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Reducing uncertainties in flood modelling using (uncertain) remotely sensed water stages

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On January 2 2003 the Advanced Synthetic Aperture Radar (ASAR) instrument onboard ENVISAT captured a high magnitude flood event on a reach of the Alzette River (G.D. of Luxembourg) at the time of flood peak. This opportunity enables detailed hydraulic analyses with spatially distributed information on flood extent and depth. A known remote sensing procedure to derive water stage information is to extract elevation data from a digital elevation model (DEM) at the land-water contact zone determined from a remote sensing image. In this study, this approach is extended by assessing uncertainties in remotely sensed water stages at the flood boundaries. A 1D flood inundation model is evaluated with a remotely sensed water stage interval, the limits of which are given by minimum and maximum values. For model calibration that takes account of observation uncertainties, the GLUE procedure is a welcomed paradigm. The strength of GLUE is that it assumes the existence of multiple acceptable model parameter sets, of which the posterior distribution is determined based on some likelihood measure. From this distribution, uncertainty quantiles can be derived to assess the model's predictive power. However, a downside of GLUE is the inherent subjectivity in the selection of an appropriate (pseudo-) likelihood measure and the thereof derived threshold value above which models are behavioural. Using an interval of remote sensing water stage uncertainty amends this limitation by defining an acceptable model as one that falls inside the interval at every location along the investigated reach. Results show that predictive uncertainties and the thereof derived flood extent maps are constrained, which demonstrates the high potential of using remotely

sensed water stage distributions.