EMS Annual Meeting Abstracts
Vol. 10, EMS2013-487, 2013
13th EMS / 11th ECAM

Systematic errors in medium-range forecasts of tropopause structure

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The presence of strong latent heating and other diabatic processes in extratropical cyclones can significantly modify tropopause-level ridges and troughs through potential vorticity modification and transport. So called 'forecast busts' can result from the downstream impact of these errors. The parameterization of diabatic processes in models implies that model error can result from the limitations of these parameterizations and previous research using ECMWF operational forecasts from the winter of 2001-2002 strikingly demonstrated such errors.

Here we demonstrate that errors in tropopause structure systematically develop with lead time in ensemble forecasts from the Met Office, ECMWF and NCEP extracted from the TIGGE archive for six winter seasons. Total ridge area in analyses exceeds that in forecasts by more than 1% of the total area of the Northern hemisphere at the 5-day lead time in the Met Office ensemble; this behaviour is also found in the ECMWF ensemble. The direction of this error is consistent with that expected from a failure of the model to generate sufficient reduced tropopause-level potential vorticity due to diabatic processes.