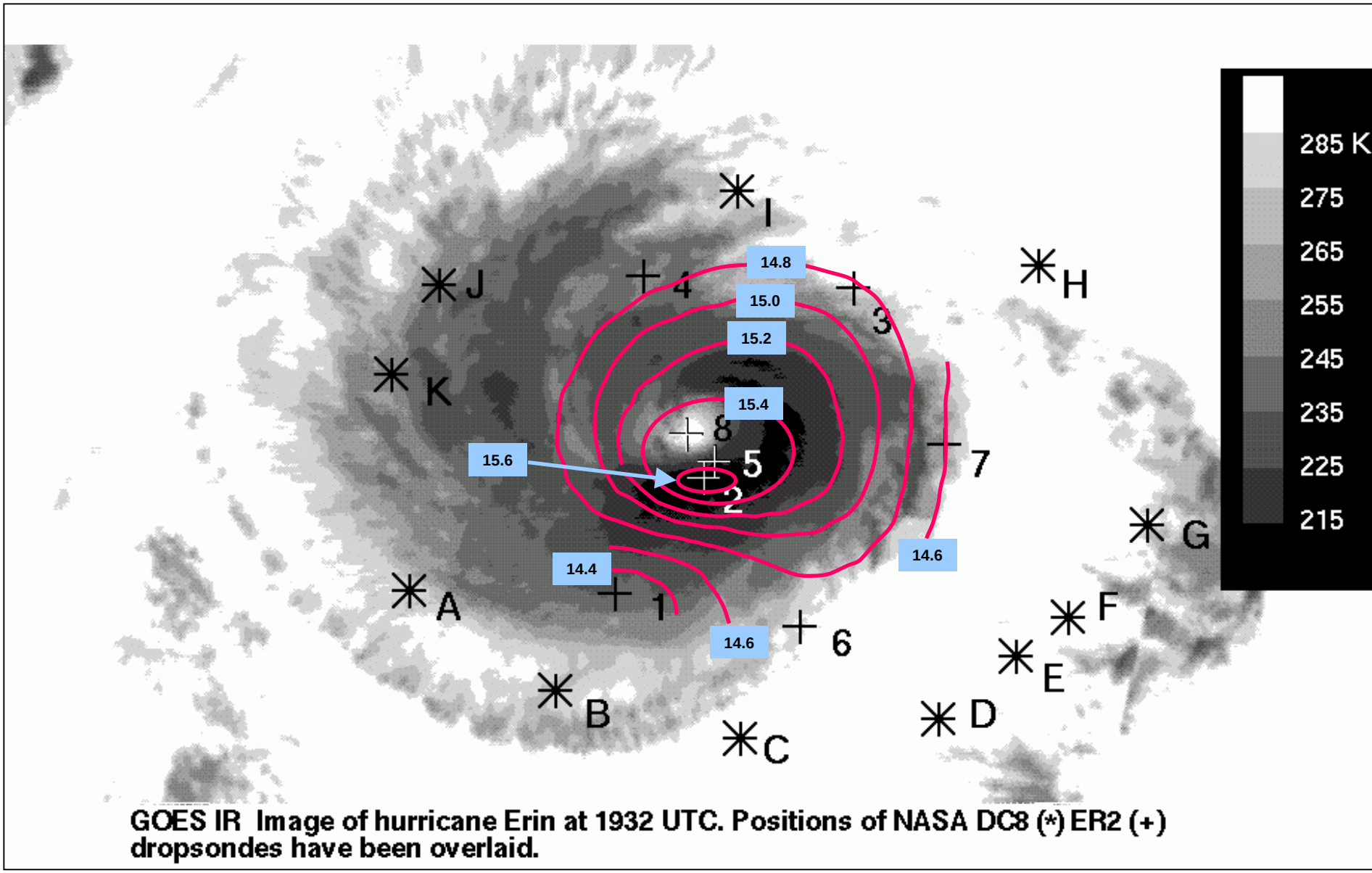

GOES IR Image of hurricane Erin at 1932 UTC. Positions of NASA DC8 (*) ER2 (+) dropsondes have been overlaid.

