

Mission Summary
991015I Aircraft: 43RF
Hurricane Irene
Landfall

Scientific Crew:

Chief Scientist Peter Dodge

Dropsonde/AXBT Joe Cione
Radar/Workstation: Mike Black
SRA Ed Walsh

Aircraft Crew:

Cockpit: LCDR Brian Taggert,
 CDR Phil Kenul, Greg
 Bast, Steve Wade,
 Dewie Floyd
Navigator: LT Carl Newman
Flight Director: Jack Parrish
Engineers: Sean McMillan, Jorge
 Delgado, LT Phil Hall
Observer: ADM Evelyn Fields

Mission Briefing:

After the NOAA P3 reconnaissance flight on 14 October 1999, it was apparent that Hurricane Irene would hit Florida. Although the model runs on the 14th predicted landfall near Naples, by noon it was clear that Irene would have an impact on Florida Bay, and the Keys and the east coast of South Florida might experience tropical storm force winds. Frank Marks, Pete Black and Sam Houston designed a flight track to measure waves, storm surge and winds. An initial figure 4 through Irene was to be followed by runs along the Keys and the coast. If possible we would fly over the land as the storm moved North up the center of the state, over the Everglades. The goals were to collect more wave and storm-surge data with Ed Walsh's Scanning Radar Altimeter (SRA), and to collect GPS sonde data near the C-MAN and other surface stations to improve real-time and post-storm surface wind field analyses. The pattern was designed to take advantage of the Miami (KAMX) and Key West (KBYX) WSR-88D radar data, and Step Frequency Microwave Radiometer (SFMR) surface wind estimates would be transmitted back to the Tropical Prediction Center in addition to the flight level data. 8000' was selected as the flight level to reduce the SRA footprint and to provide flight-level winds suitable for reduction to 10m for the real-time surface wind analyses; the Air Force would be at 5,000'.

By 1730 UTC the center of Irene was only 40 km SW of Cape Sable, so we modified the pattern for the briefing. Jack Parrish agreed that after our initial pass through the storm, followed by a leg north to Fowey Rocks, that if it looked safe we could do the second leg on a SW pass over land. He and the flight crew also agreed that 8,000' would be a good altitude for the flight. Because tropical storm-force winds were still expected at MacDill AFB, NOAA 43 would recover in Gulfport, Mississippi after the mission.

Mission Synopsis:

NOAA 43 left MacDill Air Force Base at 1934 UTC, and descended to the 8,000' flight level at 1953. Figure 1 shows the flight track. The first sonde and BT were dropped at 2009, south of Cape Romano. Jack fixed the center at 2030 UTC. We proceeded SE over Florida Bay, where we dropped a sonde and the second AXBT, and then to a point 150 km SSE of KAMX, and then turned to head north. At Fowey Rocks Light (FWYF1) we dropped the third AXBT and a

sonde. At 2105 we passed through a strong rainband with 80 kt winds at flight level, near Hollywood, and then turned back south. Conditions seemed to be OK over land, so we then headed SW, passing near Opa Locka and Miami International airports before fixing the center again at 2131, where we also dropped the seventh sonde. We concluded the initial figure 4 with a leg to KBYX. At 2138 we experienced some good bumps in the clear air over the Ten Thousand Islands region. The vertical velocity calculation on the data system was bad briefly, and the SRA went down when Ed's foot hit the wave guide switch as we bounced around.

The SRA was up again at 2158 and we turned at 2200 south of Key West and then dropped the ninth sonde near SANF1. The aircraft then flew up along the keys, deploying sondes and AXBT's at the C-MAN sites. At 2224 we could see waves breaking on the reef line between Long Key (LONF1) and Molasses Reef. The flight continued along the coast. After dropping sondes near FWYF1 and in the wind max near Pompano Beach, we launched the 15th sonde at the Lake Worth Pier (LKWF1), continued north to Hobe Sound, turned west and then at 2303 we turned south at Indiantown, just east of Lake Okeechobee, to make our third pass through the storm. This track was Mike Black's excellent suggestion, to map more of the overland wind field. Flight level winds in the northern eye wall were only 48 kts. Jack fixed the center at 2320. The first three fixes had Irene moving 35° at 9 kts. Once again we bounced around in the clear air south of the center. At 2328 a drop was deployed in this region (#16), but it had no winds. We tracked west and deployed an AXBT (#6) north of Big Pine Key at 2345.

