**2. G-IV Three-dimensional Doppler Winds Experiment**

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**Links to IFEX:**

* **Goal 1:** Collect observations that span the TC life cycle in a variety of environments for model initialization and evaluation.
* **Goal 2:** Develop and refine measurement technologies that provide improved real-time monitoring of TC intensity, structure, and environment.
* **Goal 3:** Improve understanding of the physical processes important in intensity change for a TC at all stages of its lifecycle.

**Motivation:**

This experiment is a response to the requirement listed as Core Doppler Radar in Section 5.4.2.9 of the National Hurricane Operations Plan. The goal of that particular mission is to gather airborne-Doppler wind measurements that permit an accurate initialization of HWRF, and also provide three- dimensional wind analyses for forecasters. This experiment is similar to the P-3 Three-Dimensional Winds experiment, but employs the G-IV platform and tail Doppler radar.

There are four main goals: 1) to evaluate the G-IV as a platform for observing the cores of TCs, 2) to improve understanding of the factors leading to TC structure and intensity changes, 3) to provide a comprehensive data set for the initialization (including data assimilation) and validation of numerical hurricane simulations (in particular HWRF), and 4) to develop rapid real-time communication of these observations to NCEP.

**Background:**

The real-time analysis of tail Doppler radar data was made possible by an automated quality control process (Gamache 2005) and variational wind synthesis method (Gamache 1997; Reasor et al. 2009).

**Hypotheses:**

* Hypothesis: Improving representation of a storm's inner core in the HWRF initial conditions through assimilation of the G-IV TDR data leads to reduced error in short-term structure and intensity forecasts.

**Experiment/Module Description:**

The ultimate requirement for EMC is to obtain the three-dimensional wind field of Atlantic TCs from airborne Doppler data every 6 h to provide an initialization of HWRF through assimilation every 6 h. In 2017, the maximum possible rotation of missions is two per day or every 12 h. The G-IV platform is currently used by NHC for synoptic surveillance until approximately 36 h prior to TC landfall. In 2017 the flight modules described here are likely to be limited to cases within this landfall window or not of NHC operational interest. In anticipation of future operational use of the G-IV Doppler data, we recommend storm overflight whenever possible during synoptic surveillance missions. The most effective pattern, fulfilling the needs for inner-core assimilation and the current operational requirement for synoptic measurement, will be refined through experiments using the Hurricane Ensemble Data Assimilation System (HEDAS) and consultation with NHC.

The likely scenarios in which this experiment would be carried out are as follows: 1) at the conclusion of NHC tasking for a landfalling TC, likely coordinated with the P-3 aircraft; 2) prior to NHC tasking for a TC of interest to EMC (priority is coordination with P-3 aircraft); 3) a recurving TC (priority is coordination with P-3 aircraft). Since coordination with the P-3 aircraft is an early requirement, this experiment would have to be weighed against other experiments which stagger the P-3 and G-IV flight times. This initial coordination is necessary for 1) comparing and synthesizing storm structure derived from the two radar platforms and 2) the most thorough testing of HEDAS with this new data source. Subsequent flights may relax this requirement for P-3 coordination as the quality of the G-IV data is established and G-IV overflight of systems becomes more routine.

**Analysis Strategy:**

The emphasis here is on "real-time" products. Quality-controlled, thinned Doppler radials are output, packaged and transmitted to NCO for assimilation into a parallel version of the HWRF model. Similarly, Doppler radial superobs are transmitted for use by research groups. Three-dimensional and vertical profile analyses of wind and reflectivity are also produced. Plan-view images derived from the analyses are transmitted to a location where NHC hurricane specialists can view them. Additional products include composite analysis images with dropwindsonde winds overlaid and, most recently, wind and reflectivity structure images for real-time mission planning and viewing by NHC specialists.

Following the spring 2012 NOAA acceptance of the G-IV tail Doppler radar, the experiment has focused on documenting data coverage in TCs, in particular resolution of the outflow layer (via the central dense overcast). These observations will supplement those collected by the P-3 aircraft, and through HEDAS, their added value in TC initialization will be investigated. Flight patterns will also explore the viability of the G-IV as a substitute for the P-3 aircraft in terms of Doppler radar sampling of the TC core region.

In the course of the G-IV TDR evaluation, it has become clear that corrections to the INE data for drift and Schuler oscillation are imperative, at least for producing the best quality wind analyses. This correction is currently applied in post-flight analyses. A solution appropriate in real time is being sought.

**References:**

Gamache, J. F., 1997: Evaluation of a fully three-dimensional variational Doppler analysis technique. Preprints, *28th Conf. on Radar Meteorology,* Austin, TX, Amer. Meteor. Soc., 422–423.

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Reasor, P. D., M. Eastin, and J. F. Gamache, 2009: Rapidly intensifying Hurricane Guillermo (1997). Part I: Low-wavenumber structure and evolution. *Mon. Wea. Rev.*, **137**, 603–631.