Analysis of Tropopause Heights in Hurricane Erin, Sept. 10 2001

(heights shown in km)

Studies of the Upper Atmospheric Inner Core of Hurricanes Using the NASA ER-2 Dropsonde During CAMEX-4

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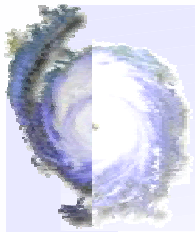
Biswadev Roy
Arlene Laing
Dean Lauritsen, Terry Hock (NCAR)

Tropical • Climates • Hurricanes



Science Objectives

Dropsonde system on NASA DC-8: NCAR AVAPS, 4 channel, Vaisala RD-93 sonde
Typical release height = 9-10 km

Dropsonde system on NASA ER-2: NCAR AAVAPS, 4 channel, modified Vaisala RD-93 sonde (full-up 3D GPS engine); release height = 21-22 km

Variables: T, RH, winds (GPS), pressure
Vertical resolution: ~ 0.5 mb (5-15 m)

1. **Map the three dimensional structure of the upper tropospheric tropical cylone inner core (temperature, moisture, winds);**

2. **Measure the cloud environment of intense eyewall convection, in conjunction with EDOP and remote sensors;**

3. **Provide critical *in situ* atmospheric profile data for initialization and validation of numerical models;**

4. **Provide independent measurements for verification of DC-8 & ER-2 temperature and moisture profilers**

MISSION	DATE	MISSION TYPE	#DC-8 DROPS	# DROP FAILURES	REASONS FOR FAILURE(S)
010406	8/28	Andros Island	2		
010407	8/20	T.S. Chantal	7	1	Partial loss of winds.
010408	8/25	Test	1		
010410	9/6	KAMP #1	2		
010411	9/7	KAMP #2	1		
010412	9/9	KAMP #3	1		
010413	9/10	Hurricane Erin	11	2	2 with complete wind loss.
010414	9/15	T.S. Gabrielle	10	1	Early termination below 31,000'.
010415	9/19	KAMP #4	2	1	Noisy data and early termination below 830 mb.
010416	9/22	T.S. Humberto	14	1	Complete failure.
010417	9/23	Hurricane Humberto	25	6	3 with complete wind loss; 2 with partial wind loss; 1 complete failure (drop #6).
010418	9/24	Hurricane Humberto	23	8	2 with complete wind loss; 4 with partial winds (2 of these also have partial PTU data loss); 2 complete failures (drops #7 and #10).

Table 1. DC-8 dropsonde deployment during CAMEX-4.

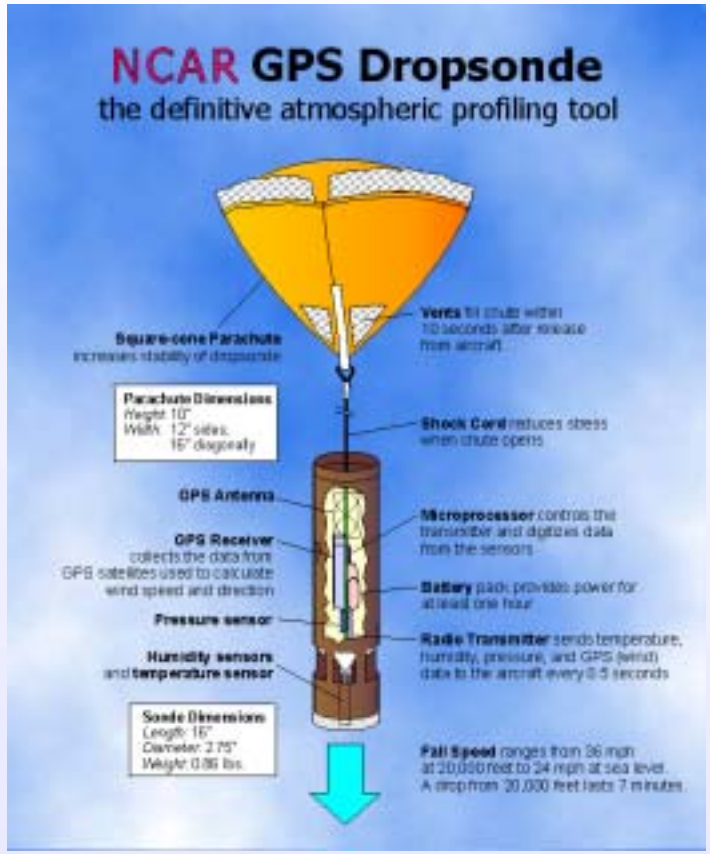
Total Dropsondes Deployed: 98
Total Without Incident: 78 (~80%)
Sondes Without Winds: 7 (~7%)
Total Sondes With Wind Loss (Partial or Complete; doesn't include those sondes that completely failed): 14 (~14%)
Complete Sonde Failures: 5 (~5%)

