Opportunities for Validating AIRS Products from South Pole to Tropics using Dropsonde Data

Outline:

1. Available long-term dropsonde data
2. Validation of AIRS products
3. Other potential opportunities

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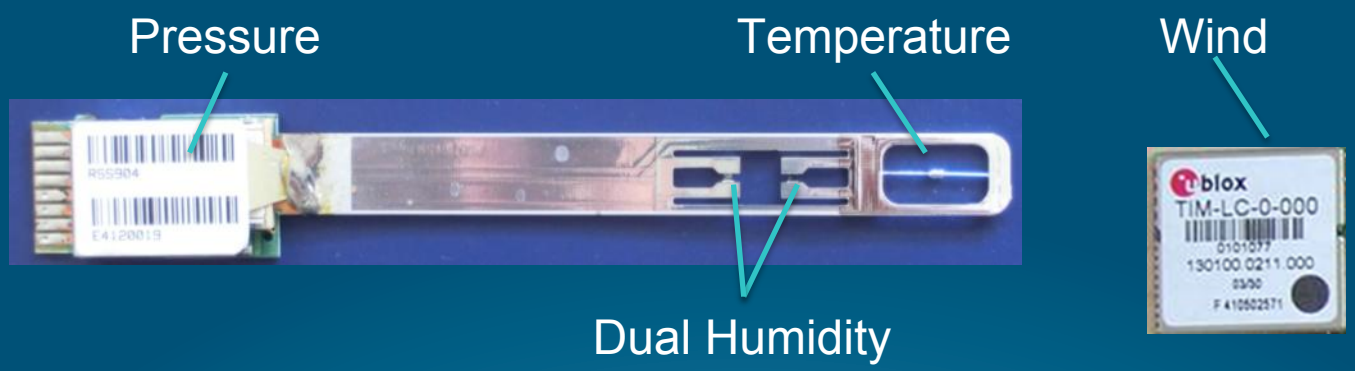
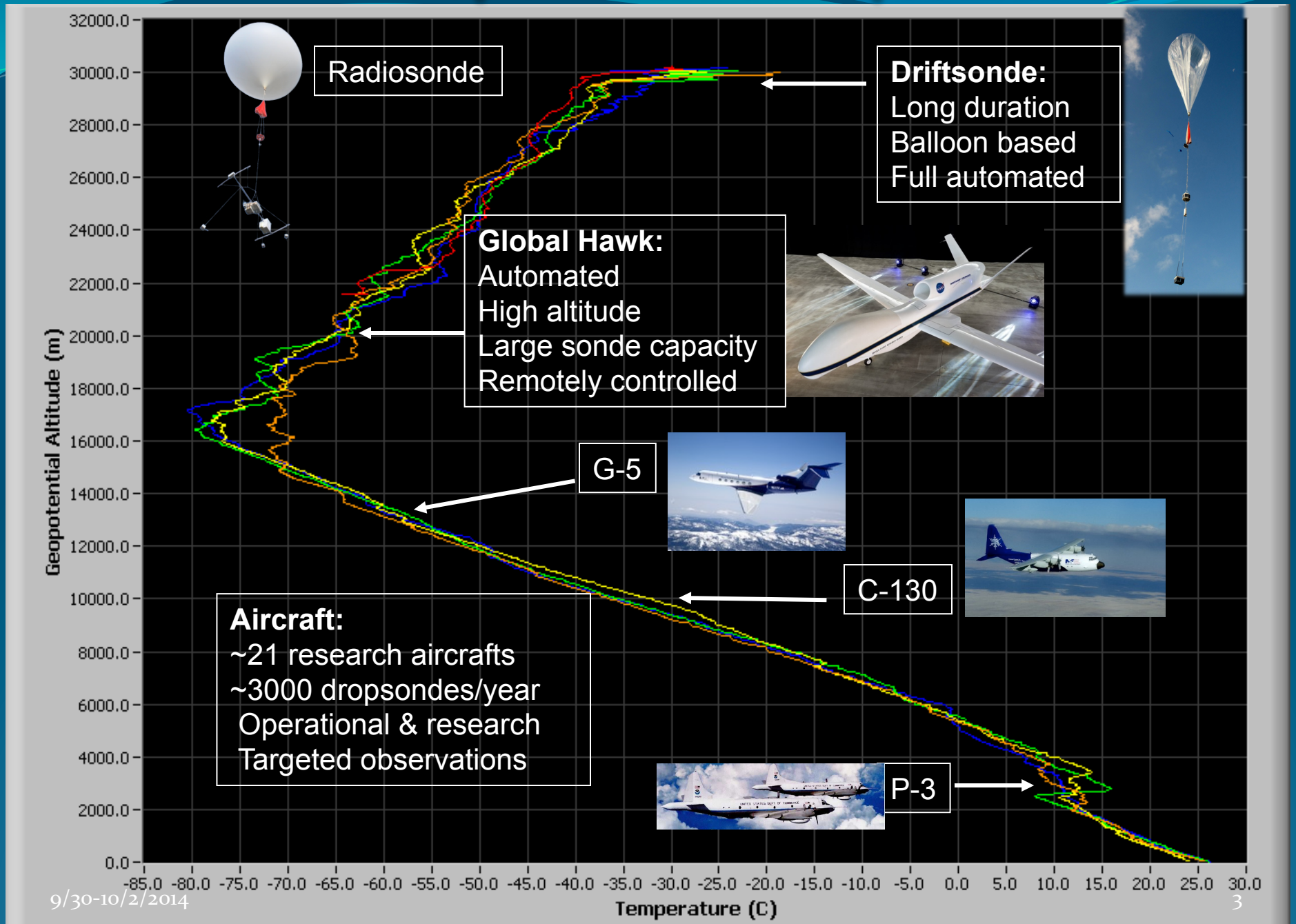
Dropsonde Measurements

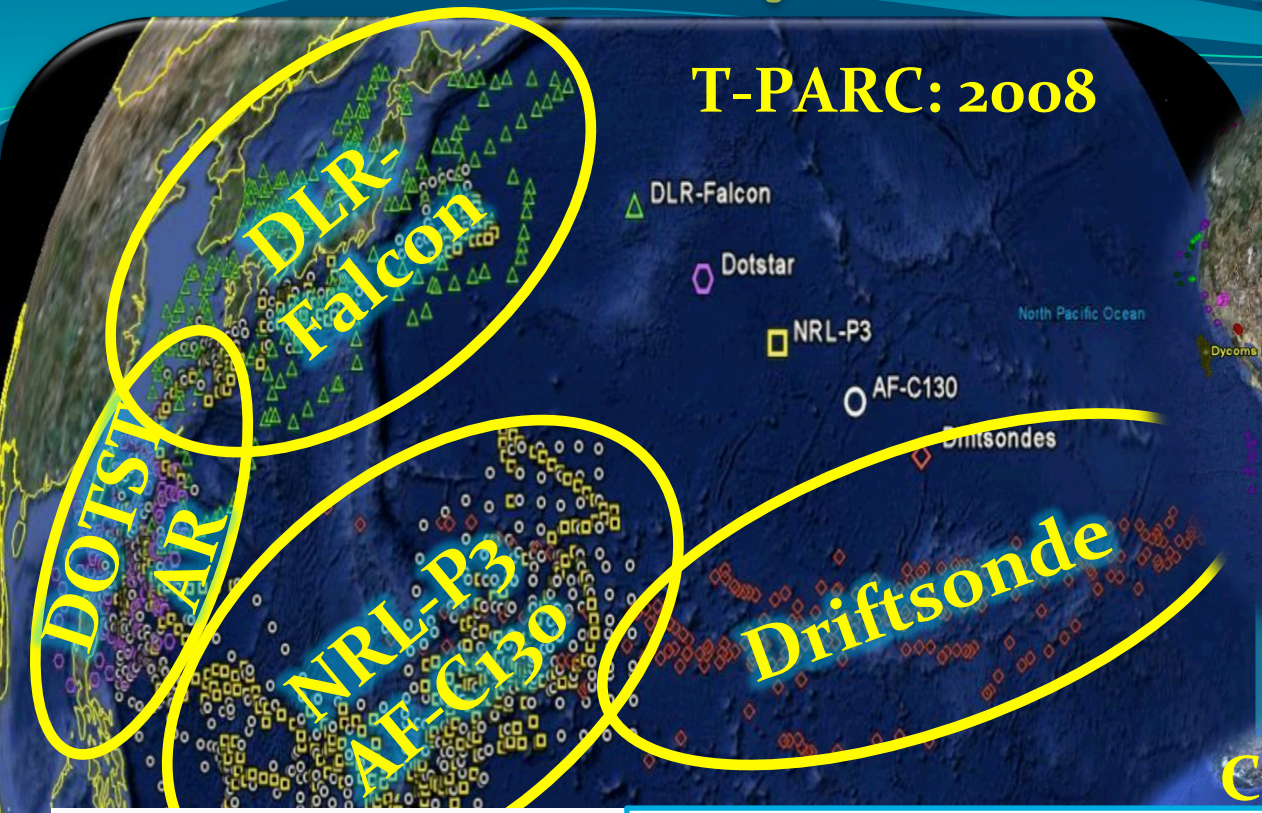


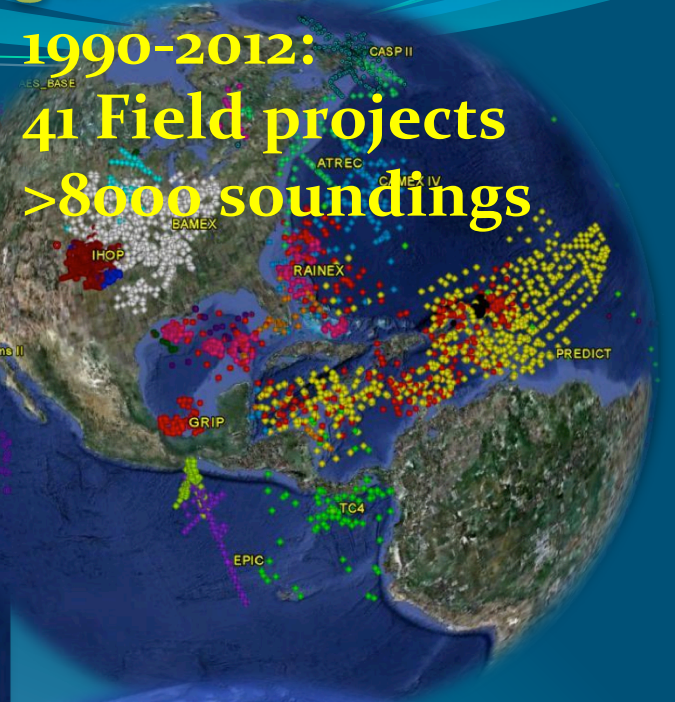
	Range	Vertical resolution	Precision	Repeatability	Bias
Pressure (hPa)	1080-3	2Hz (~5-15m)	0.01	0.4	-0.35 (corrected)
Temperature (C)	-90 ~ 60	2Hz	0.01	0.2	0.1
Relative humidity (%)	0~100	2Hz	0.1	2	Dry bias?
Wind speed (m/s)	0-100	4Hz (~3-8 m)	0.01	0.1	none

