

Detecting submarine springs in Florida's coastal zone using thermal remote sensing data

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August 6, 2010

Summary

This lab is the continuation of the lab manual - calculating temperature, helps students to locate groundwater discharges by interpreting thermal anomalies and indentifying their geologic controls on land. There are known locations of submarine springs in the study area (<http://www.dep.state.fl.us/>).

Mapping Submarine Springs

Prepare the data to export to ArcGIS

In the previous lab – Calculating Surface Temperature, you generated a surface temperature raster using ENVI. Here you will practice how to symbolize, and visualize this data in both ArcGIS and ENVI.

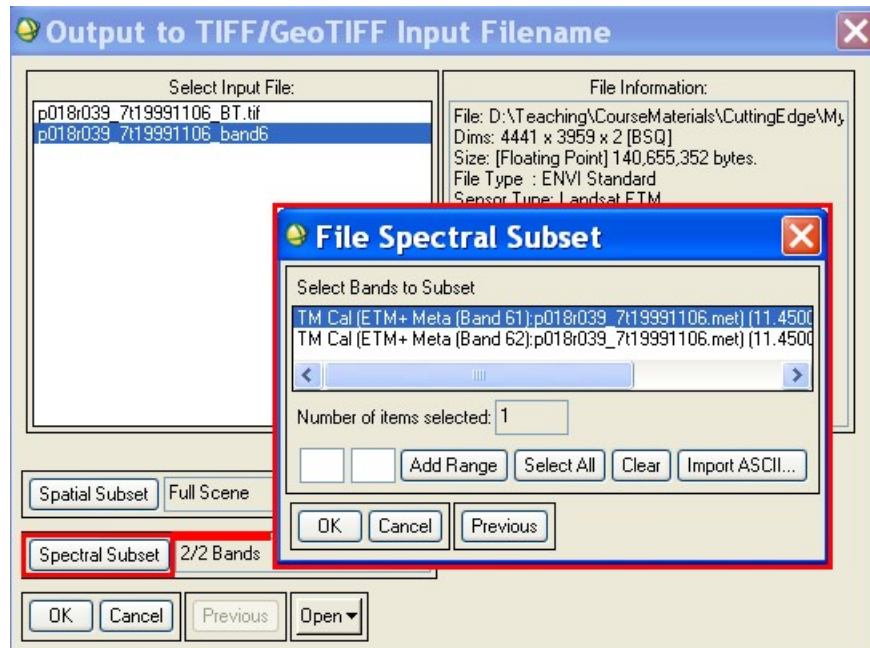
The output image was saved in ENVI native format. One way to overlay it with other data layers in ArcGIS is to export the temperature data to GeoTIFF or ESRI GRID format. While there are several ways to export ENVI native format raster to ArcGIS (such as Export to ArcMap from the display window), we use the following steps to accomplish the task.

- 1) Open temperature file you generated from the previous lab.
From ENVI main menu, **File → Open Image File**, and navigate to p018r039_7t19991106_bt

