The Alaska Satellite Facility

NEWS & NOTES

Spring 2004, Volume 1:2

GhostNet — Searching the Oceans for Dangerous Debris

Last summer a collaboration of GhostNet researchers from government, academia, and private industry conducted an aerial survey that reached from Astoria, OR, to Cold Bay, AK. The survey aircraft was instrumented with a collection of visible, IR and LIDAR sensors used to locate actual debris in the ocean.

GhostNet is a three-year, NASA-funded research project designed to demonstrate the feasibility of identifying derelict fishing nets and other anthropogenic marine debris using data from satellite remote sensing, airborne and *in situ* buoy measurements.

The GhostNet project arose from a need to locate lost or abandoned fishing gear, especially high-seas drift nets, which pose a threat to all fish species inhabiting near-surface waters. Sea birds, sea turtles and marine mammals also risk entanglement in derelict nets.

When these nets drift into coral reef environments, they cause physical damage to the reefs and continue to entangle and kill animals inhabiting the reef's ecosystem.

Collaborators designed the GhostNet project to locate derelict nets and other hazardous debris in the open ocean before they encounter reefs or wash ashore and do further damage. Regions of interest for GhostNet include the southeastern Bering Sea; the Gulf of Alaska; and the Subtropical Convergence Zone (STCZ) associated with the North Pacific subtropical high.

GhostNet researchers use a geographic information system to integrate a collection of satellite, aircraft, buoy, and static (i.e., bathymetry and coastline) data to identify potential sites where hazardous debris may be concentrated.

A combined suite of datasets used in the GhostNet project includes:

- SST images from NASA Moderate Resolution Imaging Spectroradiometer (MODIS), NOAA Coast-Watch Advanced Very High Resolution Radiometer (AVHRR), and NOAA Geostationary Operational Environmental Satellite (GOES),
- NASA MODIS chlorophyll imagery,
- Canadian Space Agency Radarsat-1 synthetic aperture radar (SAR) imagery and derived ship positions and high-resolution SAR wind images,
- NASA SeaWinds QuikSCAT scatterometer wind data and derived wind stress curl,
- NASA TOPEX/Poseidon altimeter data processed into sea surface height anomaly information,
- data from a MicroSas Optical Sensor – OCR-507,
- images from a green-laser (352 nm) LIDAR with a gated camera,
- video from a visible RGB camera,
- images from an infrared imager,
- sea surface temperatures from an infrared radiometer, and
- moored and drifting buoy reports every six hours from the National Centers for Environmental Prediction and the NOAA Data Buoy Center.

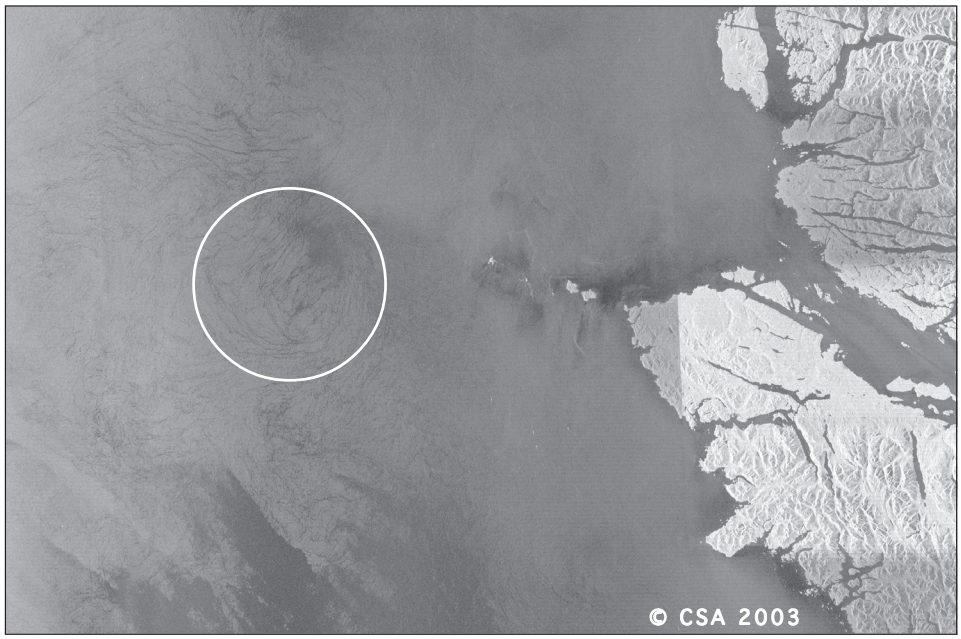
Staff at the Alaska Satellite Facility provide support through acquisition planning, image processing and consulting for SAR image interpretation.

