Wind Retrieval From Shipborne Nautical X-Band Radar Data

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This study focuses on the retrieval of wind information from nautical X-band radar data collected on R/V Roger Revelle during the Impact of Typhoons on the Ocean in the Pacific (ITOP) program in 2010. Images collected with a standard nautical HH-polarized X-band radar operating at grazing incidence exhibit a single intensity peak in upwind direction and may show wind streaks that can be used to infer the wind direction. The wind speed can be expressed as a function of the observed average backscatter intensity. The radar images used here cover two storms that are characterized by several periods of heavy rain, which complicates a radar-based wind estimate as it modifies the backscatter properties. We performed a histogram analysis of radar images from within and outside these periods which pointed to a new quality control parameter that is used to flag images collected during rain. In contrast to previous studies, where data from stationary research platforms were used, this study focuses on ship-based data. Methods that determine the wind direction from wind streaks cannot be directly applied to data from moving vessels since the ship motion obliterates the wind streak signal, which becomes visible in averaged radar images only. The wind retrieval method we developed is based on a least-squares fit that is applied to the average backscatter dependencies on range and antenna look direction and works even if the radar field of view is partially shadowed. The method is validated using measurements from two ship-based anemometers. For the comparison between radar and reference wind speed, a correlation coefficient of 0.88 and standard deviation of 0.82 m/s is found. For the wind direction, a correlation coefficient of 0.98 and standard deviation of 16.9º is found.