- 2) **Save File As GeoTIFF**

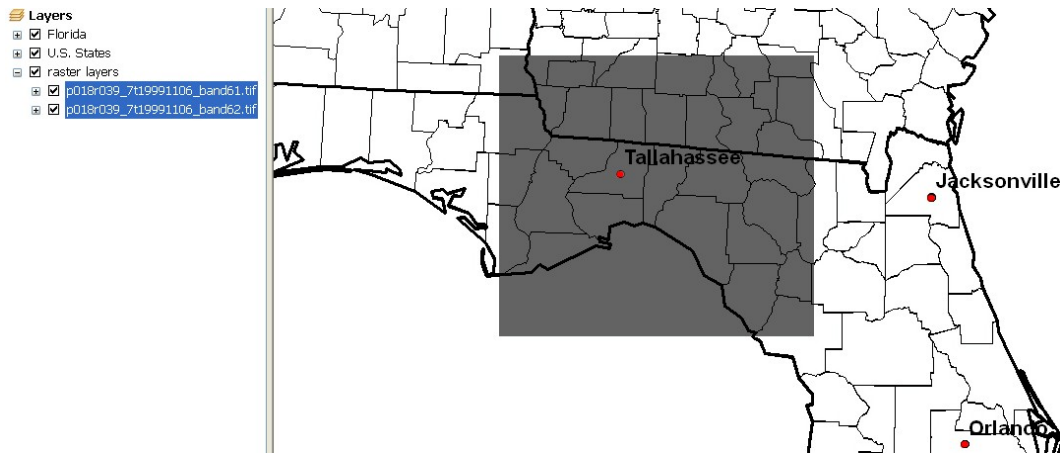
To do that, go to ENVI main menu, **File → Save File As → TIFF/GeoTIFF**. Use **Spectral Subset** button to export each thermal band to an individual image separately.
Note: You just need to export the 2nd thermal channel, i.e., band62

