The NCAR/NOAA Global Hawk Dropsonde System

Progress and Lessons Learned

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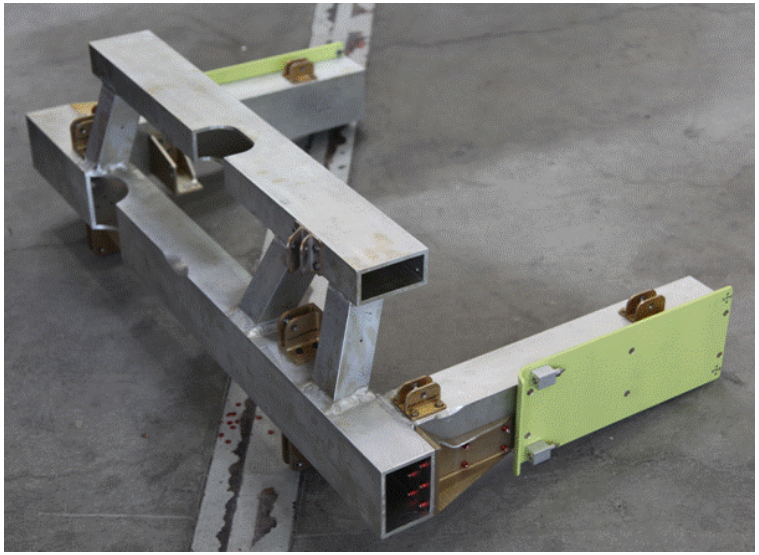
Global Hawk Dropsonde Overview

- Developed through collaborative partnership between NOAA, NCAR, and NASA
- Relies on NCAR/EOL's long experience with dropsonde development and launching
- Uses AVAPS-3 system and new Global Hawk sonde: smaller and lighter than current dropsondes
- System has 89-sonde and 8-channel capacity
  - 6 channels currently active
  - 72 sonde capacity during WISPAR; 89 by HS3
- D-file returned to ground following drop
- Ground processing enables GTS transmission

What Happened During GRIP?

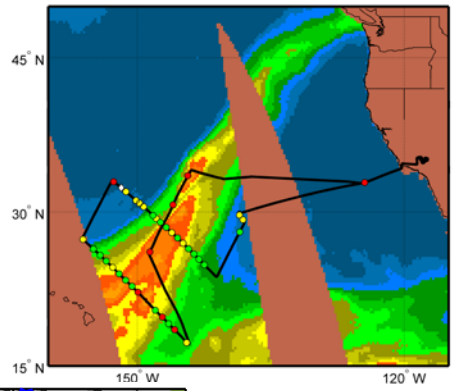
- Initial installation delayed due to delays in system completion and fabrication of mounting frame
- Installation and ground testing completed successfully
- Successful launch of first sonde at 15,000 ft on 24 Aug
- Sonde jammed in launcher on second launch attempt
  - Problem traced to safety latch
- NCAR unable to field reworked latch based on solenoid design by end of GRIP
  - Modified and alternate designs explored in Boulder
  - Solenoid design pursued for GRIP due to impacts on system electronics
  - Static performance good but could not pass vibration testing

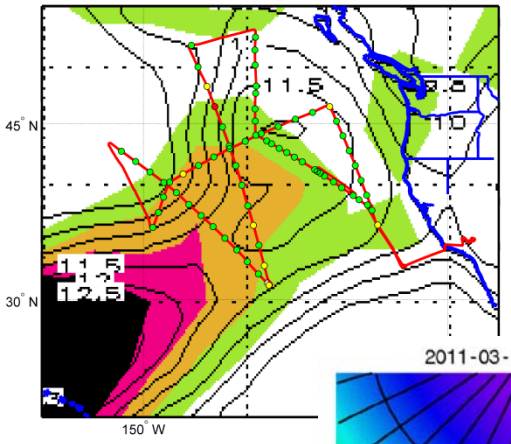


Progress Since GRIP

- **System functional!**
- NCAR redesigned the safety latch using a cylinder brake
- System passed all required testing and performed very well during WISPAR Experiment
  - 177 sondes deployed over 3 flights
- IR Communication issues resolved during WISPAR campaign
- Demonstrated capability of having all 6 channels active simultaneously
- Good engineering test including extreme Arctic conditions
- Capacity and minor improvements in progress now

