SHOUT 2016: Examples of Global Hawk Observations for Operational Impact

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SHOUT 2016 Summary

- Four Storms (2 landfalls), 9 flights in 10 weeks:
  - 2 Gaston,
  - 2 Hermine (1 pre-landfall)
  - 2 Karl,
  - Record 3 Matthew (back-to-back-to-back, one landfall)

- 213 Flight Hours
- 647 sondes: Record 90 sondes in pre-Hermine flight
  - 97% in real time to GTS
  - 95% passed HWRF and ECMWF QC
- Reduced staffing: significant cost saving
- Dual operation from Armstrong and Wallops (Matthew)

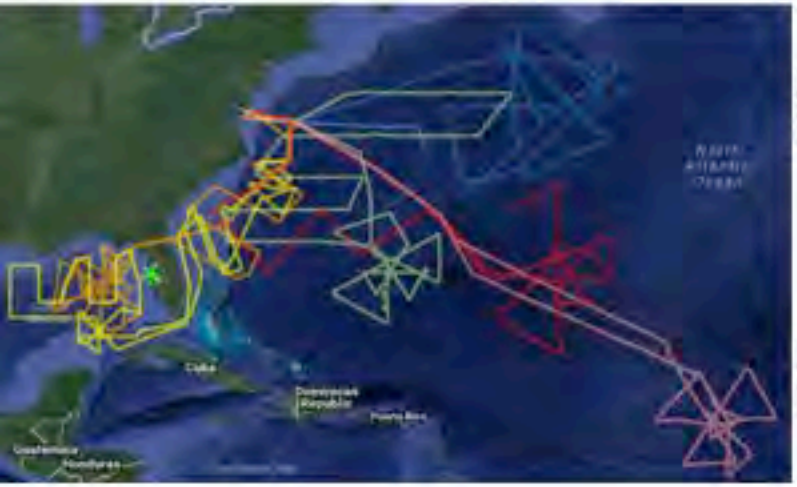
2016 SHOUT Hurricane Rapid Response Accomplishments

Total Flight Hrs	141.1 Hrs
Total Sondes	479

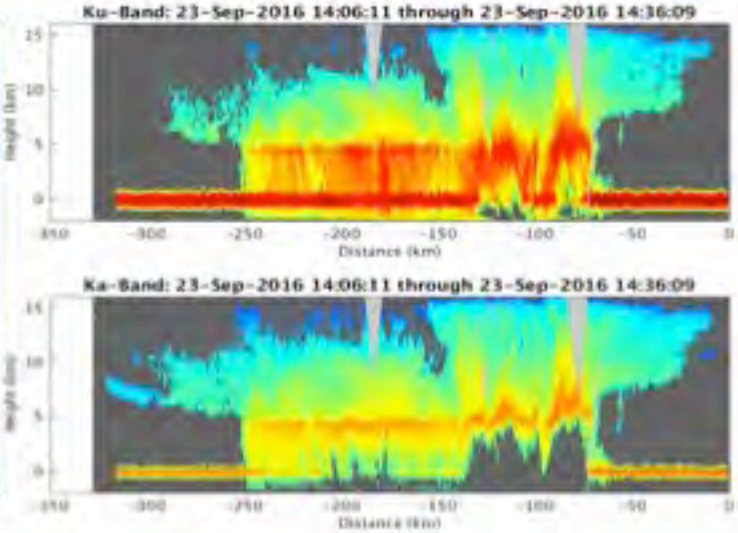
Storm	Date	Sondes
GASTON-1	24-25 Aug	84
GASTON-2	26-27 Aug	55
HERMINE-1	29-30 Aug	90
HERMINE-2	31 Aug-1 Sep	87
KARL-1	22-23 Sep	82
KARL-1	24-25 Sep	81

- Extensive usage of real-time dropsonde data by NHC in forecast discussions
- Operational assimilation/evaluation of data in HWRF and ECMWF models
- Operational efficiencies demonstrated with reduced personnel requirements, remote staffing options, lower operating costs and flexible deployment capabilities

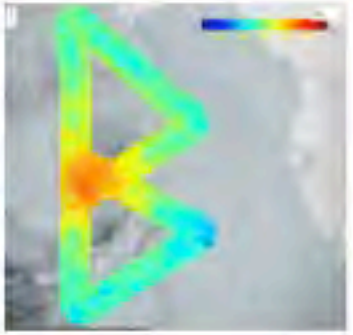
HURRICANE GASTON TROPICAL CYCLONE UPDATE
NWS NHC MIAMI FL AL072016
1215 AM AST THU AUG 25 2016
.....GASTON BECOMES THE THIRD HURRICANE OF THE ATLANTIC SEASON.....
Dropsonde data from a NASA/NOAA Global Hawk mission indicate that Gaston has strengthened to a hurricane. The maximum winds are estimated to be 75mph (120 km/h) with higher gusts.



2016 SHOUT Tracks



HIWRAP reflectivity cross section from TS Karl showing strong echoes, high tops, and precip



HAMSR horizontal temp structure showing warm core of TS Hermine

Global Hawk

TC Observational Demo/ Research Objectives (SHOUT)