- 3) Name the output file as p018r039_7t19991106 _band62_bt



GIS Visualization

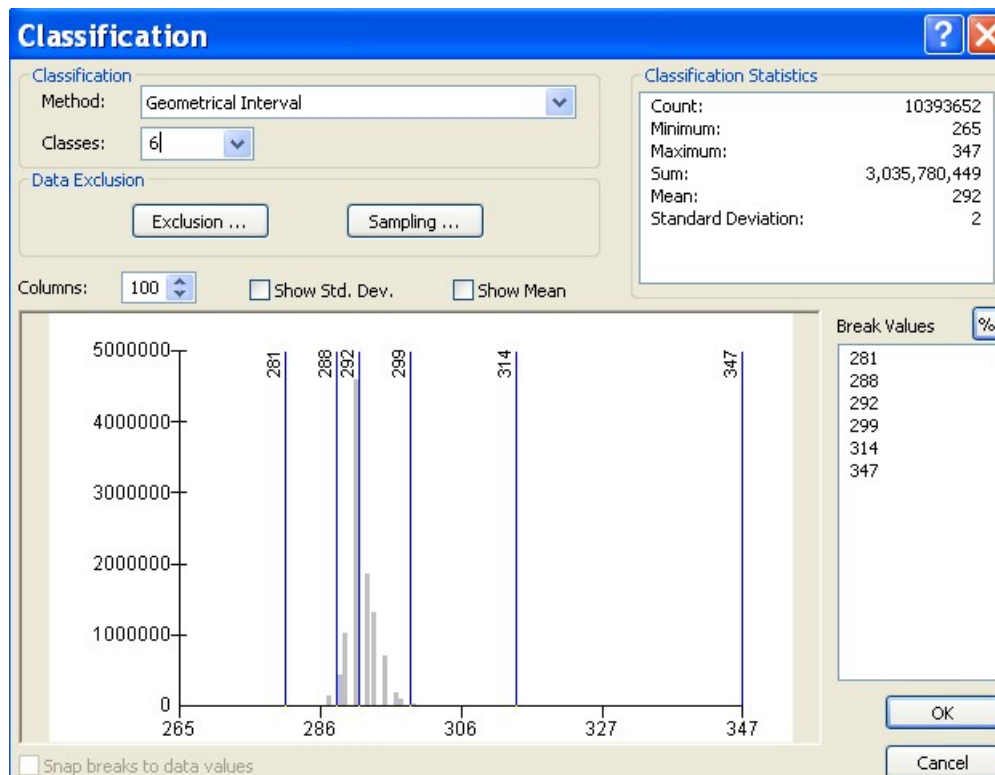
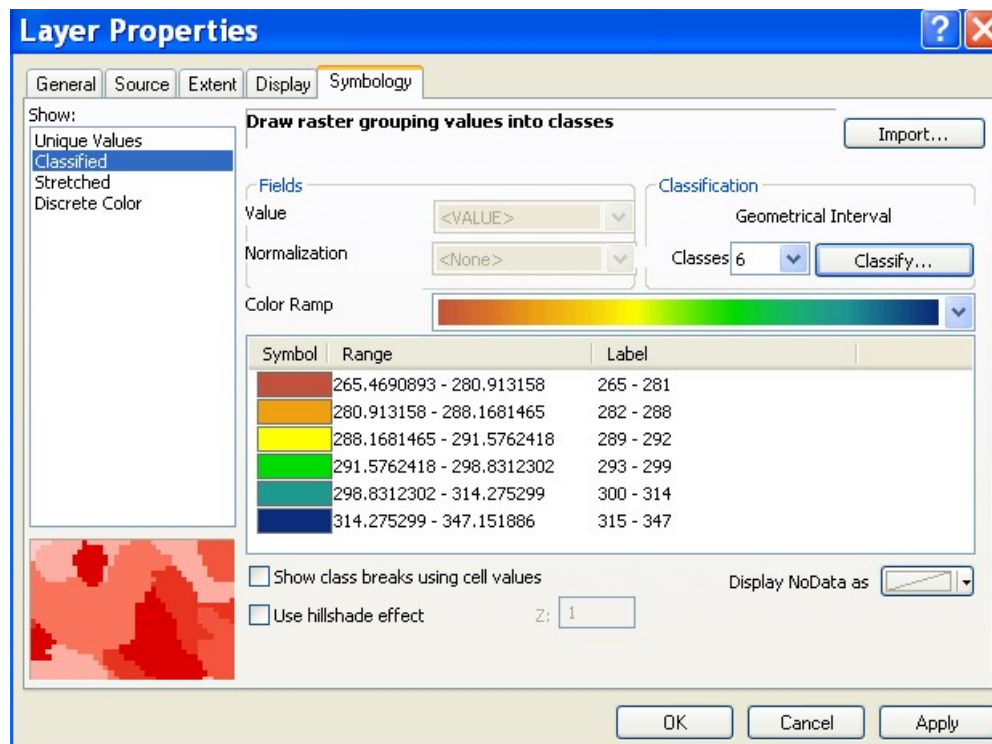
1) Open the `Springs.MXD` file in the `Florida` folder. Add the brightness temperature image `p018r039_7t19991106_band62_bt.tif`.