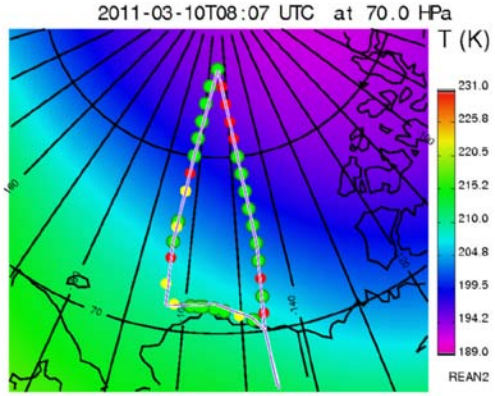
Atm. Rivers
11-12 Feb
37 sondes



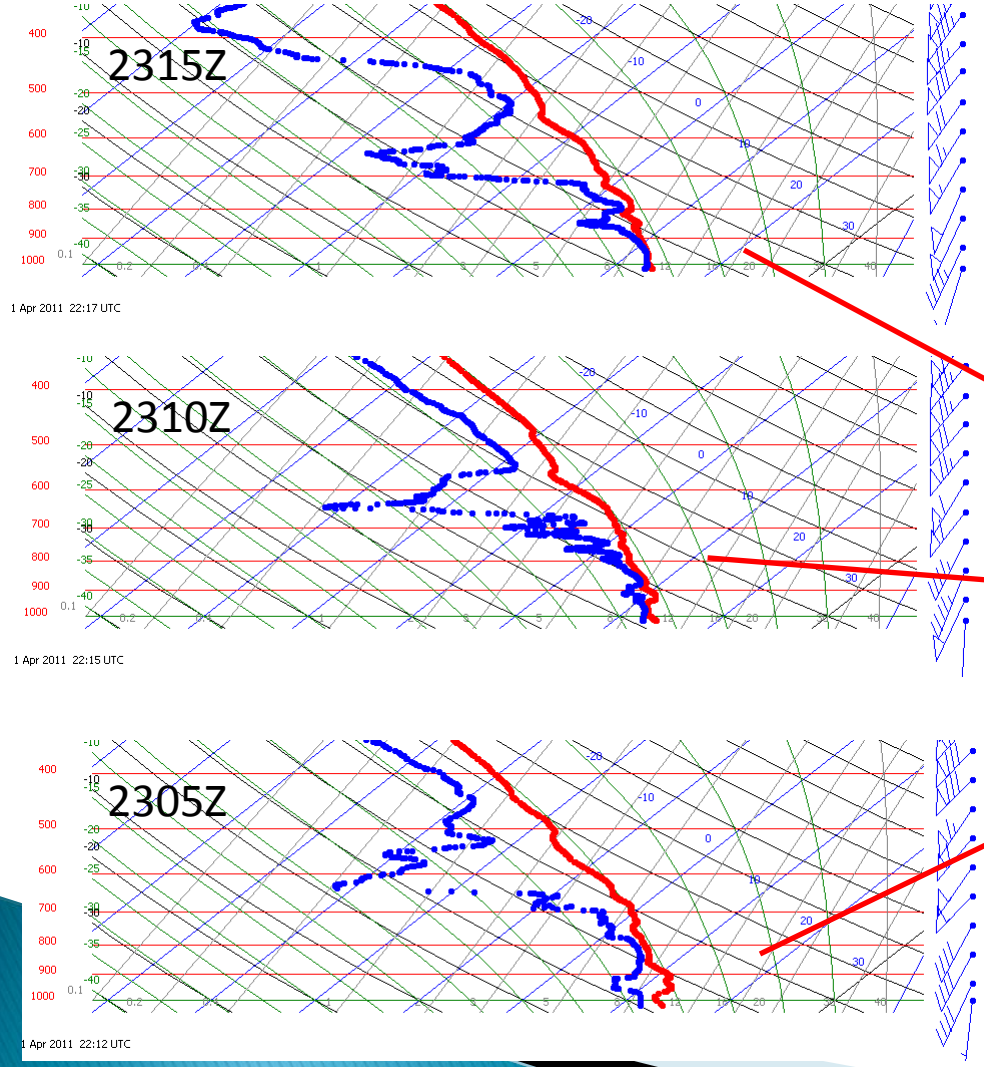


Winter
Storms
3-4 March
70 sondes

Arctic Weather
9-10 March
70 sondes
35 N of AK

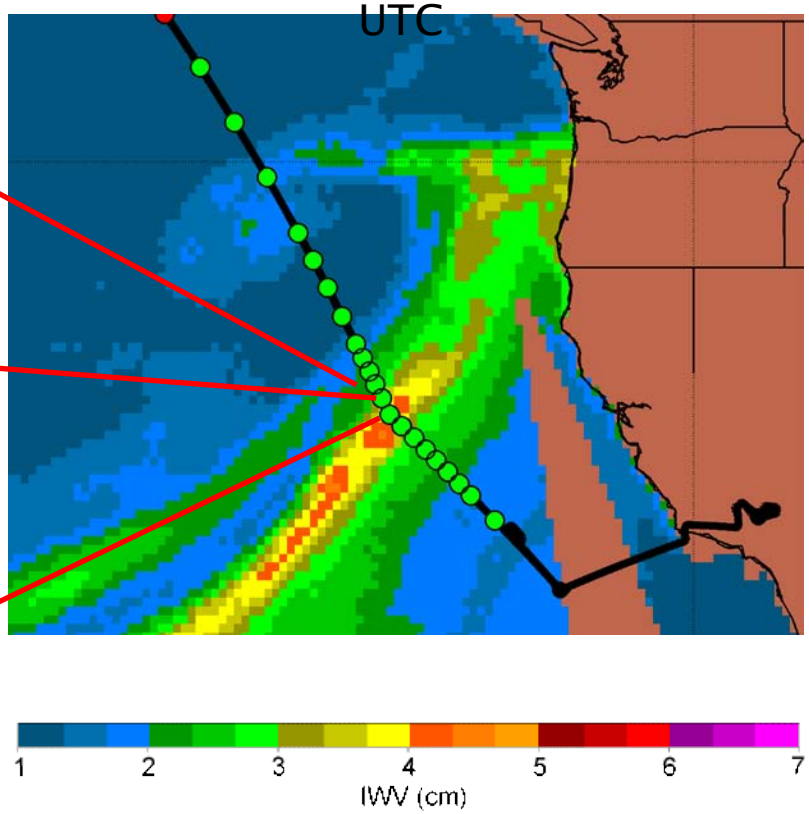


Sample Results



Northbound AR Crossing Arctic Flight, 10-11 March

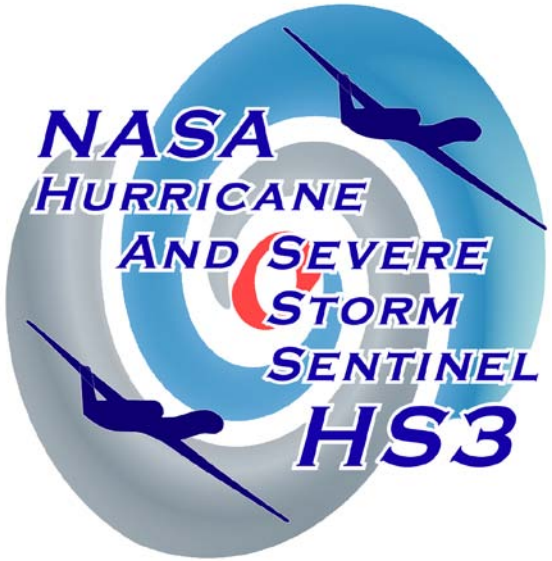
SSMIS F17 10 Mar 2011, ~0200 UTC



Lessons Learned

- Dropsonde system functional and ready for HS3
- Flexibility exists in dropsonde deployment
  - Location not need to be specified before flight
  - Able to specify lines and regions for dropsonde deployment and alter in flight
  - Working with New York Oceanic may be more challenging – but successful experience with Oakland invaluable
- Workload high for pilots, payload manager, and operators
  - Pilots in communication with ATC prior to each drop
  - Drop location transmitted over radio
  - Multiple radio calls between front and back room
  - Likely not possible for one operator to launch, monitor, and do ASPEN processing
  - Should explore data processing at external location

HS3: A Multi-Year Investigation of Hurricane Formation and Intensity Change



PI: Scott Braun

Deputy PI: Paul Newman

PM: Marilyn Vasques

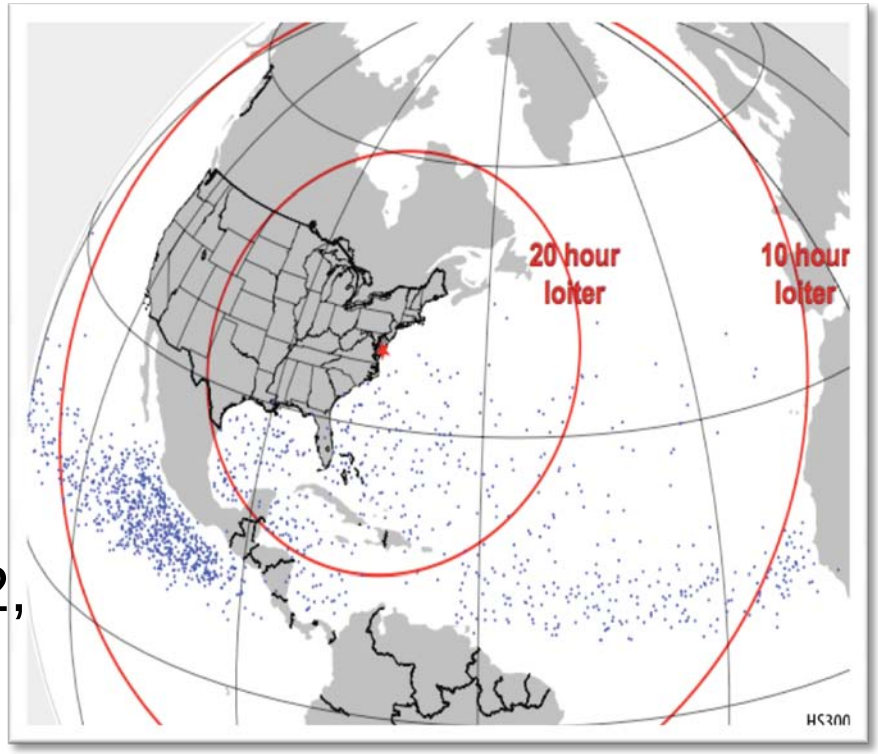
PS: Ramesh Kakar

Overall Science Objective

- To provide measurements to address key science questions related to storm formation and intensity change, including whether it is primarily a function of the storm environment or storm internal processes. Emphasis on:
  - The structure and role of the SAL, dust transport
  - Genesis processes
  - Convective bursts and wind field changes
  - Warm-core formation and evolution

