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**DATA REPORT: LONGEZ (N3R) PARTICIPATION IN THE 1999 SHOALING WAVES EXPERIMENT (SHOWEX) SPRING PILOT STUDY**

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## Table of Contents

	<u>Page</u>
Notice .....	ii
List of Figures .....	v
List of Tables .....	vii
List of Abbreviations and Acronyms .....	viii
List of Symbols .....	ix
Abstract .....	x
1 Introduction .....	1
2 Description of the LongEZ, Sensors and Data Acquisition System .....	2
2.1 LongEZ .....	2
2.2 <i>In Situ</i> and Remote Sensors .....	2
2.3 Data Acquisition System .....	5
3 Data .....	6
3.1 In-Flight Data Collection .....	6
3.2 Post-Flight Data Processing .....	9
4 Flight Summaries .....	12
4.1 Flight 1: 01 MAR 99 (MON) .....	12
4.2 Flight 2: 02 MAR 99 (TUE) .....	12
4.3 Flight 3: 02 MAR 99 (TUE) .....	12
4.4 Flight 4: 03 MAR 99 (WED) .....	16
4.5 Flight 5: 04 MAR 99 (THU) .....	16
4.6 Flight 6: 04 MAR 99 (THU) .....	16
4.7 Flight 7: 05 MAR 99 (FRI) .....	16
4.8 Flight 8: 05 MAR 99 (FRI) .....	16
4.9 Flight 9: 06 MAR 99 (SAT) .....	16
4.10 Flight 10: 07 MAR 99 (SUN) .....	17
4.11 Flight 11: 07 MAR 99 (SUN) .....	17
4.12 Flight 12: 08 MAR 99 (MON) .....	17
4.13 Flight 13: 08 MAR 99 (MON) .....	17
4.14 Flight 14: 09 MAR 99 (TUE) .....	18
4.15 Flight 15: 10 MAR 99 (WED) .....	18

4.16	Flight 16: 11 MAR 99 (THU)	18
4.17	Flight 17: 11 MAR 99 (THU)	18
4.18	Flight 18: 12 MAR 99 (FRI)	18
4.19	Flight 19: 13 MAR 99 (SAT)	19
4.20	Flight 20: 16 MAR 99 (TUE)	19
4.21	Flight 21: 17 MAR 99 (WED)	19
4.22	Flight 22: 17 MAR 99 (WED)	19
4.23	Flight 23: 18 MAR 99 (THU)	20
Acknowledgments		21
References		22
Appendix A: Marker Files		24
Appendix B: LongEZ Flight Paths		64



## List of Figures

	<u>Page</u>
Figure 1.	The LongEZ at the Wright Brother's Memorial in Kill Devil Hills, NC ..... 1
Figure 2.	Schematic of the LongEZ with sensors ..... 4
Figure 3.	Meteorological time series from FRF pier during SHOWEX ..... 15
Figure 4.	Flight 1, Monday, 1 March 1999 ..... 64
Figure 5.	Flight 2, Tuesday, 2 March 1999 ..... 65
Figure 6.	Flight 3, Tuesday, 2 March 1999 ..... 66
Figure 7.	Flight 4, Wednesday, 3 March 1999 ..... 67
Figure 8.	Flight 5, Thursday, 4 March 1999 ..... 68
Figure 9.	Flight 6, Thursday, 4 March 1999 ..... 69
Figure 10.	Flight 7, Friday, 5 March 1999 ..... 70
Figure 11.	Flight 8, Friday, 5 March 1999 ..... 71
Figure 12.	Flight 9, Saturday, 6 March 1999 ..... 72
Figure 13.	Flight 10, Sunday, 7 March 1999 ..... 73
Figure 14.	Flight 11, Sunday, 7 March 1999 ..... 74
Figure 15.	Flight 12, Monday, 8 March 1999 ..... 75
Figure 16.	Flight 13, Monday, 8 March 1999 ..... 76
Figure 17.	Flight 14, Tuesday, 9 March 1999 ..... 77
Figure 18.	Flight 15, Wednesday, 10 March 1999 ..... 78
Figure 19.	Flight 16, Thursday, 11 March 1999 ..... 79
Figure 20.	Flight 17, Thursday, 11 March 1999 ..... 80

Figure 21.	Flight 18, Friday, 12 March 1999 .....	81
Figure 22.	Flight 19, Saturday, 13 March 1999 .....	82
Figure 23.	Flight 20, Tuesday, 16 March 1999 .....	83
Figure 24.	Flight 21, Wednesday, 17 March 1999 .....	84
Figure 25.	Flight 22, Wednesday, 17 March 1999 .....	85
Figure 26.	Flight 23, Thursday, 18 March 1999 .....	86

## List of Tables

	<u>Page</u>
Table 1.	The LongEZ dimensional and performance specifications ..... 3
Table 2.	ORG data file specifications ..... 7
Table 3.	Listing from HEADER.TXT used during SHOWEX ..... 8
Table 4.	Empirical calibration constants used for wind velocity corrections ..... 10
Table 5.	Aircraft variables available in NCR and NCP netCDF data files ..... 10
Table 6.	Meteorological variables available in NCR and NCP netCDF data files ..... 11
Table 7.	Summary of LongEZ flights ..... 13
Table 8.	Data availability for SHOWEX ..... 14

## List of Abbreviations and Acronyms

A/D	Analog-to-Digital
ARA	Airborne Research Australia
ASCII	American Standard Code
ATDD	Atmospheric Turbulence and Diffusion Division
BAT	Best Aircraft Turbulence
DGPS	Differential Global Positioning System
DLS	Down-Looking Scatterometer
DSP	Design Stagnation Point
EOPACE	Electro-Optical Propagation Assessment in Coastal Environments
FFA	First Flight Airport
FRD	Field Research Division
FRF	Field Research Facility
GPS	Global Positioning System
IBL	Internal Boundary Layer
IR	Infrared
IRGA	Infrared Gas Analyzer
IRQ	Interrupt Request
ISA	Industry Standard Architecture
MFP	Mobile Flux Platform
MQI	Dare County Regional Airport
NASA	National Aeronautic and Space Administration
NCAR	National Center for Atmospheric Research
netCDF	Network Common Data Format
OSU	Oregon State University
PAR	Photosynthetically Active Radiation
PC	Personal Computer
PCI	Peripheral Component Interconnect
PPS	Pulse Per Second
PRT	Precision Resistance Temperature
RAM	Random Access Memory
REM	Remote
SAR	Synthetic Aperture Radar
SCSI	Small Computer System Interface
SIMM	Single In-line Memory Module
TANS	Trimble Advanced Navigation System
VGA	Video Graphics Array

## List of Symbols

$\alpha_0$	Angle of Attack at Zero Lift
$\epsilon_h$	Heading Offset for Relative Velocity
$\epsilon_p$	Pitch Offset for Relative Velocity
$\epsilon_q$	Adjustment to Dynamic Pressure
$\epsilon_r$	Roll Offset for Relative Velocity
$K_\alpha$	Pitch Calibration Constant
$K_\beta$	Yaw Calibration Constant
$K_{up}$	Upwash Factor
$R_t$	Temperature Recovery Factor

## Abstract

The Shoaling Waves Experiment (SHOWEX) Spring pilot study took place at the U. S. Army Corps of Engineers Field Research Facility (FRF) located in Duck, North Carolina during a three week period in March 1999 . The primary objective of SHOWEX was to measure the spatial and temporal variation of the mean wind, surface stress, and spectral wave fields in the coastal shoaling zone. These data are to be used to develop new models for the drag coefficient and momentum transfer between waves and the atmosphere. The LongEZ experimental research aircraft (N3R) flew 23 missions (75 flight hours) under a variety atmospheric and wave field conditions. Flight legs included parallel and perpendicular runs with respect to the coastline at various altitudes and numerous slant and spiral soundings. The LongEZ also acquired meteorological information on the boundary layer structures over Albermarle and Currituck Sounds. In addition, several flights were flown over Lake Mattamuskeet to document internal boundary layer development.

## 1 Introduction

Existing parameterizations of the surface wind stress in the coastal shoaling zone usually fail because of their inability to properly account for changes of surface wave characteristics such as height, steepness, period, phase speed, breaking, and age. Accurate model simulation of the surface stress and turbulence above the air-sea interface is important for a number of applications including understanding wave growth and decay. Until recently, detailed spatial and temporal observations did not exist to adequately examine the coupling of the atmosphere and ocean in the coastal shoaling zone. However, a boundary-layer research aircraft was used in a pilot study during November 1997 off the coast of North Carolina to investigate the spatial variation of both marine boundary layer and surface wave field (Mahrt et al., 1999; Sun et al., 1999; Vogel et al., 1999). An ongoing series of experiments have and will continue to address these issues by acquiring the necessary observations from a combination of research aircraft and surface-based sensors. This report focuses on data from the second pilot study. In particular, we discuss the data collected by the LongEZ research aircraft (N3R).

The Shoaling Waves Experiment (SHOWEX) Spring pilot study was successfully conducted during a three week period in March 1999 at the U. S. Army Corps of Engineers Field Research Facility (FRF) located in Duck, North Carolina. The collaborative effort included scientists from NOAA's Field Research Division (FRD) and Atmospheric Turbulence and Diffusion Division (ATDD), Oregon State University (OSU), the National Center for Atmospheric Research (NCAR), and the National Aeronautic and Space Administration (NASA). The SHOWEX scientific research team collaborated with scientists and engineers participating in the Electro-Optica Propagation Assessment in Coastal Environments (EOPACE) project to study aerosols generated by plumes associated with breaking waves in the surf zone.

The LongEZ (Fig. 1) successfully acquired the data needed to meet the SHOWEX objectives. A total of 23 missions (75 flight hours) were flown under various atmospheric and wave field conditions. LongEZ flight legs included parallel and perpendicular runs at various altitudes with respect to the coastline as well as numerous slant and spiral soundings. The LongEZ also acquired meteorological information on the boundary layer structures over Albermarle and Currituck Sounds. Several flights were flown over Lake Mattamuskeet in an attempt to further understand internal boundary layer development. The LongEZ is capable of acquiring high-fidelity turbulence measurements in the surface layer and simultaneously documenting the characteristics of the surface wave field. This unique air-sea data set will help better quantify the coupling between the atmosphere and ocean. This paper summarizes the data acquired by the LongEZ during the SHOWEX Spring pilot study.



**Figure 1.** The LongEZ at the Wright Brother's Memorial in Kill Devil Hills, NC.

## 2 Description of the LongEZ, Sensors and Data Acquisition System

The LongEZ is an experimental airplane that has been used extensively to acquire data for a variety of air quality and environmental research projects (e.g., Doran et al., 1992; Crawford et al., 1993, 1996; Brooks et al., 1997; Dobosy et al., 1997; Sun et al., 1997; Oechel et al., 1998). This aircraft has proven to be especially powerful in studying the spatial variability of air-surface exchange. The instrument suite and data acquisition system are used to measure mean properties of the atmosphere as well as turbulent fluxes of heat, moisture, momentum, carbon dioxide, ozone, and other quantities. Remote sensors such as laser altimeters and a Ka-band radar were recently added to determine wave field properties of the ocean. The following subsections briefly describe the aircraft, instrumentation, and data acquisition system used in SHOWEX.

### 2.1 LongEZ

The LongEZ was designed by Burt Rutan in the early 1980's as a high-performance sport aircraft. Built entirely from a composite structure of fiberglass and epoxy over rigid foam, the LongEZ is a safe and reliable aircraft with exceptional performance. The forward lifting surface (canard) is designed to prevent the main wing from stalling. The design combines vertical winglets, laminar flow wings, and a pusher engine. It is ideally suited for making high-fidelity turbulence measurements with minimal flow distortion at low altitudes and slow aircraft speeds. A distinct advantage of the pusher design is that it allows for the mounting of instruments on the aircraft nose which minimizes contamination due to propeller-induced turbulence, and engine vibration and exhaust. Some basic aircraft specifications of the LongEZ are listed in Table 1.

### 2.2 *In Situ* and Remote Sensors

Various *in situ* and remote sensors have been mounted on the LongEZ (Fig. 2) for the measurement of atmospheric and wave field properties. The Best Aircraft Turbulence (BAT) probe is the centerpiece of the atmospheric measurement system (Crawford and Dobosy, 1992; Hacker and Crawford, 1999). The BAT probe was the result of a collaboration of scientists and engineers from NOAA and Airborne Research Australia (ARA) of Adelaide, Australia. Additional information is available at <http://www.noaa.inel.gov/frd/BAT>.

The BAT housing consists of a 15-cm diameter carbon-fiber hemisphere mounted on a tapered carbon-fiber cone. The hemisphere and housing are mounted on the nose of the aircraft. Nine pressure ports are symmetrically located on the hemisphere. Static and differential pressure are measured by four solid-state pressure sensors that have a frequency response of about 1 kHz and an accuracy of  $\pm 0.05$  hPa. Wind velocities relative to the aircraft are computed from the pressure distributions observed over the array of pressure ports. In addition, air temperature measurements are acquired by redundant fast-response 0.13 mm micro-bead thermistors. One thermistor is mounted on the hemisphere inside the design stagnation point (DSP) ports. The second thermistor is located in the auxiliary port on the bottom of the probe. The time response of these temperature sensors is about 0.07 sec. Additionally, a precision resistance temperature (PRT) probe is included



for slow response measurements. The pressure and temperature sensors along with their respective electronics are housed within the BAT probe. This allows the sensors to be interfaced in close proximity to signal conditioning electronics with no significant loss or contamination. Further, the sensors are heated to reduce temperature related drift.

**Table 1**  
LongEZ dimensional and performance specifications.

Engine	Lycoming O-360 160 HP
Seats	2
Electrical	65 Amp @ 12 VDC
Fuselage Length	5.0 m
Fuselage Length (with probe)	5.6 m
Wing Span	8.5 m
Wing Area	10 m <sup>2</sup>
Canard Span	3.7 m
Canard Chord	0.38 m
Propeller Diameter	1.80 m
Weight (empty)	430 kg
Payload	370 kg
Fuel Capacity (normal)	200 kg
Fuel Capacity (with aux tank)	300 kg
Range (normal)	3300 km
Range (extended)	3800 km
Ceiling	8000 m
Endurance	10 - 18 hr
Cruise Speed	90 m s <sup>-1</sup>
Stall Speed	25 - 30 m s <sup>-1</sup>
Fuel Use @ 50 m s <sup>-1</sup>	11 kg hr <sup>-1</sup>
Fuel Use @ 90 m s <sup>-1</sup>	20 kg hr <sup>-1</sup>

Global positioning system (GPS) technology is integrated into the BAT data acquisition system. By using differential GPS (DGPS) correction techniques (i.e., collecting data from a fixed station at a known location), aircraft position and horizontal velocity can be computed at a rate of 10 Hz to within  $\pm 3$  m and  $\pm 2$  cm s<sup>-1</sup>, respectively. Aircraft attitude is measured using a Trimble Advanced Navigation System (TANS) vector GPS. The TANS consists of four antennas mounted on the BAT probe housing, the wings, and the rear of the cockpit. Using carrier-phase techniques, the position of three antennas is measured relative to the master antenna. Resulting measurements of attitude (aircraft pitch, roll, and heading) are acquired at 10 Hz and have an accuracy of 0.05°. All GPS data acquired at 10 Hz are mixed with accelerometer data (accelerometers are mounted in the BAT probe and the rear of the airplane) which are collected at 50 Hz to extend their frequency response as described by Crawford and Dobosy, 1992.

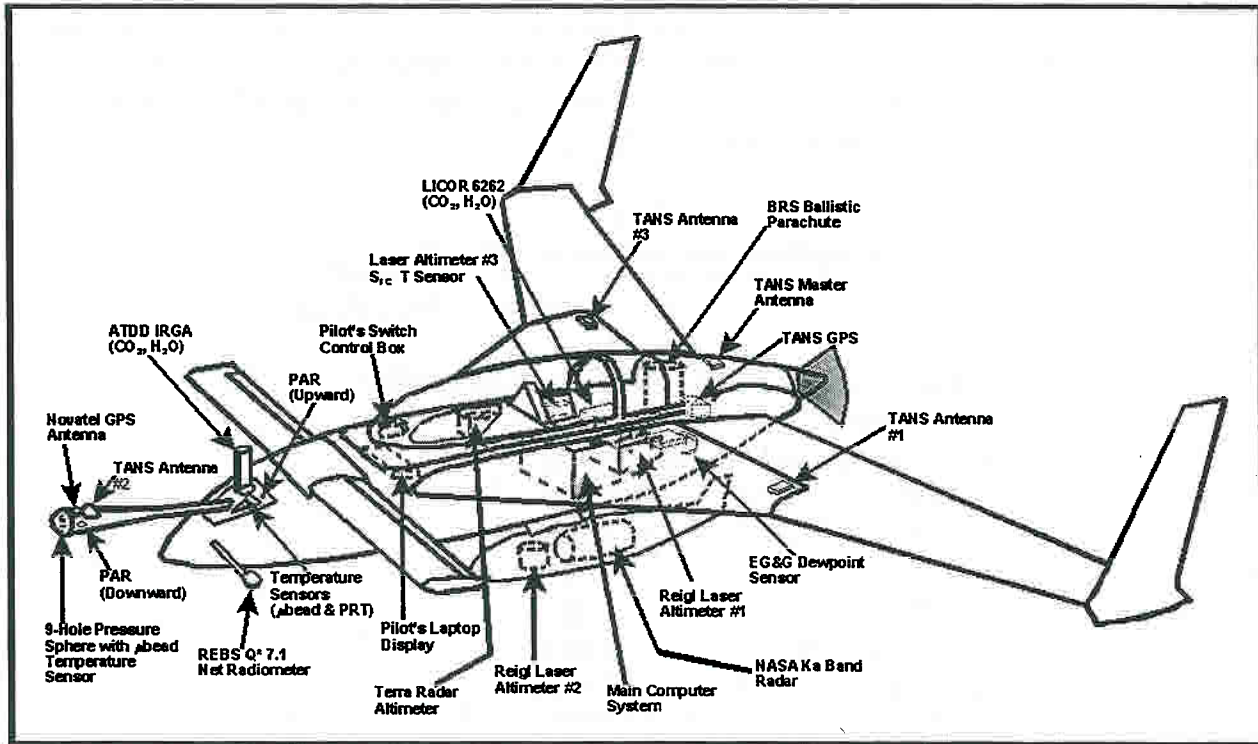


Figure 2. Schematic of the LongEZ with sensors.

A open-path infrared gas analyzer (IRGA), designed and built by ATDD, measures turbulent fluctuations in water vapor (H<sub>2</sub>O) and carbon dioxide (CO<sub>2</sub>) at frequencies up to 50 Hz. Three sets of two-each radiometric sensors mounted on the LongEZ measure both upwelling and downwelling (with respect to the aircraft) radiation. A Radiation and Energy Balance Systems Inc. Q\*7.1 net radiometer provides measurements of both long and shortwave radiation. Upward looking and downward looking (with respect to the aircraft) LI-COR Inc. photosynthetically active radiation (PAR) sensors measure the incoming and reflected portion of the visible solar spectrum, respectively. An upward and downward looking (with respect to the aircraft) Everest Interscience Inc. 4000.4GL infrared (IR) radiometer are used to measure sky and surface temperature, respectively. Dew point temperature is measured by an EdgeTech Model 200 chilled mirror sensor.

An array of three Riegl LD90-3400VHS laser altimeters are used to determine ocean wave characteristics such as wave height, slope, spectra and phase speed. The laser array consists of three downward looking lasers mounted in an equilateral triangle with 1-m separation. Two are mounted under either wing. The third is mounted in a pod below the aircraft (Fig. 2). The lasers measure distance to  $\pm 2$  mm at 50 Hz (i.e., at a nominal ground speed of 50 m s<sup>-1</sup> with 1-m spatial resolution).

A low-power Ka-band radar developed by NASA is also mounted in the pod. The radar provides estimates of mean surface slope over wave scales from 0.01 to 1 m based on back-scattered power. The addition of the laser altimeters and Ka-band radar is a special configuration used for SHOWEX and other similar air-sea interaction field studies.

### 2.3 Data Acquisition System

The Mobile Flux Platform (MFP) data acquisition system consists of several components, including a personal computer (PC), two remote A/D modules (REM), an Iomega 100 MB Zip drive for onboard data storage, a portable flat-panel display, and control box for the pilot.

The PC motherboard consists of an Intel Pentium 133 MHZ CPU, an Iwill P55TU small computer system interface (SCSI), 32 MB of random access memory (RAM) in the form of two 16 MB single in-line memory module (SIMM) chips, five industry standard architecture (ISA) slots, and three peripheral component interconnect (PCI) slots. The cards plugged into the ISA bus include a video graphics array (VGA) display adapter, an 8-port RS-232 serial interface, an RS-422 serial interface, and a NovAtel 3150 GPS interface. Data from the TANS vector GPS, NovAtel GPS, and the laser altimeters are acquired by the PC via the RS-232 serial interface. For SHOWEX, none of the PCI slots were utilized.

The BAT-REM module was developed by ARA to provide high speed, high resolution, multi-channel data logging. Numerous software algorithms for data acquisition and manipulation are implemented on the REM module. Each REM module consists of two 8-channel A/D boards with 16-bit resolution. The analog input voltage ranges from -5 to +5 volts, translating to a digital resolution of 0.15259 mv. Each of the A/D channels is signal-conditioned by an 8-pole 30 Hz low-pass (anti-alias) filter. The digital signals are transmitted at a rate of 50 Hz to the PC via an RS-422 interface. During SHOWEX, the MFP included two REM modules for a total of 32 A/D channels. The first was contained in the tapered carbon fiber cone to the rear of the pressure port dome. The second was located in the PC case.

The NovAtel 3150 GPS interface provides the primary time reference for the MFP system. The clock utilized by the NovAtel interface is synchronized with the time transmitted by the GPS satellites. The clock outputs a one pulse per second (PPS) signal to interrupt request (IRQ) 5 on the ISA bus of the PC. The interrupt is also used to synchronize flow of data transmitted to the PC from the REM modules and other sensors.

The Zip drive with SCSI interface is used for primary onboard data storage. The SCSI interface provides the necessary data transfer speed.

The pilot can observe the status of the MFP in flight using a color flat-panel VGA (640 x 480 resolution) monitor. The pilot's switch box contains an instrument power switch, a PC power switch, a file write switch, an event button, and a marker switch. In addition, two LED lights are used to indicate power and system status.

### 3 Data

#### 3.1 In-Flight Data Collection

The data acquisition programs run on top of the MS-DOS 6.22 operating system. They are written in C and consist of nine modules, each designed to execute particular tasks. The data acquisition software reads and interprets the digital data, time synchronizes and performs some housekeeping routines, and writes the data to a 100 MB Zip disk. The raw data consist of four files which typically total 70 MB for a 4-hour flight. These files have the same 8-digit root name which is based on the PC clock when the data acquisition system is started. The convention is: month (2 digits), day (2 digits), hour (2 digits), and minute (2 digits). For example, the filename with the root name of 03161322 was opened on March 16 at 1322 UTC. Each file is a unique 3-character suffix: ORG, NOV, TAN, and MKR.

The ORG file contains binary data acquired by the REM modules and all other sensors written in 1 s blocks (sometimes referred to as scan numbers). Also, this file contains information regarding device and channel assignments, measurement frequencies, engineering units, ranges, voltage scale factors and offsets, and preliminary calibration coefficients provided by an ASCII file (HEADER.TXT). The ORG data file specifications are listed in Table 2 while much of the information contained in the HEADER.TXT file is listed in Table 3.

The channel name (or label; Table 3) is a character string describing the measured variable. The device number is used to assign a logical channel with a physical device. The assignments listed below were used during SHOWEX:

0	ISA bus device channel 0 - NovAtel GPS data
1	Serial device channel 1 - TANS data
2	Serial device channel 2 - Laser input #1
3	Serial device channel 3 - Laser input #2
4	Serial device channel 4 - Laser input #3
5	Serial device channel 5 - Not used
6	Serial device channel 6 - Not used
7	Serial device channel 7 - Not used
8	Serial device channel 8 - Not used
10	REM device #1
11	REM device #2

**Table 2**  
ORG data file specifications.

Field	Bytes	Data Type	Description
title	80	character array	experiment title
date	10	character array	ORG file creation date (MM/DD/YYYY)
nochan	2	integer	number of channel groups (i)
scans	2	integer	number of 1 s data blocks
GRP(i,1)	2	integer	storage frequency for channel group i
GRP(i,2)	2	integer	no. channels for channel group i of type CHAR
GRP(i,3)	2	integer	no. channels for channel group i of type SHORT
GRP(i,4)	2	integer	no. channels for channel group i of type LONG
label(j)	12	character array	channel name label for logical channel j
device(j)	2	integer	physical device number for logical channel j
phy(j)	2	integer	physical channel for logical channel j
freq(j)	2	integer	data storage frequency for logical channel j
units(j)	12	character array	engineering unit label for logical channel j
calpwr	2	integer	no. polynomial calibration coefficients
a0	2	integer	a0 coefficient for mv to engineering unit conversion
a1	2	integer	a1 coefficient for mv to engineering unit conversion
a2	2	integer	a2 coefficient for mv to engineering unit conversion
a3	2	integer	a3 coefficient for mv to engineering unit conversion
a4	2	integer	a4 coefficient for mv to engineering unit conversion
a5	2	integer	a5 coefficient for mv to engineering unit conversion
min(j)	4	float	minimum engineering unit value for channel j
max(j)	4	float	maximum engineering unit value for channel j
scalefactor(j)	4	float	multiplier portion of count to mv conversion
addoffset(j)	4	float	offset portion of count to mv conversion
cFormat(j)	2	integer	variable type (CHAR=1, SHORT=2, LONG=3)
fillValue(j)	4	float	fill value for channel j (values -1, 0, or +1)
lname(j)	100	character array	long channel name label for logical channel j

The physical channel is used to associate the logical channel with a physical channel on a particular device. The frequency defines the rate at which the data are provided to the data acquisition system. A 12-character string is used to assign the respective engineering units for a particular channel.

**Table 3**  
Listing from HEADER.TXT used during SHOWEX.

Label	Dev	Cha	Frq	Units	a0	a1	Min	Max	Scale Fac	Offset
NLat	0	0	10	deg	0.000000	1.0000000	-90.0	90.0	0.0000305	0.000
NLon	0	1	10	deg	0.000000	1.0000000	-180.0	180.0	0.0000305	0.000
NAht	0	2	10	m	0.000000	1.0000000	-235.0	6277.0	0.1000000	3000.000
Nu	0	3	10	m s <sup>-1</sup>	0.000000	1.0000000	-200.0	200.0	0.0100000	0.000
Nv	0	4	10	m s <sup>-1</sup>	0.000000	1.0000000	-200.0	200.0	0.0100000	0.000
Nw	0	5	10	m s <sup>-1</sup>	0.000000	1.0000000	-100.0	100.0	0.0100000	0.000
GPSTime	0	6	1	s	0.000000	1.0000000	0.0	604800.0	0.1000000	0.000
Tpitch	1	0	10	deg	0.000000	1.0000000	-20.0	20.0	0.0100000	0.000
Troll	1	1	10	deg	0.000000	1.0000000	-80.0	80.0	0.0100000	0.000
Thdg	1	2	10	deg	0.000000	1.0000000	0.0	360.0	0.0100000	180.000
L1Dist	2	0	50	m	0.000000	1.0000000	0.0	400.0	0.0100000	0.000
L1Amp	2	1	50	counts	0.000000	1.0000000	0.0	256.0	1.0000000	0.000
L1Retn	2	2	50	counts	0.000000	1.0000000	0.0	127.0	1.0000000	0.000
L2Dist	3	0	50	m	0.000000	1.0000000	0.0	400.0	0.0100000	0.000
L2Amp	3	1	50	counts	0.000000	1.0000000	0.0	256.0	1.0000000	0.000
L2Retn	3	2	50	counts	0.000000	1.0000000	0.0	127.0	1.0000000	0.000
L3Dist	4	0	50	m	0.000000	1.0000000	0.0	400.0	0.0100000	0.000
L3Amp	4	1	50	counts	0.000000	1.0000000	0.0	256.0	1.0000000	0.000
L3Retn	4	2	50	counts	0.000000	1.0000000	0.0	127.0	1.0000000	0.000
Px	10	0	50	mb	16.592450	0.0033110	0.0	33.1	0.1523000	-21.627
Py	10	1	50	mb	-0.062700	0.0062640	-31.4	31.3	0.1523000	-25.891
Pz	10	2	50	mb	0.060500	0.0062700	-31.3	31.4	0.1523000	-31.526
Ps	10	3	50	mb	514.667400	0.1064450	0.0	1046.9	0.1523000	-26.196
Ax	10	4	50	m s <sup>-2</sup>	0.232958	0.0034430	-17.0	17.4	0.1523000	-22.997
Ay	10	5	50	m s <sup>-2</sup>	0.071810	-0.0037140	-18.6	18.5	0.1523000	-32.135
Az	10	6	50	m s <sup>-2</sup>	9.535680	0.0037340	-9.1	28.2	0.1523000	-28.632
Tp1	10	7	50	°C	0.000000	0.0060000	-30.0	30.0	0.1523000	-33.658
Tp2	10	8	50	°C	0.000000	0.0060000	-30.0	30.0	0.1523000	-18.733
Tbar1	10	9	1	°C	0.000000	0.0100000	-50.0	50.0	0.1523000	-20.408
HatchDelP	10	10	50	mb	18.706400	-0.0083600	-23.1	60.5	0.1523000	-21.779
Net	10	11	1	W m <sup>-2</sup>	0.000000	0.1222000	-200.0	1200.0	0.1523000	-20.713
PAR_UP	10	12	1	μM m <sup>-2</sup> s <sup>-1</sup>	119.400000	0.4975000	0.0	2487.4	0.1523000	-29.394
PAR_DN	10	13	1	μM m <sup>-2</sup> s <sup>-1</sup>	152.928000	0.5184000	0.0	2592.0	0.1523000	-22.540
F_H2O	10	14	50	g m <sup>-3</sup>	13.700000	0.0030510	-3.1	30.5	0.1523000	-21.779
F_CO2	10	15	50	mg m <sup>-3</sup>	600.700000	0.0679000	261.2	940.2	0.1523000	-22.084
Radar_A	11	2	50	volts	0.000000	0.0010000	-5.1	5.1	0.1476000	-25.830
Radar_B	11	3	50	volts	0.000000	0.0010000	-5.1	5.1	0.1476000	-22.140
Radar_C	11	4	50	volts	0.000000	0.0010000	-5.1	5.1	0.1476000	-29.520
Radar_D	11	5	50	volts	0.000000	0.0010000	-5.1	5.1	0.1476000	-26.568
Tdew	11	6	1	°C	-60.244000	0.0288250	-47.1	57.7	0.1476000	-26.125
SfcT	11	7	50	°C	0.000000	0.1000000	-40.0	100.0	0.1476000	-29.668
Axb	11	8	50	m s <sup>-2</sup>	-0.013810	-0.0004800	-2.4	2.4	0.1476000	-28.634
Ayb	11	9	50	m s <sup>-2</sup>	0.031504	-0.0004800	-2.4	2.4	0.1476000	-27.011
Azb	11	10	50	m s <sup>-2</sup>	-0.130770	0.0040140	-20.0	20.0	0.1476000	-31.291
Arol	11	11	50	s <sup>-2</sup>	0.000727	-0.0006329	-10.0	10.0	0.1476000	-23.764

Most of the variables are defined as 2-byte integers (SHORT). However, the latitude (NLat), longitude (NLon), and the GPS time (GPSTime), which require high resolution and/or large range, are stored as 4-byte integers (LONG). The scale factor and offset are used to convert the counts returned by a REM module to millivolts, or for assigning a fixed number of decimal places to the data for those devices that already report values in engineering units.

The NOV file contains binary satellite pseudo-range data acquired by the aircraft during flight. These data, when combined with satellite pseudo-range data acquired from a ground station



of known location and elevation, are used to generate differentially corrected positions and velocities for the aircraft. The TAN file contains GPS data in ASCII format. These data are used primarily for troubleshooting.

