ASTER GLOBAL DIGITAL ELEVATION MODEL EVALUATION USING PRISM ONBOARD ALOS

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1. INTRODUCTION

The Advanced Land Observing Satellite (ALOS, nicknamed “Daichi”) was successfully launched on January 24th, 2006 from Tanegashima Space Center of Japan Aerospace Exploration Agency (JAXA), and continuously works very well during almost three years. ALOS has three mission instruments i.e. an L-band Synthetic Aperture Radar (PALSAR) and two optical instruments of the Panchromatic Remote-sensing Instrument for Stereo Mapping (PRISM) and the Advanced Visible and Near Infrared Radiometer type-2 (AVNIR-2) [1]. PRISM performs the along-track triplet stereo observations by forward (FWD), nadir (NDR) and backward (BWD) independent panchromatic optical line sensors with 2.5 meter ground resolution at nadir in 35km wide swath width. FWD and BWD instruments are arranged at an inclination of +/-23.8 degrees from NDR to realize a base to height ratio equal to 1.0. It is used to derive a precise digital surface model (DSM) or digital elevation model (DEM) with high spatial resolution.

In this study, we will perform the evaluations of ASTER Global Digital Elevation Models (GDEMs) based on generated DSM by PRISM over various terrain features. Furthermore, we will consider possibility of interpolation accuracy of ASTER GDEM by PRISM DSM in un-derived DEM areas as a part of contribution of GEO Task entitled "Global Topography".

2. PERFORMANCES OF PRISM AND GENERATED DSM

The geometric calibration is important in generating a precise DSM by stereo pair image of PRISM. It is carrying out since launch the satellite [2]-[5]. The current absolute geometric accuracy of PRISM is about 6.1 meter for NDR, 5.7 meter for FWD, and 7.2 meter for BWD (RMSE), respectively. This result was obtained by more than 6,500 ground control points (GCPs) used as check points in 656 scenes in worldwide.

The DSM and ortho-rectified image (ORI) Generation Software for ALOS-PRISM (DOGS-AP) is developing at Earth Observation Research Center (EORC), JAXA as a part of validation of PRISM. It is introducing the cross-correlation based exclusive triplet images matching algorithm, and updating with the calibration results [6]-[10]. Various test sites including various terrain characteristics were prepared and used for the DSM validations with the reference DSM data sets derived from Lidar instruments or aerial photo matching [5], [9]-[10]. The current height accuracy of generated DSM by PRISM with DOGS-AP is about 4.4 meter at flat terrain, 6.9 meter in urban areas, and 7.9 meter in steep mountainous areas (RMSE) without GCP. We can basically possible to generate DSM by PRISM in any areas, if the images are available with acquisition good conditions.

3. TEST SITES FOR VALIDATION OF ASTER GDEM

We expect that PRISM DSM can be used for evaluation of ASTER GDEM in terms of resolution as well as accuracy of estimated height as described in Section 2. In order to achieve this purpose, test sites should be better to cover various terrain cover and features. We are currently considering five test sites in the world. The areas and characteristics of the test sites are as follows;

1) Mt. Tsukuba, Japan

It is covered by various terrain futures *i.e.* steep mountain with forests, trees in plain, paddy fields, and villages. The height range is 900 meters. We are validating PRISM DSM using airborne Lidar that was acquired on 2007.

2) Mt.Ibuki, Japan

This is a slightly steep mountain in Japan without forest. The height range is 700 meters. PRISM DSM is validated by airborne Lidar acquired on 2004.

3) Thun, South West (SW), and Bern, Switzerland

These areas are covered by various terrain features, and reference DSMs by aerial photos are available.

4) Kunbu, Nepal

This region is the high mountainous areas with several glaciers. Precise GCPs are available.

5) Lunana, Bhutan

This region is the high mountainous areas with several glaciers. Precise GCPs are available.

4. METHODOLOGIES

ASTER GDEM and PRISM DSM will be directly compared, and height differences and its statistics will calculate as a first step. PRISM DSM is evaluated by other reference data i.e. reference DSMs and precise GCPs as explained in Section 3. Furthermore, we will investigate spatial interpolation method of 0.3 arc-sec of PRISM DSM to 1 arc-sec ASTER GDEM. These are depends on the availability and quality of ASTER GDEM as well as PRISM imageries.

5. REFERENCES

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