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The use of radar-based ensemble rainfall forecasts to provide enhanced flood forecast and warnings in Australia

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The Australian Bureau of Meteorology has been investigating how quantitative radar rainfall estimations and ensemble nowcasting radar rainfall products can further improve its operational flood forecasting service.
The current operational flood forecasting and warning service is primarily based on the national network of rain gauges and gridded deterministic forecast rainfall from a number of Numerical Weather Prediction (NWP) models and the Bureau's official forecasts. It is expected that the incorporation of high resolution (spatial and temporal) gridded rainfall data may increase flood warning lead times and greatly improve the robustness of flood warning services provided.
The Bureau's Hydrological Forecasting System (HyFS) was modified to import gridded rainfall products for both Quantitative Precipitation Estimation (RAINFIELDS) and Quantitative Precipitation Forecast (STEPS - Short-term Ensemble Prediction System) products. STEPS produces probabilistic rainfall forecasts numbering up to 35 ensemble members that are updated every 10 minutes with only a few minutes of latency. These ensemble rainfall forecasts are based initially on radar rainfall observations that gradually are blended with a downscaled NWP model rainfall forecast to extend the rainfall predictions up to 13 hours in the future.
Selected historical flood events were used as case studies to assess the performance of the ensemble rainfall forecast and ensemble hydrological forecasts to produce suitable and accurate flood estimations.
Rainfall ensembles were analysed quantitatively compared with the skill of the deterministic NWP rainfall forecast. Overall STEPS ensemble rainfall skill is better than NWP rainfall forecast for the first 2 to 3 hours and then comparable to the NWP skill for larger lead times. Hydrological simulations were analysed qualitatively by comparing the simulated hydrographs from different rainfall forecast guidance (ensemble and deterministic). The case studies have shown that it is difficult to discriminate between errors from the data (rainfall and flow), the calibration of hydrological models and the flood forecasters.
From an operational perspective, STEPS has the key advantage of providing updated ensemble of rainfall forecasts to flood forecasters every few minutes, instead of every few hours as per NWP models. Further investigation is needed to fully address the efficient use of these very-frequent updates in an operational environment that is currently based on updating hydrological forecast a few times per day. Other areas for improvement include operational flood forecaster training, enhanced data visualisation, and data format and delivery of rainfall ensembles to best suit the need of the flood forecasting and warning services.