Kobuk Valley National Park Landscape Change Detection Using Remotely Sensed Data and Geomorphologic Assessments

Project: 20.R8003

Sponsor: SwRI® Advisory Committee for Research

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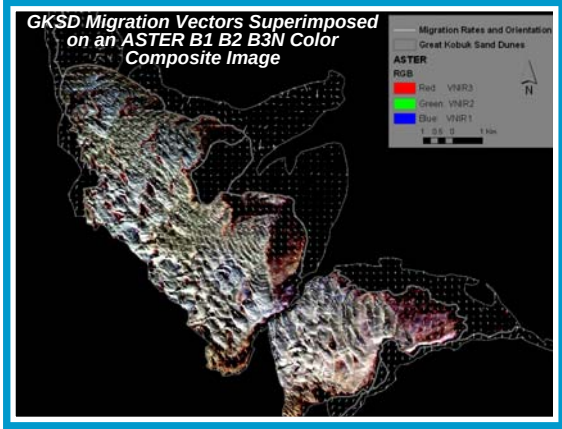
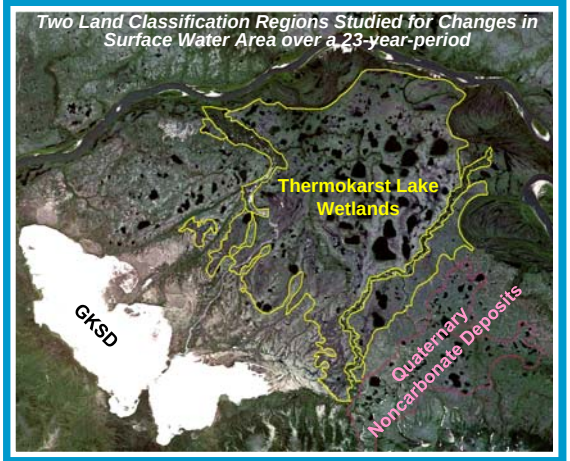
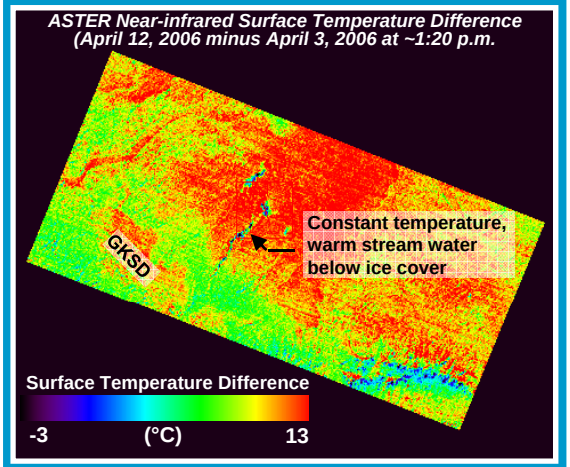
Inclusive Dates: 10/2008 to 2/2009



GKSD Migration Vectors Superimposed on an ASTER B1 B2 B3N Color Composite Image



Two Land Classification Regions Studied for Changes in Surface Water Area over a 23-year-period



ASTER Near-infrared Surface Temperature Difference (April 12, 2006 minus April 3, 2006 at ~1:20 p.m.

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Program Brief

Background: This project was undertaken to strengthen proposals submitted to the National Science Foundation (NSF) and National Aeronautics and Space Administration (NASA) to conduct geomorphologic and atmospheric field and modeling studies of the Great Kobuk Sand Dunes, Kobuk Valley National Park, Alaska. This aeolian dune system and its thermokarst environs at 67° north latitude are bellwethers for subarctic climate change; the dunes also serve as terrestrial geophysical analogs to Martian dunes potentially affected by movement-arresting permafrost. Scientific research in this park has lulled since the 1980s, so very little recent information about park resources was available at the time this IR&D project commenced.

Approach and Accomplishments: To close this knowledge gap, this 4-month project was funded to develop staff capabilities in the detection of change in remote subarctic landscapes. SwRI staff developed a new method for processing multispectral imagery to estimate rates of landscape change. The Multispectral Data Displacement Analysis (MDDA) method builds upon the foundation of the Co-registration of Optically Sensed Images and Correlation (COSI-Corr) technique. Using this method, staff estimated spatially distributed rates of sand dune migration at the Great Kobuk Sand Dunes. The Great Kobuk Sand Dunes migration rates are much lower than those of low-latitude aeolian dunes; this subarctic dune field may be arrested by the presence of permafrost deep within its core. Satellite imagery processed to quantify changes in thermokarst lake surface water area indicates a general decrease in area between 1985 and 2008; this decrease may result from a warming climate. Near-infrared imagery processed to quantify changes in land surface temperature during spring thaw revealed relatively warm temperatures along a stream bisecting the sand dunes; warm stream temperatures may indicate areas of groundwater discharge.

Client Benefits: We are the first to integrate multispectral data, the COSI-Corr technique, orientation filtering, and orientation projection to reliably measure slowly migrating sand dunes, landscape and vegetation changes, and other processes that affect optical data patterns. Adding the MDDA technology to our existing capabilities has expanded the range of ground movements we can detect using satellite data to those occurring horizontally.

Publications and Presentations: [1] Hooper, D.M., M. Necsoiu, C.L. Dinwiddie, R.N. McGinnis, and G.R. Walter. Preliminary ALOS data analysis of thaw lakes, aeolian dunes, and polygonal ground in the Kobuk River valley, Alaska. *AGU Fall Meeting*, San Francisco, CA, December 14–18, 2009. [2] Necsoiu, M., S. Leprince, C. Dinwiddie, D. Hooper, G. Walter, and R. McGinnis. Recent migration rates of the Great Kobuk Sand Dunes, Alaska: Technologic and scientific implications for planetary dune systems. *Lunar and Planetary Science Conference XXXX*, The Woodlands, TX: March 23–27, 2009, Abstract 2074. [3] Necsoiu, M., S. Leprince, D.M. Hooper, C.L. Dinwiddie, R.N. McGinnis, and G.R. Walter. Monitoring migration rates of an active subarctic dune field using optical imagery. *Remote Sensing of Environment, 113*(11):2,441–2,447, doi:10.1016/j.rse.2009.07.004, 2009. [4] Necsoiu, D., D.M. Hooper, C.L. Dinwiddie, R.N. McGinnis, and G.R. Walter. Preliminary ALOS data analysis of thaw lakes and polygonal soils in the Kobuk River valley, northwestern Alaska. *3rd ALOS Joint PI Symposium*, Kona, HI, November 9–13, 2009. [5] Necsoiu, D., C.L. Dinwiddie, G.R. Walter, D.M. Hooper, and R.N. McGinnis. Multispectral remote sensing technologies applied to assess recent aeolian activity and thaw lake changes in Kobuk River valley, Alaska. *AGU Fall Meeting*, San Francisco, CA, December 14–18, 2009.