



# Hurricane and Severe Storm Sentinel (HS3)

A Multi-Year Investigation of Atlantic  
Hurricanes

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# Outline

- ▶ Science Goals
- ▶ Mission Overview
- ▶ Instruments
- ▶ Schedule
- ▶ Data policy



# Overarching Science Questions

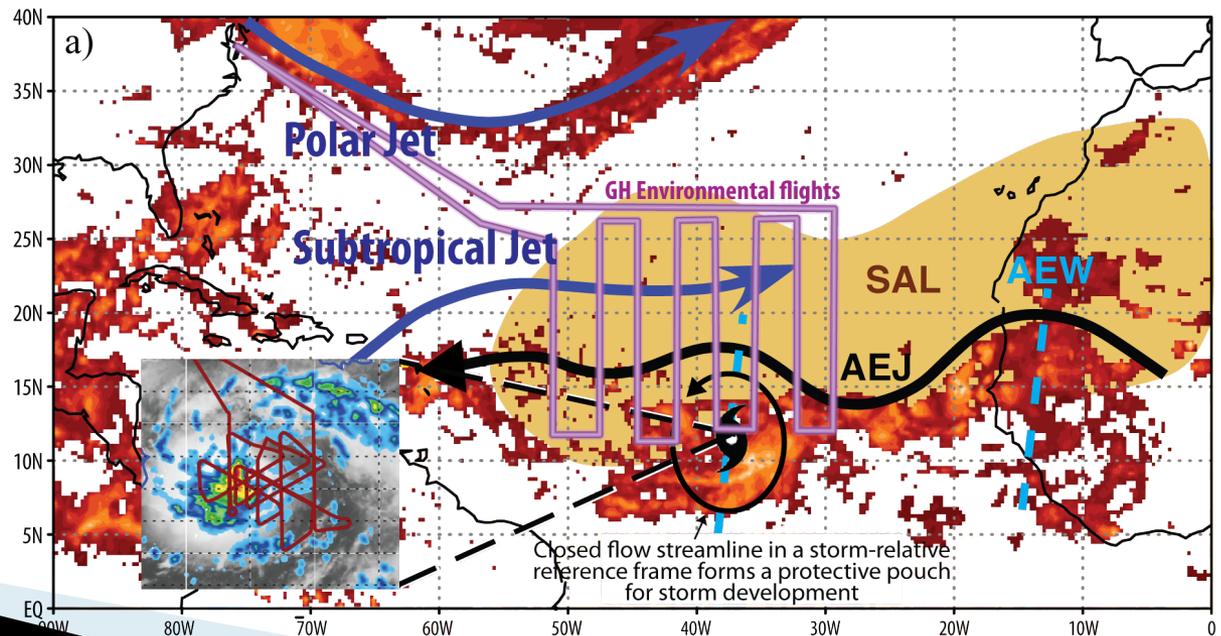


- What impact does the large-scale environment have on intensity change?
- What is the role of storm internal processes in intensification?
- To what extent are these processes predictable?

# Key focus of HS3 proposal—Environment

## The Saharan Air Layer

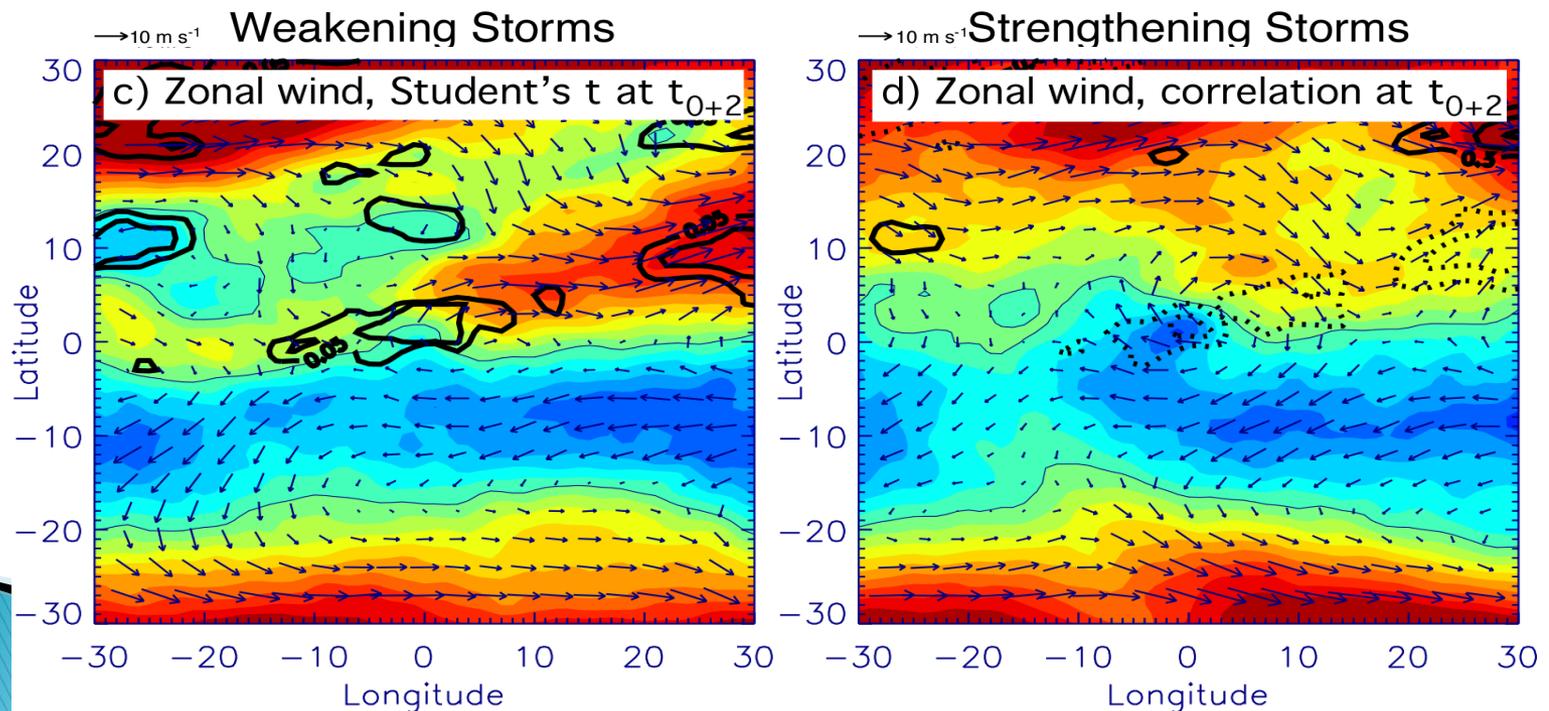
- Research has suggested both positive and negative influences on hurricane formation and development
- Hypothesis: Once TS formation occurs, the SAL is not a major determinant of subsequent intensification.
- Payloads for environmental GH selected specifically for this topic



