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EDITORIAL
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Editorial: Advances in Quantitative Geomorphology: From DEM Analysis to Modeling of Surface Processes

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Editorial on the Research Topic

Advances in Quantitative Geomorphology: From DEM Analysis to Modeling of Surface Processes

The traditional empirical-mathematical treatment of morphometric parameters related to mass, length, and time of formation of landforms has been used for a long time to constrain or formulate models and rules about morphogenetic processes. This field of investigation has gained momentum since the 1970s, but the late 1990s were characterized by a period of stagnation. Yet, in the last 2 decades, DEM analysis and modeling of short- and long-term estimation of topographic changes and geomorphological processes in different climate contexts and at different spatial and temporal scales have become an important research field in geomorphological analysis. This development within the field of applications aimed at the quantitative characterization of geomorphological processes and landform supports the elevation of the discipline of Quantitative Geomorphology. Indeed, the availability of both global DEMs and user-friendly GIS tools has promoted the development of models and quantitative techniques for the extraction of geomorphological parameters. For example, Landscape Evolution Models (LEMs), GIS-based derivation of geomorphic indexes, and algorithms of automatic landform classification strongly support traditional geomorphological approaches when it comes to solving issues of landscape characterization and morpho-evolution. Furthermore, the current availability of global DEMs derived from different sources requires a careful assessment of errors and uncertainties related to the data source, the method applied, and the modeling results. Scale issue is also an important point in terms of relations between DEMs resolution and the modeling of the geomorphic processes. UAV-derived LiDAR DEMs are a powerful tool to reconstruct short-term surface processes and subtle topographic changes, but they have significant limitations when working on large areas. New methods and techniques have recently emerged to fill this apparent knowledge gap.

The relevant role of quantitative geomorphological analysis in the investigation of landscape evolution is strongly represented in the four papers of this special issue; the issue introduces innovative contributions within the wide field of landscape analysis from different regions.

The relevant topic of the estimation of the accuracy of global-scale DEMs is introduced by Purinton and Bookhagen, who have developed a novel filtering approach and a metric to estimate the vertical variability in adjacent pixels (i.e., the inter-pixel consistency, where low inter-pixel consistency refers to high variability in adjacent pixels) of five DEMs with a spatial resolution of 30 m. The authors explore the inter-pixel consistency of the DEMs in the geomorphic impacts of the Fourier-quantified inter-pixel consistency of the DEMs in a steep and non-vegetated area of the Central Andes, highlighting how Copernicus DEM provides the highest quality landscape

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representation and should become the preferred DEM for topographic analysis in areas without sufficient coverage of higher-quality local DEMs.

Romshoo et al. investigated the influence of four global and mid-resolution DEMs (i.e., ASTER, SRTM, ALOS, and CARTO) on the RUSLE-based estimation of soil erosion in a large sector of the Kashmir Himalayan region. A detailed comparison between DEMs and GPS measurements shows that the CARTO-DEM provided a better representation of the elevation values, followed by ASTER and STRM datasets. The study also revealed that human-induced land-use changes observed from 1981 to 2019 promoted a strong increase in soil erosion.

Gao et al. analyzed the spatial distribution of one of the most important geomorphic indexes (i.e. the drainage density) in the eastern margin of the Qinghai-Tibet Plateau to assess the influence of topographic, geomorphological, and climate factors on the spatial variation of the index. After a detailed review of the main methods of automatic extraction of the drainage network from DEMs, the authors introduced several techniques of drainage density estimation and mapping and statistical analysis of the relationships between the index and topographic and climate factors. The drainage density of the study area is mainly controlled by precipitation and vegetation, as inferred by the relationships among drainage density, mean annual precipitation, and normalized vegetation index. Results also highlight a decrease in the drainage density value with the increase in the average slope, local relief, and altitude. An opposite trend has been detected on the low-relief planation surfaces of the study area, where drainage density increases at a higher altitude.

Finally, Chrobak et al. deal with the significant issue of the assessment of geodiversity and geotourism potential of the Western Carpathians. The manuscript introduces an interesting quantitative approach that combines four different basic attributes (i.e., energy of relief, landform, geology, and land cover) to extract a geodiversity map, which represents a basic but effective tool to delineate the geotourist potential of the study area. The statistical weights of the basic parameters were assigned using a GIS-based multicriteria analysis named analytic hierarchy process (AHP), which tends to reduce the subjectivity of expert-based assignation of the importance of the different basic parameters.

AUTHOR CONTRIBUTIONS

All authors listed have contributed to the research topic and this editorial article substantially and intellectually. All agreed to the publication.

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