The MKR file contains ASCII data listing specific times and locations during the flight when the marker switch was toggled to an "on" or "off" position. When the marker switch is turned "on", a value of "-1", the scan number (i.e., number of elapsed seconds since the start of data acquisition), current latitude, and current longitude are written to the MKR file. Similarly, a value of "0" is written with the time and location information when the marker switch is turned off. The event switch is used to mark a single event during flight (e.g., flying past the end of a pier). An event is recorded in the MKR file with the designation of "EVT" along with the scan number, latitude and longitude. The MKR file is usually edited at the end of the flight to include a summary of the weather conditions, flight plan, problems encountered, and other notes that may be helpful during data analysis. Appendix A contains the listings of the marker files from all flights during SHOWEX.

### **3.2 Post-Flight Data Processing**

The final data are obtained through a series of post-processing routines. In the initial step, the aircraft position and velocity data in the NOV file are differentially corrected using GPS data acquired at a ground-station of known location and elevation. This is done using programs written by M. Elizabeth Cannon of the University of Calgary and modified by ATDD for our purposes. The final product of these programs is a file with the same root name and the extension of OUT. It contains an ASCII listing of GPS time, latitude, longitude, altitude, and the horizontal and vertical velocity of the aircraft with respect to the Earth.

Small cleanup operations are then performed on the ORG file. These include removing spikes and spurious data from the various time series. Next, calibrations are updated as needed. For example, fast-response sensors such as the micro-bead thermistors can experience drift in their calibrations. In order to obtain an accurate calibration, a regression of the micro-bead thermistor data is performed against the slow-response PRT probe. Since the calibration data is contained in every data file collected during the experiment, the calibration may be updated for each flight. Additionally, if a sensor is changed or fails during flight, the calibration can be updated to reflect the condition. The OUT and ORG files are then combined and converted into a single file in network common data format (netCDF). This combined file contains all of the raw data. It again has the same root name and is given the extension NCR (netCDF Raw). The final step (and the most complex) produces the basic scientific variables in standard units. Again, this is a netCDF file given the extension NCP (netCDF Processed).

Table 4 lists several empirical calibration constants used to correct wind velocity data acquired by the LongEZ. Details about the nature of these values can be found in Leise and Masters (1991). Tables 5 and 6 list both the aircraft performance and meteorological variables available in both the NCR and NCP data files acquired during SHOWEX. The respective engineering units and storage frequency are also given.

**Table 4**  
Empirical calibration constants used for wind velocity corrections.

Calibration Constant	Value	Description
$R_t$	0.820	Temperature Recovery Factor
$K_\alpha$	0.255	Pitch Calibration Constant
$K_\beta$	0.222	Yaw Calibration Constant
$K_{up}$	0.101	Upwash Factor
$\alpha_0$	-3.61	Angle of Attack at Zero Lift
$\epsilon_q$	0.9988	Adjustment to Dynamic Pressure
$\epsilon_p$	0.02	Pitch Offset for Relative Velocity
$\epsilon_r$	1.2	Roll Offset for Relative Velocity
$\epsilon_h$	0.4	Heading Offset for Relative Velocity

**Table 5**  
Aircraft performance variables available in NCR and NCP netCDF data files.

Variable	Units	Freq (Hz)	Description
GPSTime	s	1	GPS Time
NLat	deg	10	Latitude
NLon	deg	10	Longitude
NAlt	m	10	Altitude
Nu	$m s^{-1}$	10	Eastward Ground Speed
Nv	$m s^{-1}$	10	Northward Ground Speed
Nw	$m s^{-1}$	10	Vertical Ground Speed
GndSpeed	$m s^{-1}$	1	Ground Speed
AirSpeed	$m s^{-1}$	1	Air Speed
TPitch	deg	10	Pitch
TRoll	deg	10	Roll
THdg	deg	10	Heading
Ax	$m s^{-2}$	50	Longitudinal Acceleration at BAT Probe
Ay	$m s^{-2}$	50	Lateral Acceleration at BAT Probe
Az	$m s^{-2}$	50	Vertical Acceleration at BAT Probe
Axb	$m s^{-2}$	50	Longitudinal Acceleration at Center of Gravity
Ayb	$m s^{-2}$	50	Lateral Acceleration at Center of Gravity
Azb	$m s^{-2}$	50	Vertical Acceleration at Center of Gravity
Aroll	$s^{-2}$	50	Roll



**Table 6**  
 Meteorological variables available in NCR and NCP netCDF data files.

Variable	Units	Freq (Hz)	Description
U	m s <sup>-1</sup>	50	Eastward Wind Velocity
V	m s <sup>-1</sup>	50	Northward Wind Velocity
W	m s <sup>-1</sup>	50	Vertical Wind Velocity
Px	mb	50	Longitudinal Differential Pressure
Py	mb	50	Lateral Differential Pressure
Pz	mb	50	Vertical Differential Pressure
Ps	mb	50	Static Pressure
Tp1	°C	50	Air Temperature (micro-bead) (primary)
Tp2	°C	50	Air Temperature (micro-bead) (secondary)
TBar	°C	1	Air Temperature (PRT)
Tdew	°C	1	Dew Point Temperature
F_H2O	g m <sup>-3</sup>	50	Absolute Humidity
F_CO2	mg m <sup>-3</sup>	50	Carbon Dioxide Concentration
RhoD	kg m <sup>-3</sup>	50	Dry Air Density
Net	W m <sup>-2</sup>	1	Net Radiation (short and longwave)
PAR_UP	μM m <sup>-2</sup> s <sup>-1</sup>	1	Upward Photosynthetically Active Radiation
PAR_DN	μM m <sup>-2</sup> s <sup>-1</sup>	1	Downward Photosynthetically Active Radiation
IRT_UP	°C	1	Upward Infrared Temperature (sky)
IRT_DN	°C	50	Downward Infrared Temperature (surface)
L1Dist	m	50	Altitude (Laser #1)
L1Dist	m	50	Altitude (Laser #2)
L1Dist	m	50	Altitude (Laser #3)
L1Amp	counts	50	Signal Amplitude (Laser #1)
L2Amp	counts	50	Signal Amplitude (Laser #2)
L3Amp	counts	50	Signal Amplitude (Laser #3)
L1Retn	counts	50	Number of Returned Readings (Laser #1)
L2Retn	counts	50	Number of Returned Readings (Laser #2)
L3Retn	counts	50	Number of Returned Readings (Laser #3)
Radar_A	mv	50	Transmit Power Monitor Voltage
Radar_B	mv	50	High Gain Receiver Output Voltage
Radar_C	mv	50	Low Gain Receiver Output Voltage
Radar_D	mv	50	Radar Status and Control

## 4 Flight Summaries

In order to assess changes in atmospheric turbulence and the ocean wave field through the shoaling region, repeated transects were flown both perpendicular and parallel to the coastline over the Atlantic Ocean at various altitudes. Slant and/or spiral soundings were also conducted during each flight to assess the vertical structure of the atmospheric boundary layer. A total of 23 missions (75 flight hours) were flown under various atmospheric and wave field conditions during a three week period in March 1999. Many of these flights were in the vicinity of the US Army Corps of Engineers Field Research Facility (FRF) pier located in Duck, North Carolina. The LongEZ also acquired meteorological information about the boundary layer structures over the Albermarle and Currituck Sounds. Several flights were flown over Lake Mattamuskeet in an attempt to further understand internal boundary layer (IBL) development.

The LongEZ utilized two different airports during SHOWEX. The first several flights were based out of Dare County Regional Airport (MQI) in Manteo. Hanger space was available at MQI to shelter the LongEZ from severe weather. Most of the flights, however, were flown in and out of First Flight Airport (FFA) in Kill Devil Hills. Table 7 is a summary listing of the LongEZ flights during SHOWEX. Note that the flight hours were determined by a Hobbs meter, which keeps track of time from when the aircraft engine is started until it is shutdown. An overview of the meteorological conditions acquired by a NOAA automated (C-MAN) station on the FRF pier are shown in Figure 3. The following subsections contain a brief summary of each flight.

### 4.1 Flight 1: 01 MAR 99 (MON)

This was a test flight to verify the proper operation of the various sensors and data acquisition system. The weather was dominated by sunny skies with westerly winds (260 deg) at  $11 \text{ m s}^{-1}$  and an air temperature of  $10 \text{ }^{\circ}\text{C}$ . Differential GPS corrections were not applied to this data set because the ground- station was not yet in operation.

### 4.2 Flight 2: 02 MAR 99 (TUE)

This was a second test flight in the morning for further verification on the proper operation of the sensors and data acquisition system. Sunny skies once again dominated the region with west-southwesterly winds (250 deg) at  $5 \text{ m s}^{-1}$  and an air temperature of  $8 \text{ }^{\circ}\text{C}$ . Once again, differential GPS corrections were not applied.

### 4.3 Flight 3: 02 MAR 99 (TUE)

This afternoon flight consisted of slant soundings to and from the FRF pier and numerous perpendicular flight legs with respect to the coastline at low altitudes ( $\sim 10$  to  $50 \text{ m}$ ). Weather conditions consisted of sunny skies with southwesterly winds (230 deg) at  $5 \text{ m s}^{-1}$  and an air temperature of  $12 \text{ }^{\circ}\text{C}$ . GPS differential corrections were applied to this flight, as well as all subsequent SHOWEX flights.

**Table 7**  
Summary of LongEZ flights.

FL	Date	Day	Start/End Time (UTC)	FL Hr	Arrive Depart	File Name	Comments
1	01 MAR 99	MON	2114 2145	0.5	MQI MQI	03012111	test flight
2	02 MAR 99	TUE	1507 1524	0.3	MQI MQI	03021454	test flight
3	02 MAR 99	TUE	1816 2113	3.0	MQI MQI	03021809	perpendicular legs
4	03 MAR 99	WED	1333 1728	3.9	MQI MQI	03031328	perpendicular legs
5	04 MAR 99	THU	1427 1717	3.3	MQI FFA	03041425	parallel legs
6	04 MAR 99	THU	1734 1857	2.5	MQI FFA	03041729	perpendicular legs
7	05 MAR 99	FRI	1320 1558	3.1	FFA FFA	03051312	parallel legs
8	05 MAR 99	FRI	1711 2045	3.7	FFA FFA	03051709	perpendicular legs
9	06 MAR 99	SAT	1314 1658	3.5	FFA FFA	03061308	parallel, perpendicular legs
10	07 MAR 99	SUN	1317 1800	4.7	FFA FFA	03071303	parallel legs, butterfly
11	07 MAR 99	SUN	1843 2132	3.8	FFA FFA	03071833 03071941	butterfly (2)
12	08 MAR 99	MON	1450 1818	3.5	FFA FFA	03081413	Albermarle Sound, butterfly
13	08 MAR 99	MON	1855 2121	2.5	FFA FFA	03081853	Currituck Sound, butterfly
14	09 MAR 99	TUE	1409 1618	2.1	FFA FFA	03091344 03091436	Currituck Sound, butterfly
15	10 MAR 99	WED	1819 2125	3.2	FFA FFA	03101811 03101940	parallel legs
16	11 MAR 99	THU	1335 1715	3.7	FFA FFA	03111315	parallel legs
17	11 MAR 99	THU	1812 2142	3.8	FFA MQI	03111810 03112051	Lake Mattamuskeet
18	12 MAR 99	FRI	1609 1917	3.5	FFA FFA	03121556	Lake Mattamuskeet
19	13 MAR 99	SAT	1612 1943	3.5	FFA FFA	03131533	Lake Mattamuskeet
20	16 MAR 99	TUE	1719 2051	3.6	FFA FFA	03161717	parallel legs
21	17 MAR 99	WED	1113 1640	5.7	FFA FFA	03171048 03171442	SAR Overpass, parallel legs
22	17 MAR 99	WED	1750 2206	4.4	FFA FFA	03171748 03172003	Currituck Sound, calibration maneuvers
23	18 MAR 99	THU	1359 1656	2.9	FFA FFA	03181338	parallel, perpendicular legs

**Table 8**  
Data availability for SHOWEX.

Variable	Flight	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
U		X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
V		X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
W		X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Tp1		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Tp2		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
TBar		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Tdew		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
F_H2O		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X	✓	✓
F_CO2		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X
Ps		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
RhoD		X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Net		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IRT_UP		✓	✓	✓	✓	✓	✓	✓	✓	X	X	X	X	?	?	?	?	?	?	?	?	?	?	
IRT_DN		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	?	?	?	?	?	?	?	?	?	?	
PAR_UP		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PAR_DN		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1Dist		X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1Dist		X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1Dist		X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L1Amp		X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X
L2Amp		X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X
L3Amp		X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X
L1Retn		X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L2Retn		X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
L3Retn		X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Radar_A		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X
Radar_B		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X
Radar_C		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X
Radar_D		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X	X	X	X	X	X	X	X	X	X

✓ valid data  
 X missing/invalid data  
 ? suspect data

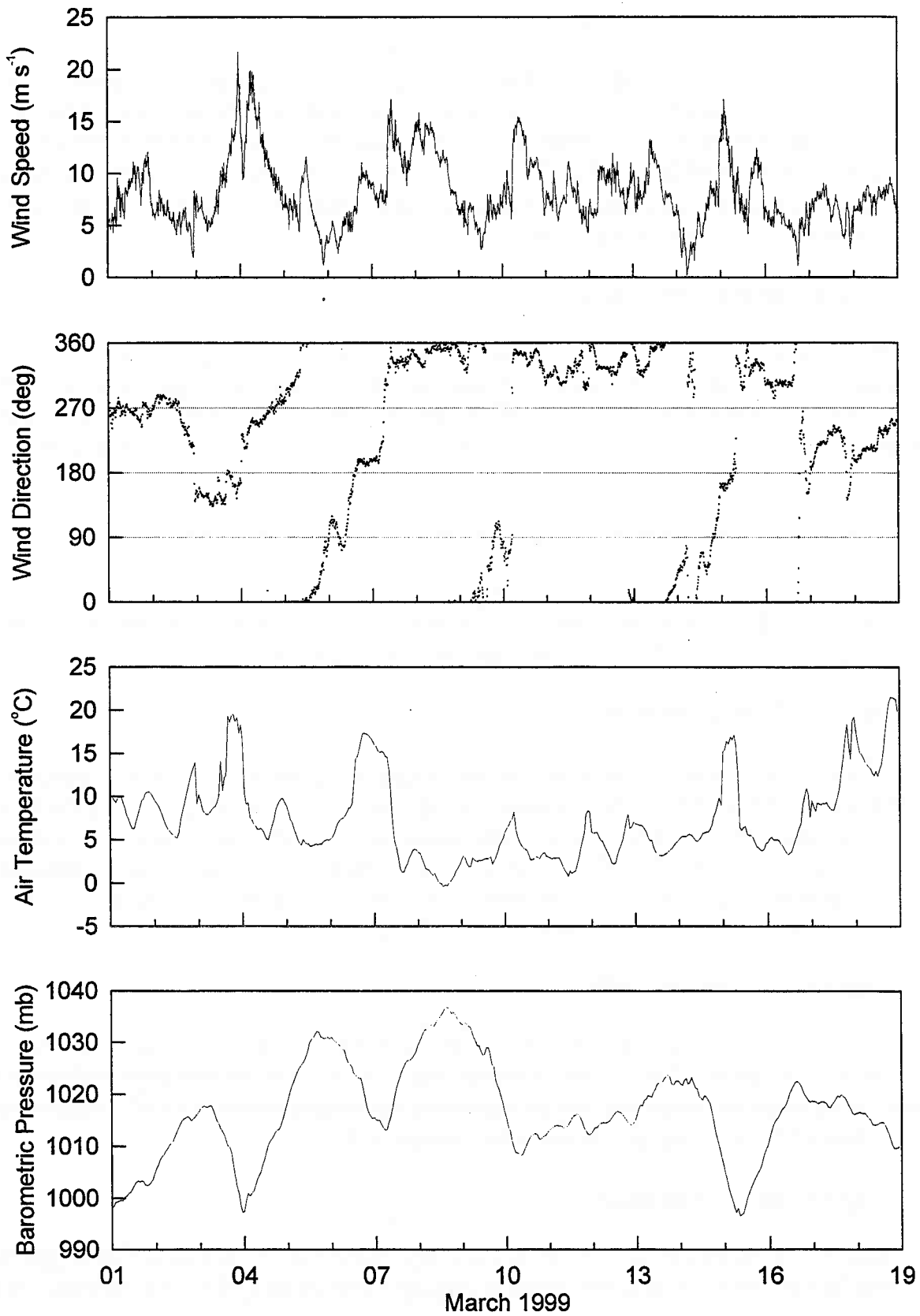


Figure 3. Meteorological time series from FRF pier during SHOWEX.

#### **4.4 Flight 4: 03 MAR 99 (WED)**

The LongEZ conducted a spiral profile ascending out of MQI and a slant sounding down to the FRF pier. Numerous perpendicular flight legs were conducted at various levels (10 to 400 m) from the coast out to about 12 km to examine IBL structure. A slant sounding from the FRF pier was conducted at the end of the mission. Prefrontal conditions dominated the weather during this flight. The region experienced sunny skies with warm air temperatures of about 15 °C. Winds were from the south-southeast (160 deg) at 10 m s<sup>-1</sup>.

#### **4.5 Flight 5: 04 MAR 99 (THU)**

This mission consisted of numerous parallel flight legs at low altitudes (10 m) with respect to the coastline. These legs were conducted along the shoreline out to a distance of 20 km. Slant soundings were conducted before and after the parallel flight legs. The weather was dominated by post-frontal conditions. Skies were clear with an air temperature of 6 °C. Winds were from the west (270 deg) at 11 m s<sup>-1</sup>.

#### **4.6 Flight 6: 04 MAR 99 (THU)**

This second flight of the day focused on the IBL. Several perpendicular flight legs were conducted until the MFP computer crashed. Skies remained clear with an air temperature of 8 °C. Winds remained westerly (270 deg) but decreased slightly to 10 m s<sup>-1</sup>.

#### **4.7 Flight 7: 05 MAR 99 (FRI)**

This mission consisted of numerous parallel flight legs in the morning at low altitudes (10 m) with respect to the coastline. These legs were conducted along the shoreline out to a distance of 10 km. Two perpendicular flight legs were also included in the mission. Slant soundings were conducted at the start of the flight. The computer system crashed near the end of the mission during one of the parallel flight legs. The weather was dominated by sunny skies and cooler air temperatures of 4 °C. Winds were from the north (10 deg) at 7 m s<sup>-1</sup>.

#### **4.8 Flight 8: 05 MAR 99 (FRI)**

Numerous perpendicular legs were flown during the afternoon across the Currituck Peninsula at various altitudes (60 to 300 m). Slant soundings were conducted at the beginning and end of the mission. Skies remained sunny with the air temperature increasing slightly to 5 °C. Winds veered to the north-northeast (30 deg) and decreased in velocity to 4 m s<sup>-1</sup>.

#### **4.9 Flight 9: 06 MAR 99 (SAT)**

Multiple parallel flight legs were included in this mission as well as four perpendicular runs. These parallel runs were flown at low levels at varying distances away from the coastline. Slant

soundings were included before and after the flight legs. Skies were partly to mostly cloudy as an advancing cold front approached the area. Winds were from the south (180 deg) at  $6 \text{ m s}^{-1}$  with an air temperature of  $15 \text{ }^{\circ}\text{C}$ .

The upward looking IR radiometer was switched with the downward looking IR sensor because due to instrument failure at the end of the flight.

#### **4.10 Flight 10: 07 MAR 99 (SUN)**

This morning flight included numerous legs parallel to the coastline. In addition, a butterfly pattern was included. This pattern is a series of slant and spiral soundings separated by horizontal flight legs at low (10 m) and high (500 m) altitudes. The weather was dominated by post-frontal conditions with an air temperature of  $2 \text{ }^{\circ}\text{C}$ . Winds were from the north-northwest (330 deg) at  $12 \text{ m s}^{-1}$ . Slant soundings were included at the beginning and the end of this mission.

#### **4.11 Flight 11: 07 MAR 99 (SUN)**

The afternoon flight was similar to the previous mission flown that morning. Two butterfly patterns were flown at 1 and 10 km from the coastline. The high-level horizontal flight leg of the butterfly was flown at an altitude of 1 km. Several parallel legs were included. Slant soundings were also performed at the start and end of the mission. Winds remained north-northwesterly (340) at  $11 \text{ m s}^{-1}$  with a slight increase in air temperature to  $3 \text{ }^{\circ}\text{C}$ .

The data acquisition PC suffered a crash in mid-flight resulting in a loss of about 8 min of data. The laser altimeter and Ka-band radar mounted in the pod under the LongEZ were severely damaged during landing. These sensors were not available for the remainder of the study.

#### **4.12 Flight 12: 08 MAR 99 (MON)**

Two butterfly patterns were flown over Albermarle Sound in the morning to examine the structure and evolution of the IBL. Two legs perpendicular to the coastline were also included in this mission. The weather was dominated by clear skies and cold air temperatures of about  $0 \text{ }^{\circ}\text{C}$ . Winds were from the north (350 deg) at  $11 \text{ m s}^{-1}$ .

#### **4.13 Flight 13: 08 MAR 99 (MON)**

This afternoon flight consisted a butterfly pattern aligned with Currituck Sound. Two low-level legs perpendicular to the shore were also included. Slant soundings at the start and end of the mission were included. Clear skies and cold temperatures ( $1 \text{ }^{\circ}\text{C}$ ) persisted. Winds remained from the north (0 deg) but decreased in speed to  $8 \text{ m s}^{-1}$ .



#### **4.14 Flight 14: 09 MAR 99 (TUE)**

An abbreviated butterfly pattern was flown parallel with Currituck Sound. Several low-level legs were included along Currituck Sound. Slant soundings were included at the start and end of the mission. Overcast (stratocumulus) skies and cold temperatures (3 °C) dominated the region. Winds were from the north-northeast (30 deg) at 6 m s<sup>-1</sup>.

The data acquisition PC suffered a crash in mid-flight resulting in a loss of about 6 min of data.

#### **4.15 Flight 15: 10 MAR 99 (WED)**

This flight consisted of numerous parallel flight legs off the coastline and an abbreviated butterfly pattern. Slant soundings were also included at the start and end of the mission. Overcast (stratocumulus) skies remained over the area with cold air temperatures of 3 °C. Winds were from the north-northwest (340 deg) at 11 m s<sup>-1</sup>.

The data acquisition PC suffered a crash in mid-flight resulting in a loss of about 5 min of data.

#### **4.16 Flight 16: 11 MAR 99 (THU)**

Numerous legs parallel to the coastline were included in this morning flight. Two perpendicular legs and slant soundings were also included. Mostly sunny skies with north-northwesterly winds (330 deg) at 8 m s<sup>-1</sup> and an air temperature of 2 °C.

#### **4.17 Flight 17: 11 MAR 99 (THU)**

This afternoon flight was flown over Lake Mattamuskeet in an attempt to understand IBL development and evolution. Numerous low-level (15 m) legs were flown across the lake at varying distances away from its northern shoreline. Slant soundings were included in the vicinity of FFA and the lake. Skies remained clear with air temperatures warming to 6°C. Winds were from the north-northwest (340 deg) at 6 m s<sup>-1</sup> at the FRF pier.

The data acquisition PC suffered a crash in mid-flight resulting in a loss of about 4.5 min of data.

#### **4.18 Flight 18: 12 MAR 99 (FRI)**

This flight was a repeat of the previous mission with multiple low-level legs over Lake Mattamuskeet. Slant soundings were included in the vicinity of FFA and the lake. Clear skies still dominated the region with air temperatures of 6 °C. Winds were from the north-northwest (340 deg) at 8 m s<sup>-1</sup> at the FRF pier.



#### **4.19 Flight 19: 13 MAR 99 (SAT)**

This was yet another repeat of the previous two missions over Lake Mattamuskeet. In addition low-level runs at various distances from the northern lake shore, a stack flight pattern perpendicular to the northern shore was conducted at various altitudes (20 to 300 m). Slant soundings were included in the vicinity of FFA and the lake. Mostly sunny skies were present with some high cirrus clouds. Winds at the FRF pier were from the north (0 deg) at  $8 \text{ m s}^{-1}$  and an air temperature of  $4 \text{ }^{\circ}\text{C}$ . However, winds over the lake were calm since the surface of the lake appeared to be very smooth.

#### **4.20 Flight 20: 16 MAR 99 (TUE)**

After a two-day layoff (due to rain), the LongEZ conducted a mission which included numerous low-level parallel legs at varying distances from the coastline. Two perpendicular flight legs were included in the mission. Slant soundings were also included at the start and end of the flight. Clear skies were observed with an air temperature of  $9 \text{ }^{\circ}\text{C}$ . Winds during the first hour of the flight are northeasterly (50 deg) at  $2 \text{ m s}^{-1}$  but then veer quickly to west-southwesterly (240 deg) at  $5 \text{ m s}^{-1}$ .

The IRGA began to experience problems due to a faulty power supply. Measurements  $\text{H}_2\text{O}$  and  $\text{CO}_2$  concentration were invalid for this flight and all subsequent flights.

#### **4.21 Flight 21: 17 MAR 99 (WED)**

The first half of this flight was dedicated to acquiring data for verification of a satellite-based synthetic aperture radar (SAR). This low-level box pattern was flown approximately parallel and perpendicular to the mean wind. Spiral soundings were included with the flight plan for this SAR overpass mission. The second half of the flight was dedicated to numerous parallel legs off the coastline. Slant soundings were included at the beginning with this flight. Skies were clear and air temperatures rose to about  $10 \text{ }^{\circ}\text{C}$ . Winds were from the west-southwest (240 deg) at  $7 \text{ m s}^{-1}$ .

The data acquisition PC suffered a crash in mid-flight resulting in a loss of about 14 min of data.

#### **4.22 Flight 22: 17 MAR 99 (WED)**

The second flight of the day was dedicated to an IBL investigation of Currituck Sound. Numerous parallel and perpendicular legs were flown with respect to the Sound. In addition, calibration maneuvers (wind box, wind circles, pitch and yaw) were conducted near the end of the flight. Mostly sunny skies dominated the region with warm temperatures reaching  $17 \text{ }^{\circ}\text{C}$ . Winds were from the southwest (220 deg) at the beginning of the flight but backed to south-southeasterly (160 deg) towards the end of the flight. Wind speeds ranged from  $4$  to  $7 \text{ m s}^{-1}$ .

The data acquisition PC suffered a crash in mid-flight resulting in a loss of about 15 min of data.

#### **4.23 Flight 23: 18 MAR 99 (THU)**

This final flight consisted of numerous parallel and perpendicular legs with respect to the coastline at various altitudes near the FRF pier. Clear skies remained over the area with warm temperatures of 16 °C. Winds were from the west-southwest (240 deg) at 8 m s<sup>-1</sup>.

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## Appendix A: Marker Files

The MKR file contains an ASCII data listing specific times and locations during the flight when the marker switch was toggled to an "on" or "off" position. When the marker switch is turned "on" during the flight, a value of "-1" along with the number of scans (i.e., number of elapsed seconds since the start of data acquisition), time, latitude and longitude are written to the MKR file. Similarly, a value of "0" is written with the time and location information when the marker switch is turned off. The event switch is used to mark a specific occurrence of significance during flight (e.g., flying past the end of a pier). An event is recorded in the MKR file with the designation of "EVT" along with the number of scans, time, latitude and longitude. The MKR file is usually edited at the end of the flight to include a summary of the weather conditions, flight plan, problems encountered, and other notes that may be helpful during data analysis.

When either the marker or event switch is toggled, a 3-character string is written in the first three columns of the time and location record. The default character string is XXX. However, during post-flight data processing, the string is replaced with a 1 to 3-character string which represents a specific flight pattern or event. The following listed below were used in the marker files for SHOWEX.

ERR	Error	SAW	Slant Sounding Ascending (westward)
EVT	Event	SD	Slant Sounding Descending
FL	Flux (level) Leg	SDE	Slant Sounding Descending (eastward)
FLE	Flux (level) Leg (eastward)	SDN	Slant Sounding Descending (northward)
FLN	Flux (level) Leg (northward)	SDS	Slant Sounding Descending (southward)
FLS	Flux (level) Leg (southward)	SDW	Slant Sounding Descending (westward)
FLW	Flux (level) Leg (westward)	TXI	Taxi
FRY	Ferry	VNT	Ventilation (static)
PFA	Profile Sounding Ascending	WBE	Wind Box Maneuver (eastward)
PFD	Profile Sounding Descending	WBN	Wind Box Maneuver (northward)
PTC	Pitch Calibration Maneuver	WBS	Wind Box Maneuver (southward)
ROL	Roll Calibration Maneuver	WBW	Wind Box Maneuver (westward)
SA	Slant Sounding Ascending	WCL	Wind Circle Left (counterclockwise)
SAE	Slant Sounding Ascending (eastward)	WCR	Wind Circle Right (clockwise)
SAN	Slant Sounding Ascending (northward)	XXX	Default Character String
SAS	Slant Sounding Ascending (southward)	YAW	Yaw Calibration Maneuver

SHOWEX 99 Spring Experiment, Duck NC

Flight: 01  
Date: 01 MAR 99 (Monday)  
Duration: 0.5 Hours  
Pilot: TLC

Weather: Cold front passage day before, clear skies and breezy in the morning, winds from the NNW at 6 m/s, shallow stratocumulus in the afternoon from moisture due to previous day's rain. Temperature about 10-12 C.

Summary: Test flight to check data system.

Problems: None

Marker for D:\03012111.ORG OPENED at 162866

XXX	-1	00391	21:20:56	35	55.0	-75	42.0	marker trial
		0	00594	21:24:19	35	55.4	-75	41.6
XXX	-1	00748	21:26:53	35	54.5	-75	44.8	marker trial
		0	01102	21:32:47	36	00.9	-75	50.4
XXX	-1	01107	21:32:52	36	01.0	-75	50.2	marker trial
		0	01248	21:35:13	36	01.8	-75	44.5
XXX	-1	01330	21:36:35	36	00.2	-75	42.1	marker trial
		0	01660	21:42:05	35	54.9	-75	42.0

Marker for D:\03012111.ORG CLOSED at 164722

Total scans : 01856  
Missed Ints : 00000  
BAT Dropouts: -000.005%  
NOV Dropouts: 001.643%  
TAN Dropouts: 005.194%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 02  
Date: 02 MAR 99 (Tuesday)  
Duration: 0.3 Hours  
Pilot: TLC

Weather: Clear skies with temperatures about 13-14 C and winds from the SE.

Summary: Test flight to check data system.

Problems: None

Marker for D:\03021454.ORG OPENED at 227216

XXX -1 00216 15:10:31 35 55.0 -75 41.7 marker trial  
       0 00224 15:10:39 35 54.9 -75 41.6  
 XXX -1 00301 15:11:56 35 55.2 -75 41.7 marker trial  
       0 00307 15:12:02 35 55.4 -75 41.8  
 XXX -1 00439 15:14:14 35 57.0 -75 45.5 marker trial  
       0 00534 15:15:49 35 57.9 -75 48.1  
 XXX -1 00903 15:21:58 35 55.4 -75 41.8 marker trial  
       0 00906 15:22:01 35 55.4 -75 41.8

Marker for D:\03021454.ORG CLOSED at 228269

Total scans : 01053  
 Missed Ints : 00000  
 BAT Dropouts: -000.006%  
 NOV Dropouts: 008.946%  
 TAN Dropouts: 000.114%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 03  
 Date: 02 MAR 99 (Tuesday)  
 Duration: 3.0 Hours  
 Pilot: TLC

Weather: Clear skies with temperatures about 13-14 C and strong winds from the SE.

Summary: Numerous perpendicular runs conducted at numerous levels. Several slant soundings included in flight.

Problems: The parallel runs were abandoned because way points were incorrect.

