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AIRCRAFT MEASUREMENTS IN THE COUPLED BOUNDARY LAYERS AIR-SEA TRANSFER (CBLAST) LIGHT WIND PILOT FIELD STUDY

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List of Abbreviations and Acronyms

A/D	Analog-to-Digital
ARA	Airborne Research Australia
ARL	Air Resources Laboratory
ASCII	American Standard Code for Information Interchange
BAT	“Best” Aircraft Turbulence
CBLAST	Coupled Boundary Layers Air-Sea Transfer
CG	Center of Gravity
DGPS	Differential Global Positioning System
DRI	Defense Research Initiative
DSP	Design Stagnation Point
ELT	Emergency Locator Transmitter
FAA	Federal Aviation Administration
FUST	Fast Ultra-Sensitive Temperature
GOES	Geostationary Operational Environmental Satellite
GPS	Global Positioning System
IR	Infrared
IRGA	Infrared Gas Analyzer
MABL	Marine Atmospheric Boundary Layer
MVCO	Martha’s Vineyard Coastal Observatory
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
netCDF	Network Common Data Format
NOAA	National Oceanic and Atmospheric Administration
OAR	Office of Atmospheric Research
ONR	Office of Naval Research
PAR	Photosynthetically Active Radiation
PC	Personal Computer
PSP	Precision Spectral Pyranometer
REM	Remote
SAR	Synthetic Aperture Radar
SST	Sea Surface Temperature
TANS	Trimble Advanced Navigation System
UTC	Coordinated Universal Time
UW	University of Washington
WHOI	Woods Hole Oceanographic Institution

List of Symbols and Variables

$"_0$	Angle of Attack at Zero Lift
$,_h$	Heading Offset for Relative Velocity
$,_p$	Pitch Offset for Relative Velocity
$,_q$	Adjustment to Dynamic Pressure
$,_r$	Roll Offset for Relative Velocity
g	Gravitational Acceleration Constant (9.81 m s^{-2})
$K_{"}$	Pitch Calibration Constant
$K_{\$}$	Yaw Calibration Constant
K_{up}	Upwash Factor
mss	Mean Square Slope
R_T	Temperature Recovery Factor
r	Linear Calibration Coefficient
SE	Standard Error
2	Accelerometer Angle

Abstract

A research aircraft was used in the low-wind pilot field study of the Coupled Boundary Layers Air-Sea Transfer (CBLAST) Departmental Research Initiative (DRI) to acquire high-resolution *in situ* atmospheric turbulent fluxes in the marine atmospheric boundary layer while simultaneously documenting the characteristics of the surface wave field with various remote sensors. The CBLAST-Low pilot study was successfully conducted during a three-week period from late July to early August 2001 off the south shore of Martha's Vineyard Island, Massachusetts. Twenty missions (~ 48 flight hours) were flown by the LongEZ (registration N3R) on days with light winds (< 7 m s^{-1}) under various atmospheric stabilities. Data acquired by N3R in CBLAST-Low will support the test and refinement of parameterizations used in air-sea models for light wind regimes. In addition, such measurements will provide important boundary conditions to determine boundary layer turbulence and other atmospheric processes controlling the exchange of energy across the air-sea interface. This report summarizes the data acquired by N3R in the CBLAST-Low pilot field study.

1 Introduction

Existing parameterizations of heat, moisture, and momentum fluxes in the marine atmospheric boundary layer (MABL) perform poorly under weak wind regimes, especially in regions of inhomogeneity (e.g., Ramage 1984; Mahrt et al. 1996; Sun et al. 1996; Serra et al. 1997; Drennan et al. 1999; Greischar and Stull 1999; Lambert and Durand 1999). These problems are due to a variety of processes including averaging techniques, gravity/capillary wave spacing, surfactants and surface tension, free convection effects, and frequency-dependent differences between wind, waves, and stress. In order to improve our understanding of air-sea interaction in extremely light wind regimes, the Office of Naval Research (ONR) created the Coupled Boundary Layers Air-Sea Transfer (CBLAST) Defense Research Initiative (DRI). The objectives of the CBLAST light-wind initiative are:

- *to measure vertical fluxes of momentum and heat in the lower atmospheric boundary layer and in the ocean surface layer;*

- *to identify the processes that influence these fluxes (e.g., shear, convection, surface wave breaking, Langmuir cells);*

- *to close budgets for heat and momentum;*

- *to test parameterizations of fluxes; and*

- *to obtain other measurements (e.g., horizontal variability of pressure and temperature) sufficient to provide boundary conditions for a large eddy simulation or local application of a regional-scale simulation.*

A research aircraft was used in the CBLAST-Low pilot field study to acquire high-resolution *in situ* atmospheric turbulent fluxes in the MABL and simultaneously document the characteristics of the surface wave field with various remote sensors. The LongEZ (registration N3R) research aircraft has proven to be an especially powerful tool for studying the spatial variability of air-sea interaction (Crawford et al. 1993; Vogel and Crawford 1997, 1999; Crescenti et al. 1999; Mahrt et al. 1999, 2001; Mourad 1999; Sun et al. 1999, 2001; Vogel et al. 1999; Vandemark et al. 1999a, 1999b, 2001; French et al. 2000, Mourad et al. 2000; Vickers et al. 2000, 2001). Data acquired by N3R in CBLAST-Low will support the test and refinement of parameterizations used in air-sea models. In addition, such measurements will provide important boundary conditions to determine boundary layer turbulence and other atmospheric processes controlling the exchange of energy across the air-sea interface.

The CBLAST-Low pilot study was conducted during a three-week period from late July to early August 2001 off the south shore of Martha's Vineyard Island, Massachusetts. Twenty missions (~ 48 flight hours) were flown on days with light winds (< 7 m s^{-1}) under various atmospheric stabilities. This report summarizes the data acquired by N3R in the CBLAST-Low pilot field study.

2 Aircraft

Over the last ten years, N3R has been used by the National Oceanic and Atmospheric Administration's (NOAA) Air Resources Laboratory (ARL) in a number of air-sea interaction research studies. The differences between N3R and that of a standard airplane are obvious (Fig. 1). Far more than just being visually striking, these design features are ideally suited for high-fidelity turbulent flux measurements, especially at low altitudes.

Fig. 1. N3R in flight during a research mission.

The LongEZ was designed in the early 1980's by Burt Rutan as a high-performance sport aircraft. N3R is a custom-built aircraft licensed by the Federal Aviation Administration (FAA) under an experimental amateur-built airworthiness category. It is a safe and reliable aircraft with exceptional performance characteristics. Unlike most aircraft that are constructed with metal, N3R is fabricated from light-weight, high-strength fiberglass and foam composite that is resistant to structural fatigue and corrosion. Another important feature is that the engine is mounted on the rear of the airframe. The large main laminar-flow wing is set back further than that of conventional aircraft. Vertical winglets found on either end of the main wing enhance aircraft lift. A smaller second wing (canard) is found near the nose of the aircraft. This forward lifting surface is designed to increase aircraft stability and to prevent the main wing from stalling.

An important characteristic of an aircraft with a pusher engine and a canard is that it responds to turbulence far less than conventional aircraft with the same wing loading (weight per unit area). Since the canard contributes to both lift and stability, it can be heavily loaded relative to the main wing. For conventional aircraft with a rear-mounted elevator, an upward wind gust will tend to make the aircraft pitch up. This increases the lift generated by the wings and amplifies the aircraft response to an upward wind gust. In contrast, canard aircraft have their elevators forward of their center of gravity (CG). The same upward wind gust will push the canard elevator up which results in a compensating downward pitch response. Aircraft pitch response to either upward or downward wind gusts is opposed to the gust direction, thus giving canard-type aircraft their superior turbulent response characteristics. A canard aircraft is also stall-resistant. As the angle of attack on the airplane is increased, the canard loses lift before the main wing. This causes the nose to drop, which decreases the angle of attack, thereby providing automatic stall recovery without allowing the main wing to stall.

The unique aerodynamic design features of N3R make it ideally suited for making high-fidelity turbulence measurements with minimal flow distortion at low altitudes (~ 10 m) and slow aircraft flight speeds (~ 50 m s^{-1}). The small low-drag airframe and rear-mounted pusher engine have clear advantages for minimizing flow distortion and exhaust contamination (Crawford and Dobosy 1992). Instruments mounted on the aircraft nose avoid flow distortion, engine vibration, and engine exhaust. On N3R, the wind measurement probe is five wing-widths (chord lengths) ahead of the canard. The resulting flow distortion is extremely low compared to other aircraft (Crawford et al. 1996).

The utility of N3R is illustrated by its impressive specifications and performance (Table 1). There are few aircraft that will carry its own weight as payload. Typically, N3R will fly a research mission at 50 m s^{-1} consuming fuel at a rate of only 11 kg hr^{-1}. Its fast cruise speed and long-range allow it to reach anywhere in the world. Because of its classification under FAA's experimental category, modifications can be made easily. N3R has been modified for scientific research with a larger engine, redundant high-output alternators, extended fuel tanks, and hard-points and port holes for instrument mounting. Fiberglass construction allows flexibility in modifying the airframe to mount sensors and instrument pods.

Table 1. N3R specifications.

Engine	Lycoming O-320 160 HP
Seats	2
Electrical	72 Amp @ 12 VDC
Fuselage Length (with probe)	5.0 m (5.6 m)
Wing Span	8.5 m
Wing Area	10 m^2
Canard Span (Chord)	3.7 m (0.38 m)
Propeller Diameter	1.80 m
Weight (empty)	430 kg
Payload	370 kg
Fuel Capacity (with aux tank)	200 kg (300 kg)
Range (extended)	3300 km (3800 km)
Ceiling	8000 m
Endurance	10 - 18 hr
Cruise Speed	90 m s^{-1}
Stall Speed	25 - 30 m s^{-1}
Fuel Use @ 50 m s^{-1} (90 m s^{-1})	11 kg hr^{-1} (20 kg hr^{-1})

A number of important safety features have been incorporated into N3R. A 406-MHz Emergency Locator Transmitter (ELT) can send a distress signal via a NOAA Geostationary Operational Environmental Satellite (GOES) to a U. S. Coast Guard station or other rescue facility within seconds of activation. In the event of a catastrophic airframe or engine failure, a solid rocket ballistic parachute can be deployed in ~ 1 s. The parachute, which is attached to the airframe, can safely lower the aircraft and pilot to the surface. A four-point harness and foam impact seat are capable of withstanding a 40-G impact. The auto-pilot is used to reduce pilot stress and fatigue for long flights. Routine radio communications are maintained with a ground-station on a regular basis. Other safety features include a life jacket, survival suit, inflatable raft, flare gun, signal mirrors, flashlights, chemical light sticks, and emergency rations.

3 Instrumentation

3.1 Wind Measurement System

The center piece of the N3R instrumentation package is the “best” aircraft turbulence (BAT) probe (Fig. 2). This device was designed, tested, and built as a result of a collaboration between ARL and Airborne Research Australia (ARA) (Crawford and Dobosy 1992; Hacker and Crawford 1999). The housing consists of a 15-cm diameter carbon-fiber hemisphere mounted on a tapered carbon-fiber cone. The housing and cone are mounted on a roughly 2-m long cylinder protruding forward from the nose of the aircraft. The housing contains four solid-state pressure sensors used to measure differential (three) and static (one) pressure from nine pressure ports symmetrically distributed on the hemisphere. The nominal accuracy of these sensors is ±0.05 mb with a response of about 1 KHz. These measurements provide the pressure distribution over the housing from which the relative air velocity may be computed.

Two global positioning systems (GPS) are used on N3R. A dual-frequency Ashtech GPS antenna is mounted on the tapered cone of the BAT probe just aft of the housing. By using differential GPS (DGPS) correction techniques, aircraft position can be measured to within several centimeters relative to a fixed point and ground velocity can be computed to an accuracy of better than 1 cm s^{-1} in the horizontal and 2 cm s^{-1} in the vertical. These data are acquired at a rate of 5 Hz. Three orthogonally-mounted accelerometers contained in the BAT housing are used to augment the GPS position and velocity data to a frequency of 50 Hz.

Aircraft attitude (pitch, roll, and heading) is measured using a Trimble Advanced Navigation System (TANS) vector GPS. The TANS-vector consists of four antennas mounted on the BAT probe housing, on both wings, and the rear of the cockpit. Using carrier-phase techniques, the position of three antennas is measured relative to a master antenna. Manufacturer specified accuracy for aircraft attitude given the geometry of N3R is 0.05°. The TANS-vector GPS acquires attitude data at a maximum rate of 10 Hz. By differencing measurements acquired by accelerometers in the BAT probe housing and by three accelerometers mounted on the aircraft centerline in the back of the fuselage, the frequency range for aircraft pitch and heading are extended up to 50 Hz. Similarly, the frequency can be extended to 50 Hz for aircraft roll by differencing two accelerometers mounted on either wing. This “blending” technique of aircraft position, velocity, and attitude from data acquired by GPS and accelerometers is described by Eckman et al. (1999).

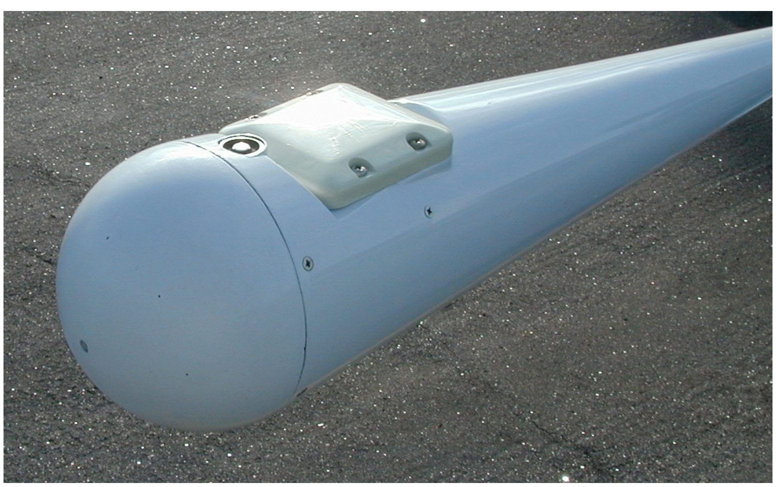

Fig. 2. BAT probe and GPS antenna.

Calibration of the differential pressure sensors is accomplished using a Mensor 4040 digital pressure transducer. The Mensor transducer and the pressure sensors are connected in parallel to a syringe that is used to adjust the pressure applied to both the calibration standard and sensors. The y- and z-axis sensors (lateral and vertical, respectively) are designed to respond to differential pressure of ±15 mb corresponding to an output of ±5 V. The x-axis sensor (longitudinal) ranges from 0 to 28 mb with a corresponding output of ±5 V. Figure 3 shows the linear calibration curves for the Px (longitudinal), Py (lateral), and Pz (vertical) pressure sensors. At least seven independent calibration points (*N*) were acquired for each sensor. A nearly perfect linear correlation *r* exists for all three sensors. The standard error SE, (i.e., the standard deviation about the linear fit) varies between 0.013 and 0.023 mb.

The accelerometers are calibrated by tipping the sensors to known angles and calculating the contribution due to gravity *g* as a function of angle 2 (i.e., *g*sin2 or *g*cos2). It is possible to produce a calibration curve over the entire range of the device by making measurements over several angles. Figure 4 shows the linear calibration curves for the Ax (longitudinal), Ay (lateral), and Az (vertical) accelerometers located in the BAT probe. At least seven independent calibration points were acquired for each sensor. A nearly perfect linear correlation *r* exists for all three sensors while values of *SE* vary between 0.024 and 0.053 m s^{-2}. The same calibration procedure was performed on the "backseat" accelerometers located along the aircraft centerline in the back of the fuselage (Fig. 5). Once again, values of *r* approach unity. Values of *SE* for all three backseat accelerometers are quite small (~ 0.008 to 0.015 m s^{-2}).

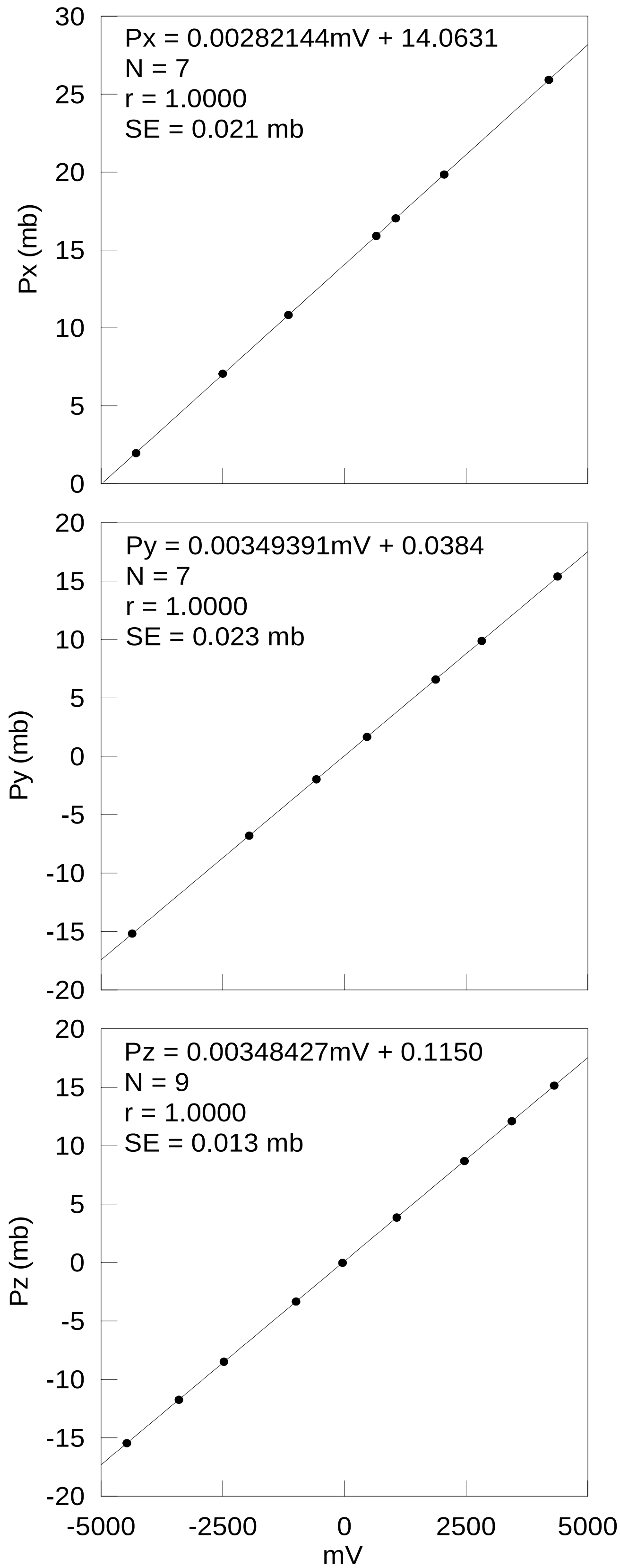

Fig. 3. Calibration curves for BAT probe pressure sensors.

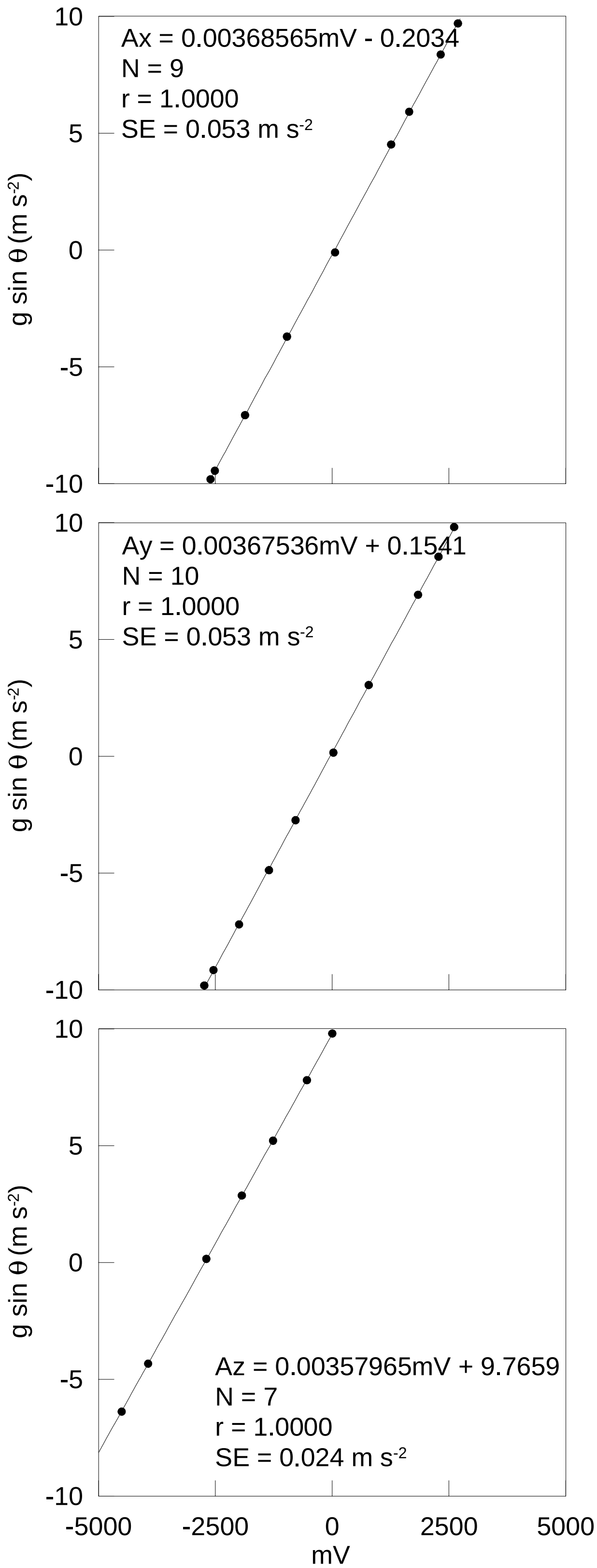

Fig. 4. Calibration curves for BAT probe accelerometers.

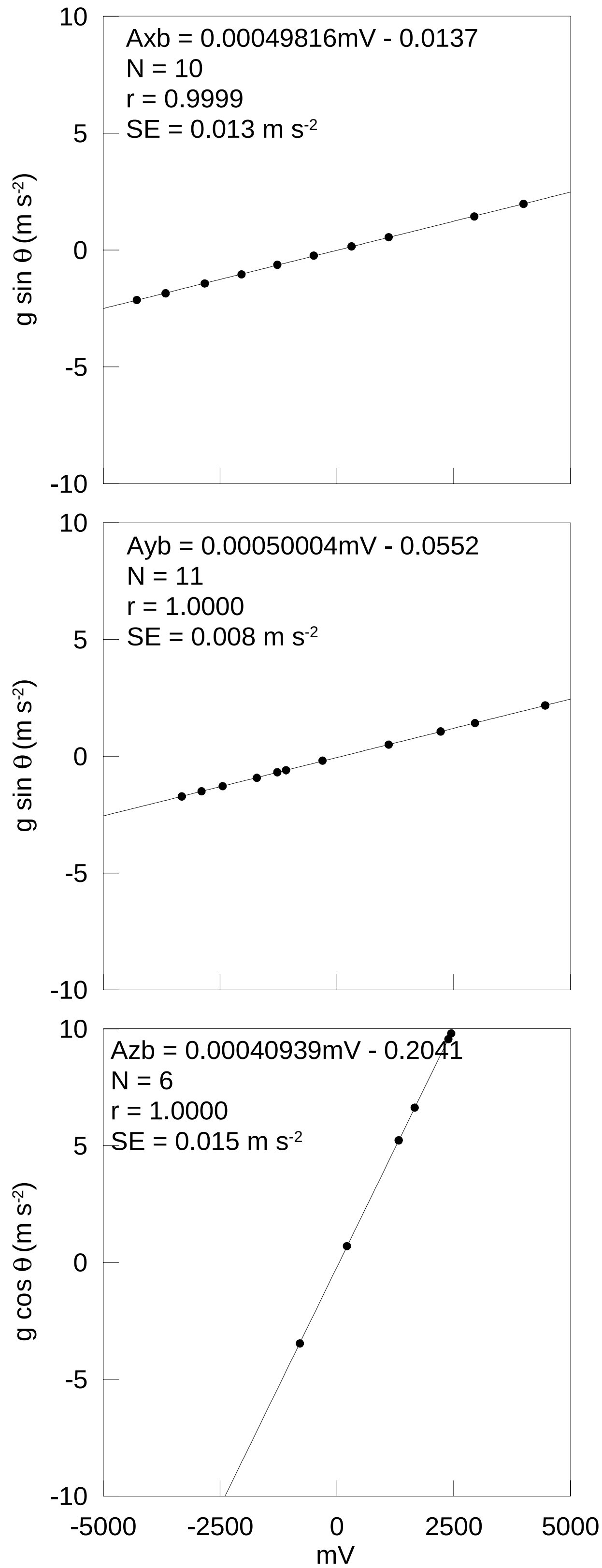

Fig. 5. Calibration curves for backseat accelerometers.

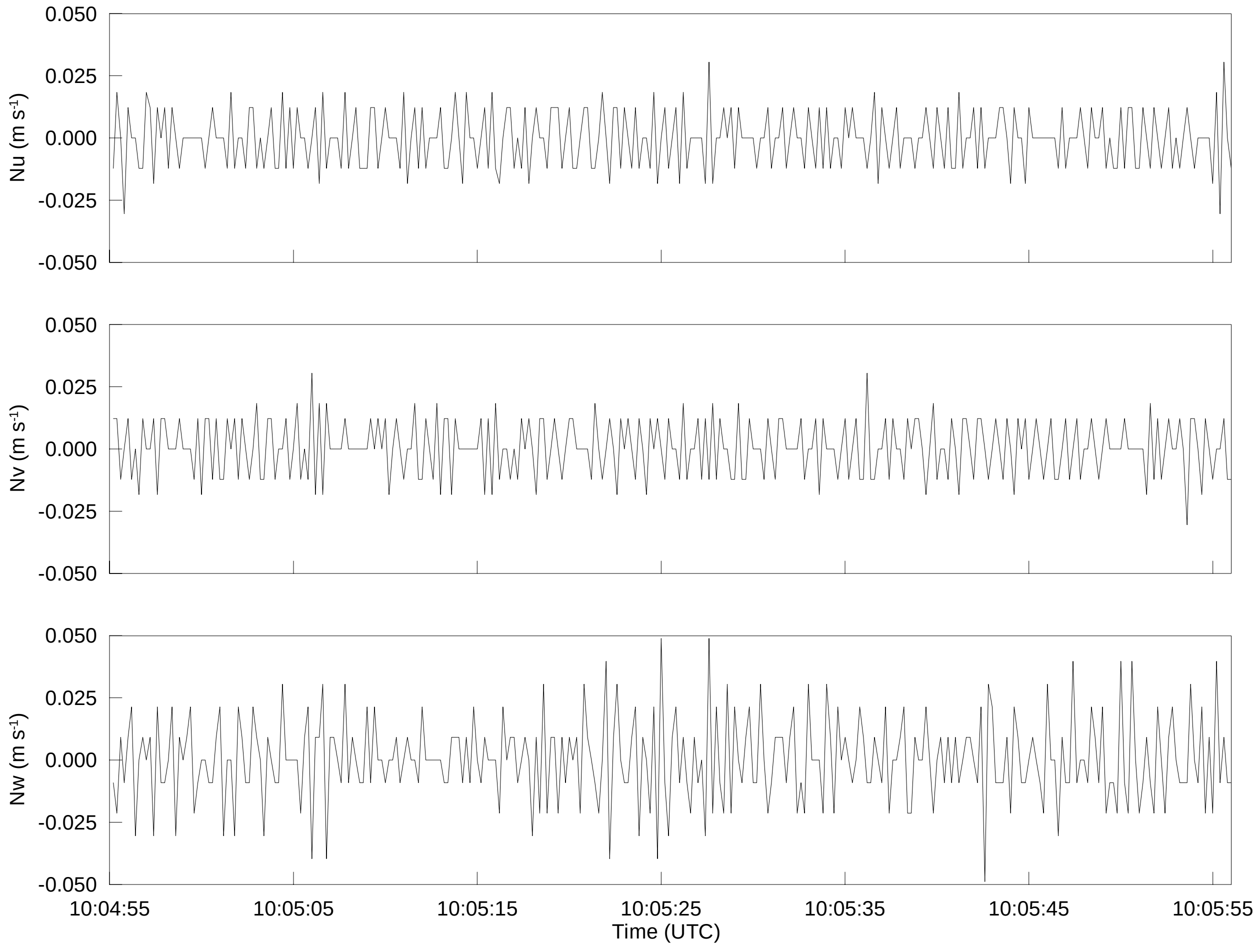

Fig. 6. Demonstration of accuracy of DGPS-derived aircraft velocity. Eastward (Nu), northward (Nv), and vertical (Nw) velocity components are reported for a one-minute period when N3R was stationary on 22 JUL 01.

The Ashtech and TANS-vector GPS are not calibrated per se, but checks are incorporated to ensure the data are within tolerance levels. For example, aircraft velocity data should be zero when N3R is parked on the tarmac. Figure 6 is an example of the DGPS eastward (Nu), northward (Nv), and vertical (Nw) aircraft velocity during a static test. This segment corresponds to a time when N3R was parked on the tarmac for about 60 s on 22 JUL 01. Over the course of the study, data from these static tests show a mean aircraft velocity of zero with a standard deviation of 1 to 2 cm s^{-1}. Spectra indicate the noise in the velocity data appears white (i.e., random). Prior studies have shown a standard deviation of 4 to 5 cm s^{-1} (French et al. 2000). This improvement is due in part to a combination of an upgraded GPS system (from the signal-frequency NovAtel GPS to the dual-frequency Ashtech GPS) and the elimination of selective availability (i.e., artificially inserted noise or variance) in the GPS satellite signals (Showstack 2000).

3.2 Temperature and Humidity Sensors

Three different probes are used to measure air temperature. A slow-response, multi-element

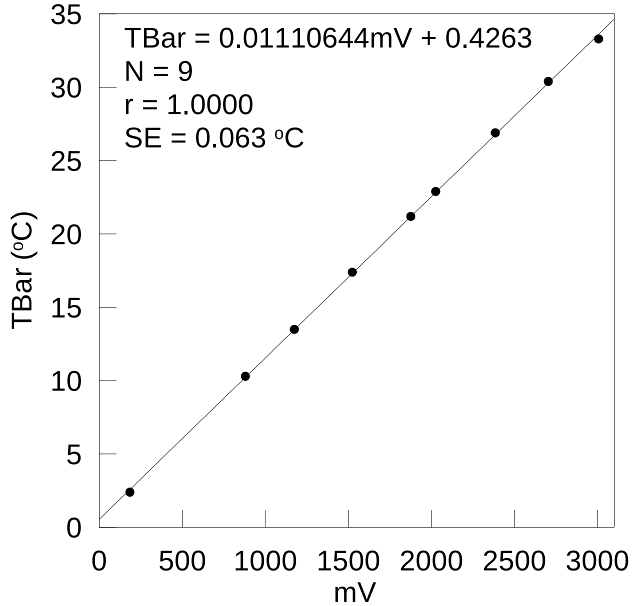

Fig. 7. Calibration curve for slow-response thermistor (TBar).

linear thermistor provides low frequency (1 Hz) temperature measurements. This sensor is mounted within the center-hole, or design stagnation point (DSP) port, on the BAT hemisphere. A second fast-response (~ 20 Hz) 0.13-mm micro-bead thermistor is also mounted inside the DSP port. The recovery factor for micro-bead thermistor is 0.82 (the current housing/element combination has a time constant of ~ 0.07 s). The calculation of the correction factor due to compression is simpler than that of conventional temperature probes because of the location of the sensors within the DSP. The third sensor is the fast ultra-sensitive temperature (FUST) probe (French et al. 2001). This sensor is a Cu-Co 0.025-mm thermocouple and has a response time of better than 20 ms (50 Hz). The probe is mounted on a post below the hemisphere of the BAT probe. The FUST probe is still in the experimental development stage. Results from this new sensor will be documented at a later date.

Humidity is measured with two different sensors. An EG&G 200 chilled mirror sensor provides dew point temperature. This sensor has a relatively long response time (as much as a few seconds). An ARL designed and built fast-response (~ 50 Hz) open-path infrared gas analyzer (IRGA) measures the attenuation of light due to H_2O and CO_2 through a known path (Auble and Meyers 1992**)**.

The slow-response thermistor is calibrated against an accurate mercury-bulb thermometer in a well mixed water bath over a range of temperatures. This method provides a stable calibration. The calibration curve for this thermistor (TBar) is shown in Figure 7. The correlation coefficient is nearly perfect with a standard error of about 0.06 °C.

The fast-response micro-bead thermistor is calibrated in flight against the output from the slow-response thermistor. Figure 8 is a scatter plot of the calibrated temperature acquired by the fast-response thermistor (Tp1) as a function of the slow response thermistor temperature (TBar).

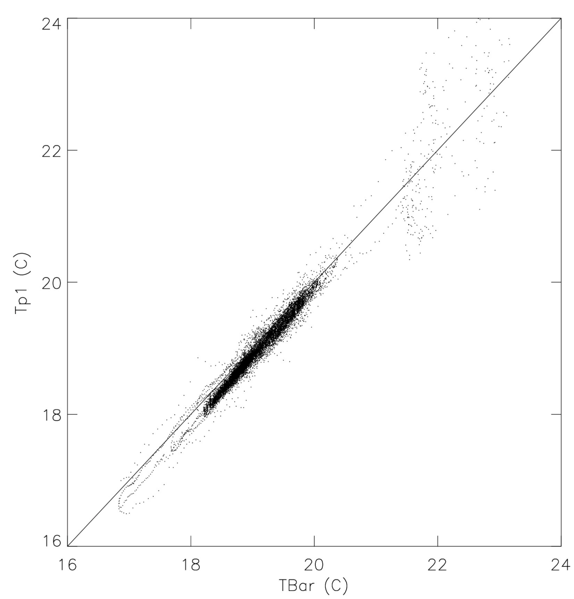

Fig. 8. Scatter plot of temperature acquired by the fast-response thermistor (Tp1) against the slow response thermistor temperature (TBar) acquire by N3R on 21 JUL 01.

In general, temperature data acquired by the micro-bead thermistor is highly correlated with data from the slow-response probe with correlation coefficients usually exceeding 0.9. It should be pointed out that some departures, especially for extreme values, represent real differences in the response time of the two sensors. For example, there are instances where the temperature from the slow-response thermistor changes more slowly than that of the micro-bead thermistor when N3R is flying through strong temperature gradients.

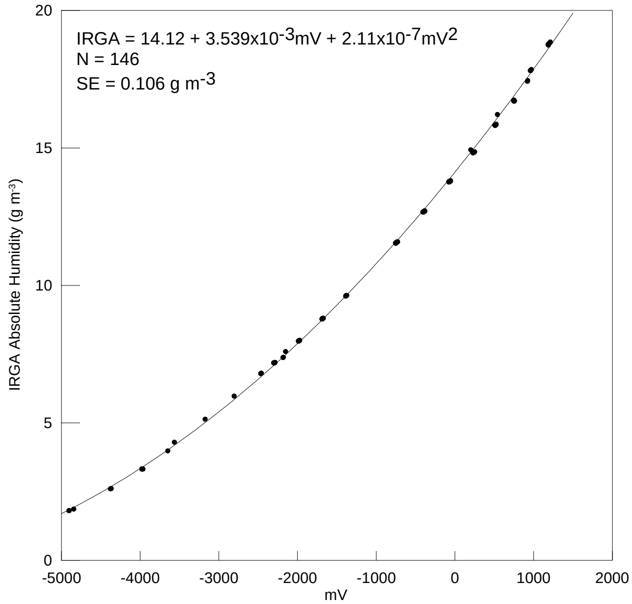

Fig. 9. Calibration curve for IRGA.

