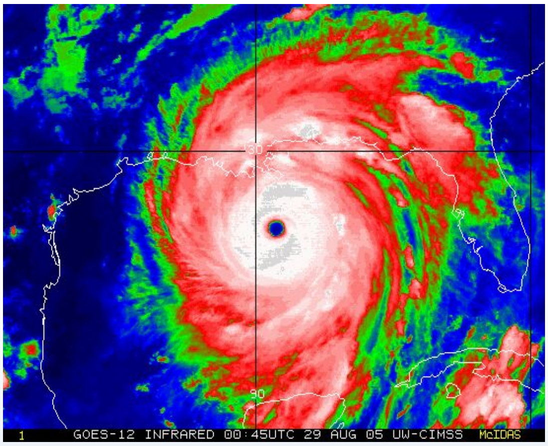
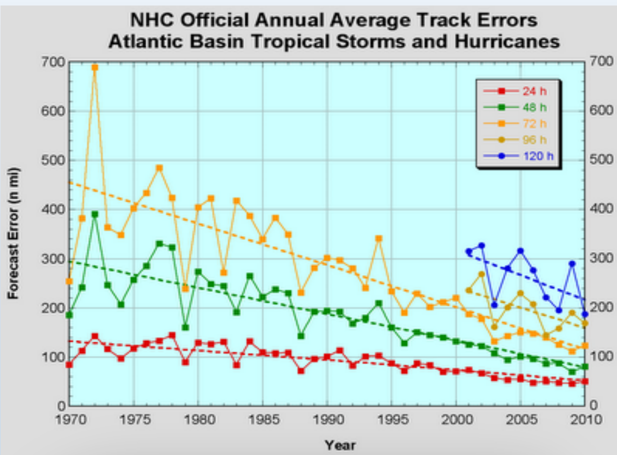
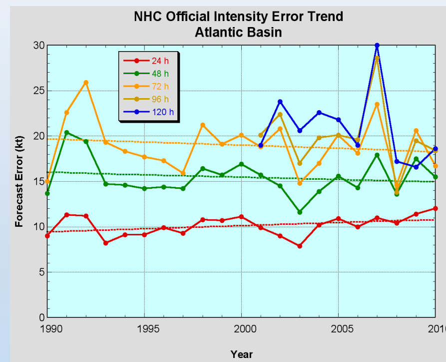
The Hurricane Problem



- ~100 million Americans live within 50 miles of the coast
- Hurricanes cause an average of $10 billion worth of damage per year

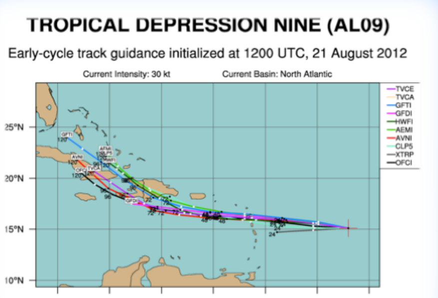


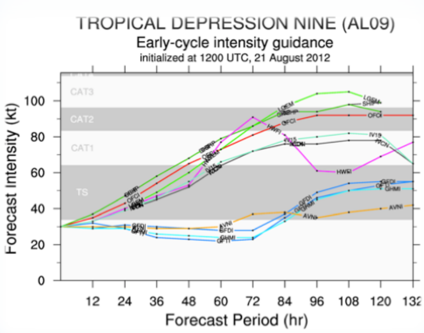
Hurricane track forecasts have improved significantly over the past several decades



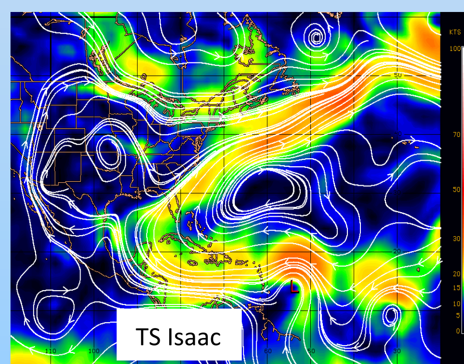
Hurricane intensity forecasts have not improved much over the same period