The last part of the flight was designed to examine the rainbands over the Gulf Stream. Our NE track took us near the Flamingo tower and then over Homestead. At 0023 we turned SE of Grand Bahama Island after crossing a rainband where two sondes were dropped, only one of which had winds (#19), and headed for SPGF1, where the 20th sonde was dropped at 0032. The pilots reported St. Elmo's fire at 0015, but I could not see it. We turned and headed WSW for our last pass through the storm. A sonde and AXBT were launched at 0037 over the Gulf Stream, but no winds were recorded by the sonde. At 0043 Mike Black noted that the east eyewall was over Miami Beach. Figure 2, a lower fuselage radar composite for 0050, shows the strong rainbands over the ocean and the weaker reflectivity in the SW eyewall. Jack made his 4th fix of the evening at 0052, placing the center west of Davie and just south of Alligator Alley. The data system froze briefly. The 23rd sonde drop, in the western wind max had no winds, so at Mike's urging, we reversed course to try to get a good sonde in this region. The 24th sonde at 0105 also had no winds. Jack took us into the center for a 5th fix, because he did not think the 4th was that good because of the data system problem. At 0109 he found the center over Davie and in the relative calm Jorge Delgado was able to dig out some sondes from a new box underneath the luggage. The 26th sonde was dropped at 0116 in the west eyewall and it had good winds. At 0118 the plane climbed to 3250 m for a smoother ride, and we dropped our final sonde just offshore of Marco Island at 0131, turned, climbed and headed for Gulfport, Mississippi, where we landed at 0311, 16 October.

Evaluation:

The flight went well, perhaps a bit bumpier than folks in the back of the plane would have liked. The sonde data will be helpful in describing the structure of a strong tropical storm/weak hurricane as it moves across land. There were no hurricane-force surface winds in the sonde data (see Figure 3), even though some of the sondes were dropped in regions where flight-level winds were > 75 kts. Mike Black and Joe Cione both have mentioned the rapid drop-off in winds with altitude in the sonde data. The thermodynamic data from the sondes, especially those dropped

over the Everglades, will help specify the stability profiles which may help explain why the higher winds could not mix down to the surface, except in occasional gusts. Careful analysis of the Doppler radar data may provide details of the three-dimensional windfield to complement the sonde measurements.

Acknowledgments:

Jack Parrish, Carl Newman and the flight crew agreed to every change in the flight pattern that we requested (there were many). Sean MacMillan kept the radar running, and Jorge Delgado managed to work with our evolving plans for GPS sonde drops, despite the rough ride that evening.

Sam Houston, Frank Marks and Pete Black made the initial flight tracks, and Jack Parrish assisted in sketching out the flight track for the briefing. Mike Black suggested several useful modifications and additions to the track during the flight, especially the N-S pass from Lake Okeechobee down to Flamingo Key. Mike called the sonde drops in rainbands and wind maxima. Joe Cione kept track of the AXBT data. Tim Crum, OSF, and Victor Murphy, Southern Region of the NWS, alerted the WSR-88D sites about our experiment. The Southern Region of the NWS also archived the 1 minute ASOS data. At TPC Colin McAdie archived the Level IV products from the KAMX and KBYX WSR-88D radars, and arranged copying the KAMX Level II data tapes after the storm.

Problems:

Only 20 of 26 GPS sondes launched had winds. Unfortunately some of the sonde wind failures were in higher wind regions of the storm. Jorge Delgado thinks that one of the boxes of sondes was from a bad batch. The reflectivity on the tail radar seemed low, perhaps 10-20 dBZ lower than the lower fuselage radar. This has been a problem on NOAA 43 throughout the 1999 season. The Doppler data appear OK.

