An Improved Oceanic Rainfall Retrieval Algorithm for the SeaWinds Scatterometer

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The SeaWinds radar scatterometer continues to operate on the QuikSCAT satellite that was launched in mid 1999 by NASA. SeaWinds is a Ku-band frequency radar that was originally designed to measure the speed and direction of the ocean surface wind vector by relating the normalized radar backscatter measurements to the near surface wind vector through a geophysical model function. In addition to the radar function, SeaWinds also simultaneously measures the polarized radiometric brightness temperature of the ocean and atmosphere, utilizing a ground signal processing algorithm known as the QuikSCAT Radiometer (QRad).

This paper describes the research performed under a PhD dissertation defended in December 2007 to develop an oceanic rainfall retrieval algorithm that combines both the simultaneous active (radar backscatter) and passive (microwave brightness temperatures) observations by the SeaWinds sensor. The retrieval algorithm is statistically based, and has been developed using collocated measurements from SeaWinds, the Tropical Rainfall Measuring Mission (TRMM) Microwave Imager (TMI) rain rates, and the National Center for Environmental Prediction (NCEP) wind fields. The rain is retrieved on a wind vector cell (WVC) measurement grid that has a spatial resolution of 25 km. Due to its broad swath coverage, SeaWinds affords additional independent sampling of the oceanic rainfall, which may contribute to the future NASA's Precipitation Measurement Mission (PMM) objectives of improving the global sampling of oceanic rain within 3-hour windows.

Examples of the passive-only, as well as the combined active/passive rain estimates from SeaWinds are presented. To evaluate the accuracy of the retrievals, comparisons are made with the standard TRMM 2A12 rain data product. Also, Monte Carlo simulations are performed to investigate the variability of SeaWinds rain rates. Results demonstrate that QRad rain measurements are in good agreement with the independent microwave rain observations obtained from TMI.

Also, since SeaWinds is the only sensor onboard QuikSCAT, the SeaWinds rain estimates can be used to improve the flagging of rain-contaminated oceanic wind vector retrievals by applying a threshold on the retrieved rain rates. In order to evaluate the performance of the SeaWinds flag, comparisons are made with the Impact based Multidimensional Histogram (IMUDH) rain flag developed by JPL. Results emphasize the powerful rain detection capabilities of the SeaWinds retrieval algorithm.