Hurricane Imaging Radiometer (HIRAD) operations and results from GRIP

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HIRAD Capabilities

- Passive C-band microwave radiometer (4, 5, 6, 6.6 GHz) to measure wind speed and rain rate over ocean surface
- HIRAD flew on the WB-57 during GRIP and will fly on the Global Hawk as part of HS3
- HIRAD’s unique contribution: Measurement of rain rate and hurricane-strength winds, even through heavy rain
  - Wind speed ~ 5 – 85 m/s
  - Rain rate ~ 0 – 100 mm/hr
  - Swath width ~3x altitude
- Operations: NHC desires better definition of max wind speed and location
- Science Hypothesis: Short-term forecasts of intensity and structure will be improved by assimilation of HIRAD data
HIRAD on the NASA WB-57
Hurricane Earl Best Track
Earl’s actual track was west of forecasts

This resulted in Earl being accessible from Tampa, although planning was a challenge!
Hurricane Earl Max Wind Speed

Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Earl.
HIRAD TB Images at 4.0, 5.0 and 6.6 GHz along Northbound Earl Overpass

4.0 GHz 5.0 GHz 6.6 GHz
WB-57/HIRAD flight over Earl (1 Sept 2010)

Storm-centric coordinate system

SFMR is the operational NOAA instrument. Tb is expected to agree only at the nadir point.
HIRAD/SFMR West Leg Overpass

“Model” data are Tb’s computed from SFMR wind & rain fields
Karl Best Track

Storm location during HIRAD flights indicated by triangles
Hurricane Karl Max Wind Speeds

Wind Speed (kt)

Date (Month/Day)

14 - 18 September 2010

HIRAD flight

HIRAD flights
HIRAD flights over Karl

**Sept 14**
Storm center indicated at 00 Z

**Sept 16**
HIRAD 19:00 – 21:55

**Sept 17**
1745-2015 UTC
Storm center indicated 18 Z
HIRAD flights over Karl

Sept 14
Karl 14 Sept WB-57 track 231 251 - 020811

Sept 16
Adjusted for storm motion

Sept 17
1745-2015 UTC
HIRAD 5 GHz Tb on Flight Tracks for Karl

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HIRAD flight over Karl on 16 Sept

- Excess Tb removes the incidence angle variation
HIRAD and SFMR (analysis) Wind Speed & Rain Rate Comparisons

Bad retrievals, to be corrected after final Tb calibration
Karl Leg 6: WS & RR Time Series (HIRAD & SFMR)

Rain Rate, mm/hr

Wind Speed, m/s

SFMR
HIRAD

SFMR
HIRAD

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Summary

• The WB-57, with HIRAD aboard, flew once over Earl and 3 times over Karl during GRIP

• The Earl flight and the 16 Sept Karl flight look to be the most likely to provide important contributions to the GRIP mission dataset
  – These two flights have priority in data processing and analysis
  – High-res wind speed and rain rate images provide snapshot of the complete inner core in a single aircraft pass (Leg 10 of Karl, 16 Sept)

• Continuing to develop data processing methodology to establish and maintain calibration in all channels and sub-bands
  – See poster by Ruf et al.

• Meanwhile, we have developed a methodology for calibrating HIRAD Tb’s against SFMR, and we are producing wind speed and rain rate retrievals that show consistency with SFMR, but with value-added details
  – See poster by Jones et al.

• Targeting release of Tb and wind/rain data for Earl and 16 Sept Karl on Aug 1