Multiple Platforms & Capabilities

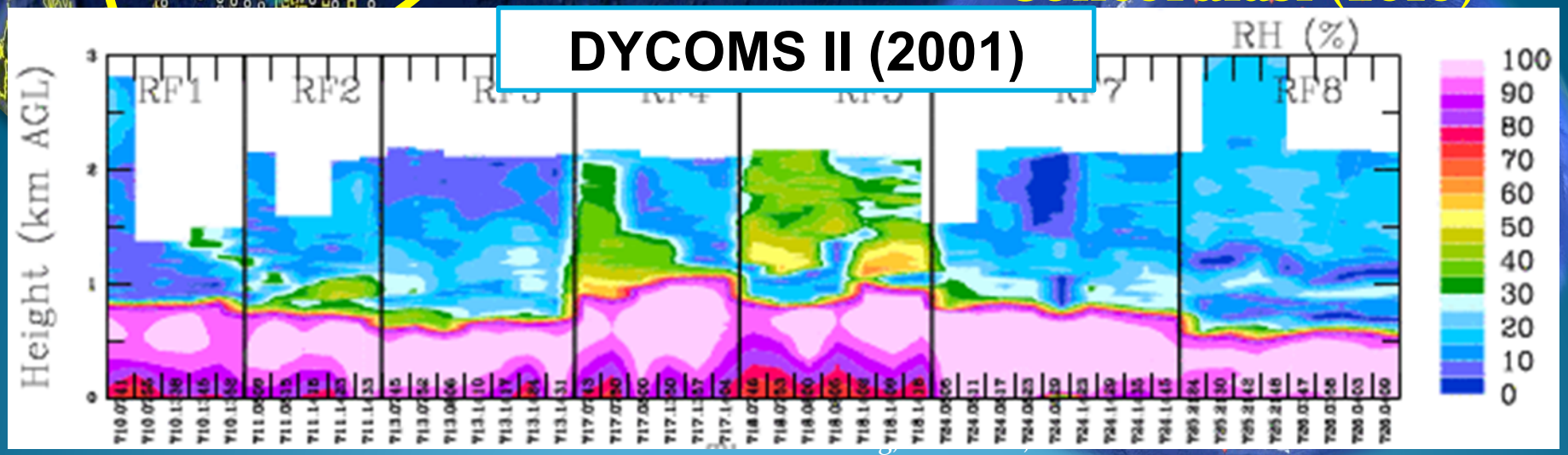


Global Operations & Longer Duration



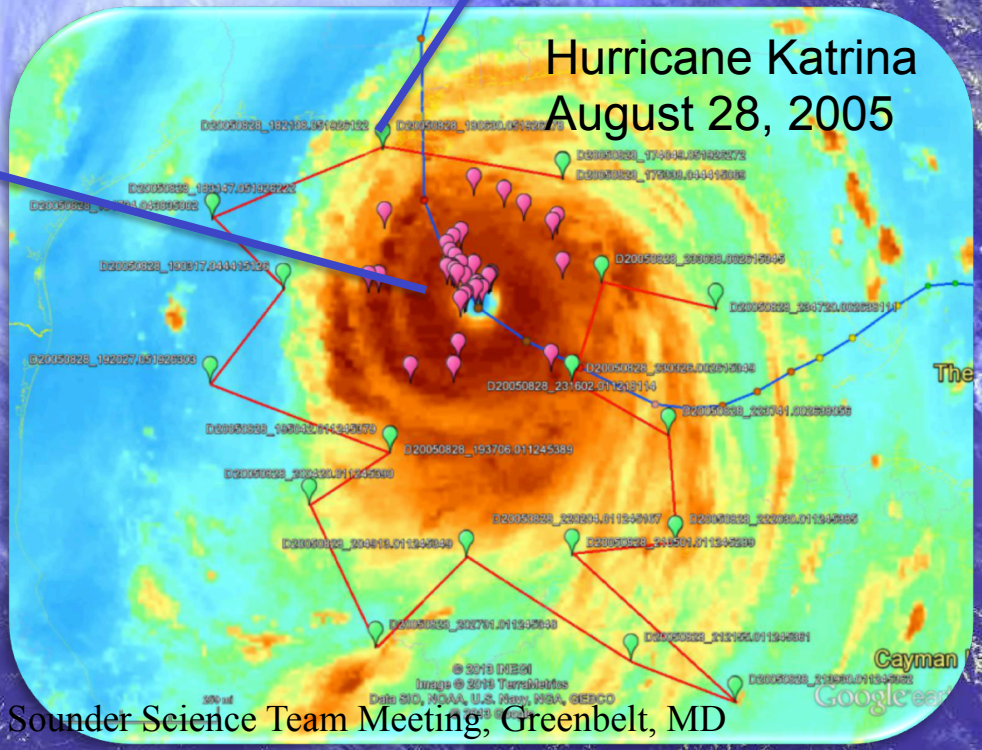


Concordiasi (2010)

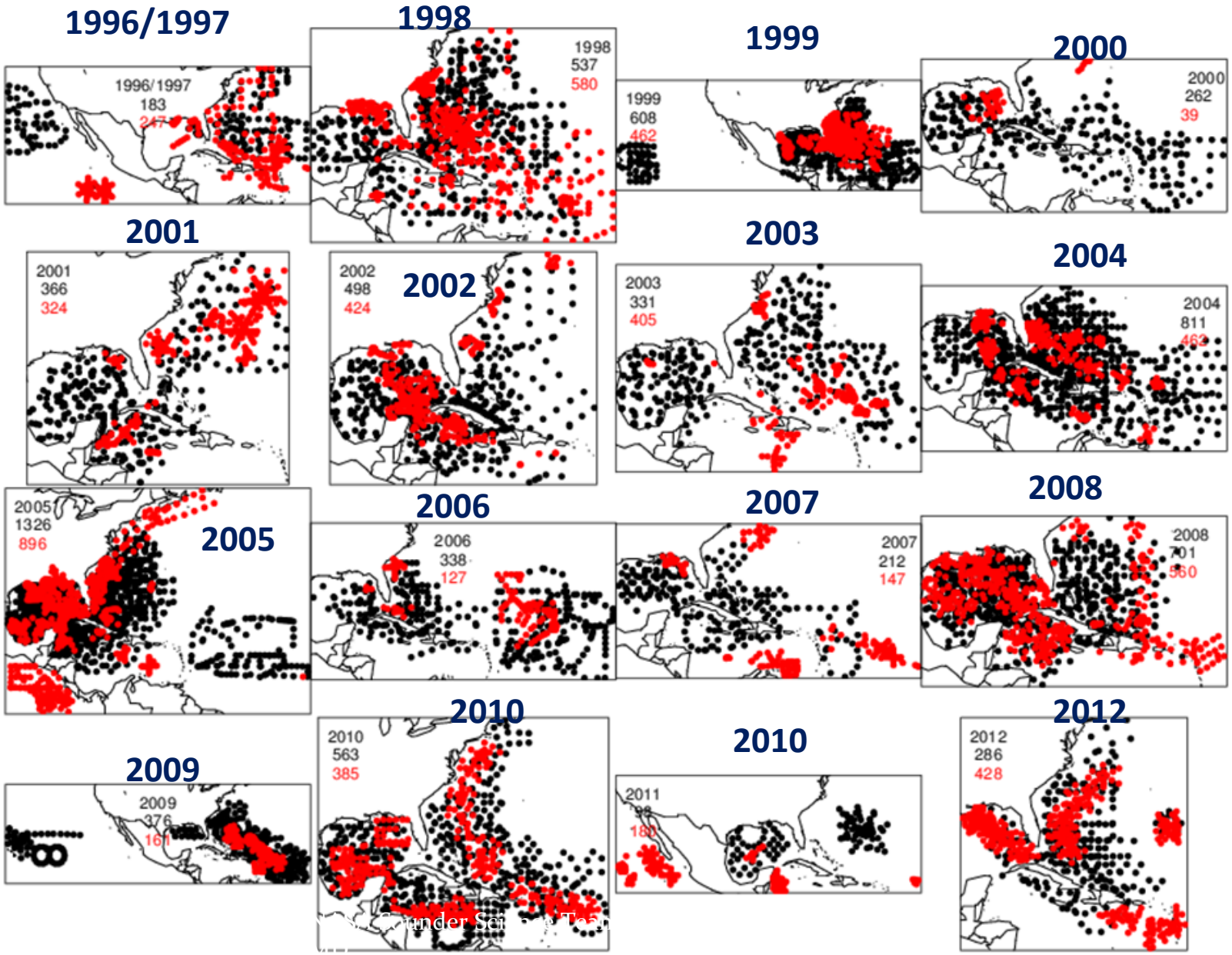


Hurricane and Dropsonde

Hurricane Observations:
Satellites
Ships and Buoys
Land-based Observations
Aircraft Reconnaissance

