EMS7/ECAM8 Abstracts,
Vol. 4, EMS2007-A-00153, 2007
7th EMS Annual Meeting / 8th ECAM

Dynamical analysis of 5-day ECMWF forecast busts

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Despite the steady improvement of numerical weather forecasts from global models (e.g. ECMWF) a few significant failures of medium-range predictions occur every year. It is not known what kind of dynamical processes and meteorological features typically are responsible for such "forecast busts" to occur. Here, simple criteria are used to identify the 10 largest busts over Central Europe and the Mediterranean in the 5-day ECMWF forecasts during the three years 2003-2005, and an analysis is undertaken of the processes leading to the different temporal evolutions in the forecast and analysis fields.

As a simple measure to identify forecast busts domain averaged differences of sea level pressure (SLP) from analyses and forecasts are calculated over a predefined domain (e.g. Central Europe) for the twice daily operational ECMWF forecasts. 10 forecast busts were selected as the forecasts with the five largest positive and five largest negative SLP "errors" (forecast minus analysis differences). For Central Europe, the domain-averaged SLP errors of the selected forecasts amount to 13-20 hPa. According to this measure, nine busts occurred during winter (December till February) and one in October. This definition of bust is not necessarily related to a severe weather event: a 20 hPa forecast error in the amplitude of a high-pressure system would also be classified as a bust. The 10 cases feature different types of meteorological phenomena: in one case misrepresentation of the track and extratropical transition of hurricane "Wilma" led to a strongly distorted downstream evolution; in several cases forecasts underestimated the deepening of extratropical cyclones in the western North Atlantic leading to a too moderate downstream wave amplification at tropopause level; and in some cases prominent upper-level potential vorticity (PV) structures were predicted with the wrong amplitude and/or shape. It appears as a common feature of the selected Central European forecast busts that they are characterized by too weak warm

conveyor belts (WCBs), an underestimation of the scale and intensity of upper-level ridges and a wrong downstream wave propagation and amplification. None of the ten cases showed the reverse behavior with too strong WCBs. This points to the possibility that underestimated latent heat release due to cloud condensation in large-scale ascending flows and subsequent downstream development are responsible for a large part of forecast busts - at least at the end of the North Atlantic storm track.