Validation of TanDEM-X Products in Polar Regions

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Precise elevation models in polar regions are of high importance for mass balance studies and ice-sheet modelling, and are used in the processing of a variety of satellite data. To improve and characterise the error bar of other satellite derived elevation data in dependence of surface slope such as from CryoSat-2 altimeter measurements we want to make use of high resolution TanDEM-X data acquired in Antarctica. However, the quality of TanDEM-X Products over polar snow and ice are also not well known. Therefore we aim to validate the TanDEM-X products against airborne laser scanner data. In the last three years the Alfred Wegener Institute has accomplished several field campaigns in Antarctica where precise high resolution laser scanner reference data sets have been acquired in three different regions with varying snow morphology and surface properties. The laser scanner was installed on the AWI Polar5/6 aircrafts, and data acquired from the nominal flight level of about 1000 m at a scan rate of 100 kHz yield a shot point separation of about 2 m across a swath width of about 1000 m. The laser footprint of every single shot is about 0.1 m, and the absolute vertical accuracy of a single measurement after the full processing is estimated with 5 cm. The TanDEM-X data were received from DLR in SSC format and processed to a DEM at 12.5 m horizontal resolution using two different software packages. We will show comparisons of the different DEMs at three different sites: (i) the flank of an Ice Ridge near the coast with relatively large surface slope where high accumulation is observed, (ii) within the interior of Antarctica at about 2800 m sea level in an area with low accumulation rate, (iii) at high undulating blue ice area near the coast with negative surface mass balance. Preliminary results show that differences in the absolute accuracy are sometimes significant larger than 50 m and largely related to the processing history of the TandDEM-X data using different software packages. However, the comparison showed a very high relative accuracy of all DEM sets with deviations normally below 15 m. In all cases the processing including ground control points gave best results. Highest overall accuracy was observed in area ii, and the largest variability in elevation difference was observed in area iii. It is concluded that deviations may be partly related to snow properties and penetration.