MISSION	DATE	MISSION TYPE	#ER-2 DROPS	# DROP FAILURES	REASONS FOR FAILURE(S)
01-131	8/18	Andros Island	2	1	No data reported on one dropsonde.
01-132	8/20	T.S. Chantal	0	0	
01-133	8/26	Test	2	0	
01-134	9/3	KAMP #1	0	0	
01-135	9/7	KAMP #2	0	0	
01-136	9/9	KAMP #3	0	0	
01-137	9/10	Hurricane Erin	8	0	Near-complete data on all accounts w/ some noise in upper levels.
01-138	9/16	T.S. Gabrielle	4	1	One drop w/out GPS winds. Some thermo is noisy.
01-139	9/19	KAMP #4	1	0	
01-140	9/22	T.S. Humberto	2	0	Intermittent wind on one drop; some thermo is noisy.
01-141	9/23	Hurricane Humberto	3	0	Intermittent winds and noisy thermo on two drops.
01-142	9/24	Hurricane Humberto	7	5	No winds and poor quality thermo on 4 out of 6 drops.

Table 2. ER-2 dropsonde deployment during CAMEX-4.

Total Dropsondes Deployed: 29
Total Without Incident: 22 (~76%)
Sondes Without Winds: 5 (~17%)

ER-2 AAVAPS System



Preliminary Data QC

DC-8 & ER-2 Dropsondes
Data Archive: NASA MSFC
http://camex.msfc.nasa.gov/camex4/data_reporting.jsp

