JHT Mid-term Report

(August 1 2005 – February 28 2006)

WSR-88D-derived Diagnosis of Tropical Cyclone Intensity Changes Near Landfall

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Accomplishments:

This document gives a mid-term progress report on the development of the Vortex Objective Radar Tracking and Circulation (VORTRAC) package for the JHT. Using the level II coastal WSR-88D data, VORTRAC tracks intensity (central pressure) and radius of maximum wind (RMW) of landfalling tropical cyclones retrieved from the ground-based velocity track display technique (GBVTD) and the hurricane volume velocity processing method (HVVP). The VORTRAC work has been focused on (1) the design and implementation of a user interface using the Qt tool kit, and (2) implementation of the radar data quality control algorithm on NEXRAD level-II data to be used in the overall VORTRAC package.

Progress has been made on the display widget using the Qt tool kit to assign key parameters to the real-time GBVTD/HVVP algorithm and product display. The Graphical User Interface (GUI) for the VORTRAC program is shown in Fig. 1. This interface was designed for use in the operational environment, with a large display of the time series of central pressure (red line) and RMW (blue line) that continuously updates in real-time when the center of a TC is within the Doppler range of coastal WSR-88Ds. Uncertainty estimates, given by the hash marks about each line, and potential dropwindsonde measurements (black dots) are also shown, providing the forecaster with confidence estimates for the radar retrievals. Additional features of the GUI include: (1) a status log indicating success or errors in the program operation, (2) a progress bar showing a graphical indication of the analysis stage, and (3) a configuration tree, allowing the user to adjust the default operational parameters of the program.

The configuration of the program relies on an extensible markup language (XML) text file that can be manually modified via a text editor, the configuration tree shown in the left panel, or more intuitively through a point and click interface shown in Fig 2. While standard configurations of most parameters will be valid for many storms, specific information such as the hurricane name and available radar coverage can be modified quickly and easily with this GUI. All of the available configuration information will be described in the user's manual to be presented in year two.

On the algorithm development side, the radar data quality control software have been rewritten from FORTRAN to C++ and integrated with the Qt tool kit. The radar data control software includes 1) simple ground clutter removal by setting thresholds on the Doppler velocity and spectrum width data, 2) Doppler velocity correction for hydrometeor terminal fall speed using a standard technique that draws from the work of Nunez and Gray (1977) and Beard (1985), and 3) Doppler velocity unfolding that uses a reliable reference wind estimated from the gradient VAD (GVAD) technique of Gao et al. (2004), which is then used to initialize the standard Bargen and Brown (1980) unfolding algorithm.

The HVVP part of VORTRAC is currently being rewritten from FORTRAN and Interactive Data Language (IDL) to C++ and will soon be integrated with the Qt tool kit. Further testing and validation of the HVVP technique on the Hurricane Charley (2004) NEXRAD data set has also been conducted. This testing has led to an improvement in the way HVVP handles environmental wind estimates in the presence of radial outflow within the tropical cyclone's circulation. The revised estimates of the environmental wind around Hurricane Charley are consistent with NOAA/NCDC/SRRS 850 and 700 mb analysis charts and the veering of Charley's track with time (Fig. 3).

Summary and Future Work:

The project is progressing well and on schedule. We have designed and nearly completed the user interface of the VORTRAC package. We have begun to port necessary software to C++ and link them to the GUI. We will test the prototype VORTRAC package using analytical data first then test it with real NEXRAD data both at UCAR and NHC.

