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Spectral nudging in an hourly 4DVar framework: Status and Plans

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The Met Office hourly 4D-Var was introduced operationally to its convective-scale limited area model (UKV) in summer 2017, improving forecast skill for nowcasting and short-range purposes. However, in recent tests a downscaler run from a global analysis tends to be better than hourly 4D-Var, especially for some variables (e.g. screen temperature). This is probably due to a poor representation of large-scale dynamics in the LAM DA system, which is now integrated on an extended domain, whilst the global model has improved to a 10km resolution and with better DA (hybrid 4D-Var). Therefore, the MO recognises the necessity of coupling large scale dynamics with convective systems using the better estimation of these motions from the global model.

We opted for a solution similar to spectral nudging, which uses large scale increments derived from a model with a better representation of these scales. At the same time, the short scales from UKV are maintained. We call this method ‘Background Increments’ (BGInc), as it updates the UKV background fields using a spectrally filtered increment derived from a different (global) model. This update is calculated just prior to computing the analysis increments from the hourly DA cycle. We investigated different set-ups for the implementation, changing the cut-off

wavelength, the vertical weights, the frequency of updates of BGInc and other set-up features.

This novel system is now in a testing phase for operational purposes. From preliminary results, the forecast is improved for about the first 12 hours for different variables. We also notice a reduction in the gravity wave activity generated when new lateral boundary conditions are introduced to the LAM from the latest global forecast. This research shows the benefits of a better representation of large-scale motions for LAM forecasts.

In the short term, future development involves the computation of new static covariances using a better representation of the large-scale error. In the longer term, this technique could be useful in a hybrid 4D-Var scheme while enabling the use of large-scale ensemble perturbations in the analysis without causing large adjustments at the lateral boundaries.