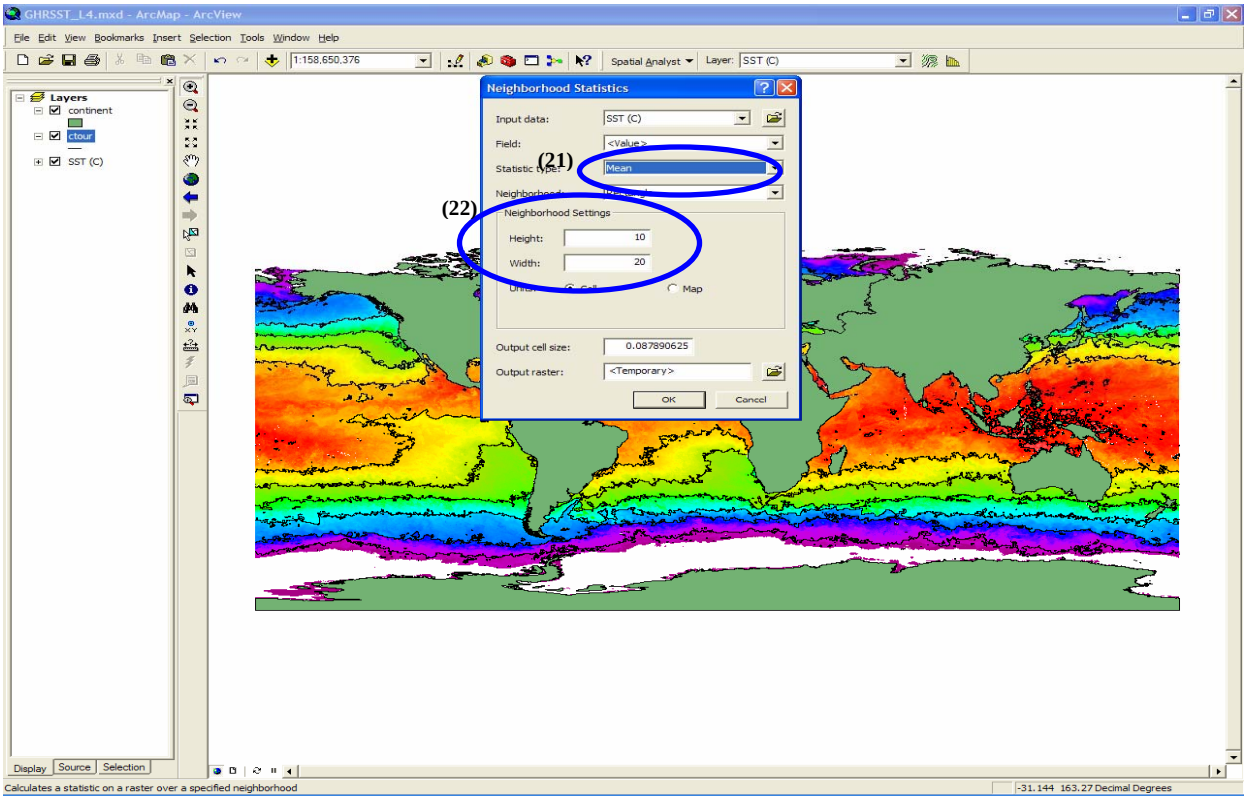


To add contour labels, double-click on the contour field in the *Table of Contents* and select the *Labels* tab. Refer to the ArcGIS Desktop Help for more information on labeling.

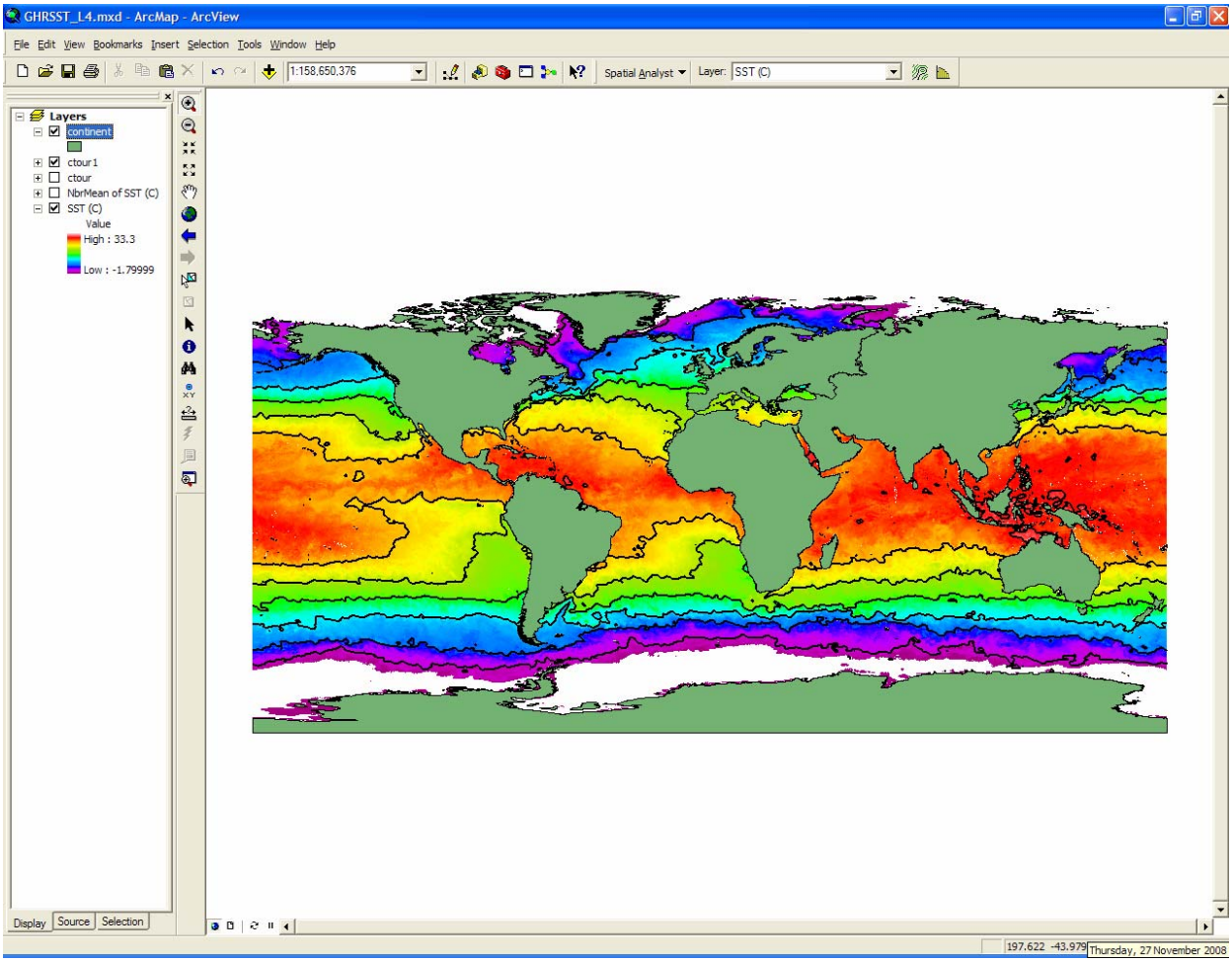
Note that the contours are very 'noisy'. This is due to the fine spatial resolution of the data. One simple way to create smoother contours whilst retaining the full resolution of the raster is to use the *Spatial Analyst Neighborhood Statistics* tool.

Select *Neighborhood Statistics* (20) from the *Spatial Analyst* drop-down menu to display the tool. The statistic type must stay as *Mean* (21). Select the neighborhood to be used for smoothing and its dimensions (22) and click OK.


GHRSST_L4.mxd - ArcMap - ArcView
File Edit View Bookmarks Insert Selection Tools Window Help
1:158,650,376
Spatial Analyst
Layer: SST (C)
Layers
continent
ctour
SST (C)
Distance
Density...
Interpolate to Raster
Surface Analysis
Cell Statistics...
Neighborhood Statistics...
(20)
Zonal Statistics...
Zonal Histogram ...
Reclassify...
Raster Calculator...
Convert
Options...
Display
Source
Selection
Calculates a statistic on a raster over a specified neighborhood
-114.572 161.76 Decimal Degrees


GHRSST_L4.mxd - ArcMap - ArcView
File Edit View Bookmarks Insert Selection Tools Window Help
1:158,650,376
Spatial Analyst
Layer: SST (C)
Layers
continent
ctour
SST (C)
Neighborhood Statistics
Input data:
SST (C)
Field:
<Value>
Statistic type:
(21)
Mean
(22)
Neighborhood Settings
Height:
10
Width:
20
Map
Output cell size:
0.087890625
Output raster:
<Temporary>
OK
Cancel
Display
Source
Selection
Calculates a statistic on a raster over a specified neighborhood
-31.144 163.27 Decimal Degrees

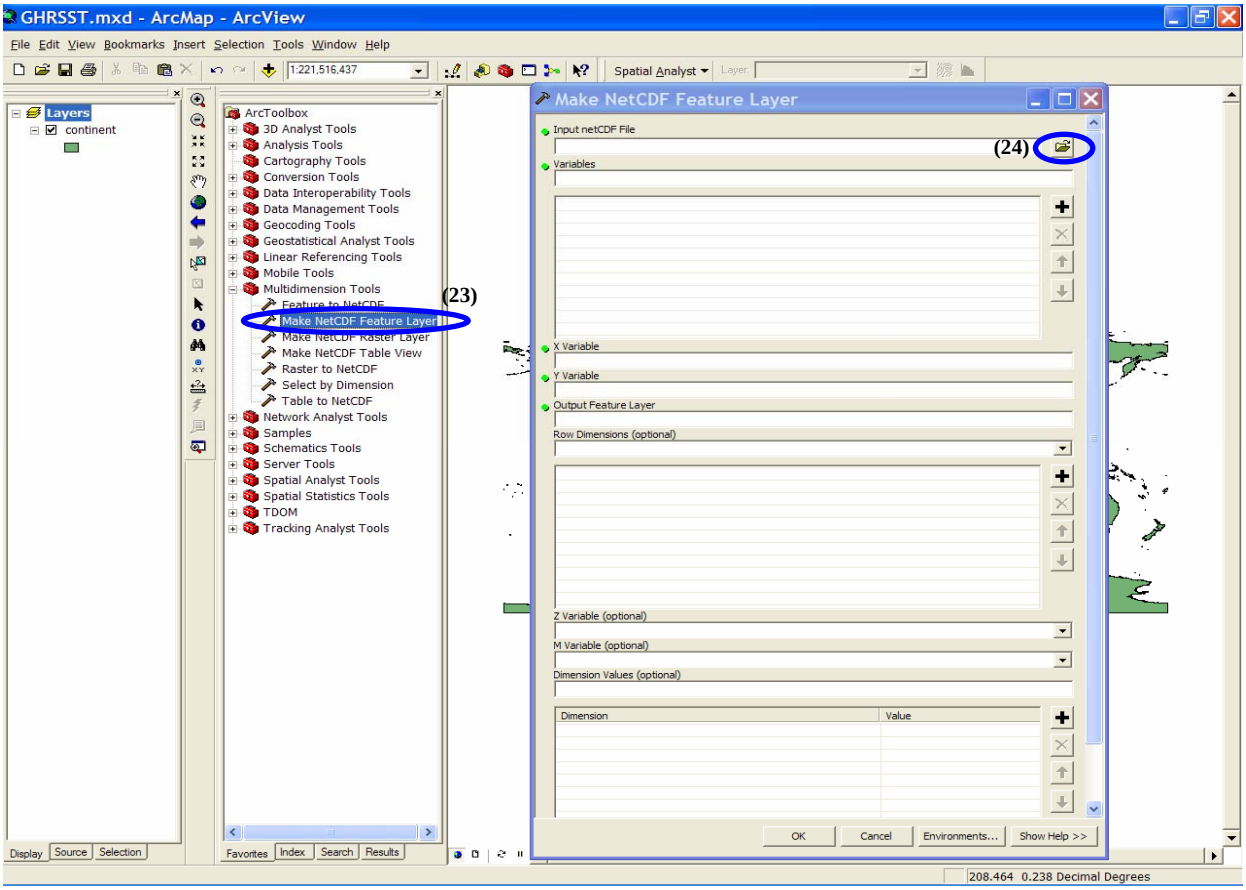
A new raster, smoothed according to the neighborhood settings, and with a default palette will be loaded into the *Table of Contents*. It can be switched off, as the original high resolution raster will be used for display. The new smoothed raster is only used for contouring. Contour the smoother raster using the *Spatial Analyst Surface Analysis* tool as described earlier and switch the new contour on in the *Table of Contents*.



