National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Microwave sounder observations during GRIP

Preliminary results from HAMSR

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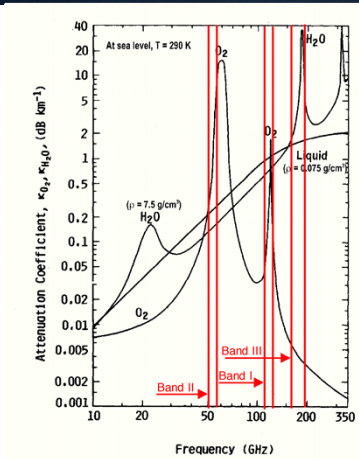
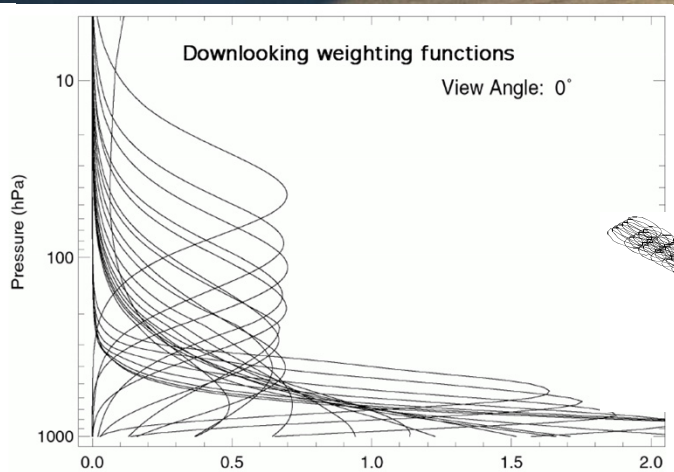
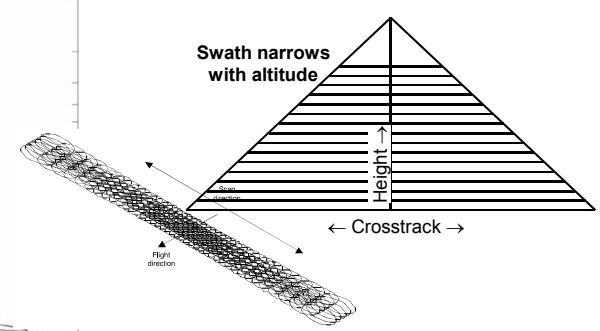
The High Altitude MMIC Sounding Radiometer

HAMSR



Chan #	Center freq. [GHz]	Offset [GHz]	Bandwidth [MHz]	Wt-func. Peak [mb or mm]
I-1	118.75	-5.500	1500	Sfc/[30 mm]
I-2	"	-3.500	1000	Surface
I-3	"	-2.550	500	Surface
I-4	"	-2.050	500	1000 mb
I-5	"	-1.600	400	750 mb
I-6	"	-1.200	400	400 mb
I-7	"	±0.800	2x400	250 mb
I-8	"	±0.450	2x300	150 mb
I-9	"	±0.235	2x130	80 mb
I-10	"	±0.120	2x100	40 mb
II-1	50.30	0	180	Sfc/[100 mm]
II-2	51.76	0	400	Surface
II-3	52.80	0	400	1000 mb
II-4	53.596	±0.115	2x170	750 mb
II-5	54.40	0	400	400 mb
II-6	54.94	0	400	250 mb
II-7	55.50	0	330	150 mb
II-8	56.02 56.67	0	270 330	90 mb
III-1	183.31	-17.0	4000	[11 mm]
III-2	"	±10.0	2x3000	[6.8 mm]
III-3	"	±7.0	2x2000	[4.2 mm]
III-4	"	±4.5	2x2000	[2.4 mm]
III-5	"	±3.0	2x1000	[1.2 mm]
III-6	"	±1.8	2x1000	[0.6 mm]
III-7	"	±1.0	2x500	[0.3 mm]

