The Alaska Satellite Facility
News & Notes
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Creating the Matsu Digital Elevation Model

ASF is expanding its role as a resource to national, state, local and tribal governments interested in mapping applications using remote-sensing data.

The Matanuska-Susitna (Matsu) Borough in southcentral Alaska recently contracted ASF to produce a digital elevation model (DEM) of its more heavily populated areas.

The Matsu, a region about the size of West Virginia, is named after two principle river drainages—the Matanuska and the Susitna rivers. Extreme and diverse terrains, from mountain ranges, valleys and glaciers to wetlands, farmlands and pristine wilderness, are all found within the Matsu boundaries.

Consequently, the area presented some challenges not previously encountered while working with DEM test areas near Fairbanks and Delta Junction, Alaska.

In particular, difficulties exceeded expectations with phase unwrapping in regions of extreme topography. We also obtained results with poorer coherence than desired along the coast due to increased precipitation and warmer temperatures. We observed a –1 m average offset, a standard deviation of 7.68 m, and a root mean squared error of 7.71 m. Although these results for low to moderate topography are encouraging, the DEM mosaic accuracy may not be adequate in some areas of extreme topography.

The project included collecting geodetic control points for mosaic processing, kinematic GPS road surveying of major roads within the Borough, and assessing the accuracy of the resulting DEM mosaic, which was produced from eleven ESA Tandem Mission pairs.

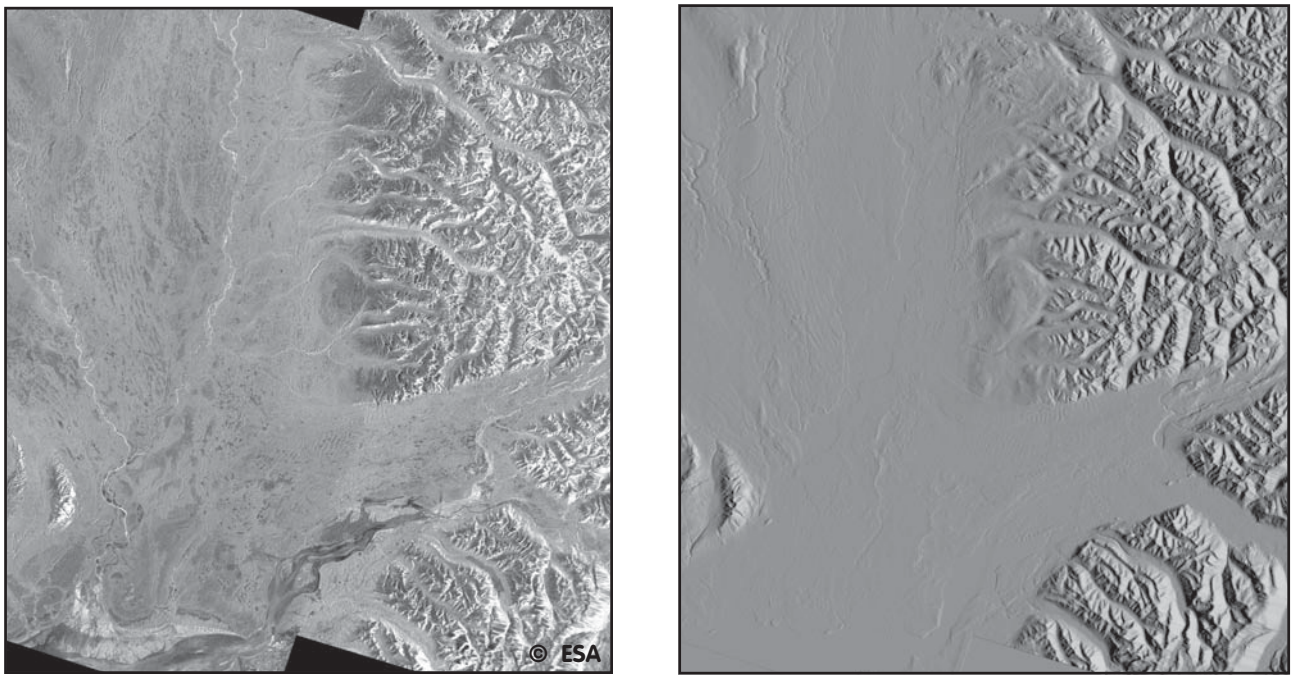
Each individual DEM was produced using ASF-developed SAR Interferometry user tools. In addition, we used a hybrid minimum cost flow phase unwrapping software developed at Stanford University, and a mosaic software developed at the Jet Propulsion Laboratory.

