Remote Sensing Science to Support Monitoring in the Great Basin

Objective: To determine the value of imagery and image classification methods to support landscape level, long-term monitoring across the Great Basin.

Background: The Great Basin Integrated Landscape Monitoring (GBILM) pilot is an interdisciplinary undertaking initiated in 2005 to address the topic of monitoring ecological and human systems in the Great Basin at the landscape scale. This call for proposals provides an excellent opportunity to develop remote sensing tools and protocols to acquire and analyze monitoring data and predict landscape change.

Proposed Approach: The GBILM pilot requires high quality, temporally robust imagery to effectively monitor the 45-million-hectare Great Basin. This imagery will be a critical component of a "monitoring toolkit" that will form the backbone for long-term natural and cultural resource monitoring in the region. GBILM proposes to develop a 'proof of concept' analysis that relies on a combination of medium-scale, large extent, and inexpensive imagery with a set of finer-scale data that will be used as a sampled subset of the area-of-interest. We propose to identify characteristic signatures of landscape change using the fine-scale imagery and develop correlates with information in the coarse-scale to 'scale up' our ability to monitor environmental changes in the region.

The time-series data will be a highly useful stand-alone product for all ongoing and proposed GBILM projects including those investigating fire and invasive species interactions, effects of land treatments, effects of groundwater use on surface vegetation, climate change scenarios, and motor vehicle impacts. For example, we could identify wildfire and land treatment boundaries and patterns that are not consistently archived region-wide. We could investigate ecosystem-specific landscape changes over time. Other applications might include using the imagery and existing algorithms (i.e., those developed by the DOI Burn Area Emergency Response (BAER) team) to model burn severity in each of the time steps or using the Landsat data to relate phreatophytic vegetation changes to groundwater withdrawal over the past 3 decades. We might also evaluate landcover changes related to climate trends over a 30 year span.

Proposed FY07 Activities: For 2007, we propose to acquire sets of Landsat scenes that depict specific (ideally, one-week) periods over a 30-year time series. The hand-selected sets of imagery will consist of cloud-free scenes that cover the entire Great Basin and Snake River Plain regions (see attached figure) in 7 time series (2005, 2000, 1995, 1990, 1985, 1980, and 1975) chosen to:

- minimize variance in reflectance distortions among the scenes from a given set
- represent a consistent time period among series (most likely mid growing season)
- provide a consistent baseline set of imagery that can be used for a broad spectrum of analyses, modeling, and monitoring by the GBILM and other USGS efforts.

We identified Landsat imagery as ideal for this application because of it has broad application, is relatively inexpensive, and long-term compatibility with similar satellite-based sensors that are planned for deployment in the near future.

We also propose to acquire high resolution satellite imagery (Quickbird or Ikonos) over an area of 1,000 km^2 to inform the content of the Landsat imagery.

Proposed FY08 Activities: In FY08, we propose to proceed on two related and concurrent paths:

1. Image processing and analysis of the Landsat imagery for vegetation and landcover and human disturbance for the entire Great Basin. Some processes that can be monitored at this scale are general vegetation and landcover changes, human disturbance of the earth's surface including roads and urban areas, changes in phreatophyte distribution related to ground-water withdrawals.
2. Collection and processing of high resolution satellite imagery (Quickbird or IKONOS) in a selected priority area to inform the content of the lower scale Landsat imagery as well as monitor finer scale processes. Potential processes that can be monitored at finer scales include specific changes in rangeland vegetation composition related to invasive species, land treatments, wildfires, and other processes. These other imagery do not have the lengthy record that Landsat does, but could serve to begin monitoring landscape processes into the future.