THE GLOBAL TANDEM-X DIGITAL ELEVATION MODEL AND THE TERRESTRIAL IMPACT CRATER RECORD

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Introduction: In the past two decades space-borne sensors have provided us with high-quality elevation data of the solid sur-faces of several large bodies of the solar system. For Earth, the German TanDEM-X mission delivered a new digital elevation model (DEM) with unprecedented accuracy. From December 2010 to March 2015 the two X-band radar satellites TerraSAR-X and TanDEM-X have been operated in close formation as a single-pass SAR interferometer. The data acquired in bistatic mode were processed to yield a global DEM with an independent pixel spacing of 12 m and an absolute height error of < 10 m. In moderate terrain the relative vertical accuracy exceeds 2 m and remains better than 4 m in scenes with steep slopes [1]. The TanDEM-X DEM covers all land surfaces between 90° S and 90° N latitude.

TanDEM-X DEM: The data of the individual radar acquisitions have been divided into individual scenes of ~30 × 50 km^2 extent, each of which was processed to yield a so-called Raw DEM. About 570000 overlapping Raw DEMs have been required to achieve full Earth coverage. Mosaicking of the individual Raw DEMs forms the final DEM. The complete global TanDEM-X DEM consists of about 20000 tiles with each tile having a size of about 110 × 110 km^2. At the time of writing, about 90% of Earth's land masses exists in final DEM form. The complete DEM should be available by mid-2016 with access for scientific purposes being granted via an AO proposal scheme. Verification confirmed that the corresponding tiles are compliant with the DEM requirements. The absolute vertical accuracy exceeds the specifications significantly [2]. This excellent performance is the result of the high quality of the two SAR instruments, the sophisticated acquisition planning and quality monitoring scheme, and the complex but effective calibration, processing and mosaicking approach.

DEM and Impact Structures: Since the release of the first Raw DEMs we have explored the TanDEM-X capabilities for terrestrial impact crater investigations. These early results have proven the high quality of the dataset for the purpose of crater morphology analyses [3]. Meanwhile we had access to the entire set of more than half a million Raw DEMs and, as part of the final DEM generation, could also study all structures with diameter > 50 km using final DEM tiles. Covering the entire sample of impact structures with DEM tiles would require in total more than 360 DEM tiles. Random orientation of the structures relative to the tile boundaries can even for small craters require multiple tiles (see Fig. 1).

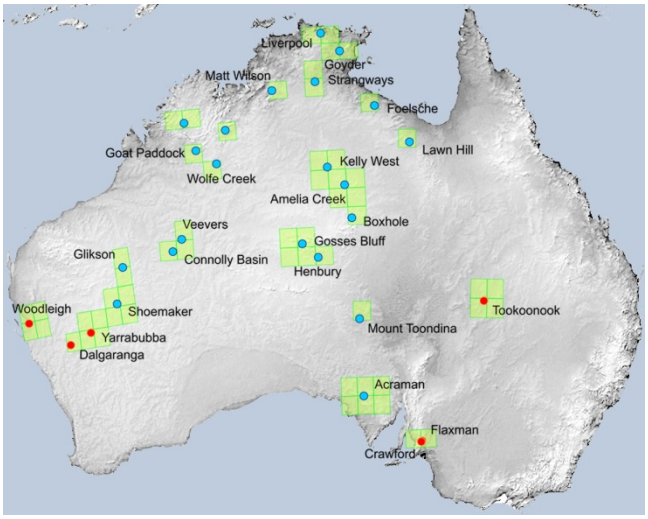

Fig. 1: The Australian impact structures (blue dots: with surface topography, red dots: without surface topography) and corresponding DEM tiles (green boxes).

Our analyses have produced a TanDEM-X sample of more than 120 structures with topographic surface imprints, all mapped with high spatial resolution in a consistent and uniform fashion. They range in size from only a few 10s of meters (Kamil) to the largest known impact of almost 200 km (Vredefort). This sample is used for ongoing and future detailed morphological studies of individual craters. It also permits qualitative and quantitative comparison with other existing global DEMs, obtained using remote sensing techniques in spaceborne missions such as SRTM or ASTER.

We present the status of the TanDEM-X DEM, show how the TanDEM-X data, including extracted morphometric parameters, compare with those derived from other existing digital elevation models and illustrate results of our global mapping project.

References: [1] Krieger G. et al. 2013. *Acta Astronautica* 89: 83-98. [2] Zink M. et al. 2015. *ISPRS Archives* XL-7/W3: 1345-1352. [3] Gottwald M. et al. 2015. *GSA Special Paper* 518: 177-211.