HS3 Mission Overview

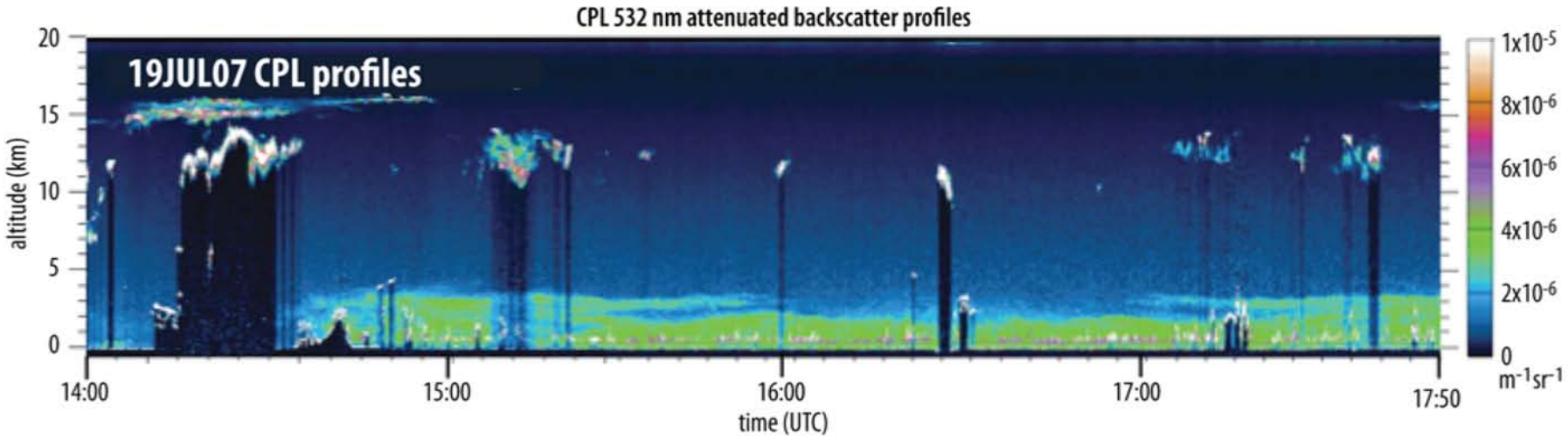
- Two aircraft, one equipped for the storm environment, one for over-storm flights
- The GHs will not do simultaneous science operations
- Deployments of GHs from the East Coast, likely Wallops Flight Facility in VA
- One-month deployments in 2012, 2013, and 2014, 300 flight hours per deployment



Dots indicate genesis locations. Range rings assume 30-h flights.

Instruments: Cloud Physics Lidar

- Cloud/aerosol lidar (CALIPSO simulator)
- Instrument PI: Matt McGill, NASA/GSFC
- Data: Profiles of atten. backscatter, cloud/aerosol boundaries, optical depth, extinction, depolarization
- Horiz., vertical resolution=200 m, 30 m



Instruments: Dropsondes (AVAPS)

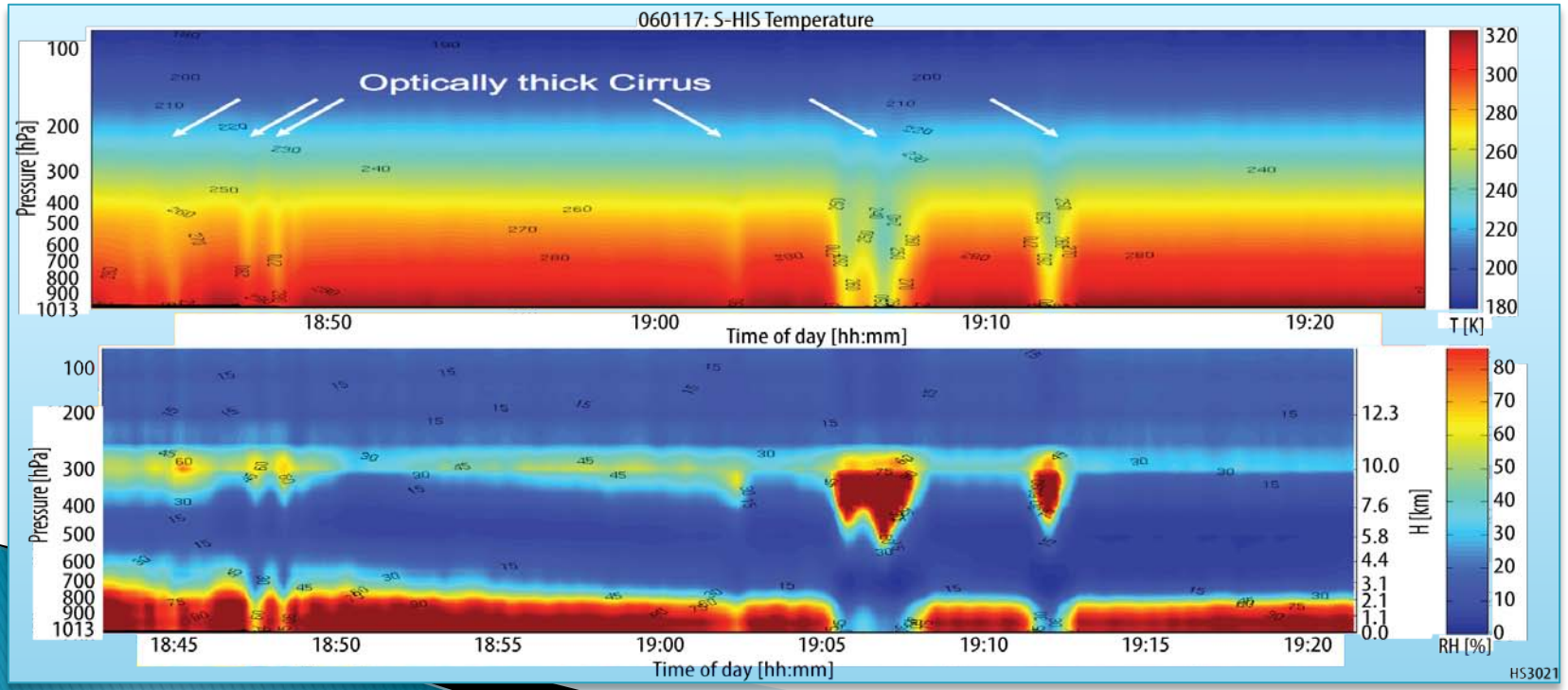
- Instrument PI: Gary Wick, NOAA
- Data: High-resolution vertical profiles of temperature, humidity, pressure, winds
- Potentially up to 70-90 drops per flight
- New design has flown on GH
  - Test flights (low, mid, high alt.) completed 2/4/11
  - NOAA science flights ongoing

