Mission Summary
990821h1 Hurricane Bret
Modified XCDX/Air-Sea Interaction Experiment

Scientific Crew (42RF)

Chief Scientist	Michael Black
Radar/Doppler Scientist	Peter Dodge
GPS Dropsonde	Rob Rogers
Workstation	Peter Dodge
AXBT	Joe Cione
Scatterometer	Jim Carswell/Eric Uhlhorn

Aircraft Crew (42RF)

Pilots	Kennel, Tennesen
Flight Director	Stan Czyzyk
Navigators	Strong
Systems Engineer	Sean McMillan
AVAPS Operator	John Hill

Mission Briefing:

On August 21, 1999 NOAA-42 would conduct a modified Extended Cyclone Dynamics Experiment (XCDX) and Air-Sea Interaction Experiment into Hurricane Bret in the Southwest Gulf of Mexico. The P-3 would depart from and return to MacDill AFB in Tampa Florida. The G-IV, also operating out of MacDill, was to sample the environment around Bret, covering all of the Gulf of Mexico and portions of the Western Caribbean Sea (Fig. 1). Hurricane Bret was intensifying and was forecast to be a strong Category two storm at the time of our flight. The P-3 would fly a rotating figure four pattern with 75 nmi radial legs separated by flying downwind 45° in azimuth (Fig. 1). GPS dropsondes would be deployed at the end points of the 75 nmi legs, in the eyewall, and eye. The flight altitude would be 14 kft. A total of 18 AXBTS would be released at or near some of the dropsonde locations, primarily in the right side of the inner core and along a west-to-east leg along 26.5° N latitude north and east of Bret.

Mission Synopsis:

Takeoff from MacDill was at 1744 UTC and NOAA-42 headed southwest to the IP, 90 miles to the east of the forecast center (23.75 ° N, 94.25° W) of Hurricane Bret. The eye of Bret first became visible on the LF radar at 200 nmi range at 1940 UTC. The first GPS dropsonde and AXBT were released near 2010 UTC, 75 nmi east of the eye. Flight-level winds were 105 kts in the eastern eyewall, and similar wind speeds were reported in the boundary layer by the GPS sonde dropped in the eyewall. The AXBT reported a sea-surface temperature (SST) of 28.7° C. An eye drop was released at 2024 UTC at 24° 13' N, 94° 57' W and reported a surface pressure of 965 mb. Hurricane Bret was further to the NW than forecast and quite a bit more intense. Bret had a well-defined, closed eyewall as viewed by the belly radar with the highest reflectivity on the north and west side (Fig. 2).

We continued on our planned pattern, returning to the eye at 2110, 2242, and 2251 UTC. During the last center pass , Bret was at 24° 37' N, 95° W and a dropsonde recorded a surface pressure of 957 mb. Apparently, Hurricane Bret was intensifying at a rapid pace and moving north toward the Texas coast at about 10 knots. Peak flight -level winds during the flight were about 120 knots in the NW eyewall, 115 in the NE, and 105-110 knots in the southern portion of the eyewall. The AXBTs in the inner core were reporting SSTs of 29°-30° C and surprisingly deep mixed-layer depths of 30-50 meters (Fig. 3). Dropsondes released in the eyewall reported surface or boundary-layer wind speeds of 100-105 knots, about what is expected based on the flight-level winds and minimum central pressure.

As NOAA-42 was about to track out of the eye to the NW on our final radial leg, it was decided to circle in the eye and fly upwind just along the edge of the visible and radar eyewall.

