



National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

HAMSR observations of the evolving inner-core structure of Karl during rapid intensification

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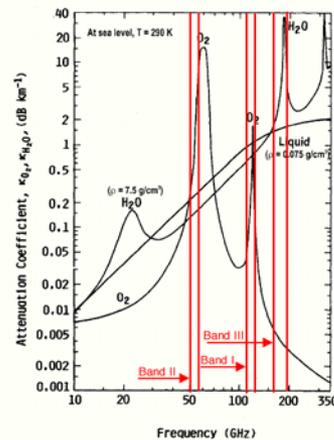
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GRIP Science Team Meeting

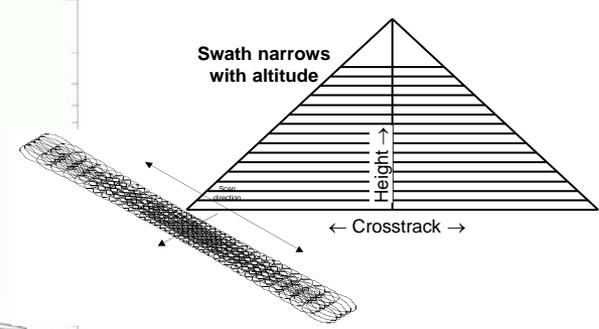
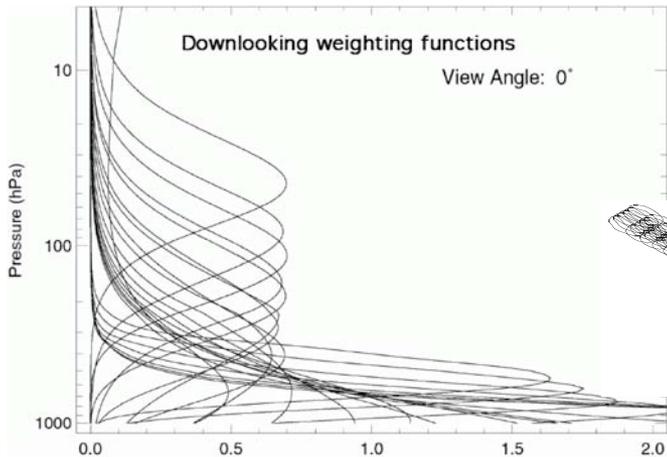
Los Angeles, CA; June 6-8, 2011



The High Altitude MMIC Sounding Radiometer HAMSr



Chan #	Center Freq [GHz]	Offset [GHz]	Bandwidth [MHz]	Vertical Res [m]
11	11.675	-5.500	1500	56 (30min)
12	"	-3.500	1000	Surface
13	"	-2.500	500	Surface
14	"	-2.000	500	1000m
15	"	-1.600	400	700m
16	"	-1.200	400	400m
17	"	+0.800	2000	200m
18	"	+0.650	2000	150m
19	"	+0.255	2000	80m
100	"	+0.120	2000	40m
101	50.30	0	180	56 (100 min)
102	51.76	0	400	Surface
103	52.80	0	400	1000m
104	59.586	+0.115	2070	700m
105	64.40	0	400	400m
106	64.94	0	400	250m
107	65.20	0	500	100m
108	64.02	0	570	80m
109	64.67	0	500	
1011	183.31	-170	4000	111m
1012	"	+0.0	20000	600m
1013	"	+7.0	20000	14.2m
1014	"	+4.5	20000	21.4m
1015	"	+3.0	20000	17.2m
1016	"	+1.8	20000	10.6m
1017	"	+1.0	2000	10.3m

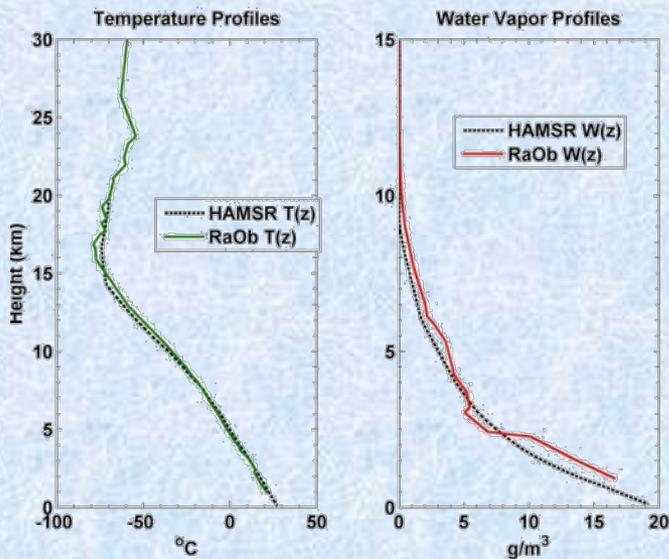




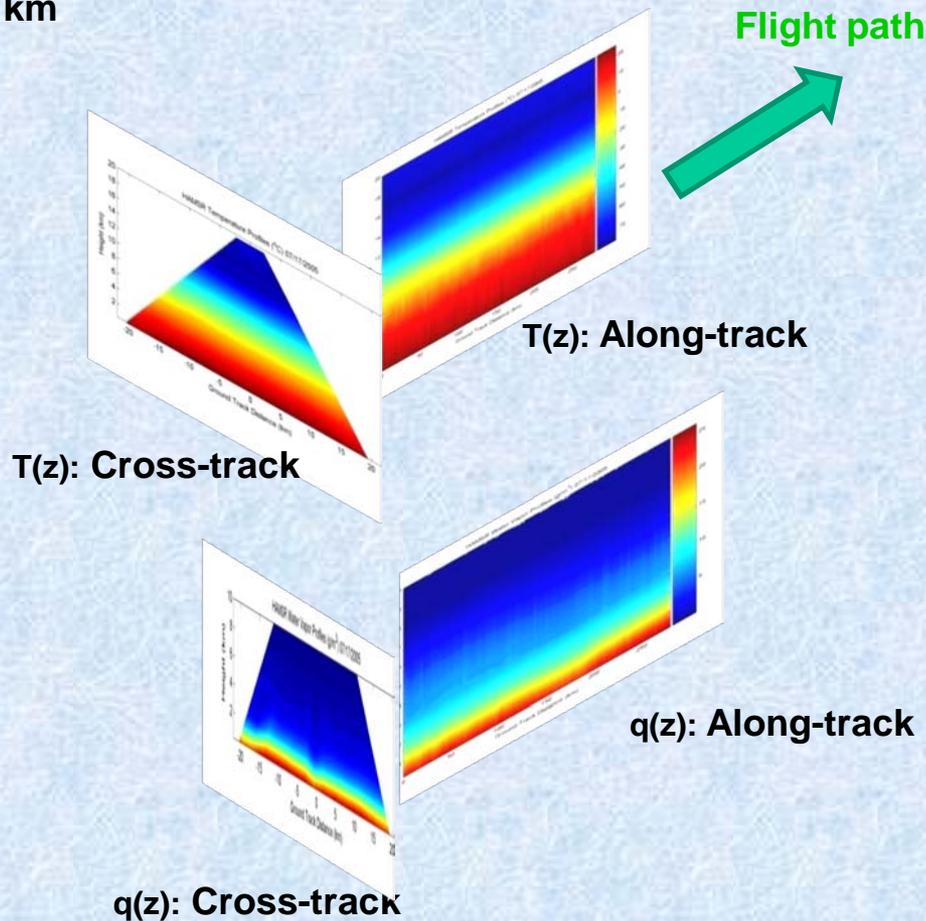
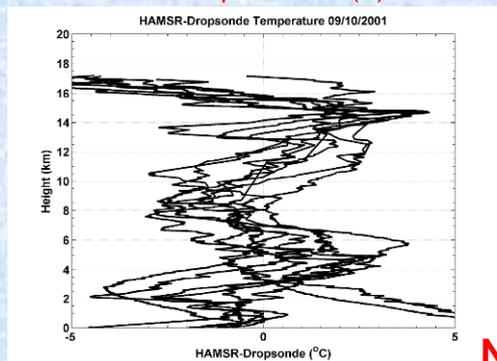
HAMSr is an accurate sounder

