Mapping Of Mesoscale And Submesoscale Wind Fields Using Synthetic Aperture Radar

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The long-term goal of the research to be discussed in this talk is to investigate the possibility of obtaining quantitative information about the near-surface wind field and perhaps other parameters that characterize the Marine Atmospheric Boundary Layer (MABL) from an analysis of Synthetic Aperture Radar (SAR) imagery. Because of its potential for yielding such information in the form of high-resolution imagery, this application of SAR, especially in coastal waters, represents a significant advance over most scatterometer and passive microwave sensors that yield only coarse-resolution estimates of the wind field.

Based on the results of our research effort over the past several years, we now believe that the possibility of generating high-resolution wind maps from (satellite) SAR has been demonstrated. In fact, our wind-map generation procedure has been automated so that high-resolution wind maps can be obtained from a SAR image within about 30 minutes after the raw image file is received at JHU/APL. Wind maps for the past several seasons may be accessed from our web site at: http://fermi.jhuapl.edu/sar/stormwatch/ click "RADARSAT Coverage".

All of our work on high-resolution SAR wind extraction to date has been concerned with satellite SAR imagery; in particular that obtained from the RADARSAT-1 SAR. The major portion of the presentation will therefore focus on this work. After discussing major issues including sensor calibration, scattering physics and scatterometer algorithms, and estimation of the wind direction, we will present sample wind maps and point out some advantages as well as potential problems in the use of SAR as a tool for measuring the ocean surface wind field. Next, we will show some of our recent work to determine, by comparisons with more conventional measurements (NDBC buoys and QuikScat scatterometer) as well as numerical weather prediction models (RAMS and MM-5), limits on the accuracy of the wind maps and sensitivity to various assumptions implicit in their generation.

Finally after the overview of our recent SAR wind mapping efforts, we hope to motivate discussion on utilizing the AirSAR platform for coastal wind mapping and general meteorological measurements. In particular, we believe that the capability of the AirSAR platform to collect multi-frequency multi-polarization SAR imagery from various look directions with respect to the local wind could be extremely useful for resolving the wind direction directly from the measurements. This capability coupled with its ability to measure surface currents using along-track interferometry make the AirSAR platform an ideal tool for characterizing the MABL in coastal regions.