Marker for D:\03021809.ORG OPENED at 238540

VNT -1 00029 18:16:08 35 55.0 -75 42.1 ventilation  
       0 00065 18:16:44 35 55.0 -75 42.1  
 TXI -1 00831 18:29:30 36 11.0 -75 45.2 taxi  
       0 00861 18:30:00 36 11.3 -75 44.1  
 FLW -1 02081 18:50:20 36 14.0 -75 29.0 W 10 m  
       0 02576 18:58:35 36 10.9 -75 45.0  
 FLE -1 02719 19:00:58 36 10.8 -75 45.0 E 15 m  
       0 03198 19:08:57 36 14.6 -75 26.7  
 FLW -1 03340 19:11:19 36 15.1 -75 24.3 W 50 m  
       0 04023 19:22:42 36 10.9 -75 45.0  
 SAN -1 04176 19:25:15 36 11.1 -75 44.6 N slant sounding up  
       0 04554 19:31:33 36 20.6 -75 46.5  
 SDS -1 04557 19:31:36 36 20.6 -75 46.6 S slant sounding down  
       0 04984 19:38:43 36 09.2 -75 43.3  
 FLE -1 05262 19:43:21 36 10.7 -75 45.6 E 110 m  
       0 05530 19:47:49 36 13.0 -75 35.6



FLW -1 05689 19:50:28 36 13.5 -75 33.2 W 110 m  
       0 06314 20:00:53 36 09.0 -75 52.0  
 FLE -1 06431 20:02:50 36 09.3 -75 52.4 E 50 m  
       0 06873 20:10:12 36 12.8 -75 35.8  
 FLW -1 07032 20:12:51 36 13.3 -75 33.4 W 50 m  
       0 07466 20:20:05 36 10.6 -75 46.7  
 FLE -1 07618 20:22:37 36 10.2 -75 47.9 E 50 m  
       0 07955 20:28:14 36 12.8 -75 35.3  
 FLW -1 08116 20:30:55 36 13.4 -75 32.8 W 50 m  
       0 08552 20:38:11 36 10.7 -75 46.1  
 FLE -1 08687 20:40:26 36 10.7 -75 47.2 E 50 m  
       0 08998 20:45:37 36 12.9 -75 35.5  
 FLW -1 09146 20:48:05 36 13.2 -75 33.1 W 50 m  
       0 09557 20:54:56 36 10.7 -75 45.7  
 SA -1 09638 20:56:17 36 10.9 -75 46.0 sounding to 1500 m  
       0 10056 21:03:15 36 00.3 -75 38.5  
 SD -1 10063 21:03:22 36 00.1 -75 38.3 down sounding  
       0 10453 21:09:52 35 54.9 -75 41.6  
 TXI -1 10460 21:09:59 35 54.9 -75 41.6 taxi  
       0 10475 21:10:14 35 55.0 -75 41.6  
 VNT -1 10599 21:12:18 35 55.0 -75 42.1 ventilation  
       0 10632 21:12:51 35 55.0 -75 42.1

Marker for D:\03021809.ORG CLOSED at 249178

Total scans : 10638  
 Missed Ints : 00000  
 BAT Dropouts: -000.005%  
 NOV Dropouts: 002.755%  
 TAN Dropouts: 001.406%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 04  
 Date: 03 MAR 99 (Wednesday)  
 Duration: 3.9 Hours  
 Pilot: TLC

Weather: Mostly sunny skies with stiff SE winds (160 deg) at start of flight  
 switching to SSW (210 deg) by the end of the flight. Cold front  
 approaching area.

Summary: Numerous perpendicular legs towards and away from the coast at  
 several levels. Parallel legs to the coast also included in flight.

Problems: None

Marker for D:\03031328.ORG OPENED at 307986

VNT -1 00005 13:33:10 35 55.0 -75 42.1 ventilation

	0	00043	13:33:48	35	55.0	-75	42.1	
TXI	-1	00251	13:37:16	35	55.3	-75	41.7	taxi
	0	00262	13:37:27	35	55.1	-75	41.6	
PFA	-1	00343	13:38:48	35	56.3	-75	40.5	spiral profile to 1500 m at MQI
	0	00778	13:46:03	36	00.7	-75	39.2	
SD	-1	00791	13:46:16	36	01.2	-75	39.1	slant sounding to pier
	0	01282	13:54:27	36	16.0	-75	49.5	
FLE	-1	01549	13:58:54	36	10.5	-75	46.8	E 11 m
	0	02067	14:07:32	36	14.4	-75	29.8	
FLW	-1	02202	14:09:47	36	14.6	-75	28.4	W 8 m
	0	02714	14:18:19	36	10.4	-75	46.4	
FLE	-1	02812	14:19:57	36	10.7	-75	46.2	E 15 m
	0	03321	14:28:26	36	14.1	-75	29.8	
FLW	-1	03456	14:30:41	36	14.1	-75	28.6	W 15 m
	0	03959	14:39:04	36	10.7	-75	46.2	
FLN	-1	04116	14:41:41	36	09.9	-75	44.2	N off pier
	0	04313	14:44:58	36	15.9	-75	46.6	
FLS	-1	04438	14:47:03	36	17.4	-75	46.5	S off pier
	0	04907	14:54:52	36	07.2	-75	40.8	
FLW	-1	05175	14:59:20	36	11.5	-75	42.8	W 20 m
EVT		05233	15:00:18	36	11.0	-75	44.7	pier
	0	05585	15:06:10	36	07.1	-75	55.5	
FLE	-1	05673	15:07:38	36	07.4	-75	54.6	E 50 m
	0	06270	15:17:35	36	12.1	-75	38.4	
FLW	-1	06422	15:20:07	36	13.6	-75	36.5	W 100 m
	0	07061	15:30:46	36	07.3	-75	55.6	
FLE	-1	07234	15:33:39	36	07.6	-75	55.7	E 200 m
	0	07721	15:41:46	36	12.6	-75	37.6	
FLW	-1	07895	15:44:40	36	14.4	-75	34.3	W 400 m
	0	08691	15:57:56	36	08.0	-75	54.7	
FLE	-1	08748	15:58:53	36	07.7	-75	53.9	E 400 m
	0	09183	16:06:08	36	12.5	-75	37.9	
FLW	-1	09328	16:08:33	36	12.7	-75	35.9	W 200 m
	0	10063	16:20:48	36	05.6	-75	53.5	
FLE	-1	10158	16:22:23	36	06.6	-75	51.8	E 100 m
	0	10552	16:28:57	36	12.7	-75	38.0	
FLW	-1	10695	16:31:20	36	13.2	-75	36.0	W 50 m
	0	11346	16:42:11	36	08.5	-75	55.0	
FLE	-1	11431	16:43:36	36	08.4	-75	53.3	E 70 m
	0	11853	16:50:38	36	12.3	-75	37.6	
FLW	-1	11995	16:53:00	36	13.0	-75	35.9	W 50 m
	0	12645	17:03:50	36	08.4	-75	54.9	
SA	-1	12662	17:04:07	36	08.2	-75	55.3	slant sounding, pier to MQI, 1700 m
	0	13237	17:13:42	36	01.8	-75	41.4	
TXI	-1	13886	17:24:31	35	55.0	-75	41.9	taxi
	0	13890	17:24:35	35	54.9	-75	42.0	
VNT	-1	14034	17:26:59	35	55.1	-75	41.5	ventilation
	0	14070	17:27:35	35	55.1	-75	41.5	

Marker for D:\03031328.ORG CLOSED at 322059

Total scans : 14073  
Missed Ints : 00000  
BAT Dropouts: -000.004%  
NOV Dropouts: 002.444%  
TAN Dropouts: 001.673%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 05  
Date: 04 MAR 99 (Thursday)  
Duration: 3.3 Hours  
Pilot: TLC

Weather: Post-frontal conditions, clear skies and strong westerly (250 deg)  
winds at 10-14 m/s. Cooler temperatures 4-6 C.

Summary: Numerous perpendicular legs at several levels. Slant sounding down  
to the pier. One round trip at target-track at 10 m. Parallel  
runs at 0.5, 1, 2, 4, and 10 km.

Problems: Problems with data acquisition system which crashed in flight  
shortly after takeoff. System was rebooted with new ZIP disk,  
no problems after that.

Marker for D:\03041425.ORG OPENED at 397635

SD	-1	00007	14:27:21	36	00.5	-75	36.4	slant sounding
	0	00531	14:36:05	36	11.7	-75	45.2	
FLE	-1	00647	14:38:01	36	10.9	-75	45.0	E 20 m
	0	01227	14:47:41	36	15.8	-75	20.3	
FLW	-1	01344	14:49:38	36	16.7	-75	18.2	W 20 m
	0	02572	15:10:06	36	09.4	-75	49.6	
FLN	-1	02900	15:15:34	36	05.7	-75	41.9	at pier S to N
	0	03399	15:23:53	36	17.8	-75	46.8	
FLS	-1	03457	15:24:51	36	18.0	-75	45.3	pier +1 km N to S
	0	03899	15:32:13	36	05.9	-75	41.4	
FLN	-1	03960	15:33:14	36	06.2	-75	40.4	pier +2 km S to N
	0	04433	15:41:07	36	17.1	-75	44.9	
FLS	-1	04491	15:42:05	36	16.9	-75	43.6	pier +4 km N to S
	0	04878	15:48:32	36	06.3	-75	39.7	
FLN	-1	05038	15:51:12	36	07.1	-75	35.2	pier +10 km S to N
	0	05512	15:59:06	36	18.1	-75	39.9	
FLS	-1	05641	16:01:15	36	18.5	-75	40.2	pier +10 km N to S
	0	06091	16:08:45	36	05.7	-75	35.8	
FLN	-1	06292	16:12:06	36	05.5	-75	29.7	pier +20 km S to N
	0	06911	16:22:25	36	20.7	-75	34.7	
FLS	-1	07011	16:24:05	36	21.1	-75	35.4	pier +20 km N to S
	0	07503	16:32:17	36	07.4	-75	30.2	
FLN	-1	08068	16:41:42	36	07.8	-75	39.9	pier +4 km S to N
	0	08462	16:48:16	36	17.2	-75	43.8	

FLS -1 08545 16:49:39 36 16.4 -75 44.8 pier +2 km N to S  
0 08876 16:55:10 36 06.9 -75 41.3  
FLN -1 08945 16:56:19 36 06.8 -75 42.1 pier +1 km S to N  
0 09353 17:03:07 36 16.6 -75 45.4  
FLS -1 09465 17:04:59 36 17.0 -75 46.1 pier +0 km N to S  
0 09875 17:11:49 36 05.6 -75 41.9  
VNT -1 10155 17:16:29 36 00.8 -75 40.3 ventilation  
0 10199 17:17:13 36 00.8 -75 40.3

Marker for D:\03041425.ORG CLOSED at 407843

Total scans : 10208  
Missed Ints : 00000  
BAT Dropouts: -000.005%  
NOV Dropouts: 002.556%  
TAN Dropouts: 003.510%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 06  
Date: 04 MAR 99 (Thursday)  
Duration: 2.5 Hours  
Pilot: TLC

Weather: Post-frontal conditions, clear skies and strong westerly winds  
at 10 m/s. Temperatures cooler 4-6 C.

Summary: Perpendicular runs, internal boundary layer flight.

Problems: Problem with data acquisition system, crashed in flight, reboot  
failed.

Marker for D:\03041729.ORG OPENED at 408844

VNT -1 00001 17:34:04 36 00.9 -75 40.3 ventilation  
0 00039 17:34:42 36 00.9 -75 40.3  
TXI -1 00166 17:36:49 36 01.3 -75 40.2 taxi  
0 00174 17:36:57 36 01.2 -75 40.3  
SD -1 00441 17:41:24 35 58.0 -75 36.6 slant sounding 1500 m down to pier  
0 01124 17:52:47 36 11.2 -75 44.9  
FLE -1 01449 17:58:12 36 09.0 -75 52.8 E 60 m  
ERR 01918 18:06:02 GPS Time Reset!  
0 02107 18:09:11 36 14.8 -75 27.0  
FLW -1 02255 18:11:39 36 15.0 -75 25.0 W 90 m  
0 03341 18:29:45 36 09.1 -75 54.2  
FLE -1 03503 18:32:27 36 08.4 -75 53.9 E 150 m  
0 03956 18:40:00 36 13.0 -75 36.1  
FLW -1 04120 18:42:44 36 13.3 -75 33.4 W 300 m  
0 04951 18:56:35 36 08.5 -75 55.5

Data system crash

Marker for D:\03041729.ORG CLOSED at 416636

Total scans : 07790  
Missed Ints : 00002  
BAT Dropouts: -000.031%  
NOV Dropouts: 004.576%  
TAN Dropouts: 001.330%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 07  
Date: 05 MAR 99 (Friday)  
Duration: 3.1 Hours  
Pilot: TLC

Weather: Clear skies and strong northerly winds at 10 m/s. Temperatures from 10-12 C.

Summary: Slant sounding followed by 12 parallel and 2 perpendicular flux transects.

Problems: Moved to First Flight (FFA) but the ground power unit (GPU) did not work. System booted with aircraft power which prohibited ground calibrations. Data acquisition system crashed towards end flight.

Marker for D:\03051312.ORG OPENED at 479982

SD	-1	00427	13:26:48	35	56.5	-75	36.6	FFA 5 km to pier
	0	01153	13:38:54	36	12.6	-75	45.2	
FLS	-1	01618	13:46:39	36	12.5	-75	45.5	S surf zone
	0	01850	13:50:31	36	05.8	-75	42.3	
FLN	-1	02017	13:53:18	36	04.0	-75	41.2	N surf zone
	0	02581	14:02:42	36	16.5	-75	47.3	
FLE	-1	03011	14:10:00	36	11.0	-75	44.6	Pier to E
	0	03447	14:17:08	36	13.6	-75	32.3	
FLW	-1	04343	14:32:04	36	07.6	-75	43.0	E to Pier
	0	04747	14:38:48	36	16.8	-75	46.5	
FLN	-1	04866	14:40:47	36	16.6	-75	45.2	parallel N +0 km
	0	05240	14:47:01	36	05.7	-75	41.6	
FLS	-1	05333	14:48:34	36	06.0	-75	40.7	parallel S +0 km
	0	05812	14:56:33	36	16.7	-75	44.7	
FLN	-1	05887	14:57:48	36	16.7	-75	43.3	parallel N +0.5 km
	0	06255	15:03:56	36	06.1	-75	39.2	
FLS	-1	06434	15:06:55	36	08.0	-75	36.5	parallel S +0.5 km
	0	06866	15:14:07	36	18.0	-75	39.9	
FLN	-1	07048	15:17:09	36	18.2	-75	39.9	parallel N +1 km
	0	07429	15:23:30	36	07.2	-75	36.2	
FLS	-1	07575	15:25:56	36	05.2	-75	39.3	parallel S +1 km
	0	08100	15:34:41	36	17.1	-75	43.5	
FLN	-1	08179	15:36:00	36	16.4	-75	44.8	parallel N +2 km

0 08551 15:42:12 36 05.7 -75 40.7  
FLS -1 08676 15:44:17 36 04.4 -75 41.1 parallel S +2 km  
0 09204 15:53:05 36 16.9 -75 45.2  
FLN -1 09329 15:55:10 36 17.2 -75 46.3 parallel N +10 km  
Data system crash

Marker for D:\03051312.ORG CLOSED at 489897

Total scans : 09914  
Missed Ints : 00001  
BAT Dropouts: -000.011%  
NOV Dropouts: 005.352%  
TAN Dropouts: 003.156%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 08  
Date: 05 MAR 99 (Friday)  
Duration: 3.7 Hours  
Pilot: EJD

Weather: High overcast skies and northeasterly winds. Temperature about 10-12 C.

Summary: Numerous east-west legs for IBL. The flight focus on Currituck Peninsula, 7 passes at 60 m, which is the lowest possible level, then 7 passes at 1000 ft, and 7 passes at 200 ft. Two slant soundings were conducted at the beginning and end of the mission.

Problems: None

Marker for D:\03051709.ORG OPENED at 493864

VNT -1 00009 17:11:12 36 00.8 -75 40.3 ventilation  
0 00033 17:11:36 36 00.8 -75 40.3  
SA -1 00458 17:18:41 36 02.6 -75 42.4 slant sounding sfc - 1500 m  
0 00828 17:24:51 36 04.6 -75 54.2  
SD -1 00832 17:24:55 36 04.7 -75 54.3 slant sounding 1500 m - sfc  
0 01374 17:33:57 36 03.3 -75 59.7  
FLE -1 01486 17:35:49 36 04.7 -75 56.8 150 m  
0 01856 17:41:59 36 09.8 -75 47.5  
FLW -1 01981 17:44:04 36 09.4 -75 47.9 60 m  
0 02270 17:48:53 36 04.7 -75 57.0  
FLE -1 02428 17:51:31 36 04.8 -75 56.8 60 m  
0 02802 17:57:45 36 09.3 -75 47.3  
FLW -1 02925 17:59:48 36 09.4 -75 47.5 60 m  
0 03228 18:04:51 36 04.7 -75 57.0  
FLE -1 03381 18:07:24 36 04.8 -75 56.8 60 m  
0 03748 18:13:31 36 09.6 -75 47.4  
FLW -1 03882 18:15:45 36 09.5 -75 47.6 60 m

0	04183	18:20:46	36	04.8	-75	57.1	
FLE	-1	04361	18:23:44	36	04.8	-75	56.9 60 m
0	04719	18:29:42	36	09.7	-75	47.4	
FLW	-1	04850	18:31:53	36	09.6	-75	47.6 60 m
0	05146	18:36:49	36	04.7	-75	57.0	
FLE	-1	05315	18:39:38	36	04.8	-75	56.9 150 m
0	05666	18:45:29	36	09.6	-75	47.4	
FLW	-1	05809	18:47:52	36	09.5	-75	47.5 300 m
0	06115	18:52:58	36	03.7	-75	56.4	
FLE	-1	06202	18:54:25	36	04.8	-75	56.8 300 m
0	06561	19:00:24	36	09.4	-75	47.3	
FLW	-1	06690	19:02:33	36	09.5	-75	47.5 300 m
0	06991	19:07:34	36	04.6	-75	56.9	
FLE	-1	07163	19:10:26	36	04.9	-75	57.0 300 m
0	07516	19:16:19	36	09.5	-75	47.3	
FLW	-1	07651	19:18:34	36	09.0	-75	48.2 300 m
0	07955	19:23:38	36	04.6	-75	56.8	
FLE	-1	08155	19:26:58	36	05.0	-75	57.0 300 m
0	08509	19:32:52	36	09.6	-75	47.3	
FLW	-1	08641	19:35:04	36	09.5	-75	47.6 60 m
0	08943	19:40:06	36	04.6	-75	56.9	
FLE	-1	09098	19:42:41	36	04.8	-75	56.9 60 m
0	09452	19:48:35	36	09.7	-75	47.4	
FLW	-1	09589	19:50:52	36	09.6	-75	47.6 60 m
ERR		09597	19:51:01				GPS Time Reset!
0	09893	19:55:57	36	04.5	-75	56.9	
FLE	-1	10069	19:58:53	36	04.7	-75	56.8 60 m
0	10421	20:04:45	36	09.5	-75	47.2	
FLW	-1	10556	20:07:00	36	09.5	-75	47.6 60 m
0	10866	20:12:10	36	04.8	-75	57.1	
FLE	-1	11033	20:14:57	36	05.1	-75	57.0 60 m
0	11382	20:20:46	36	09.6	-75	47.4	
FLW	-1	11489	20:22:33	36	09.3	-75	48.0 60 m
0	11816	20:28:00	36	04.5	-75	56.9	
SA	-1	11934	20:29:58	36	05.4	-75	58.3 slant sounding sfc - 900 m
0	12176	20:34:00	36	04.9	-75	50.5	

Marker for D:\03051709.ORG CLOSED at 506727

Total scans : 12862  
Missed Ints : 00001  
BAT Dropouts: -000.013%  
NOV Dropouts: 003.702%  
TAN Dropouts: 001.448%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 09  
Date: 06 MAR 99 (Saturday)  
Duration: 3.5 Hours

Pilot: TLC

Weather: Partly to mostly cloudy, southerly winds about 5 m/s, more humid with temperatures about 15-17 C.

Summary: Numerous parallel legs and 4 east-west legs. Slant soundings at near-shore and 10 km off-shore. Due to the drop-out problem of the new IR radiometer, the new IR radiometer was replaced by the old IR radiometer at the end of the day, pointing downward.

Problems: None

Marker for D:\03061308.ORG OPENED at 566017

VNT	-1	00354	13:19:30	36	00.7	-75	40.4	ventilation, low pass RY 2 @ FFA
	0	00368	13:19:44	36	01.2	-75	40.2	
SD	-1	01235	13:34:11	35	59.2	-75	36.1	slant sounding to pier
	0	01724	13:42:20	36	15.1	-75	46.8	
FLW	-1	01989	13:46:45	36	10.9	-75	45.0	E to W
	0	02350	13:52:46	36	13.7	-75	32.4	
FLE	-1	02519	13:55:35	36	14.2	-75	30.5	W to E
	0	02956	14:02:52	36	10.9	-75	45.0	
FLN	-1	03184	14:06:40	36	07.8	-75	43.5	S to N in surf
	0	03478	14:11:34	36	16.6	-75	47.3	
FLS	-1	03669	14:14:45	36	18.6	-75	48.0	N to S in surf
	0	04181	14:23:17	36	06.0	-75	42.4	
FLN	-1	04321	14:25:37	36	05.1	-75	41.8	S to N +0.5 km
	0	04697	14:31:53	36	16.9	-75	46.8	
FLS	-1	04893	14:35:09	36	18.7	-75	46.8	N to S +0.5 km
	0	05406	14:43:42	36	06.0	-75	42.2	
FLN	-1	05555	14:46:11	36	06.8	-75	41.7	S to N +1 km
	0	05873	14:51:29	36	16.8	-75	45.5	
FLS	-1	06011	14:53:47	36	16.3	-75	44.5	N to S +1 km
	0	06432	15:00:48	36	06.1	-75	40.8	
FLN	-1	06513	15:02:09	36	07.0	-75	39.4	S to N +2 km
	0	06850	15:07:46	36	17.3	-75	43.5	
FLS	-1	06982	15:09:58	36	18.9	-75	40.2	N to S +4 km
	0	07486	15:18:22	36	07.0	-75	36.0	
FLN	-1	07629	15:20:45	36	06.6	-75	39.7	S to N +2 km
	0	07968	15:26:24	36	17.2	-75	43.6	
FLS	-1	08037	15:27:33	36	17.0	-75	44.8	N to S +1 km
	0	08487	15:35:03	36	06.1	-75	41.0	
FLN	-1	08627	15:37:23	36	05.0	-75	40.6	S to N +1 km
	0	09022	15:43:58	36	16.8	-75	45.5	
FLS	-1	09178	15:46:34	36	17.7	-75	46.2	N to S just off pier
	0	09660	15:54:36	36	06.0	-75	42.1	
FLN	-1	09774	15:56:30	36	05.3	-75	41.8	S to N in surf
	0	10148	16:02:44	36	16.2	-75	46.5	
	-1	10269	16:04:45	36	16.6	-75	47.4	
	0	10669	16:11:25	36	06.6	-75	42.9	
FLE	-1	10892	16:15:08	36	10.9	-75	45.1	E



0 11239 16:20:55 36 13.9 -75 32.4  
 FLW -1 11408 16:23:44 36 14.1 -75 31.1 W  
 0 11817 16:30:33 36 10.9 -75 45.1  
 SA -1 11885 16:31:41 36 11.2 -75 44.5 slant sounding to FFA  
 0 12166 16:36:22 36 05.0 -75 40.7  
 TXI -1 12397 16:40:13 36 00.9 -75 40.3 taxi  
 0 12401 16:40:17 36 00.9 -75 40.4

Marker for D:\03061308.ORG CLOSED at 579502

Total scans : 13485  
 Missed Ints : 00000  
 BAT Dropouts: 000.127%  
 NOV Dropouts: 003.675%  
 TAN Dropouts: 002.918%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 10  
 Date: 07 MAR 99 (Sunday)  
 Duration: 4.7 Hours  
 Pilot: TLC

Weather: A few stattered clouds, strong north winds at 10-15 m/s, cool temperatures about 3 C.

Summary: Butterfly at start and end, then parallel legs.

Problems: None

Marker for D:\03071303.ORG OPENED at 047850

VNT -1 00040 13:18:09 36 00.8 -75 40.3 ventilation  
 0 00135 13:19:44 36 00.8 -75 40.3  
 TXI -1 00456 13:25:05 36 01.5 -75 40.4 taxi  
 0 00459 13:25:08 36 01.5 -75 40.5  
 SDN -1 01286 13:38:55 35 49.5 -75 32.3 N down slant sounding from 1800 m 1  
 0 02559 14:00:08 36 15.8 -75 46.9  
 FLS -1 02767 14:03:36 36 17.8 -75 47.5 S in surf 2  
 0 03128 14:09:37 36 06.0 -75 42.1  
 SAN -1 03284 14:12:13 36 03.5 -75 40.8 N up slant profile 3  
 0 03981 14:23:50 36 17.2 -75 47.0  
 PFD -1 03986 14:23:55 36 17.3 -75 47.0 down profile 4  
 0 04168 14:26:57 36 16.5 -75 47.1  
 FLS -1 04184 14:27:13 36 16.0 -75 47.1 near Surf S  
 0 04478 14:32:07 36 06.2 -75 42.2  
 SAN -1 04646 14:34:55 36 04.8 -75 41.6 slant pro up to N  
 0 05251 14:45:00 36 16.5 -75 47.8  
 SDS -1 05306 14:45:55 36 16.7 -75 47.0 near surf slant pro down to S  
 0 05614 14:51:03 36 05.6 -75 42.3

FLN	-1	05724	14:52:53	36	06.0	-75	42.2	PS to PN
	0	06254	15:01:43	36	17.4	-75	46.3	
FLS	-1	06331	15:03:00	36	16.7	-75	45.4	N1 to S1
	0	06646	15:08:15	36	05.6	-75	41.2	
FLN	-1	06749	15:09:58	36	05.4	-75	40.6	S2 to N2
	0	07326	15:19:35	36	17.8	-75	44.6	
FLS	-1	07412	15:21:01	36	16.7	-75	43.1	N3 to S3
	0	07726	15:26:15	36	05.7	-75	39.6	
FLN	-1	07916	15:29:25	36	06.1	-75	35.7	S4 to N4
	0	08491	15:39:00	36	18.1	-75	39.9	
FLS	-1	08765	15:43:34	36	19.4	-75	33.6	N5 to S5
	0	09045	15:48:14	36	09.2	-75	30.4	
SAN	-1	09217	15:51:06	36	06.3	-75	28.9	S5 to N5 slant up
	0	10060	16:05:09	36	22.3	-75	33.5	
XXX	-1	10157	16:06:46	36	20.0	-75	34.9	cloud base 900 m, top 1200 m
	0	10464	16:11:53	36	08.5	-75	30.7	
FLN	-1	10615	16:14:24	36	05.4	-75	28.7	S5 to N5
	0	11365	16:26:54	36	19.8	-75	34.0	
SDS	-1	11621	16:31:10	36	22.4	-75	34.9	N5 to S5 Down
ERR		11897	16:35:47					GPS Time Reset!
	0	11973	16:37:03	36	09.6	-75	31.1	
FLN	-1	12070	16:38:40	36	10.0	-75	31.3	S5 to N5
	0	12565	16:46:55	36	20.5	-75	34.6	
FLS	-1	12661	16:48:31	36	20.9	-75	34.6	N5 to S5 up to 900 m
	0	12963	16:53:33	36	09.9	-75	30.5	
FLS	-1	13041	16:54:51	36	07.9	-75	31.8	S5 to S4 down
	0	13196	16:57:26	36	06.5	-75	35.9	
FLN	-1	13197	16:57:27	36	06.5	-75	35.9	S4 to N4
	0	13737	17:06:27	36	18.1	-75	39.9	
FLS	-1	13923	17:09:33	36	15.3	-75	42.5	N3 to S3
	0	14234	17:14:44	36	04.4	-75	39.4	
FLN	-1	14323	17:16:13	36	03.4	-75	40.2	S2 to N2
	0	14936	17:26:26	36	17.7	-75	44.6	
FLS	-1	15064	17:28:34	36	17.3	-75	45.4	N1 to S1
	0	15404	17:34:14	36	05.8	-75	41.2	
FLN	-1	15494	17:35:44	36	05.7	-75	42.0	PS to PN
	0	15962	17:43:32	36	16.6	-75	45.7	
FLS	-1	16039	17:44:49	36	16.0	-75	47.0	surf S
	0	16356	17:50:06	36	05.5	-75	42.2	
SA	-1	16373	17:50:23	36	04.9	-75	41.8	pier to FFA
	0	16533	17:53:03	35	60.0	-75	38.0	
TXI	-1	16843	17:58:13	36	01.2	-75	40.3	taxi
	0	16853	17:58:23	36	01.3	-75	40.2	

Marker for D:\03071303.ORG CLOSED at 064839

Total scans : 16988  
Missed Ints : 00001  
BAT Dropouts: -000.010%  
NOV Dropouts: 001.927%  
TAN Dropouts: 002.252%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 11  
Date: 07 MAR 99 (Sunday)  
Duration: 3.8 Hours  
Pilot: EJD

Weather: A few stattered clouds, NW wind (340 deg) at 12 m/s, strong turbulence, cool temperatures of about 3 C.

Summary: Slant sounding to 1800 m, butterfly to 900 m at start and end, then parallel legs.

Problems: The pod, Laser #2 and the Ka-band radar were damaged on landing and The pod and these sensors were removed for the duration of the experiment.

Marker for D:\03071833.ORG OPENED at 067402

VNT	-1	00009	18:43:30	36	00.8	-75	40.3	ventilation
	0	00055	18:44:16	36	00.8	-75	40.3	
SA	-1	00225	18:47:06	36	01.5	-75	40.1	profile sfc - 1800 m
	0	00617	18:53:38	36	09.6	-75	43.3	
SD	-1	00687	18:54:48	36	09.8	-75	41.6	profile 1800 m - sfc
	0	01251	19:04:12	36	06.2	-75	42.6	
FLN	-1	01253	19:04:14	36	06.3	-75	42.6	15 m S-N 1 km
	0	01685	19:11:26	36	16.3	-75	46.5	
SAS	-1	01826	19:13:47	36	16.0	-75	46.2	slant 15 m - 1800 m N-S
	0	02143	19:19:04	36	06.0	-75	42.0	
PFD	-1	02163	19:19:24	36	05.4	-75	41.5	spiral Dn 1800 m - 15 m over S point
	0	02555	19:25:56	36	05.9	-75	42.4	
SAN	-1	02569	19:26:10	36	06.2	-75	42.5	slant 15 m - 1800 m S-N
	0	03059	19:34:20	36	16.4	-75	46.5	

Data system crash

Marker for D:\03071833.ORG CLOSED at 070739

Total scans : 03336  
Missed Ints : 00001  
BAT Dropouts: -000.035%  
NOV Dropouts: 006.903%  
TAN Dropouts: 001.406%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 11  
Date: 07 MAR 99 (Sunday)  
Duration: 3.8 Hours  
Pilot: EJD

Weather: A few stattered clouds, NW wind (340 deg) at 12 m/s, strong turbulence, cool temperatures of about 3 C.

Summary: Slant sounding to 1800 m, butterfly to 900 m at start and end, then parallel legs.

Problems: The pod, Laser #2 and the Ka-band radar were damaged on landing and The pod and these sensors were removed for the duration of the experiment.