Tropical Storm Isaac



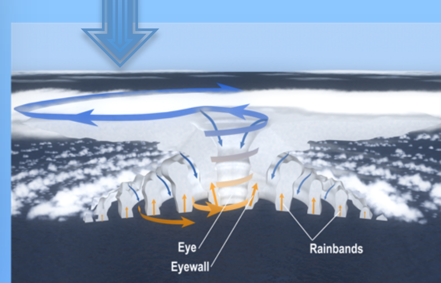


Forecasts (above) for Tropical Storm Isaac on Aug. 21, 2012, exemplify the problem of intensity forecasting



Hurricane track depends primarily on the large-scale environmental winds

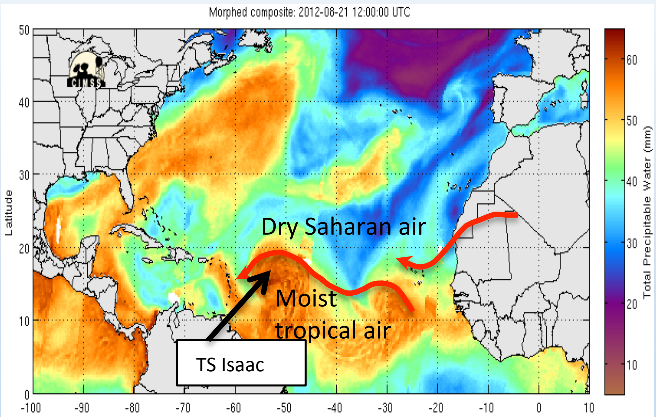
Hurricane intensity depends on the wide range of scales from large to very small



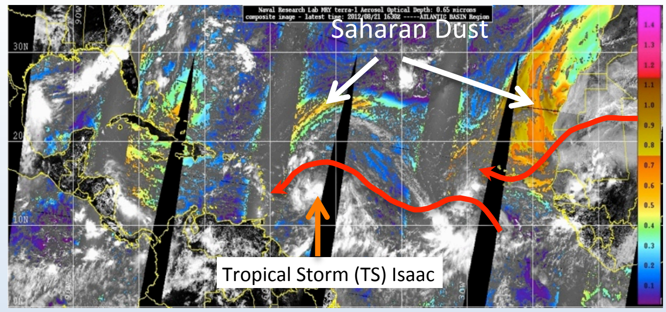
The chaotic behavior of smaller scales makes hurricane intensity change difficult to observe, understand and predict

The Role of the Environment

The Hurricane and Severe Storm Sentinel Mission (HS3) will characterize the role of the environment in storm formation and intensity change with emphasis on the role of the Saharan Air Layer (SAL)