Sensing Hazards with Operational Unmanned Technologies

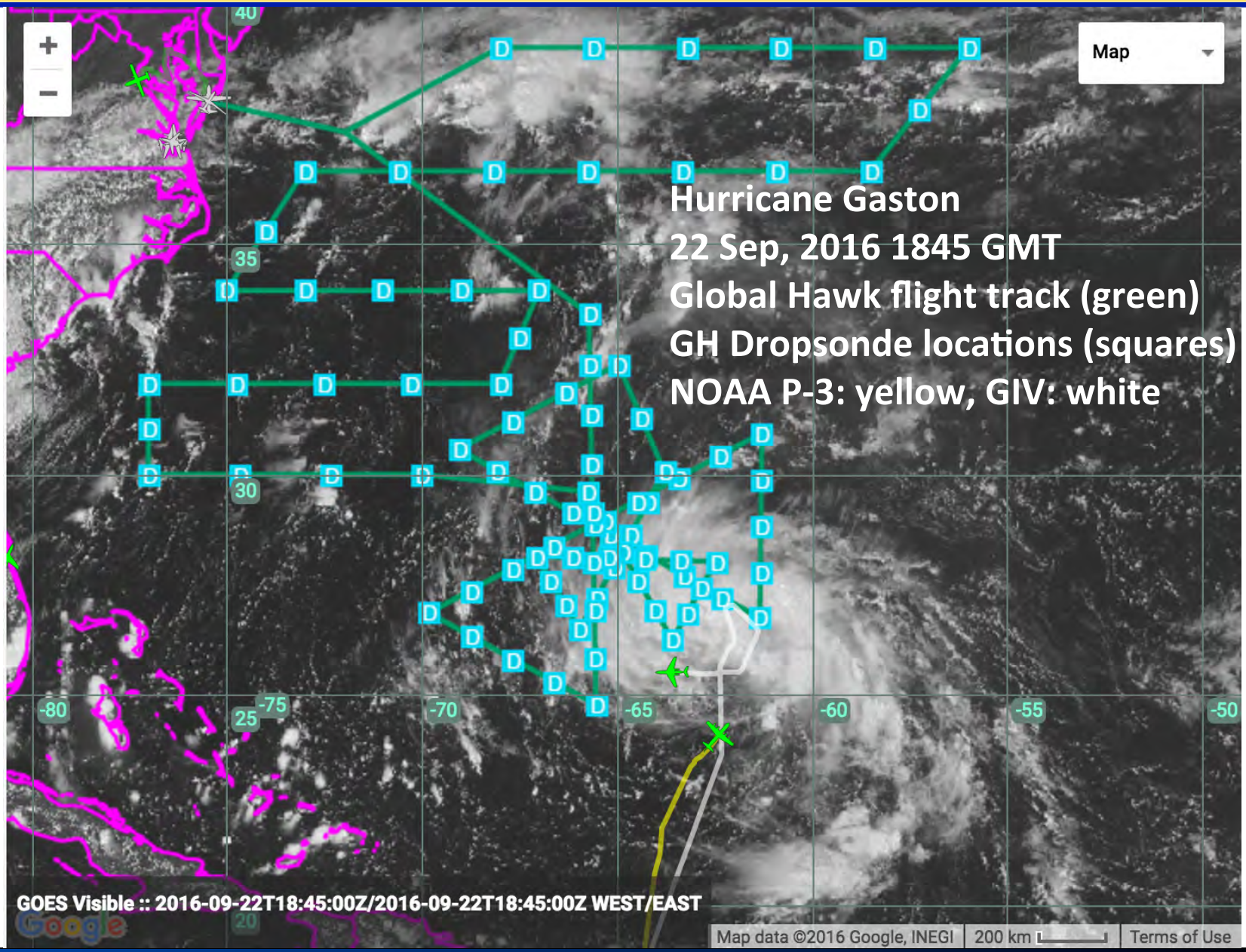
- Measure Structure
  - pattern,
  - strength,
  - Feature orientation
- Evaluate Observational Impact on operational model predictions:
  - Hurricane intensity/ size/ structure change: Vmax, Pmin, Rmax
  - Hurricane track change

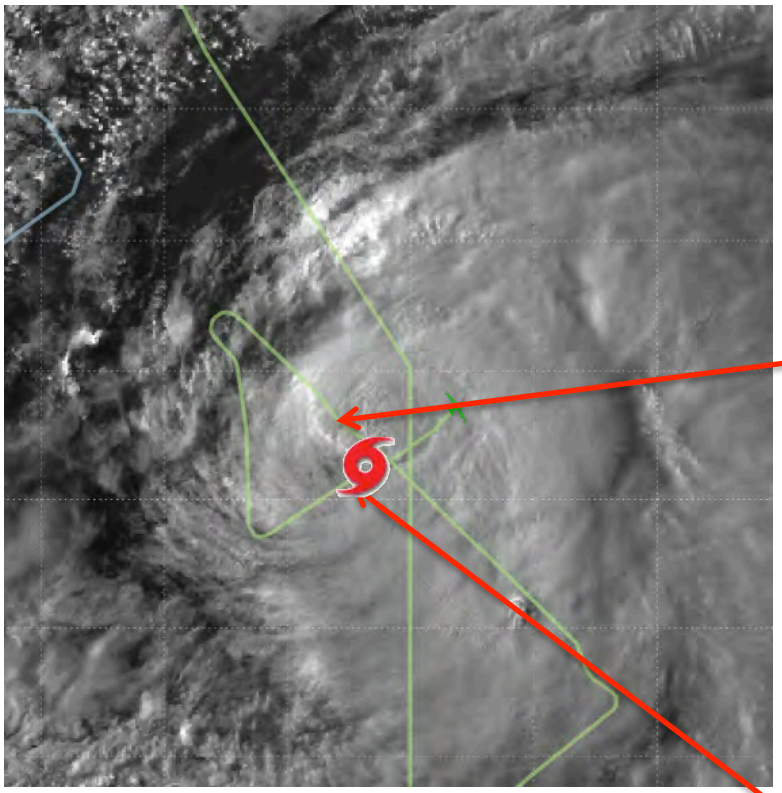
Satellite GAP Mitigation for High-Impact Weather

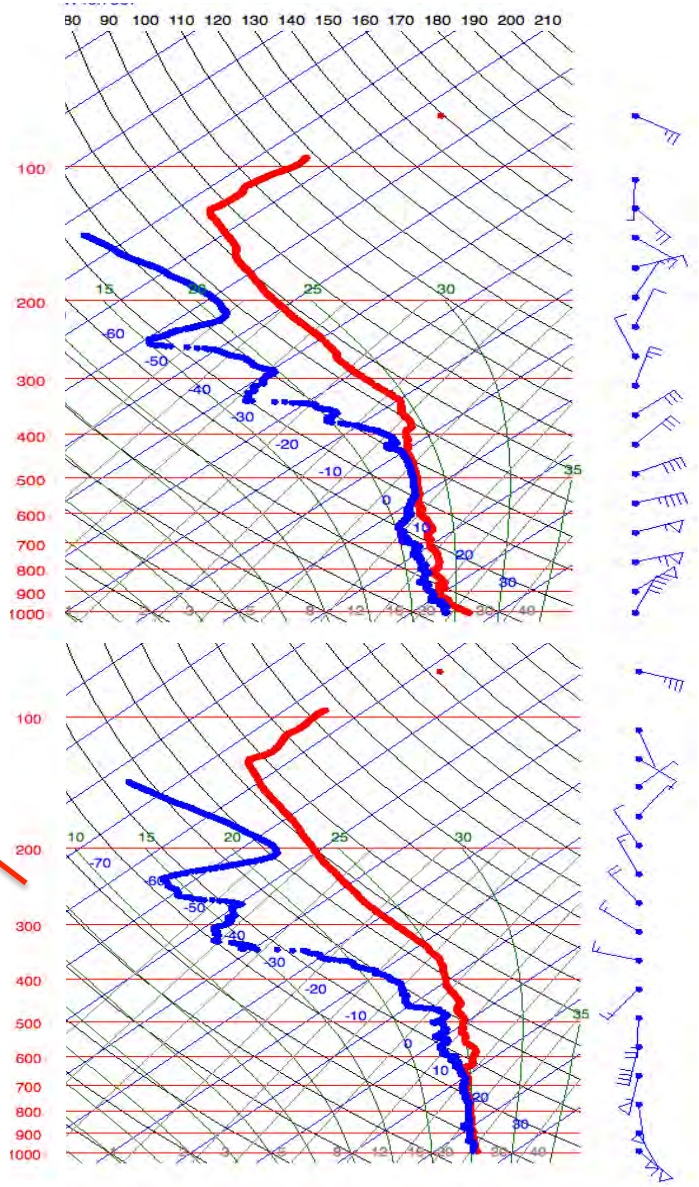
- Operational Impact: With and without concurrent satellite data