Marker for D:\03071941.ORG OPENED at 070975

FLS	-1	00112	19:44:46	36	15.5	-75	46.3	1800 m N-S
	0	00394	19:49:28	36	05.9	-75	41.6	
SDN	-1	00485	19:50:59	36	06.0	-75	42.4	slant 1800 m - 15 m S-N
	0	00953	19:58:47	36	16.3	-75	46.4	
PFA	-1	00964	19:58:58	36	16.5	-75	46.5	spiral Up 15 m - 1800 m over N point
	0	01217	20:03:11	36	15.4	-75	47.0	
SDS	-1	01315	20:04:49	36	15.4	-75	45.8	slant 1800 m - 15 m N-S
	0	01595	20:09:29	36	05.6	-75	42.0	
PFA	-1	01598	20:09:32	36	05.5	-75	42.0	spiral up 15 m - 1800 m over S point
	0	01819	20:13:13	36	05.7	-75	41.8	
FLN	-1	01839	20:13:33	36	06.0	-75	42.2	1800 m S-N
	0	02302	20:21:16	36	16.5	-75	46.4	
PFD	-1	02343	20:21:57	36	17.4	-75	46.6	spiral dn 1800 m - 15 m over N point
	0	02771	20:29:05	36	15.2	-75	45.5	
FLS	-1	02774	20:29:08	36	15.1	-75	45.5	15 m N-S
	0	03099	20:34:33	36	04.0	-75	40.7	
SAN	-1	03309	20:38:03	36	04.0	-75	40.3	slant 15 m - 1800 m S-N
	0	03714	20:44:48	36	09.7	-75	30.8	
SDS	-1	03863	20:47:17	36	09.1	-75	28.9	slant 1800 m - 15 m N-S
	0	04400	20:56:14	36	07.1	-75	36.9	
FLN	-1	04422	20:56:36	36	07.6	-75	36.7	15 m S-N
	0	04899	21:04:33	36	17.8	-75	40.0	
SAS	-1	04998	21:06:12	36	17.5	-75	40.4	slant 15 m - 1800 m N-S
	0	05305	21:11:19	36	07.1	-75	36.0	
PFD	-1	05308	21:11:22	36	07.0	-75	36.0	spiral dn 1800 m - 15 m over S point
	0	05732	21:18:26	36	06.2	-75	36.4	
SAN	-1	05734	21:18:28	36	06.2	-75	36.4	slant 15 m - 1800 m S-N
	0	06303	21:27:57	36	17.8	-75	39.9	
FLS	-1	06458	21:30:32	36	17.8	-75	40.2	1800 m N-S
	0	06754	21:35:28	36	07.2	-75	36.1	
SDN	-1	06888	21:37:42	36	04.8	-75	35.0	slant 1800 m - 15 m S-N
	0	07541	21:48:35	36	17.7	-75	40.0	
PFA	-1	07544	21:48:38	36	17.7	-75	40.0	spiral up 15 m - 1800 m over N point
	0	07807	21:53:01	36	16.8	-75	39.6	
SDS	-1	07910	21:54:44	36	17.1	-75	39.6	slant 1800 m - 15 m N-S
	0	08201	21:59:35	36	06.4	-75	35.6	
PFA	-1	08202	21:59:36	36	06.4	-75	35.6	spiral up 15 m - 1800 m over S point
	0	08401	22:02:55	36	06.3	-75	35.4	
FLN	-1	08452	22:03:46	36	07.3	-75	36.2	1800 m S-N

0 08911 22:11:25 36 17.7 -75 40.4  
PFD -1 08916 22:11:30 36 17.8 -75 40.4 spiral dn 1800 m - 15 m over N point  
0 09145 22:15:19 36 17.0 -75 39.4  
FLS -1 09147 22:15:21 36 16.9 -75 39.4 15 m N-S  
0 09407 22:19:41 36 07.3 -75 36.6

Marker for D:\03071941.ORG CLOSED at 080935

Total scans : 09960  
Missed Ints :  
BAT Dropouts:  
NOV Dropouts:  
TAN Dropouts:

SHOWEX 99 Spring Experiment, Duck NC

Flight: 12  
Date: 08 MAR 99 (Monday)  
Duration: 3.5 Hours  
Pilot: TLC

Weather: Clear skies and cold with strong northerly winds at about  
10-15 m/s.

Summary: Two butterflys and pier east and west.

Problems: Laser #2 and Ka-band radar not working.

Marker for D:\03081413.ORG OPENED at 139825

VNT -1 00006 14:50:30 36 00.8 -75 40.3 ventilation  
0 00055 14:51:19 36 00.8 -75 40.3  
TXI -1 00404 14:57:08 36 00.9 -75 40.1 taxi  
0 00407 14:57:11 36 00.9 -75 40.0  
SAE -1 00740 15:02:44 36 00.6 -75 39.0 FFA to E up  
0 01283 15:11:47 36 13.8 -75 50.5  
SDW -1 01719 15:19:03 36 08.1 -76 04.7 EW slant dn pro  
0 01911 15:22:15 36 06.3 -76 11.7  
XXX -1 02318 15:29:02 36 08.8 -76 02.1  
0 02321 15:29:05 36 08.8 -76 02.0  
PFD -1 02326 15:29:10 36 08.9 -76 01.9 down spiral at E  
0 02659 15:34:43 36 08.4 -76 01.7  
SAW -1 02734 15:35:58 36 08.3 -76 03.8 EW slant up pro  
0 03018 15:40:42 36 05.9 -76 13.8  
FLE -1 03300 15:45:24 36 04.9 -76 16.1 WE flx at 600 m  
0 03698 15:52:02 36 08.4 -76 03.3  
SDW -1 03840 15:54:24 36 08.9 -76 03.2 EW slant dn pro  
0 04227 16:00:51 36 04.3 -76 16.0  
PFA -1 04468 16:04:52 36 03.8 -76 15.7 W spiral up  
0 04625 16:07:29 36 05.1 -76 15.7

SDE	-1	04630	16:07:34	36	05.1	-76	15.6	WE slant dn pro
	0	05083	16:15:07	36	09.0	-76	02.6	
FLW	-1	05539	16:22:43	36	07.0	-76	03.6	EW flx at 600 m
	0	05799	16:27:03	36	04.9	-76	12.8	
XXX	-1	06213	16:33:57	36	08.4	-76	03.7	
	0	06215	16:33:59	36	08.5	-76	03.6	
FLW	-1	06550	16:39:34	36	05.3	-76	01.6	EW flx at sfc
	0	06761	16:43:05	36	01.0	-76	07.5	
SAE	-1	06903	16:45:27	36	00.3	-76	08.5	WE slant up pro
	0	07229	16:50:53	36	05.5	-76	02.1	
SAW	-1	07493	16:55:17	36	05.5	-76	01.1	EW slant up pro
	0	07786	17:00:10	35	59.7	-76	09.0	
FLE	-1	07996	17:03:40	36	00.0	-76	09.2	WE flx at 600 m
	0	08305	17:08:49	36	05.3	-76	01.3	
SDW	-1	08446	17:11:10	36	06.2	-76	00.1	EW slant dn pro
	0	08801	17:17:05	35	59.7	-76	09.5	
SDE	-1	09007	17:20:31	35	58.5	-76	11.0	WE slant dn pro
	0	09412	17:27:16	36	04.8	-76	02.0	
FLW	-1	09588	17:30:12	36	05.5	-76	00.7	EW flx at 600 m
	0	09823	17:34:07	36	00.6	-76	07.7	
FLE	-1	10021	17:37:25	36	00.1	-76	08.7	WE flx at sfc
	0	10305	17:42:09	36	05.1	-76	01.6	
SA	-1	10311	17:42:15	36	05.2	-76	01.4	ES4 to pier up & dn
EVT		10598	17:47:02	36	08.9	-75	54.2	top of profile
	0	11408	18:00:32	36	14.0	-75	31.1	
FLW	-1	11435	18:00:59	36	13.8	-75	32.1	pier W
	0	11785	18:06:49	36	10.9	-75	45.0	
TXI	-1	12287	18:15:11	36	01.3	-75	40.2	taxi
	0	12290	18:15:14	36	01.3	-75	40.2	
VNT	-1	12412	18:17:16	36	00.8	-75	40.3	ventilation
	0	12483	18:18:27	36	00.8	-75	40.3	

Marker for D:\03081413.ORG CLOSED at 152309

Total scans : 12484  
 Missed Ints : 00000  
 BAT Dropouts: -000.005%  
 NOV Dropouts: 000.092%  
 TAN Dropouts: 001.479%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 13  
 Date: 08 MAR 99 (Monday)  
 Duration: 2.5 Hours  
 Pilot: EJD

Weather: Clear skies and cold with stong northerly winds at about  
 10-15 m/s.

Summary: One butterfly along the river and Currituck penninsula east and west IBL runs.

Problems: Laser #2 and Ka-band radar not working.

Marker for D:\03081853.ORG OPENED at 154503

VNT	-1	00004	18:55:06	36	00.9	-75	40.3	ventilation
	0	00023	18:55:25	36	00.9	-75	40.3	
SA	-1	00192	18:58:14	36	01.4	-75	40.2	profile sfc - 1500 m
	0	00534	19:03:56	36	04.4	-75	49.1	
SD	-1	00593	19:04:55	36	03.9	-75	51.4	profile 1500 m - sfc
	0	01151	19:14:13	36	00.5	-75	53.8	
FLN	-1	01203	19:15:05	36	01.2	-75	53.0	15 m S-N
	0	01579	19:21:21	36	09.7	-75	59.3	
SAS	-1	01694	19:23:16	36	09.4	-75	59.3	slant profile 15 m - 1200 m N-S
	0	02077	19:29:39	35	59.5	-75	51.9	
PFD	-1	02142	19:30:44	35	58.2	-75	52.4	spiral dn @ S 1200 m - 15 m
	0	02691	19:39:53	35	60.0	-75	52.6	
SAN	-1	02698	19:40:00	36	00.1	-75	52.7	slant profile 15 m - 900 m S-N
	0	03019	19:45:21	36	07.0	-75	57.1	
FLS	-1	03267	19:49:29	36	09.5	-75	59.3	900 m N-S
	0	03588	19:54:50	36	00.8	-75	52.5	
SDN	-1	03722	19:57:04	35	59.4	-75	51.5	slant profile 900 m - 15 m S-N
	0	04191	20:04:53	36	09.7	-75	59.3	
PFA	-1	04192	20:04:54	36	09.7	-75	59.3	spiral up @ N 15 m - 900 m
	0	04392	20:08:14	36	09.0	-75	59.1	
SDS	-1	04394	20:08:16	36	08.9	-75	59.1	slant profile 900 m - 15 m N-S
	0	04766	20:14:28	35	58.9	-75	51.2	
PFA	-1	04767	20:14:29	35	58.9	-75	51.1	spiral up @ S 15 m - 900 m
	0	05040	20:19:02	35	59.6	-75	51.4	
FLN	-1	05075	20:19:37	36	00.2	-75	52.2	750 m S-N
	0	05512	20:26:54	36	09.7	-75	59.2	
PFD	-1	05588	20:28:10	36	09.3	-75	59.7	spiral dn @ N 750 m - 15 m
	0	06045	20:35:47	36	08.9	-75	58.8	
FLS	-1	06059	20:36:01	36	08.6	-75	58.5	15 m N-S
	0	06349	20:40:51	36	01.0	-75	52.6	
FLE	-1	06712	20:46:54	36	05.1	-75	56.8	W-E 60 m
	0	07056	20:52:38	36	09.6	-75	47.4	
FLW	-1	07154	20:54:16	36	09.7	-75	47.4	E-W 60 m
	0	07411	20:58:33	36	04.7	-75	55.5	
SA	-1	07451	20:59:13	36	03.5	-75	55.2	slant profile 15 m - 1200 m
	0	07748	21:04:10	36	03.1	-75	45.6	
SD	-1	07779	21:04:41	36	03.4	-75	44.6	slant profile 1200 m - 15 m
	0	08298	21:13:20	35	58.5	-75	43.6	
TXI	-1	08653	21:19:15	36	01.2	-75	40.2	taxi
	0	08678	21:19:40	36	01.1	-75	40.3	
VNT	-1	08748	21:20:50	36	00.8	-75	40.3	ventilation
	0	08768	21:21:10	36	00.8	-75	40.3	

Marker for D:\03081853.ORG CLOSED at 163276

Total scans : 08773  
Missed Ints : 00000  
BAT Dropouts: -000.005%  
NOV Dropouts: 003.617%  
TAN Dropouts: 001.824%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 14  
Date: 09 MAR 99 (Tuesday)  
Duration: 2.1 Hours  
Pilot: TLC

Weather: Low clouds, NE wind (20 deg) at 5 m/s, cool temperatures, about 3 C.

Summary: Abbreviated Butterfly @ start and end, then parallel legs west of Duck over Currituck sound.

WP-U 36 13.0 N, 75 47.0 W  
W-D 36 7.7 N, 75 44.5 W

Problems: System crash at start, no serious problems thereafter. Laser #2 and Ka-band radar not working.

Marker for D:\03091344.ORG OPENED at 223765

VNT -1 00004 14:09:28 36 00.9 -75 40.3 ventilation  
0 00058 14:10:22 36 00.9 -75 40.3  
TXI -1 00399 14:16:03 36 00.7 -75 40.4 taxi  
0 00415 14:16:19 36 01.2 -75 40.3  
SA -1 01002 14:26:06 35 59.9 -75 37.8 pro FFA to D  
0 01452 14:33:36 36 10.4 -75 45.6

Data system crash

Marker for D:\03091344.ORG CLOSED at 225352

Total scans : 01586  
Missed Ints : 00001  
BAT Dropouts: 000.067%  
NOV Dropouts: 001.620%  
TAN Dropouts: 001.614%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 14  
Date: 09 MAR 99 (Tuesday)  
Duration: 2.1 Hours  
Pilot: TLC



Weather: Low clouds, NE wind (20 deg) at 5 m/s, cool temperatures, about 3 C.

Summary: Abbreviated Butterfly @ start and end, then parallel legs west of Duck over Currituck sound.

WP-U 36 13.0 N, 75 47.0 W

W-D 36 7.7 N, 75 44.5 W

Problems: System crash at start, no serious problems thereafter. Laser #2 and Ka-band radar not working.

Marker for D:\03091436.ORG OPENED at 225562

SD	-1	00003	14:39:24	36	14.4	-75	47.1	slant down from 600 m
	0	00218	14:42:59	36	08.0	-75	44.9	
SA	-1	00326	14:44:47	36	07.5	-75	44.8	slant up to 600 m
	0	00586	14:49:07	36	14.1	-75	47.2	
FL	-1	00791	14:52:32	36	14.2	-75	46.8	parallel +0.5 km
	0	00986	14:55:47	36	08.3	-75	44.9	
FL	-1	01145	14:58:26	36	07.9	-75	44.8	parallel +0.5 km
	0	01370	15:02:11	36	13.8	-75	46.5	
FL	-1	01512	15:04:33	36	13.1	-75	47.0	parallel +1 km
	0	01714	15:07:55	36	07.8	-75	45.5	
FL	-1	01867	15:10:28	36	07.3	-75	45.9	parallel +2 km
	0	02088	15:14:09	36	12.7	-75	47.9	
FL	-1	02244	15:16:45	36	12.7	-75	49.4	parallel +4 km
	0	02458	15:20:19	36	06.8	-75	46.9	
FL	-1	02525	15:21:26	36	07.4	-75	46.0	parallel +2 km
	0	02736	15:24:57	36	12.9	-75	48.4	
FL	-1	02873	15:27:14	36	13.2	-75	47.8	parallel +1 km
	0	03068	15:30:29	36	07.8	-75	45.3	
FL	-1	03203	15:32:44	36	07.8	-75	44.8	parallel +0.5 km
	0	03425	15:36:26	36	13.5	-75	46.5	
FL	-1	03519	15:38:00	36	13.5	-75	47.6	parallel +1 km
	0	03732	15:41:33	36	07.8	-75	45.2	
FL	-1	03869	15:43:50	36	07.9	-75	46.0	parallel +2 km
	0	04076	15:47:17	36	13.0	-75	48.4	
FL	-1	04159	15:48:40	36	12.1	-75	49.4	parallel +4 km
	0	04345	15:51:46	36	07.2	-75	46.7	
SA	-1	04510	15:54:31	36	06.0	-75	46.5	slant up to 600 m
	0	04781	15:59:02	36	12.7	-75	49.4	
SA	-1	04948	16:01:49	36	14.1	-75	50.0	slant up to 1500 m at FFA
	0	05400	16:09:21	36	02.5	-75	43.1	
TXI	-1	05707	16:14:28	36	01.1	-75	40.3	taxi
	0	05720	16:14:41	36	01.2	-75	40.2	
VNT	-1	05845	16:16:46	36	00.8	-75	40.3	ventilation
	0	05888	16:17:29	36	00.8	-75	40.3	

Marker for D:\03091436.ORG CLOSED at 231455

Total scans : 05893

Missed Ints : 00000  
BAT Dropouts: -000.006%  
NOV Dropouts: 001.539%  
TAN Dropouts: 001.369%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 15  
Date: 10 MAR 99 (Wednesday)  
Duration: 3.2 Hours  
Pilot: TLC

Weather: Low clouds, north wind at 10 m/s, cool temperatures, about 3 C.  
There is a bit of an on-shore flow.

Summary: Two abbreviated Butterfly @ middle then parallel legs E of Duck, surf zone about 100 m and 2 transects down center made. Parallel run was conducted to off-shore distance of 8 km. Two simplified butterfly soundings were done at the shore-line and 8 km off-shore. A surf-zone run was included.

Problems: System crash half way into flight, no serious problems thereafter.  
Laser #2 and Ka-band radar not working.

Marker for D:\03101811.ORG OPENED at 325112

VNT	-1	00003	18:18:34	36	00.8	-75	40.3	ventilation
	0	00061	18:19:32	36	00.8	-75	40.3	
SD	-1	00149	18:21:00	36	00.9	-75	40.3	down profile FFA to pier
	0	00179	18:21:30	36	01.5	-75	40.4	
VNT	-1	00521	18:27:12	36	02.1	-75	36.1	ventilation
	0	00838	18:32:29	36	08.7	-75	42.7	
SAN	-1	00842	18:32:33	36	08.7	-75	42.8	up profile S to N near pier
	0	01034	18:35:45	36	13.2	-75	45.1	
SAS	-1	01212	18:38:43	36	14.1	-75	46.1	up profile N to S near pier
	0	01418	18:42:09	36	07.4	-75	42.2	
FLN	-1	01570	18:44:41	36	03.9	-75	41.1	SP to NP
	0	02142	18:54:13	36	16.9	-75	46.2	
FLS	-1	02206	18:55:17	36	16.2	-75	47.2	NP to SP just off pier
	0	02516	19:00:27	36	06.1	-75	42.5	
FLN	-1	02682	19:03:13	36	06.2	-75	42.7	in surf zone
	0	03164	19:11:15	36	16.8	-75	47.5	
FLS	-1	03256	19:12:47	36	17.3	-75	45.6	N2 to S2 +1 km
	0	03623	19:18:54	36	05.4	-75	41.3	
FLN	-1	03722	19:20:33	36	05.6	-75	40.5	S2 to N2 +2 km
	0	04263	19:29:34	36	16.8	-75	44.6	
FLS	-1	04342	19:30:53	36	16.5	-75	43.0	N3 to S3 +4 km
	0	04650	19:36:01	36	06.1	-75	39.5	

Marker for D:\03101811.ORG CLOSED at 329945

Total scans : 04832  
Missed Ints : 00001  
BAT Dropouts: 000.333%  
NOV Dropouts: 004.089%  
TAN Dropouts: 004.071%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 15  
Date: 10 MAR 99 (Wednesday)  
Duration: 3.2 Hours  
Pilot: TLC

Weather: Low clouds, north wind at 10 m/s, cool temperatures, about 3 C.  
There is a bit of an on-shore flow.

Summary: Two abbreviated Butterfly @ middle then parallel legs E of Duck, surf zone about 100 m and 2 transects down center made. Parallel run was conducted to off-shore distance of 8 km. Two simplified butterfly soundings were done at the shore-line and 8 km off-shore. A surf-zone run was included.

Problems: System crash half way into flight, no serious problems thereafter.  
Laser #2 and Ka-band radar not working.

Marker for D:\03101940.ORG OPENED at 330147

FLN	-1	00002	19:42:28	36	06.1	-75	36.0	S4 to N4	+8 km
		0	00569	19:51:55	36	18.0	-75	39.9	
SAN	-1	00710	19:54:16	36	18.9	-75	40.3	up profile S to N @	+8 km
		0	01007	19:59:13	36	09.4	-75	36.0	
SAS	-1	01212	20:02:38	36	08.2	-75	37.1	up profile N to S @	+8 km
		0	01625	20:09:31	36	15.9	-75	40.3	
FLS	-1	01899	20:14:05	36	19.6	-75	39.9	N4 to S4	
		0	02277	20:20:23	36	06.5	-75	35.5	
FLN	-1	02462	20:23:28	36	05.8	-75	39.7	S3 to N3	
		0	02963	20:31:49	36	17.1	-75	43.5	
FLS	-1	03040	20:33:06	36	16.6	-75	44.8	N2 to S2	
		0	03362	20:38:28	36	05.9	-75	41.2	
FLN	-1	03499	20:40:45	36	03.8	-75	40.9	S1 to N1	
		0	04083	20:50:29	36	16.8	-75	45.4	
FLS	-1	04165	20:51:51	36	15.9	-75	45.7	NP to SP	
		0	04470	20:56:56	36	06.1	-75	42.2	
FLN	-1	04634	20:59:40	36	05.7	-75	42.3	S to N off pier	
		0	05112	21:07:38	36	16.9	-75	47.4	
FLS	-1	05193	21:08:59	36	16.6	-75	47.4	N to S in surf	
		0	05510	21:14:16	36	06.5	-75	42.9	
SAS	-1	05514	21:14:20	36	06.4	-75	42.8	up S to FFA	
		0	05662	21:16:48	36	01.9	-75	40.3	
TXI	-1	05865	21:20:11	36	01.2	-75	40.3	taxi	

0 05876 21:20:22 36 01.3 -75 40.2  
VNT -1 06141 21:24:47 36 00.8 -75 40.3 ventilation  
0 06160 21:25:06 36 00.8 -75 40.3

Marker for D:\03101940.ORG CLOSED at 336309

Total scans : 06162  
Missed Ints : 00000  
BAT Dropouts: -000.006%  
NOV Dropouts: 002.345%  
TAN Dropouts: 002.994%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 16  
Date: 11 March 99 (Thursday)  
Duration: 3.7 Hours  
Pilot: TLC

Weather: Sunny, temperature of 8 C with NW wind (310) at 8 m/s.

Summary: Parallel runs and target run.

Problems: Laser #2 and Ka-band radar not working.

Marker for D:\03111315.ORG OPENED at 394463

TXI -1 00203 13:37:45 36 00.9 -75 40.4 taxi  
0 00213 13:37:55 36 01.2 -75 40.3  
SD -1 00538 13:43:20 35 54.6 -75 35.9 slant 1200 m - 15 m FFA-PS  
0 01097 13:52:39 36 06.1 -75 42.5  
XXX -1 01098 13:52:40 36 06.2 -75 42.5  
0 01485 13:59:07 36 14.1 -75 46.1  
XXX -1 01673 14:02:15 36 15.7 -75 46.4  
0 01965 14:07:07 36 06.9 -75 42.5  
XXX -1 02282 14:12:24 36 06.1 -75 42.3  
EVT 02513 14:16:15 36 11.0 -75 44.7  
0 02817 14:21:19 36 17.6 -75 47.6  
XXX -1 03084 14:25:46 36 17.0 -75 47.6  
EVT 03290 14:29:12 36 11.0 -75 44.9  
0 03449 14:31:51 36 06.3 -75 42.7  
XXX -1 03546 14:33:28 36 06.9 -75 42.3  
0 03954 14:40:16 36 15.9 -75 45.7  
XXX -1 04073 14:42:15 36 16.3 -75 44.8  
0 04428 14:48:10 36 05.4 -75 41.4  
XXX -1 04510 14:49:32 36 05.7 -75 40.7  
0 05020 14:58:02 36 17.0 -75 44.7  
XXX -1 05115 14:59:37 36 16.6 -75 43.0  
0 05490 15:05:52 36 05.1 -75 39.3  
XXX -1 05643 15:08:25 36 05.4 -75 35.2

0	06215	15:17:57	36	17.8	-75	40.1	
XXX	-1	06330	15:19:52	36	18.7	-75	40.3
0	06715	15:26:17	36	07.1	-75	34.8	
XXX	-1	06943	15:30:05	36	05.2	-75	34.6
0	07317	15:36:19	36	12.7	-75	38.9	
XXX	-1	07567	15:40:29	36	16.1	-75	39.2
0	07902	15:46:04	36	06.0	-75	35.4	
XXX	-1	08065	15:48:47	36	04.1	-75	39.0
0	08643	15:58:25	36	17.4	-75	43.4	
XXX	-1	08716	15:59:38	36	16.7	-75	44.6
0	09065	16:05:27	36	06.1	-75	40.6	
XXX	-1	09167	16:07:09	36	05.1	-75	41.0
0	09669	16:15:31	36	16.5	-75	45.4	
XXX	-1	09809	16:17:51	36	17.1	-75	45.9
0	10165	16:23:47	36	06.1	-75	42.1	
XXX	-1	10287	16:25:49	36	04.6	-75	41.4
0	10774	16:33:56	36	15.4	-75	46.9	
XXX	-1	10861	16:35:23	36	15.4	-75	47.0
EVT		11007	16:37:49	36	11.2	-75	45.1
EVT		11014	16:37:56	36	11.0	-75	45.0
0	11180	16:40:42	36	06.3	-75	42.7	
XXX	-1	11464	16:45:26	36	11.0	-75	44.5
0	11819	16:51:21	36	13.5	-75	32.3	
XXX	-1	12016	16:54:38	36	13.7	-75	31.5
0	12433	17:01:35	36	10.9	-75	44.9	
ERR		12482	17:02:25				BAT time new
SA	-1	12496	17:02:38	36	09.7	-75	44.3 pier-FFA profile
0	12706	17:06:08	36	03.9	-75	41.5	
TXI	-1	13050	17:11:52	36	01.2	-75	40.2 taxi
0	13060	17:12:02	36	01.3	-75	40.2	
VNT	-1	13201	17:14:23	36	00.8	-75	40.3 ventilation
0	13243	17:15:05	36	00.8	-75	40.3	

Marker for D:\03111315.ORG CLOSED at 407709

Total scans : 13246  
 Missed Ints : 00000  
 BAT Dropouts: 000.018%  
 NOV Dropouts: 001.163%  
 TAN Dropouts: 002.080%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 17  
 Date: 11 MAR 99 (Thursday)  
 Duration: 3.8 Hours  
 Pilot: EJD

Weather: Sunny, NNW wind at 5 m/s, cool temperatures, about 1 C.

Summary: Flew parallel patterns over Lake Matamuskeet (35 SW of FFA).

Problems: Laser #2 and Ka-band radar not working.

Marker for D:\03111810.ORG OPENED at 411098

VNT	-1	00005	18:11:42	36	00.8	-75	40.4	ventilation
	0	00022	18:11:59	36	00.8	-75	40.3	
SA	-1	00138	18:13:55	36	01.7	-75	40.1	profile sfc - 1500 m
	0	00981	18:27:58	35	35.6	-75	48.8	
SD	-1	00990	18:28:07	35	35.4	-75	49.1	profile 1500 m - sfc
	0	01645	18:39:02	35	31.9	-76	11.0	
FL	-1	01837	18:42:14	35	33.3	-76	06.4	150 m shore run
	0	02076	18:46:13	35	31.7	-76	13.2	
FLW	-1	02195	18:48:12	35	31.1	-76	12.3	0.9 km, 15 m E-W
	0	02343	18:50:40	35	33.3	-76	07.6	
FL	-1	02985	19:01:22	35	30.3	-76	10.4	
	0	03116	19:03:33	35	31.5	-76	05.9	
FLE	-1	03187	19:04:44	35	32.2	-76	06.5	1.8 km, 15 m W-E
	0	03352	19:07:29	35	30.1	-76	11.5	
FLE	-1	03475	19:09:32	35	29.2	-76	10.9	3.7 km, 15 m W-E
	0	03627	19:12:04	35	31.2	-76	05.8	
FLW	-1	03773	19:14:30	35	29.6	-76	06.3	7.4 km, 15 m E-W
	0	03922	19:16:59	35	28.2	-76	11.1	
FLE	-1	04078	19:19:35	35	28.7	-76	11.2	7.4 km, 15 m W-E
	0	04228	19:22:05	35	30.4	-76	06.3	
FLW	-1	04363	19:24:20	35	31.3	-76	05.5	3.7 km, 15 m E-W
	0	04542	19:27:19	35	29.2	-76	11.0	
FLE	-1	04651	19:29:08	35	30.2	-76	11.2	1.8 km, 15 m W-E
	0	04807	19:31:44	35	31.6	-76	05.5	
FLW	-1	04936	19:33:53	35	31.8	-76	06.1	0.9 km, 15 m E-W
	0	05124	19:37:01	35	31.0	-76	12.3	
FLE	-1	05322	19:40:19	35	31.6	-76	11.7	0.9 km, 15 m W-E
	0	05429	19:42:06	35	33.0	-76	08.1	
SA	-1	05448	19:42:25	35	33.4	-76	07.7	profile sfc - 1500 m @ E
	0	05876	19:49:33	35	32.0	-76	04.8	
SD	-1	06730	20:03:47	35	31.7	-76	05.7	profile 1500 m - sfc @ E
	0	07238	20:12:15	35	32.0	-76	06.8	
FLW	-1	07240	20:12:17	35	32.0	-76	06.9	1.8 km, 15 m E-W
	0	07390	20:14:47	35	30.1	-76	11.6	
FLE	-1	07454	20:15:51	35	29.2	-76	10.7	3.7 km, 15 m W-E
	0	07598	20:18:15	35	31.2	-76	05.9	
FLW	-1	07697	20:19:54	35	29.9	-76	05.4	5.6 km, 15 m E-W
	0	07857	20:22:34	35	28.3	-76	10.5	
FLE	-1	07982	20:24:39	35	28.3	-76	10.7	5.6 km, 15 m W-E
	0	08150	20:27:27	35	30.7	-76	05.2	
FLW	-1	08247	20:29:04	35	31.7	-76	06.4	3.7 km, 15 m E-W
	0	08411	20:31:48	35	29.2	-76	11.0	
FLE	-1	08484	20:33:01	35	30.4	-76	11.2	1.8 km, 15 m W-E
	0	08625	20:35:22	35	32.0	-76	06.3	
FLW	-1	08763	20:37:40	35	31.6	-76	07.6	1.8 km, 15 m E-W

0 08893 20:39:50 35 30.1 -76 11.5  
FLE -1 08964 20:41:01 35 29.0 -76 10.8 3.7 km, 15 m W-E  
0 09118 20:43:35 35 31.2 -76 05.9  
FLW -1 09210 20:45:07 35 29.9 -76 06.0 5.6 km, 15 m E-W  
0 09353 20:47:30 35 28.3 -76 10.4

Data system crash

Marker for D:\03111810.ORG CLOSED at 420616

Total scans : 09517  
Missed Ints : 00001  
BAT Dropouts: -000.016%  
NOV Dropouts: 003.845%  
TAN Dropouts: 001.606%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 17  
Date: 11 MAR 99 (Thursday)  
Duration: 3.8 Hours  
Pilot: EJD

Weather: Sunny, NNW wind at 5 m/s, cool temperatures, about 1 C.

Summary: Flew parallel patterns over Lake Matamuskeet (35 SW of FFA).

Problems: Laser #2 and Ka-band radar not working.

Marker for D:\03112051.ORG OPENED at 420812

FLE -1 00024 20:53:55 35 28.2 -76 10.6 5.6 km, 90 m W-E  
0 00178 20:56:29 35 30.3 -76 05.4  
FLW -1 00265 20:57:56 35 31.4 -76 06.1 3.7 km, 90 m E-W  
0 00431 21:00:42 35 29.2 -76 11.0  
FLE -1 00533 21:02:24 35 30.1 -76 11.4 1.8 km, 90 m W-E  
0 00680 21:04:51 35 32.3 -76 06.4  
SA -1 00682 21:04:53 35 32.3 -76 06.4 profile sfc - 1500 m @ E  
0 01430 21:17:21 35 33.6 -75 53.5  
SD -1 01607 21:20:18 35 35.4 -75 47.4 slant profile 1500 m - sfc to MQI  
0 02428 21:33:59 35 56.6 -75 46.9  
TXI -1 02796 21:40:07 35 55.3 -75 41.9 taxi  
0 02829 21:40:40 35 55.2 -75 42.0  
VNT -1 02854 21:41:05 35 55.2 -75 42.0 ventilation  
0 02876 21:41:27 35 55.2 -75 42.0

Marker for D:\03112051.ORG CLOSED at 423694

Total scans : 02882  
Missed Ints : 00000  
BAT Dropouts: -000.005%

NOV Dropouts: 007.988%  
TAN Dropouts: 001.017%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 18  
Date: 12 MAR 99 (Friday)  
Duration: 3.5 Hours  
Pilot: EJD

Weather: Clear skies, N wind 5-10 m/s, cool temperatures, about 8 C.

