ASTER Science Team Meeting Report

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The 32nd Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Science Team Meeting was held December 3-6, 2007 in Kailua-Kona Hawaii. About 65 participants attended the meeting. The weekend before the meeting, ***M. Ramsey*** *[University of Pittsburgh and University of Hawaii] arranged field trips to Kilauea volcano and the Hawaii Volcano Observatory. After the meeting there was a field trip planned to the top of Mauna Kea to visit the observatories.*

Opening Plenary

H. Tsu [Earth Remote Sensing Data and Analysis Center (ERSDAC)] and **M. Abrams** [Jet Propulsion Laboratory (JPL)] welcomed U.S. and Japanese ASTER Science Team members, U.S. Government attendees, and interested parties to the 32nd ASTER Science Team Meeting.

Abrams reviewed new ASTER Science Team membership based on the 2006 research announcements. Four new members were selected: **M. Pritchard** [Cornell University], **J. Masek** [Goddard Space Flight Center (GSFC)], **R. Crippen** [JPL], and **S. Tulaczyk** [University of California Santa Cruz]. The JPL ASTER project was funded for two years through NASA's Senior Review process for FYs 2008 and 2009.

T. Sato [Japan Resources Observation System Organization (JAROS)] reported on instrument status, particularly problems with the shortwave infrared (SWIR) cooler to be discussed in detail later. Everything else was performing nominally.

M. Hato [Earth Remote Sensing Data and Analysis Center (ERSDAC)] reported on the operational status of the Japan Ground Data System. Data scheduling and production were nominal.

M. Fujita [ERSDAC] reported on scheduling status, including the Global Map-3, Global digital elevation map (DEM) data acquisitions, gap-filler acquisitions, and the nighttime thermal infrared (TIR) data acquisitions. Each would be discussed during the working groups, and updated actions decided.

T. Tachikawa [ERSDAC] talked about further progress on the Global DEM, including schedules and start date. The first Level 1A data were delivered to Sensor Information Laboratory Corp. (SILC), and DEM production has commenced.

Ramsey gave a special talk on use of full-mode nighttime data to map and characterize the most recent Kilauea lava flows and eruptions. Results allowed the U.S. Geological Survey (USGS) to complete their maps of activity.

Operations and Mission Planning Working Group

Fujita reviewed progress on the Global Map-3 Science Team Acquisition Request (STAR). There was a discussion about starting a new Global Map, but team members decided to continue with Global Map-3. He reviewed progress on the Global DEM STAR, and it is satisfactory. The Nighttime Thermal Infrared STAR is going well. The Operations and Mission Planning (OMP) group will wait for a report from the Temperature/Emissivity Separation (TES) group to decide how to continue. The Gap-filler STAR ended with good progress. It was recommended to re-submit it for next year, and to look for any gaps in the Southern Hemisphere.

Hato reported on monitoring of buffer filling of the solid state recorder (SSR). The maximum was 98%, so we will maintain the current settings.

Sato went over the SWIR re-cycling plans, similar to his presentation at the opening plenary session.

Tachikawa presented details of his study to change all of the STARs to *Low2* gain for the SWIR. Most of the large STARs (Global map, glaciers, volcanoes) can be changed easily. There are a few hundred smaller STARs that will require manual intervention. Tachikawa will prepare a list of all active STARs for review by the Science Team. Unused STARs will be eliminated, some will continue with current gains, the remainder will be re-submitted with *Low2* gain for SWIR.

Abrams and **L.Maldonado** [JPL] reported on a draft version of a Data Acquisition Request (DAR) user survey. The survey will be sent to U.S. DAR users through a web interface, and results will be reported at the next team meeting.

K. Duda [Land Processes Distributed Active Archive Center (LPDAAC)] reviewed the status of the Direct Downlink (DDL) test. The next attempt is scheduled for January 28, barring any conflicts with other activities, like SWIR recycling or Shuttle flights.

L1/DEM Working Group Level

H. Fujisada [SILC] reported on results from several different Japanese contractors who evaluate ASTER geometric performance and on the status of Level 1 (L1) software. The contractors found no problems in

the L1 software. Inter- and intra-telescope registration errors are nominal and well within required limits. Examination of SWIR data acquired with *Low2* gain indicates that the lower signal-to-noise causes an increase in the parallax correction accuracy.

