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Airborne ROWS Data Report for the High Resolution Experiment, June 1993

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Introduction

NASA's airborne Radar Ocean Wave Spectrometer (ROWS) recently participated in an experiment conducted by the Office of Naval Research's High Resolution Remote Sensing Program. Field measurements were taken during June 1993 off the coast of North Carolina near Cape Hatteras. Five aircraft and two ocean research vessels participated. All ROWS flights coincided with the passage of the ERS-1 satellite SAR. A primary experimental objective was to increase understanding of the relationship between submesoscale surface roughness features and the synthetic and real aperture radar (SAR and RAR) signatures obtained when illuminating these features (Reference 1). Two key physical processes at play in the generation of features near the gulf stream north wall are strong gradients in currents and large air to sea temperature differences. Several fundamental elements needed to properly model radar backscatter from these features are the underlying swell field in the region and, more importantly, small-scale roughness characteristics. ROWS participated in the experiment to provide broad spatial coverage of the long-wave directional field about the High Resolution Experiment sites and to attempt investigation of small-scale roughness using ROWS backscatter analysis.

ROWS is a K_u-band short pulse radar configured to continuously switch between two distinct modes of operation. The modes are 1) a nadir-pointing radar altimeter, and 2) an azimuthally-scanning, near-nadir (16°) pointing spectrometer (i.e., a high-resolution radar scatterometer). Data products produced by the combined system have been described in some detail (References 2, 3, 4, and 5). Figure 1 shows example ROWS data. For the High Resolution Experiment, the primary ROWS data products are the 2-D long-wave ($\lambda > 40$ m) spectra and altimeter-derived surface mean square slope. This report presents these primary ROWS data products. Additional data related to the mean backscatter measured with the spectrometer are still being processed.

Mission Overview

ROWS successfully collected data on six separate dates during the High Resolution Experiment of June 1993. The system was operated aboard NASA's T-39 aircraft. Five flights were coordinated to occur within the ERS-1 SAR's regional swath at the time of the satellite's overpass. The sixth was flown underneath a TOPEX/POSEIDON satellite altimeter overpass. A summary of aircraft times on site and operating altitudes is given in Table 1.

Flight line maps are provided in the data presentation to follow. ASCII files containing the ground track positions in latitude and longitude were derived using the aircraft inertial navigation system (INS) and are readily available.

In general, ROWS measurements were of high quality. The system had no failures but data dropouts do occur infrequently because of aircraft attitude instabilities. Altimeter and long-wave data are presented in the following sections. Some difficulty has been encountered in absolutely scaling the ROWS long-wave spectra for this experiment. This was expected, since wave heights and surface roughness were low during the experiment period. These conditions negatively affect

the ROWS transfer function used to generate wave slope spectra. The altimeter retrieval of significant wave height (SWH) was affected as well. System digitizer range resolution limits our ability to make SWH estimates below 2 m. Notes regarding the overall usage of ROWS data are provided.

Table 1. ROWS Flight Summary for High Resolution Experiment

T-39 Flight	1993 Date	Times On Site (UTC)	Satellite Underflown	Nominal Altitude (km)
1	11 June	0234 - 0451	ERS-1	4.9
2	14 June	0226 - 0439	ERS-1	7.3
3	17 June	1514 - 1724	ERS-1	4.8
4	20 June	1536 - 1803	ERS-1	4.8
5	26 June	1713 - 1826	TOPEX	9.5
6	27 June	0142 - 0340	ERS-1	8.0

Altimeter Data Summary

ROWS altimeter data were collected continuously along with the "standard" scanning antenna. The radar's transmit frequency is 13.9 GHz (2.15 cm). The ROWS pulse-limited altimeter footprint diameter is 270 m at 5 km altitude. Flight altitude for this experiment varied from 5 - 10 km. The wide-beamwidth altimeter antenna (29° -3dB pts., one-way) allows robust determination of the radar cross section roll-off versus incidence. This roll-off is uniquely related to the integrated sea surface slope distribution through our mean square slope parameter. Typically, an altimeter also generates an estimate of the sea surface SWH through a measurement of the return pulse's leading edge spread. The ROWS' digitizing resolution is not fine enough to permit reliable SWH estimates below ~2.5 m. Maximum SWH for this experiment was less than 2 m and so we do not include SWH estimates in this data.

Figures 2 through 37 were generated to provide a synoptic view of the radar's estimate of sea surface roughness about the experiment area. They also serve to document the time and place of each ROWS data collection segment. Each figure contains data for a given flight leg (or file). A map highlighting that segment of the ROWS flight line is included. Data are plotted versus latitude or longitude. Time and flight direction are indicated. The figures contain four data plots. Data shown in these plots are:

- mean precision radiometric thermometer (PRT-5) sea surface temperature
- relative normalized radar cross section at 0° incidence (σ^0)
- K_u-band effective surface mean square slope (mss)
- surface wind speed at 10 m (U_{10}) inferred from mss

The along-track extent for each individual estimate (marked with a symbol on the PRT-5 or cross-section data) is about 2 km. Any system drop-outs will be evidenced by a break in the symbols in the PRT-5 data. Following are some notes regarding these ROWS altimeter and PRT-5 data.

The PRT-5 (infrared, 10 - 13 μm) data is often corrupted by clouds and icing because of the high flight altitudes but we present them because we noted frequent correlation between PRT-5 temperature estimates, ROWS altimeter data and Advanced Very-High-Resolution Radiometer (AVHRR) derived surface temperature features. PRT-5 voltages were transferred to temperature based on comparison with in situ data supplied by the Bartlett, Iselin, and experiment buoys. The sensor provides a voltage linearly proportional to temperature. The empirical equation used to generate the estimate is y(°C)=-63.24+0.0252x(mV).

Altimeter relative radar cross sections were derived from the return wave-form peak as determined by a least squares fit of the data. The mss estimate is derived from the wave form's trailing-edge slope determined with the same fit. These two parameters, 0° radar cross section and mss, are inversely related. Each is an indicator of the 'diffraction-effective' integrated surface roughness for those waves with $\lambda >= 6 - 8$ cm, the approximate diffraction limit for the ROWS wavelength. The data clearly show the inverse relationship. A relationship between ROWS mss estimates and Cox and Munk's (Reference 6) optically-derived data is documented (Reference 4).

When processing, the composite leading edge/trailing edge altimeter model (Reference 4) is applied to an averaged return waveform. For this experiment the averaged waveform is the composite of 500 individual waveforms which corresponds to 10 seconds or a 1.5 - 2 km along-track extent. Along-track realignment is performed when building up the composite to remove aircraft vertical motion smearing effects. When estimating the trailing edge exponent (mss) a cutoff is made at the first occurrence of 12° incidence or signal level of 10 dB below the peak. All cases in which the aircraft's mean roll was greater than 2° have been eliminated from the data set.

We emphasize that the ROWS-derived σ^0 estimate is relative. The system is not absolutely calibrated but the return power measurement is stable during flight legs to within a very reasonable uncertainty (typically 0.1 dB). See Vandemark and Chapron (Reference 7) for further details and a TOPEX/ROWS altimeter σ^0 intercomparison.

We provide the final plot, U_{10}, with the disclaimer that, for this experiment, such an inference from the mss will often be in error because of a closer correlation of surface roughness to wind stress than to mean wind speed. The algorithm used is for neutral stability conditions and is the modified Chelton-Wentz altimeter wind retrieval relation (Reference 8). We generate the absolute σ^0 data needed for input to the algorithm from ROWS mss estimates using the relationship σ^0=10.*log10(.38/mss) as given in Jackson et al. (Reference 4). Preliminary comparisons of this data with in situ measurements clearly show cases where ROWS U_{10} estimates are in error but general agreement is evidenced.

ASCII data files for any or all of the files shown can be readily produced. At the current time they reside on DOS floppy disks and 8 mm tapes in UNIX tar format.

Spectrometer Data Summary

ROWS spectrometer mode data were collected on most of the longer T-39 flight legs over the High Resolution Experiment region. Data have been processed to create 2-D long-wave modulation spectra for 11, 14, 20, 26, and 27 June 1993. Only data from 17 June was not processed. On this day the surface was very calm and no long waves were detectable using the ROWS. Extraction of 2-D long-wave modulation spectra from ROWS data has been described in detail (References 5 and 2). Because swell in the region was not very energetic during the experiment period, ROWS spectra do not provide any dramatic long-wave field evolutions through the area. SWH never exceeded 2 m in the region according to buoy measurements. Despite the low-wave conditions, ROWS did detect swell on each flight. These data may be useful to those attempting to include tilting effects or other swell influences into scattering models or wind stress estimates.

Shown in Figures 38 through 59 are flight line maps and representative spectra for each of the five remaining flights. Tables in appendix A provide all processed spectra file names, positions and ancillary parameters related to processing and spectral power. The flight maps show the mid-point for each ROWS spectrum along the T-39 flight path. Data for a specific file on a given day are denoted by differing symbols. Rather than include all the spectra, we limit the presentation to those regions near the Hi-Res ship measurement regions. Plots of data not shown are available upon request. ASCII files for any of the data are available.

The spectra are presented in a format showing the directional and integrated ROWS modulation spectrum together on a page. Wave number is in rad/m. The 2-D spectra have been folded about the 180° axis to add a degree of freedom and to ease wave-field interpretation. Data are oriented with true North pointed to the top of the page. All data are contoured to the same linear scale to allow absolute comparison. Contours are differentiated by a changing gray scale noted in the legend. Also included is a frequency spectrum derived using the normal deep-water dispersion relationship to convert wave number to frequency. These spectra are not scaled to provide absolute wave height at this stage. Scaling of the ROWS modulation spectra to absolute slope or height is normally feasible for roughened seas with SWH > 2 - 2.5 m. Typically, SWH estimates are scaled by a factor α which is related to the mean surface roughness and is derived from the altimeter channel data. In lower wind and non-fully-developed wave conditions, ROWS linear tilt theory breaks down. The signal-to-noise ratio (snr) also decreases. Point comparisons against High Resolution Experiment wave buoys should allow reasonable levels of confidence in scaling.

Discussion

Following are brief discussions of sample spectra for each ROWS flight. Discussion is intended to provide some insight into the quality and applicability of this data to ongoing High Resolution Experiment investigations.

In Figures 39 through 46, spectra from the 2nd leg of the 11 June flight are shown. They come from file 2 and represent estimates extending from north of the research area (36.5 N, 73.5) to the Sargasso sea. As shown in Figure 38, leg 2 was just to the east of the ship locations. The gulf stream north wall region was at about 36.2° N as derived from a NOAA oceanographic features analysis analysis of 11 June 1993. South wall on leg 2 was about 35.4° N. The altimeter measured a strong dip in surface roughness as the T-39 flew south over the north wall region. This dip was also apparent in the ERS-1 SAR image. Spectra near the north wall show inconsistent long-wave energy, with spread wavelength 100 - 200 m, in the SE(NW) quadrant. The lack of a well-defined swell is typical in the ROWS Hi-Res spectra. This is partly due to the lack of energetic waves and partly because of low modulation snr under these conditions. A more defined wave field does appear to the south of the research site. At 36° N (Figure 42), ~100 m waves are apparent at 15°(195°). This is in the gulf stream. These waves are seen to shift direction and wave number rapidly over the 70 km region from 36° N to 35.1° N. The dominant waves shift progressively clockwise and shorten to end at 55°(235°) and 70 m. These waves are likely travelling north-east and become modulated by the gulf stream but this is not completely evident. Buoy wind measurements support this idea in that wind direction has been S/SW in this region for several days. It is clear that these waves are not seen by the ROWS into the north wall area.

Note: occasionally, strong spectral peaks will be visible near a wavenumber of 0.015 rad/m, these are artifacts caused by an antenna pattern problem being addressed. They should be ignored, as no 400 m waves were noted during the experiment period.

14 June 1993 ROWS spectra showed a somewhat defined bi-modal long-wave field in the region. N/NE winds suggest the waves were travelling from N/NE. The research ships were near 35.25° N and 75° W. Data from the more westerly ROWS flight legs (see Figure 47) are shown in Figures 48 - 51. They come from files 3 and 8. Figure 48 was measured over the gulf stream and shows swell of 160 m and a 15° sea of 90 m. Figure 49 shows a spectrum very near the ship site and is non-descript and of lower snr. One still sees swell from the northeast, but also some energy 90° off this mode. Figure 50 is from about 40 km to the north of the site and shows the swell and sea clearly. Figure 51 is given near buoy 44014 at 36.6° N. The ROWS data agree well here with wave buoy data. Directional evolution of the waves along the flight legs support west/southwest propagation premise.

Spectra derived from 20 June data (see map of Figure 52) show a well-defined swell traveling to 315° (propagation direction derived from wave buoy). The three spectra shown (Figures 53 - 55) represent data north of, centered at, and south of the research site. Wavelength is ~160 m, somewhat shorter at the southern point (Figure 55, 34.7° N). At the southern point, a mode at

60°(240°) is also present. Again, ignore the .015 rad/m thumbtack swells; they are an artifact of processing.

ROWS spectra for the 26 and 27 June 1993 flights (see maps of Figures 56 and 58) were very noisy. No clear picture of any low-level swell was obtained, but data do show the temporal development of a dominant wind sea being generated by steady southerly winds. Two spectra are shown in Figures 57 and 59, each collected at the same spatial location, approximately 12 hours apart in time. The spectrum of 26 June (Figure 57) shows significant energy spread in wave number towards 10°, but no clear wave modes. At the same point on 27 June, one sees a well-defined sea with wavelength of 60 m and some spread around to the N/NW direction. The complete set of ROWS spectra for these two flights provides a clear spatial depiction of this sea.

Acknowledgments

We would like to thank John Ward and Gerry McIntire for their help with the ROWS data system and aircraft installation, Fred Jackson and Bertrand Chapron for their comments regarding data processing, and most of all, the crew and support personnel of the NASA T-39 aircraft.

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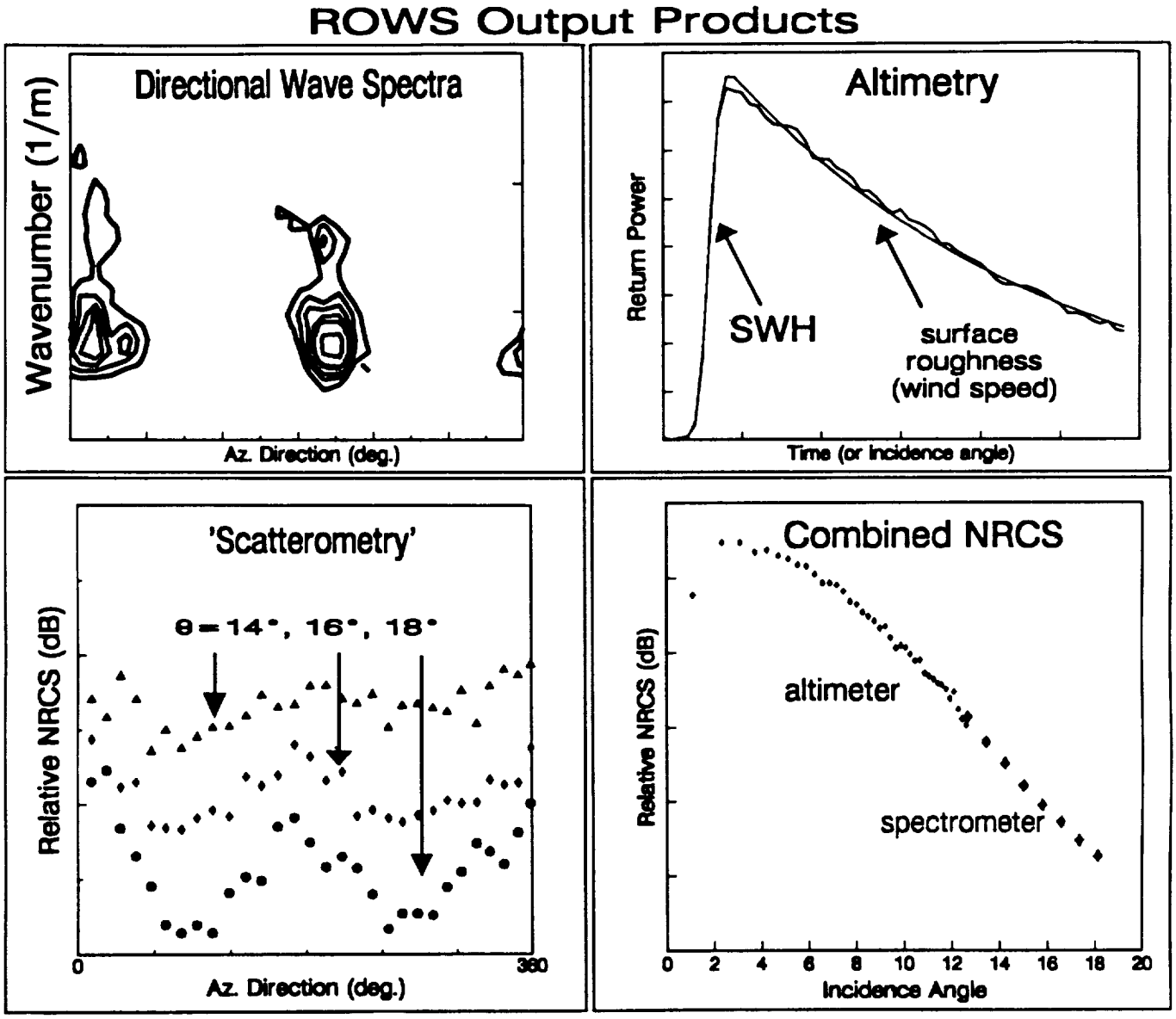


Figure 1. Data products derived from the ROWS dual-mode measurements. All products are collected simultaneously.

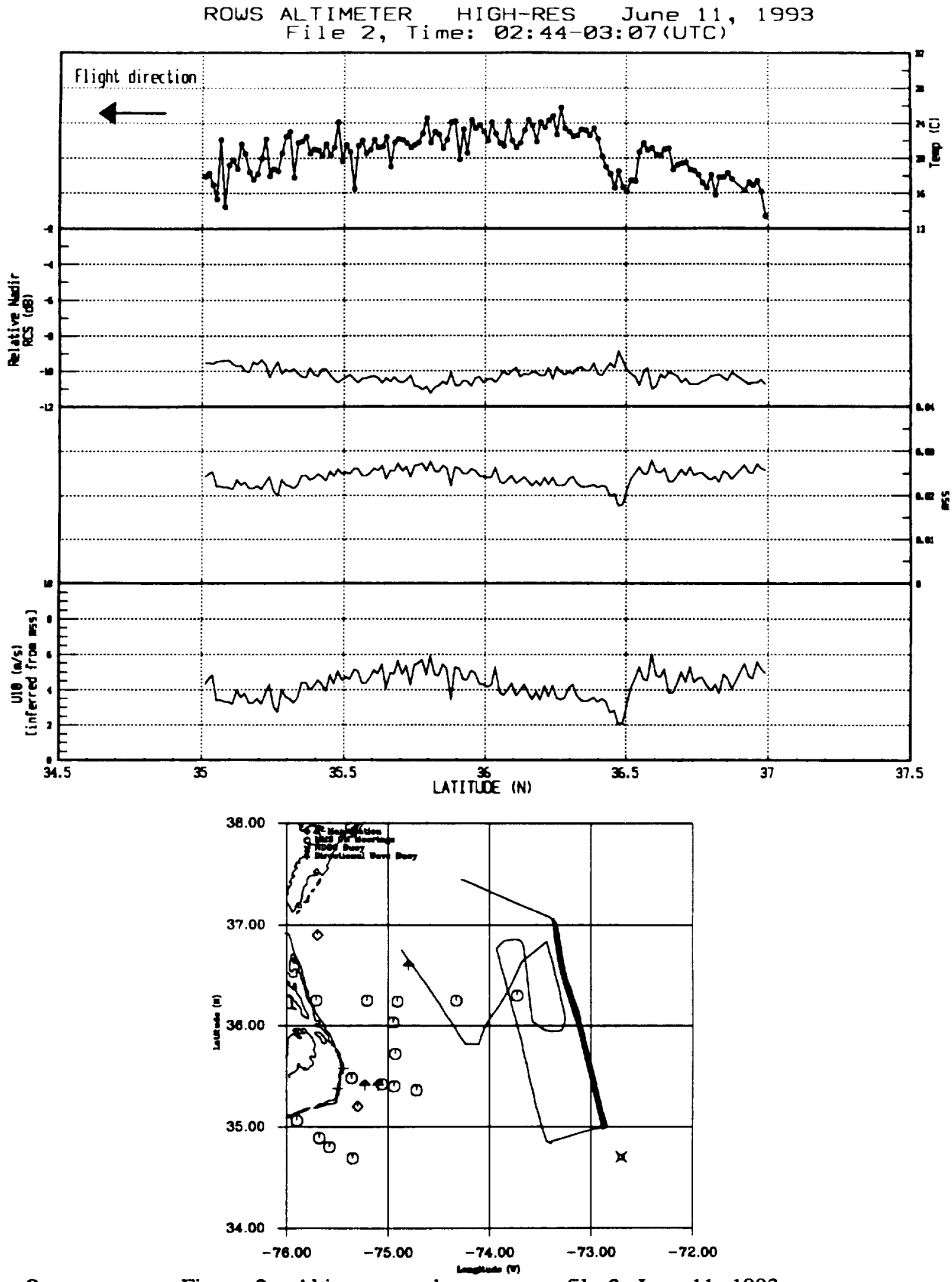


Figure 2. Altimeter mode summary, file 2, June 11, 1993.

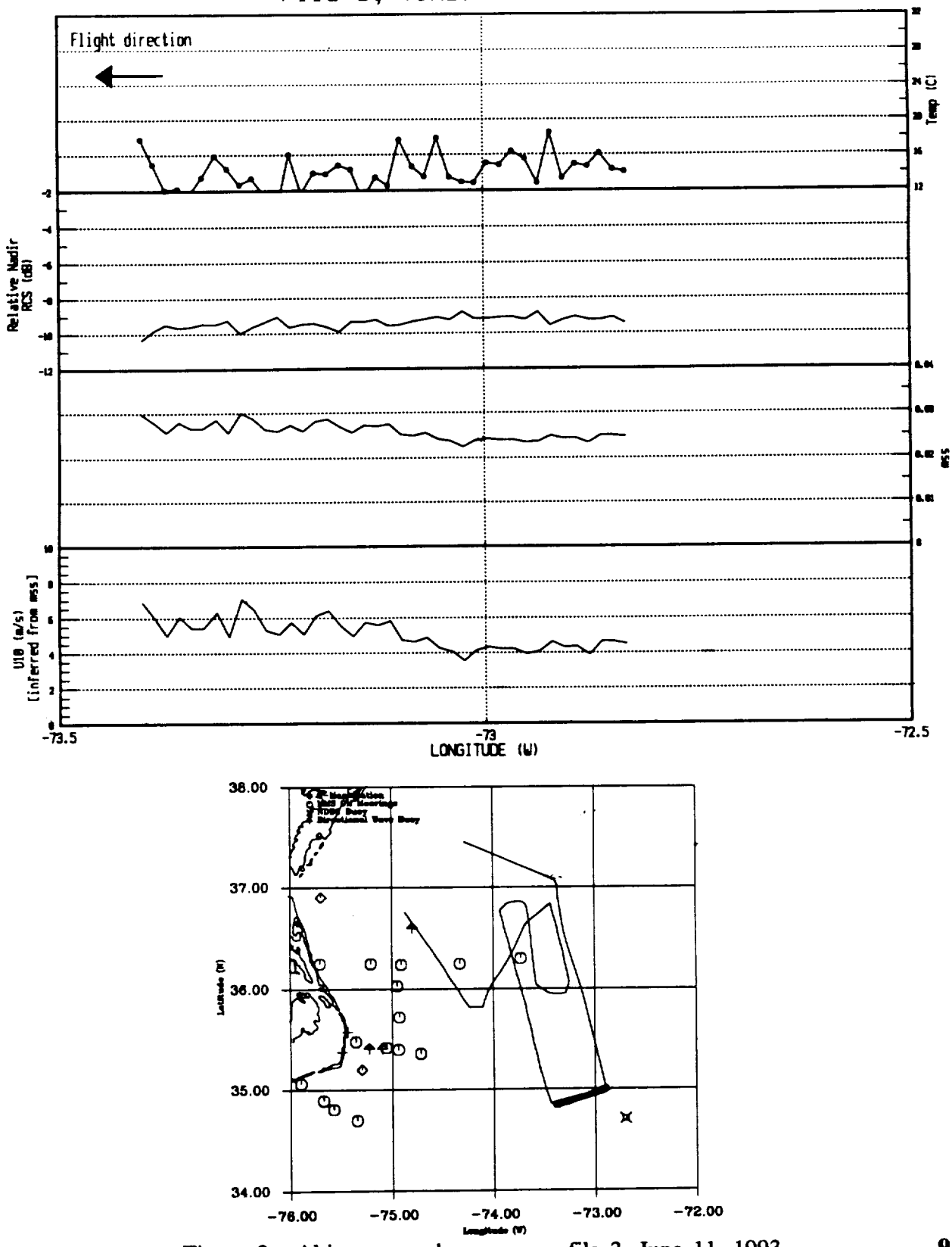
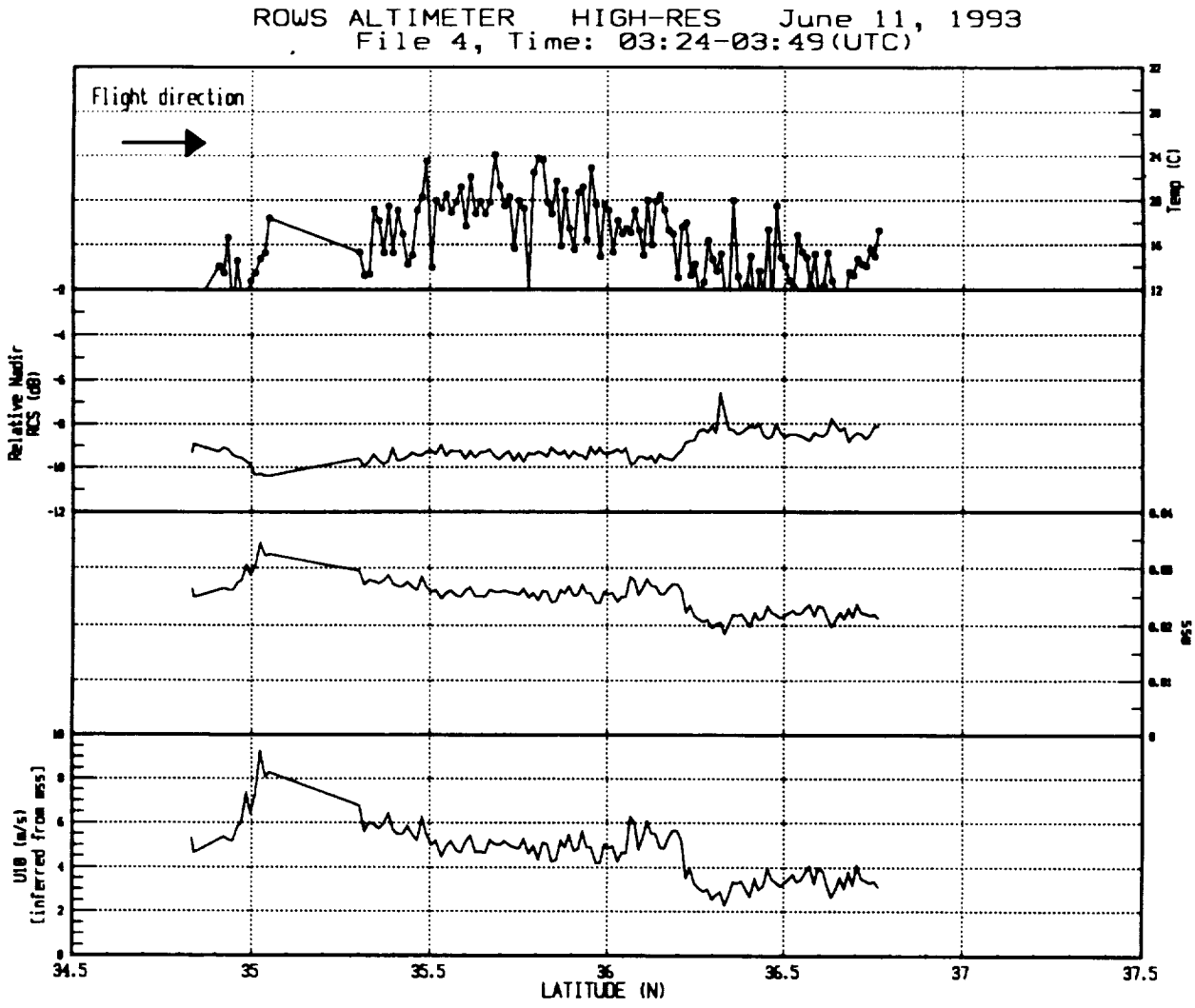


Figure 3. Altimeter mode summary, file 3, June 11, 1993.



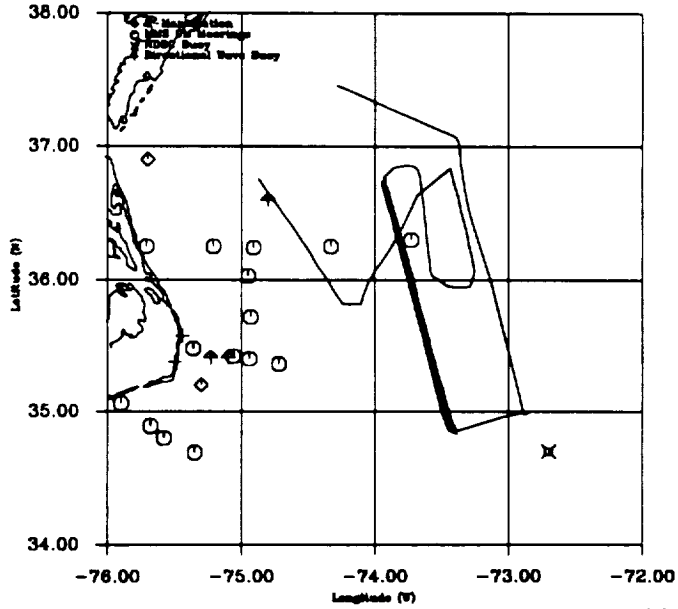
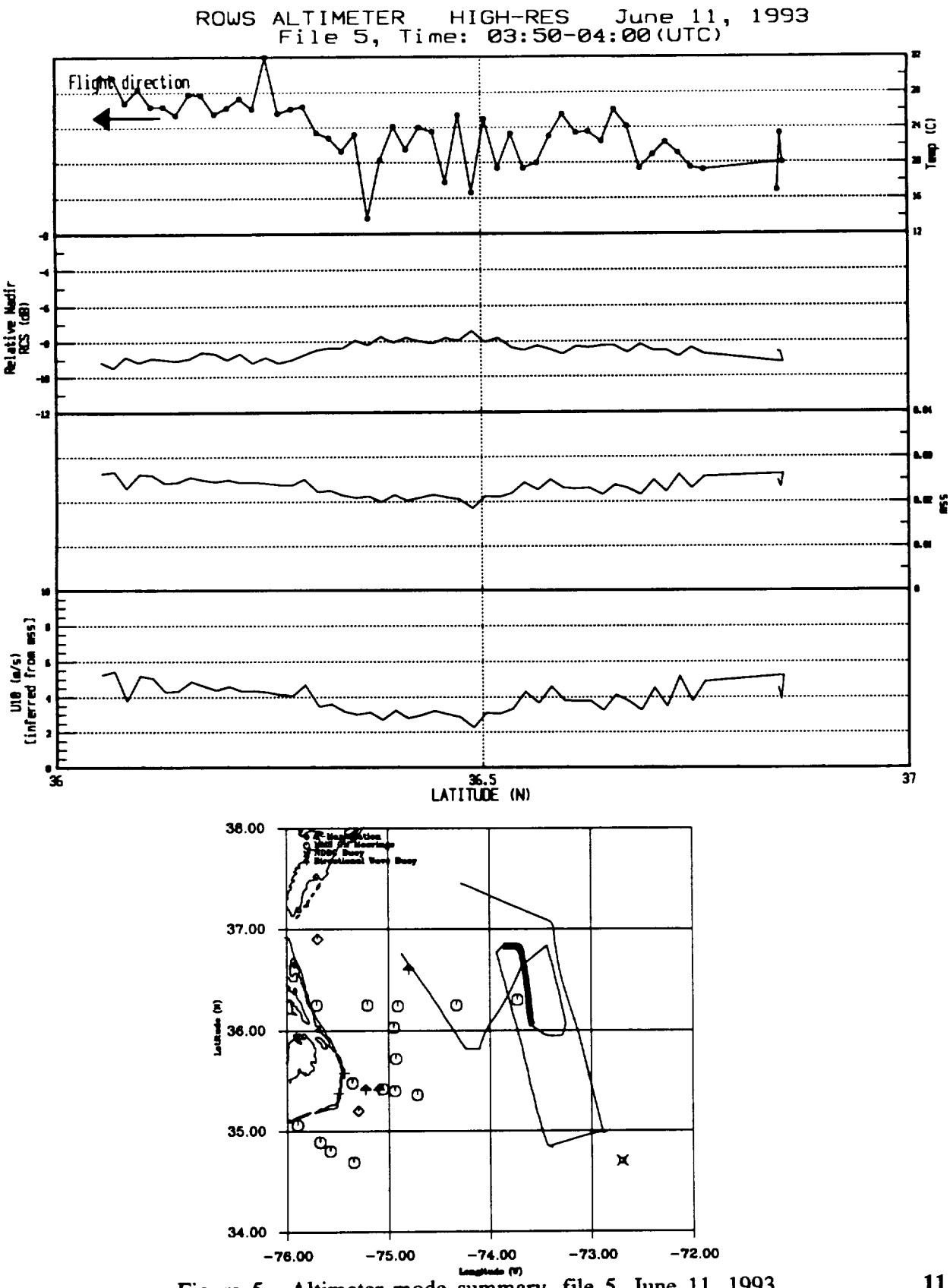


Figure 4. Altimeter mode summary, file 4, June 11, 1993.