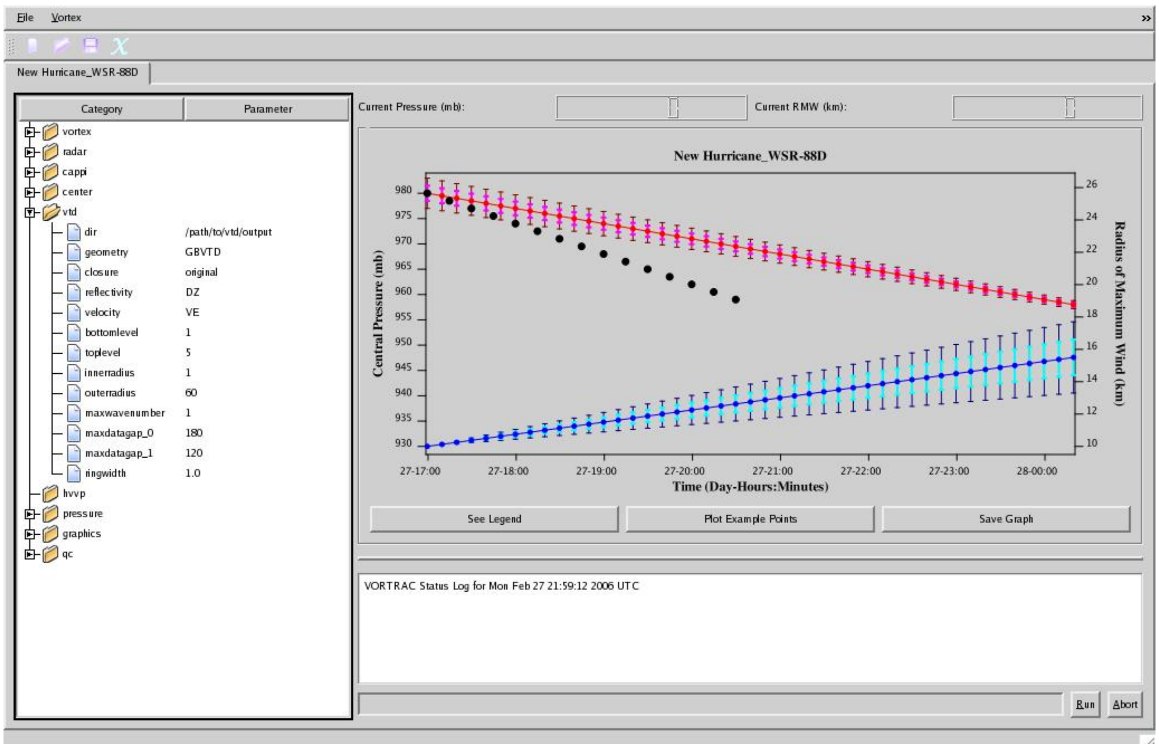

Figure 1. Time series display (screen shot) of central pressure (in red) and radius of maximum wind (in blue) in VORTRAC. Central pressure observed by dropsonde or other sources is displayed in black dots when available. Hash marks represent the uncertainty estimate associated with each computation. See text for details.

