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MOGREPS-UK - 5-day Convection-permitting ensemble forecasts for the UK

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MOGREPS-UK is the operational 2km grid-length convection-permitting ensemble prediction system run by the Met Office and covering Great Britain and Ireland and immediate surrounds. In March 2019 we introduced the largest and most significant upgrade to MOGREPS-UK since its original inception in 2012 in time for demonstration at the London Olympic Games, bringing a major step forward in capability and performance. One of the big challenges of convection-permitting ensembles is that, unlike synoptic-scale medium-range ensembles, we don't yet have a good theoretical basis for generating high-resolution initial condition perturbations, so the previous versions of MOGREPS-UK simply used the low-resolution perturbations downscaled from the global ensemble and allowed it to develop its own high-resolution spread. The upgraded MOGREPS-UK takes advantage of the new hourly 4D-Var high-resolution analyses introduced in 2017 for NWP-based nowcasting to provide a time-lagged high-resolution perturbation. Rather than running the ensemble as a big batch every 6 hours, the new "hourly-cycling" MOGREPS-UK runs three members each hour centred around the latest high-resolution analysis, and forms an 18-member ensemble by combining the forecasts from the last 6 hours – so the ensemble is updated every hour with the replacement of the oldest three members. This time-lagged approach results in an increase in ensemble spread, with a reduction in errors at most lead-times. Despite improvements, the ensemble remains significantly underspread and research is underway with the aim of further improving spread, including a planned major upgrade to the driving global ensemble MOGREPS-G and improvements to the MOGREPS-UK physics perturbations.

At the same time as introducing the hourly-cycling approach, MOGREPS-UK forecasts were extended from 2-days to 5-days ahead. Conventionally convection-permitting models are only run to 1 or 2 days ahead. Beyond this, deterministic prediction of the high-resolution detail becomes subject to very large errors due to the synoptic scale uncertainty in the boundary conditions. However, in an ensemble context the ensemble spans that uncertainty and provides a sampling of the type of high-impact weather which might occur, such as flood-generating convective rainfall. Undersampling of this uncertainty with an 18-member ensemble can be compensated by appropriate use of neighbourhood processing techniques, as used in the IMPROVER post-processing system (see separate EMS presentation by Mylne, Roberts and Flowerdew). Synoptically the MOGREPS-UK follows closely the performance of the MOGREPS-G global ensemble, but adds detail for aspects of high-impact weather not resolved by MOGREPS-G.