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Evaluating the uncertainty in modelled runoff due to spatial heterogeneity in infiltration rates

K. Michaelides (1) and M.D. Wilson (2)

(1) School of Geographical Sciences, University of Bristol, University Road, Bristol BS8 1SS, UK (Katerina.Michaelides@bristol.ac.uk)

(2) Department of Geography, University of Exeter, Tremough Campus, Penryn, TR10 1EZ, UK (Matthew.D.Wilson@exeter.ac.uk)

In this work we evaluate the effect of spatial patterns in infiltration rate on the uncertainty in modelled runoff from two hypothetical catchments with distinct topographic characteristics. Specifically, in the first catchment the hillslopes are directly coupled to the channel, while in the second, the hillslopes are de-coupled from the channel by floodplains. Spatial patterns of infiltration were generated as model inputs using the geostatistical method of stochastic simulation. Multiple infiltration scenarios were produced with spatial autocorrelation based on a spherical variogram model with a variable range and nugget and were used as inputs to the model COUP2D. Monte Carlo simulations were run for each condition. Results show that increasing the range of spatial correlation of infiltration rates leads to increased connectivity in runoff pathways and an increased uncertainty in modelled runoff. The uncertainty in modelled runoff increased as the spatial connectivity in infiltration rates increased. Conversely, increasing the proportion of non-spatially correlated variation in infiltration decreased the uncertainty in modelled runoff to variable infiltration. The presence of floodplains, buffered total runoff from the hillslope to the channel but increased the modelled uncertainty of runoff.