Airborne Measurement of Sea Surface Mean Square Slope in 2008 Hurricane Ike Using GNSS Reflections and Wide-Swath Radar Altimeter

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The mean square slope (MSS) of wind-driven waves in hurricanes is an important quantity for understanding the physical processes at the air–sea interface and for verifying new advanced models of the hurricane development. However, in situ MSS measurements in hurricanes do not exist, and the MSS data obtained with remote sensing techniques are very rare and difficult to obtain. Recently the bistatic scatterometric technique has been increasingly employed for measurements of ocean winds and waves using GNSS scattered signals. The model which describes such scattering from the rough ocean surface indicates that the power waveform of the scattered signal depends on the MSS of large-scale "smoothed" surface slopes which is lacking very small-scale components of the surface spectrum (of the order of several tens of centimeters). This is a consequence of using 0.2 m-long L-band radio waves emitted by the GNSS.

In this presentation we present a technique for estimating the mean square slope of surface waves during 2008 Hurricane Ike in the Gulf of Mexico using both GNSS reflections and independent Wide-Swath Radar Altimeter (WSRA) measurements. A GPS reflection data logger and WSRA instrument were both carried on the same aircraft during a flight through the eye of Hurricane Ike. First, we describe the method used to process and calibrate the retrieved waveforms processed from the raw data collected from the on-board GPS reflection data logger. Second, the ocean surface waves mean square slope along the GNSS measurement tracks is estimated using a least squares model fitting technique. Subsequently, MSS estimates from a higher frequency WSRA instrument which senses slopes of correspondingly shorter surface waves is used to perform a correction to the GPS estimated L-band limited MSS values. Additionally, the MSS estimates over the measurement track are converted into an MSS vs surface wind function using Hwind maps. This independently derived MSS to wind speed function is then compared to theoretical models and empirically derived hurricane MSS/wind models.