The factory calibration was used for the chilled mirror dew point sensor. Data output from this sensor were checked against humidity data acquired by a fan-aspirated psychrometer. The IRGA was calibrated by placing the sensor inside a chamber with known concentrations of water vapor between 2 and 19 g m^{-3}. The calibration curve for the IRGA is a second-order polynomial (Fig. 9). It should be pointed out that values outside this range can be subject to larger errors. For very dry conditions, the IRGA can not acquire reliable data when absolute humidity is less than 1.7 g m^{-3} (corresponding to the minimum sensor output voltage of -5000 mV). Extrapolation of the calibration curve for absolute humidity greater than 19 g m^{-3} can also lead to uncertainty.

3.3 Radiometers

Radiometric sensors mounted on N3R measure both upwelling and downwelling (with respect to the aircraft) radiation. Upward looking and downward looking LI-COR photosynthetically active radiation (PAR) sensors measure the incoming and reflected portion of the visible solar spectrum, respectively. Upward and downward looking Everest Interscience 4000.4GL and 4000.4GXL infrared (IR) radiometer are used to measure sky and sea surface temperature (SST), respectively. The SST radiometer is shown in Figure 10. The upward looking radiometer has a response time of 0.25 s while the downward looking SST sensor has a response time of 0.02 s. The

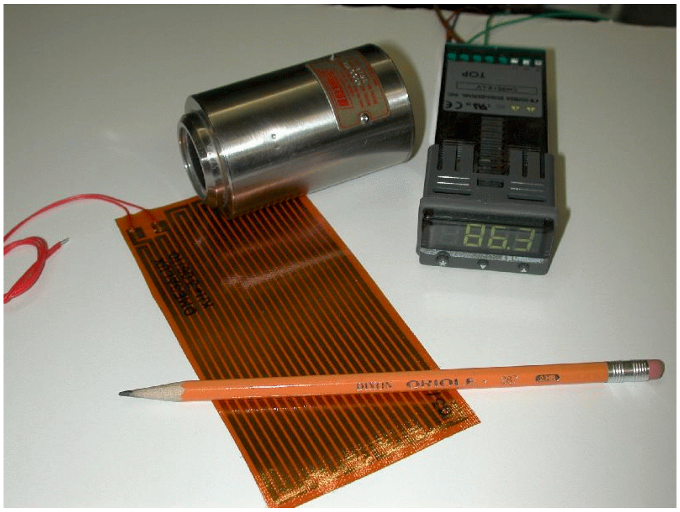

Fig. 10. Everest Interscience 4000.4GXL infrared radiometer with a flexible heater and a temperature controller.

manufacturer specified accuracy for both sensors is ±0.5 ‹C.

The PAR sensors were calibrated against an Eppley Precision Spectral Pyranometer (PSP). These radiometers were placed outdoors under a clear, unobstructed sky for more than eight hours. One minute averages were acquired during this time and were used to determine the calibration curves for the PAR sensors (Fig. 11). Unlike the PSP which is responsive to the entire solar spectrum (0.285 to 2.8 :m), the PAR sensors are responsive only to the visible portion of the spectrum (0.4 to 1.1 :m). Thus, considerable scatter exists when clouds are present.

The upward looking Everest Interscience 4000.4GL (sky) radiometer was calibrated over a well-mixed water bath over a temperature range of 0 to 40 °C (Fig. 12). The linear regression over this range provides a good fit with an excellent correlation and a standard error of about 0.2 °C. It should be noted that a calibration could not be extended down to -40 °C which is the expected sky temperature for clear conditions.

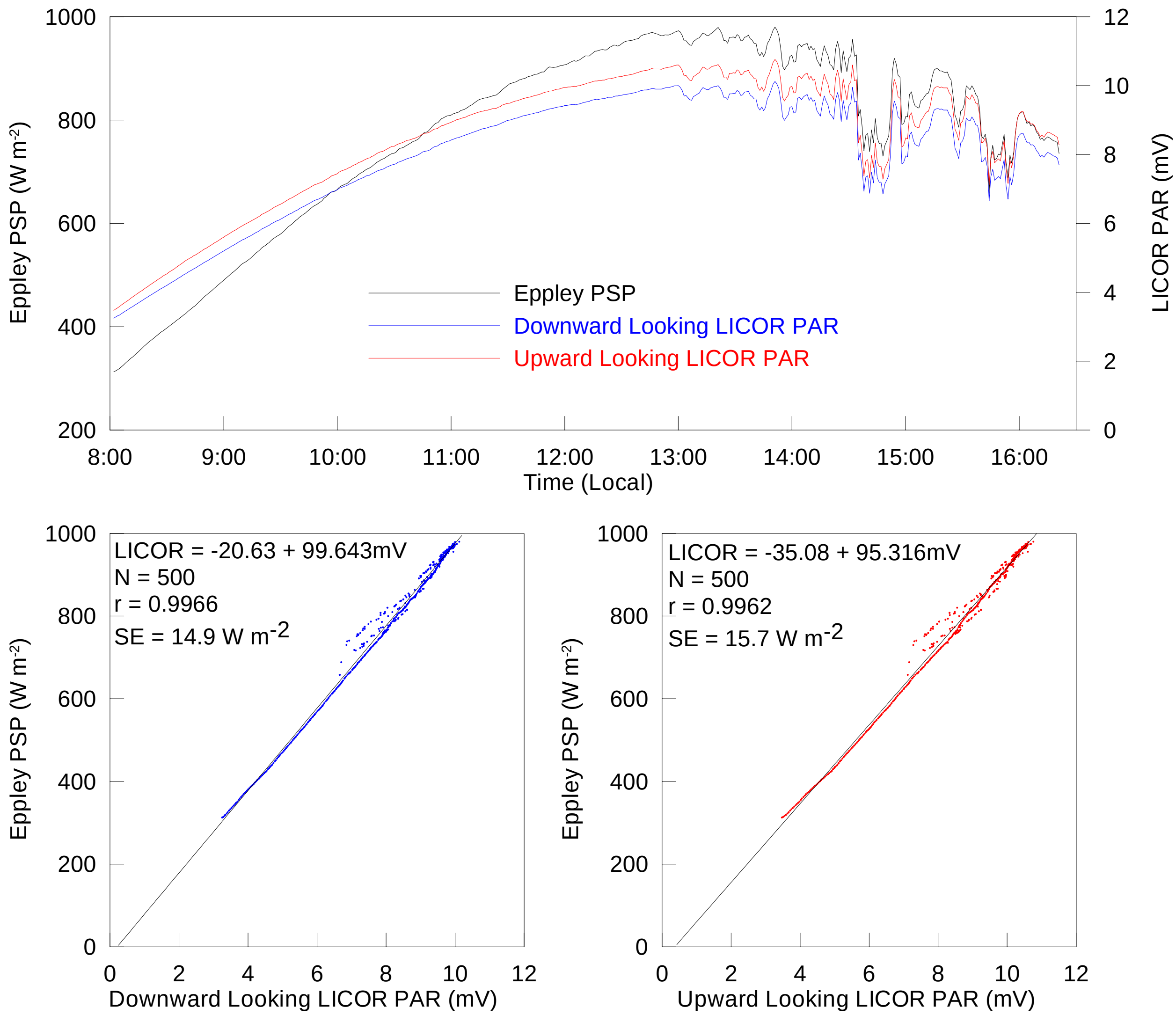

Fig. 11. Calibration curves for PAR sensors.

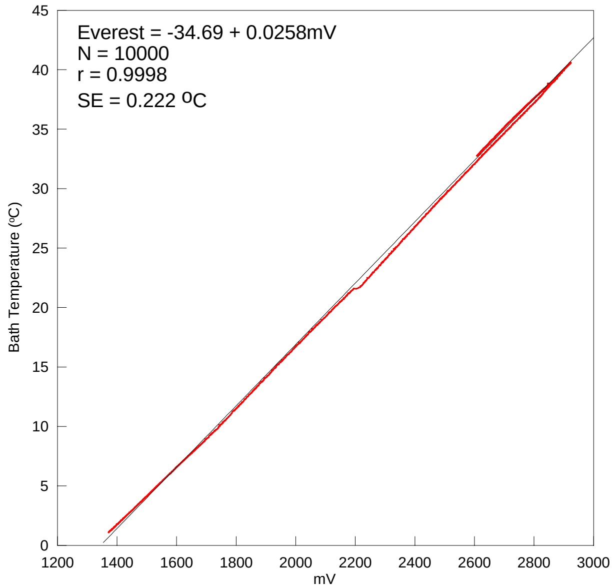

Fig. 12. Calibration curve for Everest Interscience 4000.4GL (sky) radiometer.

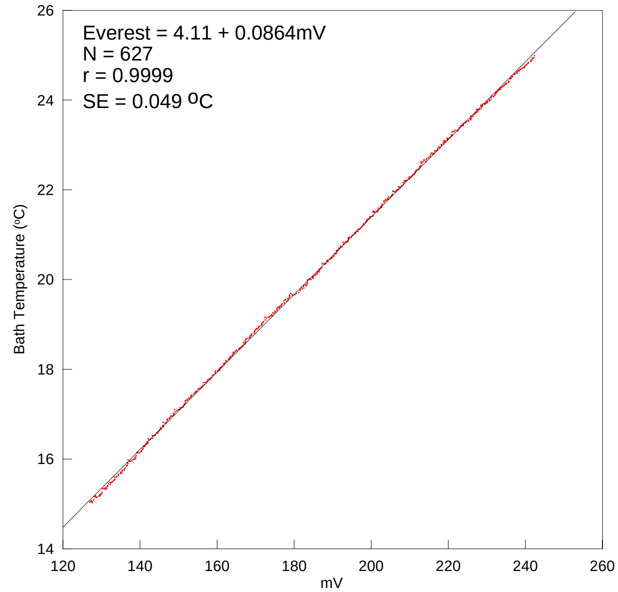

Fig. 13. Calibration curve for Everest Interscience 4000.4GXL (SST) radiometer.

Previous air-sea studies have shown that the SST data are subject to significant errors (> 1 to 2 °C) due to a temperature dependency of the sensor. Laboratory testing showed that SST measurements could be improved to better than 0.2 °C if the body temperature of the radiometer could be kept at a constant temperature. A flexible heater was wrapped around the body of the Everest 4000.4GXL radiometer and encased in a plastic shell with a layer of insulation. A controller is used to maintain a constant sensor body temperature of 30 °C. While the body temperature of the sensor is maintained at a constant value, no corrections are applied for the effects of the intervening atmosphere. The SST radiometer was calibrated over a well mixed water bath over a temperature range of 15 to 25 °C (expected SST off the coast of Martha's Vineyard in the summer). A nearly perfect linear correlation was found for this calibration with a standard error of about 0.05 °C (Fig. 13).

3.4 Ocean Surface Remote Sensors

A laser altimeter array and a nadir-pointing Ka-band scatterometer are used to determine long and short wave characteristics, respectively, of the sea surface. The data obtained from these remote sensors is unique in that it provides wave information from small capillary waves to long swells coupled with wind stress and turbulence measurements acquired by the BAT probe in the atmospheric surface layer. One of the lasers and the scatterometer are carried in an instrument pod suspended beneath the fuselage of N3R (Fig. 14).

Fig. 14. N3R instrument pod.

Fig. 15. Riegl LD90-3100VHS laser altimeter.

An array of three Riegl downward looking laser altimeters is designed to measure the sea surface profile and the one- and two-dimensional slopes of intermediate scale waves on the order of 1 to 10 m (Fig. 15). The laser array consists of three downward looking lasers mounted on the vertices of an equilateral triangle with 1-m separation. Two are mounted under either wing (model LD90-3100VHS) while the third is mounted in the instrument pod (model LD90-3100EHS). These lasers simultaneously measure sea surface height at points about the 1-m diameter circular footprint of the radar scatterometer. The circular footprint of each laser is about 7.5 mm in diameter at an altitude of 15 m. The two lasers mounted in either wing operate with a pulse repetition frequency of 2 KHz while the third laser in the pod operates at a frequency of 12 KHz. The individual pulses are averaged down to a rate of 150 Hz to reduce noise resulting in 13 pulses per scan for the 2-KHz lasers and 80 pulses per scan for the 12-KHz laser. The lasers output distance, normalized amplitude of the returned pulse, and number of valid returns. The focal length of the lasers was set to 15 m providing a nominal accuracy of ±2 mm. The maximum altitude for which the lasers provide useful data is about 50 m. Given the laser measurements and aircraft attitude at any given time, matrix multiplications yield the vector normal to the sea surface plane. Other derived products include significant wave height, dominant wavelength of the wind sea, and the slope variance of the measured two-dimensional probability density function. This last parameter is denoted as the mean square slope (*mss*) of long waves. The *mss* can be considered as the slope variance associated with intermediate scale gravity waves.A fourth Riegl LD90-3100VHS laser was installed in the left wing of N3R at angle of 15° from the vertical. This sensor will serve as a "glint" laser during those instances when the vertically pointing lasers receive few or no returns.

Along-track changes in the integrated roughness of short ocean waves on the order of 2 to 100 cm are determined using a nadir-pointing 36-GHz (8.3 mm) continuous wave scatterometer (Fig. 16). This sensor, developed and built at the National Aeronautics and Space Administration (NASA) by Douglas C. Vandemark, is used to infer the short wave characteristics by relating backscatter intensity to the surface slope variance. The two-antenna remote sensor has a two-way, 3-dB beamwidth of 4.1° which corresponds to a 1.1-m footprint diameter at 15 m. Coincident laser altimeter

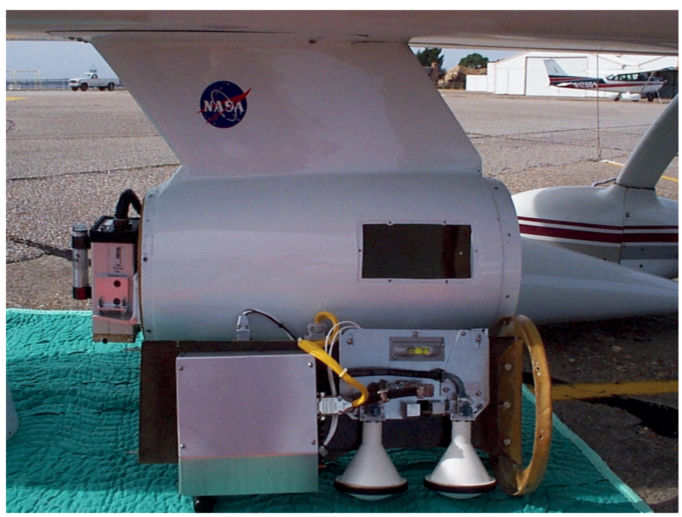

Fig. 16. NASA Ka-band scatterometer.

measurements provide the precise range information for computation of the normalized radar cross section which is used in turn to derive the *mss*. The radar/laser combination leads to high fidelity observations of the long-wave, short-wave hydrodynamic modulation transfer function.

3.5 Other Sensors

An independent suite of remote sensors was also flown by N3R during the CBLAST-Low pilot study. An SST imaging system was developed by Andrew T. Jessup of the University of Washington (UW) and Christopher J. Zappa of the Woods Hole Oceanographic Institution (WHOI). The UW/WHOI system incorporates a Raytheon Galileo IR imager, a Pulnix video camera, a Heitronics KT-15 radiometer, and GPS. The IR imager and video camera were mounted in the rear portion of the instrument pod. The KT-15 radiometer was mounted under the right wing of N3R. These data were acquired and stored on a separate computer and are not included with the N3R data acquisition system.

4 Data Acquisition System

Fig. 17. N3R data acquisition PC, BAT auxiliary box, Ashtech dual-frequency GPS, and PCMCIA flash disk.

The N3R data acquisition system consists of a modified personal computer (PC) powered by a Intel® Celeron® 600-MHz processor (Fig. 17), two remote (REM) analog-to-digital (A/D) modules, and flash card drive, flat-panel display, and a control switch box for the pilot. The PC and most associated electronics are mounted on the floor of the backseat of N3R. The data acquisition programs, written in C, run on top of the Microsoft DOS 6.22 operating system.

Analog sensor signals are digitized by the REM modules. This electronics package was developed by ARA to provide high-speed, high-resolution, multi-channel data logging. 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 about 0.15 mV. The incoming analog signals are filtered using a 5-pole Butterworth anti-aliasing filter with a low-pass cutoff of 30 Hz. The signals are over-sampled by a factor of 32 before being averaged to 50 Hz for further noise reduction. The digital signals are transmitted to the PC for data storage via RS-422 serial lines. Two REM modules are currently used in the data acquisition system for a total of 32 A/D channels. One is contained in the tapered carbon fiber cone of the BAT probe to the rear of the pressure port dome. The second is inside the BAT auxiliary box located next to the data acquisition PC.

Calibration of the A/D channels for both REM modules was done prior to the CBLAST-Low pilot field study. Precise inputs of -4500, 0, and 4500 mV were inserted into each A/D channel. Simple linear calibration curves were computed for each input channel.

Most of the sensors described in the previous section provide analog signals that are digitized by the REMs. The exceptions include the Ashtech and TANS-vector GPS, and the Riegl lasers. These instruments transmit their respective digital data directly to the PC via RS-232 lines. The GPS data are ingested by the PC at 10 Hz while the Riegl lasers transmit their data at 150 Hz. All of the data are written to the PC hard disk once per second and are copied to a flash card at the end of each flight for post processing.

The Ashtech GPS provides the primary time reference for the data acquisition system. The clock utilized by the Ashtech receiver is synchronized with the time transmitted by the GPS satellites. The clock outputs a one pulse per second signal to the PC. The pulse is also used to synchronize flow of data transmitted to the PC from the REM modules and other digital sensors.

Three separate files are created for each flight. These files have the same 8-digit root name which is based on the PC clock when the data acquisition system is started (UTC). The convention is: month (2 digits), day (2 digits), hour (2 digits), and minute (2 digits). Each file has a unique 3-character suffix: ORG, BIN, and MKR.

The ORG file contains binary data from all of the *in situ* and remote sensors which are written in 1-s blocks. This file also contains information (i.e., a “header” listing) regarding device and channel assignments, measurement frequencies, engineering units, ranges, voltage scale factors and offsets, and calibration coefficients.

The BIN file contains binary satellite pseudo-range, carrier phase and Doppler data acquired by the Ashtech GPS during the flight.

The MKR file contains an ASCII listing of specific times and locations during the flight when the pilot toggles the “on”, “off”, or “event” switch on the control switch box. This file is used to mark the start and end of flux legs, profiles, or other specific maneuvers.

In addition to the three files collected by the N3R data acquisition system, two files are collected from a stationary ground-based Ashtech GPS. These data, when combined with GPS data acquired by N3R, are used to generate differentially corrected positions and velocities for the aircraft. A BIN file contains binary satellite pseudo-range, carrier phase and Doppler data acquired by the Ashtech GPS ground station while N3R was in flight. An EPH file contains the ephemeris information. The location of the ground station was 41° 22' 29.9" N, 70° 31' 38.3" W.

5 Post Flight Data Processing

Upon completion of each flight, files are transferred off the N3R data acquisition system to a ground-based PC for post-flight processing. These data are put through a series of post-flight processing programs with each performing a specific task. All programs are in written in GNU C and are executed on a PC under a Linux operating system. The following is a brief outline of the processing steps. Raw GPS data from the aircraft and ground station are combined to produce a set of differentially-corrected GPS aircraft positions and velocities. Next, the *in situ* and remote sensor data are merged with the differentially corrected GPS data and converted into a network common data format (netCDF). Quality control programs are implemented on these data to remove spikes and outliers and to perform a series of other data quality checks. Finally, the calibrations are applied, low- and high-rate data are merged, winds are computed, and dynamic heating corrections are applied to the air temperature. During each step, time stamps are written in the output file header. These stamps describe when the data were processed and the version of the processing programs. This information is carried through to the final product. Additionally, the marker files are manually edited to reflect special notes regarding the flight and designate special legs for analysis purposes. Figure 18 contains a flow chart illustrating the steps for data post-processing. The rectangles in the figure represent specific data files while the ovals represent individual programs. Table 2 is a summary of the various acquired and processed data files.

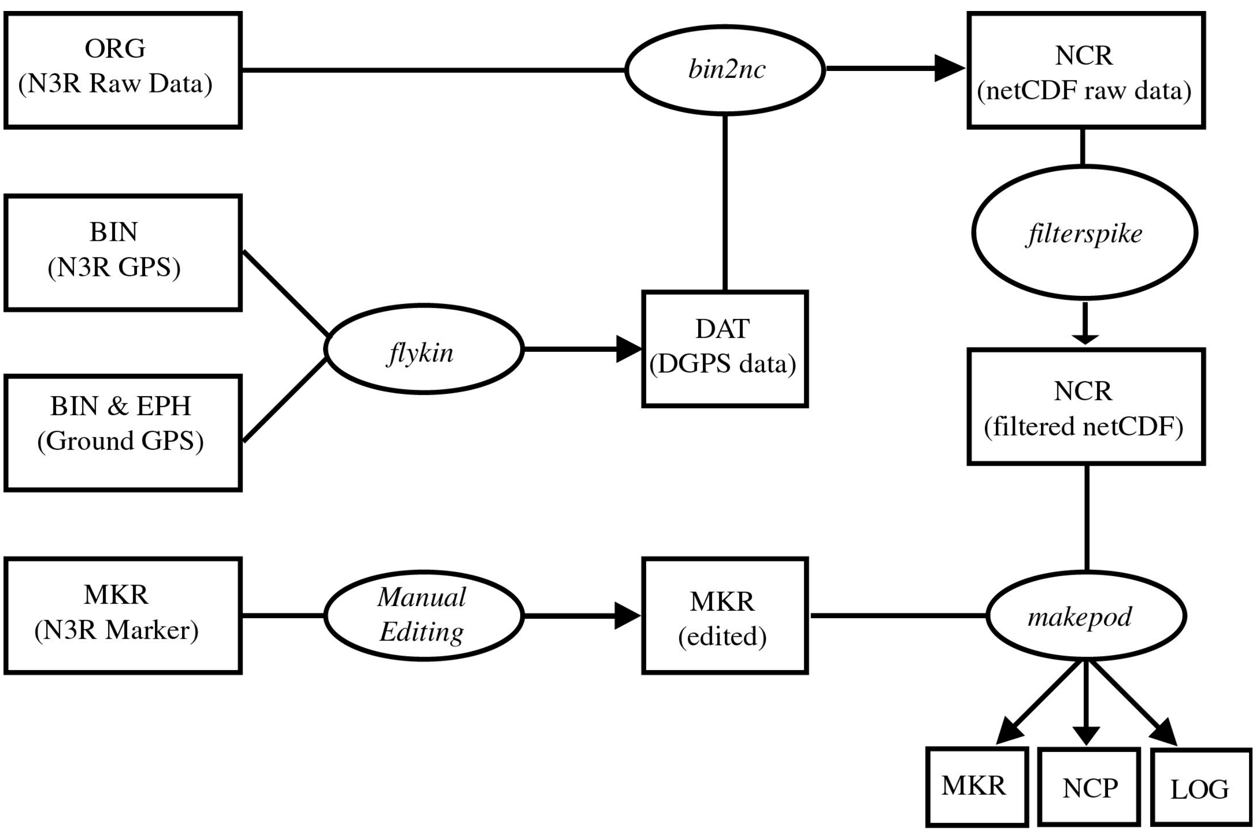

Fig. 18. Flowchart summarizing N3R data post-processing steps.

5.1 Differential GPS Corrections

The initial step in post-flight processing calculates positions and velocities using differential GPS techniques. Although the raw GPS data from N3R contains positions and velocities, accuracies are coarse (even after the elimination of selective availability) and are of little scientific use. The raw GPS data used in the corrections algorithm contain satellite navigation information and, for each epoch, signal phase, pseudo-range, and satellite number. Based on these data collected from two separate locations, one of which is precisely known (the ground-station), it is possible to calculate very accurate position and speed of the remote observing station (N3R). For this purpose, an algorithm (*flykin*) developed by the Department of Geomatics Engineering at the University of Calgary is used (Cannon et al. 1993). The algorithm, written in C, uses advanced filtering techniques and phase information to resolve ambiguities resulting from the determination of position based solely on pseudo-range. The source code for this software package was modified by ARL for our application on N3R. The algorithm creates an ASCII file of precise GPS information with the same root name and a DAT extension.

5.2 NetCDF Conversion

The next step in the data post-processing converts the files from their native format into netCDF (Rew et al. 1997). This program (*bin2nc*) executes a simple file conversion of the ORG data file. It also merges output from the differentially corrected GPS data, replacing the uncorrected GPS data stored in the original aircraft files. During the merging process, flags are set for missing GPS data. Also, because data are stored either as short- or long-word integers, a scale factor and offset must be computed. These values are assigned to variable attributes in the netCDF file. This binary file has the same root name with a NCR (netCDF "raw") extension.

5.3 Quality Control

The next program applies quality control checks on the raw NCR data file and applies corrections as necessary. A despike routine (*filterspike*) checks the data for regions where values fall outside of a prescribed range or are equal to some predefined "fill" value. In these regions, data are linearly interpolated based on the last and next "good" value. After completing the interpolation, flags are set for those regions where data were interpolated. Flags are set to mark these records.

5.4 Final Processing

The final step in the post processing algorithms is to carry through the actual computation of winds, apply recovery factors based on aircraft velocity, and to merge data from slow- and fast-response sensors. A program (*makepod*) calculates winds based on the raw pressure measurements from the BAT probe in combination with data from the GPS. High- and low-frequency measurements of position, velocity, temperature, and water vapor are blended by first performing Fourier transforms followed by passing the data through appropriate high- and low-pass filters, merging the sets, and finally calculating the inverse transform (Eckman et al. 1999). The final output file has the same root name and is given the extension NCP (netCDF "processed"). In addition, a LOG file is created by *makepod*. This ASCII file contains calibration information and statistics (e.g., mean, standard deviation, skewness, kurtosis, minimum, maximum) for all variables.

Wind calculations use a method similar to the National Center for Atmospheric Research (NCAR) method described by Leise and Masters (1991). Modifications to the NCAR method result from the unique configuration of the BAT probe in that a reference pressure (not a true static pressure) is provided by the pneumatic average of the four reference pressure ports. Consequently, the dynamic pressure must be corrected not only for variations in attack angle and sideslip, but also for deviations of reference pressure from the static pressure. The computation of accurate wind measurements requires the empirical determination of several BAT probe calibration constants. Of particular interest are the angle offsets, roll, pitch, heading, angle of attack offset, and dynamic pressure adjustment (Table 3). The values of these constants are determined by minimizing the variance of the three individual wind components for various flight legs. These legs include straight and level flight, dynamic and steady-state pitch and yaw maneuvers, reverse-heading maneuvers, and wind circles and boxes. Theoretically determined constants, based on theory of potential flow over a sphere are also included in the wind calculations. These include attack and sideslip calibration constants and the aircraft upwash factor.

Table 2. Summary of data files.

File	Description	Format	Output from:
mmddhhmn.ORG	raw aircraft data	binary	N3R data acquisition system
mmddhhmn.BIN	Ashtech GPS data	binary	N3R data acquisition system
mmddhhmn.MKR	marker data	ASCII	N3R data acquisition system
ammdd-0x.BIN	Ashtech GPS data	binary	ground station
ammdd-0x.EPH	Ashtech GPS data	binary	ground station
mmddhhmn.DAT	DGPS data	ASCII	*flykin*
mmddhhmn.NCR	netCDF raw data	binary	*bin2nc*, *filterspike*
mmddhhmn.NCP	netCDF processed data	binary	*makepod*
mmddhhmn.LOG	calibrations, data statistics	ASCII	*makepod*

mm month
dd day
hh hour
mn minute
a “Ashtech ground station”
x = 1, 2, 3, etc. (if multiple flights are conducted during the same day)

Table 3. Calibration constants and switches used in *makepod*.

Constant	Value	Description
LicorSw	0	switch for LICOR 6262 (0 = off, 1 = on)
LaserSW	1	switch for laser altimeters (0 = off, 1 = on)
RadarSw	1	switch for Ka-band radar scatterometer (0 = off, 1 = on)
EG&GSw	1	switch for EG&G dew point sensor (0 = off, 1 = on)
FlightQ	9	minimum Px for which winds are computed
Pad	50	maximum elements to pad arrays for FFT edge effect reduction
R_T	0.82	temperature recovery factor
"$_0$	-0.0663225	angle of attack of DSP at zero lift
K"	0.24	pitch calibration constant
K$	0.19	yaw calibration constant
K_{up}	0.101	upwash factor
,$_q$	1.0175	dynamic pressure correction
,$_p$	-1.43	pitch offset for relative velocity
,$_r$	0.0	roll offset for relative velocity
,$_h$	-0.5	heading offset for relative velocity
Apass	0.75	highest frequency passed by low-pass filter (attitude)
		highest frequency stopped by high-pass filter (attitude)
Astop	1.333	lowest frequency stopped by low-pass filter (attitude)
		lowest frequency passed by high-pass filter (attitude)
Vpass	0.25	highest frequency passed by low-pass filter (velocity)
		highest frequency stopped by high-pass filter (velocity)
Vstop	0.444	lowest frequency stopped by low-pass filter (velocity)
		lowest frequency passed by high-pass filter (velocity)
Hpass	0.0075	highest frequency passed by low-pass filter (hor. position)
		highest frequency stopped by high-pass filter (hor. position)
Hstop	0.01333	lowest frequency stopped by low-pass filter (hor. position)
		lowest frequency passed by high-pass filter (hor. position)
Wpass	0.0375	highest frequency passed by low-pass filter (vert. position)
		highest frequency stopped by high-pass filter (vert. position)
Wstop	0.0666	lowest frequency stopped by low-pass filter (vert. position)
		lowest frequency passed by high-pass filter (vert. position)

6 Data

6.1 NCR Files

The NCR file includes only non-calculated quantities (e.g., static pressure, uncorrected temperature, unblended positions and velocities from GPS and accelerometers, etc.). The structure of the NCR files is based on the netCDF file structure (Rew et al. 1997).Further information on these netCDF libraries can be found at www.unidata.ucar.edu/packages/netcdf. Users familiar with the netCDF file type will be able to read these files with tools available for accessing standard netCDF libraries.

The header of the file contains information relating to the data variables, their dimensions, attributes for each variable, and attributes for the entire file. All of the data are stored either as short-word (4-byte) or long-word (8-byte) integers. All variables either contain one or two dimensions. The primary dimension for the NCR variables is *scan* which is equal to the number of seconds contained in the file. Higher rate variables (greater than 1 Hz) have a second dimension. For the present data set, channels were sampled at either 5, 10, 50 Hz, or 150 Hz, depending on the variable. Thus, 5-, 10-, 50- or 150-Hz data have a second dimension of *5HzData*, *10HzData*, *50HzData*, or *150HzData*, respectively.

Table 4 lists all of the variables in the NCR files along with a short description of each. Most of these variables are native N3R data. Three additional variables include information related to good/bad data flags. Native N3R variables have eight attributes. The *scale_factor* and *add_offset* attribute are used to convert the data into floating point numbers in the proper engineering units (as defined by the attribute *units*). The attributes *valid_min* and *valid_max* define the range in which values must fall between for them to be valid. The *fill_value* attribute has value either -1, 0, or 1. For *fill_value* = -1, non-valid data will have values equal to the *valid_min*. For *fill_value* = 1, non-valid data will have values equal to the *valid_max*. For *fill_value* = 0, non-valid data will have values equal to 0. The *long_name* attribute simply furnishes a longer, more detailed name for the variable. Finally, the attribute *cal_coef* is a six- element vector containing 5-degree polynomial coefficients used to convert data from raw voltages into engineering units. This information is already contained within the *scale_factor* and *add_offset*, but is required to change the calibration at a later time, if necessary.

Global attributes (file-wide) include the title and date of the file. The *title* attribute contains the name of the aircraft and the associated experiment or project. The *date* attribute describes the day the file was acquired. All other global attributes are used to describe the names of the processing programs executed on the data. For each program there exists two attributes, one that describes the control version of that program and another describing the date it was executed. For example, each NCR file should have an attribute *filterspike* that is equal to a character string describing the control version of *filterspike* that was run (*i.e.*, filterspike.c, v1.2). Each should also have an attribute *filterspike_date* describing the date and time *filterspike* was executed. This attribute is also stored as a character string. Note that quality flag variables PVflag and Angflag are determined in *bin2nc* while the variable Ambiguities is output from *flykin*.

Table 4. Summary of NCR file variables.

Variable	Units	Freq	S/A	Description
GPSTime	s	1	S	Ashtech Time
TTime	s	10	S	TANS-vector Time
NLat	deg	5	S	Ashtech Latitude
NLon	deg	5	S	Ashtech Longitude
NAlt	m	5	S	Ashtech Altitude
Nu	m s^{-1}	5	S	Ashtech Velocity (east)
Nv	m s^{-1}	5	S	Ashtech Velocity (north)
Nw	m s^{-1}	5	S	Ashtech Velocity (vertical)
TPitch	deg	10	S	TANS-vector Pitch
TRoll	deg	10	S	TANS-vector Roll
THdg	deg	10	S	TANS-vector Heading
Px	mb	50	A	Differential Pressure (x-axis)
Py	mb	50	A	Differential Pressure (y-axis)
Pz	mb	50	A	Differential Pressure (z-axis)
Ps	mb	50	A	Static (reference) Pressure
Ax	m s^{-2}	50	A	BAT Probe Acceleration (x-axis)
Ay	m s^{-2}	50	A	BAT Probe Acceleration (y-axis)
Az	m s^{-2}	50	A	BAT Probe Acceleration (z-axis)
Axb	m s^{-2}	50	A	Backseat Acceleration (x-axis)
Ayb	m s^{-2}	50	A	Backseat Acceleration (y-axis)
Azb	m s^{-2}	50	A	Backseat Acceleration (z-axis)
Arol	s^{-2}	50	A	Differential (Roll) Acceleration (normalized)
Tp1	°C	50	A	Fast-Response Microbead Temperature
Fust_mv	:V	50	A	Fast-Response FUST Probe Thermocouple
TBar	°C	1	A	Slow-Response Thermistor Temperature
H2O	g m^{-3}	50	A	IRGA Absolute Humidity
CO2	mg m^{-3}	50	A	IRGA Carbon Dioxide
Tdew	°C	1	A	Chilled Mirror Dew Point Temperature
SfcT	°C	50	A	Sea Surface Temperature
SkyT	°C	1	A	Sky Temperature
Qs_up	W m^{-2}	1	A	Downwelling (Upward Looking) Visible Radiation
Qs_dn	W m^{-2}	1	A	Upwelling (Downward Looking) Visible Radiation
BodyT	°C	1	A	Everest 4000.4GXL (SST) Body Temperature
L1Dist	m	150	S	Distance (left wing)
L2Dist	m	150	S	Distance (instrument pod)
L3Dist	m	150	S	Distance (right wing)
L4Dist	m	150	S	Distance (15° "glint" laser)
L1Retn	counts	150	S	Number of Valid Returns (left wing)
L2Retn	counts	150	S	Number of Valid Returns (instrument pod)
L3Retn	counts	150	S	Number of Valid Returns (right wing)
L4Retn	counts	150	S	Number of Valid Returns (15° "glint" laser)
Ka_Ctl	mV	50	A	Ka-band Scatterometer Control
Ka_Rcv1	mV	50	A	Ka-band Scatterometer Receive Channel 1
Ka_Rcv2	mV	50	A	Ka-band Scatterometer Receive Channel 2
PVflag		5		Position / Velocity Flag
Angflag		10		Angles Flag
Ambiguities		5		Number of Ambiguities for Differential Correction

6.2 NCP Files

The NCP file contains derived quantities such as the wind velocity, corrected air temperature, and dry air density. Like the NCR file, the structure of the NCP is based on netCDF. All of the variables contained within the NCP file are either 1 Hz (dimension *scan*), 50 Hz (dimensions *scan* and *50HzScan*), or 150 Hz (dimensions *scan* and *150HzScan*). Table 5 lists the variables in the NCP files with a short description of each. Also contained in the table are variable dependencies for derived quantities. For example, NAlt (altitude) in the NCP file depends not only on NAlt in the NCR file, but also on the three BAT probe accelerations (Ax, Ay, and Az) used to augment the 10-Hz GPS data. Note also that NAlt in the NCP file therefore differs from NAlt in the NCR file.