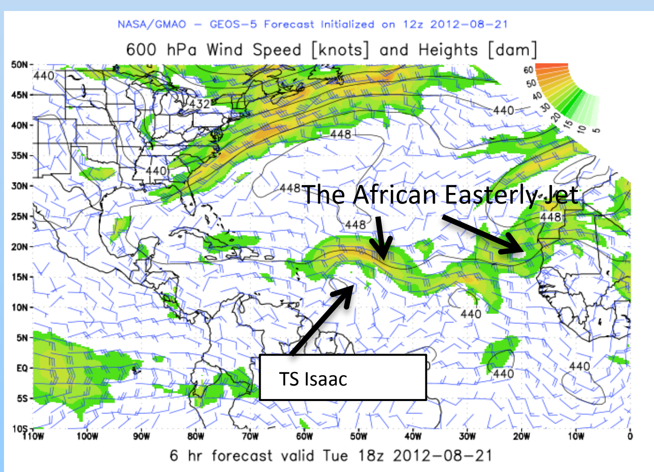


Vertically Integrated Water Vapor



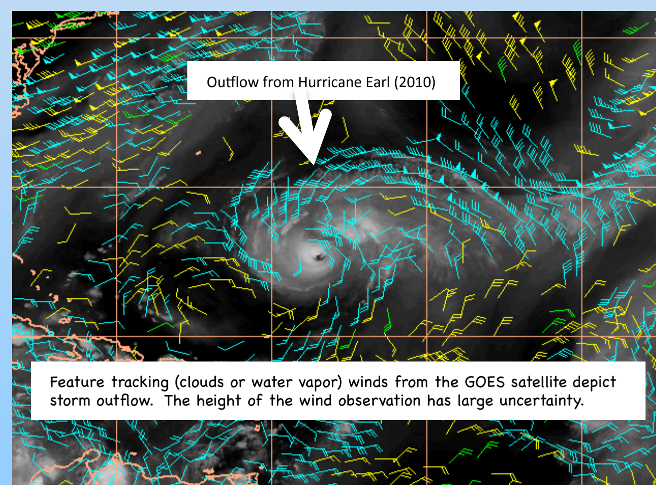
Dust from NASA's MODIS instruments on Aqua and Terra

The hot, dry, dusty SAL air mass has been argued to both favor and suppress tropical cyclone development



Wind speeds and wind barbs from the NASA's GEOS-5 Model

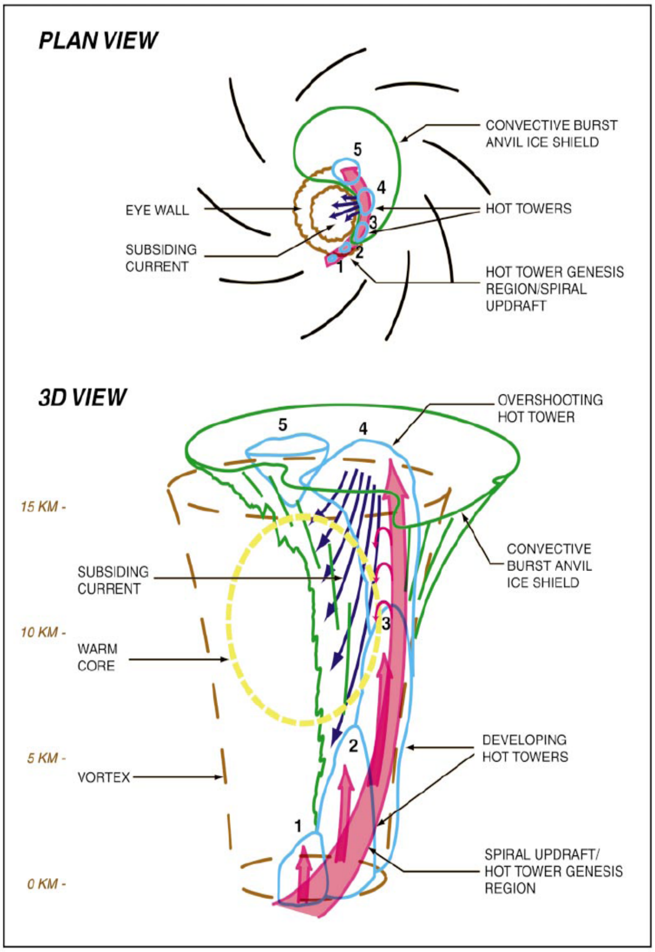
HS3 will determine the importance and role of the SAL



Previous research suggests that hurricanes strongly interact with their environment at upper levels, but few direct measurements have ever been obtained at these heights