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)

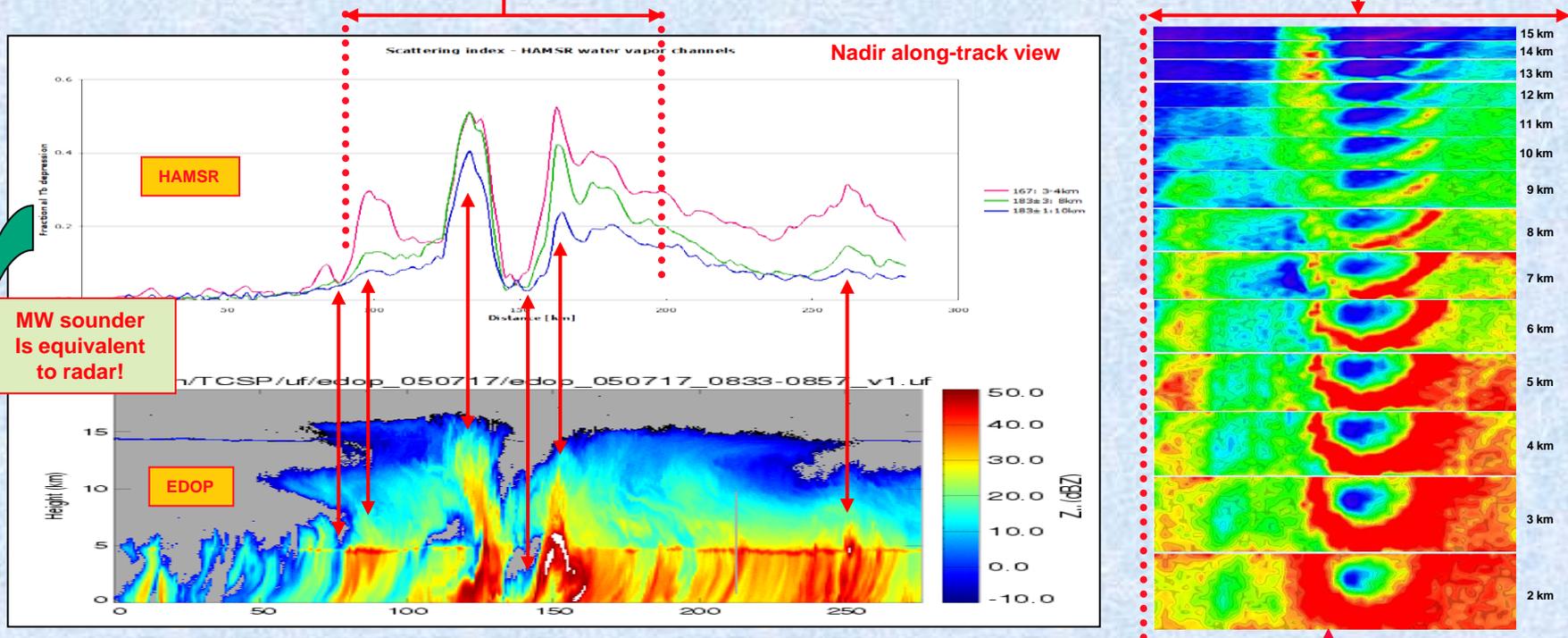


NEW: Scattering profiling \Rightarrow Reflectivity algorithm

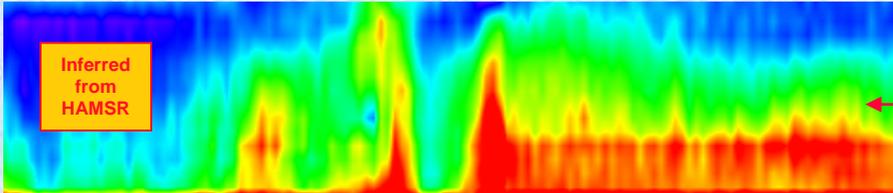
Based on comparison of microwave sounder (HAMSR) with doppler radar (EDOP) during TCSP/2005

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!