Data in the NCP file are stored as 4-byte or 8-byte integers. Again, the variable attributes *scale_factor* and *add_offset* are used to convert to floating-point values with the proper engineering units given by the attribute *units*. The final variable attribute is *long_name*.

The variable *Dataflag* uses bit settings to flag bad data. The variable attribute *bit_settings* is a vector string describing the bit settings for this variable. A set bit indicates bad data. The first four bits are reserved for flagging bad winds. Bit one indicates the determination of bad data was made in makepod (the values lie outside some predetermined valid minimum or maximum). Bit 2 indicates bad GPS data (most likely due to missing data). Bit 3 indicates bad TANS-vector data (GPS attitude). Bit 4 indicates no differential corrections for the GPS. This is separate from the bit 2 case because it may result from a lack of ground station data or simply too few satellites to provide useful differential corrections. Bit settings are easily checked using the standard C operators AND, OR, AND/OR (or their non-C equivalent).

6.3 MKR Files

The MKR file contains an ASCII listing of specific times and locations during the flight when the pilot toggles the "on/off" switch or presses the "event" button on the control switch box. This file is used to mark the start and end of flux legs, profiles, or other specific maneuvers. When the marker switch is turned "on", a three-character string of XXX, a value of "-1", the scan number (i.e., number of elapsed seconds since the start of data acquisition), and current 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 event during flight (e.g., flying over a buoy, crossing the coastline). An event is recorded in the MKR file with a three-character string of EVT along with the scan number, latitude and longitude. The MKR file is manually edited at the end of the flight. The default character string of XXX is usually replaced with three-character identifiers that are used to describe marker pair. For example, FLX is used to denote flux leg while PRO is used to indicate a profile. Other manually edited notes include a summary of the weather conditions, flight plan, problems encountered, and other remarks that may be helpful during data analysis. Appendix A contains the listings of the marker files from all flights during the CBLAST-Low pilot field study. In addition, a key is provided which identifies each three-character identifier.

Table 5. Summary of NCP file variables.

Variable	Units	Freq	Description	Dependencies
GPSTime	s	1	GPS Time	GPSTime
NLat	deg	50	Latitude	NLat, Ax, Ay, Az
NLon	deg	50	Longitude	NLon, Ax, Ay, Az
NAlt	m	50	Altitude	NAlt, Ax, Ay, Az
GndSpd	m s^{-1}	1	Ground Speed	Nu, Nv
AirSpd	m s^{-1}	1	Air Speed	Px, Py, Pz, Ps, Tp1, TBar, H2O, Tdew
TPitch	deg	50	Pitch	TPitch, Ax, Ay, Az, Ayb, Azb, Arol
TRoll	deg	50	Roll	TRoll, Ax, Ay, Az, Ayb, Azb, Arol
THdg	deg	50	Heading	THdg, Ax, Ay, Az, Ayb, Azb, Arol
Axb	m s^{-2}	50	Acceleration (a-axis)	Axb
Ayb	m s^{-2}	50	Acceleration (y-axis)	Ayb
Azb	m s^{-2}	50	Acceleration (z-axis)	Azb
U	m s^{-1}	50	East Wind Speed	Px, Py, Pz, Ps, Ax, Ay, Az, Ayb, Azb, Arol,
V	m s^{-1}	50	North Wind Speed	Nu, Nv, Nw, TPitch, TRoll, THdg, TBar, H2O,
W	m s^{-1}	50	Vertical Wind Speed	Tdew (all three vectors)
Tp1	°C	50	Air Temperature	Px, Py, Pz, Ps, Tp1, TBar
Fust_mv	:V	50	Air Temperature	to be determined
H2O	g m^{-3}	50	Absolute Humidity	H2O, Tdew
CO2	mg m^{-3}	50	Carbon Dioxide	CO2
Tdew	°C	1	Dew Point	Tdew
Ps	mb	50	Static Pressure	Ps, Px, Py, Pz, Tp1, TBar, H2O, Tdew
RhoD	kg m^{-3}	50	Dry Air Density	Ps, Tp1, TBar, H2O, Tdew
SfcT	K	50	Sea Surface Temperature	SfcT
SkyT	K	1	Sky Temperature	SkyT
Qs_up	W m^{-2}	1	Downwelling Visible Radiation	Qs_up
Qs_dn	W m^{-2}	1	Upwelling Visible Radiation	Qs_dn
L1Dist	m	150	Distance (left wing)	L1Dist
L2Dist	m	150	Distance (pod)	L2Dist
L3Dist	m	150	Distance (right wing)	L3Dist
L4Dist	m	150	Distance (glint laser)	L4Dist
L1Retn	counts	150	No. Valid Returns (left wing)	L1Retn
L2Retn	counts	150	No. Valid Returns (pod)	L2Retn
L3Retn	counts	150	No. Valid Returns (right wing)	L3Retn
L4Retn	counts	150	No. Valid Returns (glint laser)	L4Retn
Ka_Ctl	counts	50	Scatterometer Control	Ka_Ctl
Ka_Rcv1	counts	50	Scatterometer Receive Ch. 1	Ka_Rcv1
Ka_Rcv2	counts	50	Scatterometer Receive Ch. 2	Ka_Rcv2
Dataflag		50	Quality Data Flag	

Note: Dependencies are those variables from NCR files that are used in the calculation of *variable*, for specific bit settings, see variable attribute *bit_settings* in NCP files.

6.4 LOG Files

The LOG file contains a listing of input parameters passed through *makepod*. Contained are switches indicating what instruments were on the aircraft and hence what variables exist in the files. Also included are calibration factors for wind calculations. Filter pass and stop bands are recorded in the LOG files. These describe the frequency bands for the high- and low-pass filters used to blend variables (e.g., TANS-vector GPS data and accelerometers). Valid minima and maxima are also defined. Statistics for the raw and processed variables are determined, including minimum, maximum, and moments.

6.5 Known Problems

There were occasional problems with instrument failures during the CBLAST-Low pilot field study. These problems, generally minor, were quickly identified and corrected. The following is a brief synopsis of those problems.

The roll accelerometer in right wing was not functioning properly for the first three flights. This sensor was probably damaged during a microburst event when N3R was parked at small regional airport in Illinois during its transit from Idaho Falls to Martha's Vineyard. The sensor was replaced prior to Flight 4 and functioned properly for the remainder of the experiment. Data from the roll accelerometers is used to augment the 10-Hz TANS-vector GPS roll data to a rate of 50 Hz. The roll accelerometer data is one of many variables used in the calculation of the wind. Its contribution is useful, but not vital.

Data from the 15° glint laser was invalid during the first two flights because of partial blockage of the optical lens due to a fiberglass cover. As a result, the laser reports a "missing" distance with no return pulses. The hole in this cover was enlarged prior to Flight 3. The glint laser worked properly for this flight, however, a few drop outs remained. The opening in the fiberglass cover was enlarged a second time prior to Flight 4. All glint laser data for the remainder of the field study were valid.

Dew point temperature data acquired by the chilled mirror sensor is questionable during Flight 2. Misalignment of the port-hole openings which lead into the mirror chamber are suspected to cause an over aspiration of the sensor which leads to extreme values reported by the instrument. The port-hole alignment problem was corrected prior to Flight 3. Near the end of Flight 4, the dew point temperature data are questionable. In this case where the MABL was very humid and was marked with patches of visible fog, the sensor may have experienced difficulties in "burning off" moisture residing on the mirror (over saturation).

The TANS-vector GPS usually converges on a proper solution of aircraft pitch, roll, and heading within the first several minutes of operation when the unit is turned on. On occasion, this instrument fails to provide a valid solution. This was encountered during Flight 8 where the TANS-vector GPS did not output valid aircraft attitude data. The flight was prematurely terminated and the TANS-vector GPS was manually reinitialized. Approximately 15 min of TANS-vector GPS data were lost during in the middle of Flight 15. The lack of available satellites may be a possible reason why this instrument failed to provide valid solutions for a short time.

There are several instances where DGPS corrections were not made. The first twenty three minutes of data acquired in Flight 9 could not be differentially corrected because of a brief power outage which shut down the ground station computer. DGPS corrections failed about 15 minutes before the end of Flight 18. DGPS corrections were not available for the first twenty one minutes of Flight 19 because the GPS ground station was started late.

Data from both Everest IR radiometers and the chilled mirror sensor were subject to interference from N3R radio transmissions. As a result, data from these sensors (SfcT, SkyT, Tdew) have occasional spikes which may last up to several seconds. Radio transmissions were avoided during flux legs and other specific maneuvers in order to minimize the spikes in these variables. No attempt was made to remove the spikes.

7 Flight Summaries

The CBLAST-Low pilot study was conducted during a three-week period in July and August 2001 off the south shore of Martha's Vineyard Island, Massachusetts. A total of twenty missions (~ 48 flight hours) were flown by N3R on days with light winds (< 7 m s^{-1}) under various atmospheric stabilities. Numerous flux legs and MABL profiles were acquired during the course of the study. When possible, N3R flew over other CBLAST-Low "assets", including the R/V *Asterias*, the Air-Sea Interaction Meteorology (ASIMET) buoy (40° 59.5' N, 70° 35.9' W), and a three-dimensional SST array (41° 15.0' N, 70° 36.0' W).

All N3R flights were based out of the Martha's Vineyard Airport (MVY). Table 6 is a summary listing of flights during the CBLAST-Low pilot study. Included is the flight number, date, filename, start and end times for each file (UTC), number of scans (seconds) for each file, approximate flight hours, and miscellaneous comments. Flight hours were determined by a Hobbs meter, which keeps track of time from when the aircraft engine is started until it is shutdown. Appendix B contains figures of N3R flight tracks. The following is a brief summary of each flight.

7.1 Flight 1 (21 JUL 01)

The region was dominated by high pressure, clear skies, and relatively dry (low humidity) conditions. Winds were initially calm in the early morning hours becoming southwesterly at about 4 m s^{-1} by late morning to early afternoon. The first CBLAST-Low flight (Fig. 19) included roll and pitch radar calibration maneuvers, twelve low-level (~ 10 m) north-south flux legs, and two MABL profiles.

7.2 Flight 2 (22 JUL 01)

The coastal waters of southern New England were dominated by high pressure, clear skies but with a slight increase in humidity. Winds were initially calm around sunrise and became southwesterly at 2 to 3 m s^{-1} by mid-morning. A simple north-south, east-west box pattern (Fig. 20) was flown at about ~ 10 m in the early morning flight to acquire mean wind and turbulent flux data to validate satellite-based synthetic aperture radar (SAR) derived winds. The SAR overpass for waters south of Martha's Vineyard and Nantucket occurred at 1049 UTC. Two MABL profiles were also included in the flight.

7.3 Flight 3 (23 JUL 01)

Thick early morning fog eventually cleared by late morning with southwesterly winds of about 4 to 5 m s^{-1} with gusts up to 8 to 9 m s^{-1}. The early afternoon flight (Fig. 21) included six north-south flux legs over the ASIMET buoy, multiple short altitude profiles (~ 150 m), and roll and pitch radar calibration maneuvers.

Table 6. Summary of N3R flights.

FL	Date	File Name	Start/End Time (UTC)		Scans	FL Hr	Flight Pattern
1	21 JUL 01	07211228	12:58:29	16:29:01	12633	3.4	north-south flux legs, radar calibration maneuvers
2	22 JUL 01	07220953	10:04:45	11:27:42	4978	1.4	SAR intercomparison
3	23 JUL 01	07231646	16:50:15	19:13:14	8580	2.4	north-south flux legs, radar calibration maneuvers
4	25 JUL 01	07251641	16:54:11	18:52:47	7117	2.0	north-south flux legs, IR camera runs
5	27 JUL 01	07271211	12:31:32	16:32:30	14459	4.0	north-south flux legs, IR camera runs
6	27 JUL 01	07272229	22:37:34	23:14:04	2191	0.7	“mowing the lawn” IR camera runs
7	28 JUL 01	07281042	11:02:21	13:59:25	10625	3.0	multi-directional flux legs, IR camera runs
8	29 JUL 01	07290928	09:31:22	10:18:13	2806	1.5	sunrise IR camera runs
9	29 JUL 01	07291112	11:43:54	13:46:36	7363	2.0	“spirograph” flux legs
10	30 JUL 01	07301120	11:43:48	15:10:56	12429	3.5	east-west “bow tie” flux legs, IR camera runs, wind calibration maneuvers
11	31 JUL 01	07310909	09:29:00	11:52:59	8640	2.4	north-south “bow tie” flux legs, sunrise “mowing the lawn” IR camera runs
12	01 AUG 01	08010911	09:40:09	12:54:59	11691	3.3	SAR intercomparison, IR camera runs, “spirograph” flux legs
13	01 AUG 01	08011644	16:54:29	19:40:33	9965	2.8	“bow tie” flux legs over R/V *Asterias*, “spirograph” flux legs
14	02 AUG 01	08021423	14:47:23	17:12:35	8713	2.4	“spirograph” flux legs, IR camera runs
15	03 AUG 01	08030052	00:58:21	02:22:29	5049	1.9	nighttime “mowing the lawn” IR camera runs
16	05 AUG 01	08051541	15:51:03	16:30:35	2373	0.7	flight terminated due to heavy fog and poor visibility
17	05 AUG 01	08052006	20:11:12	20:55:25	2654	0.8	flight terminated due to heavy fog and poor visibility
18	07 AUG 01	08071320	13:29:19	17:32:00	14558	4.1	“spirograph” and “bow tie” flux legs
19	08 AUG 01	08080955	10:03:04	14:01:50	14327	4.0	SAR intercomparison, “spirograph” flux legs
20	08 AUG 01	08081526	15:37:21	17:06:38	5358	1.5	“bow tie” flux legs over R/V *Asterias*

7.4 Flight 4 (25 JUL 01)

Moderate southwesterly winds of 5 to 6 m s^{-1} were present during much of the day with shallow "puffs" of low-level fog moving over the island in the early afternoon. Four north-south flux legs were flown (Fig. 22) from near the coast over the 3D SST array and past the ASIMET buoy. The UW/WHOI camera system was installed on the day before this flight. Several transects were flown at about 400 m for the UW/WHOI camera system. Visibility at this level was poor because of the fog banks under N3R. Because of the poor visibility, visual navigation and reference to surface ships and buoys was difficult.

7.5 Flight 5 (27 JUL 01)

A cold front had moved through the region on the previous evening. A northeasterly wind of 4 to 6 m s^{-1} created a dry, well-mixed MABL. This flight (Fig. 23) included numerous north-south flux legs extending from near the Martha's Vineyard Coastal Observatory (MVCO) meteorological tower to the ASIMET buoy. Three MABL profiles and high altitude (~ 400 m) UW/WHOI camera runs were also included.

7.6 Flight 6 (27 JUL 01)

The wind speed decreased by late afternoon and early evening to less than 3 m s^{-1} for the second flight of the day. For this mission, a "mowing the lawn" or "radiator" pattern was flown by N3R (Fig. 24) at 400 m to map out SST variability by the UW/WHOI camera system. The N3R data acquisition system was manually shut down prior to landing since power was needed for aircraft landing lights.

7.7 Flight 7 (28 JUL 01)

The region continued to enjoy fair weather dominated by high pressure system with light northwesterly winds of 3 m s^{-1} in early morning. By late morning the wind direction became northeasterly and remained fairly light (~ 3 m s^{-1}). Numerous low-level flux legs were flown by N3R (Fig. 25) over the ASIMET buoy with shallow profiles at the ends of each flux leg. Three MABL profiles were also included in the flight. High level camera runs flown for the UW/WHOI camera system at the beginning of the mission.

7.8 Flight 8 (29 JUL 01)

High pressure continued to dominate the weather with a few mid- and high-level clouds moving into the region. Winds were calm to very light and variable (< 2 m s^{-1}) for this early morning flight which started prior to sunrise. A simple north-south, east-west box pattern was flown (Fig. 26) at 400 m for the UW/WHOI camera system. The box was to be repeated at low levels for a SAR intercomparison, however, the flight was terminated because the TANS-vector GPS was not outputting valid pitch, roll, and heading solutions. It should be noted that the data file begins after take off in an attempt to reinitialize the TANS-vector GPS.

7.9 Flight 9 (29 JUL 01)

Once the TANS-vector GPS was properly reinitialized about an hour after the end of Flight 8, N3R conducted a flux mission utilizing a “spirograph” pattern centered over the ASIMET buoy with multiple short profiles (~ 150 m) at the end of each flux leg (Fig. 27). This pattern has the advantage of quickly mapping the spatial variability of the atmosphere and ocean in about an hour A MABL profile was also included during this flight. The first twenty three minutes of the data file were not differentially corrected due to a brief power outage which shut down the ground station computer.

7.10 Flight 10 (30 JUL 01)

Fair weather continued to dominate the coastal waters with high clouds to the south from a low pressure system in the mid-Atlantic region. Light winds of about 2 to 3 m s^{-1} from the northeast were present in the early morning, increasing to about 5 to 6 m s^{-1} and from the east by late morning. Wind calibration maneuvers were included in this flight, along with three MABL profiles, a box pattern at 400 m for the UW/WHOI camera system, east-west “bow tie” flux legs and shallow profiles over ASIMET buoy, and multiple flux legs and short profiles over the R/V *Asterias*. which surveyed the waters several kilometers off the coast of Martha’s Vineyard (Fig. 28).

7.11 Flight 11 (31 JUL 01)

Fair weather continued to persist with a few high clouds from a low pressure system to the south which was quickly moving to the northeast. Light winds of 2 to 3 m s^{-1} were from the north. The flight included another “mowing the lawn” pattern prior to and shortly after sunrise for the UW/WHOI camera system, two MABL profiles, and seven northeast-southwest flux legs over the ASIMET buoy (Fig. 29).

7.12 Flight 12 (01 AUG 01)

High pressure continued to dominate the region with very light winds of 2 to 3 m $s^{-1}$from the northwest to northeast. N3R flew a simple north-south, east-west box prior to sunrise for the UW/WHOI camera system prior and repeated the same exact flight track at 10 m during a SAR overpass which occurred at 1057 UTC (Fig. 30). A “spirograph” flux pattern was flown over the ASIMET buoy with multiple shallow profiles at the end of each flux leg. Three MABL profiles were also included in this flight.

7.13 Flight 13 (01 AUG 01)

Flight 13 was the second flight of the day. Winds continued to be light and variable under fair weather. Numerous east-west “bow tie” flux legs were flown in the vicinity of the R/V *Asterias* several kilometers off the coast of Martha’s Vineyard (Fig. 31). Another “spirograph” flux pattern was flown again over the ASIMET buoy. Two MABL profiles were included in this flight.

7.14 Flight 14 (02 AUG 01)

Very hazy, hot, and humid conditions were present as a high pressure system slowly moved eastward. Winds were about 4 to 5 m s^{-1} from the southwest. The late morning flight included a simple north-south, east-west box pattern for the UW/WHOI camera system and a "spirograph" flux pattern over the ASIMET buoy with multiple shallow profiles at the end of each flux leg (Fig. 32). Two MABL profiles were included in this flight.

7.15 Flight 15 (03 AUG 01)

The weather continued to be hazy and humid with steady southwesterly winds of 5 to 6 m s^{-1} as a high pressure system slowly moved eastward. A "mowing the lawn" pattern was flow at 400 m during this nighttime flight for the UW/WHOI camera system (Fig. 33). The N3R data acquisition system was booted up after takeoff and shut down prior to landing since power was needed for external and internal aircraft lights. Approximately 15 min of TANS-vector GPS data were lost about 40 min into the flight. The lack of available satellites may be a possible reason why this instrument failed to provide valid solutions. The UW/WHOI camera system was removed after the end of this flight.

7.16 Flight 16 (05 AUG 01)

Hazy, hot, and humid conditions prevailed with light southwesterly winds of 2 to 3 m s^{-1} ahead of a stalled cold front. This flight was terminated shortly after take off because of heavy offshore fog and very poor visibility (Fig. 34).

7.17 Flight 17 (05 AUG 01)

A second N3R mission was attempted later on the same day. The weather continued to be hazy, hot, and humid with light southwesterly of 4 to 5 m s^{-1}. Once again, the flight was terminated shortly after take off because of heavy offshore fog and very poor visibility (Fig. 35). Note that the N3R data acquisition was shut down prior to landing.

7.18 Flight 18 (07 AUG 01)

The weather continued to be hazy, hot, and humid, moderate southwesterly winds of 4 to 6 m s^{-1} ahead of a stalled cold front. Flight visibility was only about 1 km. Two sets of "spirograph" and "bow tie" flux patterns were flown near the coastline and over the ASIMET buoy (Fig. 36). A single MABL profile was included in this flight. DGPS corrections failed about 15 minutes before the end of the flight.

7.19 Flight 19 (08 AUG 01)

Hazy, very hot, and humid conditions persisted with light and variable winds ahead of a stalled cold front. N3R flew a simple north-south, east-west box during a SAR overpass which occurred at 1053 UTC (Fig. 37). Two "spirograph" flux patterns were flown near the coastline and over the ASIMET buoy with multiple shallow profiles at the end of each flux leg. Three MABL profiles and various calibration maneuvers were also included in this flight. Note that DGPS corrections were not available for the first twenty one minutes of the flight because the GPS ground station was started late.

7.20 Flight 20 (08 AUG 01)

N3R flew a second time in the early afternoon on the same day. The weather continued to be hazy, very hot, and humid with light and variable winds. This flight was dedicated to numerous low-level north-south flux legs from the coastline over the R/V *Asterias* (Fig. 38). A single MABL profile was included at the end of the flight.

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Appendix A: Marker Files

The MKR file contains an ASCII listing of specific times and locations during the flight when the pilot toggles the “on/off” switch or presses the “event” buttons on the control switch box. This file is used to mark the start and end of flux legs, profiles, or other specific maneuvers. When the marker switch is turned “on”, a three-character string of XXX, a value of “-1”, the scan number (i.e., number of elapsed seconds since the start of data acquisition), and current 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 event during flight (e.g., flying over a buoy, crossing the coastline). An event is recorded in the MKR file with a three-character string of EVT along with the scan number, latitude and longitude. The MKR file is manually edited at the end of the flight. The default character string of XXX is usually replaced with three-character identifiers that are used to describe the marker pair. For example, FLX is used to denote a flux leg while PRO is used to indicate a profile. Other manually edited notes include a summary of the weather conditions, flight plan, problems encountered, and other remarks that may be helpful during data analysis. Listed below are three-character identifiers which describe these marker pairs for CBLAST-Low.

ACC	Acceleration Calibration Maneuver	PRO	Profile Sounding
ERR	Error	PTC	Pitch Calibration Maneuver
EVT	Event	STC	Static
FLX	Flux Leg	WAG	Wag (Roll) Calibration Maneuver
FRY	Ferry	WCL	Wind Circle Left (counterclockwise)
IRC	Infrared Camera Run	WCR	Wind Circle Right (clockwise)
MSG	Message	YAW	Yaw Calibration Maneuver

```
CBLAST-Low Pilot Study - Summer 2001

  Flight: 01
    Date: 21 JUL 01 (Saturday)
Duration: 3.4 hr
   Pilot: Timothy L. Crawford

Summary: First flight, roll and pitch calibrations, profile, 12 north-south flux
         legs, and profile.  Flux legs centered over 41/ 11' N,  70/ 35' W,
         headings of 20/ and 200/.

Weather: Region dominated by high pressure, clear skies, relatively dry
         conditions, winds initially calm, increasing to 8 kts from the SW.

MVY ATIS: 1053 UTC   calm 10V clear 12//11/ 30.08
MVY ATIS: 1153 UTC   calm 10V clear 18//13/ 30.09
MVY ATIS: 1353 UTC 200/05 10V clear 22//13/ 30.07
MVY ATIS: 1453 UTC 220/08 10V clear 21//14/ 30.08
MVY ATIS: 1553 UTC 220/08 10V clear 22//13/ 30.08

Instrumentation Notes & Comments:

IRGA #2 installed
Five Riegl laser altimeters installed
NASA Ka-band radar scatterometer installed
```

Roll accelerometer in right wing not functioning properly
L4 "glint" laser not functioning because of partial lens blockage

Marker for D:07211228.ORG OPENED at 565109

```
STC -1 00017 12:58:45  41 23.3   -70 36.8 all systems on
     0 00183 13:01:31  41 23.3   -70 36.8
WAG -1 00688 13:09:56  41 18.1   -70 37.8 roll wag cal for radar
     0 00768 13:11:16  41 15.8   -70 37.3
PTC -1 00789 13:11:37  41 15.2   -70 37.2 pitch up/dn cal for radar
     0 00844 13:12:32  41 13.7   -70 37.0
PRO -1 00905 13:13:33  41 11.9   -70 36.5 profile up to 3700' (1130 m)
     0 01340 13:20:48  41 11.3   -70 37.0
PRO -1 01340 13:20:48  41 11.3   -70 37.0 profile down from 3700' (1130 m)
     0 01721 13:27:09  41 09.6   -70 36.1
FLX -1 02146 13:34:14  41 19.8   -70 33.9 flux leg south (185/)
     0 02763 13:44:31  41 02.7   -70 35.9
FLX -1 02955 13:47:43  41 01.2   -70 36.4 flux leg north (005/)
     0 03547 13:57:35  41 19.1   -70 34.0
FLX -1 03714 14:00:22  41 20.1   -70 33.8 flux leg south (185/)
     0 04359 14:11:07  41 02.8   -70 35.9
FLX -1 04505 14:13:33  41 01.6   -70 36.2 flux leg north (005/)
     0 05106 14:23:34  41 19.9   -70 33.8
FLX -1 05292 14:26:40  41 20.2   -70 33.7 flux leg south (185/)
     0 05923 14:37:11  41 03.0   -70 35.8
FLX -1 06235 14:42:23  41 04.9   -70 36.0 flux leg north (005/)
     0 06689 14:49:57  41 19.2   -70 33.9
FLX -1 06911 14:53:39  41 19.6   -70 34.3 flux leg south (185/)
     0 07520 15:03:48  41 02.9   -70 35.9
FLX -1 07709 15:06:57  41 01.8   -70 36.2 flux leg north (005/)
     0 08270 15:16:18  41 19.0   -70 34.0
FLX -1 08430 15:18:58  41 20.3   -70 33.7 flux leg south (185/)
     0 09075 15:29:43  41 02.8   -70 35.9
FLX -1 09298 15:33:26  41 00.9   -70 36.1 flux leg north (005/)
     0 09908 15:43:36  41 19.0   -70 34.0
FLX -1 10041 15:45:49  41 20.2   -70 33.8 flux leg south (185/)
     0 10692 15:56:40  41 02.5   -70 35.9
FLX -1 10870 15:59:38  41 00.5   -70 36.7 flux leg north (005/)
     0 11469 16:09:37  41 19.3   -70 33.9
MSG    11472 16:09:40                     BAT 0 frequency slow: Freq=49
MSG    11472 16:09:40                     BAT 1 frequency slow: Freq=49
PRO -1 11678 16:13:06  41 15.1   -70 35.6 profile up to 1300' (400 m)
     0 12097 16:20:05  41 16.0   -70 34.6
```

Marker for D:07211228.ORG CLOSED at 577742

```
Total scans:   12633
Missed Ints:   00000
      BAT A: 0631649 of 0631650 000.000% Dropouts
      BAT B: 0631649 of 0631650 000.000% Dropouts
        ASH: 0063165 of 0063165 000.000% Dropouts
        TAN: 0123702 of 0126330 002.080% Dropouts
```

CBLAST-Low Pilot Study - Summer 2001

Flight: 02
Date: 22 JUL 01 (Sunday)
Duration: 1.4 hr
Pilot: Timothy L. Crawford

Summary: Early morning SAR flight, overpass at 1049 UTC. Profile, simple box pattern, profile.

Weather: Region dominated by high pressure, clear skies, slight increase in

```
         humidity.  Winds initially calm, increasing to 5 kts from the SW.

MVY ATIS: 0943 UTC   calm 10V clear 16//16/ 30.04
MVY ATIS: 0953 UTC   calm 10V clear 16//16/ 30.04
MVY ATIS: 1053 UTC 240/05 09V clear 18//17/ 30.04

Instrumentation Notes & Comments:

Roll accelerometer in right wing not functioning properly
L4 "glint" laser not functioning because of partial lens blockage
Chilled mirror dew point sensor was over-aspirated resulting in bad data

Marker for D:07220953.ORG OPENED at 036285

STC -1 00012 10:04:56  41 23.3   -70 36.8 all systems on
     0 00072 10:05:56  41 23.3   -70 36.8
PR0 -1 00483 10:12:47  41 18.8   -70 35.0 profile down from 2600' (800 m)
     0 00632 10:15:16  41 14.3   -70 34.0
FLX -1 00633 10:15:17  41 14.3   -70 34.0 SAR flux leg south (185/)
     0 01334 10:26:58  40 54.5   -70 36.2
FLX -1 01371 10:27:35  40 53.8   -70 35.3 SAR flux leg east (100/)
     0 02227 10:41:51  40 50.2   -70 00.6
FLX -1 02281 10:42:45  40 51.2   -69 59.4 SAR flux leg north (000/)
EVT    02491 10:46:15  40 58.0   -70 00.1 visible surface discontinuity
EVT    02622 10:48:26  41 02.3   -70 00.3 visible surface discontinuity
     0 02845 10:52:09  41 09.6   -70 00.0
FLX -1 02888 10:52:52  41 10.4   -70 01.2 SAR flux leg west (275/)
     0 03787 11:07:51  41 15.3   -70 36.0
PRO -1 03793 11:07:57  41 15.3   -70 36.2 profile up to 3000' (900 m)
     0 04388 11:17:52  41 14.4   -70 32.8
STC -1 04915 11:26:39  41 23.3   -70 36.8 preparing to shut down all systems
     0 04976 11:27:40  41 23.3   -70 36.8

Marker for D:07220953.ORG CLOSED at 041263

Total scans:   04978
Missed Ints:   00000
      BAT A: 0248900 of 0248900 000.000% Dropouts
      BAT B: 0248900 of 0248900 000.000% Dropouts
        ASH: 0024890 of 0024890 000.000% Dropouts
        TAN: 0048768 of 0049780 002.033% Dropouts


CBLAST-Low Pilot Study - Summer 2001

  Flight: 03
    Date: 23 JUL 01 (Monday)
Duration: 2.4 hr
   Pilot: Timothy L. Crawford

Summary: Early afternoon flight, six north-south flux legs, multiple
         short altitude profiles, roll and pitch calibrations.

Weather: Thick early morning fog, clearing by late morning, SW winds.

MVY ATIS: 1552 UTC 220/02     10V  scat 24//20/ 30.04
MVY ATIS: 1752 UTC 240/09/G18 10V clear 25//21/ 30.02
MYV ATIS: 1852 UTC 240/10/G18 10V clear 25//21/ 29.99

Instrumentation Notes & Comments:

Roll accelerometer in right wing not functioning properly
L4 "glint" laser now functioning properly, however with a few drop outs
Aspiration on chilled mirror dew point sensor fixed
```

```
Marker for D:07231646.ORG OPENED at 147015

STC -1 00004 16:50:18  41 23.3   -70 36.8 all systems on
     0 00060 16:51:14  41 23.3   -70 36.8
PRO -1 00643 17:00:57  41 16.5   -70 35.9 profile up/dn to 3500' (1050 m)
     0 01105 17:08:39  41 17.0   -70 32.9
PRO -1 01105 17:08:39  41 17.0   -70 32.9 profile down from 3500' (1050 m)
     0 01375 17:13:09  41 17.2   -70 31.6
FLX -1 01410 17:13:44  41 16.5   -70 32.6 flux leg south (180/)
     0 02250 17:27:44  40 54.4   -70 35.9
PRO -1 02250 17:27:44  40 54.4   -70 35.9 profile up/dn to 500' (150 m)
     0 02438 17:30:52  40 52.7   -70 36.3
FLX -1 02438 17:30:52  40 52.7   -70 36.3 flux leg north (000/)
     0 03212 17:43:46  41 17.9   -70 35.2
PRO -1 03212 17:43:46  41 17.9   -70 35.2 profile up/dn to 500' (150 m)
     0 03369 17:46:23  41 20.0   -70 35.7
FLX -1 03369 17:46:23  41 20.0   -70 35.7 flux leg south (180/)
     0 04310 18:02:04  40 54.5   -70 35.9
PRO -1 04310 18:02:04  40 54.5   -70 35.9 profile up/dn to 500' (150 m)
     0 04466 18:04:40  40 51.8   -70 35.3
FLX -1 04466 18:04:40  40 51.8   -70 35.3 flux leg north (000/)
     0 05302 18:18:36  41 19.3   -70 34.0
PRO -1 05302 18:18:36  41 19.3   -70 34.3 profile up/dn to 500' (150 m)
     0 05451 18:21:05  41 19.8   -70 33.3
FLX -1 05453 18:21:07  41 19.8   -70 33.3 flux leg south (180/)
     0 06373 18:36:27  40 54.3   -70 35.9
PRO -1 06373 18:36:27  40 54.3   -70 35.9 profile up/dn to 500' (150 m)
     0 06603 18:40:17  40 52.9   -70 35.4
FLX -1 06603 18:40:17  40 52.9   -70 35.4 flux leg north (000/)
     0 07389 18:53:23  41 19.3   -70 36.2
PRO -1 07389 18:53:23  41 19.3   -70 36.2 profile up/dn to 500' (150 m)
     0 07539 18:55:53  41 19.2   -70 36.6
PTC -1 07539 18:55:53  41 19.2   -70 36.6 pitch up/dn cal for radar
     0 07664 18:57:58  41 16.6   -70 39.4
PRO -1 07697 18:58:31  41 16.0   -70 40.2 profile up to 3000' (930 m)
     0 08064 19:04:38  41 17.1   -70 40.6
PRO -1 08069 19:04:43  41 17.2   -70 40.8 descent into MVY
     0 08514 19:12:08  41 23.3   -70 36.8
STC -1 08518 19:12:12  41 23.3   -70 36.8 preparing to shut down all systems
     0 08575 19:13:09  41 23.3   -70 36.8

Marker for D:07231646.ORG CLOSED at 155595

Total scans:   08580
Missed Ints:   00000
      BAT A: 0429000 of 0429000 000.000% Dropouts
      BAT B: 0429000 of 0429000 000.000% Dropouts
        ASH: 0042900 of 0042900 000.000% Dropouts
        TAN: 0085572 of 0085800 000.266% Dropouts


CBLAST-Low Pilot Study - Summer 2001

  Flight: 04
    Date: 25 JUL 01 (Wednesday)
Duration: 2.0 hr
   Pilot: Timothy L. Crawford

Summary: Four north-south flux legs from near the coast over the 3D SST array
         to the ASIMET buoy plus another 5 nm.  Several transects at 1250'
         for the infrared/visible cameras.

Weather: Moderate SW winds with shallow "puffs" of fog moving over the region
         in the early afternoon at several hundred feet.  Visibility at 1250'
         was poor due to elevated fog.  Because of the poor visibility, visual
```

navigation and reference to surface ships and buoys was difficult.

```
MVY ATIS: 1552 UTC 270/10 10V clear 30//23/ 29.86
MVY ATIS: 1753 UTC 240/12  9V clear 26//23/ 29.85
```

Instrumentation Notes & Comments:

Roll accelerometer in right wing fixed
Chilled mirror dew point sensor questionable near end of flight (oversaturation)
University of Washington/WHOI infrared/visible camera system installed