HS3 Specifics

- Planning for 500 sondes for each year of the experiment (2012, 2013, 2014)
- Transmission of data on GTS a NOAA priority
  - Exploring testing of coincident drops with standard sondes
  - Model impact study using data from WISPAR Winter Storms flight
- Operation likely to transition from NCAR to NOAA during the experiment

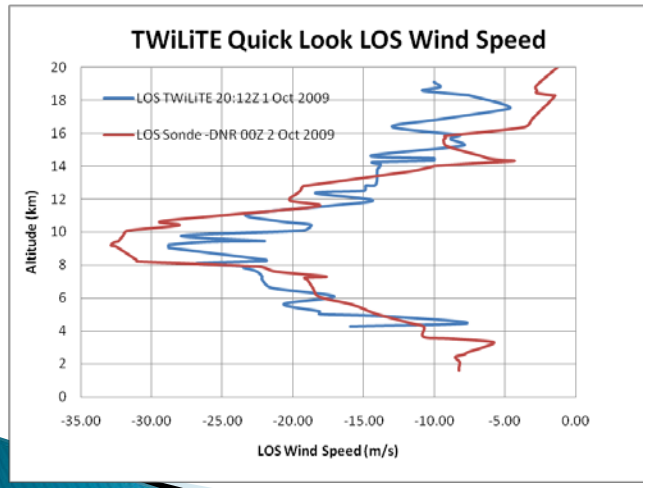
Instruments: Scanning High-resolution Interferometer Sounder

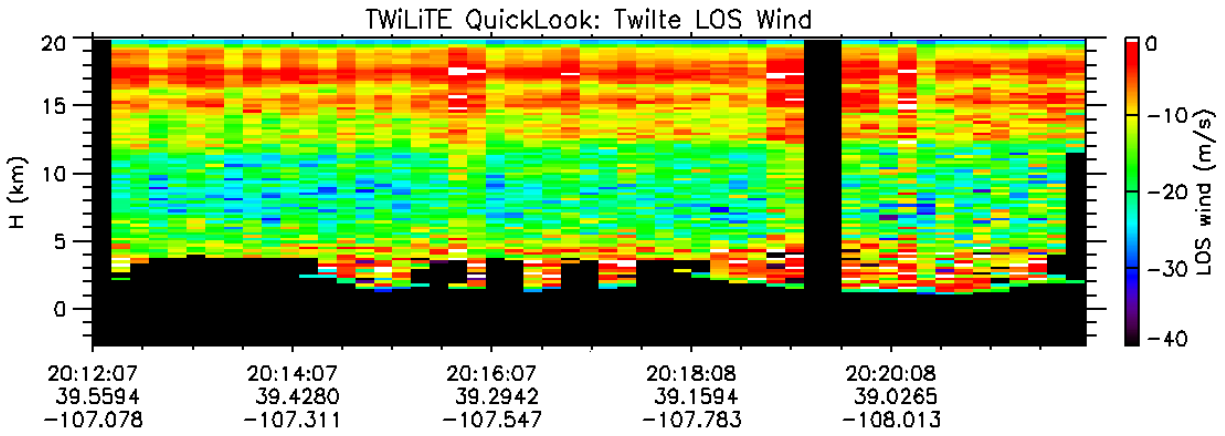
- Instrument PI: Hank Revercomb, Univ. Wisconsin
- Data: IR TB spectra; Cloud-top temperature, height; sfc skin temperature; profiles of temperature and water vapor in clear-sky conditions
- Horiz., vertical resolution=2 km, 1-3 km



Instruments: TWiLiTE Wind Lidar

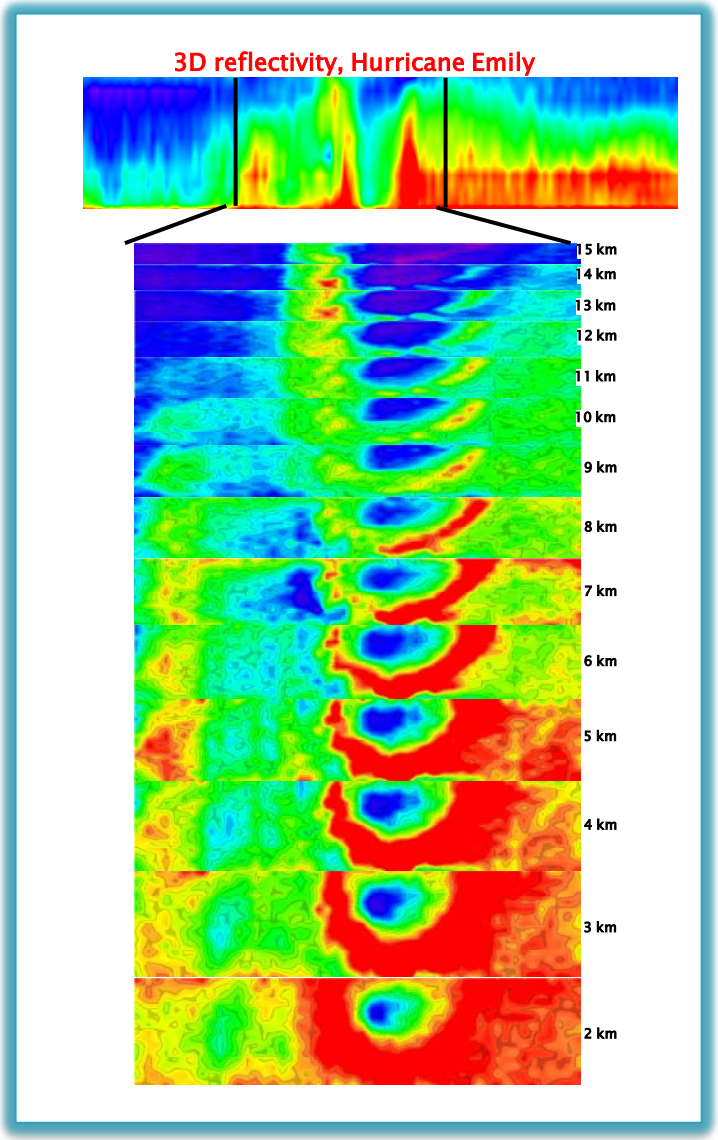
- Instrument PI: Bruce Gentry, NASA/GSFC
- Data: Profiles of backscatter intensity, Doppler velocity, horizontal winds in clear-sky conditions
- Will fly as part of HS3 in 2013-14 only due to NGC schedule, wind pod availability
- Horiz., vertical resolution=~2 km radial winds, 8 km for retrieved horizontal winds, 250 m