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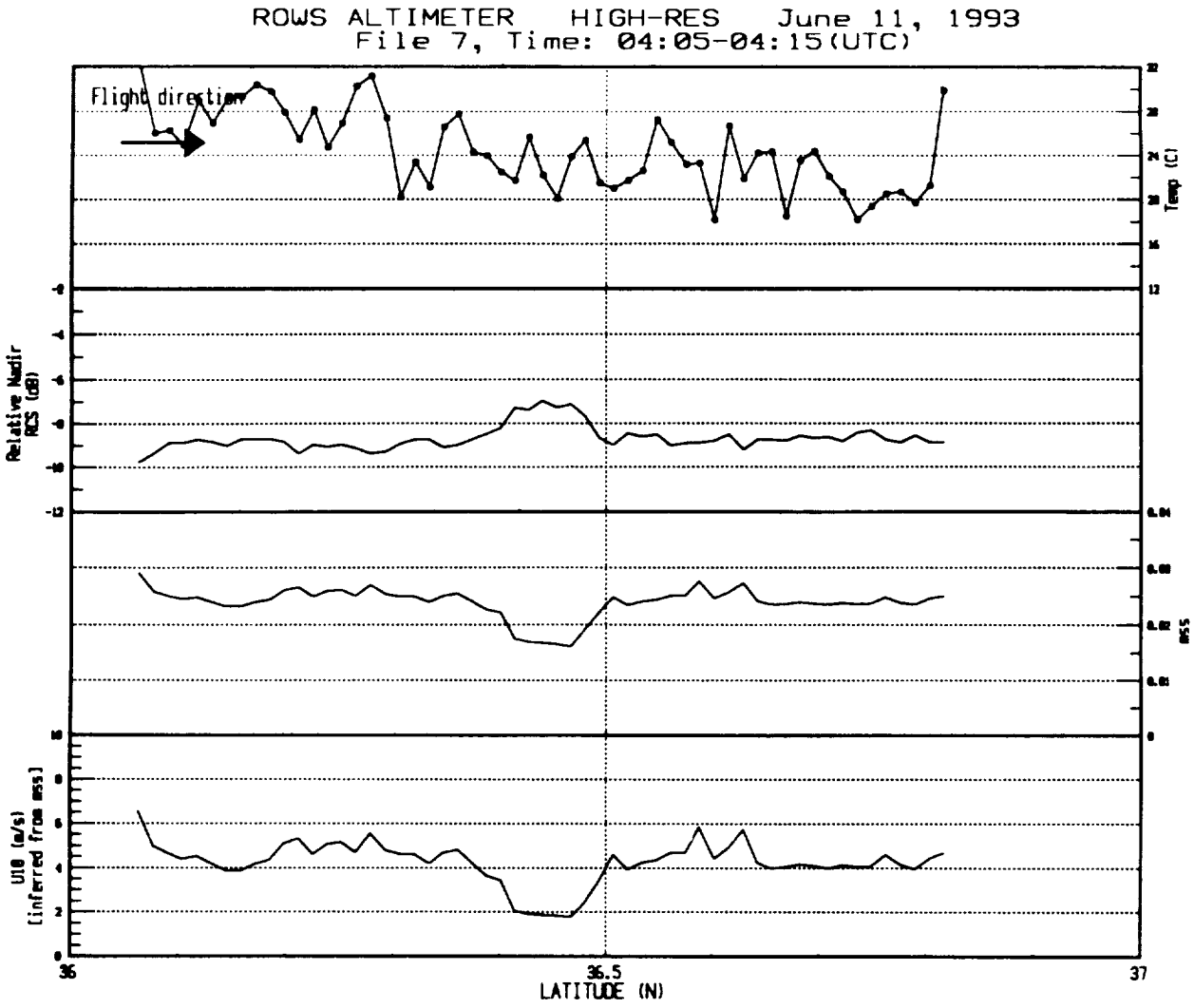


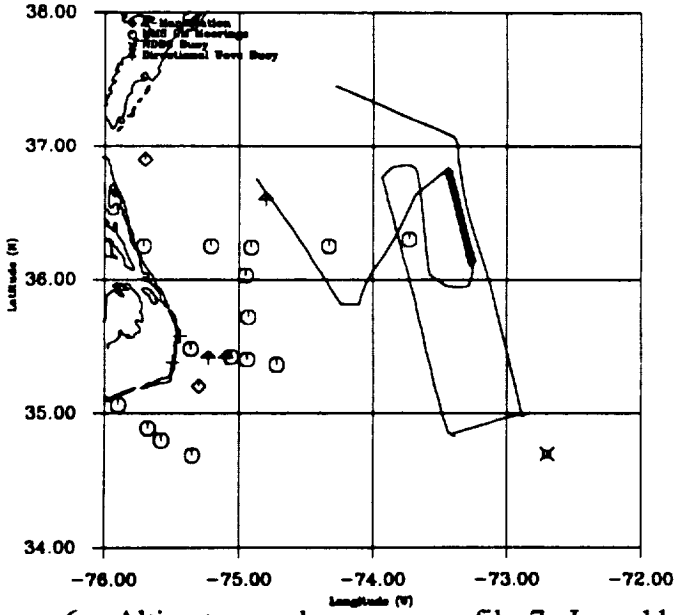
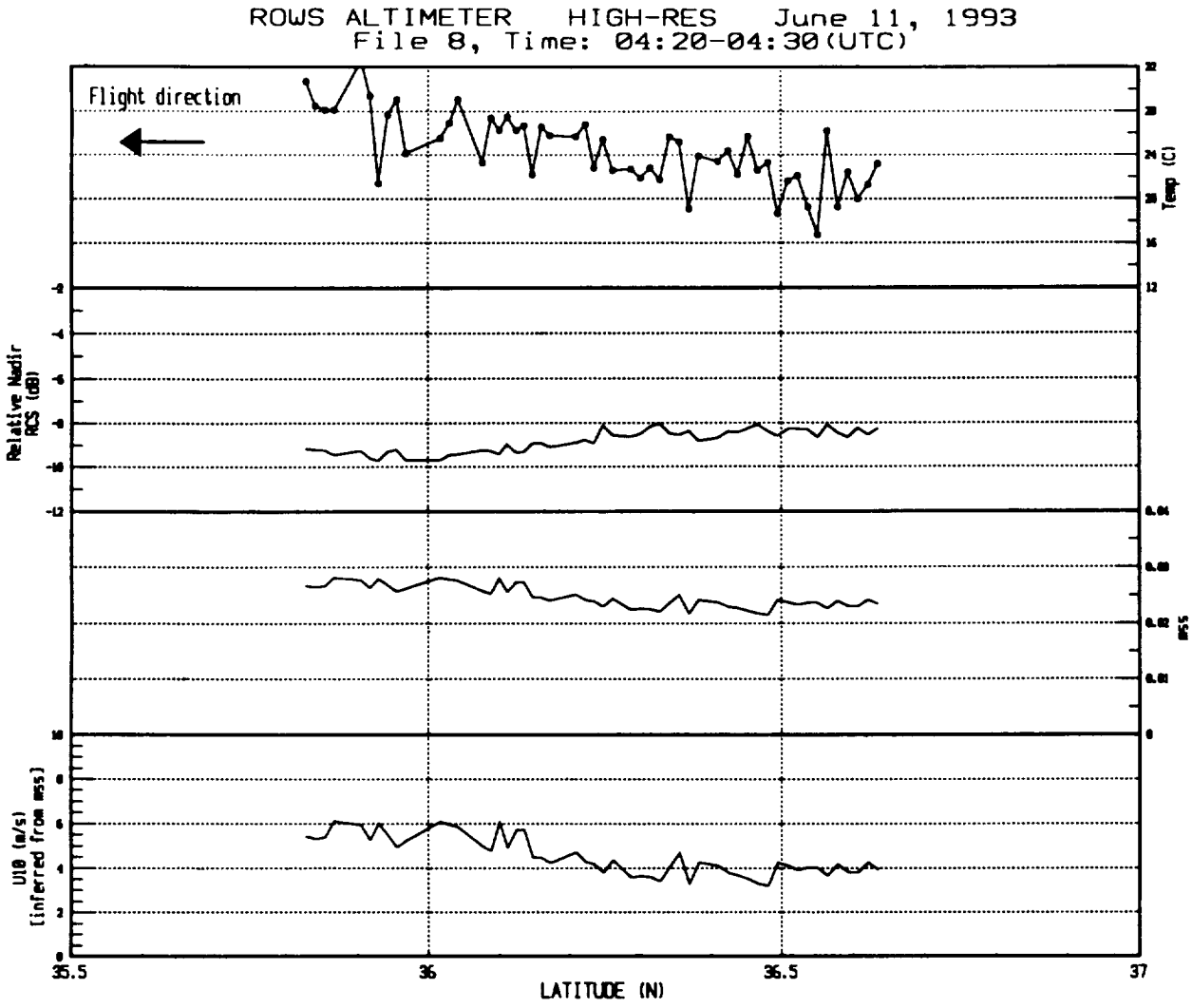
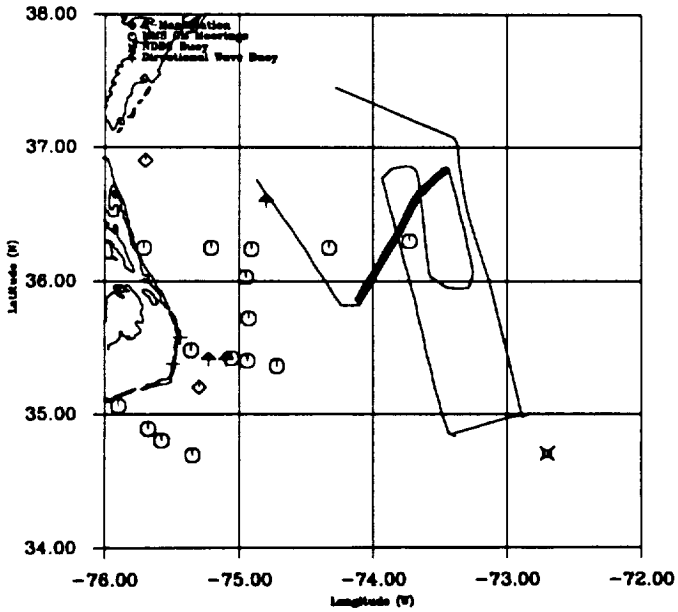


Figure 6. Altimeter mode summary, file 7, June 11, 1993.





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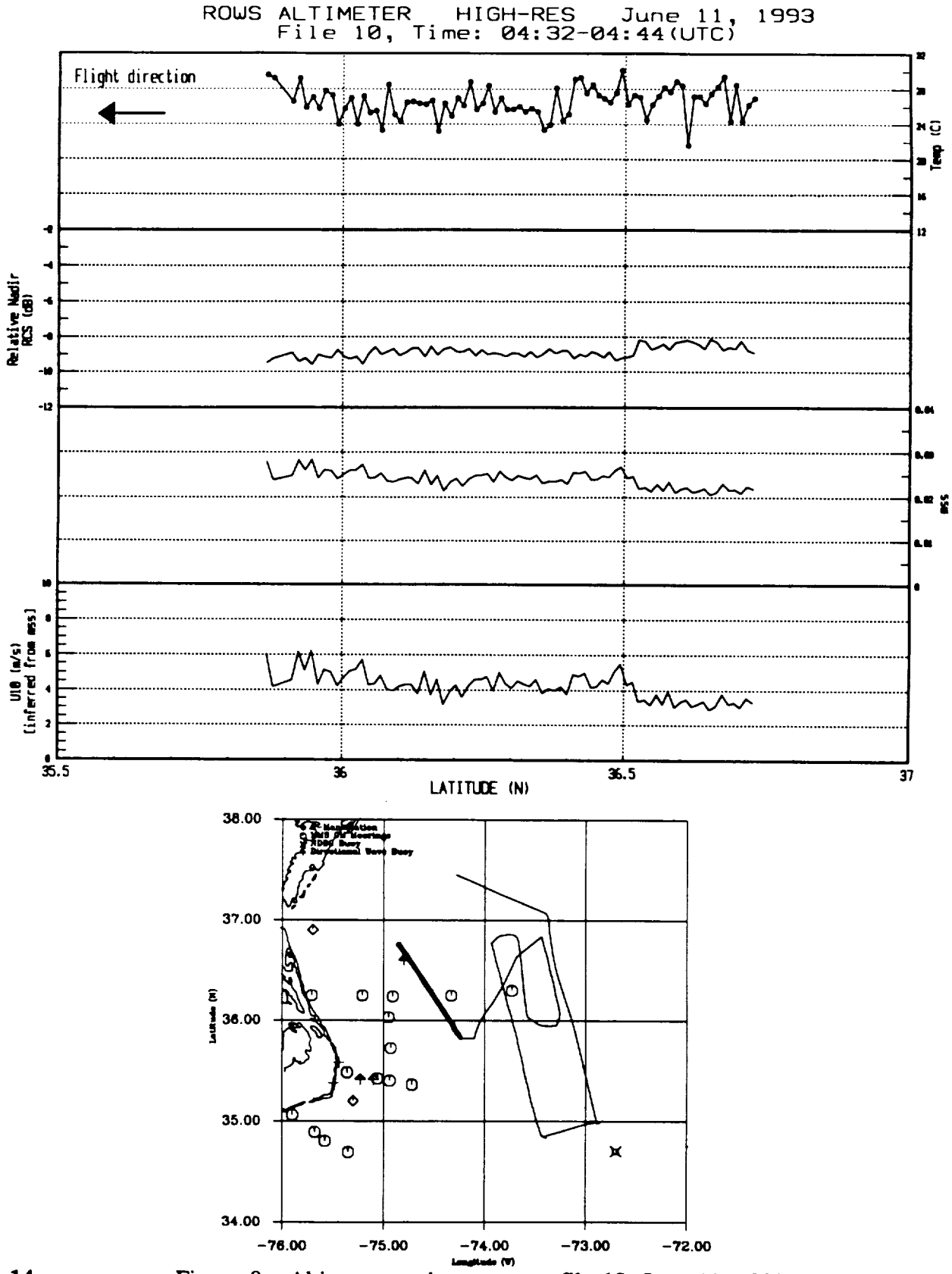

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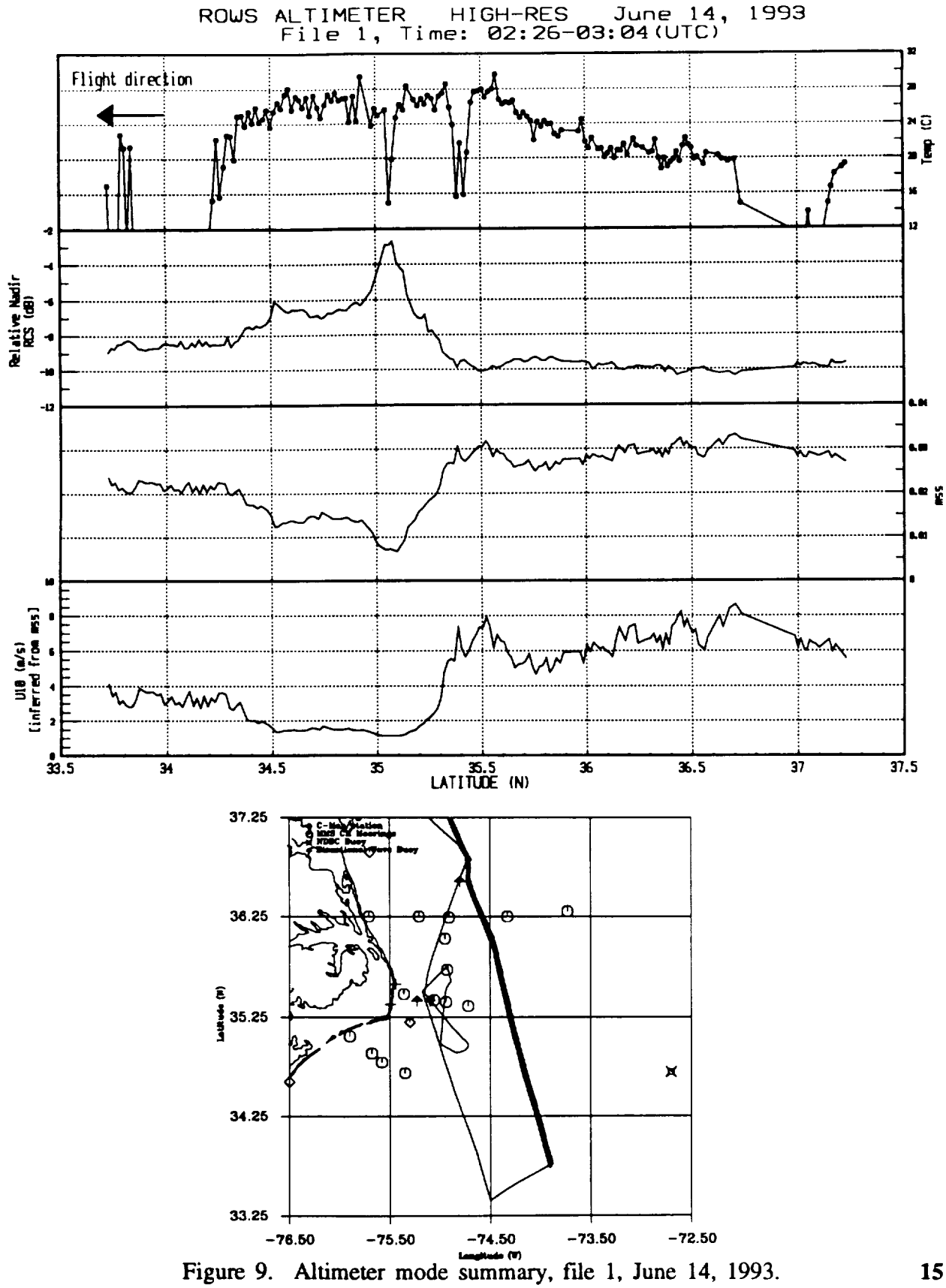

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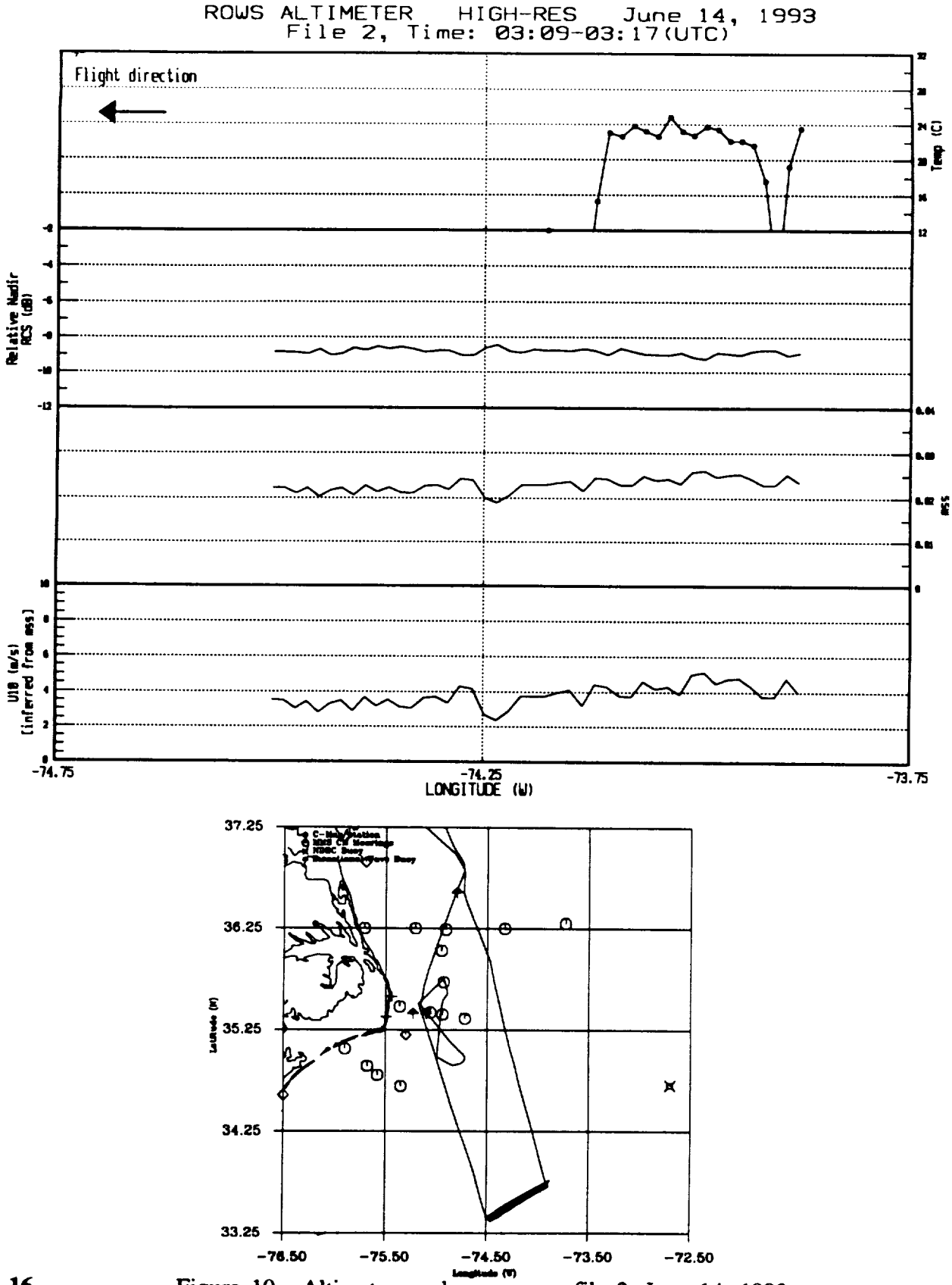

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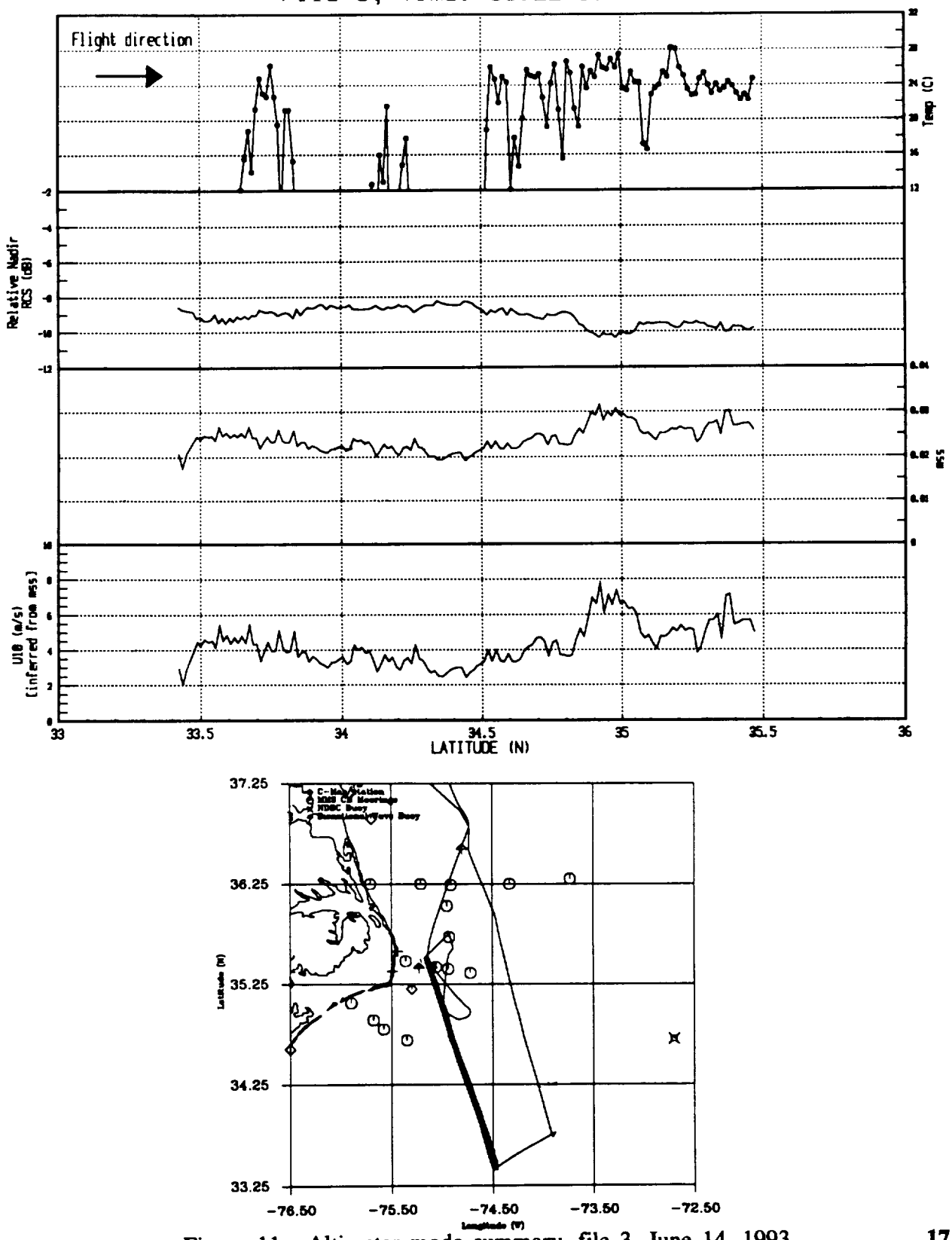

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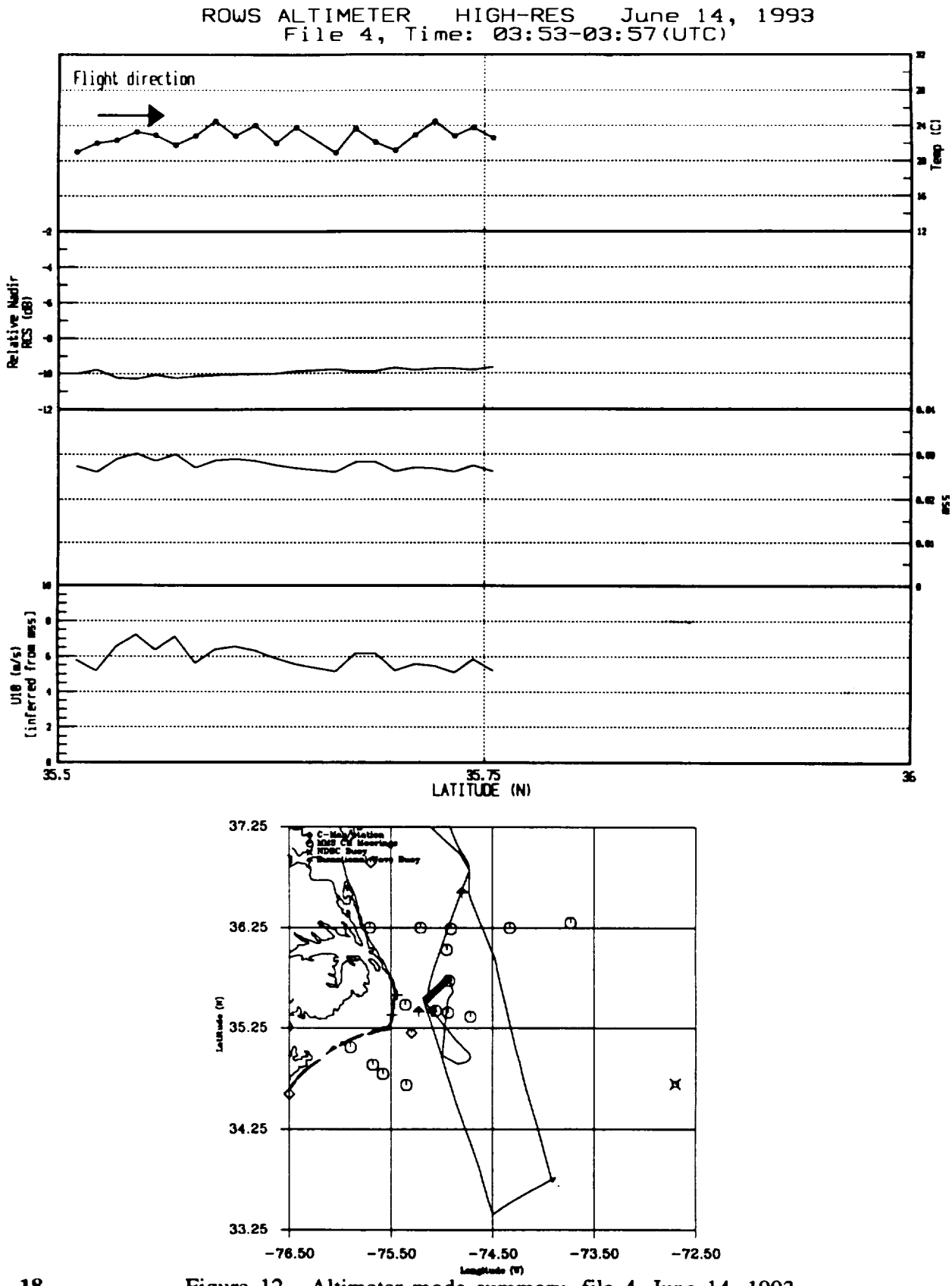

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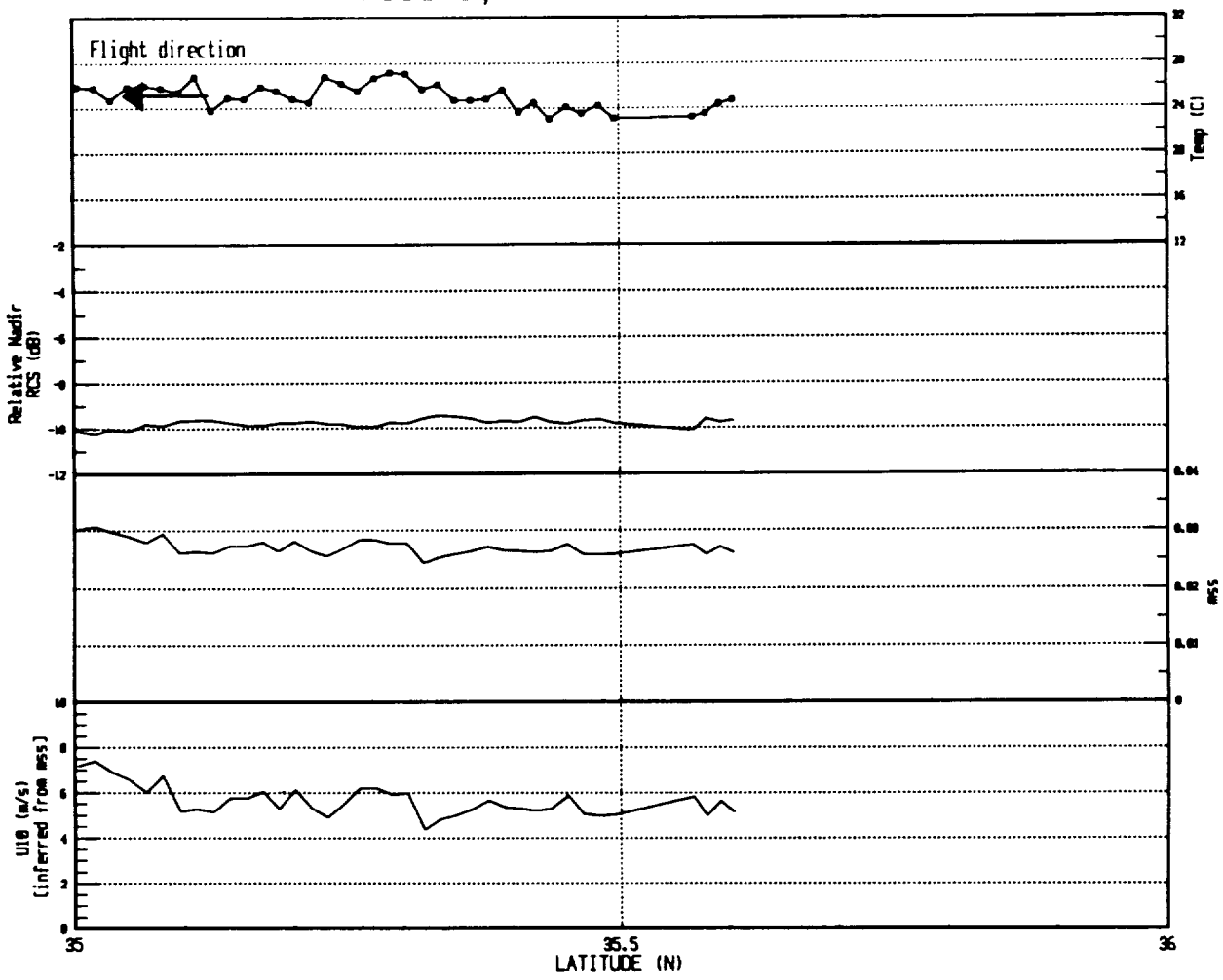