TC Model Real-Time Data Assimilation

- Improve targeting (timing/location/ pattern) of Real Time dropsondes
- Provide input for *BALANCED* initialization of TC models: HAMSR/ HIWRAP


Map
Hurricane Gaston
22 Sep, 2016 1845 GMT
Global Hawk flight track (green)
GH Dropsonde locations (squares)
NOAA P-3: yellow, GIV: white
GOES Visible :: 2016-09-22T18:45:00Z/2016-09-22T18:45:00Z WEST/EAST
Map data ©2016 Google, INEGI
200 km
Terms of Use

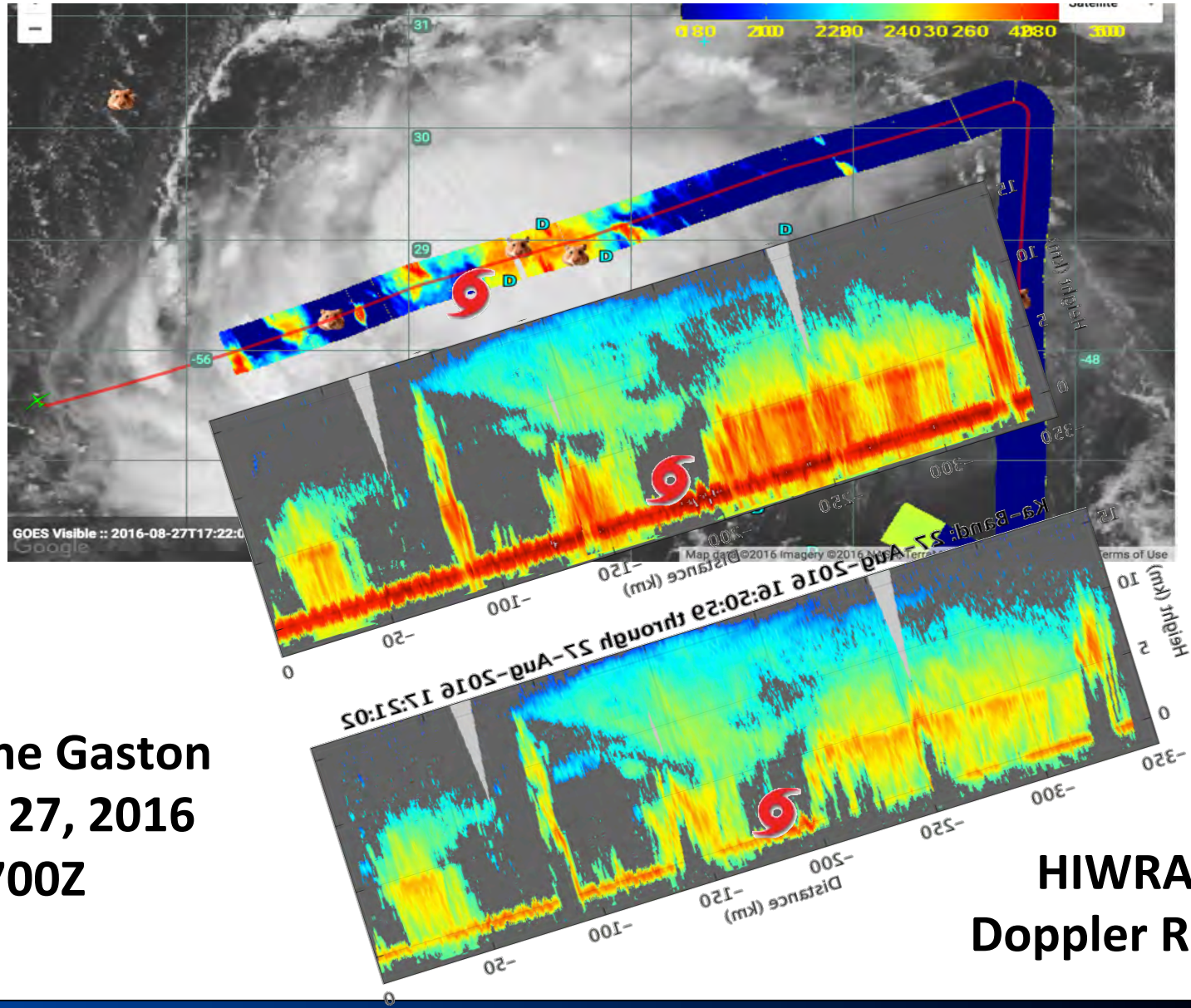




Hurricane Gaston
August 25, 2016

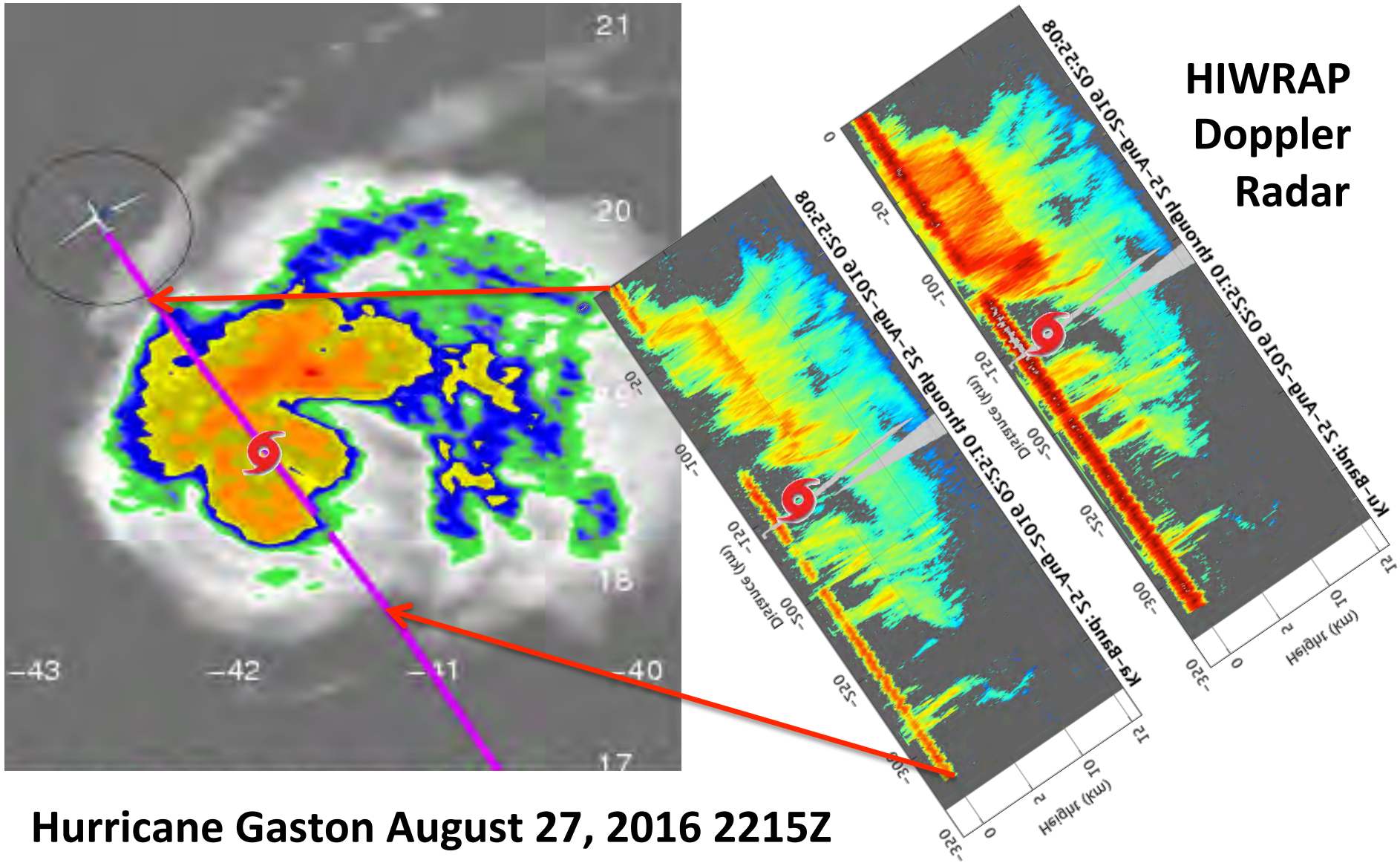
Advanced Vertical Atmospheric Profiling System (AVAPS) Mini-Dropsonde