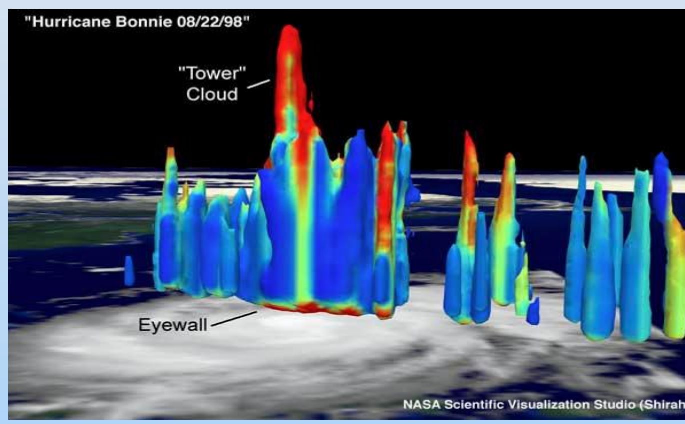
HS3 will characterize storm outflow, environmental wind systems, and their interaction through the depth of the troposphere and in the lower stratosphere

The Role of Inner-Core Processes

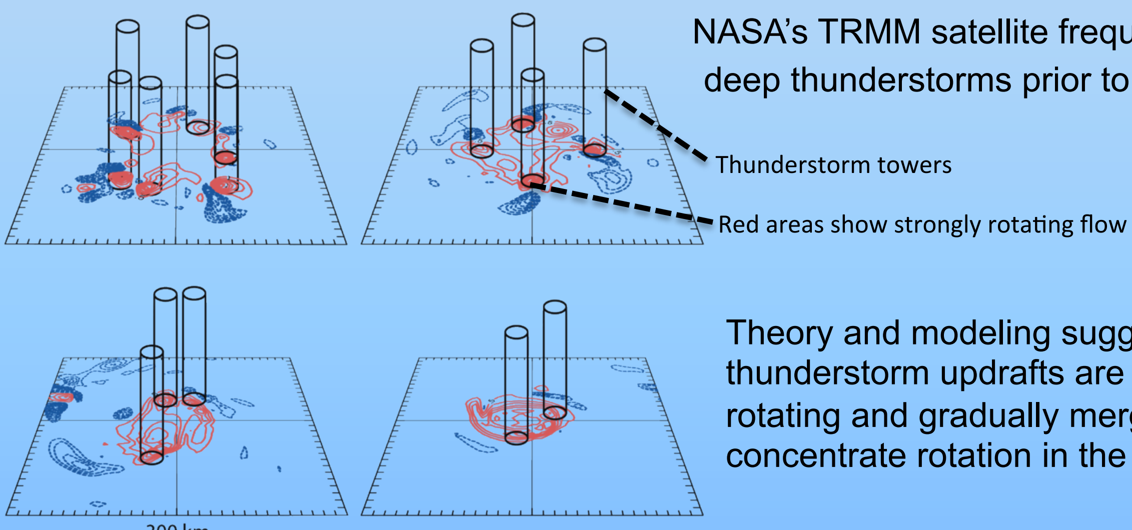


HS3 will characterize the role of deep thunderstorms in the inner-core region in storm formation and intensity change

Previous observations suggest that deep thunderstorm bursts force sinking of air over the storm center, contributing to surface pressure falls



NASA's TRMM satellite frequently observes deep thunderstorms prior to intensification