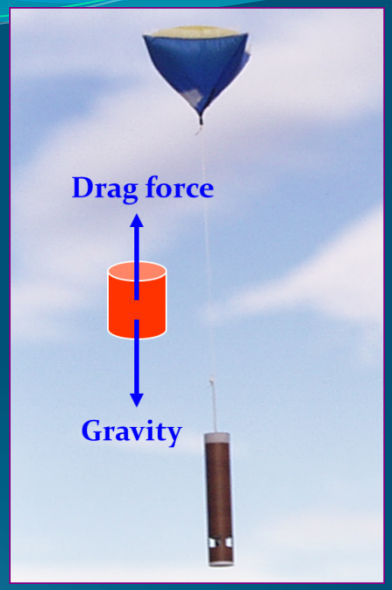


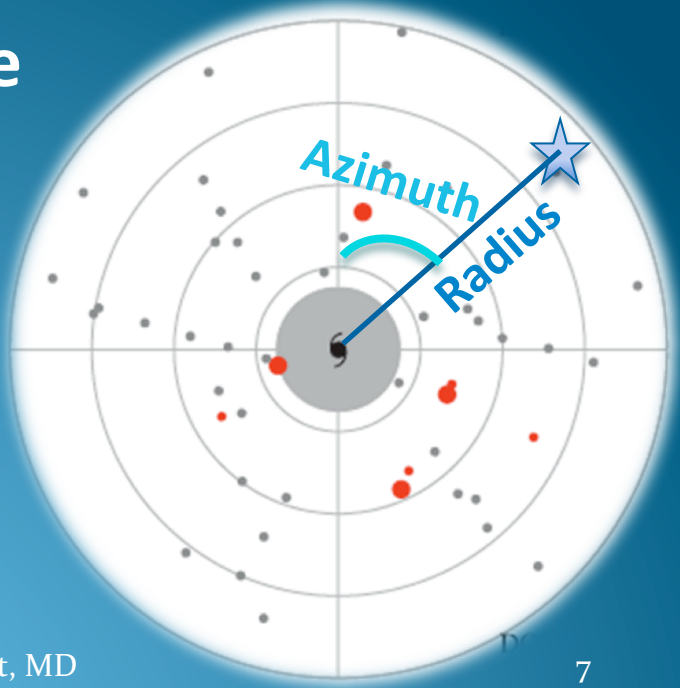
NOAA G-IV & P3, 1996-2012

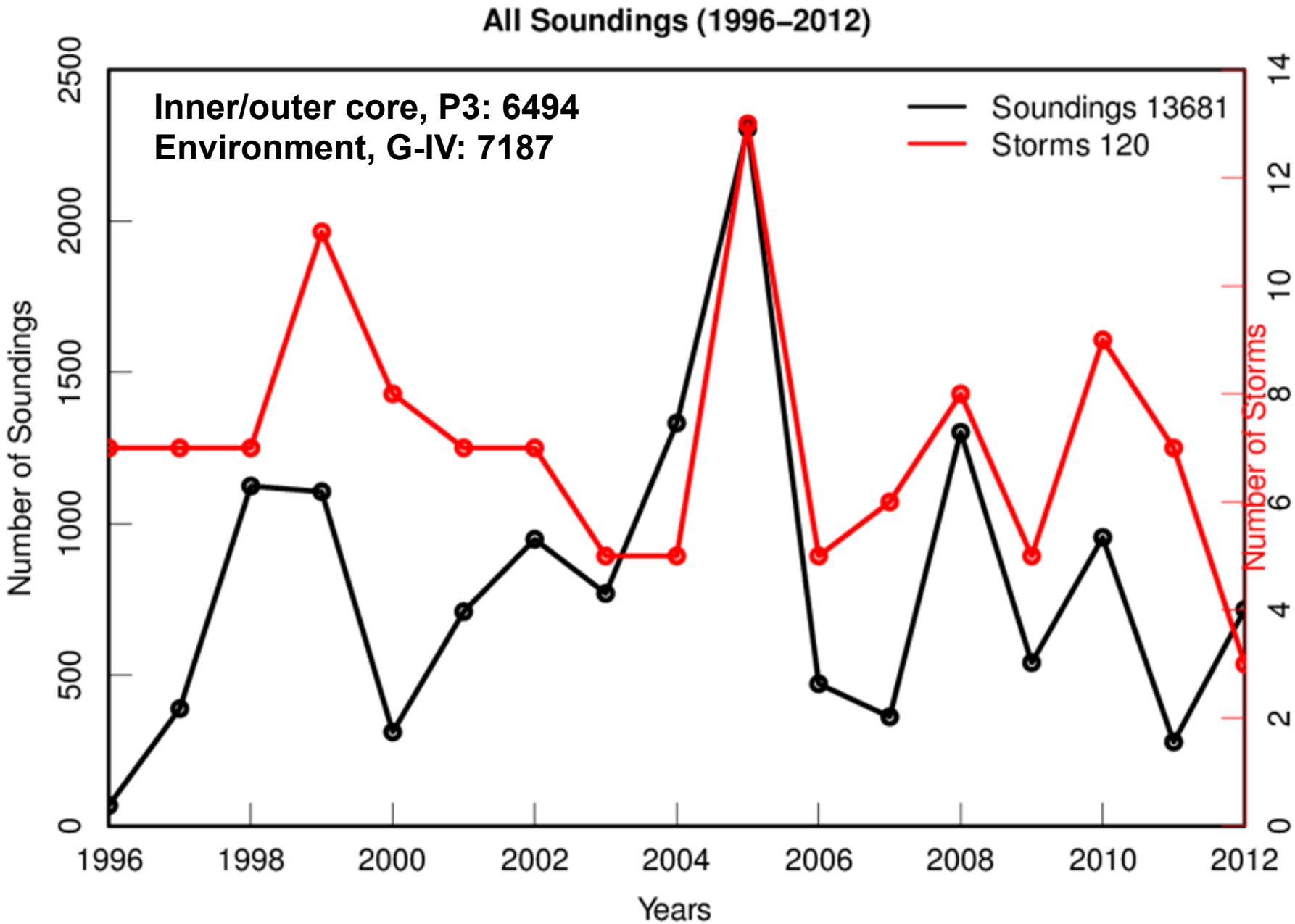


Value Added Products

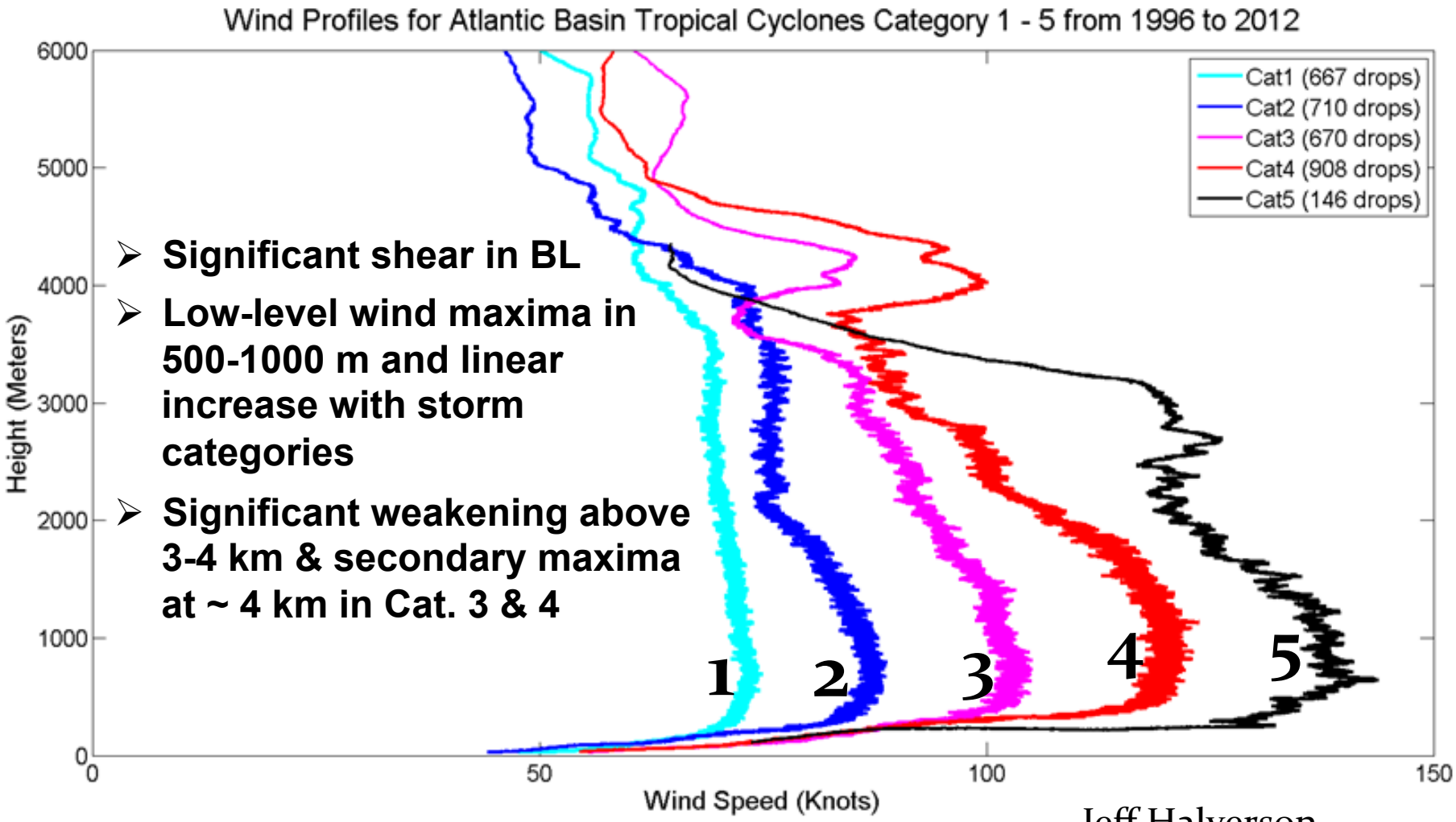
- **Vertical air velocity: Difference between measured and still air fall rates.** Still air fall rate is a function of mass, parachute size, drag coefficient, air density (Wang et al. 2009).
- **Radius: Determined by the spherical distance from the storm center to the sonde location.**
- **Azimuth angle: Determined trigonometrically from the latitudes and longitudes of the storm center and the sonde.**