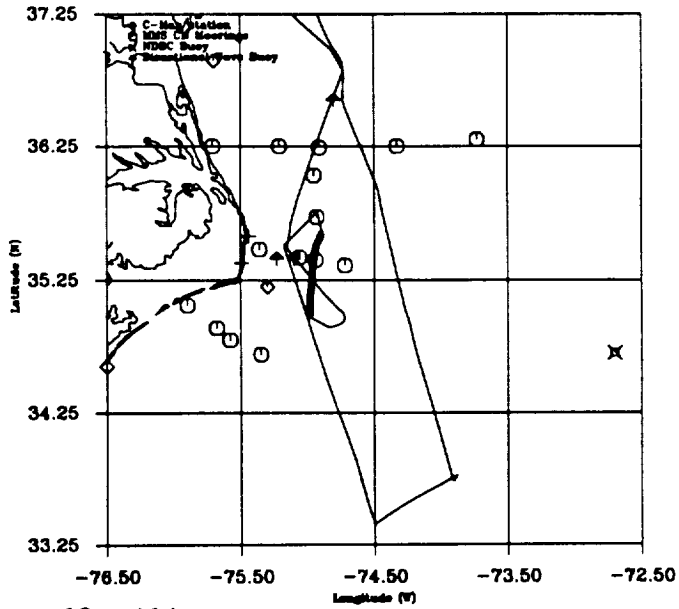

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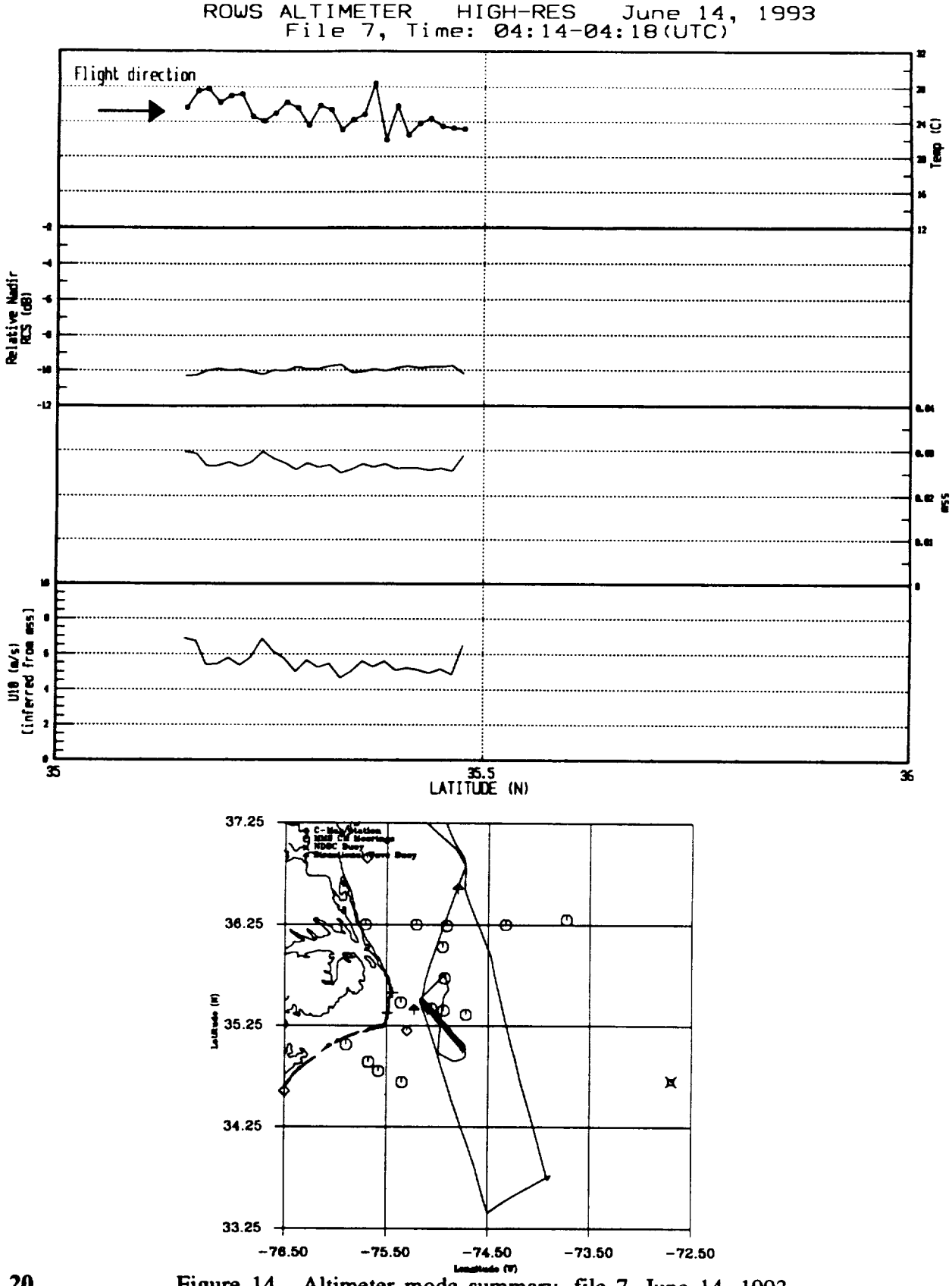

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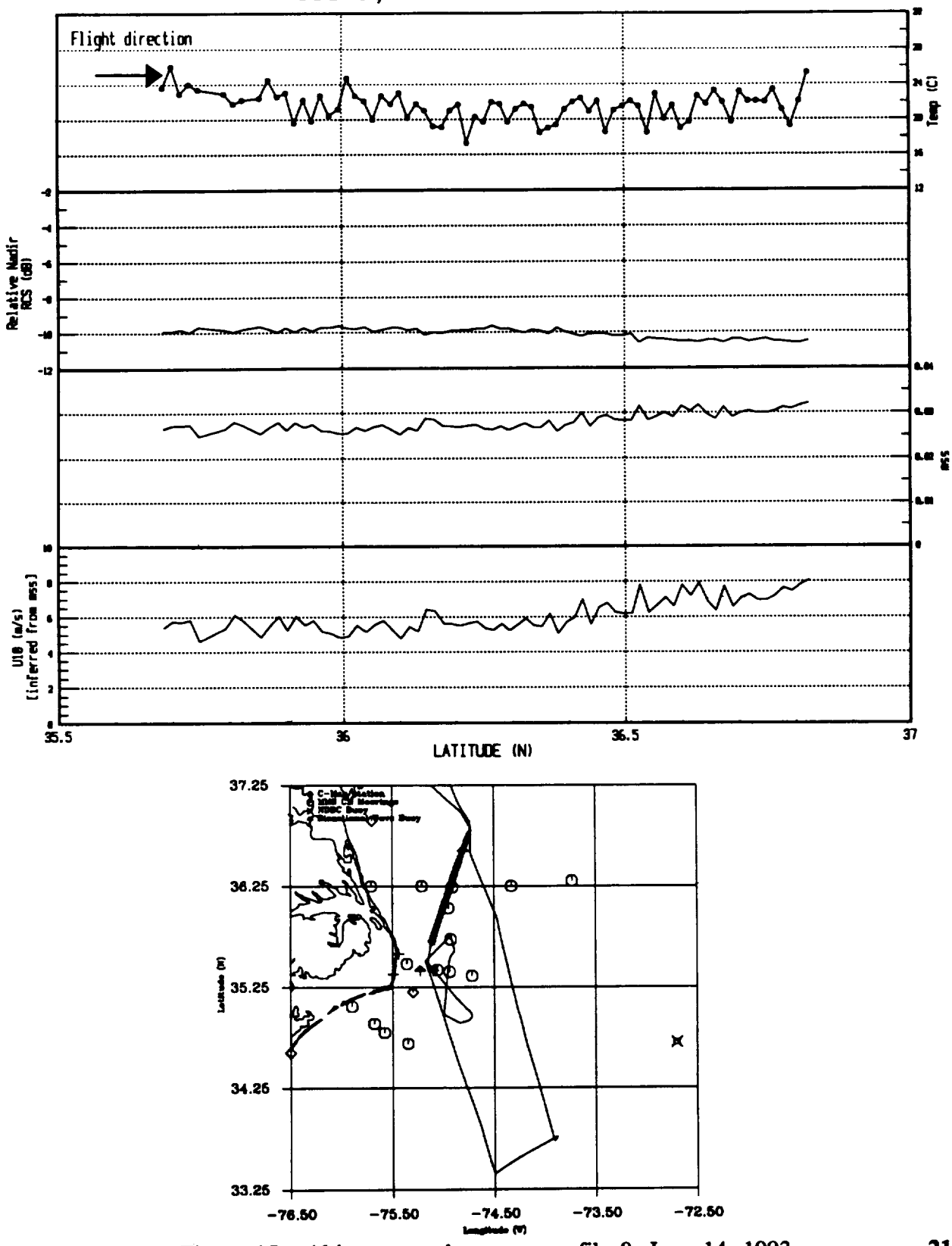

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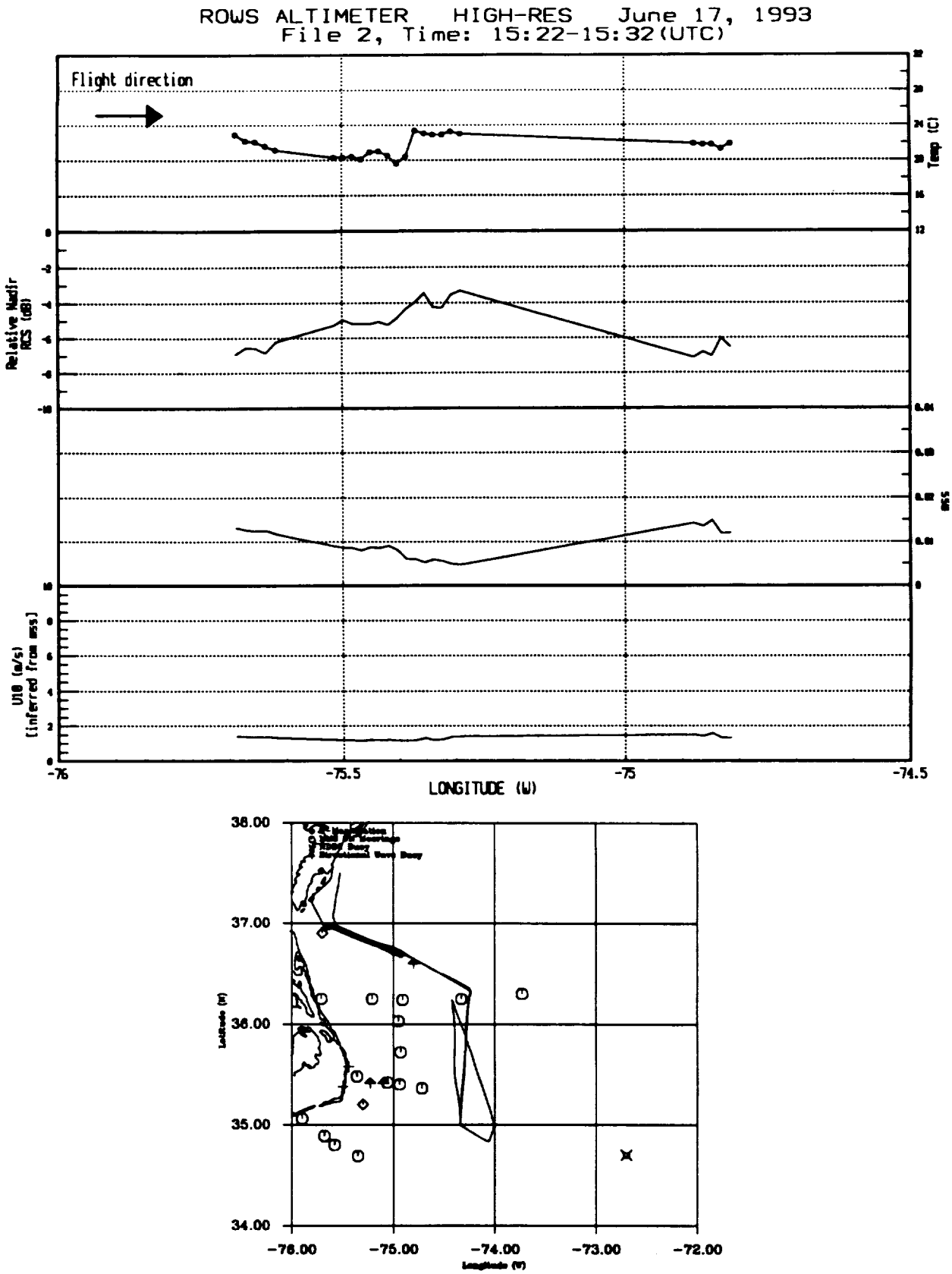

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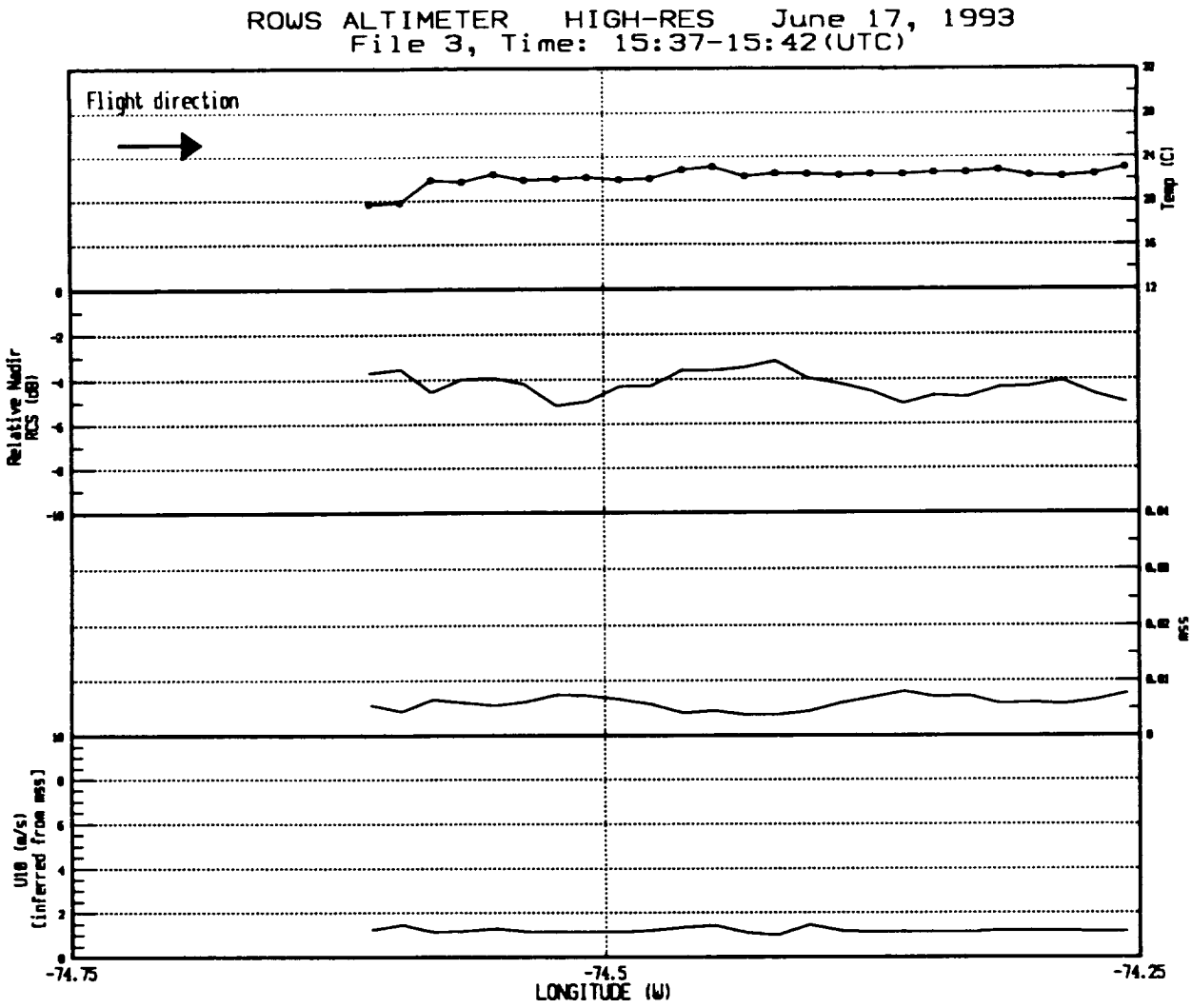

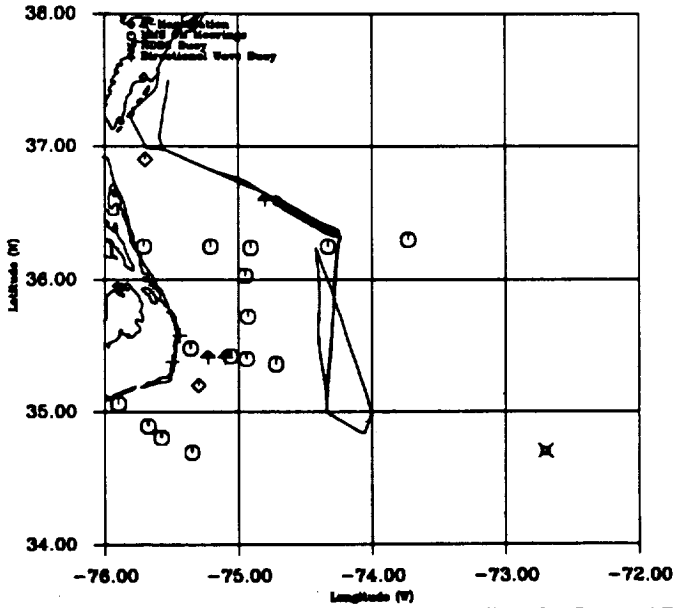

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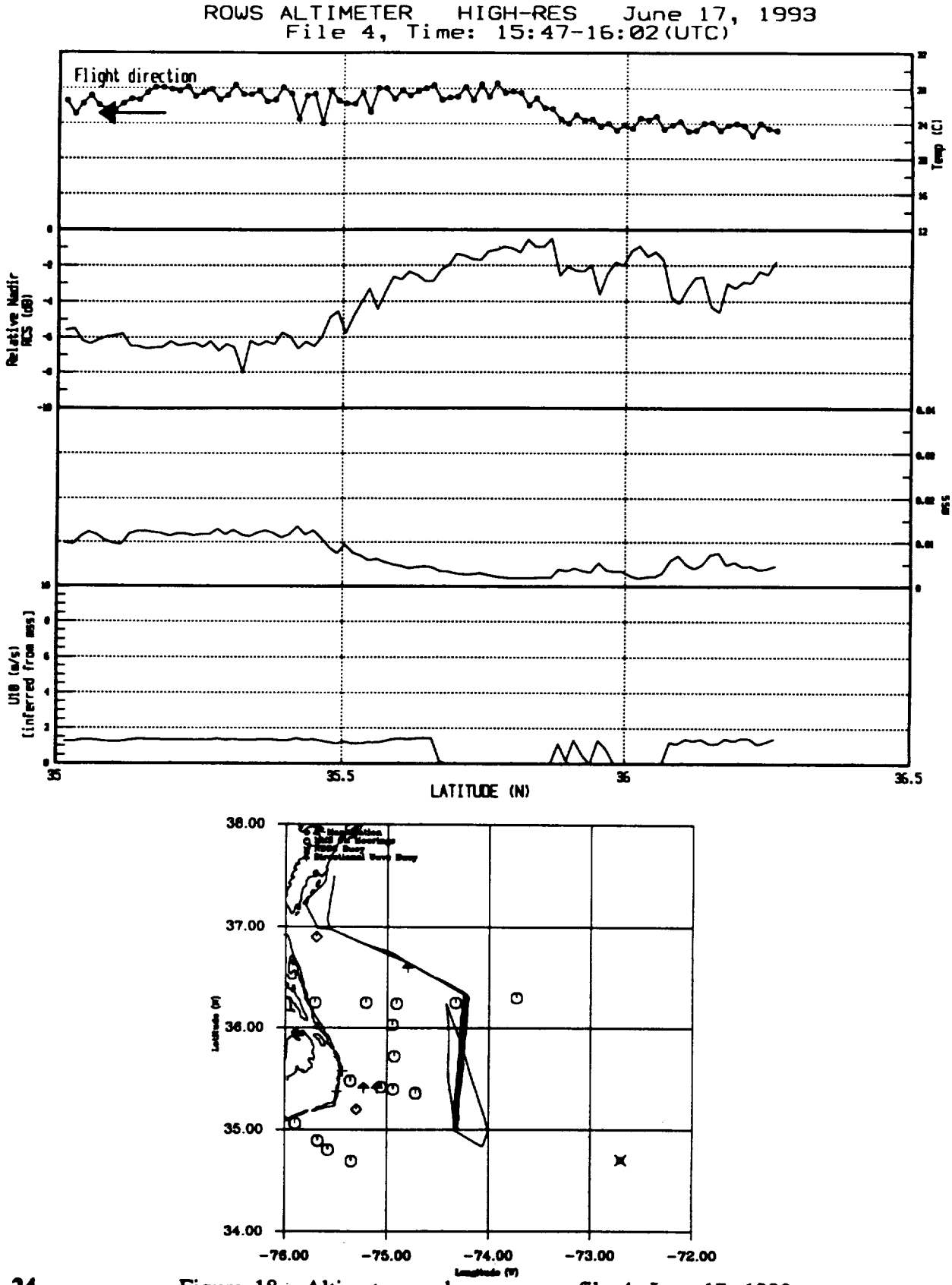

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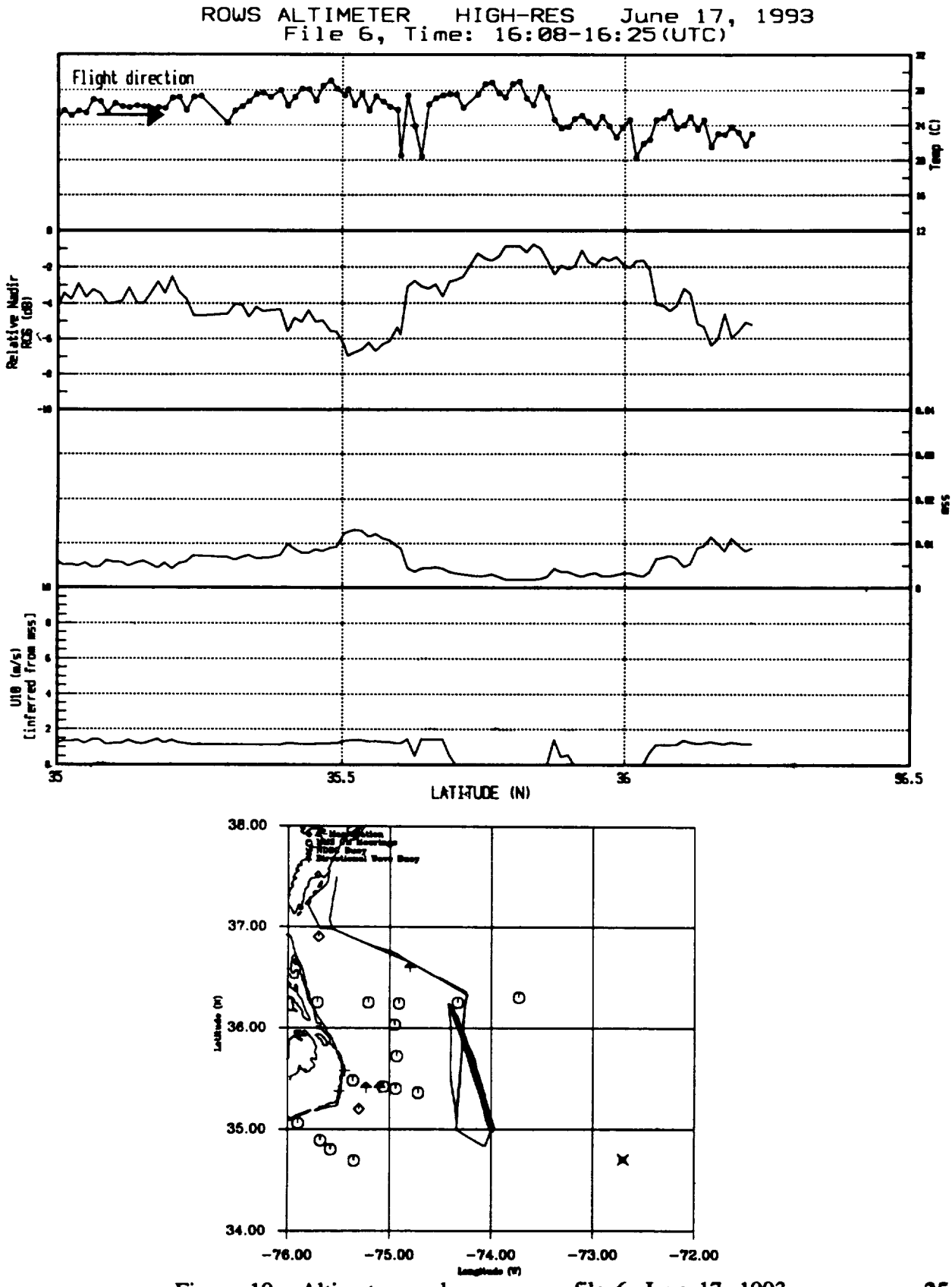

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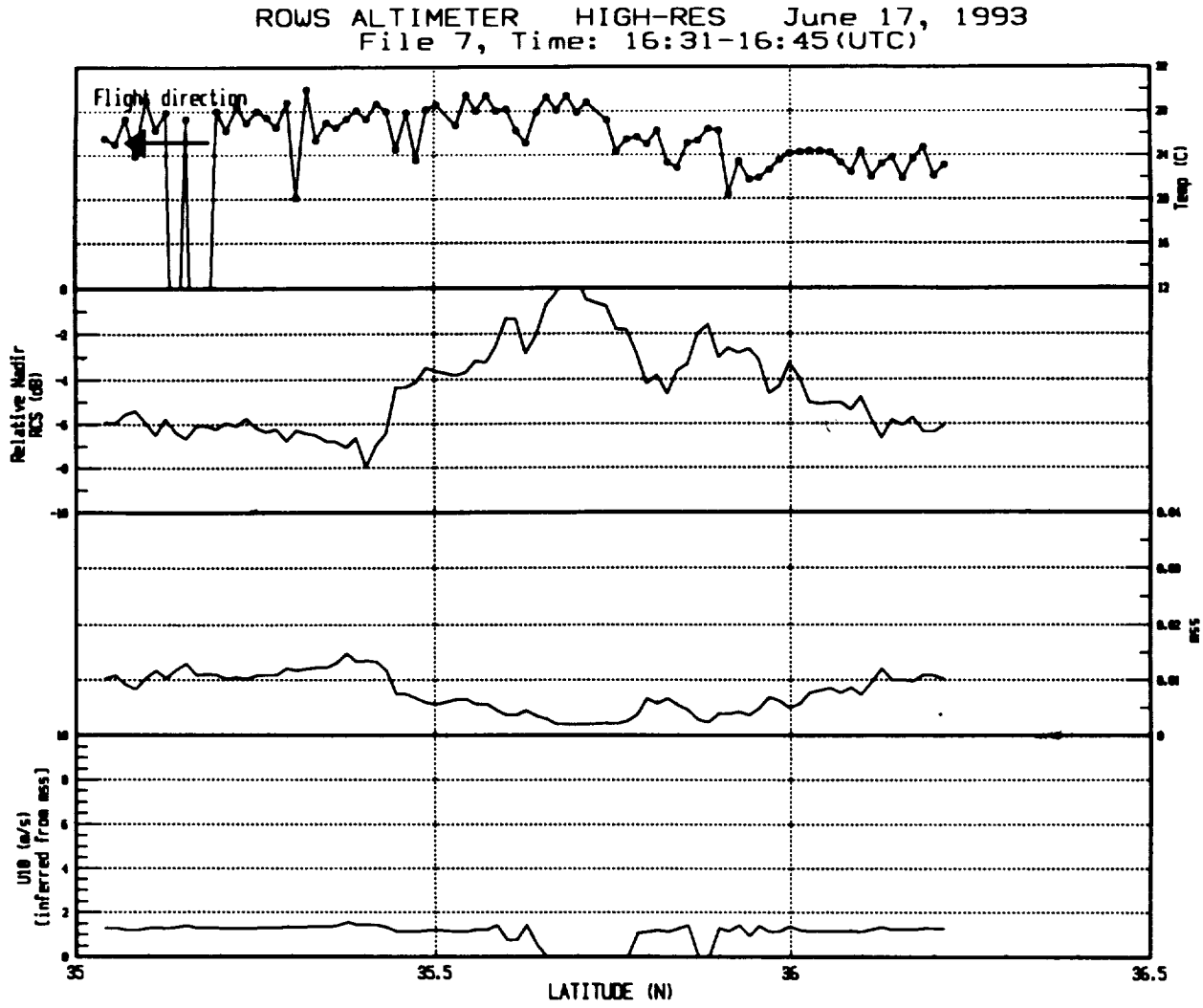

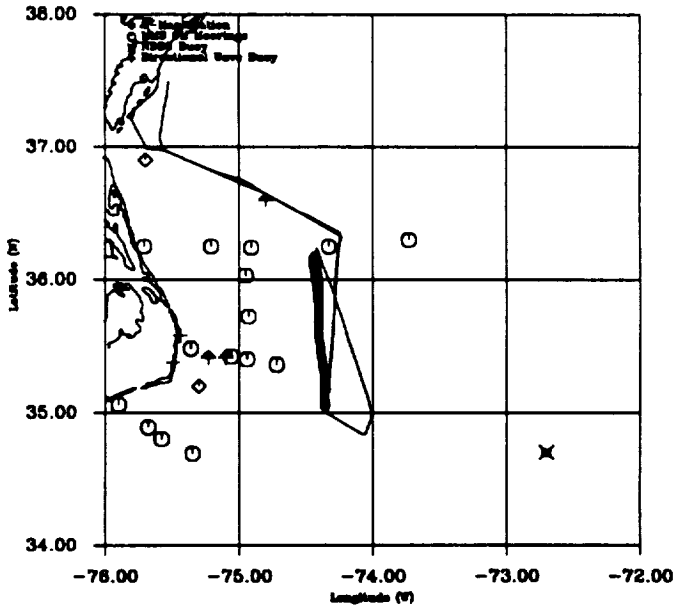

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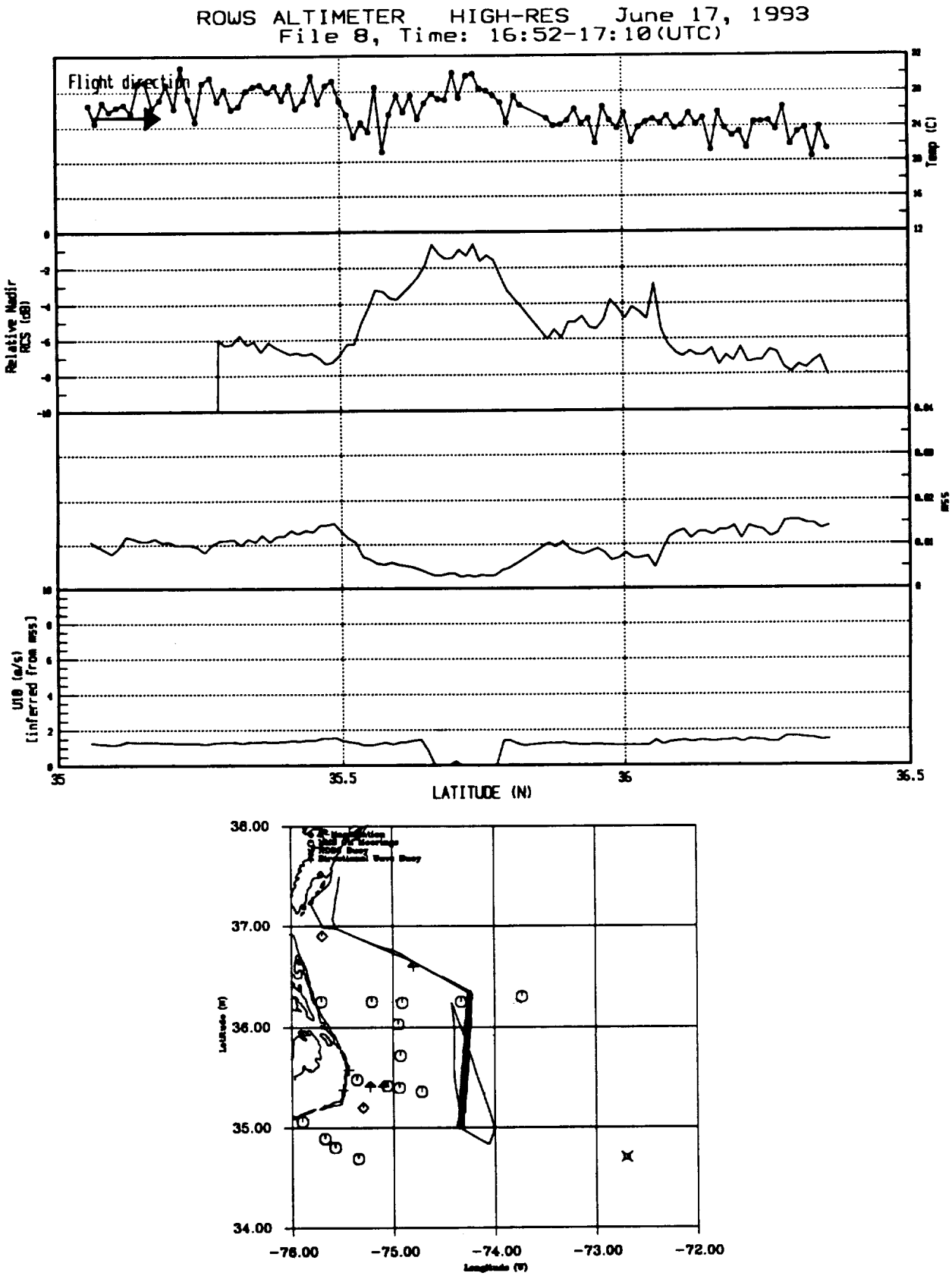


Figure 21. Altimeter mode summary, file 8, June 17, 1993.

