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Height Maps from Bistatic TanDEM-X Acquisitions using SAR Interferometry for Study Sites in the Swiss Alps

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The TanDEM-X mission delivers high resolution Synthetic Aperture Radar (SAR) data with its main goal to provide an accurate global Digital Elevation Model (DEM) [1]. The single-pass bistatic acquisitions are especially suitable to compute up-to-date topography information using SAR interferometry (InSAR), one of the established techniques for elevation extraction from SAR data [2]. In this study, InSAR is used to generate height maps from several bistatic TanDEM-X co-registered single look slant range complex (CoSSC) products over Alpine terrain in Switzerland. The computed elevation information can support a variety of geoscientific applications. Here, the topography information is used to identify landform and surface changes for selected study sites in the Haute Valais in Switzerland where landslide displacement, rock glacier movement and glacier change monitoring are ongoing activities [3], [4]. Differences of the computed height maps to each other, to other available DEMs, such as the Shuttle Radar Topography Mission (SRTM) DEM, DEMs of Switzerland by the Swiss Federal Office of Topography (swisstopo) and to height maps from a terrestrial radar interferometer [5] are examined. The potential and limitations of the computed height maps for applications in Alpine geomorphology are discussed. The data processing for each bistatic pair included the multi-looking of the SAR data and the computation of the interferogram. Then, reference heights to update the baseline geometry model were selected, either manually or by automatically extracting ground control points from available external DEMs. Finally, the interferometric phase was converted to height and geocoded. The resulting height maps were calculated at around 5 meters pixel spacing. The obtained height maps show good agreement with the other available external DEMs. In areas of continuous changes like over glaciers, differences can be observed. This is as expected since each DEM shows the state of the terrain at the time of observation. As typical for spaceborne SAR interferometry in mountains, limitations are radar shadow and layover effects resulting in data gaps. Here, further height data or observations taken with another acquisition geometry are needed. The computed height maps provide up-to-date topographic information. And, they can now be used as input to Differential InSAR (DInSAR) processing for landslide displacement and deformation monitoring activities for the selected study sites. References: [1] G. Krieger, A. Moreira, H. Fiedler, I. Hajnsek, M. Werner, M. Younis, and M. Zink, "TanDEM-X: A satellite formation for high-resolution SAR interferometry", *IEEE Trans. Geosci. Remote Sens.*, vol. 45, no. 11, pp. 3317-3341, Nov. 2007. [2] T. Toutin and L. Gray, "State-of-the-art of elevation extraction from satellite SAR data", *ISPRS Journal of Photogrammetry and Remote Sensing*, vol. 55, no. 1, pp. 13-33, Feb. 2000. [3] T. Strozzi, R. Delaloye, A. Kääh, C. Ambrosi, E. Perruchoud, and U. Wegmüller, "Combined observations of rock mass movements using satellite SAR interferometry, differential GPS, airborne digital photogrammetry and airborne photography interpretation", *Journal of Geophysical Research*, vol. 115, issue, F1, Mar. 2010. [4] C. Werner, A. Wiesmann, T. Strozzi, R. Caduff, U. Wegmüller, and A. Kos, "The GPRI Multi-mode Differential Interferometric Radar for Ground-based Observations", 9th European Conference on Synthetic Aperture Radar (EUSAR), Electronic Proceedings, 23-26 April 2012, Nürnberg, Germany. [5] T. Strozzi, C. Werner, A. Wiesmann, and U. Wegmüller, "Topography mapping with a portable real-aperture radar interferometer", *Geoscience and Remote Sensing Letters*, vol. 9, no.2, pp. 277-281, Mar. 2012.