B. Bailey [USGS] revealed that DEM and orthorectified products produced at the LPDAAC are going out in satisfactory numbers. A few features in DEM products were noted, and were under investigation.

Hato reported that ERSDAC had delivered 110,000 L1A scenes to SILC for Global DEM processing. Every 3 weeks, another delivery of 110,000 scenes will be made until the entire archive is transferred.

Tachikawa showed additional validation of the Global DEM in Japan with added control points. Accuracy was unchanged form June report.

Fujisada described the status of the Global DEM project. Final delivery of the 23,000 1° x 1° tiles should be at the end of May, 2009.

Crippen showed previous work he had done using ASTER DEMs to fill holes in Shuttle RadarTopography Mission (SRTM) DEMs. Results were very satisfactory.

SWIR Processing Special Meeting

The team held a special session to discuss data processing issues involving compromised SWIR data.

Hato reported that there were many impacts upon the data products, starting with Level 0 processing. Best case is if SWIR is still *on*, even if data are 0's or 255's. Hato presented analysis of impacts if SWIR instrument powered *off*. A test done during the October recycle allowed visible and thermal data to be processed manually while full mode data were captured and transmitted. Changes that will be needed include: reengineering of the scheduler; reengineering of the L1A software; and reengineering the tape archive control system.

Duda reported that 13 of 19 LPDAAC ASTER products will be affected if no SWIR data are available. The impacts range from needing to eliminate a product entirely, to modifying a product. Much work needs to be done to mitigate these impacts.

Tachikawa reported that some of the cloud assessment algorithms would be affected by lack of SWIR data; the main impact would be separating snow/ice from cold clouds.

B. Eng [JPL] said that impacts at JPL would be similar to the Duda assessment but changes to production software may not require a huge effort.

K. Thome [University of Arizona] discussed the impact of the SWIR problems on higher level SWIR products. Since SWIR data are not used as derivative for any other products, the impact only requires eliminating products—e.g., SWIR reflectance.

Temperature-Emissivity Separation Working Group

A. Mushkin [University of Washington] presented a calibration method for roughness data extracted from ASTER stereo images and showed how it could be used to correct TIR emissivity data for loss of spectral contrast arising from multiple scattering. The roughness data are based on shadowing differences between the nadir and back-looking images and are an unintended serendipitous product from ASTER bands 3N and 3B, designed to produce DEMs.

H. Tonooka [Ibaraki University] reported on the effort to mosaic emissivity images in Asia. Single-frame and stacked-frame mosaics were analyzed. Stacking allows better statistical characterization. *Mosaiced* emissivity products have important applications to the broader community for temperature recovery and energy-balance calculations.

G. Hulley [JPL] reported on the JPL seasonal emissivity mosaics of California for the summer and winter seasons. Mosaics were based on the TES standard emissivity product and an advanced cloud screening procedure. An analysis of one season for California was completed using 800+ standard data products.

A. Gillespie [University of Washington] gave a progress report on investigations at the University of Washington into the nature and behavior of temperature/emissivity fields represented by image data at remote-sensing scales. A TIR radiosity model was created and tested using forward looking infrared (FLIR) broadband and Telops hyperspectral field images. Results can be used to interpret ASTER temperature and emissivity data more closely.

Tonooka reported that cloud masks for ASTER nighttime scenes are inaccurate. He discussed the success of using the MOD35 11-km Cloud Mask Products to improve the accuracy of the 1-km ASTER cloud mask for the ASTER database.

Tonooka also led a discussion of the best plan to complete the global nighttime TIR acquisition. The highest priority will include Saudi Arabia and northern Australia, and then Brazil. Recommendations were made as to how best to organize the plans submitted to the Operations and Mission Planning Working Group (OMPWG) and two new Action Items were generated.

Geology Working Group

Mushkin used ASTER stereo data to determine sub-pixel surface roughness, and thus estimate erosional surface age and roughness corrections for TIR data. Using this technique he derived a slip rate that was four times faster than previously estimated.

W. Sneed [University of Maine] talked about studies of glaciers in Canada and Greenland to determine volume changes, elevation changes, and ice velocity changes. The studies used data from ASTER, Moderate Resolution Imaging Spectroradiometer (MODIS) and Landsat.

