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Digital Elevation Models of the Earth derived from space-based observations: Advances and potential for geomorphological studies

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Digital Elevation Models (DEMs) are an inherently interdisciplinary topic, both due to their production and validation methods, as well as their significance for numerous disciplines.
The most utilized contemporary topographic datasets worldwide are those of global DEMs. Several space-based sources have been used for the production of (almost) global DEMs, namely satellite Synthetic Aperture Radar (SAR) Interferometry/InSAR, stereoscopy of multispectral satellite images and altimetry, producing several versions of autonomous or mixed products (i.e. SRTM, ACE, ASTER-GDEM). Complementary space-based observations, such as those of Global Navigation Satellite Systems (GNSS), are also used, mainly for validation purposes. The apparent positive impact of these elevation datasets so far has been consolidated by the plethora of related scientific, civil and military applications.
Topography is a prominent element for almost all Earth sciences, but in Geomorphology it is even more fundamental. In geomorphological studies, elevation data and thus DEMs can be extensively used for the extraction of both qualitative and quantitative information, such as relief classification, determination of slope and slope orientation, delineation of drainage basins, extraction of drainage networks and much more.
Global DEMs are constantly becoming finer, i.e. of higher spatial resolution and more "sensitive" to elevation changes, i.e. of higher vertical accuracy and these progresses are undoubtedly considered as a major breakthrough, each time a new improved global DEM is released.
Nevertheless, for Geomorphology in particular, if not already there, we are close to the point in time, where the need for discrimination between DSM (Digital Surface Model) and DTM (Digital Terrain Model) is becoming critical; if the distinction between vegetation and man-made structures on one side (DSM), and actual terrain elevation on the other side (DTM) cannot be made, then, in many cases, any further increase of elevation accuracy in DEMs will have little impact on geomorphological studies.
After shortly reviewing the evolution of satellite-based global DEMs, the purpose of this paper is to address their current limitations and challenges from the perspective of a geomorphologist. Subsequently, the implications for geomorphological studies are discussed, with respect to the expected near-future advances in the field, such as the TanDEM-X Global Digital Elevation Model ("WorldDEM", 2014), as well as spaceborne LIDAR (Light Detection and Ranging) approaches (e.g. Lidar Surface Topography/LIST mission, 2016-2020).