The Impact of Global Hawk Dropsondes Upon NCEP Hurricane Forecasts

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This study examines the impact of Global Hawk dropsondes on NCEP model forecast of tropical cyclones from 2012-2016. The Global Hawk (GH) is a high-altitude, long-endurance unmanned aerial system that was used for North Atlantic hurricane reconnaissance by the NASA HS3 project from 2012-2014 and then by NOAA SHOUT project from 2015-2016. A joint NASA/NOAA project is planned for August 2017 flights over Eastern Pacific tropical cyclones as well. The GH is unique among hurricane reconnaissance aircraft due extreme duration (24 h), which is about three times that of current operational hurricane reconnaissance missions. This allows sampling of vast areas of remote oceans in addition to ample coverage of a storm. Furthermore, its high cruise altitude (~60 kft) allows it to sample much more of the troposphere than other operational aircraft.

Historically, Global Hawk dropsondes have had limited impacts on NCEP forecasts. Before 2017, the NCEP GFS model rejected this data over concerns regarding data quality. Though the HWRF model began assimilating the data in 2015, its impact was mostly neutral due to the reliance of HWRF upon GFS for all but the immediate tropical cyclone vortex. Thus, these experiments first test the impact of data addition in GFS and then use the GFS analyses to further test the impact in the downstream HWRF model.

Preliminary results indicate assimilation of GH dropsondes results in a large improvement in tropical cyclone track forecasts not limited to the storms sampled. The GH sampled hurricanes Gaston, Hermine, and Matthew as well as tropical storm Karl 2016. Not only did the average GFS track error decrease for all of those storms when GH dropsondes were assimilated, but errors also decreased substantially for TD8, which was not sampled. Average track error for 150 cases over the North Atlantic in 2016 decreased at every hour after 36h with a peak reduction of about 15% at 72 h. Furthermore, substantial decreases in track errors were also observed in both the eastern and western North Pacific basins, which were not sampled. The reasons for the decrease in remote errors is being explored. Meanwhile, initial results from downstream HWRF retrospectives indicate that the addition of GH data can improve both track and intensity forecasts. These results have prompted NCEP to allow GH data to be assimilated into the GFS starting with the May 2017 GFS upgrade.

Retrospectives from earlier years are more difficult to assess due to an upper-level dry bias that plagued all Vaisala dropsondes before 2016. Though this impacted all operational dropsondes used by NOAA as well as the GH, the impacts on the GH were much more severe due to its higher cruise altitude. Experiments from 2014 have begun, focused on late August through late September and covering Hurricanes Cristobal and Edouard as well as Tropical Storm Dolly. Preliminary results again suggest substantial track improvement in spite of the aforementioned dry bias. Additional experiments are planned with upper level GH moisture data rejected to assess the impact of the dropsonde moisture bias. More GH data addition experiments are planned for Hurricane Nadine in 2012, which is one of the longest-lived tropical cyclones on record and was sampled by 5 GH missions.