Validation Of Rain Rate Retrievals For The Airborne Hurricane Imaging Radiometer (HIRAD)

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Abstract

NASA's Global Hawk aircraft (AV1) has two microwave sensors: the passive Hurricane Imaging Radiometer (HIRAD), and the active High-altitude Imaging Wind and Rain Airborne Profiler (HIWRAP). Results are presented for a rain measurement validation opportunity that occurred in 2013, when the AV1 flew over a tropical squall-line that was simultaneously observed by the Tampa NEXRAD radar. During this experiment, Global Hawk made 3 passes over the rapidly propagating thunderstorm, while the TAMPA NEXRAD performed volume scans every 5-min. In this poster, the three-way inter-comparison of HIRAD Tb, HIWRAP dbZ and NEXRAD rain rate imagery are presented. Also, observed HIRAD Tbs are compared with theoretical radiative transfer model results using HIWRAP Rain Rates.

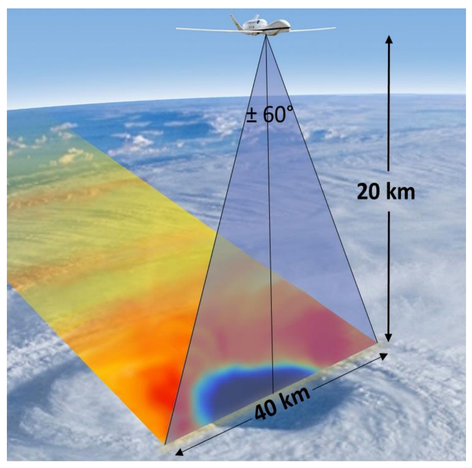
INTRODUCTION

- HIRAD is a collaborative effort of NASA MSFC, CFRSL, and Univ. of Michigan
- HIRAD & HIWRAP flew on an unmanned Global Hawk UAV, in NASA's Hurricane and Severe Storms Sentinel (HS3) flight program
- Sept 2013 AV1 flew over a tropical squall-line of thunderstorms in the Gulf of Mexico, near Tampa Bay
  - These rain events were simultaneously observed by NOAA's National Weather Service NEXRAD

INSTRUMENTS OVERVIEW

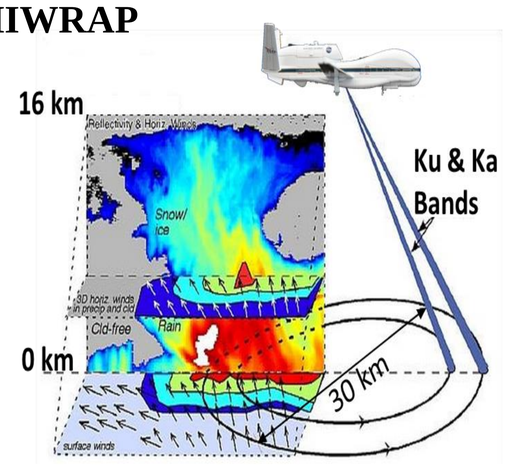
HIRAD

- 4-freq C-band Radiometer
  - 4, 5, 6 & 6.6 GHz
- Provides mapping of hurricane surface wind field and rain structure
- IFOV ~2km @ Nadir & 5km @ edge of swath
- 1-D Synthetic Thinned Aperture Radiometer with 40 km swath



HIWRAP

- Dual freq (Ka- & Ku-band), dual-beam, conical scan Doppler Radar
- Measures line-of-sight & surface winds from volume backscattering of clouds & rain



CONCLUSIONS

- Results demonstrate an excellent correlation in the 3-way comparison of spatial patterns:
  - NEXRAD rain rate, HIRAD Tb @ 5 GHz and HIWRAP dBz
- HIWRAP Z-R relationship tuned to NEXRAD rain rates
- HIRAD observed Tb calibration tuned to radiative transfer model (RTM) calculations
  - HIRAD Tb forward RTM uses the 3D rain patterns inferred by HIWRAP

