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The link between catchment precipitation forecast skill and spread to that of downstream ensemble hydrological forecasts

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Operational rainfall and flood forecasting systems across the world are increasingly using ensemble approaches. Such systems are operated by the Flood Forecasting Centre (FFC) and Scottish Flood Forecasting Service (SFFS) across Great Britain producing ensemble gridded hydrological forecasts for the next 5-6 days. In order to maximise the practical day-to-day use of these systems for decision-making and warning, duty hydro-meteorologists require a sound understanding of both the meteorological and hydrological ensemble forecast skill. In this work, a common verification framework is defined and used in order to understand the relative levels of skill in both rainfall and river flow forecasting systems.

A blended 24-member ensemble precipitation forecast, produced by the Met Office, is used to drive the operational distributed hydrological model in ensemble mode. The hydrological forecasts provide output every 15 minutes out to 6 days on a 1km grid. The blended rainfall forecast is a mixture of the 2.2 km MOGREPS-UK ensemble up to 36h and the 32 km global MOGREPS-G ensemble at longer lead-times. The forecasts are interpolated on to a common 2 km grid and the hydrological model used is the Grid-to-Grid model (G2G) developed by the Centre for Ecology & Hydrology. To establish an upper bound on skill, assessments over a daily lead-time interval are studied first, and will be the focus here. Spatial and regional variations in forecast skill are compared between the precipitation (e.g. daily accumulations) and the river flow forecasts. Also of interest is the impact of catchment size and how to pool and present the skill metrics in a meaningful way for end-users. For precipitation, the impact of observation type: gridded gauge-only analyses and a radar-derived (gauge calibrated) precipitation product, is compared to quantify the uncertainty that comes from the observations. Of particular interest is understanding how the spread in the precipitation forecast is modulated by the downstream hydrological model. Is it inflated, does it remain comparable, or is it reduced? The work aims to establish the basis for a real-time monitoring tool that can assist hydro-meteorologists in their interpretation of operational ensemble forecasts, and facilitate associated decision making processes.