Marker for D:07251641.ORG OPENED at 320051

```
STC -1 00052 16:55:02  41 23.3   -70 36.8 all systems on
     0 00126 16:56:16  41 23.3   -70 36.8
IRC -1 00497 17:02:27  41 20.7   -70 37.2 focus run for IR camera @ 1500' (460 m)
     0 00501 17:02:31  41 20.6   -70 37.2
EVT    00628 17:04:38  41 16.9   -70 34.6 over R/V Nobska @ 300' (90 m)
PRO -1 00683 17:05:33  41 15.7   -70 34.5 profile up to 3300' (1000 m)
     0 01097 17:12:27  41 17.1   -70 35.5
FLX -1 01245 17:14:55  41 20.3   -70 35.4 flux leg south (180/)
EVT    01455 17:18:25  41 15.2   -70 35.4 east of 3D SST array
     0 02228 17:31:18  40 54.4   -70 36.1
PRO -1 02228 17:31:18  40 54.4   -70 36.1 profile up/dn to 500' (150 m)
     0 02416 17:34:26  40 52.6   -70 35.6
FLX -1 02416 17:34:26  40 52.6   -70 35.6 flux profile north (000/)
EVT    02626 17:37:56  40 59.5   -70 35.8 over ASIMET buoy
EVT    03103 17:45:53  41 15.3   -70 35.5 over 3D SST array
     0 03244 17:48:14  41 19.9   -70 35.4
PRO -1 03244 17:48:14  41 19.9   -70 35.4 profile up/dn to 500' (150 m)
     0 03376 17:50:26  41 19.8   -70 34.0
FLX -1 03376 17:50:26  41 19.8   -70 34.0 flux profile south (180/)
     0 04357 18:06:47  40 55.3   -70 36.0
PRO -1 04357 18:06:47  40 55.3   -70 36.0 profile up/dn to 500' (150 m)
     0 04553 18:10:03  40 54.5   -70 35.0
FLX -1 04553 18:10:03  40 54.5   -70 35.0 flux profile north (000/)
EVT    04705 18:12:35  40 59.5   -70 35.8 over ASIMET buoy
EVT    05188 18:20:38  41 15.3   -70 35.5 over 3D SST array
     0 05317 18:22:47  41 19.5   -70 35.4
PRO -1 05317 18:22:47  41 19.5   -70 35.4 profile up to 3300' (1000 m)
EVT    05424 18:24:34  41 18.1   -70 34.1 over R/V Nobska
EVT    05574 18:27:04  41 14.5   -70 35.8 over 3D SST array
     0 05611 18:27:41  41 13.7   -70 36.5
IRC -1 05857 18:31:47  41 11.1   -70 38.5 IR camera run @ 1280' (390 m)
EVT    05992 18:34:02  41 15.4   -70 35.6 over 3D SST array
     0 06036 18:34:46  41 16.8   -70 34.6
IRC -1 06156 18:36:46  41 16.0   -70 32.6 IR camera run @ 1280' (390 m)
EVT    06256 18:38:26  41 15.3   -70 35.8 over 3D SST array
     0 06327 18:39:37  41 15.6   -70 38.3
EVT    06507 18:42:37  41 15.7   -70 35.2 over 3D SST array
EVT    06621 18:44:31  41 19.4   -70 33.9 over R/V Nobska
```

Marker for D:07251641.ORG CLOSED at 327168

```
Total scans:   07117
Missed Ints:   00000
      BAT A: 0355850 of 0355850 000.000% Dropouts
      BAT B: 0355850 of 0355850 000.000% Dropouts
        ASH: 0035585 of 0035585 000.000% Dropouts
        TAN: 0069897 of 0071170 001.789% Dropouts
```

CBLAST-Low Pilot Study - Summer 2001

Flight: 05

```
    Date: 27 JUL 01 (Friday)
Duration: 4.0 hr
   Pilot: Timothy L. Crawford

Summary: Profile, four north-south flux legs from Katama to ASIMET buoy,
         profile, four upwind/downwind flux legs, profile, and infrared
         camera runs.

Weather: Cold front moved through previous evening, northeasterly
         flow creating a well mixed, unstable marine atmospheric boundary
         layer, strong winds off shore in the morning.

MVY ATIS: 0924 UTC 020/08 10V clear 13//11/ 30.17
MVY ATIS: 0952 UTC 020/08 10V clear 13//11/ 30.19
MVY ATIS: 1052 UTC 020/11 10V clear 16//10/ 30.20
MVY ATIS: 1152 UTC 030/11 10V clear 16//10/ 30.22
MVY ATIS: 1452 UTC 040/12 10V clear 19//09/ 30.22
MVY ATIS: 1555 UTC 040/08 10V clear 19//08/ 30.23

Instrumentation Notes & Comments: None

Marker for D:07271211.ORG OPENED at 477092

STC -1 00023 12:31:54  41 23.3   -70 36.8 all systems on
     0 00084 12:32:55  41 23.3   -70 36.8
PRO -1 00606 12:41:37  41 24.9   -70 29.7 profile up to 4600' (1400 m)
     0 01160 12:50:51  41 21.8   -70 24.3
PRO -1 01162 12:50:53  41 21.8   -70 24.3 profile dn from 4600' (1400 m)
     0 01345 12:53:56  41 20.6   -70 32.1
FLX -1 01351 12:54:02  41 20.5   -70 32.3 flux leg south (190/)
     0 02141 13:07:12  40 53.7   -70 37.1
PRO -1 02141 13:07:12  40 53.7   -70 37.1 profile up/dn to 500' (150 m)
     0 02347 13:10:38  40 50.7   -70 38.5
FLX -1 02347 13:10:38  40 50.7   -70 38.5 flux leg north (010/)
     0 03573 13:31:04  41 20.7   -70 31.7
FLX -1 03610 13:31:41  41 20.3   -70 32.3 flux leg south (185/)
     0 04382 13:44:33  40 53.5   -70 37.4
PRO -1 04382 13:44:33  40 53.5   -70 37.4 profile up/dn to 500' (150 m)
     0 04597 13:48:08  40 50.3   -70 38.7
FLX -1 04597 13:48:08  40 50.3   -70 38.7 flux leg north (010/)
     0 05793 14:08:04  41 20.6   -70 31.9
FLX -1 05853 14:09:04  41 19.7   -70 32.8 flux leg south (185/)
     0 06613 14:21:44  40 53.8   -70 37.1
PRO -1 06619 14:21:50  40 53.6   -70 37.1 profile up/dn to 4600' (1400 m)
EVT    07055 14:29:06  41 01.6   -70 35.0 top of profile
     0 07337 14:33:48  41 07.1   -70 28.0
FLX -1 07394 14:34:45  41 07.2   -70 28.9 flux leg southwest (215/)
     0 07954 14:44:05  40 50.9   -70 43.9
FLX -1 08005 14:44:56  40 50.4   -70 43.2 flux leg northeast (030/)
     0 08807 14:58:18  41 08.2   -70 29.6
FLX -1 08852 14:59:03  41 08.2   -70 30.5 flux leg southwest (210/)
     0 09426 15:08:37  40 50.5   -70 42.0
FLX -1 09481 15:09:32  40 50.9   -70 42.9 flux leg northeast (030/)
     0 10242 15:22:13  41 08.2   -70 29.2
PRO -1 10283 15:22:54  41 08.2   -70 30.3 profile up/dn to 4900' (1500 m)
EVT    10695 15:29:46  40 56.1   -70 41.5 top of profile
     0 10942 15:33:53  40 55.1   -70 50.9
IRC -1 11042 15:35:33  40 57.2   -70 50.6 IR camera run @ 1280' (390 m)
     0 11783 15:47:54  41 02.6   -70 23.9
IRC -1 11849 15:49:00  41 01.4   -70 24.2 IR camera run @ 1280' (390 m)
     0 12413 15:58:24  40 56.9   -70 48.7
IRC -1 12510 16:00:01  40 54.4   -70 48.9 IR camera run @ 1280' (390 m)
     0 12907 16:06:38  40 48.4   -70 34.4
IRC -1 12988 16:07:59  40 49.6   -70 32.7 IR camera run @ 1250' (390 m)
     0 13839 16:22:10  41 12.8   -70 40.0
```

```
IRC -1 13865 16:22:36  41 13.5   -70 40.1 IR camera run @ 1250' (390 m)
     0 14156 16:27:27  41 21.2   -70 39.0
FRY -1 14157 16:27:28  41 21.2   -70 39.0 ferry and descent to MVY
     0 14264 16:29:15  41 23.2   -70 37.1
STC -1 14410 16:31:41  41 23.3   -70 36.8 preparing to shut down all systems
MSG    14452 16:32:23                     BAT 0 frequency slow: Freq=36
     0 14456 16:32:27  41 23.3   -70 36.8

Marker for D:07271211.ORG CLOSED at 491551

Total scans: 14459
Missed Ints: 00000
      BAT A: 0722936 of 0722950 000.002% Dropouts
      BAT B: 0722950 of 0722950 000.000% Dropouts
        ASH: 0072295 of 0072295 000.000% Dropouts
        TAN: 0143421 of 0144590 000.808% Dropouts
```

CBLAST-Low Pilot Study - Summer 2001

```
  Flight: 06
    Date: 27 JUL 01 (Friday)
Duration: 0.7 hr
   Pilot: Timothy L. Crawford
```

Summary: Infrared camera runs using the "mowing the lawn" flight plan.

Weather: Cold front moved through previous evening, northeasterly flow creating a well mixed, unstable marine atmospheric boundary layer, winds decreasing in magnitude by late afternoon.

```
MVY ATIS: 2152 UTC 090/07 10V clear 19//09/ 30.20
MVY ATIS: 2252 UTC   calm 10V clear 18//11/ 30.23
```

Instrumentation Notes & Comments:

Data acquisition system manually shut down prior to landing for landing lights

```
Marker for D:07272229.ORG OPENED at 513454

STC -1 00003 22:37:36  41 23.3   -70 36.8 all systems on
     0 00093 22:39:06  41 23.3   -70 36.8
IRC -1 00585 22:47:18  41 19.9   -70 35.5 W IR camera run @ 1280' (390 m)
     0 00730 22:49:43  41 18.5   -70 41.6
IRC -1 00785 22:50:38  41 17.5   -70 41.4 E IR camera run @ 1280' (390 m)
     0 00959 22:53:32  41 19.0   -70 34.5
IRC -1 01026 22:54:39  41 17.9   -70 34.2 W IR camera run @ 1280' (390 m)
     0 01118 22:56:11  41 17.1   -70 38.1
IRC -1 01195 22:57:28  41 16.6   -70 36.8 E IR camera run @ 1280' (390 m)
     0 01289 22:59:02  41 16.9   -70 32.9
IRC -1 01359 23:00:12  41 15.6   -70 33.3 W IR camera run @ 1280' (390 m)
     0 01491 23:02:24  41 14.2   -70 38.7
IRC -1 01543 23:03:16  41 13.2   -70 38.3 E IR camera run @ 1280' (390 m)
     0 01630 23:04:43  41 13.9   -70 35.1
EVT    01852 23:08:25  41 10.5   -70 41.4 fishing ship

Marker for D:07272229.ORG CLOSED at 515645

Total scans: 02191
Missed Ints: 00000
      BAT A: 0109550 of 0109550 000.000% Dropouts
      BAT B: 0109550 of 0109550 000.000% Dropouts
        ASH: 0010955 of 0010955 000.000% Dropouts
        TAN: 0021906 of 0021910 000.018% Dropouts
```

CBLAST-Low Pilot Study - Summer 2001

```
  Flight: 07
    Date: 28 JUL 01 (Saturday)
Duration: 3.0 hr
   Pilot: Timothy L. Crawford

Summary: Infrared camera run, profile, northeast-southwest flux legs,
         profile, northwest-southeast flux legs, several more flux leg
         of various headings, multiple short profiles.

Weather: Region dominated by high pressure system, light northwesterly
         winds in early morning, becoming northeasterly by late
         morning.

MVY ATIS: 0939 UTC 330/05 08V clear 09//08/ 30.27
MVY ATIS: 0951 UTC 320/06 10V clear 11//10/ 30.27
MVY ATIS: 1053 UTC 330/06 10V clear 15//13/ 30.28
MVY ATIS: 1253 UTC 020/06 10V clear 19//11/ 30.29

Instrumentation Notes & Comments: None

Marker for D:07281042.ORG OPENED at 558141

STC -1 00004 11:02:24  41 23.3   -70 36.8 all systems on
     0 00051 11:03:11  41 23.3   -70 36.8
IRC -1 00568 11:11:48  41 18.2   -70 35.5 S IR camera run @ 1280' (390 m)
     0 01367 11:25:07  40 51.9   -70 35.0
IRC -1 01474 11:26:54  40 52.3   -70 36.9 N IR camera run @ 1280' (390 m)
     0 01904 11:34:04  41 04.6   -70 35.3
IRC -1 02015 11:35:55  41 03.2   -70 33.5 SW IR camera run @ 1250' (390 m)
     0 02300 11:40:40  40 55.1   -70 39.6
PRO -1 02510 11:44:10  40 57.5   -70 40.2 profile down from 3600' (1100 m)
     0 02884 11:50:24  41 06.7   -70 31.9
FLX -1 02967 11:51:47  41 05.8   -70 30.6 flux leg southwest (215/)
     0 03445 11:59:45  40 52.6   -70 40.6
PRO -1 03445 11:59:45  40 52.6   -70 40.6 profile up/dn to 500' (150 m)
     0 03614 12:02:34  40 51.6   -70 41.6
FLX -1 03614 12:02:34  40 51.6   -70 41.6 flux leg northeast (025/)
     0 04183 12:12:03  41 06.1   -70 30.7
PRO -1 04183 12:12:03  41 06.1   -70 30.7 profile up/dn to 500' (150 m)
     0 04370 12:15:10  41 07.3   -70 29.5
FLX -1 04370 12:15:10  41 07.3   -70 29.5 flux leg southwest (215/)
EVT    04654 12:19:54  40 59.4   -70 35.9 over ASIMET buoy
     0 04894 12:23:54  40 53.1   -70 41.4
PRO -1 04900 12:24:00  40 52.9   -70 41.5 profile up to 3600' (1100 m)
     0 05275 12:30:15  41 00.6   -70 50.1
PRO -1 05275 12:30:15  41 00.6   -70 50.1 profile down from 3600' (1100 m)
     0 05574 12:35:14  41 02.8   -70 43.3
FLX -1 05577 12:35:17  41 02.8   -70 43.2 flux leg southeast (120/)
     0 05997 12:42:17  40 55.6   -70 27.2
PRO -1 05997 12:42:17  40 55.6   -70 27.2 profile up/dn to 500' (150 m)
     0 06181 12:45:21  40 54.3   -70 25.2
FLX -1 06181 12:45:21  40 54.3   -70 25.2 flux leg northwest (300/)
     0 06774 12:55:14  41 03.3   -70 44.7
PRO -1 06774 12:55:14  41 03.3   -70 44.7 profile up/dn to 500' (150 m)
     0 06959 12:58:19  41 03.7   -70 46.3
FLX -1 06959 12:58:19  41 03.7   -70 46.3 flux leg southeast (115/)
     0 07485 13:07:05  40 55.6   -70 27.1
PRO -1 07485 13:07:05  40 55.6   -70 27.1 profile up/dn to 500' (150 m)
     0 07654 13:09:54  40 55.6   -70 30.7
FLX -1 07654 13:09:54  40 55.6   -70 30.7 flux leg northwest (315/)
     0 08005 13:15:45  41 02.7   -70 39.9
PRO -1 08005 13:15:45  41 02.7   -70 39.9 profile up/dn to 500' (150 m)
     0 08120 13:17:40  41 02.7   -70 37.8
```

```
FLX -1 08120 13:17:40  41 02.7   -70 37.8 flux leg southeast (155/)
EVT    08227 13:19:27  40 59.5   -70 35.9 over ASIMET buoy
     0 08383 13:22:03  40 54.8   -70 33.2
PRO -1 08383 13:22:03  40 54.8   -70 33.2 profile up/dn to 500' (150 m)
     0 08507 13:24:07  40 55.0   -70 35.1
FLX -1 08507 13:24:07  40 55.0   -70 35.1 flux leg north (350/)
EVT    08658 13:26:38  40 59.4   -70 35.9 over ASIMET buoy
     0 08841 13:29:41  41 04.5   -70 37.2
PRO -1 08841 13:29:41  41 04.5   -70 37.2 profile up/dn to 500' (150 m)
     0 08948 13:31:28  41 03.8   -70 35.1
FLX -1 08948 13:31:28  41 03.8   -70 35.1 flux leg south (190/)
EVT    09080 13:33:40  40 59.5   -70 35.9 over ASIMET buoy
     0 09236 13:36:16  40 54.4   -70 37.1
PRO -1 09236 13:36:16  40 54.4   -70 37.1 profile up/dn to 500' (150 m)
     0 09358 13:38:18  40 55.9   -70 38.4
FLX -1 09358 13:38:18  40 55.9   -70 38.4 flux leg northeast (025/)
EVT    09495 13:40:35  40 59.5   -70 35.8 over ASIMET buoy
     0 09680 13:43:40  41 04.2   -70 32.6
PRO -1 09690 13:43:50  41 04.5   -70 32.5 profile up to 3600' (1100 m)
     0 10044 13:49:44  41 14.7   -70 35.3
PRO -1 10044 13:49:44  41 14.7   -70 35.3 profile down from 3600' (1100 m)
     0 10370 13:55:10  41 23.7   -70 36.6
STC -1 10567 13:58:27  41 23.3   -70 36.8 preparing to shut down all systems
     0 10621 13:59:21  41 23.3   -70 36.8

Marker for D:07281042.ORG CLOSED at 568766

Total scans:   10625
Missed Ints:   00000
      BAT A: 0531250 of 0531250 000.000% Dropouts
      BAT B: 0531250 of 0531250 000.000% Dropouts
        ASH: 0053125 of 0053125 000.000% Dropouts
        TAN: 0105729 of 0106250 000.490% Dropouts
```

CBLAST-Low Pilot Study - Summer 2001

Flight: 08
Date: 29 JUL 01 (Sunday)
Duration: 1.5 hr
Pilot: Timothy L. Crawford

Summary: Infrared camera run prior to sunrise, simple north-south, east-west box pattern at 1280' (390 m) for SAR overpass.

Weather: Region dominated by high pressure system, mid and high level clouds moving into region, calm to very light and variable winds.

MVY ATIS: 0818 UTC calm 10V clear 12//11/ 30.22
MVY ATIS: 0916 UTC calm 10v clear 12//11/ 30.23
MVY ATIS: 0953 UTC calm 10v clear 12//11/ 30.23
MVY ATIS: 1053 UTC calm 10v clear 17//15/ 30.23
MVY ATIS: 1253 UTC calm 10v clear 20//16/ 30.23

Instrumentation Notes & Comments:

Data file was started after takeoff because of difficulty with the TANS not functioning properly and was terminated early before the overpass.

```
Marker for D:07290928.ORG OPENED at 034282

IRC -1 00005 09:31:26  41 19.2   -70 36.2 S IR camera run @ 1280' (390 m)
     0 00266 09:35:47  41 10.8   -70 35.6
IRC -1 00507 09:39:48  41 10.4   -70 32.7 S IR camera run @ 1280' (390 m)
```

```
     0 00985 09:47:46  40 55.7   -70 35.5
IRC -1 01032 09:48:39  40 54.5   -70 34.2 E IR camera run @ 1280' (390 m)
     0 01584 09:57:51  40 55.1   -70 10.1
IRC -1 01637 09:58:44  40 56.2   -70 08.9 N IR camera run @ 1280' (390 m)
     0 02075 10:06:02  41 09.2   -70 09.3
IRC -1 02132 10:06:59  41 10.1   -70 10.7 W IR camera run @ 1280' (390 m)
     0 02800 10:18:07  41 09.9   -70 35.8

Marker for D:07290928.ORG CLOSED at 037094

Total scans:   02806
Missed Ints:   00006
      BAT A: 0140232 of 0140300 000.048% Dropouts
      BAT B: 0140232 of 0140300 000.048% Dropouts
        ASH: 0013994 of 0014030 000.257% Dropouts
        TAN: 0000000 of 0028060 100.000% Dropouts


CBLAST-Low Pilot Study - Summer 2001

  Flight: 09
    Date: 29 JUL 01 (Sunday)
Duration: 2.0 hr
   Pilot: Timothy L. Crawford

Summary: "Spirograph" flux legs over the ASIMET buoy with multiple short
         altitude profiles and a deep boundary layer profile.

Weather: Region dominated by high pressure system, mid and high level
         clouds moving into region, calm to very light and variable
         winds.

MVY ATIS: 0818 UTC calm 10V clear 12//11/ 30.22
MVY ATIS: 0916 UTC calm 10v clear 12//11/ 30.23
MVY ATIS: 0953 UTC calm 10v clear 12//11/ 30.23
MVY ATIS: 1053 UTC calm 10v clear 17//15/ 30.23
MVY ATIS: 1253 UTC calm 10v clear 20//16/ 30.23

Instrumentation Notes & Comments:

TANS functioning after manually- and velocity-aided search reset
Data not differentially corrected prior to scan 01400, ground station off

Marker for D:07291112.ORG OPENED at 042234

FLX -1 01400 12:07:14  40 55.1   -70 37.3 flux leg north (010/)
     0 01730 12:12:43  41 04.8   -70 36.1
PRO -1 01730 12:12:43  41 04.8   -70 36.1 profile up/dn to 500' (150 m)
     0 01843 12:14:36  41 04.2   -70 38.2
FLX -1 01843 12:14:36  41 04.2   -70 38.2 flux leg southeast (155/)
     0 02190 12:20:23  40 55.2   -70 32.9
PRO -1 02190 12:20:23  40 55.2   -70 32.9 profile up/dn to 500' (150 m)
     0 02281 12:21:54  40 56.2   -70 30.9
FLX -1 02281 12:21:54  40 56.2   -70 30.9 flux leg northwest (305/)
     0 02616 12:27:29  41 02.8   -70 41.0
PRO -1 02616 12:27:29  41 02.8   -70 41.0 profile up/dn to 500' (150 m)
     0 02742 12:29:35  41 01.0   -70 41.0
FLX -1 02742 12:29:35  41 01.0   -70 41.0 flux leg east (110/)
     0 03034 12:34:27  40 58.7   -70 29.5
PRO -1 03034 12:34:27  40 58.7   -70 29.5 profile up/dn to 500' (150 m)
     0 03154 12:36:27  41 00.5   -70 29.7
FLX -1 03154 12:36:27  41 00.5   -70 29.7 flux profile west (255/)
     0 03473 12:41:46  40 58.2   -70 42.4
PRO -1 03473 12:41:46  40 58.2   -70 42.4 profile up/dn to 500' (150 m)
     0 03578 12:43:31  40 56.6   -70 41.2
```

```
FLX -1 03578 12:43:31  40 56.6   -70 41.2 flux leg northeast (060/)
     0 03896 12:48:49  41 02.3   -70 30.2
PRO -1 03896 12:48:49  41 02.3   -70 30.2 profile up/dn to 500' (150 m)
     0 04005 12:50:38  41 03.5   -70 31.9
FLX -1 04005 12:50:38  41 03.5   -70 31.9 flux leg southwest (215/)
     0 04358 12:56:31  40 55.6   -70 40.1
PRO -1 04358 12:56:31  40 55.6   -70 40.1 profile up/dn to 500' (150 m)
     0 04475 12:58:28  40 55.2   -70 37.6
FLX -1 04475 12:58:28  40 55.2   -70 37.6 flux leg north (020/)
     0 04772 13:03:25  40 04.2   -70 34.2
PRO -1 04772 13:03:25  40 04.2   -70 34.2 profile up/dn to 500' (150 m)
     0 04888 13:05:21  41 04.2   -70 36.7
FLX -1 04888 13:05:21  41 04.2   -70 36.7 flux leg south (170/)
     0 05222 13:10:55  40 54.3   -70 34.8
PRO -1 05222 13:10:55  40 54.3   -70 34.8 profile up/dn to 500' (150 m)
     0 05336 13:12:49  40 55.3   -70 32.8
FLX -1 05336 13:12:49  40 55.3   -70 32.8 flux leg northwest (330/)
     0 05652 13:18:05  41 03.9   -70 39.3
PRO -1 05652 13:18:05  41 03.9   -70 39.3 profile up/dn to 500' (150 m)
     0 05754 13:19:47  41 02.9   -70 41.2
FLX -1 05754 13:19:47  41 02.9   -70 41.2 flux leg southeast (130/)
     0 06105 13:25:38  40 56.3   -70 30.5
PRO -1 06116 13:25:49  40 56.1   -70 30.1 profile up to 4900' (1500 m)
     0 06657 13:34:50  41 11.8   -70 35.2
PRO -1 06661 13:34:54  41 11.9   -70 35.2 profile down to MVY
     0 07197 13:43:50  41 23.6   -70 36.7
STC -1 07314 13:45:47  41 23.3   -70 36.8 preparing to shut down all systems
     0 07357 13:46:30  41 23.3   -70 36.8

Marker for D:07291112.ORG CLOSED at 049597

Total scans: 07363
Missed Ints: 00000
      BAT A: 0368150 of 0368150 000.000% Dropouts
      BAT B: 0368150 of 0368150 000.000% Dropouts
        ASH: 0036815 of 0036815 000.000% Dropouts
        TAN: 0071765 of 0073630 002.533% Dropouts


CBLAST-Low Pilot Study - Summer 2001

  Flight: 10
    Date: 30 JUL 01 (Monday)
Duration: 3.5 hr
   Pilot: Timothy L. Crawford

Summary: Wind calibrations, infrared camera run (box pattern), east-west
         "bow tie" flux legs and short profiles over ASIMET buoy, profile,
         multiple flux legs and short profiles over the R/V Asterias.

Weather: Fair weather with high clouds to the south from a low pressure
         system in the mid-Atlantic region.  Light winds from the
         northeast and east.

MVY ATIS: 0953 UTC 060/04 10V clear         30.16
MVY ATIS: 1053 UTC 060/03 10V clear 14//12/ 30.17
MVY ATIS: 1153 UTC 110/07 10V clear 19//13/ 30.18
MVY ATIS: 1402 UTC 090/12 10V clear 21//14/ 30.18
MVY ATIS: 1453 UTC 090/11 10V clear 22//14/ 30.17

Instrumentation Notes & Comments: None

Marker for D:07301120.ORG OPENED at 128628

STC -1 00005 11:43:52  41 23.3   -70 36.8 all systems on
```

```
     0 00057 11:44:44  41 23.3   -70 36.8
PTC -1 00687 11:55:14  41 18.6   -70 35.0 pitch up/dn calibration
     0 00810 11:57:17  41 14.9   -70 34.7
YAW -1 00815 11:57:22  41 14.7   -70 34.7 yaw calibration
     0 01003 12:00:30  41 08.9   -70 34.6
ACC -1 01009 12:00:36  41 08.8   -70 34.6 acceleration run calibration
     0 01253 12:04:40  41 01.7   -70 35.7
WCR -1 01481 12:08:28  41 01.0   -70 36.3 wind circle right
     0 01709 12:12:16  41 01.2   -70 36.6
WCL -1 01791 12:13:38  40 59.7   -70 34.3 wind circle left
     0 01994 12:17:01  40 60.0   -70 34.2
PRO -1 02053 12:18:00  41 01.5   -70 32.7 profile down from 3800' (1150 m)
     0 02393 12:23:40  41 02.8   -70 27.1
IRC -1 02456 12:24:43  41 02.9   -70 30.0 W IR camera run @ 1280' (390 m)
     0 02690 12:28:37  41 02.6   -70 41.0
IRC -1 02690 12:28:37  41 02.6   -70 41.0 S IR camera run @ 1280' (390 m)
     0 02957 12:33:04  40 54.6   -70 42.0
IRC -1 02957 12:33:04  40 54.6   -70 42.0 E IR camera run @ 1280' (390 m)
     0 03358 12:39:45  40 54.6   -70 28.
IRC -1 03358 12:39:45  40 54.6   -70 28.8 N IR camera run @ 1280' (390 m)
     0 03722 12:45:49  41 05.1   -70 28.6
FLX -1 04001 12:50:28  41 01.5   -70 28.0 flux leg west (250/)
     0 04348 12:56:15  40 57.8   -70 42.4
PRO -1 04348 12:56:15  40 57.8   -70 42.4 profile up/dn to 500' (150 m)
     0 04438 12:57:45  40 59.0   -70 42.8
FLX -1 04438 12:57:45  40 59.0   -70 42.8 flux leg east (085/)
     0 04835 13:04:22  40 59.7   -70 29.2
PRO -1 04835 13:04:22  40 59.7   -70 29.2 profile up/dn to 500' (150 m)
     0 04959 13:06:26  41 01.5   -70 31.1
FLX -1 04959 13:06:26  41 01.5   -70 31.1 flux leg southwest (240/)
     0 05256 13:11:23  40 56.9   -70 43.4
PRO -1 05256 13:11:23  40 56.9   -70 43.4 profile up/dn to 500' (150 m)
     0 05360 13:13:07  40 58.4   -70 43.8
FLX -1 05360 13:13:07  40 58.4   -70 43.8 flux leg east (080/)
     0 05784 13:20:11  41 00.2   -70 29.2
PRO -1 05784 13:20:11  41 00.2   -70 29.2 profile up/dn to 500' (150 m)
     0 05906 13:22:13  41 01.7   -70 31.3
FLX -1 05906 13:22:13  41 01.7   -70 31.3 flux leg southwest (240/)
     0 06168 13:26:35  40 57.8   -70 42.4
PRO -1 06168 13:26:35  40 57.8   -70 42.4 profile up/dn to 500' (150 m)
     0 06264 13:28:11  40 59.3   -70 42.9
FLX -1 06264 13:28:11  40 59.3   -70 42.9 flux leg east (085/)
     0 06632 13:34:19  40 59.8   -70 28.9
PRO -1 06632 13:34:19  40 59.8   -70 28.9 profile up/dn to 500' (150 m)
     0 06756 13:36:23  41 01.5   -70 31.1
FLX -1 06756 13:36:23  41 01.5   -70 31.1 flux leg southwest (245/)
     0 07028 13:40:55  40 57.5   -70 42.6
PRO -1 07097 13:42:04  40 58.6   -70 44.5 profile up to 4100' (1250 m)
     0 07393 13:47:00  41 07.2   -70 42.9
PRO -1 07399 13:47:06  41 07.4   -70 42.8 profile down from 4100' (1250 m)
     0 07711 13:52:18  41 16.7   -70 39.2
FLX -1 07824 13:54:11  41 16.1   -70 35.7 flux leg southeast (145/)
     0 07953 13:56:20  41 12.4   -70 33.1
PRO -1 07953 13:56:20  41 12.4   -70 33.1 profile up/dn to 500' (150 m)
     0 08050 13:57:57  41 11.1   -70 35.2
FLX -1 08050 13:57:57  41 11.1   -70 35.2 flux leg north (340/)
     0 08266 14:01:33  41 17.4   -70 40.0
PRO -1 08266 14:01:33  41 17.4   -70 40.0 profile up/dn to 500' (150 m)
     0 08379 14:03:26  41 18.0   -70 37.7
FLX -1 08379 14:03:26  41 18.0   -70 37.7 flux leg southeast (135/)
     0 08618 14:07:25  41 12.2   -70 31.4
PRO -1 08618 14:07:25  41 12.2   -70 31.4 profile up/dn to 500' (150 m)
     0 08730 14:09:17  41 11.1   -70 34.0
FLX -1 08730 14:09:17  41 11.1   -70 34.0 flux leg northwest (350/)
     0 08990 14:11:37  41 18.9   -70 36.9
```

```
PRO -1 08990 14:11:37  41 18.9   -70 36.9 profile up/dn to 500' (150 m)
     0 09093 14:15:20  41 18.8   -70 34.4
FLX -1 09093 14:15:20  41 18.8   -70 34.4 flux leg south (180/)
     0 09329 14:19:16  41 11.1   -70 35.6
PRO -1 09329 14:19:16  41 11.1   -70 35.6 profile up/dn to 500' (150 m)
     0 09460 14:21:27  41 12.0   -70 38.3
FLX -1 09460 14:21:27  41 12.0   -70 38.3 flux leg northeast (040/)
     0 09724 14:25:51  41 17.9   -70 32.9
PRO -1 09724 14:25:51  41 17.9   -70 32.9 profile up/dn to 500' (150 m)
     0 09841 14:27:48  41 16.2   -70 32.0
FLX -1 09841 14:27:48  41 16.2   -70 32.0 flux leg west (250/)
     0 10034 14:31:01  41 14.2   -70 40.3
PRO -1 10034 14:31:01  41 14.2   -70 40.3 profile up/dn to 500' (150 m)
     0 10145 14:32:52  41 15.9   -70 41.0
FLX -1 10145 14:32:52  41 15.9   -70 41.0 flux leg east (090/)
     0 10426 14:37:33  41 15.3   -70 30.8
PRO -1 10426 14:37:33  41 15.3   -70 30.8 profile up/dn to 500' (150 m)
     0 10562 14:39:49  41 13.8   -70 33.0
FLX -1 10562 14:39:49  41 13.8   -70 33.0 flux leg northwest (320/)
     0 10742 14:42:49  41 17.7   -70 38.7
PRO -1 10742 14:42:49  41 17.7   -70 38.7 profile up/dn to 500' (150 m)
     0 10862 14:44:49  41 18.6   -70 37.2
FLX -1 10862 14:44:49  41 18.6   -70 37.2 flux leg southeast (145/)
     0 11128 14:49:15  41 12.0   -70 32.3
PRO -1 11140 14:49:27  41 11.7   -70 32.0 profile up to 4600' (1400 m)
     0 11708 14:58:55  41 12.6   -70 32.4
PRO -1 11712 14:58:59  41 12.7   -70 32.5 profile down to MVY
     0 12295 15:08:42  41 23.6   -70 36.6
STC -1 12400 15:10:27  41 23.3   -70 36.8 preparing to shut down all systems
     0 12420 15:10:47  41 23.3   -70 36.8

Marker for D:07301120.ORG CLOSED at 141057

Total scans:   12429
Missed Ints:   00000
      BAT A: 0621450 of 0621450 000.000% Dropouts
      BAT B: 0621450 of 0621450 000.000% Dropouts
        ASH: 0062145 of 0062145 000.000% Dropouts
        TAN: 0123243 of 0124290 000.842% Dropouts
```

CBLAST-Low Pilot Study - Summer 2001

```
  Flight: 11
    Date: 31 JUL 01 (Tuesday)
Duration: 2.4 hr
   Pilot: Timothy L. Crawford
```

Summary: Infrared camera runs using the "mowing the lawn" flight plan just prior to and shortly after sunrise, profile, several north/south (040//220/) flux legs over ASIMET buoy with short altitude profiles.

