Title: Consequences of Modern Energy Use: A Remote Sensing analysis of the gulf oil spill using ArcGIS software.

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Activity:

Before completing this activity, students should have a good working knowledge of computer applications.

In Physical Geography, this activity could be used as a laboratory section after discussions on remote sensing and GIS applications. In Introduction to Environmental Science, the laboratory activity will fit in well after discussions on traditional and renewable energy sources.

This laboratory activity takes place in a computer lab that is equipped with ArcGIS (we are currently using ArcGIS 9.3). Students will go to NASA's oil spill gallery website <http://www.nasa.gov/topics/earth/features/oilspill/oil\_spill\_gallery.html> and download the full size image of the Deepwater Horizon oil slick from July 14th, 2010 taken by the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA’s Aqua satellite at 1:55 p.m. Central Daylight Time. Their task is to to analyze the satellite imagery as an RGB composite and to experiment with reclassification techniques to subdivide the continuous raster dataset into user-defined numbers of ranges that will help visualize the oil spill. The activity introduces students to GIS software, remote sensing analysis, and sets up questions on spatial patterns and consequences of energy use.

Students will answer short questions designed to help them understand concepts as they proceed through a worksheet. After completing the activity, a few open-ended questions challenge students to synthesize ideas on the use of GIS and remote sensing, and the consequences of modern energy use.

**Consequences of Modern Energy Use: A Remote Sensing analysis of the gulf oil spill using ArcGIS software.**

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1. Go to the NASA oil spill gallery

* <http://www.nasa.gov/topics/earth/features/oilspill/oil_spill_gallery.html>
* Download the full size image of the oil slick from July 14th 2010 taken by the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA’s Aqua satellite at 1:55 p.m. Central Daylight Time.
* Name the image *Oil Slick July 14* and save it as a JPEG

2. Open ArcGIS (we’re using 9.3), click on Add Data, navigate to the folder where you saved *Oil Slick July 14* JPEG

* Add the data in 4 ways: First, add the *Oil Slick July 14* file, then double click on the file and add each band (Bands 1, 2, and 3) separately.
* Look at the oil slick in each of the 4 layers.

**Which layer or layers show the oil slick the best?**

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3. Work with these images to try and get the oil slick to show up better.

* Display only the **Band 1** image
* Zoom in so that the oil slick is large on your screen
* Right click on Band 1 and scroll down to the **Properties** tab and click it
* In the layer properties window, click on the **Symbology** tab
* Note that the image (raster) is in a stretched format, showing values along a black and white ramp

**What is a raster?**

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**Is this dataset a continuous raster or a discrete raster?**

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**How can you tell?**

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4. One way to highlight a particular phenomenon in an image is to **Reclassify** the image. Reclassification subdivides a continuous raster dataset into a user-defined number of ranges. This can help to visualize a dataset.

* With the Symbology window still open, click on **Classified**
* In the window it now says “Draw raster grouping values into classes”
* Click on the **Classify** tab and look at the different **methods** of classification
* Try highlighting each method in turn, clicking on apply, and analyzing the oil slick
* Compare each with the color image of the oil slick

**Which classification method showed the oil slick best?**

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* Change the display back to **Stretched**

5. We’re going to try and make our classification of the oil slick better by using the Manual classification setting. First, we need to determine a common range of pixel values for the oil affected area, and common pixel values for ocean that is not affected by oil.

* Zoom in on one of the edges of the oil slick, where you can see pixels representing open ocean and pixels representing the oil slick.
* Use the **identify tool** (it is a blue circle with the letter “i” in it),to highlight pixel boxes and determine pixel values.

**What is a common range for the oil slick?**

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**What is a common range for the open ocean just next to the oil slick?**

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* Return to previous extent and open the Symbology window again
* Click on classified and the classify tab
* Click on the manual method, now in the window you can slide the bars around on the histogram and put them wherever you want them.

**Based on where you found ranges for the oil slick, where is the best place to divide the data?**

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* Experiment with the manual method and find a good way to display the oil slick

**Is your Manual Breaks method better than the best default method?**

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6. Now highlight the RGB composite image in GIS and open the properties tab, click on symbology.

* Experiment with changing the colors represented by each band.

**Which color combination best highlights the oil slick?**

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* Try the different **histogram stretches**
* Click on the invert tab

**What happened?**

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* Run statistics on the current display extent.

**What happened?**

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* Try Pan Sharpening

**What happened?**

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7. Download and analyze the oil slick imagery from April 29 and May 24 and compare the 3 sets of images.

**Describe the spatial and temporal patterns of the oil spill.**

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**How are wind patterns related to ocean currents in the Gulf of Mexico?**

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**What do the spatial patterns of the oil spill tell you about ocean currents in the Gulf of Mexico?**

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**Describe in detail, another application of these methods.**

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