# Key focus of HS3 proposal—Environment

## Environmental Winds

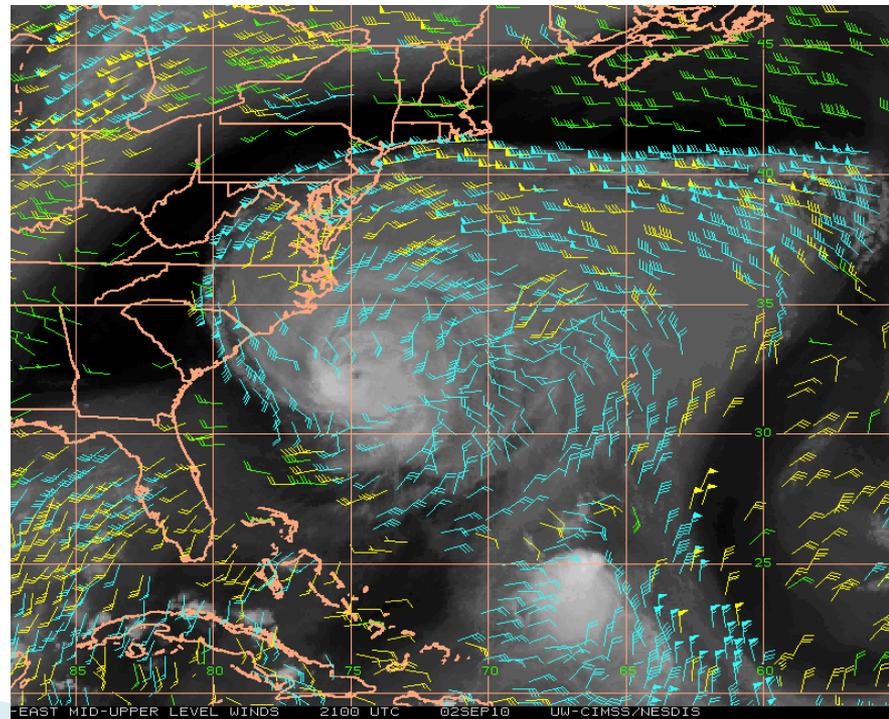
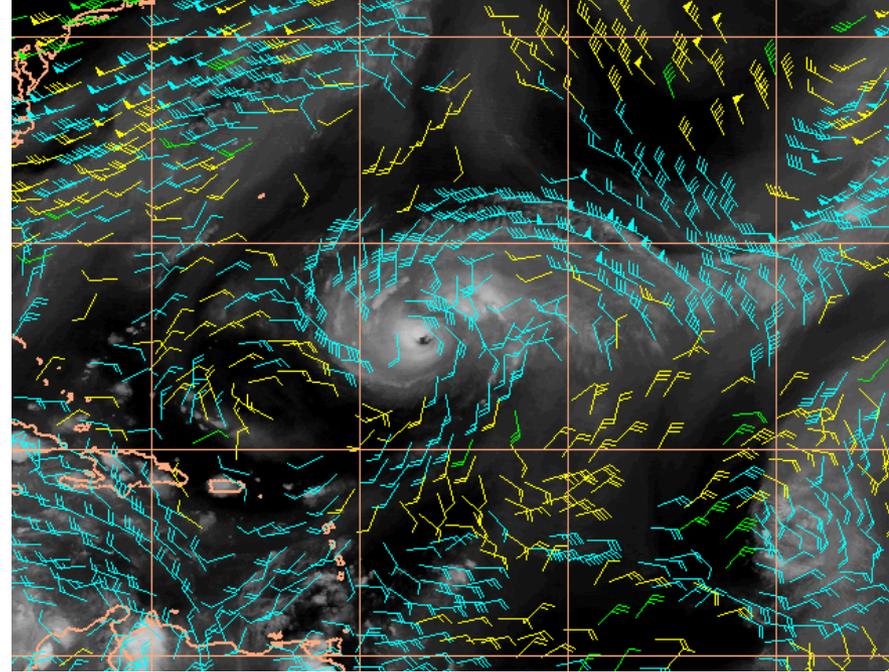
- Shear generally unfavorable, but sometimes beneficial
- Dependence on shear profile?
- Hypothesis: Potential for RI increased when upper-level westerlies are weak and when broad outflow is favored.



# Recent additional focus area

## Outflow Layer Interactions

- How does outflow interaction with the environment affect storm evolution?
- How does outflow modify the environment or impact other tropical disturbances?



