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THE HURRICANE IMAGING RADIOMETER (HIRAD): INSTRUMENT STATUS AND PERFORMANCE PREDICTIONS

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Abstract

The Hurricane Imaging Radiometer (HIRAD) is an innovative radiometer which offers new and unique remotely sensed observations of both extreme oceanic wind events and strong precipitation. It is based on the airborne Stepped Frequency Microwave Radiometer (SFMR) [Uhlhorn and Black, 2004]. The HIRAD instrument advances beyond the current nadir viewing SFMR to an equivalent wide-swath SFMR imager using passive microwave synthetic thinned aperture radiometer (STAR) technology [Ruf et al., 1988]. This sensor operates over 4-7 GHz, where the required tropical cyclone remote sensing physics has been validated by both SFMR and WindSat radiometer [Bettenhausen et al., 2006; Brown et al., 2006]. HIRAD incorporates a new and unique array antenna design along with several technologies successfully demonstrated by the Lightweight Rain Radiometer instrument [Ruf et al., 2002; Ruf and Principe, 2003]. HIRAD will be a compact, lightweight, low-power instrument with no moving parts that will produce wide-swath imagery of ocean winds and rain in hurricane conditions.

Accurate observations of surface ocean vector winds (OVW) with high spatial and temporal resolution are required for understanding and predicting tropical cyclones. The Hurricane Imaging Radiometer (HIRAD) is an innovative architecture which offers new and unique remotely sensed observations of both extreme oceanic wind events and strong precipitation. It is based on the airborne Stepped Frequency Microwave Radiometer (SFMR), which is a proven remote sensing technique for observing tropical cyclone (TC) ocean surface wind speeds and rain rates. The proposed HIRAD instrument advances beyond the current nadir viewing SFMR to an equivalent wide-swath SFMR imager using passive microwave synthetic thinned aperture radiometer (STAR) technology combined with a a unique array antenna design. The overarching design concept of HIRAD is to combine the multi-frequency C-band observing strategy of the SFMR with STAR technology to produce a wide-swath imager. Single frequency STAR technology

has been successfully demonstrated by the X-band Lightweight Rain Radiometer (LRR). The successful hybrid of LRR and SFMR will be a lightweight, low-power, planar array instrument with cross-track field of view of +/- 61° achieved with no moving parts by software beamsteering.

The HIRAD instrument completed its first laboratory integration and testing of all critical subsystems in summer 2008. The complete airborne version is currently in development, with complete system integration expected in spring 2009 . In parallel with HIRAD instrument development, extensive raditibve transfer forward modeling and OVW and precip retrieval simulations are underway. The focus of this work has been on characterization of the effects on current SFMR performance of extending the operation out to significant non-nadir angles of incidence.

The current status of HIRAD instrument development as well as a summary of its expected OVW and precip retrieval performance will be presented.

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