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Uncertainty based amplification factors benchmarked by large ensembles of inundation simulations

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Tsunami maximum inundation heights (MIH) are normally estimated by modelling the hydrodynamics of the overland flow over a limited area using high resolution long wave models. However, in situations where there one need to simulate inundation over large areas, we demand methods that are less resource intensive. The method of amplification factors represents one such simplified and resource efficient method. It is based on precomputed factors using linear shallow water models modelled over bathymetric transects to estimate the ratio of the offshore maximum surface elevation to that at the shoreline. It has been shown previously that we can get a relatively good estimate of the median value of the MIH at given coastline location using amplification factors. Yet, as this method is associated with considerably higher epistemic uncertainty than e.g. solving the nonlinear shallow water equations (due to the additional simplifications), there is need to include a measure of its uncertainty and bias. The main sources of uncertainty include among others the misfit of the method (towards data or more accurate methods) and local spatial variability of the inundation. Here, we present results from recent advancements of the amplification factor method emphasising a much more elaborate uncertainty analysis than employed previously. To this end, we use a unique set of synthetic data from several hundreds of thousands of massive scale nonlinear shallow simulations as a benchmark for estimating uncertainty concerned the amplification factors. The simulation dataset comprises ensembles of about 50 000 scenarios each for six different sites and includes sensitivity studies related to the Manning friction. When analysing the entire ensembles, we have revised the previous mathematical model for the uncertainty treatment (Glimsdal et al., 2019, PAGEOPH) by normalising the ensemble scenario outputs with the median MIH from each simulation. We further measure the bias of the amplification factor method by measuring its offset towards median MIH output from the shallow water simulations. The model provides input to the probabilistic tsunami hazard (PTHA) map for Italy, and we present related results of the amplification factor uncertainty analysis here. We will also discuss further and advocate the use of the method, both for long term hazard (PTHA) and for rapid post assessment following an event, e.g. through the ARISTOTLE framework. This work is supported by the European Union's Horizon

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