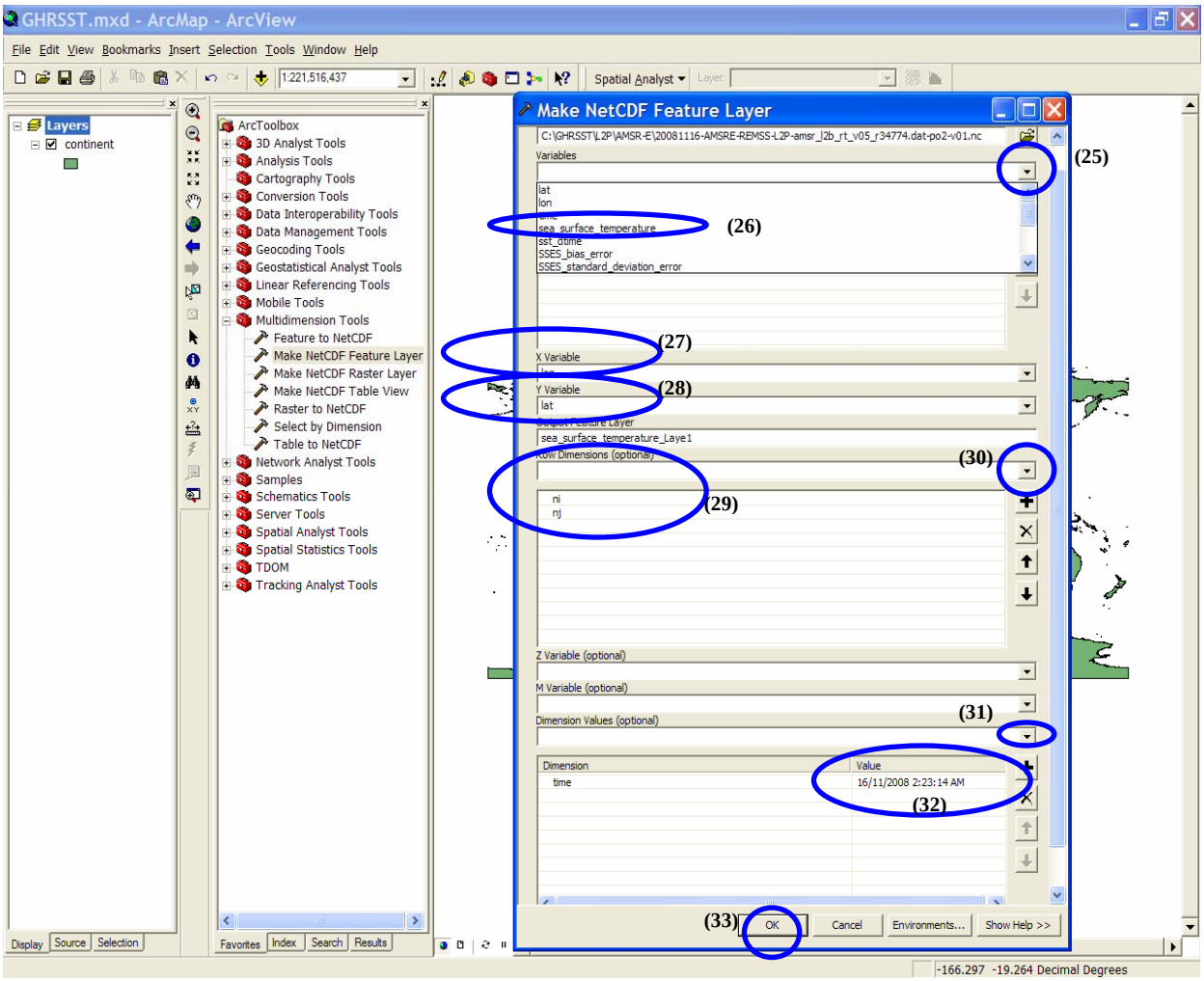
Displaying L2P Products

L2P products are published in satellite projection or swathes and hence are not on a regular grid and cannot be treated as rasters. Also, whilst the L4 products are gridded and fully cover their global or regional spatial extents, the L2 product filename gives no indication of which swath it contains. Users should use the GDAC search tool or the LTSRF .jpg file in the L2P directory to select the required swath.

To display L2P products they must be imported into ArcView as features. Double click on the *Make NetCDF Feature Layer* tool (23) in the *Multidimension Toolbox* to bring up the dialogue box.

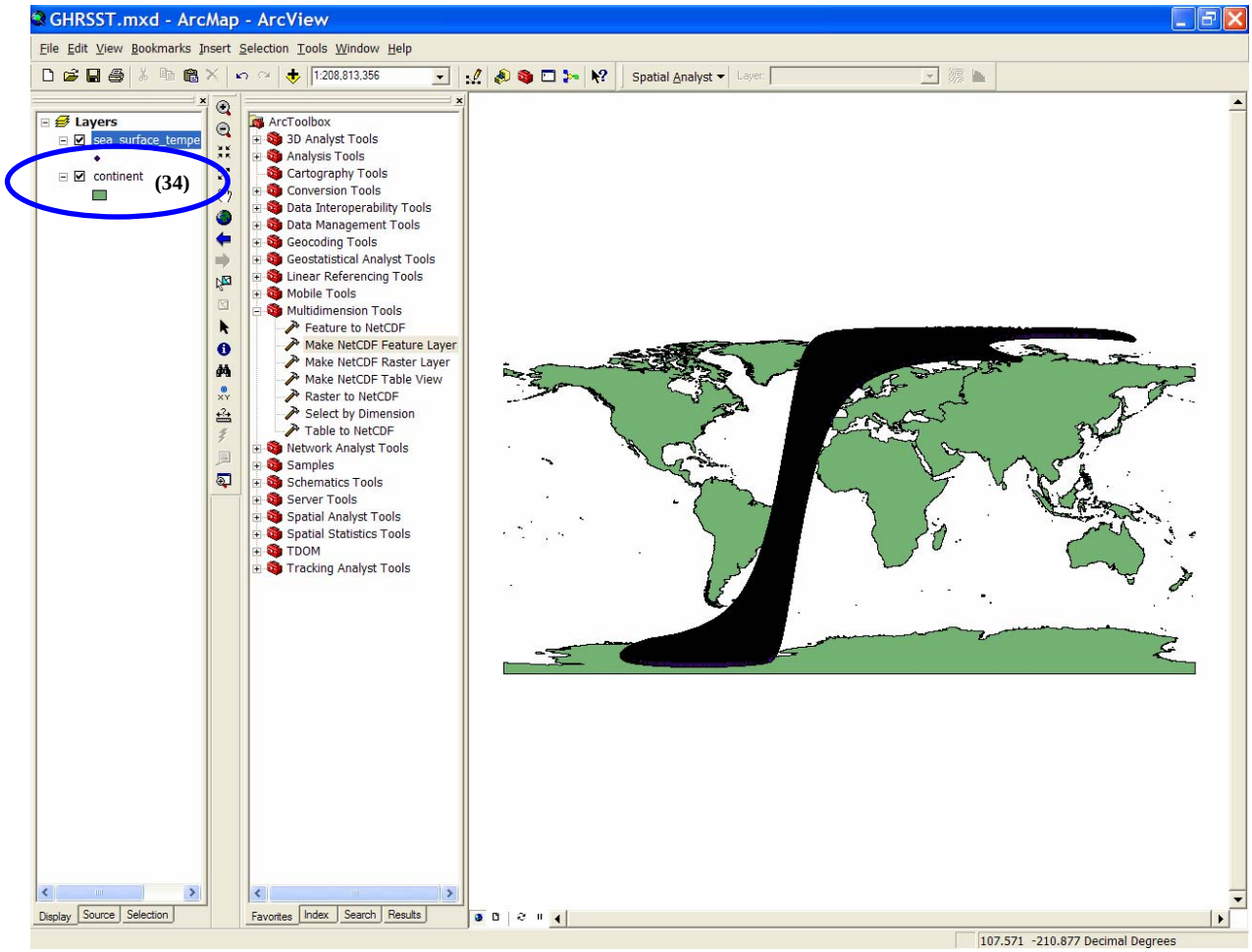


The *Make NetCDF Feature Layer* tool is similar to the *Make NetCDF Raster Layer* tool, but requires additional information. Select the *Input netCDF File* by navigating to the local folder containing the downloaded L2P file (24) and double clicking the filename.



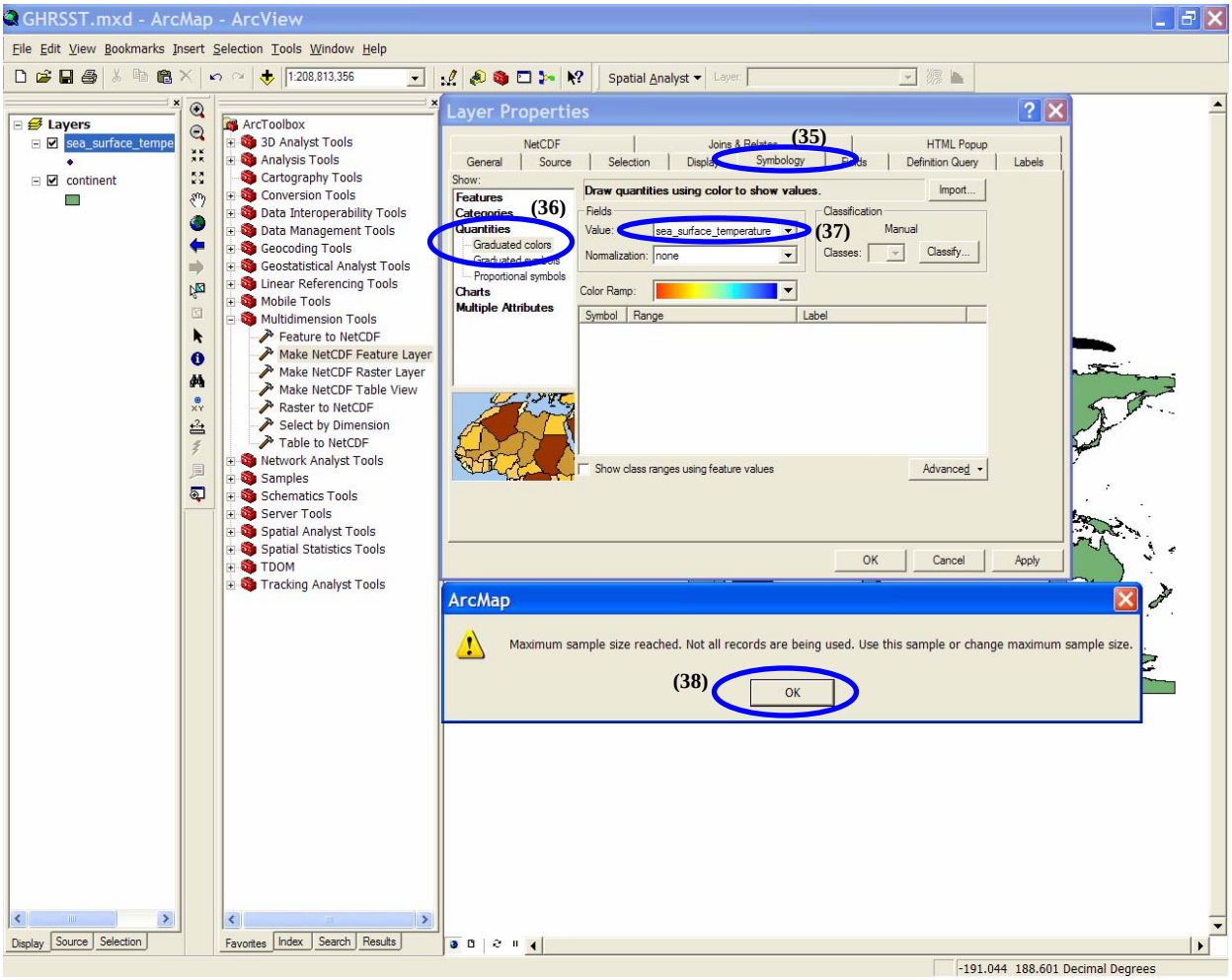
The *Variables* drop down menu (25) provides a list of the variables in the netCDF file. Select sea_surface_temperature (26), or another variable if desired and the *X Variable* = lat(27) and *Y Variable* =lon(28) will be automatically populated. Next, rename the *Output Feature Layer* if desired. Then, despite being labeled as optional, the *Row Dimensions* (29) **<u>must be completed</u>**. Use the drop down menu (30) and select ni then nj. Select time as the *Dimension Value* (31) and click under *Value* (32) to display the time of the L2P swath

Click on OK (33) and the L2P swath product will be created and loaded. The creation of the Feature layer from the netCDF file takes significantly longer than creating a L4 raster layer with times of up to one minute not unusual depending on the computer.



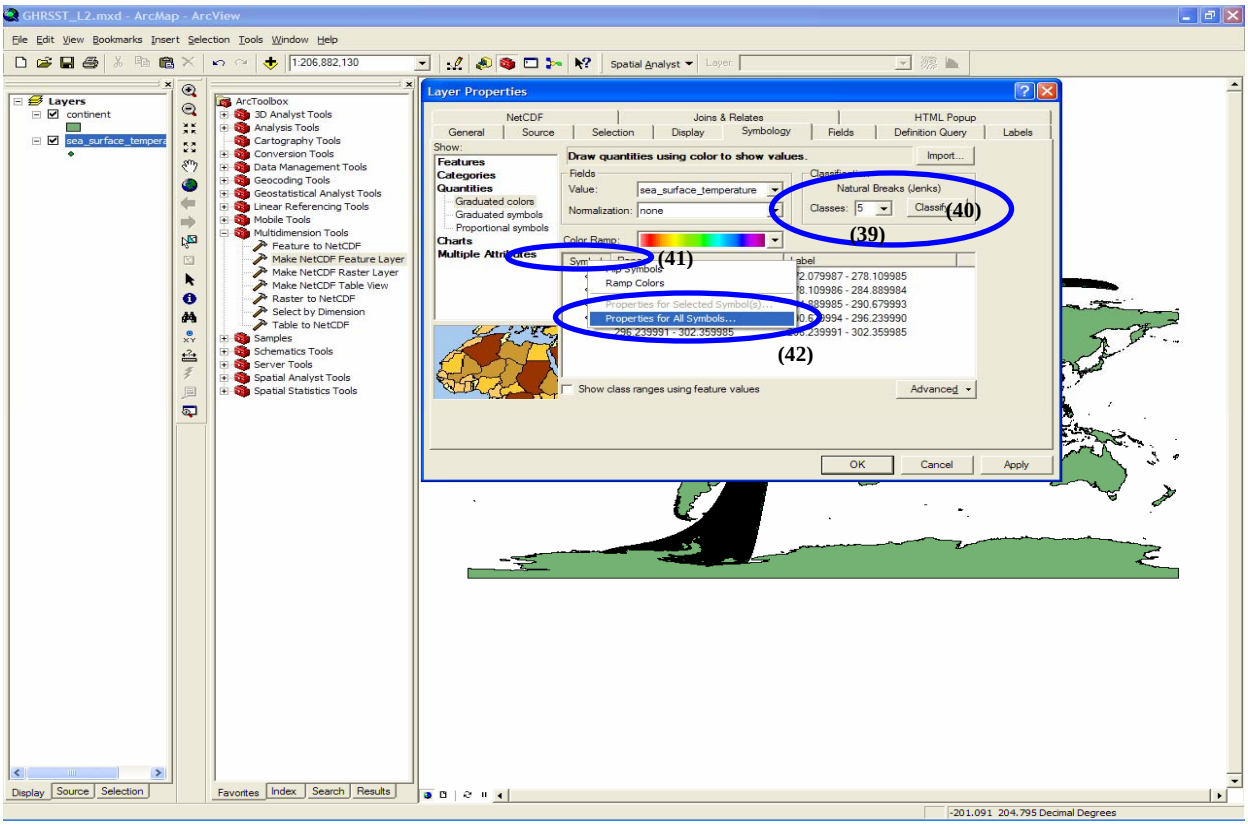
To display the features in a ‘raster like’ way, each pixel can be coloured according to its temperature. Move the background layer, in this case continent (34) above the sea surface temperature layer in the Table of Contents, then double click on the sea surface temperature layer to pop-up the *Layer Properties*.

