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A new approach for improving flood model predictions based on the sequential assimilation of SAR-derived flood extent maps

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Hydrodynamic models represent an important component in flood prediction systems. However, providing reliable model predictions and reducing the associated uncertainties remain challenging, especially in poorly gauged river basins. As Synthetic Aperture Radar-derived flood image databases are significant (and expected to grow rapidly with contributions from new satellites such as Sentinel-1) there are emerging opportunities for using these data collections to improve model predictions.
In this context our aim is to contribute to the development of a global and near real-time remote sensing-based service that delivers flood predictions to support flood management. The study takes advantage of recently developed efficient, rapid and automatic algorithms for the delineation of flood extent using SAR images. The main objective of the study is to show how near real-time sequential assimilation of SAR derived flood extents can improve model predictions.
As a test case we use the July 2007 flood event of the river Severn (UK) and the February 2007 flood event of the lower Zambezi (Mozambique). We use the Lisflood-FP hydraulic model and we adopt a particle filter-based assimilation scheme. An important issue in the framework of the assimilation of remote sensing-derived information is to quantify observation uncertainty. To do so we introduce for the first time an image processing approach that assigns to each pixel a 'probability to be flooded' based on its backscatter values.
The sequential assimilation of SAR-derived flood extent maps shows a significant improvement in the hydraulic model predictions. The main achievement of the study is that model predictions are clearly improved by the assimilation of SAR-derived flood extent not only in terms of predicted flooded areas but also in terms of predicted discharge and water level surface elevation hydrographs.