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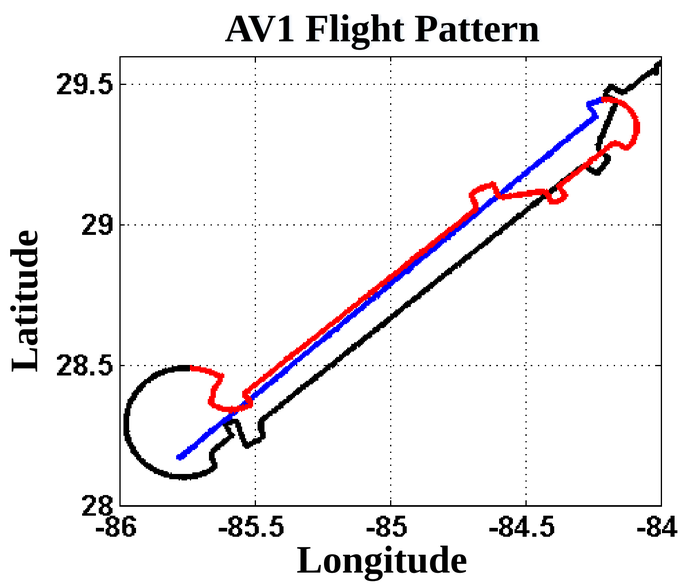
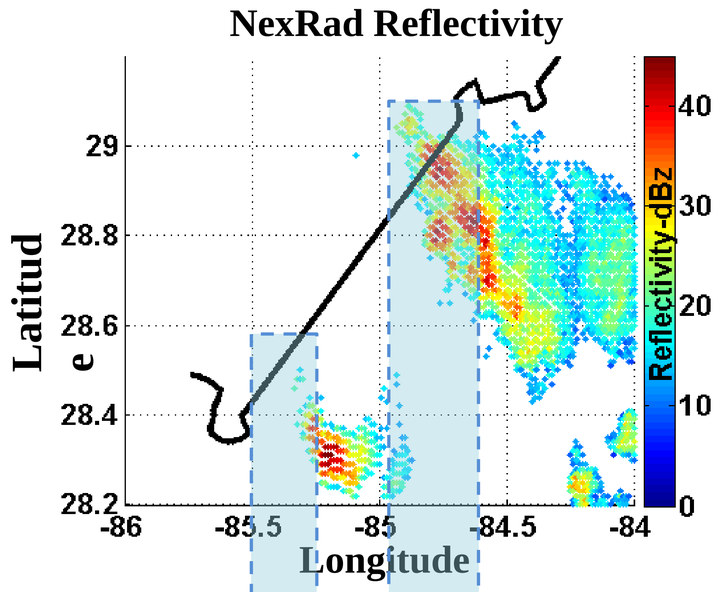
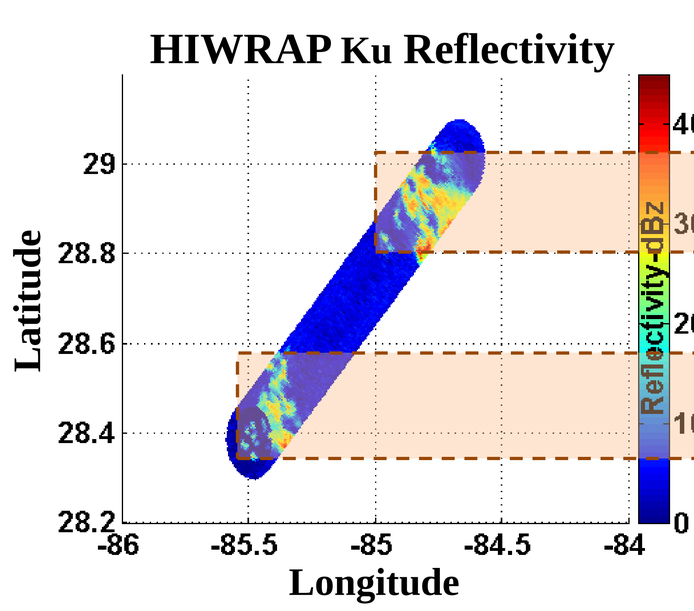
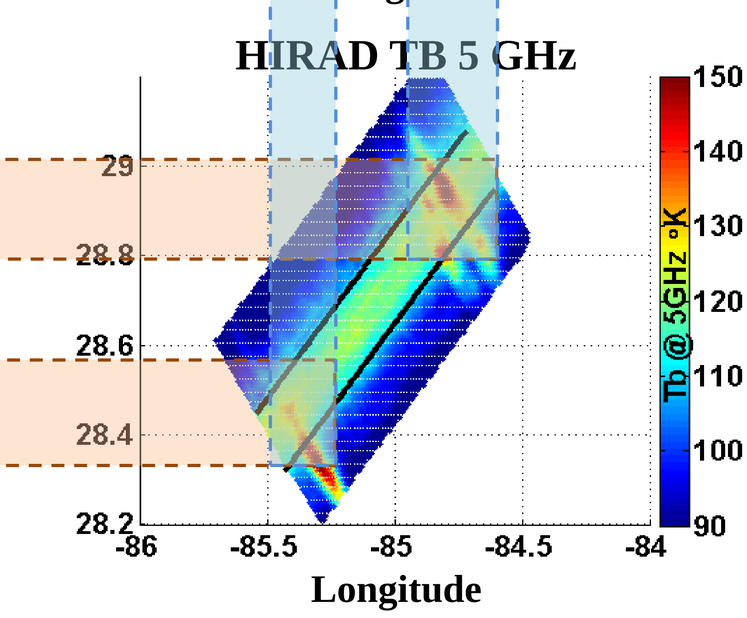
TAMPA BAY RAIN MEASUREMENTS

