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Optimization of the resolution of remotely sensed digital elevation model to facilitate the simulation and spatial propagation of flood events in flat areas

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The use of satellite remote sensing products, such as Digital Elevation Models (DEMs), under specific computational interfaces of Geographic Information Systems (GIS) has fostered and facilitated the acquisition of data on specific hydrologic features, such as slope, flow direction and flow accumulation, which are crucial inputs to hydrology or hydraulic models at the river basin scale. However, even though DEMs of different resolution varying from a few km up to 20m are freely available for the European continent, these remotely sensed elevation data are rather coarse in cases where large flat areas are dominant inside a watershed, resulting in an unsatisfactory representation of the terrain characteristics.
This scientific work aims at implementing a combing interpolation technique for the amelioration of the analysis of a DEM in order to be used as the input ground model to a hydraulic model for the assessment of potential flood events propagation in plains. More specifically, the second version of the ASTER Global Digital Elevation Model (GDEM2), which has an overall accuracy of around 20 meters, was interpolated with a vast number of aerial control points available from the Hellenic Mapping and Cadastral Organization (HMCO). The uncertainty that was inherent in both the available datasets (ASTER & HMCO) and the appearance of uncorrelated errors and artifacts was minimized by incorporating geostatistical filtering. The resolution of the produced DEM was approximately 10 meters and its validation was conducted with the use of an external dataset of 220 geodetic survey points. The derived DEM was then used as an input to the hydraulic model InfoWorks RS, whose operation is based on the relief characteristics contained in the ground model, for defining, in an automated way, the cross section parameters and simulating the flood spatial distribution. The plain of Serres, which is located in the downstream part of the Struma/Strymon transboundary river basin shared by Bulgaria and Greece, was selected as the case study area, because of its importance to the regional and national economy of Greece and because of the numerous flood events recorded in the past. The results of the simulation processing demonstrated the importance of high resolution relief models for estimating the potential flood hazard zones in order to mitigate the catastrophe caused, both in economic and environmental terms, by this type of extreme event.