IMPACT OF THE DUAL-FREQUENCY SCATTEROMETER ON NOAA OPERATIONS

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1. INTRODUCTION

In an effort to establish an operational ocean surface vector wind satellite capability, NESDIS has been exploring the possibility of flying a U.S. scatterometer on board the Japan Aerospace Exploration Agency's (JAXA's) Global Change Observation Mission (GCOM) satellite series. In response to the community's requirements for a full-performance ocean vector winds measurement capability, a Dual Frequency Scatterometer (DFS) was designed by Jet Propulsion Laboratory and accepted as the GCOM-W2 baseline scatterometer. The DFS instrument concept design uses the synergy between Ku-band and C-band scatterometers. The Ku-band scatterometer continues the QuikSCAT heritage in order to preserve wide-swath measurements, high temporal sampling capabilities, and achieve higher spatial resolution. The C-band scatterometer (ASCAT heritage) provides much more accurate measurements in rain and achieve better performance in all wind speed ranges. The DFS is designed as a scanning pencil-beam scatterometer with a 360° field of view similar to QuikSCAT. The two incidence angles will be chosen to preserve the 1800-km wide swath at the GCOM-W2 altitude.

2. IMPACT ON TROPICAL CYCLONE FORECASTS

• More accurate estimates of TC intensity from tropical depressions to category 2 hurricanes (Fig.1)

  – Addressing TC intensity forecast problem requires better TC intensity estimates, especially when/where aircraft reconnaissance is not available, which is the case in most of the world's TC basins

  – Differentiate tropical depressions from tropical storms, and tropical storms from hurricanes with greater certainty, which helps to determine coastal and marine watch/warning categories [1]

• Improved TC identification and center fixing

– Initiate or discontinue TC advisories based on existence or lack of a well-defined surface circulation, especially where/when aircraft reconnaissance not available, resulting in earlier issuance of advisories and warnings for developing systems [1]

– Helping to determine the initial motion, important for the official forecast and for initialization of model guidance

• More accurate analysis of the 34-kt, 50-kt, and 64-kt wind radii in all TCs

– Critical to the placement and timing of coastal watches and warnings and definition of ship avoidance areas [1]

• Improved information on TC climatology in areas not sampled by aircraft reconnaissance

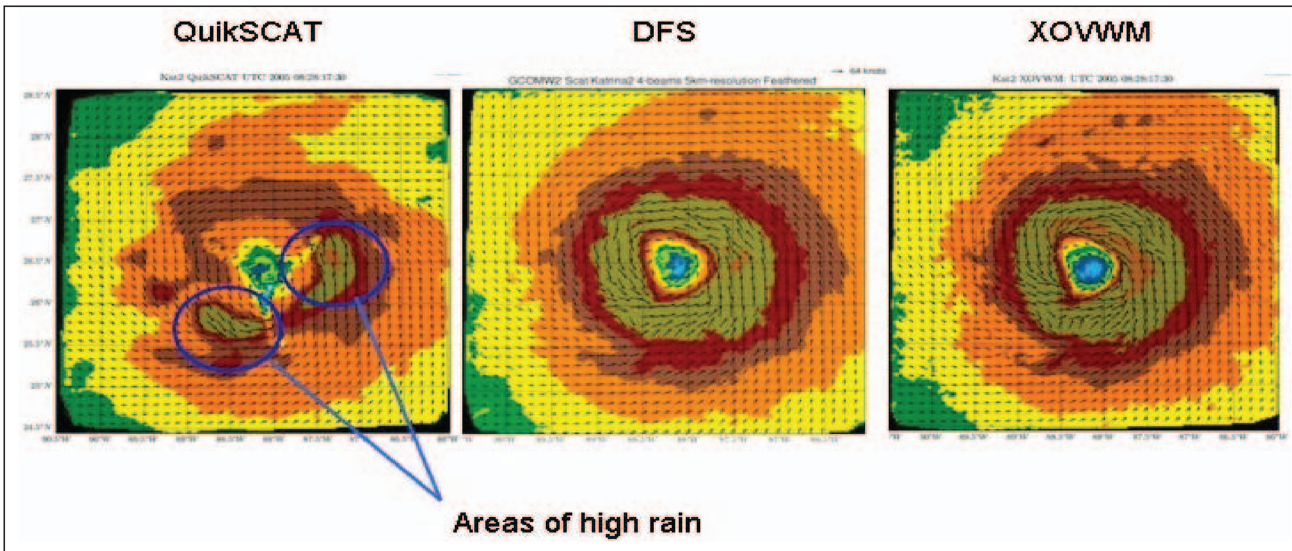

Fig.1 Simulated QuikSCAT, DFS and XOVWM wind vector retrievals for Katrina-like hurricane