Weather: Fair weather with a few high clouds from a low pressure system to the south quickly moving to the north and east. Light winds from the north with a confused wave state.

```
MVY ATIS: 0745 UTC 020/07 10V clear               15//13/ 30.15
MVY ATIS: 0911 UTC 020/05 10V  scat 440 scat 5000 17//15/ 30.19
MVY ATIS: 0953 UTC 010/05 10V clear               13//12/ 30.18
MVY ATIS: 1052 UTC 020/04 10V clear               17//15/ 30.19
```

Instrumentation Notes & Comments: None

Marker for D:07310909.ORG OPENED at 206940

```
STC -1 00004 09:29:03  41 23.3   -70 36.8 all systems on
     0 00067 09:30:06  41 23.3   -70 36.8
IRC -1 00582 09:38:41  41 17.4   -70 32.2 W IR camera run @ 1280' (390 m)
     0 00756 09:41:35  41 16.7   -70 40.1
IRC -1 00846 09:43:05  41 15.0   -70 40.6 E IR camera run @ 1280' (390 m)
     0 01148 09:48:07  41 15.0   -70 29.9
IRC -1 01262 09:50:01  41 12.7   -70 30.2 W IR camera run @ 1280' (390 m)
     0 01484 09:53:43  41 12.7   -70 40.2
IRC -1 01582 09:55:21  41 11.0   -70 40.2 E IR camera run @ 1280' (390 m)
     0 01876 10:00:15  41 11.3   -70 29.9
IRC -1 01995 10:02:14  41 08.9   -70 30.0 W IR camera run @ 1280' (390 m)
     0 02233 10:06:12  41 08.7   -70 40.7
IRC -1 02333 10:07:52  41 07.0   -70 41.0 E IR camera run @ 1280' (390 m)
     0 02643 10:13:02  41 07.1   -70 29.9
IRC -1 02769 10:15:08  41 04.7   -70 30.4 W IR camera run @ 1280' (390 m)
     0 02987 10:18:46  41 04.7   -70 40.2
IRC -1 03080 10:20:19  41 02.9   -70 40.5 E IR camera run @ 1250' (390 m)
     0 03383 10:25:22  41 02.8   -70 29.8
PRO -1 03603 10:29:02  40 58.5   -70 33.8 profile down from 3900' (1200 m)
     0 04071 10:36:50  40 58.0   -70 39.0
FLX -1 04393 10:42:12  41 02.5   -70 34.4 flux leg south (200/)
     0 04632 10:46:11  40 54.7   -70 38.2
PRO -1 04632 10:46:11  40 54.7   -70 38.2 profile up/dn to 500' (150 m)
     0 04748 10:48:07  40 55.4   -70 40.5
FLX -1 04748 10:48:07  40 55.4   -70 40.5 flux leg northeast (040/)
     0 05112 10:54:11  41 03.6   -70 31.6
PRO -1 05112 10:54:11  41 03.6   -70 31.6 profile up/dn to 500' (150 m)
     0 05233 10:56:12  41 03.7   -70 34.4
FLX -1 05233 10:56:12  41 03.7   -70 34.4 flux leg south (200/)
     0 05517 11:00:56  40 54.7   -70 38.3
PRO -1 05517 11:00:56  40 54.7   -70 38.3 profile up/dn to 500' (150 m)
     0 05608 11:02:27  40 55.3   -70 40.2
FLX -1 05608 11:02:27  40 55.3   -70 40.2 flux leg northeast (040/)
     0 05983 11:08:42  41 03.4   -70 31.5
PRO -1 05983 11:08:42  41 03.4   -70 31.5 profile up/dn to 500' (150 m)
     0 06100 11:10:39  41 03.5   -70 34.1
FLX -1 06100 11:10:39  41 03.5   -70 34.1 flux leg south (200/)
     0 06389 11:15:28  40 54.5   -70 38.4
PRO -1 06389 11:15:28  40 54.5   -70 38.4 profile up/dn to 500' (150 m)
     0 06509 11:17:28  40 55.4   -70 38.9
FLX -1 06509 11:17:28  40 55.4   -70 38.9 flux leg northeast (030/)
     0 06866 11:23:25  41 03.8   -70 32.1
PRO -1 06866 11:23:25  41 03.8   -70 32.1 profile up/dn to 500' (150 m)
     0 06963 11:25:02  41 04.0   -70 34.0
FLX -1 06963 11:25:02  41 04.0   -70 34.0 flux leg south (200/)
     0 07271 11:30:10  40 54.3   -70 38.4
PRO -1 07345 11:31:24  40 54.3   -70 40.7 profile up to 4900'(1500 m)
     0 07766 11:38:25  41 06.2   -70 39.9
PRO -1 07766 11:38:25  41 06.2   -70 39.9 profile down to MVY
     0 08235 11:46:14  41 19.7   -70 39.1
STC -1 08574 11:51:53  41 23.3   -70 36.8 preparing to shut down all systems
     0 08635 11:52:54  41 23.3   -70 36.8

Marker for D:07310909.ORG CLOSED at 215580

Total scans:   08640
Missed Ints:   00000
      BAT A: 0432000 of 0432000 000.000% Dropouts
      BAT B: 0432000 of 0432000 000.000% Dropouts
        ASH: 0043200 of 0043200 000.000% Dropouts
        TAN: 0085324 of 0086400 001.245% Dropouts
```

```
  Flight: 12
    Date: 01 AUG 01 (Wednesday)
Duration: 3.3 hr
   Pilot: Timothy L. Crawford

Summary: Infrared camera run prior to sunrise, simple north-south,
         east-west box pattern at 1280' (390 m) prior to SAR overpass.
         Same box pattern flow at 10 m for SAR intercomparison at
         1057 UTC.  "Spirograph" flux legs over the ASIMET buoy with
         multiple short  altitude profiles and a deep boundary layer
         profile.

Weather: Region dominated by high pressure with very light winds from
         the northwest to northeast.  Wave state somewhat confused.

MVY ATIS: 0803 UTC   calm 10V clear 14//14/ 30.23
MVY ATIS: 0835 UTC 320/03 10V clear 14//13/ 30.24
MVY ATIS: 0854 UTC 310/04 10V clear 14//13/ 30.24
MVY ATIS: 0937 UTC 330/03 08V clear 16//15/ 30.26
MVY ATIS: 0953 UTC   calm 07V clear 16//15/ 30.37
MVY ATIS: 1153 UTC 020/06 10V clear 22//17/ 30.29

Instrumentation Notes & Comments: None

Marker for D:08010911.ORG OPENED at 294009

STC -1 00004 09:40:12  41 23.3   -70 36.8 all systems on
     0 00065 09:41:13  41 23.3   -70 36.8
IRC -1 00354 09:46:02  41 21.1   -70 34.5 S IR camera run @ 1280' (390 m)
     0 00699 09:51:47  41 10.0   -70 35.5
IRC -1 00703 09:51:51  41 09.9   -70 35.5 S IR camera run @ 1280' (390 m)
     0 01121 09:58:49  40 55.8   -70 35.6
IRC -1 01173 09:59:41  40 55.0   -70 34.0 E IR camera run @ 1280' (390 m)
     0 01701 10:08:29  40 55.0   -70 10.5
MSG    01741 10:09:09                     BAT 0 frequency slow: Freq=49
MSG    01741 10:09:09                     BAT 1 frequency slow: Freq=49
IRC -1 01748 10:09:16  40 55.9   -70 09.4 N IR camera run @ 1280' (390 m)
     0 02188 10:16:36  41 08.9   -70 09.2
FLX -1 02249 10:17:37  41 09.5   -70 10.9 W IR camera run @ 1280' (390 m)
EVT    02666 10:24:34  41 09.9   -70 26.9 ship wake
     0 02883 10:28:11  41 09.9   -70 35.2
PRO -1 03025 10:30:33  41 13.2   -70 36.8 profile down from 3600' (1100 m)
     0 03452 10:37:40  41 13.0   -70 33.0
FLX -1 03585 10:39:53  41 10.1   -70 35.2 SAR flux leg south (180/)
     0 04058 10:47:46  40 55.9   -70 35.5
FLX -1 04110 10:48:38  40 55.0   -70 34.0 SAR flux leg east (090/)
     0 04688 10:58:16  40 55.0   -70 10.5
FLX -1 04739 10:59:07  40 55.9   -70 09.3 SAR flux leg north (000/)
     0 05208 11:06:56  41 09.0   -70 09.1
FLX -1 05259 11:07:47  41 09.7   -70 10.3 SAR flux leg west (270/)
     0 05961 11:19:29  41 09.9   -70 35.5
PRO -1 05965 11:19:33  41 09.9   -70 35.6 profile up to 3100' (950 m)
     0 06270 11:24:38  40 59.6   -70 36.0
PRO -1 06270 11:24:38  40 59.6   -70 36.0 profile down from 3100' (950 m)
     0 06531 11:28:59  40 54.6   -70 34.0
FLX -1 06534 11:29:02  40 54.7   -70 34.0 flux leg north (340/)
     0 06909 11:35:17  41 04.3   -70 38.2
PRO -1 06909 11:35:17  41 04.3   -70 38.2 profile up/dn to 500' (150 m)
     0 07008 11:36:56  41 02.9   -70 39.5
FLX -1 07008 11:36:56  41 02.9   -70 39.5 flux leg southeast (140/)
     0 07291 11:41:39  40 55.6   -70 31.5
PRO -1 07291 11:41:39  40 55.6   -70 31.5 profile up/dn to 500' (150 m)
     0 07401 11:43:29  40 56.8   -70 29.9
FLX -1 07401 11:43:29  40 56.8   -70 29.9 flux leg northwest (300/)
     0 07766 11:49:34  41 02.1   -70 41.8
```

```
PRO -1 07766 11:49:34  41 02.1   -70 41.8 profile up/dn to 500' (150 m)
     0 07874 11:51:22  41 00.2   -70 42.0
FLX -1 07874 11:51:22  41 00.2   -70 42.0 flux leg east (100/)
     0 08196 11:56:44  40 58.5   -70 28.4
PRO -1 08196 11:56:44  40 58.5   -70 28.4 profile up/dn to 500' (150 m)
     0 08311 11:58:39  41 00.0   -70 28.7
FLX -1 08311 11:58:39  41 00.0   -70 28.7 flux leg west (265/)
     0 08684 12:04:52  40 58.6   -70 42.5
PRO -1 08684 12:04:52  40 58.6   -70 42.5 profile up/dn to 500' (150 m)
     0 08801 12:06:49  40 56.7   -70 41.2
FLX -1 08801 12:06:49  40 56.7   -70 41.2 flux leg northeast (055/)
     0 09133 12:12:21  41 02.0   -70 30.1
PRO -1 09133 12:12:21  41 02.0   -70 30.1 profile up/dn to 500' (150 m)
     0 09245 12:14:13  41 02.9   -70 31.7
FLX -1 09245 12:14:13  41 02.9   -70 31.7 flux leg southwest (225/)
     0 09580 12:19:48  40 55.5   -70 40.4
PRO -1 09580 12:19:48  40 55.5   -70 40.4 profile up/dn to 500' (150 m)
     0 09697 12:21:45  40 54.6   -70 38.3
FLX -1 09697 12:21:45  40 54.6   -70 38.3 flux leg north (015/)
     0 10058 12:27:46  41 04.3   -70 33.6
PRO -1 10058 12:27:46  41 04.3   -70 33.6 profile up/dn to 500' (150 m)
     0 10160 12:29:28  41 23.2   -70 33.5
FLX -1 10160 12:29:28  41 23.2   -70 33.5 flux leg south (180/)
     0 10467 12:34:35  40 54.9   -70 35.7
PRO -1 10550 12:35:58  40 54.9   -70 35.0 profile up to 4600' (1400 m)
     0 11002 12:43:30  41 08.5   -70 37.2
FRY -1 11010 12:43:38  41 08.8   -70 37.3 return to MVY
     0 11531 12:52:19  41 23.7   -70 36.6

Marker for D:08010911.ORG CLOSED at 305700

Total scans: 11691
Missed Ints: 00000
      BAT A: 0584549 of 0584550 000.000% Dropouts
      BAT B: 0584549 of 0584550 000.000% Dropouts
        ASH: 0058455 of 0058455 000.000% Dropouts
        TAN: 0115974 of 0116910 000.801% Dropouts


CBLAST-Low Pilot Study - Summer 2001

  Flight: 13
    Date: 01 AUG 01 (Wednesday)
Duration: 2.8 hr
   Pilot: Timothy L. Crawford

Summary: East-west "bow tie" flux runs near and over the R/V Asterias
         and "spirograph" flux runs over the ASIMET buoy, profiles.

Weather: Region dominated by high pressure with light and variable
         winds.   Wave state somewhat confused.

MVY ATIS: 1553 UTC 080/06 10V clear 26//18/ 30.29
MVY ATIS: 1852 UTC 210/06 10V clear 26//    30.30

Instrumentation Notes & Comments: None

Marker for D:08011644.ORG OPENED at 320069

PRO -1 00361 17:00:29  41 20.1   -70 32.2 profile down from 1000' (300 m)
     0 00547 17:03:35  41 18.8   -70 29.4
FLX -1 00622 17:04:50  41 18.5   -70 32.7 flux leg west (255/)
     0 00842 17:08:30  41 16.9   -70 41.3
PRO -1 00842 17:08:30  41 16.9   -70 41.3 profile up/dn to 500' (150 m)
     0 00947 17:10:15  41 18.5   -70 41.0
```

```
FLX -1 00947 17:10:15  41 18.5   -70 41.0 flux leg east (100/)
     0 01292 17:16:00  41 16.6   -70 27.7
PRO -1 01292 17:16:00  41 16.6   -70 27.7 profile up/dn to 500' (150 m)
     0 01419 17:18:07  41 18.2   -70 28.3
FLX -1 01419 17:18:07  41 18.2   -70 28.3 flux leg west (260/)
     0 01740 17:23:28  41 16.6   -70 41.4
PRO -1 01740 17:23:28  41 16.6   -70 41.4 profile up/dn to 500' (150 m)
     0 01845 17:25:13  41 18.1   -70 41.1
FLX -1 01845 17:25:13  41 18.1   -70 41.1 flux leg east (100/)
     0 02188 17:30:56  41 16.7   -70 27.9
PRO -1 02188 17:30:56  41 16.7   -70 27.9 profile up/dn to 500' (150 m)
     0 02292 17:32:40  41 18.3   -70 27.9
FLX -1 02292 17:32:40  41 18.3   -70 27.9 flux leg west (260/)
     0 02615 17:38:03  41 16.8   -70 41.1
PRO -1 02615 17:38:03  41 16.8   -70 41.1 profile up/dn to 500' (150 m)
     0 02716 17:39:44  41 16.2   -70 39.8
FLX -1 02716 17:39:44  41 16.2   -70 39.8 flux leg east (090/)
     0 03028 17:44:56  41 16.8   -70 27.5
PRO -1 03028 17:44:56  41 16.8   -70 27.5 profile up/dn to 500' (150 m)
     0 03142 17:46:50  41 15.4   -70 28.5
FLX -1 03142 17:46:50  41 15.4   -70 28.5 flux leg west (270/)
     0 03456 17:52:04  41 16.2   -70 41.5
PRO -1 03456 17:52:04  41 16.2   -70 41.5 profile up/dn to 500' (150 m)
     0 03540 17:53:28  41 15.6   -70 41.6
FLX -1 03540 17:53:28  41 15.6   -70 41.6 flux leg east (090/)
     0 03883 17:59:11  41 16.0   -70 27.7
PRO -1 03883 17:59:11  41 16.0   -70 27.7 profile up/dn to 500' (150 m)
     0 03962 18:00:30  41 14.6   -70 27.8
FLX -1 03962 18:00:30  41 14.6   -70 27.8 flux leg west (275/)
     0 04299 18:06:07  41 16.2   -70 40.9
PRO -1 04299 18:06:07  41 16.2   -70 40.9 profile up/dn to 500' (150 m)
     0 04379 18:07:37  41 15.4   -70 39.6
FLX -1 04379 18:07:37  41 15.4   -70 39.6 flux leg east (095/)
     0 04662 18:12:10  41 15.3   -70 28.0
PRO -1 04662 18:12:10  41 15.3   -70 28.0 profile up to 1600' (500 m)
     0 04823 18:14:51  41 10.7   -70 29.0
PRO -1 04823 18:14:51  41 10.7   -70 29.0 profile down from 1600' (500 m)
     0 04960 18:17:08  41 07.2   -70 32.2
FLX -1 04963 18:17:11  41 07.1   -70 32.3 flux leg south (200/)
     0 05426 18:24:54  40 54.7   -70 38.3
PRO -1 05426 18:24:54  40 54.7   -70 38.3 profile up/dn to 500' (150 m)
     0 05544 18:26:52  40 54.6   -70 35.8
FLX -1 05544 18:26:52  40 54.6   -70 35.8 flux leg north (355/)
     0 05872 18:32:20  41 04.7   -70 36.0
PRO -1 05872 18:32:20  41 04.7   -70 36.0 profile up/dn to 500' (150 m)
     0 05979 18:34:07  41 04.3   -70 38.0
FLX -1 05979 18:34:07  41 04.3   -70 38.0 flux leg south (165/)
     0 06315 18:39:43  40 54.7   -70 33.7
PRO -1 06315 18:39:43  40 54.7   -70 33.7 profile up/dn to 500' (150 m)
     0 06431 18:41:39  40 55.6   -70 31.6
FLX -1 06431 18:41:39  40 55.6   -70 31.6 flux leg northwest (315/)
     0 06775 18:47:23  41 03.4   -70 40.2
PRO -1 06775 18:47:23  41 03.4   -70 40.2 profile up/dn to 500' (150 m)
     0 06891 18:49:19  41 02.0   -70 41.3
FLX -1 06891 18:49:19  41 02.0   -70 41.3 flux leg southeast (125/)
     0 07206 18:54:34  40 57.0   -70 30.0
PRO -1 07206 18:54:34  40 57.0   -70 30.0 profile up/dn to 500' (150 m)
     0 07324 18:56:32  40 58.7   -70 29.3
FLX -1 07324 18:56:32  40 58.7   -70 29.3 flux leg west (280/)
     0 07683 19:02:31  41 00.3   -70 42.8
PRO -1 07683 19:02:31  41 00.3   -70 42.8 profile up/dn to 500' (150 m)
     0 07788 19:04:16  40 58.6   -70 42.7
FLX -1 07788 19:04:16  40 58.6   -70 42.7 flux leg east (080/)
     0 08105 19:09:33  41 00.3   -70 29.2
PRO -1 08105 19:09:33  41 00.3   -70 29.2 profile up/dn to 500' (150 m)
```

```
     0 08225 19:11:33  41 02.1   -70 29.8
FLX -1 08225 19:11:33  41 02.1   -70 29.8 flux leg southwest (245/)
     0 08588 19:17:36  40 57.1   -70 41.8
PRO -1 08588 19:17:36  40 57.1   -70 41.8 profile up/dn to 500' (150 m)
     0 08704 19:19:32  40 55.7   -70 40.1
FLX -1 08704 19:19:32  40 55.7   -70 40.1 flux leg northeast (040/)
     0 09034 19:25:02  41 03.4   -70 31.5
PRO -1 09038 19:25:06  41 03.5   -70 31.4 profile up to 3600' (1100 m)
MSG    09319 19:29:47                     BAT 0 frequency slow: Freq=49
MSG    09319 19:29:47                     BAT 1 frequency slow: Freq=49
     0 09405 19:31:13  41 14.2   -70 34.6
PRO -1 09407 19:31:15  41 14.3   -70 34.6 profile down to MVY
     0 09833 19:38:21  41 23.3   -70 37.0
STC -1 09908 19:39:36  41 23.3   -70 36.8 preparing to shut down all systems
     0 09960 19:40:28  41 23.3   -70 36.8
```

Marker for D:08011644.ORG CLOSED at 330034

```
Total scans:   09965
Missed Ints:   00000
      BAT A: 0498249 of 0498250 000.000% Dropouts
      BAT B: 0498249 of 0498250 000.000% Dropouts
        ASH: 0049825 of 0049825 000.000% Dropouts
        TAN: 0099041 of 0099650 000.611% Dropouts
```

CBLAST-Low Pilot Study - Summer 2001

```
  Flight: 14
    Date: 02 AUG 01 (Thursday)
Duration: 2.4 hr
   Pilot: Timothy L. Crawford
```

Summary: Late morning flight, IR camera run with simple box pattern around ASIMET buoy, "spirograph" flux legs with short profiles over ASIMET buoy, profiles.

Weather: Very hazy, hot, and humid, light southwesterly winds as a high pressure system slowly moves eastward.

MVY ATIS: 1352 UTC 230/08 10V clear 25//20/ 30.25
MVY ATIS: 1652 UTC 220/09 10V clear 26//20/ 30.21

Instrumentation Notes & Comments: None

Marker for D:08021423.ORG OPENED at 398843

```
STC -1 00006 14:47:28  41 23.3   -70 36.8 all systems on
     0 00062 14:48:24  41 23.3   -70 36.8
PRO -1 00521 14:56:03  41 17.1   -70 35.6 profile up to 4000' (1200 m)
     0 00877 15:01:59  41 06.6   -70 35.5
PRO -1 00882 15:02:04  41 06.4   -70 35.5 profile down from 4000' (1200 m)
     0 01362 15:10:04  40 54.1   -70 43.4
IRC -1 01606 15:14:08  40 49.3   -70 46.9 E IR camera run @ 1280' (390 m)
     0 02098 15:22:20  40 49.3   -70 25.1
IRC -1 02145 15:23:07  40 50.3   -70 23.8 N IR camera run @ 1280' (390 m)
     0 02727 15:32:49  41 09.0   -70 23.9
IRC -1 02773 15:33:35  41 09.7   -70 25.0 W IR camera run @ 1280' (390 m)
     0 03329 15:42:51  41 09.7   -70 44.7
IRC -1 03376 15:43:38  41 08.8   -70 45.5 S IR camera run @ 1280' (390 m)
     0 03702 15:49:04  40 59.7   -70 45.1
FLX -1 03802 15:50:44  40 59.0   -70 41.4 flux leg east (085/)
EVT    04036 15:54:38  41 00.2   -70 31.7 wake
     0 04097 15:55:39  41 00.4   -70 29.2
FLX -1 04226 15:57:48  41 02.2   -70 29.8 flux leg southwest (240/)
```

```
     0 04604 16:04:06  40 57.0   -70 41.8
PRO -1 04604 16:04:06  40 57.0   -70 41.8 profile up/dn to 500' (150 m)
     0 04704 16:05:46  40 55.6   -70 40.0
FLX -1 04704 16:05:46  40 55.6   -70 40.0 flux leg northeast (040/)
     0 05012 16:10:54  41 03.6   -70 31.6
PRO -1 05012 16:10:54  41 03.6   -70 31.6 profile up/dn to 500' (150 m)
     0 05140 16:13:02  41 04.2   -70 33.6
FLX -1 05140 16:13:02  41 04.2   -70 33.6 flux leg southwest (205/)
     0 05511 16:19:13  40 54.6   -70 38.5
PRO -1 05511 16:19:13  40 54.6   -70 38.5 profile up/dn to 500' (150 m)
     0 05623 16:21:05  40 54.1   -70 35.8
FLX -1 05623 16:21:05  40 54.1   -70 35.8 flux leg north (355/)
     0 05944 16:26:26  41 04.7   -70 35.9
PRO -1 05944 16:26:26  41 04.7   -70 35.9 profile up/dn to 500' (150 m)
     0 06057 16:28:19  41 04.6   -70 37.9
FLX -1 06057 16:28:19  41 04.6   -70 37.9 flux leg south (165/)
EVT    06126 16:29:28  41 02.7   -70 37.0 visible surface change
     0 06428 16:34:30  40 54.4   -70 33.3
PRO -1 06428 16:34:30  40 54.4   -70 33.3 profile up/dn to 500' (150 m)
     0 06533 16:36:15  40 55.4   -70 30.8
FLX -1 06533 16:36:15  40 55.4   -70 30.8 flux leg northwest (315/)
     0 06886 16:42:08  41 03.5   -70 40.2
PRO -1 06886 16:42:08  41 03.5   -70 40.2 profile up/dn to 500' (150 m)
     0 06995 16:43:57  41 02.2   -70 41.2
FLX -1 06995 16:43:57  41 02.2   -70 41.2 flux leg southeast (130/)
     0 07322 16:49:24  40 57.0   -70 29.9
PRO -1 07322 16:49:24  40 57.0   -70 29.9 profile up/dn to 500' (150 m)
     0 07426 16:51:08  40 58.7   -70 28.4
FLX -1 07426 16:51:08  40 58.7   -70 28.4 flux leg west (275/)
     0 07804 16:57:26  41 00.4   -70 42.5
PRO -1 07854 16:58:16  41 01.6   -70 42.7 profile up to 4300' (1300 m)
     0 08233 17:04:35  41 14.6   -70 38.0
PRO -1 08236 17:04:38  41 14.7   -70 37.9 profile down to MVY
     0 08595 17:10:37  41 23.4   -70 36.8
STC -1 08669 17:11:51  41 23.3   -70 36.8 preparing to shut down all systems
     0 08709 17:12:31  41 23.3   -70 36.8

Marker for D:08021423.ORG CLOSED at 407556

Total scans:   08713
Missed Ints:   00000
      BAT A: 0435650 of 0435650 000.000% Dropouts
      BAT B: 0435650 of 0435650 000.000% Dropouts
        ASH: 0043565 of 0043565 000.000% Dropouts
        TAN: 0086800 of 0087130 000.379% Dropouts
```

CBLAST-Low Pilot Study - Summer 2001

```
  Flight: 15
    Date: 03 AUG 01 (Friday)
Duration: 1.9 hr
   Pilot: Timothy L. Crawford
```

Summary: Nighttime flight for infrared camera runs using the "mowing the lawn" flight plan after sunset.

Weather: Hazy and humid, steady southwesterly winds as a high pressure system slowly moves eastward.

```
MVY ATIS: 2252 UTC 240/10     10V clear 23//18/ 30.11
MVY ATIS: 2357 UTC 250/11     10V clear 22//17/ 30.11
MVY ATIS: 0213 UTC 260/10/G18 10V clear 22//17/ 30.11
```

Instrumentation Notes & Comments:

Data acquisition system booted up after takeoff and shut down prior to
   landing for this nighttime flight (power needed for landing lights).

Marker for D:08030052.ORG OPENED at 435501

```
IRC -1 00001 00:58:21  41 17.0   -70 33.0 W IR camera run @ 1280' (390 m)
     0 00241 01:02:21  41 17.0   -70 39.6
IRC -1 00333 01:03:53  41 15.8   -70 39.0 E IR camera run @ 1280' (390 m)
     0 00551 01:07:31  41 15.9   -70 27.1
IRC -1 00668 01:09:28  41 14.2   -70 26.0 W IR camera run @ 1280' (390 m)
     0 01166 01:17:46  41 14.3   -70 40.1
IRC -1 01240 01:19:00  41 13.1   -70 39.1 E IR camera run @ 1280' (390 m)
     0 01415 01:21:55  41 13.3   -70 29.8
IRC -1 01521 01:23:41  41 11.6   -70 28.6 W IR camera run @ 1280' (390 m)
     0 01925 01:30:25  41 11.5   -70 40.4
IRC -1 01995 01:31:35  41 10.2   -70 39.0 E IR camera run @ 1280' (390 m)
     0 02165 01:34:25  41 10.4   -70 29.8
IRC -1 02255 01:35:55  41 08.7   -70 28.2 W IR camera run @ 1280' (390 m)
     0 02630 01:42:10  41 08.5   -70 40.2
IRC -1 02714 01:43:34  41 07.2   -70 38.7 E IR camera run @ 1280' (390 m)
     0 02875 01:46:15  41 07.5   -70 29.6
IRC -1 02959 01:47:39  41 09.5   -70 28.7 W IR camera run @ 1280' (390 m)
     0 03321 01:53:41  41 09.5   -70 40.1
IRC -1 03438 01:55:38  41 12.1   -70 38.5 E IR camera run @ 1280' (390 m)
     0 03593 01:58:13  41 12.5   -70 29.6
IRC -1 03682 01:59:42  41 14.5   -70 28.6 W IR camera run @ 1280' (390 m)
     0 04059 02:05:59  41 14.3   -70 40.2
IRC -1 04178 02:07:58  41 17.0   -70 38.7 E IR camera run @ 1280' (390 m)
     0 04334 02:10:34  41 17.2   -70 29.7
IRC -1 04422 02:12:02  41 19.2   -70 28.7 W IR camera run @ 1280' (390 m)
     0 04782 02:18:02  41 19.1   -70 39.9
IRC -1 04876 02:19:36  41 20.8   -70 39.1 E IR camera run @ 1280' (390 m)
     0 05022 02:22:02  41 21.2   -70 30.6
```

Marker for D:08030052.ORG CLOSED at 440550

```
Total scans: 05049
Missed Ints: 00000
      BAT A: 0252450 of 0252450 000.000% Dropouts
      BAT B: 0252450 of 0252450 000.000% Dropouts
        ASH: 0025245 of 0025245 000.000% Dropouts
        TAN: 0039478 of 0050490 021.810% Dropouts
```

CBLAST-Low Pilot Study - Summer 2001

  Flight: 16
    Date: 05 AUG 01 (Sunday)
Duration: 0.7 hr
   Pilot: Timothy L. Crawford

Summary: Flight terminated because of heavy offshore fog and poor
         visibility.

Weather: Hazy, hot, and humid, light southwesterly winds ahead of a
         stalled cold front.

MVY ATIS: 1453 UTC calm 05V haze 1,200' broken 25//22/ 30.14
MVY ATIS: 1553 UTC calm 03V haze 1,900' broken 26//22/ 30.14

Instrumentation Notes & Comments:

University of Washington/WHOI infrared/visible camera system removed

Marker for D:08051541.ORG OPENED at 057063

```
STC -1 00005 15:51:07  41 23.3   -70 36.8 all systems on
     0 00063 15:52:05  41 23.3   -70 36.8
PRO -1 00635 16:01:37  41 19.6   -70 34.6 profile up to 3300' (1000 m)
     0 00944 16:06:46  41 10.3   -70 30.7
PRO -1 00946 16:06:48  41 10.2   -70 30.7 profile down from 3300' (1000 m)
     0 01581 16:17:23  41 00.8   -70 36.5
```

Marker for D:08051541.ORG CLOSED at 059436

```
Total scans:   02373
Missed Ints:   00000
      BAT A: 0118650 of 0118650 000.000% Dropouts
      BAT B: 0118650 of 0118650 000.000% Dropouts
        ASH: 0011865 of 0011865 000.000% Dropouts
        TAN: 0023636 of 0023730 000.396% Dropouts
```

CBLAST-Low Pilot Study - Summer 2001

Flight: 17
Date: 05 AUG 01 (Sunday)
Duration: 0.8 hr
Pilot: Timothy L. Crawford

Summary: Flight terminated because of heavy offshore fog and poor visibility.

Weather: Hazy, hot, and humid, light southwesterly winds ahead of a stalled cold front.

MVY ATIS: 1952 UTC 220/10 05V haze 1800' broken 24//21/ 30.15

Instrumentation Notes & Comments: None

Marker for D:08052006.ORG OPENED at 072672

```
STC -1 00002 20:11:13  41 23.3   -70 36.8 all systems on
     0 00202 20:14:33  41 23.5   -70 36.8
PRO -1 00624 20:21:35  41 19.2   -70 37.7 profile down from 1400' (440 m)
     0 00836 20:25:07  41 20.4   -70 37.6
```

Marker for D:08052006.ORG CLOSED at 075326

```
Total scans:   02654
Missed Ints:   00000
      BAT A: 0132700 of 0132700 000.000% Dropouts
      BAT B: 0132700 of 0132700 000.000% Dropouts
        ASH: 0013270 of 0013270 000.000% Dropouts
        TAN: 0026529 of 0026540 000.041% Dropouts
```

CBLAST-Low Pilot Study - Summer 2001

Flight: 18
Date: 07 AUG 01 (Tuesday)
Duration: 4.1 hr
Pilot: Timothy L. Crawford

Summary: "Spirograph" and "bow tie" flux legs with short profiles over ASIMET and near-shore buoy, profiles. Flight visibility about half a of mile.