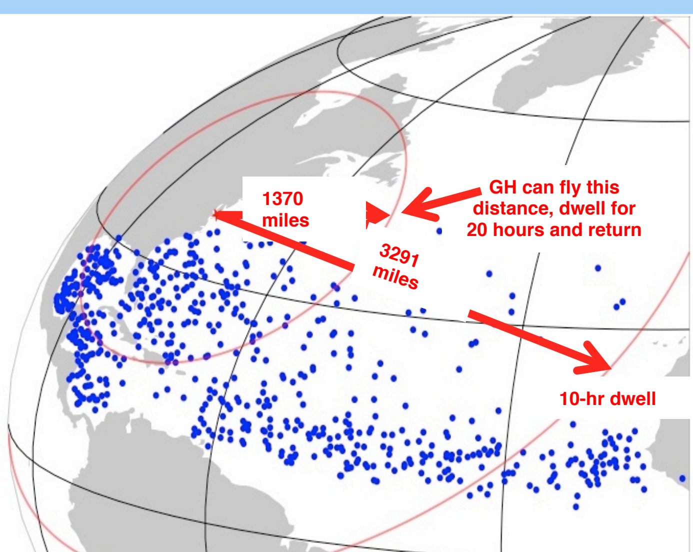


Theory and modeling suggest that thunderstorm updrafts are strongly rotating and gradually merge to concentrate rotation in the storm

HS3 will characterize the response of the low-level wind field and storm intensity to deep thunderstorms in the inner-core region of tropical cyclones

The Hurricane and Severe Storm Sentinel (HS3) Mission

NASA Earth Venture Class Mission (2010-2015)
Aircraft: Two Global Hawk Unmanned Aircraft System (AV-1, AV-6)
Payloads: AV-1 (overstorm payload), AV-6 (environmental payload)
Deployment Site: NASA Goddard's Wallops Flight Facility
Deployment Dates: September 2012, 2013, 2014
Principal Investigator: Dr. Scott Braun
Project Manager: Ms. Marilyn Vasques



Hurricane genesis locations


Global Hawk Mobile Operations Facility, Payload Mobile Operations Facility, and Ku Satellite Communications Dish

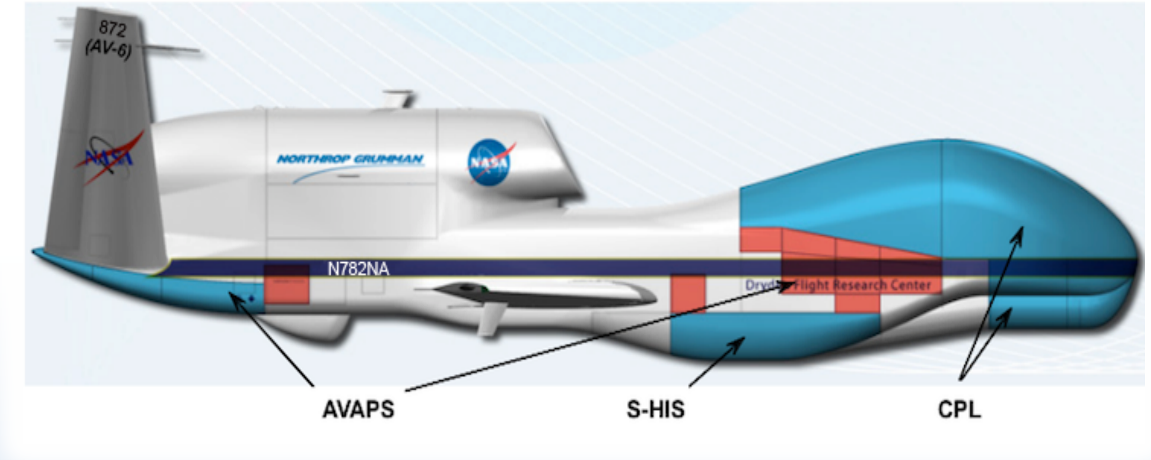
NASA Hurricane And Severe Storm Sentinel HS3

NASA Global Hawk Unmanned Aircraft Systems

Endurance	> 30 hours
Range	>10,000 nmi
Service Ceiling	65,000 ft
Airspeed (55K+ ft)	335 KTAS
Payload	1,000-1,500 lb
Take-off Weight	26,750 lb
Length	44 ft
Wingspan	116 ft

