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Adjustment of a spaceborne DEM for use in floodplain hydrodynamic modelling

YAMAZAKI, Dai[1*], Calum Baugh[2], Paul Bates[2], Shinjiro Kanae[3], Doug Alsdorf[4], Taikan Oki[1]

[1]The University of Tokyo, [2]University of Bristol, [3]Tokyo Institute of Technology, [4]The Ohio State University

Precise Digital Elevation Models (DEMs) are required for the accurate modelling of floodplain hydrodynamics. The accuracy of currently available spaceborne DEMs however is hindered by a variety of errors which reduce the flow connectivity between river channels and the surrounding floodplains. Here we introduce a new algorithm for adjusting a spaceborne DEM which utilizes the information from a prescribed drainage networks dataset. The algorithm is designed to remove all the pits in the spaceborne DEM caused by vegetation canopies, sub-pixel sized structures, and random radar speckles while minimizing the amount of modification required for removing the pits. The proposed algorithm was applied to the SRTM3 DEM with reference to the drainage network information in the HydroSHEDS flow direction map. With consideration of the systematic errors in the SRMT3 DEM, small channels connecting floodplains were successfully implemented into the adjusted DEM. The accuracy of the adjusted DEM was validated using hydrodynamic simulations with the LISFLOOD-FP model in a middle reach of the Amazon River. The simulated water surface elevations and flooded areas with the adjusted DEM shows better agreement to observation data when compared to the results from the original SRTM3 DEM. The flow connectivity ensured by the DEM adjustment algorithm is found to be essential for representing realistic water exchanges between river channels and floodplains in hydrodynamics modeling.

Keywords: DEM adjustment, Floodplain Hydrodynamics, Pit Removal, Flow Connectivity, SRTM, HydroSHEDS