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The generation of DEM from ALOS/PRISM and ice volume change in Mt. Qomolangma region

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Calculation on glacier volume variations are still greatly limited by the vertical accurate of various data sources till now (Stevens et al., 2004). Therefore, one of the major methodological gaps in the observation of glaciers from space is the measurement of glacier volume changes (Kääb, 2008). Glacier volume changes needs an integrated study and correction on generated DEMs from multi-sources remote sensing data and evaluation of the vertical errors and accuracy. Here, we produced DEMs over mountain glaciers from ASTER and ALOS/PRISM on the northern slope of Mt. Qomolangma (hereafter called the Mt. Qomolangma region), also known as the Mt. Everest, located in the middle Himalayan Mountains, 27˚59-28˚11´N and 86˚44´- 86˚59´E. A series of digital images, include Aster images on 23 Oct 2003, ALOS/AVNIR-2 on 19 Jan 2007, ALOS/AVNIR-2 on 24 Oct 2008, 3 scenes of ALOS/PRISM on 04 Dec 2006, 1:50,000 topographic maps with contour interval of 20 m produced from aerial photographs acquired in 1974 and the 1:50,000 DEM (cell size: 25 m) generated from the topographic maps were used.

The DEM was generated based on the three scenes from ALOS/PRISM images and PCI Orthoengine module. The process of DEM generation from ASTER images is very similar to that of ALOS/PRISM. The difference is that: only two images ASTER from nadir and backward views were used here.

Table 1 The differences between generated DEMs and the 1:50,000 topographic maps in the non-glacierized area

	dem5w	demaster	prism12_50m	prism13_50m	prism14_25m	prism15_100m	SRTM DEM	ASTER_
Maximum	80.0	920.0	218.0	174.0	258.0	168.0	240.0	437.0
Minimum	-123.0	-331.0	-297.0	-367.0	-459.0	-393.0	-315.0	-182.0
aveDEV	23.8	84.0	33.9	36.0	31.3	45.9	67.6	57.9
AVERAGE	6.9	75.3	11.3	5.9	1.7	17.2	32.3	45.0
StDEV	30.5	128.0	55.7	59.4	60.6	64.4	85.8	77.2
RMSe	31.2	148.3	56.7	59.6	60.5	66.5	91.5	89.2

Compared various kinds of products of the generated DEMs in the non-glacierized area with the 1:50,000 topographic maps using 215 random points, we found that the mean difference of PRISM DEM to the topographic maps is 1.7 m. However, the mean difference of ASTER GDEM (ASTER_GDEM) is 45m, which is released Version 1 of the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Model (GDEM) on 29 June, 2009. Our result shows that the quality of ALOS/PRISM DEM is better than that of ASTER GDEM, and the calibrated ALOS/PRISM DEM based on the relationship between aspect and DEM difference was more accurate than the original generated one.

Fig.1 The generated ASTER DEM on 23 Oct 2003 Fig.2 the generated PRISM DEM on 04 Dec 2006