The SFMR winds seemed too high in some regions of the storm. In some cases this may be caused by RFI, according to Eric Uhlhorn, but Mike Black will be using this data set to investigate whether or not there are some systematic biases in the SFMR winds.

Peter Dodge
10/28/99

Tables:

Table 1. Some Centers

Time	Lat	Lon	Source
1913	25° 17'	81° 03'	Air Force
2019	25° 30'	80° 58'	NOAA
2131	25° 40'	80° 52'	NOAA, GPS drop # 7
2320	25° 54'	80° 39'	NOAA, 982 mb
0052	26° 04'	80° 26'	NOAA, 983 mb
0109	26° 06'	80° 23'	NOAA

Table 2. GPS Sondes

#	Sonde ID	Launch UTC	Splash Lat	Splash Lon	Comments
1	985035277	2009	25.67	81.70	MBL WND 01557 RAINBAND
2	984325106	2015	25.50	81.30	MBL WND 03055 EYEWALL 315
3	991515021	2028	25.07	80.63	MBL WND 20064
4	984325477	2055	25.14	80.01	MBL WND 17553
5	984325219	2101	25.67	80.05	MBL WND 15552
7	992515737	2131	25.67	80.87	EYE, position from Jack's fix
8	991515252	2139	25.18	81.13	MBL WND 31055 LST WND 011
9	984325386	2201	24.47	81.76	MBL WND 29534
11	984715020	2218	24.81	80.79	MBL WND 24544 SST 278
12	984325236	2225	25.02	80.32	MBL WND 21054 SST 275
13	990415208	2232	25.61	80.08	MBL WND 16561 RAINBAND SST 277
14	991435022	2240	26.24	80.08	MBL WND 10054 RAINBAND
15	984325552	2248	26.61	80.11	MBL WND 09550 LST WND 012 RAINBAND
16	984325460	2328	25.41	80.65	SST 259, 10 m wind 258/45 kts
17	985035020	0010	25.70	79.43	MBL WND 16059 RAINBAND
19	985035218	0019	26.00	78.78	MBL WND 13048 RAINBAND
20	984715021	0032	26.61	79.08	MBL WND 11045 RAINBAND
22	984715323	0044	26.35	79.96	MBL WND 11051 EYEWALL 045
25	984325044	0116	25.98	80.69	MBL WND 02036 EYEWALL 270
26	990415261	0131	25.98	81.86	MBL WND 00543

Note: Sondes 6, 18, 21, 23, 24 had no winds, and 10 had no launch detect

Table 3. AXBT's (Compiled from Joe Cione's log)

#	Launch (UTC)	Lat	Lon	SST (°C)
1	200926	23° 41'	81° 39'	26.8°
2	202841	25° 01'	80° 40'	25.5° Florida Bay
3	210137	25° 38'	80° 03'	27.7° FWYF1
4	221226	24° 38'	81° 06'	27.8° SMKF1
5	222506	24° 59'	80° 20'	27.5° MLRF1
6	234445	24° 53'	81° 22'	26.0°
7	003801	26° 27'	79° 24'	28.3° Gulf Stream

Figures: (files are located on thor, in /hrd/dat/irene99)

1. NOAA 43RF flight track noaa_991015i_map.ps
2. Lower Fuselage radar image irene15lf4.gif
3. Surface winds from GPS sondes sfc_sondes.ps