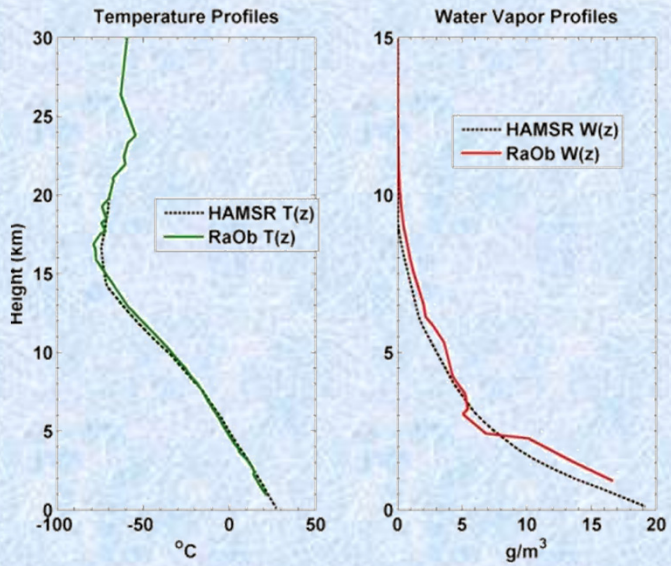




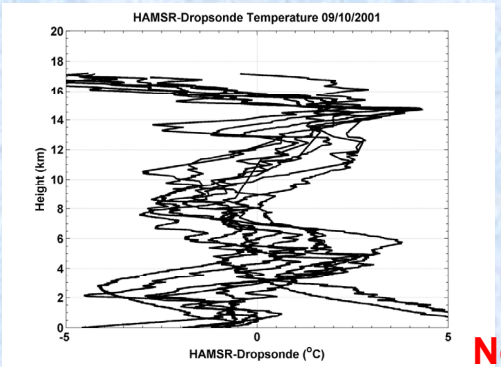
HAMSR is an accurate sounder

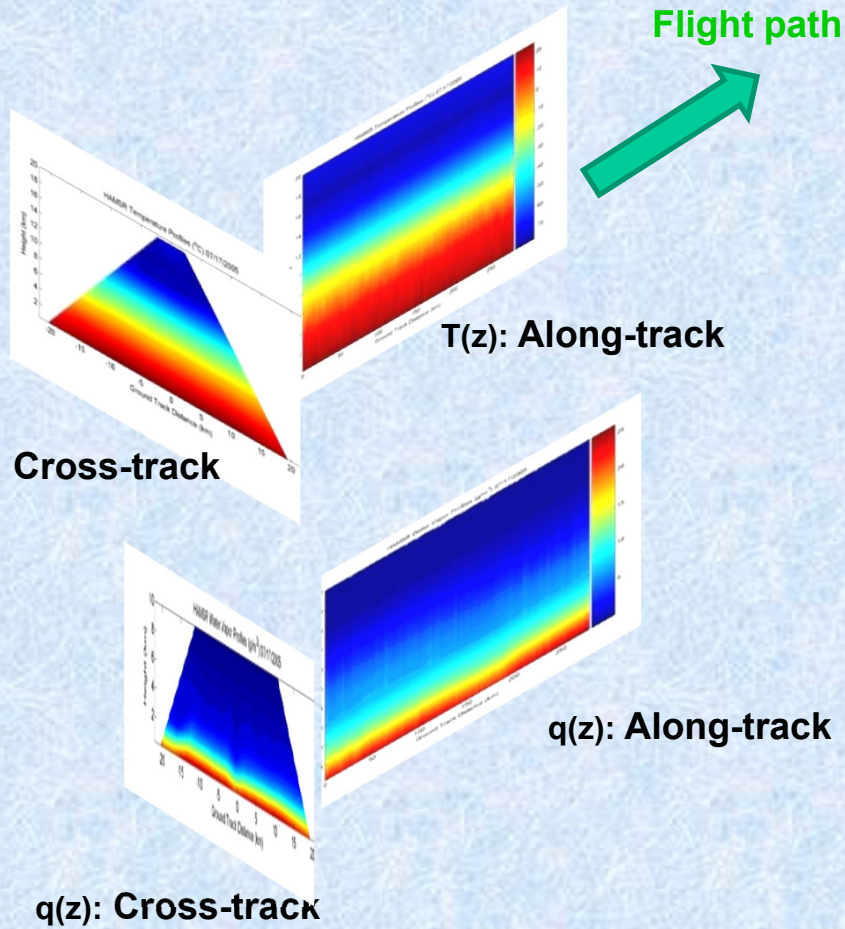
Sounders are normally used to determine thermodynamic structure:

- **Retrieval of 3-D atmospheric temperature, water vapor and cloud liquid water profiles using optimal estimation inversion approach**
- **Good agreement with dropsonde observations**
- **Vertical resolution (averaging kernels) is 1-2 km**



HAMSR – Dropsonde T(z) CAMEX -4





Note: Third band (118 GHz) also makes it possible to retrieve L(z)

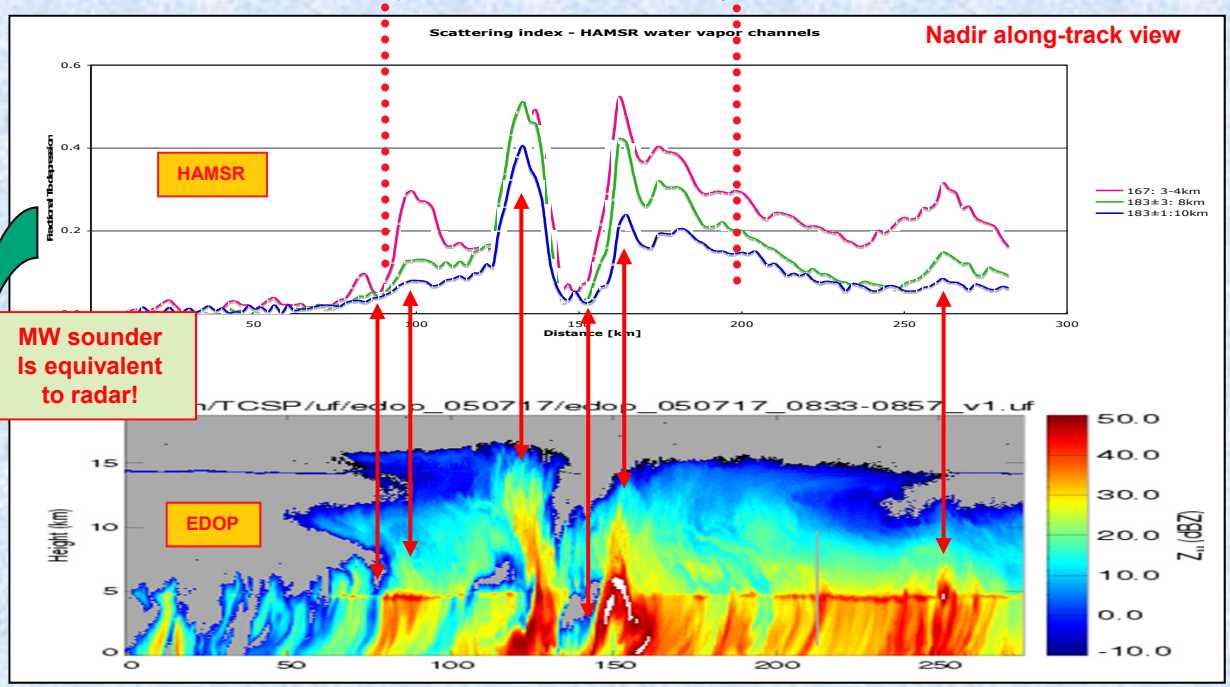
NEW: Scattering profiling ⇒ Reflectivity algorithm

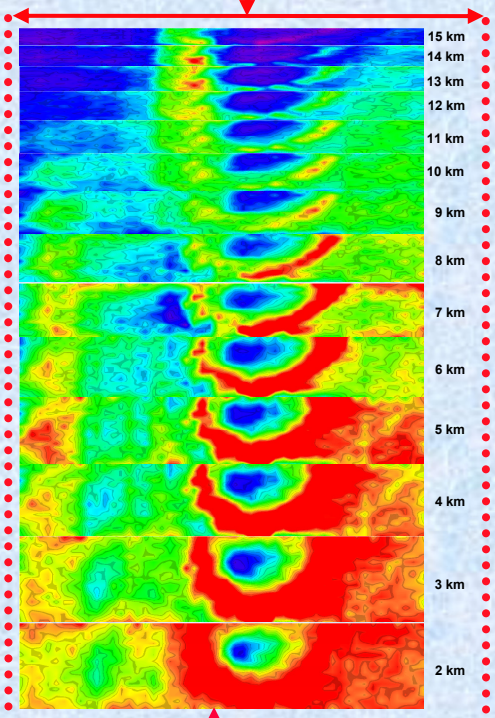
Based on comparison of microwave sounder (HAMSR) with doppler radar (EDOP) during TCSP/2005

Hurricane observations with MW sounder (HAMSR) compared with doppler radar (EDOP)

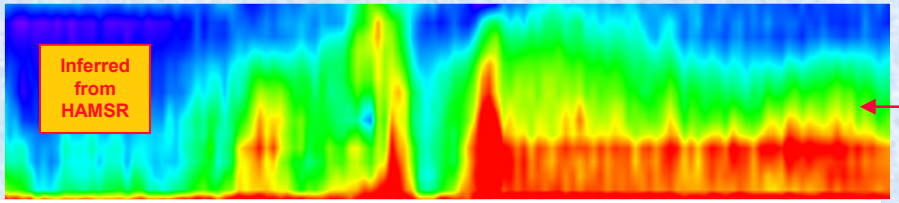
Observations from NASA TCSP campaign, Costa Rica, 2005

Vertical slicing through hurricane Emily - July 17, 2005





MW sounder Is equivalent to radar!



