The Hurricane Imaging Radiometer (HIRAD) is an experimental, airborne, microwave remote sensor that was developed to measure hurricane wind speed and rain rate and thereby provide data for scientific research and for next generation operational hurricane surveillance. The object of this dissertation is to perform a quantitative evaluation of the 4-frequency HIRAD brightness temperature images of ocean scenes to determine the accuracy of: the measured brightness temperatures, the image spatial resolution and the geolocation of its pixels. The emphasis of this research concerns the development of robust evaluation methods, which are presented.

First, the approach used to determine the accuracy of the observed radiometric brightness temperature (Tb) images is described. Examples are presented for several ocean scenes, which covers a wide range of ocean wind speed conditions that includes Hurricanes. For these cases, surface truth in the form of independent ocean brightness temperature measurements are obtained by satellite or airborne microwave radiometers for comparison. Also, HIRAD Tb images were compared to theoretical Tb’s from a Radiative Transfer Model (RTM).

Next, an approach, that was developed for geolocation (latitude and Longitude) accuracy determination of HIRAD image pixels, is presented. Using statistical estimation theory, high-contrast HIRAD imagery are compared with high resolution maps at land/water boundaries, and an error model and measurement results are presented for a variety of pixel locations. Also, a procedure is presented for estimating the HIRAD feature resolution, i.e., the effective spatial resolution (instantaneous field of view, IFOV) in the HIRAD Tb images. Finally, an image spectral analysis is described and results are presented to characterize HIRAD’s systematic and random image artifacts.

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The public is welcome to attend.