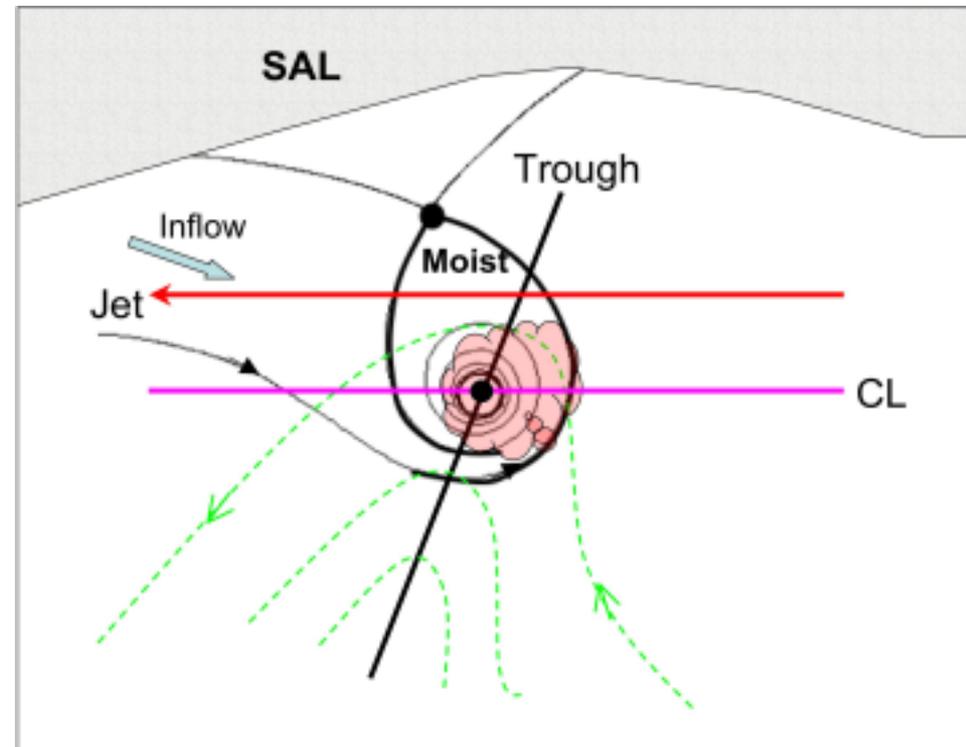
# Genesis and Pouch Theory

## Role of the pouch

- What is the structure of the pouch and how well does it protect incipient disturbances from the SAL?

HS3 will likely NOT answer questions related to

- Detailed evolution of the pouch
- Top-down/bottom-up development



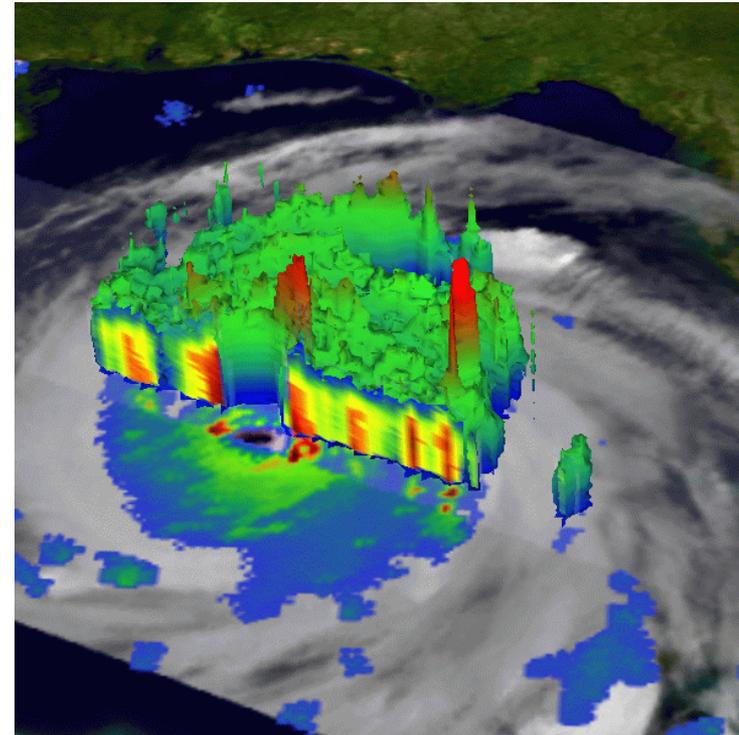
# Key focus of HS3 proposal—Inner Core

## Deep, Strong Convection

Are the deep towers the building blocks of the vortex or just contributing to the total mass flux needed for development?

Hypothesis: Hot towers actively contribute to genesis and RI through vortex tube stretching and convergence of low-level angular momentum.

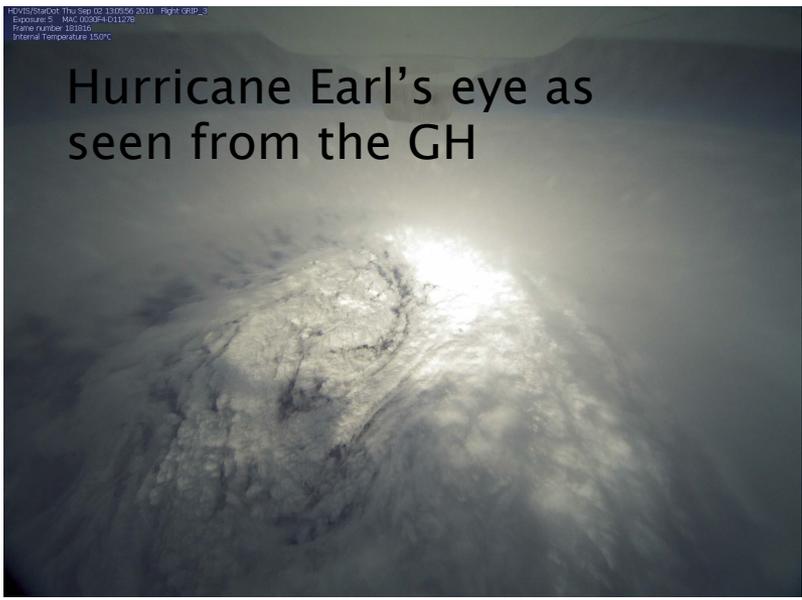
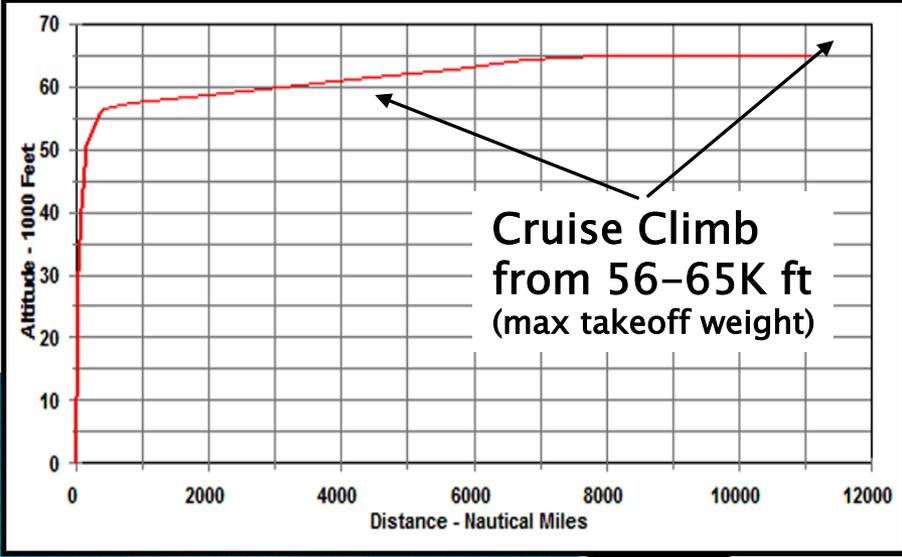
Over-storm payload chosen to measure the wind field response to convection and the formation/evolution of the warm core.