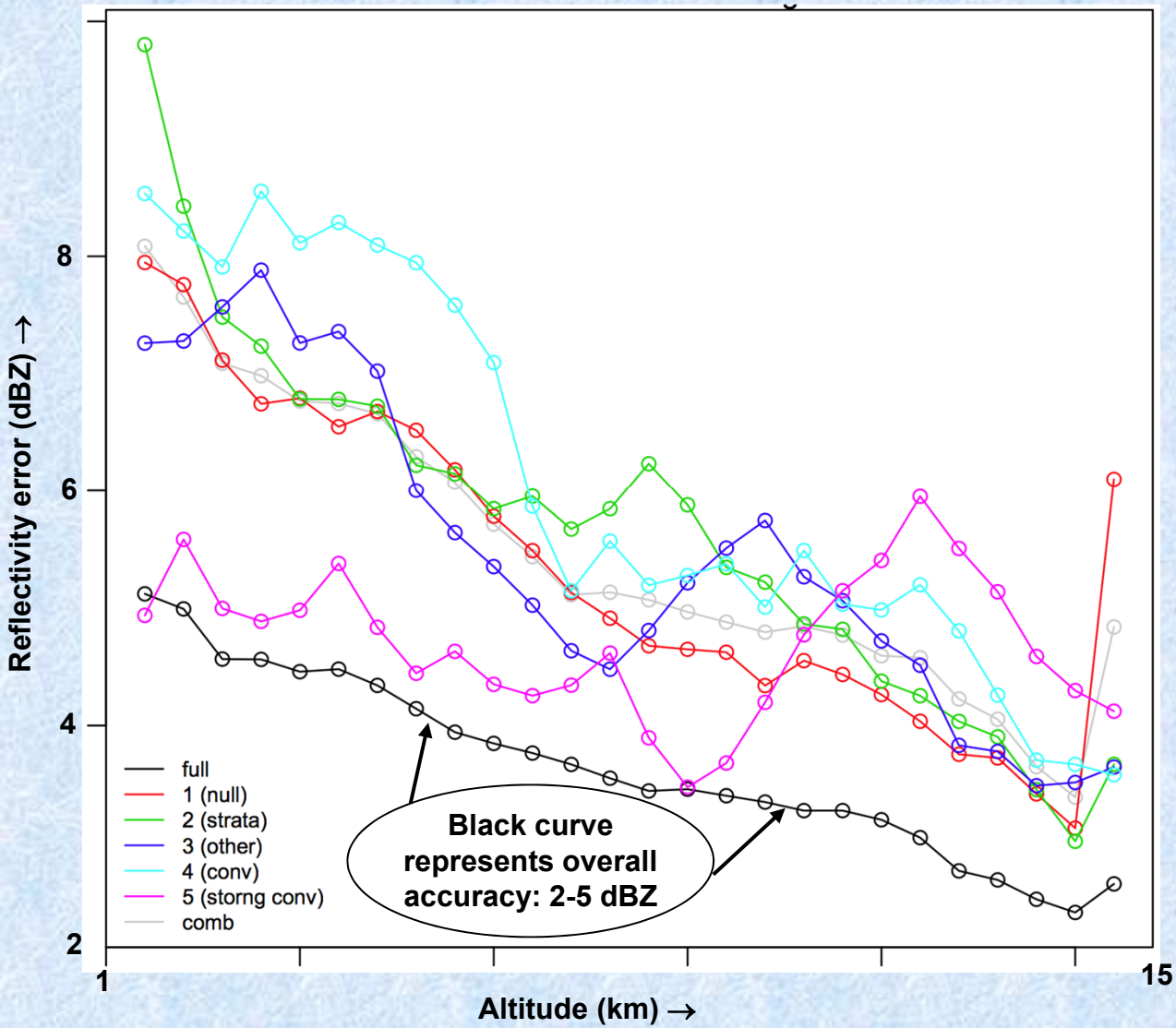
Correlation between MW-sounder ΔTb and radar reflectivity exceeds 90% at all levels except near surface

Height resolved "Radar reflectivity"

⇒ Use radar algorithms to derive

- Precipitation rate
- Ice water path
- Convective intensity
- Vertical structure