1940

Hurricane Irene Landfall Flight, NOAA 43, 15 October 1999, 1940 - 0200 UTC

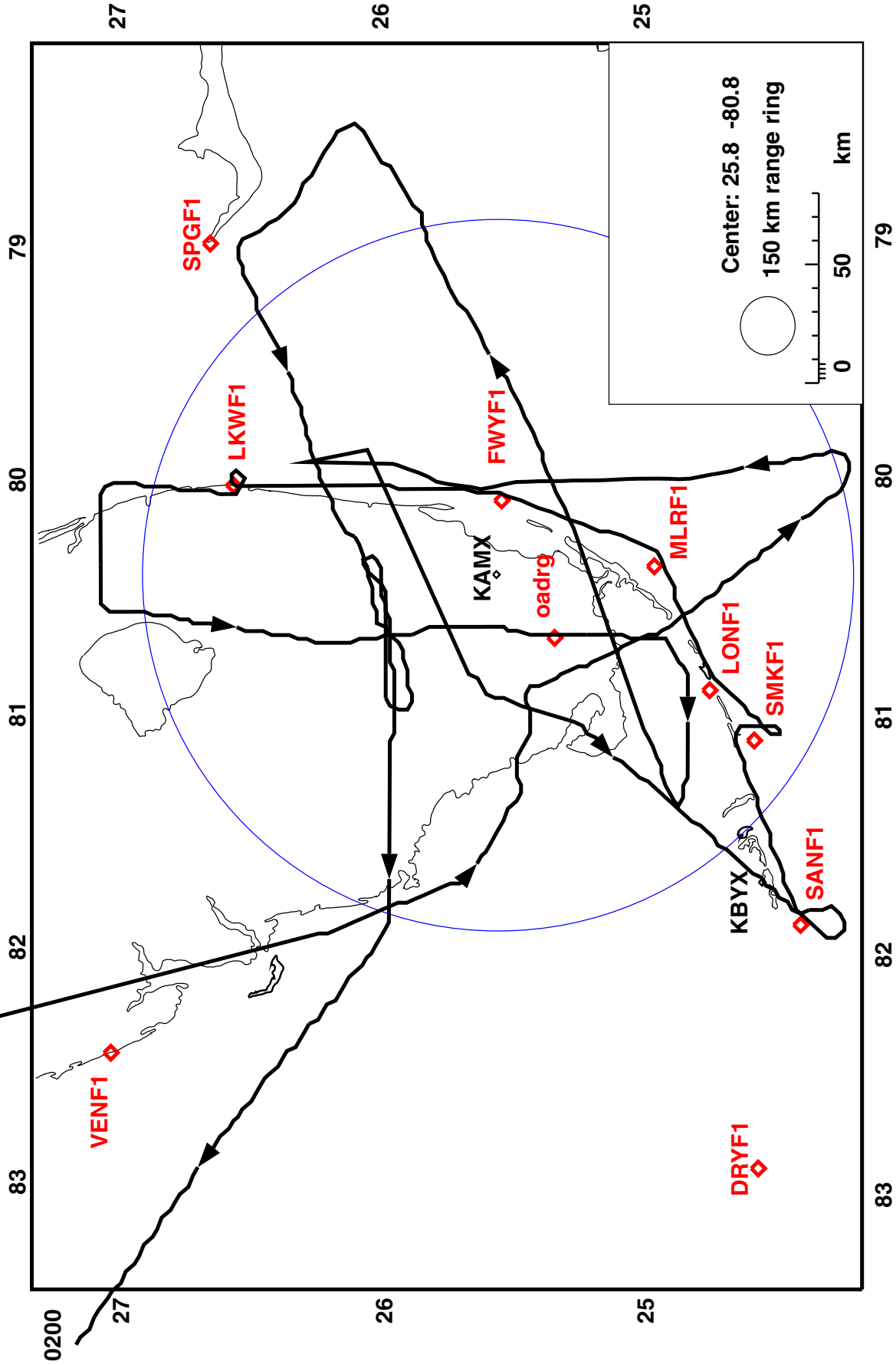


Figure 1

991015I1

IRENE

(min.) (max.)

