Remote-sensing study quantifies permafrost degradation in Arctic Alaskan wetlands

April 18 2013

A team of geoscientists from Southwest Research Institute (SwRI) using newly available remote-sensing technology has achieved unprecedented detail in quantifying subtle, long-period changes in the water levels of shallow lakes and ponds in hard-to-reach Arctic wetlands.

Analysis comparing time-lapsed, high-resolution satellite imagery of the Ahnewetut Wetlands in Kobuk Valley National Park, Alaska, revealed an accelerated loss of surface water in shallow thaw lakes and ponds over a recent 27-year period compared to the preceding 27-year timespan. Those periods generally coincide with a well-known cooling and warming cycle known as the Pacific Decadal Oscillation, whose period is about five decades.

The analysis compared historical high-resolution aerial photography with more recent satellite imagery to quantify the evolution of 22 shallow lakes and surrounding permafrost in the park over 54 years between 1951 and 2005.

"Total water-body surface area decreased by only 0.4 percent during the first 27 years, but decreased by 5.5 percent during the second 27-year interval," said Dr. Marius Necsoiu, principal investigator for the study and a principal scientist in SwRI's Geosciences and Engineering Division. Water body surface area was relatively stable during the early, cooler time interval, with large relative losses in small ponds balanced by small relative gains in large lakes. More significant decreases in surface area occurred during the latter, warmer timespan, including complete

drainage of two ponds.

Meanwhile, ice-wedge "polygons" in the soil between the water bodies (so-named because of their geometric shapes when viewed from above), transformed from having relatively low centers to relatively high centers during the more recent interval after little change was detected during the first 27 years. The change can be explained by the melting away of ice wedges that had formed the elevated rims of the polygons, leaving the rims depressed in comparison to the polygon centers.

"This project showed that semi-automated analysis of remote-sensing data can yield important information about wetland lake dynamics and permafrost degradation in remote areas where limited funding and staff shortages prevent detailed inspections on the ground," Necsoiu said.

The SwRI-funded study was published under the title, "Multi-temporal image analysis of historical aerial photographs and recent satellite imagery reveals evolution of water body surface area and polygonal terrain morphology in Kobuk Valley National Park, Alaska," by Necsoiu, Dinwiddie, Walter, Larsen, and Stothoff in the journal *Environmental Research Letters*.

Provided by Southwest Research Institute