Announcement of Collaborative Opportunity

ASTER Global DEM Validation

International and Alaska Component

I. Introduction

This Collaborative Opportunity is being announced to identify individuals to participate as collaborators in verifying the accuracy of, and otherwise characterizing, international and Alaska segments of the new Global DEM (GDEM) product being produced from Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) data. The ASTER GDEM is being produced by Japan's Ministry of Economy, Trade, and Industry (METI) and the National Aeronautics and Space Administration (NASA). Validation of the ASTER GDEM will be accomplished as a cooperative activity of the U.S. Geological Survey (USGS), NASA, and METI's Earth Remote Sensing Data Analysis Center (ERSDAC), with the USGS having lead agency responsibility. This Collaborative Opportunity will afford a limited number of cooperators pre-release access to portions of the ASTER GDEM to assist the USGS, NASA, and METI in a more robust validation of this new data product.

A. ASTER

ASTER is an advanced multispectral imager developed by METI and launched onboard the Terra spacecraft in December 1999. Terra is the flagship of NASA's Earth Observing System (EOS) program and is in a sun-synchronous, near-polar orbit at an altitude of 705 km at the equator. ASTER records reflected and emitted electromagnetic radiation in 14 wavelength bands using three separate telescopes and sensor systems. These include three visible and near-infrared (VNIR) bands with a spatial resolution of 15 m, six short-wave-infrared (SWIR) bands with a spatial resolution of 30 m, and five thermal infrared (TIR) bands that have a spatial resolution of 90 m. VNIR Band-3 also is acquired using a backward-looking telescope, thus providing along-track stereo coverage from which high-quality digital elevation models (DEMs) are generated as one of a suite of ASTER standard data products. ASTER DEM standard data products are produced with 30m postings, and have Z accuracies generally between 10m and 25m RMSE.

B. ASTER Global DEM

ASTER was not designed to provide routine global coverage, but rather is operated at an 8% duty cycle. Most observations are scheduled to fulfill long-term global mapping mission requirements and to meet the needs of scientific investigators. Nevertheless, nearly 1.5 million ASTER scenes have been acquired since launch, covering virtually the total global land surface. Consequently, the decision was made in 2007 to attempt to create a high-quality digital elevation model of the global land surface from ASTER data.

The ASTER GDEM is being generated by first stereo-correlating the entire 1.5-million-scene ASTER archive and producing individual DEMs. Each pixel is produced by using all DEM values derived from multi-temporal images to compute a single, averaged value. This approach enhances the overall accuracy of the ASTER GDEM compared to DEMs

generated from single ASTER scenes, and at the same time it helps eliminate cloudy pixels from the compilation.

The ASTER GDEM will be offered at no charge to users worldwide as a contribution to the Global Earth Observing System of Systems (GEOSS). It will be packaged in 1°-by-1° tiles, and will cover land surfaces between 83°N and 83°S with estimated accuracies of 20 meters at 95 % confidence for vertical data and 30 meters at 95 % confidence for horizontal data. The ASTER GDEM is expected to be available in the first half of calendar year 2009, and will be delivered in geotiff format and geographic lat/long coordinates on a 1 arc-second (30m) grid.

II. Validating the ASTER Global DEM

The strategy for validating the ASTER GDEM involves two fundamental components: a U.S. component and an International/Alaska component. The former will provide a detailed and very accurate assessment of the ASTER GDEM over the conterminous United States (CONUS), while the latter is designed to confirm that detailed accuracy assessments obtained for the conterminous U.S. reliably can be extended across the global land masses.

A. Validation over the Conterminous United States

The ASTER GDEM will be delivered in 1ºx1° tiles. Each of the 934 tiles that cover the CONUS will be compared to the corresponding 1-arc-second data from the USGS National Elevation Dataset (NED). The comparison will include differencing the ASTER GDEM with the NED data on a pixel-by-pixel basis. Difference statistics will be generated for each 1x1-degree tile, and they will be aggregated from all 934 tiles resulting in an overall characterization of the differences for the CONUS.

The absolute vertical accuracy of the ASTER GDEM will be measured by comparison to an independent reference geodetic control point dataset from the National Geodetic Survey (NGS). The “GPS on bench marks” dataset includes more than 13,000 points distributed throughout the conterminous United States that NGS uses for gravity and geoid modeling. These points have centimeter-level accuracy in their horizontal and vertical coordinates, as they are produced by high-precision GPS observations on established survey benchmarks. The vertical accuracy of the NED data also will be assessed using the NGS reference points to give further context to the ASTER results.

The reference control points also provide a useful sample of locations at which land surface characteristics (slope, aspect, local relief) can be measured and compared among the three elevation datasets. Measurement of these derivative parameters will allow for examination of the vertical accuracy as a function of specific terrain conditions. Additionally, the land cover at each of the reference control point locations will be recorded based on the National Land Cover Dataset, which will allow the assessment to include calculation of vertical accuracy by land cover class.

B. ASTER GDEM Validation over International Test Sites and Alaska

In addition to the 934 tiles covering the conterminous U.S., as many as 200 ASTER GDEM 1ºx1° tiles covering land surface areas distributed across the globe will be evaluated **in cooperation with individuals selected through this Announcement, including collaborators from the international community and Alaska.** The 200 additional 1ºx1° tiles represents nearly 1% of the non-CONUS tiles.