All Soundings (1996–2012)
Inner/outer core, P3: 6494
Environment, G-IV: 7187
Soundings 13681
Storms 120
Number of Soundings
Number of Storms
Years
0
500
1000
1500
2000
2500
0
2
4
6
8
10
12
14
1996
1998
2000
2002
2004
2006
2008
2010
2012

Composite wind profiles (2,300 P3)

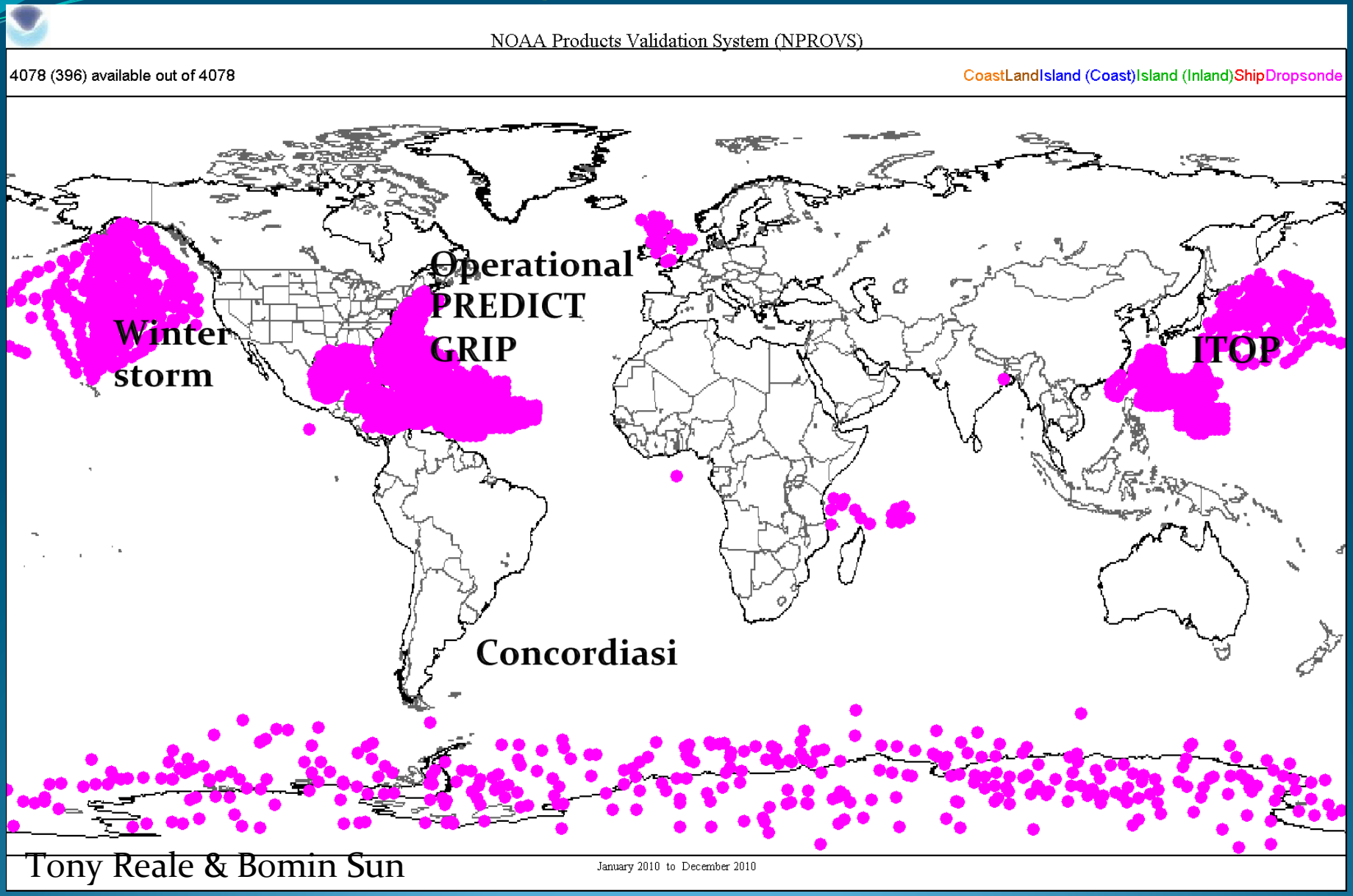


- Significant shear in BL
- Low-level wind maxima in 500-1000 m and linear increase with storm categories
- Significant weakening above 3-4 km & secondary maxima at ~ 4 km in Cat. 3 & 4