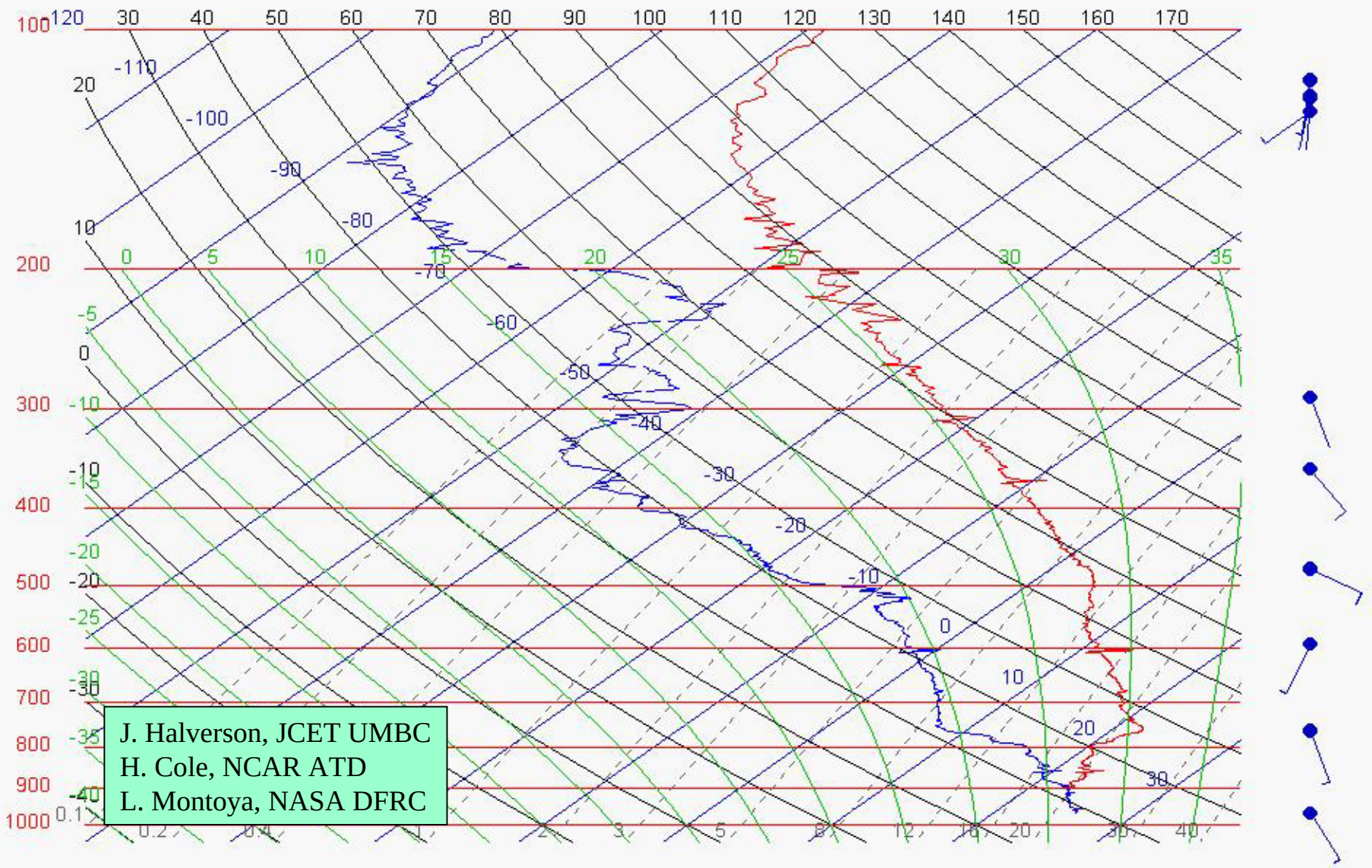
Images: .jpeg skewT-logP with filtered wind barbs
Files: ASCII NCAR CLASS format
Header: Launch date, time, location, comments
Time, Press, Temp, Dewpt, RH, U, V, W, Dir, Long, Lat, Alt, Flags

Initial QC: NCAR Aspen Software
22 algorithms
Limit checks, T and winds dynamic adjustments, smoothing
User interface: Graphical checks
Problems: Wind loss, data noise in upper troposphere