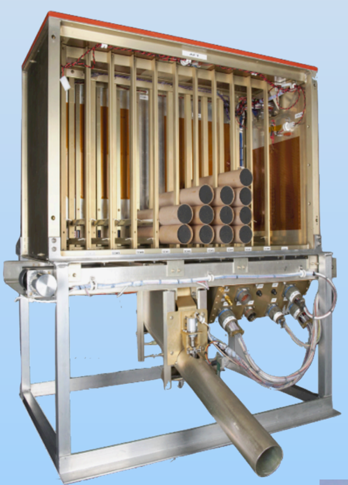
- NASA operates two Global Hawk (GH) Unmanned Aircraft Systems (UAS) under the NASA Airborne Science Program
- GH program supported by the National Oceanic and Atmospheric Administration (NOAA) and a partnership with the Northrop Grumman Corporation
- GH Program is operated from NASA Dryden Flight Research Center
- Program Manager: Mr. Chris Naftel

- The GH is a fully autonomous aircraft
- The GH communicates with the ground via both satellite and direct line-of-sight links
- The GH flight mission is monitored and controlled using a ground station that is staffed by pilots and a mission director
- The GH instruments are remotely operated by scientists and a payload manager

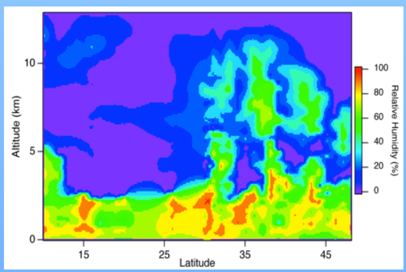


AV-6 Environmental Payload

Airborne Vertical Atmospheric Profiling System (AVAPS)

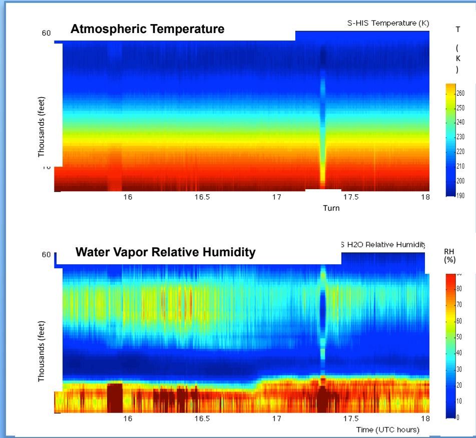


PI: Dr. Gary Wick
NOAA, NCAR
Measurements: Temperature, Pressure, wind, humidity vertical profiles; 89 Dropsondes per flight

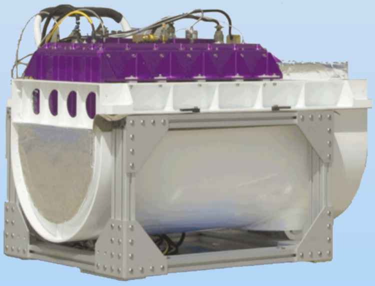


Scanning High Resolution Infrared Sounder (S-HIS)

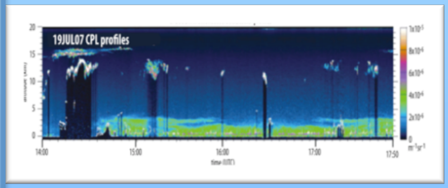
PI: Dr. Hank Revercomb
University of Wisconsin
Measurements: Upwelling thermal radiation at high spectral resolution between 3.3 and 18 microns.
Temperature, water vapor vertical profiles



