IMPROVED HURRICANE ACTIVE/PASSIVE SIMULATED WIND VECTOR RETRIEVALS

Suleiman Alsweiss[1], Peth Laupattarakasem[1], Salem El-Nimri[1], W. Linwood Jones[1], and Svetla Hristova-Veleva[2]

1. Central Florida Remote Sensing Laboratory
University of Central Florida
Orlando, Florida 32816
<*suleimanalsweiss@gmail.com*>

2. Jet Propulsion Laboratory
Pasadena, CA

ABSTRACT

Wind force over the ocean modulates air-sea fluxes and regulates the crucial coupling between atmosphere and ocean that establishes and maintains global and regional climate. Hurricanes and tropical storms are generated by the oceanic and atmospheric physical interaction driven by force winds. Thus, it is crucial to have an accurate estimate of the peak winds in such events during the monitoring process.

Wind vectors derived from scatterometers are impeded with the presence of rainfall, which alters the value of radar ocean backscatter, measured by scatterometers, and change its anisotropy characteristics [1]. This paper describes a novel active/passive ocean vector winds (OVW) retrieval algorithm to infer wind velocities in severe weather conditions. This active/passive microwave sensor combination has the potential to mitigate rain effects and to extend the useful wind speed measurement range for tropical cyclones beyond that exhibited by the current operating scatterometers.

Results in this paper are based on simulated measurements from the proposed Dual Frequency Scatterometer (DFS), a candidate design of the next-generation NOAA/NASA scatterometer, which has been proposed to fly on the future Japan Aerospace Exploration Agency (JAXA) GCOM-W2 earth-observing mission. DFS, a wide swath (1800 km) conical-scan pencil beam instrument, with a 360 field of view, utilizes dual frequency radar channels: two horizontally polarized C-band (5.4 GHz) beams (inner at 49.6°, and outer at 57.7° EIA), and two dual polarized (horizontal and vertical)

Ku-band (13.4 GHz) beams (outer V-pol at 57.7° and inner H-pol at 49.6° EIA). A unique opportunity afforded by GCOM-W2 is the simultaneous operation with the JAXA Advanced Microwave Scanning Radiometer (AMSR).

The feasibility of the new active/passive algorithm implemented in this work is assessed using a realistic end-to-end simulation for high-resolution radar backscatter measurements from the DFS (Ku- and C-band) channels, and radiometric brightness temperatures from AMSR dual polarized channels (6.9, 10.7, 18.7, 23.8, 36.5, and 89 GHz) in a typical hurricane environment. The Weather Research and Forecasting model (WRF) is used to model environmental hurricane parameters in a high resolution (1.3 km) grid with realistic eyewall, rain bands, and *meso-scale* structure. Figure 1 (a, b) shows a WRF simulation for Hurricane Katrina decimated surface wind vectors and rain rates respectively.

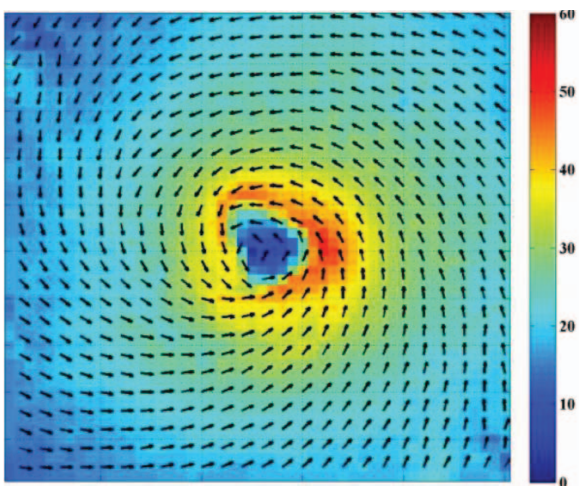

Fig.1 a) WRF simulation for Hurricane Katrina surface wind vectors (m/s)

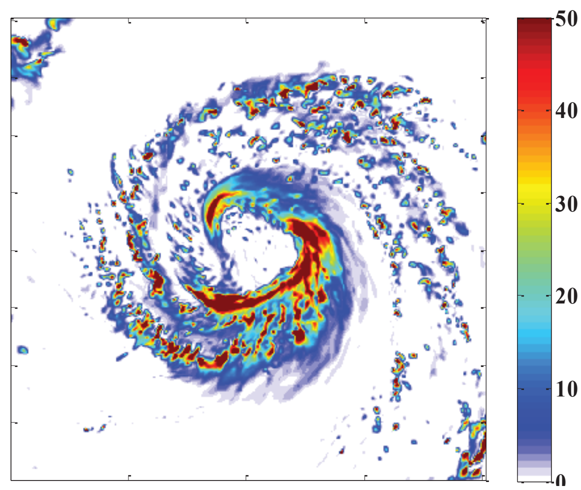

Fig.1 b) WRF simulation for Hurricane Katrina rain rates (mm/hr)

The unique aspect of this technique is that it exploits the coincident passive observations to correct the active measurements for the effects of rain volume backscatter and atmospheric transmissivity using AMSR brightness temperature measurements from different frequencies through an advanced multivariate regression procedure. Subsequently, the corrected active measurements were used in geophysical model function inversion to generate maximum likelihood estimates of wind speed and direction [2]. Figure 2 (a, b, c, and d) shows AMSR horizontally polarized brightness temperatures for four different frequencies (6.9, 18.7, 36.5, and 89 GHz respectively), where the color indicates the brightness temperature in kelvin.