Jeff Halverson

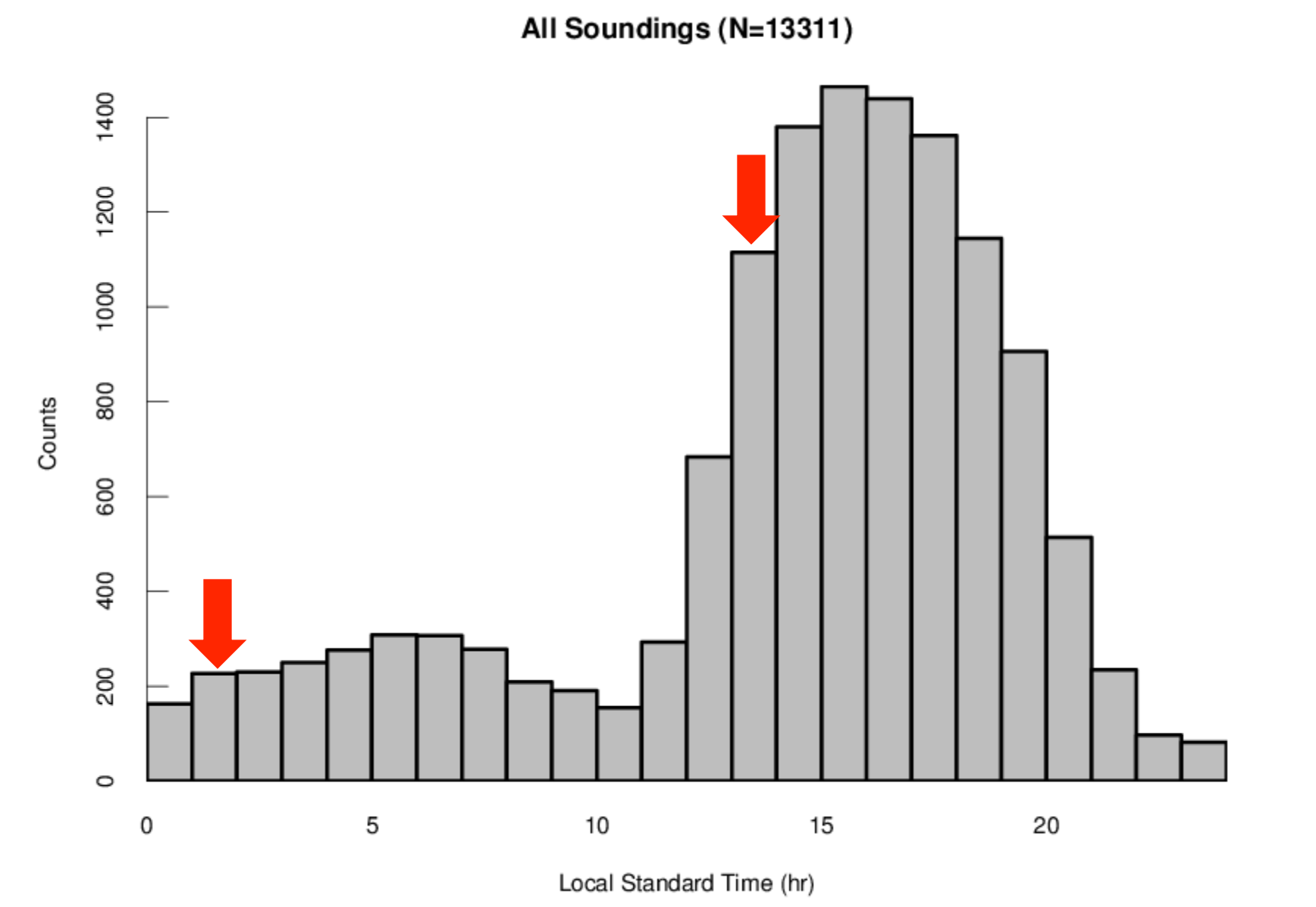
Satellite Validations using NOAA NPROVS

4078 Dropsonde Soundings matched with satellite profiles in 2010

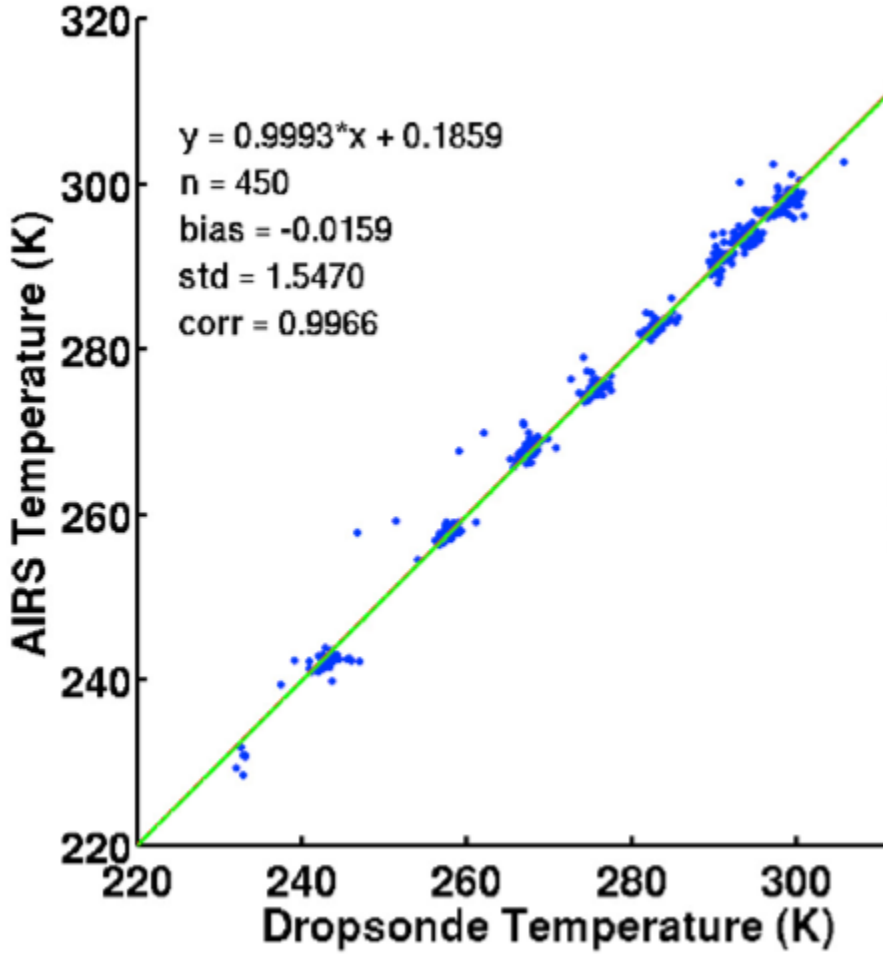


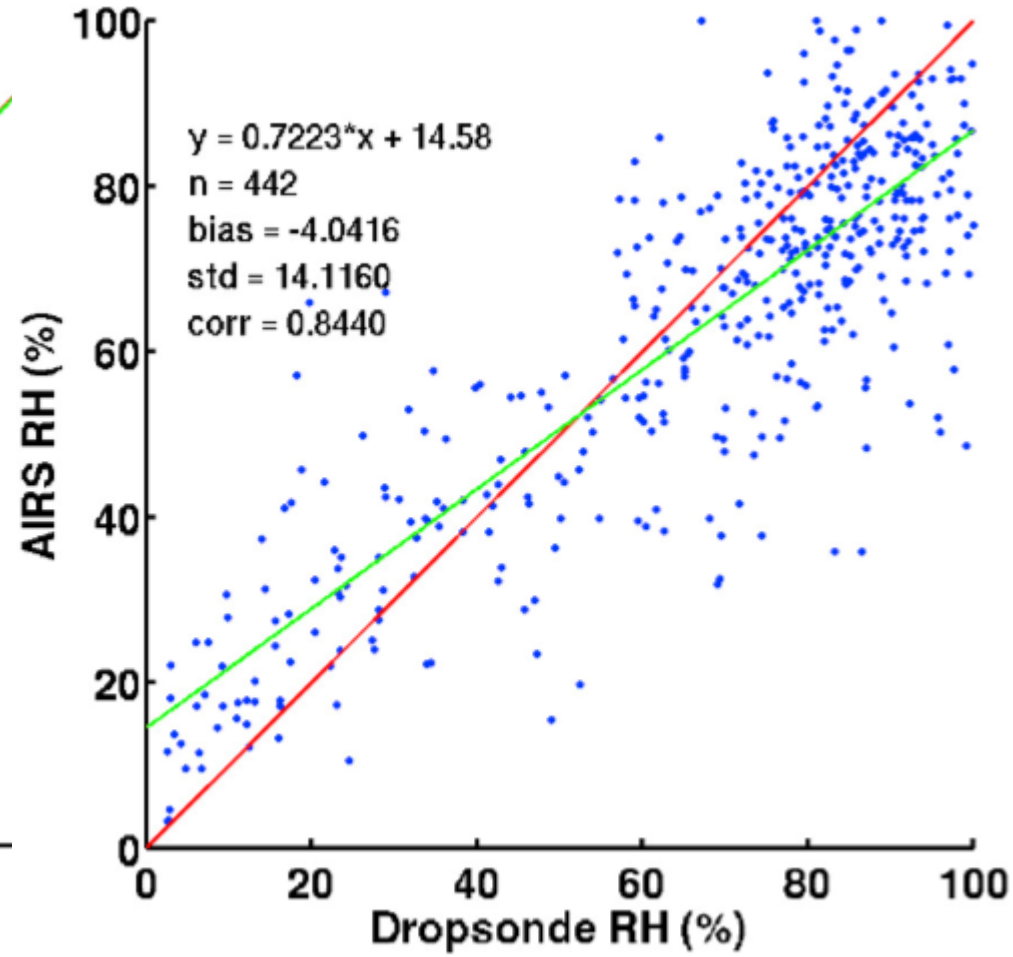
Tony Reale & Bomin Sun

Matching with AIRS in time (all)



Comparisons of AIRS & dropsonde (TCs)





1. **W**u (2009): NAMMA
2. **Pu et al. (2010): NAMMA (67) & T-PARC (104)**
3. **Long-term dataset: more samplings under different conditions**

A Long-Term (1996-2012), High-quality, High Vertical Resolution GPS Dropsonde Dataset for Hurricane and Other Studies

