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Evaluating models of varying complexity with uncertain water levels from space-borne imagery

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This paper details the incorporation of uncertainties in calibration and validation data of varying type within a comparison of zero-, one- and two-dimensional flood inundation modelling methods. As field data for model evaluation are often very limited, the ability to analyse model predictions with multiple data types and the addition of measurement uncertainty provides a rigorous evaluation framework for competing model structures and parameterisations. Specifically, there is now a general consensus that remote sensing, due to its large spatial coverage and high resolution, can offer ways to not only fill the data gap but also go beyond extraction of a simple binary flood map. This study demonstrates how uncertainty associated with water stages from a single remote sensing observation can be used to calibrate flood inundation models within a behavioural model selection criterion. The 1D HEC-RAS model code and 2D LISFLOOD-FP model code are both applied to a flood event that occurred on the River Alzette (Grand Duchy of Luxembourg) on 2 January 2003. Findings highlight the importance of local, rather than global, model evaluation in addition to discriminating between model structures. In particular, the results suggest that LISFLOOD-FP is capable of representing complex flow patterns on the floodplain but is penalised, in terms of practicality, by longer simulation times. On the other hand, HEC-RAS provides a more detailed description of in-channel processes and significantly reduced computation times. These results provide evidence for generalisations regarding the utility of models of varying dimensionality for practical application to flood risk assessment and flood forecasting.