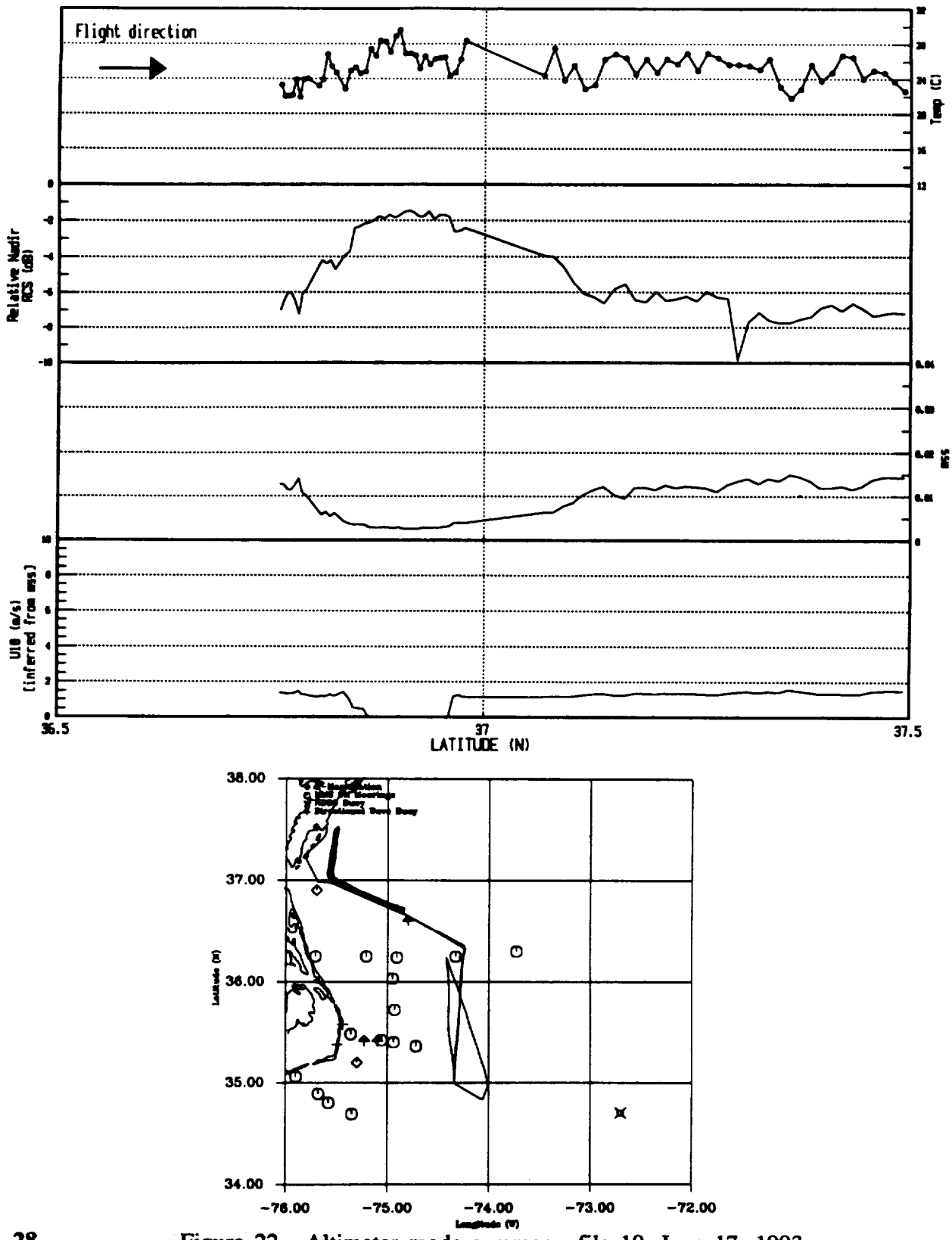


Figure 22. Altimeter mode summary, file 10, June 17, 1993.

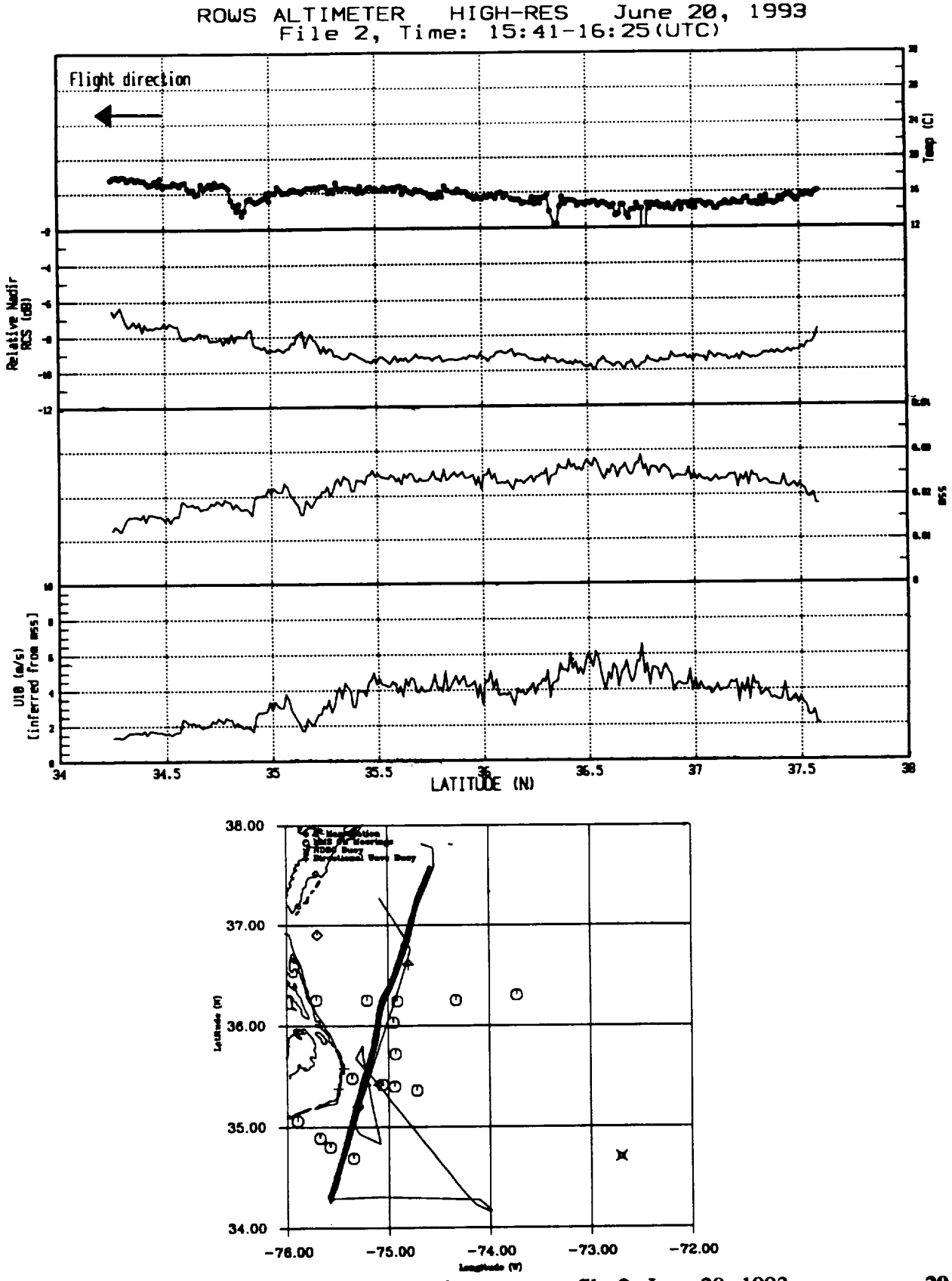


Figure 23. Altimeter mode summary, file 2, June 20, 1993.

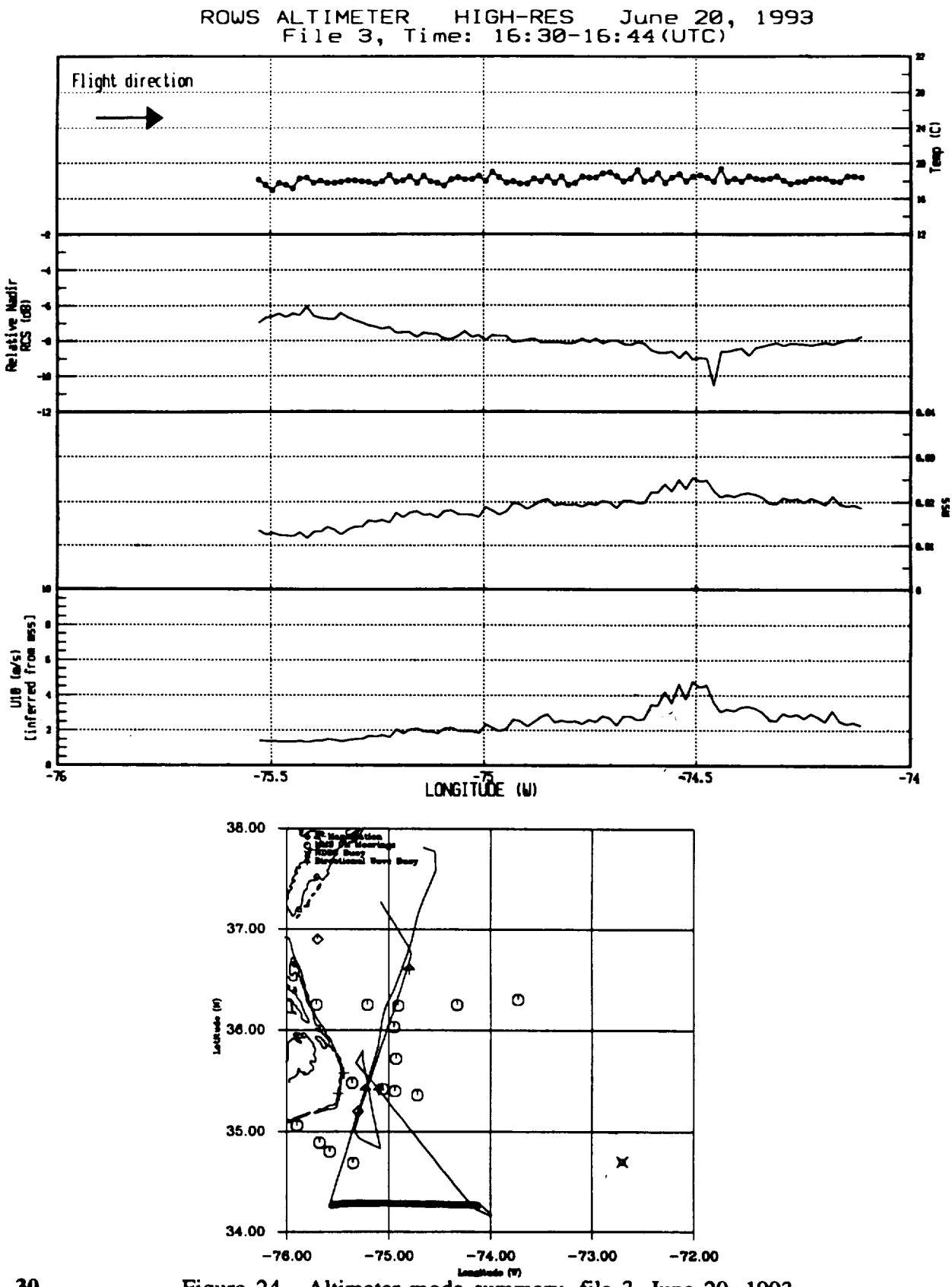


Figure 24. Altimeter mode summary, file 3, June 20, 1993.

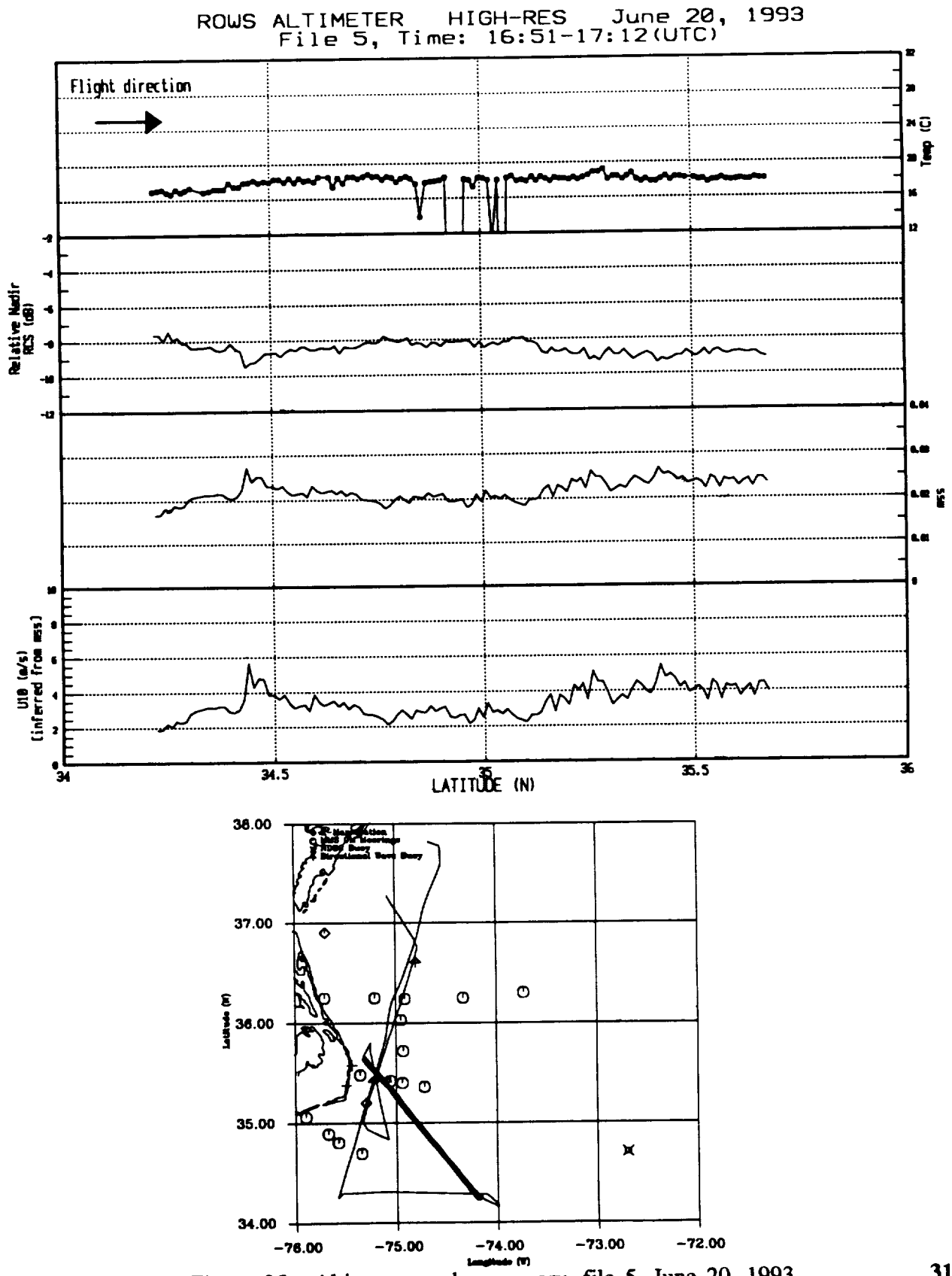


Figure 25. Altimeter mode summary, file 5, June 20, 1993.

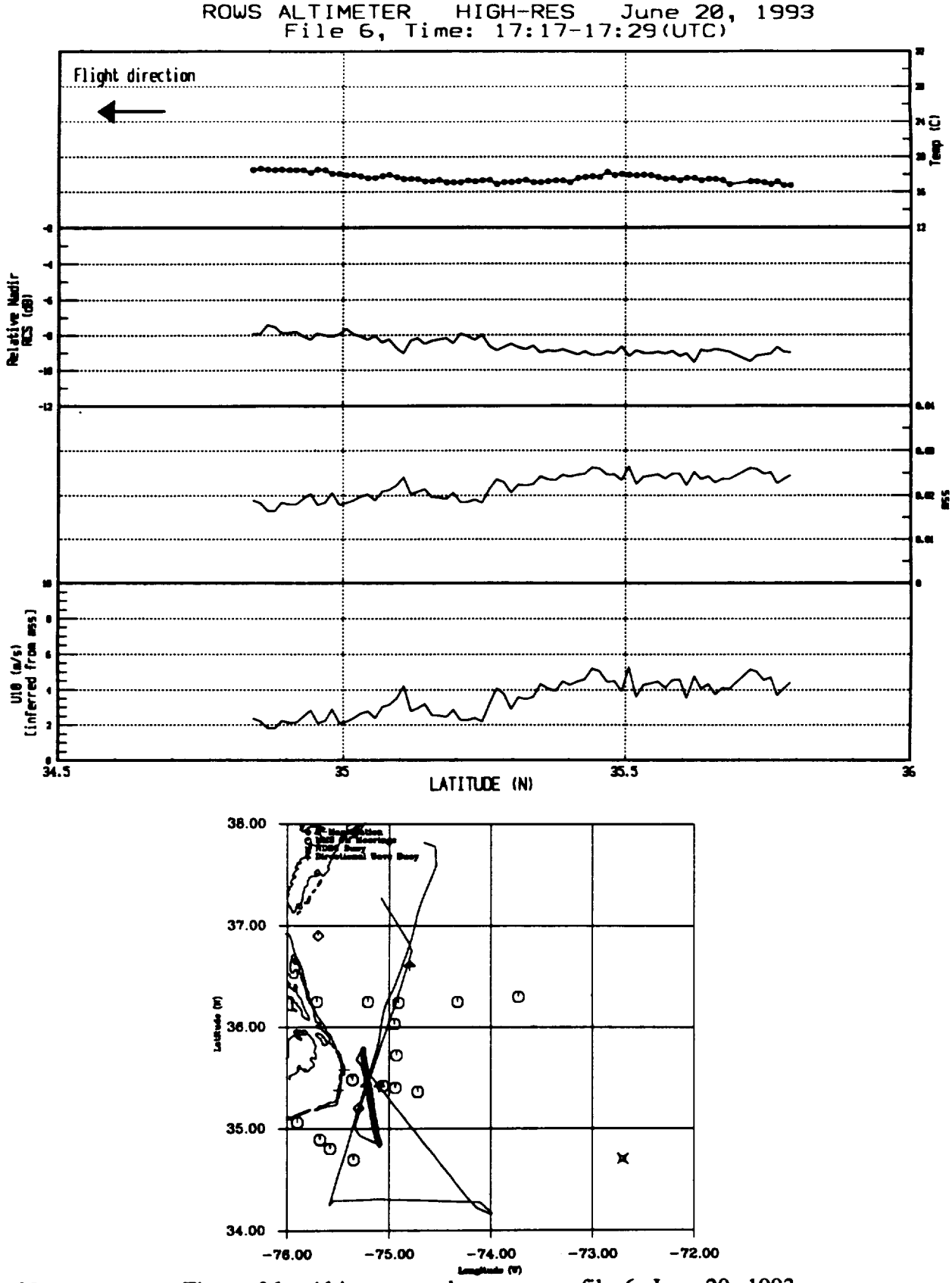


Figure 26. Altimeter mode summary, file 6, June 20, 1993.

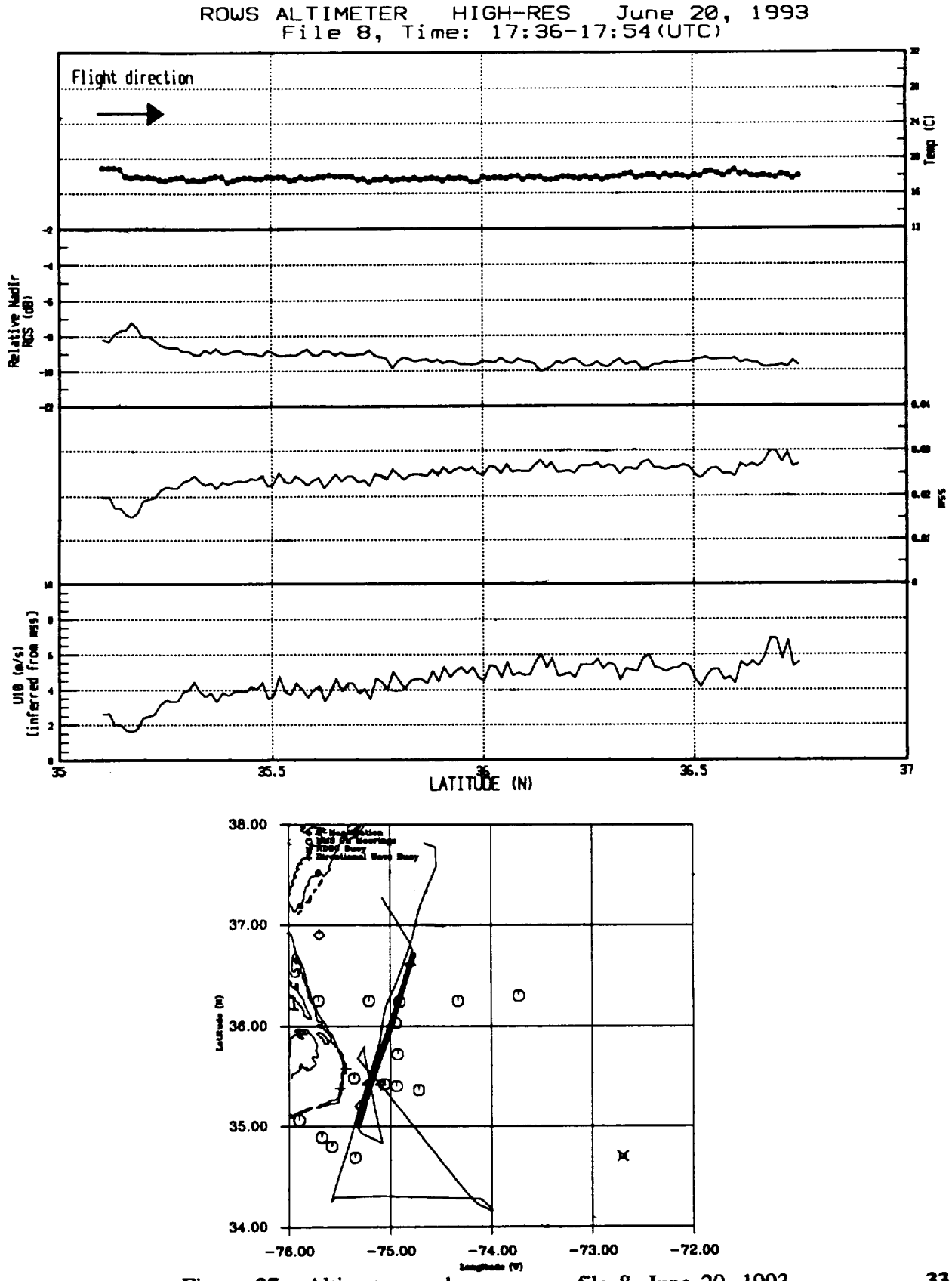


Figure 27. Altimeter mode summary, file 8, June 20, 1993.

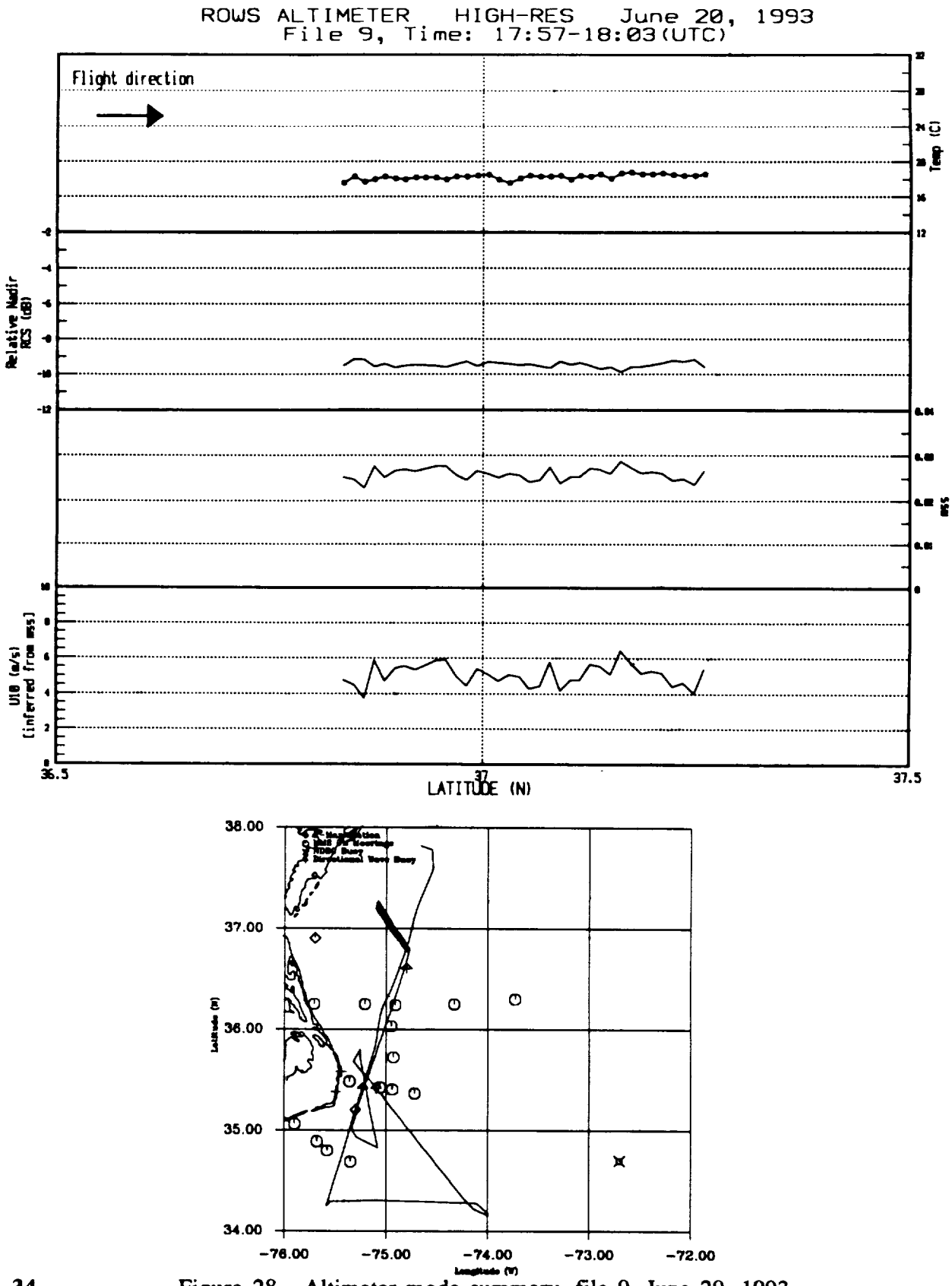


Figure 28. Altimeter mode summary, file 9, June 20, 1993.

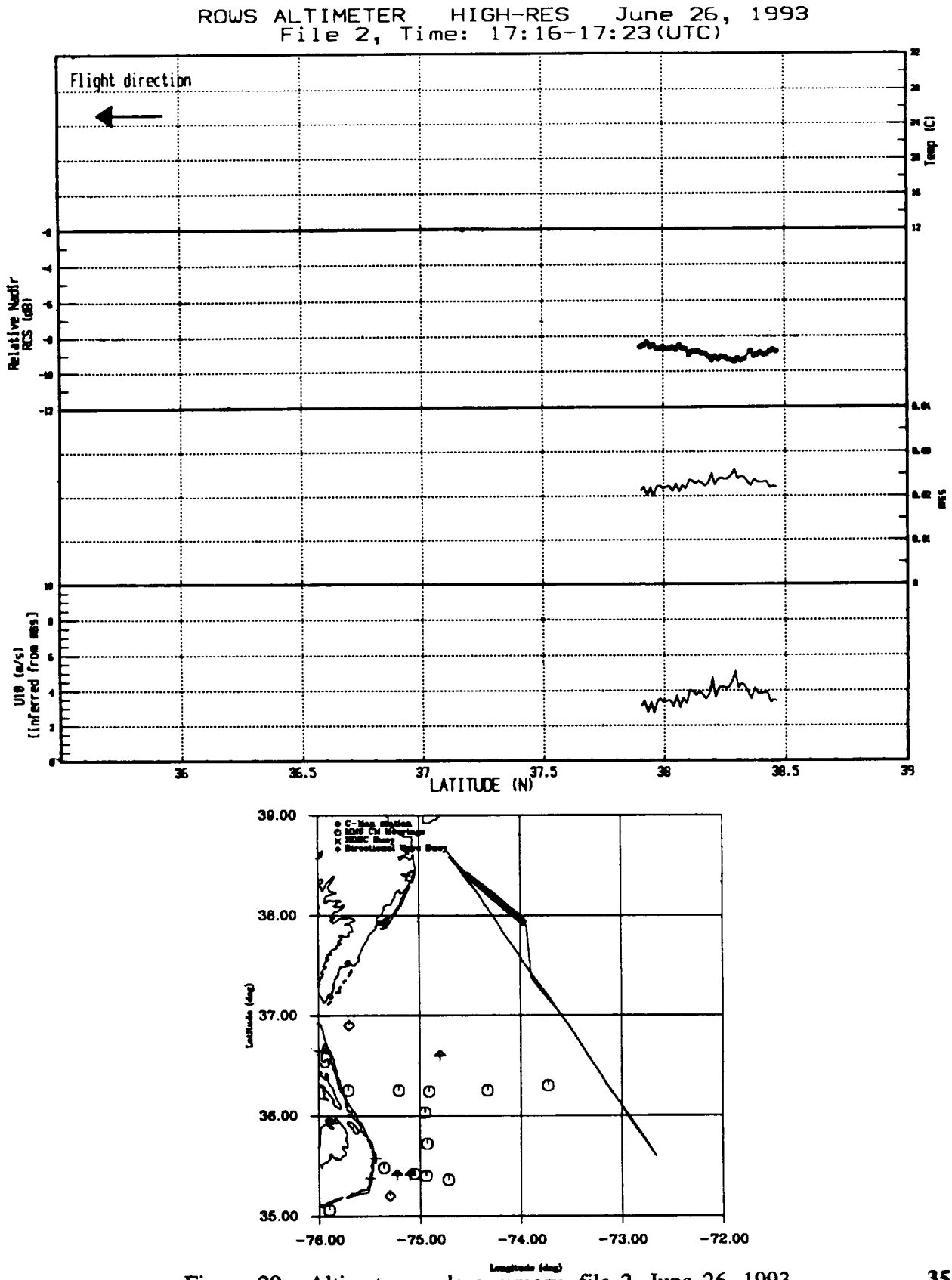


Figure 29. Altimeter mode summary, file 2, June 26, 1993.

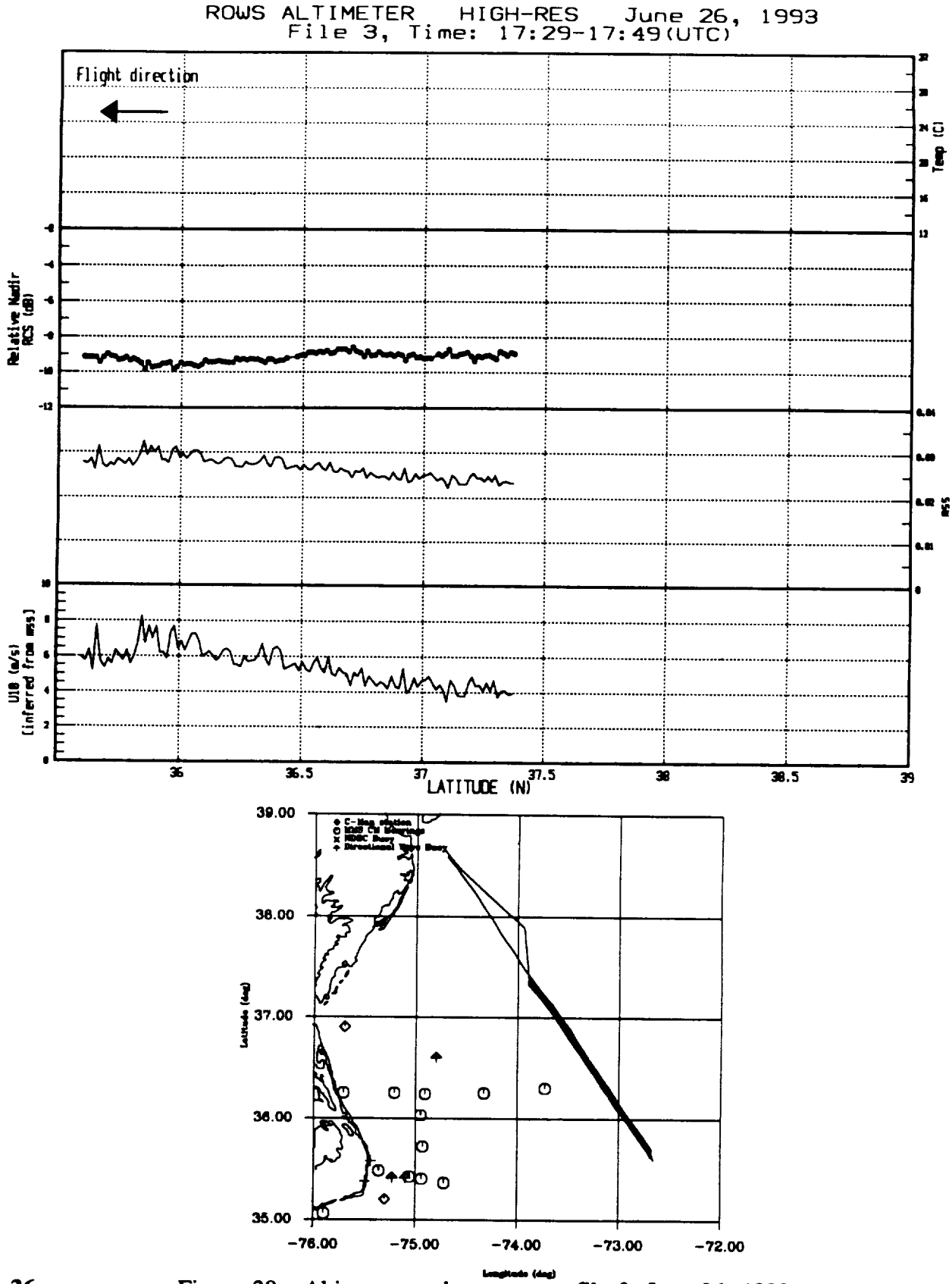


Figure 30. Altimeter mode summary, file 3, June 26, 1993.