We released two dropsondes in rapid succession along the western eyewall (Fig 4) to investigate the continuity of convective features that they might fall through. A similar drop in Hurricane Mitch (27 October 1998) revealed surprisingly high winds for a sonde released in the clear air of the eye. The two sondes were dropped at 224901 and 224913 UTC, which translates to a separation distance of about 1 km. Vertical cross sections of reflectivity from the tail radar (Fig. 5) shows that the drop locations were adjacent to strong convection along the inner edge of the western eyewall. The wind profiles from the two sondes revealed vertical structure quite different from each other (Figs. 6 and 7). The altitude of the peak winds varied considerably as did the vertical motion estimated from the sonde's fall velocity. Apparently, these two sondes took a different trajectory through different convective features in the eyewall. Both of the sondes, however recorded the highest winds of any so far during the flight with peak winds of 149 knots at 2400 ft, and boundary-layer winds of 120-130 knots. Since the winds were sufficiently higher than those dropped elsewhere in the eyewall, it was decided to call CARCAH and report the times of the drops so that forecasters at NHC could use the data in their next advisory. As it turned out, NHC increased the intensity estimate of Bret to a Category 4 hurricane with surface winds of 115 knots, based upon the data from these drops. These wind speeds are considerably stronger than those expected from a wind-pressure relationship. An Air Force reserve plane that investigated Bret immediately following our flight confirmed a 120 knot surface wind estimated with dropsondes and a further lowering of the MSLP.

After another short circle in the eye, we resumed our track outbound through the NW eyewall to 26.5° N, 96° W. We then headed east, releasing AXBT's every degree of longitude until 91° W. These six AXBTs reported SSTs of about 30° C and mixed-layer depths of 20-40 meters. From there, we headed straight for MacDill and landed at 0203 UTC 22 August.

A total of 23 GPS sondes were dropped within 75 nmi of the eye, including 12 in the eyewall and 2 in the eye. All of the sondes were good and were sent back to NCEP and NHC in real-time. In addition the GPS drops , NOAA-42 deployed 18 AXBT's total, 14 that sent back good data. The AXBTs were always released near a dropsonde location. Also, we transmitted 4 lower-fuselage radar composites to TPC/NHC.

Evaluation:

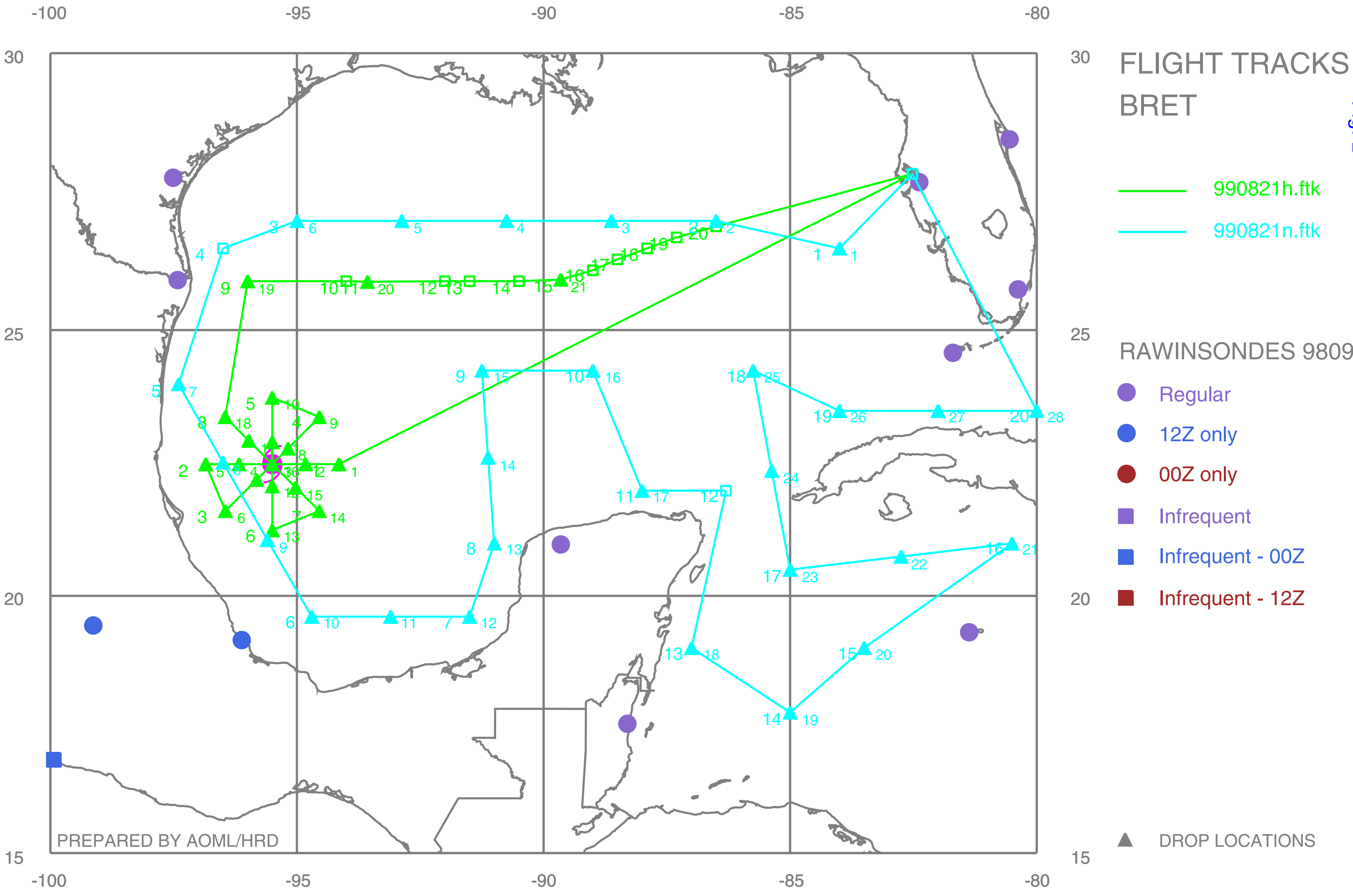
Overall, the mission was highly successful providing both excellent synoptic coverage (from the G-IV) and good inner core observations with Doppler radar, GPS dropsondes, and AXBTs. This is the most comprehensive data set HRD has collected in a rapidly-intensifying hurricane. The ocean element may prove to be a valuable source of data in subsequent studies of Hurricane Bret. The radar data systems operated normally and the tail Doppler data was always in the Forward/Aft scanning mode, providing nearly continuos dual-Doppler coverage of the eyewall region.

