

Impacts of Rossby Wave Packets on Forecast Uncertainties and Errors

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Rossby wave packets (RWPs) have frequently been linked to high impact weather events, including being precursors to explosive cyclogenesis and severe flooding. Previous studies have also shown that short range forecast errors and uncertainties frequently develop and propagate like linear RWPs. However, to date it is not clear how RWPs impact the development of forecast uncertainties and errors, although there have been suggestions that in some cases, large forecast uncertainties developed simultaneously with the initiation of RWPs.

Ensemble sensitivity analysis has been applied to examine how forecast track and intensity uncertainties in medium range forecasts of the development of strong cyclones depend on uncertainties in the initial conditions. Results suggest that in some cases, coherent sensitivity signals can be traced back in time to at least 6-7 days prior to the explosive cyclogenesis events. In those cases, it is frequently observed that a RWP can be found to propagate into the region of cyclogenesis, and the sensitivity signal also develop and propagate with the same group velocity as the observed RWP, suggesting that the RWP may have also amplified uncertainties in the cyclone forecast. Real time ensemble sensitivity analysis implemented in collaboration with NCEP based on the GEFS, SREF, CMC, and ECMWF ensembles (access to ECMWF results requires a password) targeting uncertainties in the forecasts of east coast cyclones are available at http://dendrite.somas.stonybrook.edu/CSTAR/Ensemble_Sensitivity/EnSense_Main.html.

Medium range GFS forecast errors of 300 hPa geopotential height over a region covering eastern North America and western North Atlantic during 5 cold seasons have been examined. Time-lagged composites of RWP amplitudes (computed based on a Hilbert Transform technique) based on forecasts with large errors show a significant signal of enhanced wave packet amplitude developing over the western North Pacific 5-6 days in advance, with the composite wave packet propagating across the Pacific and North America towards the large error domain. More detailed analyses of these cases will be discussed at the workshop.