CAPABILITIES AND IMPACT ON WIND ANALYSES OF THE HURRICANE IMAGING RADIOMETER (HIRAD)

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The Hurricane Imaging Radiometer (HIRAD) is a new airborne microwave remote sensor for hurricane observations that is currently under development by NASA Marshall Space Flight Center in partnership with the NOAA Atlantic Oceanographic and Meteorological Laboratory/Hurricane Research Division, the University of Central Florida, the University of Michigan, and the University of Alabama in Huntsville. The instrument is being test flown in January and is expected to participate in or collaborate with the tropical cyclone experiment GRIP (Genesis and Rapid Intensification Processes) in the 2010 season. HIRAD is designed to study the wind field in some detail within strong hurricanes and eventually to enhance the real-time airborne ocean surface winds observation capabilities of NOAA and USAF Weather Squadron hurricane hunter aircraft currently using the operational Stepped Frequency Microwave Radiometer (SFMR) [1]. Unlike SFMR, which measures wind speed and rain rate along the ground track at a single point directly beneath the aircraft, HIRAD will provide images of the surface wind and rain field over a wide swath (~ 3 x the aircraft altitude) with ~2 km resolution. See Figure 1, which depicts a simulated HIRAD swath versus the line of data obtained by SFMR.

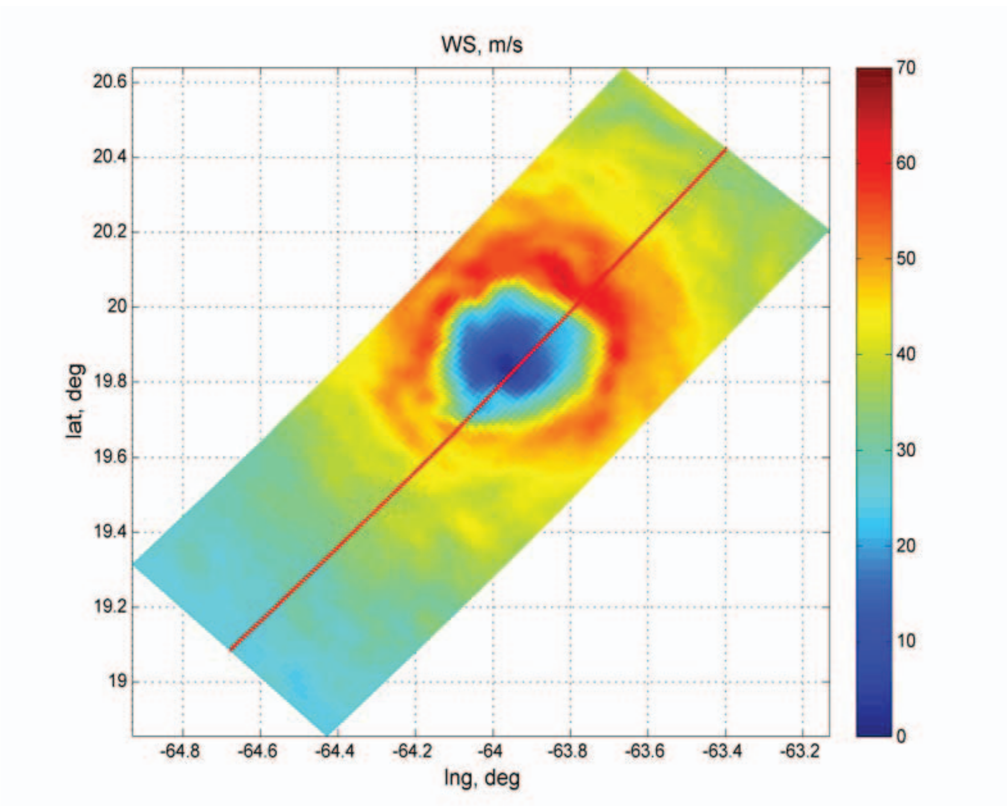

Figure 1. Simulated HIRAD wind speed image from model output. The red line is the flight track and also the line where SFMR obtains data.