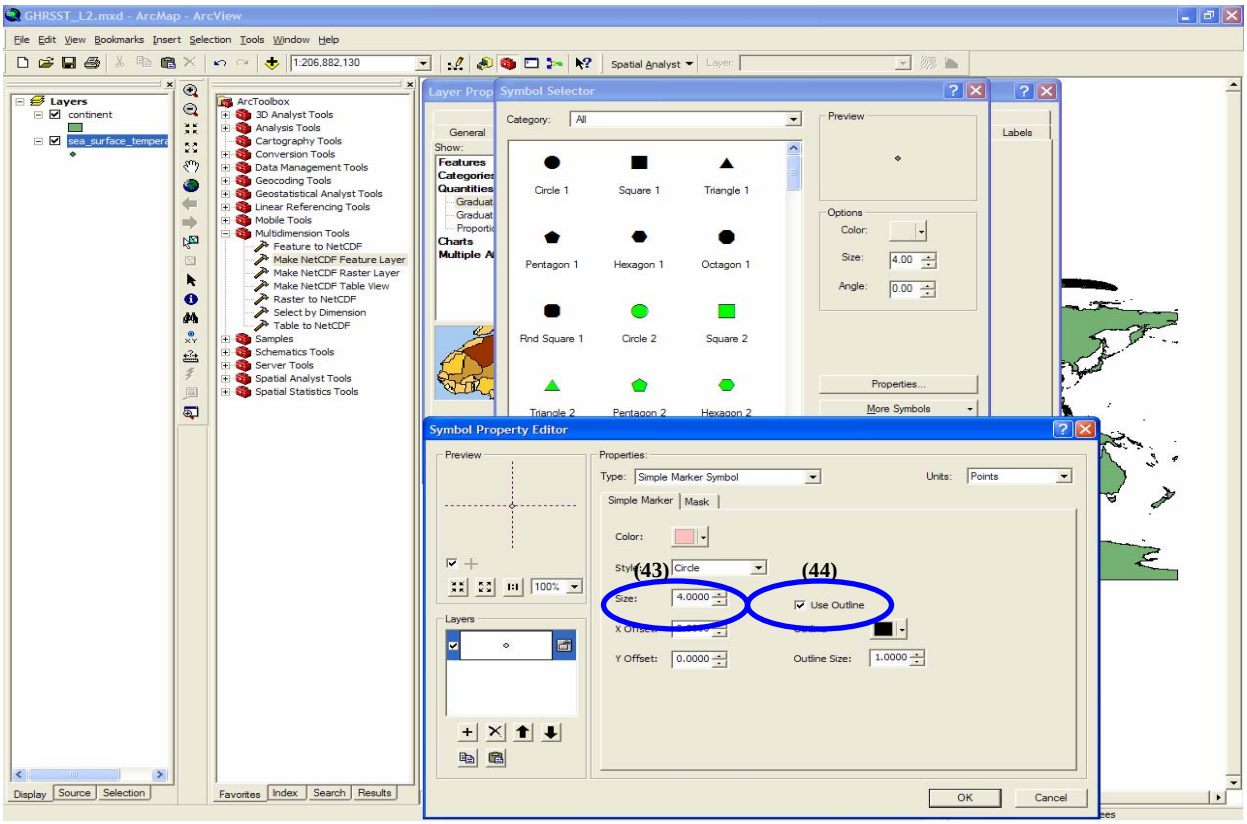
Select the *Symbology* tab (35), *Graduated colors* from *Quantities* (36) and sea_surface_temperature from *Fields -> Value* (37). Click the *OK* (38) on the popup dialogue box



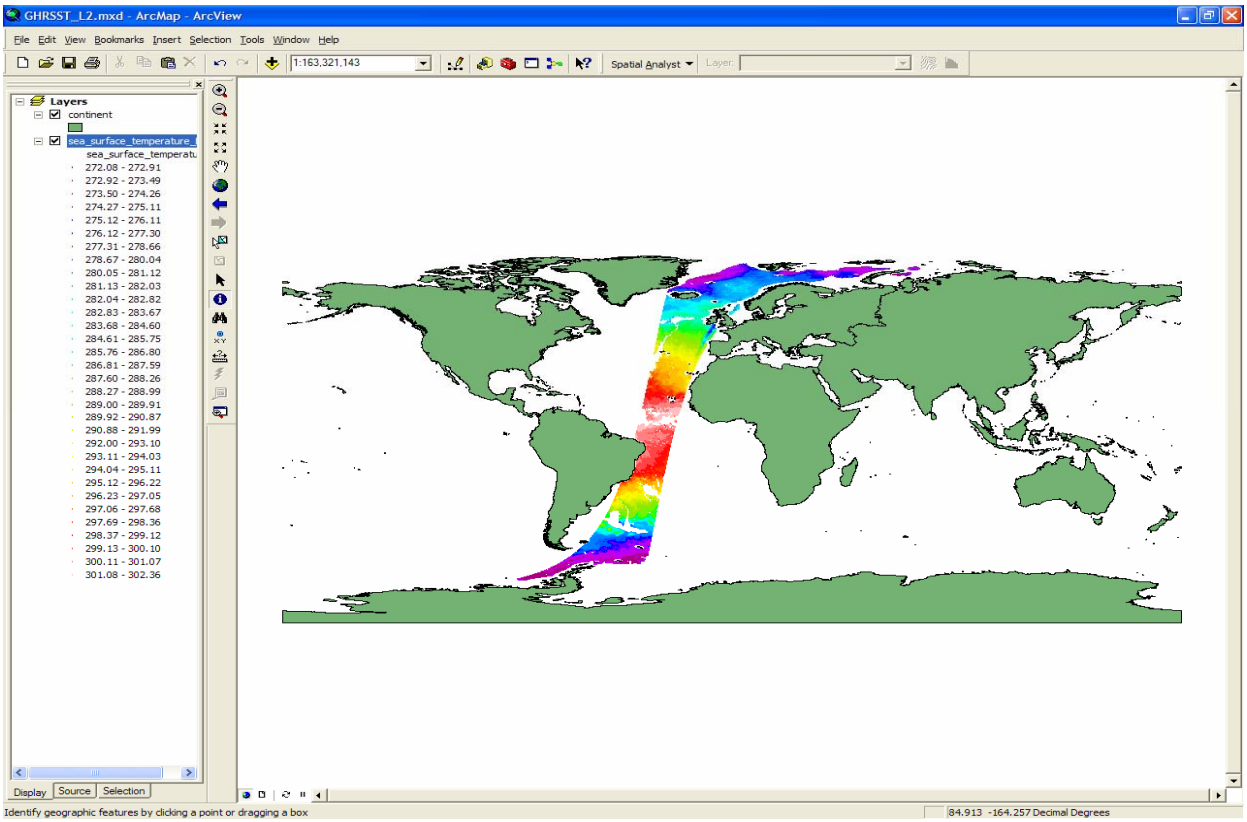
The features will now be symbolized according to the default settings, which are to divide the data into five classes and display using a small circle with a black outline. To change the number of classes, select from the classes drop-down box (39). The maximum value of 32 is recommended. The classes can be further customized by clicking on the *Classify* button (40).

To change the symbol, click *Symbols* (41), then *Properties for All Symbols* (42). This will load the *Symbol Selector* tool. Select *Properties* (43) to load the *Symbol Property Editor*. Select the *Symbol Size* (recommend 1) and click off the *Use Outline* check box. Select OK to exit the *Symbol Property Editor* and OK again to exit the *Symbol Selector* tool. When back in the *Layer Properties* tab click on *Color Ramp* and re-select the desired palette. If choosing a temperature or spectrum palette, click on *Symbol* again and select *Flip Symbols*.


GHRSST_L2.mxd - ArcMap - ArcView
File Edit View Bookmarks Insert Selection Tools Window Help
Layers
continent
sea_surface_tempera
ArcToolbox
3D Analyst Tools
Analysis Tools
Cartography Tools
Conversion Tools
Data Management Tools
Geocoding Tools
Geostatistical Analyst Tools
Linear Referencing Tools
Mobile Tools
Multidimension Tools
Feature to NetCDF
Make NetCDF Feature Layer
Make NetCDF Raster Layer
Make NetCDF Table View
Raster to NetCDF
Select by Dimension
Table to NetCDF
Samples
Schematics Tools
Server Tools
Spatial Analyst Tools
Spatial Statistics Tools
Layer Properties
Draw quantities using color to show values.
Fields
Value: sea_surface_temperature
Normalization: none
Natural Breaks (Jenks)
Classes: 5
(39)
(40)
(41)
Ramp Colors
Properties for Selected Symbol(s)...
Properties for All Symbols...
(42)
Show class ranges using feature values
Advanced
OK
Cancel
Apply
-201.091 204.795 Decimal Degrees

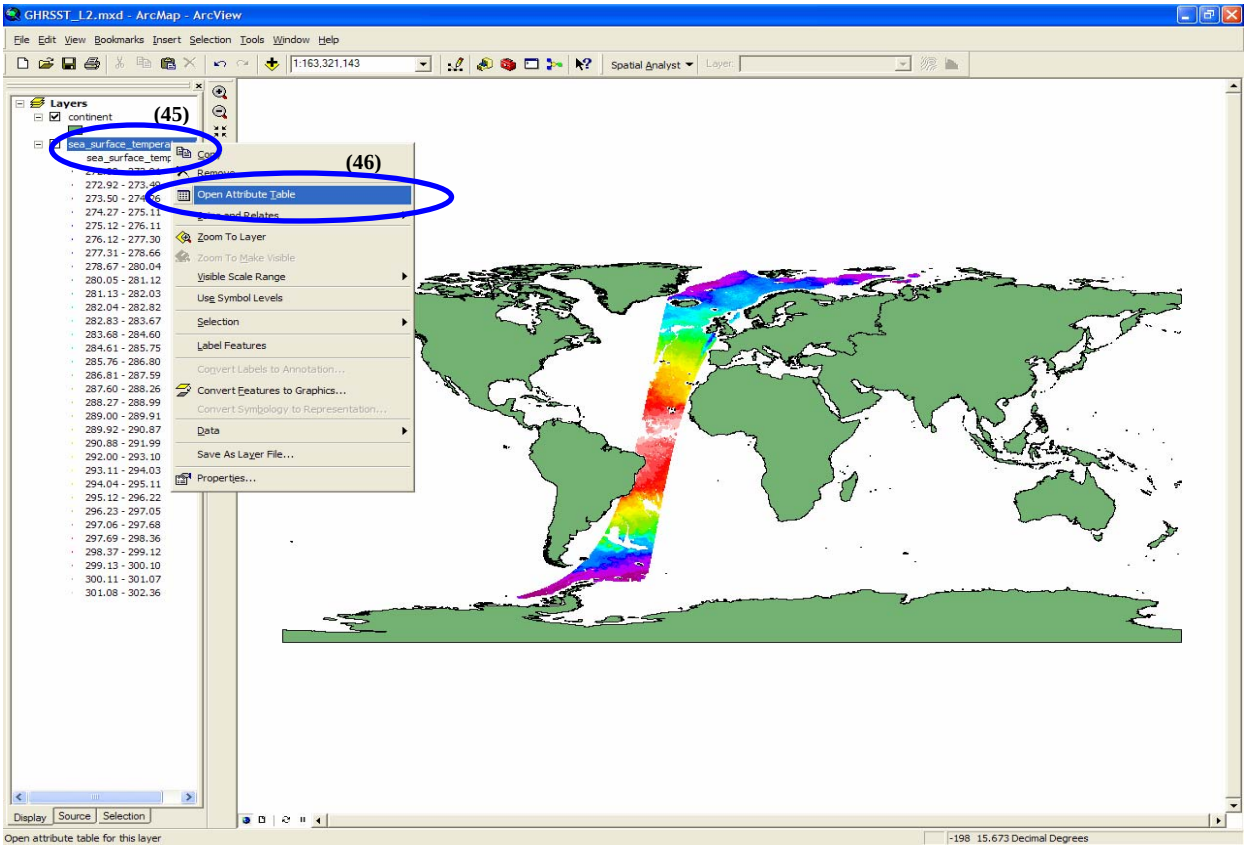

GHRSST_L2.mxd - ArcMap - ArcView
File Edit View Bookmarks Insert Selection Tools Window Help
Symbol Selector
Category: All
Circle 1
Square 1
Triangle 1
Pentagon 1
Hexagon 1
Octagon 1
Rnd Square 1
Circle 2
Square 2
Triangle 2
Pentagon 2
Hexagon 2
Preview
Options
Color:
Size: 4.00
Angle: 0.00
Properties...
More Symbols
Symbol Property Editor
Properties:
Type: Simple Marker Symbol
Units: Points
Simple Marker
Mask
Color:
Style: Circle
(43)
(44)
Size: 4.0000
Use Outline
Y Offset: 0.0000
Outline Size: 1.0000
OK
Cancel

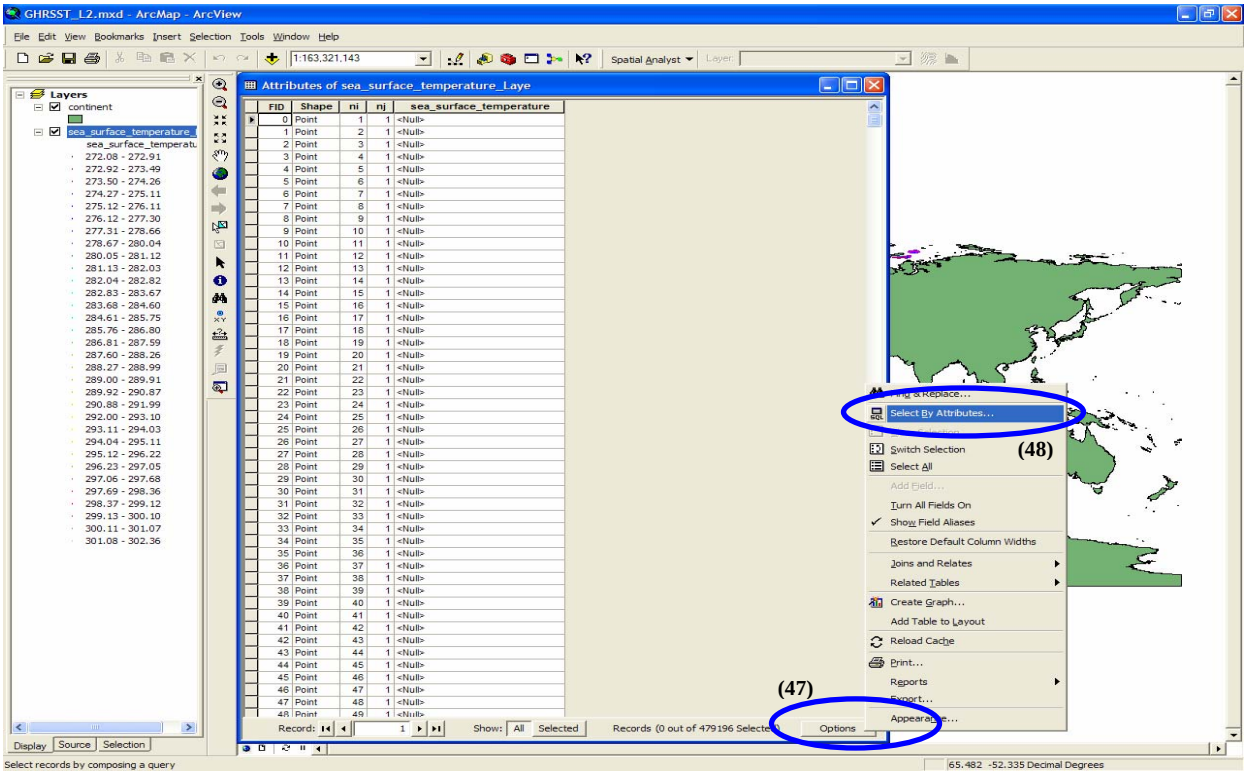
The L2P data will now be displayed as a pseudo-raster where each point is symbolized with a graduated color. All the standard GIS navigation tools can now be used on the view and individual values extracted using the identify tool. Note that when zooming to a larger scale, the feature size may have to be increased to make the features appear as a contiguous plot.



