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IMPROVER: A probabilistic, multi-model post-processing system for meteorological forecasts

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The UK Met Office is developing an open-source probability-based post-processing system called IMPROVER to exploit convection permitting, hourly cycling ensemble forecasts to deliver a wide range of probabilistic products. Such ensemble models provide a wealth of detailed information that, if properly processed, can provide skilful and consistent meteorological forecasts. Included in the post-processing system is verification after each processing step, enabling a quantitative assessment of the step's impact on forecast performance. This talk will discuss the motivation for developing this new system and progress to date.

Numerical weather prediction models are now commonly run with resolutions sufficiently high to capture orographic detail and to enable the direct modelling of convection. Forecasts produced by such models are capable of capturing significant local detail, for example orographically forced convection or valley fog. At the same time, representivity errors mean that any one model realization cannot be relied upon to provide a locally accurate forecast. For this reason an ensemble approach is used to represent plausible variations for any given forecast period. At the Met Office we run an ensemble for the UK area called MOGREPS-UK with 3 forecasts every hour out to 5 days and a grid spacing of 2.2km as well as a deterministic 1.5km 12-hour forecast (UKV model), precipitation nowcasts and the global ensemble MOGREPS-G. The challenge in post-processing is to consolidate the very large amount of resulting data in such a way that it is useful to the end-user, be that meteorologists, customers or the public.

To achieve this IMPROVER includes a variety of post-processing techniques, and its modular design makes it straightforward to add new steps into the processing. Typically processing starts by applying physical downscaling techniques to model fields prior to their translation into probability space. These techniques are primarily concerned with enhancing the accuracy of orographic effects on wind speeds and temperatures. Neighbourhood processing techniques are applied to deal with under-sampling from a small ensemble and improve ensemble spread, with these techniques refined to preserve orographically dependent features. The sample size is further increased by the application of time-lagging and mutli-model blending. Finally statistical post-processing techniques, such as ensemble model output statistics (EMOS), may be applied to correct model biases.

The end product of post-processing with IMPROVER is a set of smooth, but not bland, probabilistic forecasts. These forecasts capture the likelihood of meteorological phenomena whilst preserving local detail where it is statistically significant. The final outputs can be either probabilistic or deterministic and presented on the grid or for specific locations or regions according to requirements.