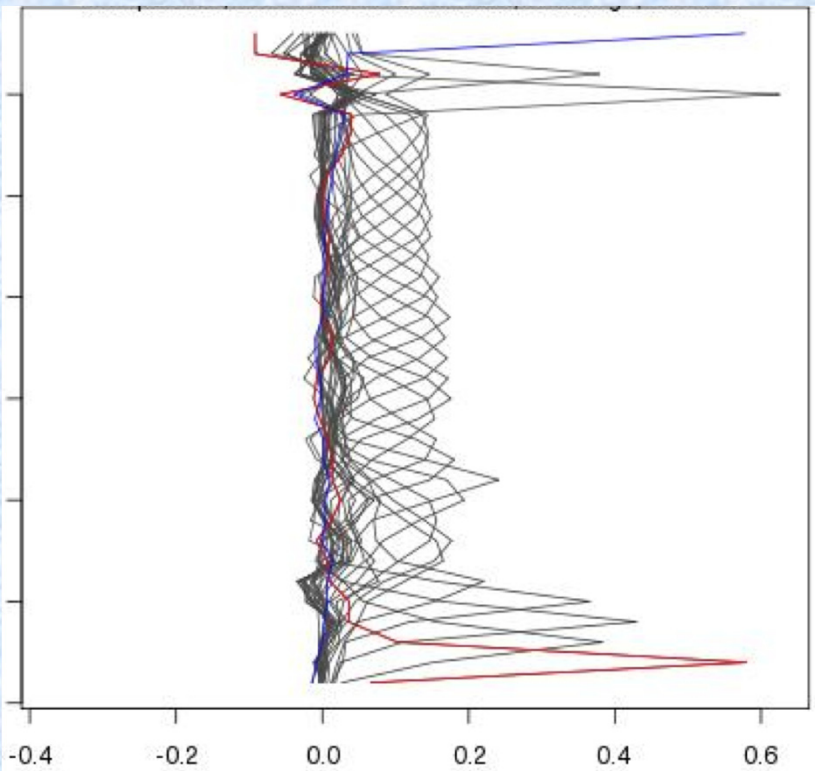
Reflectivity retrieval accuracy



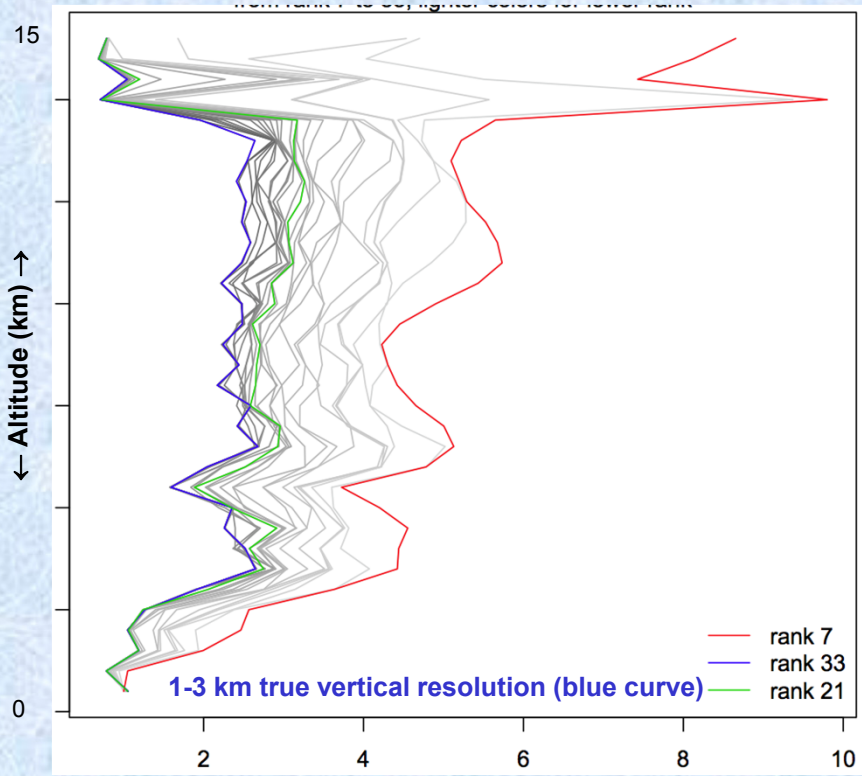
Colored curves represent clusters and reflect clustering uncertainty

Averaging kernels and vertical resolution

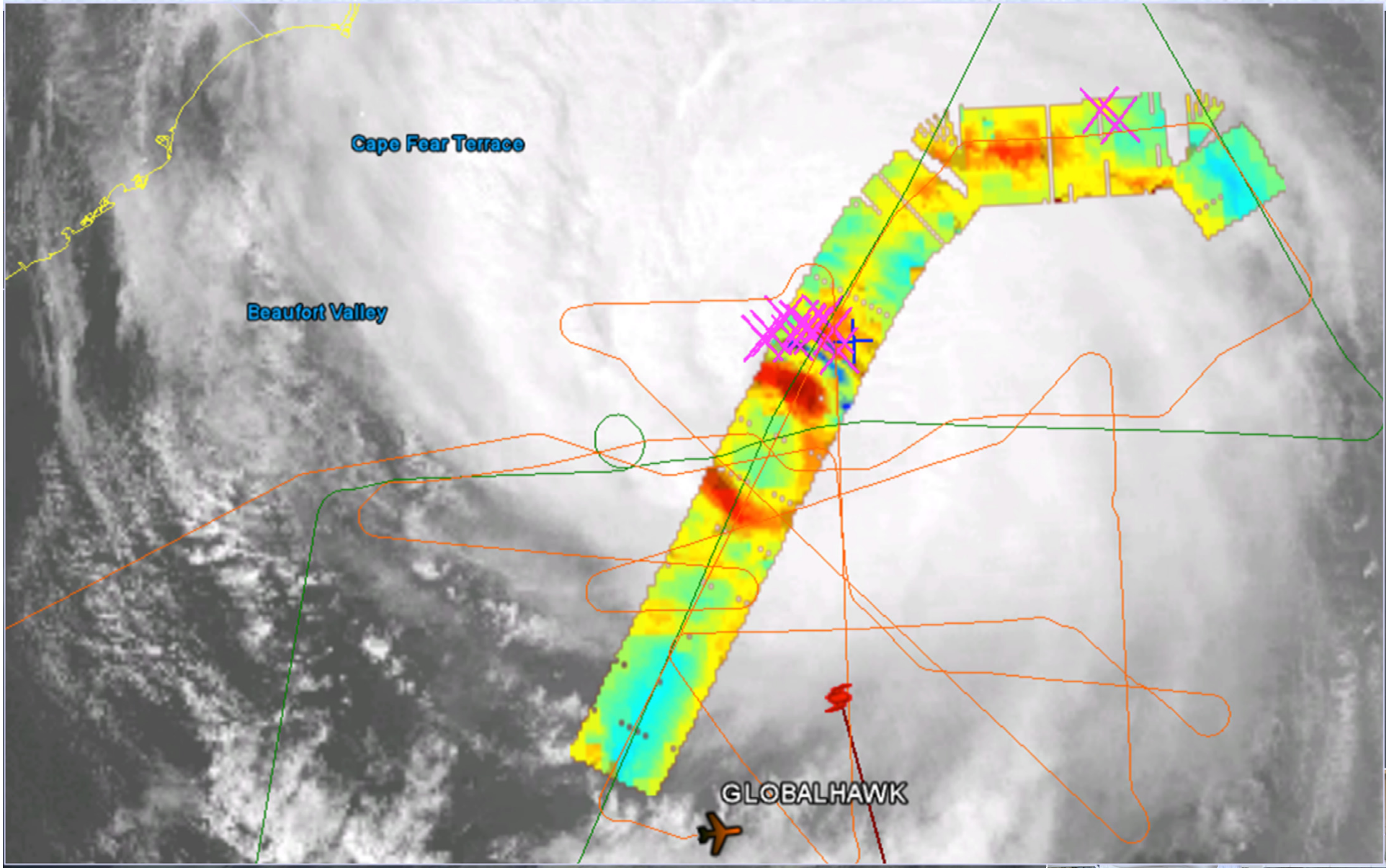
Averaging kernels:



Vertical resolution:



