NOAA Joint Hurricane Testbed (JHT)
Mid-Year Progress Report, Year 1

Date:	Feb. 1, 2012
Project Title:	*Development of a Real-Time Automated Tropical Cyclone Surface Wind Analysis*
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Project Dates:	Aug.2011-Jul.2013

1. Long-Term Objectives and Specific Plans to Achieve Them

Although surface and near surface wind observations and flight-level winds and their proxies exist in sufficient quantity to create high quality tropical cyclone surface wind analyses (cf., H*Wind analyses; Powell et al. 1998), a real-time and fully automated surface wind analysis system is not available at the National Hurricane Center (NHC). Such analyses could however be invaluable; providing useful information for a variety of operational products.

In this project we endeavor to create a real-time and fully automated surface wind analysis system at NHC by combining accepted operational wind reduction procedures and a comparably simple variational data analysis methodology (Knaff et al. 2011). Specifically, this project will make use of the Franklin et al (2003) flight-level to surface wind reduction findings along with current operational procedures and the automated analysis and quality control (QC) procedures used in the Multi-platform tropical cyclone surface wind analyses (MTCSWA; Knaff et al. 2011). The aircraft reconnaissance wind data (flight-level and SFMR), and the MTCSWA satellite-based MTCSWA will be used. The MTCSWA will serve as a first guess field with very low weighting and the aircraft-based data will be composited over a finite period of time and analyzed. The analysis will be performed on a polar grid at the surface level. The proposed wind analysis will run at NHC and make use of the local data stream and JHT servers. The resulting two-dimensional wind analysis will produce 1-min sustained winds valid for 10 meter (m) marine exposure with sufficient resolution to properly capture the radii of maximum winds. The polar grid resolution and domain size will be consistent with the resolution of the aircraft reconnaissance data and the needs of the forecasters.

The timeline for Year 1 of this project is provided in the Appendix.

2. Accomplishments

The accomplishments on the four main project tasks are described below.

1. **Desired analysis properties were determined** through discussion with NHC project advisors. The basic questions of when the analysis would be run, how datasets would be weighted and the flight-level-to-surface wind reductions that

would be used were determined for the initial analysis attempts.

Analysis timing: Analyses would be triggered at 30 minutes prior to synoptic time (T), at T and again at T+1:30. This would fit the Hurricane Specialist's potential need namely generation of the TC Bogus/TC vitals/request for model guidance at T-:30 and T and just prior to releasing the advisory package.

Flight-level-to-surface reduction factors (FLTSRF): Here Franklin et al. (2003) is used as guidance, where eyewall FLTSRF would be used within twice the radius of maximum wind (RMW) and outer vortex FLTSRF would be used outside four times RMW and a linearly weighting of eyewall and outer vortex FLTSRF would be used for 2RMW < r < 4RMW. In addition the FLTSRF would be a function of storm direction reduction factors (i.e., left quadrants would be 4% higher than the right quadrants). This 4% will be maintained in the outer vortex. Finally it was agreed that convective FLTSRF would be used throughout, thus producing conservatively high surface wind estimates.

Data weights for the variational analysis: It was decided that the data weights for the flight-level winds and the SFMR surface wind estimates would be a function of the magnitude of the flight-level winds. SFMR would be preferentially weighted when the flight-level winds exceeded hurricane strength and flight-level winds would be preferentially weighted when the flight-level winds were less than 50-kt. Again more equal weighting will be used when the flight-level winds are between 50 and 64 kt.

Inflow angles: A consensus was reached that 20 degree inflow seemed reasonable.

2. **Scripts and programs to combine aircraft center fixes, operational best tracks and OFCI/OFCL** were created. These take into account whether the analysis is run at T-:30, T, or T+1:30. Points from the CARQ lines and the latest available official forecast and all of the aircraft center fixes in the fdecks are sorted and provided to the analysis software. These files (*.inp) are the starting point for each analysis.

3. **Scripts and programs were developed to ingest real-time aircraft flight-level, and SFMR datasets**. GPS sonde decoders are under development.

4. **The design of the local data ingest (i.e. aircraft from NHC, MTCSWA from NESDIS, a/f decks from NHC) and analysis** has begun. Aircraft, ATCF, and MTCSWA datasets are being mirrored locally and the *.inp files will be generated automatically at T-:30, T and T+1:30, when Atlantic and East Pacific storms become active.

3. Plans for the remainder of Year 1

In the remainder of Year 1 our goal is to continue developing and testing the data ingest and analysis system. We still need to make the agreed upon changes to the analysis code. Details such as data weights, FLTSRFs, and tests for sufficient data availability remain to be coded up. We fully expect that the analysis code will be ready for testing in February and that some preliminary analyses will be available for presentation at the IHC. We fully expect to be running analyses locally (at CIRA) by the active portion of the 2012 hurricane season.
While preparing for local runs we will begin installing the ingest/analysis system on JHT servers. Note we still do not have access to those machines.

References:

Franklin, J. L., M. L. Black, and K. Valde, 2003: GPS dropwindsonde wind profiles in hurricanes and their operational implications. *Wea. Forecasting*, **18**, 32–44.

Knaff, J.A., M. DeMaria, D.A. Molenar, C.R. Sampson and M.G. Seybold, 2011: An automated, objective, multi-satellite platform tropical cyclone surface wind analysis. *J. of Applied Meteorology and Climatology.***50**, 2149-2166.

Powell, M. D., S. H. Houston, L. R. Amat, and N. Morisseau-Leroy, 1998: The HRD real-time hurricane wind analysis system. *J. Wind Eng. Ind. Aerodyn*., **77-78**, 53–64.

Appendix: Year-1 Project timeline:

Sep 2011 - Project begins
Sep 2011 - Discussions with NHC to determine desired analysis properties
Sep 2011 - Begin the development of local data ingest design
Sep 2011 - Develop routines to ingest aircraft flight-level, SFMR, and GPS sonde data
Oct 2011 - Develop scripts to combine aircraft center fixes, operational best tracks and OFCI
Dec 2011 - Combine the TC track and the analysis
Jan 2011 - Develop methods to standardize the data types based on NHC's preferences
Mar 2012 - Meet with NHC specialists to discuss options for data weights and smoothing constraints.