# NASA's Global Hawk UAS

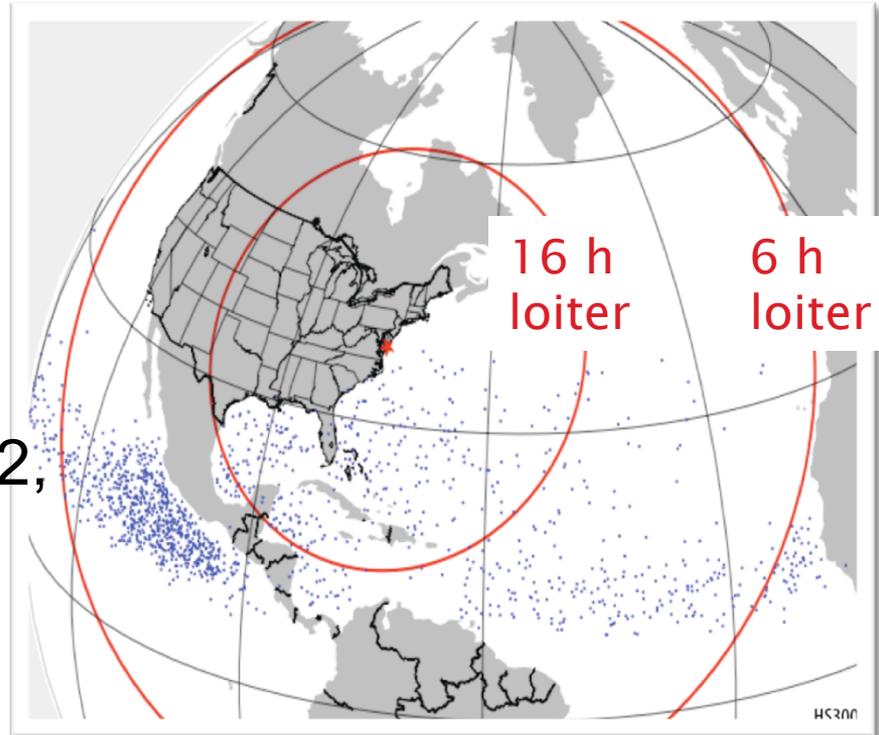
Endurance	> 30 hours
Range	>11,000 nmi
Service Ceiling	65,000 ft
Airspeed (55K+ ft)	335 KTAS
Payload	1,000-1,500 lb
Length	44 ft
Wingspan	116 ft





# HS3 Mission Overview

- Two aircraft, one equipped for the storm environment, one for over-storm flights
- Deployments of GHs from the East Coast— Wallops Flight Facility in VA
- One-month deployments in 2012, 2013, and 2014
- 275 flight hours per deployment (10-11 flights)



Dots indicate genesis locations. Range rings assume 26-h flights.