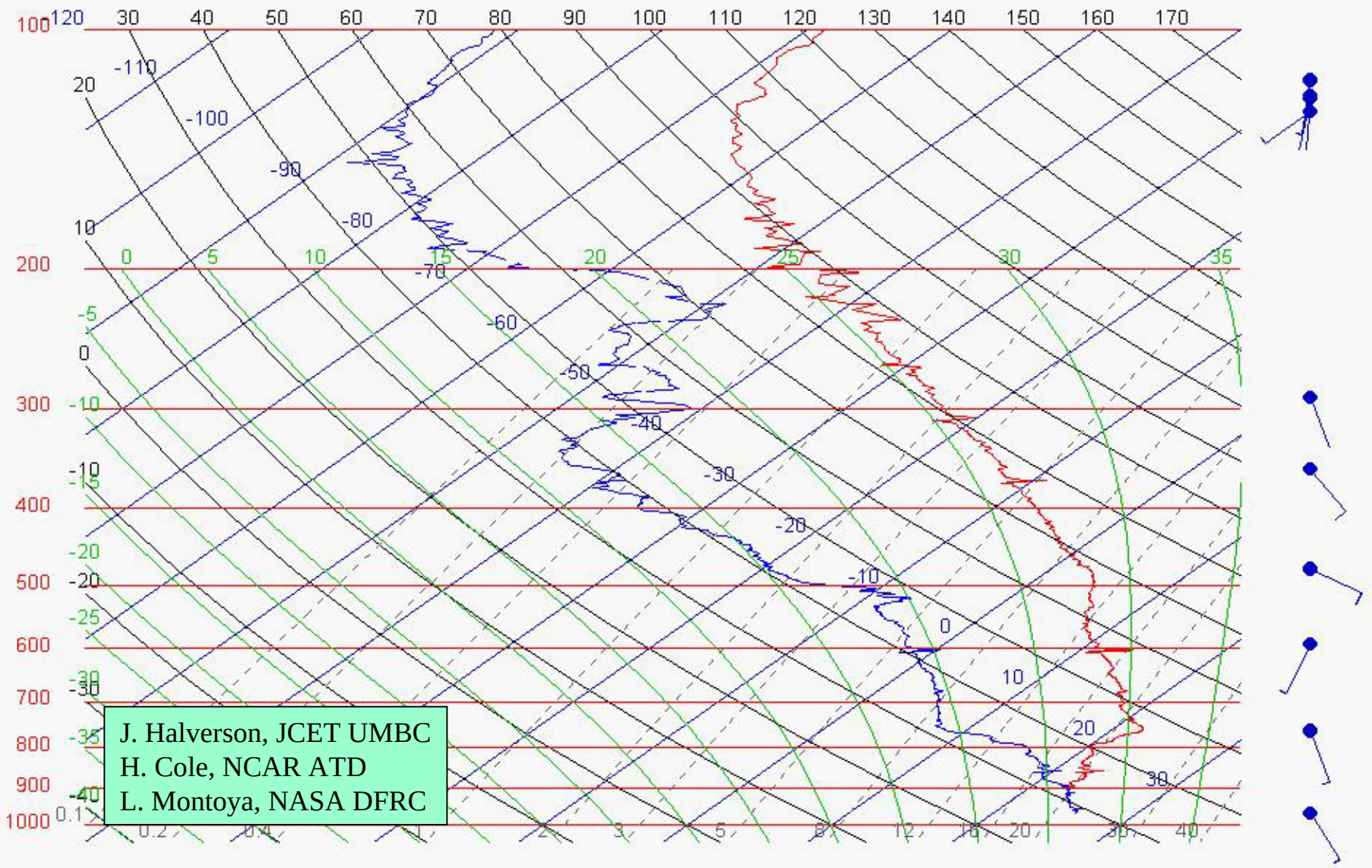
Final NCAR QC: End of April/Early May 2002

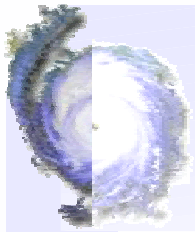
P.I. Halverson: halverson@gilbert.gsfc.nasa.gov

NASA ER-2 High Altitude Dropsonde (EHAD) Sounding of Hurricane Erin'S Eye During CAMEX-4



NASA ER-2 High Altitude Dropsonde (EHAD) Sounding of Hurricane Erin'S Eye During CAMEX-4





CAMEX Work - Ongoing & Future

Hurricane Bonnie:

Heymsfield, G., J. Halverson, J. Simpson, L. Tian and P. Bui, 2001: ER-2 Doppler Radar Investigations of the eyewall of Hurricane Bonnie during the Convection and Moisture Experiment-3, *J. Appl. Meteor.*, **40**, 1310-1330.