To minimize the impact of phase unwrapping errors on baseline refinement, we used new quality assurance methods. These methods detect, quantify, and in most cases, correct the phase unwrapping errors by using existing reference topography data. This technique is referred to as bootstrapping for phase unwrapping.

Using these methods, we generated good quality DEMs for regions of low to moderate relief. We also developed a mask to delineate regions of high versus low confidence. The resulting DEM mosaic, in regions of high confidence, was evaluated with the kinematic GPS road survey data.

The team gained valuable insight into what it takes to produce high quality data in regions of extreme terrain. Some of the lessons learned provide a good foundation for two recently funded projects: 1) a National Geospatial-Intelligence Agency (NGA) University Research Initiative grant to study ICESAT data as a possible source of geodetic control for topographic mapping, and 2) an NGA Feasibility Study to evaluate alternative mapping methods to supplement Shuttle Radar Topography Mission (SRTM) data north of 60 degrees latitude. ♦

by Rick Guritz



Shown above are the mosaiked ESA Tandem Mission data (left) and the shaded relief image of the Matanuska-Susitna Borough InSAR DEM (right).

Southern California Coastal Pollution Observed with SAR

The rapidly expanding southern California megalopolis, which includes San Diego, Orange, Los Angeles, Ventura and Santa Barbara counties, is home to approximately 20 million people who represent nearly 25 percent of the total U.S. coastal population.

Activities of this large human population result in the discharge of a broad range of pollutants—pesticides, fertilizers, trace metals, synthetic organic compounds, petroleum, and pathogens—into the coastal waters of the Southern California Bight (SCB).

The area has a complex physical circulation pattern due to varying bathymetry, offshore islands, and numerous prominent headlands, which affects transport of these pollution hazards.

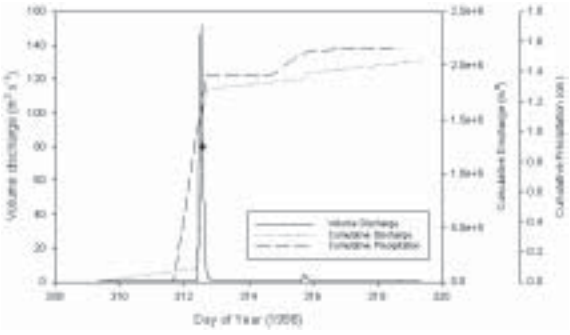
Urban stormwater runoff is currently the most significant source of pollution hazard for coastal waters in the SCB. Stormwater runoff rates and volumes are growing in urban regions due to the expanding population and proliferation of impervious surfaces, i.e., roads and buildings, which limit the area where rainwater can soak into the ground.

Episodic storm events, normally occurring late fall through early spring, contribute more than 95 percent of the annual runoff volume and pollutant load in the SCB. These inputs modify the physical and biogeochemical state of coastal waters while presenting health hazards to swimmers and surfers in the area. Nutrient concentrations become elevated, promoting rapid phytoplankton growth.

Wastewater discharge from publicly owned treatment works (POTWs) and shoreline industries is another source of pollutants entering coastal waters. About half of this effluent receives secondary treatment.

Discharge of the effluent offshore at depth (typically ~60 m) and the subsequent formation of submerged wastewater plumes promotes dilution and dispersal of contaminant loadings.

Occasionally, however, the submerged plumes surface, leading to possible onshore transport of contaminants. In addition, natural hydrocarbon seeps in the Santa Barbara Channel, and to a much lesser extent, in Santa Monica Bay, deposit tar and oil over many southern California beaches.



