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Towards operational joint river flow and precipitation ensemble verification: considerations and strategies

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Operational rainfall and flood forecasting systems across the world are increasingly using ensemble approaches. In Britain such systems are operated by the Flood Forecasting Centre (FFC) over England & Wales and by the Scottish Flood Forecasting Service (SFFS) over Scotland producing ensemble gridded hydrological forecasts out to 5 or 6 days. In order to maximise the practical day-to-day use of these systems for flood guidance and warning, duty hydrometeorologists require a sound understanding of both the meteorological and hydrological ensemble forecast skill. To help meet this requirement, a common framework for the verification of river flow and precipitation ensembles is developed and demonstrated over Britain for eventual use in an operational flood forecasting setting.

The river flow ensembles are obtained from the distributed hydrological model Grid-to-Grid (G2G), configured with national coverage on a 1 km grid and using an ensemble of 15 minute precipitation accumulations as input. The precipitation ensemble consists of operational Numerical Weather Prediction (NWP) forecasts from the Met Office Unified Model. Given the different physical characteristics of river flow and catchment precipitation, and differences in forecast verification methodologies routinely employed by the hydrological and meteorological communities, key considerations for the common verification framework are identified and investigated. These include the appropriateness of different precipitation accumulation periods given timing errors and hydrological response times, the operationally relevant use of river flow and rainfall thresholds for contingency tables and skill scores based on them, and the effects of precipitation observation error on verification.

The practical challenges of verification using a limited record of precipitation ensembles, from a system only relatively recently made operational, are highlighted. Methods of obtaining more robust verification statistics, given the available ensembles, are presented and demonstrated for example periods in December 2015. At the regional scale, both river flow and precipitation verification results are shown to be dependent on the locations considered and related to variations in precipitation totals. For river flows, catchment size is found to be a key influence on ensemble performance. It is demonstrated how this behaviour can be used to obtain more-robust river flow verification statistics at sub-regional scales.