Hurricane Earl: Eye in visible, IR and microwave



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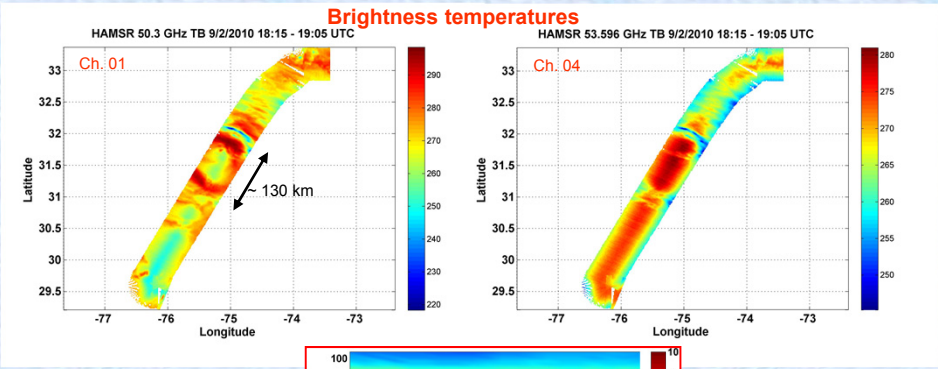
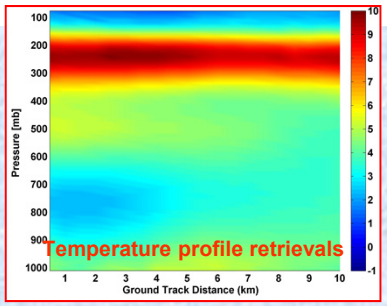
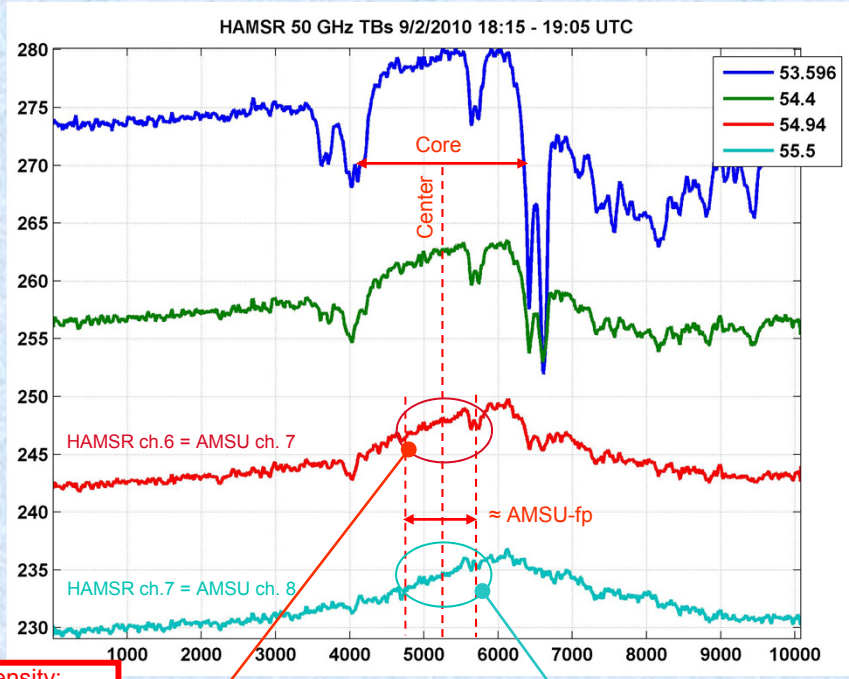
Microwave sounder observations during GRIP: Preliminary results

Earl's intensity from HAMSR warm core anomaly

Earl, 9/2/2010, 1815-1905 UTC



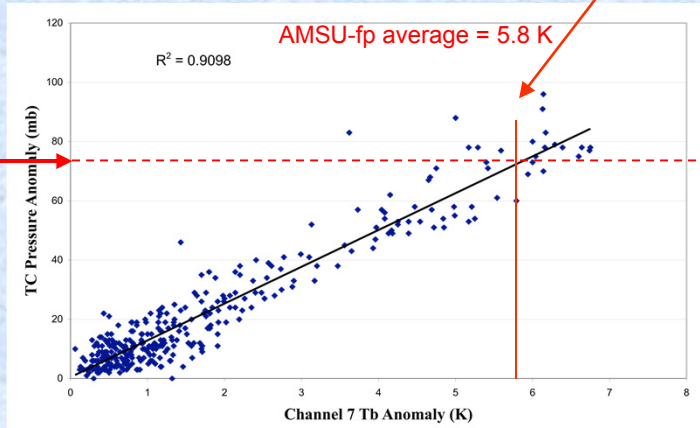


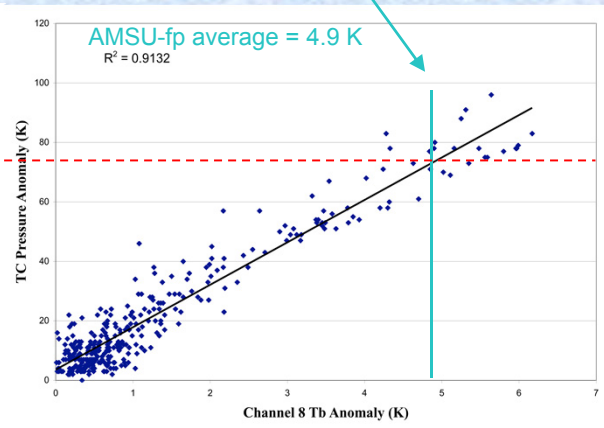


NHC uses method developed at CIMSS to estimate intensity:
- Based on inner core Tb-anomaly from AMSU
- Scatter plots below show correlation Δp vs. ΔTb for 2 channels
  See http://amsu.ssec.wisc.edu/explanation.html

On September 2 NHC estimated the intensity of Earl as follows:
932 mb @ 1500 UTC (Δp = 81 mb)
947 mb @ 2100 UTC (Δp = 66 mb)