Customizing the L2P Features Display

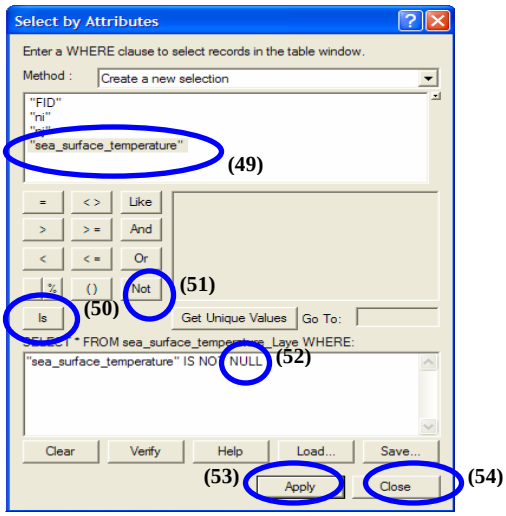
<u>Converting Units.</u> To convert the units from Kelvin to Celsius of Fahrenheit, the non-null features must first be saved to a local shapefile. To select those features with a valid SST value, right click on the feature name in the *Table of Contents* (45) and select *Open Attribute Table* (46). From the *Attributes Table* select *Options* (47) then *Select by Attributes* (48).


GHRSST_L2.mxd - ArcMap - ArcView
File Edit View Bookmarks Insert Selection Tools Window Help
1:163,321,143
Spatial Analyst
Layers
continent
(45)
sea_surface_tempera
sea_surface_temp
(46)
Open Attribute Table
Zoom To Layer
Zoom To Make Visible
Visible Scale Range
Use Symbol Levels
Selection
Label Features
Convert Labels to Annotation...
Convert Features to Graphics...
Convert Symbology to Representation...
Data
Save As Layer File...
Properties...
Display Source Selection
Open attribute table for this layer
-198 15.673 Decimal Degrees

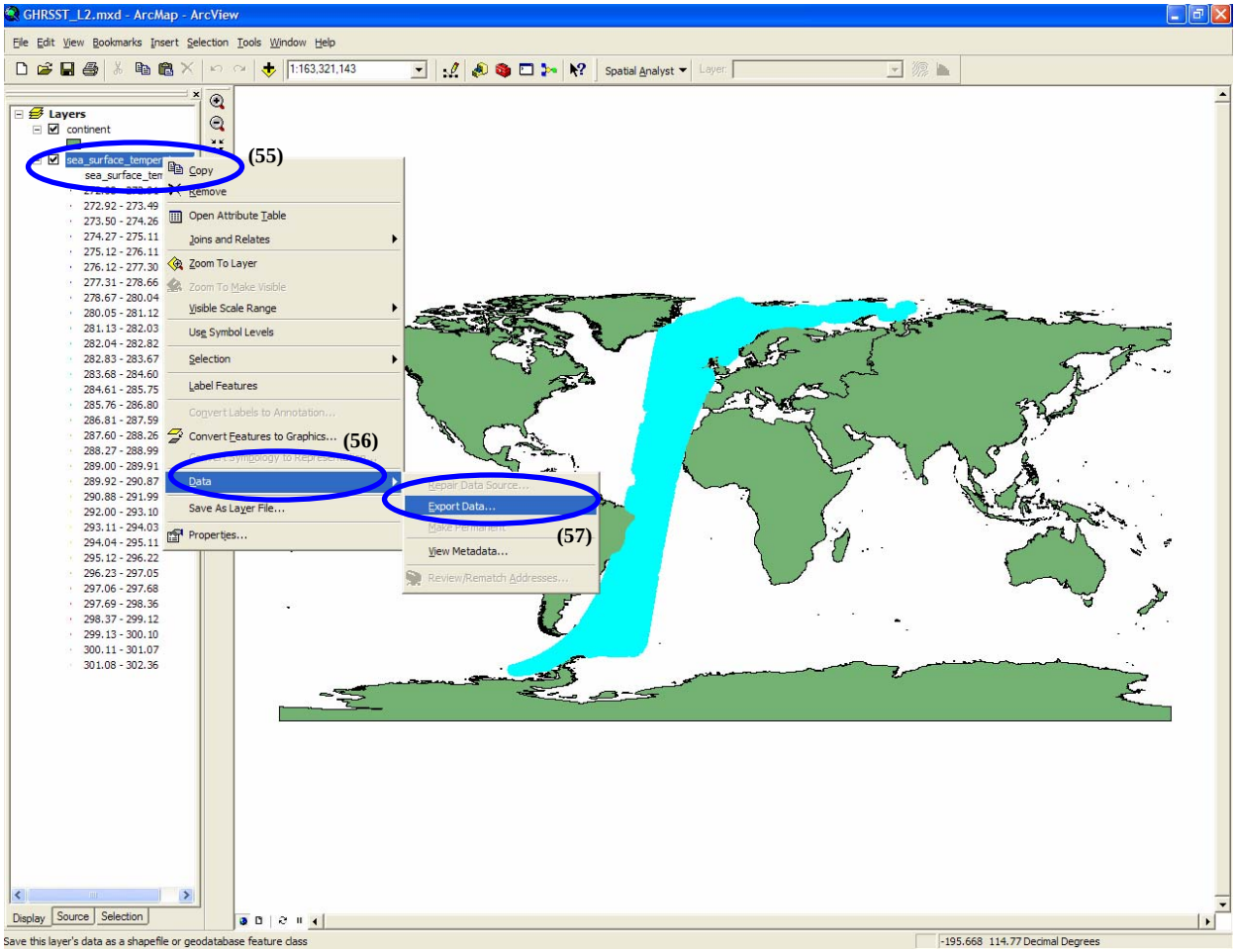

GHRSST_L2.mxd - ArcMap - ArcView
File Edit View Bookmarks Insert Selection Tools Window Help
1:163,321,143
Spatial Analyst
Layers
continent
sea_surface_temperature_
Attributes of sea_surface_temperature_Laye
FID Shape ni nj sea_surface_temperature
Select By Attributes...
(48)
Switch Selection
Select All
Add Field...
Turn All Fields On
Show Field Aliases
Restore Default Column Widths
Joins and Relates
Related Tables
Create Graph...
Add Table to Layout
Reload Cache
Print...
Reports
Export...
(47)
Options
Record: 1
Show: All Selected
Records (0 out of 479196 Selected)
Display Source Selection
Select records by composing a query
65.482 -52.335 Decimal Degrees

To enter the query, double click the feature name (49), then *Is* (50), then *Not* (51) then type NULL (52) as shown. Click on Apply (53). All the points with non-Null values will be highlighted in a light blue color.

Close the Select by Attributes tool (54)

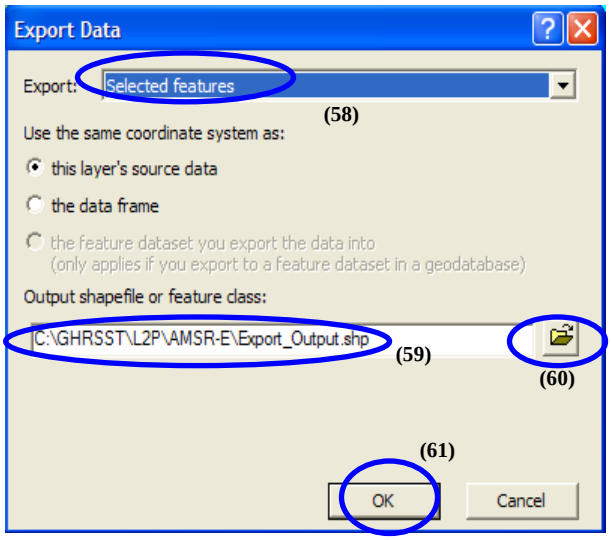


To save these points, right click on the feature name (55) in the *Table of Contents*, then select *Data* (56), then *Export Data* (57).

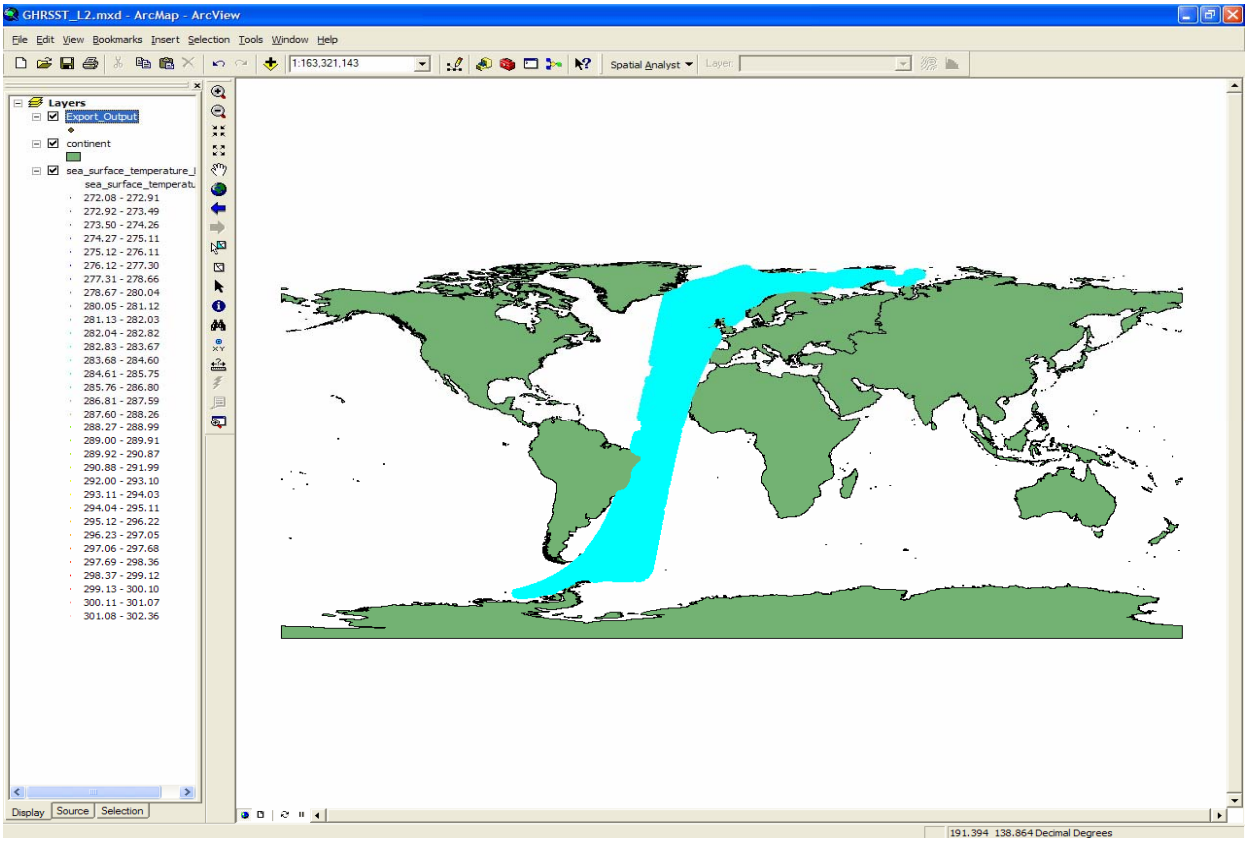


The *Export Data* tool should default to *Selected features* as shown.

Enter a shapefile path and name (59) or navigate to the desired folder (60) the click OK (61) to commence the Export.

