Detecting ocean surface wind using the TRMM Precipitation Radar

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Spaceborne scatterometery has been used for several years now to retrieve the ocean surface wind field based on measurements of the normalized radar cross section, denoted as σ°, at the Earth's surface level. Though designed specifically for the measurement of precipitation profiles in the atmosphere, the Precipitation Radar (PR) of the Tropical Rainfall Measuring Mission (TRMM) also acquires surface backscattering measurements over global ocean. As such, this instrument provides an interesting opportunity to explore the benefits and pitfalls of alternative radar configurations in satellite remote sensing of ocean winds. The small incidence angles of the PR beam and the single look capability of its cross-track scan geometry may act to limit its wind retrieval potential. Nonetheless, the small horizontal footprint and vertical range gate of the PR offer other advantages over the conventional scatterometer systems presently in use.

In this paper, we investigate the potential application of ocean surface backscattering observed by TRMM Precipitation Radar (PR) in estimating the ocean surface wind conditions. First, the TRMM PR normalized radar cross section (σ°) measurements are collocated with TRMM Microwave Imager (TMI) brightness temperature data, from which ocean surface winds are retrieved in rain-free regions. It is found that PR σ° data are in excellent agreements with Seasat scatterometer model function and TMI wind retrievals. Next, a field-wise ocean wind algorithm is derived for TRMM PR using maximum likelihood estimation. A unique feature of this wind algorithm is its capability to incorporate σ° sensitivity and noise information consistently in along- and cross-track directions. It also can estimate surface wind inside a storm without using the rain-contaminated σ° measurements. Finally, this PR wind algorithm is tested with TMI and QuikSCAT ocean surface wind data. Excellent agreements are achieved among wind fields retrieved from these three different sensors.

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