REAL-TIME For HWRF, ECMWF Model Input

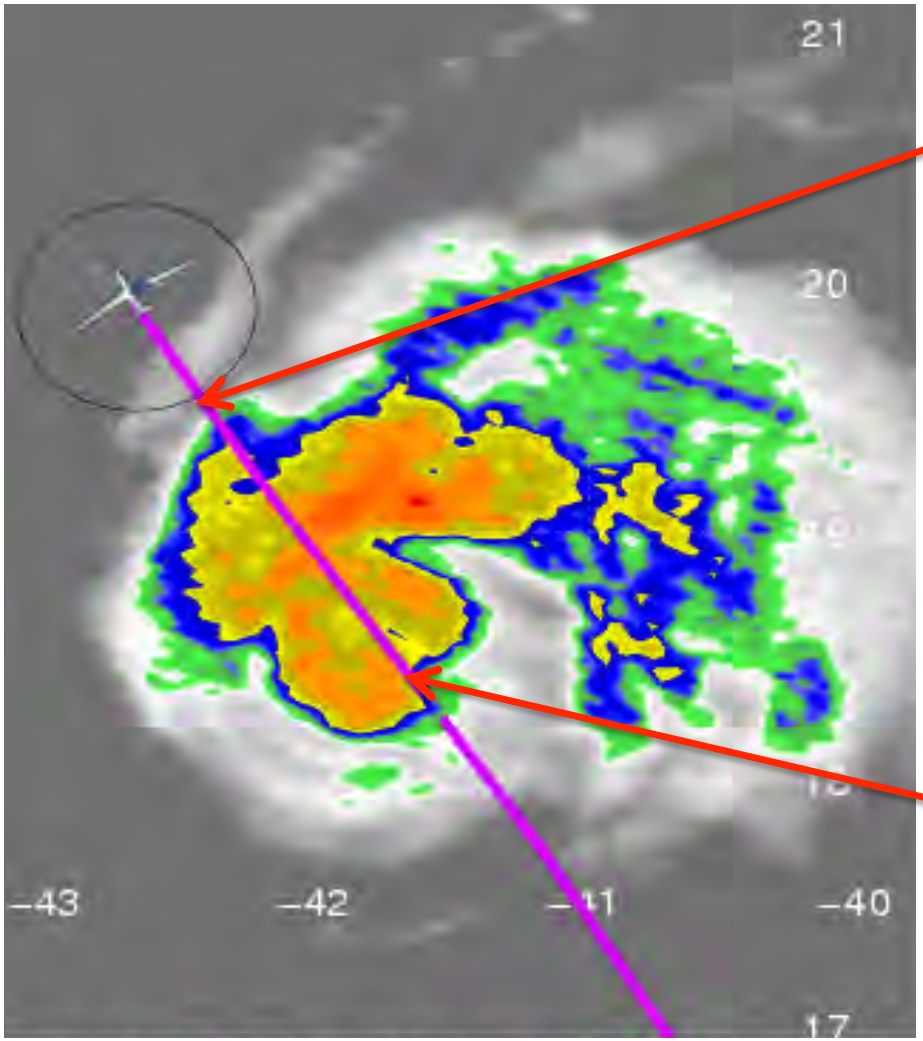


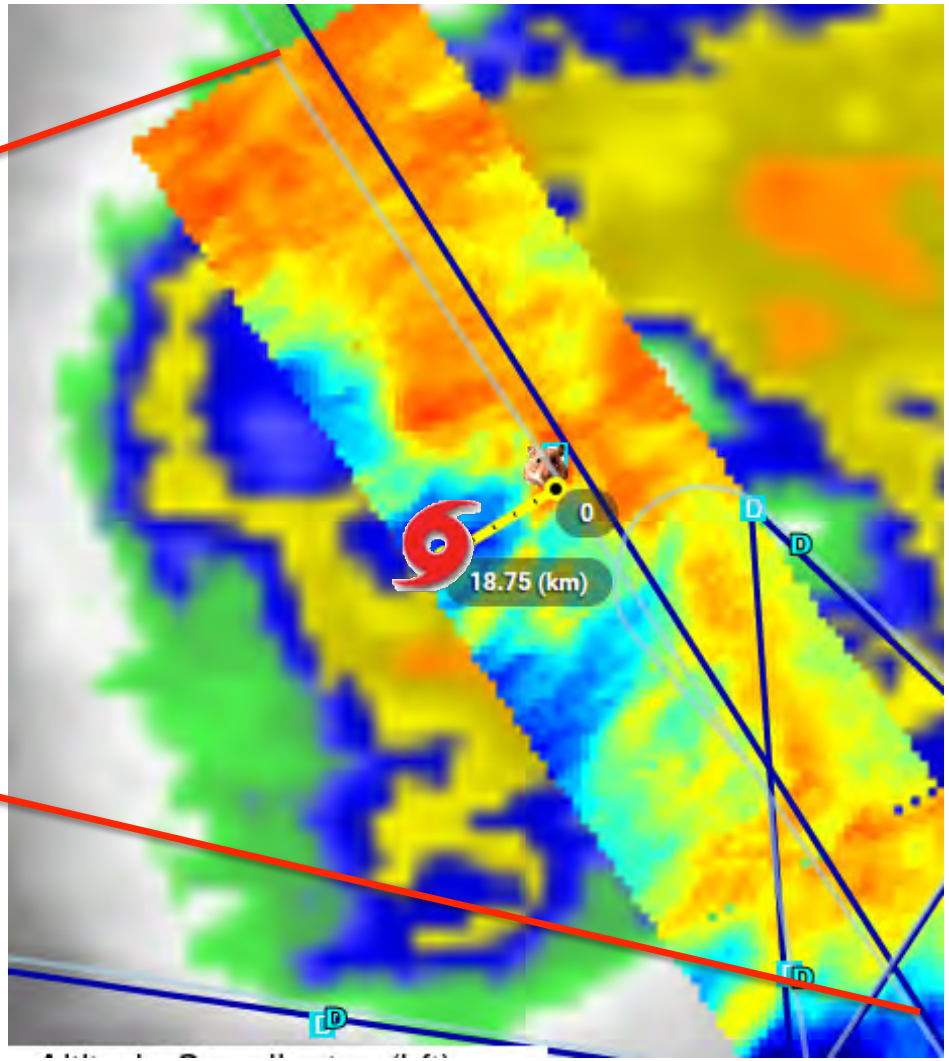
Hurricane Gaston
August 27, 2016
1700Z

HIWRAP
Doppler Radar



Hurricane Gaston August 27, 2016 2215Z





GOES IR **Hurricane Gaston August 25, 2016 2215Z** **HAMSR**

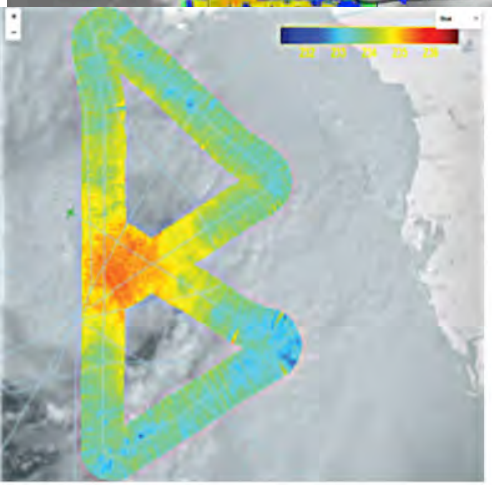
(High Altitude Monolithic Microwave Sounding Radiometer)

