A REVISED GEOPHYSICAL MODEL FUNCTION FOR THE ADVANCED SCATTEROMETER (ASCAT) AT NOAA/NESDIS

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1. INTRODUCTION

The Advanced Scatterometer (ASCAT) is a radar instrument, on board the MetOp-A satellite, designed specifically to retrieve ocean surface wind speed and direction. The ASCAT transmits 5.255 GHz (C-band) microwave energy, using vertically polarized fan-beam antennas, to the ocean surface and measures the returned radar backscatter signal from small-scale wind-driven sea surface roughness. ASCAT views the surface from three different azimuth angles at incidence angles from ~27°-63° across the 550-km measurement swaths on each side of the satellite sub-track. As the satellite travels forward the surface normalized radar cross section (σ^0) are measured from the fore-, mid- and aft-looks, respectively, resulting in a triplet of σ^0 measurements for each wind vector cell. Given knowledge of the ASCAT measurement geometry parameters and the relationship between the σ^0 and wind vector, wind speed and direction can be determined. The ASCAT wind vectors are currently used operationally in near-real-time at NOAA based on CMOD5.n model function [1]. These wind vectors have been validated against the Global Data Assimilation System (GDAS) global wind fields, QuikSCAT satellite scatterometer wind retrievals, and oceanic buoy wind measurements. The result shows ASCAT wind retrieval performance is within 2 m/s RMS error for wind speeds from 3-15 m/s under clear and rain conditions, and wind directional RMS errors below 20° wind speeds > ~10 m/s for all conditions. However, ASCAT wind speed retrievals are bias low compared to GDAS and QuikSCAT winds for wind speeds > ~15 m/s [2]

2. GEOPHYSICAL MODEL FUNCTION

Scatterometer wind retrievals are dependent on the Geophysical Model Function (GMF) that relates radar backscatter to ocean surface wind fields. The operational ASCAT GMF (CMOD5.n) is written in harmonic terms [1]

$$\sigma^0 = B_0(v,\theta)\cdot[1 + B_1(v,\theta)\cos\phi + B_2(v,\theta)\cos 2\phi]^{1.6} \qquad (1)$$

where B_1 and B_2 are assumed to be modeled correctly. However B_0 appear to be biased high at wind speed greater than ~10 m/s and therefore B0 need to be adjusted. According to the aircraft experiment (IWRAP) the high GMF B_0 was modeled as [3]

$$B_0(v,\theta) = 10 \cdot [\beta + \gamma_1 \log(v) + \gamma_2 (\log(v))^2] \qquad (2)$$

where wind speed ν are valid from 25-65 m/s and incidence angle are valid at 29°, 34°, 40° and 50°. We modified the B_0 in (1) for wind speed greater than 10 m/s to follow the trend of B_0 in (2) while keep B_0 under 10 m/s identical to the original. A revised geophysical model function lookup table is then modified by this new B_0 for high wind speed region.

3. RESULTS

The new ASCAT wind retrievals were generated using above GMF and subsequently validated. A statistical analysis in comparison with QuikSCAT shows that wind speed retrievals biases and RMS errors are improved for high wind speed while directional errors are nearly identical to operational ASCAT retrievals. A case analysis shows that new ASCAT retrievals increase number of hurricane-force winds detection and improve gale or higher force wind detection accuracy in general.

4. CONCLUSION

A revised ASCAT GMF was developed by modify the B_0 term for the high wind speed region. These new B_0's are matching IWRAP GMF high wind speed trend and correcting for the observed B_0 biases. The new ASCAT high wind speed retrievals compare better to QuikSCAT where the bias and RMS errors are improved. However, the ASCAT wind retrievals are still biased low but resultant biases are smaller.

5. REFERENCES

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