On multiscale error covariance localisation for the Ensemble Transform Kalman Filter (ETKF) and the challenge of assimilating observations of convective clouds and rainfall

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The differing forecast error growth rates associated with, for example, large scale baroclinic instability and small scale moist convective instability, inevitably result in forecast error variances at different scales. High resolution ensemble forecasts can represent possible realisations of multiscale forecast error. However, the distance dependent localisation typically used in the Local ETKF (LETKF) is ill-suited to flows where synoptic and convective forecast error scales are simultaneously present. First, the standard localisation spuriously broadens when the forecast error variance becomes larger than the observation error variance – a likely situation when rapidly growing convective instabilities are present. Second, the current approach does not allow for scale dependent observation error variance inflation. The Met Office is strongly considering using an LETKF type data assimilation scheme for their LFric regional data assimilation scheme. Here, we present solutions to the two problems mentioned above and then use idealised but relevant data assimilation problems to demonstrate that these solutions result in superior ETKF data assimilation performance when the forecast error distribution is multiscale.