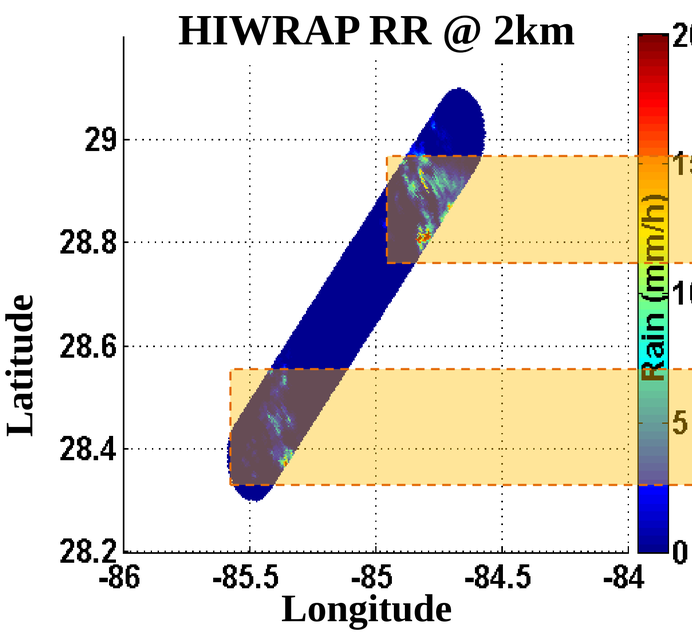


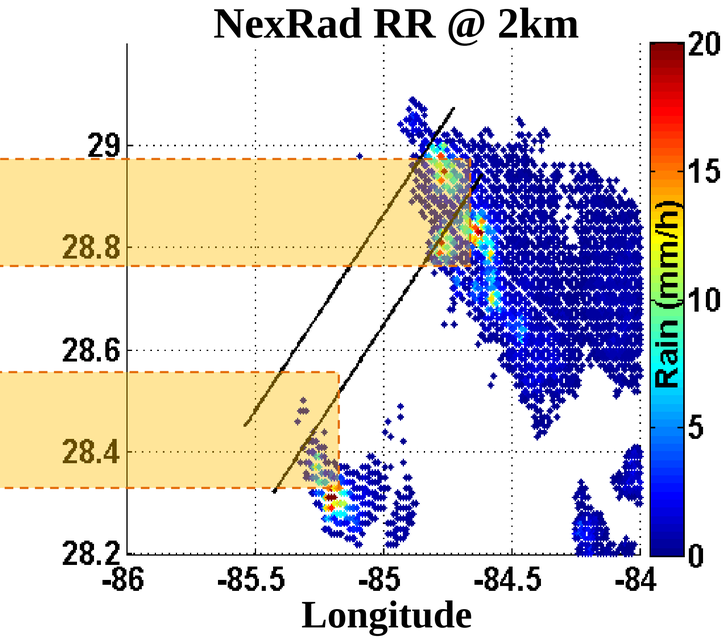






RAIN RATE CALCULATIONS





HIRAD OBSERVED & MODELED COMPARISONS

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