Last summer's GhostNet participants identified likely areas of debris accumulation by searching for convergent processes in the ocean using circulation models and analyses of scatterometer wind data.

Next they observed likely regions with multi-platform satellite imagery to pinpoint convergence zones.

Finally, the group made the aerial survey to verify the location of convergence zones and locate actual debris. The researchers discovered logs, fishing debris, and other foreign materials, which had become preferentially concentrated in the areas of convergence indicated by analysis of the data. ♦

by Jeremy Nicoll and Bill Pichel



This Radarsat-1 SAR image, acquired July 18, was used in conjuction with MODIS Chlorophyll and NOAA-16 AVHRR imagery to pinpoint the eddy (circled in the image above) in the ocean northwest of Vancouver Island.

The Reflector Array Maintained in Delta Junction, Alaska

ASF has maintained an array of tri-hedral reflectors in the fields at Delta Junction since 1991 to aid in calibration and ground truth evaluation of several international environmental satellites. These reflectors provide a known radiometric return to measure the strength of the satellite signal.

Reflector positions are well known, so they are useful for measuring geographical accuracy and geometric distortions. When used this way, the reflectors help tie the satellite images from space to earth.

Many of the reflectors are mounted on ring bases, which allows easy and accurate orientation toward the origin of any satellite signal.

The trihedral shape of the reflectors causes a triple bounce of the incident rays of the radar beam, which makes them all appear to reflect from the apex no matter where they impinge upon the reflector panel.

In other words, the distance between the satellite and all points on the reflector appear to be the same.

A corner reflector returns forward scatter rather than the typical backscatter; it actually turns the incident beams back on a parallel path to the satellite.

This allows for a brighter return because it simulates a longer illumination time than the single point would normally have.

This brighter return allows calibration engineers to easily identify the reflector in an image and perform impulse response measurements, such as resolution, peak-to-side-lobe ratio, and radar cross section, which would usually be lost in the clutter of a normal target.

These measurements help determine the optimal processing options for a given application.

ASF calibration engineers used the Delta reflector array to assist with calibrating two European Remote Sensing satellites (ERS-1 and ERS-2), the Japanese Earth Resource Satellite (JERS-1), and multiple beam modes of the Canadian Radarsat-1 (R-1) satellite.

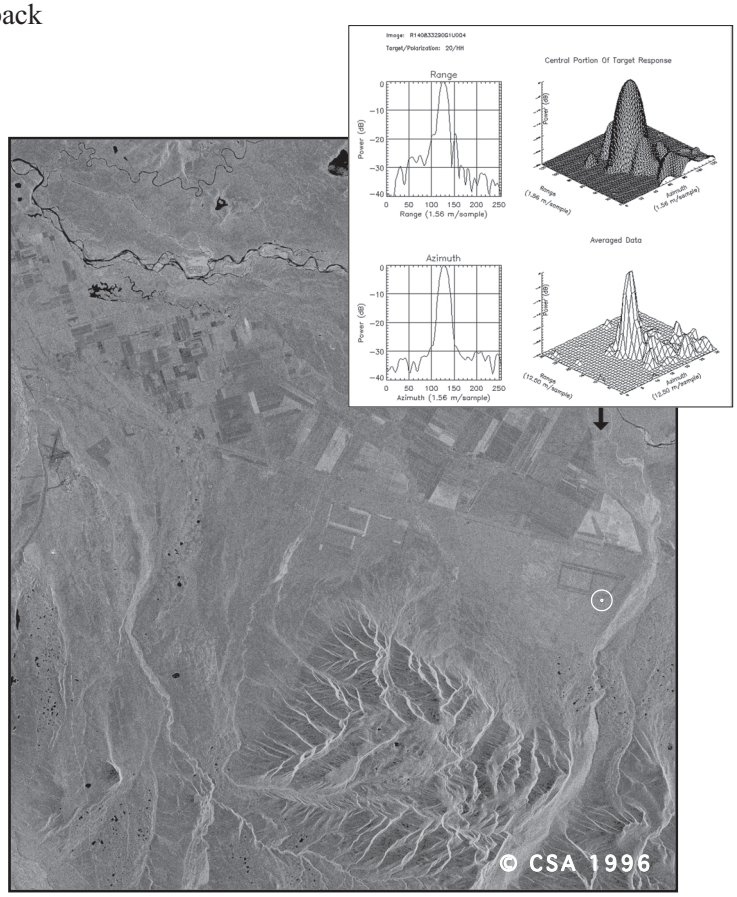
The reflectors are useful to monitor long-term stability of the satellites and provide ground control points for producing Alaska digital elevation maps.