D. Adams and **M. Eneva** [both from Imageair, Inc.] discussed their studies to investigate possible thermal precursors to earthquakes in California. No unique thermal signatures have been found related to earthquakes.

J. Mars [USGS] compared new ASTER cross-talk corrected data products with Visible/Infrared Imaging Spectrometer (AVIRIS) recovered spectra. Differences were attributed to incorrect atmospheric water vapor models. He also discussed his regional alteration mapping in Iran using techniques developed and validated in Nevada.

F. Kruse [Horizon GeoImaging, LLE] talked about nested hyperspectral/ASTER mineral mapping techniques. Using Airborne (AVIRIS) data, ASTER is used to extend results regionally. While ASTER does not have the ability to map nearly the same number of minerals, the technique is a vast improvement over existing methods.

B. Raup [National Snow and Ice Data Center] provided an update on the Global Land Ice Measurement from Space (GLIMS) project. GLIMS now involves 140 people in 20 countries, studying glaciers worldwide.

Ramsey described his project to use the ASTER *urgent request protocol* for volcano monitoring in Alaska and Siberia. The data are provided to the Alaska Volcano Observatory for use in their ash hazard assessments for aircraft safety.

Ramsey also talked about recent ASTER observations of Kilauea eruption activity, and the use of full-mode nighttime data to characterize the volcanic activity.

M. Watson [University of Bristol] discussed modeling the limits to detect sulfur dioxide (SO_2) using ASTER TIR data by studying two adjacent volcanoes in Guatemala. The limit seems to be about 500 tons/day.

R. Wessels [USGS] reported on seven years of ASTER observations of Pavlof and Mount Hague volcanoes in Alaska. These tend to be low temperature anomalies, and provide constraints on ASTER's ability to detect anomalies.

Eneva discussed using ASTER TIR data to look for geothermal anomalies in the California Coso geothermal field. Many environmental factors conspire to confuse true geothermal heating signals with other false positives.

M. Urai [National Institute of Advanced Industrial Science and Technology (AIST)] talked about thermal anomalies associated with the Merapi volcano and its 2006 lava dome. He used day and night TIR data as well as DEMs for his analyses.

Abrams reported on behalf of **G. Vaughan** [JPL] and discussed work on Oldoinyo Lengai natrocarbonatite eruptions in east Africa. This unusual volcano had an explosive event, nicely captured by ASTER, which Vaughn has characterized.

D. Pieri [JPL] provided an update on the ASTER Volcano Archive project at JPL. The on-line web interface provides full scale JPEGs, links to the Smithsonian Catalog, and draping over *GoogleEarth*.

Ecosystems/Oceans Working Group

G. Geller [JPL] reported that since June five new STARS were submitted through the Ecosystems Working group.

Y. Yamaguchi [Nagoya University] reported on preliminary results of regional evapotranspiration estimates for Nagoya, Japan, using a two-source model with ASTER and meteorological data as inputs. Results met the goal of less than 50 W/m^2 error compared with flux tower measurements and the plan is to apply this method to agricultural areas in Nepal in the future[1].

S. Scheidt [University of Pittsburgh] provided an update on work focusing on the relationships between sand transport pathways and dust emission hot spots in the Sahara Desert.

T. Matsunaga [National Institute for Environmental Studies] reported for **G. Saito** [Tohoku U.] on results of analyses that Saito's group conducted of several upland farming regions. The results demonstrated that upland farming areas can be characterized in terms of topography, area, and shape of farmland.

Matsunaga reported for **Y. Sakuno** [Hiroshima University] on his recent study on eelgrass habitat mapping using ASTER data. More efforts will be necessary to validate maps derived from ASTER.

[1] See page 4 of the July-August 2007 issue of *the Earth Observer* for background on this research.

A. French [U.S. Department of Agriculture (USDA)] presented methodology and results from combining MODIS and Geostationary Operational Environmental Satellites (GOES) land surface temperature into 1-km, half-hourly datasets over the Southwest U.S.