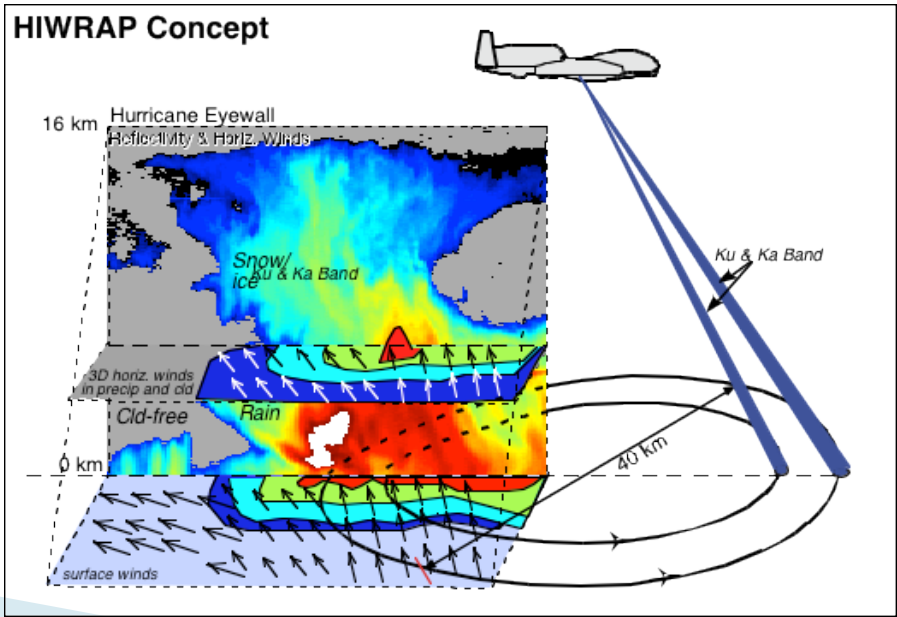
Instruments: High-Altitude MMIC Sounding Radiometer (HAMSR)

- Instrument PI: Bjorn Lambrigtsen, JPL
- Data: Calibrated brightness temperature; vertical profiles of temperature and water vapor and liquid water; precipitation structure
- Horiz., vertical resolution=2km, 1-3 km



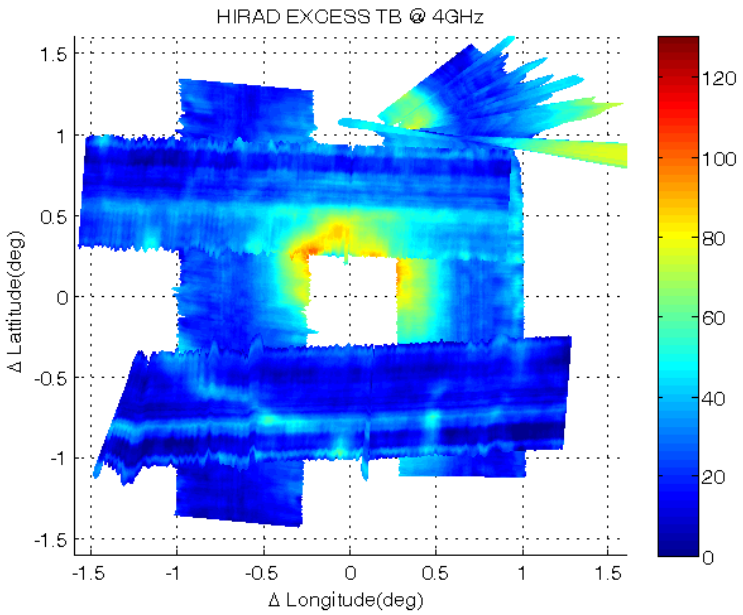
Instruments: High-altitude Imaging Wind and Rain Airborne Profiler (HIWRAP)

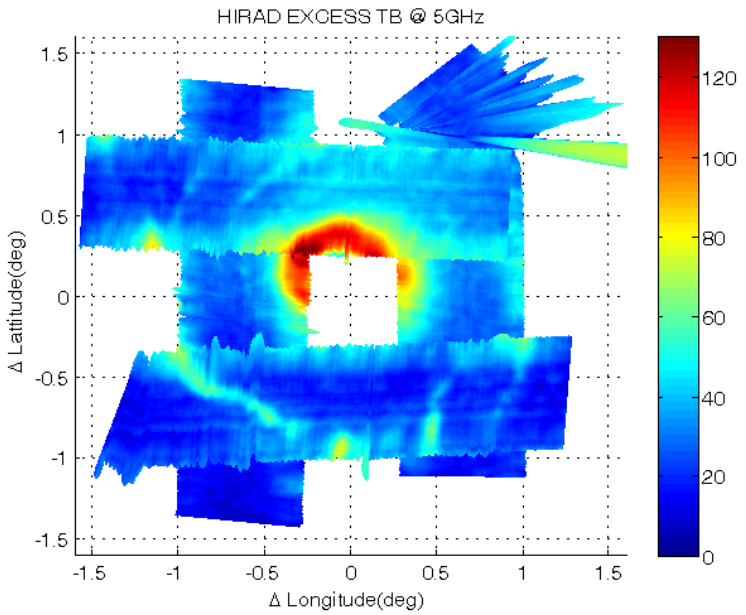
- Instrument PI: Gerald Heymsfield, NASA/GSFC
- Data: Calibrated reflectivity, Doppler velocity, 3D reflectivity and horizontal winds, ocean surface winds in precipitation free areas
- Horiz., vertical resolution=
  - 1 km, 200 m for dBZ, Doppler velocity
  - 1 km, 500 m for horiz. winds
  - 2 km for surface winds



Instruments: Hurricane Imaging Radiometer (HIRAD)

- Instrument PI: Tim Miller, NASA/MSFC
- Data: Surface wind speed, rain rate, and temperature; brightness temperature fields at 4 frequencies
- Technology similar to NOAA's SFMR, but scans cross track instead of just nadir
- Horiz. resolution=~1.5-2.5 km





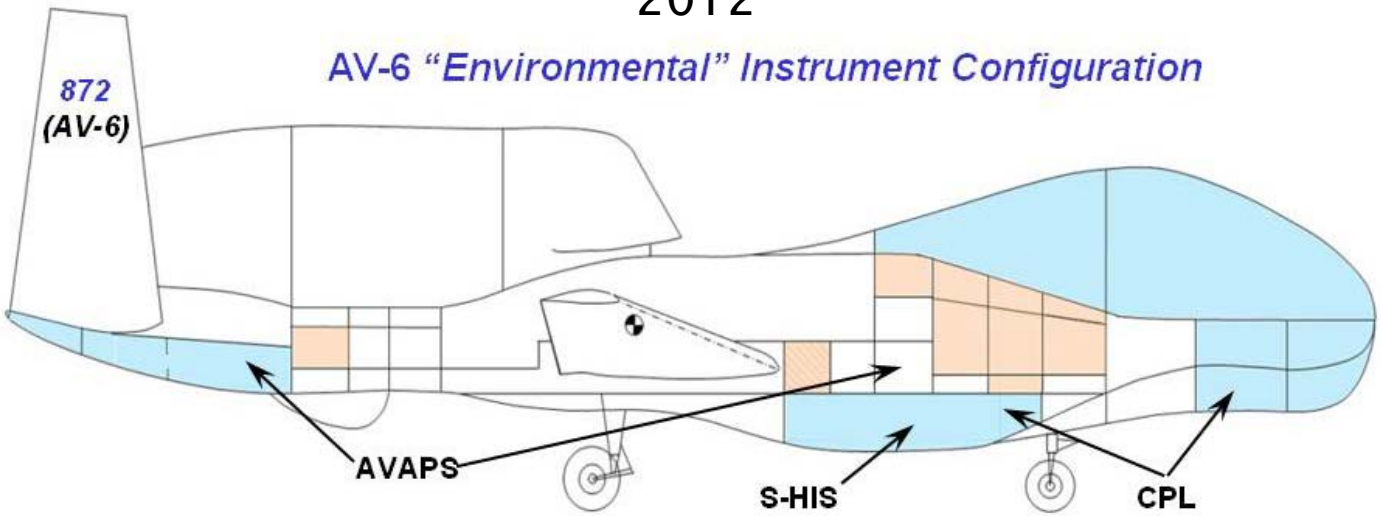
Example from Hurricane Earl flight during GRIP