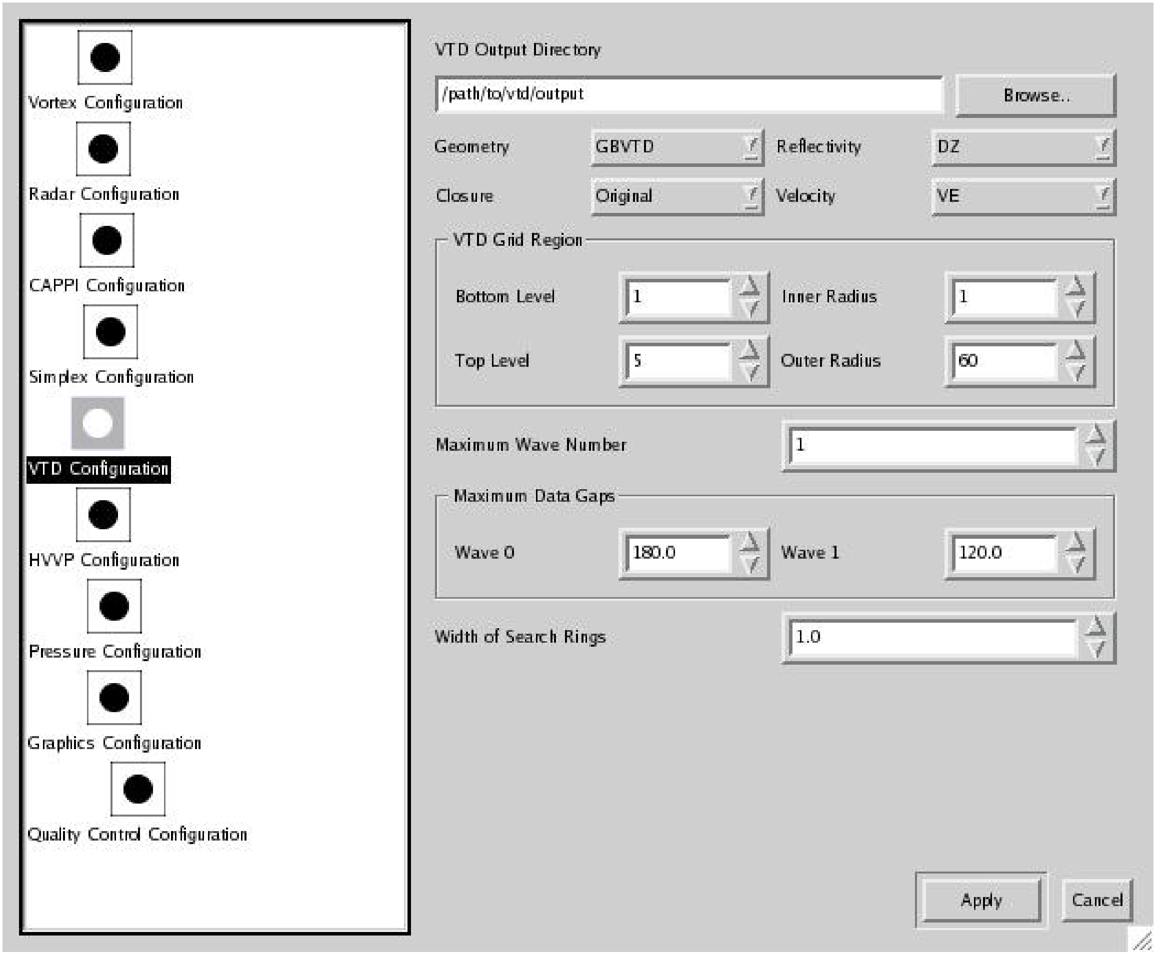

Figure 2. Example of the point and click user interface to change VORTRAC parameters. See text for details.

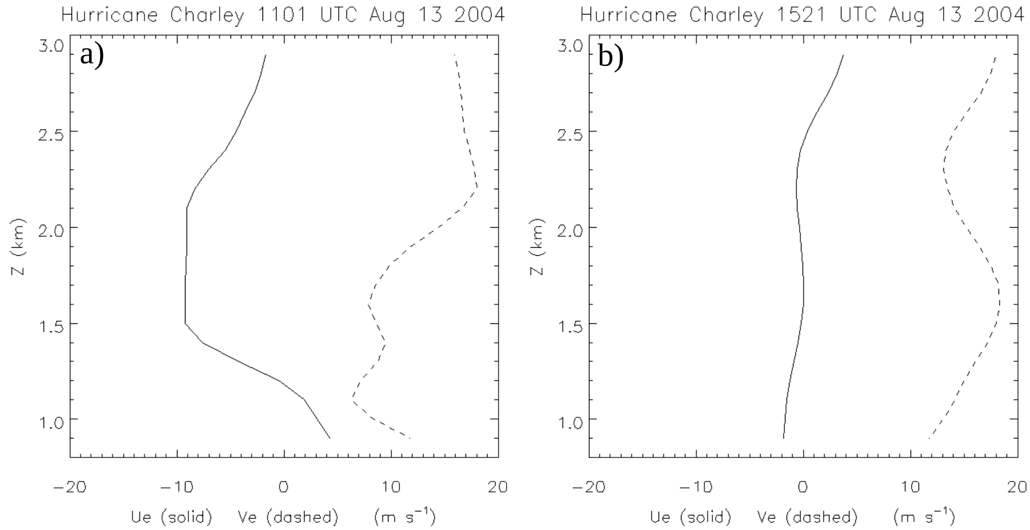

Figure 3. Vertical profiles of the Cartesian wind components of the environmental wind (Ue, Ve) around Hurricane Charley on August 13 2004 at a) 1101 UTC and b) 1521 UTC. Note the decrease in negative magnitude of Ue above 1.2 km is consistent with more steering toward the north (veering) during the 4 hours and 20 minutes between HVVP analyses, assuming all other winds aloft, not estimated by HVVP, also contribute to this possibility in the vertically integrated sense of steering.