Pitch= .5; 1.3

52 Roll= -7.6; 18.6

49

46 Track=233.4;241.7

43

40 Drift= 2.1; 6.9

37

35 Tilt= 3.7; 4.2

32

29 Alt= 2436 m

26

23 Slat= 26.34 N

20 Slon= 80.03 W

17 Rlat= 26.13 N

15 Rlon= 80.30 W

dBZ

245041 Z

Lower Fuselage

360 X 360 km

produced by

HRD / AOC

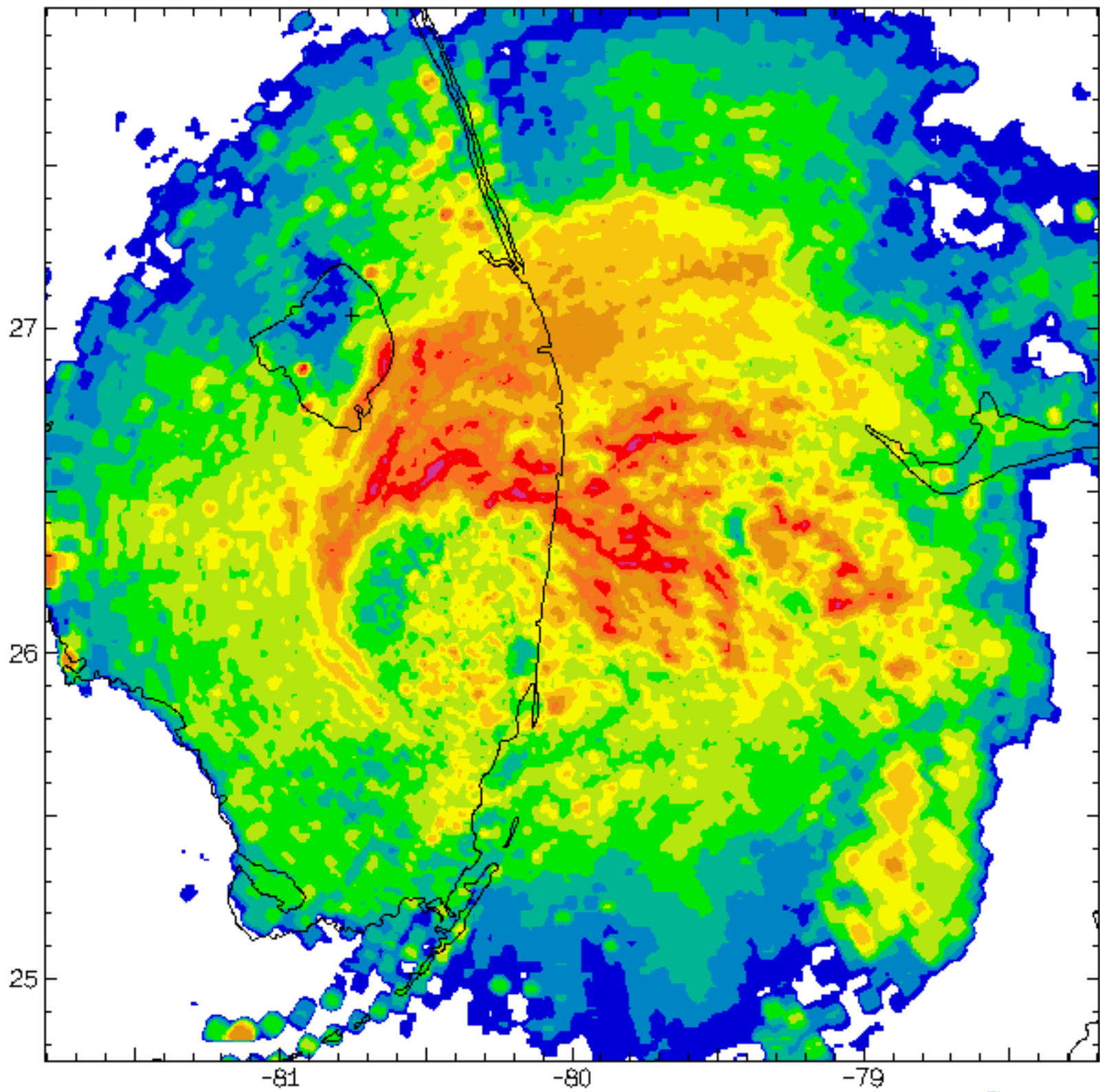


Figure 2

Figure 3