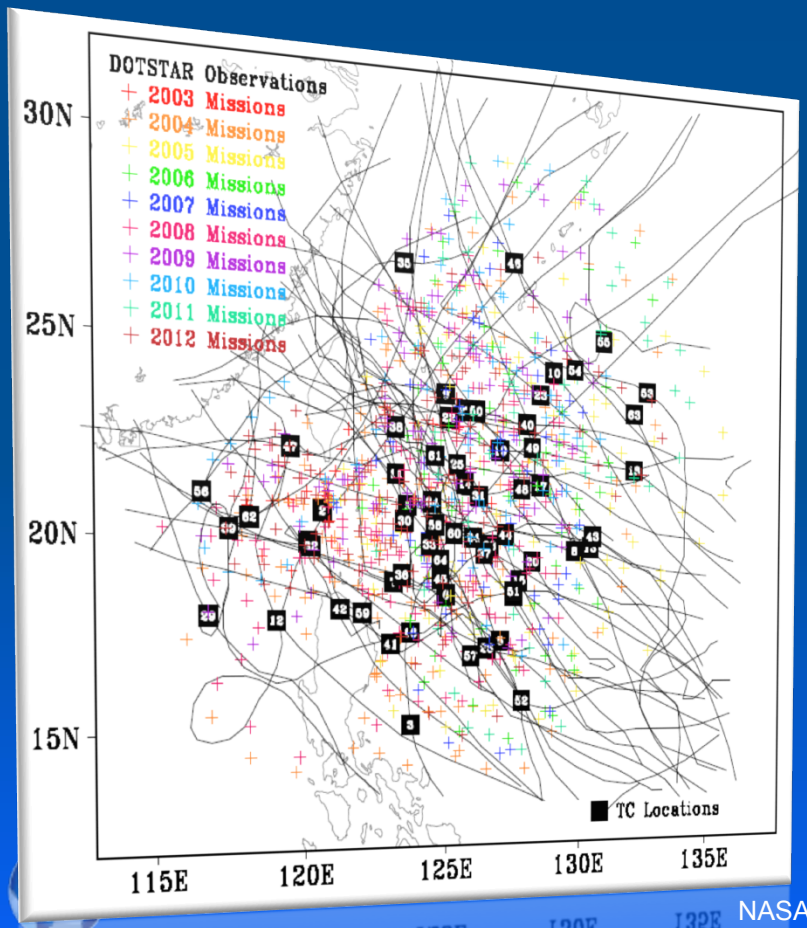
Junhong (June) Wang

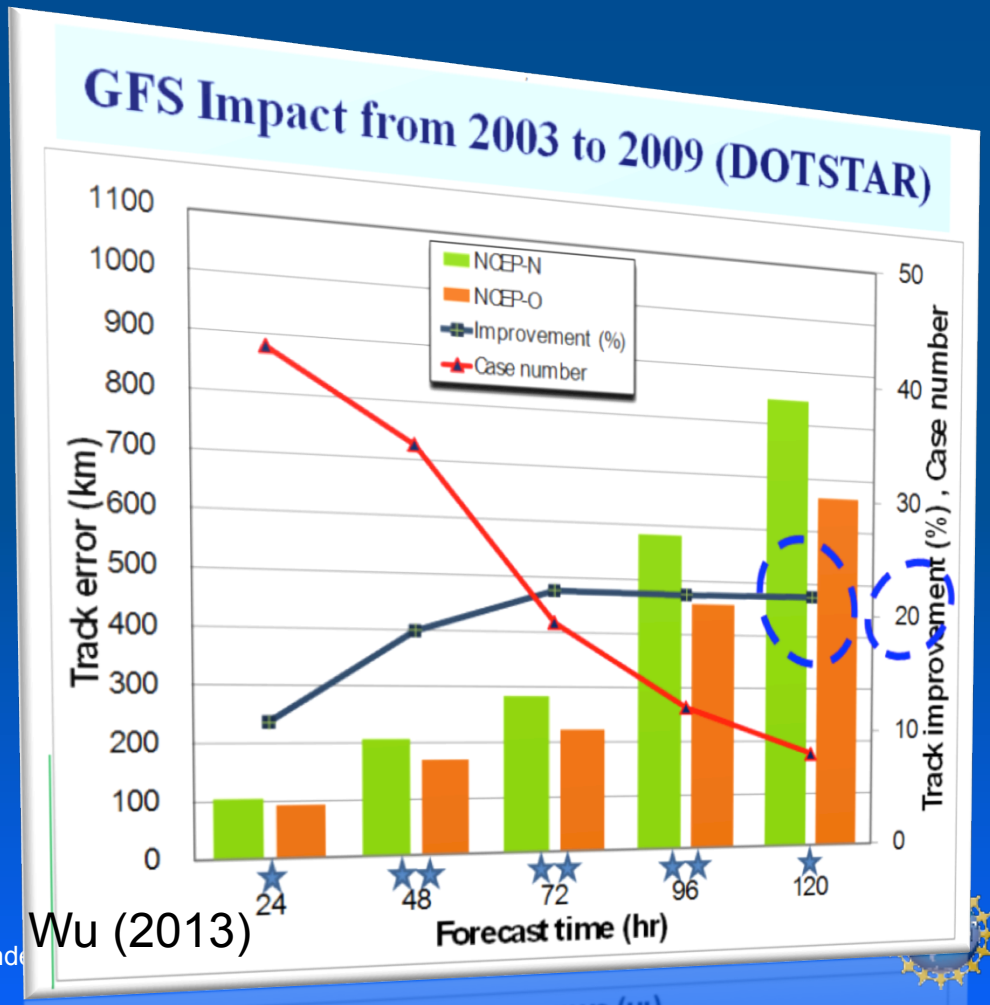
Kate Young, Terry Hock, Dean Lauritsen, Dalton Behringer, Michael Black, Peter G. Black, James Franklin, Jeff Halverson, John Molinari, Leon Nguyen, Tony Reale, Jeff Smith, Bomin Sun, Qing Wang, Jun A. Zhang

BAMS, in press

Dropwindsonde Observations for Typhoon Surveillance near the TAiwan Region

2003-2012, 64 missions, 49 typhoons, 1051 dropsondes





Wu (2013)

Stratéole 2 (~2017-2018)

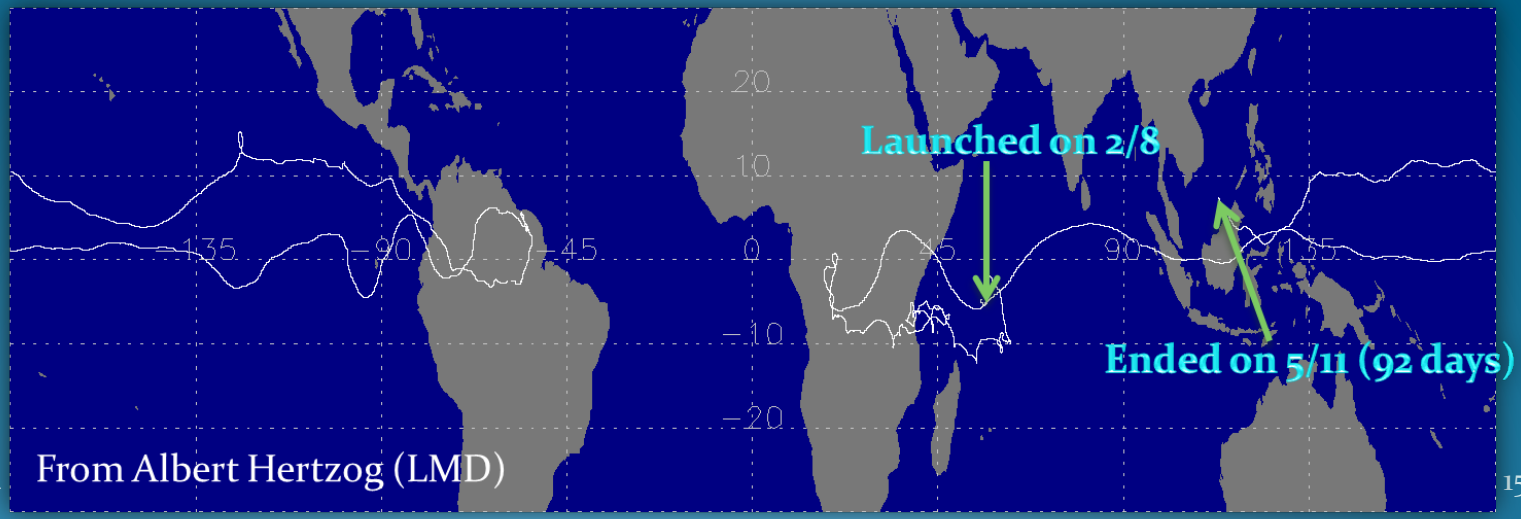
Joint US-French field campaign in the tropics to sample the atmosphere with long-duration super-pressure balloons

Research Topics:

1. Dynamics of the Equatorial middle atmosphere
2. Transport and dehydration in the tropical tropopause layer Clouds and aerosols
3. Operational meteorology
4. Satellite validation

Instruments:

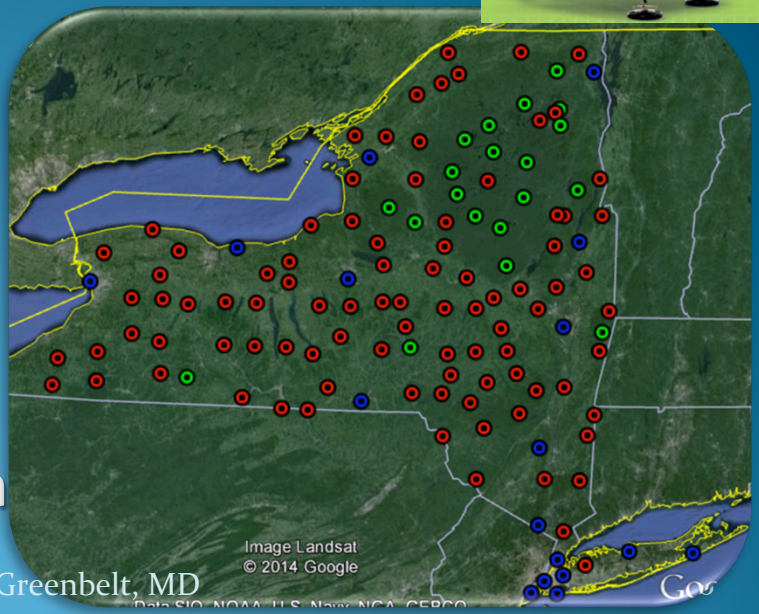
- In-situ sensors (mete. & trace gases)
- Profiling: (driftsonde, GPS RO, lidar …)



From Albert Hertzog (LMD)

Building New York State's First Statewide Mesonet

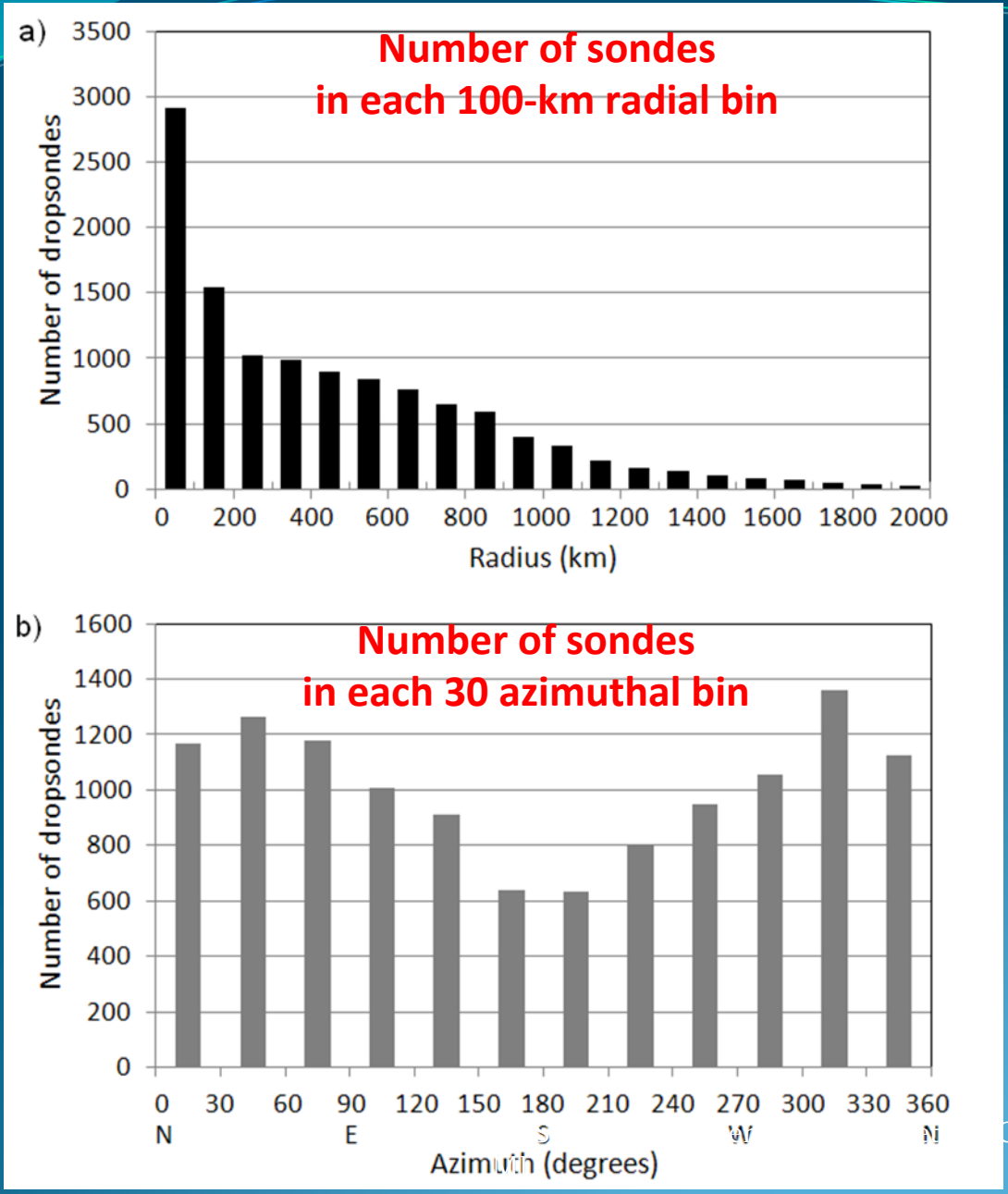
- More accurate and reliable weather information & forecasts, more informed emergency management decisions
- 125 stations spread across NY State (17 profiler & 20 snow sites); 1st 3-D mesonet
- Surface meteorological, hydrological and wind & thermodynamic profile measurements
- Collaborations among UAlbany, NWS and NYS agencies
- Validation of satellite data near surface and in LT over complex terrain



