EVALUATION OF SAMPLES OF THE ASTER GLOBAL DEM USING STAR-3*i* AIRBORNE INTERFEROMETRIC SAR DATA

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A recent Announcement of Collaborative Opportunity (AOCO) [1], offers an invitation to interested parties to participate in an exercise to validate the new ASTER Global DEM (GDEM). At the time of this abstract submission, the ASTER GDEM has not yet been released but is expected to be available for validation purposes in early 2009 and for general use later in 2009. The validation program is co-sponsored by METI (the Japanese Ministry of Trade, Economy and Industry), NASA and USGS. Prospective participants in the validation are required to submit a proposal to the sponsors of AOCO, detailing approach, data sources to be used as reference, and other information. In particular, the AOCO is seeking validation in areas external to the continental USA (CONUS) where USGS will perform its validation. Assuming a successful AOCO submission, this paper will describe the results of an ASTER GDEM validation activity covering a 1°x 1° tile in Germany, using the DSM (Digital Surface Model), DTM (Digital Terrain Model) and ORI (Ortho-rectified Radar Image) products created using the STAR-3*i* interferometric airborne SAR system as part of the NEXTMap® Europe program, summarized in [2].

The ASTER multi-spectral, multi-sensor system, carried aboard the TERRA spacecraft, has been acquiring image data since 1999. Along-track stereo images are collected by a nadir-looking and backward-looking telescope pair at 15 meter resolution. DEM products from single image pairs have been created with 30m posts and stated vertical accuracies 'generally between 10m and 25m RMSE' [1]. Because of the extensive archive of scenes covering most of the land-mass within +/- 83° latitudes, there is considerable redundancy in many areas allowing the opportunity to gain accuracy and robustness through stacking of multiple DEMs. The ASTER GDEM represents the result of the stereo-correlation and merging of all the scenes in the archive. This program, under the sponsorship of METI, NASA and USGS[1] has estimated vertical accuracy of 20m (95% confidence level) for the GDEM which is created on a 1 arc-sec (~30 m) grid. The GDEM will be made publicly available free-of-charge as a contribution to GEOSS.

The NEXTMap® Europe program, includes DEM coverage of about 2.2 million km^2 of Western Europe with a DSM posted at 5 meters and vertical accuracy specified as 1m RMSE (absolute) in unobstructed terrain of moderate (<10°) slopes [2]. A 5 m DTM with the same specification, is extracted from the DSM. The associated ORI has

1.25 m resolution and about 2 m horizontal accuracy. This partially complete data-base, which is publicly available on a commercial licensing basis, will be completed in early 2009.

Of value for the ASTER GDEM validation program, is the wide area nature of the DEM coverage, the horizontal detail, as implied by the 5 meter sample spacing, and the low systematic errors inherent in the specification. In order to achieve this low (<1 m RMSE) absolute accuracy figure, the operational implementation of the InSAR program incorporates overlapping swaths of 'primary' data crossed orthogonally by tie-lines which are populated by radar reflectors surveyed in at the cm level. During the processing stage, systematic errors are minimized using an adjustment procedure, and the DSM is tied by the reflectors to the appropriate frame of reference. Because the 5 meter InSAR DEMs will be averaged down to the 30 m ASTER grid size, the random error component of the reference surface, will therefore be reduced by about a factor of 5, leaving the residual systematic errors as the dominant component.

The location of the validation exercise is to be centered on Euskirchen, Germany, and was chosen in part because of a variety of terrain and terrain-cover situations. The DSM will be masked to exclude vegetated areas so that comparisons will be made under similar terrain surface conditions. Standard DEM differencing statistics and visualizations will be created. A slope mask will be created to enable an assessment of slope/aspect accuracy. For inter-comparison purposes, the SRTM DEM will also be tested in this area.

References:

[1] Bailey, G.Bryan, Notification of 'Announcement of Collaborative Opportunity', e-mail circulated December 1, 2008

[2] Mercer, J. Bryan and Qiaoping Zhang, 'Recent Advances In Airborne InSAR for 3D Applications', Proceedings of the ISPRS XXI Congress, Beijing, ISSN 1682-1750, Volume XXXVII, 2008