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Quantifying the skill in probabilistic forecast for the sea breeze deriving from large-scale variables

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High resolution (kilometre-scale) regional models can represent the dynamics of mesoscale phenomena that cannot be captured currently in global simulations. They can generate flow structures that are qualitatively similar to observations (for example frontal banding in precipitation). However, for kilometre-scale ensemble forecasts downscaled from global ensemble members, there is no additional observational information so any improvement in probabilistic forecast skill must derive from small scale dynamics and the differences between large-scale members.
Here, the prediction of the probability of sea breeze occurrence by the Met Office 2.2 km ensemble (MOGREPS-UK) is compared to a Bayesian statistical model driven by physical parameters derived from the parent global 33 km ensemble (MOGREPS-G). The question is what proportion of forecast skill is derived solely from knowledge of the large-scale environment and what information is gained from downscaling that cannot be represented by this reduction of the problem ?
A new method for identifying sea breezes is proposed for deriving the probabilistic forecast of sea breeze occurrence from the MOGREPS-UK ensemble. The Bayesian statistical forecast was created using paired MOGREPS-UK and MOGREPS-G ensemble members as a training dataset. Although MOGREPS-G is not able to represent the dynamics of the sea breeze, it can generate a probabilistic forecast that correlates well (from day to day) with the MOGREPS-UK (2.2km) forecasts. The correlation generally decreases with increasing lead time. This shows that the likelihood of inland occurrence of the sea breeze has predictive skill using only two large-scale parameters and their statistical relationship with small-scale phenomena. The approach has potential applications to the probabilistic prediction of high impact weather.