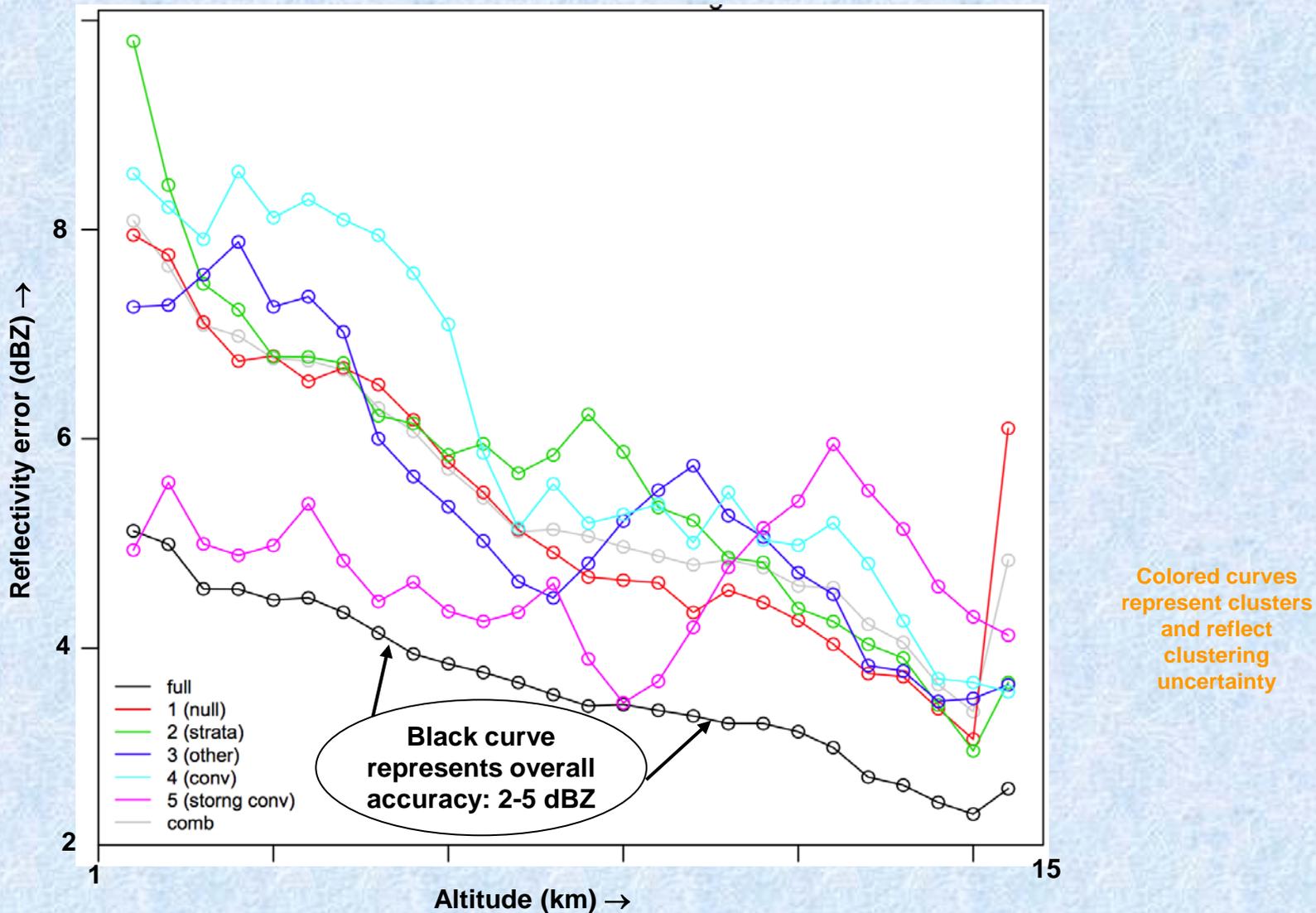


Height resolved "Radar reflectivity"
 \Rightarrow Use radar algorithms to derive

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

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

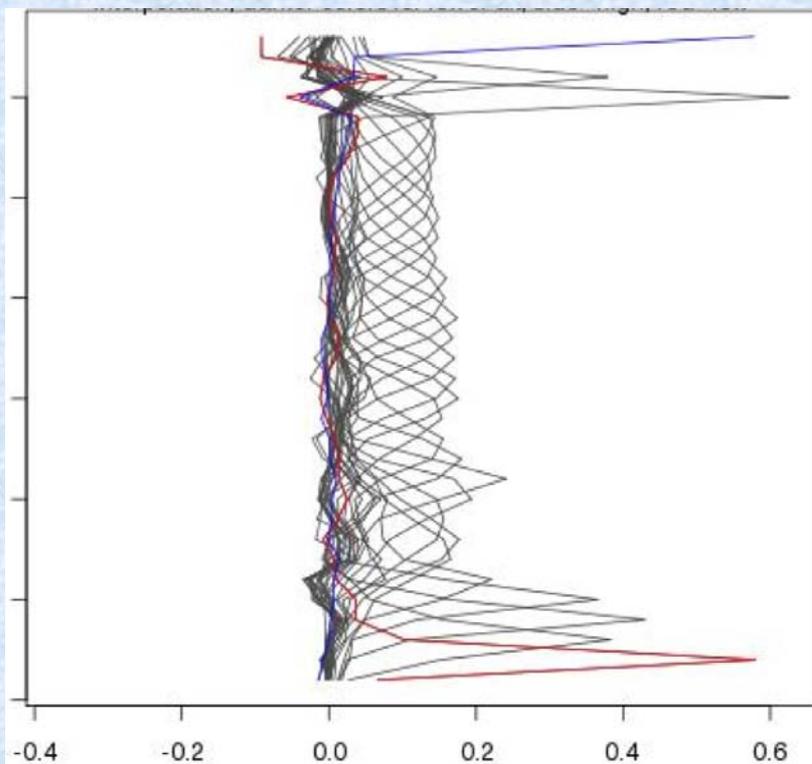
Reflectivity retrieval accuracy



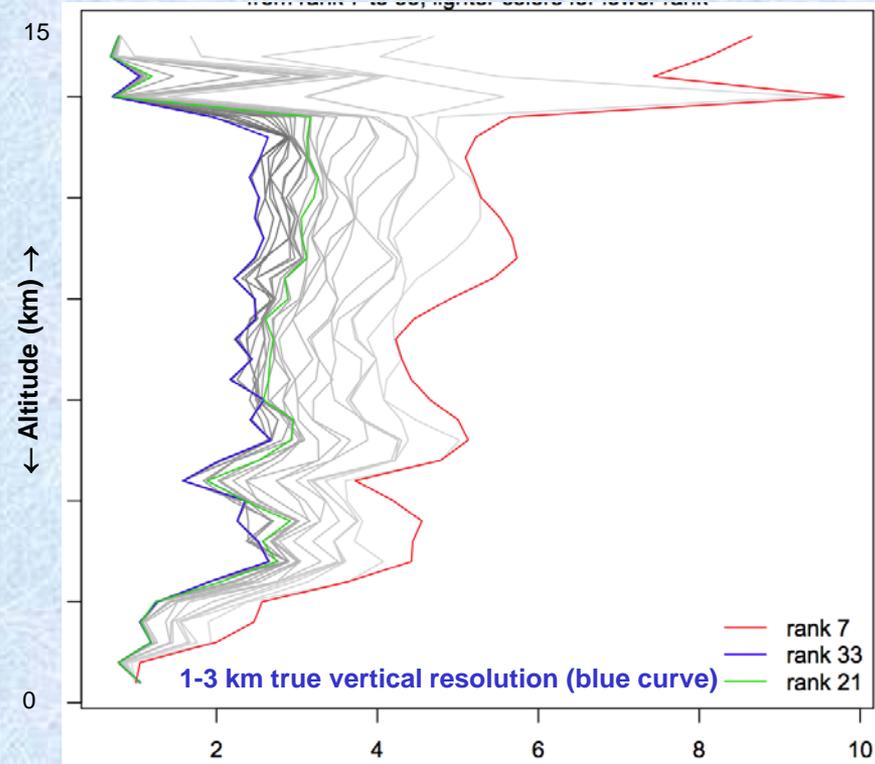


Averaging kernels and vertical resolution

Averaging kernels:



Vertical resolution:





Hurricane Karl flight on September 16-17

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NASA Hurricanes

Observation Data

Septeml ▾ 2011 ▾

Su	M	T	W	Th	F	S
			01	02	03	04
05	06	07	08	09	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

At hour: 19:00:00 ▾

STORM TRACKS

- Best Tracks
- Pouch Tracks
- PGI41L
- PGI43L
- PGI44L
- PGI45L
- PGI46L

SATELLITE DATA

- SST
- OHC
- Wind (ASCAT)
- TPW (AMSU-A)
- RH-AIRS Press. Level 850 ▾
- CAPE-AIRS
- LI-AIRS
- Geostationary
- GOES-IR
- GOES-VAPOR
- GOES-VIS
- 85GHZ

The current time is Wed, 25 May 2011 05:23:19 GMT

Animation: Observation Data Model Data

Select a time range to animate: (from 2010-09-15 19:00:00 to 2010-09-16 19:00:00)

Start 2010-09-1 21:00:00 ▾ End 010-09-17 06:00:00 ▾ Animation Step 1 hour ▾

Model Data

Septeml ▾ 2011 ▾

Su	M	T	W	Th	F	S
			01	02	03	04
05	06	07	08	09	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