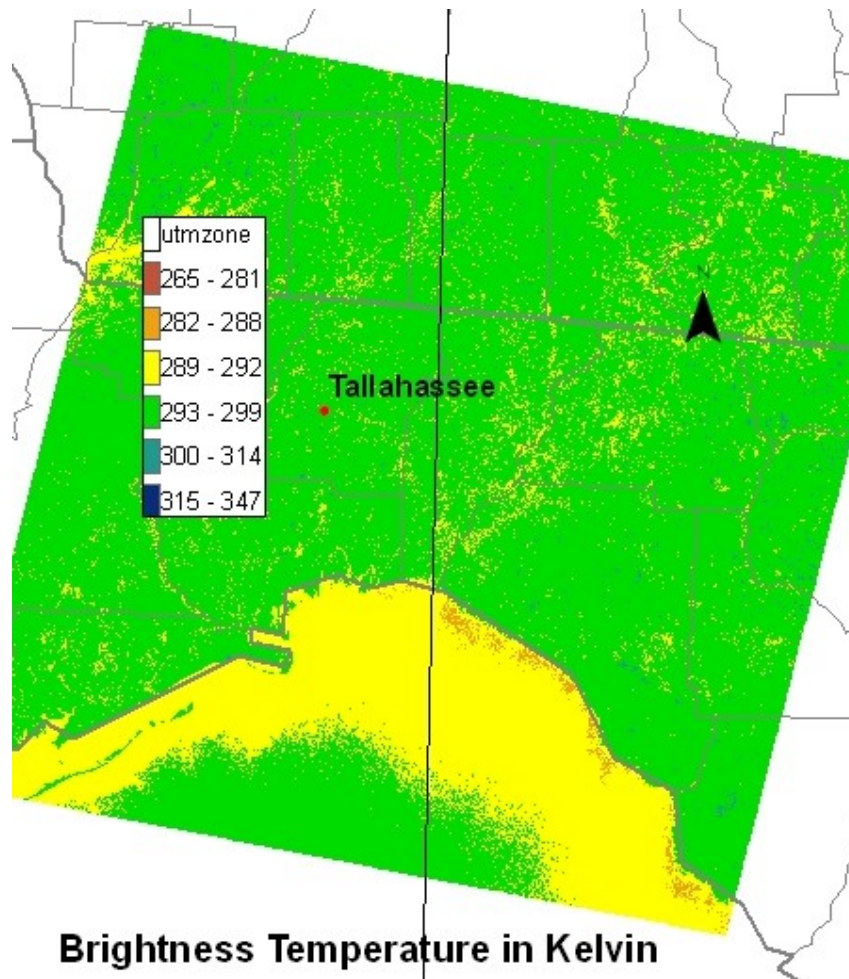


2) Right click on the image file just loaded → Properties → Symbology tab
Select **Classify** in the **Show** panel, set the **Classes** drop-down value to **6**, then **Classify**
→ **Geometrical Interval**

To exclude NoData values, click **Exclusion** button, and type **0** for the **Excluded values**.
You may notice the maximum and minimum brightness temperature from the image is 347.151886 and 265.4690893, respectively.

“The geometrical interval classification scheme creates class breaks based on class intervals that have a geometrical series. The geometrical coefficient in this classifier can change once (to its inverse) to optimize the class ranges. The algorithm creates geometrical intervals by minimizing the square sum of element per class. This ensures that each class range has approximately the same number of values with each class and that the change between intervals is fairly consistent. This algorithm was specifically designed to accommodate continuous data. It produces a result that is visually appealing and cartographically comprehensive. It minimizes variance within classes and can even work reasonably well on data that is not normally distributed.” – from *ArcGIS 10 help file*.





Quiz#1:

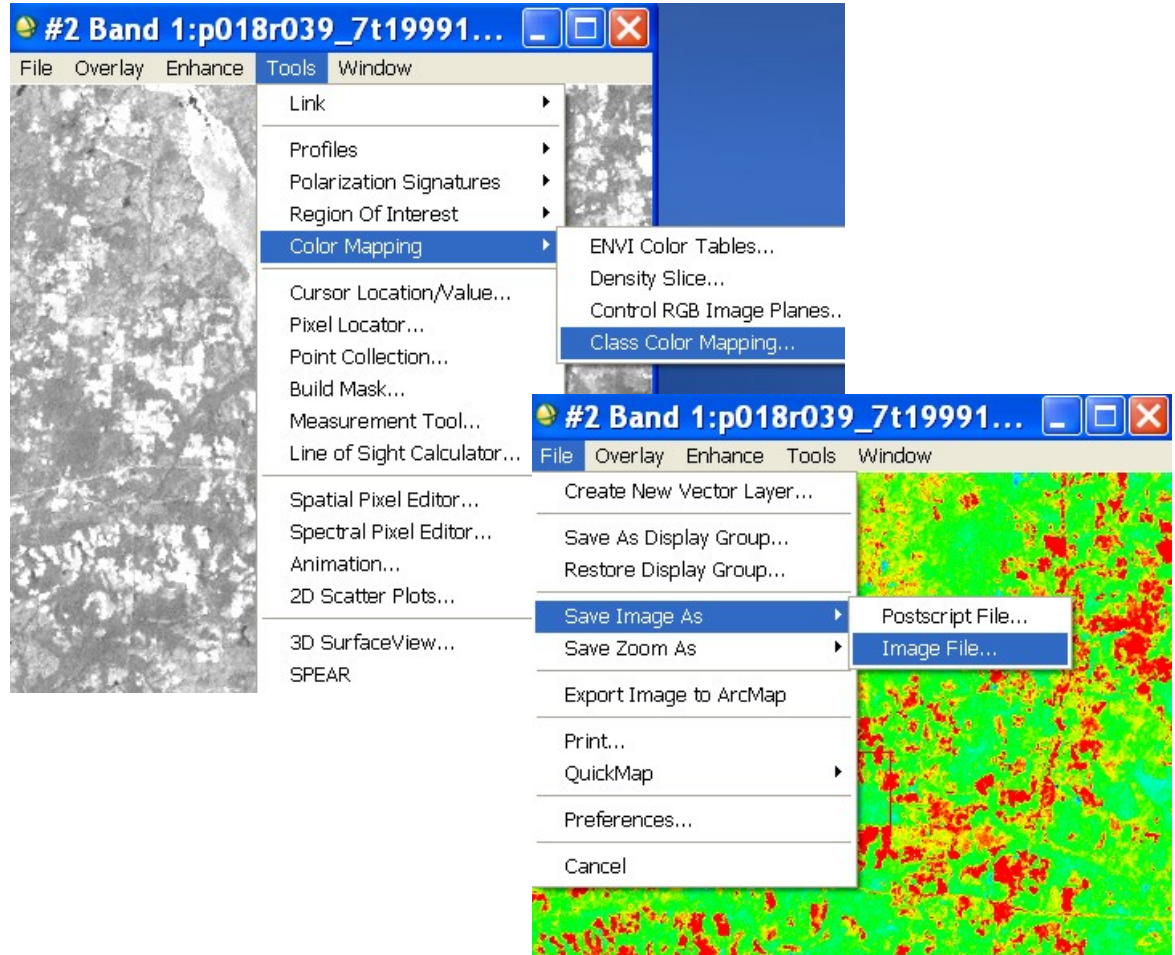
Do you think the low temperature zone in red along the coastline (to the right of the black solid line) represents submarine springs? Explain why and why not?

ENVI Color Mapping

Another way to visualize a raster image is ENVI Color Mapping tool. It is a simple and handy classification tool.

- 1) Open the temperature file in ENVI. **File → Open Image file**, and navigate to p018r039_7t19991106_band62_bt.tif
- 2) On the Display window **Tools → Color Mapping → Rainbow**, then save the file as **GeoTIFF**, name it Envi_Color_Mapping_band62
- 3) Now, load the newly saved Envi_Color_Mapping_band62 image file in your GIS map document
- 4) Right click on the newly added layer, **→ Properties → Symbology**, then check the **Display Background Value: (R,G,B)** check box.

Now, compare the maps from *Geometrical Interval* classification and *ENVI Color Mapping*



Quiz#2:

What is the difference between the ENVI functions Save File As from the ENVI main menu and Save Image As from the display window?

Signatures of submarine springs

In both images, there are low temperature zones indentified along the coastline. Aren't you convinced yet these pixels represent prospective submarine springs?

Florida Geological Survey has conducted extensive field work over the area to verify any of such potential submarine springs. BigSpring_Spring_UTM shape file included in the **vector** folder shows the site locations for the verified submarine springs. Load this shape file in your GIS map and try to associate it with thermal signatures derived from the Landsat temperature maps.

References and Resources

Akawwi, E., et al. Using Thermal Infrared Imagery (TIR) for Illustrating the Submarine Groundwater Discharge into the Eastern Shoreline of the Dead Sea-Jordan. American Journal of Environmental Sciences, 2008, 4(6): 693-700, 2008

Shaban, A., et al. Geologic controls of submarine groundwater discharge: application of remote sensing to north Lebanon. Environmental Geology, 2005, 47:512-522.

<http://www.dep.state.fl.us/geology/programs/hydrogeology/springs/powerpoint/McClean.ppt>
<http://www.dep.state.fl.us/>