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Forecasting future water levels to aid in flash flood risk management

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Flash floods are typically triggered by local intense rainfall in small catchments with short response times. The work presented explores the use of ensemble numerical weather prediction products coupled with a simplified hydrological model to forecast such floods, with up to 2 days lead time, when water level observations can be regularly assimilated. The techniques outlined are presented with reference to a case study, the Gardon d'Anduze basin in France.

A Data Based Mechanistic time series model of the rainfall run-off dynamics of the catchment is constructed. The model formulated to address two common sources of observational errors, shifting baselines in the water level observation and incorrect characterisation of the magnitude of the precipitation. It is cast in a state space form shown to be an effective forecaster when driven by observed precipitation data.

Substitution of ensemble precipitation forecasts the observed data is used to generate forecasts with with longer lead times. A simple adaptation of the hydrological model is used to represent the uncertainty in the forecasts that may result from incorrect characterisation of the magnitude of the forecast precipitation.

Observed water levels are assimilated condition the model forecasts. They can be used both to condition the initial states to the hydrological model prior to being run with the ensemble NWP input but also to condition the hydrological forecasts generated by running the ensemble NWP inputs after they have been generated. The balance between using the hydrological forecasts of most recent NWP ensemble, or those of an older generated by an older ensemble which have undergone more data assimilation is considered.