Problems:

The data and radar systems performed flawlessly, as did the GPS AVAPS systems. The only drawback was the failure of 4 of the AXBTS, but not surprising given the age of these expendables. Minor software problems were encountered on the HAPS workstation that was corrected later and did not hinder operations.

Michael Black
5 September 1999

Fig. 1


FLIGHT TRACKS
BRET
990821h.ftk
990821n.ftk
RAWINSONDES 9809
● Regular
● 12Z only
● 00Z only
■ Infrequent
■ Infrequent - 00Z
■ Infrequent - 12Z
▲ DROP LOCATIONS
PREPARED BY AOML/HRD
-100
-95
-90
-85
-80
30
25
20
15

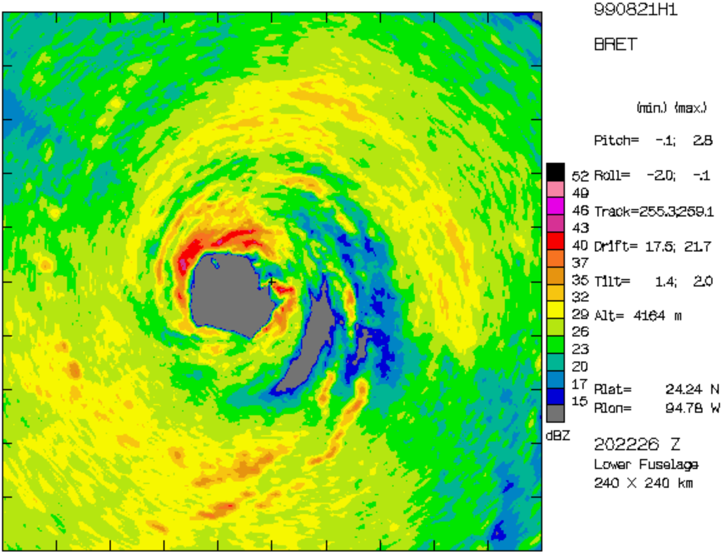
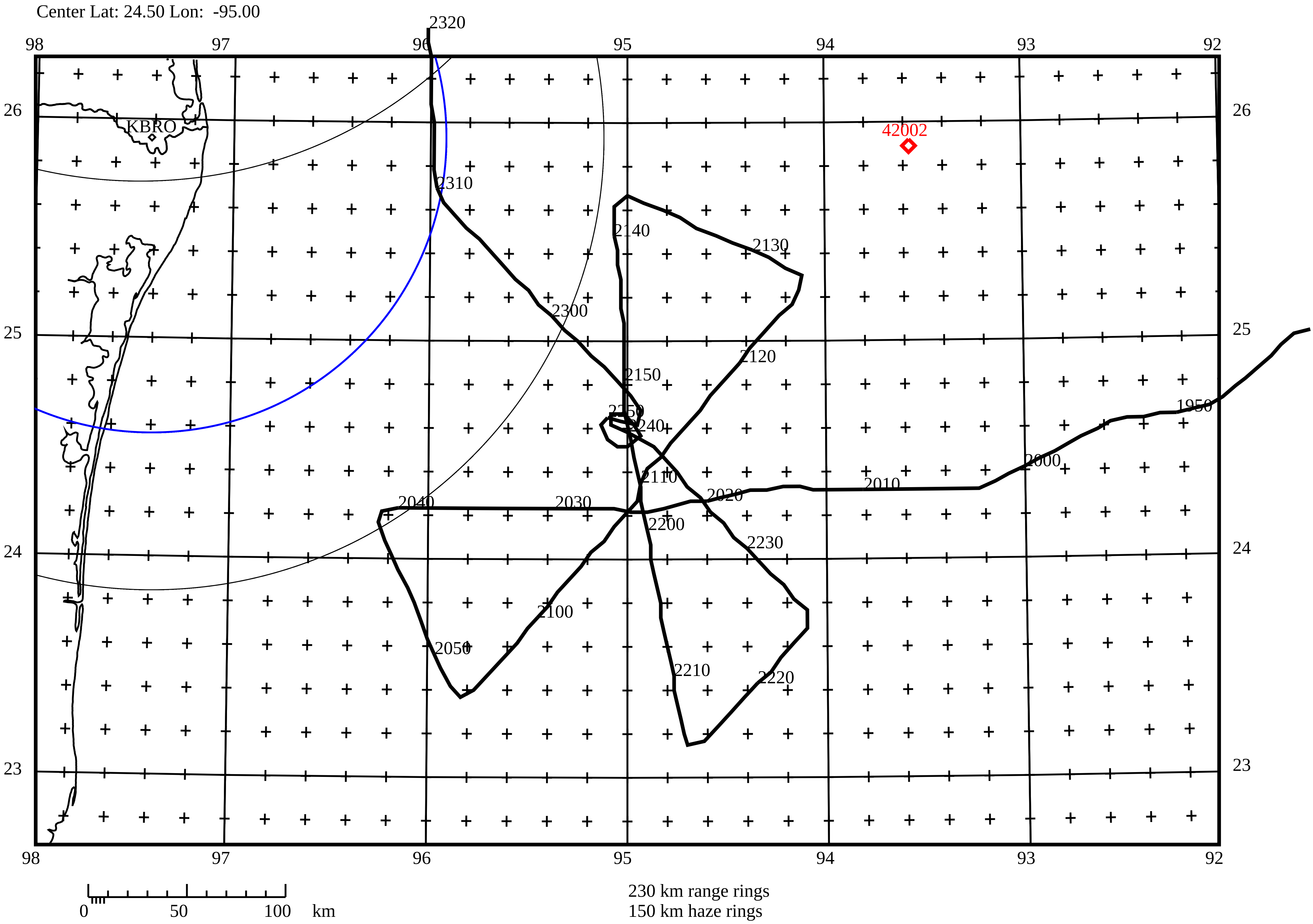
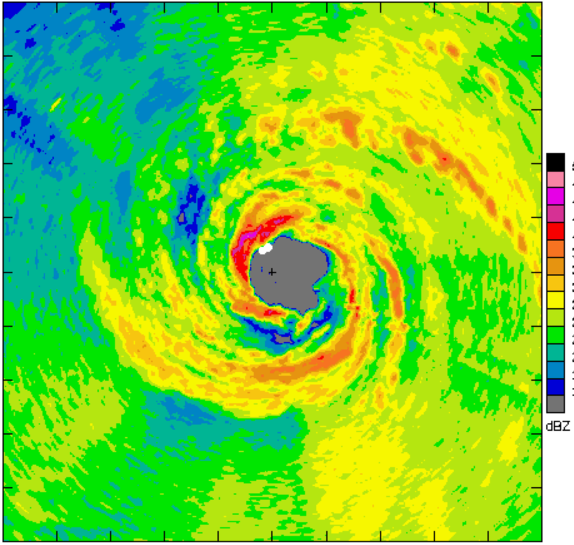