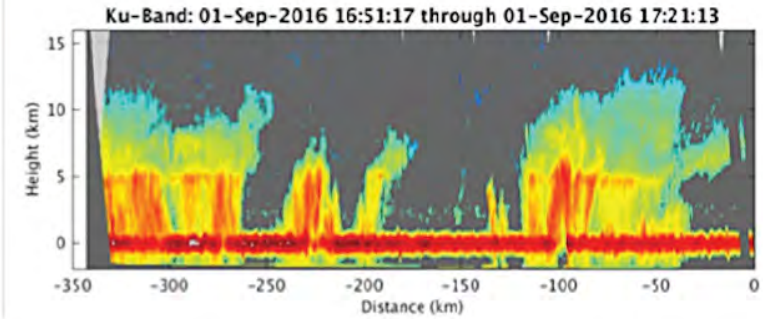
Black- GH
Blue- WP-3D

Red- GH track

GOES Visible :: 2016-09-01T19:45:00Z/2016-09-01T19:55:00Z WEST/EAST

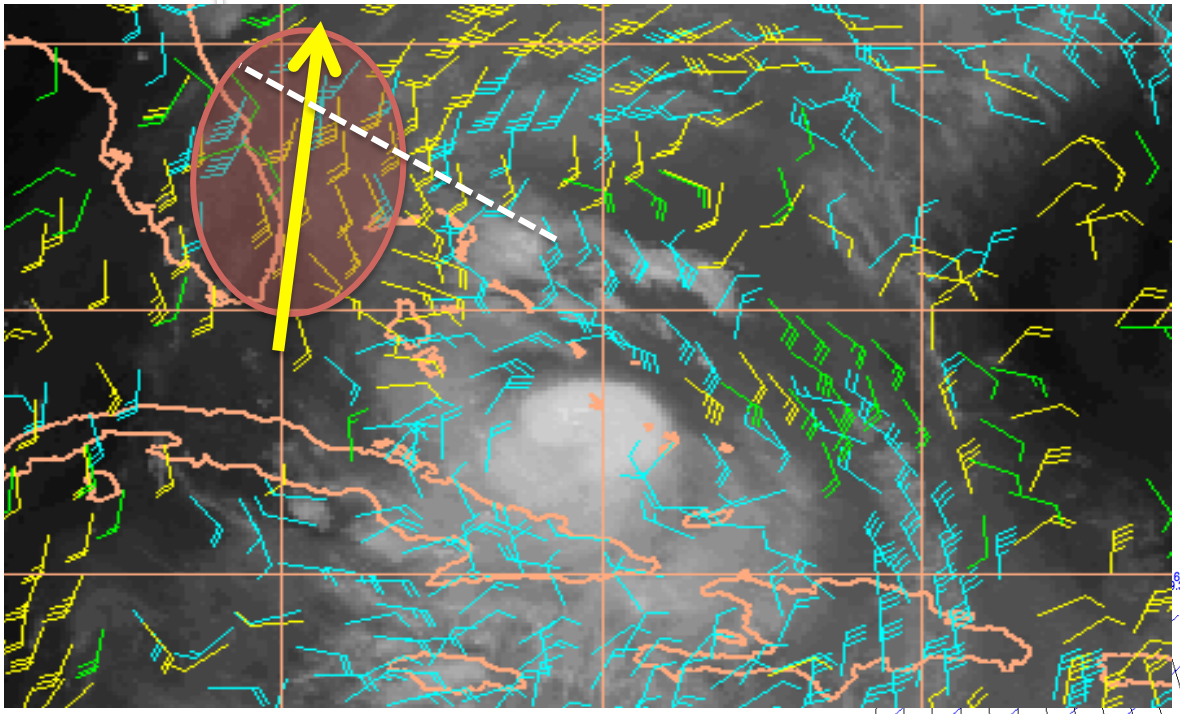
NEXRAD Base Reflectivity (N0Q) :: 2016-09-01T20:00:00Z





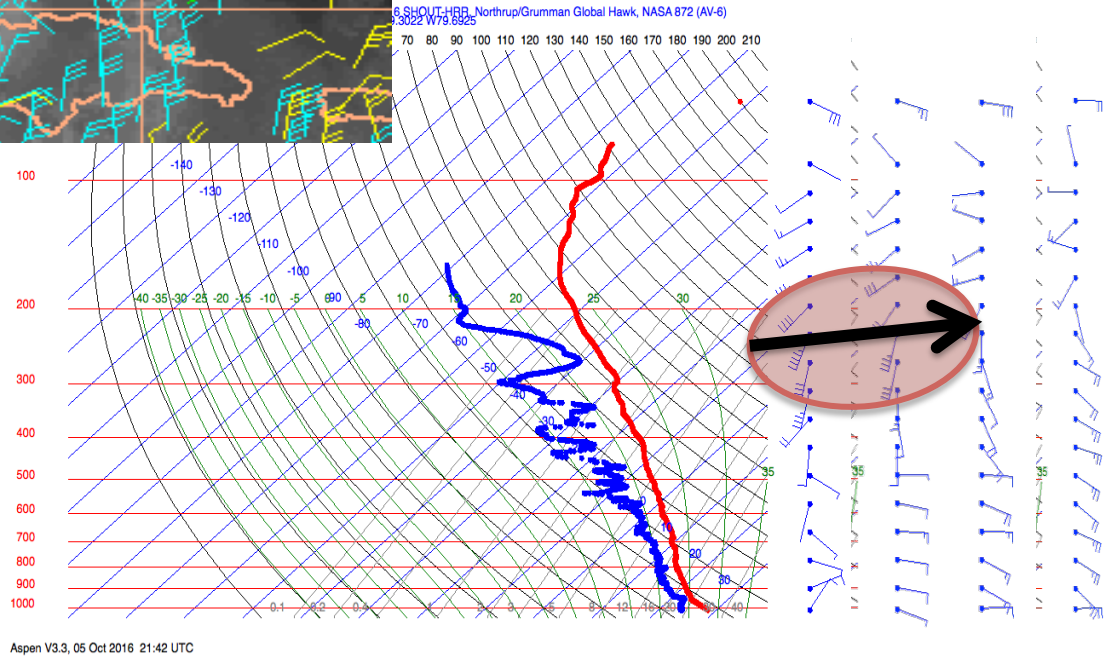
Transition of Hermine from TS (left) to Hurricane (right) On 1 Sept observed by HAMSR, HIWRAP and AVAPS sondes.

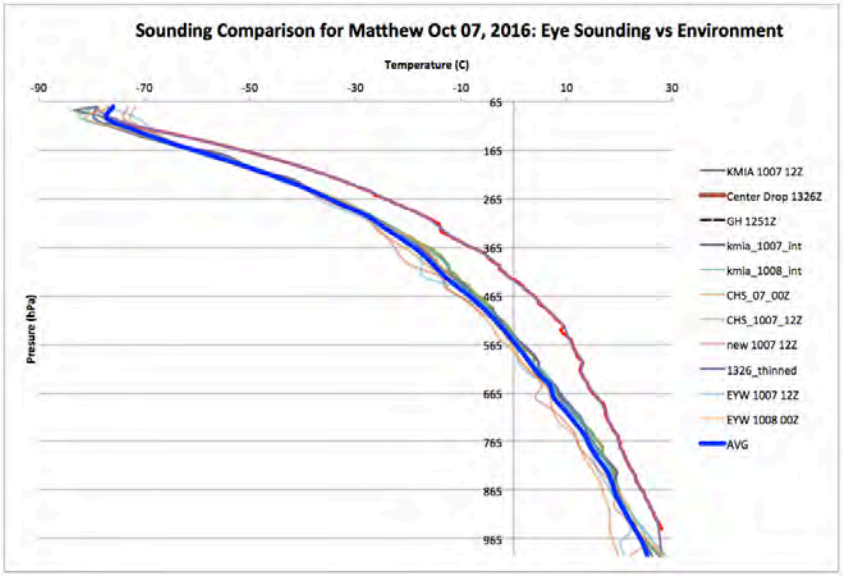
Horizontal temperature structure measured by HAMSR (left) and a [illegible] reflectivity profile sampled by HIWRAP (right) from Tropical Storm Hermine HAMSR results provided courtesy Mathias Schreier, JPL, and HIWRAP results provided courtesy Matthew McLinden, NASA Goddard.