This graph is a time series for Ballona Creek, depicting volume discharge rate (solid line), cumulative discharge volume (dotted line), and cumulative precipitation (dashed line). The dot on the graph corresponds to the acquisition date (November 8, 1998) for the SAR image below.

Space-borne Synthetic Aperture Radar (SAR) is a valuable tool for examining these pollution hazards in the SCB. Hazard detection with SAR is possible due to the surfactants deposited on the sea surface, smoothing capillary and small gravity waves to produce areas of reduced backscatter compared with the surrounding ocean.

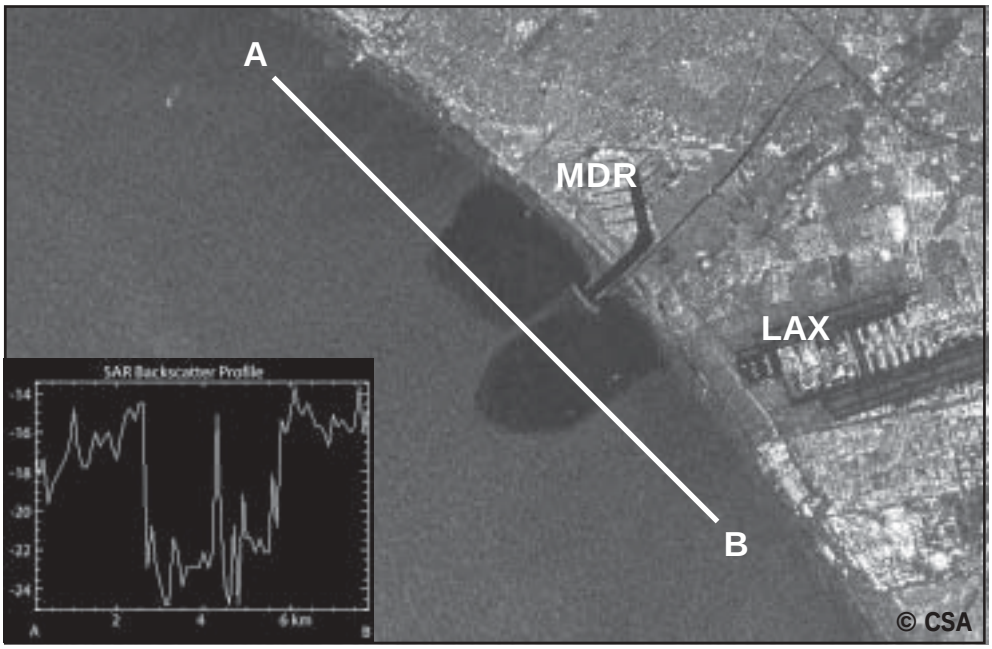
The smoothed, surfactant-covered areas appear darker on SAR imagery compared with the usually wind-roughened surrounding ocean, which has higher backscatter and thus appears brighter on SAR imagery. Researchers can also use the imagery to visualize complex, small-scale oceanographic processes, such as coastal eddies, which are thought to be important in controlling the transport, near-shore residence times and fates of pollutants associated with these hazards.

The figures on this page show Radarsat-1 imagery of the Ballona Creek stormwater runoff discharge into Santa Monica Bay (bottom) and a coincident discharge and precipitation time series graph for one storm event (top). The SAR image shows a two-lobed stormwater plume, on each side of a breakwater, imaged near the discharge peak.

Cumulative event discharge volume from Ballona Creek into the bay up to the time of the SAR image acquisition was $1.6 \times 10^6 m^3$. This is associated with a cumulative event precipitation total of ~1.2 cm. Discharge, averaged over 15-minute intervals, peaked at 152 $m^3 s^{-1}$ about 1.5 hours prior to image acquisition.