MODEL DATA

Pressure Level: 850 ▾

Forecast Time: 000 ▾

GFS

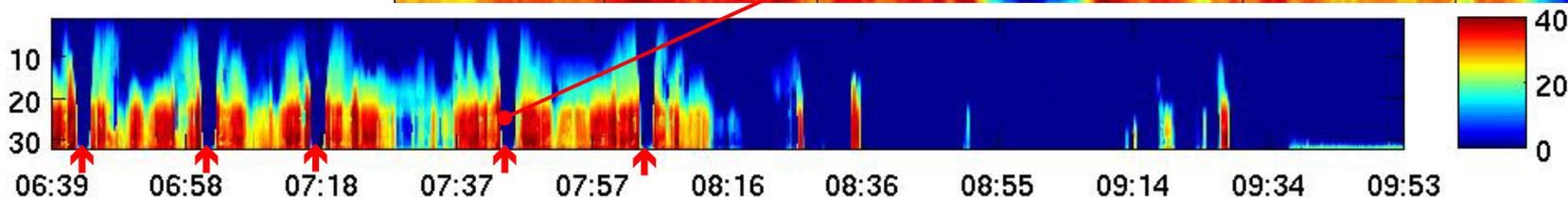
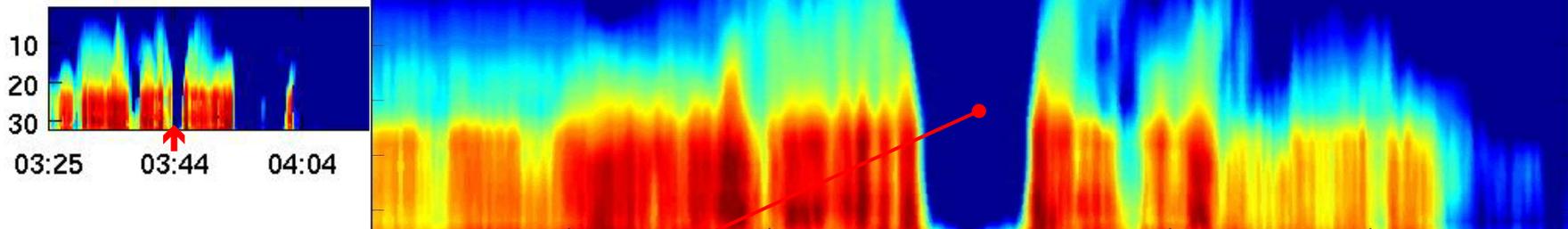
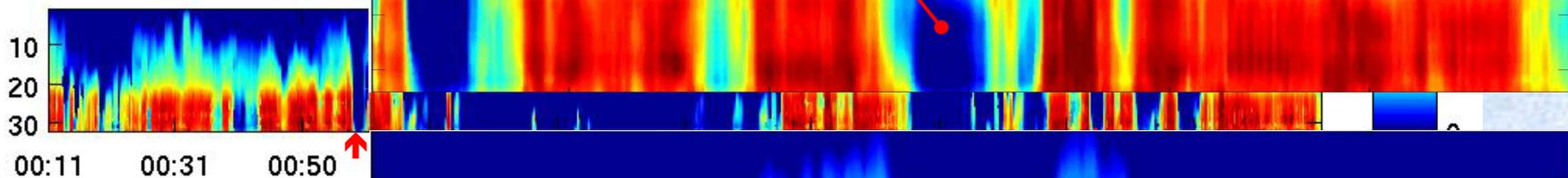
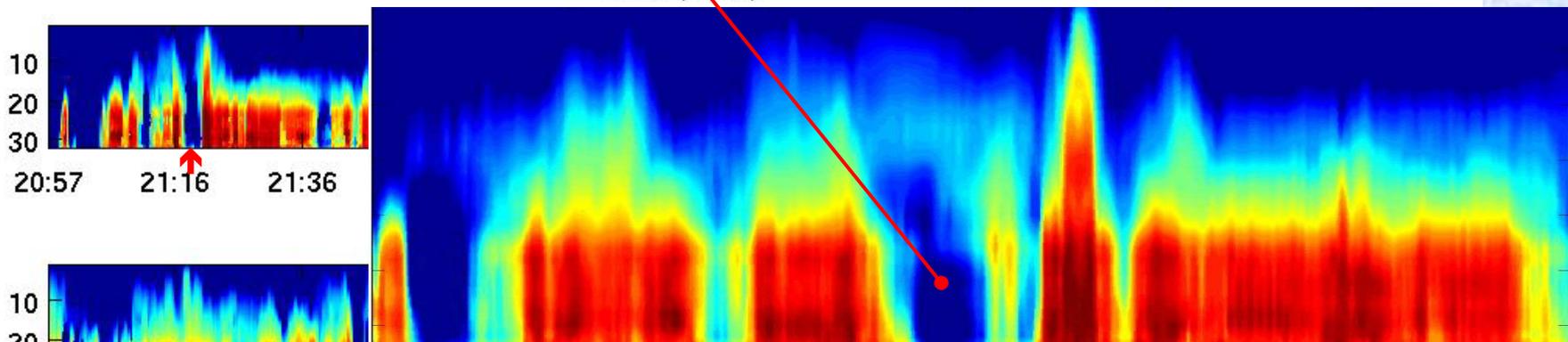
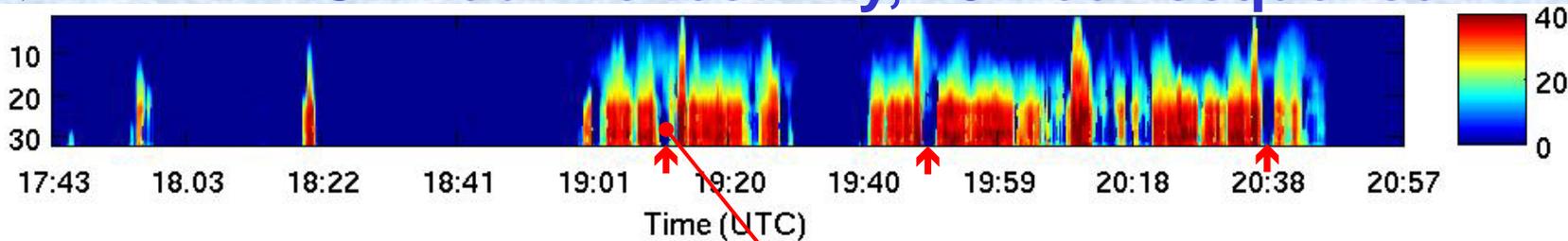
- Speed Earth Relative
- Streamline Earth Relative
- PGI41L
- PGI43L
- PGI44L
- PGI45L
- PGI46L
- Relative Humidity
- OW
- Vorticity
- Deep shear
- Pouch shear
- Sea Level Pressure
- ECMWF
- UKMET
- NOGAPS

