Impact of Tropical Cyclone Relocation and Assimilation of Surveillance Dropsondes in the Operational NCEP GFS/GDAS

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Global numerical weather prediction continues to provide some of the best guidance for tropical cyclone track prediction. However, as the spatial resolution and complexity of operational global numerical weather prediction systems continues to increase, tropical cyclone (TC) vortex initialization becomes increasingly important for yielding continuing improvements in the forecast of TC track and especially intensity. In addition to the assimilation of observations from the global observing system including surveillance dropsondes, the current operational global data assimilation system (GDAS) and global forecast system (GFS) utilizes a combination of vortex relocation, bogus wind assimilation, and assimilation of minimum sea-level pressure information driven by real-time information from operational TC forecast agencies.

A sensitivity experiment performed for Hurricane Joaquin (2015) using the 2015 hybrid 3D EnVar-based GDAS system to initialize the operational resolution GFS was compared to an experiment that excludes the vortex relocation component of the operational tropical cyclone initialization. When the vortex relocation was turned off in the GDAS, the GFS track forecasts were improved by 35-45%. These forecasts correctly showed more of a threat from Joaquin to the Bahamas and showed much less of an incorrect threat from Joaquin to the mainland United States. Here we will present the results from a more comprehensive sensitivity study covering much of the 2015 hurricane season to examine the impact of the vortex relocation scheme on GFS track forecasts for a larger sample of systems across global TC basins. We will also present the results of companion studies that separately explore the impact of assimilation supplemental surveillance observations deployed by NOAA prior to United States landfall.

From these results, we will present a forward looking set of priorities to continue to improve tropical cyclone numerical guidance. Specifically, we aim to explore a more direct assimilation of storm information such as location and trajectory to initialize our models as well as use information from the data assimilation to inform surveillance flight planning through the most sensitive regions to deploy observations that will potentially yield the largest impacts.