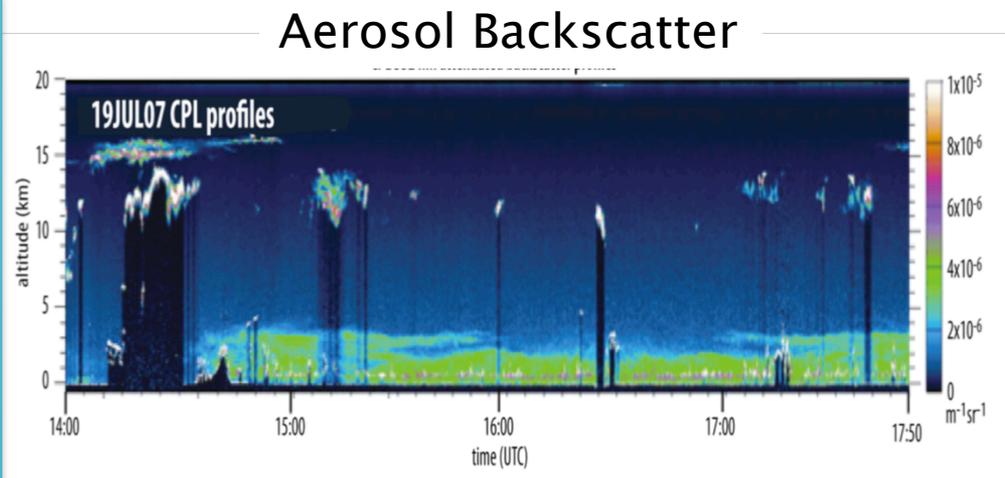
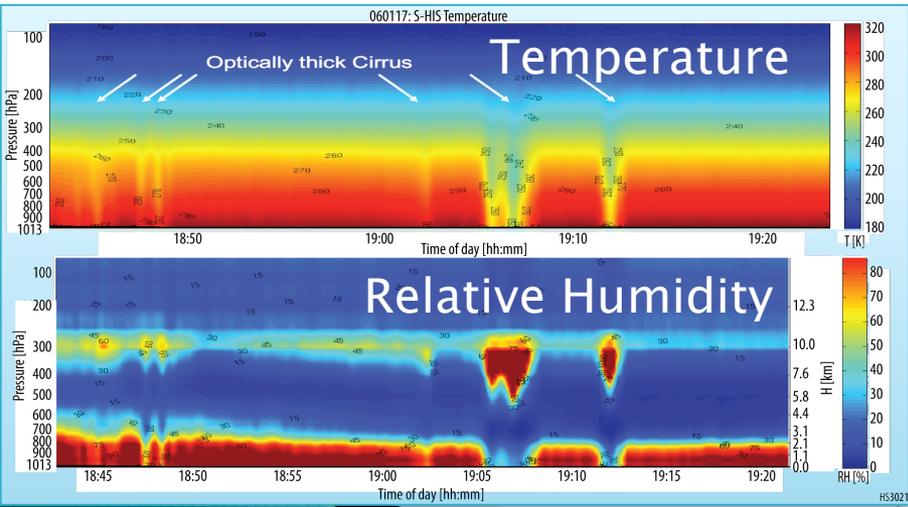
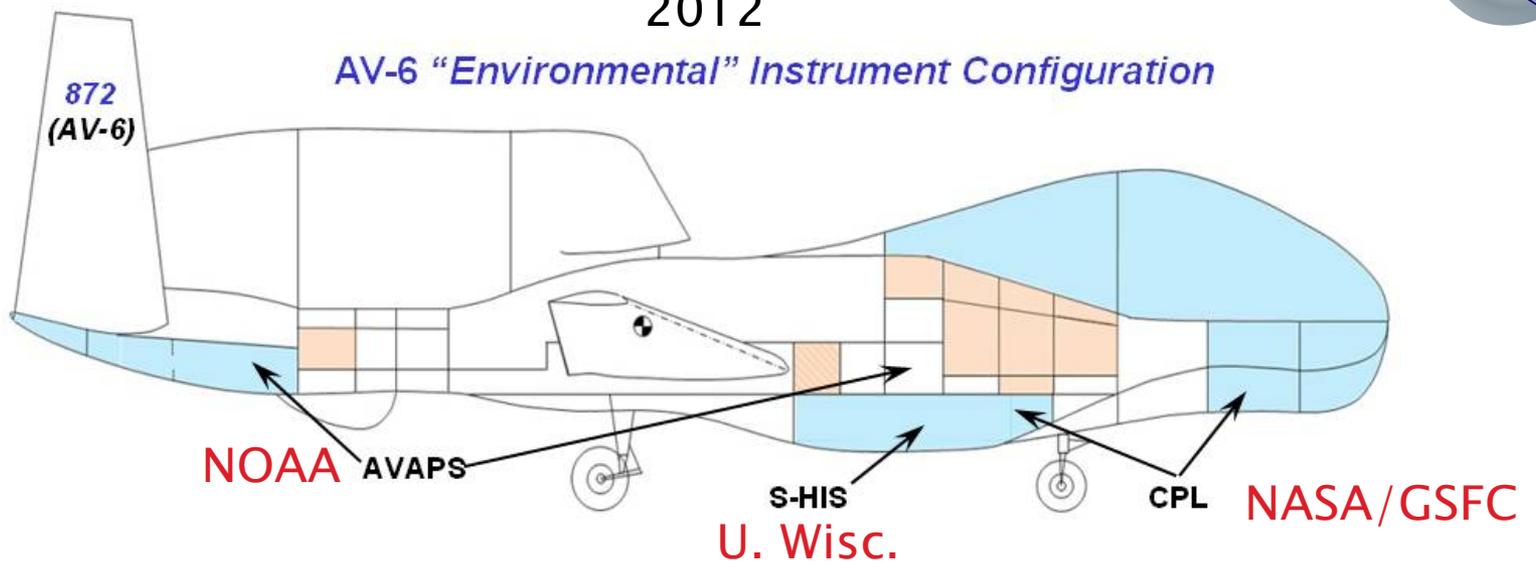