GRIP STM, Los Angeles, June 7, 2011

Lambrigtsen

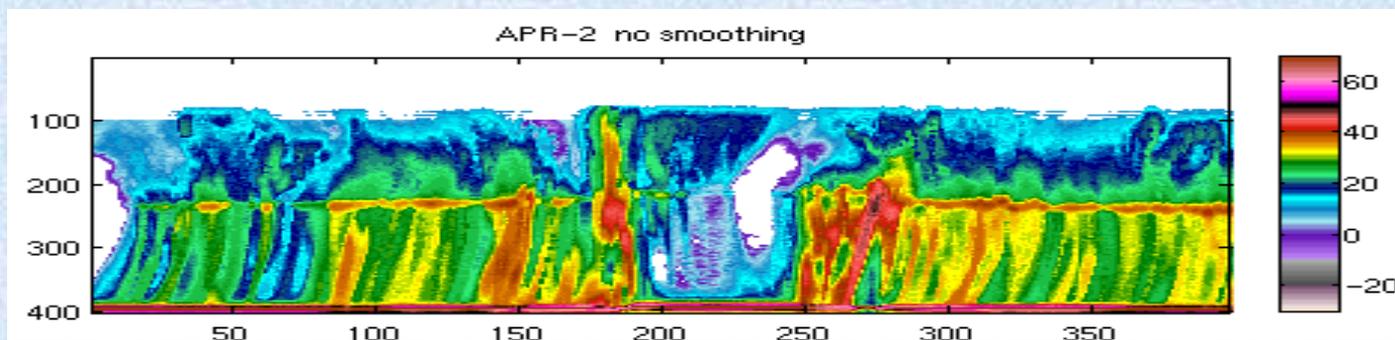
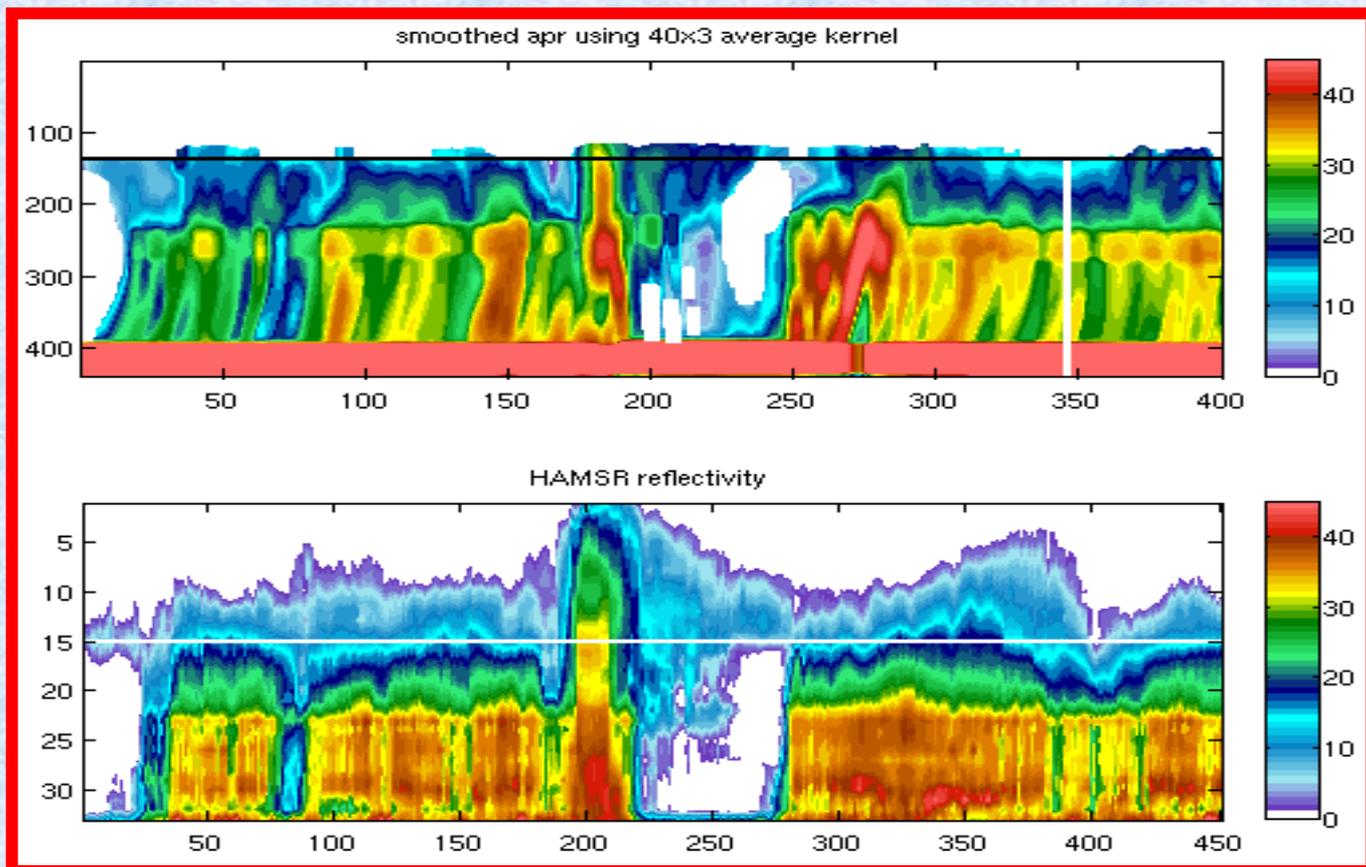
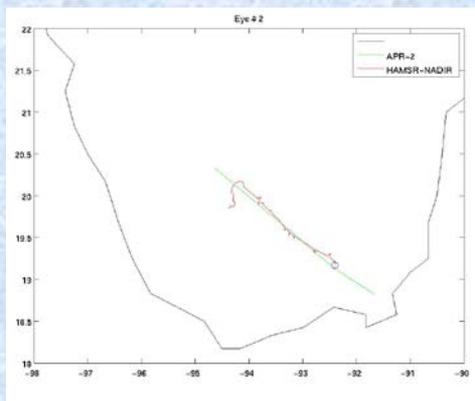