This presentation will describe the HIRAD instrument and the physical basis for its operations, including chamber test data from the instrument. (See Figure 2 for a photograph of the instrument and Figure 3 for a schematic functional diagram of the system.) HIRAD adds the capability for cross-track wind retrievals by using a synthetic thinned array planar antenna, similar to that developed for the Lightweight Rain Radiometer (LRR) by NASA's Instrument Incubator Program. There is a real aperture in the along-track direction and synthetic aperture [2] cross-track, based on 10 linear elements. The antenna is essentially a printed circuit board with an array of layered, rectangular antenna elements in which each layer is resonant with the desired frequency.

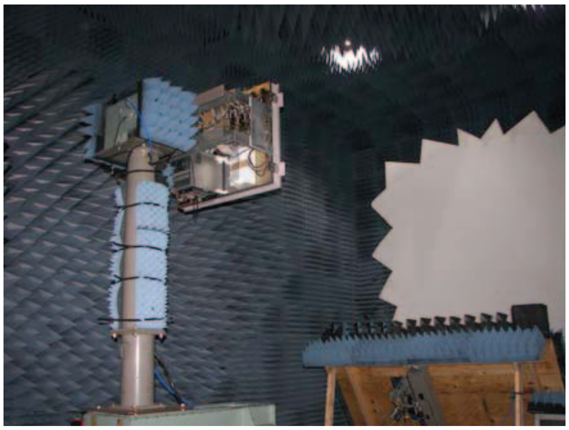

Figure 2. Photograph of the HIRAD instrument in the test chamber.

The potential value of future HIRAD observations will be illustrated with a summary of Observing System Simulation Experiments (OSSEs) in which measurements from the new instrument as well as those from existing instruments (air, surface, and space-based) are simulated from the output of a detailed numerical model, and those results are used to construct simulated H*Wind analyses. Evaluations will be presented on the impact on H*Wind and other wind analyses of using the HIRAD instrument observations to replace those of the SFMR instrument, and also on the impact of a future satellite-based HIRAD in comparison to instruments with more limited capabilities for observing strong winds through heavy rain. Potential impact on numerical prediction of hurricane intensity will also be discussed.

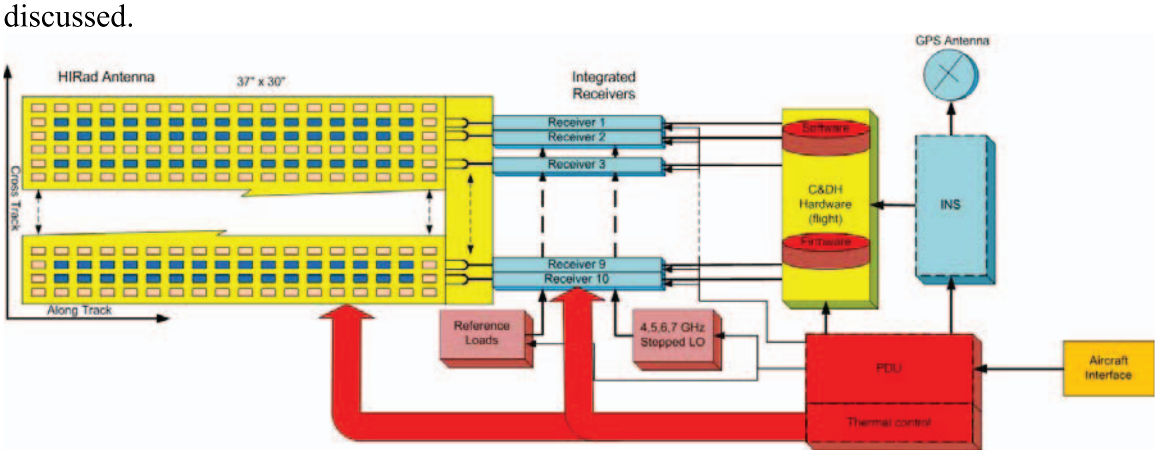

Figure 3. Schematic functional diagram of the HIRAD instrument.

REFERENCES

[1] E.W. Uhlhorn and P.G. Black, "Verification of Remotely Sensed Sea Surface Winds in Hurricanes," *J. Atmos. Oceanic Technol.,* 20, 100-115, 2003.

[2] C.S, Ruf, C.T. Swift, A.B. Tanner, and D.M. Le Vine, "Interferometric synthetic aperture microwave radiometry for the remote sensing of the earth," *IEEE Trans. Geosci. Remote Sens.*, **26**, 597-611, 1988.