These results suggest that SAR imagery provides valuable information about pollution hazards, supporting improved coastal management in the SCB. Improved access to SAR data is needed, as well as studies linking SAR data with *in situ* water quality indicators. Together these data may allow synoptic assessments of the consequences of these pollution hazards for human health and ecological impact. ♦

by Ben Holt



The Radarsat-1 image above illustrates stormwater plumes, at two stages in plume evolution, emerging from Ballona Creek, located just south of the entrance to Marina del Rey (MDR), California. Line AB marks the location of the SAR backscatter profile (inset).

Monitoring River Ice Breakup in Alaska

Each spring, Alaska rivers 'breakup,' the local term for the yearly melting, shifting, breaking and 'running' of tons of river ice. ASF provides SAR data to the National Weather Service (NWS) to help monitor this dramatic phenomenon.

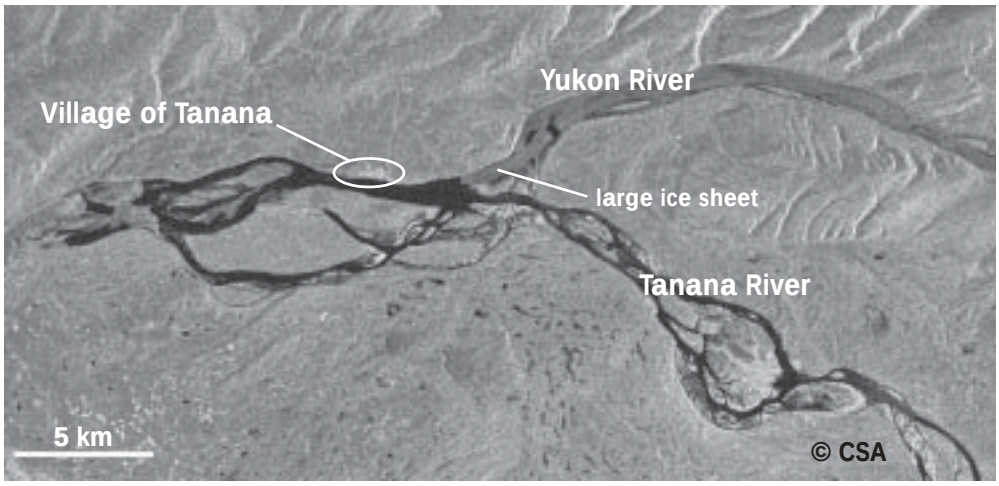
Sudden warm temperatures can quickly melt heavy winter snow, dumping large volumes of water into ice-clogged waterways. Since SAR data is exceptional for imaging both ice and flood events, it's a natural choice for monitoring river ice breakup.

Ice sheets and chunks can jam in a river, forming ice-dams that impede the flow of water, causing flooding. For the inhabitants of Alaska's fly-in rural villages, seasonal flooding during breakup can mean inconvenience, property damage or even evacuation.

Arleen Lunsford of the NWS uses 30 m resolution standard beam Radarsat-1 imagery each spring to detect the location and condition of river ice. "We look for many different clues (in SAR imagery)," says Lunsford.

"Does the ice appear to be getting rotten? Has it cleared out of a given reach? Is the ice moving? Is the main channel clear, but is ice remaining in side channels or sloughs? Is there an ice-run upstream of ice that hasn't moved?"

Lunsford, a staff member of the Alaska-Pacific River Forecast Center in Anchorage, is one of a team who provides river breakup forecasts, flood warnings and other hydrometeorological products during the breakup season.



This image, acquired on May 3, 2004, shows the confluence of the Tanana River and the Yukon River. The Tanana is mostly open and has pushed the ice out a short distance downstream onto the Yukon.

The center began using ERS-2 and Radarsat-1 data from ASF in 1997 to monitor spring breakup. Information derived from the imagery regularly contributes to the river analyst team's daily 'breakup discussion' and the 'breakup map for Alaska,' which can be viewed at http://aprfc.arh.noaa.gov/. (The maps are updated only during the active breakup time frame.)