HAMSR nadir reflectivity, 13-hour sequence



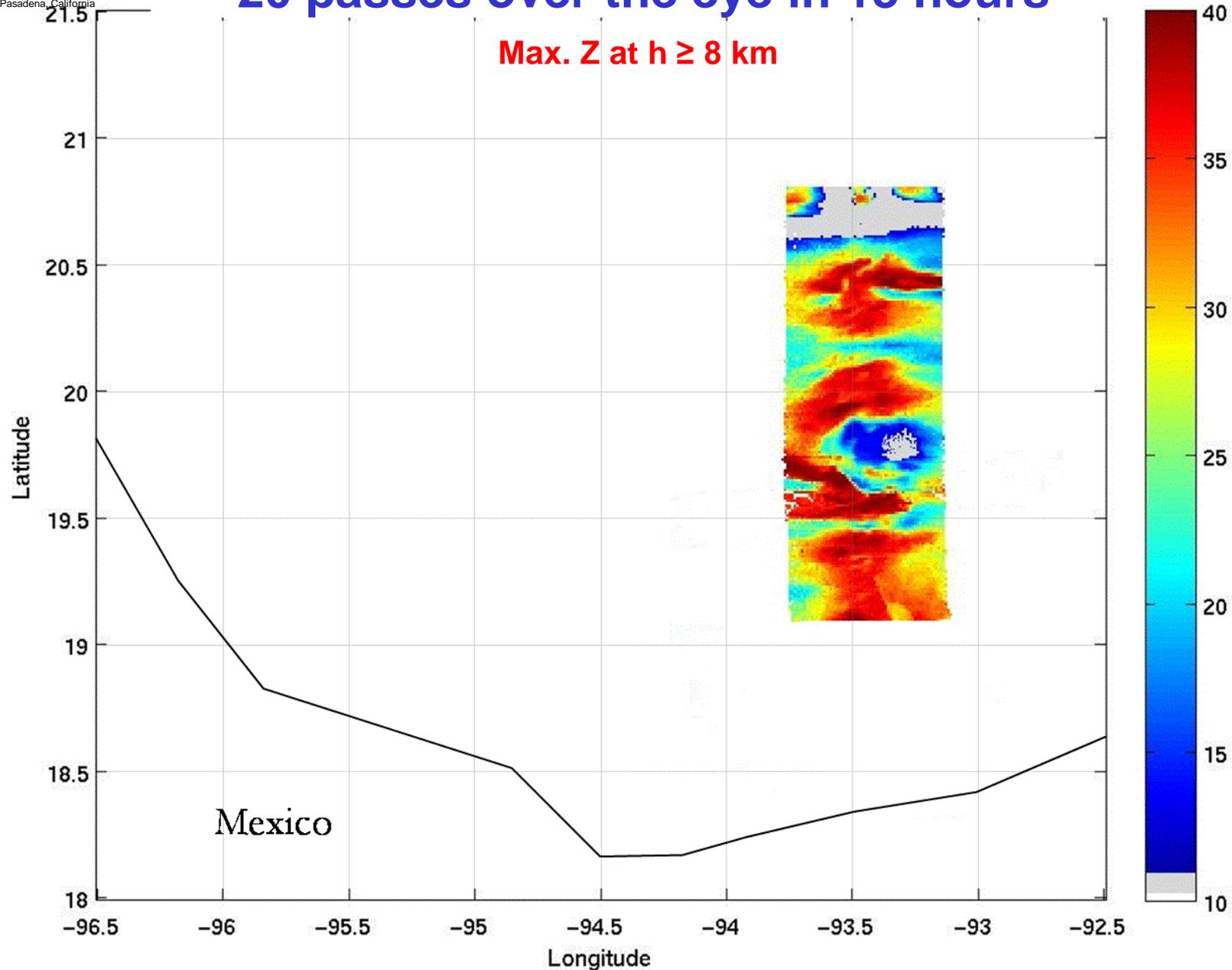
Comparison with APR-2

Eye pass #2 (1949 UTC)



20 passes over the eye in 13 hours

Max. Z at $h \geq 8$ km





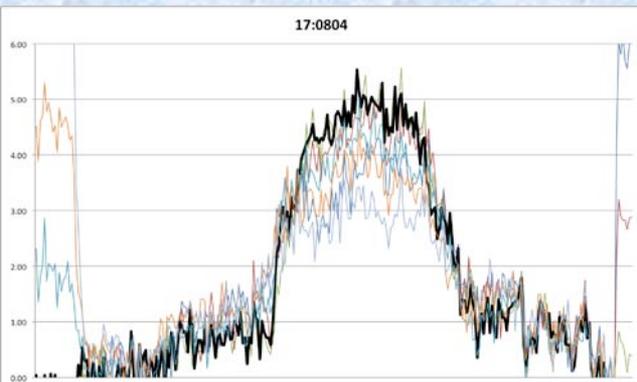
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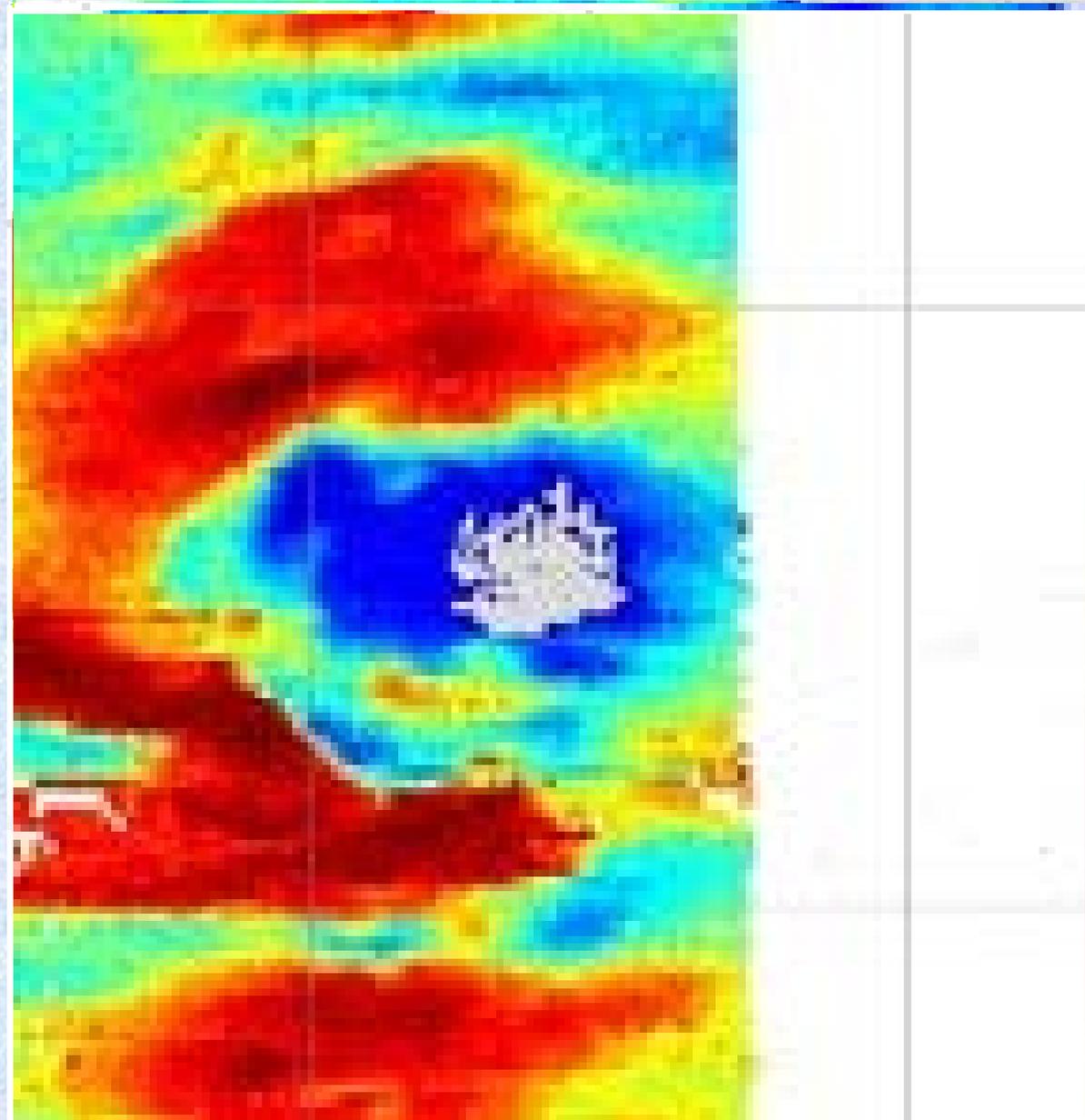
HAMSR observations of the evolving inner-core structure of Karl

