Landscape Dynamics and Terrestrial Vegetation

Protocol: Landscape Processes

Parks Where Protocol Will Be Implemented: LACL, KATM, ANIA, ALAG, KEFJ

Justification/Issues Being Addressed: SWAN parks are in an extremely dynamic region. The major landscape drivers are climate and terrain and the interactions between them. The climate is driven by the interplay of cold arctic and warm maritime systems that meet across the SWAN area. The parks are arrayed along the edge of the subduction zone where the North Pacific plate is diving beneath the North American plate. This tectonically active area has multiple arcs of mountains rising abruptly from sea level, frequent earthquakes and uplift, and numerous active volcanoes. The coastal mountains are distinguished as some of the snowiest places on the planet, resulting in the greatest density of tidewater and valley glaciers outside Antarctica. The annual storm pattern in the region is a critical feature of the climate-hydrologic cycle in the network parks (Bennett et al. 2004).

SWAN has identified several physical and biological processes to monitor across all the parks in the Network. These processes have been combined into the vital sign Landscape Processes. These processes include freeze-up and break-up of large freshwater and marine water bodies, pattern and timing of snow cover, pattern and timing of surface sediment in large lakes, timing of vegetation green-up and senescence, and relative biomass. Some of these are affected by large-scale patterns that extend beyond the immediate park boundaries into the surrounding region of southwest Alaska and marine waters. A common theme of these Landscape Processes is the need for a temporal window of days to weeks, a large spatial scale across the region, and the potential to use remotely sensed data to interpret and integrate these processes. Remotely sensed data also provide an opportunity to build an archive of historic images that may be used to evaluate episodic events such as ash deposition from volcanoes or large-scale human development, including logging and mines.

Specific Monitoring Questions and Objectives to be Addressed by the Protocol:

Questions:

- How are onset, duration, and extent of ice cover changing on large lakes in SWAN parks?
- How are timing, location, and duration of snow cover changing in SWAN parks?
- How are timing and relative extent of sediment plumes changing in large lakes and river mouths in SWAN parks?
- How are onset, duration, and relative biomass of vegetation productivity changing in SWAN parks?

Objectives:

- Track long-term trends in lake freeze-up and ice break-up dates in large lakes in SWAN parks.
- Estimate long-term trends in duration of snow cover in SWAN parks.
- Estimate long-term trends in spatial extent of August sediment plumes for Lake Clark, Naknek Lake, and Resurrection Bay offshore of Bear Glacier.
- Estimate long-term trends in growing season normalized difference vegetation index in SWAN parks.

Basic Approach: The primary tool to monitor landscape processes will be multispectral satellite data similar to that currently acquired by the MODIS satellites. MODIS satellites fly a polar orbit and acquire data for the entire earth daily. Data are acquired in visible, near infrared, and thermal bands that can be composited and enhanced to provide images and time-integrated products. Initial investigations reveal complex spatial and temporal patterns of lake and sea ice, snow cover, and green-up/senescence timing and patterns across North America and the SWAN region (Reed 2005). Images derived from MODIS data can be analyzed manually or with algorithms to provide information about the landscape processes discussed above. Rectified images and derivative products will be archived in the SWAN databases or

served through the Alaska Geographic Data Clearinghouse through USGS. Interpretations will be stored as geographic information system or flatfile data as appropriate. Initial protocol development is being accomplished through an interagency agreement (IA) with USGS at the Earth Resources Observation & Science (EROS) Data Center (Reed and Budde 2004).

Principal Investigators and NPS Lead:

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Development Schedule, Budget, and Expected Interim Products:

The IA with USGS EROS began March 1, 2005. A draft protocol will be presented to SWAN by October 1, 2005, with the final protocol available by December 15, 2005. NPS personnel will test the protocols in FY06, with implementation in FY07. The IA is funded for $40,376. An additional $10,000 will be used to purchase software and training for NPS use to test and implement the protocols. MODIS data are free.

Literature Cited:

Bennett, A. J., K. L. Oakley, and D. C. Mortenson. 2004. Phase II vital signs monitoring report, Southwest Alaska Network. National Park Service, Anchorage.

Reed, B. 2005. Monitoring phenological trends from satellite imagery. USGS Land Remote Sensing Science Fair, April 12, 2005. Reston, Va. PowerPoint file.

Reed, B., and M. Budde. 2004. Study plan for protocol development for satellite-derived measures of landscape processes. USGS-EDC.