Mesoscale convective systems as a source of model error

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In the search for the dominant sources of systematic and random model error, high model resolution datasets and satellite imagery are highlighted as particularly useful tools. With the recent introduction of simulated infra-red (IR) radiance to global operational model forecast diagnostics, direct comparison with the corresponding satellite product gives a new way of assessing model error. Typically, the simulated IR over the North Atlantic ocean and Europe shows impressive agreement with actual imagery, apart from textual differences that reflect the higher resolution of the satellite data. However, in spring and early summer in particular, the extent, brightness temperature and location of upper cloud over the United States and the Caribbean often exhibit large errors due to the explosive growth of mesoscale convective systems (MCS) for which the assumptions of convection parametrization schemes are not strictly valid. Furthermore, these major convective events often occur in baroclinic environments close to jetstreams and their effect on the meso- to synoptic scale potential vorticity field can influence downstream Atlantic cyclogenesis.

Simulated IR images from 2.2 km forecasts with the Met Office Unified Model (UM), in which convection is explicitly represented, appear to show much more realistic representations of MCS cloud shields although the MCSs are often too intense and sometimes triggered spuriously.

This presentation shows examples of simulated IR versus actual brightness temperature and for one case that was well-simulated by the 2.2 km UM , model winds and potential vorticity are computed. Divergent winds within the cloud shield carry low potential vorticity away from the updraught cores and attempts are made to compute the mean absolute vorticity for different specifications of the cloud shield in terms of brightness temperature. In addition to these quasi-operational high resolution forecasts, idealized simulations of mesoscale convective events are made with the Met Office Large Eddy Model with a view to better understanding their impact on the mesoscale vorticity field.

The ultimate goal of these studies is to quantify the likely random model vorticity and divergence errors associated with MCSs and relate these to, and improve, the formulation of the Stochastic Convective Backscatter scheme (Shutts, 2015).