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Fusion of flood hazard and risk in model calibration

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Major flood events occur very rarely and thus historical records are scarce. Therefore, most flood hazard maps are based on numerical modelling, and these models are usually calibrated and evaluated on data from past events. A flood hazard map can be derived by using the performance of the calibration exercise. It has been documented that the different ways of computing the performance have a significant impact on how a flood hazard maps looks. However, the problem of deriving a correct flood hazard map is more fundamental: to date, 2D inundation models have always been evaluated against inundation extent using global performance measures that are obtained by averaging spatial performance across a suitable domain. In the case of flood inundation models this is normally an estimate of the flood prone area. Conditioning models on global performance has the disadvantage that the performance at a local scale is only considered indirectly. This leads to the possibility that two simulations that have the same global performance may result in a local cell to be dry in one simulation and wet in the other.

Moreover, should the affected cells contain buildings, transportation links or similar, then the potential economic and social consequences of the inadequate prediction of local hazard will be more severe, than if the cells contain only barren or limited agricultural land. The ranking of the importance of the various consequences of flooding is based on utility functions. In order to aid flood risk management decisions, the calibration or conditioning of flood inundation models should ideally involve evaluations that are weighted in favour of target structures such as buildings and roads rather than just relying on global performance. Indeed, the potential consequences of false flood warnings to key buildings such as hospitals are sufficiently severe that it might even

be considered prudent to condition a model solely in relation to the fit associated with a single structure.

Consequently, in a setting in which the model is used to produce flood risk maps for e.g. a particular town, the flood risk cannot be used as a simple add-on to the modelling process, but has to be part of the calibration procedure. In an extreme case, every citizen of this town will have an individual flood risk map, which may differ from the one his/her neighbour has. This raises important questions regarding whether a model can be only calibrated on sub-domains or how we deal with individual flood risk maps.