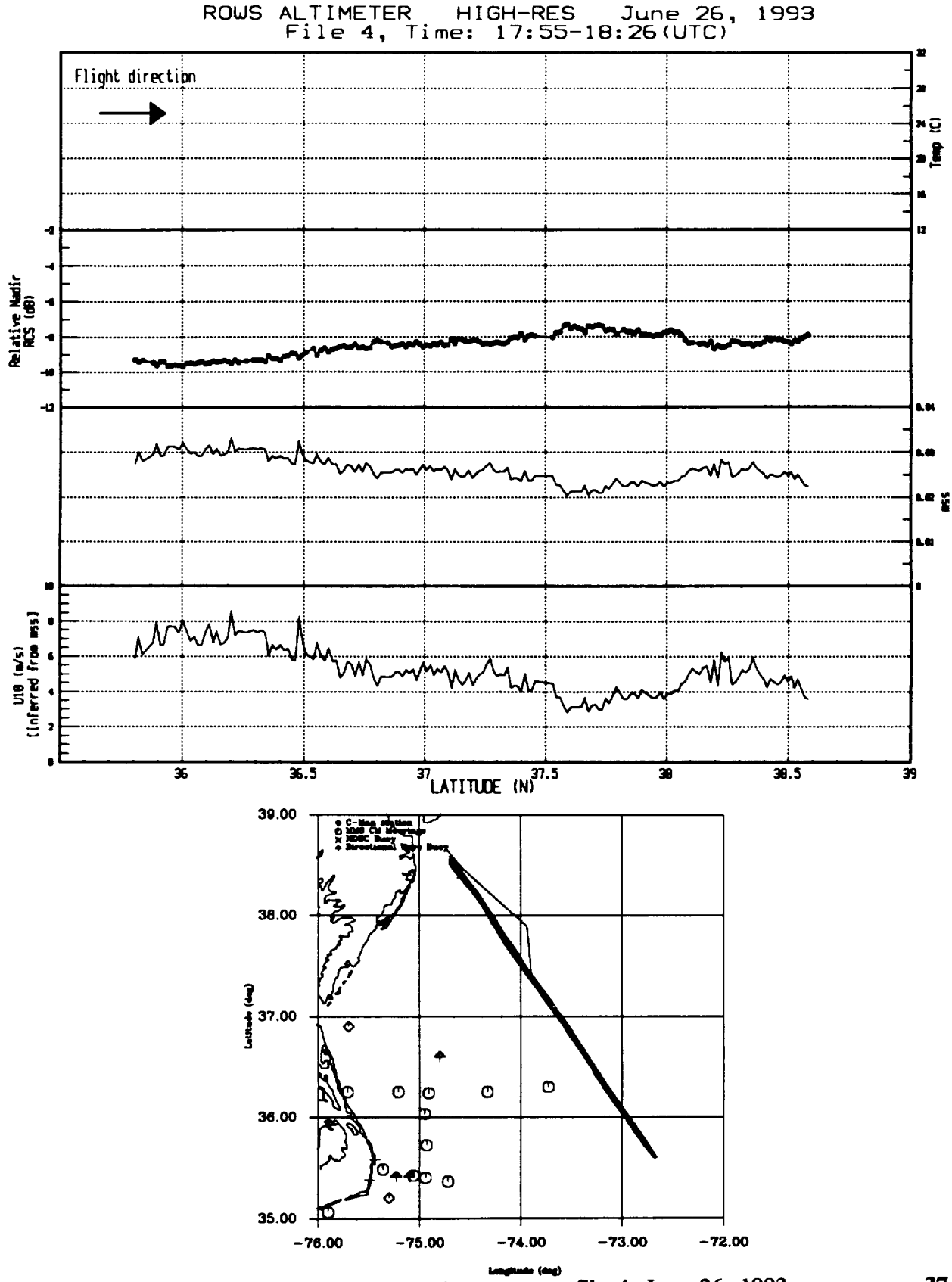


Figure 31. Altimeter mode summary, file 4, June 26, 1993.

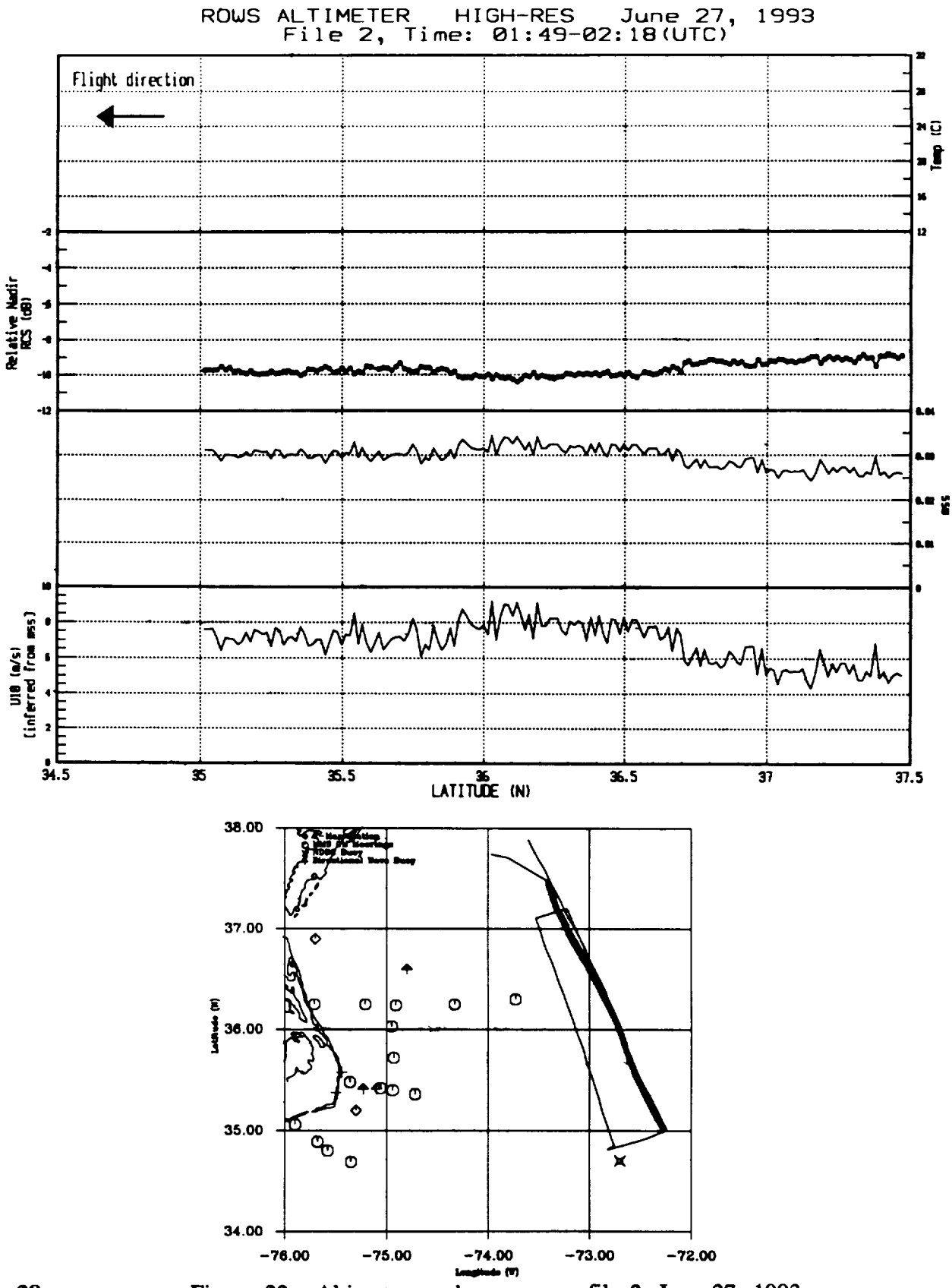
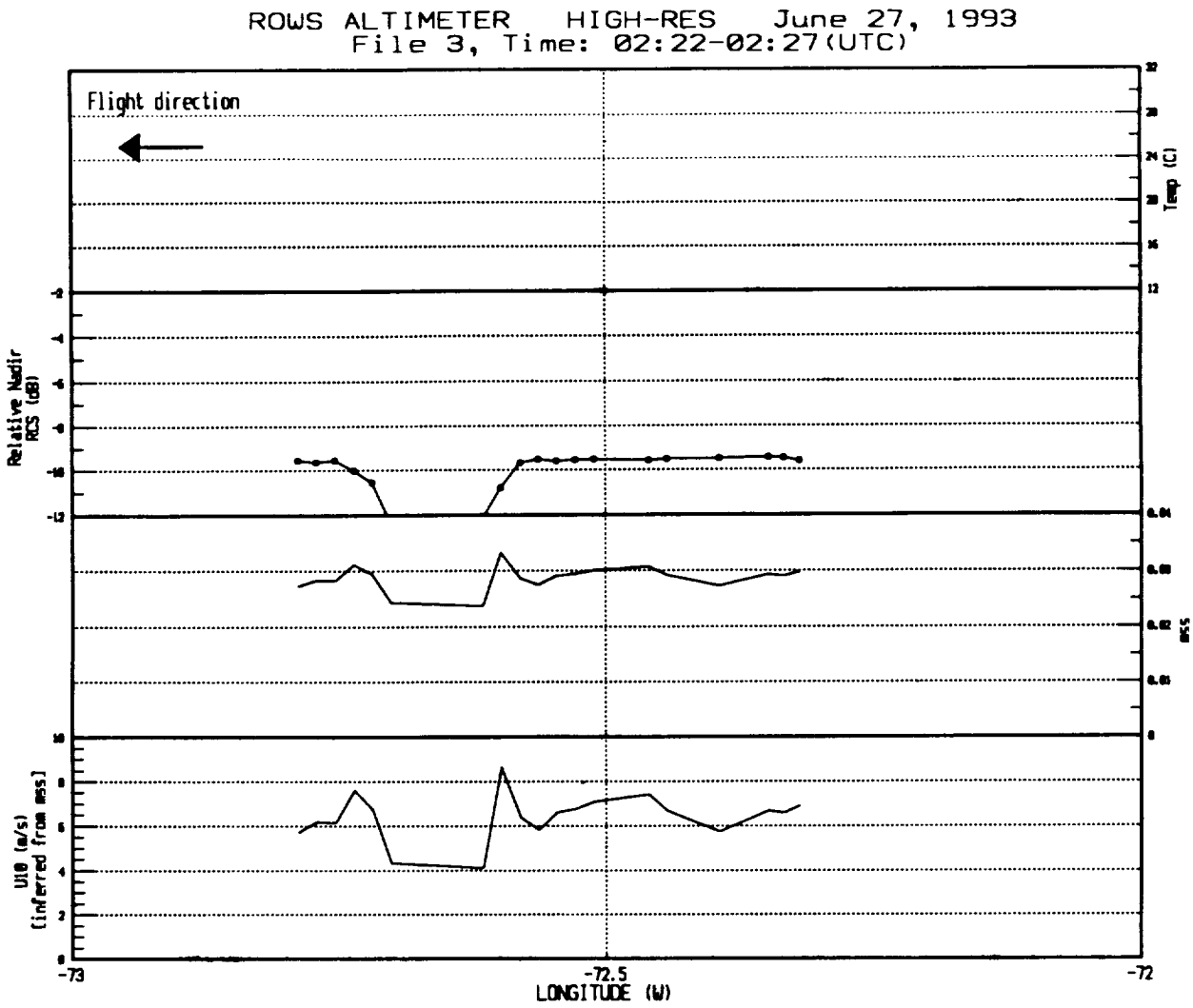


Figure 32. Altimeter mode summary, file 2, June 27, 1993.



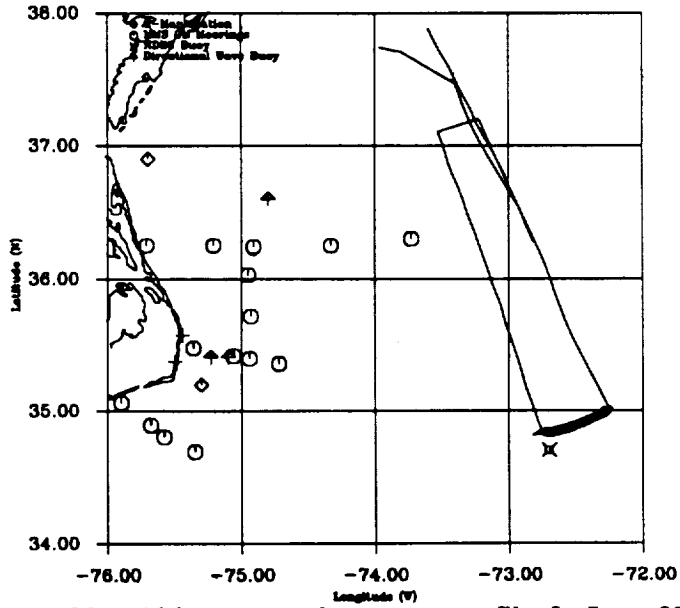


Figure 33. Altimeter mode summary, file 3, June 27, 1993.

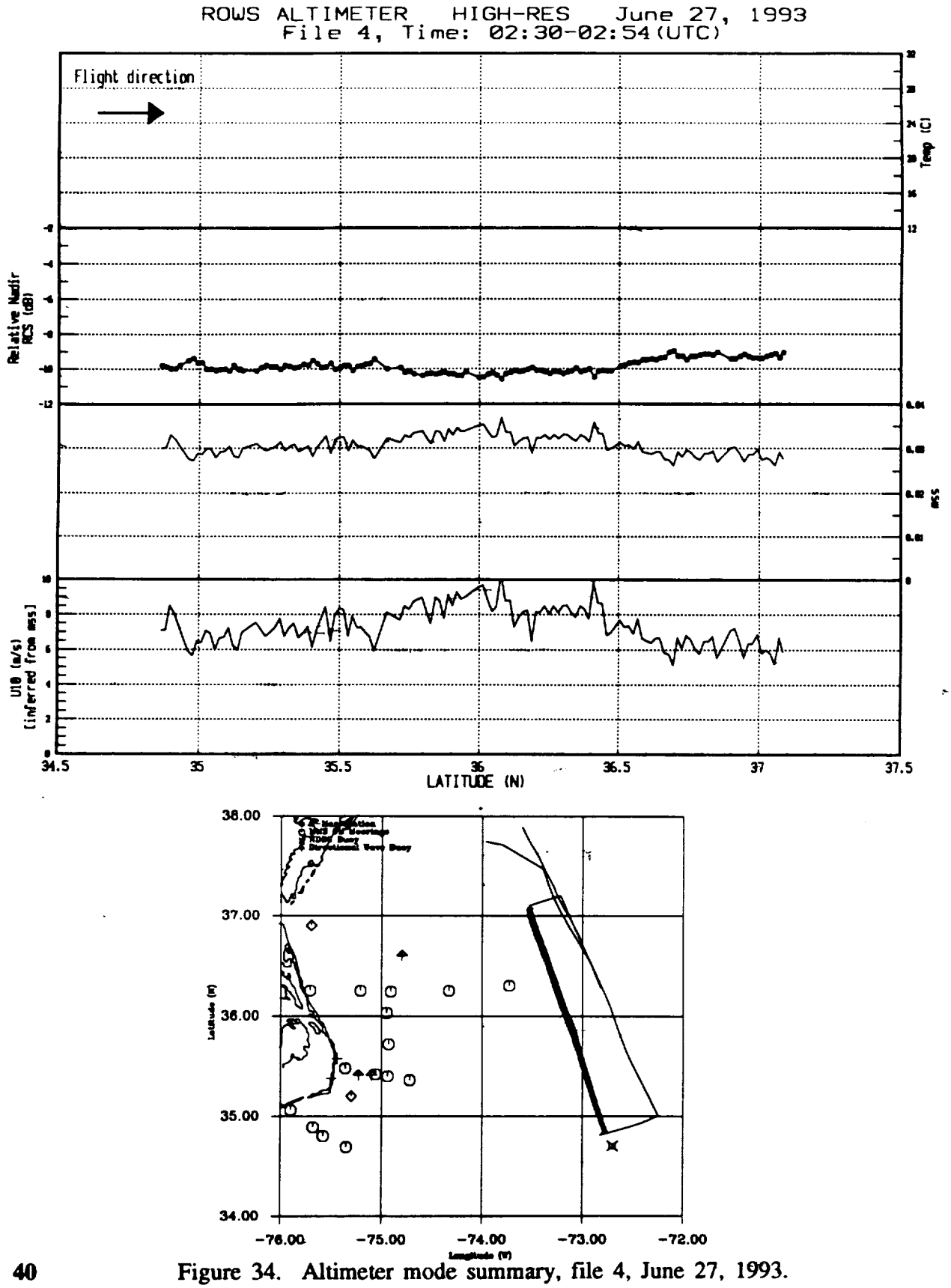


Figure 34. Altimeter mode summary, file 4, June 27, 1993.

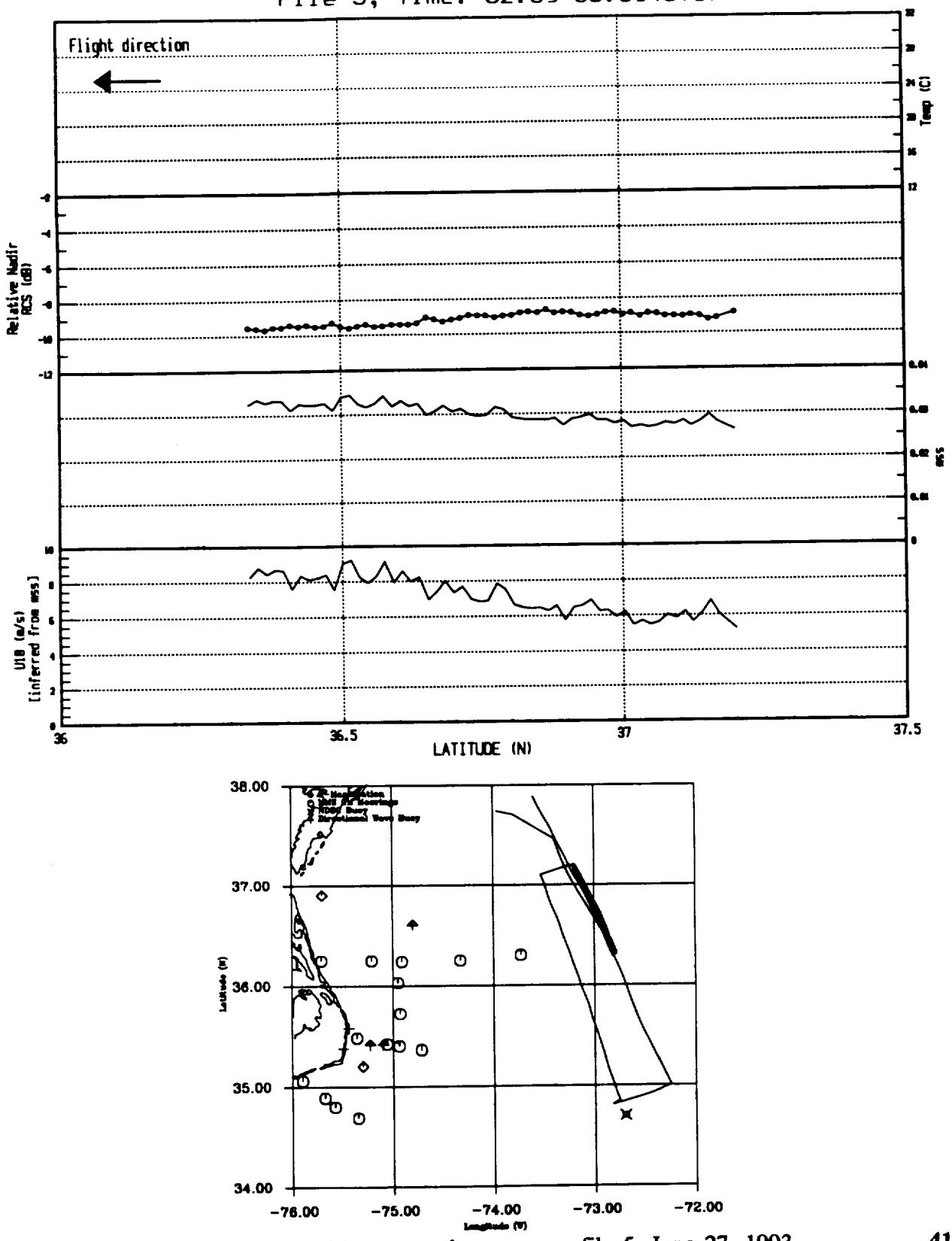


Figure 35. Altimeter mode summary, file 5, June 27, 1993.

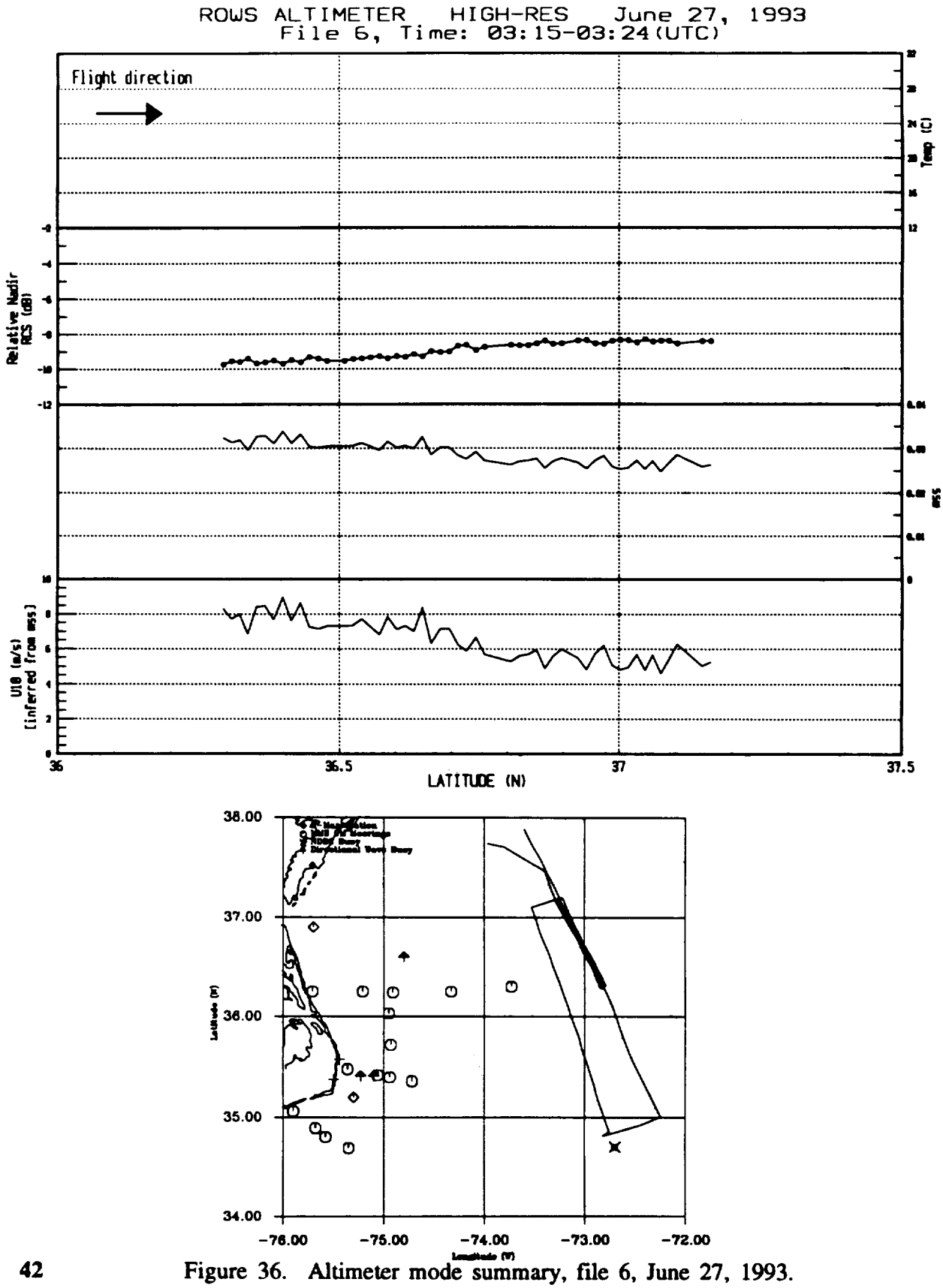


Figure 36. Altimeter mode summary, file 6, June 27, 1993.

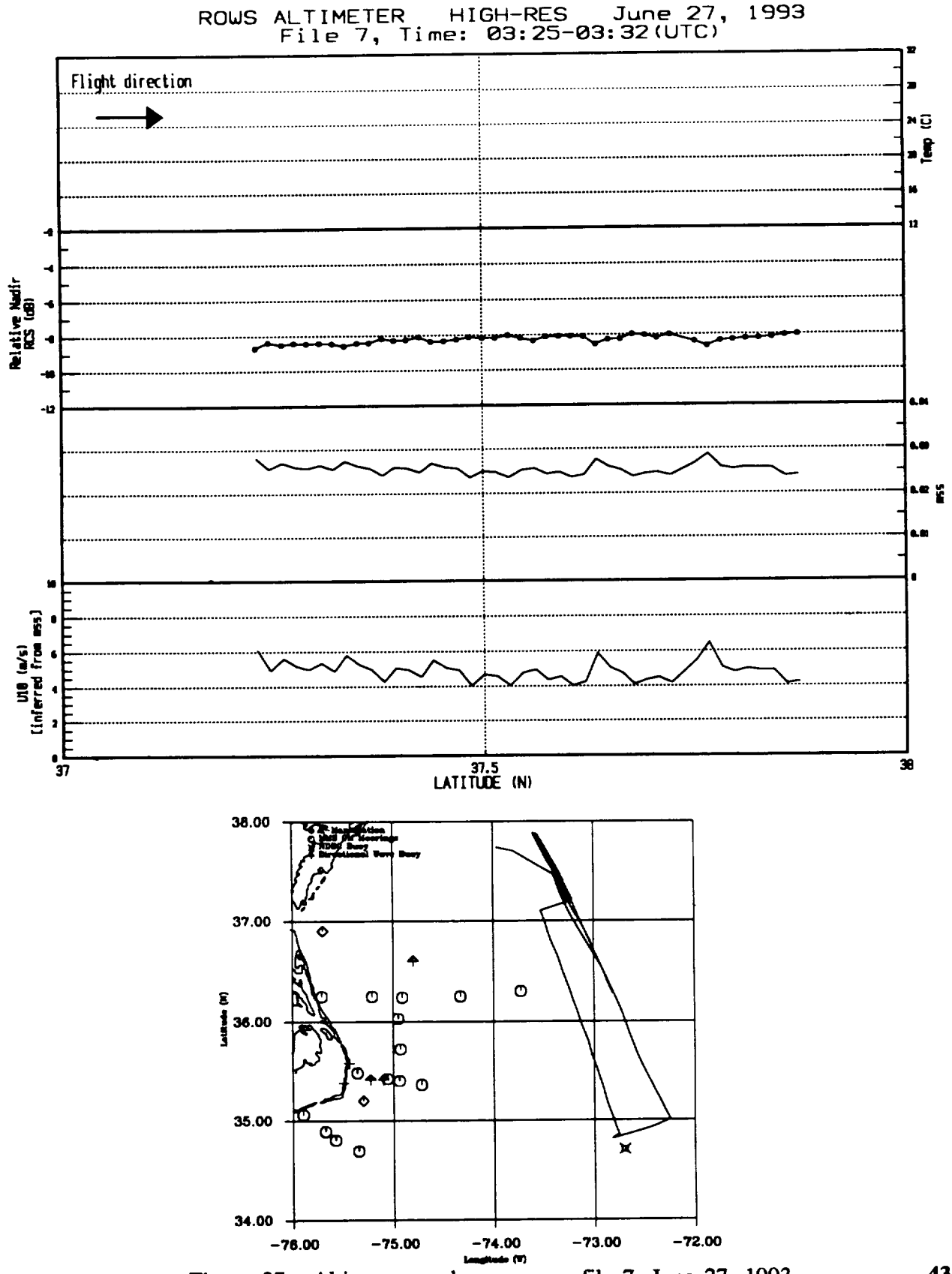


Figure 37. Altimeter mode summary, file 7, June 27, 1993.

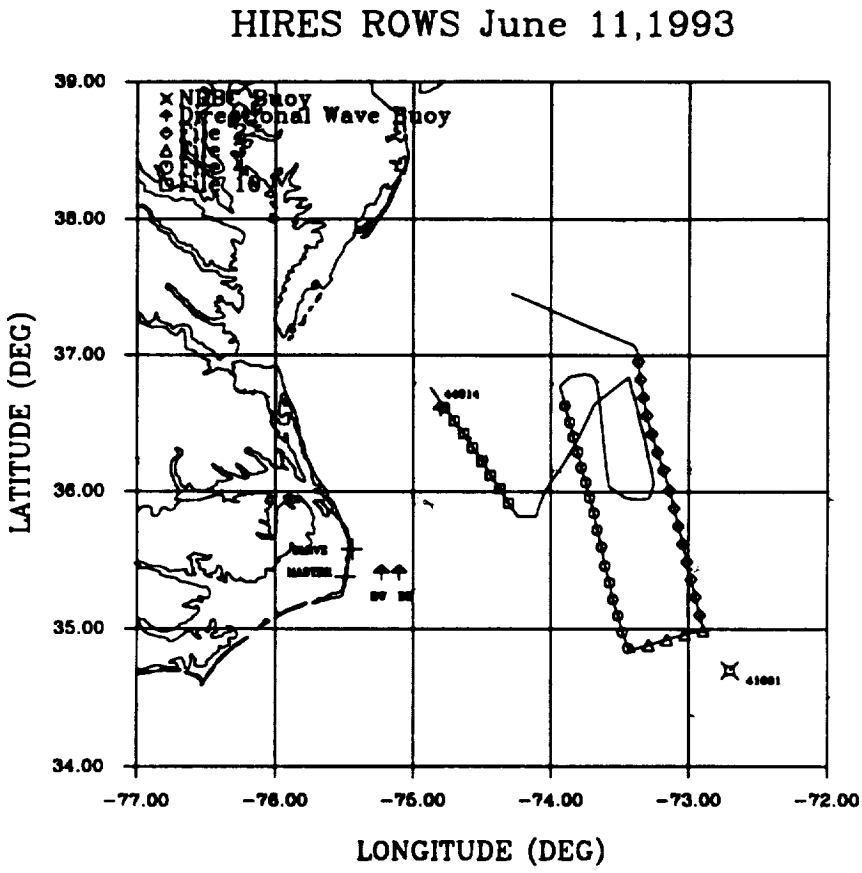


Figure 38. ROWS flight lines for June 11, 1993 with symbols denoting the midpoint for a given ROWS directional wave spectrum estimate.

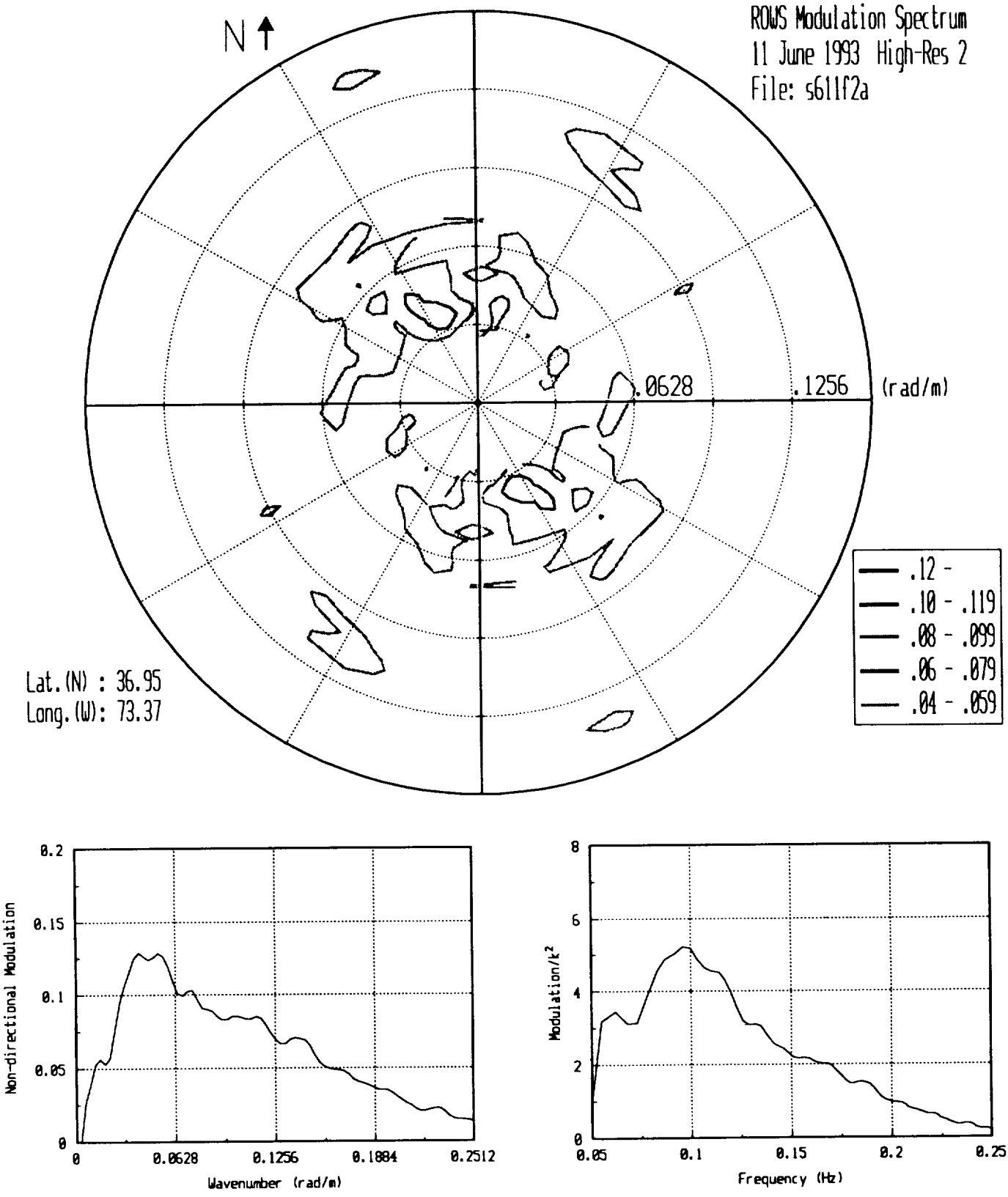


Figure 39. ROWS spectral data, file s611f2a.