Summary: Lake Mattamuskeet flight at 1.8, 3.7, and 5.6 km parallel to N shore to study the internal boundary layer off-shore. Water temperature at the Mattamuskeet National Wildlife Refuge was measured with two simple thermometers. The lake temperature is very homogeneous, about 7 C. Close to the shore line the temperature rises to 9 C. The lake is very shallow, the deepest part is about 1.5 m.

Problems: IRGA changed from AC2 to AC3 this flight. Laser #2 and Ka-band radar not working.

Marker for D:\03121556.ORG OPENED at 490142

VNT	-1	00006	16:09:07	36	00.8	-75	40.3	ventilation
	0	00095	16:10:36	36	00.8	-75	40.3	
SA	-1	00317	16:14:18	36	01.6	-75	40.1	slant profile sfc - 1800 m
	0	00718	16:20:59	35	50.6	-75	41.5	
SD	-1	01126	16:27:47	35	35.0	-75	49.8	slant profile 1800 m - sfc
	0	01798	16:38:59	35	30.5	-76	13.2	
FLE	-1	01881	16:40:22	35	31.6	-76	11.9	0.9 km dog-leg track 30 m W-E
	0	02012	16:42:33	35	33.0	-76	07.0	
FLW	-1	02343	16:48:04	35	31.8	-76	06.0	1.8 km, 30 m E-W
	0	02527	16:51:08	35	30.1	-76	11.7	
FLE	-1	02598	16:52:19	35	29.1	-76	10.8	3.7 km, 30 m W-E
	0	02753	16:54:54	35	31.3	-76	05.8	
FLW	-1	02875	16:56:56	35	30.1	-76	05.3	5.6 km, 30 m E-W
	0	03043	16:59:44	35	28.3	-76	10.4	
FLE	-1	03171	17:01:52	35	28.2	-76	10.6	5.6 km, 30 m W-E
	0	03341	17:04:42	35	30.7	-76	05.1	
FLW	-1	03408	17:05:49	35	31.3	-76	06.1	3.7 km, 30 m E-W
	0	03573	17:08:34	35	29.1	-76	11.0	
FLE	-1	03662	17:10:03	35	30.3	-76	11.5	1.8 km, 30 m W-E
	0	03810	17:12:31	35	32.1	-76	06.4	
SA	-1	03827	17:12:48	35	32.5	-76	05.9	profile sfc - 1500 m @ E
	0	04235	17:19:36	35	30.8	-76	04.1	
SD	-1	04304	17:20:45	35	29.7	-76	05.2	profile 1500 m - sfc @ E
	0	05110	17:34:11	35	31.7	-76	06.6	
FLW	-1	05123	17:34:24	35	31.6	-76	07.0	1.8 km, 30 m E-W
	0	05280	17:37:01	35	29.7	-76	11.8	



FLE	-1	05343	17:38:04	35	29.0	-76	10.5	3.7 km, 30 m W-E
	0	05491	17:40:32	35	31.3	-76	05.9	
FLW	-1	05578	17:41:59	35	30.0	-76	05.2	5.6 km, 30 m E-W
	0	05745	17:44:46	35	28.2	-76	10.4	
FLE	-1	05844	17:46:25	35	28.1	-76	10.6	5.6 km, 100 m W-E
	0	06011	17:49:12	35	30.5	-76	05.2	
FLW	-1	06088	17:50:29	35	31.2	-76	06.0	3.7 km, 100 m E-W
	0	06263	17:53:24	35	28.9	-76	11.0	
FLE	-1	06359	17:55:00	35	30.3	-76	11.4	1.8 km, 100 m W-E
	0	06510	17:57:31	35	32.3	-76	06.4	
SA	-1	06516	17:57:37	35	32.4	-76	06.3	slant profile 90 - 1400 m
	0	06951	18:04:52	35	32.4	-76	07.8	
SD	-1	06983	18:05:24	35	32.0	-76	08.7	slant profile 1400 - 90 m
	0	07551	18:14:52	35	31.6	-76	06.5	
FLW	-1	07554	18:14:55	35	31.6	-76	06.6	1.8 km, 30 m E-W
	0	07710	18:17:31	35	30.1	-76	11.5	
FLE	-1	07792	18:18:53	35	29.1	-76	10.3	3.7 km, 30 m W-E
	0	07933	18:21:14	35	31.2	-76	05.9	
FLW	-1	08011	18:22:32	35	30.0	-76	05.7	5.6 km, 30 m E-W
	0	08164	18:25:05	35	28.2	-76	10.4	
FLE	-1	08294	18:27:15	35	28.1	-76	10.2	5.6 km, 30 m W-E
	0	08449	18:29:50	35	30.4	-76	05.5	
FLW	-1	08507	18:30:48	35	31.0	-76	06.0	3.7 km, 30 m E-W
	0	08672	18:33:33	35	29.1	-76	10.9	
FLE	-1	08765	18:35:06	35	30.2	-76	11.2	1.8 km, 30 m W-E
	0	08890	18:37:11	35	31.8	-76	07.0	
FLW	-1	09121	18:41:02	35	31.5	-76	07.7	1.8 km, 100 m E-W
	0	09245	18:43:06	35	30.0	-76	11.5	
FLE	-1	09313	18:44:14	35	29.1	-76	10.5	3.7 km, 100 m W-E
	0	09471	18:46:52	35	31.8	-76	05.9	
FLW	-1	09571	18:48:32	35	30.1	-76	05.3	5.6 km, 100 m E-W
ERR		09655	18:49:57					BAT time new
	0	09737	18:51:18	35	28.1	-76	10.3	
SA	-1	09807	18:52:28	35	29.3	-76	10.6	slant profile 90 - 2000 m
	0	10295	19:00:36	35	33.9	-75	54.1	
SD	-1	10566	19:05:07	35	40.5	-75	45.1	slant profile 2000 m - sfc

Data system crash

Marker for D:\03121556.ORG CLOSED at 501531

Total scans : 11389  
 Missed Ints : 00000  
 BAT Dropouts: 002.293%  
 NOV Dropouts: 003.780%  
 TAN Dropouts: 001.281%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 19  
 Date: 13 MAR 99 (Saturday)

Duration: 3.5 Hours

Pilot: TLC

Weather: High clouds, clear below 3000 m, light and variable NNW wind, cool cool temperatures. Not much wind, lake was very smooth.

Summary: Lake Mattamuskeet flight perpendicular and parallel to north shore. In addition to the traditional parallel runs at 1, 2, and 4 km off northern shore, a stack flight pattern along a perpendicular to shore track was done at 20, 40, 80, 160, and 320 m. Navigation difficult on parallel runs due to poor way points.

Problems: Laser #2 and Ka-band radar not working.

Marker for D:\03131533.ORG OPENED at 576703

VNT	-1	00009	16:11:51	36	00.8	-75	40.3	ventilation
	0	00050	16:12:32	36	00.8	-75	40.3	
TXI	-1	00105	16:13:27	36	00.9	-75	40.3	taxi
	0	00125	16:13:47	36	01.3	-75	40.2	
SDS	-1	01552	16:37:34	35	35.2	-75	50.1	
	0	02225	16:48:47	35	33.8	-76	14.1	
FLS	-1	02487	16:53:09	35	33.4	-76	07.8	N to S @ 20 m
	0	02634	16:55:36	35	28.8	-76	07.3	
FLN	-1	02778	16:58:00	35	28.9	-76	07.4	S to N @ 40 m
	0	02944	17:00:46	35	33.9	-76	08.6	
FLS	-1	03088	17:03:10	35	34.7	-76	08.6	N to S @ 80 m
	0	03298	17:06:40	35	28.3	-76	07.5	
FLN	-1	03487	17:09:49	35	28.5	-76	07.2	S to N @ 160 m
	0	03708	17:13:30	35	35.0	-76	07.3	
FLS	-1	03920	17:17:02	35	35.6	-76	07.0	N to S @ 320 m
EVT		03987	17:18:09	35	33.5	-76	06.8	
EVT		04134	17:20:36	35	29.2	-76	06.8	
	0	04161	17:21:03	35	28.4	-76	06.8	
FLS	-1	04310	17:23:32	35	27.4	-76	06.9	N to S @ 320 m
EVT		04365	17:24:27	35	28.9	-76	07.1	
ERR		04528	17:27:11					GPS Time Reset!
	0	04565	17:27:48	35	34.5	-76	07.1	
FLN	-1	04714	17:30:17	35	35.6	-76	06.9	S to N @ 160 m
EVT		04938	17:34:01	35	29.0	-76	07.0	
	0	04950	17:34:13	35	28.7	-76	07.1	
FLN	-1	05162	17:37:45	35	27.2	-76	06.5	S to N @ 80 m
	0	05439	17:42:22	35	35.1	-76	07.0	
FLS	-1	05604	17:45:07	35	35.6	-76	06.6	N to S @ 40 m
EVT		05669	17:46:12	35	33.5	-76	07.0	
EVT		05824	17:48:47	35	29.0	-76	07.1	
	0	05832	17:48:55	35	28.7	-76	07.1	
FLN	-1	06039	17:52:22	35	28.3	-76	06.8	S to N @ 20 m
EVT		06218	17:55:21	35	33.6	-76	07.3	
	0	06272	17:56:15	35	35.1	-76	07.3	
PFA	-1	06418	17:58:41	35	32.2	-76	06.6	spiral profile

	0	07107	18:10:10	35	29.7	-76	08.9	
FLW	-1	07390	18:14:53	35	32.5	-76	05.4	N shore +50 m
	0	07665	18:19:28	35	31.6	-76	14.0	
FLE	-1	07738	18:20:41	35	31.3	-76	14.4	N shore +500 m
	0	07978	18:24:41	35	32.9	-76	06.5	
FLW	-1	08072	18:26:15	35	31.9	-76	07.1	N shore +1 km
	0	08257	18:29:20	35	29.5	-76	12.6	
FLE	-1	08425	18:32:08	35	29.7	-76	12.4	N shore +1 km
	0	08623	18:35:26	35	32.5	-76	06.6	
FLW	-1	08770	18:37:53	35	32.5	-76	06.3	N shore +2 km
	0	08982	18:41:25	35	29.7	-76	13.0	
FLE	-1	09049	18:42:32	35	30.3	-76	12.7	N shore +4 km
	0	09245	18:45:48	35	33.1	-76	06.9	
FLW	-1	09337	18:47:20	35	33.1	-76	06.3	N shore +4 km
	0	09565	18:51:08	35	31.7	-76	13.1	
FLE	-1	09645	18:52:28	35	31.2	-76	12.4	N shore +2 km
	0	09839	18:55:42	35	33.2	-76	06.5	
FLW	-1	09899	18:56:42	35	32.2	-76	06.3	N shore +1 km
	0	10106	19:00:09	35	29.6	-76	12.7	
FLE	-1	10188	19:01:31	35	30.5	-76	12.7	N shore +1 km
	0	10395	19:04:58	35	33.3	-76	06.9	
FLW	-1	10492	19:06:35	35	33.3	-76	06.5	N shore +50 m
	0	10712	19:10:15	35	31.8	-76	13.1	
SAN	-1	10819	19:12:02	35	30.1	-76	11.2	
	0	11046	19:15:49	35	27.7	-76	04.2	
SDN	-1	11631	19:25:34	35	45.6	-75	42.8	
	0	12084	19:33:07	36	00.8	-75	40.4	
TXI	-1	12110	19:33:33	36	01.1	-75	40.2	taxi
	0	12122	19:33:45	36	01.3	-75	40.2	
VNT	-1	12624	19:42:07	36	00.8	-75	40.3	ventilation
	0	12664	19:42:47	36	00.8	-75	40.3	

Marker for D:\03131533.ORG CLOSED at 589372

Total scans : 12668  
 Missed Ints : 00001  
 BAT Dropouts: 000.009%  
 NOV Dropouts: 002.347%  
 TAN Dropouts: 001.595%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 20  
 Date: 16 MAR 99 (Tuesday)  
 Duration: 3.6 Hours  
 Pilot: TLC

Weather: Clear, west wind 3 m/s switching to south 5 m/s, 9 C and warming.

Summary: Two perpendicular & many parallel east of Duck Pier. Two

soundings, one close to the shore and one at 20 km off-shore was done.

Problems: IRGA not working. Laser #2 and Ka-band radar not working.

Marker for D:\03161717.ORG OPENED at 235155

VNT	-1	00004	17:19:18	36	00.8	-75	40.3	ventilation
	0	00171	17:22:05	36	00.8	-75	40.4	
TXI	-1	00193	17:22:27	36	00.9	-75	40.3	taxi
	0	00292	17:24:06	36	00.3	-75	41.5	
SA	-1	00528	17:28:02	35	59.3	-75	38.1	slant sounding 1200 m FFA to pier
ERR		00768	17:32:03					GPS Time Reset!
	0	01006	17:36:01	36	11.1	-75	43.9	
SDS	-1	01018	17:36:13	36	11.3	-75	44.0	slant sounding 1200 m headed S
	0	01343	17:41:38	36	17.9	-75	47.1	
SDN	-1	01388	17:42:23	36	17.5	-75	47.6	slant sounding 1200 m headed N
	0	01827	17:49:42	36	06.1	-75	41.3	
FLE	-1	02226	17:56:21	36	10.9	-75	45.1	
	0	02575	18:02:10	36	13.7	-75	32.7	
FLW	-1	02746	18:05:01	36	13.9	-75	31.6	
	0	03123	18:11:18	36	10.9	-75	45.1	
FLN	-1	03385	18:15:40	36	06.5	-75	42.8	over east edge of surf
EVT		03549	18:18:24	36	11.0	-75	44.9	
	0	03748	18:21:43	36	16.6	-75	47.4	
FLS	-1	03892	18:24:07	36	17.5	-75	47.3	about 0.7 km off shore
	0	04320	18:31:15	36	06.3	-75	42.4	
FLN	-1	04493	18:34:08	36	05.2	-75	41.9	
	0	04900	18:40:55	36	16.5	-75	46.1	
FLS	-1	05027	18:43:02	36	17.5	-75	45.4	
	0	05473	18:50:28	36	05.9	-75	41.5	
FLN	-1	05546	18:51:41	36	06.5	-75	40.7	
	0	05914	18:57:49	36	17.0	-75	44.8	
FLS	-1	05991	18:59:06	36	17.4	-75	43.4	
	0	06413	19:06:08	36	06.5	-75	39.8	
FLN	-1	06541	19:08:16	36	07.3	-75	36.4	
	0	06901	19:14:16	36	18.0	-75	40.3	
FLS	-1	07055	19:16:50	36	20.2	-75	40.9	
	0	07538	19:24:53	36	07.6	-75	35.7	
FLN	-1	07738	19:28:13	36	05.3	-75	35.4	
	0	08156	19:35:11	36	16.6	-75	39.7	
FLS	-1	08329	19:38:04	36	18.9	-75	40.2	
	0	08777	19:45:32	36	07.3	-75	36.2	
FLN	-1	08923	19:47:58	36	06.0	-75	39.6	
	0	09328	19:54:43	36	17.2	-75	43.4	
FLS	-1	09402	19:55:57	36	16.7	-75	44.5	
	0	09790	20:02:25	36	06.1	-75	40.9	
FLN	-1	09901	20:04:16	36	05.3	-75	41.4	
	0	10310	20:11:05	36	16.6	-75	45.1	
FLS	-1	10436	20:13:11	36	17.1	-75	45.8	
	0	10832	20:19:47	36	06.3	-75	42.3	

FLN -1 10954 20:21:49 36 05.3 -75 41.9  
       0 11365 20:28:40 36 16.4 -75 47.1  
 FLS -1 11462 20:30:17 36 17.0 -75 47.6  
 EVT 11693 20:34:08 36 10.9 -75 44.9  
 ERR 11765 20:35:21 GPS Time Reset!  
       0 11860 20:36:56 36 06.6 -75 42.8  
 SAS -1 11863 20:36:59 36 06.5 -75 42.8 slant sounding to FFA  
       0 12126 20:41:22 36 00.4 -75 37.1  
 TXI -1 12515 20:47:51 36 01.0 -75 40.3 taxi  
       0 12527 20:48:03 36 00.9 -75 40.3  
 VNT -1 12643 20:49:59 36 00.8 -75 40.3 ventilation  
       0 12670 20:50:26 36 00.8 -75 40.3

Marker for D:\03161717.ORG CLOSED at 247830

Total scans : 12673  
 Missed Ints : 00002  
 BAT Dropouts: 000.904%  
 NOV Dropouts: 002.550%  
 TAN Dropouts: 003.768%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 21  
 Date: 17 MAR 99 (Wednesday)  
 Duration: 5.7 Hours  
 Pilot: TLC

Weather: Clear, WSW wind 3 m/s, temperature rising from 8 to 18 C.

Summary: SAR pattern then parallel legs E & S of Duck Pier.

SAR Way Points    A = 36 10 N, 75 10 W  
                   B = A + 56 km @ 150  
                   C = A + 83 km @ 150  
                   D = C + 37 km @ 60  
                   E = D + 28 km @ 330  
                   F = E + 74 km @ 240  
                   G = F + 28 km @ 150

Problems: Data system crashed between SAR and Parallel runs. IRGA power  
 supply replaced, H2O channel working but not CO2. Laser #2 and  
 Ka-band radar not working.

Marker for D:\03171048.ORG OPENED at 299585

VNT -1 00004 11:13:08 36 00.8 -75 40.3 static  
       0 00029 11:13:33 36 00.8 -75 40.3  
 TXI -1 00157 11:15:41 36 00.8 -75 40.4 taxi  
       0 00173 11:15:57 36 01.1 -75 40.3

FLE	-1	00446	11:20:30	36	01.9	-75	33.9	FFA to A
	0	01022	11:30:06	36	09.6	-75	11.8	
PFA	-1	01031	11:30:15	36	09.7	-75	11.5	spiral up
	0	01585	11:39:29	36	07.7	-75	08.1	
PFD	-1	01585	11:39:29	36	07.7	-75	08.1	altitude dump
	0	01851	11:43:55	36	09.1	-75	12.8	
FLS	-1	01851	11:43:55	36	09.1	-75	12.8	A to B
	0	02965	12:02:29	35	47.1	-74	45.8	
PFA	-1	02969	12:02:33	35	47.0	-74	45.7	spiral up
	0	03347	12:08:51	35	45.6	-74	44.8	
PFD	-1	03347	12:08:51	35	45.6	-74	44.8	altitude dump
	0	03567	12:12:31	35	47.9	-74	45.6	
FLS	-1	03567	12:12:31	35	47.9	-74	45.6	B to C
	0	04089	12:21:13	35	36.3	-74	34.4	
FLE	-1	04143	12:22:07	35	36.3	-74	32.5	C to D
	0	04677	12:31:01	35	48.4	-74	16.1	
FLN	-1	04720	12:31:44	35	49.4	-74	16.4	D to E
	0	05229	12:40:13	35	59.9	-74	26.4	
FLW	-1	05272	12:40:56	35	59.9	-74	27.5	E to F
	0	06875	13:07:39	35	33.7	-75	03.5	
FLS	-1	06913	13:08:17	35	32.7	-75	03.3	F to G
	0	07333	13:15:17	35	23.2	-74	52.8	
FLE	-1	07395	13:16:19	35	23.6	-74	50.4	G to C
	0	07898	13:24:42	35	35.4	-74	34.7	
FLS	-1	07944	13:25:28	35	36.6	-74	34.7	C to B
	0	08456	13:34:00	35	47.2	-74	45.5	
PFA	-1	08465	13:34:09	35	47.4	-74	45.7	spiral profile
	0	08876	13:41:00	35	46.5	-74	42.8	
PFD	-1	08876	13:41:00	35	46.5	-74	42.8	altitude dump
	0	09048	13:43:52	35	46.1	-74	47.3	
FLN	-1	09048	13:43:52	35	46.1	-74	47.3	B to A
ERR		09792	13:56:17					GPS Time Reset!
	0	10118	14:01:43	36	10.1	-75	10.2	
FLW	-1	10184	14:02:49	36	10.4	-75	12.1	A to FFA
	0	11128	14:18:33	36	01.2	-75	39.5	
SAN	-1	11197	14:19:42	36	02.8	-75	40.3	slant profile N
ERR		11716	14:28:22					GPS Time Reset!
	0	11980	14:32:46	36	09.4	-75	44.1	

Data system crash

Marker for D:\03171048.ORG CLOSED at 311572

Total scans : 11985  
Missed Ints : 00002  
BAT Dropouts: 000.003%  
NOV Dropouts: 004.458%  
TAN Dropouts: 002.640%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 21  
Date: 17 MAR 99 (Wednesday)  
Duration: 5.7 Hours  
Pilot: TLC

Weather: Clear, WSW wind 3 m/s, temperature rising from 8 to 18 C.

Summary: SAR pattern then parallel legs E & S of Duck Pier.

SAR Way Points    A = 36 10 N, 75 10 W  
                  B = A + 56 km @ 150  
                  C = A + 83 km @ 150  
                  D = C + 37 km @ 60  
                  E = D + 28 km @ 330  
                  F = E + 74 km @ 240  
                  G = F + 28 km @ 150

Problems: Data system crashed between SAR and Parallel runs. IRGA power supply replaced, H2O channel working but not CO2. Laser #2 and Ka-band radar not working.

Marker for D:\03171442.ORG OPENED at 312422

FLE -1 00137 14:49:18 36 04.2 -75 44.8 target run E at 75 m  
0 00405 14:53:46 36 07.0 -75 34.1  
FLW -1 00559 14:56:20 36 06.8 -75 31.6 target run W at 75 m  
0 01002 15:03:43 36 04.6 -75 44.8  
FLN -1 01308 15:08:49 36 00.4 -75 39.0 S to N in surf at 15 m  
0 01653 15:14:34 36 09.0 -75 44.1  
FLS -1 01824 15:17:25 36 09.6 -75 44.1 N to S +0.5 km at 15 m  
0 02216 15:23:57 35 59.3 -75 38.1  
FLN -1 02276 15:24:57 35 59.2 -75 37.0 S to N +0.9 km at 15 m  
0 02671 15:31:32 36 08.7 -75 43.3  
FLS -1 02781 15:33:22 36 08.2 -75 42.0 N to S +1.8 km at 15 m  
0 03092 15:38:33 35 59.9 -75 36.9  
FLN -1 03166 15:39:47 36 00.5 -75 35.5 S to N +3.7 km at 15 m  
0 03555 15:46:16 36 09.7 -75 42.3  
SAS -1 03691 15:48:32 36 11.3 -75 43.0 N to S sounding up to 800 m  
0 04009 15:53:50 36 02.7 -75 37.7  
SDS -1 04211 15:57:12 35 59.7 -75 35.5 N to S sounding down to sfc  
0 04531 16:02:32 36 07.7 -75 40.6  
FLS -1 04697 16:05:18 36 09.4 -75 41.4 N to S +3.7 km at 15 m  
0 05043 16:11:04 36 00.5 -75 35.9  
FLN -1 05131 16:12:32 36 00.2 -75 37.2 S to N +1.8 km at 15 m  
0 05502 16:18:43 36 09.3 -75 43.3  
FLS -1 05587 16:20:08 36 09.4 -75 44.1 N to S +0.9 km at 15 m  
0 05959 16:26:20 35 60.0 -75 37.6  
FLN -1 06079 16:28:20 35 59.0 -75 37.4 S to N +0.5 km at 15 m  
0 06463 16:34:44 36 08.4 -75 43.5  
FLS -1 06601 16:37:02 36 09.6 -75 44.4 N to S in surf at 15 m  
Data system crash

Marker for D:\03171442.ORG CLOSED at XXXXXX

Total scans :  
Missed Ints :  
BAT Dropouts:  
NOV Dropouts:  
TAN Dropouts:

SHOWEX 99 Spring Experiment, Duck NC

Flight: 22  
Date: 17 MAR 99 (Wednesday)  
Duration: 4.4 Hours  
Pilot: EJD

Weather: Clear, WSW wind 3 m/s, temperature rising from 8 to 18 C.

Summary: Parallel pattern W of Duck pier along Currituck penninsula shore.  
Parallel runs at three off-shore distances. 10 passes perpendicular  
to the coast line of the peninsula to off-shore 5 km at 120 m.

Parallel Way Points: N = 36 22 N, 75 55.5 W  
S = 36 17 N, 75 53.5 W  
E = 165 DEG 4.6 km FROM N  
W = 75 DEG 4.6 km FROM E  
N1 = 75 DEG 0.6 km FROM N  
N2 = 75 DEG 0.9 km FROM N  
N3 = 75 DEG 1.8 km FROM N  
S1 = 75 DEG 0.6 km FROM S  
S2 = 75 DEG 0.9 km FROM S  
S3 = 75 DEG 1.8 km FROM S

Problems: Data system crashed halfway through flight. IRGA power supply  
replaced, H2O channel working but not CO2. Laser #2 and Ka-band  
radar not working.

Marker for D:\03171748.ORG OPENED at 323405

VNT -1 00006 17:50:10 36 00.8 -75 40.3 ventilation  
0 00026 17:50:30 36 00.8 -75 40.3  
TXI -1 00131 17:52:15 36 00.8 -75 40.4 taxi  
0 00171 17:52:55 36 03.7 -75 40.9  
SA -1 00510 17:58:34 36 00.5 -75 45.5 profile sfc - 1200 m  
0 00823 18:03:47 36 09.0 -75 48.9  
SD -1 00845 18:04:09 36 09.6 -75 49.1 profile 1200 m - sfc  
ERR 01398 18:13:23 GPS Time Reset!  
0 01475 18:14:40 36 26.7 -75 59.8  
FLS -1 01773 18:19:38 36 21.8 -75 55.5 N-S shore run 150 m  
0 01952 18:22:37 36 17.1 -75 52.9  
FLN -1 02131 18:25:36 36 18.1 -75 53.0 S1-N1 15 m



	0	02275	18:28:00	36	22.0	-75	55.4		
FLS	-1	02405	18:30:10	36	21.8	-75	55.1	N1-S1	15 m
	0	02581	18:33:06	36	17.2	-75	52.9		
FLN	-1	02710	18:35:15	36	17.4	-75	52.8	S2-N2	15 m
	0	02860	18:37:45	36	21.8	-75	55.0		
FLS	-1	03027	18:40:32	36	22.1	-75	54.6	N3-S3	15 m
	0	03212	18:43:37	36	17.3	-75	52.3		
FLN	-1	03339	18:45:44	36	17.4	-75	52.4	S3-N3	15 m
	0	03510	18:48:35	36	22.5	-75	54.6		
FLS	-1	03667	18:51:12	36	21.9	-75	54.8	N2-S2	15 m
	0	03840	18:54:05	36	17.2	-75	52.8		
FLN	-1	04003	18:56:48	36	17.7	-75	53.1	S1-N1	15 m
	0	04151	18:59:16	36	21.9	-75	55.4		
FLS	-1	04310	19:01:55	36	21.9	-75	55.4	N1-S1	15 m
	0	04489	19:04:54	36	17.3	-75	52.9		
FLN	-1	04632	19:07:17	36	17.6	-75	52.8	S2-N2	15 m
	0	04785	19:09:50	36	21.9	-75	55.2		
FLS	-1	04988	19:13:13	36	21.8	-75	54.3	N3-S3	15 m
	0	05166	19:16:11	36	17.4	-75	52.3		
FLN	-1	05273	19:17:58	36	17.3	-75	52.4	S2-N2	15 m
	0	05458	19:21:03	36	22.8	-75	54.7		
FLS	-1	05564	19:22:49	36	22.1	-75	54.9	N1-S1	15 m
	0	05755	19:26:00	36	17.2	-75	52.7		
FLN	-1	05880	19:28:05	36	17.3	-75	52.9	S1-N1	15 m
	0	06049	19:30:54	36	22.0	-75	55.4		
FLS	-1	06209	19:33:34	36	21.9	-75	55.3	N2-S2	15 m
	0	06394	19:36:39	36	17.2	-75	52.8		
FLN	-1	06549	19:39:14	36	17.4	-75	52.8	S3-N3	15 m
	0	06711	19:41:56	36	21.9	-75	55.1		
FLS	-1	06850	19:44:15	36	22.3	-75	54.3	N3-S3	15 m
	0	07045	19:47:30	36	17.4	-75	52.2		

Data system crash

Marker for D:\03171748.ORG CLOSED at 331254

Total scans : 07847

Missed Ints : 00002

BAT Dropouts: -000.030%

NOV Dropouts: 003.926%

TAN Dropouts: 001.678%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 22

Date: 17 MAR 99 (Wednesday)

Duration: 4.4 Hours

Pilot: EJD

Weather: Clear, WSW wind 3 m/s, temperature rising from 8 to 18 C.

Summary: Parallel pattern W of Duck pier along Currituck penninsula shore.  
Parallel runs at three off-shore distances. 10 passes perpendicular  
to the coast line of the peninsula to off-shore 5 km at 120 m.

Parallel Way Points: N = 36 22 N, 75 55.5 W  
S = 36 17 N, 75 53.5 W  
E = 165 DEG 4.6 km FROM N  
W = 75 DEG 4.6 km FROM E  
N1 = 75 DEG 0.6 km FROM N  
N2 = 75 DEG 0.9 km FROM N  
N3 = 75 DEG 1.8 km FROM N  
S1 = 75 DEG 0.6 km FROM S  
S2 = 75 DEG 0.9 km FROM S  
S3 = 75 DEG 1.8 km FROM S

Problems: Data system crashed halfway through flight. IRGA power supply  
replaced, H2O channel working but not CO2. Laser #2 and Ka-band  
radar not working.