H. Yamamoto [AIST] presented an inter-comparison of in-house ASTER/MODIS surface reflectance products using 6S radiative transfer code, aeronet, and ASTER/MODIS surface reflectance. This experiment expanded on previous research that had shown significant differences between ASTER and MODIS surface reflectance products. Yamamoto explained that the Global Earth Observation (GEO) Grid is an E-Infrastructure designed to accelerate GEO sciences and described the system they developed for applying radiometric re-calibration coefficients and Rayleigh/ozone/water vapor corrected reflectance without aerosol correction. This research enables the intercomparison between ASTER and MODIS top-of-atmosphere radiance, top-of-atmosphere reflectance, and Rayleigh/ozone/water vapor corrected reflectance.

L. Preshad [Arizona State University] summarized the *100 Cities Project*, which focuses on studying urban heat islands. The Project includes the United Nation's International Human Development Program, the Chinese Academy of Sciences, the Chinese Ministry of Land and Resources, U.S. Center for Disease Control, and U.S. Environmental Protection Agency. A *Google Earth* mapserver tool is being developed to facilitate getting ASTER-derived surface temperature scenes, vegetation indices, and land cover classifications for the 100 cities to urban practitioners and researchers.

Matsunaga reported for **T. Ishiyama** [Chiba University] on 40-year changes in land cover/vegetation around oases in the Taklimakan Desert using Corona, Landsat, and ASTER data. Long-term increases in cotton field extent and recent increases in saline deposits were indicated.

T. Gubbels [Science Systems and Applications, Inc.] explained **J. Masek's** (GSFC) and his work on assessing forest cover change and disturbance between 2000 and 2005 using Landsat Geocover and ASTER. Gubbels also reported on **M. Pritchard's** work on snow melt, ice dynamics, and mass balance for Patagonian ice fields.

Geller provided an update on the *TerraLook* project, which makes recent ASTER and historical Landsat data available at no cost to non-technical users. He also summarized the plans for the Group on Earth Observations (GEO) Biodiversity Observation Network, which will use ASTER as one of its many data sources.

Atmospheric Correction Working Group

Thome led a discussion on how best to inform users of saturation of SWIR data. Participants discussed the impact that changing file names or data values would have on end users and decided against making these changes.. They decided to keep the data products the same, and warn users via web-based alerts.

Eng went over the status of atmospheric correction software. The next version of the software (*Version 3.2*) is in process of predelivery testing. The newest version removes artifacts at boundaries of inputs; updates ozone sources; and makes available MODIS profile information.

Yamamoto presented capabilities of the GEO Grid system (available to Science Team members). The site will allow interactive change of processing parameters, and has available different atmospheric correction algorithms.

Mars described his evaluation of SWIR cross-talk corrected data, comparing the ASTER standard *AST07XT* product, and a product he himself developed. Discrepancies between the two products seem to indicate a problem with Band 9 water vapor factors in the standard product, and a reflectance-dependent error in Band 5.

Radiometric Calibration Working Group

S. Tsuchida [AIST] showed team members how to access the GEO Grid processing system for custom production of higher level products, including different kinds of atmospheric corrections.

Thome reported finding no significant temporal trends in Visible/Near Infrared (VNIR) or SWIR data over the past four years. A new web site is in place to convert ASTER values to Landstat Enhanced Thematic Mapper Plus (ETM+) equivalent results. Ground-monitor results are showing promise for providing accurate calibration results using automatic stations.

Tonooka showed his web site for recalibration of TIR data. The site continues to operate nominally, and provides users with a simple way to obtain the most accurate calibration coefficients.

A. Kamei [AIST] and **Tsuchida** reported on 2007 field campaigns to validate VNIR and SWIR data. They showed results based on *6S* radiative transfer code, and discussed differences with standard methods.