This Collaborative Opportunity seeks proposals from qualified investigators to evaluate one or more ASTER GDEM 1ºx1° tiles covering land areas outside of the CONUS using appropriate validation data sets at their disposal, as outlined below. Participating investigators will be encouraged to employ evaluation methodologies similar to those generally described above for the CONUS tiles. This will enhance the ability to correlate detailed results from the CONUS evaluations with results from the global sites.

There are no funds provided with this collaborative validation study. ASTER GDEM data only will be provided to participating collaborators. Selected cooperators will receive advance access to ASTER GDEM data covering their selected validation area(s). The data will be provided by the USGS, NASA, and METI to selected cooperators under a short technical assistance/use agreement.

The following information is provided to prospective collaborators for consideration in proposal preparation.

1. Criteria for Participation

   Investigators will be selected for participation in the ASTER GDEM Validation Project based on several criteria. Among the most important of these will be the number, type, and characteristics of the validation or reference data sets they have at their disposal to use in evaluating the ASTER GDEM tile(s) they specify. The experience and expertise of the proposer in assessing the accuracy and quality of digital elevation models will be considered in the selection. It is a goal of this activity to evaluate DEMs that cover a significant range of latitudes and represent a variety of terrain and cover types. Consequently, characteristics of the proposed tiles as relate to these variables will be considered in selecting collaborators.

2. Data and Information to be Provided to Collaborators

   The ASTER GDEM Validation Project will provide to participating investigators, in advance of public release, the ASTER GDEM data sets for the tiles to be evaluated. Two files will be provided for each tile to be evaluated: a) DEM data file; and b) a number file, showing the number of scene-based DEMs contributing to the final DEM value at each pixel and showing the location of data anomalies that have been corrected and the data source used for the correction. **Individual investigators may propose to evaluate up to <u>five (5) separate 1ºx1° tiles</u>**, as long as those tiles exhibit variation in terrain type, cover type, and geographic distribution.

Additional guidelines intended to promote consistent evaluation methodologies among investigators will be provided. For example, it will be a requirement of participation that the ASTER GDEM remains unchanged during evaluation. If formats, datums, image size, etc. need to be changed to facilitate comparison, those changes must be applied to the reference data sets rather than the ASTER GDEM. Also, difference images produced between the ASTER GDEM and DEM validation data sets should subtract the reference image from the ASTER GDEM, so that positive and negative values will denote corresponding highs and lows in the ASTER GDEM relative to the reference data.

Once again, please understand that there are **no monetary awards** associated with this Collaborative Opportunity. Investigators will be expected to fund their own participation. However, as noted above, investigators will be provided access to portions of the ASTER GDEM approximately three months ahead of its public release to the global user community.

3. Reference Data Sets

High-quality reference data sets will be key to meaningful evaluation of the ASTER GDEM over the 200 non-CONUS 1ºx1° tiles. Two types of reference data sets are required for participation in this validation exercise.

For each 1ºx1° tile, investigators must have access to a good quality **raster DEM** for comparison with the ASTER GDEM. It is not required that the raster DEM(s) coincide with the entire 1ºx1° tile, but should cover at least 25% of the tile. The minimum requirement is for a 3 arc-sec DEM with a known absolute vertical accuracy expressed as RMSE. ***Preferred*** is a bare earth DEM at 1 arc-sec or better with a known absolute vertical accuracy expressed as RMSE.

Also required is some type of absolute control. These may include (in order of preference) the following: a) high-precision geodetic control points (minimum of 10/tile with RMSE $_{(x,y,z,)}$ = <1 m), including real-time kinematic GPS; b) terrestrial lidar with total accuracy = <1 m; c) airborne lidar point cloud data; d) ICESat data; and e) photogrammetric mass points with absolute control.

4. Deliverables

Participants in this ASTER GDEM validation exercise will be expected to submit a brief report that identifies the 1ºx1° tile(s) evaluated; describes the general physiographic, terrain, and land cover characteristics of the tile; explains the validation methodologies employed; and provides a detailed summary of all results obtained. In addition, investigators will be asked to submit copies of reference DEMs compared, difference images produced, absolute control used, and available land cover data. If copies of some of these items cannot be provided, please note in your proposal those that will not be available. Deliverables will be due six weeks following receipt of ASTER GDEM tiles to be evaluated. An

ASTER GDEM Validation workshop may be convened following release of the ASTER GDEM for collaborators to present and discuss results of this validation exercise. A workshop publication also will be considered.

III. ASTER GDEM Validation Proposal Process

Investigators interested in participating in the validation of the ASTER Global DEM should submit a proposal, not to exceed three (3) single-spaced pages in length, to ASTER_GDEM_Validation@usgs.gov by **January 5, 2009**. Proposals should include the following: name(s), address, and contact information for investigator(s) and brief description of qualifications; **lower left** coordinates of the 1ºx1° tile proposed for evaluation; a list and brief description of reference data sets (both raster DEMs and absolute control) available to the investigation; notation of any deliverable that cannot be provided and reason; and any other information worthy of consideration. Please submit separate proposals for each 1ºx1° tile you would like to evaluate (max. 5). For raster DEMs listed as reference data sets, please note the percent of the 1ºx1° tile covered by the reference DEMs.

Collaborators selected to participate in the ASTER GDEM validation will be notified by January 12, 2009. ASTER GDEM 1ºx1° tiles are expected to be ready for distribution to investigators very shortly thereafter.