Marker for D:\03172003.ORG OPENED at 331512

FLN	-1	00170	20:08:01	36	17.2	-75	52.9	S1-N1	15	m
		0	00333	20:10:44	36	21.9	-75	55.4		
FLE	-1	00550	20:14:21	36	20.0	-75	54.4	W-E	120	m
		0	00642	20:15:53	36	21.5	-75	51.2		
FLW	-1	00840	20:19:11	36	21.5	-75	51.0	E-W	120	m
		0	00964	20:21:15	36	20.5	-75	54.5		
FLE	-1	01113	20:23:44	36	20.9	-75	54.8	W-E	120	m
		0	01207	20:25:18	36	21.9	-75	51.1		
FLW	-1	01353	20:27:44	36	21.6	-75	50.7	E-W	120	m
		0	01477	20:29:48	36	20.5	-75	54.3		
FLE	-1	01580	20:31:31	36	19.9	-75	54.1	W-E	120	m
		0	01667	20:32:58	36	21.4	-75	51.1		
FLW	-1	01812	20:35:23	36	21.3	-75	50.4	E-W	120	m
		0	01938	20:37:29	36	20.5	-75	54.3		
FLE	-1	02030	20:39:01	36	20.0	-75	54.3	W-E	120	m
		0	02118	20:40:29	36	21.5	-75	51.3		
FLW	-1	02271	20:43:02	36	21.3	-75	51.0	E-W	120	m
		0	02385	20:44:56	36	20.7	-75	54.4		
FLE	-1	02452	20:46:03	36	19.7	-75	54.1	W-E	120	m
		0	02552	20:47:43	36	21.8	-75	51.0		
FLW	-1	02716	20:50:27	36	21.6	-75	50.7	E-W	120	m
		0	02847	20:52:38	36	20.6	-75	54.6		
FLE	-1	02895	20:53:26	36	19.9	-75	54.0	W-E	120	m
EVT		03023	20:55:34	36	22.3	-75	49.9	west ocean shore		
EVT		03038	20:55:49	36	22.6	-75	49.4	east ocean shore		
		0	03039	20:55:50	36	22.6	-75	49.4		
FLW	-1	03183	20:58:14	36	21.7	-75	50.6	E-W	120	m
		0	03315	21:00:26	36	20.6	-75	54.6		
SA	-1	03407	21:01:58	36	18.9	-75	52.7	profile sfc -	1800	m
		0	03872	21:09:43	36	07.9	-75	42.4		

PTC	-1	04097	21:13:28	36	03.5	-75	47.5	pitchcal 120 - 60 kts
	0	04330	21:17:21	35	58.6	-75	52.9	
PTC	-1	04331	21:17:22	35	58.6	-75	52.9	pitchcal 60 - 120 kts
	0	04636	21:22:27	35	51.7	-75	59.2	
WBE	-1	04762	21:24:33	35	53.7	-75	59.7	windbox W-E
	0	04883	21:26:34	35	56.7	-75	56.5	
WBN	-1	04925	21:27:16	35	57.8	-75	56.6	windbox S-N
	0	05046	21:29:17	35	59.9	-75	59.7	
WBW	-1	05093	21:30:04	35	59.4	-76	00.9	windbox E-W
	0	05215	21:32:06	35	56.0	-76	02.7	
WBS	-1	05261	21:32:52	35	54.7	-76	02.1	windbox N-S
	0	05386	21:34:57	35	52.6	-75	57.2	
WCL	-1	05430	21:35:41	35	52.6	-75	55.5	wind circle left
	0	05552	21:37:43	35	52.6	-75	54.8	
WCR	-1	05587	21:38:18	35	53.7	-75	54.5	wind circle right
	0	05741	21:40:52	35	53.8	-75	53.7	
YAW	-1	05786	21:41:37	35	55.0	-75	52.6	yaw left (1/4, 1/2, 3/4, 1 ball)
	0	05872	21:43:03	35	57.7	-75	51.6	
YAW	-1	05899	21:43:30	35	58.6	-75	51.8	yaw right (1/4, 1/2, 3/4, 1 ball)
	0	05981	21:44:52	36	00.9	-75	51.2	
PTC	-1	05997	21:45:08	36	01.3	-75	50.8	pitch up/dn slow
	0	06095	21:46:46	36	03.9	-75	48.5	
PTC	-1	06098	21:46:49	36	04.0	-75	48.4	pitch up/dn medium
	0	06177	21:48:08	36	06.3	-75	47.1	
PTC	-1	06213	21:48:44	36	07.4	-75	46.5	pitch up/dn fast
	0	06263	21:49:34	36	09.0	-75	46.0	
SD	-1	06337	21:50:48	36	08.8	-75	47.1	profile 1800 - 300 m
	0	06860	21:59:31	36	00.8	-75	43.8	
VNT	-1	07218	22:05:29	36	00.8	-75	40.3	ventilation
	0	07245	22:05:56	36	00.8	-75	40.3	

Marker for D:\03172003.ORG CLOSED at 338764

Total scans : 07252  
 Missed Ints : 00000  
 BAT Dropouts: -000.005%  
 NOV Dropouts: 017.292%  
 TAN Dropouts: 001.434%

SHOWEX 99 Spring Experiment, Duck NC

Flight: 23  
 Date: 18 MAR 99 (Thursday)  
 Duration: 2.9 hours  
 Pilot: TLC

Weather: Clear, WSW wind at 5 m/s, temperature rising from 14 to 20 C.

Summary: Parallel legs E & S of Duck Pier.

Problems: IRGA power supply replaced, H2O channel working but not CO2.  
Laser #2 and Ka-band radar not working.

Marker for D:\03181338.ORG OPENED at 395937

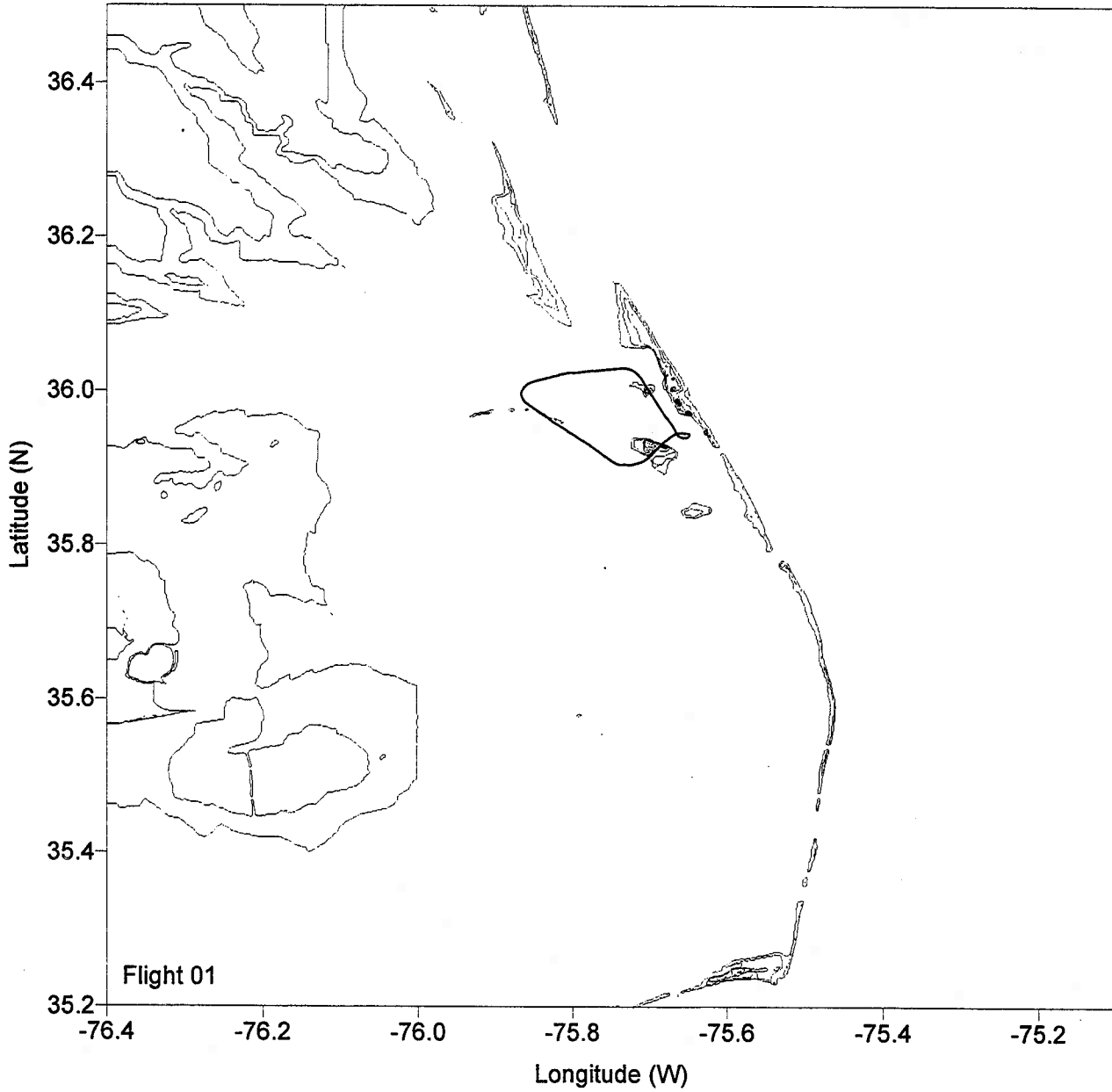
VNT	-1	00011	13:59:07	36	00.8	-75	40.4	ventilation
	0	00056	13:59:52	36	00.8	-75	40.4	
TXI	-1	00124	14:01:00	36	01.4	-75	40.2	taxi
	0	00127	14:01:03	36	01.4	-75	40.2	
FLN	-1	00360	14:04:56	35	59.1	-75	38.1	stack N @ 15 m near shore
	0	00756	14:11:32	36	09.2	-75	44.2	
FLS	-1	00807	14:12:23	36	09.3	-75	43.2	stack S @ 15 m shore +1.8 km
	0	01182	14:18:38	35	59.7	-75	36.6	
FLN	-1	01282	14:20:18	35	59.6	-75	38.2	stack N @ 120 m near shore
	0	01642	14:26:18	36	09.1	-75	43.9	
FLS	-1	01700	14:27:16	36	09.3	-75	42.7	stack S @ 120 m shore +1.8 km
	0	02061	14:33:17	35	59.8	-75	36.9	
FLN	-1	02152	14:34:48	35	59.7	-75	38.3	stack N @ 275 m near shore
	0	02550	14:41:26	36	08.5	-75	43.7	
FLS	-1	02675	14:43:31	36	07.9	-75	41.5	stack S @ 275 m shore +1.8 km
	0	02932	14:47:48	36	00.3	-75	37.1	
FLN	-1	03082	14:50:18	35	58.4	-75	35.6	stack N @ 200 m shore +1.8 km
	0	03537	14:57:53	36	09.2	-75	42.7	
FLS	-1	03618	14:59:14	36	08.2	-75	43.5	stack S @ 200 m near shore
	0	03946	15:04:42	35	59.4	-75	38.1	
FLN	-1	04009	15:05:45	36	00.4	-75	37.3	stack N @ 120 m shore +1.8 km
	0	04370	15:11:46	36	09.5	-75	43.2	
FLS	-1	04443	15:12:59	36	08.7	-75	43.8	stack S @ 120 m near shore
	0	04823	15:19:19	35	59.1	-75	38.1	
FLN	-1	04901	15:20:37	36	00.5	-75	37.6	stack N @ 15 m shore +1.8 km
	0	05225	15:26:01	36	09.2	-75	43.0	
FLS	-1	05280	15:26:56	36	08.8	-75	44.0	stack S @ 15 m
	0	05646	15:33:02	35	59.2	-75	38.3	
FLE	-1	06009	15:39:05	36	04.7	-75	44.3	stack E @ 75 m
	0	06243	15:42:59	36	06.3	-75	35.5	
FLW	-1	06392	15:45:28	36	07.1	-75	32.6	stack W @ 150 m
	0	06806	15:52:22	36	04.3	-75	44.6	
FLE	-1	06955	15:54:51	36	04.2	-75	45.7	stack E @ 300 m
	0	07170	15:58:26	36	06.3	-75	35.3	
FLW	-1	07363	16:01:39	36	07.5	-75	31.0	stack W @ 600 m
	0	07795	16:08:51	36	04.0	-75	44.4	
FLE	-1	07949	16:11:25	36	04.2	-75	45.1	stack E @ 600 m
	0	08179	16:15:15	36	06.7	-75	34.2	
FLW	-1	08346	16:18:02	36	07.7	-75	29.8	stack W @ 300 m
	0	08890	16:27:06	36	04.2	-75	44.3	
FLE	-1	09051	16:29:47	36	04.7	-75	44.5	stack E @ 150 m
	0	09260	16:33:16	36	06.1	-75	35.4	
FLW	-1	09405	16:35:41	36	06.9	-75	32.2	stack W @ 75 m
	0	09822	16:42:38	36	04.5	-75	44.4	
TXI	-1	10271	16:50:07	36	01.0	-75	40.3	taxi
	0	10289	16:50:25	36	00.9	-75	40.4	

VNT -1 10358 16:51:34 36 00.8 -75 40.3 ventilation  
0 10386 16:52:02 36 00.8 -75 40.3

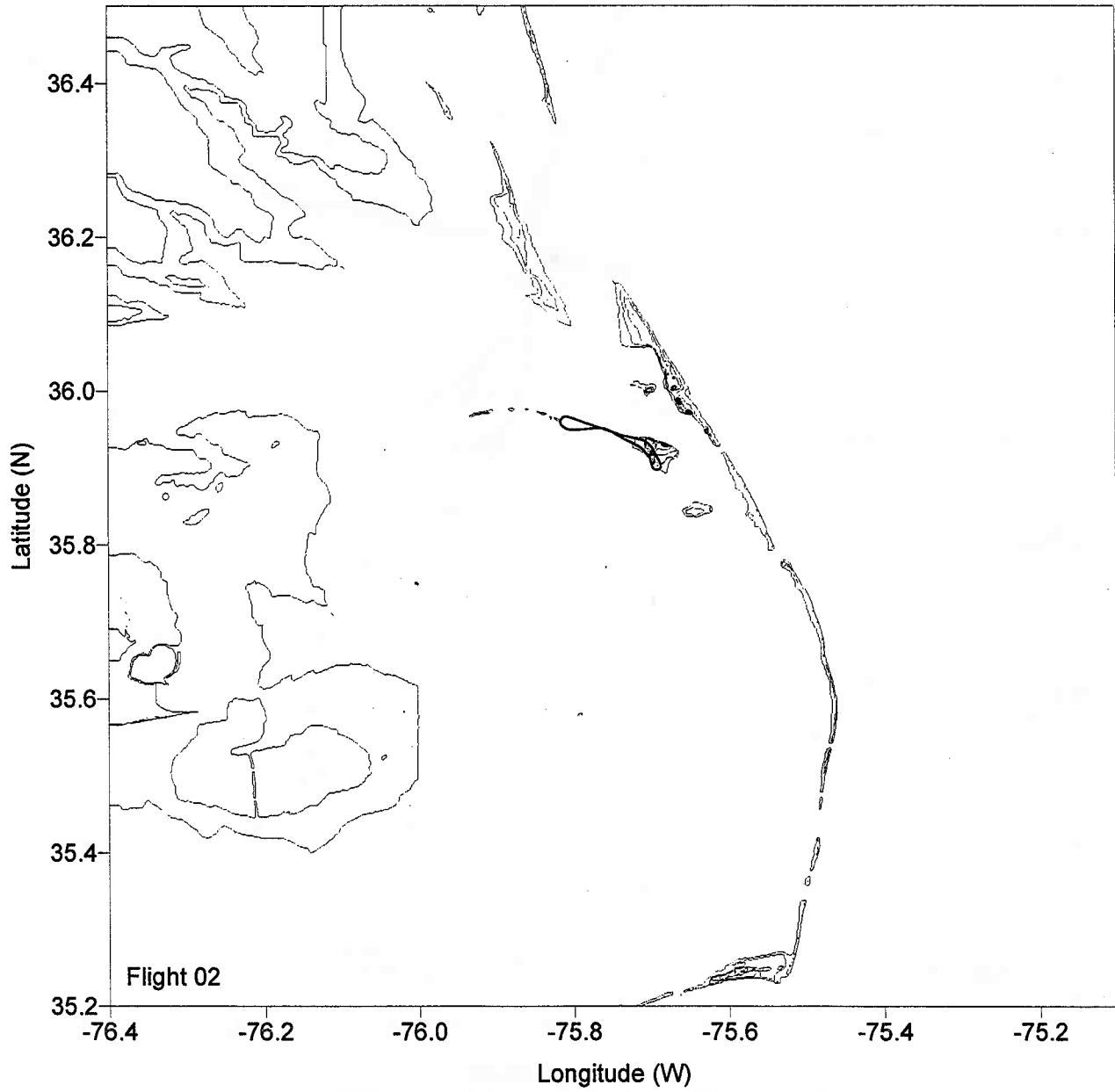
Marker for D:\03181338.ORG CLOSED at 406575

Total scans : 10638  
Missed Ints : 00000  
BAT Dropouts: 000.064%  
NOV Dropouts: 000.911%  
TAN Dropouts: 000.995%

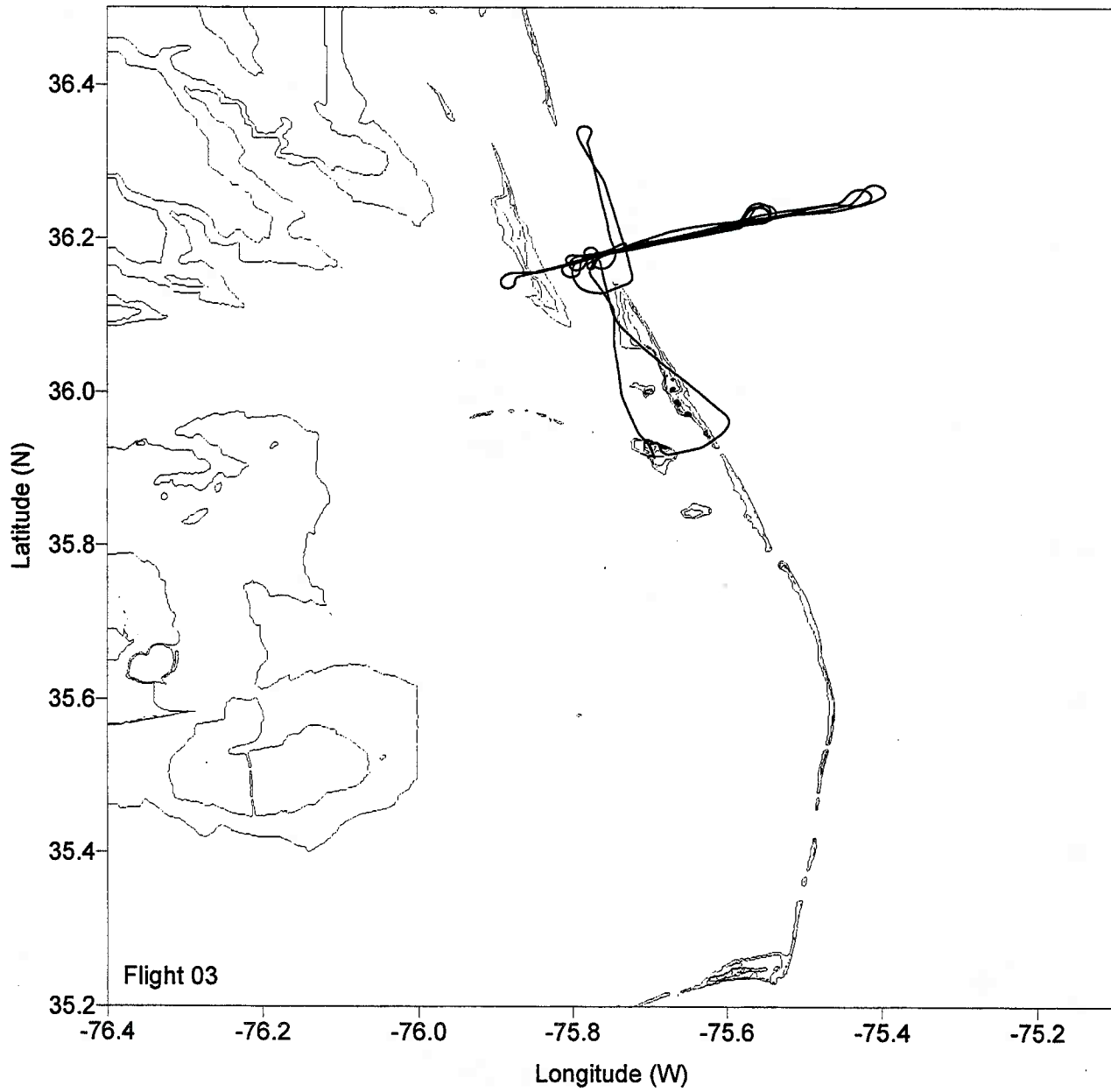
**Appendix B: LongEZ Flight Paths**



**Figure 4.** Flight 1, Monday, 1 March 1999.

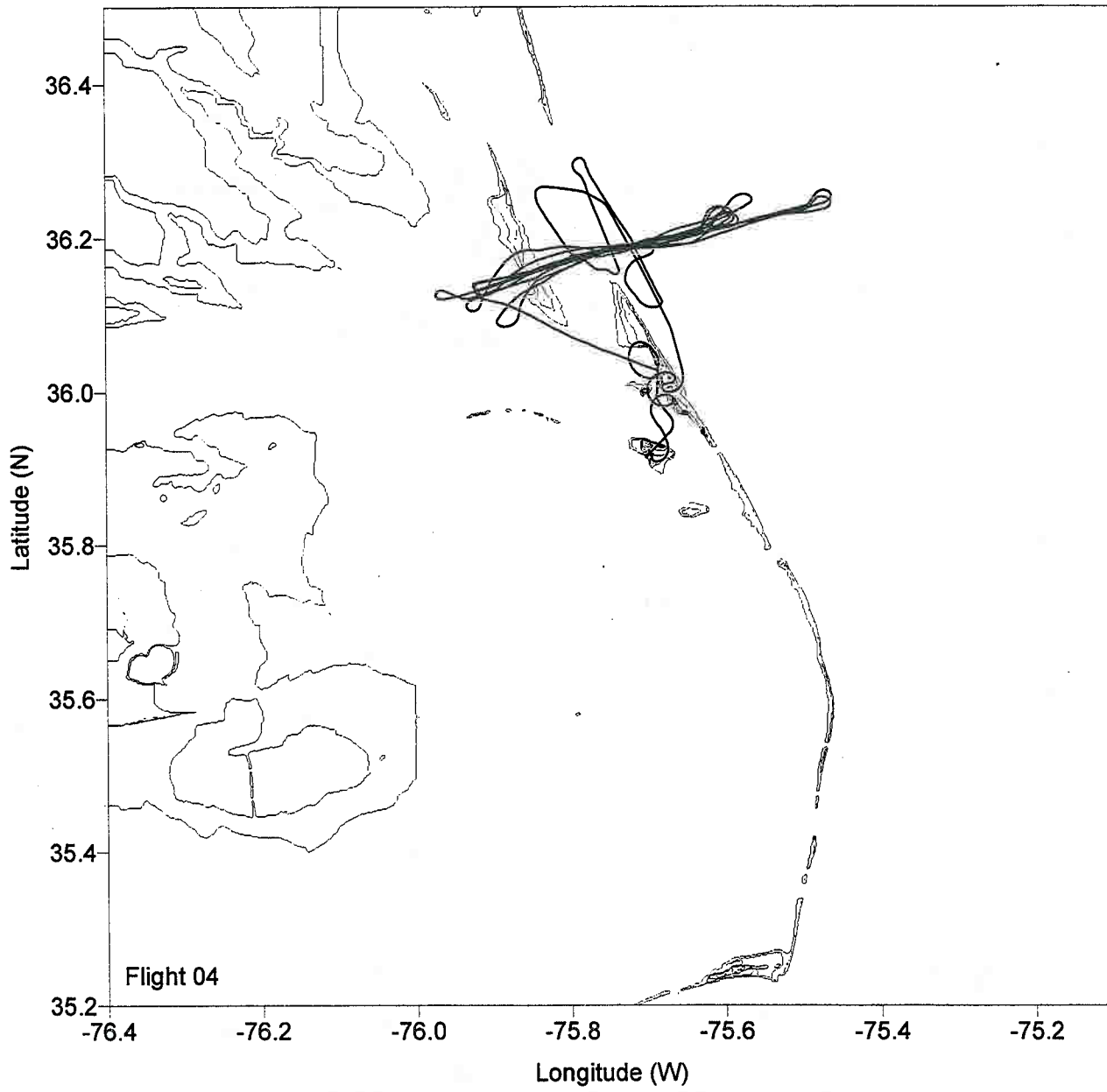


**Figure 5.** Flight 2, Tuesday, 2 March 1999.

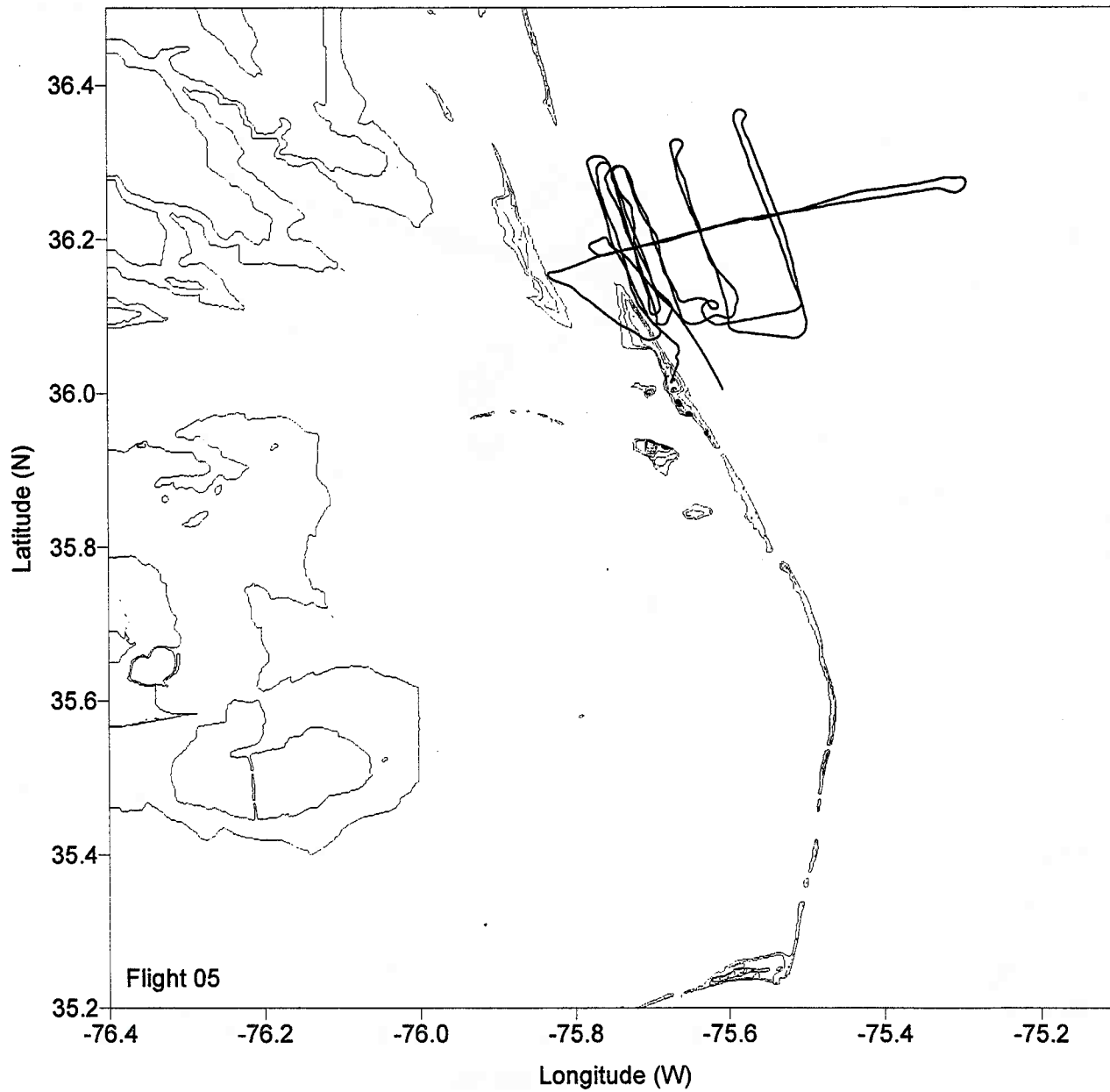


**Figure 6.** Flight 3, Tuesday, 2 March 1999.

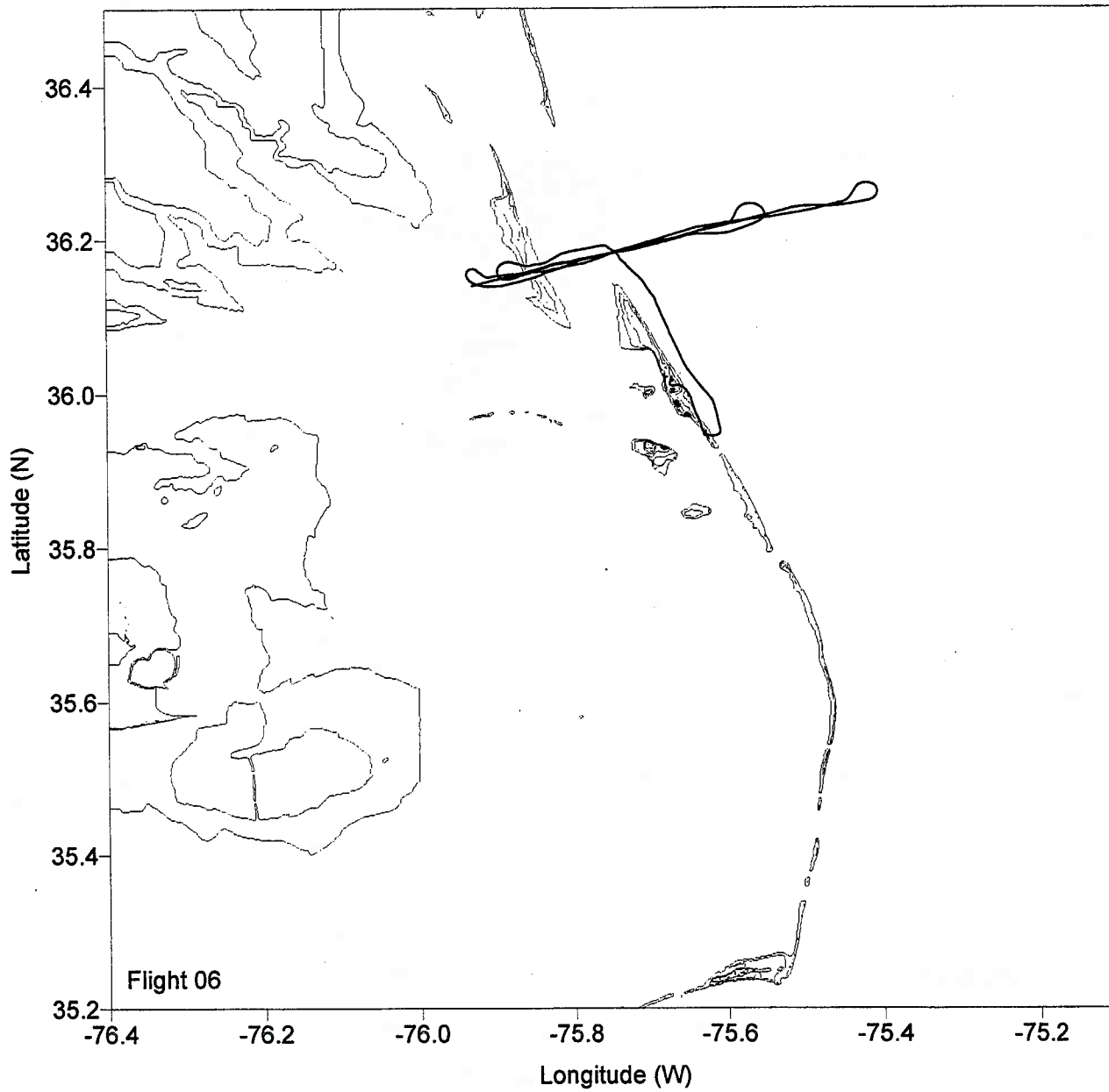




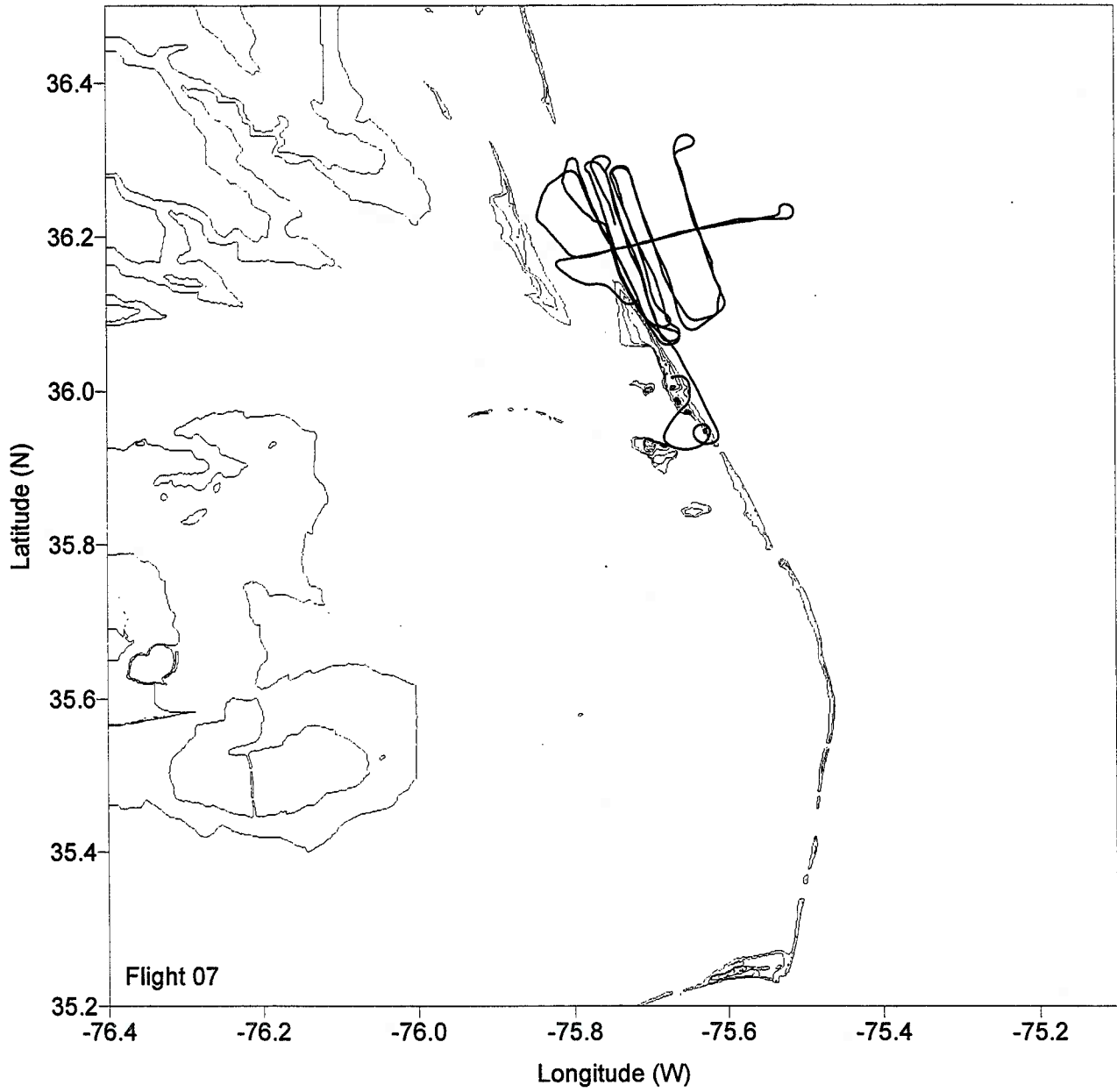
**Figure 7.** Flight 4, Wednesday, 3 March 1999.