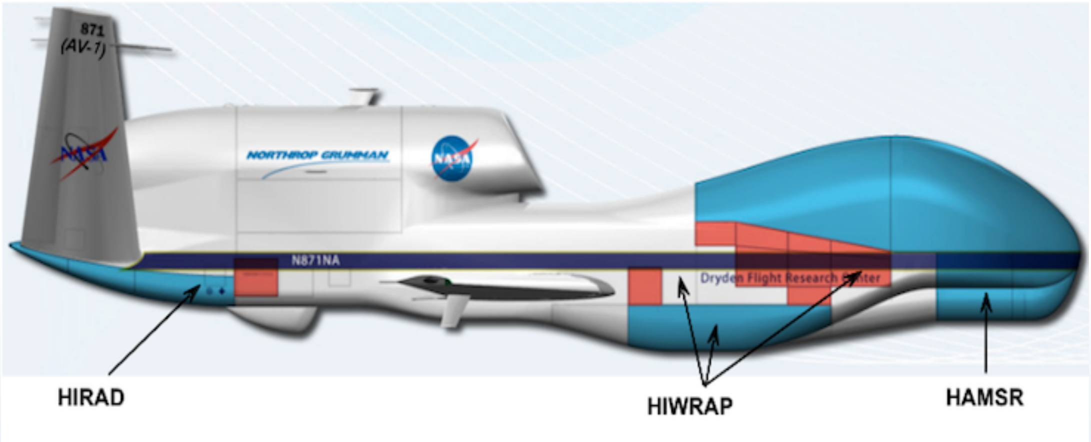
Cloud Physics Lidar (CPL)



PI: Dr. Matt McGill
NASA Goddard Space Flight Center
Measurements: Cloud structure and depth

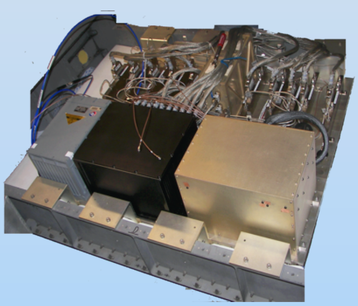


NASA Hurricane and Severe Storm Sentinel HS3

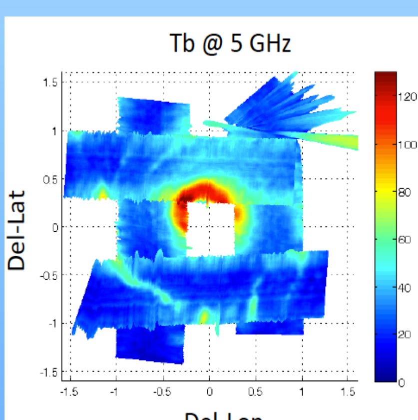


AV-1 Over-Storm Payload

Hurricane Imaging Radiometer (HIRad)

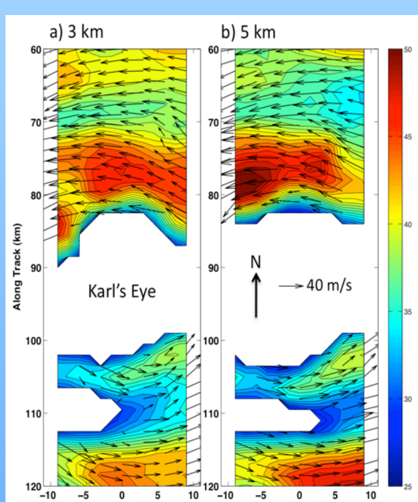


PI: Dr. Tim Miller
NASA Marshall Space Flight Center
Measurements:
Surface wind speed, rain rate

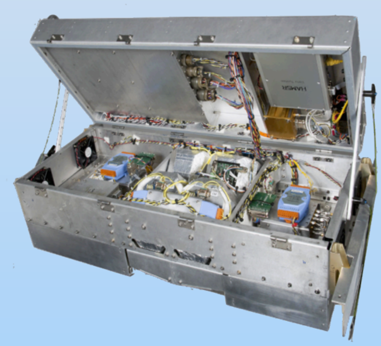


High Altitude Imaging Wind and Rain Airborne Profiler (HIWRAP)

PI: Dr. Gerry Heymsfield
NASA Goddard Space Flight Center
Measurements: Radar reflectivity, wind profiles



High Altitude Monolithic Microwave integrated Circuit Sounding Radiometer (HAMSR)



PI: Dr. Bjorn Lambrigtsen
Jet Propulsion Laboratory
Measurements:
Temperature, water profiles, cloud liquid water