Extra Slides

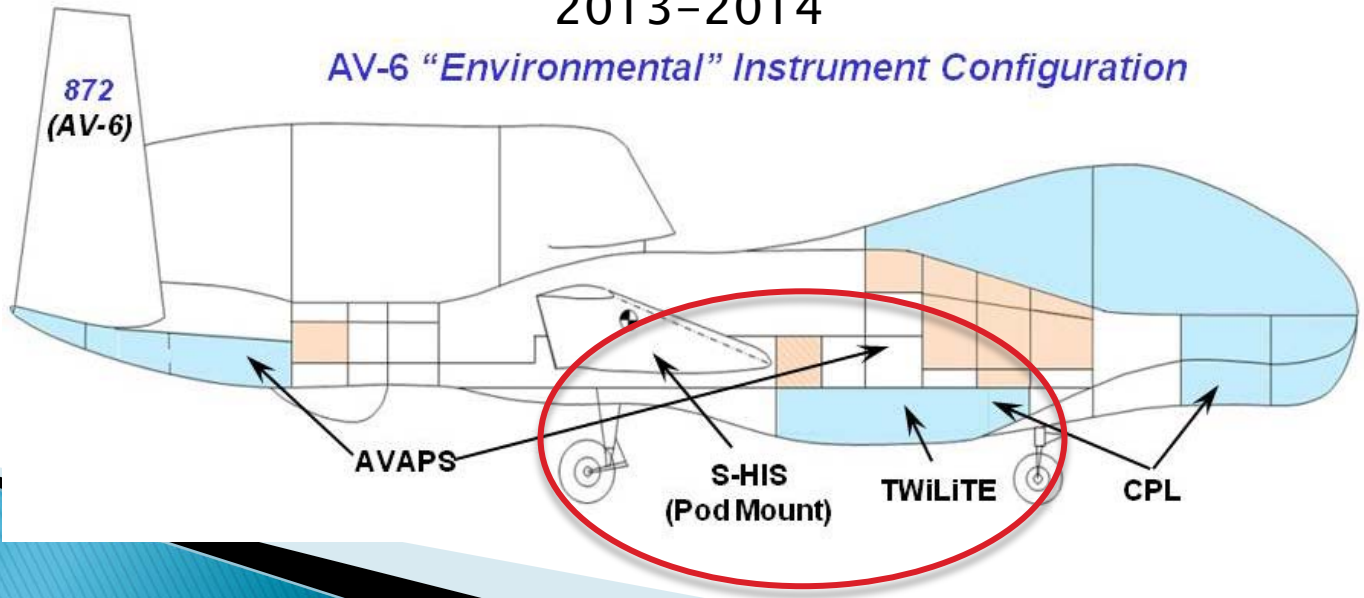
- Extra Slides

Environmental Payload

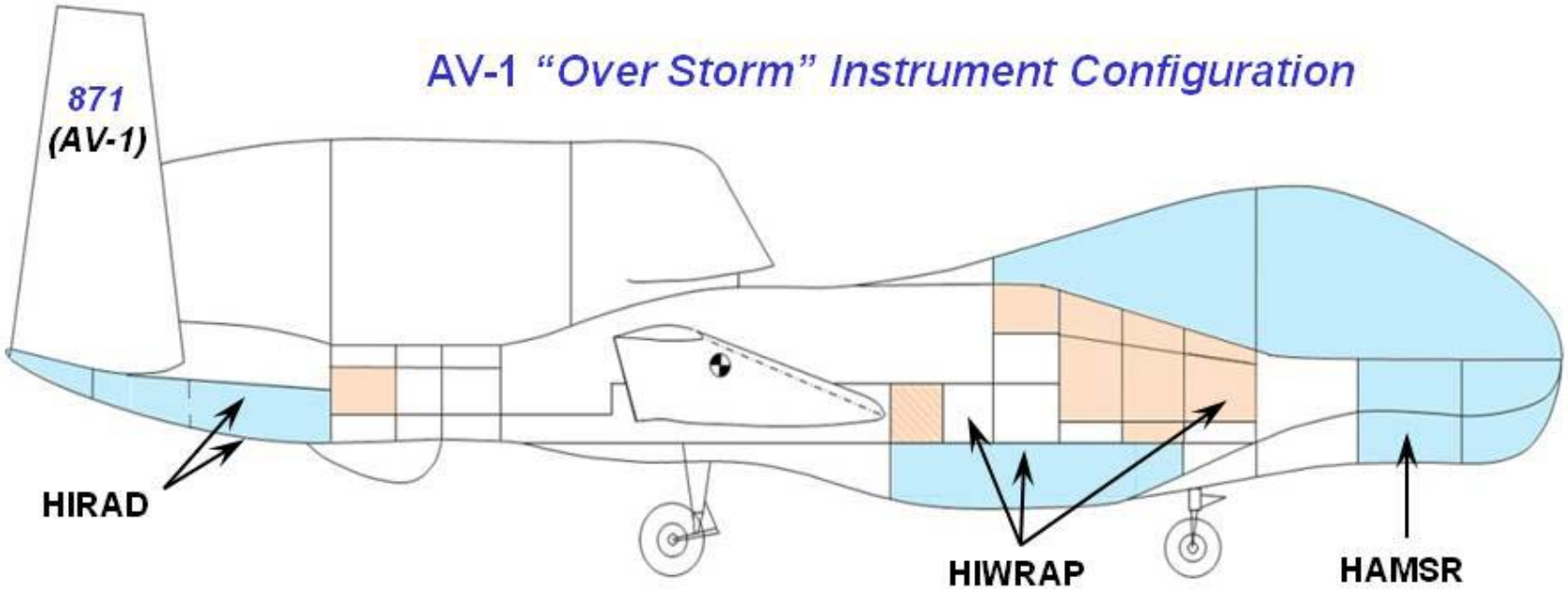
2012



2013-2014



Over-Storm Payload

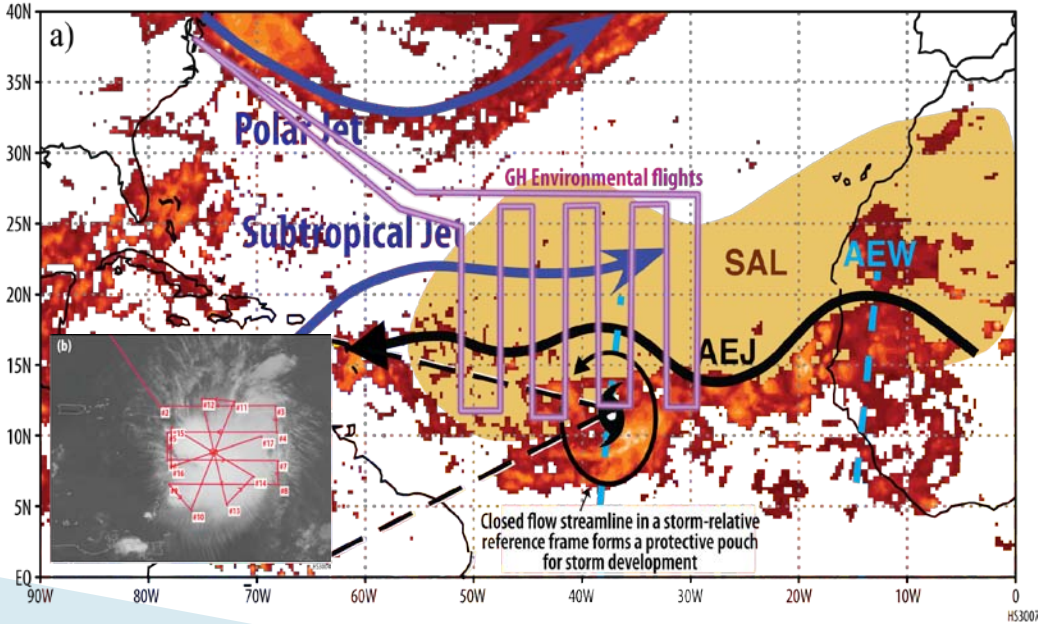


Sampling of the Environment

- Environmental observing suite unique for examining the SAL
  - –Coincident dust, thermodynamics, and wind measurements
  - –Sampling in central and eastern Atlantic, where SAL characteristics can be much different than to the west
- Able to reach early genesis regions of the eastern Atlantic not usually accessible

Enhancements to models:

- Validation of global analyses of SAL structure and evolution