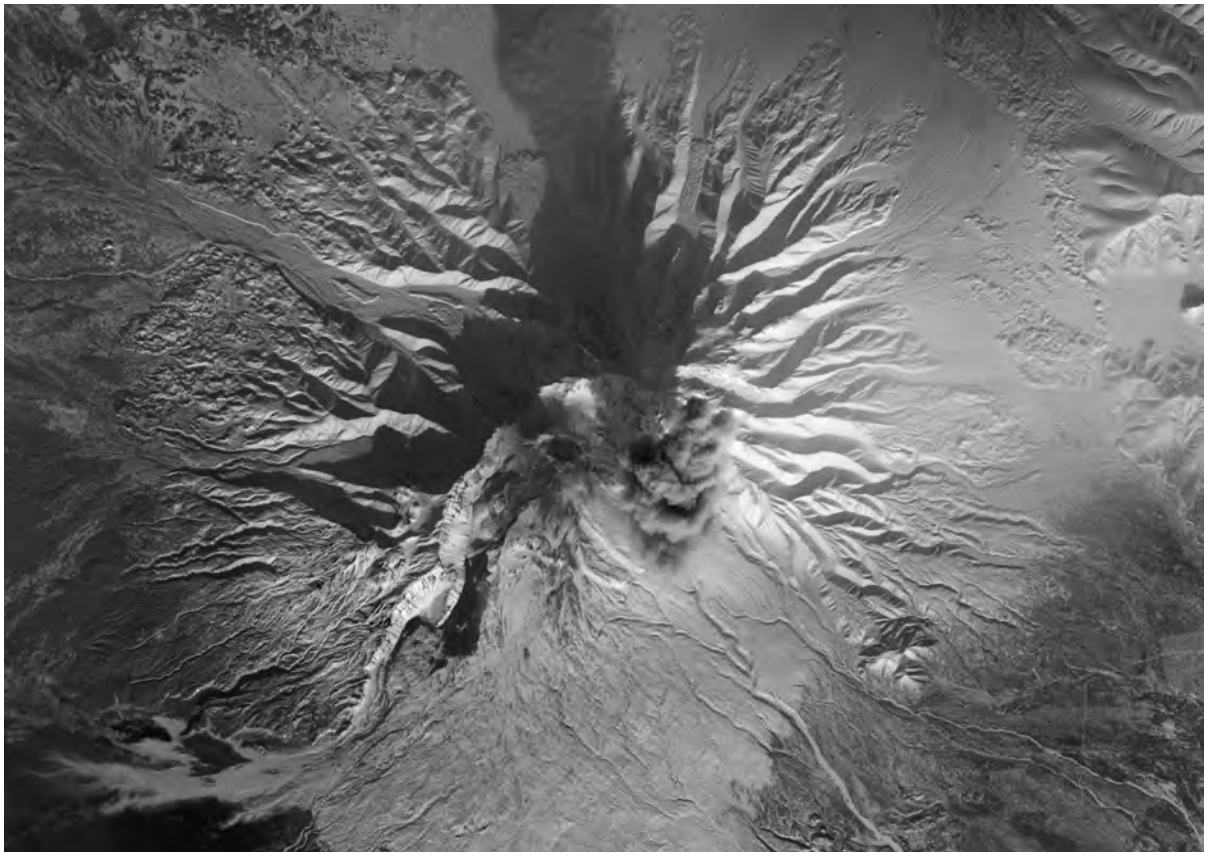
Sato showed that the SWIR onboard calibration lamps were saturated due to the increased offset, so they could not be used to evaluate sensitivity coefficient values.

Closing Plenary Session

During the final gathering, each Working Group chairperson presented a summary of the discussions and talks that were given during the Working Group session.

With most of the ASTER instrument and related systems working flawlessly, it is not surprising that much of the meeting addressed the sickly SWIR system and how to minimize effects of its problems. Suggested actions include changing to *Low2* gain while allowing the values to be what they will and notifying users by web-based alert. Some products may eventually be eliminated. Other topics of most interest were how to allocate the allowable resources and complete Global Map 3, Global DEM, Nighttime TIR Map, and Gap Filler Map while fulfilling other demands on the instrument.

Overall, the group felt that the instrument and systems are performing extremely well, and look forward to the next ASTER Science Team Meeting to be held in Tokyo, Japan in the second week of June 2008. ■



On Sunday morning, February 17, 2008, the skies above Shiveluch Volcano in Russia's Far East were clear and calm. When the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) on NASA's Terra satellite passed overhead, it caught this view of a column of ash from a recent eruption seemingly frozen in the air over the mountain. The southern slopes of the snow-covered volcano were dark with ash. The the ash column rises over the volcano to the east (right) of the active caldera. The shadow of the ash column looms over the northern flank of the volcano. Shiveluch (sometimes spelled Sheveluch) is among the largest and most active of the dozens of volcanoes that sit on the Kamchatka Peninsula in Russia's Far East. **Credit:** NASA's Earth Observatory.