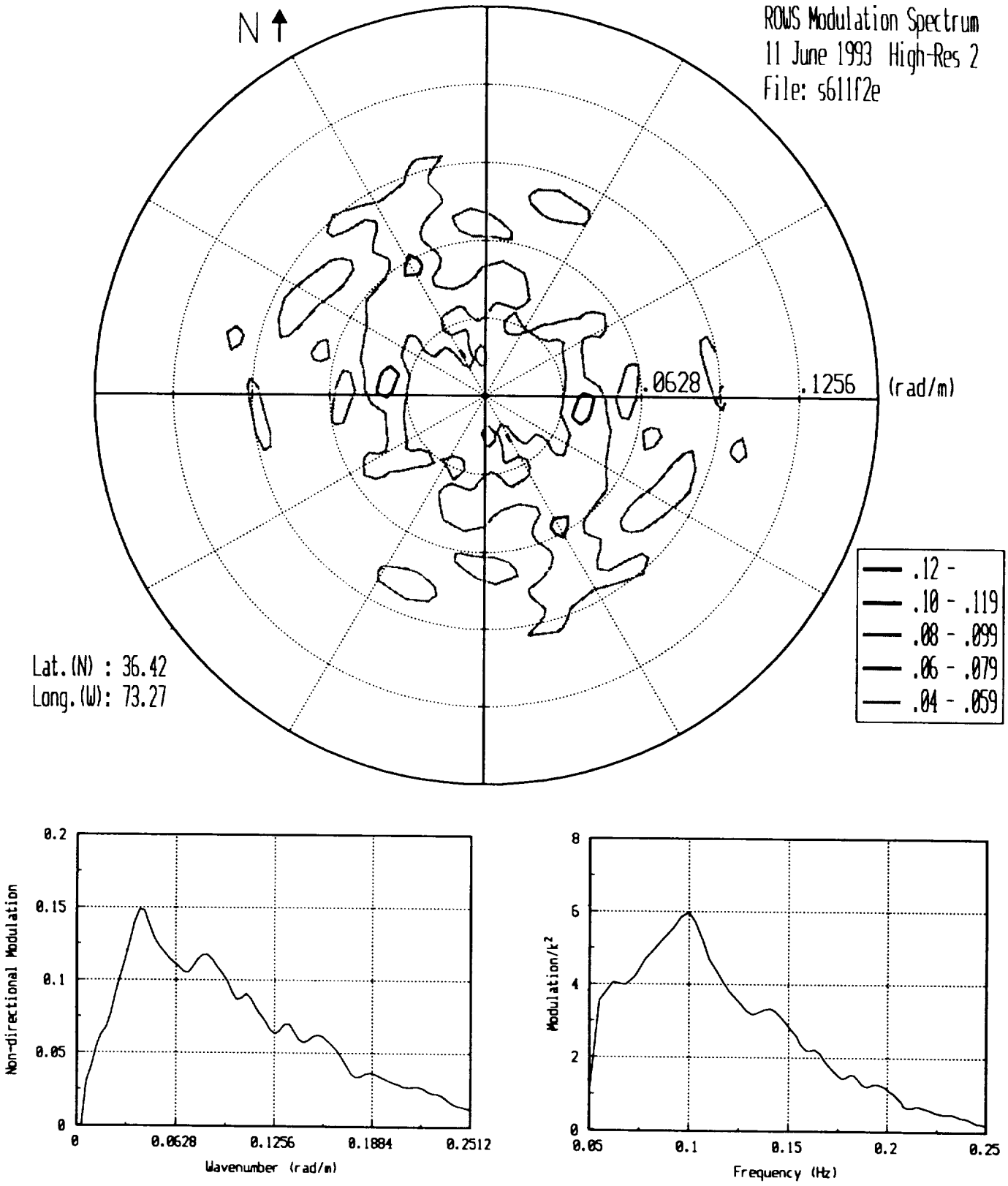


Figure 40. ROWS spectral data, file s611f2e.

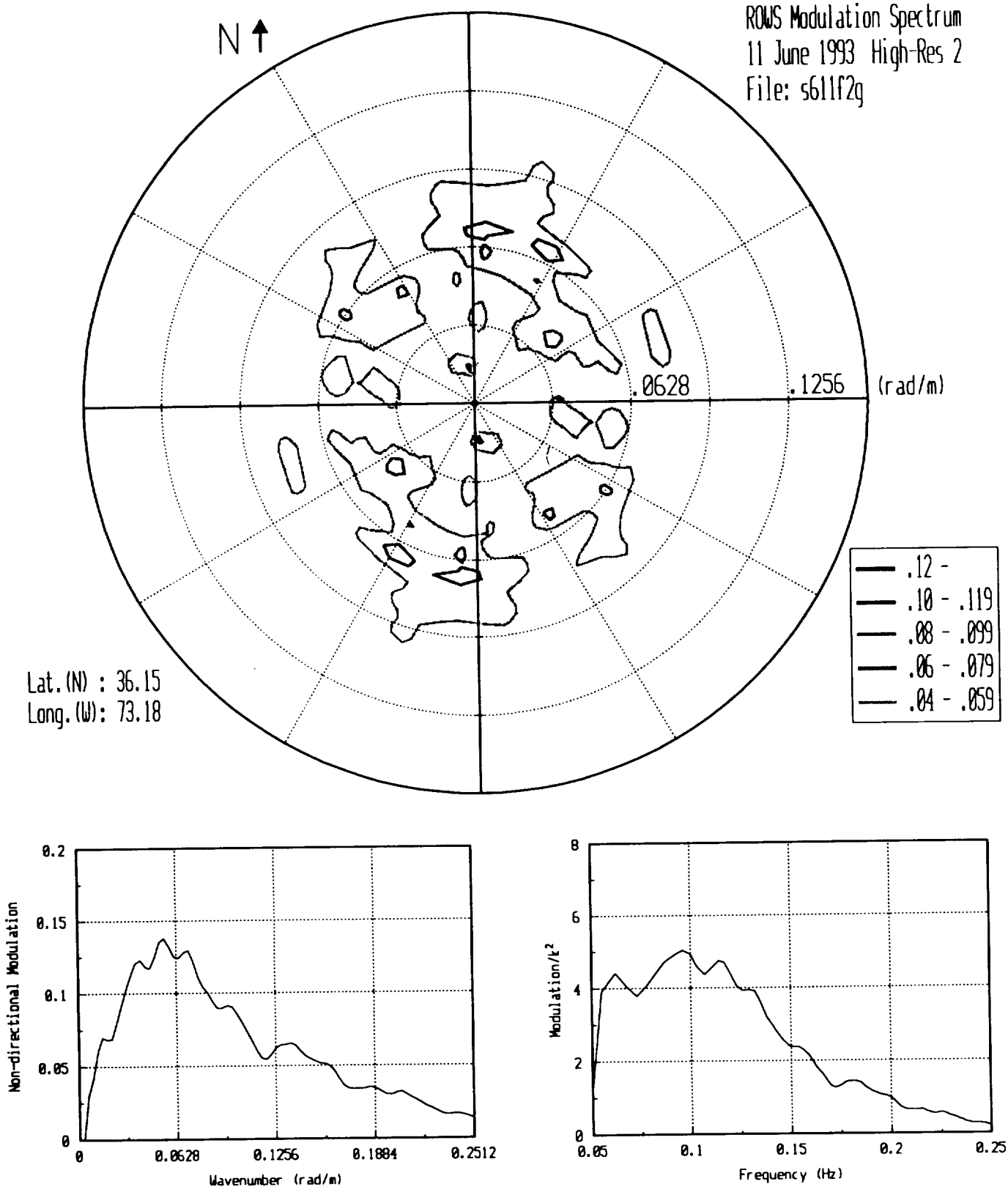


Figure 41. ROWS spectral data, file s611f2g.

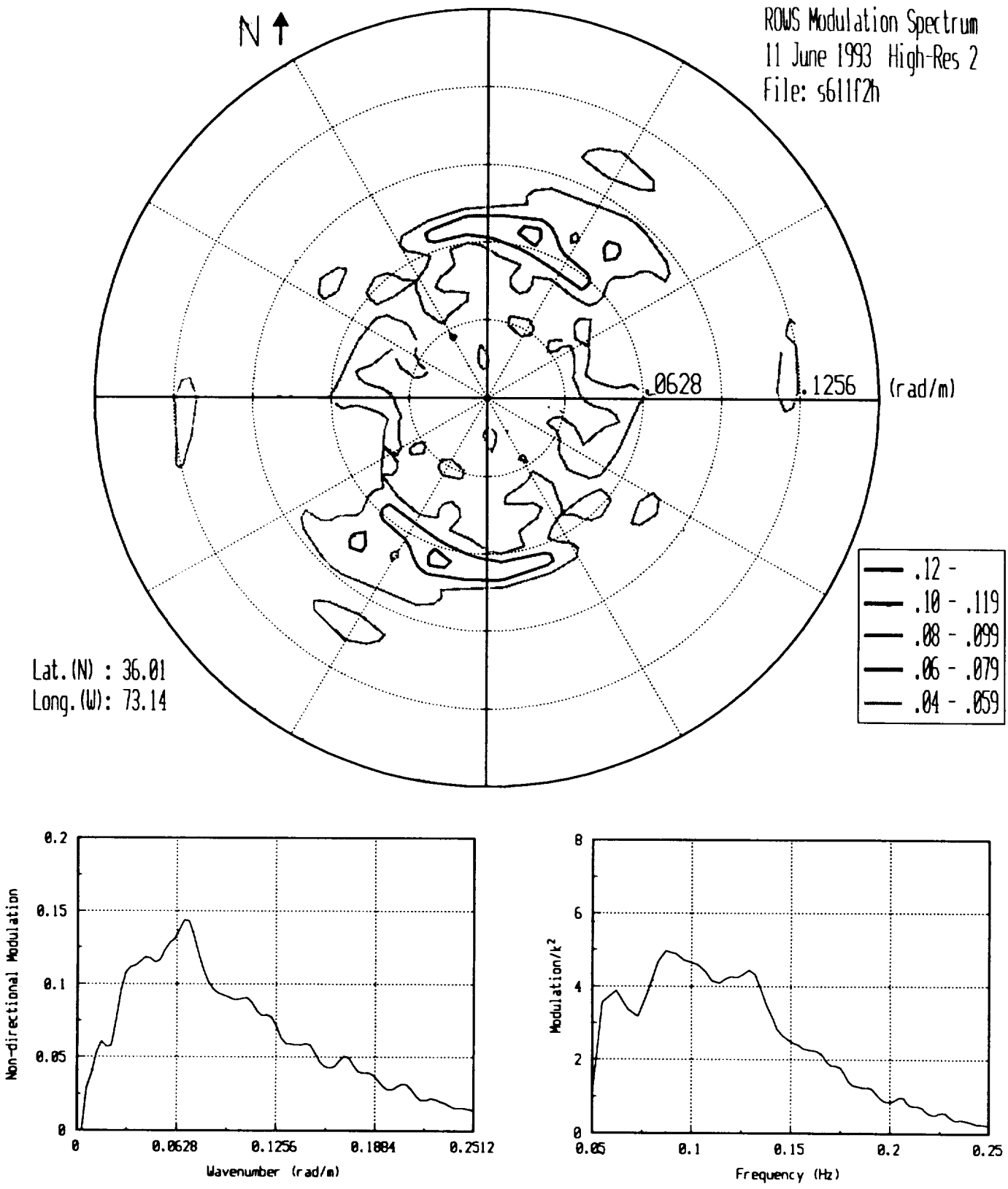


Figure 42. ROWS spectral data, file s611f2h.

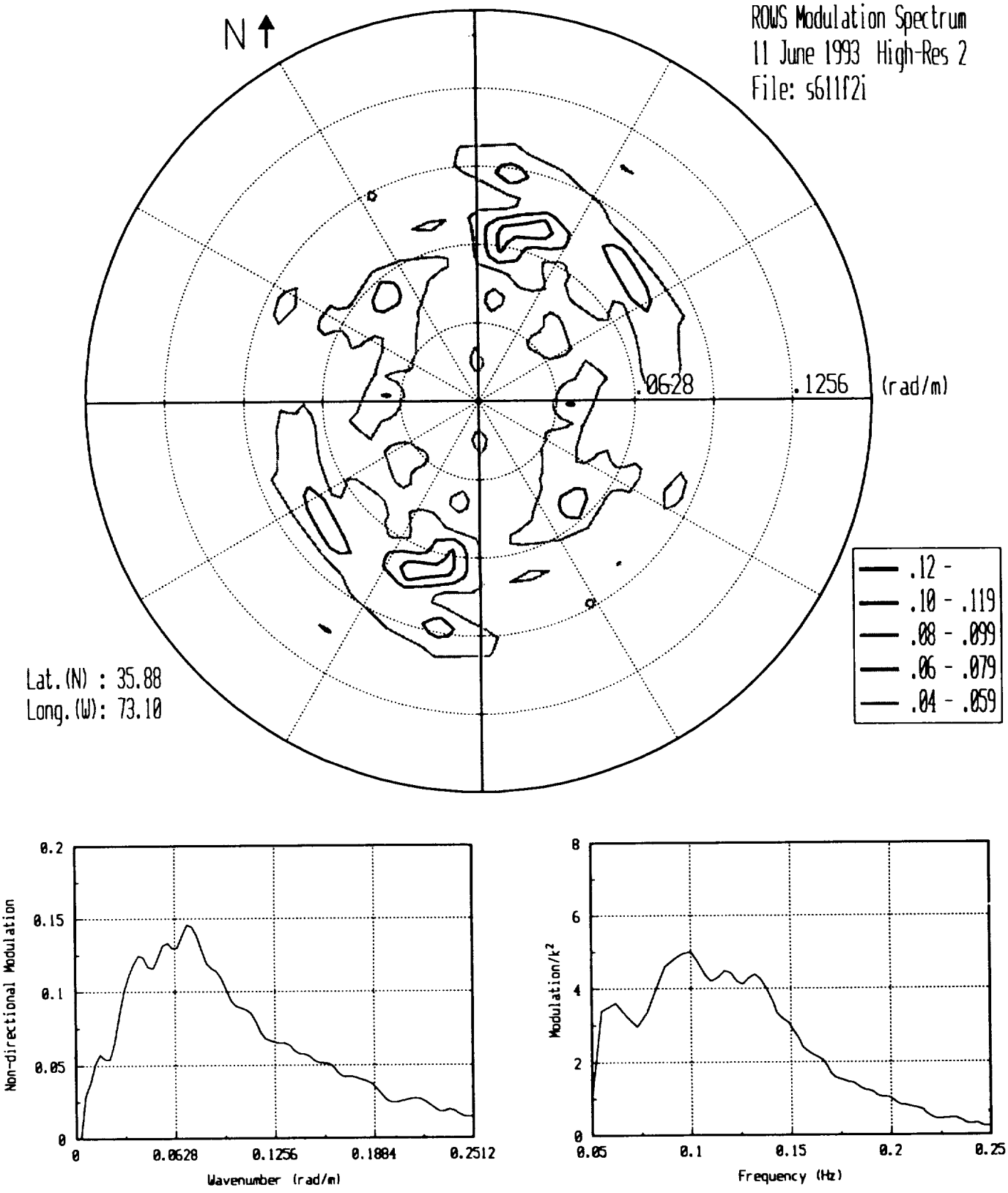


Figure 43. ROWS spectral data, file s611f2i.

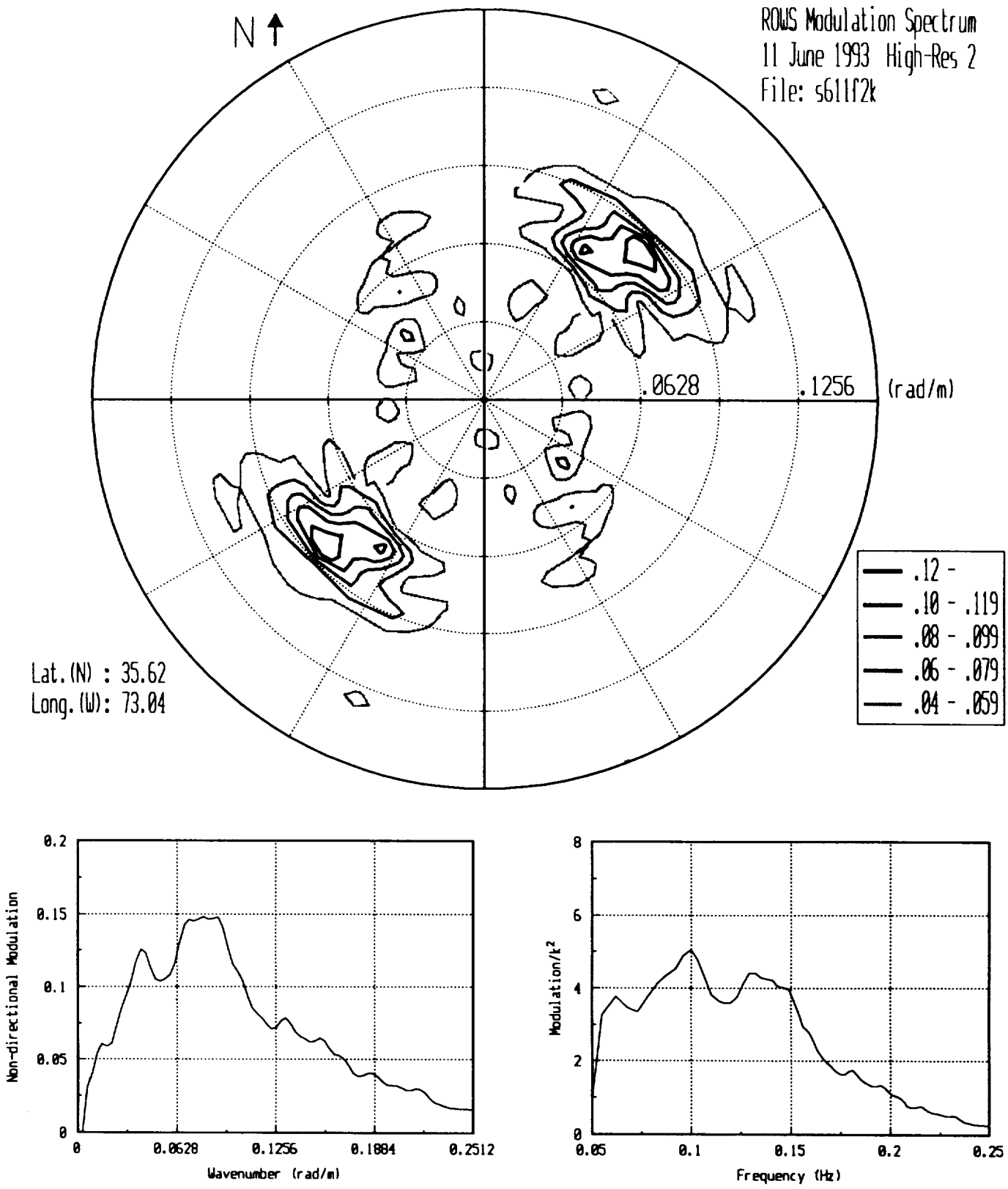


Figure 44. ROWS spectral data, file s611f2k.

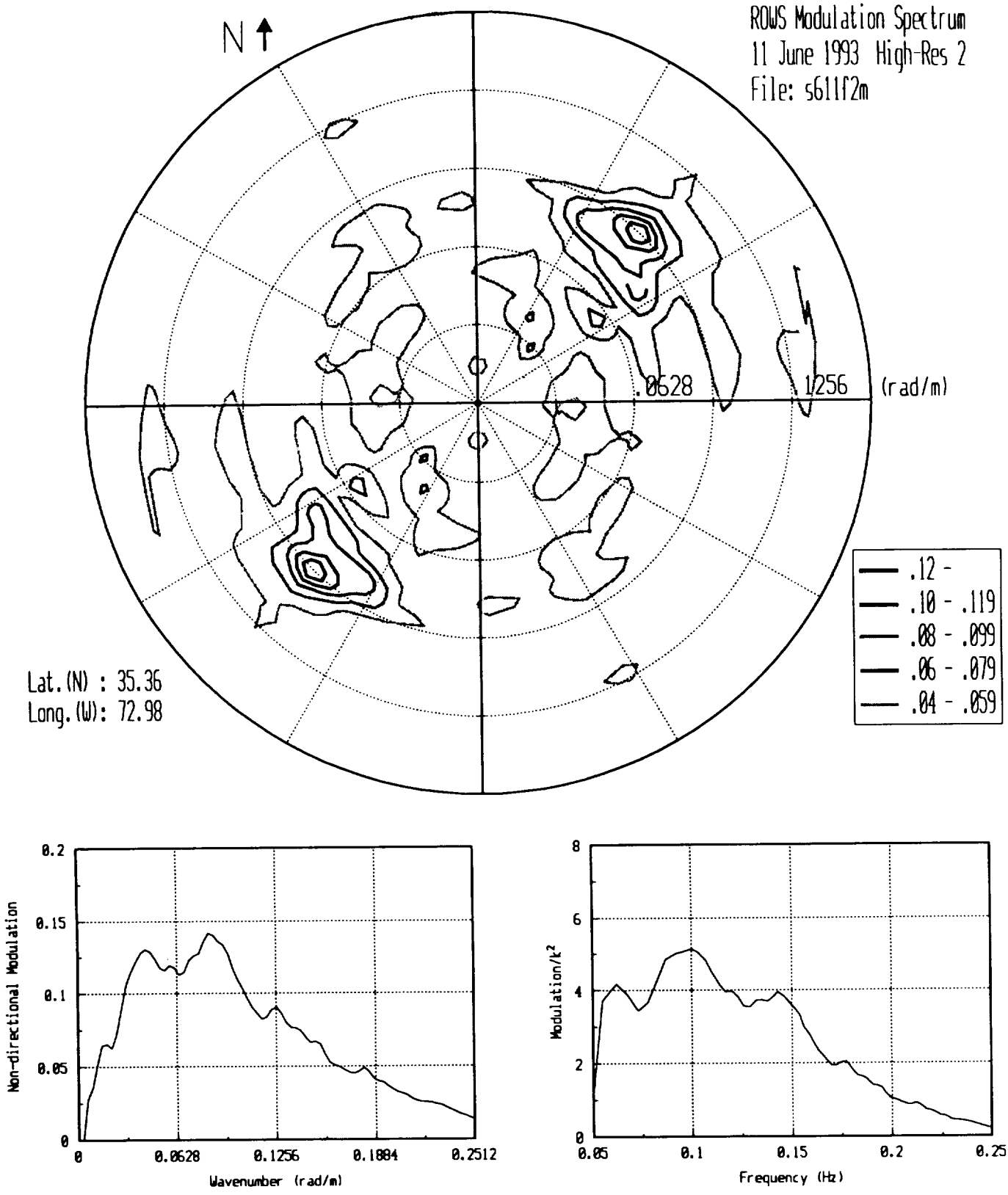


Figure 45. ROWS spectral data, file s611f2m.

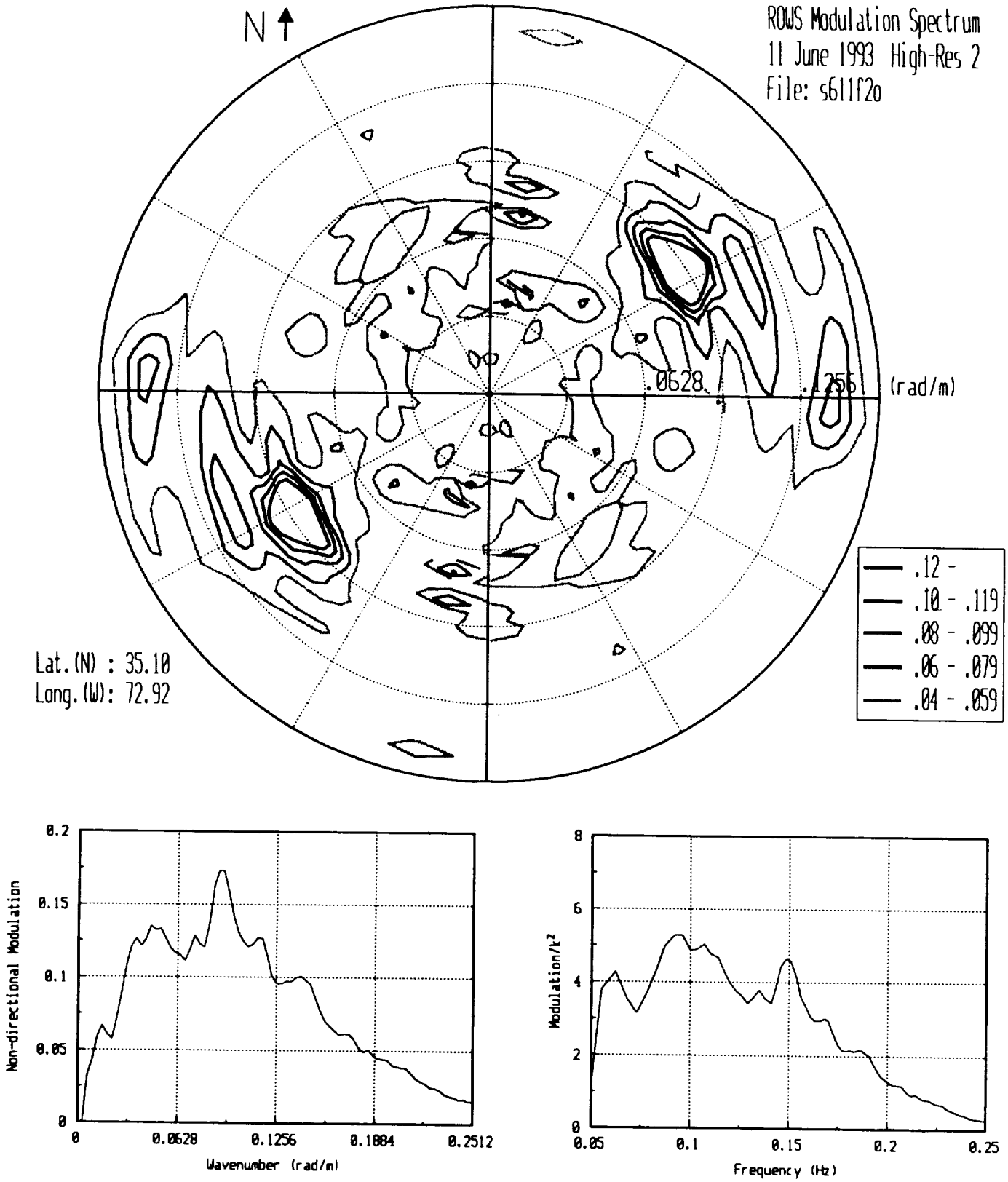


Figure 46. ROWS spectral data, file s611f2o.

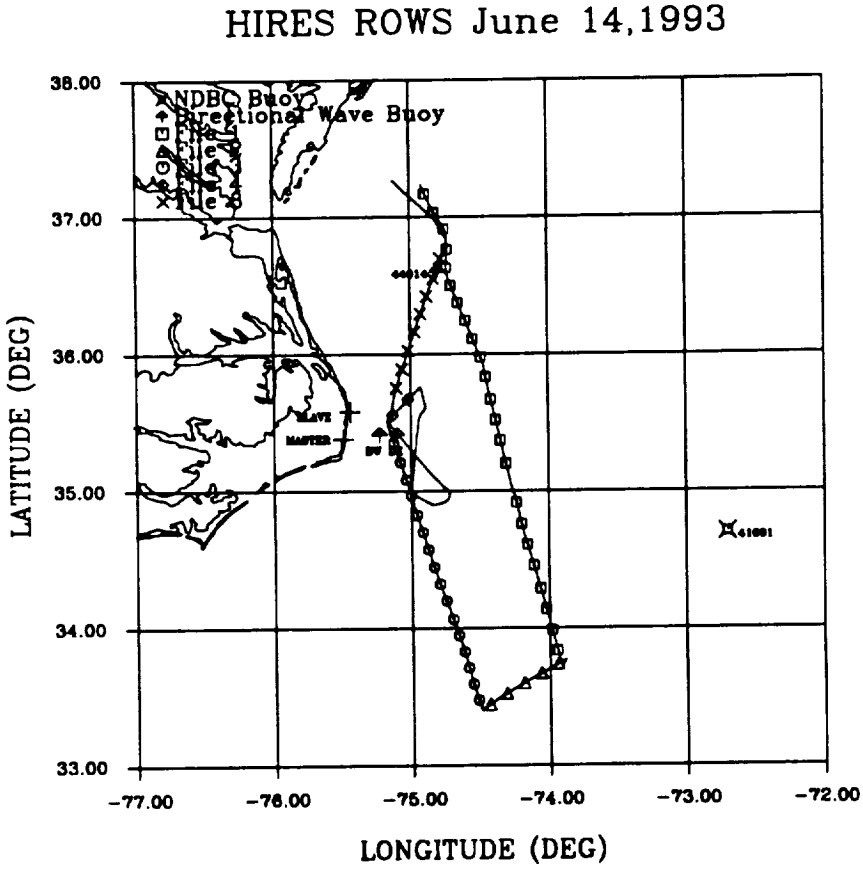


Figure 47. ROWS flight lines for June 14, 1993 with symbols deonting the midpoint for a given ROWS directional wave spectrum estimate.

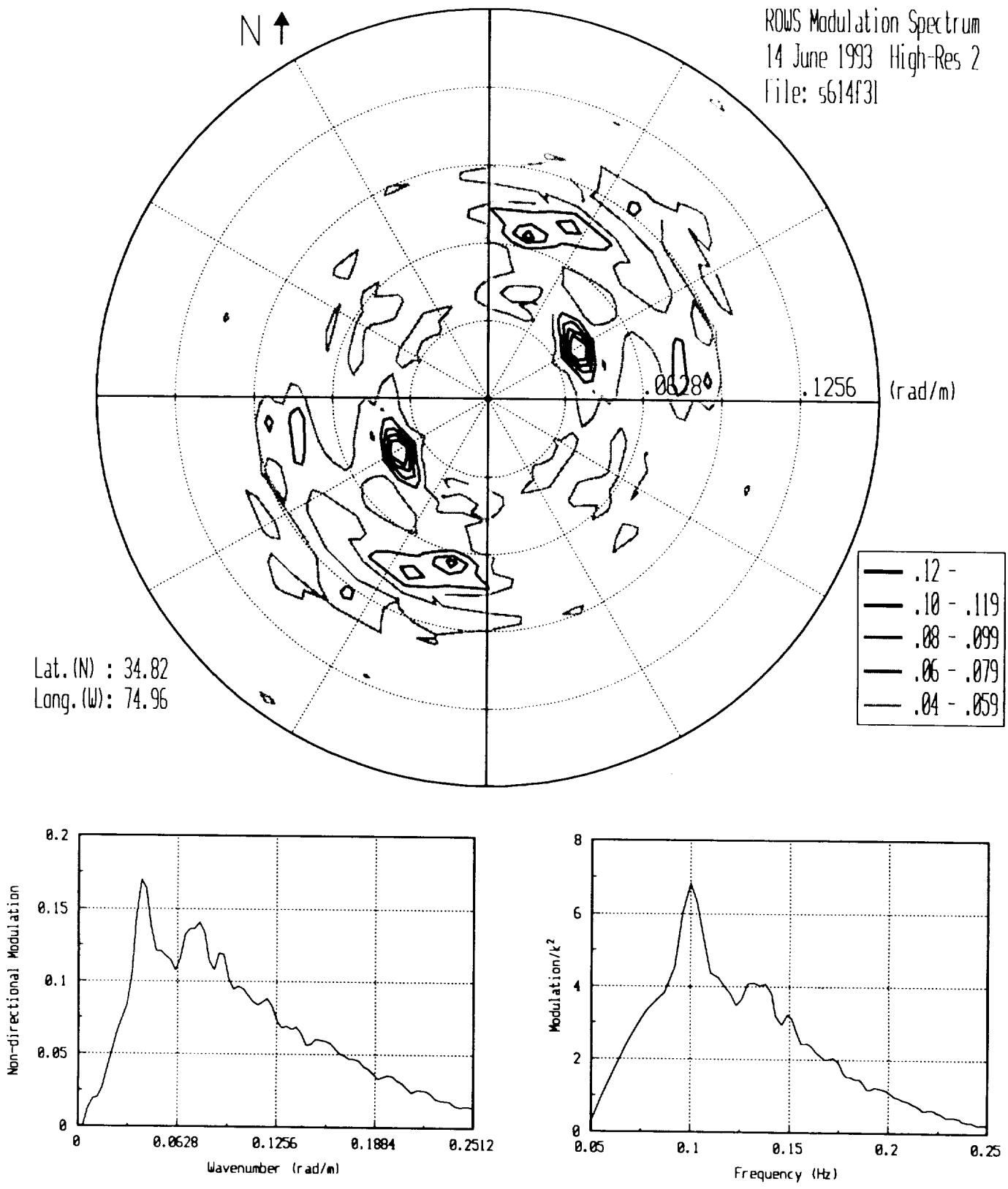


Figure 48. ROWS spectral data, file s614f31.

