# Preparing Images for Change Detection

Change detection is a very common and powerful application of satellite based remote sensing (RS). We now have at our disposal a potential archive of images spanning more than 30 years. Depending on your specific project requirements you may need to work with several different images. For example, a vegetation phenology study might require images of different seasons. To examine change over long periods of time you may work with images from different sensors that have different spectral and spatial resolutions. A landcover change project examining a region in 1975, 1990, and 2002 might use Landsat MSS, TM, and ETM+ images.

You need to consider and resolve any image-based differences before you can examine real changes on the surface of the Earth. This important category of processing functions is generally referred to as image preprocessing. Common preprocessing steps include: atmospheric correction, image rectification (georeferencing), and image subsetting.

## *Atmospheric Correction*

Images acquired at different times usually have different amounts of haze and dust in the atmosphere. These differences can mask real changes or make similar landcover appear to have changed. For example, if haze covered a forest in only one of two images, the calculated NDVI for this area would be different between dates and may register as a change. This topic is beyond the scope of this document. You should refer to literature on the subject if you wish to perform this process. Useful review papers include Chavez (1996) and Hadjmitsis (2004).

## *Image Rectification*

Before you can compare differences between images you have to make sure that they properly align to each other. This is referred to as image rectification. If they actually align to real world coordinates, these images will also be *geo*referenced. Detailed instructions on how to do this can be found in textbooks, RS software manuals, or in the Lab04 exercise in the *Observing Earth From Space* (OEFS) course.

There are a couple of techniques that you can use to examine how well your images are rectified. If the images do not align well to each other, you will need to rectify them before you can perform a change detection analysis or compare them in detail.

The first method to check alignment is to visually inspect the images. Open two (or more) windows and load an image in each. Resize the windows so they are large enough to show detail and can fit side by side on the screen at the same time. Make them the same size by temporarily overlaying one window on the other and dragging a corner to align them. Rearrange the windows for easy viewing and geolink them. You can now zoom in to various features within the scenes to compare the two images. Make sure that you check the alignment at multiple locations around the scenes.

Another useful technique to compare rectification is to overlay two images in the *same* window. Create an RGB algorithm and place one image in the Red layer and the other image in the Green layer. Turn off or delete the Blue layer. Finally apply the NDVI formula to each layer. Now you can roam and zoom within the scene to examine the alignment, paying particular attention to features with regular edges. Misaligned images will display a uniform shifting of colors. You may see a large building, field or river that has a thin red edge on one side while the opposite side has a thin green edge.

## *Image Subsetting*

Once you have properly rectified the images and performed any other preprocessing, you should consider spatially subsetting the images to reduce the area of analysis. Typically you will simply subset an image by cutting a rectangular area around your region of interest. You can also subset an image to an irregular boundary using a vector file. Students of the OEFS course can refer to Lab06 for instructions on how to do this.

The CEO Users Guide provides detailed instructions on how to subset an image using the ERMapper software. Basically you zoom in to an area slightly larger that your study area, adjusting the window height and width to your liking. You can then cut the image using the image cell coordinates.

Cutting the first image is the easy part. Subsetting a second image, to exactly the same footprint as the first image, can be a bit of a challenge. To do this you will use some of the techniques described above in the Image Rectification section. Load your previously subset image into a window and select the "Zoom to All Dataset" option in ERMapper. This will resize the aspect (height and width) of the window to fit the entire dataset.

Open a second window and load the image you wish to subset. Adjust the size of this window to match your subset image window exactly. Now you can geolink the two images and, if the rectification between images is good, you should see exactly the same area in both windows. Remember in ERMapper you must geolink the *previously* subset image first, then geolink the image you *wish* to subset. Make the window for the *image to be subset* active and use these image cell values to cut this image. You will now have two images of the same size (within a fraction of a pixel) covering the same place on the Earth.