COINCIDENT OBSERVATIONS, WITH QUIKSCAT AND ASCAT, OF THE EFFECTS OF RAIN-INDUCED SEA SURFACE STRESS DURING HURRICANE IKE

David E. Weissman
Dept. of Engineering
Hofstra University
Hempstead, New York 11549
E-Mail: eggdew@hofstra.edu

Mark A. Bourassa
Center for Ocean-Atmospheric
Prediction Studies
Florida State University

The use of satellite scatterometers to probe the winds in and near strong storms and hurricanes is a valuable tool for weather forecasters. The presence of widespread rain in these storms makes the estimates of surface winds from the satellite data problematic. As hurricane IKE was impacting the Texas coastline near Houston, on September 13, 2008 both QuikSCAT (01:13Z) and ASCAT (03:28Z) observed with their respective NRCS measurements, within a two hour time interval. The NEXRAD rain reflectivity images (available every 6 minutes) show that there was wide rain coverage. The sustained surface wind estimates from NOAA/AOML/HRD show a maximum of 90 kts, and a wide inhomogeneity even within 50 km areas. The broad swath coverage of the NEXRAD radar enables us to select and compare NRCS effects in both rain and non-raining areas.

The unique aspect of this method is that it combines satellite based data with high-resolution 3-D volumetric rain measurements, from the near-simultaneous collocated NEXRAD data. The volumetric scans of this high resolution S-Band radar are used to model the 3-dimensional Ku-band reflectivity of the volume of precipitation that the scatterometer beam passes through as it samples the sea surface. The removal of these effects leaves the total contribution of the sea surface; both the wind driven and rain-impact roughness terms. In addition, at winds of cyclone intensity, the surface geometry may be affected by both rain-induced stress resulting from wind-driven raindrops impacting the surface obliquely and sea spray [3].

Measurements of the NRCS in both non-raining and rain-filled areas within Hurricane Ike will be presented, analyzed and interpreted. The method of collocating the Qscat, ASCAT and NEXRAD observations, and computing the effect of atmospheric precipitation is described in [1]. The specific data collection studied here was observed using both the Houston and Corpus Christi NEXRAD radar stations (KHGX and KCRP) coincident with both overpass. The analysis to be presented will show how both radar frequency signals are affected by rain-impacted surfaces [2]. The size of the area that we survey gives us the ability to examine a range of rain and wind magnitudes.

[1] D.E. Weissman and M.A. Bourassa, “Measurements of the effect of rain-induced sea surface roughness on the QuikSCAT scatterometer radar cross section”, IEEE Trans. Geosci. Remote Sens., Vol. 46, No. 10, October, 2008, pp 2882-2894

[2] B.L. Le Mehaute and T. Khangaonkar, “Dynamic Interaction of Intense Rain with Water Waves”, J. Phys. Oceanogr., Vol. 20, No. 12, Dec. 1990, pp 1805-1812

[3] E.L. Andreas, “Spray Stress Revisited’, J. Phys. Oceanogr., Vol. 34, No. 6, June 2004, pp 1429-1440