Closeup views of the inner core

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



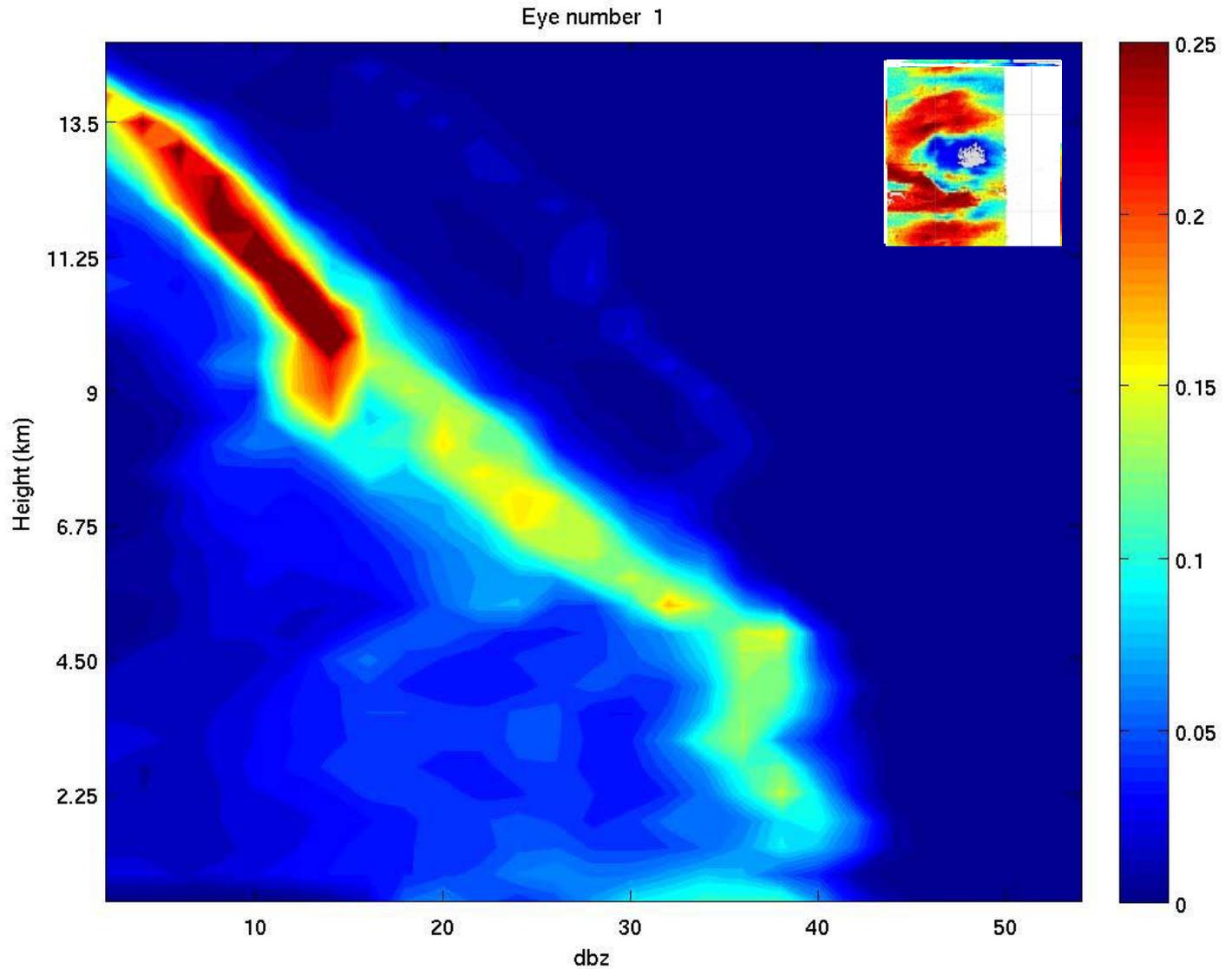
10 minutes





CFADs

Surface to 15 km, 70 km square @ eye

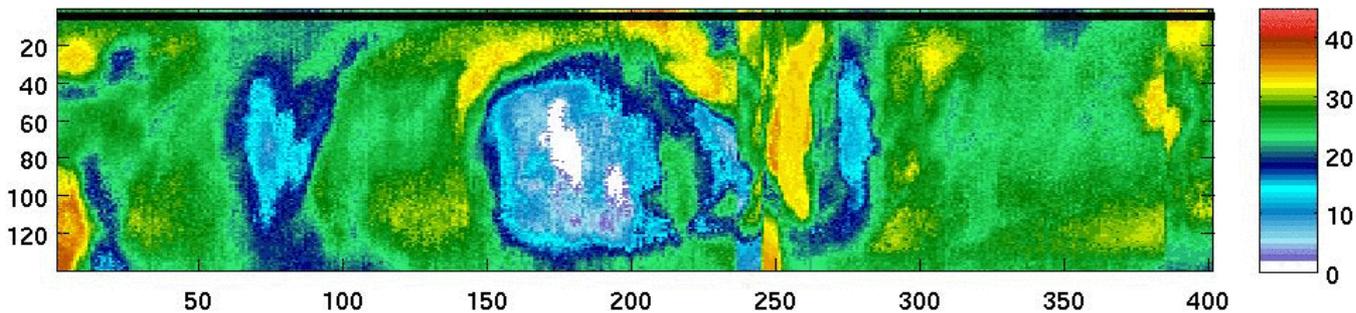
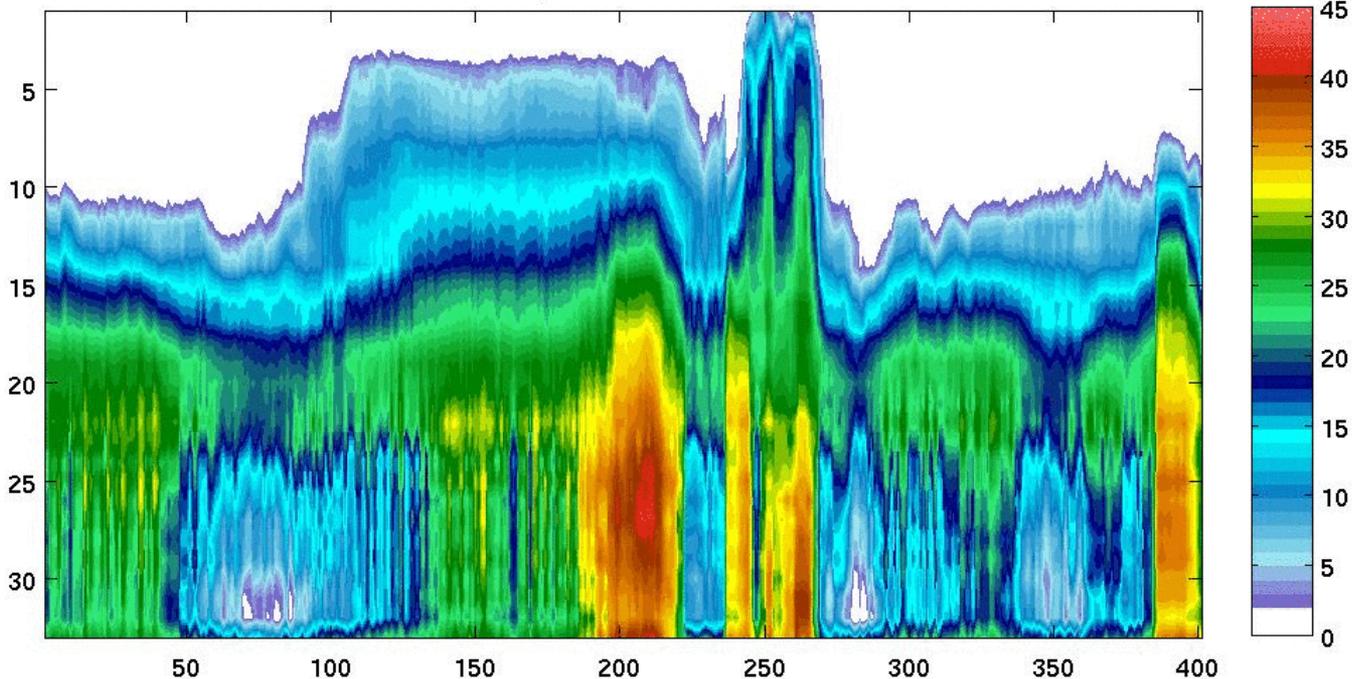




