Landscape Processes - *Seasonality of Growing Season, Snowpack, and Lake Ice*

Resource Brief
October 2011

Importance

Regional warming is expected to result in more variable snowpack, lake ice, and growing season length in southwest Alaska, all of which will affect ecosystem and landscape-level processes. For example, the timing of snowpack development and snowmelt, the duration of snowpack, and the area covered by snow affect the timing of runoff, soil thaw, stream flow, plant growth, and wildlife movements. In some areas, early loss of snow could lead to frost damage and dieback of vegetation, whereas in others, it could result in a longer growing season.

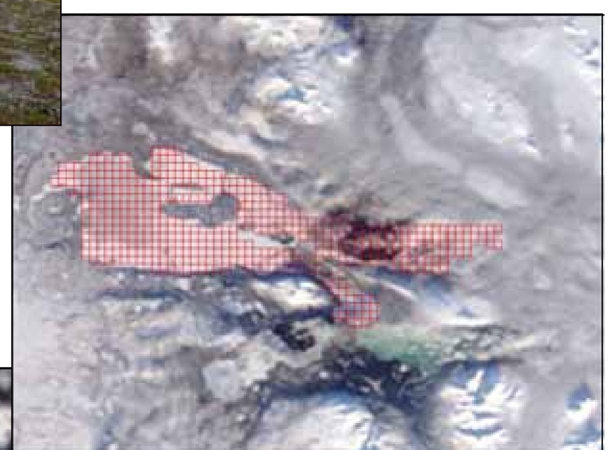
Status and Trends

The SWAN has worked with the Earth Resource Observation and Science Center - a division of the U.S. Geological Survey (USGS) and the University of Alaska – Geographic Information Network of Alaska (GINA) to develop methods for using Moderate Resolution Imaging Spectroradiometer (MODIS) data to monitor changes in seasonality of key ecological events. USGS developed a protocol that has been used by GINA to (1) obtain, reprocess and serve MODIS and Advanced Very High Resolution Radiometer data through web coverage and mapping services, and (2) automate the calculation of growing season metrics (e.g., start and end of growing season, as determined from the Normalized Difference Vegetation Index or NDVI). To date, seasonal variation in growing season, lake ice, and snow extent have been described for 2001-2006 (Reed et al. 2009). Calculation of growing season metrics and lake ice cover through 2011 are ongoing. In 2010, three time-lapse cameras ('phenocams') were installed at remote automated weather stations (RAWS) in the SWAN to validate the timing of green-up, snowpack development, and snowmelt at individual sites.

Chuck Lindsay, SWAN physical scientist, installs a time-lapse camera at the Contact Creek weather station in KATM.

Discussion

Lake ice has been manually interpreted for 17 lakes in SW Alaska for 2001-2010. Freeze-up dates have varied widely during that time. Average winter lake ice duration is 124 days. Freeze-up has generally lagged the snow season by 2-3 months (Reed et al. 2009). Warmer than average temperatures during two strong El Niño events (winters of 2002-03 and 2004-05) resulted in only brief or partial freezing many large lakes, including Naknek Lake (Fig. 1).



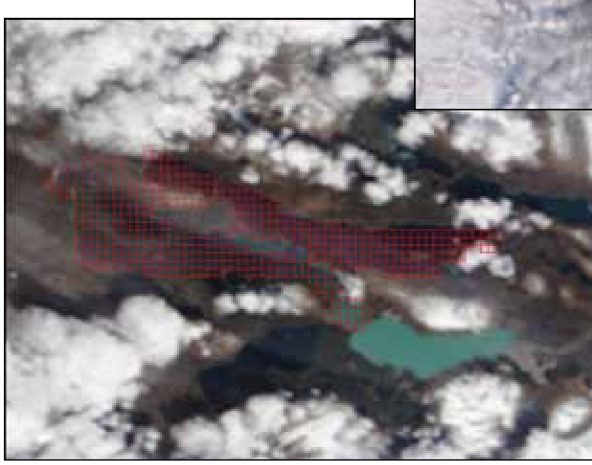


Figure 1. Lake ice cover is estimated by superimposing a grid over MODIS images throughout the winter. These MODIS images show that freeze up didn't occur on Nakenk Lake (KATM) until Jan. 21, 2010 (upper); complete break up occurred on May 17, 2010 (left).

Discussion (continued)

Growing season metrics analyzed for 2001-2006 showed MODIS-derived start of season dates varying by as much as 22 days across years, and end of season dates varying by as much as 25 days (Reed et al. 2009). Start of season dates correlate with snowmelt, such that early snowmelt resulted in early green-up. Photos downloaded from phenocams have shown that for the 2010-2011 season, snowpacks were thin and often ephemeral at these sites. A time-series of photos from Contact Creek showed a nearly 2-month lag between snowmelt and green-up in 2011 (Fig. 2)).

