The Met Office has developed an experimental convective scale version of the Met Office ensemble prediction system, MOGREPS, where the analysis perturbations are produced using an Ensemble Transform Kalman Filter (ETKF). The primary goals of this work were 1) to conduct examinations of 1-hour forecast error covariances for the benefit of a NWP-based research system currently under development at the Met Office and 2) to perform predictability studies of localized weather at very short time scale.

In this poster we present the issues we faced due to the discontinuities between the limited area initial condition (IC) perturbations and the parent EPS introduced by the ETKF method. A new method to alleviate these discontinuities is presented.

Discontinuities arise because the limited-area ETKF (like other limited-area ensemble methods) does not explicitly take into account the large scale perturbations from the parent EPS when computing the IC perturbations. We tried to correct this by implementing a blending technique where the large scale part of the IC perturbations is taken from the parent EPS while the small scale part is obtained by applying the ETKF transform only to the small-scale part of the forecast perturbations. We called this approach the scale-selective ETKF.

The Southern UK 1.5 km ETKF-based EPS

**Scale-Selective ETKF** (SS-ETKF)

- Control analysis from a hourly cycling 1.5km 3DVAR with cloud and latent heat nudging and UK 4km LBC
- IC perturbations are produced by the ETKF using 1h forecast perturbations.
- All the observations assimilated in 3DVAR are taken into account in the transform (Surface, Arctoc, Radiosonde, EPS and Radar(sonic))
- No localizations
- Variable inflation factor derived from surface obs(u, v, T) and aircraft data (u ,v, T)
- Vertical correlation
- The covariances were computed in terms of the Met ETKF.

**How to build IC perturbations coherent with the parent EPS?**

Discontinuities arise because the limited-area ETKF (like other limited-area ensemble methods) does not explicitly take into account the large scale perturbations from the parent EPS when computing the IC perturbations. We tried to correct this by implementing a blending technique where the large scale part of the IC perturbations is taken from the parent EPS while the small scale part is obtained by applying the ETKF transform only to the small-scale part of the forecast perturbations. We called this approach the scale-selective ETKF.

**The Southern UK 1.5 km ETKF-based EPS**

This convective scale ETKF system uses a model with a grid resolution of 1.5 km covering southern United Kingdom and has an hourly cycle. The lateral boundaries are provided by the 24 km (now 18 km) and 1.2-hourly cycling regional component of MOGREPS which cover the North Atlantic and Europe.

**The impact of the scale-selective ETKF approach**

- a) On 1-h ensemble forecasts
- All three scale-selective configurations removed the bias in the surface pressure spread with MOGREPS-R and mitigated the r.m.s. of the differences.
- The scale-selective configuration using the filter response F192-384 gave the best results, however there was a small benefit on average with respect to the ETKF.
- b) On 1-h ensemble forecast perturbation covariances
- We computed the forecast perturbation covariances using all ensemble forecasts from the last 7 cycles to estimate the potential impact of these forecast error estimates on e.g. a hybrid DA system.
- The covariances were computed in terms of the Met Office’s climatological covariance model with control variables: streamfunction (\(\psi\)), velocity potential (\(\chi\)), pressure (p), surf. temperature (T), significant wave height (Hs), and relative humidity (RH).

**Conclusions and Discussion**

- Not taking explicitly into account the parent EPS perturbations in the generation of limited-area IC perturbations can introduce significant discontinuities at the lateral boundaries in the child EPS and trigger spurious gravity wave activity. These issues are not only relevant for EPS but for EnDA also.
- All approaches to generate limited-area IC perturbations/increments currently used (apart from downscaling and except perhaps breeding) should face this problem to some extent.
- The scale-selective approach tested here in a ETKF context provided generally good results but this approach introduces an arbitrary choice (the filter response) in the method. However, the small-scale component of the IC perturbations may become inconsistent with the large-scale component.
- What is the best way to take into account large scale information from parent EPS/EnDA and produce small-scale IC perturbations/increments coherent with the large-scale component?