High Wind Observations within Extratropical Cyclones as Observed by Different Microwave Radiometers and Scatterometers

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The validation of high wind speed measurements has proven to be extremely challenging due to the lack of surface truth, different sensor characteristics and their suitability for high wind observations, as well as different observation times. Because of this lack of surface truth, the forward models and geophysical model functions utilized in wind retrieval algorithms for different sensors are more often than not extrapolated and very hard to verify. Moreover, many high wind speed algorithms, especially from microwave radiometers, were developed with the goal of retrieving the extreme winds within tropical cyclones that would match aircraft-based high spatial resolution observations, even though the spatial resolution of the satellite observations is much coarser than that of both the aircraft-based measurements and measured physical phenomena. The implications have impact on both the operational use of high wind speed data as well as determining climatological trends and wind field characteristics.

Extratropical cyclones that reach hurricane force (HF) intensity are a significant threat to the safety of life at sea and a risk to cargo and vessels. Extratropical cyclones vary on scales from less than 100 km in diameter up to 4,000 km in diameter and have an average life cycle of five days from genesis to death. Associated wind conditions can range from light (10 to 20 knots), near gale (25 to 32 knots) gale force (33 to 47 knots), storm force (48 knots to 63 knots), or HF (greater than 63 knots). Knowledge of the wind structure, and in particular the frequency of occurrence and distribution of HF winds in extratropical cyclones has been greatly enhanced by data from the QuikSCAT scatterometer. Studies of the wind distribution within mature ETCs from the QuikSCAT scatterometer (cite our igarss paper) have shown there is more than a 20% probability of encountering gale force winds within 1000 km of the storm center at any time and direction for extratropical cyclones that reached the mature stage. The storm force winds can span beyond 1000 km from the storm center with the frequency decreasing significantly in the overall direction of motion. HF winds are concentrated within 1000 km radius west, south and southeast from the center relative to storm motion direction. Therefore, the spatial resolution of high winds within extratropical cyclones is suitable for all current radiometer and scatteroemter sensor observations. However, frequent observation of ETC’ s by the RapidScat and GPM sensors as well as the two ASCAT scatterometers have shown that high winds can change drastically over a 30 min time period. Therefore, any comparisons of wind retrievals by different sensors can be misleading and must be done carefully. To overcome this problem we compare composites of ETCs as obtained from wind observations from all radiometer and scatterometer different sensors.

To study the wind field distribution in these extreme ocean storm, composites of ocean surface wind speed fields were created by using a 50˚x 50˚ wide box that was divided into 400 lat/lon grid cells. This resulted in an approximate grid resolution of 12.5 km. The grid box was centered on the storm center locations obtained from Ocean Prediction Center best track storm file.

Keywords: extratropical cyclones, high winds, scatterometer, microwave radiometer