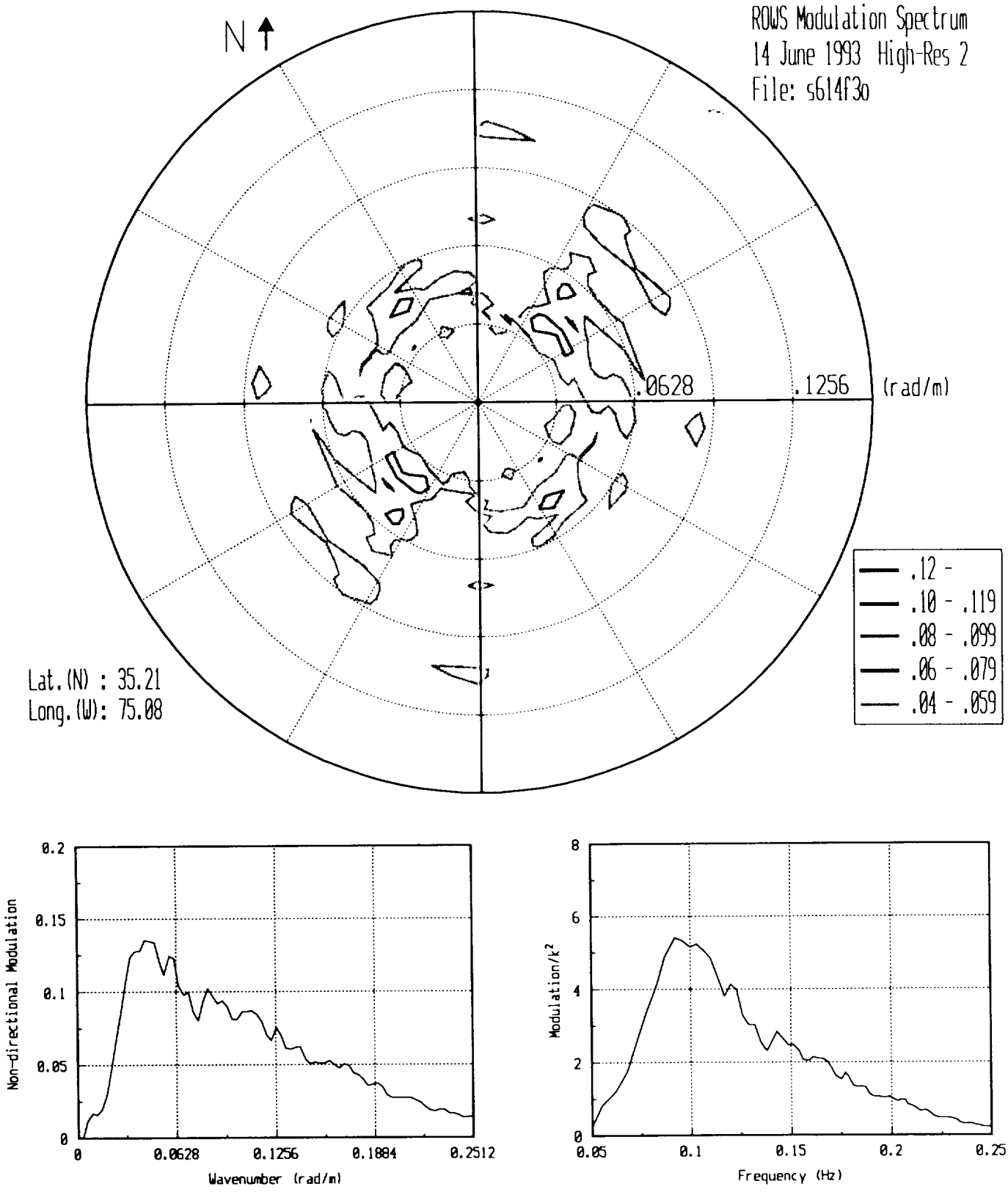


Figure 49. ROWS spectral data, file s614f3o.

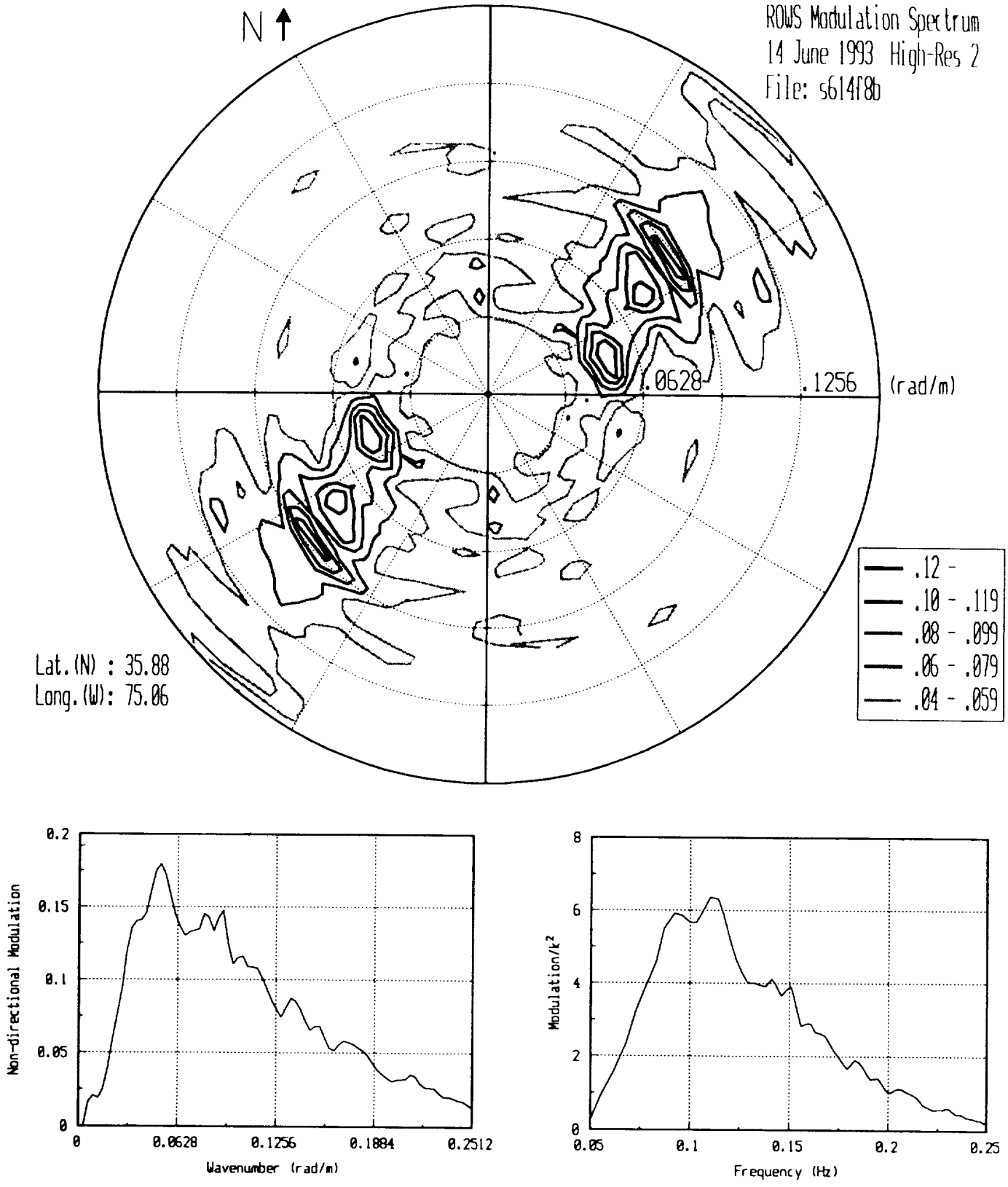


Figure 50. ROWS spectral data, file s614f8b.

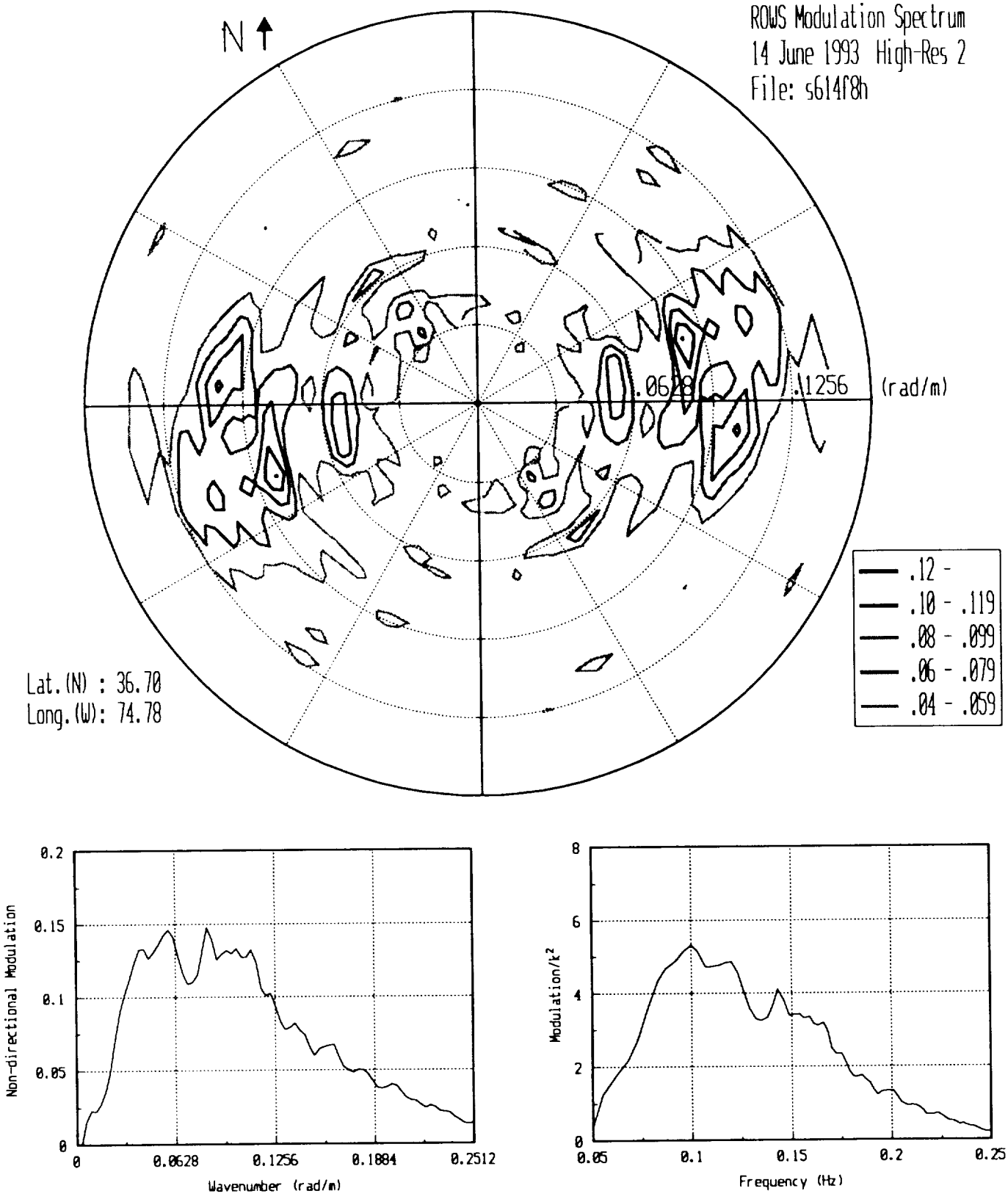


Figure 51. ROWS spectral data, file s614f8h.

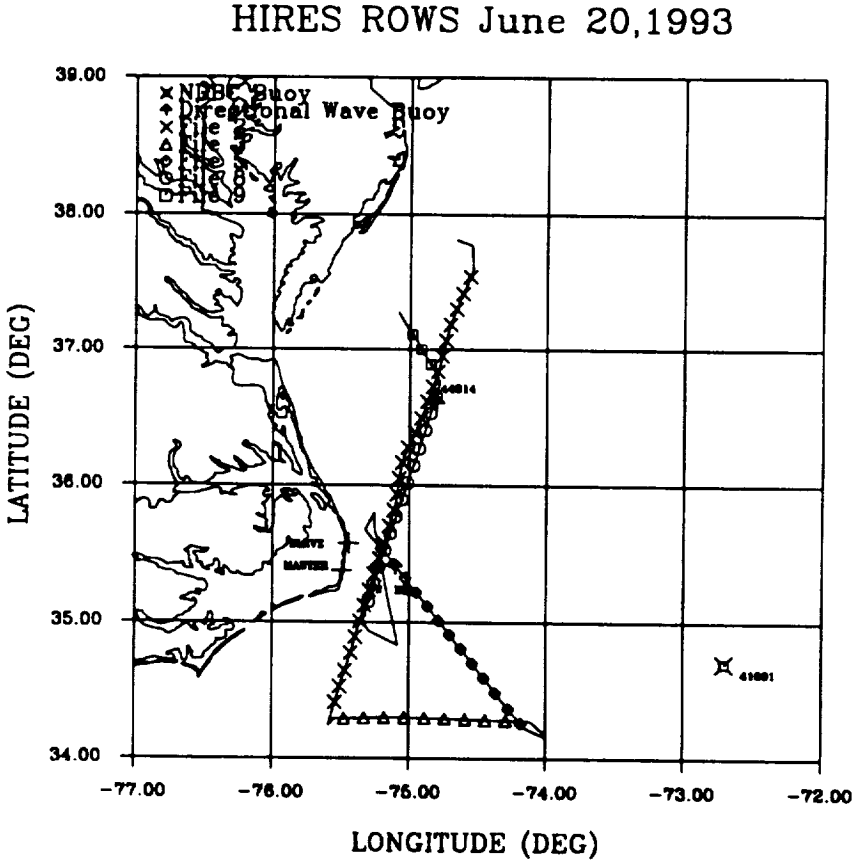


Figure 52. ROWS flight lines for June 20, 1993 with symbols denoting the midpoint for a given ROWS directional wave spectrum estimate.

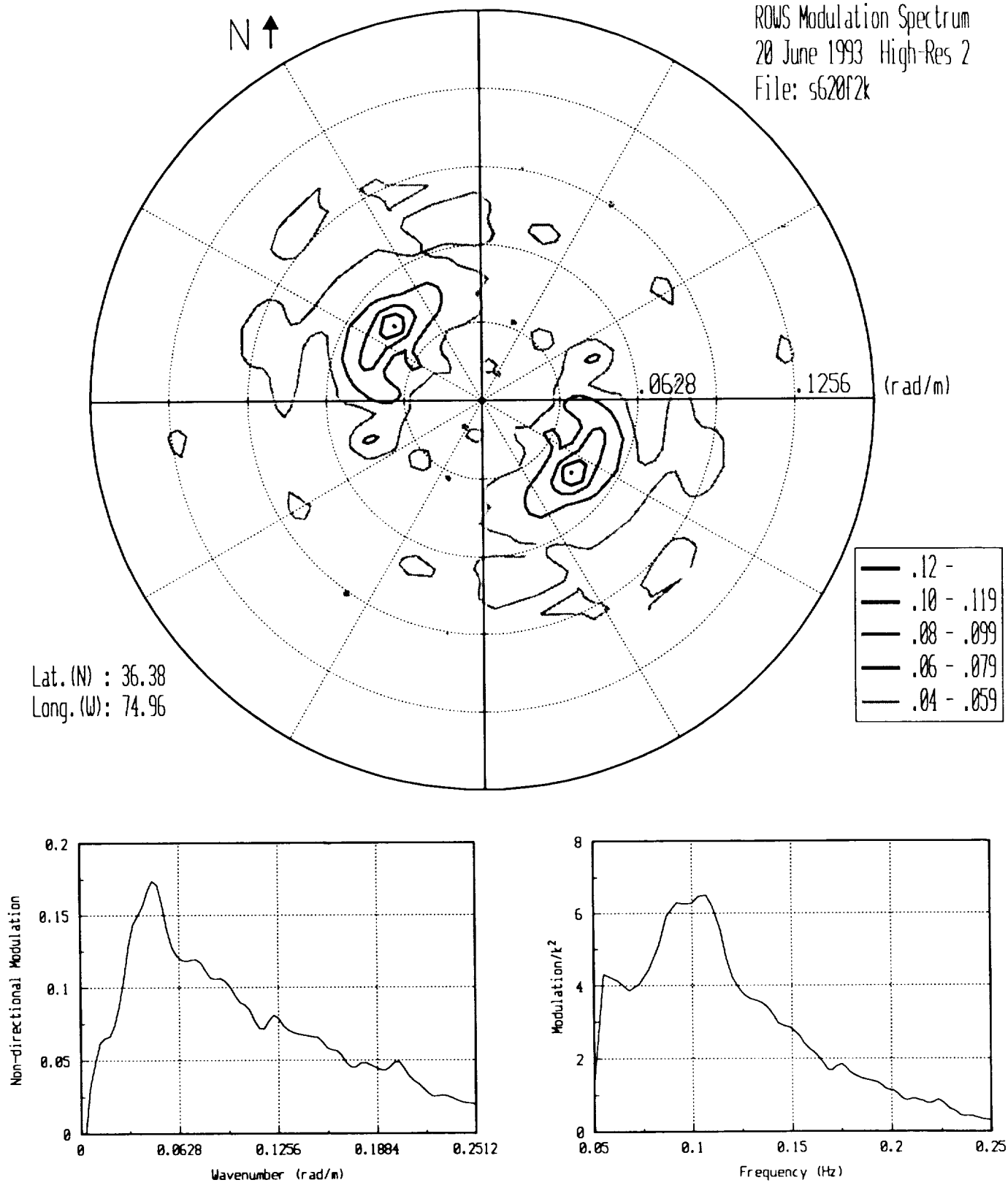


Figure 53. ROWS spectral data, file s620f2k.

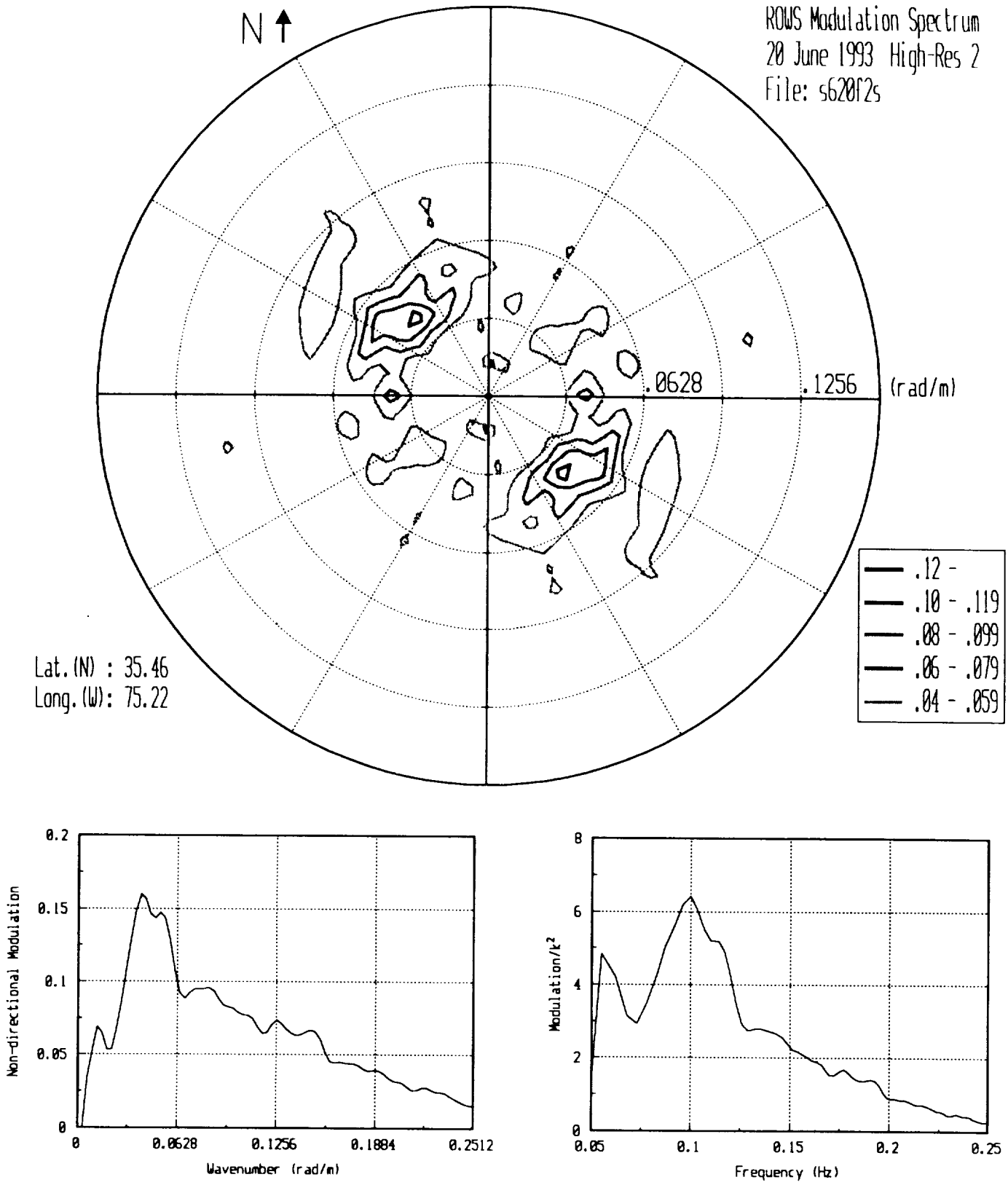


Figure 54. ROWS spectral data, file s620f2s.

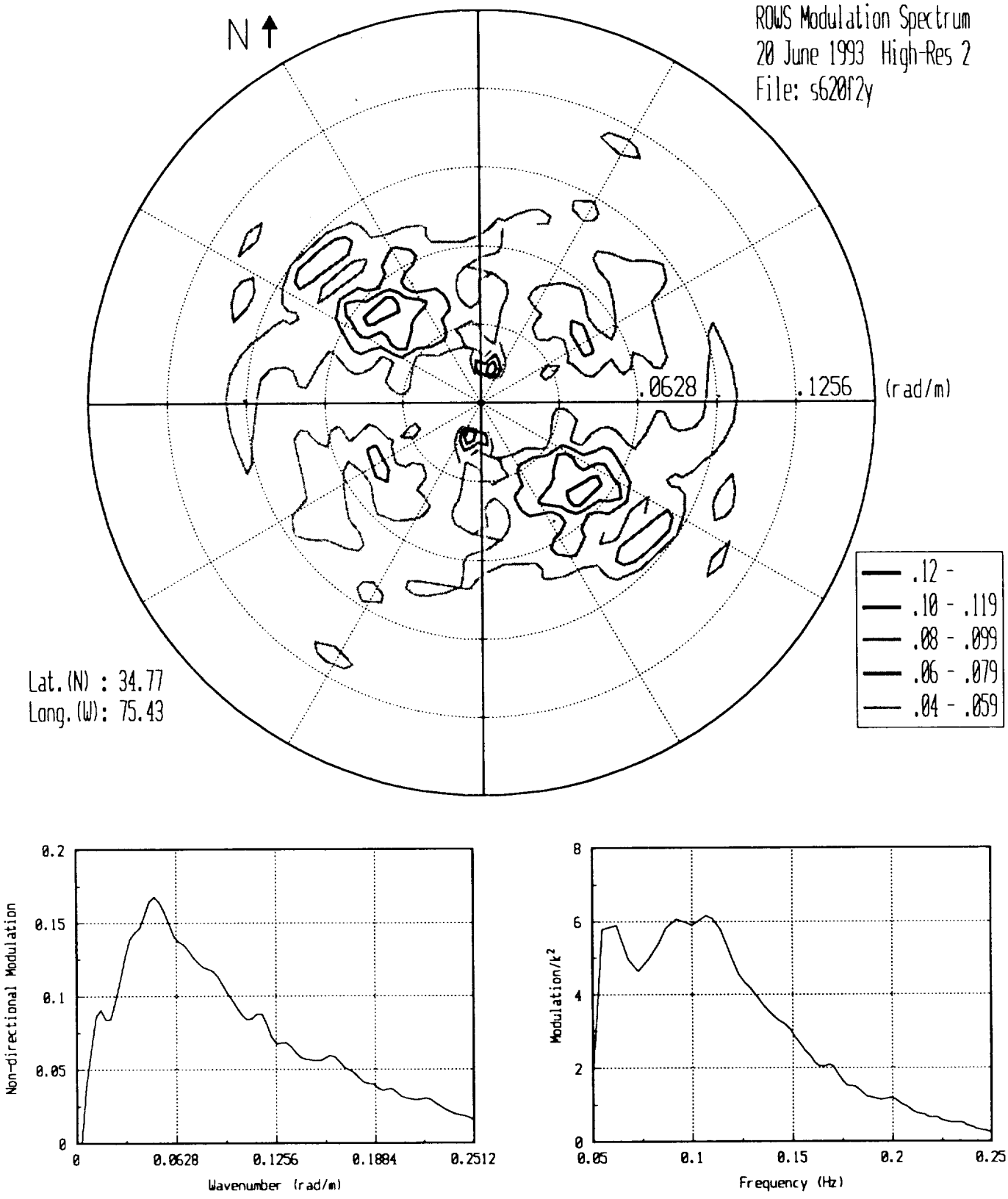


Figure 55. ROWS spectral data, file s620f2y.

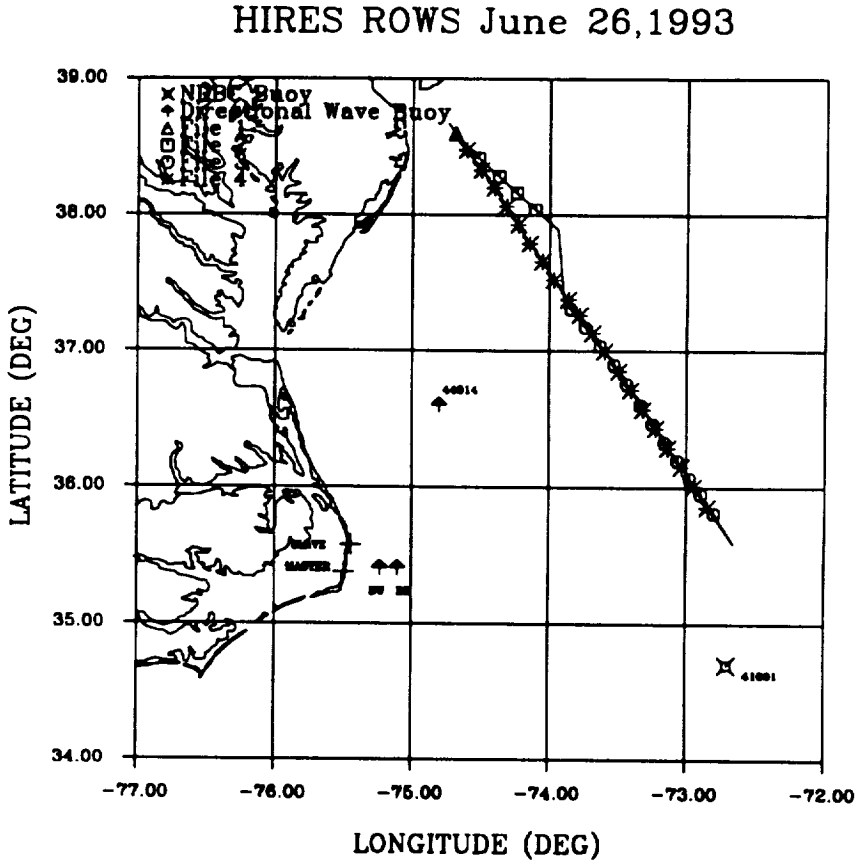


Figure 56. ROWS flight lines for June 26, 1993 with symbols denoting the midpoint for a given ROWS directional wave spectrum estimate.

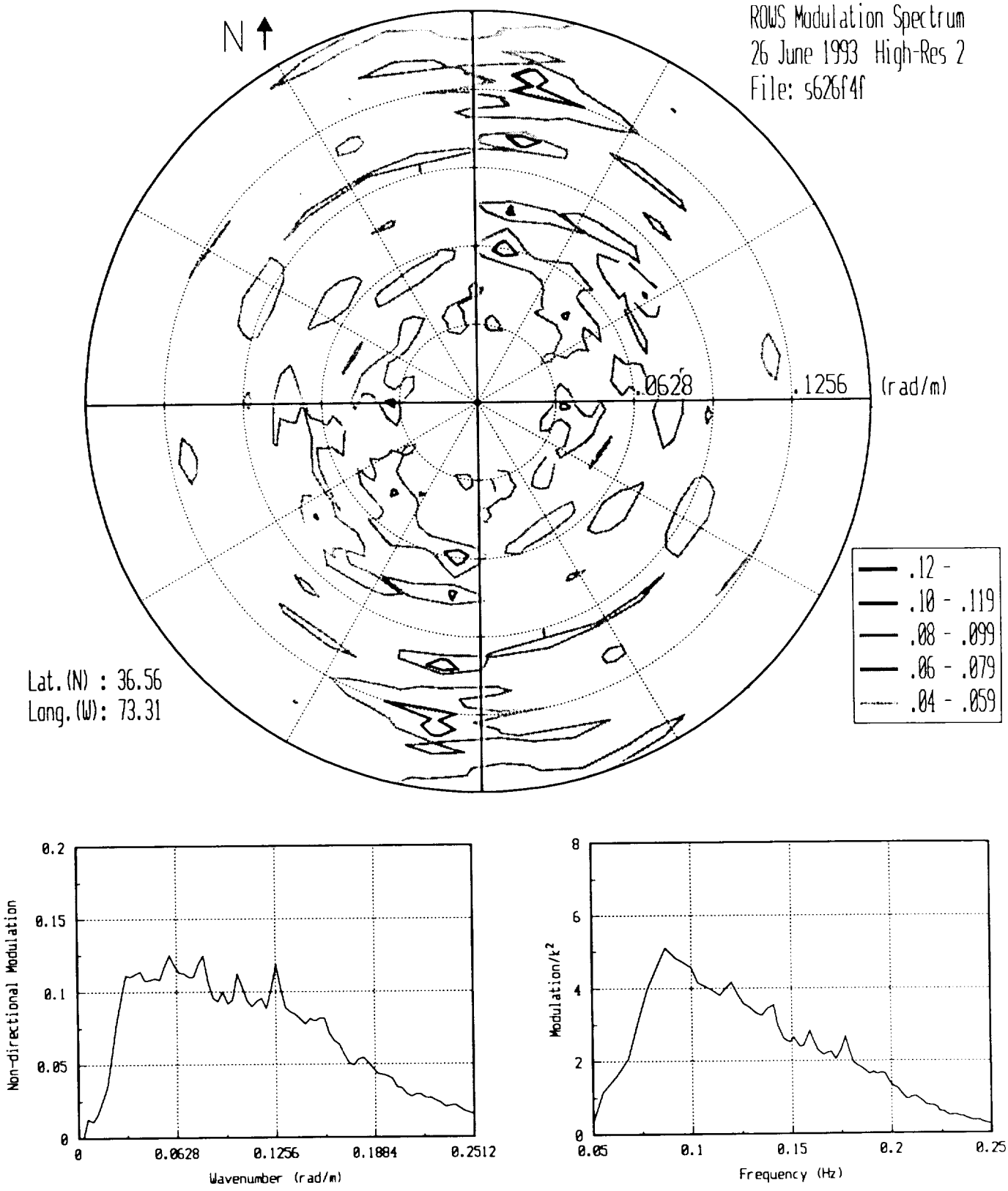


Figure 57. ROWS spectral data, file s626f4f.

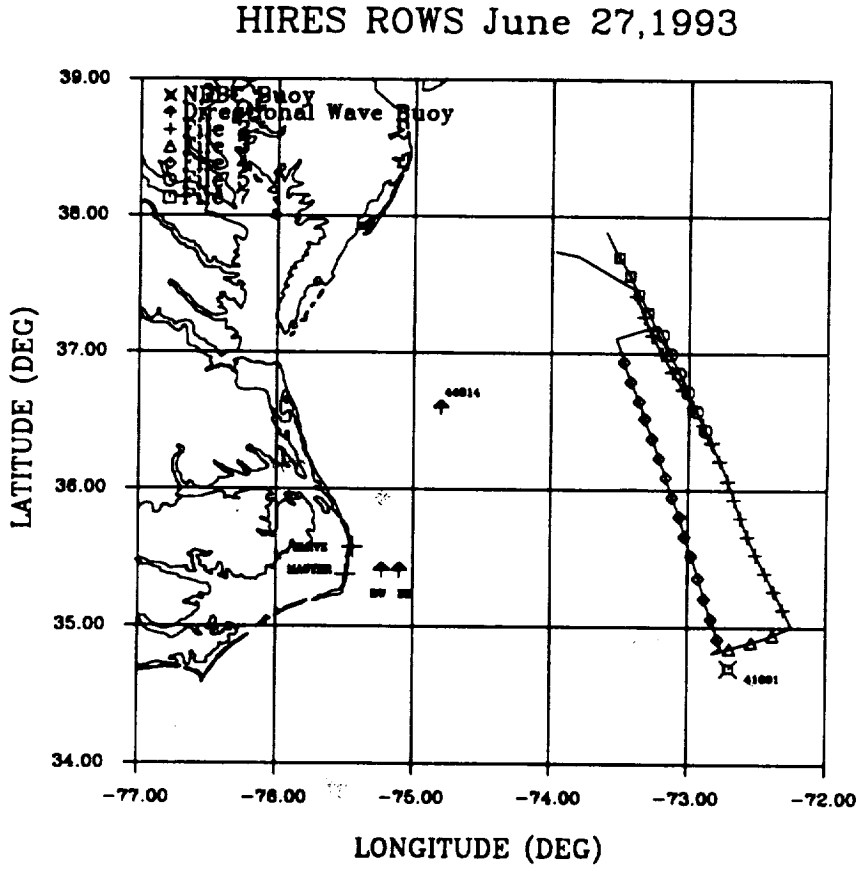


Figure 58. ROWS flight lines for June 27, 1993 with symbols denoting the midpoint for a given ROWS directional wave spectrum estimate.

