Hurricane Imaging Radiometer (HIRAD) Wind Speed Retrieval Assessment With Dropsondes

Daniel J. Cecil[1] and Sayak K. Biswas[2]

Daniel.J.Cecil@nasa.gov

[1]NASA Marshall Space Flight Center; [2]Universities Space Research Association

Surface wind speed retrievals have been generated and evaluated using Hurricane Imaging Radiometer (HIRAD) measurements from flights over Hurricane Joaquin, Hurricane Patricia, Hurricane Marty, and the remnants of Tropical Storm Erika, all in 2015. Retrievals of surface wind speed and rain rate cover a ~50 km wide swath for each flight leg. An iterative retrieval approach has been developed to take advantage of HIRAD's measurement characteristics. Validation of the wind speed retrievals has been conducted, using 636 dropsondes released from the same WB-57 high altitude aircraft carrying HIRAD during the Tropical Cyclone Intensity (TCI) experiment.

The wide swath mapping by HIRAD depicts realistic spatial patterns for the structure of the hurricanes observed, particularly asymmetries in the surface wind field. For the small inner core of Hurricane Patricia near peak intensity, a single aircraft pass across the center allows mapping the entire eyewall region. For larger storms such as Hurricane Joaquin or Patricia earlier in its lifecycle, swaths from two perpendicular legs are sufficient for capturing much of the storm structure.

The HIRAD wind speed retrievals exhibit very small bias relative to the dropsondes, for winds tropical storm strength (17.5 m s^{-1}) or greater. HIRAD has reduced sensitivity to winds weaker than tropical storm strength, and a small positive bias (~2 m s^{-1}) there. Two flights with predominantly weak winds according to the dropsondes have abnormally large errors from HIRAD, and large positive biases. From the other flights, root mean square errors are 4.1 m s^{-1} (33%) for winds below tropical storm strength, 5.6 m s^{-1} (25%) for tropical storm strength winds, and 6.3 m s^{-1} (16%) for hurricane strength winds. Mean absolute errors for those categories are 3.2 m s^{-1} (25%), 4.3 m s^{-1} (19%), and 4.8 m s^{-1} (12%), with bias near zero for tropical storm and hurricane strength winds.