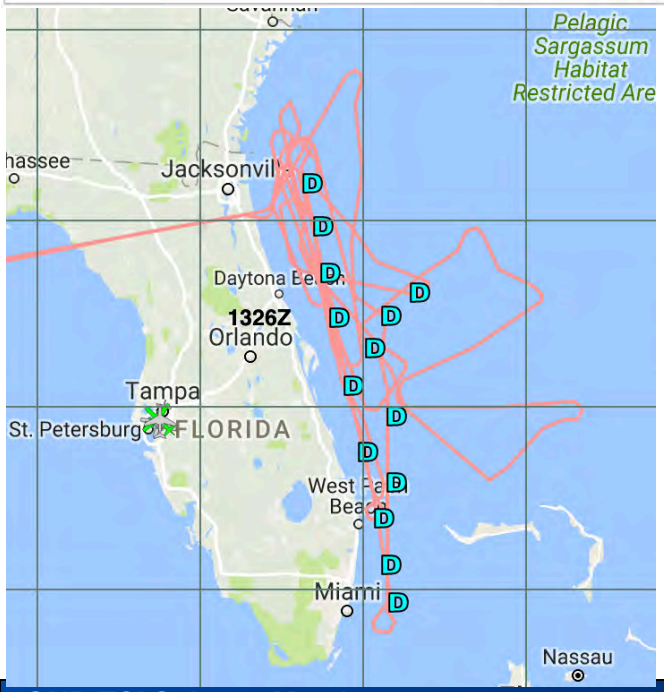


Hurricane Matthew
5 Oct, 2016
Outflow Channel
GH dropsonde profile

(dashed line is GH track)