Interpolate to ~ 1800 UTC ⇒ **Δp = 73 mb**





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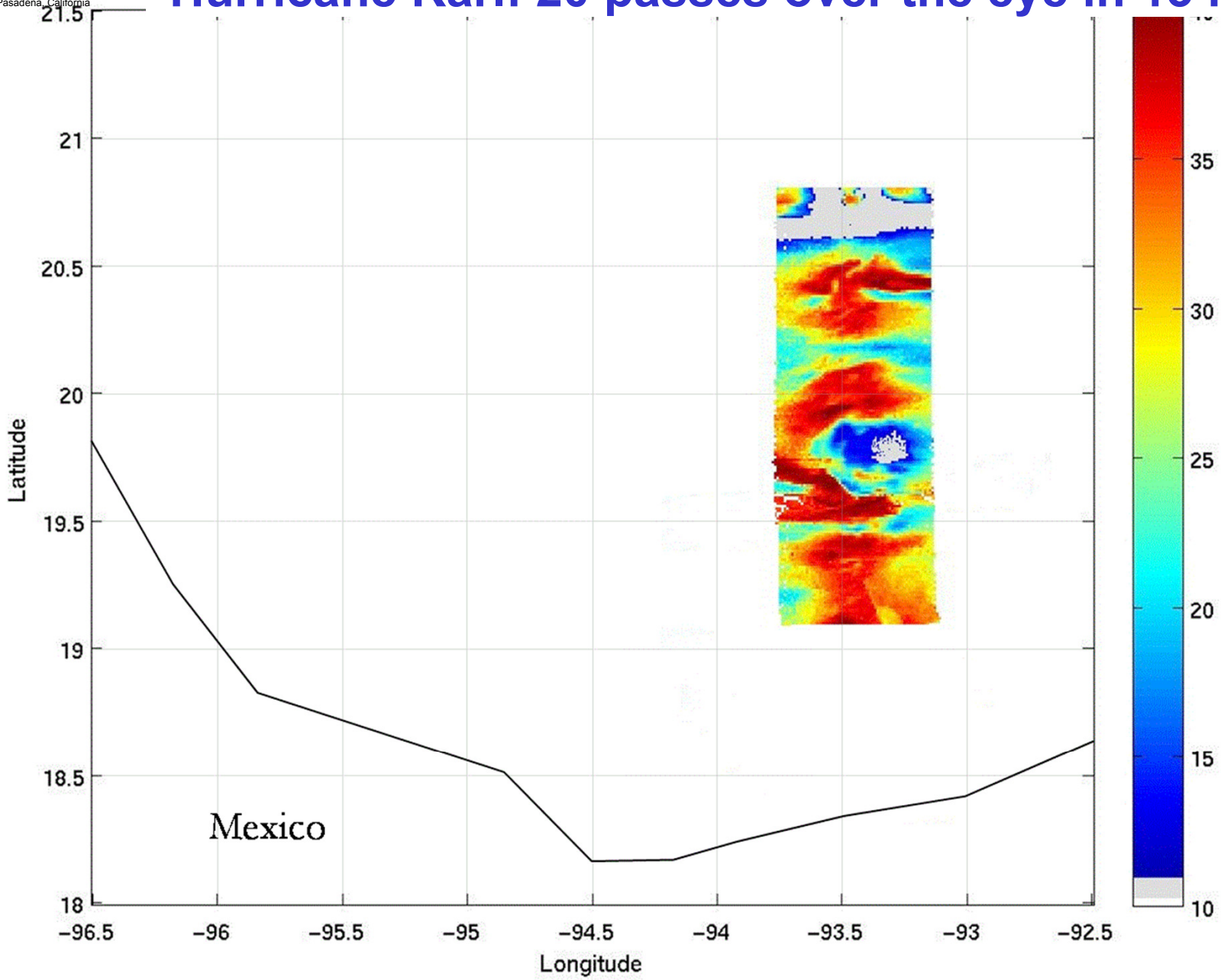
Hurricane Karl: 20 passes over the eye in 13 hours



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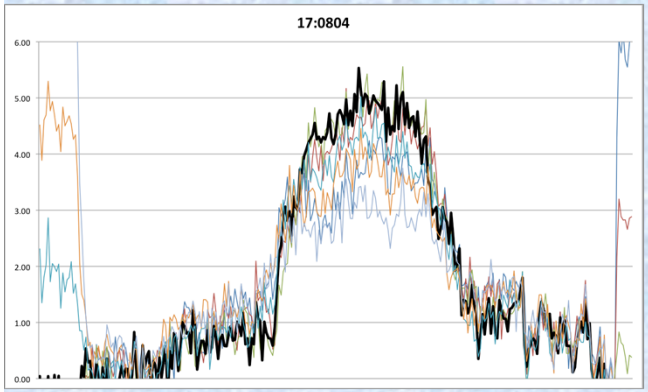
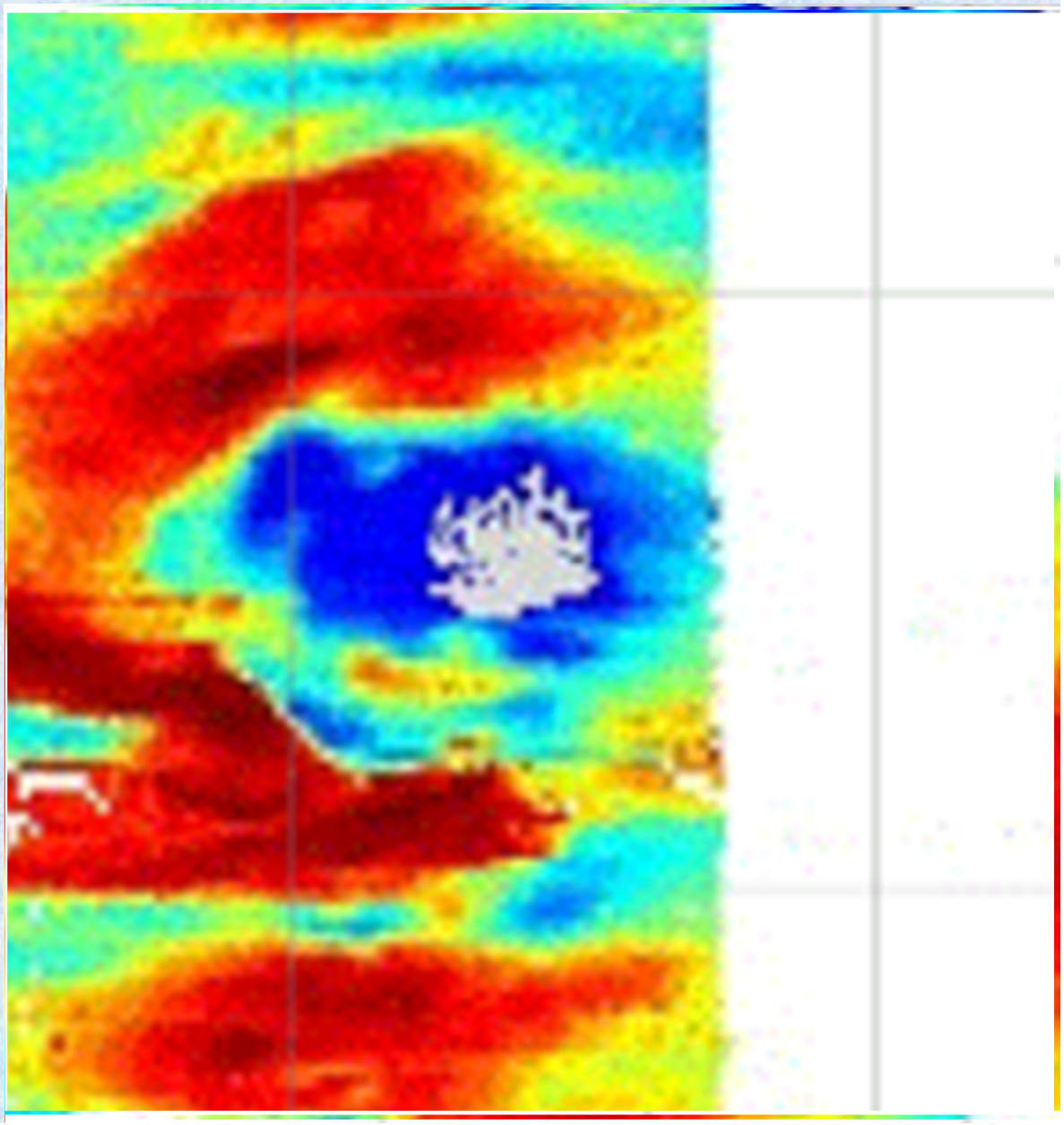
Hurricane Karl: A closer look

