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Ensemble-based flood forecasting with real-time observations for data assimilation

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Ensemble modelling in hydrology is often motivated by the need to address and quantify model uncertainty. In operational flood forecasting, flood managers are increasingly recognising the need to associate uncertainties and risk estimates with decisions to operate flood protection reservoirs, issue of flood warnings or evacuation orders. Furthermore the need to protect property and infrastructure and in particular to save lives is a major driver for finding efficient ways to reduce flood forecast uncertainty. Recent work has suggested that there may be some advantages in combining several models into so-called multi-model ensembles (Georgakakos et al., 2004, Butts et al. 2004) for flood modelling. Alternatively a powerful method for reducing forecasting uncertainty is to combine hydrological (or meteorological models) with real-time observations using data assimilation (forecast updating).

In this paper an ensemble-based flood forecasting methodology is presented that combines ensemble modelling with real-time data assimilation for flood forecasting. A number of flood forecasting case studies are used to show this approach provides both improved forecasts and operational estimates of forecast uncertainty. The methodology is used to compare ensemble rainfall forecasts with updating of the subcatchment states with ensemble inflow forecasts with updating of river states for catchments in the US and New Zealand. The results show that updating the catchment states provides an improvement in forecast accuracy also further into the future but this depends on the response time of the catchment to rainfall. These alternatives must therefore be se-

lectively applied. This improvement in long term accuracy for flood forecasts requires further investigation but can also be exploited for low flow forecasting for water quality, river aesthetics and habitat protection.