990821H1
BRET
(min.) (max.)
Pitch= -.1; 2.8
Roll= -2.0; -.1
Track=255.3;259.1
Drift= 17.5; 21.7
Tilt= 1.4; 2.0
Alt= 4164 m
Plat= 24.24 N
Plon= 94.78 W
202226 Z
Lower Fuselage
240 X 240 km
52
49
46
43
40
37
35
32
29
26
23
20
17
15
dBZ

Fig. 3


Center Lat: 24.50 Lon: -95.00
98
97
96
95
94
93
92
26
25
24
23
KBRO
42002
2320
2310
2300
2250
2240
2230
2220
2210
2200
2150
2140
2130
2120
2110
2100
2050
2040
2030
2020
2010
2000
1950
0
50
100
km
230 km range rings
150 km haze rings



990821H1

BRET

(min.) (max.)

Pitch= 1.0; 4.4

Roll= -3.1; 13.1

Track=114.1;120.2

Drift= 2.7; 5.0

Tilt= 1.5; 2.2

Alt= 4267 m

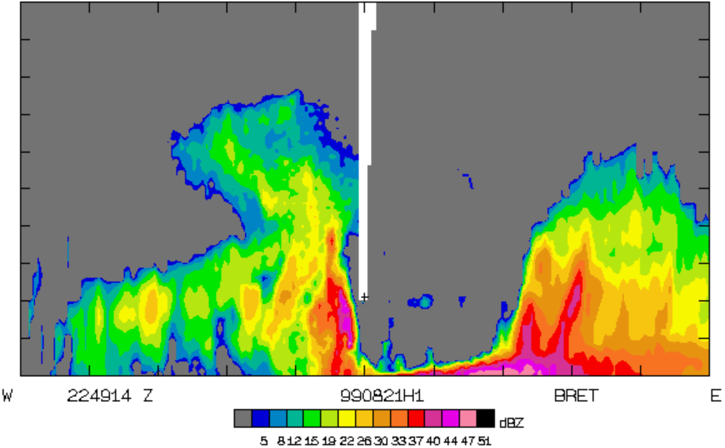
Rlat= 24.63 N

Rlon= 95.04 W

225054 Z

Lower Fuselage

240 X 240 km



(min) (max)
Pitch= .2; 1.3
Roll= 4.6; 12.7
Track=346.9;352.3

(min) (max)
Drift= -4.2; -2.8
Tilt= -.5; 23.0
120 X 20 km

Tail Radar