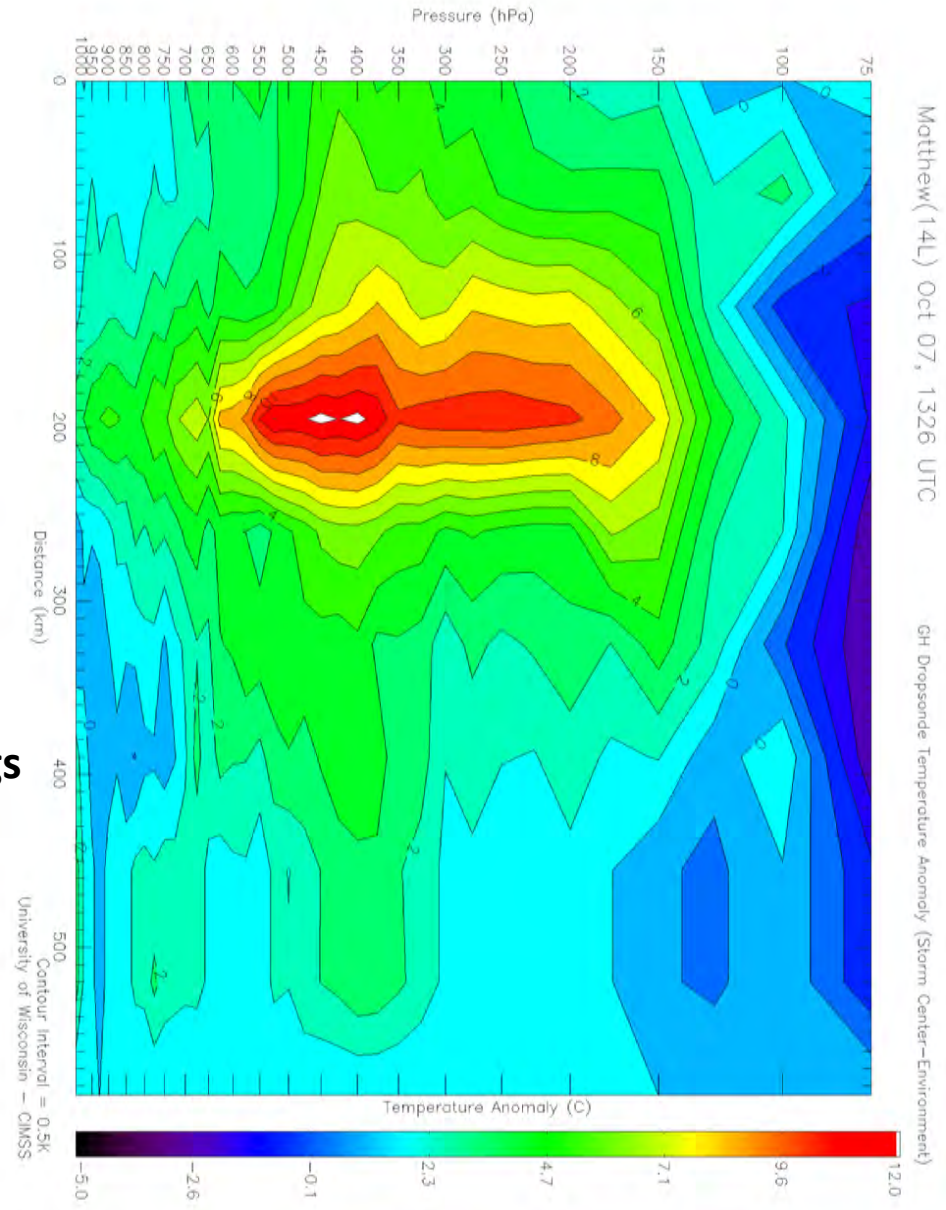






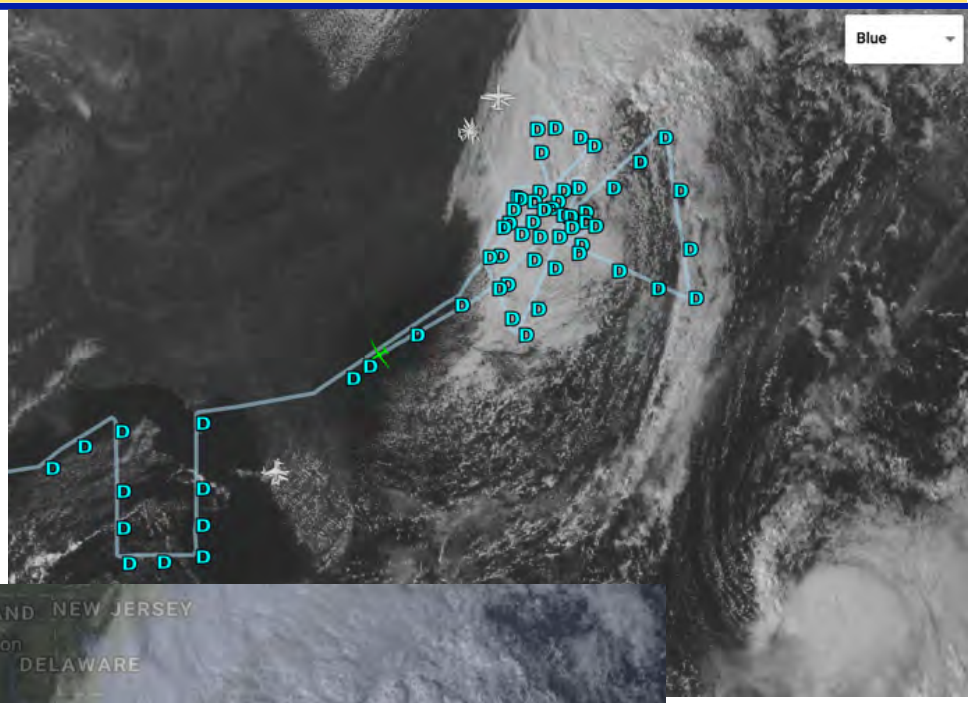
Hurricane Matthew Eye Soundings 7 Oct, 2016

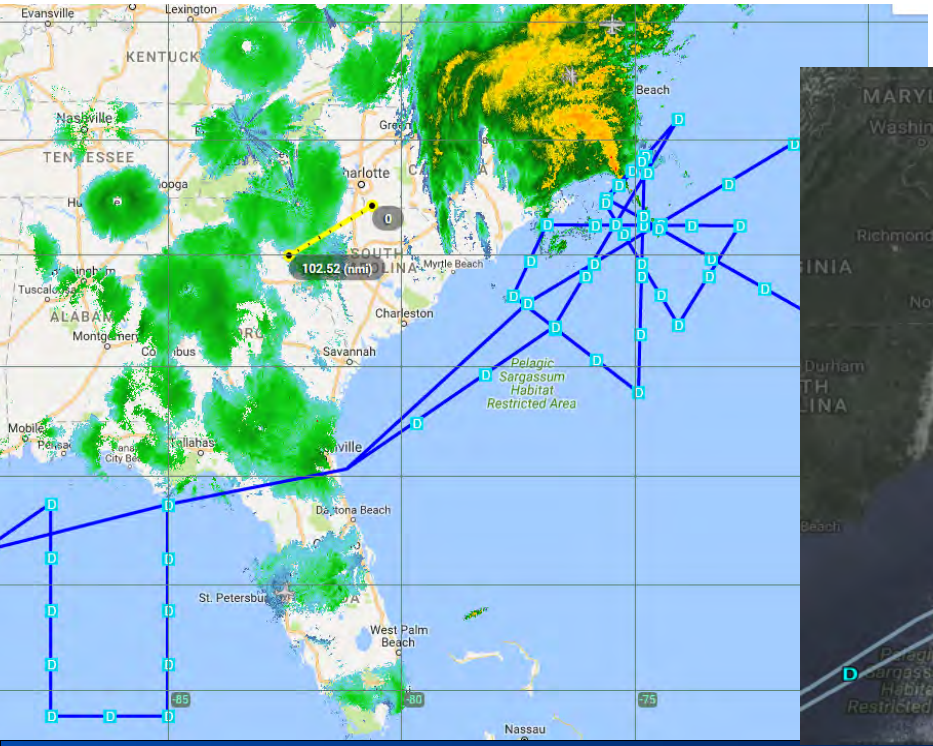
Courtesy
Derrick Herndon,
CIMSS

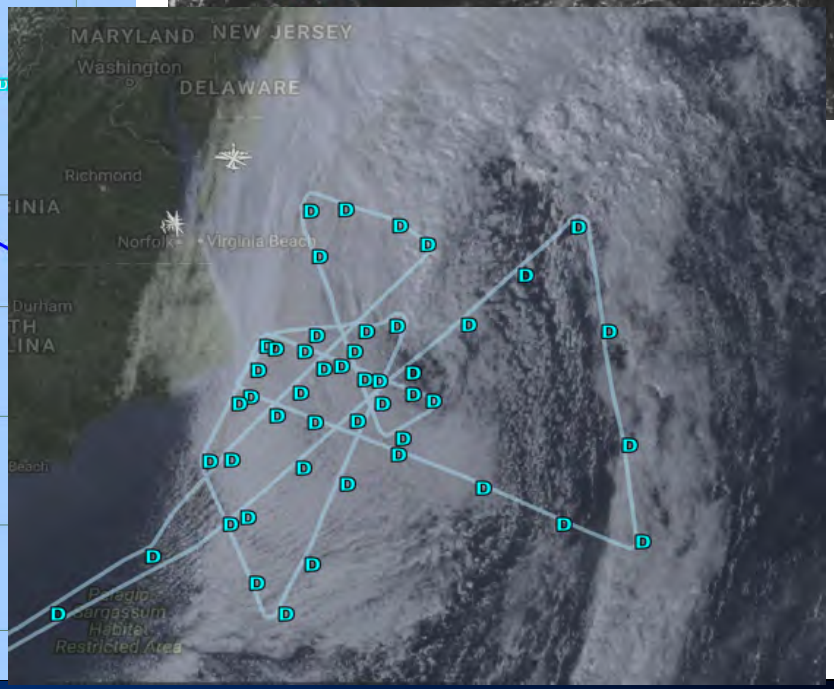


Hurricane Matthew during ET
9 Oct, 2016

GH Flight track as eyewall disappears
And flooding continues in North Carolina







Flight Plan Strategy Summary

1. Pattern alignment
   a. Storm-relative
   b. Shear-Relative
   c. Earth-relative
2. Feature-Relative
   a. Inner-core features
      i. Convective bursts
      ii. Outflow Roots
   b. Environmental features
      i. Outflow jets
      ii. Upper cold lows
      iii. Subtropical jet streaks
   c. Ocean features
      i. Pre-existing eddies
      ii. Cold wake
3. Pattern Temporal Phasing
   i. DA cycle
   ii. RI onset time
   iii. Diurnal convective/outflow surge onset
4. Collaborative Observation times
   i. Aircraft
   ii. Satellite