3. IMPACT ON MARINE WEATHER FORECASTS

• Improved wind field structure in critical marine features such as tropical waves, fronts, squall lines, areas of convection, the ITCZ, and tropical and extratropical cyclones

– Retrievals from QuikSCAT often degraded by heavy rainfall in these systems

• More accurate retrievals in a wider range of weather conditions and at higher resolution will improve timing and quality of warnings for high-wind regions

• Radii of 34-kt, 48-kt, and 64-kt winds, and maximum winds (that could exceed 100 kt) in extratropical cyclones better defined, which is critical to timing and placement of marine and coastal warnings

• Improved identification and delineation of wave and swell generation areas, swell directions, and swell magnitudes

– As a result of improved swell identification, improved forecasts of high surf along coasts could result, for increased lead time and accuracy of high surf advisories and warnings and coastal flood watch and warnings [2], [3], [4]

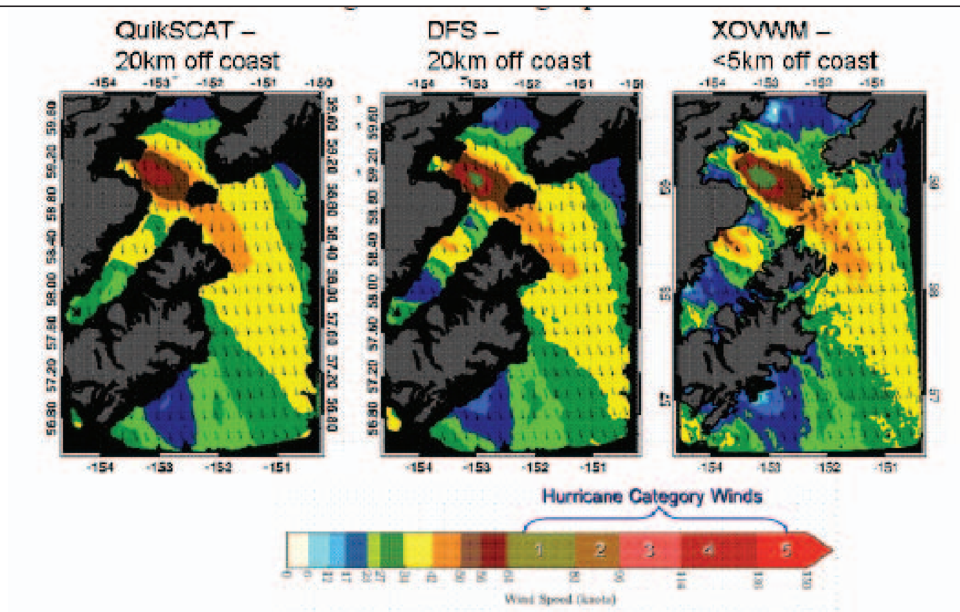

Fig 2. Simulated QuikSCAT, DFS and XOVWM retrievals. DFS and QuikSCAT coastal mask is set to 20km however it is expected that oversampling of the ocean area by DFS, 20% better resolution, better performance in rain and better wind speed sensitivity will lead to improved coastal wind products.

4. IMPACT ON CLIMATOLOGY

• The DFS would provide another several-year record of OSVW data over the global oceans that is critical to both operational forecasters (since accurate documentation of past events is a key component to forecasting future events) and climate researchers

• The DFS OSVW measurements will therefore directly supports climate research and services by providing measurements needed to document:

– heat uptake, transport, and release by the ocean;

– ocean carbon sources and sinks (ocean surface vector winds modulates air-sea exchanges of gases such as CO_2) and

– air-sea exchange of water and the ocean’s overturning circulation

5. SUMMARY

We studied the impact that the DFS instrument would have on different National Weather Service (NWS) weather forecasting and warning products and services. The main conclusion of the study is that the huge advantage of the DFS instrument over QuikSCAT is in its ability to provide ocean surface vector wind (OSVW) measurements in nearly all weather conditions and significantly better depiction of wind fields across a wide range of weather phenomena. With a 50% improvement in the accuracy of wind estimates in high wind regimes, a 20% improvement in resolution and its ability to see through rain, DFS will address NWS's operational OSVW requirements significantly better than a QuikSCAT-like instrument. It is expected that DFS data will have a medium to high impact for all marine weather and tropical cyclone analysis and warning applications, real time diagnostics and climatological wind applications for which wind data are necessary. Economic impact of QuikSCAT and XOVWM scatterometer measurements are estimated to produce between $173 and $306 millions in annual saving distributed between marine transportation, commercial fishing, offshore energy, recreational boating, and search and rescue [5]. DFS economic impact would be somewhere in between.

6. BIBLIOGRAPHY

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