Weather: Hazy, hot, and humid, moderate southwesterly winds ahead of a stalled cold front.

```
MVY ATIS: 1252 UTC 270/07 03V mist clear 26//23/ 29.96
MVY ATIS: 1455 UTC 210/12 04V haze clear 27//23/ 29.95
MVY ATIS: 1652 UTC 230/09 04V haze clear 28//23/ 29.91

Instrumentation Notes & Comments:

DGPS corrections unavailable after scan 13635 (flykin solution fails)

Marker for D:08071320.ORG OPENED at 221359

STC -1 00003 13:29:21  41 23.3   -70 36.8 all systems on
     0 00076 13:30:34  41 23.3   -70 36.9
FLX -1 00535 13:38:13  41 19.7   -70 35.7 flux leg south (180/)
     0 00871 13:43:49  41 10.2   -70 34.7
PRO -1 00871 13:43:49  41 10.2   -70 34.7 profile up/dn to 500' (150 m)
     0 01101 13:47:39  41 13.7   -70 35.4
FLX -1 01101 13:47:39  41 13.7   -70 35.4 flux leg northwest (335/)
     0 01329 13:51:27  41 20.0   -70 38.2
PRO -1 01329 13:51:27  41 20.0   -70 38.2 profile up/dn to 500' (150 m)
     0 01464 13:53:42  41 18.3   -70 38.1
FLX -1 01464 13:53:42  41 18.3   -70 38.1 flux leg southeast (150/)
     0 01766 13:58:44  41 11.2   -70 31.0
PRO -1 01766 13:58:44  41 11.2   -70 31.0 profile up/dn to 500' (150 m)
     0 01866 14:00:24  41 12.5   -70 29.6
FLX -1 01866 14:00:24  41 12.5   -70 29.6 flux leg northwest (295/)
     0 02228 14:06:26  41 17.8   -70 41.5
PRO -1 02228 14:06:26  41 17.8   -70 41.5 profile up/dn to 500' (150 m)
     0 02324 14:08:02  41 16.8   -70 41.1
FLX -1 02324 14:08:02  41 16.8   -70 41.1 flux leg east (110/)
     0 02627 14:13:05  41 14.7   -70 28.8
PRO -1 02627 14:13:05  41 14.7   -70 28.8 profile up/dn to 500' (150 m)
     0 02732 14:14:50  41 16.4   -70 27.8
FLX -1 02732 14:14:50  41 16.4   -70 27.8 flux leg west (255/)
     0 03149 14:21:47  41 14.4   -70 42.2
PRO -1 03149 14:21:47  41 14.4   -70 42.2 profile up/dn to 500' (150 m)
     0 03253 14:23:31  41 13.0   -70 41.0
FLX -1 03253 14:23:31  41 13.0   -70 41.0 flux leg northeast (060/)
     0 03545 14:28:23  41 18.1   -70 29.7
PRO -1 03545 14:28:23  41 18.1   -70 29.7 profile up/dn to 500' (150 m)
     0 03645 14:30:03  41 19.7   -70 30.2
FLX -1 03645 14:30:03  41 19.7   -70 30.2 flux leg southwest (220/)
     0 04060 14:36:58  41 11.4   -70 40.0
PRO -1 04060 14:36:58  41 11.4   -70 40.0 profile up/dn to 500' (150 m)
     0 04177 14:38:55  41 11.2   -70 37.3
FLX -1 04177 14:38:55  41 11.2   -70 37.3 flux leg north (015/)
     0 04477 14:43:55  41 20.5   -70 33.1
PRO -1 04477 14:43:55  41 20.5   -70 33.1 profile up/dn to 500' (150 m)
     0 04570 14:45:28  41 19.6   -70 32.0
FLX -1 04570 14:45:28  41 19.6   -70 32.0 flux leg southwest (220/)
     0 04944 14:51:42  41 11.1   -70 39.5
PRO -1 04944 14:51:42  41 11.1   -70 39.5 profile up/dn to 500' (150 m)
     0 05032 14:53:10  41 12.3   -70 40.4
FLX -1 05032 14:53:10  41 12.3   -70 40.4 flux leg northeast (050/)
     0 05318 14:57:56  41 18.5   -70 30.1
PRO -1 05318 14:57:56  41 18.5   -70 30.1 profile up/dn to 500' (150 m)
     0 05412 14:59:30  41 19.7   -70 31.3
FLX -1 05412 14:59:30  41 19.7   -70 31.3 flux leg southwest (215/)
     0 05801 15:05:59  41 11.1   -70 39.6
PRO -1 05801 15:05:59  41 11.1   -70 39.6 profile up/dn to 500' (150 m)
     0 05896 15:07:34  41 12.8   -70 39.9
FLX -1 05896 15:07:34  41 12.8   -70 39.9 flux leg northeast (060/)
     0 06164 15:12:02  41 18.0   -70 29.5
PRO -1 06164 15:12:02  41 18.0   -70 29.5 profile up/dn to 500' (150 m)
     0 06272 15:13:50  41 19.3   -70 30.4
FLX -1 06272 15:13:50  41 19.3   -70 30.4 flux leg southwest (220/)
```

```
     0 06674 15:20:32  41 11.1   -70 39.4
PRO -1 06701 15:20:59  41 10.5   -70 40.0 profile up to 3300' (1000 m)
     0 06987 15:25:45  41 02.0   -70 34.7
PRO -1 06989 15:25:47  41 02.0   -70 34.7 profile down from 3300' (1000 m)
     0 07318 15:31:16  40 54.4   -70 36.0
FLX -1 07322 15:31:20  40 54.6   -70 36.0 flux leg north (355/)
     0 07625 15:36:23  41 04.7   -70 36.1
PRO -1 07625 15:36:23  41 04.7   -70 36.1 profile up/dn to 500' (150 m)
     0 07728 15:38:06  41 04.4   -70 37.9
FLX -1 07728 15:38:06  41 04.4   -70 37.9 flux leg south (170/)
     0 08092 15:44:10  40 54.4   -70 33.8
PRO -1 08092 15:44:10  40 54.4   -70 33.8 profile up/dn to 500' (150 m)
     0 08194 15:45:52  40 55.8   -70 31.9
FLX -1 08194 15:45:52  40 55.8   -70 31.9 flux leg northwest (310/)
     0 08518 15:51:16  41 03.3   -70 40.3
PRO -1 08518 15:51:16  41 03.3   -70 40.3 profile up/dn to 500' (150 m)
     0 08625 15:53:03  41 02.0   -70 40.9
FLX -1 08625 15:53:03  41 02.0   -70 40.9 flux leg southeast (130/)
     0 08940 15:58:18  40 56.7   -70 29.7
PRO -1 08940 15:58:18  40 56.7   -70 29.7 profile up/dn to 500' (150 m)
     0 09065 16:00:23  40 58.9   -70 28.3
FLX -1 09065 16:00:23  40 58.9   -70 28.3 flux leg west (270/)
     0 09454 16:06:52  41 00.3   -70 42.7
PRO -1 09454 16:06:52  41 00.3   -70 42.7 profile up/dn to 500' (150 m)
     0 09556 16:08:34  40 58.7   -70 41.9
FLX -1 09556 16:08:34  40 58.7   -70 41.9 flux leg east (085/)
     0 09895 16:14:13  41 01.1   -70 27.1
PRO -1 09895 16:14:13  41 01.1   -70 27.1 profile up/dn to 500' (150 m)
     0 10013 16:16:11  41 02.6   -70 28.0
FLX -1 10013 16:16:11  41 02.6   -70 28.0 flux leg southwest (240/)
     0 10475 16:23:53  40 56.9   -70 41.9
PRO -1 10475 16:23:53  40 56.9   -70 41.9 profile up/dn to 500' (150 m)
     0 10584 16:25:42  40 55.8   -70 39.7
FLX -1 10584 16:25:42  40 55.8   -70 39.7 flux leg northeast (040/)
     0 10866 16:30:24  41 03.6   -70 31.7
PRO -1 10866 16:30:24  41 03.6   -70 31.7 profile up/dn to 500' (150 m)
     0 10986 16:32:24  41 04.7   -70 33.5
FLX -1 10986 16:32:24  41 04.7   -70 33.5 flux leg south (200/)
     0 11400 16:39:18  40 54.3   -70 38.4
PRO -1 11400 16:39:18  40 54.3   -70 38.4 profile up/dn to 500' (150 m)
     0 11526 16:41:24  40 54.9   -70 39.8
FLX -1 11526 16:41:24  40 54.9   -70 39.8 flux leg northeast (040/)
     0 11824 16:46:22  41 02.9   -70 30.8
PRO -1 11824 16:46:22  41 02.9   -70 30.8 profile up/dn to 500' (150 m)
     0 11921 16:47:59  41 01.9   -70 29.4
FLX -1 11921 16:47:59  41 01.9   -70 29.4 flux leg southwest (240/)
     0 12318 16:54:36  40 57.1   -70 42.0
PRO -1 12318 16:54:36  40 57.1   -70 42.0 profile up/dn to 500' (150 m)
     0 12422 16:56:20  40 55.8   -70 40.0
FLX -1 12422 16:56:20  40 55.8   -70 40.0 flux leg northeast (040/)
     0 12713 17:01:11  41 03.7   -70 31.6
PRO -1 12713 17:01:11  41 03.7   -70 31.6 profile up/dn to 500' (150 m)
     0 12818 17:02:56  41 02.6   -70 30.4
FLX -1 12818 17:02:56  41 02.6   -70 30.4 flux leg southwest (235/)
     0 13229 17:09:38  40 56.7   -70 42.3
PRO -1 13229 17:09:38  40 56.7   -70 42.3 profile up/dn to 500' (150 m)
     0 13332 17:11:30  40 56.4   -70 38.9
FLX -1 13332 17:11:30  40 56.4   -70 38.9 flux leg northeast (040/)
     0 13589 17:15:47  41 03.4   -70 31.3

Marker for D:08071320.ORG CLOSED at 235921

Total scans: 14558
Missed Ints: 00004
      BAT A: 0727898 of 0727900 000.000% Dropouts
```

```
       BAT B: 0727898 of 0727900 000.000% Dropouts
         ASH: 0072750 of 0072790 000.055% Dropouts
         TAN: 0145105 of 0145580 000.326% Dropouts


CBLAST-Low Pilot Study - Summer 2001

  Flight: 19
    Date: 08 AUG 01 (Wednesday)
Duration: 4.0 hr
   Pilot: Timothy L. Crawford

Summary: SAR overpass, "spirograph"  and "bow tie" flux legs with short
         profiles over ASIMET and near-shore buoy, profiles.

Weather: Hazy, very hot, and humid, very light northwesterly winds ahead
         of a stalled cold front.

MVY ATIS: 0921 UTC   calm 04V mist clear 20//19/ 29.86
MVY ATIS: 0953 UTC 190/06 03V      clear 20//19/ 29.87
MVY ATIS: 1301 UTC 010/03 07V      clear 28//22/ 29.88

Instrumentation Notes & Comments:

Data not differentially corrected prior to 01275, ground station off

Marker for D:08080955.ORG OPENED at 295384

FLX -1 01640 10:30:23  41 12.8   -70 36.0 SAR flux leg south (180/)
     0 02192 10:39:35  40 56.1   -70 35.6
FLX -1 02249 10:40:32  40 55.1   -70 34.1 SAR flux leg east (090/)
     0 02800 10:49:43  40 55.1   -70 10.6
FLX -1 02855 10:50:38  40 56.2   -70 09.1 SAR flux leg north (000/)
     0 03263 10:57:26  41 08.9   -70 09.2
FLX -1 03313 10:58:16  41 09.7   -70 10.5 SAR flux leg west (270/)
     0 03994 11:09:37  41 10.1   -70 36.2
PRO -1 04005 11:09:48  41 10.1   -70 36.6 profile up to 4000' (1200 m)
     0 04350 11:15:33  40 59.3   -70 36.2
PRO -1 04353 11:15:36  40 59.2   -70 36.2 profile down from 4000' (1200 m)
     0 04544 11:18:47  40 52.9   -70 36.6
FLX -1 04610 11:19:53  40 53.1   -70 35.1 flux leg north (355/)
     0 04986 11:26:09  41 04.6   -70 35.9
PRO -1 04986 11:26:09  41 04.6   -70 35.9 profile up/dn to 500' (150 m)
     0 05100 11:28:03  41 03.9   -70 37.9
FLX -1 05100 11:28:03  41 03.9   -70 37.9 flux leg south (165/)
     0 05418 11:33:21  40 54.7   -70 33.9
PRO -1 05418 11:33:21  40 54.7   -70 33.9 profile up/dn to 500' (150 m)
     0 05524 11:35:07  40 55.3   -70 31.3
FLX -1 05524 11:35:07  40 55.3   -70 31.3 flux leg northwest (315/)
     0 05877 11:41:00  41 03.4   -70 40.3
PRO -1 05877 11:41:00  41 03.4   -70 40.3 profile up/dn to 500' (150 m)
     0 05986 11:42:49  41 01.8   -70 41.2
FLX -1 05986 11:42:49  41 01.8   -70 41.2 flux leg southeast (125/)
     0 06282 11:47:45  40 57.0   -70 29.9
PRO -1 06282 11:47:45  40 57.0   -70 29.9 profile up/dn to 500' (150 m)
     0 06391 11:49:34  40 58.8   -70 28.7
FLX -1 06391 11:49:34  40 58.8   -70 28.7 flux leg west (275/)
     0 06743 11:55:26  41 00.3   -70 42.5
PRO -1 06743 11:55:26  41 00.3   -70 42.5 profile up/dn to 500' (150 m)
     0 06846 11:57:09  40 58.5   -70 41.9
FLX -1 06846 11:57:09  40 58.5   -70 41.9 flux leg east (080/)
     0 07143 12:02:06  41 00.4   -70 29.2
PRO -1 07143 12:02:06  41 00.4   -70 29.2 profile up/dn to 500' (150 m)
     0 07246 12:03:49  41 01.8   -70 30.1
FLX -1 07246 12:03:49  41 01.8   -70 30.1 flux leg southwest (240/)
```

```
     0 07584 12:09:27  40 56.9   -70 41.7
PRO -1 07584 12:09:27  40 56.9   -70 41.7 profile up/dn to 500' (150 m)
     0 07682 12:11:05  40 55.7   -70 40.2
FLX -1 07682 12:11:05  40 55.7   -70 40.2 flux leg northeast (040/)
     0 07988 12:16:11  41 03.5   -70 31.5
PRO -1 07988 12:16:11  41 03.5   -70 31.5 profile up/dn to 500' (150 m)
     0 08107 12:18:10  41 04.1   -70 33.4
FLX -1 08107 12:18:10  41 04.1   -70 33.4 flux leg southwest (205/)
     0 08433 12:23:36  40 54.7   -70 38.2
PRO -1 08437 12:23:40  40 54.6   -70 38.2 profile up to 4000' (1200 m)
     0 08783 12:29:26  41 02.1   -70 38.7
PRO -1 08785 12:29:28  41 02.2   -70 38.7 profile down from 4000' (1200 m)
     0 09030 12:33:33  41 10.0   -70 36.8
FLX -1 09044 12:33:47  41 10.4   -70 36.7 flux leg north (000/)
     0 09347 12:38:50  41 20.1   -70 35.6
PRO -1 09347 12:38:50  41 20.1   -70 35.6 profile up/dn to 500' (150 m)
     0 09435 12:40:18  41 19.4   -70 37.1
FLX -1 09435 12:40:18  41 19.4   -70 37.1 flux leg south (170/)
     0 09723 12:45:06  41 10.5   -70 33.4
PRO -1 09723 12:45:06  41 10.5   -70 33.4 profile up/dn to 500' (150 m)
     0 09840 12:47:03  41 11.3   -70 31.2
FLX -1 09840 12:47:03  41 11.3   -70 31.2 flux leg northwest (320/)
     0 10171 12:52:34  41 19.2   -70 39.8
PRO -1 10171 12:52:34  41 19.2   -70 39.8 profile up/dn to 500' (150 m)
     0 10284 12:54:27  41 17.5   -70 41.0
FLX -1 10284 12:54:27  41 17.5   -70 41.0 flux leg southeast (120/)
     0 10572 12:59:15  41 12.8   -70 29.6
PRO -1 10572 12:59:15  41 12.8   -70 29.6 profile up/dn to 500' (150 m)
     0 10687 13:01:10  41 14.5   -70 28.7
FLX -1 10687 13:01:10  41 14.5   -70 28.7 flux leg west (280/)
     0 11032 13:06:55  41 16.2   -70 42.3
PRO -1 11032 13:06:55  41 16.2   -70 42.3 profile up/dn to 500' (150 m)
     0 11146 13:08:49  41 14.2   -70 41.8
FLX -1 11146 13:08:49  41 14.2   -70 41.8 flux leg east (080/)
     0 11439 13:13:42  41 16.1   -70 28.9
PRO -1 11439 13:13:42  41 16.1   -70 28.9 profile up/dn to 500' (150 m)
     0 11549 13:15:32  41 17.7   -70 29.7
FLX -1 11549 13:15:32  41 17.7   -70 29.7 flux leg southwest (240/)
     0 11898 13:21:21  41 12.6   -70 41.7
PRO -1 11898 13:21:21  41 12.6   -70 41.7 profile up/dn to 500' (150 m)
     0 12008 13:23:11  41 11.0   -70 39.9
FLX -1 12008 13:23:11  41 11.0   -70 39.9 flux leg northeast (035/)
     0 12329 13:28:32  41 19.3   -70 31.3
PRO -1 12329 13:28:32  41 19.3   -70 31.3 profile up/dn to 500' (150 m)
     0 12437 13:30:20  41 19.9   -70 33.7
FLX -1 12437 13:30:20  41 19.9   -70 33.7 flux leg south (205/)
     0 12768 13:35:51  41 10.6   -70 38.1
WAG -1 12778 13:36:01  41 10.3   -70 38.3 roll wag cal for radar
     0 12848 13:37:11  41 08.3   -70 38.9
PTC -1 12864 13:37:27  41 07.9   -70 39.0 pitch up/dn cal for radar
     0 12949 13:38:52  41 05.6   -70 40.1
PRO -1 12968 13:39:11  41 05.0   -70 40.4 profile up to 3300' (1000 m)
     0 13173 13:42:36  41 05.9   -70 43.9
WCR -1 13238 13:43:41  41 06.9   -70 43.1 wind circle right
     0 13418 13:46:41  41 06.9   -70 41.8
WCL -1 13425 13:46:48  41 07.1   -70 41.0 wind circle left
     0 13560 13:49:03  41 07.2   -70 40.2
STC -1 14286 14:01:09  41 23.3   -70 36.8 preparing to shut down all systems
     0 14323 14:01:46  41 23.3   -70 36.8

Marker for D:08080955.ORG CLOSED at 309711

Total scans: 14327
Missed Ints: 00000
      BAT A: 0716350 of 0716350 000.000% Dropouts
```

```
      BAT B: 0716350 of 0716350 000.000% Dropouts
        ASH: 0071635 of 0071635 000.000% Dropouts
        TAN: 0141766 of 0143270 001.050% Dropouts
```

CBLAST-Low Pilot Study - Summer 2001

```
  Flight: 20
    Date: 08 AUG 01 (Wednesday)
Duration: 1.5 hr
   Pilot: Timothy L. Crawford
```

Summary: Flux leg intercomparisons with R/V Asterias.

Weather: Hazy, very hot, and humid, very light northwesterly winds ahead of a stalled cold front.

```
MVY ATIS: 1452 UTC 340/05 07V clear 30//23/ 29.88
MVY ATIS: 1652 UTC 290/06 09V clear 31//23/ 29.87
```

Instrumentation Notes & Comments: None

Marker for D:08081526.ORG OPENED at 315441

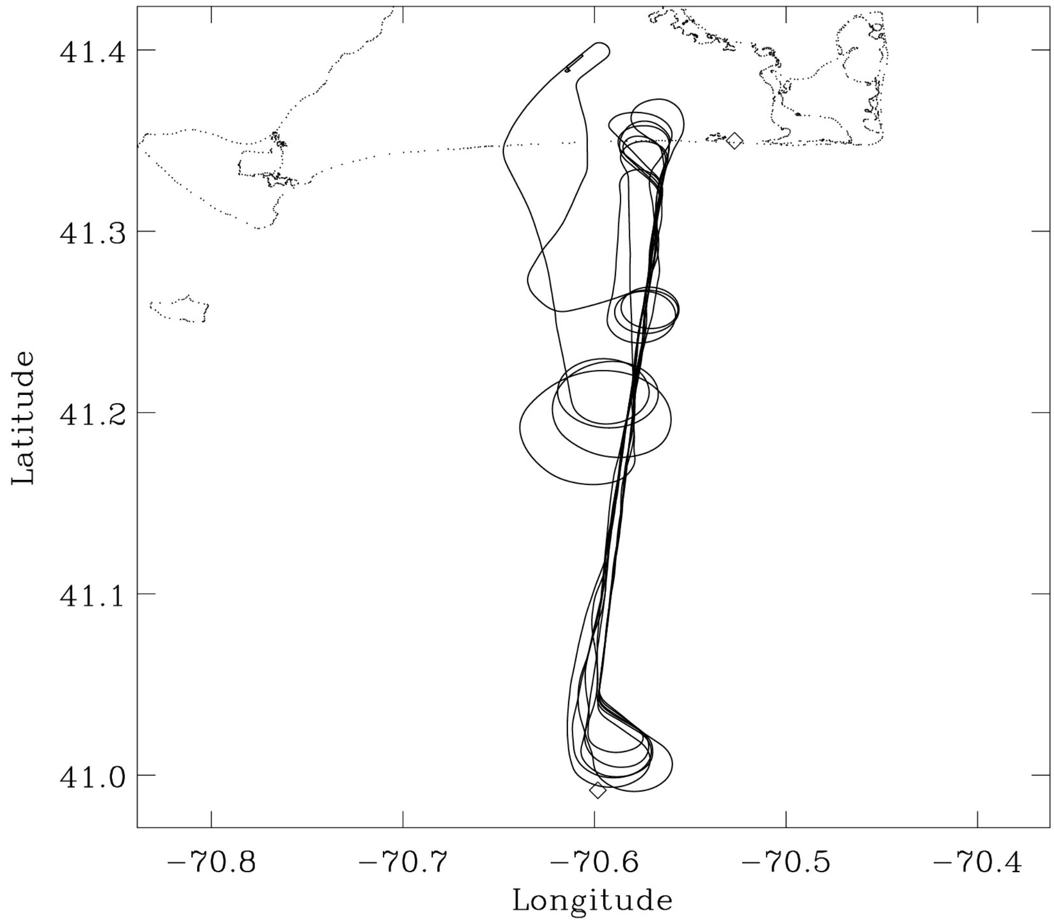
```
STC -1 00002 15:37:22  41 23.3   -70 36.8 all systems on
     0 00034 15:37:54  41 23.3   -70 36.8
FLX -1 00468 15:45:08  41 19.2   -70 33.7 flux leg south (200/)
     0 00615 15:47:35  41 15.0   -70 35.2
PRO -1 00615 15:47:35  41 15.0   -70 35.2 profile up/dn to 500' (150 m)
     0 00795 15:50:35  41 12.9   -70 36.2
FLX -1 00795 15:50:35  41 12.9   -70 36.2 flux leg north (010/)
     0 00993 15:53:53  41 18.9   -70 34.1
FLX -1 01094 15:55:34  41 19.9   -70 33.6 flux leg south (200/)
     0 01265 15:58:25  41 14.9   -70 35.7
PRO -1 01265 15:58:25  41 14.9   -70 35.7 profile up/dn to 500' (150 m)
     0 01430 16:01:10  41 13.1   -70 36.4
FLX -1 01430 16:01:10  41 13.1   -70 36.4 flux leg north (010/)
     0 01627 16:04:27  41 18.8   -70 34.1
FLX -1 01734 16:06:14  41 20.1   -70 33.2 flux leg south (200/)
     0 01926 16:09:26  41 14.6   -70 35.3
PRO -1 01926 16:09:26  41 14.6   -70 35.3 profile up/dn to 500' (150 m)
     0 02075 16:11:55  41 12.7   -70 36.5
FLX -1 02075 16:11:55  41 12.7   -70 36.5 flux leg north (010/)
     0 02286 16:15:26  41 18.9   -70 34.1
FLX -1 02389 16:17:09  41 19.8   -70 33.3 flux leg south (200/)
     0 02579 16:20:19  41 14.7   -70 35.8
PRO -1 02579 16:20:19  41 14.7   -70 35.8 profile up/dn to 500' (150 m)
     0 02749 16:23:09  41 12.6   -70 36.5
FLX -1 02749 16:23:09  41 12.6   -70 36.5 flux leg north (010/)
     0 02965 16:26:45  41 18.9   -70 34.1
FLX -1 03077 16:28:37  41 19.9   -70 33.2 flux leg southwest (220/)
     0 03282 16:32:02  41 14.8   -70 36.5
PRO -1 03282 16:32:02  41 14.8   -70 36.5 profile up/dn to 500' (150 m)
     0 03431 16:34:31  41 13.7   -70 36.8
FLX -1 03431 16:34:31  41 13.7   -70 36.8 flux leg north (020/)
     0 03630 16:37:50  41 19.1   -70 33.0
FLX -1 03746 16:39:46  41 19.9   -70 32.2 flux leg southwest (210/)
     0 03971 16:43:31  41 14.4   -70 36.1
PRO -1 03971 16:43:31  41 14.4   -70 36.1 profile up/dn to 500' (150 m)
     0 04124 16:46:04  41 12.5   -70 36.1
FLX -1 04124 16:46:04  41 12.5   -70 36.1 flux leg north (010/)
     0 04346 16:49:46  41 19.1   -70 33.5
FLX -1 04426 16:51:06  41 19.7   -70 33.4 flux leg southwest (210/)
     0 04636 16:54:36  41 14.3   -70 36.2
PRO -1 04639 16:54:39  41 14.2   -70 36.2 profile up to 3000' (1000 m)
```

```
     0 04970 17:00:10  41 14.7   -70 40.5

Marker for D:08081526.ORG CLOSED at 320799

Total scans:   05358
Missed Ints:   00000
      BAT A: 0267900 of 0267900 000.000% Dropouts
      BAT B: 0267900 of 0267900 000.000% Dropouts
        ASH: 0026790 of 0026790 000.000% Dropouts
        TAN: 0053153 of 0053580 000.797% Dropouts
```

Appendix B: N3R Flight Tracks



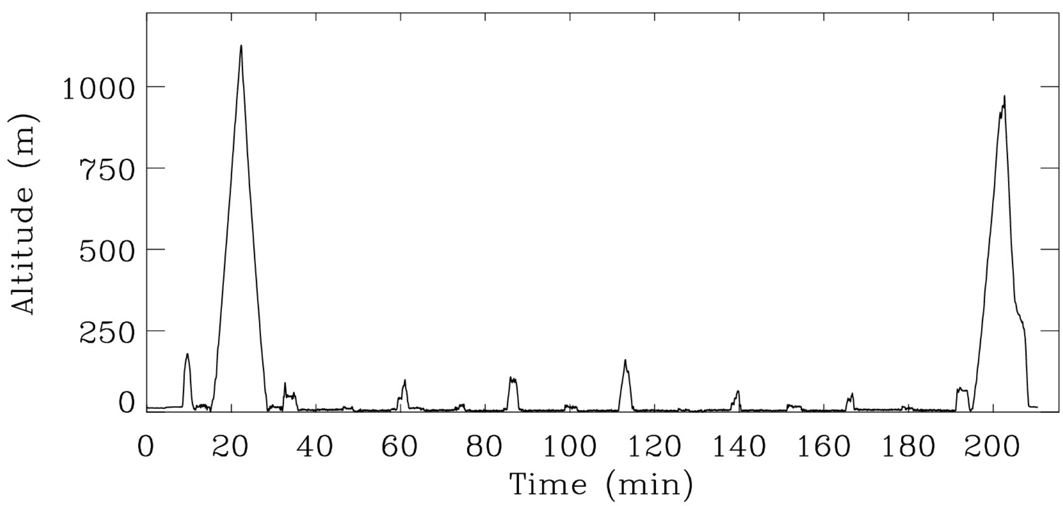


Fig. 19. N3R track for Flight 1 (21 JUL 01).

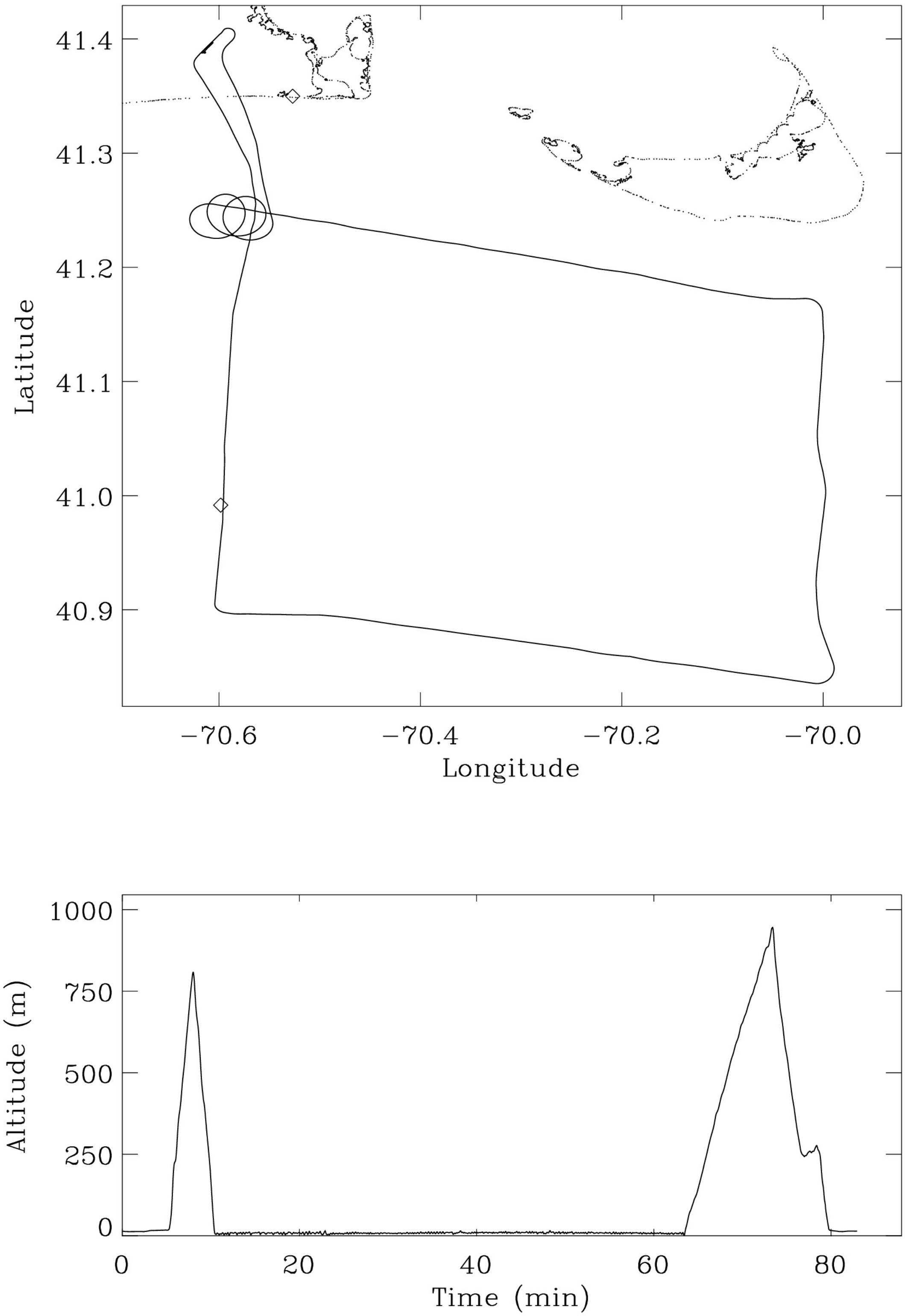
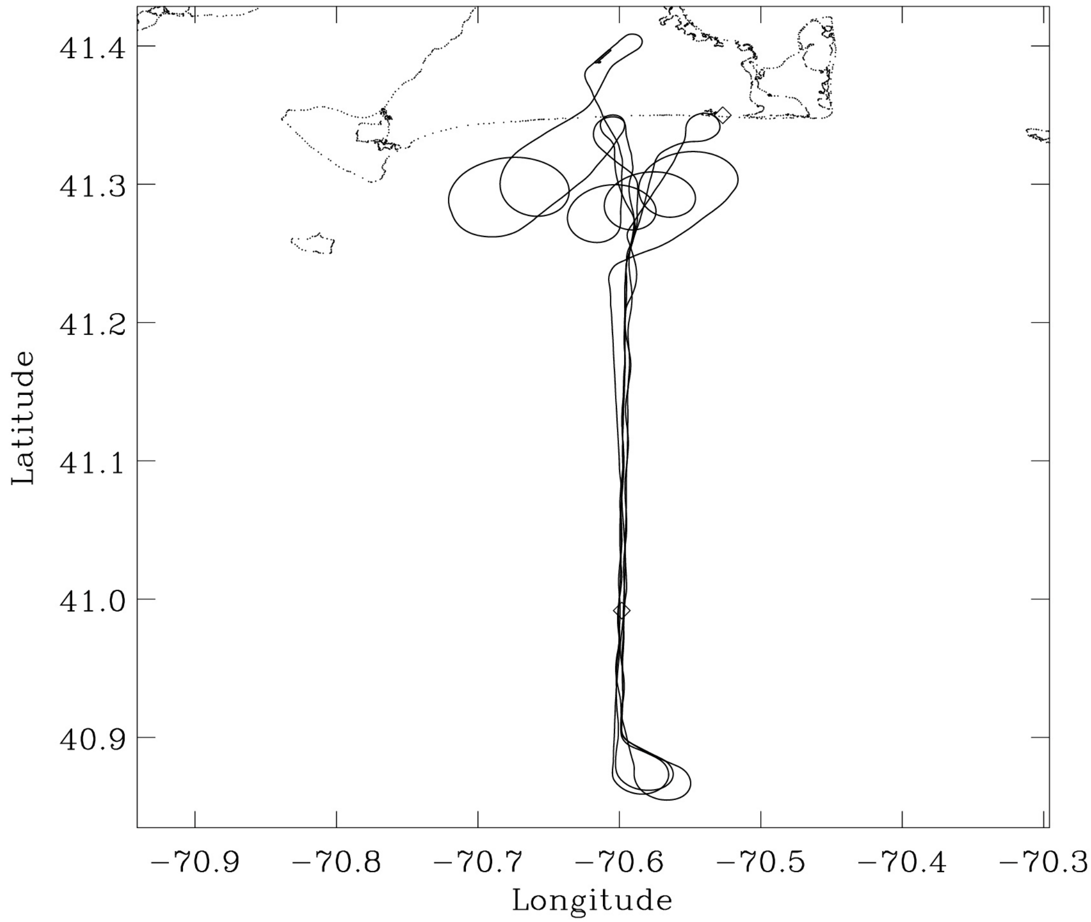


Fig. 20. N3R track for Flight 2 (22 JUL 01).



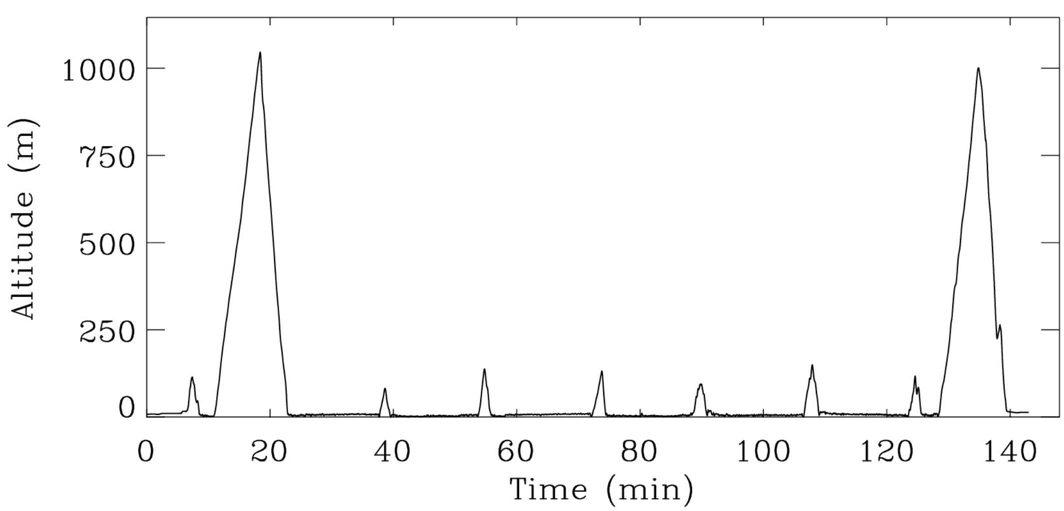
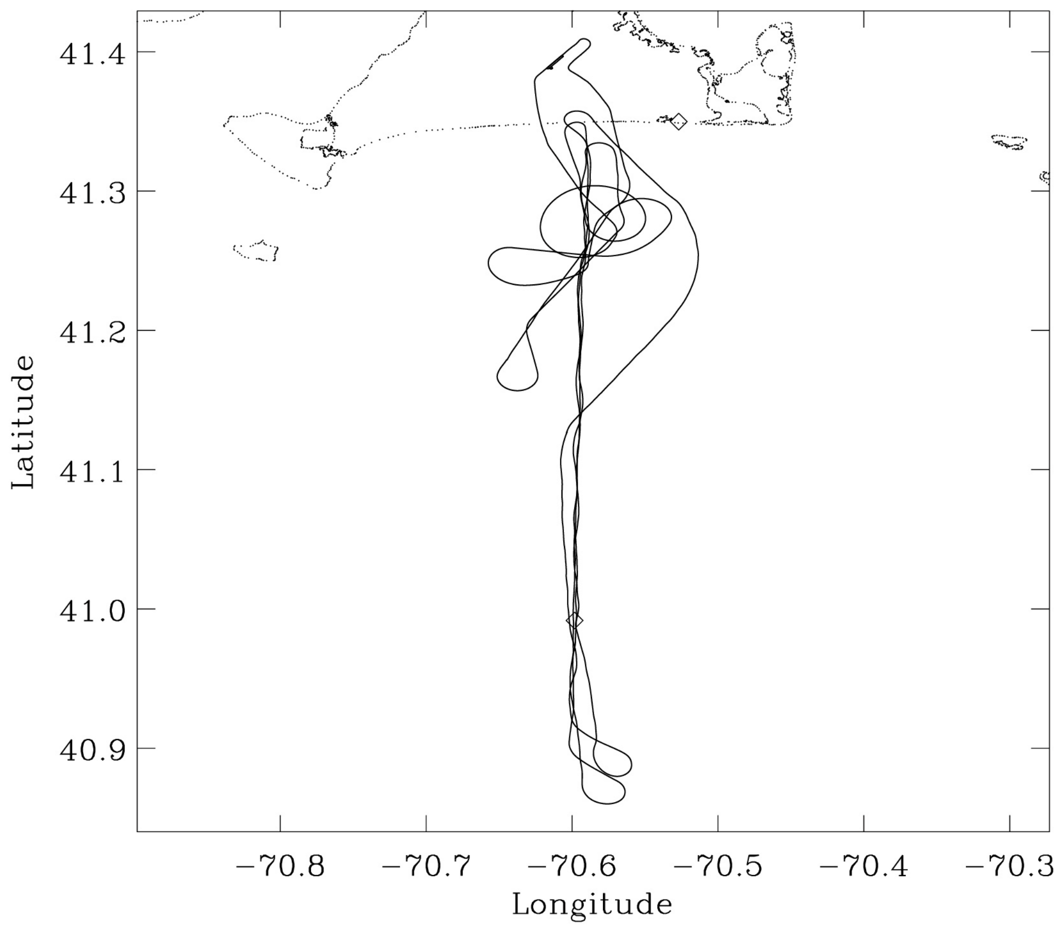


Fig. 21. N3R track for Flight 3 (23 JUL 01).