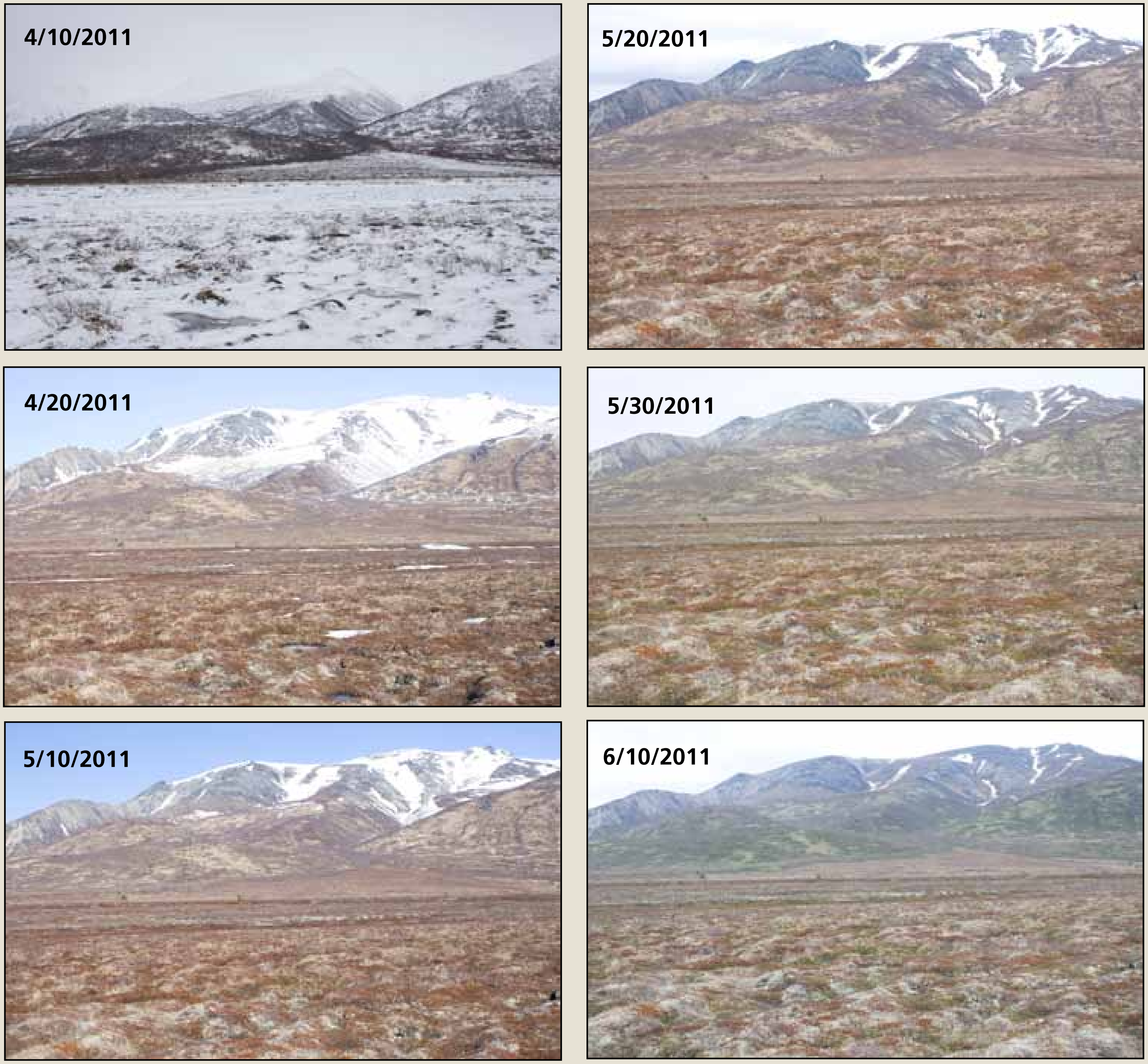


Figure 2. Daily images from a time-lapse camera ('phenocam') at Contact Creek, KATM. Photos will be analyzed yearly for estimation of approximate snowmelt (left; April 10-May 10) and green-up dates (right; May 20-June 10).

References

Reed B, Budde M, Spencer P, Miller A. 2009. Integration of MODIS-derived metrics to assess interannual variability in snowpack, lake ice and NDVI in southwest Alaska. Remote Sensing of Environment 113:1443-1452.

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