Application of Coincident Sub-Footprint Scale Winds to Observe the Effect of Surface Vorticity on the RapidScat Scatterometer on Ku-Band NRCS and Retrieved Winds

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Abstract

This study examines very high resolution wind vectors measured in the Gulf of Mexico and their correlation with coincident Ku-Band NRCS measured by NASA's RapidScat scatterometer on its Jason-2 satellite. In the past, the Remote Sensing Systems (RSS) model-estimated ocean surface winds were compared with coincident NRCS observations (e.g., Westerling et al., 2016), but the study here is unique in that we compare coincident sub-footprint scale winds and NRCS measurements for the very first time. The objective of the project is to understand the sensitivity of wind field structures and their impact on NRCS. The comparison is done by processing the winds and NRCS data through a Grant to Hofstra University.

Introduction

Spatial derivatives of the wind fields are very important for atmospheric boundary-layer processes, upper ocean forcing, and deep ocean forcing. These quantities are inherent in the curl of the ocean vector (wind). There are many methods to calculate the (wind) curl from the SST, using different wind products. The vortex wind product is from a relatively new, high-resolution, hourly wind vector product that is based on an accumulation of multiple surface and space sensors. The approach is to study both the radar measurements and radial data from different points of view.

RapidScat and Data

The RapidScat scatterometer is a science mission contribution to the Jason-2 satellite, launched in 2008. RapidScat is an ocean scatterometer operating at Ku-band with 2° by 2° spatial resolution and 22.3 km swath width. The data are 86.4 km long in the north-south direction (along track). The collocated wind data are used from the RapidScat PO.DAAC NRCS products (Level 2A) and the Level 2B product that is based on an accumulation of multiple surface and space sensors. The RapidScat PO.DAAC NRCS product has been implemented and tested extensively in methods not yet tested for (Bourassa, 2015).

Objectives

The objectives of the current study are to observe and assess the effect of wind (small) scale changes in wind magnitude and direction on the measured NRCS through the RapidScat scatterometer. The study is focused on the Gulf of Mexico, an area near the so-called Storm Track at the western edge of the North Atlantic Ocean, where meteorological conditions are highly variable and are associated with areas of high sea surface wind and wave variability. The study is to examine the spatial and temporal coherence of wind and NRCS observations in the Gulf of Mexico through a Grant to Hofstra University.

The Spatial Scale of the Vorticity Calculation Matters

Our approach is to study both the RapidScat PO.DAAC NRCS product (Level 2A) and the Level 2B product that is based on an accumulation of multiple surface and space sensors. This image is within 25 minutes of RapidScat orbit 4881. The horizontal line at Latitude=28° demarcates a region to the north which is likely to be affected by rain. The RapidScat PO.DAAC NRCS product has been implemented and tested extensively in methods not yet tested for (Bourassa, 2015).

Summary

This was a unique opportunity for high-resolution, near-coincident sea surface winds covering a wide area to complement with the RapidScat Ku-band scatterometer. The ability of the sub-footprint wind product to estimate the vorticity and divergence of the ocean wind field is very important for understanding the impact on ocean dynamics and processes. This study was supported by the NASA Physical Oceanography Program through a grant to Hofstra University.

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