Vertical sclices

Eye pass #1

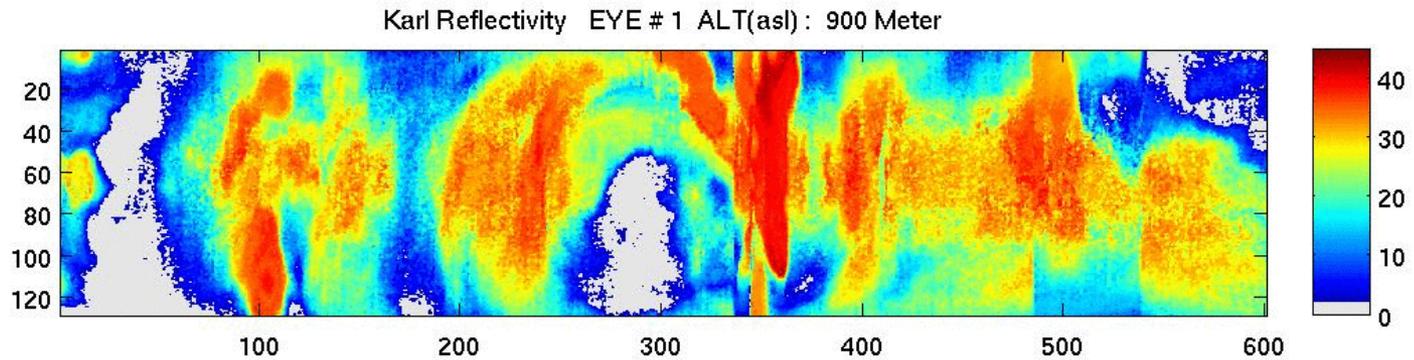
Karl Reflectivity EYE # 1 scan line : 138





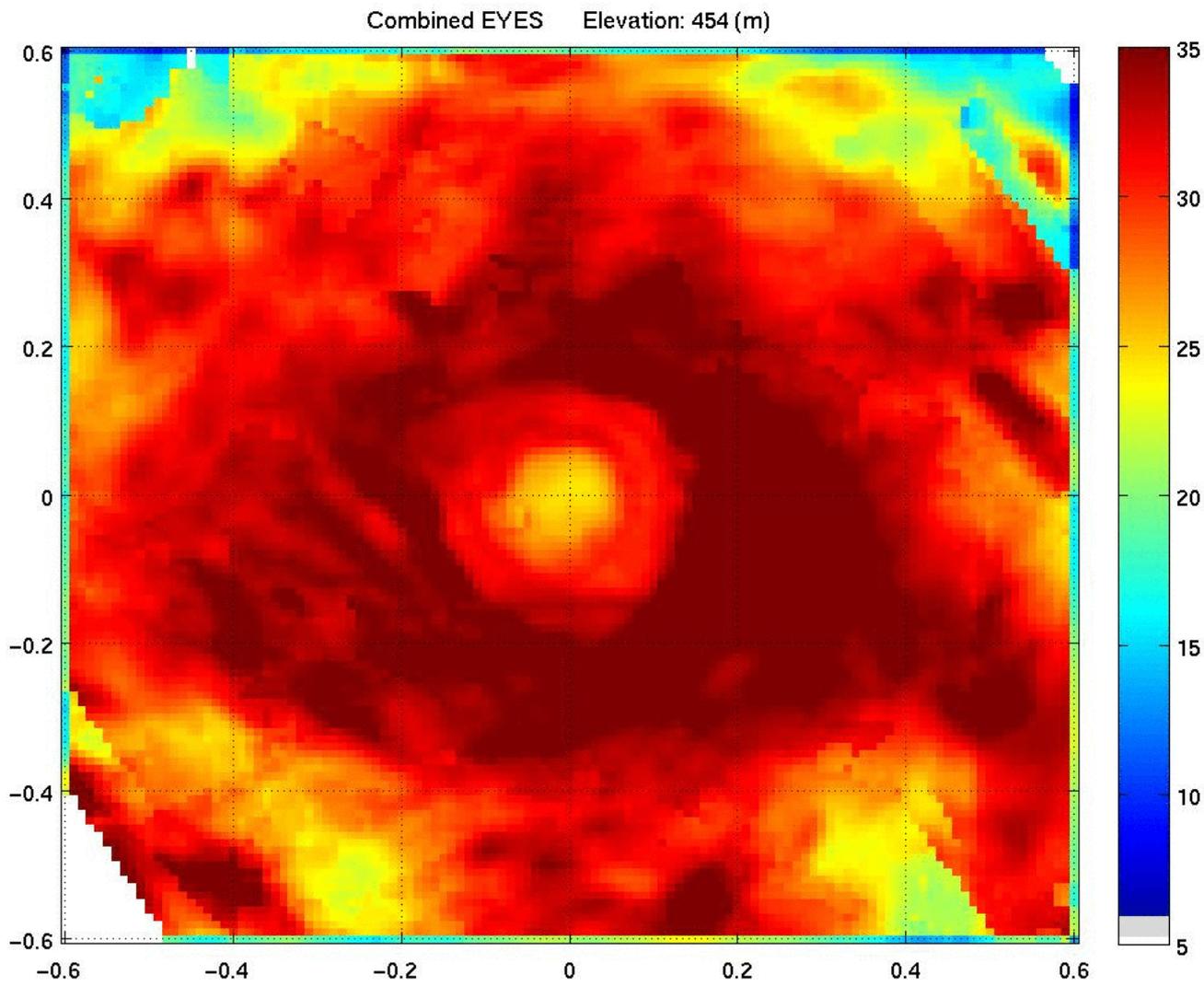
Horizontal sclices

Eye pass #1



Mean 3-D structure

All 20 eye passes



GRIP continues...

Done

- Process all HAMSR data to L1b (calibrated TB' s)
- Distribute data through 3 servers
 - GRIP archive server (MSFC)
 - HAMSR data server (JPL)
 - Hurricane portal (JPL)
- Preliminary retrievals
 - $T(z)$, $q(z)$, $L(z)$ for non-precipitating FOVs
 - $Z(z)$ for precipitating FOVs

In process

- Definitive retrievals
- Validation
 - Brightness temperatures
 - 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.

Next

- Case studies
 - Karl: a) genesis; b) RI (long time series)
 - Earl: decline
 - Matthew: genesis
- Comparison with reflectivity derived from AMSU