ASF Alaska Satellite Facility
News & Notes
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DEM Control in Arctic Alaska Using ICESat Laser Altimetry

Dedicated researchers are known for doing whatever it takes in the field to get the data they need. In this case, dedication meant traveling to Barrow, Alaska, in March 2004 and setting out on snow machines with an Inuit guide who kept watch for polar bears.

PHOTOS COURTESY OF REGINALD MUSKETT

Using the scope on his rifle, guide Perry Anashoak keeps an eye out for any signs of polar bear in the distance while others on the team assemble equipment and collect GPS measurements on the surfaces of frozen tundra lakes near Barrow, Alaska. In this case, the creature spotted out on the distant horizon turned out to be a caribou.

Reginald Muskett, a UAF Geophysical Institute (GI) doctoral candidate in geophysics, and ASF Remote Sensing Service Center Manager Don Atwood took Global Positioning System (GPS) measurements of geographical position and elevation on five frozen tundra lakes within 50 miles of Barrow.

Their GPS data collection is part of a project investigating the suitability of ICESat laser altimeter data for control of digital elevation models (DEMs) in arctic Alaska. Accurate control is essential for DEMs.

On-ground differential GPS measurements, such as those made by the researchers, have excellent accuracy. The Barrow GPS measurements taken in March were compared to elevation measurements on the same tundra lakes derived from data acquired in fall 2003 by NASA's Geoscience Laser Altimeter System (GLAS), which is carried onboard the ICESat satellite.

GLAS instrumentation is a next-generation space lidar that combines a precision surface lidar with a sensitive cloud and aerosol lidar.

ICESat is a NASA Earth Observing System (EOS) satellite mission, launched in January 2003.

The 2003 ICESat/GLAS-derived elevations on the tundra lakes compare closely to the ground differential GPS eleva-tions measured on those same lakes. ICESat altimetry will therefore provide high quality DEM control in this region.

More recent ICESat/GLAS elevations, derived from data acquired during February and March 2004, will also be included in the analysis after these data are processed and made available by the National Snow and Ice Data Center in Boulder, Colorado.

Comparing datasets taken over the flat, relatively uniform terrain of the Alaska North Slope is an important first step in this project. Additional verification will involve comparisons to accurate high-resolution DEMs derived from STAR3i (airborne) interferometric SAR data provided by Intermap Technologies, Inc.

In the next, more challenging phase of the project, comparisons will be

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Shown above is sunrise at the Barrow Arctic Science Consortium (BASC) facility, which hosted the researchers. The consortium is a community-based organization dedicated to establishing closer contacts between scientists and community members.

The BASC facility was once the Naval Arctic Research Laboratory, which was assumed from the U.S. Office of Naval Research in 1980 by the local Ukpeagvik Inupiat Corporation. A cooperative agreement with the National Science Foundation's Office of Polar Programs provides funding for BASC, outfitting and providing logistical support to researchers conducting fieldwork in the area.

Muskett's breath entered through the vents at the bottom of his goggles and condensed, freezing his eyelashes shut. Temperatures ranged from 20 to 25 degrees below zero (F) that day, with a wind chill factor that effectively lowered them further to more like 53 to 60 degrees below zero (F).

InSAR Workshop

The recently formed InSAR Working Group will hold a workshop October 20-22, 2004 at the Embassy Suites Mandalay Beach in Oxnard, California.

Travel support for U.S. participants have been secured from NASA. Foreign participants are invited, but are expected to fund their own travel.

The workshop will provide an assessment of current InSAR science research and mission technology and further define science objectives that can be addressed through the use of InSAR.

It will also include discussions of mission architecture scenarios, ideas for community education and advocacy, and the objectives and structure of the InSAR Working Group.

For more information about the InSAR working group, see the webpage at http://solidearth.jpl.nasa.gov/insar/. If you want to attend the workshop, please fill out the application form there. ♦

— DEM Control (*continued*)

made over some of Alaska's more rugged and varied terrain. Analogous comparisons will be carried out among ICESat-derived elevations, ground GPS measurements, and airborne interferometric SAR-derived DEMs in suitable areas.

The preliminary results in this project indicate that ICESat/GLAS-derived elevations on frozen tundra ponds have accuracies of about 3-30 cm relative to ground GPS measurements. ICESat altimetry will thus be an excellent source of control for digital elevation models in this region, which may include DEMs derived from ASF SAR data.