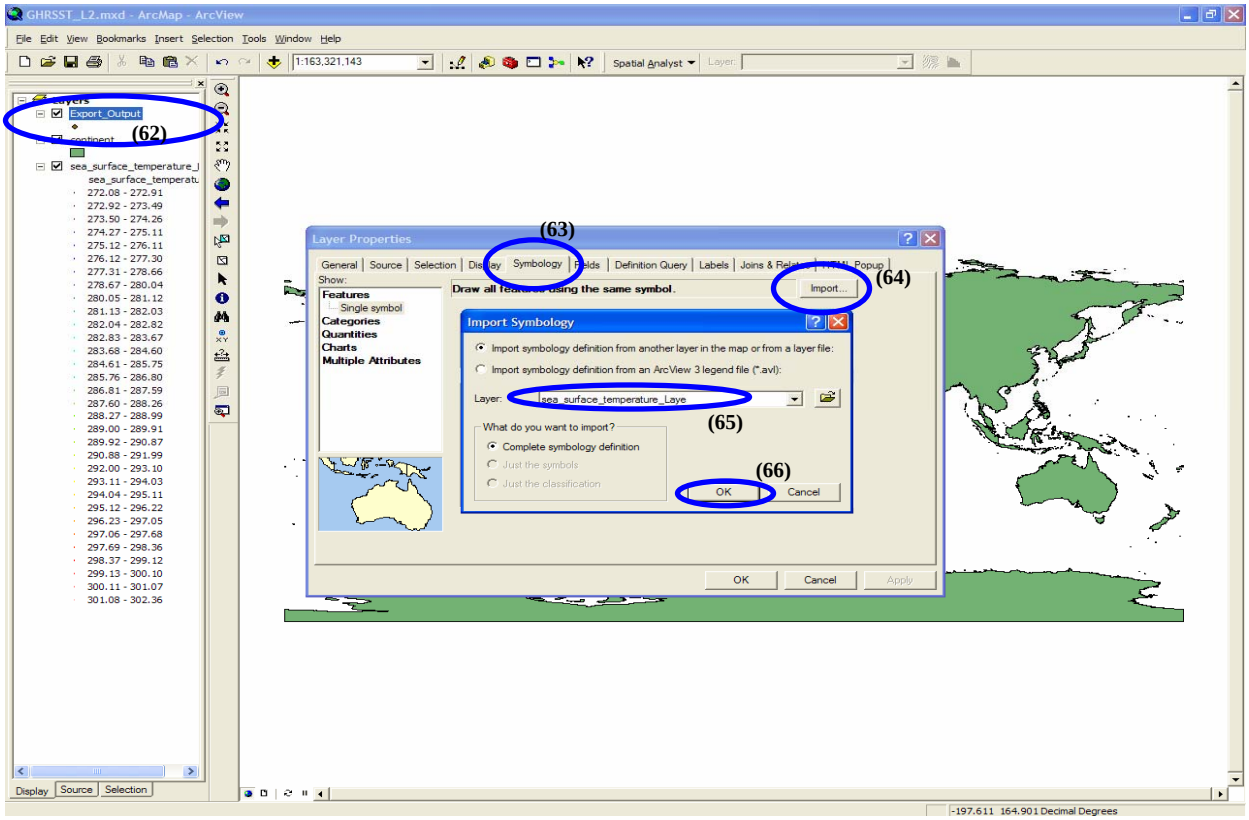


When prompted to add the exported data to the map as a layer, select *Yes*, and the new shapefile will be added. The selected features will, however remain displayed in the View.



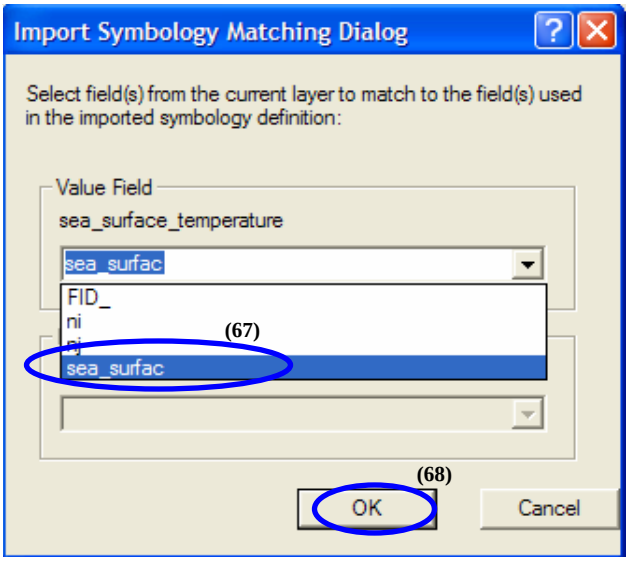
To display only the new data, first copy the palette from the original file. Double click on the new layer name (62), select the *Symbology* tab

(63) in the *Layer Properties* and click on *Import* (64). The original layer name will be displayed (65) and click *OK* (66).

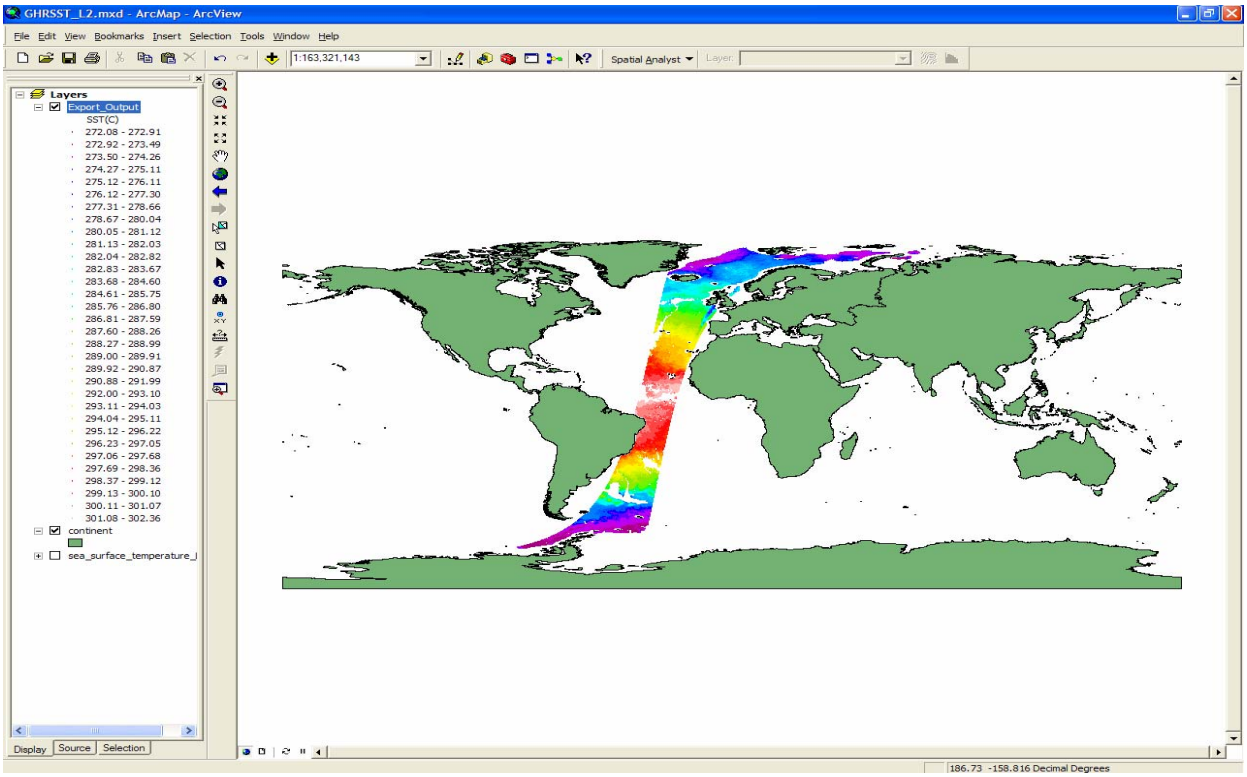


An *Import Symbology Matching Dialog* box will be displayed. Select the matching field from the old layer (67) in the *Value Field* and click OK (68).

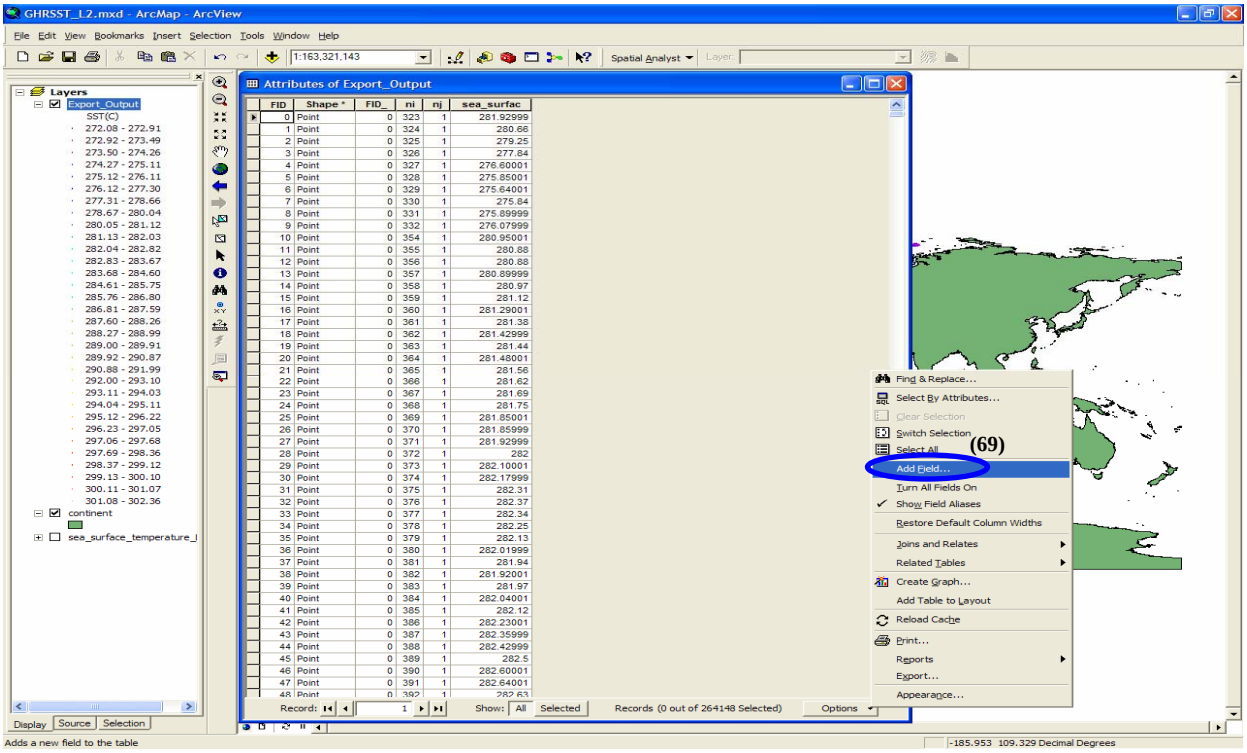
This will populate the new *Layer Properties Symbology Tab* with the old layer symbology.



Select *OK* to apply the symbology and display the data. Click off the old layer in the *Table of Contents* and a new locally saved layer comprising only the non-null values will be displayed.

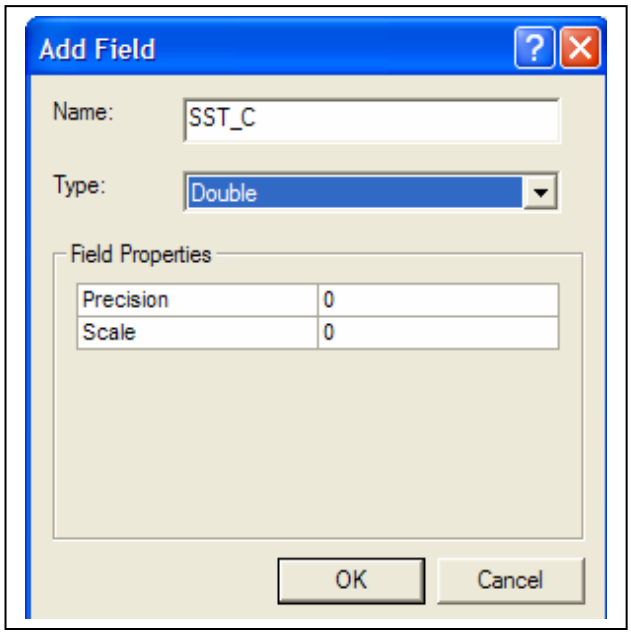


Next, convert the units using the local copy of the features as saved in the shapefile. Open the *Attribute Table* and this time select *Add Field* (69) from the *Options*.

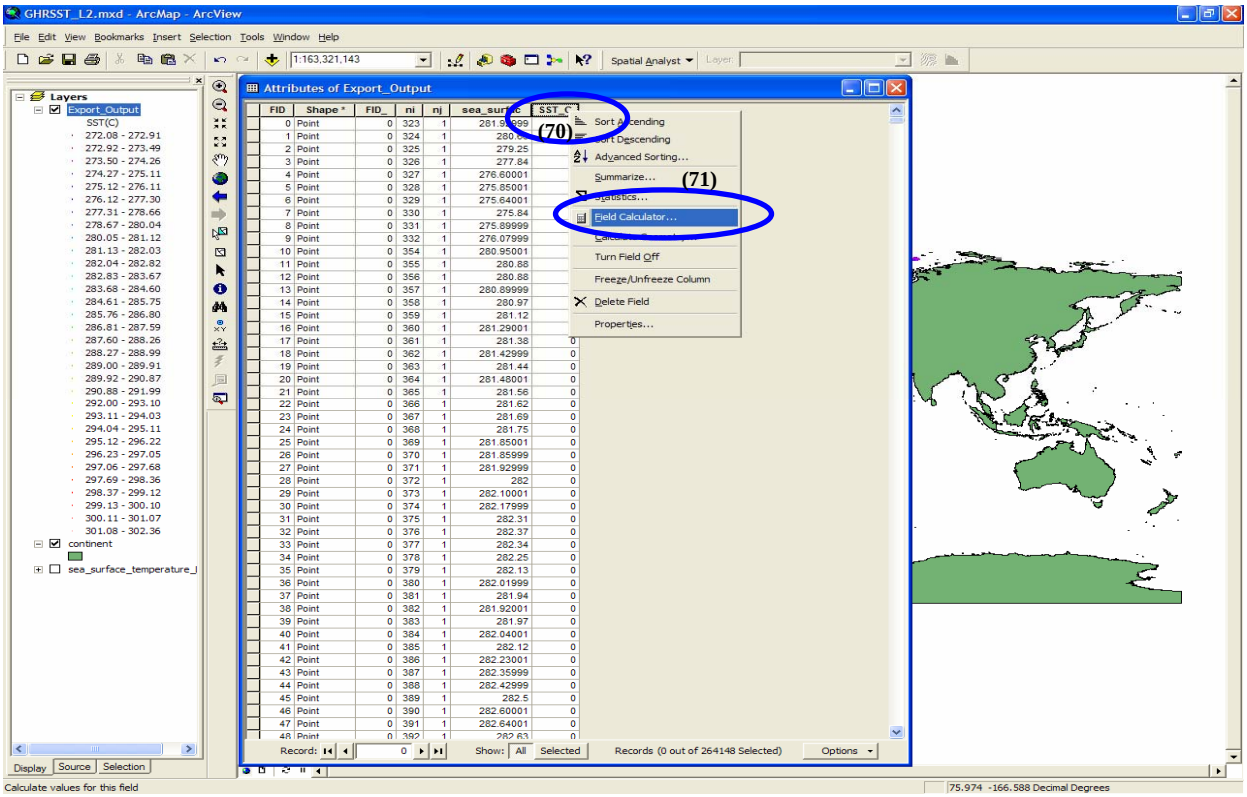


An *Add Field* dialogue box will appear. Type the name you wish to give the new Field. e.g. SST_C or SST_F and select *Double* as the type.