Summary

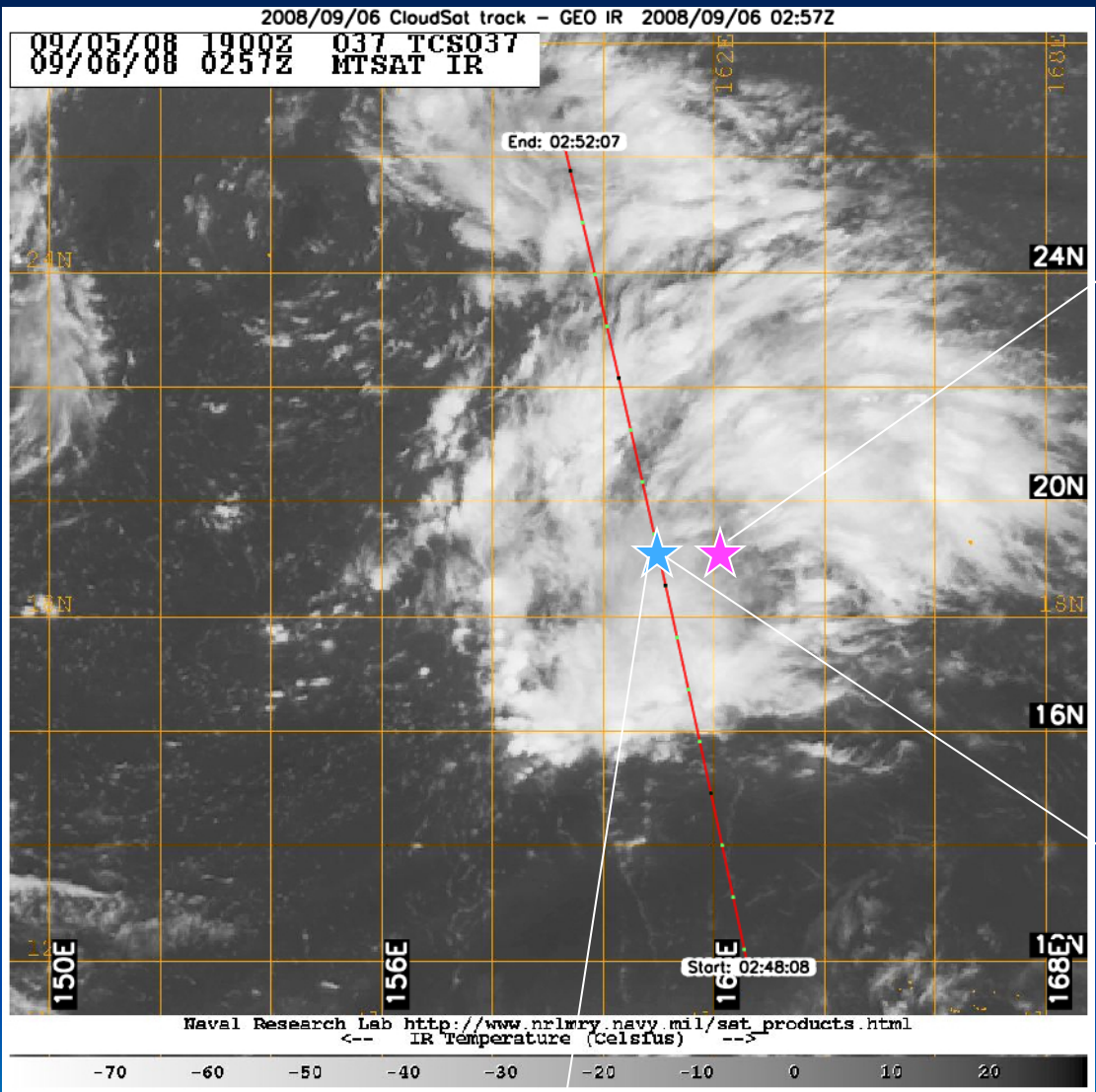
1. A long-term (1996-2012), high-quality, high vertical resolution (~5-15 m) GPS dropsonde dataset is created and consists of 13,681 atmospheric profiles for 120 tropical cyclones.
2. The scientific applications of this long-term dropsonde dataset have been demonstrated, and more wait to be discovered in the future, including validate satellite data.
3. The dataset can be expanded by including Air Force, field projects, DOTSTAR and other dropsonde data archive.
4. This long-term dropsonde dataset provides a unique opportunity to validate AIRS and other satellite data under TC environments for different conditions and regions.
5. Other opportunities exist for future dedicated measurements for satellite validations (Stratéole 2 & NYS Mesonet).

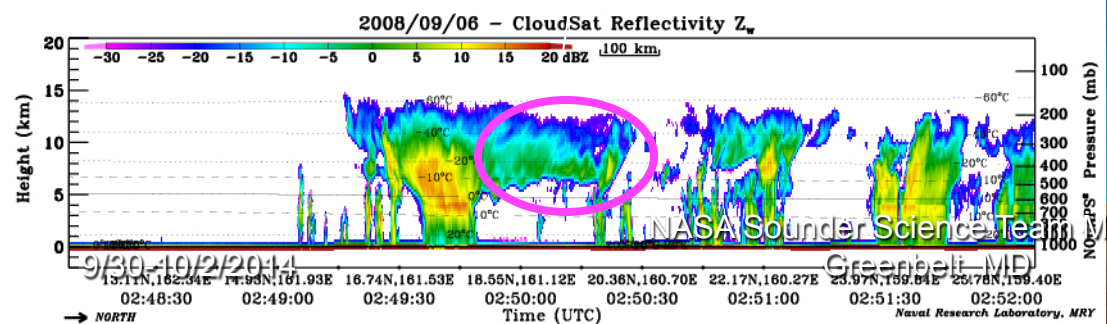
Number of sondes v.s. radius & azimuth

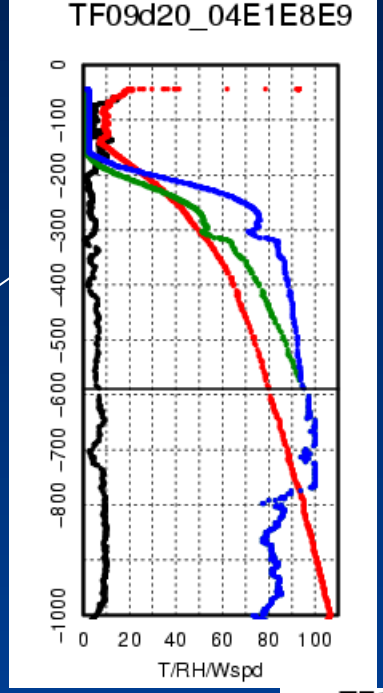


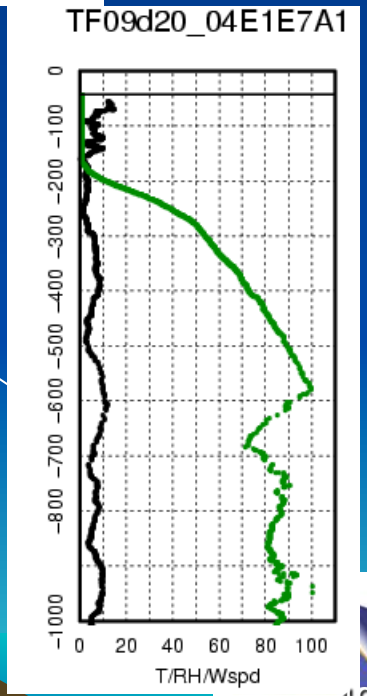
Most frequently located within 100 km, then gradually decrease with increasing radius.

