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Simulating candidate DEMs for flood inundation studies

Laurence Hawker (1), Jonathan Rougier (2), Jeffrey Neal (1), and Paul Bates (1)

(1) University of Bristol, Geographical Sciences, Bristol, United Kingdom , (2) University of Bristol, School of Mathematics, Bristol, United Kingdom

Topography remains a key input and source of uncertainty in modelling natural hazards. In data-sparse environments, the almost 2-decade-old SRTM DEM (Shuttle Radar Topography Mission) remains the most commonly used, yet we still have a poor understanding of the spatial error structure of the product. Nowadays, increased effective computing power makes Monte Carlo simulations possible, yet typically only a single source of topographic information is used, thus we have little understanding of the role of topographic uncertainty has on hazard assessment. With the lack of a high resolution global DEM, be it now and in the imminent future, we propose a method to simulate multiple plausible DEMs so we can use multiple topographic layers for hazard assessment, thus moving beyond using a single DEM to using multiple DEMs.

In this work we present our workflow to simulate multiple candidates of the true DEM based on the spatial error structure of deltaic and floodplain environments. The spatial error of the SRTM and the recently developed SRTM error reduced MERIT DEM (Yamazaki et al., 2017) has been calculated for numerous floodplain environments across the world by comparing to near ground truth LIDAR data, with the MERIT DEM consistently being more accurate. Based on this catalogue of spatial error structures, we can simulate multiple statistically plausible DEMs quickly and efficiently using our open source code. We tested these multiple DEMs in flood hazard studies, demonstrating the inundation extent can vary significantly in a highly non-linear manner. In the absence of high-resolution topographic data for most parts of the world, this approach allows us to understand the role topography has on the risk, helping us to constrain the most risky areas.