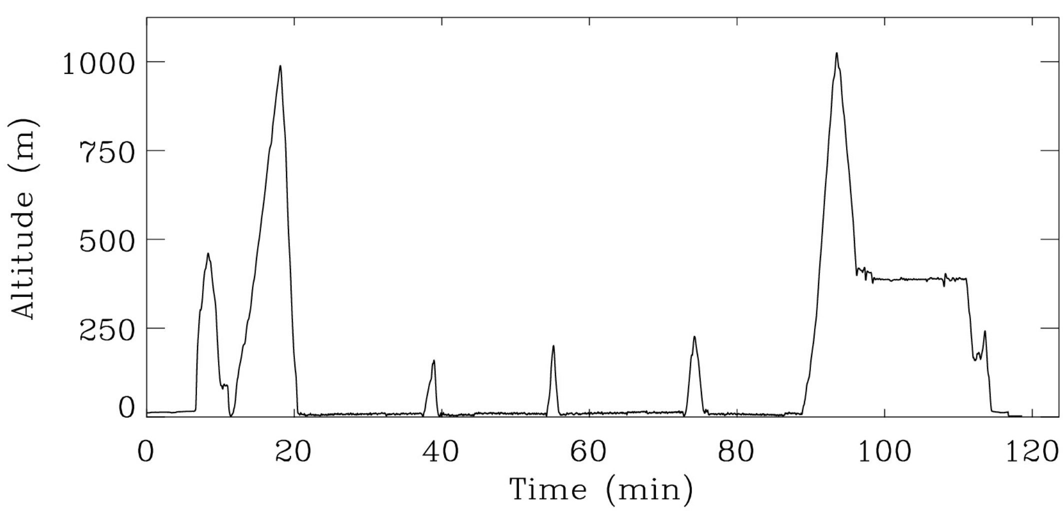


Fig. 22. N3R track for Flight 4 (25 JUL 01).

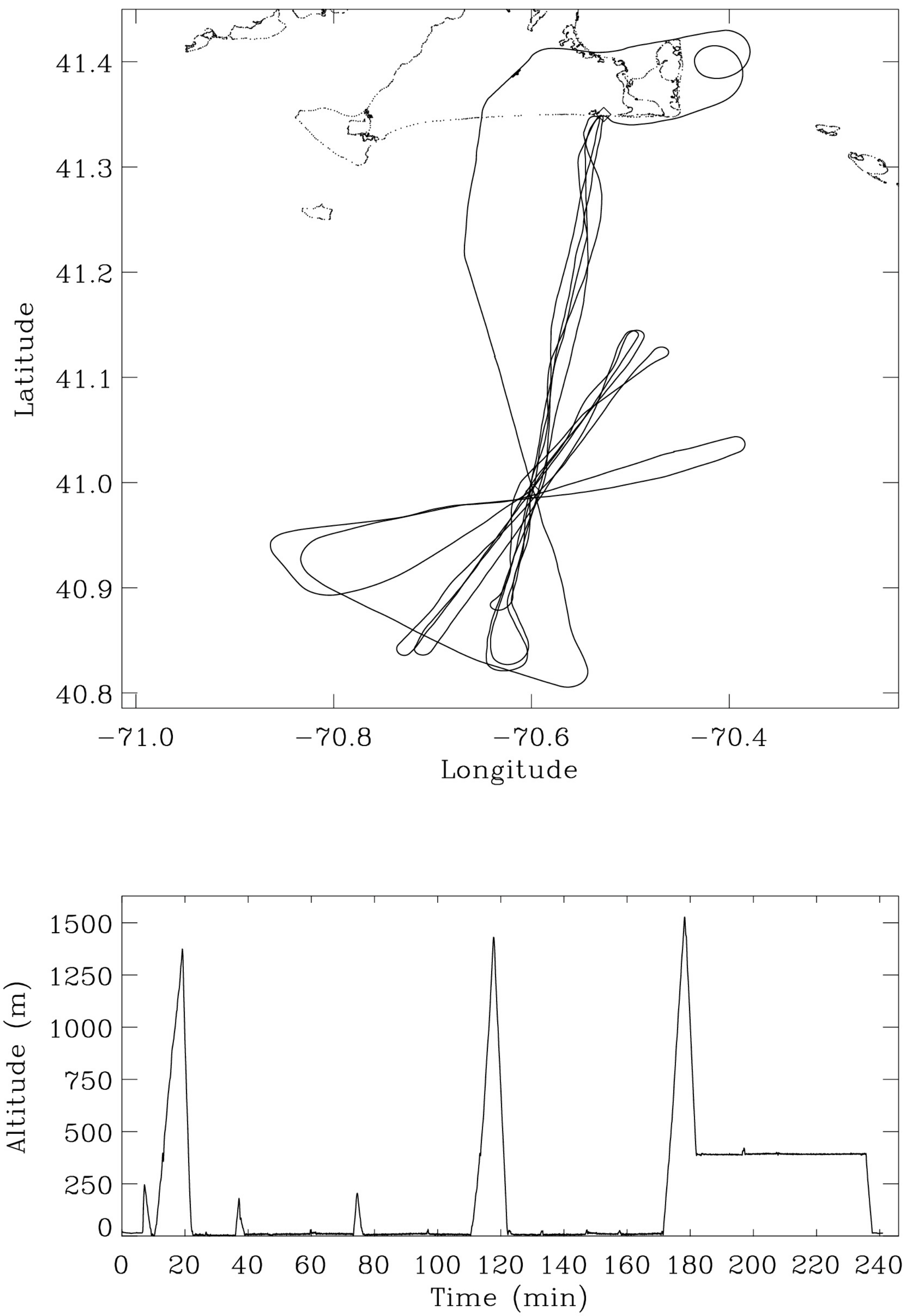
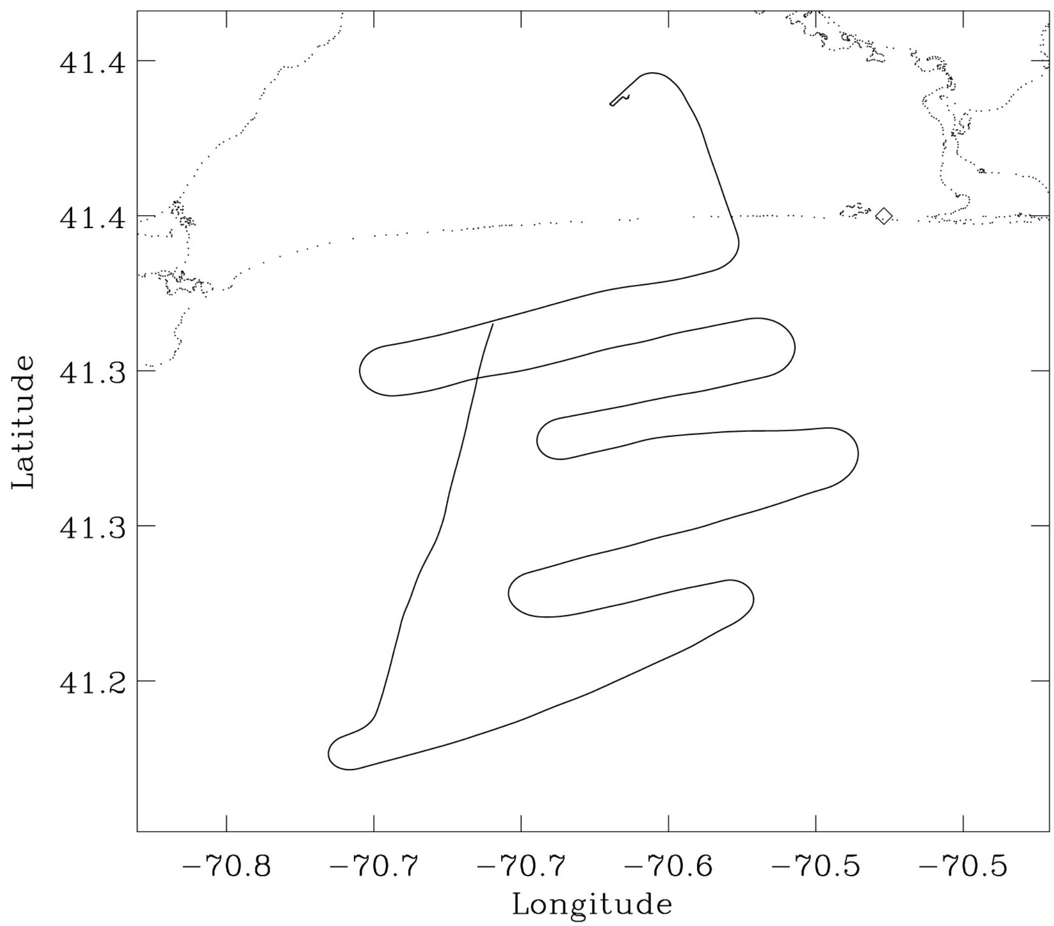


Fig. 23. N3R track for Flight 5 (27 JUL 01).



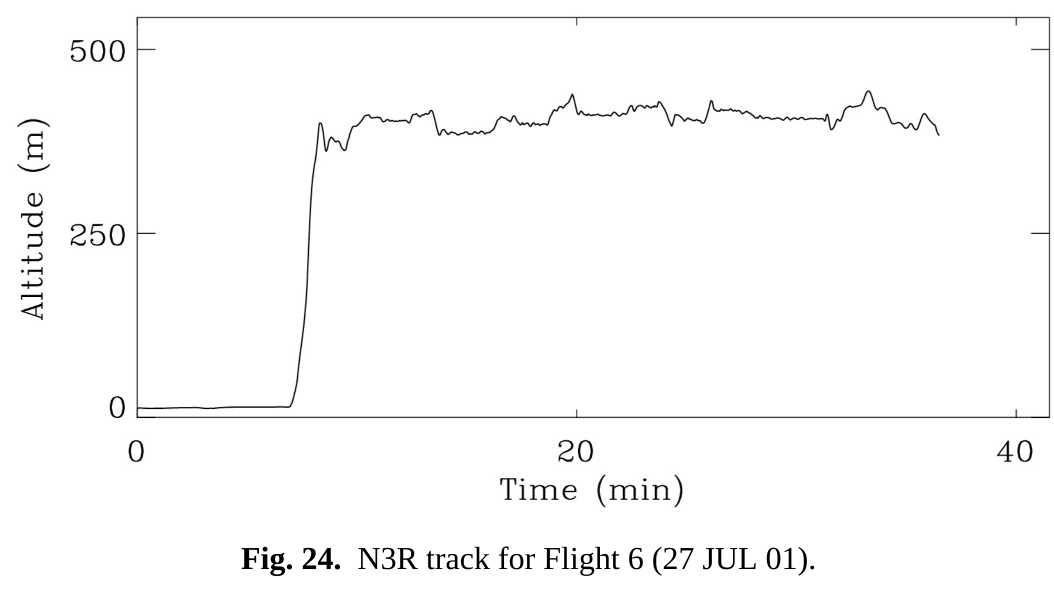


Fig. 24. N3R track for Flight 6 (27 JUL 01).

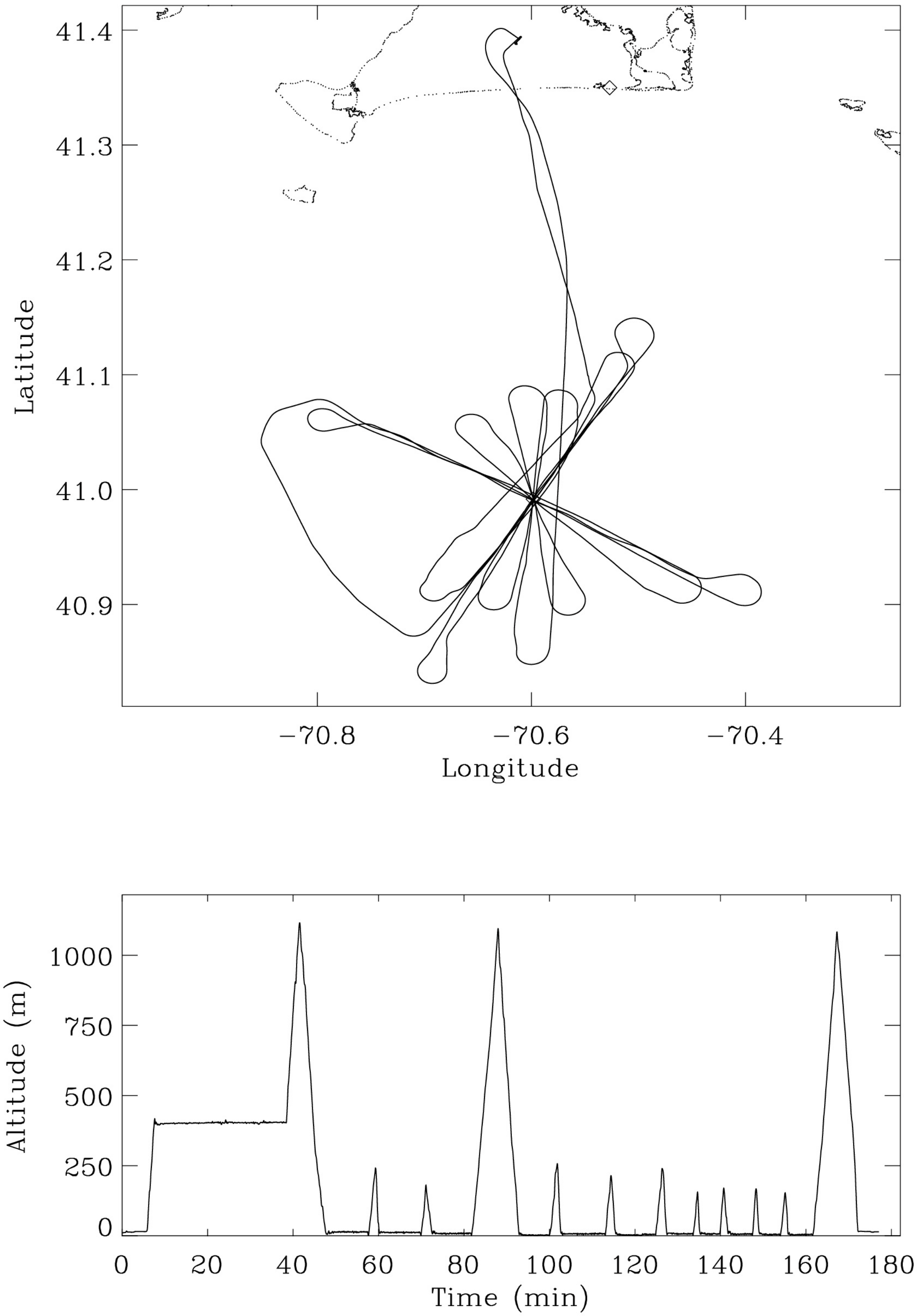
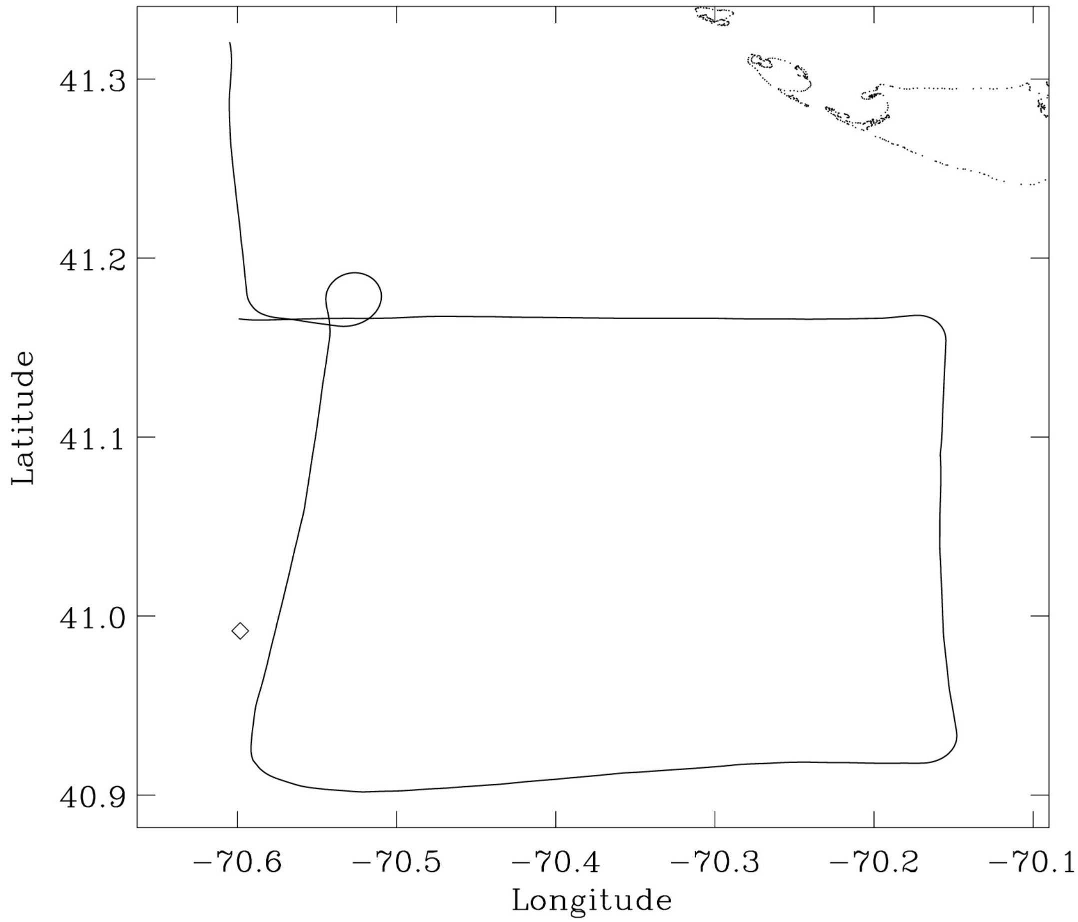


Fig. 25. N3R track for Flight 7 (28 JUL 01).



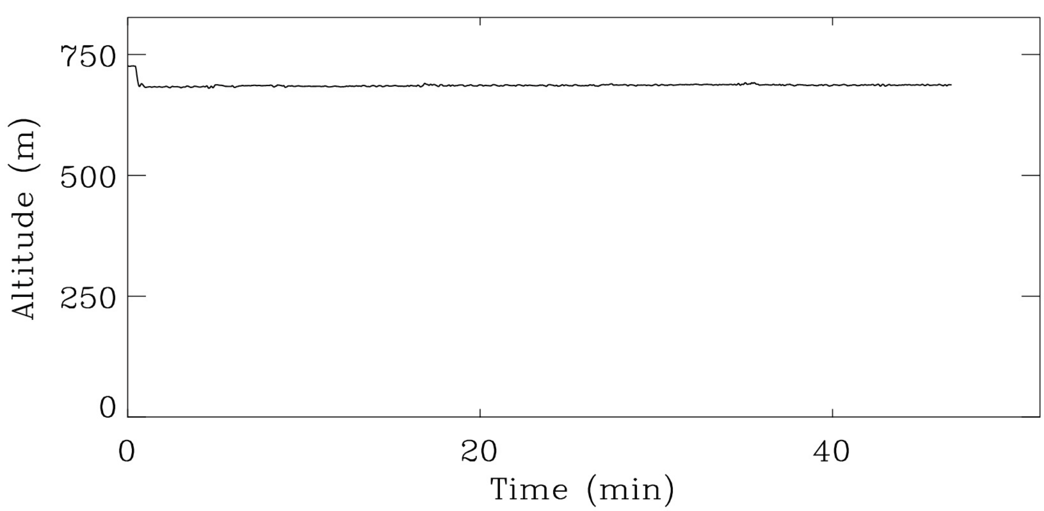
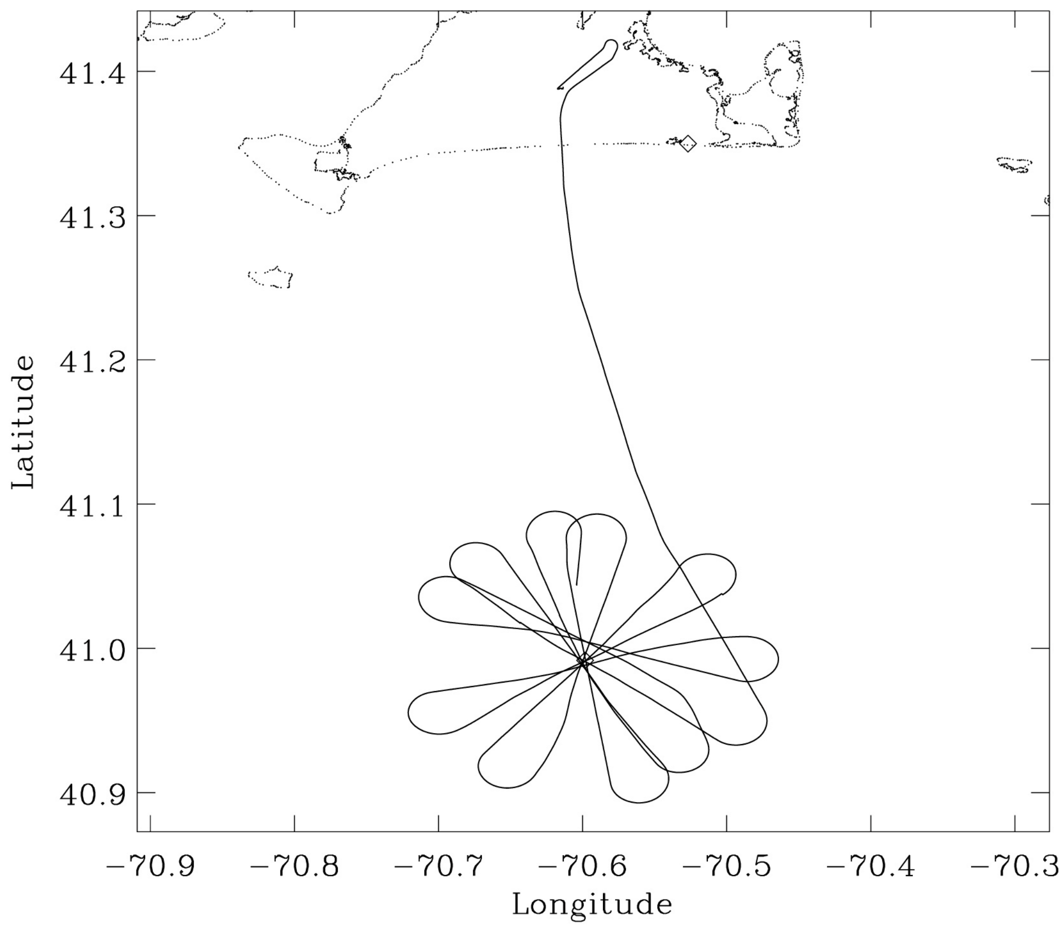


Fig. 26. N3R track for Flight 8 (29 JUL 01).



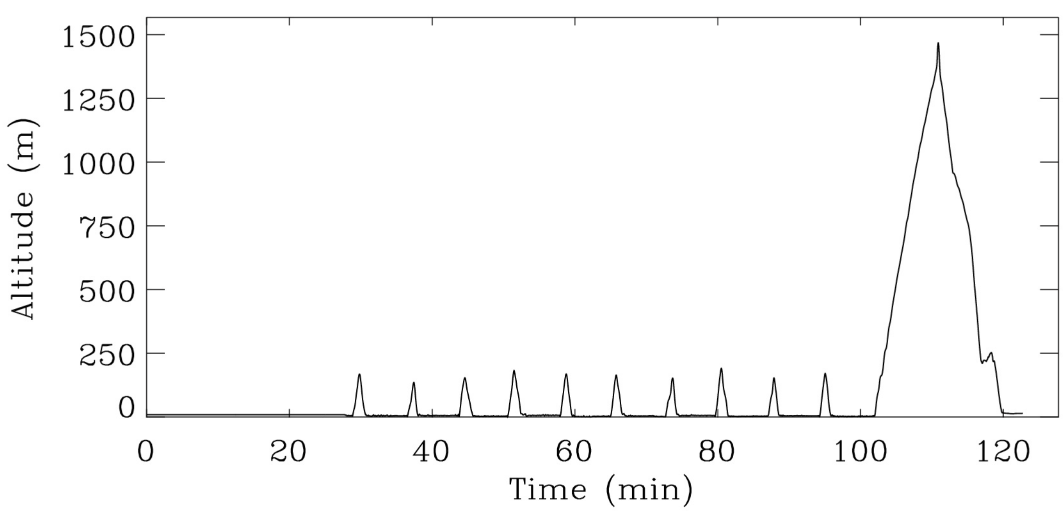
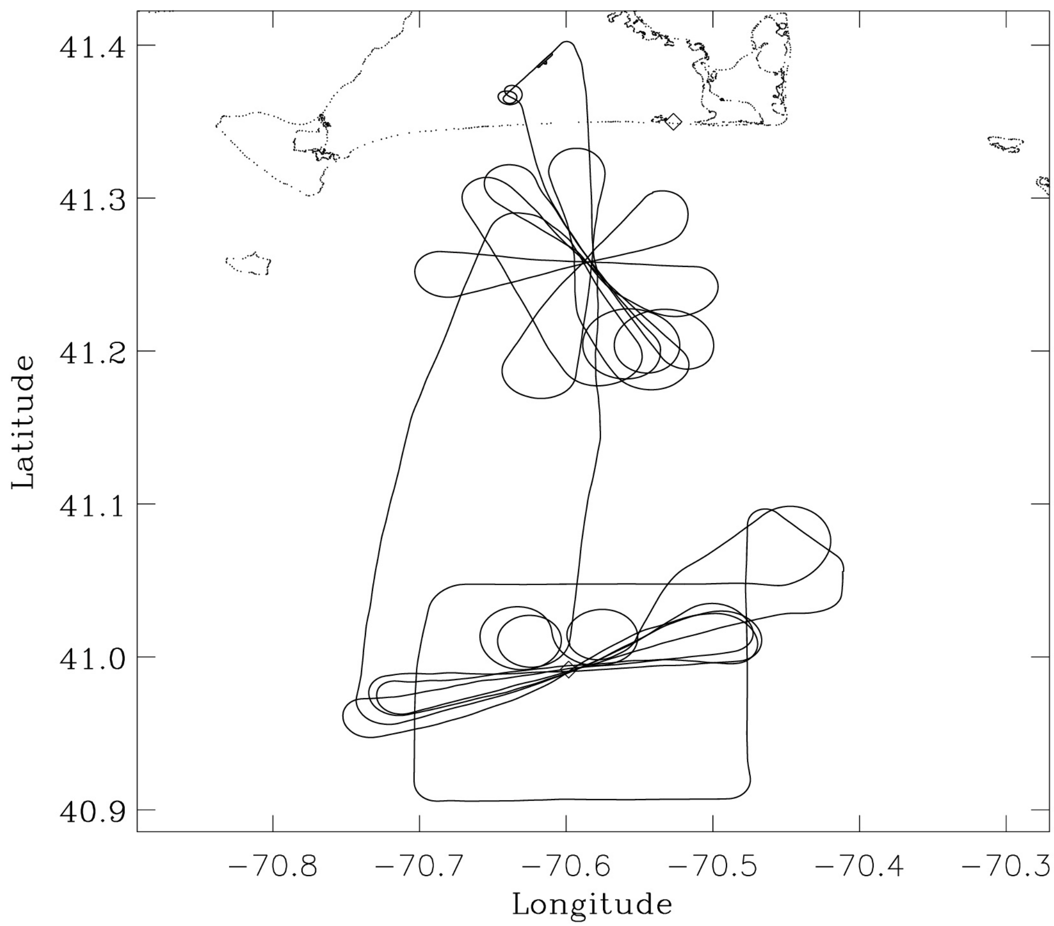


Fig. 27. N3R track for Flight 9 (29 JUL 01).



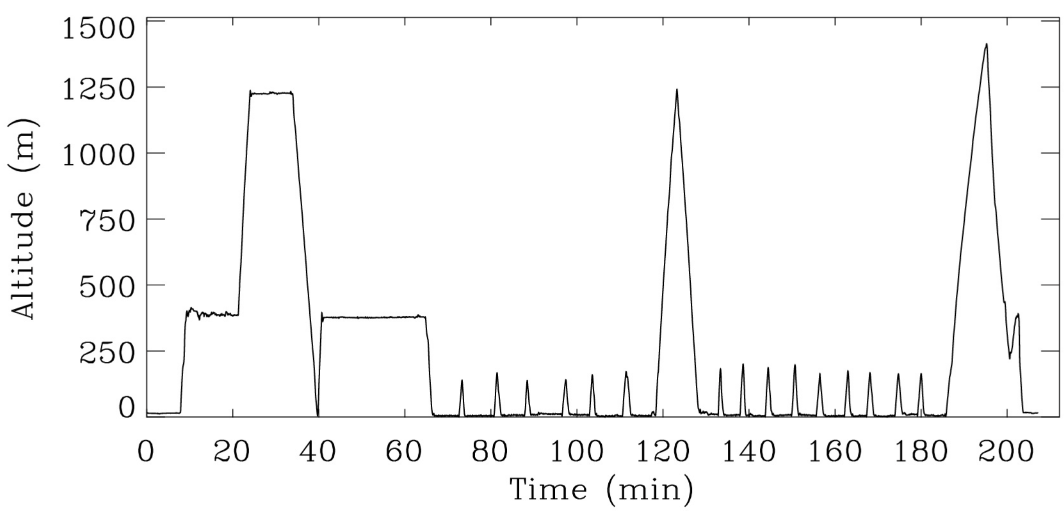
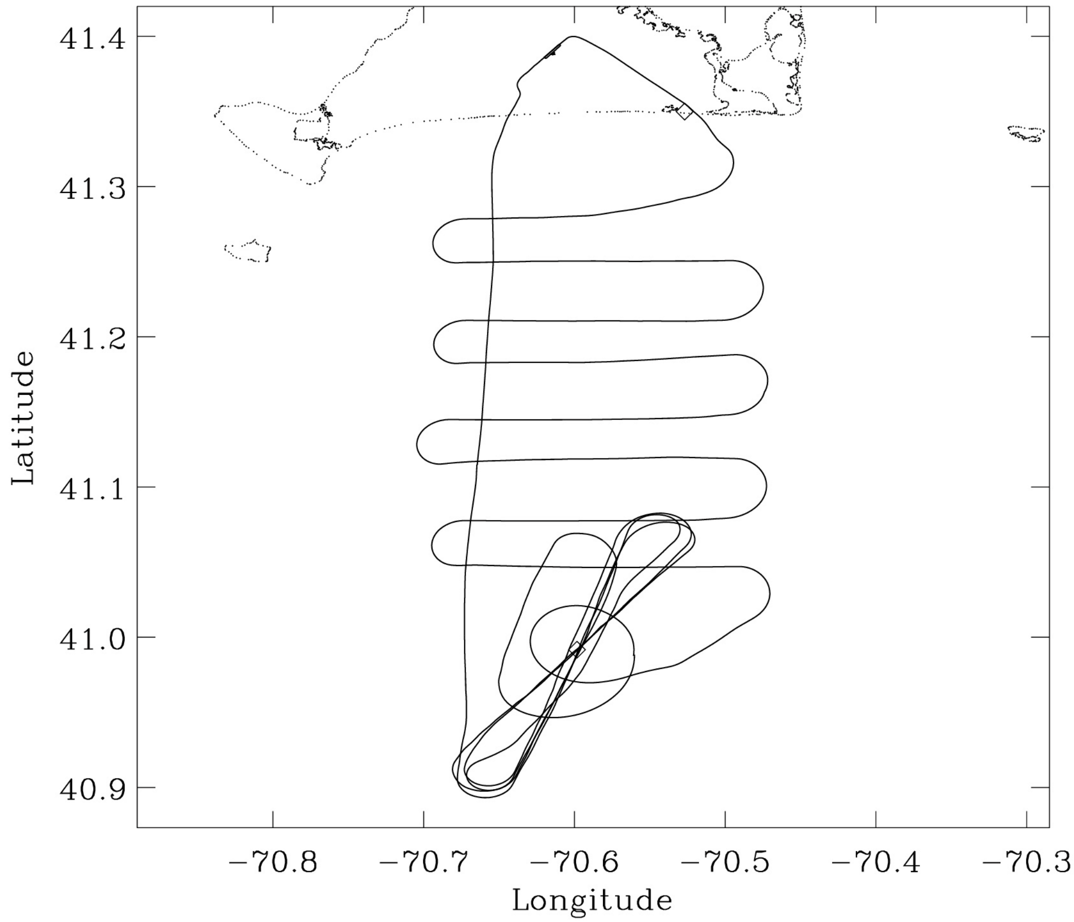


Fig. 28. N3R track for Flight 10 (30 JUL 01).



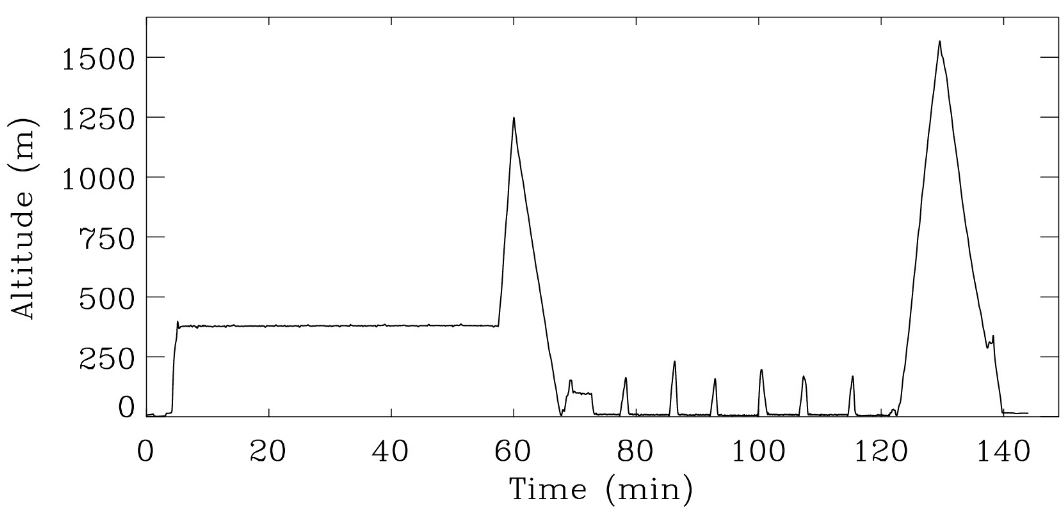


Fig. 29. N3R track for Flight 11 (31 JUL 01).

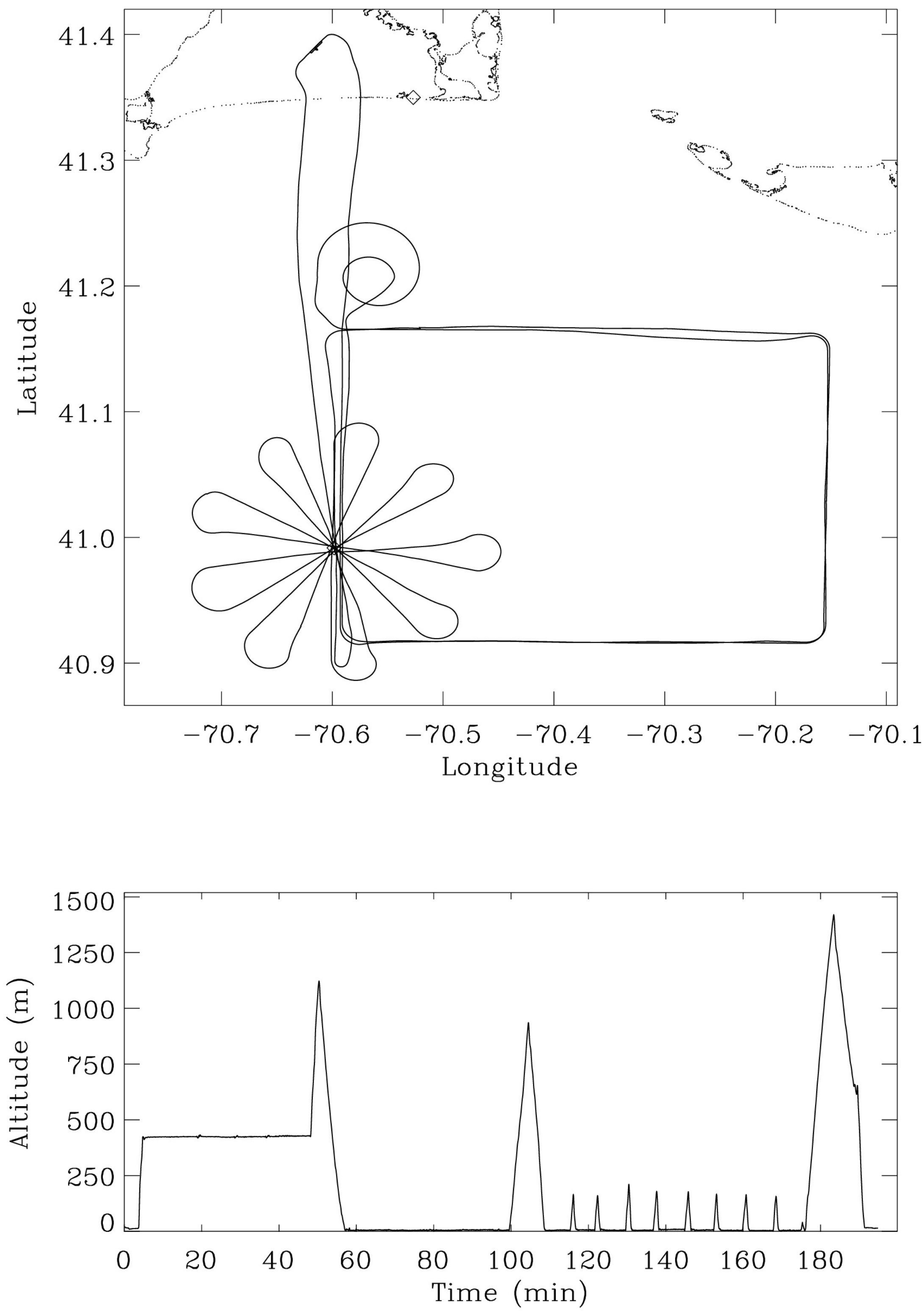


Fig. 30. N3R track for Flight 12 (01 AUG 01).

