Development of Improved Satellite Microwave Scatterometer Ocean Vector Wind Retrievals in Extreme Wind Events

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ABSTRACT

As a member of NASA's Ocean Vector Winds Science Team (OVWST), the Central Florida Remote Sensing Laboratory (CFRSL) is involved in research for satellite scatterometer algorithm development and validation. Over the past few years, our focus has been to improve the ocean surface wind vector retrievals (OVW) in the presence of precipitation especially for severe weather events such as hurricanes and typhoons. Although these weather events are rare in nature, they impact majority of variability in oceanic and atmospheric physical events. Moreover, since these severe weather events are usually associated with high rain rates, we have taken the lead in developing combined active and passive OVW retrieval algorithms to mitigate the effects of rain, and reduce the associated errors in the retrievals. This paper presents an overview of our research and results of recent developments for near-real-time application to hurricane surveillance.

In our approach, simultaneous collocated passive microwave observations (brightness temperatures) were used to characterize the rain environment and to improve the OVW retrievals in tropical cyclones. Recently [1], a novel active/passive wind vector retrieval algorithm designed specifically for extreme wind events (identified as the QuikSCAT wind retrieval Q-Winds) has been developed by the CFRSL. The unique aspect of this algorithm is that it incorporates the QuikSCAT Radiometer (QRad) brightness temperatures as a third dimension in the geophysical model function (GMF), which is used to correct the highly rain contaminated measurements. Validation results are presented for several hurricanes that demonstrate significant improvements for Q-Winds over the standard L2B science data processing.

Also as an extension to the NASA OVWST research, CFRSL was selected by the NOAA Joint Hurricane Testbed (JHT) Program to develop an improved near real-time (NRT) Hurricane OVW from QuikSCAT. Under this project, we are working to transitioning satellite OVW measurements from research to operations. The main objective of this phase of the project is to provide an improved near real-time (NRT) wind speed retrieval algorithm in extreme wind events and to provide an automated QuikSCAT data capture and data processing as summarized in Table-1.

Feature	Comments
1. Storm Detection	• Detects storm(s) by locating cluster(s) of high σ^0
2. Storm Eye Location	• Locates "centroid" by searching the minimum gradient of σ^0differences from all polarizations
3. Initial Wind Direction Field	• Initial Wind direction estimation before performing MLE retrieval • Provides guideline in ambiguity selection
4. Incorporates rain correction via XW-GMF	• No rain flags required • Preserves high wind speed pixels

Table 1: "X-Winds" features

Finally, CFRSL is supporting the Jet Propulsion Laboratory to develop an OVW retrieval algorithm for the future NOAA/NASA Dual Frequency Scatterometer (DFS) onboard the Global Change Observation Mission - Water cycle (GCOM-W) satellite series planned by the Japanese Aerospace Exploration Agency's (JAXA). This algorithm will combine C- and Ku-band active measurements with passive microwave measurements from JAXA's Advanced Scanning Microwave Radiometer (AMSR) to retrieve an improved OVW in hurricanes. Our algorithm will exploit the higher instrument resolution and better GMF wind sensitivity of the Ku-band channel and the reduced rain susceptibility of the C-band [2]. Preliminary results of an end-to-end simulation are presented that suggest significant improvement over present satellite scatterometer (e.g., QuikSCAT and ASCAT) capabilities.

REFERENCES

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