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Estimation and visualisation of predictive hydrological uncertainty for Ovens River, Australia

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Australia's Bureau of Meteorology (BoM) is currently exploring how to integrate estimates of predictive hydrological uncertainty in its new short-term forecasting system. To investigate issues associated with delivering a real time short-term forecasting service, a pilot real-time forecasting system for Ovens River was set-up. . One of its objectives is the routine estimation and visualisation of short-term (up to 10 days) predictive hydrological uncertainty for a number of locations along the river. The system is based on the Delft-FEWS forecasting shell and includes import modules for several Numerical Weather Prediction (NWP) products, the SWIFT rainfall – runoff application, an implementation of the Hydrological Uncertainty Processor (HUP) and a number of options for visualisation of forecasts.

Predictive hydrological uncertainty is estimated by the Hydrological Uncertainty Processor. This post-processor is run after the SWIFT rainfall – runoff application has produced a deterministic forecast of future water levels at the forecast locations. In addition, the uncertainty estimates are based on current water levels at the forecast location and recent water levels at an upstream location. Two estimates of uncertainty are produced: one based on "perfect forcing" (in hindcast mode only) and one based on NWP forecasts.

The FEWS Ovens pilot system also allows for use of meteorological forecast ensembles produced by the "short term ensemble prediction system" (STEPS) The realisations of future precipitation are routed through the hydrological model to produce an ensemble of hydrological forecasts. The spread of these members is a measure for uncertainty due to the unknown initial state of the atmosphere at the forecast time (only). In the future, STEPS and the Hydrological Uncertainty Processor may be integrated to allow for an estimate of total hydro – meteorological uncertainty.

While the "correctness" of a single estimate of predictive hydrological uncertainty cannot be established, a multi-year record of probability hindcasts was produced to allow for verification of the forecasts. Verification includes a number of performance metrics that measure several aspects of forecast quality such as reliability, sharpness and resolution. These metrics include Brier's probability score, reliability diagrams, relative operating characteristics and the ranked probability score. Where possible, quality is expressed in terms of skill relative to an unskilled forecast.

Verification shows that the Hydrological Uncertainty Processor performs reasonably well. Although not perfect, estimates of predictive hydrological uncertainty show skill up to a few days leadtime.