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Improving Flood Forecasts using SAR-based Flood Extent Assimilation

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Studies have demonstrated the potential of Synthetic Aperture Radar (SAR) based Flood Extent Assimilation (FEA) for improving flood forecasting accuracy. As the number of high-resolution SAR sensors increases, the likelihood of observing flood events from space also increases. This implies that for ungauged catchments where information about model boundary data, model forcing data, and model parameters are highly uncertain, remote sensing could be used to support flood forecasting services. Here, advanced techniques to derive more accurate flood maps from SAR data are combined with an improved implementation of the particle filter to optimize forecast accuracy. Twin experiments were set up at 90 m grid resolution using the 2D hydraulic model LISFLOOD-FP, for the flood event which occurred in the Clarence Catchment of NSW, Australia from the 8th-16th Jan 2011. Temporally correlated, heteroscedastic errors in inflows and normally distributed errors in parameters - channel roughness, depth, and shape - were considered in this study to generate the open loop ensemble. Observational errors were represented by fuzzy flood extent maps derived from two post-peak, texture-enhanced, Cosmo-Skymed X-band images by applying a neuro-fuzzy mapping approach. Reliability diagrams were subsequently used to compare binary modelled flood extents to the fuzzy SAR-based flood observations. Aerial photos and hydrometric gauges were also used for evaluating the improvements yielded by the assimilation of the remote sensing observations. Preliminary results indicate that the proposed sequential FEA strategy has the potential to improve flood forecasting in data scarce regions, where satellite data may be the only available source of flood information. Indeed, errors in posterior predictions (after assimilation) of flood extent and water level are substantially reduced by the assimilation.