ASF is exploring the idea of allowing its users to utilize this array of corner reflectors for optimizing their own geolocation or image focusing algorithms.

Interested parties should contact ASF User Services to discuss possible collaboration with ASF's calibration team on using the corner reflectors. ♦

by Phil Utley and Wade Albright

A third generation corner reflector, deployed in Delta Junction, is shown above.



One of the corner reflectors is pointed out in the SAR image above, with an impulse response of a typical corner reflector super imposed in the upper right.

Software Tool Suite Updated

The Alaska Satellite Facility is updating its downloadable suite of software tools used for SAR data manipulation. New versions of the tools can be accessed using a standard internet browser through an http download.

Executable binaries for Sun SOLARIS and Silicon Graph-ics IRIX operating system environments are now available. Source code (ANSI C) is also available, dependent upon tool-specific distribution guidelines imposed by ASF's parent institution, the University of Alaska Fairbanks, and various U.S. federal agencies.

To access source code or U.S. Department of Commerce export-restricted tools, users must submit online forms or print and fax forms, and use a download password. Users with an approval form already on file at ASF User Services are asked to update their contact and institutional affiliation information.

• Departure from binary-encoded metadata: Within the SAR tools domain, ASF has eliminated the Data Descriptor Record (.ddr) file.

Instead, ASF's proprietary metadata file definition has been expanded. This affects every tool and the associated metadata generating/parsing functionality has been encoded into the updated ASF metadata ANSI C library. The expanded .meta file is ASCII encoded, which enables metadata keyword value viewing or editing with any text editor—an improvement over the binary-encoded approach associated with the .ddr file. Complementary conversion utilities *meta2ddr* and *ddr2meta* are now available in the event files manipulated using previous versions of SAR tools need to be utilized by any of the newly released software.

• Byte addressing standards: Transferring data files between computing environments can introduce compatibility problems due to byte addressing standards.

'Big-endian' refers to computing environments in which multi-byte quantities (e.g., long, float, or double data types) are addressed by pointing to their most significant byte. This applies to data stored in computer memory and in files.

For example, a generic binary image data file created on your UNIX system may not be directly imported into a PC-based version of ArcGIS without considering the byte order. The dependency is understood to be CPU-based and not operating system dependent.

ASF SAR tools and the data they manipulate adhere to the IEEE 'big-endian' standard. Because the .ddr metadata file has been eliminated, the 'endian-ness' checking function has been relocated. When an executable version of a SAR tool is created from source code, the config tool determines the architecture of the host computer. This system value (representing 'endian' order) gets stored in the metadata file.

The byte order swapping function, when required, is now added to each tool via the *ioline.c* function of the *asf.a* ANSI C library. Byte swapping has not been applied to all SAR tools yet; it will be done incrementally over the next two software releases.

• Software documentation: ASF now provides up to five software documentation outlets for the SAR tools. A UNIX man(ual) page is available at the command line after tool installation, and a more verbose version is published at ASF's website in HTML/XML and Adobe PDF formats.

Executable versions of most SAR tools offer brief usage guidance from the UNIX command line by typing the tool name followed by no arguments. In select cases, such as with *sarview*, documentation is provided through a GUI pull-down menu.

In addition, the *ASF SAR Tools Software Manual 2003* is available in Adobe PDF format from the website. The manual contains usage, algorithm (equation), and dependency information for every tool. Contact information for each tool has been replaced with the ASF User Services email address (uso@asf.alaska.edu; or see http://www.asf.alaska.edu/).