Warm core anomaly
HAMSR ch. 6 = AMSU ch. 7

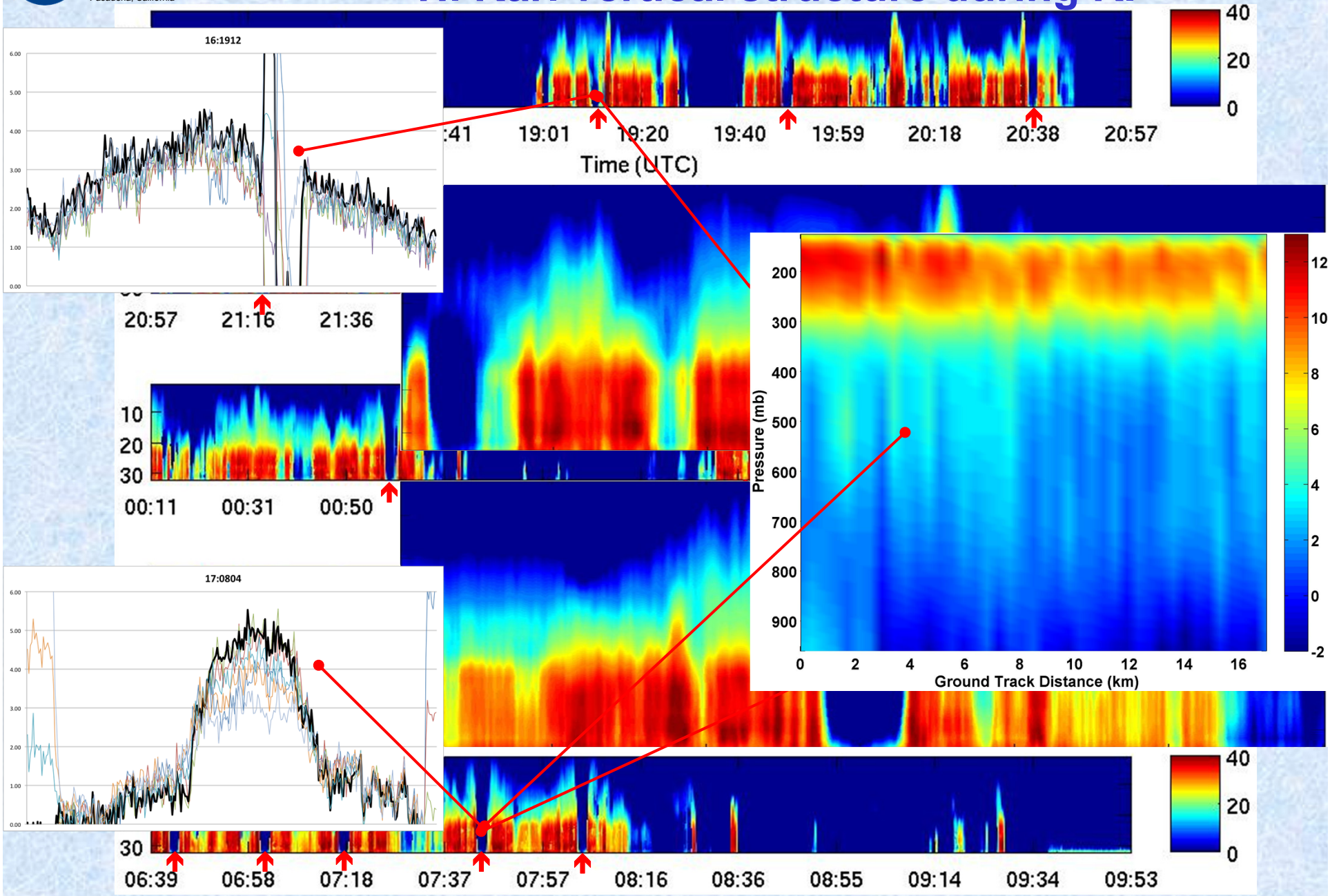


10 minutes



Microwave sounder observations during GRIP: Preliminary results

H. Karl vertical structure during RI



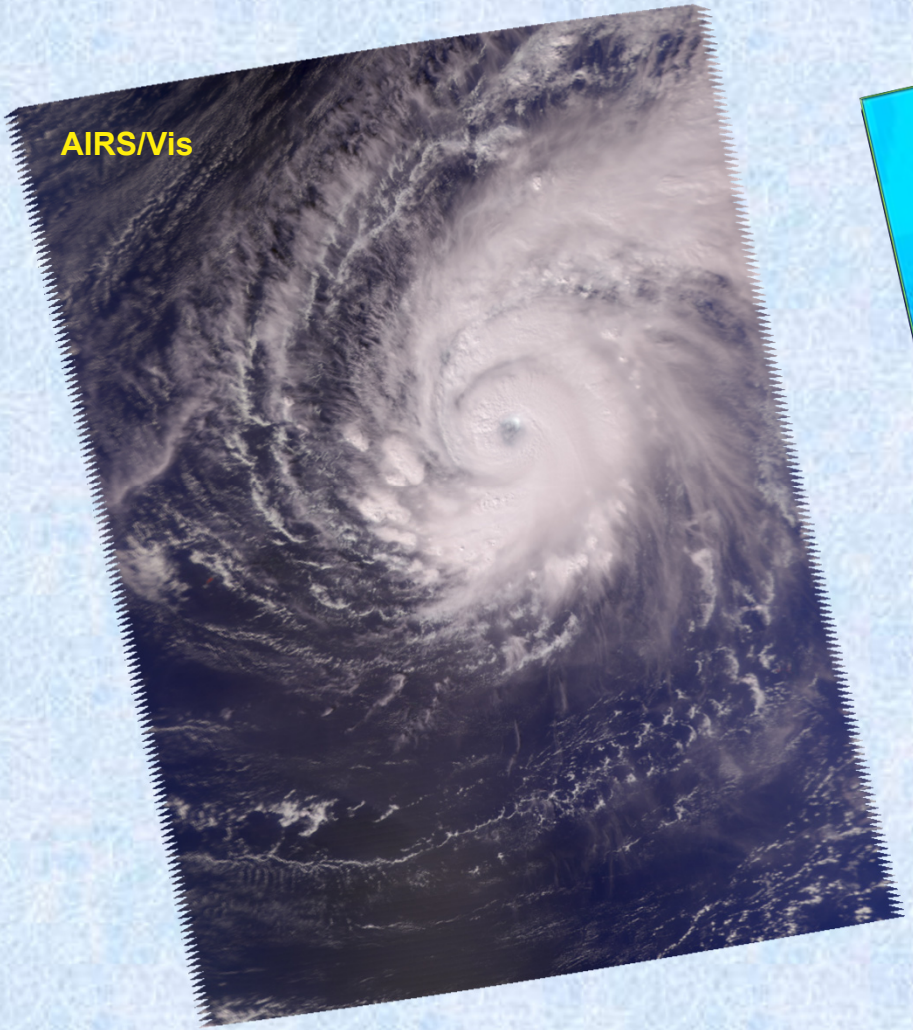
Reflectivity algorithm works on LEO sounders too

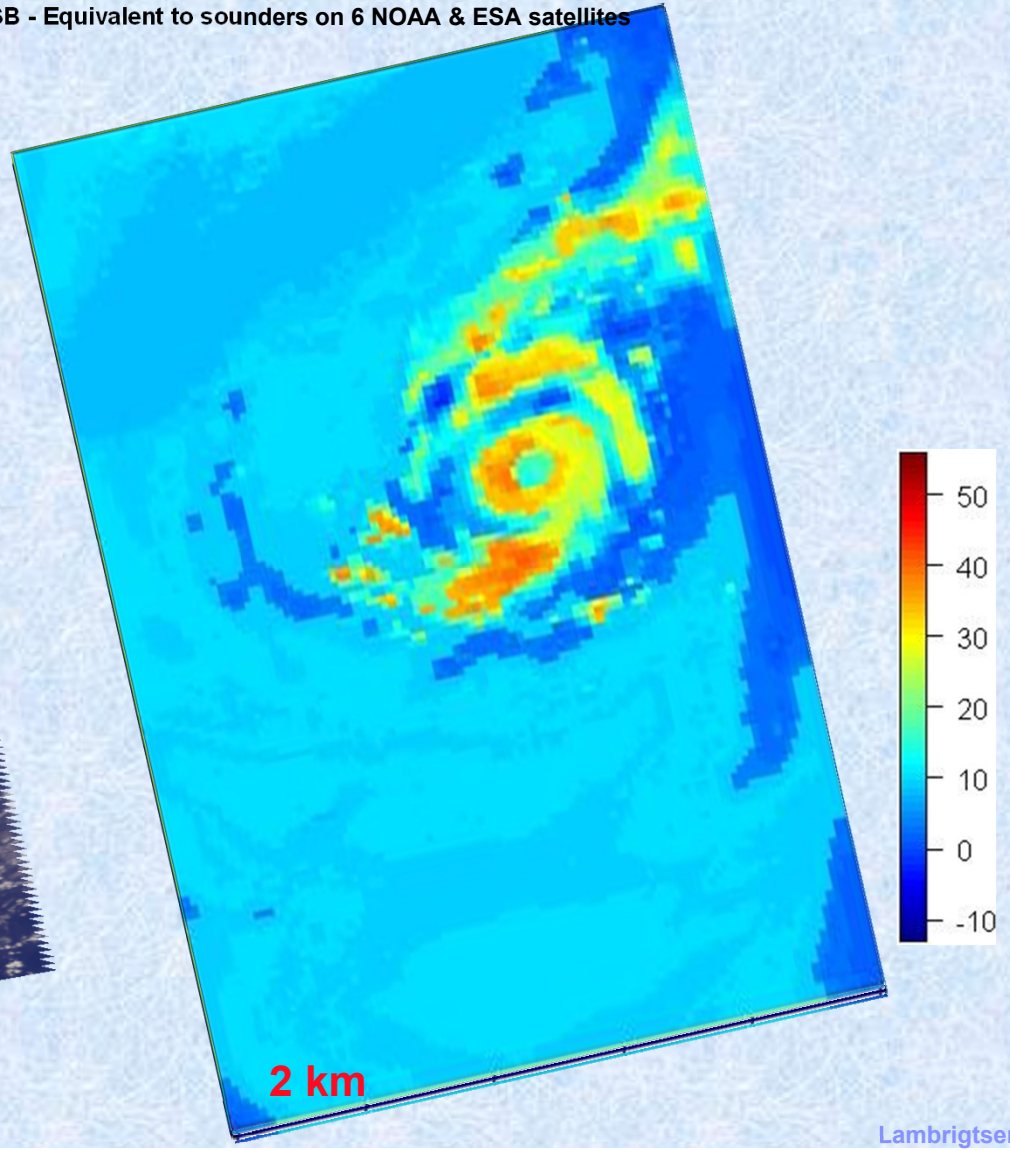
This algorithm will work on the coming GEO MW sounder as well

⇒ 3D convective structure every 15-30 minutes!

Example: Supertyphoon Pongsona, December 8, 2002 - Aqua overpass (Guam)

Reflectivity derived from Aqua AMSU/HSB - Equivalent to sounders on 6 NOAA & ESA satellites





Coming soon: "AMSU in GEO" (Poster #P10)

GRIP continues…

Next steps:

- Process all HAMSR data to L1b (calibrated TB's)
  - Verify & validate
- Distribute data through 3 servers
  - GRIP archive server (MSFC)
  - HAMSR data server (JPL)
  - Hurricane portal (JPL)
- Preliminary → definitive retrievals
  - T(z), q(z), L(z) for non-precipitating FOVs
  - Z(z) for precipitating FOVs
- Validation
  - TPW, T(z) & q(z) vs. sondes, satellites & analysis
  - Z(z) vs. APR-2, HIWRAP & TRMM
- Derived products & analyses
  - Warm core anomaly & intensity vs. time
  - Convective structure vs. intensity
  - New products: precipitation etc.

Research:

- Case studies
  - Karl: a) genesis; b) RI (long time series)
  - Earl: decline
  - Matthew: genesis