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TanDEM-X: Advantages, Limits and Possibilities Beyond the First Global DEM

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The twin German satellites TerraSAR-X and TanDEM-X have been collecting SAR data in bistatic configuration since 2010. This is currently the only available bistatic mission, where the interferometric image pair is acquired within the same survey avoiding temporal decorrelation. In September 2016 the global TanDEM-X DEM was completed achieving an unprecedented homogeneity and accuracy at 12 m horizontal spacing. Its relative height accuracy is specified with 90% confidence level below 2 m and under 4 m for flat and steep terrain, respectively. It achieves in more than the half of the tiles globally 1 m and 2 m for flat and steep terrain, respectively. The global absolute accuracy with 90% confidence level is below 3.5 m. The unedited 90 m spacing version is freely available since October 2018. It is purely derived from the acquired interferometric SAR data, which delivers reliable values on non-water surfaces, and covers almost the complete landmass 99.89%. The generation of an edited version is planned for the end of 2019, where opportune water levelling and gap filling are considered. On the other hand, it is very important to be aware of the intrinsic radar characteristics when using the TanDEM-X global DEM: the height of forested and snow covered areas corresponds to the mean measured phase center that returns from the illuminated volume. The wave's capability to penetrate into a volume depends on its density, structure and the radar frequency. The height of the generated DEM is in these cases under the surface. For forest the height is over the terrain close to the top of the canopy and for ice under the terrain. This aspect is sometimes seen as an obstacle to use DEM derived by SAR, on the other hand we see an opportunity to detect volume as it leads to a certain amount of decorrelation on the data. As other decorrelation can be well assessed is possible to estimate the volume decorrelation from the coherence. Since the delivered raw data is remarkably good, further analysis have been conducted and the data has been used for mapping other bio-physical variables, based on these principles. Classification algorithms on ice, forest, and water have been developed, as well as tested and validated. A global forest map has been derived and is freely accessible for scientists. Planned is also a global water map and Antarctica ice facies map. Furthermore the satellites are well in shape and resources are available to acquire the globe at least once more and allow for the generation of a change DEM. From the lessons learned the acquisition plan has been adapted in order to achieve the best in the less time, considering an edited version of the DEM as base. Finally, the land cover maps in addition to the edited DEM and change DEM are very promising products for geomorphology purposes.