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Thinking globally, acting locally: Monte Carlo evaluation of a global flood hazard model applied to the Po river basin

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A suite of global flood hazard models has been developed over the past five years, that are increasingly being used for research, humanitarian, and commercial purposes. While appearing generally effective for hazard mapping throughout several studies, little in-depth analysis of performance and parameter sensitivities exists for specific locations. If and how the models are effective requires assessment so that a path to improvement can be found.

We apply a global flood hazard model (Sampson et al, 2015) to the extensively gauged Po river basin in northern Italy. A prior sensitivity analysis identified a subset of parameters which were important to varying simulated output with respect to the geoclimatic domain features of the Po and at the targeted event magnitude of interest, a 1-in-100 year flood.

5000 Monte Carlo parameter samples were evaluated using a-priori, non-local plausible ranges, taken from literature. Using uniform random samples we evaluated model inundation estimates using performance metrics against a local flood map to produce posterior distributions of parameter values. Whilst some parameters were identifiable, in fact all simulations did not generate acceptably behavioural performance due to a large under-prediction of the expected 1-in-100 year peak flow. This was caused primarily by the flood frequency analysis component of the global flood model underpredicting flows when compared to data from locally obtained gauge data from the Po river.

A further 8000 model evaluations were performed with the addition of a flow coefficient, to envelop the observed peak flow, thus attempting find a subset of models with higher performance. Therefore we obtained identifiable behavioural posterior distributions. Accounting for the uncertainty of the flood frequency analysis component in this way produced performance indices similar to those presented in literature for other sites, although a more refined method of accounting for peak flow uncertainty is required in future studies.

Sampson C C S, Andrew M, Bates P B, Neal J C, Alfieri L and Freer J E 2015 A high-resolution global flood hazard model Water Resour. Res. 51 7358–81