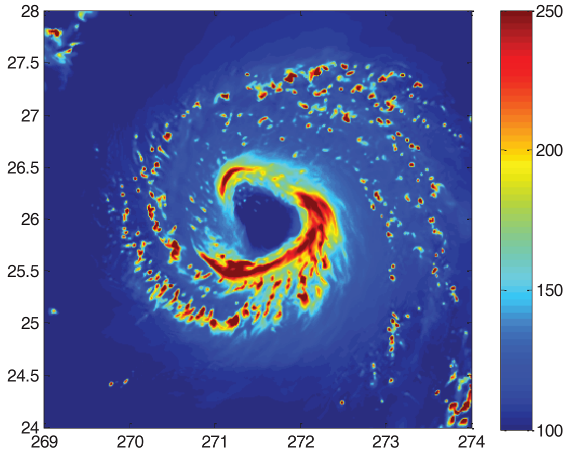

Fig.2 a) AMSR 6.9 GHz Tb, H-pol

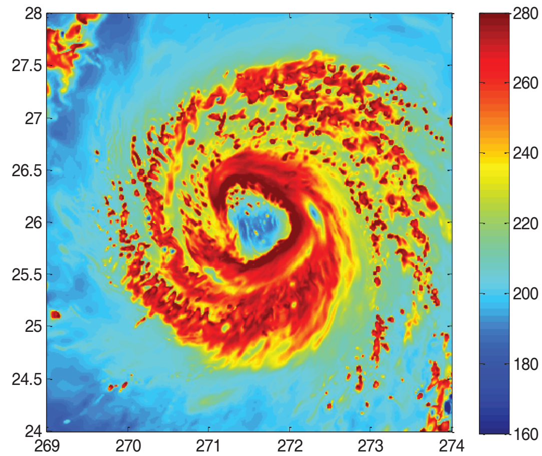

Fig.2 b) AMSR 18.7 GHz Tb, H-pol

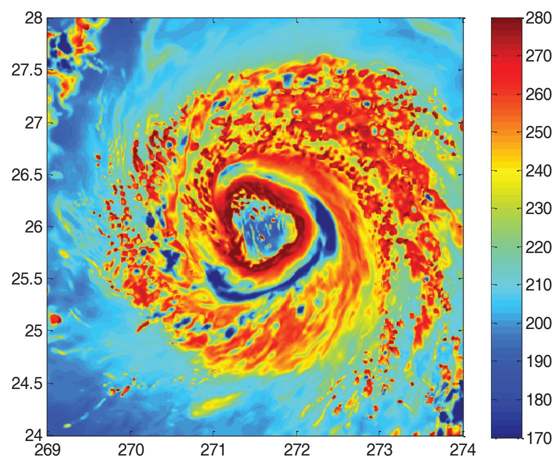

Fig.2 c) AMSR 36.5 GHz Tb, H-pol

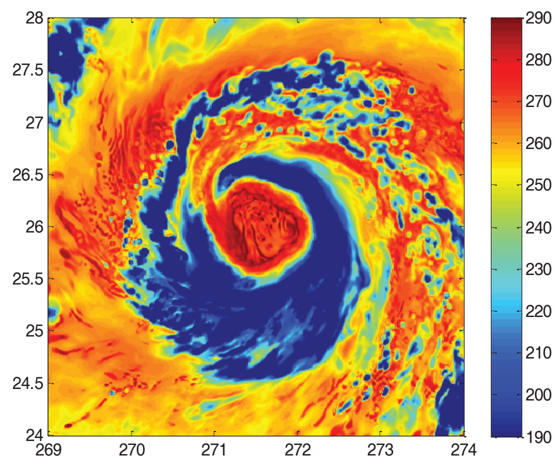

Fig.2 d) AMSR 89 GHz Tb, H-pol

This technique is envisioned to provide a more accurate and reliable OVW retrievals in the presence of precipitation in extreme wind events. More details will be described throughout this paper, along with results and comparisons between active/passive wind vector retrievals, and the WRF nature run.

References

[1] D. E. Weissman, M. A. Bourassa, and J. Tongue, "Effects of rain-rate and wind magnitude on SeaWinds scatterometer wind speed errors," *J. Atmos. Oceanic. Tech.,* 2001.

[2] C. Chi and F. K. Li, "Comparative study of several wind estimation algorithms for spaceborne scatterometers," *IEEE Trans. Geosci. Rem. Sens.,* vol. 26, pp. 115–121, 1988.