Title: Rain, Wind, and Backscatter: Modeling rain effects on Ku-band ocean wind scatterometers

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Abstract:

Spaceborne Ku-band ocean wind scatterometers (SeaWinds, NSCAT) enable frequent global coverage of meso-scale ocean surface winds. These instruments measure the normalized backscatter cross-section (sigma-0) of the ocean's surface from multiple look directions and use this information to estimate ocean surface wind vectors. Although sigma-0 is strongly related to surface winds, at Ku-band it is also impacted to varying degrees by rain. Arguably, the most important error source for Ku-band wind scatterometers is rain contamination. In order to calibrate out the effects of rain as much as possible, we must understand the impact of rain on the backscatter measurements which are used to retrieve wind vectors.

NCEP ?

This study uses co-located SSM/I rain rate measurements, NCEP wind fields, and SeaWinds on QuikSCAT backscatter measurements to empirically fit a theoretical model of the effect of rain on sigma-0 and to check the validity of that model. The model is based on three separate modes in which rain impacts backscatter: scattering from the rain column, modulation of the surface scattering due to rain impacting the ocean surface, and attenuation of the transmitted signal and returned surface scattering signal by the rain column.

The chief findings of the study are: (1) horizontal polarization measurements are more sensitive to rain than vertical polarization, (2) sensitivity to rain varies dramatically with wind speed, (3) the additional backscatter due to rain overshadows the rain-related attenuation for low to moderate wind speeds (< 15 m/s) whereas for higher wind speeds attenuation dominates, and (4) directional modulation in the surface scattering signal is usually preserved in the presence of rain. The latter is especially important, without directional modulation there would be no hope for retrieving wind vectors from rain-contaminated backscatter measurements.

Although the authors have approached this study as a means to remove rain contamination from remoted-sensed wind measurements, it is also relevant to the opposite problem. When they are pointed away from nadir, precipitation radars suffer from contamination due to surface scattering. A better understanding of surface scattering in the presence of rain and wind can lead to rain radars (over ocean) which are usable at higher incidence angles and thus have more frequent coverage.