Asymmetric, with a maximum in the northern quadrant and a minimum in the southern quadrant

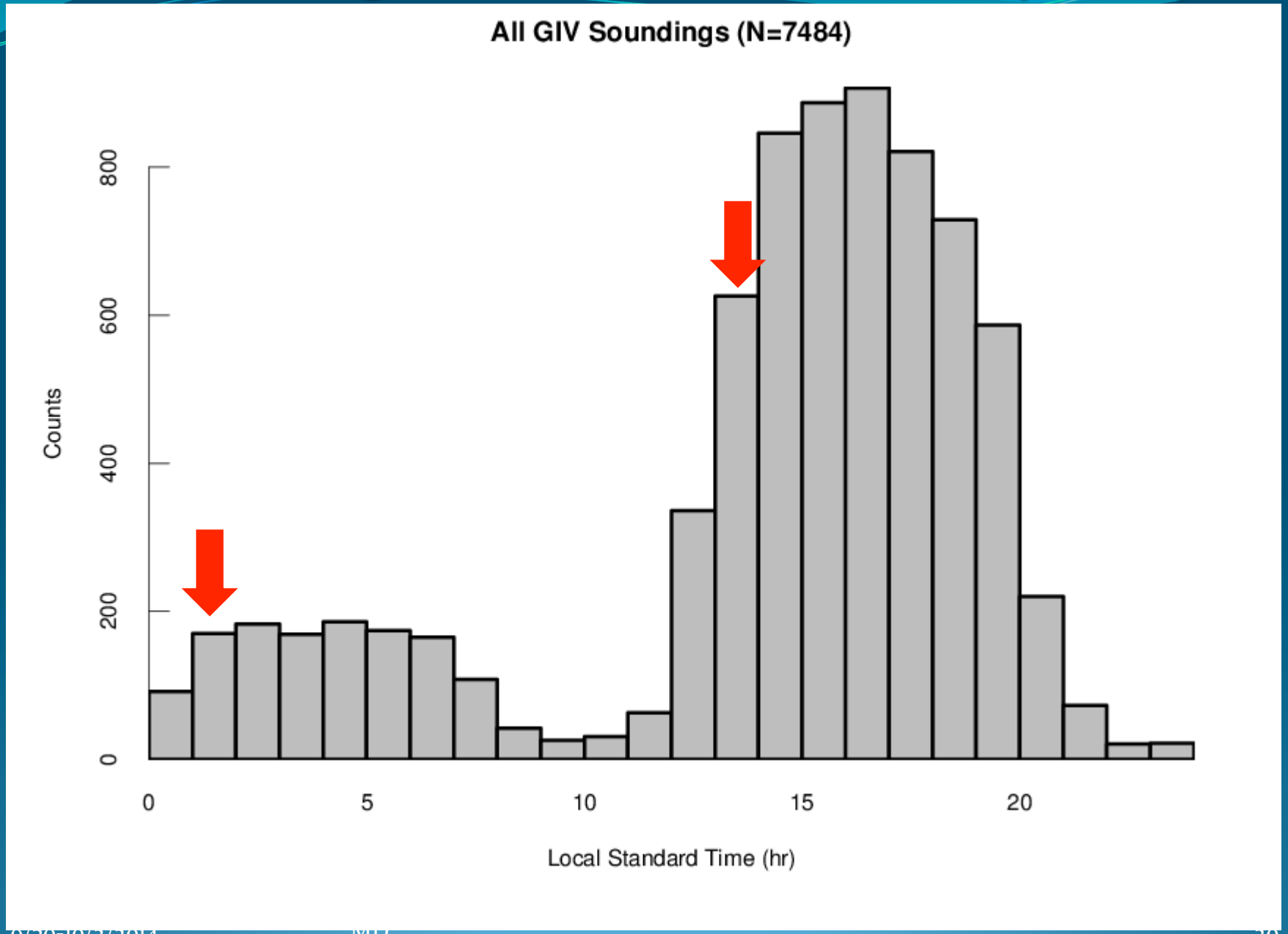

2008/09/06 CloudSat track – GEO IR 2008/09/06 02:57Z
09/05/08 1900Z 037 TCS037
09/06/08 0257Z MTSAT IR
End: 02:52:07
Start: 02:48:08
24N
20N
16N
12N
150E
156E
162E
168E
Naval Research Lab http://www.nrlmry.navy.mil/sat_products.html
<-- IR Temperature (Celsius) -->
-70 -60 -50 -40 -30 -20 -10 0 10 20


2008/09/06 – CloudSat Reflectivity Z_e
-30 -25 -20 -15 -10 -5 0 5 10 15 20 dBZ
100 km
Height (km)
Pressure (mb)
02:48:30 02:49:00 02:49:30 02:50:00 02:50:30 02:51:00 02:51:30 02:52:00
Time (UTC)
NORTH
Naval Research Laboratory, MRY

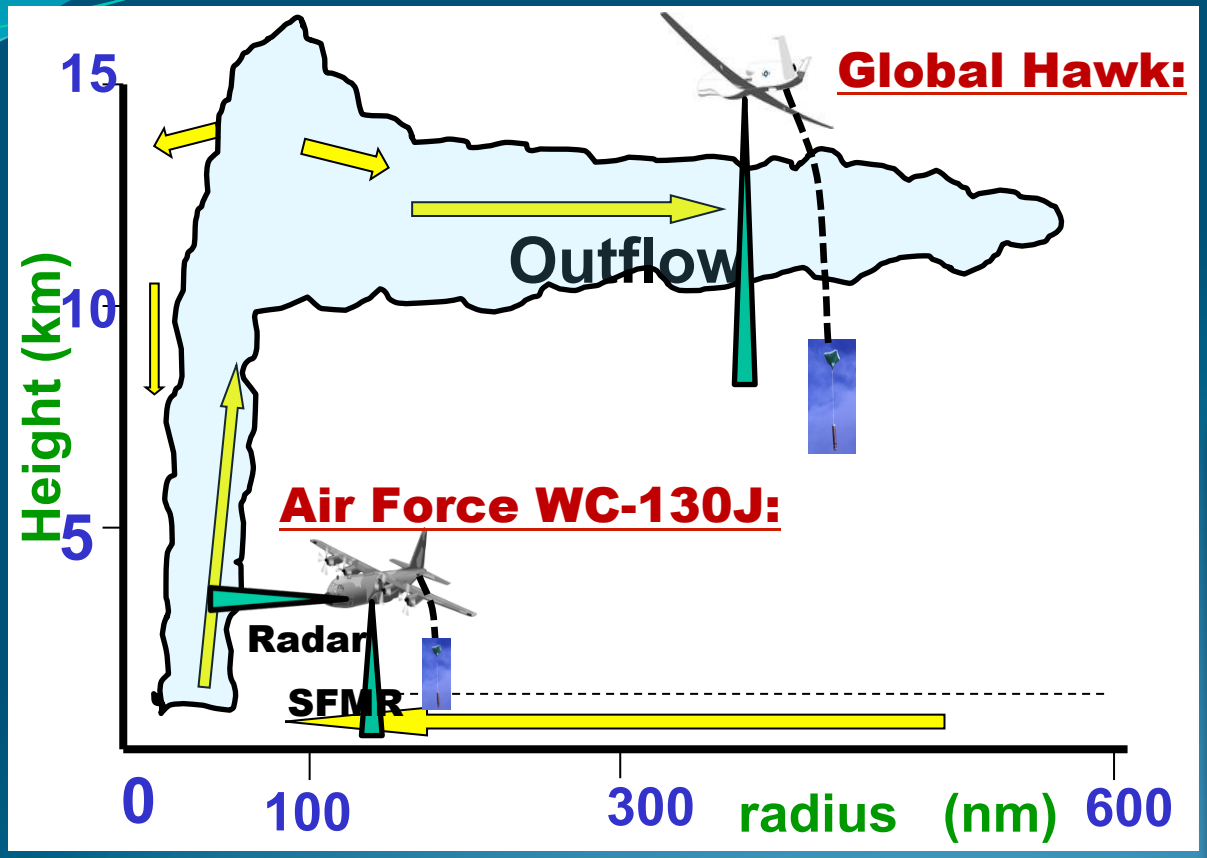

TF09d20_04E1E8E9
T/RH/Wspd

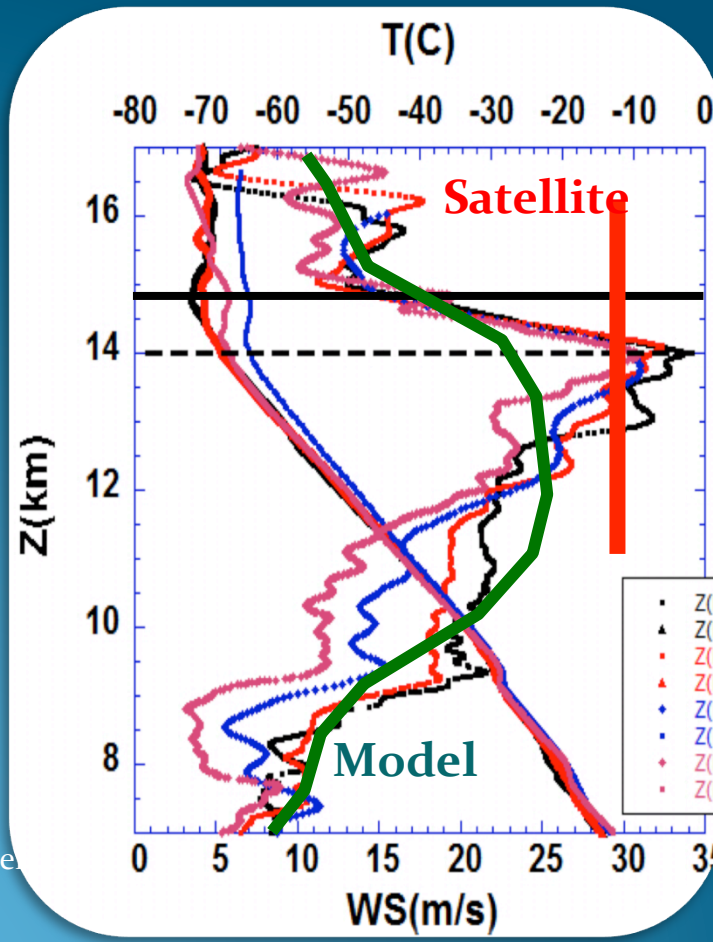

TF09d20_04E1E7A1
T/RH/Wspd

Matching with AIRS in time (G-IV)



HS3: Leslie's outflow





Courtesy of Pete Black