**Figure 8.** Flight 5, Thursday, 4 March 1999.



**Figure 9.** Flight 6, Thursday, 4 March 1999.



**Figure 10.** Flight 7, Friday, 5 March 1999.

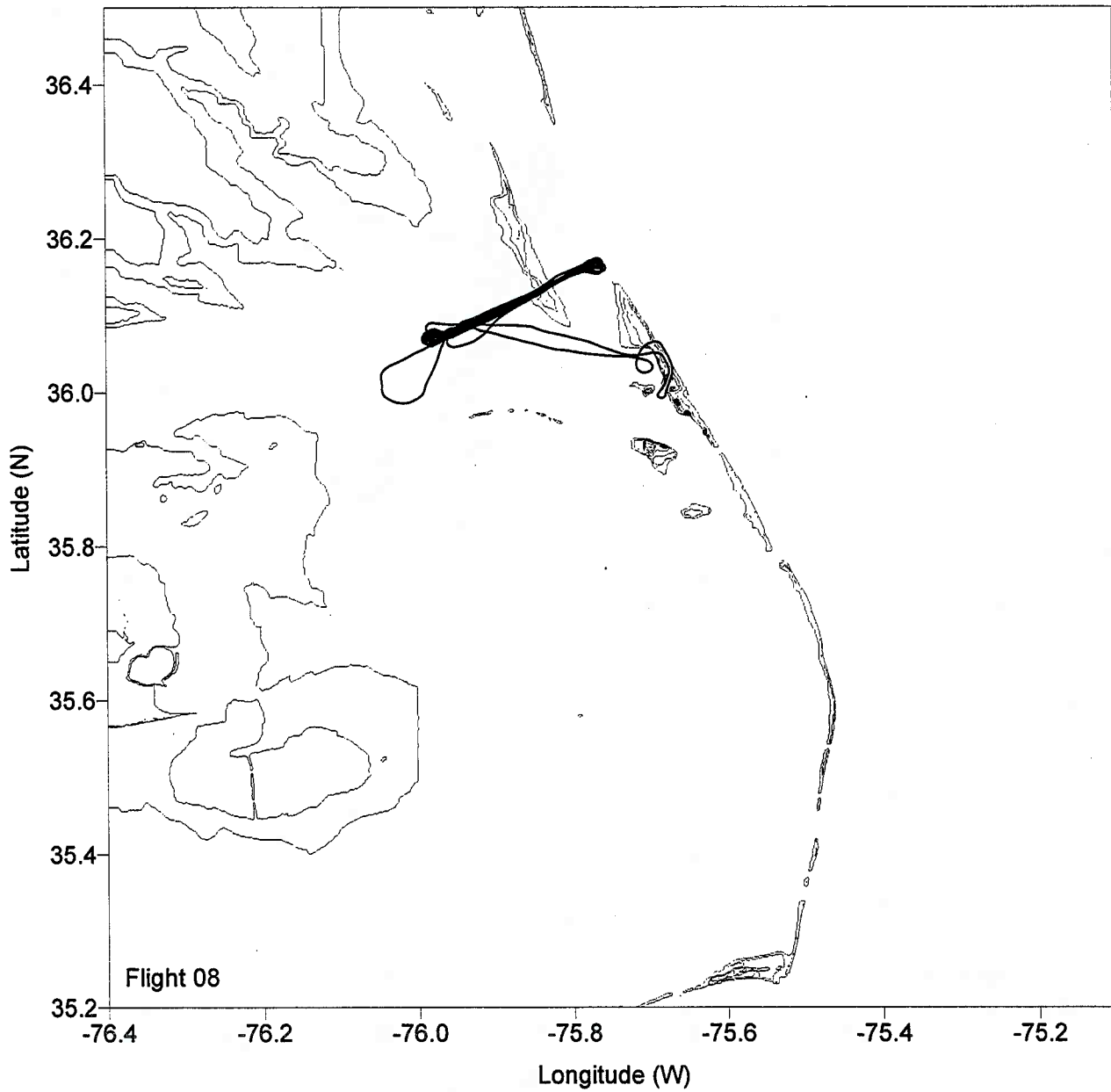
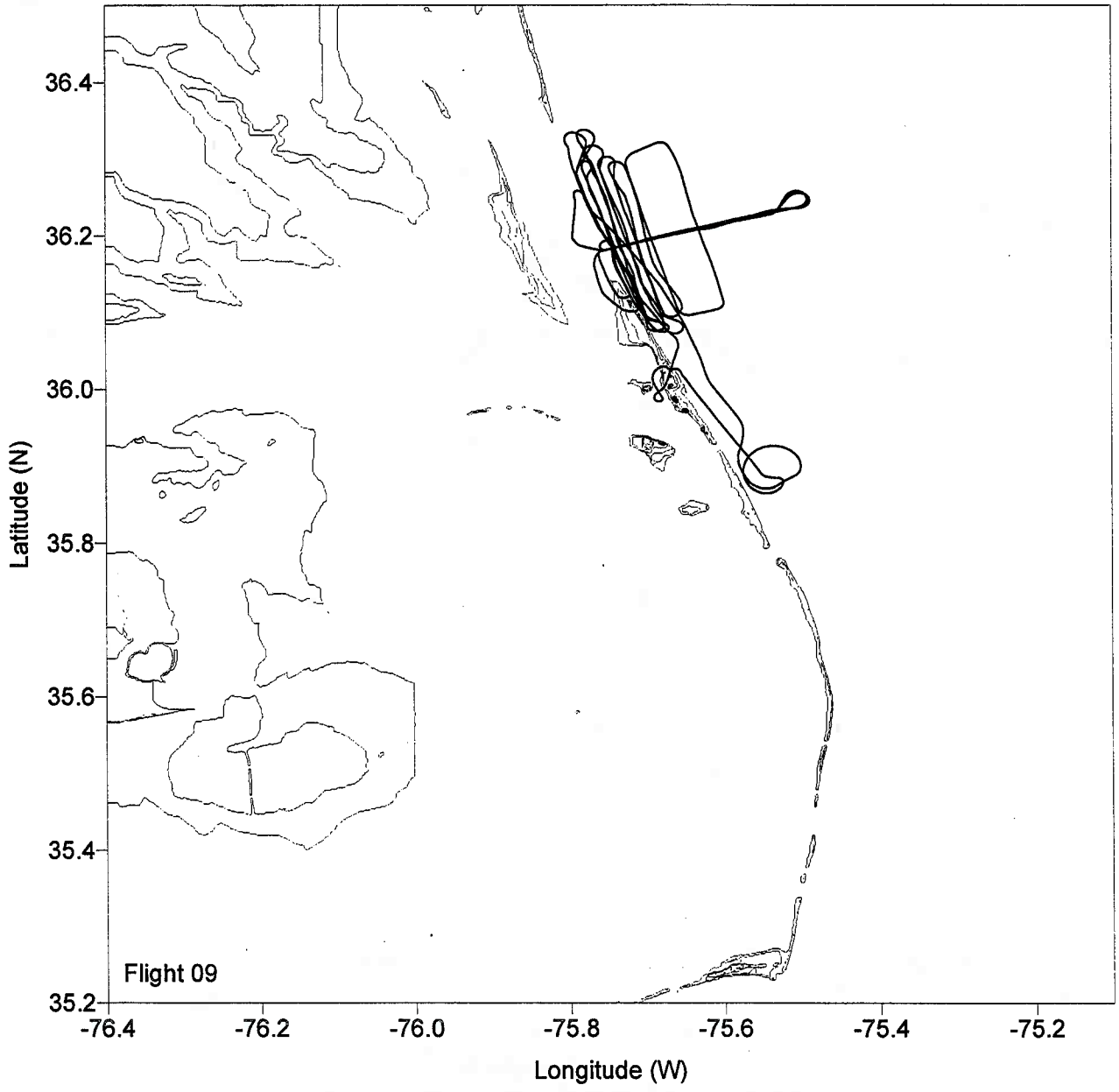
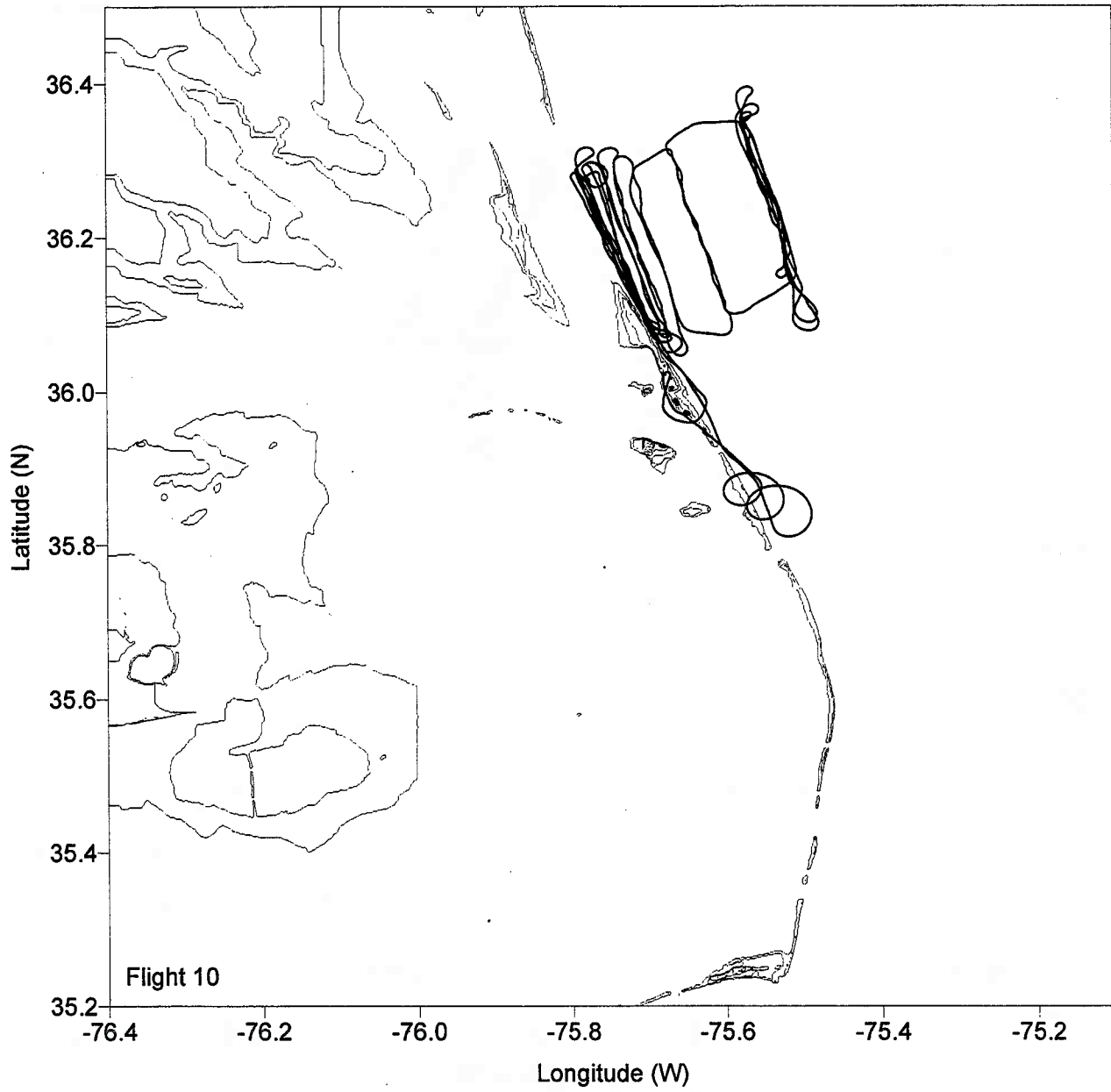


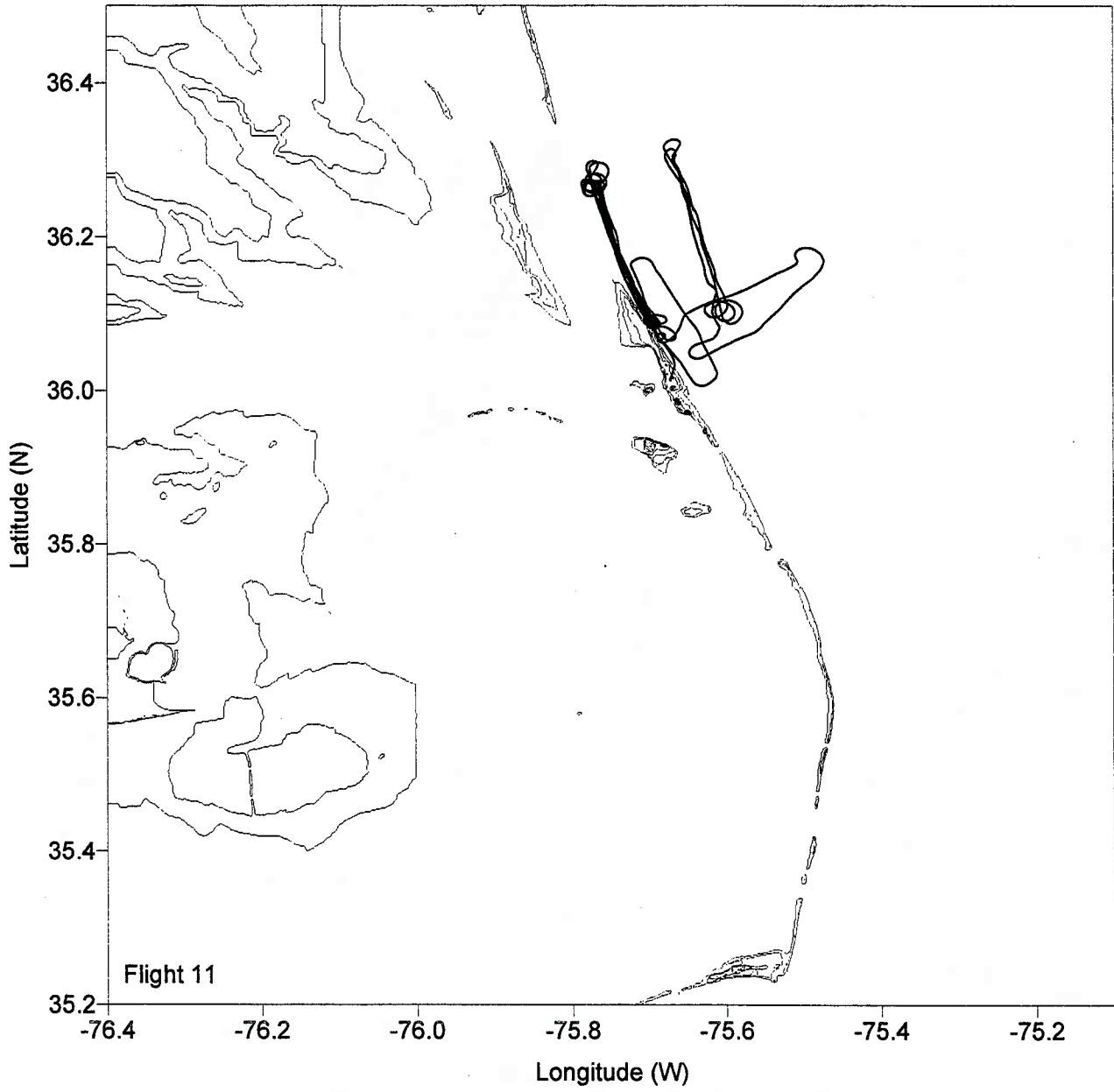
Figure 11. Flight 8, Friday, 5 March 1999.



**Figure 12.** Flight 9, Saturday, 6 March 1999.



**Figure 13.** Flight 10, Sunday, 7 March 1999.



**Figure 14.** Flight 11, Sunday, 7 March 1999.



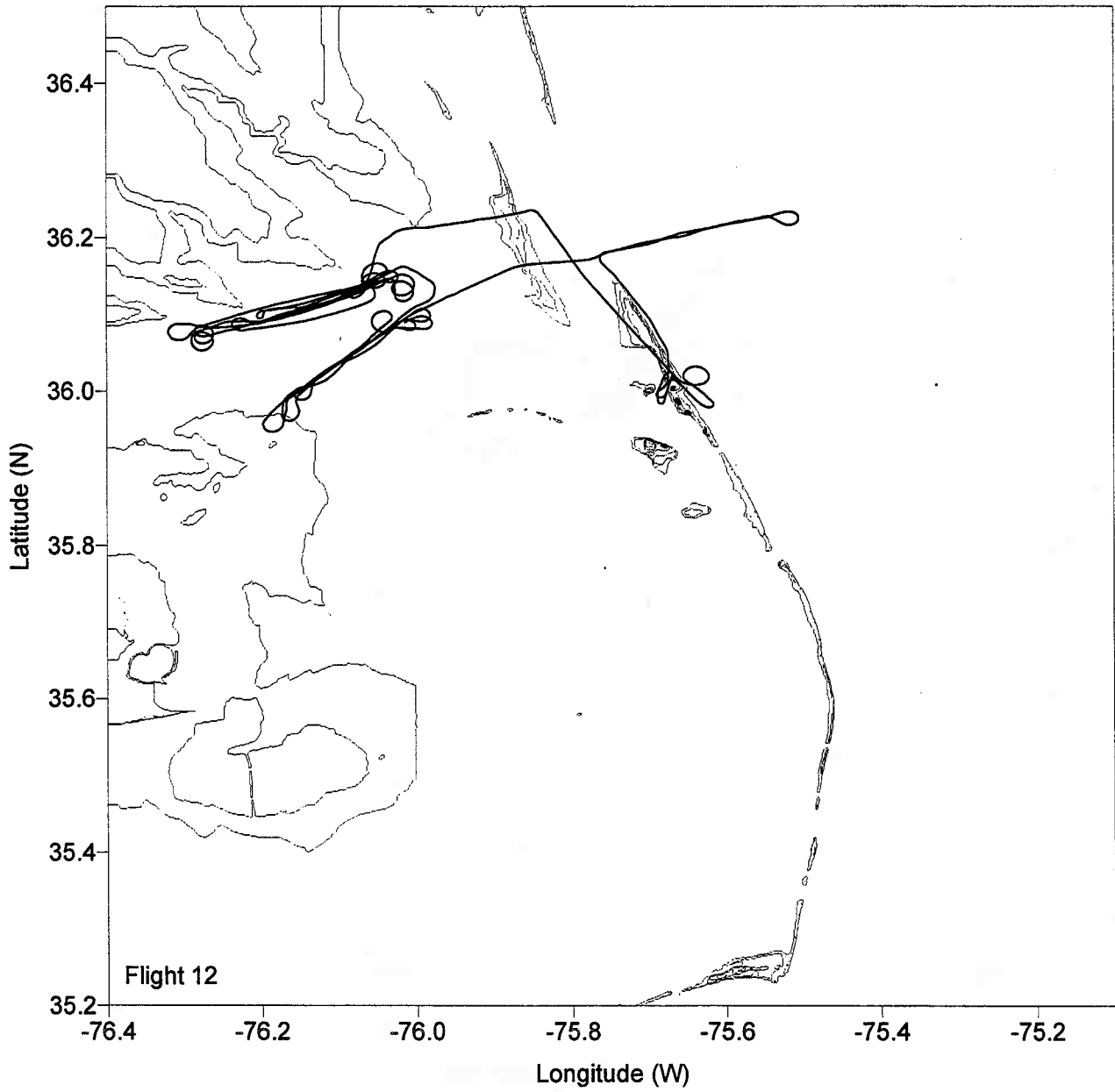
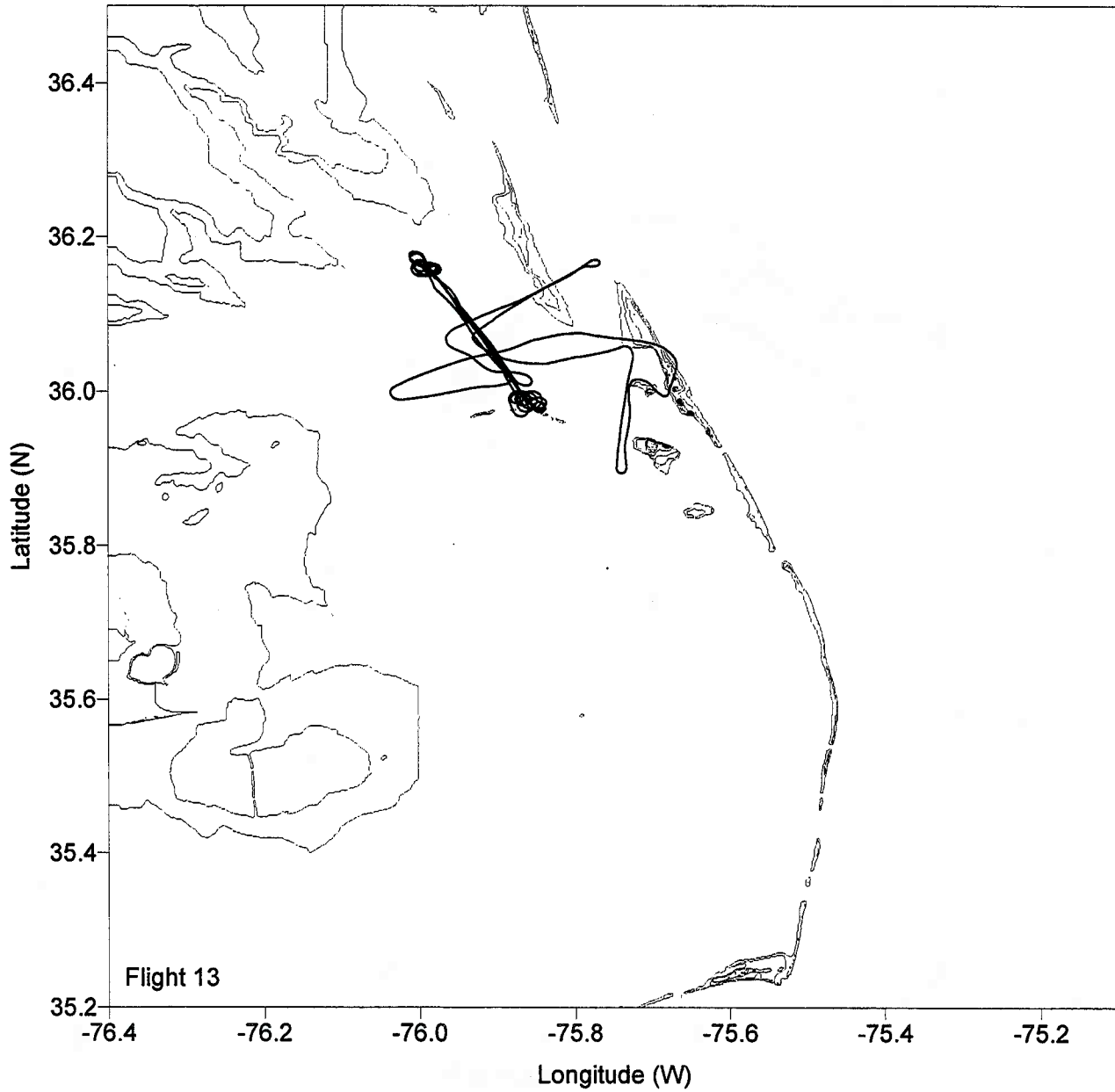
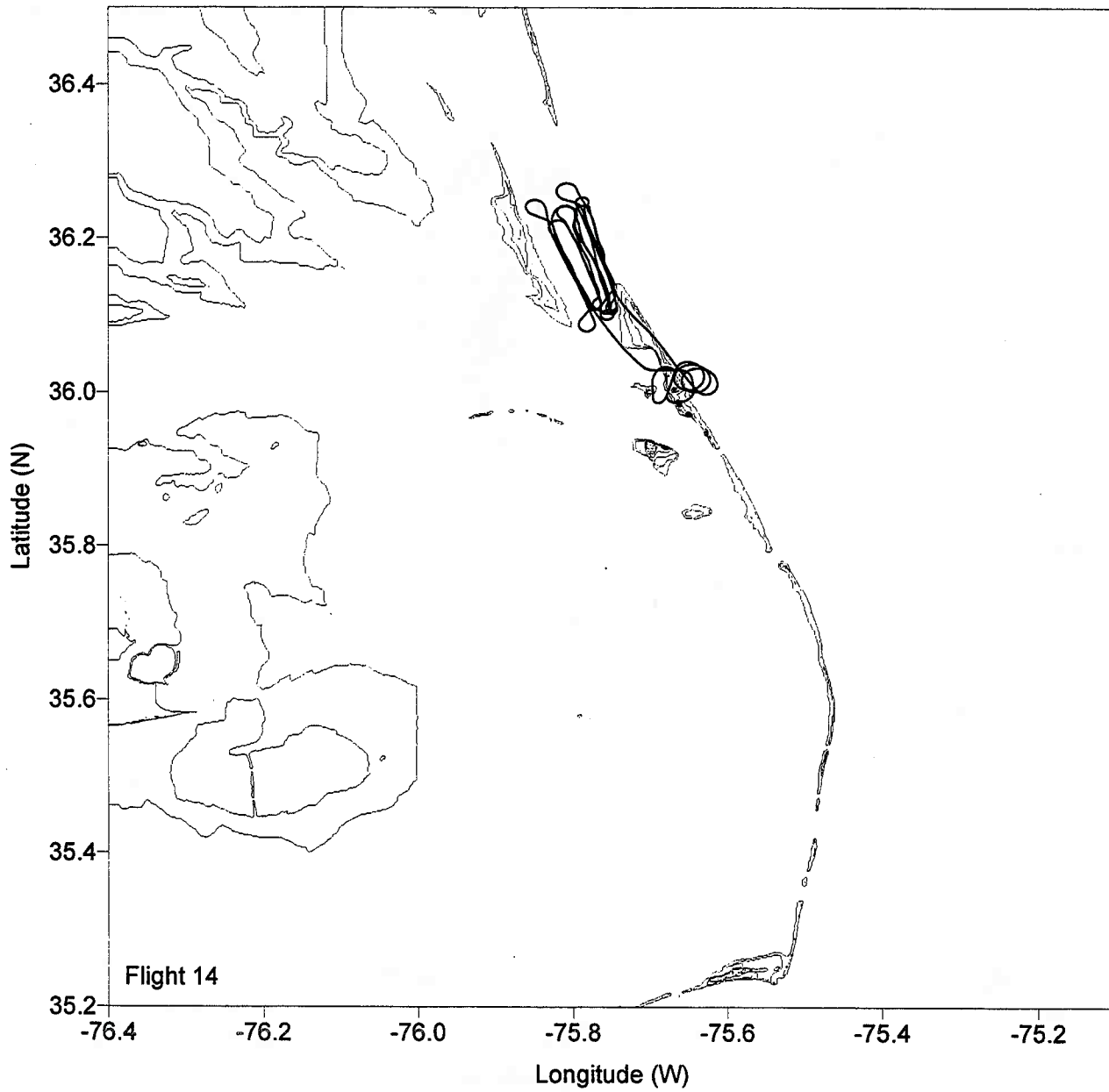


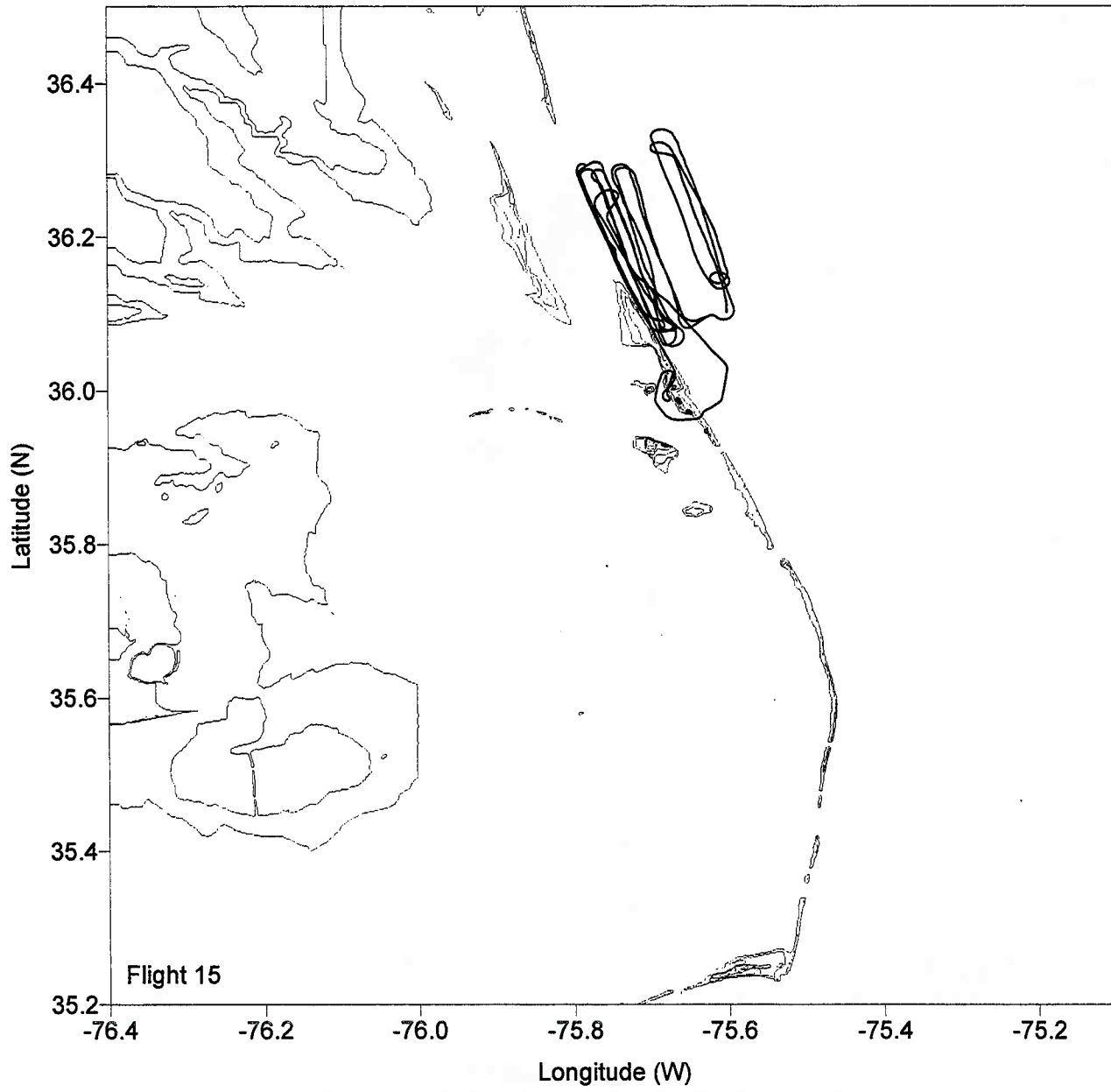
Figure 15. Flight 12, Monday, 8 March 1999.