# Environmental Payload



2012

AV-6 "Environmental" Instrument Configuration



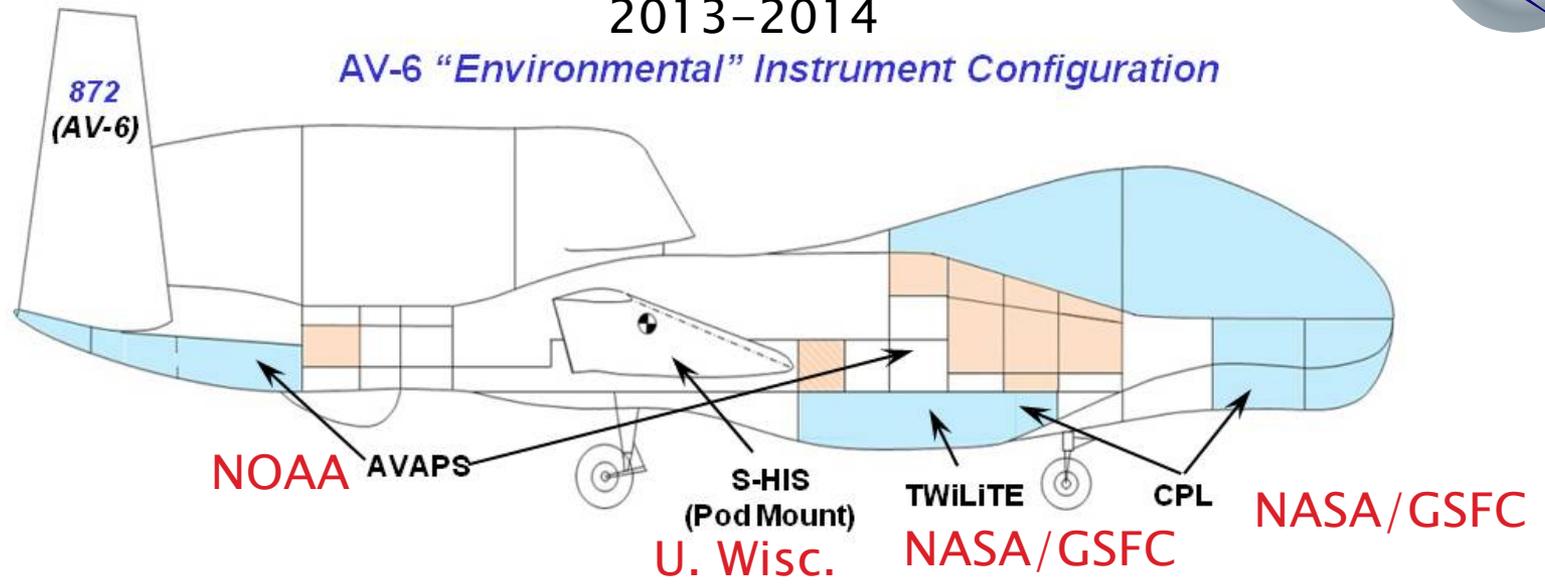


# Environmental Payload

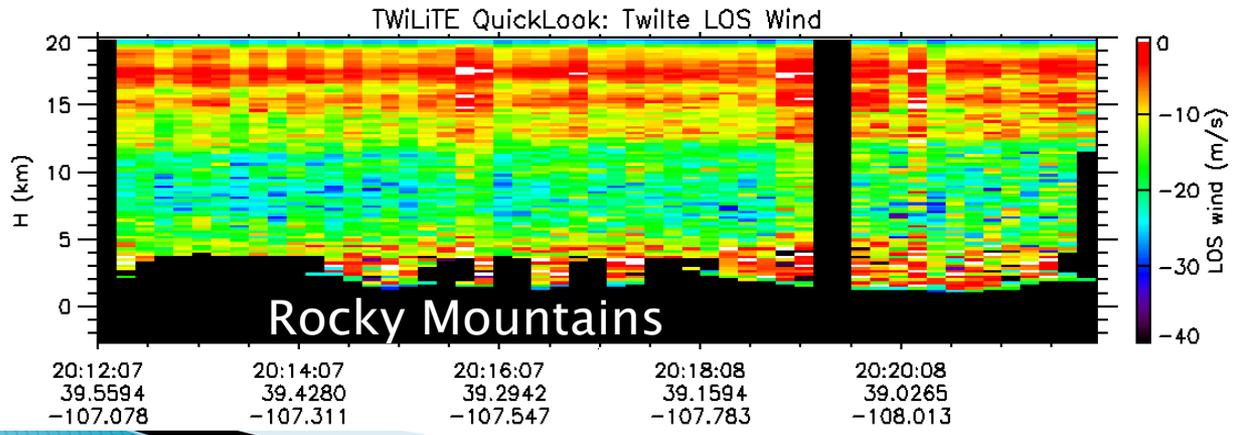


2013-2014

AV-6 "Environmental" Instrument Configuration



TWiLiTE wind lidar to be added in 2013



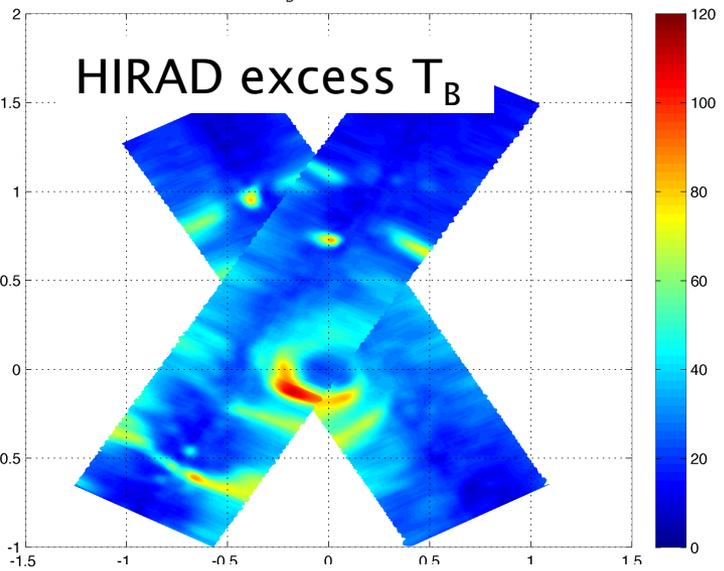


# Over-Storm Payload

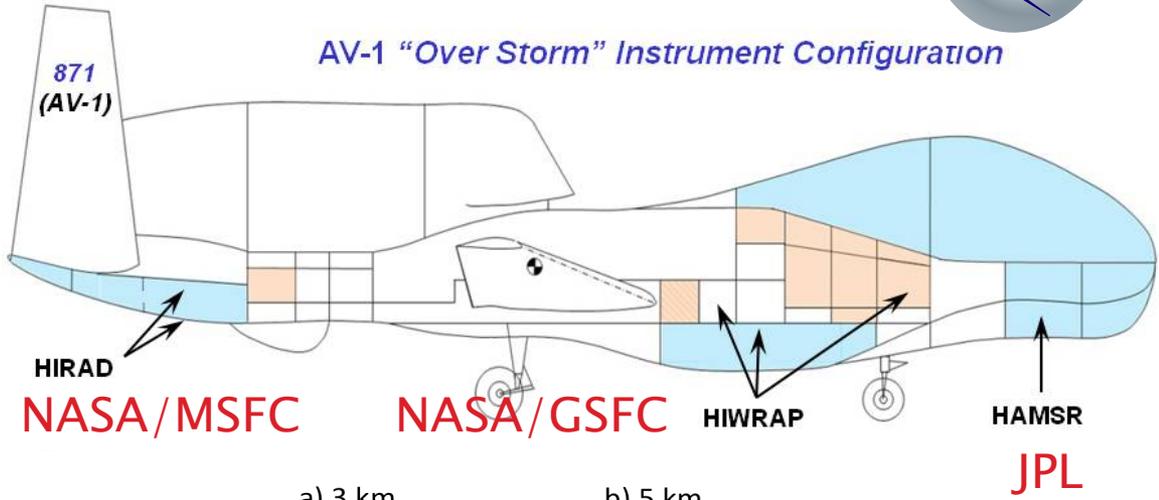


HIRAD 5 GHz excess  $T_B$  filtered 16 Sep Karl legs 4 and 2