• Intellectual property considerations: Source code developed by ASF will be distributed either by the Berkeley Standard Distribution (BSD) model or by collaborative agreement. Previous references to GPL (GNU Public License) have been removed from all source code.

• Internet bulletin board support forum: Loosely associated with the February 2004 release is the introduction of a newly created electronic bulletin board resource for SAR tools software support (see https://forum.asf.alaska.edu/). Following a test drive by the ASF User Working Group, the forum is open to the user community. (See the story in this newsletter.)

• SAR tools problem reports: Since the 2002 SAR tools release, a number of known/reported coding errors have been repaired in a number of tools. Where such fixes have successfully graduated from testing, the repaired version of the tool has been included in the February 2004 release.

The remaining repairs (i.e., the backlog) are being performed in priority order based upon customer demand and resource availability.

Let ASF know what's critical to your SAR-dependent projects.

• Future software tool development: The professional staff at ASF are committed to making SAR data more accessible. Efforts are underway to bring the entire suite of tools to the LINUX computing platform. In addition, we are in the process of bundling multiple tools that are commonly used in succession into user-friendly versions.

The Alaska Satellite Facility values guidance from its customers, so please take a moment to provide input the next time you see us at a NASA Earth Sciences booth or when a survey comes across your desk. ♦

by Rory O'Neill

ASF Opens New Forum Online

ASF has unveiled a new open forum service. The user community and ASF staff can now interact with each other online about technical topics related to ASF data, ASF software tools, SAR applications and other issues. The forum features two posting areas—Support and Discussion.

The Support forum brings together questions and answers, helping users get the most out of their ASF data products. Users can post and answer questions relating to such topics as software tool installation, software tool use, and data product specifications; as well as feedback about integrating ASF data and non-ASF software.

In the Discussion forum, users are encouraged to submit more generalized topics associated with ASF and remote sensing, e.g., SAR theory, SAR applications, future missions, or even Alaska trivia! As the knowledge base held in the forum grows, the frequently asked questions (FAQ) area will include sections addressing the most common issues encountered by users.

ASF invites everyone to take advantage of this new service, hoping you will contribute generously of your knowledge and experience from incorporating SAR data into your research and operations.

Registration is required prior to posting information to the forum, and instructions are found under the registration icon on the main page. The URL for the site is https://forum.asf.alaska.edu/. ♦

by Chris Wyatt

News & Notes Subscription Information

The Alaska Satellite Facility *News & Notes* newsletter was created for ASF data users to contain detailed information about special projects and noteworthy developments at ASF, as well as science articles that highlight the utilization of ASF data.

Principle investigators of approved ASF projects will automatically be mailed a copy of this newsletter. Anyone else interested in receiving the *News & Notes* can contact ASF User Services via email (uso@asf.alaska.edu) to subscribe. Be sure to include your name and mailing address in the request.

On occasion, articles submitted by ASF data users will be published in this newsletter. If you are interested in contributing materials for the *News & Notes*, please contact User Services at the email address listed above.

The ASF User Working Group

ASF is one of NASA's eight Distributed Active Archive Centers (DAACs). Each DAAC has an advisory group consisting of data users who meet regularly to assess the products and services offered by that DAAC.

The ASF User Working Group (UWG) met at ASF in Fairbanks on Nov. 19-20, 2003, where the management team presented a review of ASF activities over the past year, as well as plans for the future.

The UWG assessment resulting from this meeting was very positive, and the group made several recommendations for improving ASF's products and services.

Comments from data users on any aspect of ASF operations are welcome. Notes from UWG meetings and contact information are posted on their website: psc.apl.washington.edu/ASFUWG.

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ASF encourages everyone to contact the User Services Office with questions and comments about our products and services.

Radarsat-1 2004 Cycle Reminders

Cycle 127: March 15 - April 8

Cycle 128: April 8 - May 2

Cycle 129: May 2 - May 26

Cycle 130: May 26 - June 19

Cycle 131: June 19 - July 13

Plan ahead!

New data acquisition requests (DARs) for Radarsat-1 should be submitted nine to ten weeks in advance of the acquisition start date. Meeting this deadline improves the scheduling success rate at CSA.

New ERS-2 DARs should be submitted a minimum of six to seven weeks prior to the desired start date.