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The use of a topographically aware neighbourhood technique to produce probabilistic forecasts

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The Met Office is developing a new probabilistic post-processing system, called IMPROVER, which will provide blended forecasts from multiple models. Initially it will use the UK ensemble, MOGREPS-UK, and the high-resolution deterministic UK model, the UKV. High-resolution (km-scale) models produce very realistic looking detail at spatial scales smaller than those the models can reliably predict. Convection-permitting ensembles are therefore necessary to give information about the forecast uncertainty, but because only a small ensemble is available the uncertainty is still under sampled. Neighbourhood processing is a technique that can help account for spatial uncertainties by sampling the area around each grid point and using these points as a pseudo-ensemble for each grid point. This effectively increases the ensemble size and is used to produce smoothly varying probabilistic fields, which can be blended between forecast runs and different models to give a seamless probabilistic forecast. However, in order to sensibly forecast a range of meteorological variables relevant to users, refinements to the basic neighbourhood processing method are needed to take into account the particular properties of the fields.

Standard neighbourhood processing samples all grid points within a given radius of the central grid point to provide a representative (mean) probability for that point. However, without refinement, it can smear probabilities across land-sea boundaries, or up and down changes in altitude. For variables that are strongly dependent on altitude, this smoothing may negatively impact the accuracy of the forecasts. For example if fog is forming in a valley, we only want to generate a probability of fog at each point in the valley that is representative of locations in the valley, and not smooth the probability field in a way which combines lower probabilities on adjacent hills with higher probabilities in the valley. We may also want to sample adjacent valleys, as this is likely to give us useful information about the probability of fog at similar altitudes. Therefore, in order to improve the neighbourhood processing, a simple method for accounting for topography has been developed. This method involves separating grid points into bands of similar altitude and calculating neighbourhood-mean probabilities by only using points in the same altitude band. Results from adjacent bands are combined using weights, which depend on the altitude of the given grid point, since some points end up very close to band boundaries. We present the results from short verification trials comparing the topographic neighbourhood processing technique with basic neighbourhood processing and show example output fields. The output probability fields show sharper features over regions of varying topography that give detail to our forecasts. We discuss the variables we have chosen to apply topographic neighbourhood processing to along with further possible improvements to the technique.