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Do you understand your model? Exploring flood inundation models with Global Sensitivity Analysis

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Most physically based flood inundation models require the specification of a large number of parameters such as surface roughness and many other input data e.g. boundary conditions. Many recent studies have established that most of these parameters cannot be identified uniquely (concept of equifinality) and that their actual meaning as model parameters is only loosely connected to real measured field parameters. Traditional uncertainty methods, such as GLUE, help to identify this problem, but need to be complemented by Global Sensitivity Analysis (GSA) to give a full understanding. This understanding becomes vital as soon as these models are applied to climate change and land use scenarios.

GSA analyses the entire response surface, and thus is advantageous to local sensitivity analysis which concentrates only around a so-called optimum. This sensitivity analysis will focus on different types of results of a one dimensional flood inundation model such as inundation extent and flow hydrographs. Moreover, temporal and spatial changes in the sensitivity towards the data will be explored and the influence of evaluation measures and their combinations on model sensitivity established.

Most studies of GSA concentrate on one model implementation although several recent studies suggest that the choice of model structures has significant importance. This is because different structures have different dimensionalities of the parameter space. Moreover, parameters with the same name are effective parameters and thus do not necessarily have the same meaning if used in models with different structures. This study will highlight this problem and demonstrate a holistic solution.