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Observation impact in data assimilation for flood inundation forecasting.

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Accurate flood inundation forecasting provides vital information, enabling local residents and emergency services to make necessary preparations. Data assimilation is a powerful technique for combining forecasts from mathematical models with observations to give an improved forecast. In this study, numerical inundation simulations are carried out in a river channel topography using Clawpack. Data assimilation is performed using an Ensemble Transform Kalman Filter (ETKF) and synthetic observations of water depth in identical twin experiments. In agreement with other studies, we find that using data assimilation to combine observations of water depth with forecasts from a hydrodynamic model works very well at the time of the observations, but that the observation impact is short-lived. The forecast errors quickly increase to the level of a free-running forecast with no assimilation. We show that the time taken for the forecast to lose the added skill from the assimilation of observations depends on the length of the domain of interest. This is because the assimilation corrects water depths in all parts of the domain (even those which are unobserved) and error growth in the forecast step propagates downstream. We demonstrate that this pattern of error growth can be due to incorrect friction parameter specification, rather than errors in upstream inflow. Joint state-parameter estimation leads to an improvement in the forecast skill, and is less dependent on domain length.