The *Field Properties* are optional. *Precision* refers to the total number of significant figures and *Scale*, the number of decimal places. Click OK when finished.

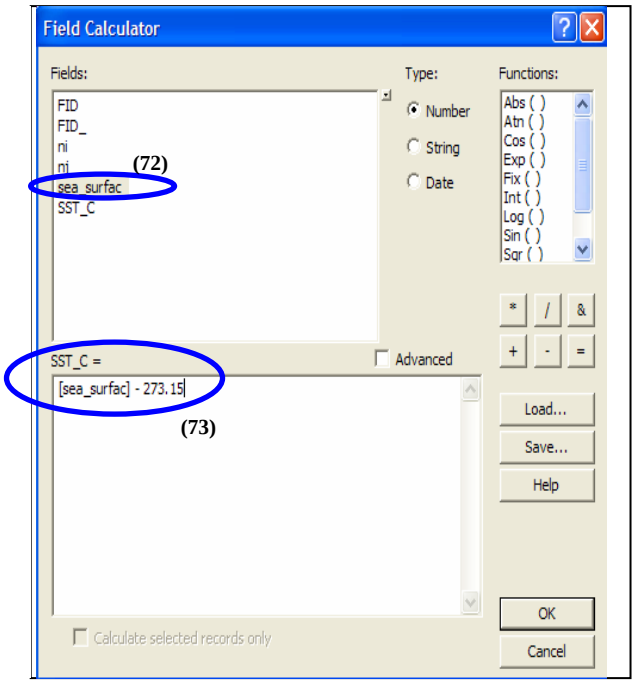


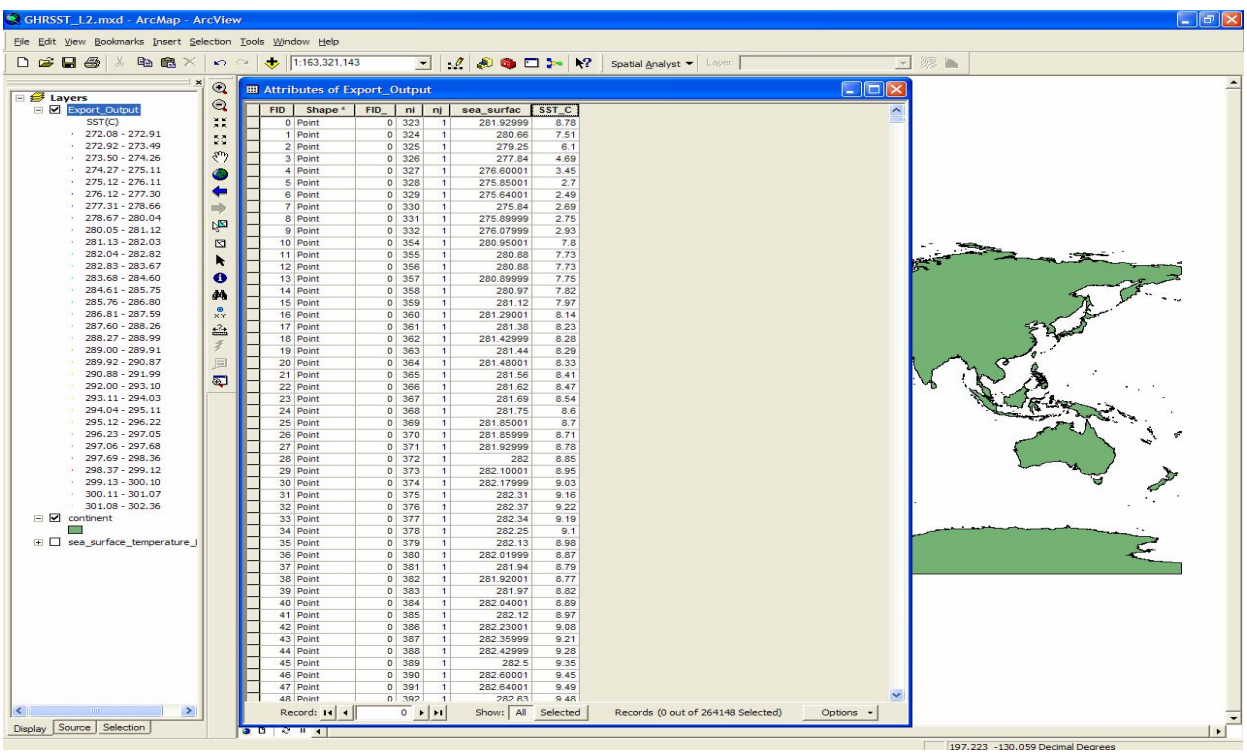
A new field with the selected name (70) will be created in the table and filled with zero values. To calculate the new values, right click on the field name and select *Field Calculator* (71).



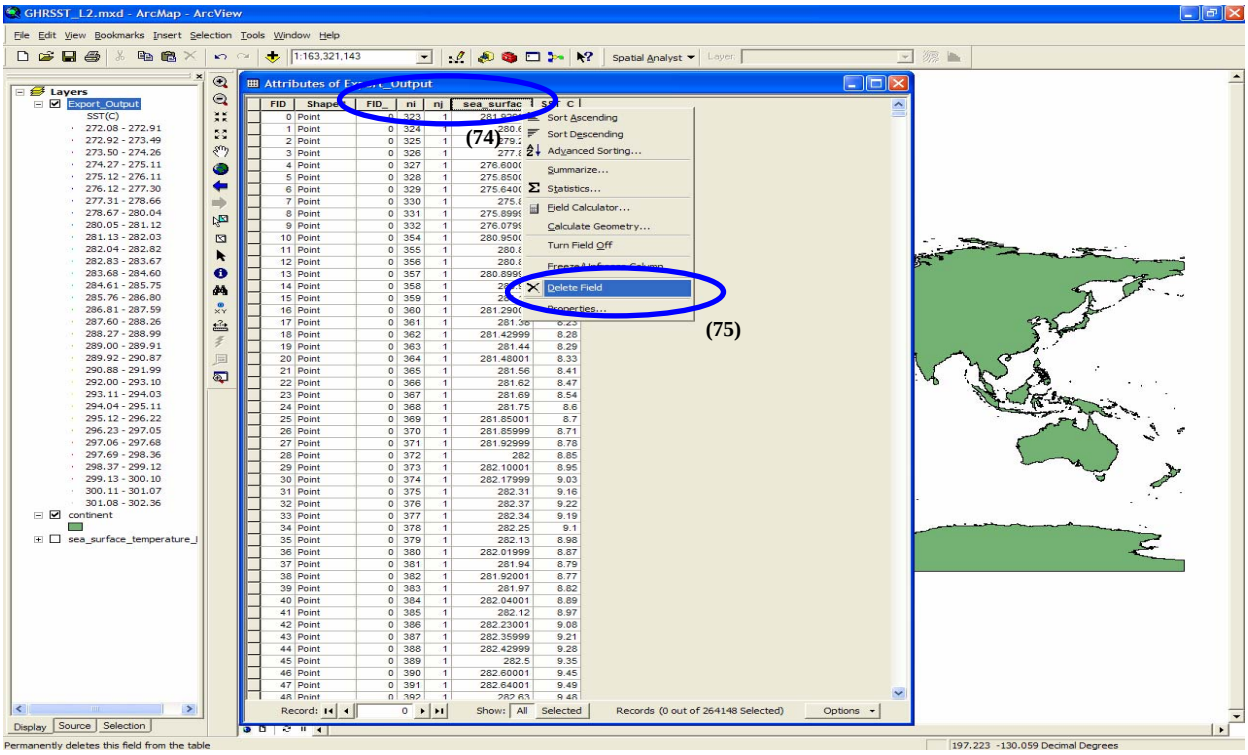
The *Field Calculator* is similar to the earlier *Raster Calculator*. To complete the formula, double click on the Kelvin value (72) then use the keyboard to enter subtract 273.15 (73) to convert to Celsius.

Click OK, and every value in the table's new field will be calculated according to the formula.

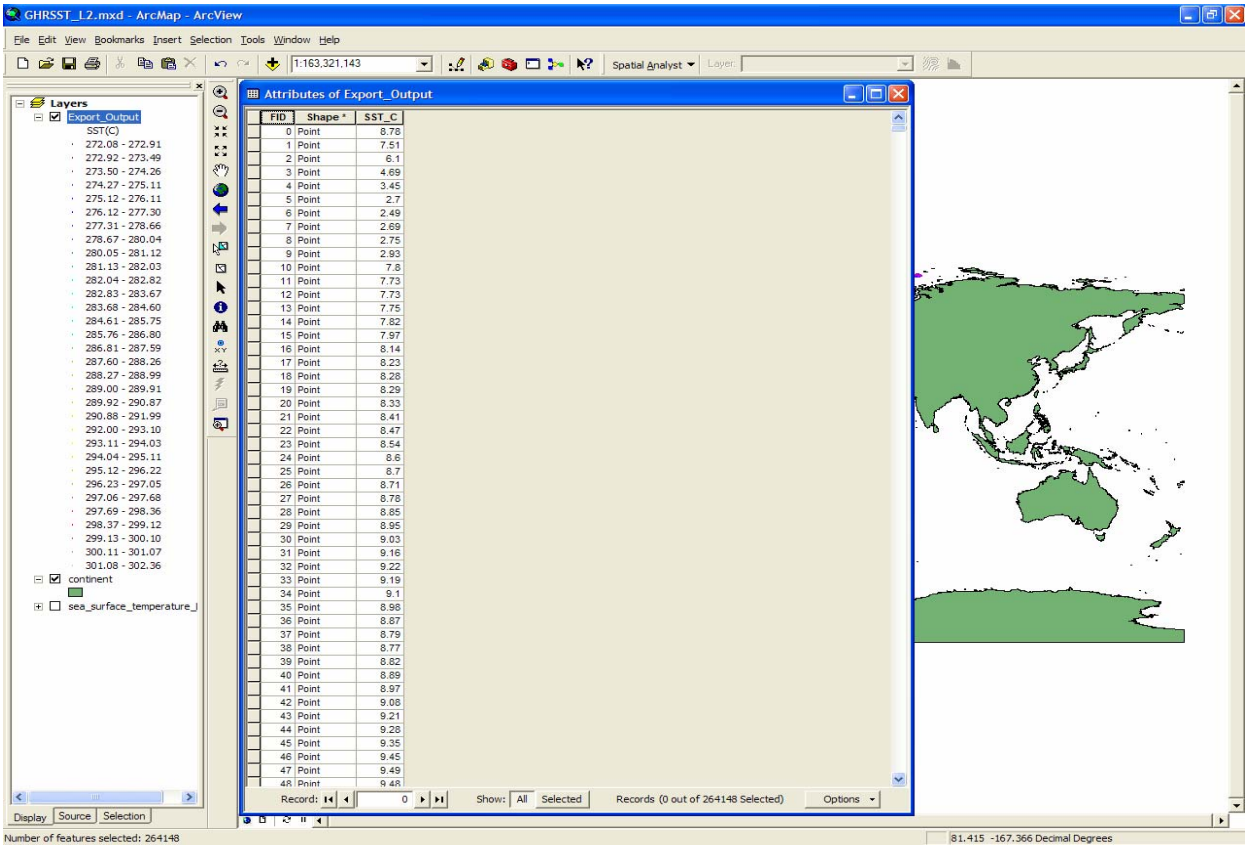




Before saving, the interim fields can be deleted to reduce file sizes and improve performance. To delete a field, right click on the field name (74), then select *Delete Field* (75). In this example, the fields FID_, ni, nj and sea_surfac can all be deleted to leave FID, Shape and SST_C.

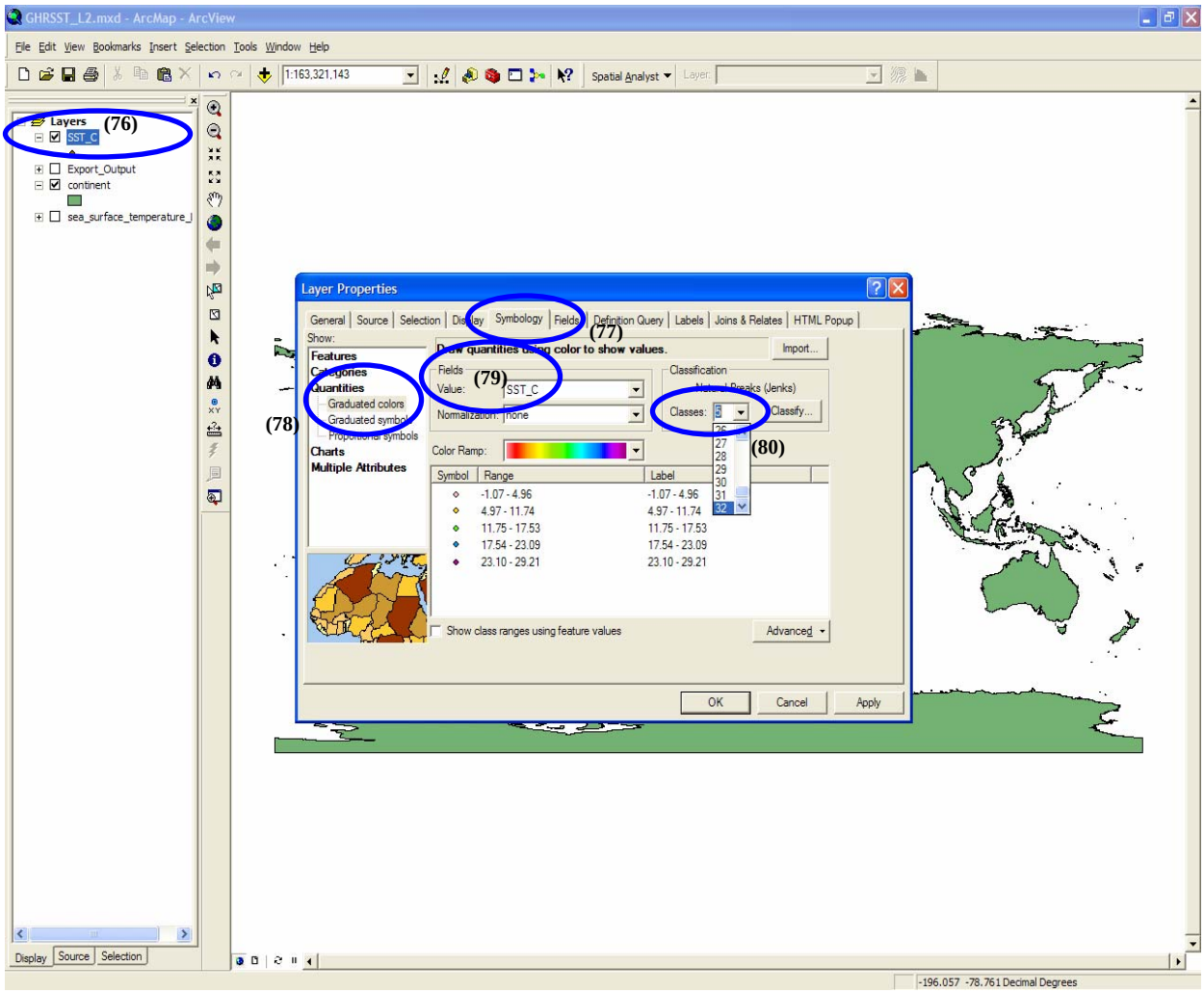


The remaining fields are shown in the following figure.