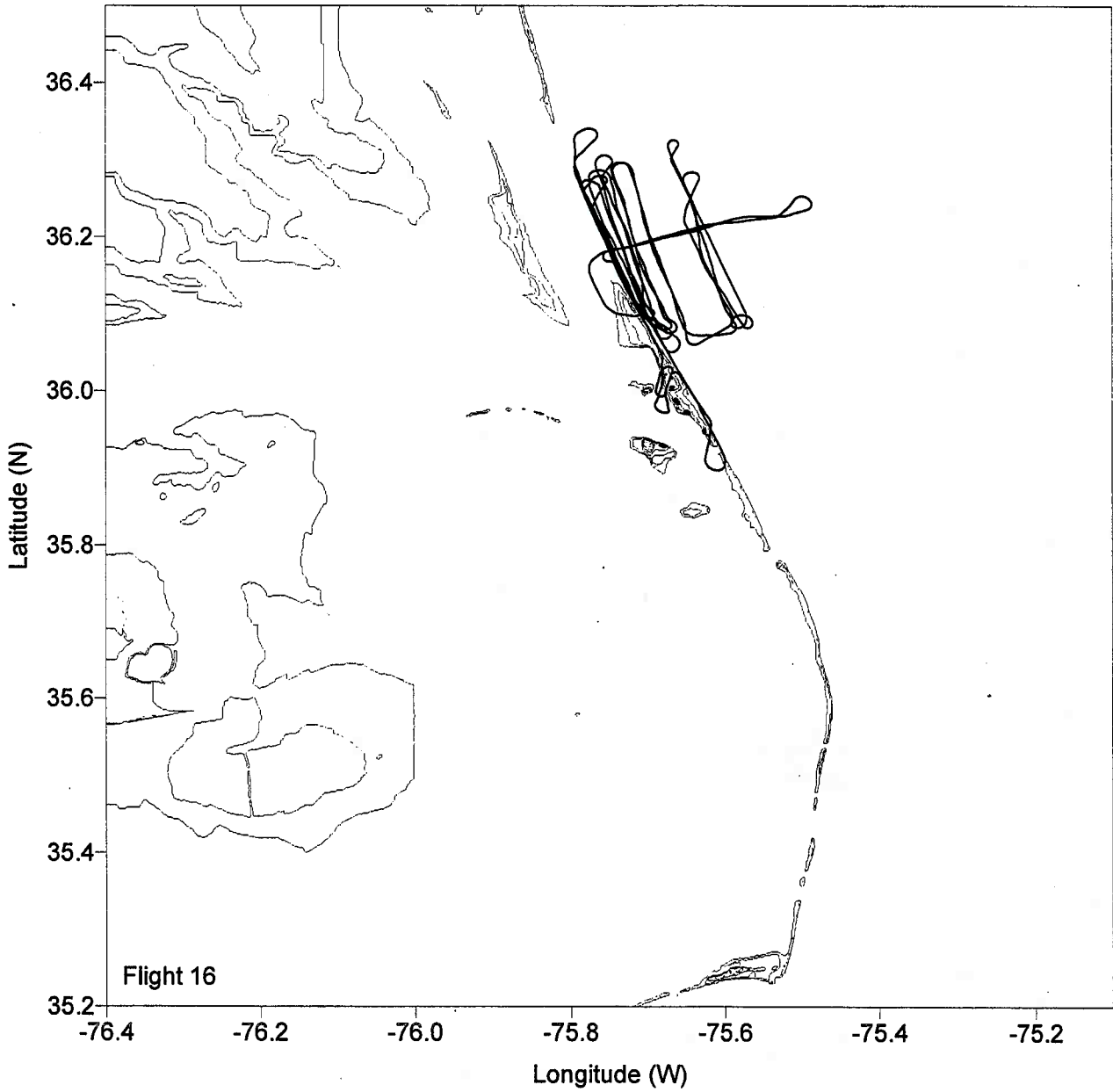
**Figure 16.** Flight 13, Monday, 8 March 1999.



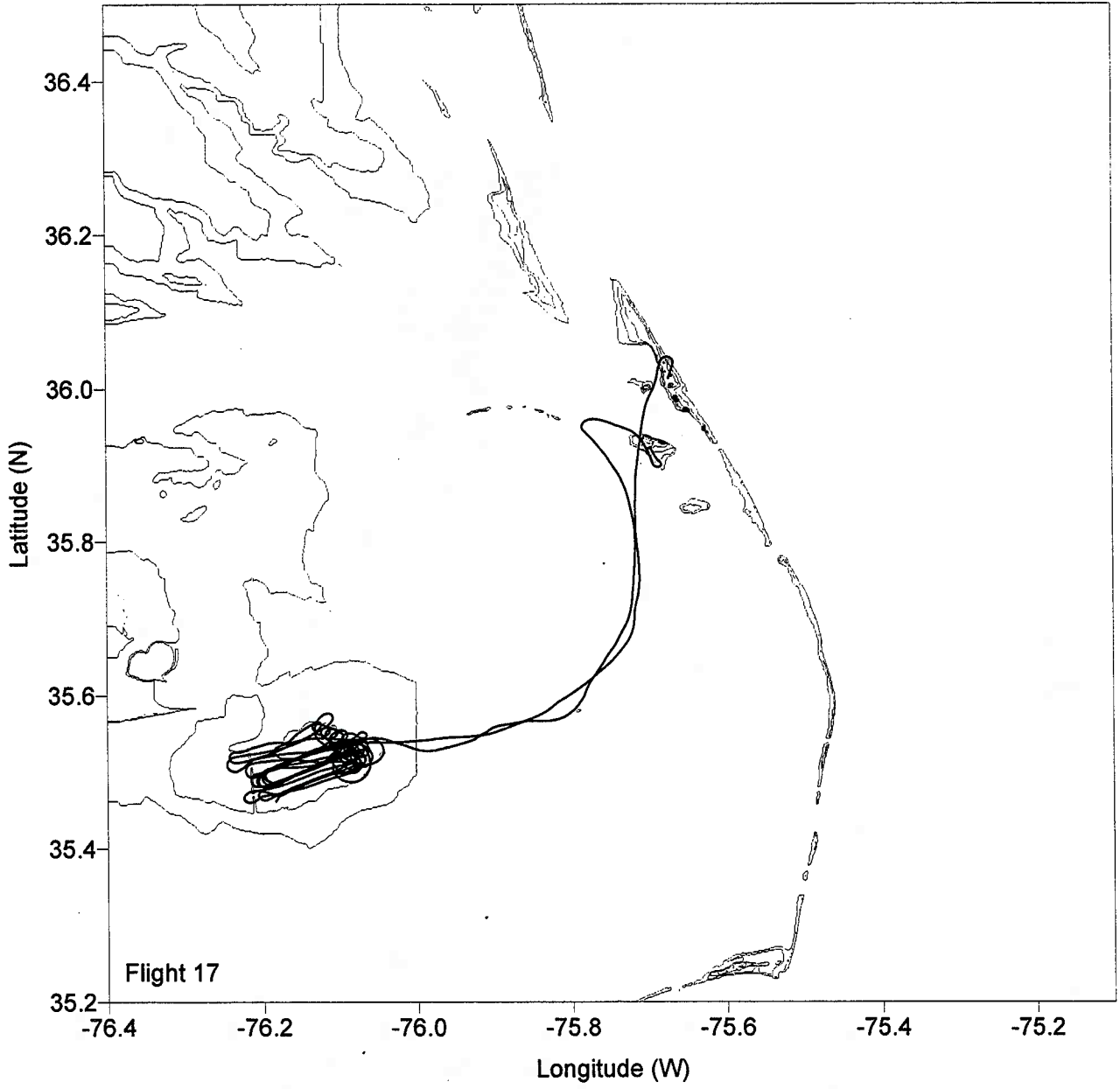
**Figure 17.** Flight 14, Tuesday, 9 March 1999.



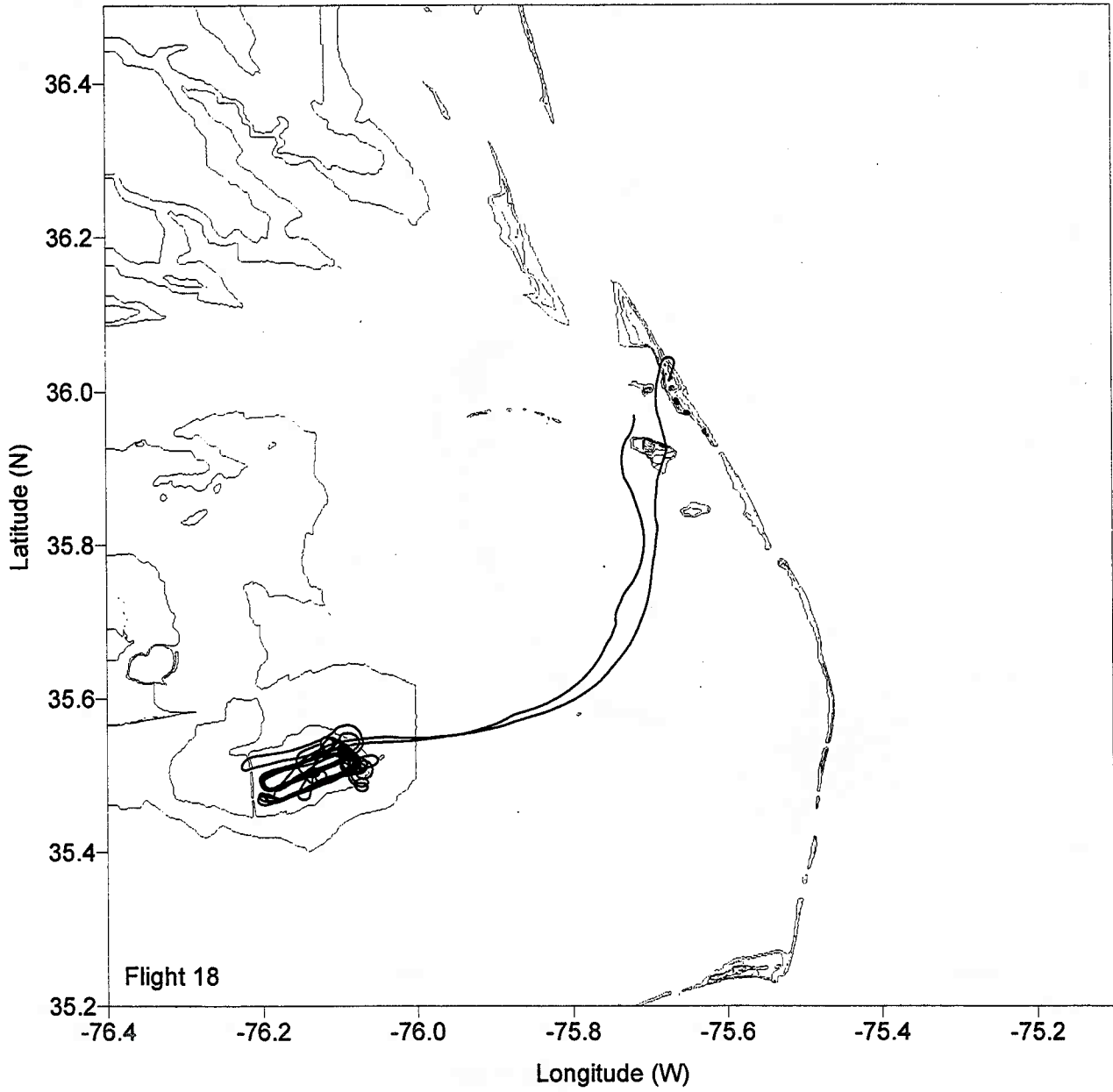
**Figure 18.** Flight 15, Wednesday, 10 March 1999.



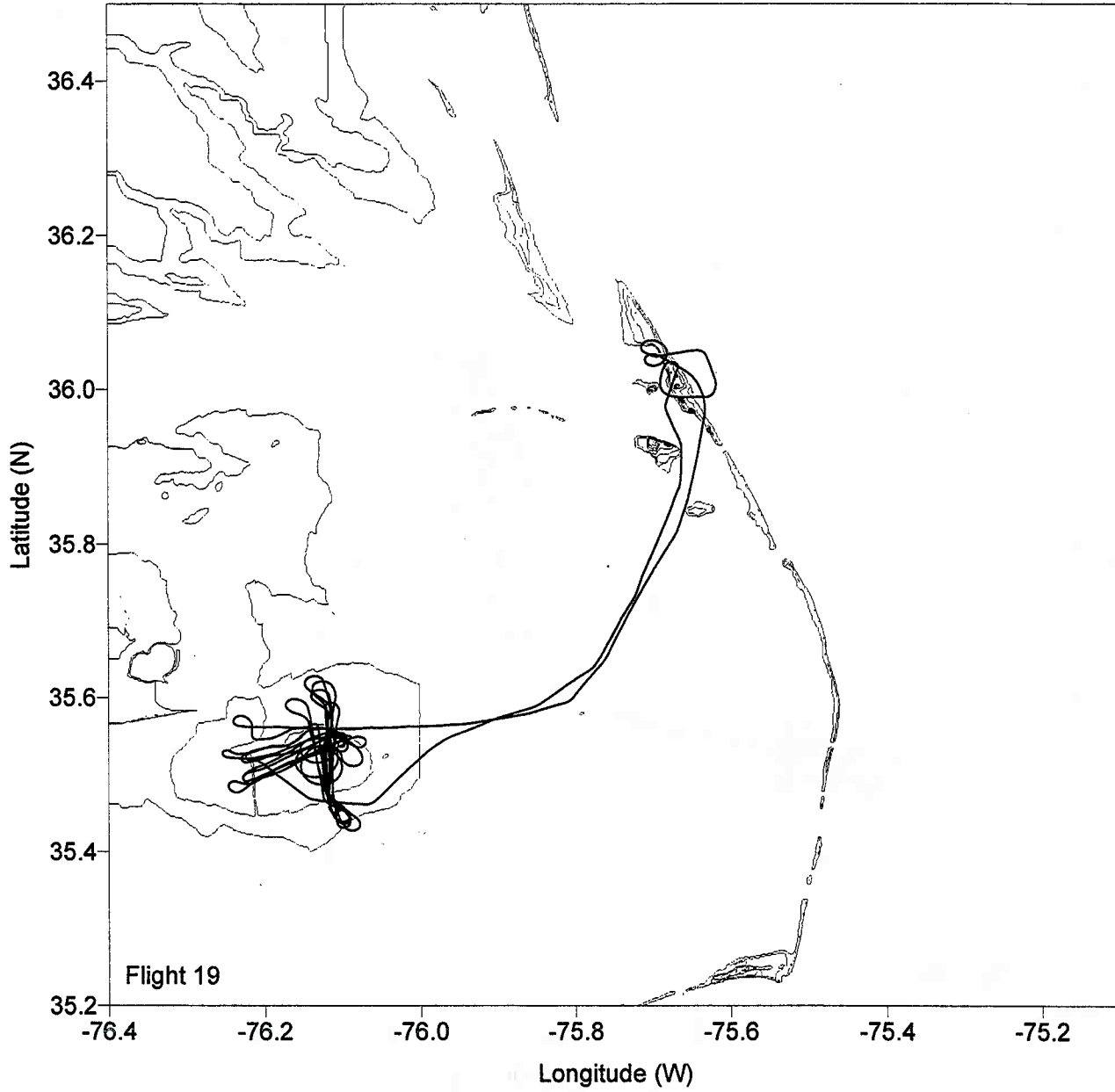
**Flight 19.** Flight 16, Thursday, 11 March 1999.



**Figure 20.** Flight 17, Thursday, 11 March 1999.

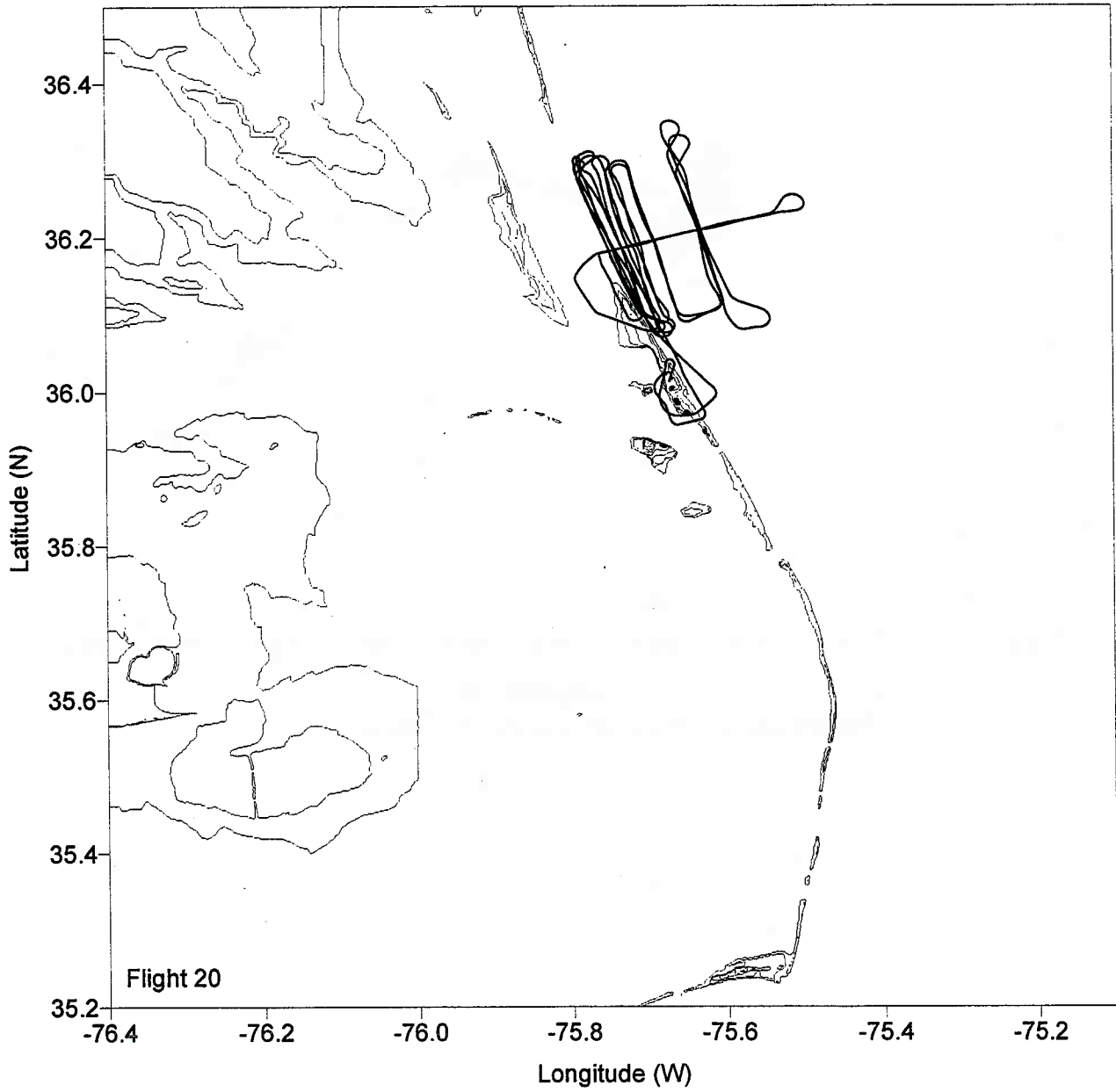


**Figure 21.** Flight 18, Friday, 12 March 1999.

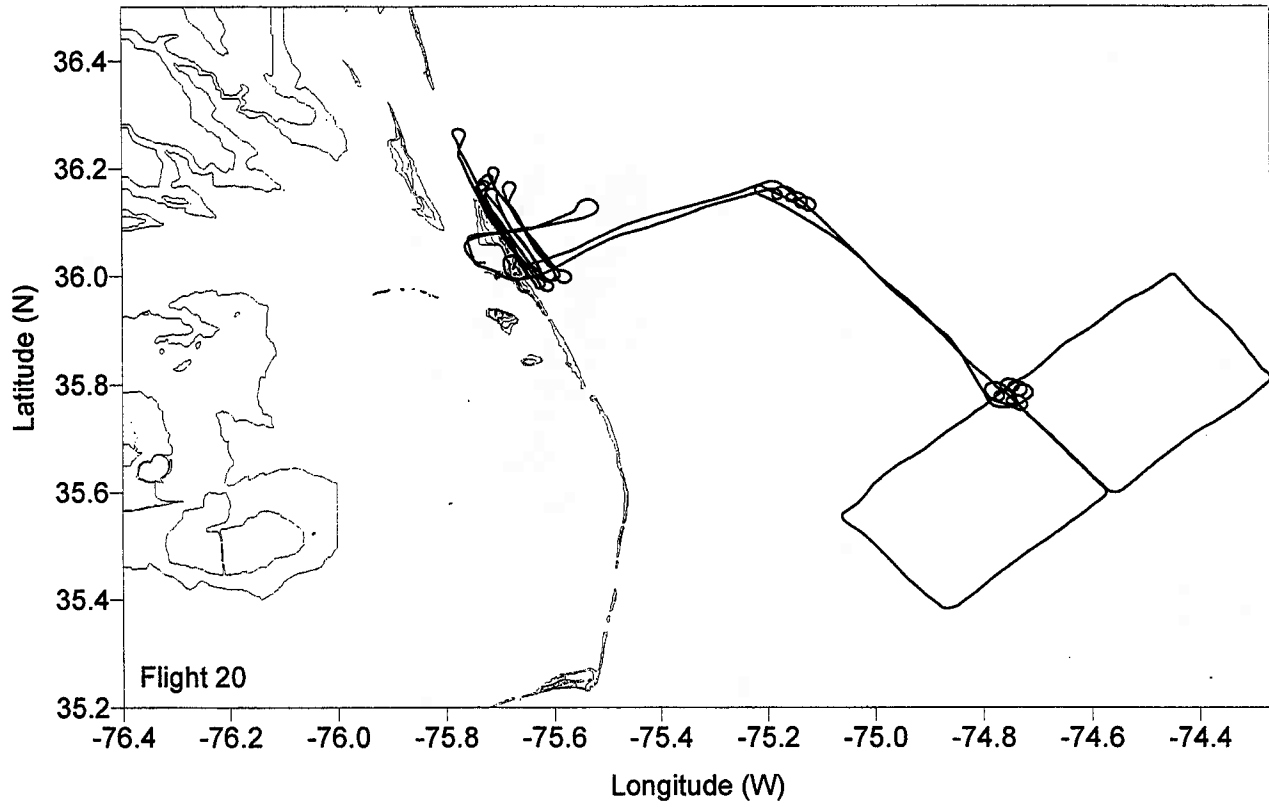


**Figure 22.** Flight 19, Saturday, 13 March 1999.

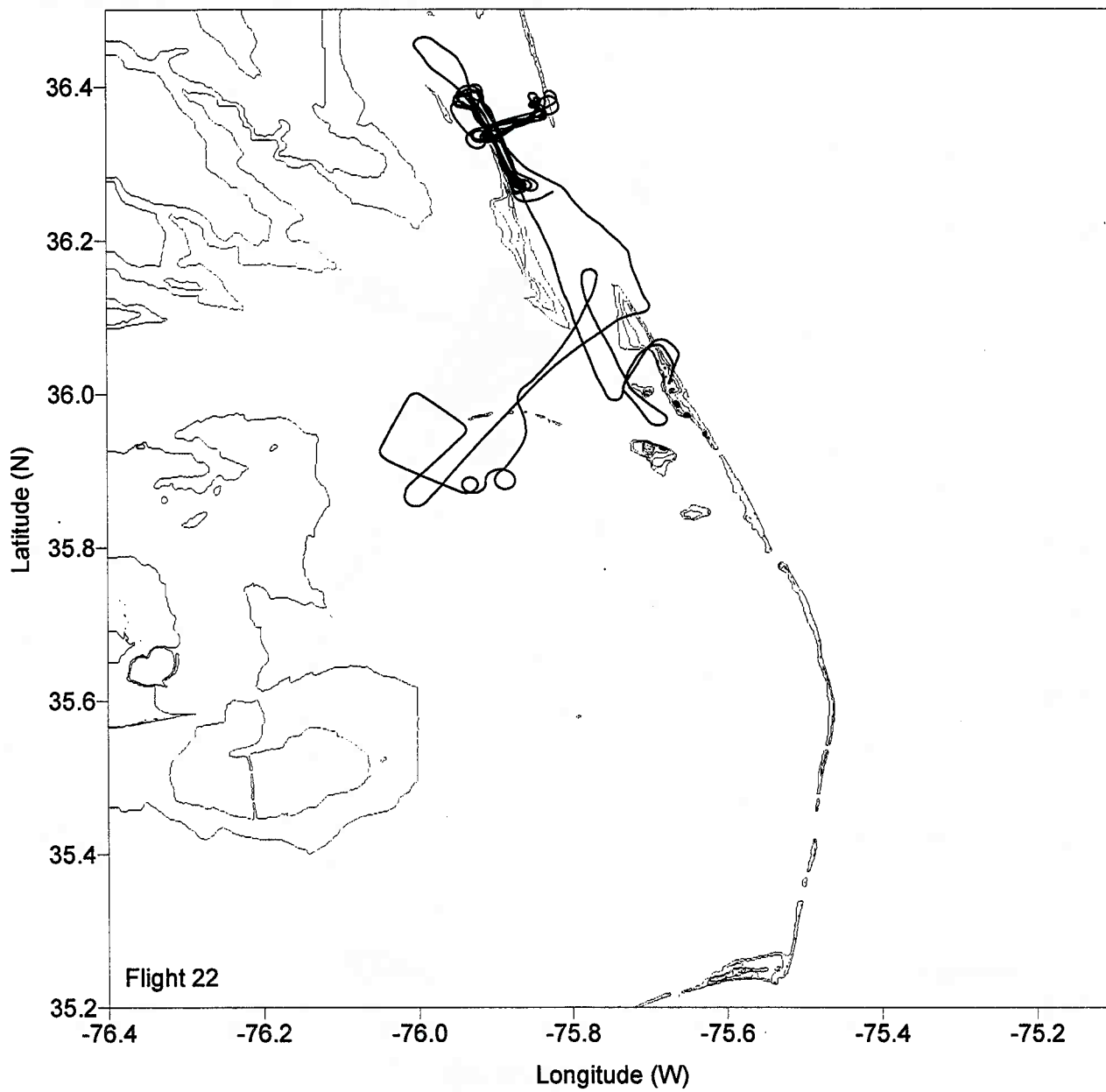




**Figure 23.** Flight 20, Tuesday, 16 March 1999.



**Figure 24.** Flight 21, Wednesday, 17 March 1999.



**Figure 25.** Flight 22, Wednesday, 17 March 1999.

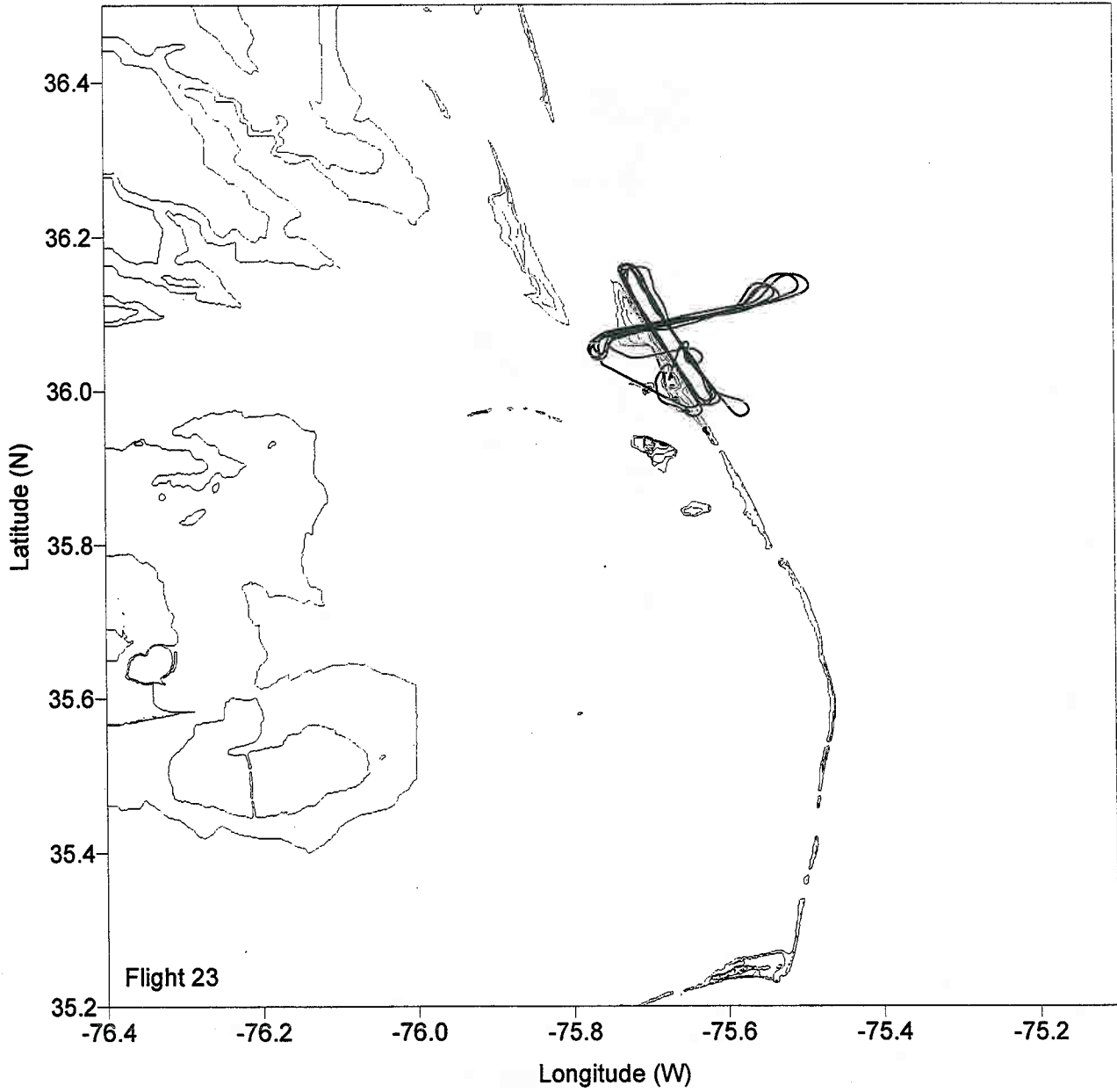


Figure 26. Flight 23, Thursday, 18 March 1999.