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An ensemble flow forecasting system for New Zealand—calibrating hourly precipitation forecast with daily observations.

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We present key aspects and challenges of the development of a new national streamflow forecasting system for New Zealand. Flooding is the most frequent natural disaster in New Zealand and hydropower makes up most of the renewable energy (NZ, 2015). A national flow forecasting system capable of providing forecast information, at both gauged and ungauged river reaches, will be a great asset for New Zealand for assessing risk of floods and supporting hydropower operations.

The forecast system uses high resolution ensemble precipitation forecasts to force the NZ Water Model™-Hydro. The water model is a distributed hydrological model, based on TOPMODEL concepts of runoff generation controlled by sub-surface water storage (Beven et al., 1995). The forecast system is updated every 6 hours, and produces river flow forecasts at more than 60,000 sub-catchments in the highly diverse New Zealand environment to provide water information required nationally.

A central component of the system is a new precipitation forecast calibration and ensemble generation method to post-process deterministic numerical weather predictions. Deterministic precipitation forecasts are taken from a local implementation of the UK Met Office Unified Model System (UM) for New Zealand, with a grid resolution of 1.5 km and an hourly time step. At the national scale, the only precipitation observations available to calibrate precipitation forecasts are a 5 km gridded daily product (Virtual Climate Station Network (Tait et al., 2006)), generated by interpolating meteorological station observations.

To produce calibrated ensemble precipitation forecasts at a 1.5 km spatial resolution and at an hourly time step, we implement a new method based on the Bayesian joint probability method (Robertson et al., 2013). A particularly challenging aspect of the calibration is the use of daily observations to post-process hourly precipitation forecasts. We compare three different methods for overcoming this problem: i) calibrate daily precipitation totals and disaggregate daily forecasts to hourly; ii) generate ‘pseudo-hourly’ observations from daily precipitation observations, and use these to calibrate hourly precipitation forecasts; and iii) combining aspects of (i) and (ii). Method (iii) tended to produce the best performing ensemble precipitation forecasts over a range of metrics. Overall, we show that valuable spatial and temporal information from the forecast can be extracted for calibration with daily data, with a trade-off between forecast bias and reliability.

References

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