### HIRAD excess $T_B$

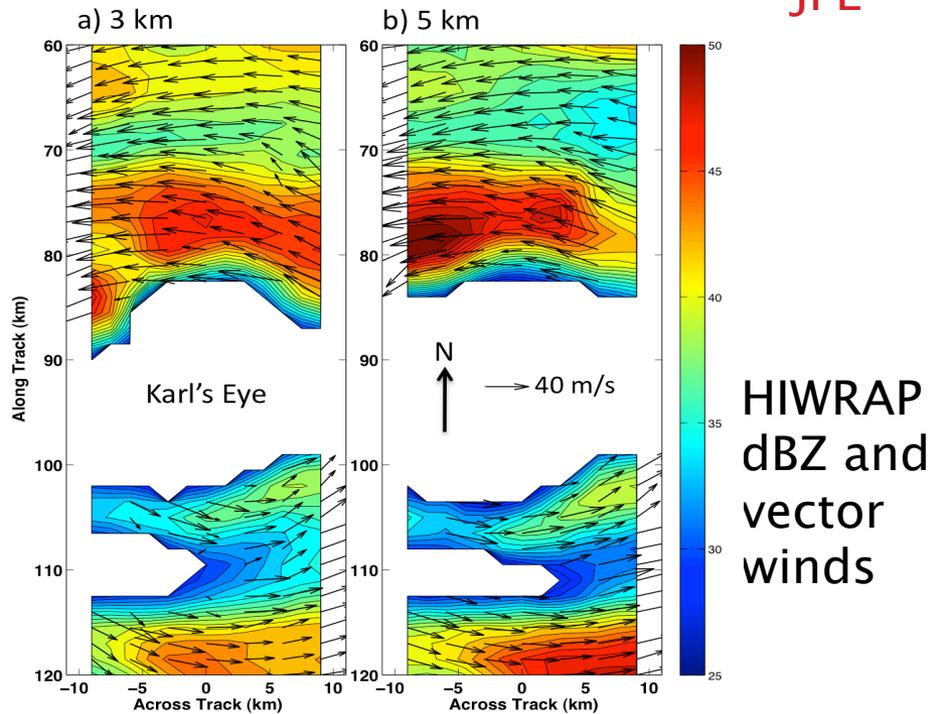
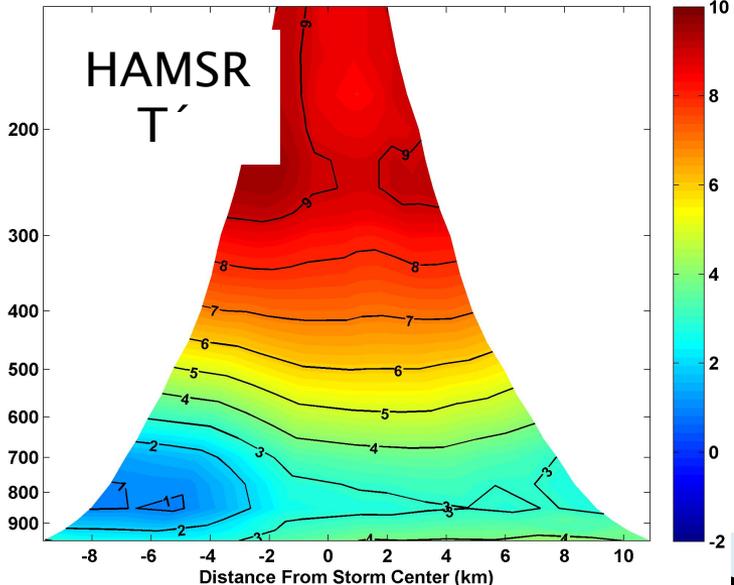


### AV-1 "Over Storm" Instrument Configuration



HAMSR Derived Warm Core Anomaly for Karl 2010 17-Sep-2010 06:44:05

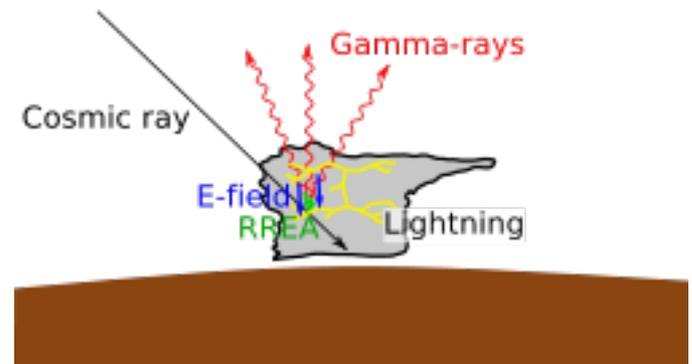
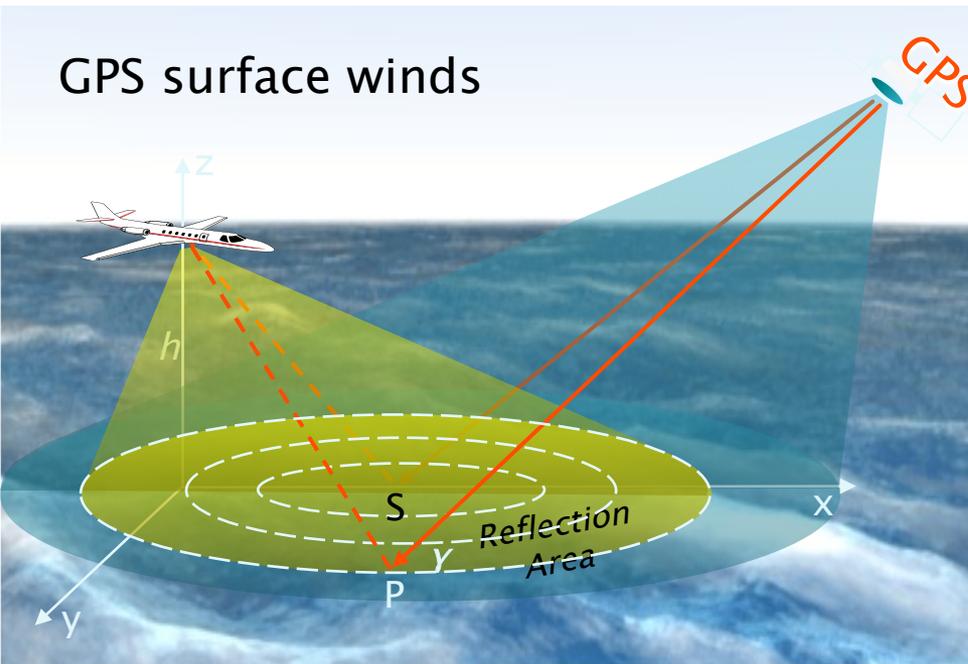
### HAMSR $T'$



# Possible Piggybacks for 2013–2014

- ▶ Yankee Environmental Systems dropsonde
- ▶ GPS surface wind sensors
- ▶ Gamma ray detector