- Evaluation of dust transport
- Improved initial conditions for simulations and forecasts

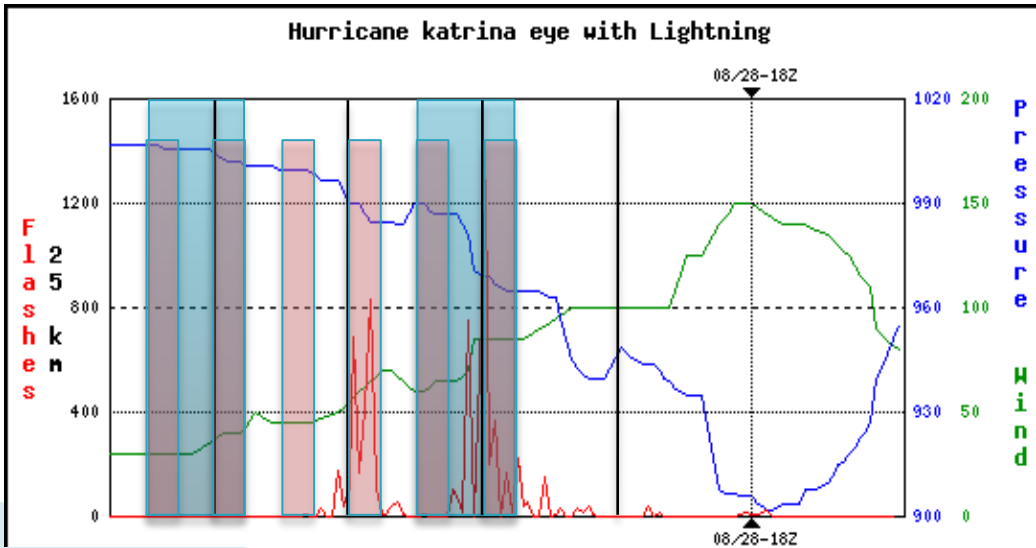


Sampling In-Storm Processes

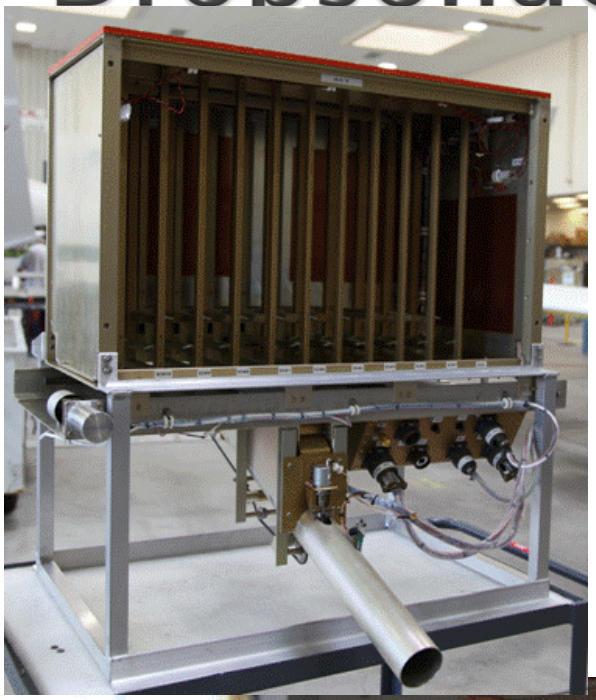
- Long duration of the GHs enables unprecedented duration of observations in the interior of the storm
  - –Different approach from most studies. Previously, short looks ~ twice per day
  - –HS3, long looks as much as every other day
    - Combined with high altitude, allows for better description of convective burst cycles

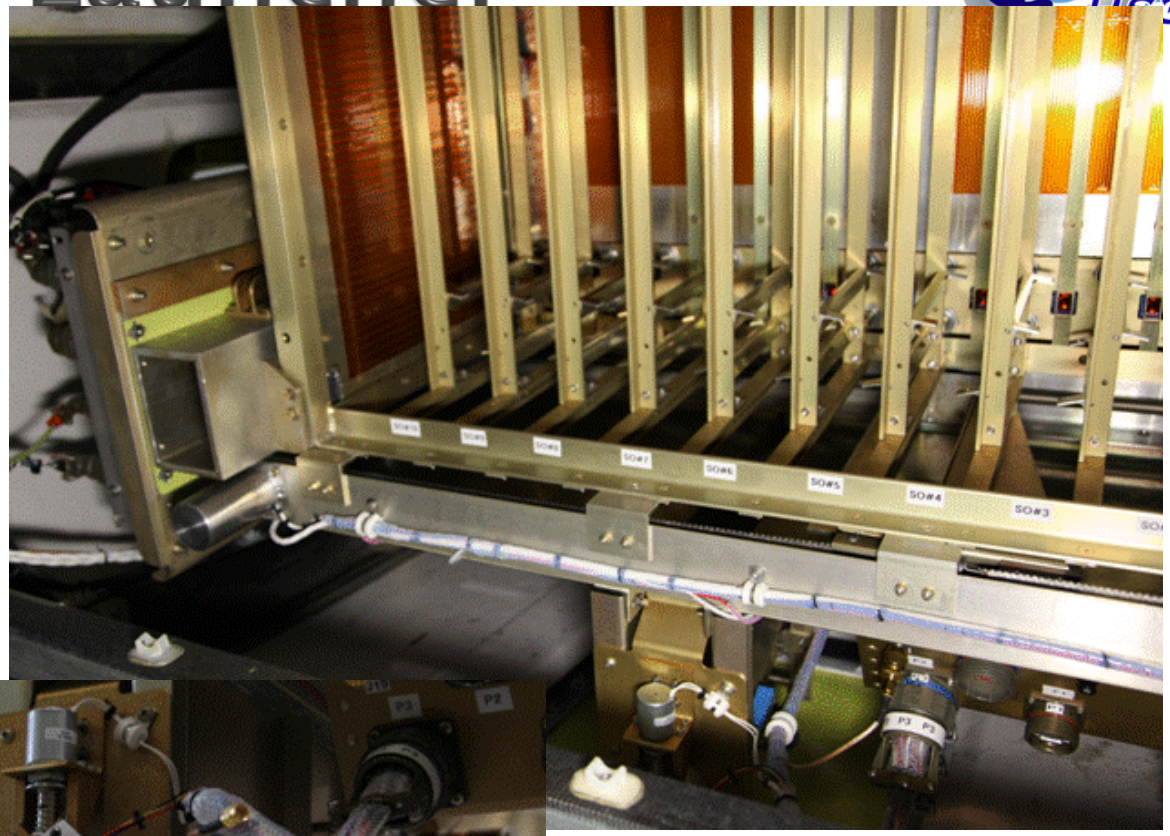
Enhancements to models:

