



## Diagnosing observation error statistics for numerical weather prediction

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High-resolution observations, such as Doppler radar radial winds (DRWs), SEVIRI radiances and atmospheric motion vectors (AMVs), are now routinely assimilated in operational systems, though to avoid violating the assumption of uncorrelated observation errors the observation density is reduced. Taking into account the full, potentially correlated, error statistics will allow an increased quantity of observations to be used and may improve the impact that the observations have in the assimilation. In this work we prove theoretical results relating to a diagnostic that makes use of statistical averages of background and analysis innovations to characterise observation error statistics. We then use the diagnostic and the theoretical results to estimate and interpret observation errors for the DRWs, SEVIRI radiances and AMVs that are assimilated into the Met Office 1.5km model. We carry out comparison experiments to understand the sources of correlated error and to test the sensitivity of the diagnostic. For all observation types the results suggest that the estimated correlation length scales are larger than operational thinning distances. This implies that it is necessary to include the observation error correlations in the data assimilation system.