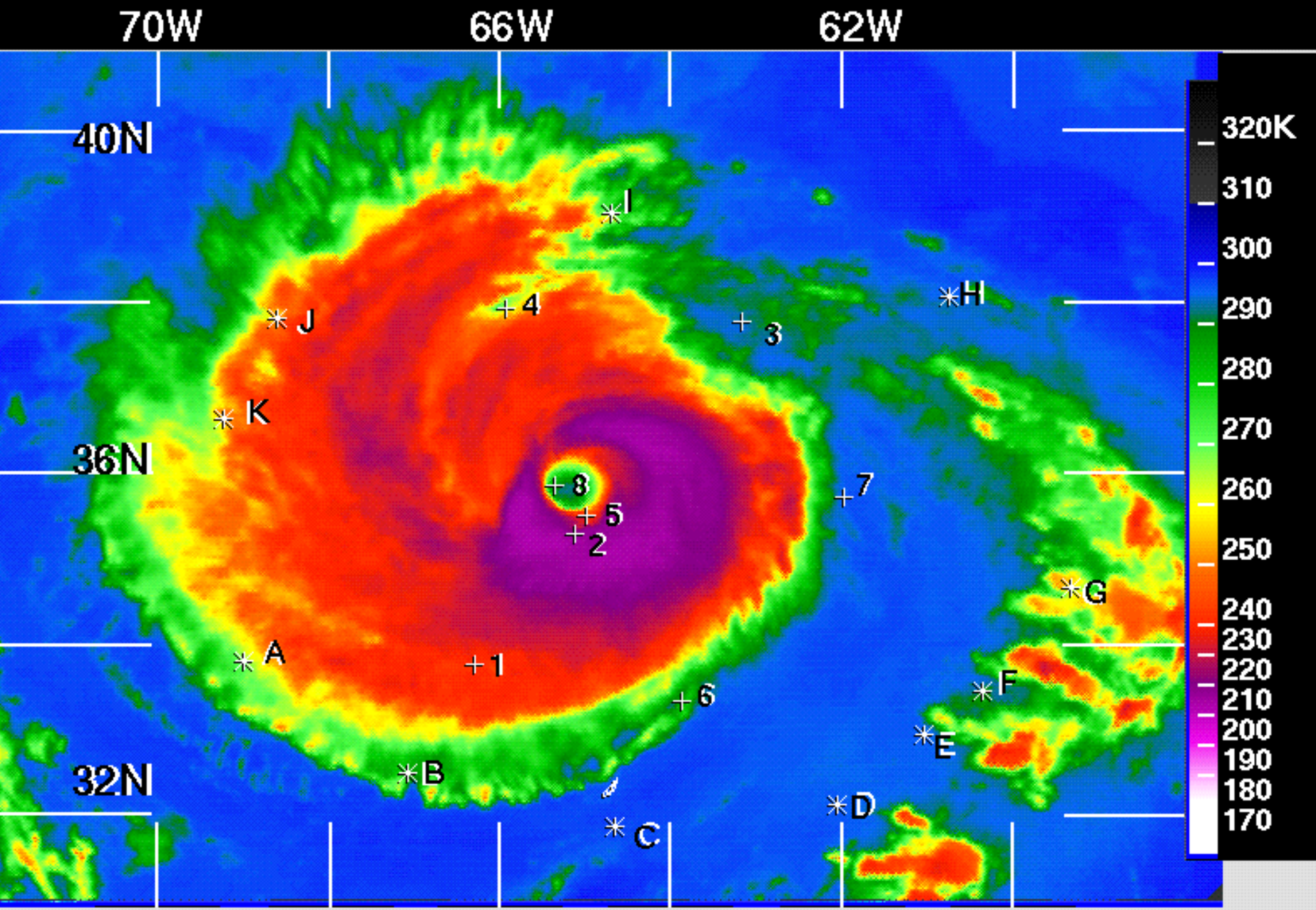
Hurricane Erin:

Halverson, J., T. Hock, H. Cole, J. Simpson, G. Heymsfield, H. Pierce, C. Velden and K. Brueske, 2002: Thermal structure of Hurricane Erin's core using dropsonde data from 68,000 feet and comparison with AMSU satellite measurements. *25th Conference on Hurricanes and Tropical Meteorology.*

Goddard Visualization and Analysis Lab (VAL): 3D Anatomy of Hurricane Erin, Sept. 10 2002. Combine NASA dropsonde data with remote sensors (TRMM, QuickSCAT, GOES) to show the 3D relationship between surface winds, rainfall, clouds, ice, latent heating and eye warming. *AMS Electronic Journal, TRMM Science & Education Outreach*.

Tropical Storm Chantal:

Ongoing collaborations with G. Heymsfield (GSFC) and Liz Ritchie (DRI) examining scale interactions between storm and environment (dropsondes, EDOP, numerical modeling).



GOES IR Image of hurricane Erin at 1744 UTC. Positions of NASA DC8 (*) ER2 (+) dropsondes have been overlaid.