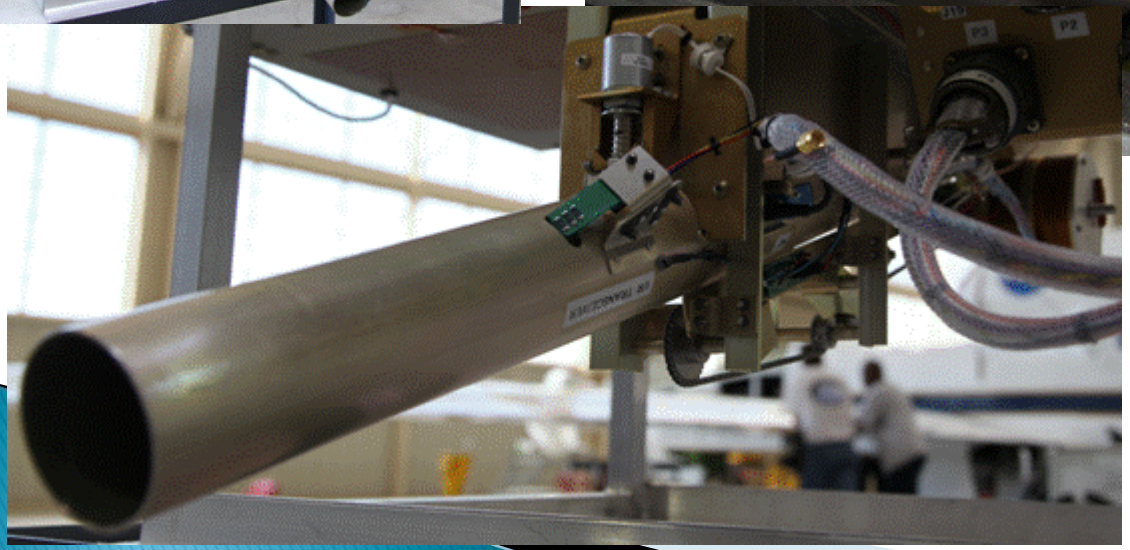
- Validation of precipitation, wind structure
- Evaluation of microphysics parameterizations
- Improved initial conditions for simulations and forecasts



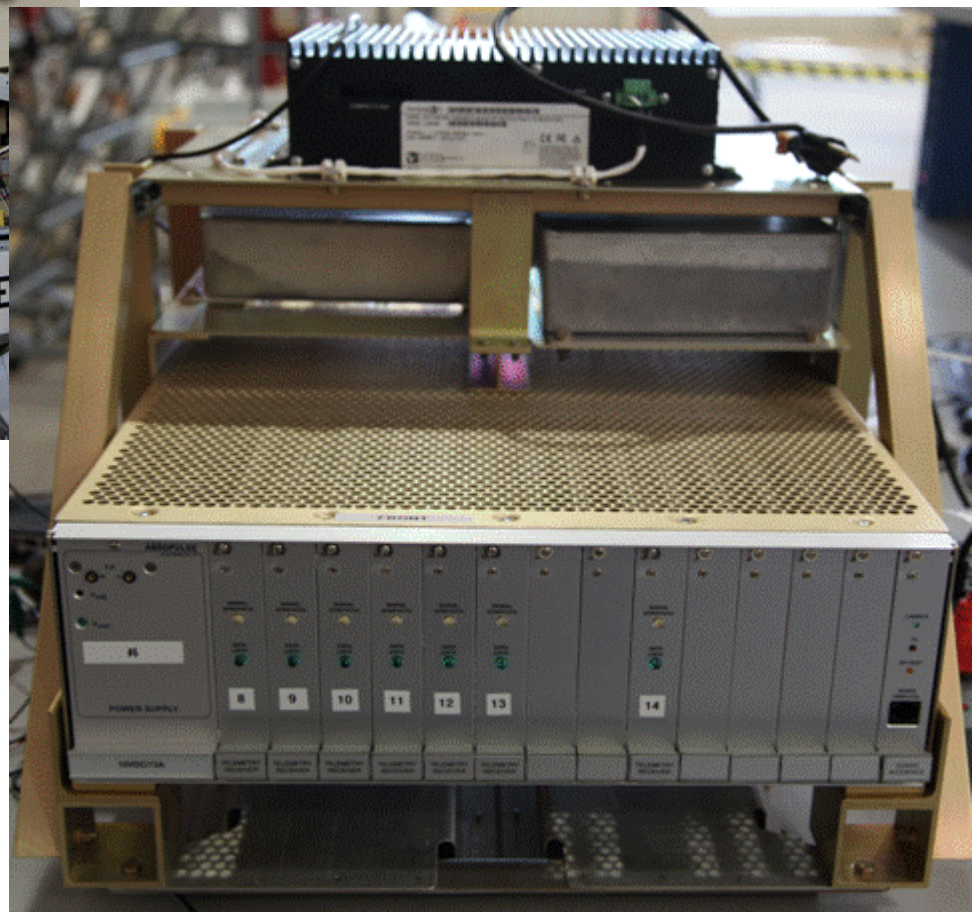
Dropsonde Launcher







AVAPS Electronics



Initial Sonde Specifications

- Size: 4.56 cm dia. X 30.5 cm length
- Mass: ~175 g
- Fall rate: ~12 m/s at surface
- Sensors based on Vaisala RS-92 radiosonde sensor module
  - Temperature: +60° to -90 ° C , 0.1 ° C resolution
  - Humidity: 0 to 100 %, 1 % resolution
  - Pressure: 1080 to 3 mb, 0.1 mb resolution
  - 2 Hz update rate
- Winds based on OEM GPS receiver and position
  - 4 Hz update rate
- Stable cone parachute design
- Remote control of power on/off and sonde release
- Designed for extreme environmental conditions