Analysis of Remote Sensing Observations of Air-Sea Interaction

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Award Number: N00014-13-1-0389

LONG-TERM GOALS

The long term goal of this proposed project is to improve our understanding of the air-sea interaction as observed by synthetic aperture radar (SAR). From numerous studies in the past it has been shown that the atmosphere leaves an imprint on the ocean surface. We propose to analyze and examine different SAR data from L-band, C-band and X-band systems, to refine algorithms that extract information on interactions between the ocean and atmosphere for different meteorological conditions including cyclonic forcing.

OBJECTIVES

The specific scientific objectives of this study are:

1. To improve how accurately C-band wind algorithms can measure the wind vector field in tropical cyclones such as hurricanes and typhoons.
2. To improve how accurately C-band wave algorithms can measure the properties of directional wave field in tropical cyclones such as hurricanes and typhoons.

3. To examine how the wind and wave algorithms could be extended to perform for SAR data from L-band and X-band systems.
4. To examine meso-scale roll features leaving an imprint of the ocean surface in SAR images.
5. To examine the jet-like features inside the eyewall of tropical cyclones.
6. To examine the surface roughness in SAR data and how this affects the atmospheric boundary layer.

APPROACH

The meteorological community has long recognized the critical environmental importance of ocean vector winds. Satellite remote sensing offers a unique approach to acquire routinely winds over the ocean and in extreme weather conditions such as hurricanes and typhoons. The first spaceborne wind measurements were produced by the NASA's scatterometer on Seasat in 1978. Seasat also flew a synthetic aperture radar (SAR) that was used to view tropical and polar storm systems during its short life cycle. Many more satellite scatterometers were put in space to cover the earth with nearly continuous observations of ocean vector winds. The primary shortcoming of scatterometers is the lack of detailed spatial resolution necessary to resolve meso- and submesoscale weather systems such as hurricanes and typhoons.

The development of high-resolution SAR wind and wave retrieval algorithms has allowed the application of these data to a variety of operational and scientific problems. However, most of the existing approaches have been developed and extensively validated only under moderate to low sea state and wind conditions. The purpose of this proposed program is to improve and extend the capabilities to utilize a SAR-derived wind and wave data as input to typhoon and hurricane prediction models. Furthermore, filter and enhance SAR data to extract atmospheric roll and jet features the influence the air-sea exchanges of momentum and heat inside tropical weather systems.

WORK COMPLETED

We have validated and refined existing wind algorithms with data acquired during the ITOP experiment and also explored the use of cross-pol data. Similarly, a simple, but effective wave algorithm has been developed and tested with ITOP data.

RESULTS

We continue to evaluate our wind and wave algorithm and examine applications to different frequency bands, polarization and imaging modes covering a wide range of wind and wave conditions.

PUBLICATIONS

Romeiser, R., H.C. Graber, M.J. Caruso, R.E. Jensen, D.T. Walker, A.T. Cox, 2014: A New Approach to Ocean Wave Parameter Estimates From C-Band ScanSAR Images. *IEEE Trans. Geosci. Remote Sens.,* **53**(3), 1320 – 1345.

Horstmann, J., S. Falchetti, C. Wackerman, S. Maresca, M. Caruso and H.C. Graber, 2014: High Resolution Tropical Cyclone Winds Retrieved from Satellite Borne C-band Cross Polarized Synthetic Aperture Radar. Submitted to *IEEE Trans. Geosci. Remote Sens.*