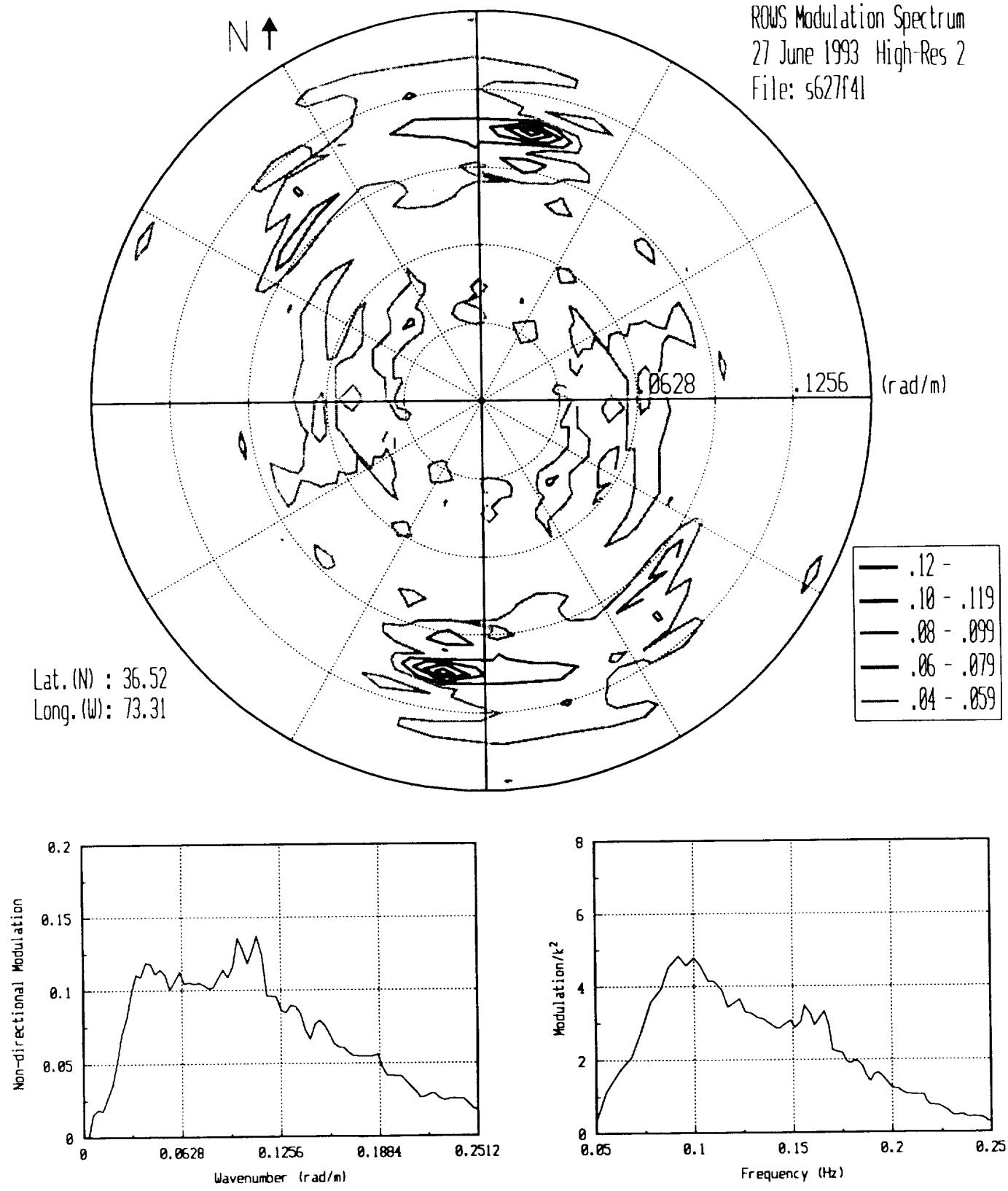


Figure 59. ROWS spectral data, file s627f41.

Appendix A
Spectrometer Processing Tables

This appendix consists of a set of tables containing summary information for ROWS spectrometer mode data from the High Resolution experiment of June 1993. All spectrometer mode data collected have been processed, with the exception of the 17 June 1993 flight. On this occasion, the sea surface was slick, and no long waves were present. Tables A.1 through A.6 list information related to *.srf files, which are the basic output files of the ROWS spectral processing program HRCTOT. *.srf files contain the two-dimensional unscaled modulation spectrum and directionally-integrated wave number and frequency spectra. All spectral figures shown in this document were derived from *.srf files, the only modification made to the data for the figures was a folding of the 2-D spectrum to present a symmetric image. Naming convention for the files is noted in the header; a sample file s614f1j.srf translates to file 1, spectrum j of the 14 June 93 data set. The tables show the midpoint ground track position for each spectral estimate, along with time given in UTC. Also given are data related to the aircraft's speed and heading, processing parameters, and spectral energy values.

Processing x-axis spacing (column H) is the surface range bin size used when translating the ROWS' off-nadir return to surface coordinates. Our nominal value for this experiment was 8 m to allow highest possible resolution for the expected shorter wavelength seas. The number of antenna rotations processed (column I) is used along with the aircraft speed, to determine the spatial extent of a spectral estimate. For this experiment, the nominal spatial extent of these spectra is ~12.8 km. This number is obtained by multiplying the number of rotations (nominal 8) by 10 seconds and by the ground speed (average 160 m/s). In azimuth, spectra are processed in sectors of size 12°. Column J represents the number of sectors rejected from the total (8 rotations * 30 sectors=240) because of extreme aircraft attitude variations. Column K is the value for volume integration of ROWS-derived wave height spectrum. It is representative of sea surface significant wave height multiplied by a scaling term α. The term α is still undetermined for this data set. Column L is the peak value of the unsmoothed modulation spectrum. The variability of this value gives some indication of spectral stability along-track. The positions of all spectral files listed in these tables are plotted on the maps of the spectrometer data summary section in the main document.

Table A.1 ROWS Spectrometer Processing Summary

Columns:
A - Filename (convention sDateFile#)
B - Time (UTC)
C - Latitude (North)
D - Longitude
E - Aircraft Ground Speed (m/s)
F - Aircraft Heading (deg. with respect to true north)
H - Processing x-axis spacing (m)
I - Antenna rotations processed (scan rate is 6 rpm)
J - Rejected sectors in processing (30 sectors per rotation)
K - SWH*sqrt(α)
L - Modulation spectrum peak value

A	B	C	D	E	F	H	I	J	K	L
s611f2a.srf	02:44:27	36.9534	-73.3650	173	183	8	8	36	2.73	0.105
s611f2b.srf	02:45:58	36.8195	-73.3499	174	178	8	8	0	2.75	0.106
s611f2c.srf	02:47:29	36.6856	-73.3286	175	178	8	8	0	2.76	0.099
s611f2d.srf	02:48:59	36.5510	-73.3032	176	174	8	8	0	2.72	0.100
s611f2e.srf	02:50:30	36.4172	-73.2668	176	171	8	8	0	2.87	0.107
s611f2f.srf	02:52:01	36.2853	-73.2256	175	170	8	8	0	2.72	0.104
s611f2g.srf	02:53:32	36.1549	-73.1837	174	170	8	8	0	2.79	0.088
s611f2h.srf	02:55:13	36.0100	-73.1384	173	171	8	8	0	2.78	0.100
s611f2i.srf	02:56:43	35.8788	-73.1041	172	173	8	8	0	2.79	0.122
s611f2j.srf	02:58:14	35.7484	-73.0725	171	174	8	8	0	2.89	0.153
s611f2k.srf	02:59:45	35.6186	-73.0402	170	174	8	8	0	2.83	0.197
s611f2l.srf	03:01:16	35.4895	-73.0093	170	174	8	8	0	2.77	0.092
s611f2m.srf	03:02:47	35.3611	-72.9777	170	174	8	8	0	2.88	0.214
s611f2n.srf	03:04:17	35.2320	-72.9468	170	174	8	8	0	2.99	0.166
s611f2o.srf	03:05:48	35.1016	-72.9166	171	174	8	8	0	2.98	0.240
s611f3a.srf	03:12:42	34.9896	-72.8905	147	259	8	8	0	2.79	0.114
s611f3b.srf	03:14:13	34.9615	-73.0251	149	255	8	8	0	2.86	0.184
s611f3c.srf	03:15:44	34.9230	-73.1576	150	253	8	8	0	2.83	0.161
s611f3d.srf	03:17:15	34.8832	-73.2901	149	253	8	8	0	2.77	0.151
s611f4a.srf	03:23:38	34.8619	-73.4398	147	328	8	8	143	2.86	0.186
s611f4b.srf	03:25:09	34.9759	-73.4790	156	341	8	8	0	2.73	0.092
s611f4c.srf	03:26:40	35.0961	-73.5105	158	343	8	8	0	2.76	0.121
s611f4d.srf	03:28:11	35.2148	-73.5463	159	344	8	8	0	2.82	0.160
s611f4e.srf	03:29:42	35.3384	-73.5710	161	344	8	8	0	2.87	0.151
s611f4f.srf	03:31:13	35.4593	-73.6039	161	344	8	8	0	2.73	0.102
s611f4g.srf	03:32:54	35.5987	-73.6300	162	344	8	8	0	2.68	0.081
s611f4h.srf	03:34:25	35.7216	-73.6630	163	344	8	8	0	2.79	0.448
s611f4i.srf	03:35:56	35.8438	-73.6863	152	344	8	8	0	2.68	0.232
s611f4j.srf	03:37:27	35.9557	-73.7179	147	342	8	8	0	2.64	0.091
s611f4k.srf	03:38:58	36.0670	-73.7454	145	342	8	8	0	2.73	0.117
s611f4l.srf	03:40:28	36.1761	-73.7783	144	344	8	8	0	2.63	0.110
s611f4m.srf	03:41:59	36.2867	-73.8037	144	342	8	8	0	2.78	0.087
s611f4n.srf	03:43:30	36.3959	-73.8360	145	344	8	8	0	2.76	0.083
s611f4o.srf	03:45:01	36.5057	-73.8635	143	341	8	8	0	2.75	0.105
s611f4p.srf	03:46:42	36.6266	-73.8971	144	346	8	8	0	2.77	0.091
s611f10a.srf	04:33:04	35.9173	-74.3077	148	329	8	8	0	2.60	0.083
s611f10b.srf	04:34:34	36.0203	-74.3695	146	328	8	8	0	2.68	0.082
s611f10c.srf	04:36:05	36.1192	-74.4382	146	328	8	8	0	2.99	0.756
s611f10d.srf	04:37:36	36.2215	-74.4986	145	329	8	8	0	2.92	0.098
s611f10e.srf	04:39:07	36.3203	-74.5666	145	328	8	8	0	2.98	0.099
s611f10f.srf	04:40:38	36.4192	-74.6318	144	324	8	8	0	2.98	0.108
s611f10g.srf	04:42:09	36.5147	-74.7019	143	328	8	8	0	2.89	0.103
s611f10h.srf	04:43:40	36.6101	-74.7712	142	324	8	8	0	2.87	0.117
s614f1a.srf	02:26:56	37.1649	-74.8866	189	157	8	8	15	2.92	0.200
s614f1b.srf	02:28:27	37.0310	-74.8241	176	150	8	8	0	2.86	0.209
s614f1c.srf	02:29:57	36.9095	-74.7479	172	151	8	8	174	2.81	0.390
s614f1d.srf	02:31:38	36.7612	-74.7280	173	176	8	8	55	2.94	0.263

Table A.2 ROWS Spectrometer Processing Summary (cont.)

Columns:
A - Filename (convention sDateFile#)
B - Time (UTC)
C - Latitude (North)
D - Longitude
E - Aircraft Ground Speed (m/s)
F - Aircraft Heading (deg. with respect to true north)
H - Processing x-axis spacing (m)
I - Antenna rotations processed (scan rate is 6 rpm)
J - Rejected sectors in processing (30 sectors per rotation)
K - SWH*sqrt(α)
L - Modulation spectrum peak value

A	B	C	D	E	F	H	I	J	K	L
s614f1e.srf	02:33:09	36.6273	-74.7335	168	175	8	8	24	2.89	0.217
s614f1f.srf	02:34:40	36.5016	-74.7026	165	157	8	8	240	0.00	0.000
s614f1g.srf	02:36:11	36.3760	-74.6531	173	157	8	8	0	2.95	0.262
s614f1h.srf	02:37:42	36.2462	-74.5989	177	156	8	8	15	2.92	0.185
s614f1i.srf	02:39:13	36.1116	-74.5460	183	159	8	8	0	2.96	0.165
s614f1j.srf	02:40:43	35.9743	-74.4897	187	158	8	8	53	2.98	0.197
s614f1k.srf	02:42:14	35.8301	-74.4547	190	171	8	8	0	2.97	0.244
s614f1l.srf	02:43:55	35.6667	-74.4190	194	170	8	8	0	3.06	0.242
s614f1m.srf	02:45:26	35.5197	-74.3846	195	170	8	8	0	3.27	0.471
s614f1n.srf	02:46:57	35.3700	-74.3510	195	170	8	8	0	3.29	0.337
s614f1o.srf	02:48:39	35.2004	-74.3105	197	171	8	8	12	4.41	0.725
s614f1p.srf	02:51:30	34.9155	-74.2363	198	171	8	8	11	3.43	0.442
s614f1q.srf	02:53:03	34.7596	-74.1992	199	171	8	8	0	3.01	0.180
s614f1r.srf	02:54:34	34.6079	-74.1574	200	169	8	8	0	3.07	0.157
s614f1s.srf	02:56:04	34.4561	-74.1127	201	170	8	8	6	2.95	0.183
s614f1t.srf	02:57:45	34.2879	-74.0633	200	170	8	8	0	2.79	0.143
s614f1u.srf	02:59:16	34.1354	-74.0221	199	170	8	8	0	2.84	0.099
s614f1v.srf	03:00:47	33.9837	-73.9823	199	171	8	8	0	2.71	0.125
s614f1w.srf	03:02:18	33.8361	-73.9418	190	171	8	8	0	2.81	0.105
s614f2a.srf	03:09:42	33.7379	-73.9370	158	240	8	8	0	2.70	0.091
s614f2b.srf	03:11:13	33.6685	-74.0612	163	240	8	8	0	2.72	0.123
s614f2c.srf	03:12:44	33.5985	-74.1896	166	239	8	8	0	2.72	0.112
s614f2d.srf	03:14:15	33.5230	-74.3173	169	238	8	8	0	2.70	0.092
s614f2e.srf	03:15:46	33.4419	-74.4396	166	236	8	8	2	2.78	0.110
s614f4a.srf	03:53:58	35.5520	-75.1324	171	37	8	8	0	2.66	0.112
s614f4b.srf	03:55:39	35.6680	-75.0184	171	39	8	8	0	2.73	0.112
s614f3a.srf	03:23:10	33.4776	-74.5240	152	341	8	8	0	2.63	0.086
s614f3b.srf	03:24:41	33.5930	-74.5590	154	343	8	8	0	2.53	0.082
s614f3c.srf	03:26:12	33.7104	-74.5913	153	343	8	8	0	2.59	0.088
s614f3d.srf	03:27:43	33.8278	-74.6229	155	343	8	8	0	2.64	0.087
s614f3e.srf	03:29:14	33.9453	-74.6607	157	340	8	8	0	2.59	0.092
s614f3f.srf	03:30:45	34.0654	-74.7019	161	340	8	8	0	2.54	0.090
s614f3g.srf	03:32:26	34.1993	-74.7506	162	340	8	8	0	2.59	0.096
s614f3h.srf	03:33:57	34.3215	-74.7946	164	342	8	8	0	2.64	0.097
s614f3i.srf	03:35:27	34.4451	-74.8371	166	342	8	8	0	2.61	0.093
s614f3j.srf	03:36:58	34.5715	-74.8790	167	344	8	8	0	2.71	0.149
s614f3k.srf	03:38:29	34.6985	-74.9182	168	344	8	8	0	2.78	0.200
s614f3l.srf	03:40:00	34.8248	-74.9594	167	345	8	8	0	2.76	0.183
s614f3m.srf	03:41:41	34.9663	-75.0019	168	345	8	8	0	2.70	0.143
s614f3n.srf	03:43:02	35.0796	-75.0369	169	344	8	8	0	2.73	0.137
s614f3o.srf	03:44:33	35.2073	-75.0781	168	344	8	8	0	2.63	0.116
s614f3p.srf	03:46:14	35.3494	-75.1248	169	344	8	8	0	2.62	0.109
s614f8a.srf	04:21:17	35.7497	-75.1042	182	16	8	8	0	2.78	0.155
s614f8b.srf	04:22:48	35.8884	-75.0624	182	19	8	8	0	2.95	0.211
s614f8c.srf	04:24:19	36.0251	-75.0157	183	19	8	8	0	2.83	0.179
s614f8d.srf	04:25:50	36.1610	-74.9690	176	19	8	8	240	0.00	0.000
s614f8e.srf	04:27:21	36.2915	-74.9237	170	19	8	8	0	2.87	0.217
s614f8f.srf	04:28:52	36.4185	-74.8783	172	19	8	8	0	2.82	0.179

Table A.3 ROWS Spectrometer Processing Summary (cont.)

Columns:
A - Filename (convention sDateFile#)
B - Time (UTC)
C - Latitude (North)
D - Longitude
E - Aircraft Ground Speed (m/s)
F - Aircraft Heading (deg. with respect to true north)
H - Processing x-axis spacing (m)
I - Antenna rotations processed (scan rate is 6 rpm)
J - Rejected sectors in processing (30 sectors per rotation)
K - SWH*sqrt(α)
L - Modulation spectrum peak value

A	B	C	D	E	F	H	I	J	K	L
s614f8g.srf	04:30:23	36.5490	-74.8310	175	19	8	8	0	2.77	0.122
s614f8h.srf	04:32:04	36.6952	-74.7774	175	19	8	8	0	2.84	0.142
s620f2a.srf	15:41:25	37.5391	-74.5604	156	198	8	8	3	3.04	0.201
s620f2b.srf	15:43:06	37.4121	-74.6140	154	198	8	8	0	3.06	0.189
s620f2c.srf	15:44:37	37.2981	-74.6614	154	196	8	8	0	2.84	0.099
s620f2d.srf	15:46:08	37.1828	-74.7046	154	195	8	8	0	2.79	0.119
s620f2e.srf	15:47:39	37.0653	-74.7362	153	192	8	8	0	2.84	0.134
s620f2f.srf	15:49:09	36.9486	-74.7630	150	192	8	8	0	2.93	0.148
s620f2g.srf	15:50:40	36.8339	-74.7932	149	195	8	8	0	2.96	0.112
s620f2h.srf	15:52:11	36.7220	-74.8316	147	198	8	8	0	2.94	0.119
s620f2i.srf	15:53:42	36.6115	-74.8722	147	197	8	8	0	3.10	0.155
s620f2j.srf	15:55:23	36.4886	-74.9161	146	197	8	8	0	2.89	0.153
s620f2k.srf	15:56:54	36.3794	-74.9600	147	201	8	8	0	2.98	0.136
s620f2l.srf	15:58:24	36.2730	-75.0122	147	203	8	8	0	2.97	0.156
s620f2m.srf	15:59:55	36.1624	-75.0527	148	192	8	8	0	2.89	0.126
s620f2n.srf	16:01:26	36.0484	-75.0754	148	187	8	8	0	2.90	0.183
s620f2o.srf	16:02:57	35.9338	-75.0919	149	187	8	8	0	2.73	0.120
s620f2p.srf	16:04:28	35.8191	-75.1125	149	192	8	8	2	2.85	0.111
s620f2q.srf	16:05:59	35.7051	-75.1454	150	193	8	8	0	2.70	0.124
s620f2r.srf	16:07:40	35.5788	-75.1832	150	193	8	8	0	2.77	0.113
s620f2s.srf	16:09:11	35.4648	-75.2175	151	194	8	8	0	2.81	0.115
s620f2t.srf	16:10:42	35.3508	-75.2539	151	194	8	8	0	2.84	0.185
s620f2u.srf	16:12:12	35.2361	-75.2903	152	194	8	8	0	2.98	0.153
s620f2v.srf	16:13:43	35.1208	-75.3267	153	193	8	8	1	3.33	0.200
s620f2w.srf	16:15:14	35.0068	-75.3590	153	192	8	8	0	2.93	0.147
s620f2x.srf	16:16:45	34.8908	-75.3913	153	192	8	8	0	3.20	0.189
s620f2y.srf	16:18:16	34.7740	-75.4256	153	193	8	8	0	3.07	0.155
s620f2z.srf	16:19:57	34.6456	-75.4661	154	194	8	8	1	3.11	0.158
s620f2aa.srf	16:21:28	34.5289	-75.5039	154	193	8	8	1	3.34	0.242
s620f2ab.srf	16:22:59	34.4115	-75.5382	155	192	8	8	2	3.27	0.197
s620f3a.srf	16:30:24	34.2920	-75.4716	155	90	8	8	7	3.78	0.275
s620f3b.srf	16:31:55	34.2968	-75.3253	156	88	8	8	0	3.44	0.249
s620f3c.srf	16:33:26	34.3016	-75.1784	156	90	8	8	0	3.07	0.255
s620f3d.srf	16:34:57	34.3016	-75.0308	156	93	8	8	0	3.01	0.173
s620f3e.srf	16:36:28	34.2982	-74.8831	157	93	8	8	0	2.94	0.200
s620f3f.srf	16:37:59	34.2941	-74.7355	156	93	8	8	0	3.01	0.218
s620f3g.srf	16:39:30	34.2899	-74.5879	157	93	8	8	0	2.80	0.159
s620f3h.srf	16:41:01	34.2851	-74.4396	157	93	8	8	0	2.86	0.182
s620f3i.srf	16:42:32	34.2803	-74.2913	157	93	8	8	0	3.04	0.233
s620f8a.srf	17:36:28	35.1510	-75.2965	159	12	8	8	0	3.29	0.280
s620f8b.srf	17:38:09	35.2863	-75.2594	160	16	8	8	0	2.92	0.281
s620f8c.srf	17:39:40	35.4071	-75.2196	160	14	8	8	0	2.80	0.118
s620f8d.srf	17:41:11	35.5286	-75.1770	162	15	8	8	0	2.74	0.157
s620f8e.srf	17:42:42	35.6509	-75.1379	163	16	8	8	0	2.80	0.101
s620f8f.srf	17:44:13	35.7738	-75.0960	162	12	8	8	0	2.81	0.138
s620f8g.srf	17:45:44	35.8967	-75.0555	162	16	8	8	0	2.97	0.182
s620f8h.srf	17:47:15	36.0196	-75.0150	163	12	8	8	0	3.29	0.446
s620f8i.srf	17:48:46	36.1418	-74.9697	163	16	8	8	0	2.97	0.152

Table A.4 ROWS Spectrometer Processing Summary (cont.)

Columns:
A - Filename (convention sDateFile#)
B - Time (UTC)
C - Latitude (North)
D - Longitude
E - Aircraft Ground Speed (m/s)
F - Aircraft Heading (deg. with respect to true north)
H - Processing x-axis spacing (m)
I - Antenna rotations processed (scan rate is 6 rpm)
J - Rejected sectors in processing (30 sectors per rotation)
K - SWH*sqrt(α)
L - Modulation spectrum peak value

A	B	C	D	E	F	H	I	J	K	L
s620f8j.srf	17:50:17	36.2647	-74.9298	161	11	8	8	0	2.93	0.136
s620f8k.srf	17:51:58	36.4007	-74.8852	162	13	8	8	0	2.80	0.107
s620f8l.srf	17:53:29	36.5243	-74.8481	163	13	8	8	0	3.02	0.175
s620f8m.srf	17:55:00	36.6486	-74.8104	163	11	8	8	0	2.97	0.132
s620f9a.srf	17:58:12	36.8902	-74.8474	156	329	8	8	0	3.09	0.157
s620f9b.srf	17:59:43	37.0015	-74.9147	158	333	8	8	0	2.89	0.115
s620f9c.srf	18:01:14	37.1113	-74.9827	158	327	8	8	0	2.96	0.149
s620f5a.srf	18:51:21	34.2632	-74.1800	161	322	8	8	0	3.00	0.237
s620f5b.srf	16:52:52	34.3662	-74.2713	163	327	8	8	1	2.83	0.156
s620f5c.srf	16:54:33	34.4856	-74.3661	165	329	8	8	0	2.74	0.162
s620f5d.srf	16:56:04	34.5934	-74.4512	163	324	8	8	1	2.89	0.214
s620f5e.srf	16:57:35	34.6999	-74.5350	161	329	8	8	0	2.86	0.204
s620f5f.srf	16:59:06	34.8049	-74.6188	160	324	8	8	0	3.03	0.248
s620f5g.srf	17:00:37	34.9086	-74.7012	159	329	8	8	0	2.99	0.179
s620f5h.srf	17:02:08	35.0123	-74.7843	159	325	8	8	0	2.91	0.172
s620f5i.srf	17:03:40	35.1167	-74.8639	158	327	8	8	0	2.93	0.164
s620f5j.srf	17:05:11	35.2190	-74.9491	158	325	8	8	0	2.81	0.194
s620f5k.srf	17:06:42	35.3240	-75.0273	158	326	8	8	0	2.71	0.148
s620f5l.srf	17:08:13	35.4270	-75.1111	158	327	8	8	0	2.69	0.157
s620f5m.srf	17:09:54	35.5403	-75.2052	157	320	8	8	0	2.64	0.126
s626f1a.srf	17:14:34	38.6000	-74.6861	199	149	8	8	35	2.86	0.130
s626f2a.srf	17:16:46	38.4160	-74.5172	203	142	8	8	14	2.74	0.116
s626f2b.srf	17:18:27	38.2821	-74.3716	204	142	8	8	6	2.71	0.111
s626f2c.srf	17:19:58	38.1605	-74.2391	206	141	8	8	6	2.64	0.097
s626f2d.srf	17:21:29	38.0390	-74.1052	208	141	8	8	17	2.81	0.125
s626f3a.srf	17:29:35	37.3098	-73.8436	207	151	8	8	10	2.69	0.092
s626f3b.srf	17:31:06	37.1731	-73.7351	208	150	8	8	4	2.69	0.091
s626f3c.srf	17:32:37	37.0372	-73.6266	207	151	8	8	24	2.69	0.088
s626f3d.srf	17:34:09	36.8978	-73.5257	207	154	8	8	21	2.71	0.091
s626f3e.srf	17:35:40	36.7564	-73.4330	203	155	8	8	3	2.67	0.075
s626f3f.srf	17:37:21	36.6019	-73.3334	199	156	8	8	0	2.65	0.087
s626f3g.srf	17:38:52	36.4638	-73.2455	198	155	8	8	0	2.67	0.091
s626f3h.srf	17:40:23	36.3279	-73.1569	197	154	8	8	0	2.72	0.110
s626f3i.srf	17:41:55	36.1954	-73.0656	192	153	8	8	0	2.67	0.089
s626f3j.srf	17:43:26	36.0663	-72.9757	192	153	8	8	0	2.64	0.092
s626f3k.srf	17:44:47	35.9496	-72.8933	196	154	8	8	0	2.61	0.076
s626f3l.srf	17:46:18	35.8143	-72.8006	200	155	8	8	0	2.61	0.119
s626f4a.srf	17:55:15	35.8569	-72.8445	201	328	8	8	7	2.42	0.118
s626f4b.srf	17:56:56	36.0079	-72.9461	205	331	8	8	2	2.65	0.091
s626f4c.srf	17:58:28	36.1494	-73.0347	204	327	8	8	6	2.66	0.086
s626f4d.srf	17:59:59	36.2874	-73.1336	204	329	8	8	7	2.73	0.100
s626f4e.srf	18:01:30	36.4302	-73.2215	204	329	8	8	1	2.68	0.108
s626f4f.srf	18:03:01	36.5675	-73.3155	203	330	8	8	24	2.73	0.106
s626f4g.srf	18:04:32	36.7103	-73.4027	203	330	8	8	3	2.79	0.109
s626f4h.srf	18:06:04	36.8497	-73.4899	198	330	8	8	16	2.77	0.095
s626f4i.srf	18:07:45	36.9974	-73.5943	194	327	8	8	6	2.67	0.081
s626f4j.srf	18:09:16	37.1306	-73.6829	194	330	8	8	13	2.76	0.107
s626f4k.srf	18:10:47	37.2617	-73.7763	194	327	8	8	0	2.71	0.093

Table A.5 ROWS Spectrometer Processing Summary (cont.)

Columns:
A - Filename (convention sDateFile#)
B - Time (UTC)
C - Latitude (North)
D - Longitude
E - Aircraft Ground Speed (m/s)
F - Aircraft Heading (deg. with respect to true north)
H - Processing x-axis spacing (m)
I - Antenna rotations processed (scan rate is 6 rpm)
J - Rejected sectors in processing (30 sectors per rotation)
K - SWH*sqrt(α)
L - Modulation spectrum peak value

A	B	C	D	E	F	H	I	J	K	L
s626f4l.srf	18:12:08	37.3778	-73.8614	195	326	8	8	5	2.72	0.099
s626f4m.srf	18:13:49	37.5240	-73.9672	194	331	8	8	46	2.75	0.112
s626f4n.srf	18:15:20	37.6593	-74.0502	194	329	8	8	29	2.80	0.168
s626f4o.srf	18:16:51	37.7904	-74.1443	194	328	8	8	84	2.58	0.186
s626f4p.srf	18:18:23	37.9271	-74.2267	195	331	8	8	22	2.71	0.152
s626f4q.srf	18:19:54	38.0610	-74.3160	195	327	8	8	33	2.85	0.145
s626f4r.srf	18:21:25	38.1969	-74.4032	196	330	8	8	14	2.64	0.108
s626f4s.srf	18:22:56	38.3281	-74.5007	195	325	8	8	9	2.60	0.093
s626f4t.srf	18:24:37	38.4743	-74.6064	191	327	8	8	16	2.66	0.087
s627f2a.srf	01:49:58	37.4135	-73.3801	185	165	8	8	1	2.70	0.140
s627f2b.srf	01:51:39	37.2610	-73.3252	182	164	8	8	0	2.76	0.112
s627f2c.srf	01:53:10	37.1271	-73.2675	182	160	8	8	5	2.71	0.107
s627f2d.srf	01:54:41	36.9960	-73.1974	183	157	8	8	0	2.75	0.126
s627f2e.srf	01:56:12	36.8655	-73.1219	184	157	8	8	0	2.76	0.138
s627f2f.srf	01:57:43	36.7358	-73.0450	180	157	8	8	0	2.83	0.254
s627f2g.srf	01:59:14	36.6080	-72.9674	182	158	8	8	0	2.72	0.106
s627f2h.srf	02:00:45	36.4776	-72.8974	183	162	8	8	0	2.75	0.101
s627f2i.srf	02:02:16	36.3451	-72.8349	182	162	8	8	0	2.71	0.124
s627f2j.srf	02:03:47	36.2125	-72.7752	179	163	8	8	0	2.77	0.131
s627f2k.srf	02:05:28	36.0656	-72.7140	178	166	8	8	0	2.68	0.124
s627f2l.srf	02:06:59	35.9310	-72.6680	179	167	8	8	0	2.70	0.121
s627f2m.srf	02:08:30	35.7971	-72.6200	181	165	8	8	0	2.74	0.104
s627f2n.srf	02:10:01	35.6619	-72.5685	183	164	8	8	10	2.77	0.110
s627f2o.srf	02:11:32	35.5286	-72.5087	183	160	8	8	0	2.74	0.107
s627f2p.srf	02:13:03	35.3954	-72.4421	183	159	8	8	1	2.70	0.103
s627f2q.srf	02:14:34	35.2629	-72.3748	185	159	8	8	0	2.74	0.101
s627f2r.srf	02:16:05	35.1290	-72.3076	186	160	8	8	0	2.77	0.137
s627f3a.srf	02:22:50	34.9443	-72.3824	167	243	8	8	8	2.78	0.107
s627f3b.srf	02:24:21	34.8914	-72.5355	178	249	8	8	0	2.71	0.098
s627f3c.srf	02:25:52	34.8454	-72.6941	176	248	8	8	11	3.01	0.118
s627f4a.srf	02:31:06	34.9127	-72.7800	191	341	8	8	0	2.74	0.111
s627f4b.srf	02:32:37	35.0583	-72.8287	195	343	8	8	0	2.83	0.127
s627f4c.srf	02:34:08	35.2059	-72.8795	199	345	8	8	6	2.79	0.108
s627f4d.srf	02:35:39	35.3584	-72.9221	196	343	8	8	0	2.79	0.126
s627f4e.srf	02:37:20	35.5211	-72.9736	190	342	8	8	0	2.73	0.104
s627f4f.srf	02:38:51	35.6612	-73.0237	185	344	8	8	23	2.88	0.217
s627f4g.srf	02:40:22	35.8047	-73.0622	188	342	8	8	7	2.80	0.108
s627f4h.srf	02:41:54	35.9461	-73.1171	190	341	8	8	0	2.79	0.176
s627f4i.srf	02:43:25	36.0910	-73.1645	191	342	8	8	0	2.74	0.098
s627f4j.srf	02:44:56	36.2331	-73.2160	190	342	8	8	0	2.75	0.125
s627f4k.srf	02:46:27	36.3773	-73.2654	191	339	8	8	0	2.66	0.141
s627f4l.srf	02:47:58	36.5208	-73.3197	190	344	8	8	3	2.72	0.165
s627f4m.srf	02:49:19	36.6486	-73.3615	191	340	8	8	1	2.89	0.138
s627f4n.srf	02:50:50	36.7907	-73.4227	191	341	8	8	1	2.86	0.142
s627f4o.srf	02:52:21	36.9342	-73.4714	188	346	8	8	15	2.81	0.161
s627f5a.srf	02:59:57	37.1313	-73.1913	186	162	8	8	0	2.77	0.165
s627f5b.srf	03:01:28	36.9939	-73.1315	188	163	8	8	0	2.74	0.160
s627f5c.srf	03:02:59	36.8552	-73.0704	189	163	8	8	0	2.87	0.197

Table A.6 ROWS Spectrometer Processing Summary (cont.)

Columns:
A - Filename (convention sDateFile#)
B - Time (UTC)
C - Latitude (North)
D - Longitude
E - Aircraft Ground Speed (m/s)
F - Aircraft Heading (deg. with respect to true north)
H - Processing x-axis spacing (m)
I - Antenna rotations processed (scan rate is 6 rpm)
J - Rejected sectors in processing (30 sectors per rotation)
K - SWH*sqrt(α)
L - Modulation spectrum peak value

A	B	C	D	E	F	H	I	J	K	L
s627f5d.srf	03:04:30	36.7165	-73.0066	190	162	8	8	0	2.86	0.191
s627f5e.srf	03:06:01	36.5771	-72.9420	189	162	8	8	0	2.69	0.126
s627f5f.srf	03:07:32	36.4398	-72.8795	187	163	8	8	0	2.71	0.127
s627f7a.srf	03:25:42	37.2961	-73.2956	187	337	8	8	8	2.83	0.156
s627f7b.srf	03:27:13	37.4313	-73.3670	188	336	8	8	7	2.82	0.158
s627f7c.srf	03:28:44	37.5693	-73.4323	188	337	8	8	7	2.86	0.187
s627f7d.srf	03:30:15	37.7032	-73.5092	189	334	8	8	20	2.80	0.142

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13. ABSTRACT *(Maximum 200 words)*

Airborne radar ocean wave spectrometer (ROWS) data collected during the Office of Naval Research's High Resolution Remote Sensing Experiment of June 1993 are presented. This data summary covers six flights made using NASA's T-39 aircraft over a region of the North Atlantic off the coast of North Carolina and includes multiple crossings of the gulf stream. The Ku-band ROWS was operated in a configuration which continuously switched between an altimeter and a spectrometer channel. Data derived from the two channels include altimeter radar cross-section, altimeter-derived sea surface mean square slope and wind speed, and directional and nondirectional long-wave spectra. Discussion is provided for several events of particular interest.

14. SUBJECT TERMS
Mean square slope, directional ocean wave spectra, radar altimeter, scatterometer, sea surface roughness

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