Alaska's widest rivers, the Yukon and the Kuskokwim, are the two main targets for ice analysis with SAR imagery, but Lunsford says that an ice/no-ice determination can usually be made from SAR data for narrower rivers as well. "A huge advantage of the SAR data," claims Lunsford, "besides the (high) resolution of the standard scale imagery, is the fact that it doesn't matter if we are cloud-covered or if it is night. We still get the image, unlike high-resolution visible satellite imagery, which is of no use at night or when the area of interest is fully overcast."

Breakup for spring 2004 was mild with minor flooding in only a few areas. Villagers were cautioned, however, to keep watch for late ice-runs coming from the upriver tributaries of a few northern rivers, incidents that could leave small boats capsized or crushed. ♦

by Melanie Engram

Radarsat-1 Orbit Adjustment Notification

Note: The following notice was received from the CSA and forwarded to ASF data users May 7, 2004.

On Sunday April 25th, a routine manoeuvre to adjust the orbit of RADARSAT-1 resulted in a slight modification of the nominal orbit of a 24-day repeat cycle. Since that event, the Canadian Space Agency, in consultation with its program partners, has been looking at several scenarios to correct the situation.

In the end, in the interest of the program, it has been decided that an orbit manoeuvre will be implemented shortly to get back to the nominal orbit. To proceed with this manoeuvre, a 48-hour long total payload outage will be required beginning at 17-MAY-04 at 19:00 UTC. With this manoeuvre the nominal orbit and ground track would be restored by the end of the month. In the mean time, users may be seeing a difference in the location of the actual acquired data compared with that ordered, especially in the cross-track direction.

This situation should be corrected shortly for the interim period by the release to the order desks of a new version of the Swath Planning Application (SPA) tool that will include a proper correction. The Canadian Space Agency and its program partners are keeping their clients informed and working together to ensure that the impact on clients is minimized during the interim period.

Maneuvers were performed by CSA in mid and late May to readjust the satellite's orbit. Radarsat-1 was reported back to nominal status by June 1. All data acquired between April 25 and June 1 will not be appropriate for interferometry.

However, the data can still be processed successfully for applications requiring backscatter images. There was some cross-track drift occurring that altered the area covered. Feel free to contact ASF User Services with any concerns or questions you may have (uso@asf.alaska.edu).

Research Announcements of Opportunity

The ASF Remote Sensing Service Center keeps a list of research funding sources at http://www.asf.alaska.edu/~rgens/rfp_specific.html

Below are some of those links to research announcements of opportunity, provided for our users' information. ASF welcomes your feedback and any additional research opportunities you are aware of; please send additions to User Services (uso@asf.alaska.edu).

- NSF Arctic Research Opportunities
  http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf04587
- NSF EarthScope: Science, Education, and Related Activities
  http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf04589
- NSF Earth Sciences Research: Geology and Paleontology, Geophysics, Hydrological Sciences
  http://www.nsf.gov/pubsys/ods/getpub.cfm?ods_key=nsf03590
- NSF Earth Sciences: Instrumentation and Facilities (EAR/IF)
  http://www.nsf.gov/pubsys/ods/getpub.cfm?ods_key=nsf04507

Unrestricted Data Products Available from ASF

The following DVD and CD products can be ordered using the online form at http://www.asf.alaska.edu/unrestricted_products/CDorderform.html

- √ Boreal North America Mosaic DVD-ROM: JERS-1 mosaics of boreal North America acquired 1997 - 1998
- √ Amazon Mosaic CD: JERS-1 mosaic coverage of the entire Amazon river basin acquired 1995 - 1996
- √ Central America and Pantanal Mosaic CD: JERS-1 images of Central America rain forests from July and August 1996 and South America Pantanal region from February 1997
- √ African Rain Forest Mosaic CD: JERS-1 imagery of Africa's rain forests acquired 1996 - 1997
- √ Glacier Power CD: multimedia Earth Sciences curriculum supplement for middle school teachers (Macintosh CD-ROM)

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.

To receive the newsletter by postal mail, please fill out the subscription form linked to the ASF homepage at www.asf.alaska.edu. Current and back issues of the newsletter can also be obtained in PDF format through the ASF website.

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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