This dissertation presents results for an end-to-end computer simulation of a new airborne microwave remote sensor, the Hurricane Imaging Radiometer, HIRAD, which will provide improved hurricane surveillance. The emphasis of this research is the retrieval of hurricane-force wind speeds in the presence of intense rain and over long atmospheric slant path lengths that are encountered across its wide swath. Brightness temperature (Tb) simulations are performed using a forward microwave radiative transfer model (RTM) that includes an ocean surface emissivity model at high wind speeds developed especially for HIRAD high incidence angle measurements and a rain model for the hurricane environment. Also included are realistic sources of errors (e.g., instrument NEDT, antenna pattern convolution of scene Tb, etc.), which are expected in airborne hurricane observations. Case studies are performed using 3D environmental parameters produced by numerical hurricane models for actual hurricanes. These provide realistic “nature runs” of rain, water vapor, clouds and surface winds from which simulated HIRAD Tb’s are derived for various flight tracks from a high altitude aircraft. Using these simulated HIRAD measurements, Monte Carlo retrievals of wind speed and rain rate are performed using available databases of sea surface temperatures and climatological hurricane atmospheric parameters (excluding rain) as a priori information. Examples of retrieved hurricane wind speed and rain rate images are presented, and comparisons of the retrieved parameters with the numerical model data are made. Statistical results are presented over a broad range of wind and rain conditions and as a function of path length over the full swath.

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The public is welcome to attend.