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Influence of Rainfall Product on Hydrological and Sediment Outputs when Calibrating the STREAP Rainfall Generator for the CAESAR-Lisflood Landscape Evolution Model

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The use of Landscape Evolution Models often requires a timeseries of rainfall to drive the model. The spatial and temporal resolution of the driving data has an impact on several model outputs, including the shape of the landscape itself. Attempts to compensate for the spatiotemporal smoothing of local rainfall intensities are insufficient and may exacerbate these issues, meaning that to produce the best results the model needs to be run with data of highest spatial and temporal resolutions available. Some rainfall generators are able to produce timeseries with high spatial and temporal resolution. Observed data is used for the calibration of these generators. However, rainfall observations are highly uncertain and vary between different products (e.g. raingauges, weather radar) which may cascade through the Landscape Evolution Model.

Here, we used the STREAP rainfall generator to produce high spatial (1km) and temporal (hourly) resolution ensembles of rainfall for a 50-year period, and used these to drive the CAESAR-Lisflood Landscape Evolution Model for a test catchment. Three different calibrations of STREAP were used against different products: gridded raingauge (TBR), weather radar (NIMROD), and a merged of the two. Analysis of the discharge and sediment yields from the model runs showed that the models run by STREAP calibrated by the different products were statistically significantly different, with the raingauge calibration producing 12.4 % more sediment on average over the 50-year period. The merged product produced results which were between the raingauge and radar products.

The results demonstrate the importance of considering the selection of rainfall driving data on Landscape Evolution Modelling. Rainfall products are highly uncertain, different instruments will observe rainfall differently, and these uncertainties are clearly shown to cascade through the calibration of the rainfall generator and the Landscape Evolution Model. Merging raingauge and radar products is a common practise operationally, and by using features of both to calibrate the rainfall generator it is likely a more robust rainfall timeseries is produced.