The new Table must now be exported by right clicking on the layer name in the *Table of Contents*, then selecting *Data* then *Export Data*. Rename as desired and add the exported data to the map as a layer.

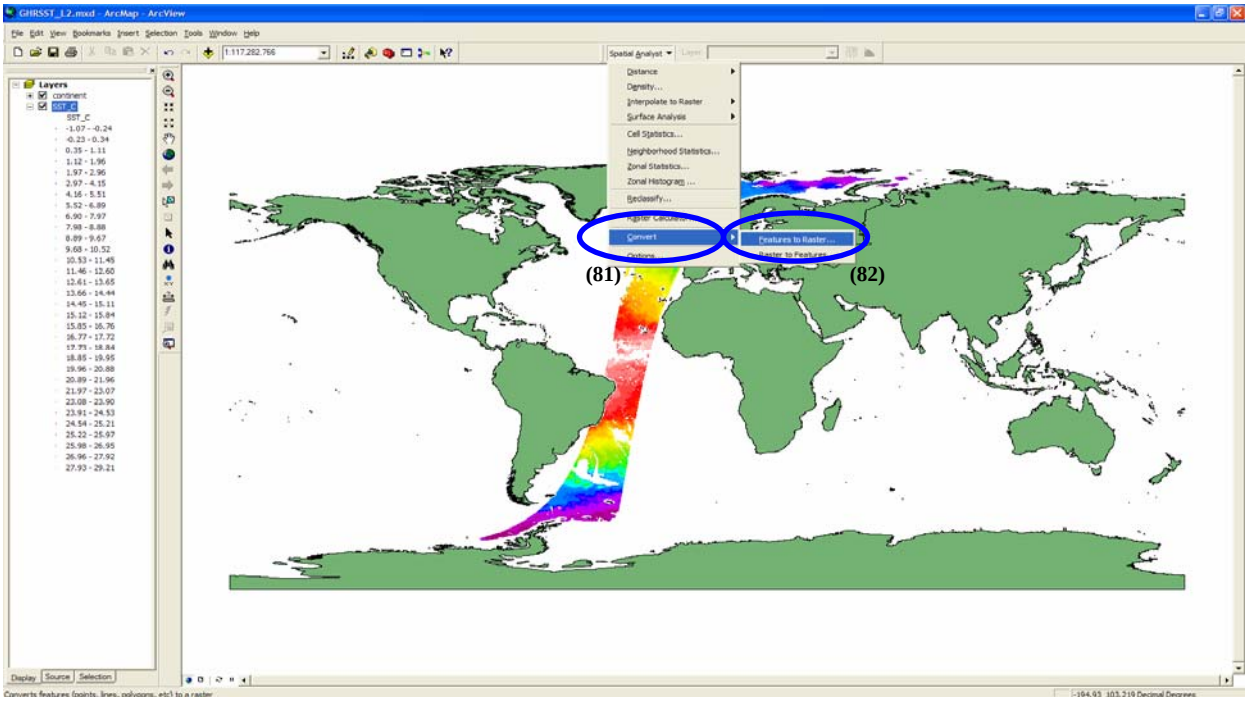
Finally, add new symbology for the values in the new units by double clicking on the layer name in the *Table of Contents* (76), selecting the *Symbology* tab (77), *Show Quantities* then *Graduated colors* (78), select the new *Field Value* (79) and number of classes in the new classification (80).



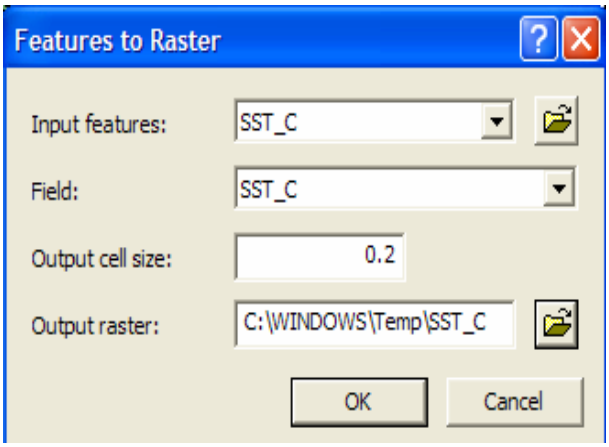
Follow the earlier instructions for changing the symbol size, symbol outline and flipping the symbols to finally arrive at a plot of the data in the desired units, suitable for interrogating with the identify tool, symbolized at a pseudo-raster.

<u>Converting Features to Raster.</u> The use of raster layers significantly improves GIS performance compared with rendering features and may be preferred by some users.

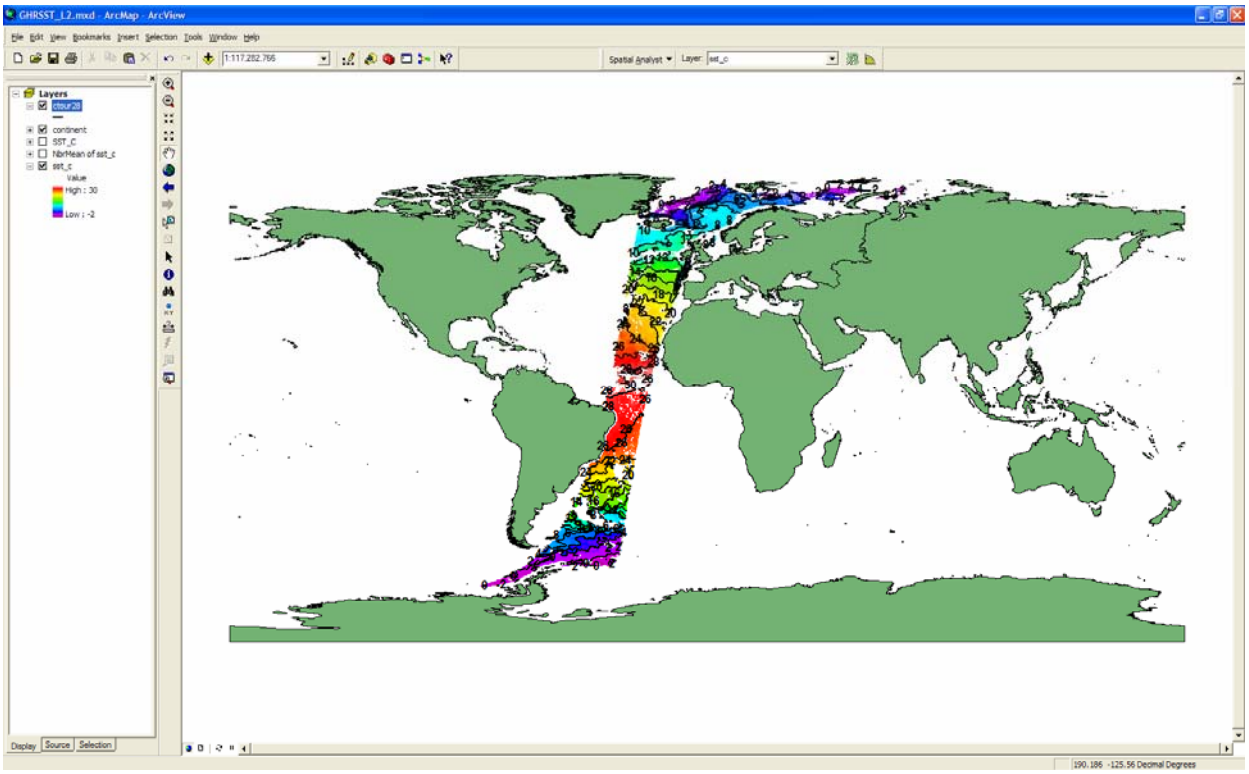
To convert the local features to a raster, use the *Spatial Analyst* toolbar and select *Convert* (81), then *Features to Raster* (82).



Select the name of the feature from the drop down menu, then the field in that feature to be converted. Select an output raster cell size that matches the resolution of the data and enter the path and name of the output raster.



Click OK and a new raster will be created and loaded into the Table of Contents with a default palette. Change the palette, contour using neighborhood statistics and label as required for the final product, examples of which are shown below.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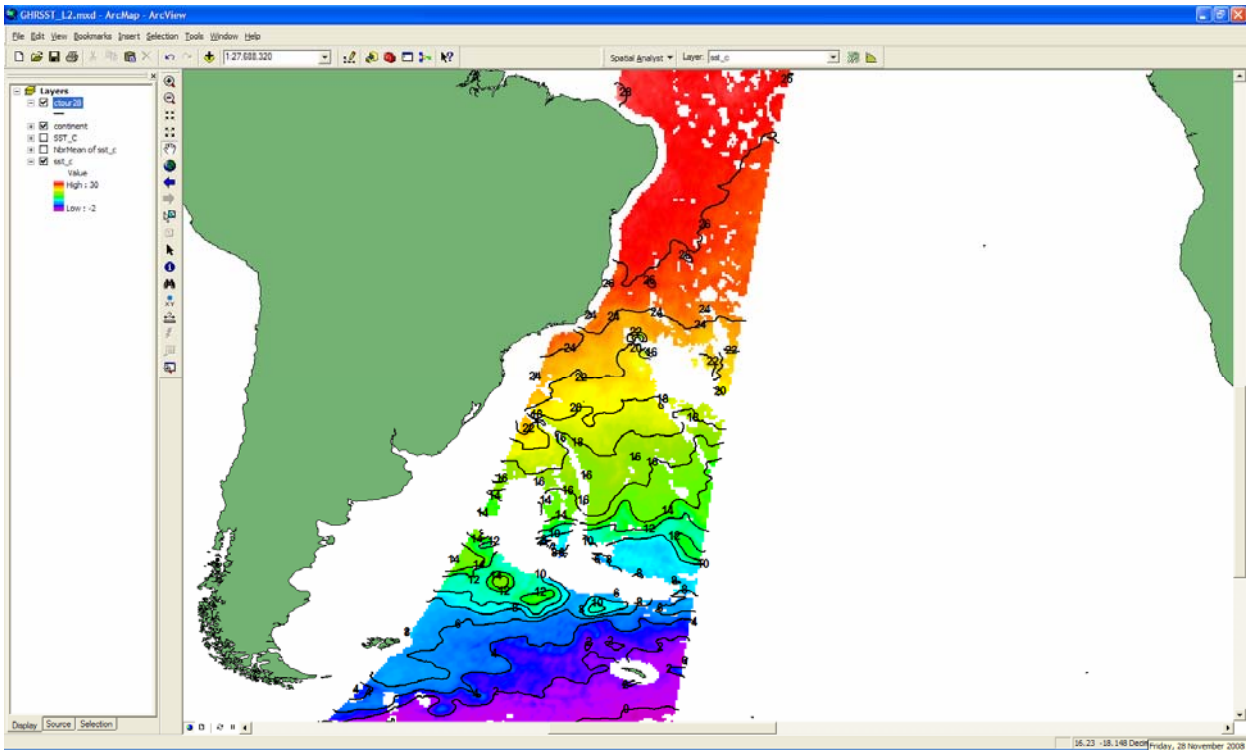
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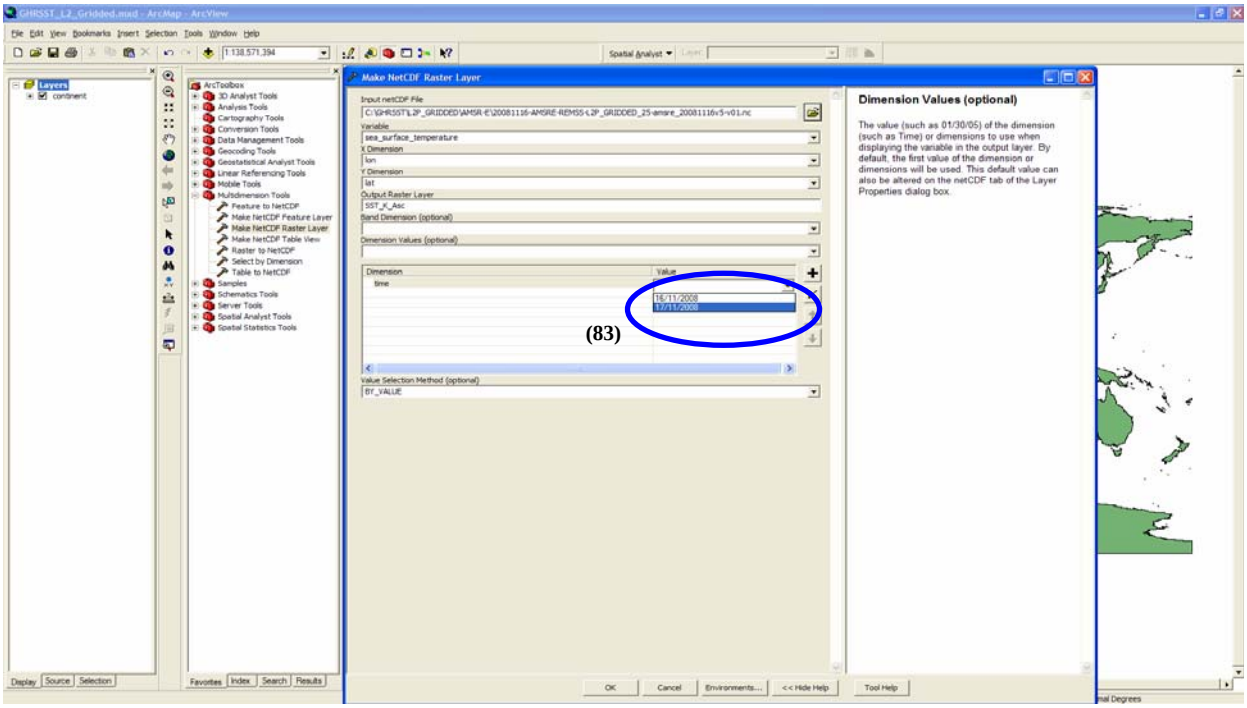
Friday, 28 November 2008