In addition to Muskett and Atwood, others at the GI carrying out this National Geospatial Intelligence Agency-funded project include Research Professor Craig Lingle (principal investigator) and co-investigators from ASF: Nettie La Belle-Hamer (director), Rudi Gens (remote sensing scientist) and Rick Guritz (special projects manager). GI Research Professor Jeffrey Freymueller is carrying out precision differential reduction of the GPS data, and Britton Kerin from ASF is software engineer for the project. ♦

by Craig Lingle

Corner Reflectors — TEXAS STYLE

In the spring of 2004, a different sort of equipment was put to work in the south Texas brush country. Alongside stock tanks, cattle guards and center-pivot irrigators, five ASF corner reflectors were deployed in an array nearly 150 km in diameter.

And though you might hesitate to label them as state-of-the-art agricultural technology, these corner reflectors and the Radarsat-1 data being acquired over the region will be valuable components for water resources research and management in this region dominated by multi-thousand acre private farms.

The corner reflector installation is part of an ASF effort to support the work of NASA-funded researcher Ni-Bin Chang at the Texas A&M University – Kingsville (TAMUK) Department of Environmental Engineering.

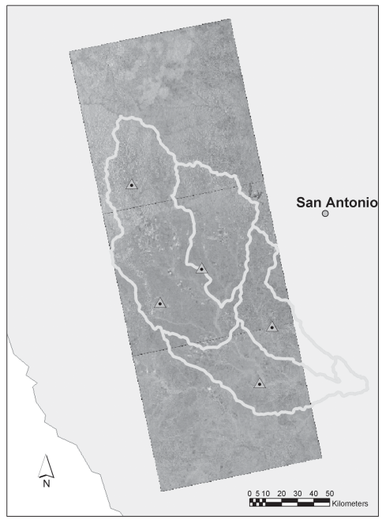
Chang's research at TAMUK includes using Radarsat-1 Standard Beam SAR data to study soil moisture within the watershed above the Choke Canyon Reservoir southwest of San Antonio. Chang's Data Acquisition Request (DAR) specifies repeat-pass data acquired during 16 consecutive cycles beginning in April 2004.

Coincident with the SAR data collection, TAMUK student, staff and faculty researchers will be in the field to obtain a grid of soil moisture measurements at selected calibration sites.

Prior to the initiation of Chang's Radarsat-1 campaign, technical staff from ASF and TAMUK discussed the need to coregister the SAR and soil moisture datasets, agreeing that geolocation accuracy was critical to the success of this project.

Ground control points (GCPs) must be identifiable in the imagery, as well as being accessible on foot, in order to obtain Global Positioning System (GPS) data at that site. Because 99 percent of Texas land is privately owned, access to existing features with strong radar signatures observed in previously acquired data could not be taken for granted.

ASF had recently removed several Generation-1 corner reflectors from the field in Alaska and agreed to loan five of these devices to TAMUK for the duration of Chang's DAR. A corner reflector, when precisely pointed at the satellite in azimuth and elevation, will appear as a very distinct bright object in the resulting imagery.



Five ASF corner reflectors (represented above by the small dotted triangles) were installed in south Texas in April 2004. Texas A&M University – Kingsville researcher Ni-Bin Chang is using Radarsat-1 data to study soil moisture in the watershed above the Choke Canyon Reservoir (outlined by the light-grey boundary lines) .

Using a Geographic Information System (GIS) with cultural, physiographic, and SAR image layers, TAMUK and ASF staff developed an approximate deployment pattern to provide sufficient spatial distribution for coregistering the image data to the GPS points.

The final step in site identification was to find cooperative landowners near the proposed GCPs who were willing to host an inverted 8-foot aluminum trihedron on their property for a year and a half.

Mark Beaman, a research associate at TAMUK, accomplished this via truck, foot and cell phone. With a laptop computer at his side, Beaman, a Texas native, sat down with farm owners and ranch managers, often at the kitchen table, and gave PowerPoint presentations to introduce the project. More than once, the hosts impressed Beaman with their own GIS familiarity, and shared data and shapefiles from their precision agriculture GIS applications.