GPS surface winds





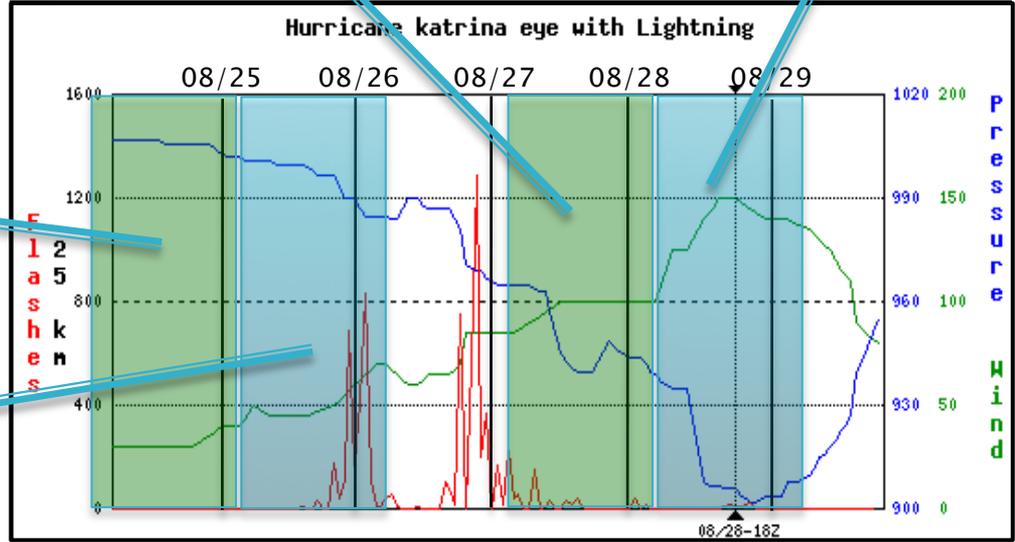
# HS3 Mission Overview

- Environmental and Over-Storm GH flights will not be simultaneous, but in series
- ~48-h turn around time

• Outflow interaction with environment

• Warm core structure

Over-Storm GH  
Environmental GH



• Favorability of environment

Convective structure at onset of intensification

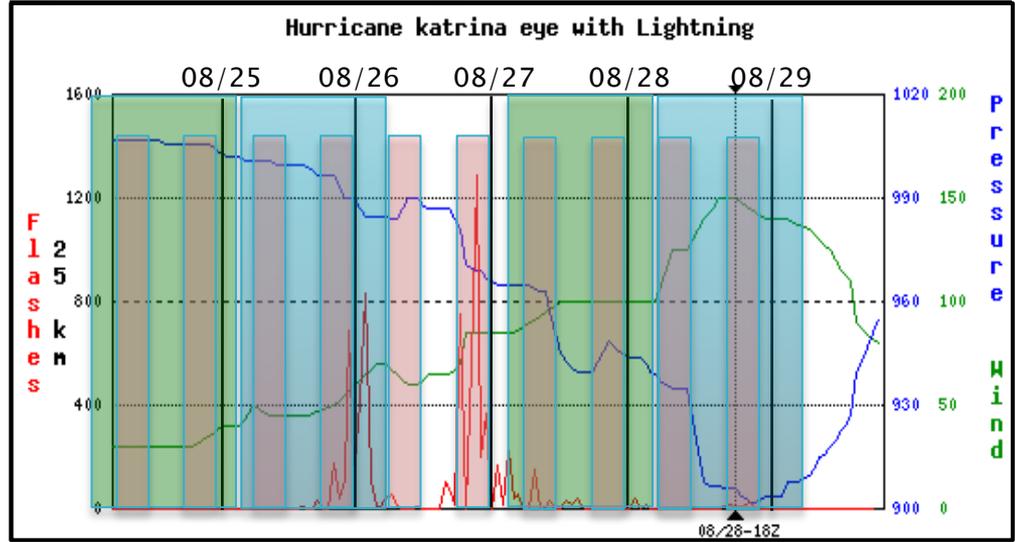
Blue line: Minimum SLP  
Green line: Max wind speed  
Red line: Lightning occurrence



# HS3 Mission Overview

- Environmental and Over-Storm GH flights will not be simultaneous, but in series
- ~48-h turn around time
- Collaboration with NOAA very important

■ Over-Storm GH  
■ Environmental GH    ■ NOAA P-3 (on-station only)



Blue line: Minimum SLP  
 Green line: Max wind speed  
 Red line: Lightning occurrence



# Schedule

## ▶ 2012

- Env. GH Sept. 1 to Oct. 5
- Over-storm GH Sept. 8 to Oct. 5

## ▶ 2013–2014

- Integration of TWiLiTE, piggybacks in 2013
- Science flights: Aug 22–Sept 22



# HS3 Data Plan

- ▶ All data to be publically available
- ▶ Some data products to be made available in real time
- ▶ Following each deployment, ~6–9 months for data QC, processing
  - Includes all Level-1 and higher products



Instrument	Data Product	Description	Data Delivery Date
HIWRAP	Level 1	Calibrated reflectivity, Doppler velocity	3 months
HIWRAP	Level 2	Radial coordinate products including VAD, surface winds	6-9 months
HIWRAP	Level 3	Gridded reflectivities, winds	Mission close out
HAMSR	Level 1	Calibrated radiances	3 months
HAMSR	Level 2	Retrieved temperature and humidity, precipitation profiles	6-9 months
HIRAD	Level 1	Calibrated radiances	3 months
HIRAD	Level 2	Retrieved surface wind speed and rainfall rate	6-9 months
S-HIS	Level 1	Calibrated radiances	3 months
S-HIS	Level 2	Retrieved profiles of temperature and humidity	6-9 months
CPL	Level 1	Calibrated 1064 and 532 nm backscatter	3 months
CPL	Level 2	Cloud and aerosol 1064 and 532 nm extinction, optical depth, and lidar ratio	6-9 months
Dropsonde	Level 1	Quality controlled profiles of temperature, humidity, winds	3 months
TWiLiTE	Level 1	Calibrated backscatter and radial velocities	3 months
TWiLiTE	Level 2	Retrieved horizontal wind velocities, direction	6-9 months

# Goals of this meeting

- ▶ Review instrument status
  - ▶ Discuss real-time products and possible PREDICT-style data catalog
  - ▶ Lessons learned from 2011 dry run and test flights
  - ▶ Review science goals
  - ▶ Discuss operational strategies
  - ▶ Go over deployment details
  - ▶ Tour WFF
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