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A Proxy Calibration Monitoring Technique for the NCAR Airborne W-band Radar

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The National Center for Atmospheric Research (NCAR) has recently tested and deployed its new 94 GHz HIAPER Cloud Radar (HCR). HCR is a scanning W-band system, mounted in an under-wing pod on the National Science Foundation/NCAR High-Performance Instrumented Airborne Platform for Environmental Research (HIAPER, a Gulfstream-V). In order to ensure operational accuracy of this radar, the technique of Li, et al. (2005) has been reformulated to provide a simple means of estimating reflectivity bias using routine measurements of the ocean surface scattering. The methodology and formulation for reflectivity bias determination will be described, along with bias determination results from the 2015 Cloud Systems Evolution in the Trades (CSET) experiment.

The HCR radar system is subjected to extreme changes in its operational environment that can cause changes in component response that affect radar calibration. While engineering efforts have focused on temperature and pressure stabilization of the wing pod, along with internal vessel and component temperature monitoring, it is recognized that some form of independent and ongoing verification of calibration stability is desired. When available, ocean surface scanning, with an assumed knowledge of ocean surface backscatter cross-section, can provide a useful proxy for this calibration. Therefore, during the CSET experiment, special care was taken to collect ocean scanning data during short episodes of stable flight with no clouds present; scans were coordinated with atmospheric profiling through release of dropsondes, and atmospheric attenuation calculated with the use of those data. Downward looking lidar data are also used to verify cloud and haze conditions during sampling.

For HCR in CSET, eighteen usable ocean-scanning cases were found. Several of these were discarded due to cloud/haze issues that prevented accurate determination of atmospheric attenuation. Initial results show that a large (but fairly constant) bias exists in HCR reflectivity calibration, but that the system is stable to within 1 dB over the course of all flights.

This work will present a simplified re-formulation of reflectivity bias determination using the ocean surface as a calibration target, outline a suggested best methodology for the ocean surface scanning technique, review the process for determination of atmospheric attenuation, and provide details on the calibration of HCR.