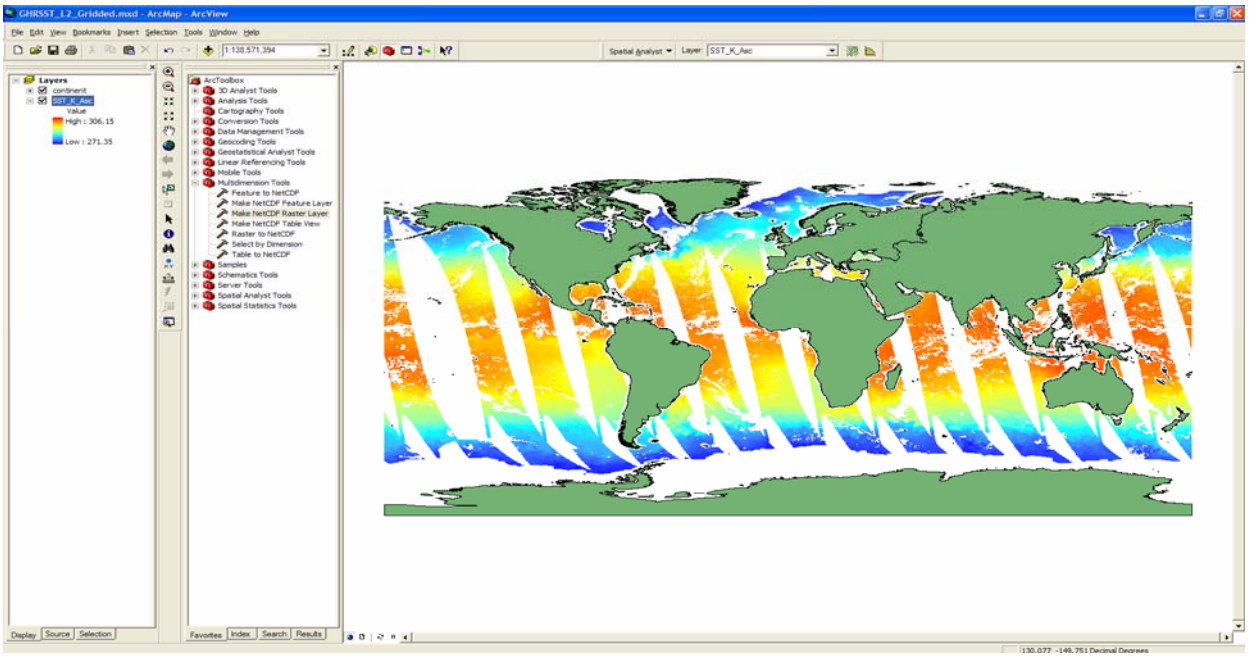
Displaying L2P-Gridded Products

L2P-Gridded products are instrument level products re-mapped from the L2 swaths or satellite views to a regular grid, but without additional interpolation or value-adding. They typically contain the same fields as the L2P products. Remote Sensing Systems currently provide L2P-Gridded data to GHRSST for the AMSR-E and TMI instruments. This data is at ftp://podaac.jpl.nasa.gov/pub/GHRSST/data/L2P_GRIDDED/ and can be downloaded for display in ArcGIS. Each daily folder contains two zipped netCDF files, one containing 'real-time' data and the second, designated V5, undergoes additional quality control.

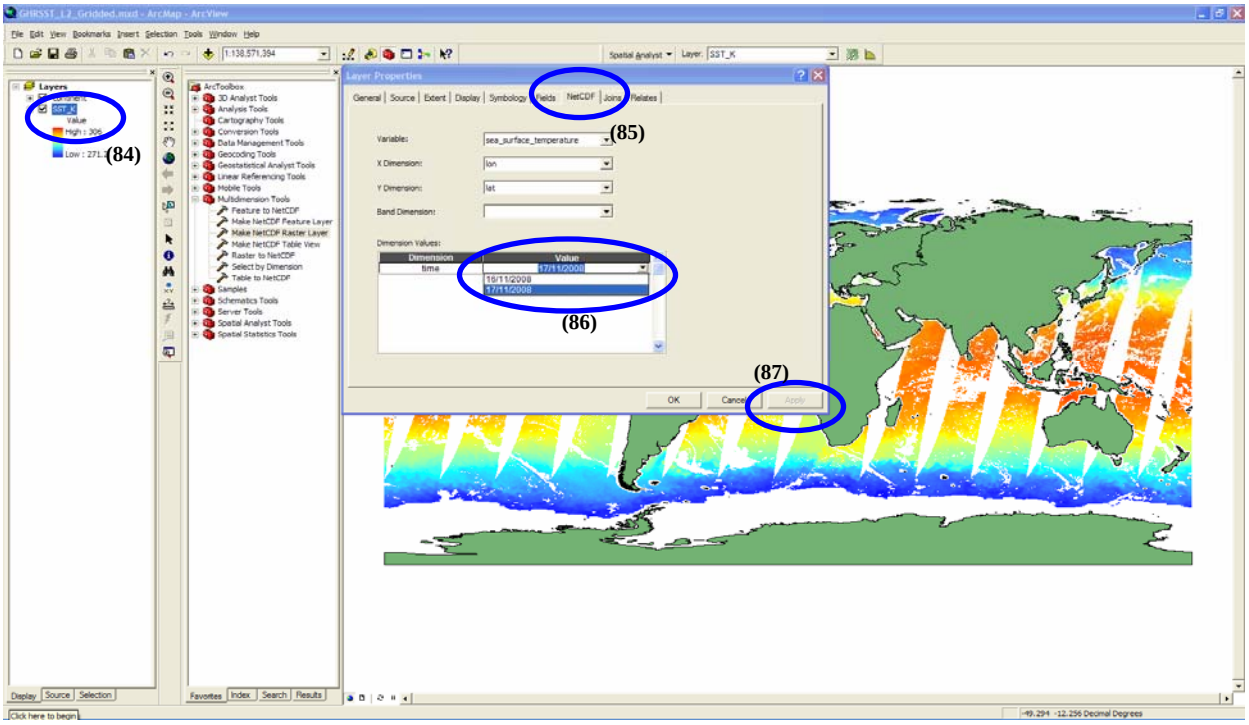
The gridding of the data allows the netCDF file to be imported as a raster layer in the same manner as the L4 data described earlier. Import as a raster using the *Make NetCDF Raster Layer* tool in the *MultiDimension Toolbox*. In a variation to the L4 import, the *Time Dimension* now has two options (83) corresponding to the Ascending and Descending passes.



Select either and the L2P grid will be displayed.



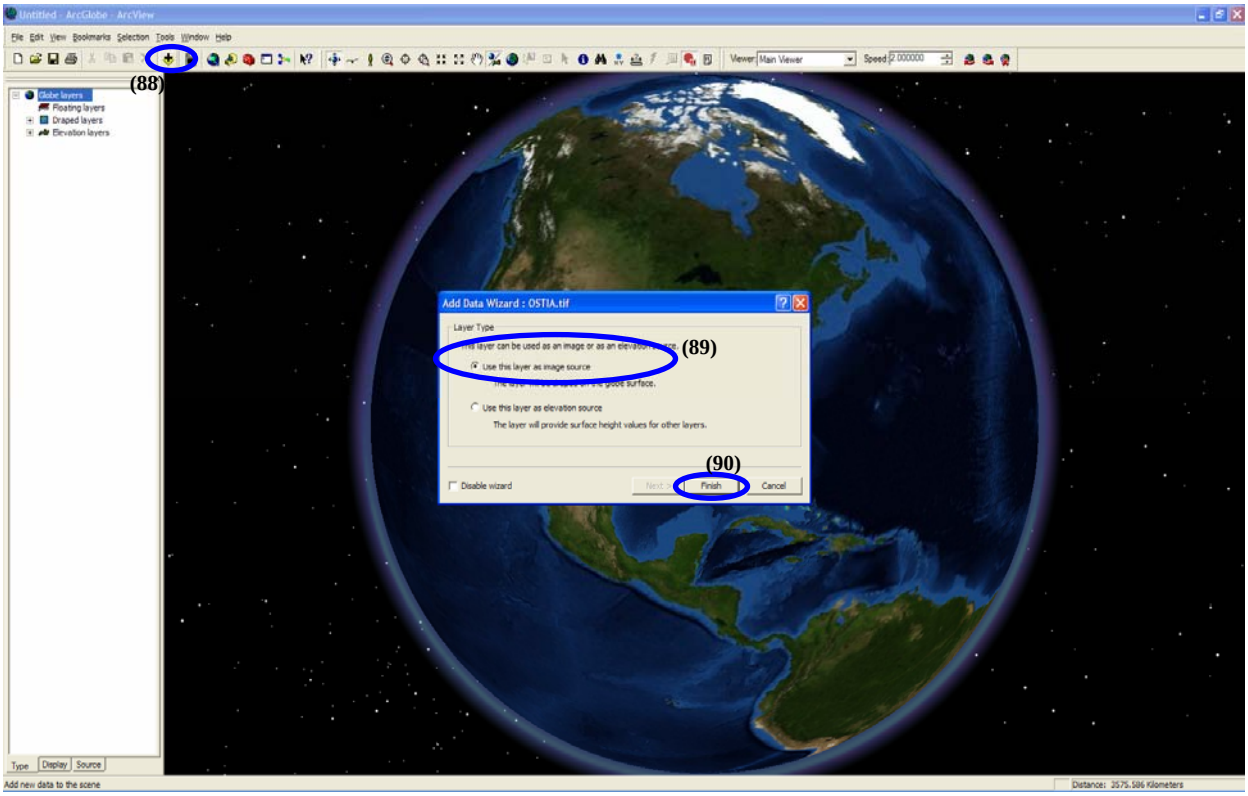
To select the descending passes, double click on the layer name (84) and select the *netCDF* tab (85). Click under *Value* (86) for the time Dimension and select the alternate value. Click Apply (87) to display.



The raster values can now be contoured or converted to other units using the *Raster Calculator*.

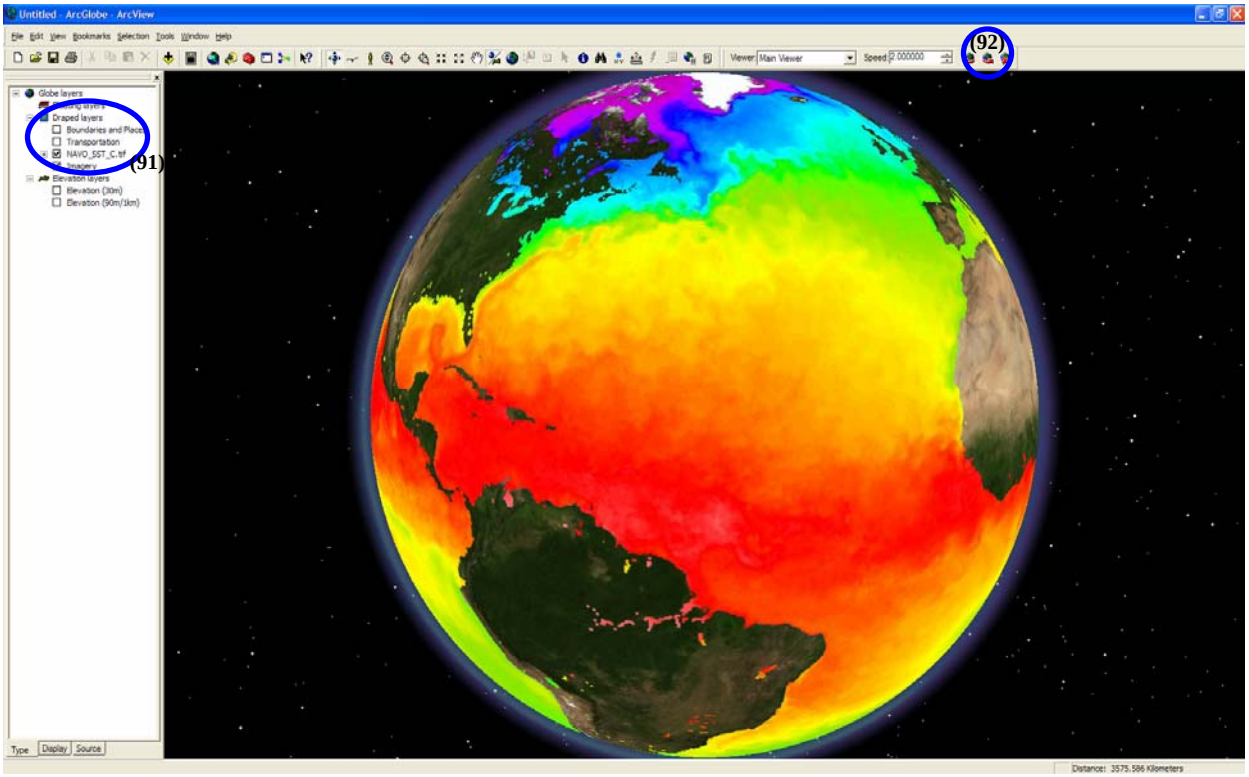
Adding L4 Products to ArcGlobe

Raster products can be added to ArcGlobe to provide a 'real world' perspective of the sea surface temperature fields. Open ArcGlobe from the ArcMap 3-D Toolbar or from the Program List. Click the *Add Data* button (88) and navigate to select a locally stored raster created from of any GHRSST product. Add the data and when prompted, click on the radio button to *Use this data as image source* (89). Click Finish (90) to exit the Add Data Wizard and add the raster as a new Layer with default symbology to the *Table of Contents*.



The raster layer is added, by default, as a *Draped Layer* to *ArcGlobe* and listed at the bottom of other *Draped Layers*. If it is not displayed automatically, drag the GHRSST layer above any other layers that are switched on (91). To modify the palette, double click on the GHRSST raster layer in the *Table of Contents* and use the *Symbology* tab.

To spin the Globe, click on the Spin Counter-Clockwise button (92).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