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Reconstructing floods in small-medium scale data-scarce catchments using field interview data and hydrodynamic modelling

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We develop a technique for reconstructing floods in small-scale data scarce regions using field interview data and hydro-dynamic modelling. The field interview data consist of flood depths and duration data collected from 300 buildings from a flood event in 2017 in Suleja/Tafa area, Nigeria. The flood event resulted from an overflow of water from five river reaches. The hydrodynamic model utilized, called CAESER LisFLOOD, is an integration of a landscape evolution model (CAESER) and a hydraulic model (LisFLOOD-FP). We employ three steps to reconstruct the 2017 Suleja/Tafa flood event. Firstly, we use a linearly increasing hydrograph to; (a) calibrate Manning's coefficient and (b) determine optimal peak discharge on each reach. This was carried out by minimizing the Root Mean Square Error (RMSE) between the distributed observed flood depths and the simulated flood depths. Secondly, we use synthetic hydrographs with durations between 6, 12, 18, 20, 24 hours, having peak discharge (extracted from the previous step), to simulate flows on all upstream reaches. Using collected flood duration data, we minimized RMSE between distributed observed flood duration and simulated flood duration to determine optimal flow durations on each upstream reach. In the last step, utilizing peak discharge and flow duration for all upstream reaches, we carried out multiple spatial and temporal iterations to match downstream peak discharge. Thereafter, we use determined upstream hydrographs with their relative catchment response timing to simulate the entire river network. Minimum RMSE computed for the entire river network was between ±15 cm of many current studies that use distributed observed data to calibrate flood models. The method developed in this study is useful for simulating floods in regions where data such as high resolution DEMs, river bathymetry and river discharge are limited. In addition, the study extends current knowledge, on utilizing distributed flood data to determine peak discharge, from a single to multiple river networks.