Corner reflector panels were shipped from Alaska to Texas in March 2004. ASF Advanced Product Developer Chris Wyatt and Calibration Technician Charley Slater traveled to Texas in mid-April, where they joined Beaman and the equipment in time to install the reflectors prior to the first Radarsat-1 acquisition on April 20.

Slater generated reflector-pointing parameters in the field for each reflector using real-time GPS coordinates and a laptop computer running software developed at ASF.

The deployment went smoothly, and then began the waiting as the data was acquired, transcribed and shipped from the Canadian ground station, where it was downlinked, to ASF for processing.

Preliminary analysis of the SAR data collected in April and June indicates that the corner reflector ground control effort will achieve the desired improvement in geolocation accuracy. (Chang's May data was affected by the Radarsat-1 orbit anomaly.)

All five reflectors are visually identifiable in the slant range and ground range image data. The imagery, once calibrated and projected using ASF software, has been observed to deviate by as much as 500 m from the differentially corrected GPS data and other reliable GIS layers.

Ammarin Makkeasorn, a Texas A&M University – Kingsville student assistant (left) and ASF Calibration Technician Charley Slater (right), install an ASF Generation-1 corner reflector at one of the field sites in the watershed. The reflectors provide ground control for geometric registration of the Radarsat-1 imagery. Each reflector is posted with ASF contact information, available in the event that local residents need to coordinate details with the equipment's owner. ASF User Services has received calls from several cordial and curious south Texas ranchers, inquiring about the function of "that shiny hollow pyramid" planted at the back of their field.

By carefully adjusting the image data to the known latitude and longitude of the GCPs, the mean planimetric error can be reduced to less than 1 pixel (12.5 m) without significant impact to the absolute radiometry. This will allow the in situ soil moisture measurements to be confidently correlated with the coincident SAR data.

The work by Dr. Chang and his students will attempt to model soil moisture at scales ranging from a few acres at calibration sites to a watershed-wide model spanning nearly 15,000 km^2. ♦

by Chris Wyatt

Unrestricted Data Products: New SAR CD Available

The Alaska Satellite Facility is proud to announce the availability of a new unrestricted CD product — *Capturing a Dynamic Planet: Using Synthetic Aperture Radar to View the Earth*.

This CD features a SAR Image Gallery and a SAR Science Concepts section. The image gallery contains Level-2 data products contributed by ASF users, as well as an assortment of SAR images. The Science Concepts section explains the basic concepts of SAR and InSAR.

Request your copy through the ASF homepage at http://www.asf.alaska.edu/unrestricted_products/CDorderform.html. ♦

News Briefs

- ASF Deputy Director Recruitment: The ASF Deputy Director position is currently open until filled; review of applicants began August 31, 2004. For more information, a complete copy of the vacancy announcement and an employment application can be obtained at http://www.gi.alaska.edu/admin/human_resources/.

- Continued ADRO Support: Beginning October 1, 2004, data credits and foreign ground station costs for ADRO projects will no longer be supported through the NASA ADRO program. However, ASF encourages investigators wishing to maintain data continuity for ongoing investigations to obtain continued access and use of SAR data through the ASF data proposal process.
  The ASF User Services Office staff are available to assist investigators with their pursuit of a new project data account. (Investigators need to secure their own funding for continued foreign ground station data transcription costs, which apply to data downlinked anywhere other than ASF or McMurdo ground stations.) Instructions for writing a short, two-page project proposal can be found on the ASF website at http://www.asf.alaska.edu/5_1_1.html. Contact ASF User Services via email at uso@asf.alaska.edu or by phone at (907) 474-6166.

- Research Announcement of Opportunity: *Science and Operational Applications Research for RADARSAT-2 Program (SOAR)*
  http://radarsat2.info/
  A list of research funding sources can be accessed online at http://www.asf.alaska.edu/~rgens/rfp_specific.html. ASF welcomes your comments about any additional research opportunities; send inquiries and additions to User Services (uso@asf.alaska.edu).

Submissions and Subscriptions

This newsletter, published by the Alaska Satellite Facility, was created to provide detailed information about special projects and noteworthy developments, as well as science articles highlighting the use of ASF data.

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Submissions to the *News & Notes* and suggestions about content are always welcome. If you are interested in contributing materials, please call or send an email to the editor:

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