Alt= 4263 m
Rlat= 24.63 N
Rlon= 95.13 W

Fig. 6

DROPSONDE DATA PLOT 224901 UTC 21 AUG 1999
Sonde ID: 984325497 24.62 N 95.13 W

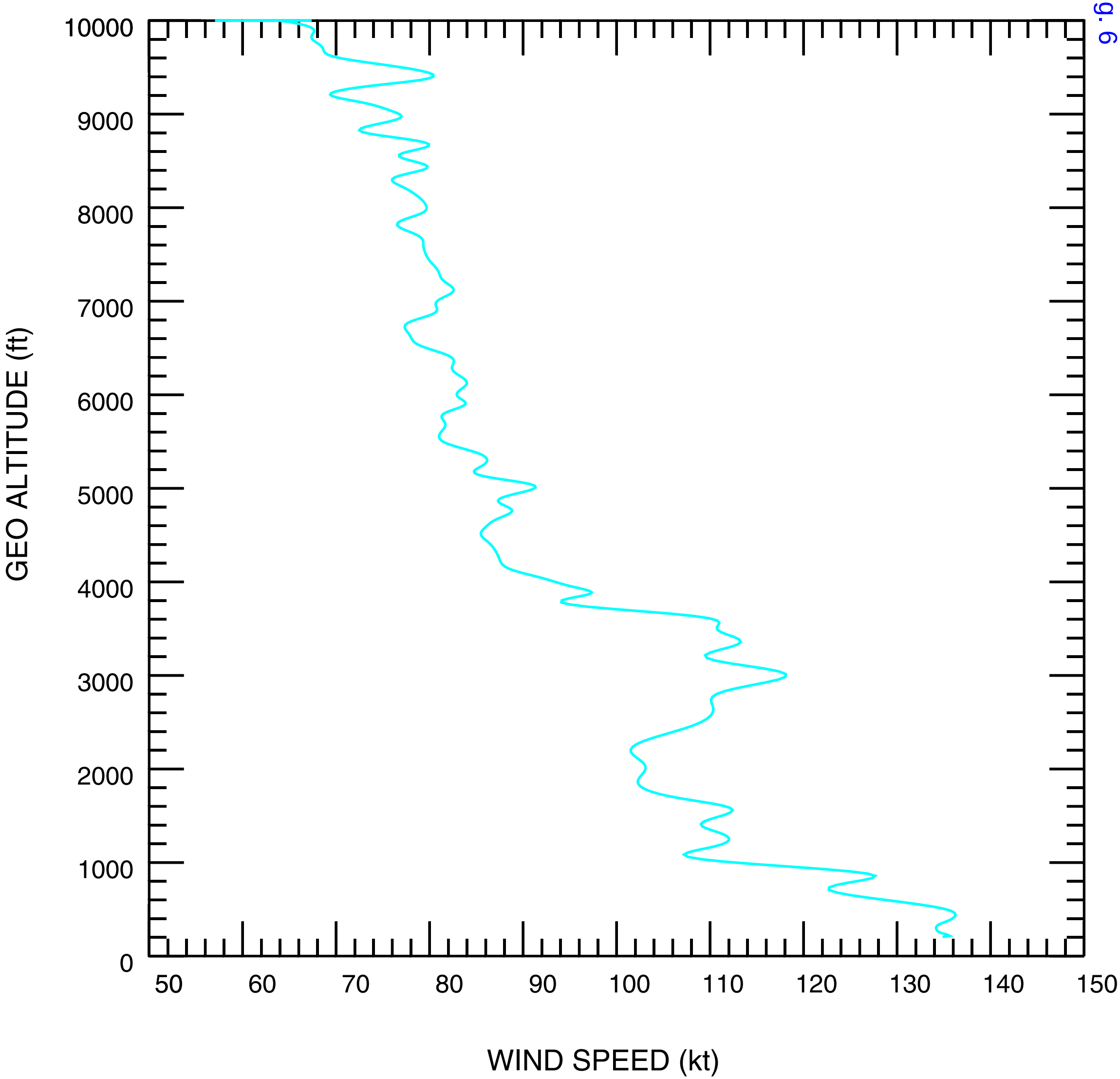
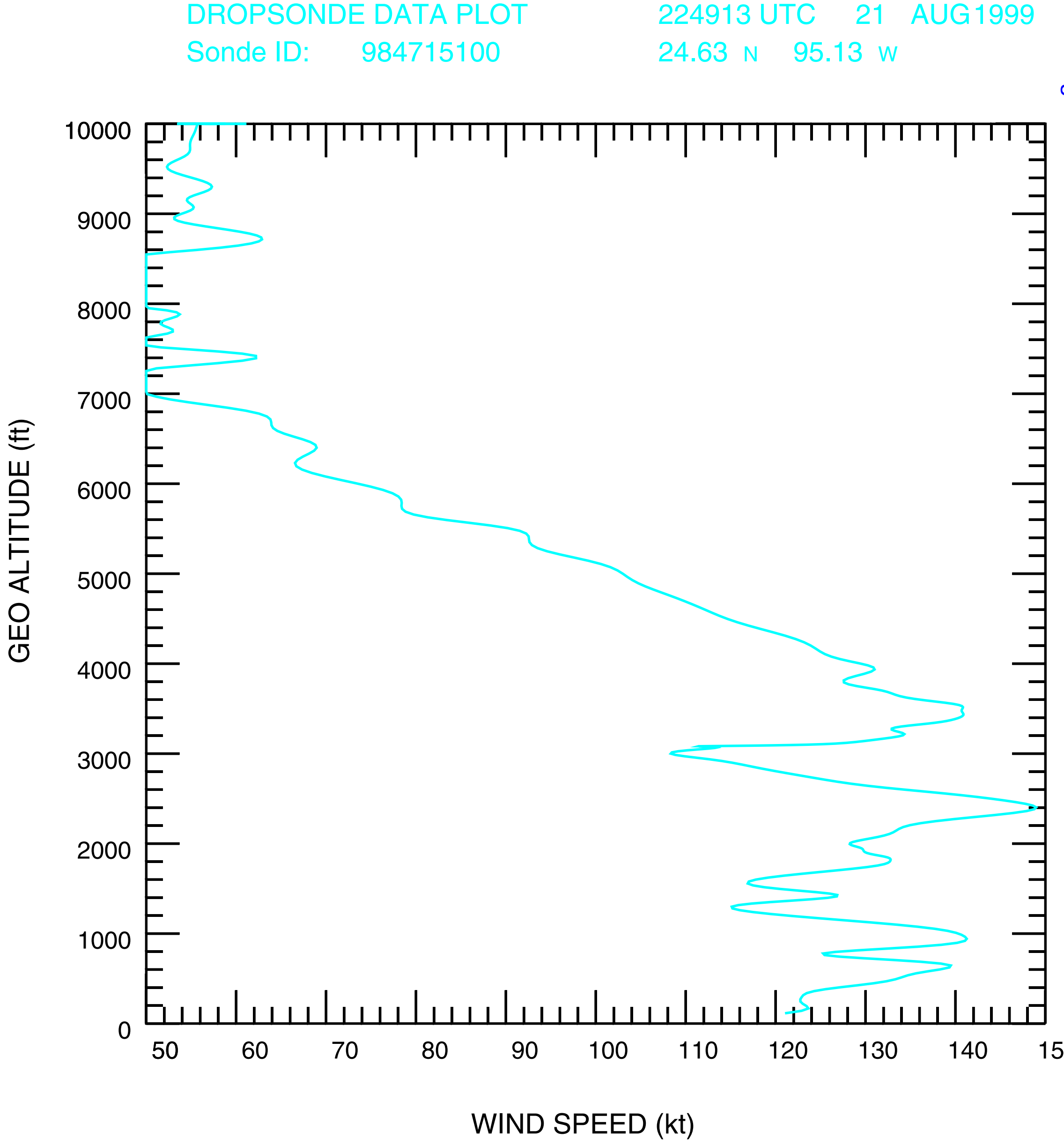


Fig. 7


DROPSONDE DATA PLOT
224913 UTC 21 AUG 1999
Sonde ID: 984715100
24.63 N 95.13 W
GEO ALTITUDE (ft)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
50
60
70
80
90
100
110
120
130
140
150
WIND SPEED (kt)