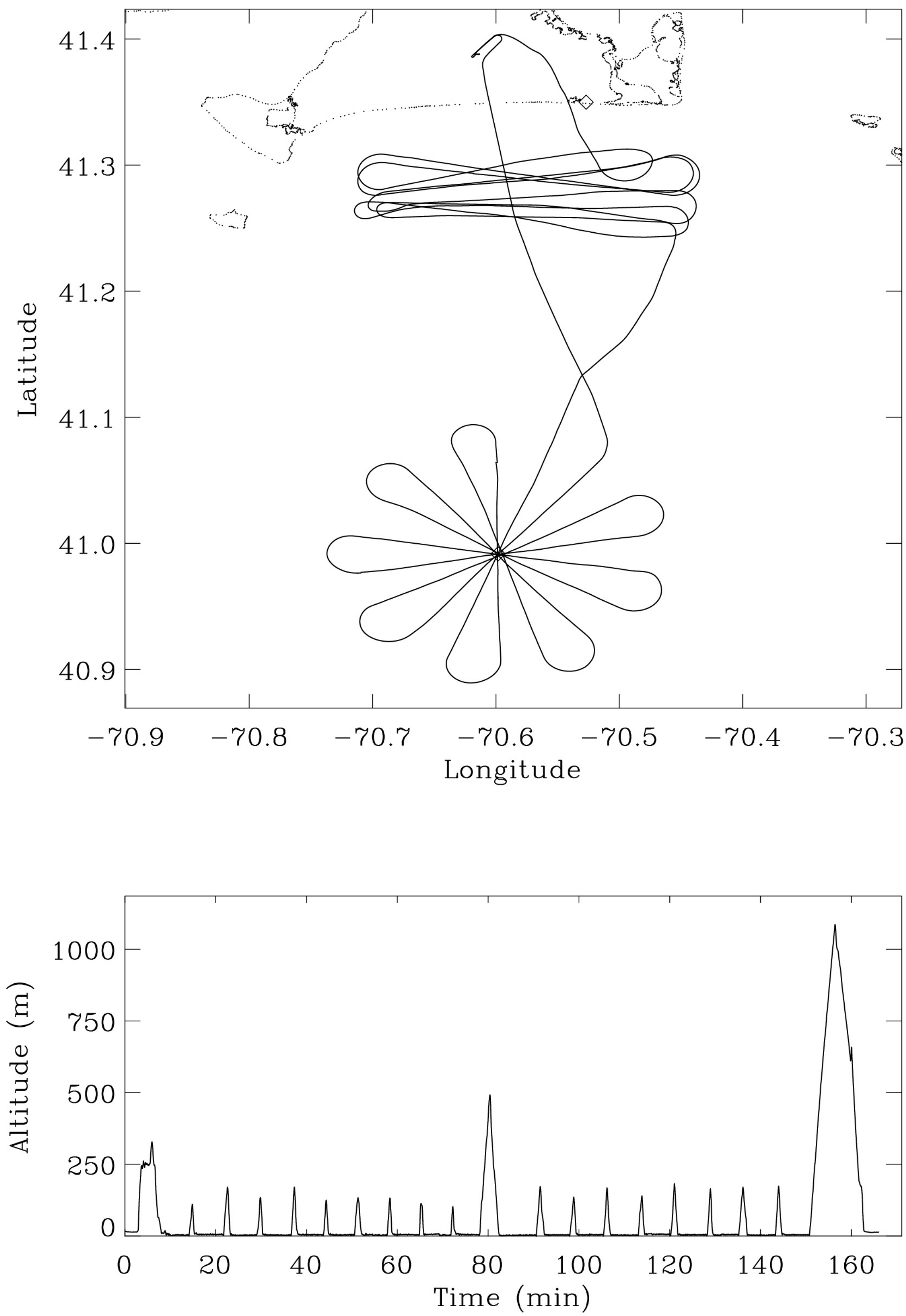
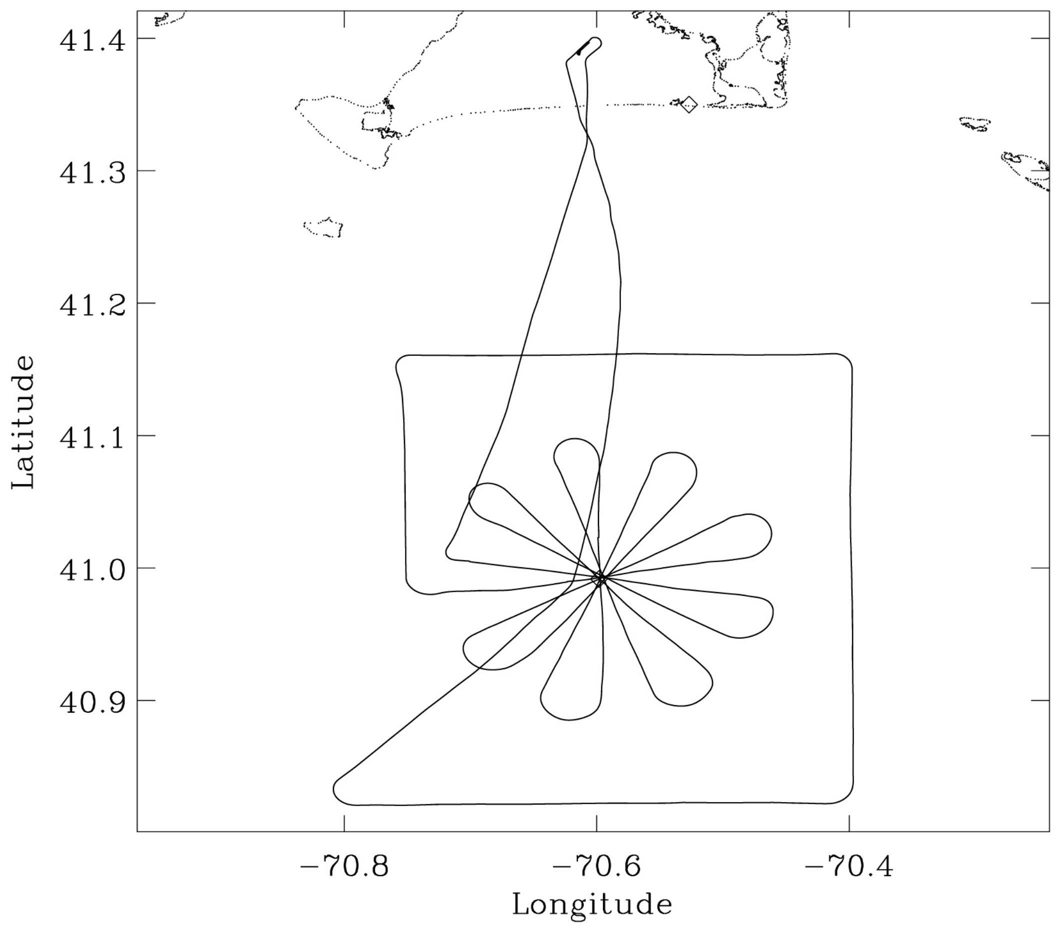


Fig. 31. N3R track for Flight 13 (01 AUG 01).



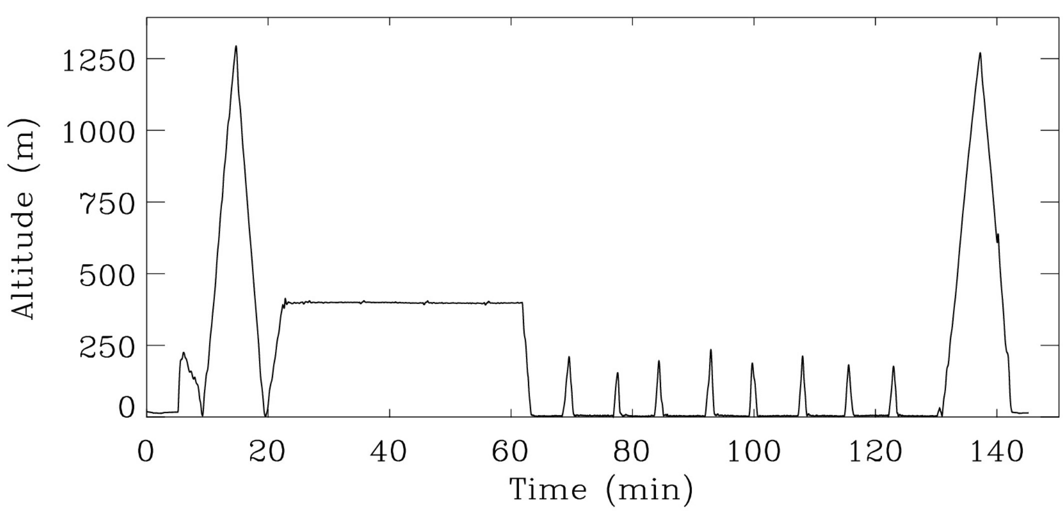
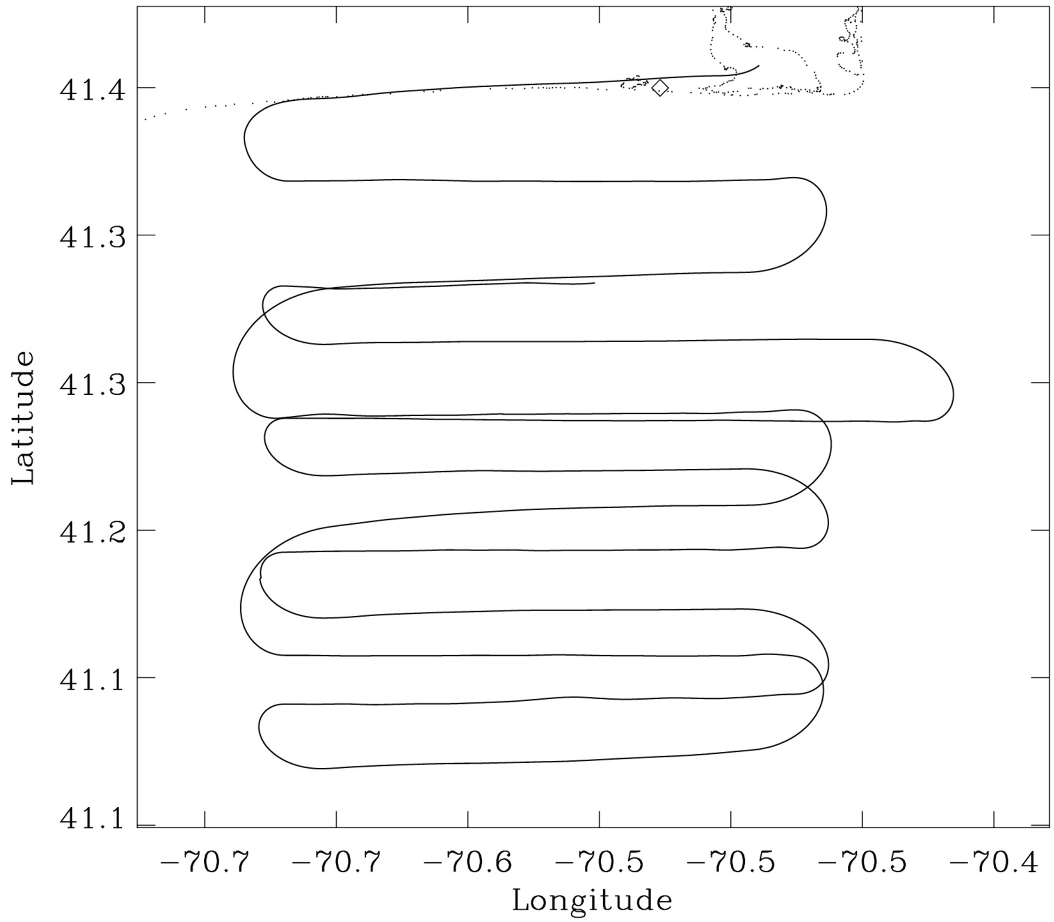


Fig. 32. N3R track for Flight 14 (02 AUG 01).



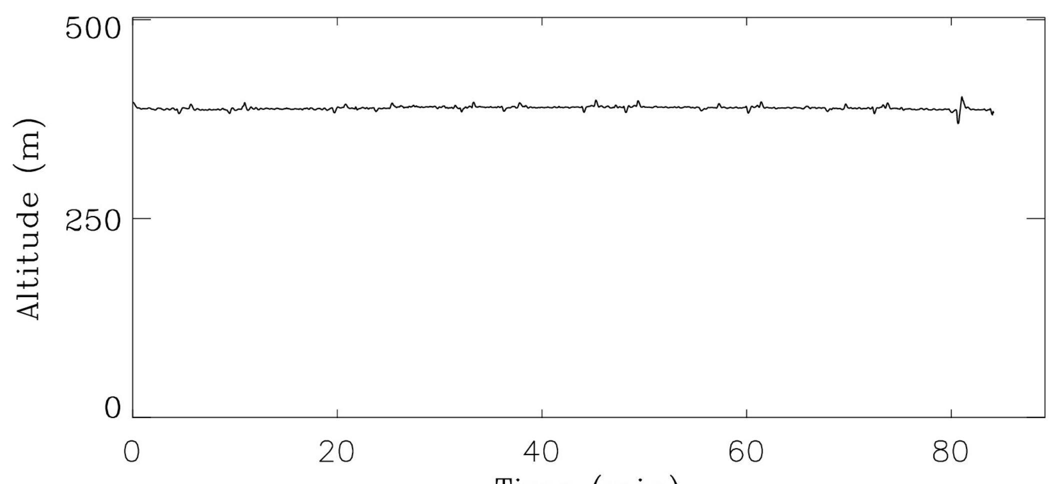


Fig. 33. N3R track for Flight 15 (03 AUG 01).

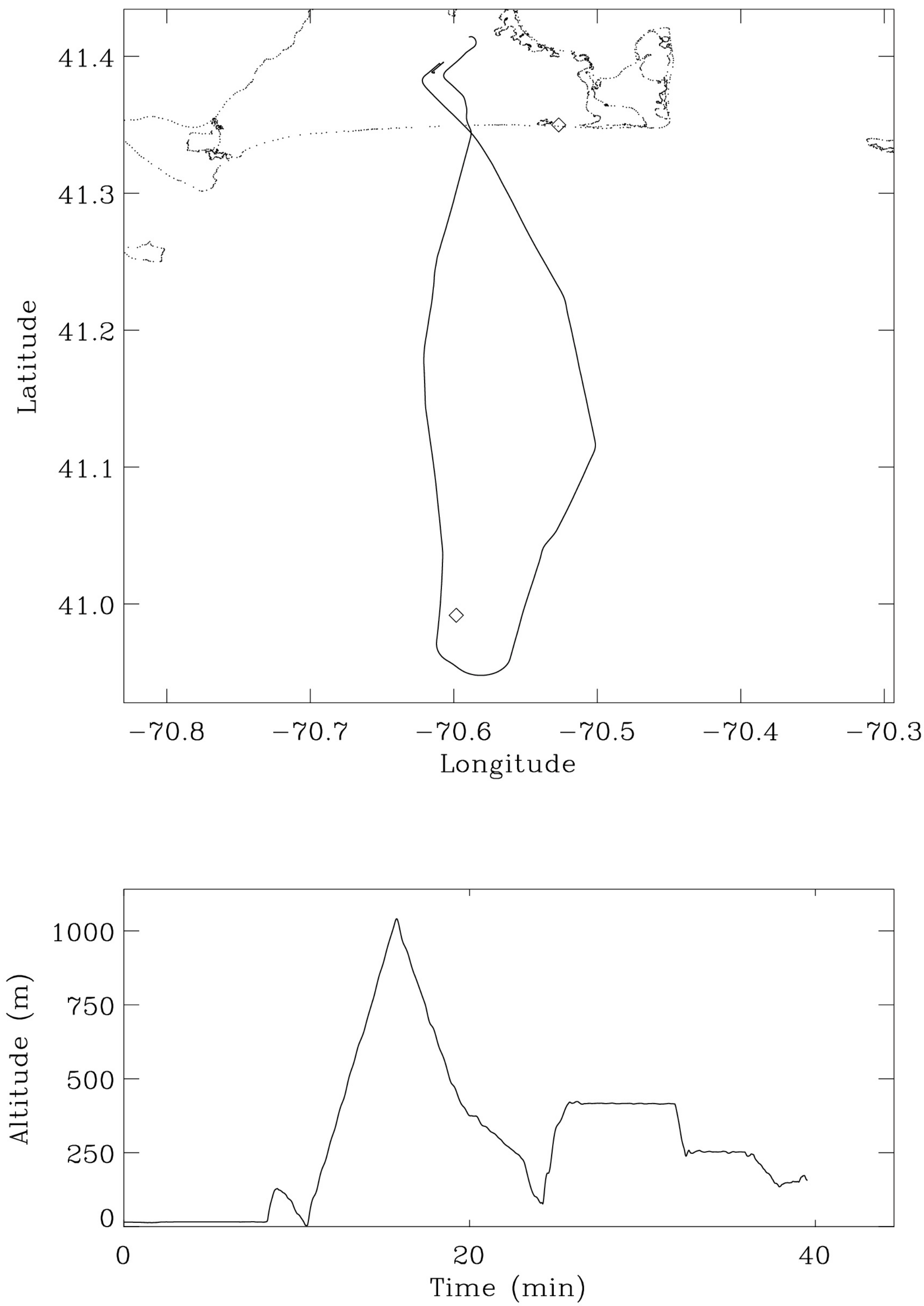


Fig. 34. N3R track for Flight 16 (05 AUG 01).

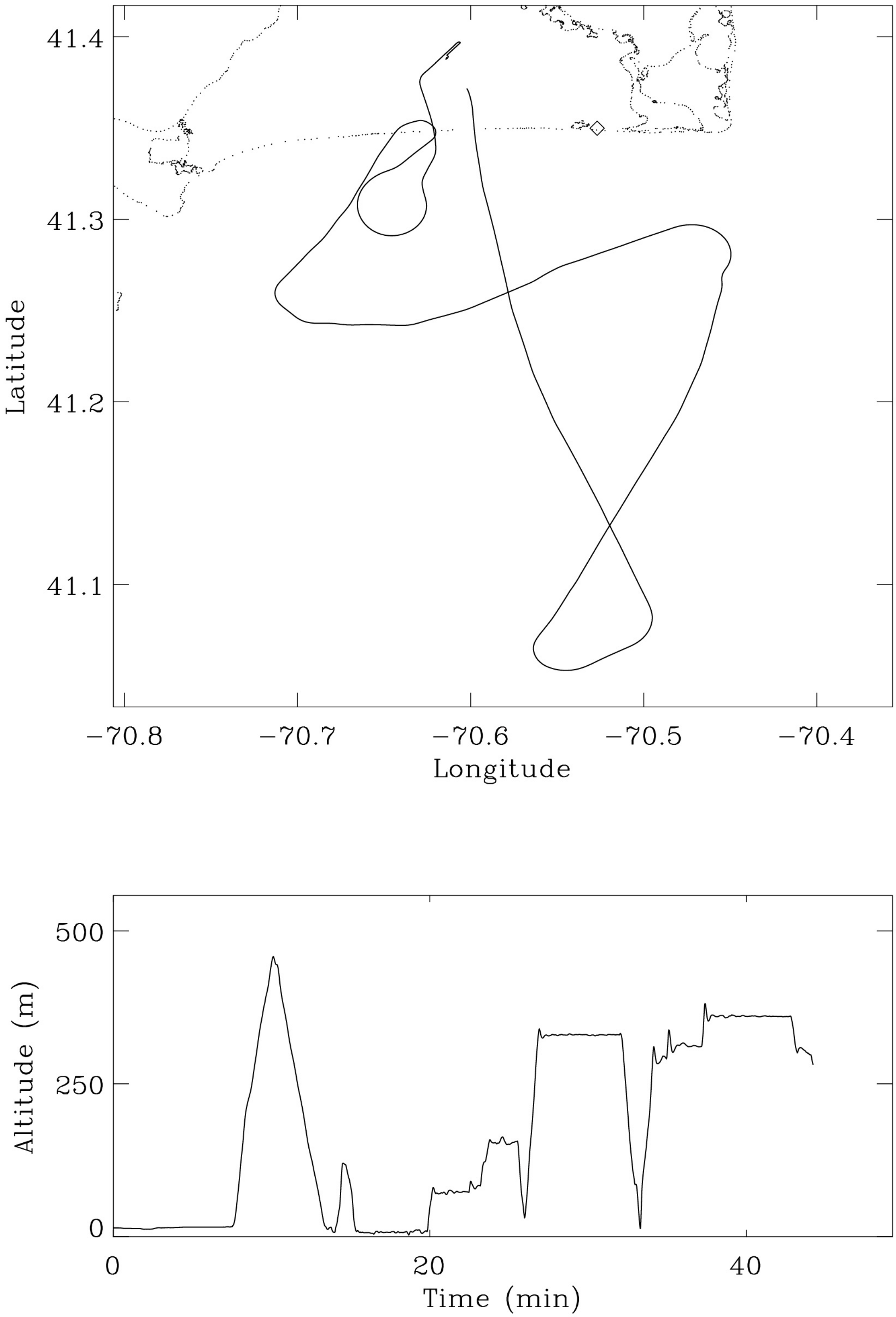
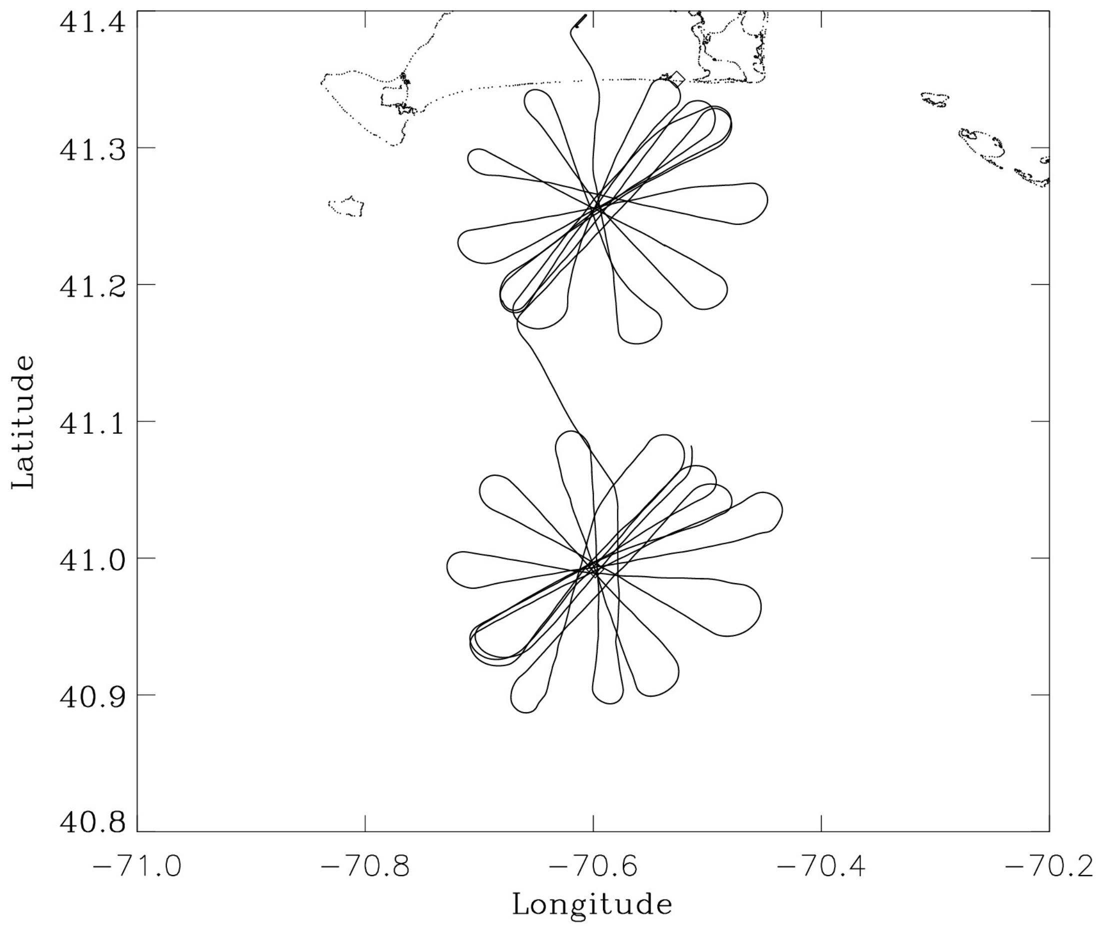


Fig. 35. N3R track for Flight 17 (05 AUG 01).



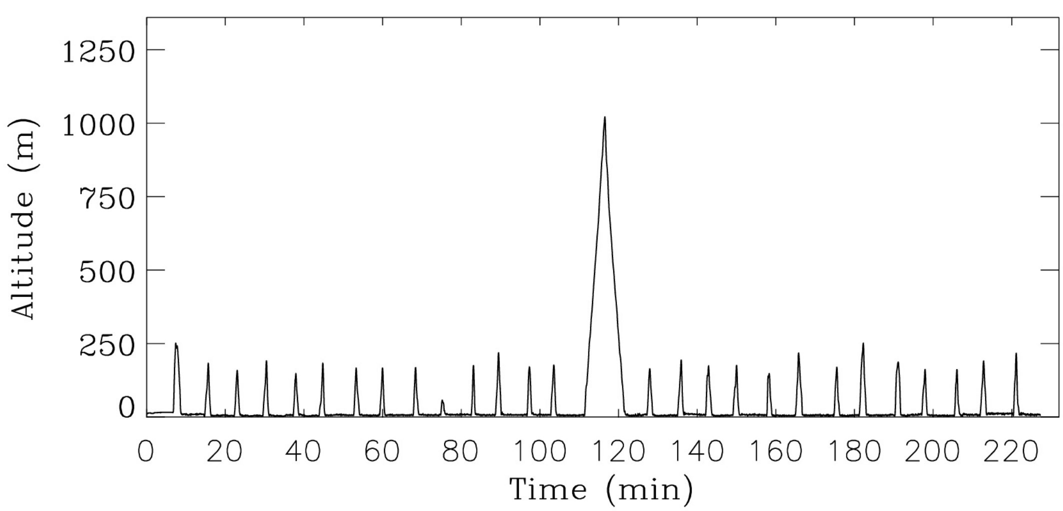


Fig. 36. N3R track for Flight 18 (07 AUG 01).

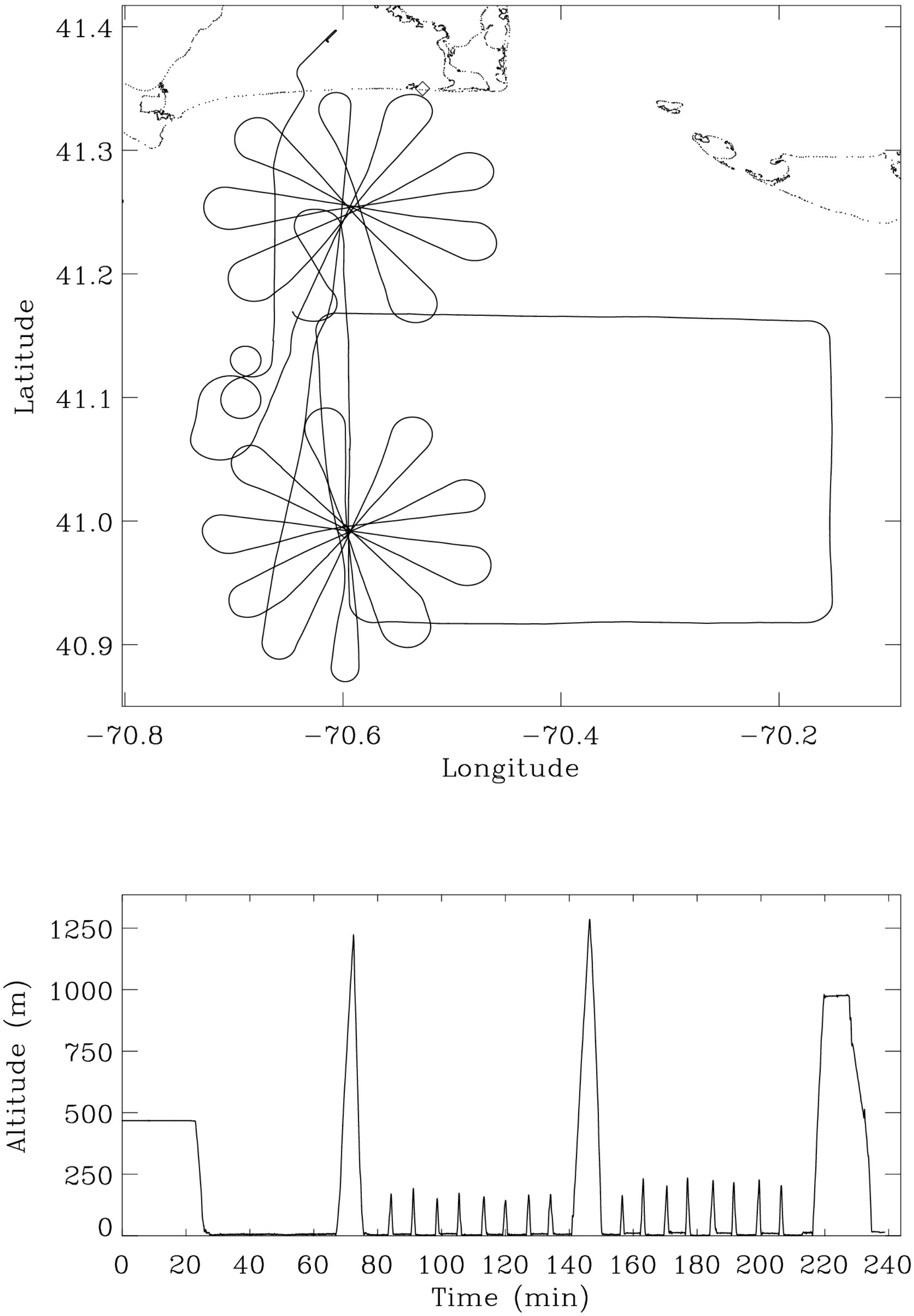


Fig. 37. N3R track for Flight 19 (08 AUG 01).

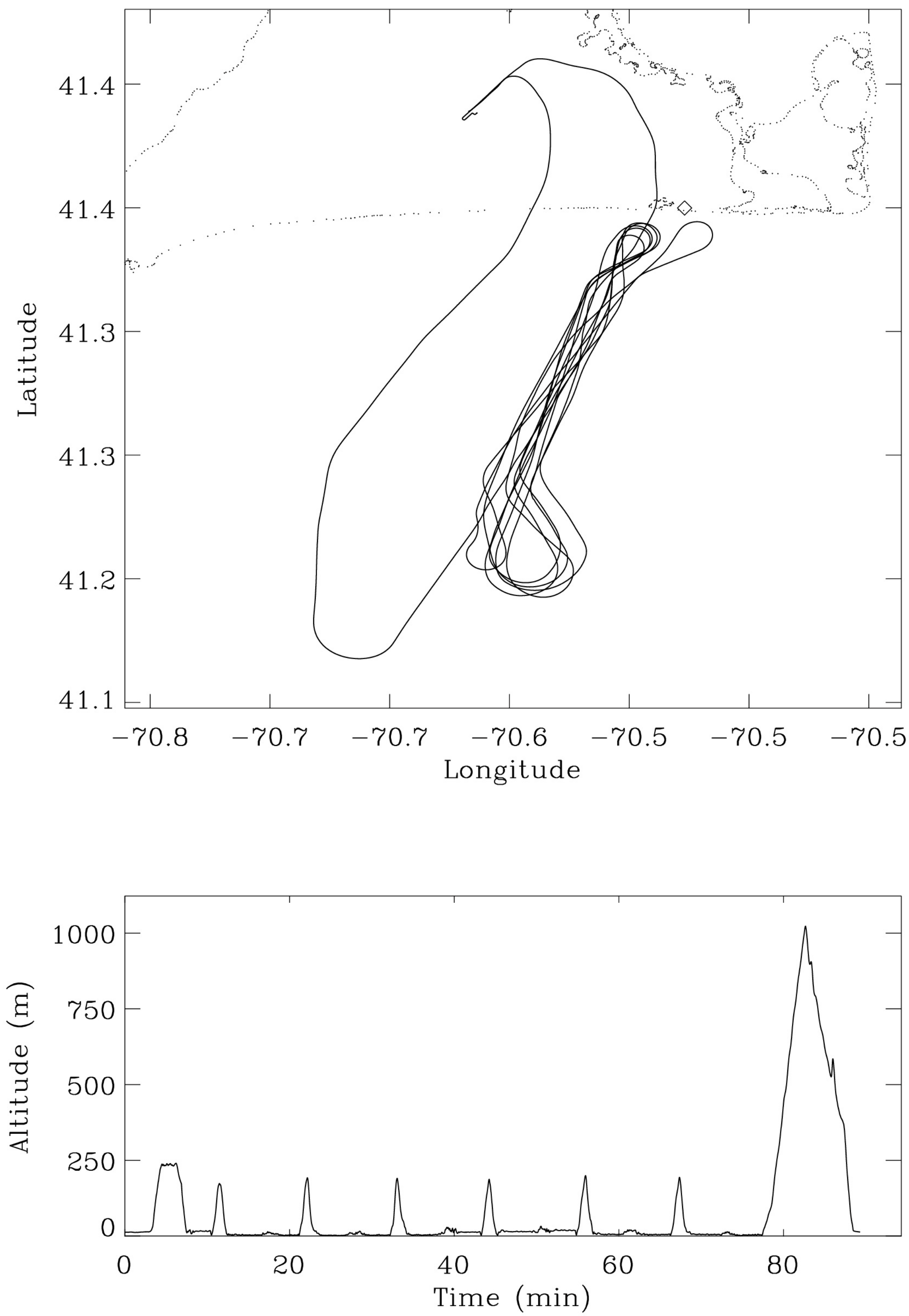


Fig. 38. N3R track for Flight 20 (08 AUG 01)**.**