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Suitability of different digital elevation models for landform classification methods and further geomorphometric analysis in the Atacama desert

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The importance of digital elevation models (DEMs) for many geomorphometric applications is still rising. To provide accurate terrain information high-resolution digital elevation models are necessary. In the last decades two publicly available DEMs with a near-global coverage were provided by the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) and the Shuttle Radar Topography Mission (SRTM). Both elevation models became very popular and are widely used for landform mapping. However, both datasets have disadvantages in strongly dissected regions due to their medium pixel resolution of 30 m. For high detailed landform classification on a regional scale in many regions higher resolutions are necessary. Thus, the new globally available TanDEM-X WorldDEM™ is tested for landform mapping approaches as it has a higher pixel resolution of about 12 m and also a higher precision.

The study area contains the regions of Tarapacá and Antofagasta in the northern part of Chile. The region has a hyper arid climate and is one of the driest areas on earth. The relief is characterized by large height differences and a diverse topography. Accurate topographic information is necessary for numerous applications, such as sediment transport estimation and studies on plant distribution. For these areas, a 12 m TanDEM-X WorldDEM™ and a SRTM dataset with a pixel resolution of 30 m were classified with two different landform classification approaches: the topographical position index and the geomorphons approach. Parameters of both were fitted to achieve the best results. All results were compared by calculating the percentage of classified area for each landform class. Furthermore, the accuracy was checked with location related images of the landscape. To evaluate the accuracy of the utilized DEMs, the root mean square error of both elevation models was calculated, by comparing their heights with highly accurate elevation data derived from Pleiades stereo satellite imagery.

The RMSE for the SRTM for this specific region is 5.85 m, the RMSE for TanDEM-X WorldDEM™ is 5.61 m. For mountainous regions the results of the TanDEM-X WorldDEM™ shows a significant increase of the percentage of classified areas for landform classes, which represent valleys or ridges compared to the SRTM results. In contrast, for plain regions no significant differences between both datasets are recognizable. The differences in the results of the TPI approach are generally higher than for the geomorphons approach. Thus, for areas with rough relief the TanDEM-X WorldDEM™ elevation model improves the classification accuracy of landforms significantly compared to medium resolution datasets, as it is able to detect smaller landforms.

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