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CryoVex 2008
Final report

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CRYOVEX 2008

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DTU Space
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ABSTRACT
This report describes the airborne part of the field work of the CryoSat Validation Experiment (CryoVEx) 2008 and the processing of the collected datasets. The airborne part of the campaign was carried out by DTU Space (former Danish National Space Center, DNSC) using a Twin Otter chartered from Air Greenland. The main purpose was to collect coincident ASIRAS and laser elevation data form validation sites on land and sea ice and in addition offer logistical support to ground teams. Overflights of corner reflectors were done at main validation sites in order to calibrate the ASIRAS data. The datasets from this campaign will be important for understanding the CryoSat-2 radar signals.

The airborne part of CryoVEx 2008 was successfully carried out between April 15 and May 8 and the datasets have been stored and secured at DTU Space and Alfred Wegener Institute (AWI). Afterwards extensive data processing has been done by DTU Space and AWI in cooperation.

This report describes the airborne system, the field work, and the data processing together with short descriptions of each validation site. The data from AWI's helicopter electromagnetic sea ice sounder (EM bird) are included along with the field report of the sea ice in situ validation work carried out near Alert in May 2008.

**The work described in this report was done under ESA Contract.
Responsibility for the contents resides in the author or organisation that prepared it.**

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Introduction

The European Space Agency (ESA) CryoSat Validation Experiment, CryoVEx 2008 was carried out in April and May 2008. The airborne operations were coordinated by the National Space Institute, Danish Technical University (DTU Space) and took place in the period April 15 to May 8. The work consisted of:

- Airborne data collection with ASIRAS and laser scanner system. The operations were coordinated with ground and helicopter activities over land and sea ice in Greenland and Canada.
- Logistical support for participants in the CryoVEx 2008 experiment especially concerning transport and access to military facilities in Canadian Forces Station Alert and Thule Air Base as well as aircraft support to the UK team on the north Greenland ice sheet.
-

Figure 1 shows the full flight tracks for the airborne Twin Otter operation in April and May 2008.

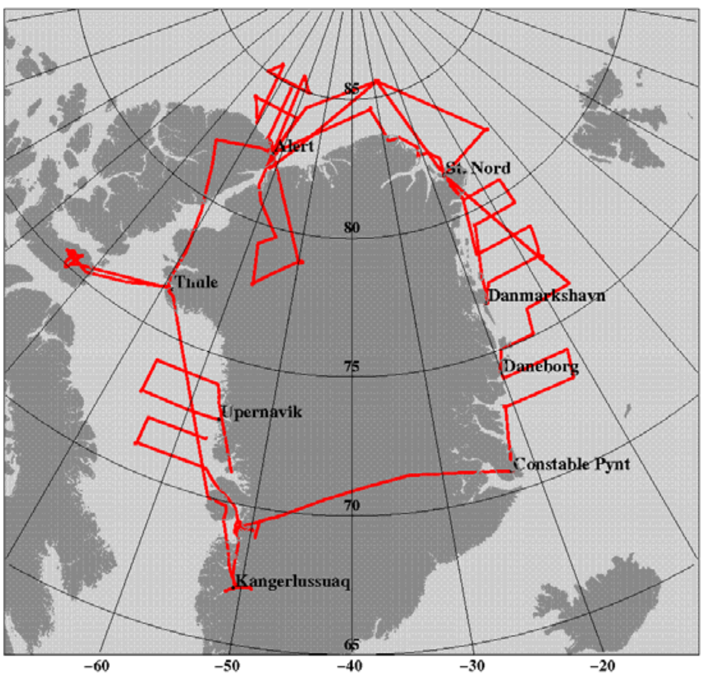


Figure 1. Flight tracks for airborne Twin Otter operations

This report outlines the airborne field operations and the processing of the data acquired during the CryoVEx 2008 campaign. In addition examples from the processed datasets will be presented. The appendices include data descriptions along with processing details and the field report of the in-situ sea ice measurements near Alert.

1 Summary of operations

The DTU Space operations started out on April 15 in Kangerlussuaq, Greenland, with installation of the laser scanner and ASIRAS system in the Air Greenland Twin Otter reg. OY-POF following the same procedures as certified in 2006. Due to a minor technical problem with the Twin Otter the aircraft was not available until the 16th. This did not affect the installation since the first day was spent on retrieving the cargo with the equipment and unpacking the boxes. Assistance with the ASIRAS system was provided by Raumfahrt Systemtechnik's engineer.

After installing the equipment in the Air Greenland hanger and performing ground tests, a successful test flight was carried out on April 17th. Apart from minor problems with the backup system for the laser measurements – INS and laser altimeter – the full system of laser scanner and ASIRAS was working as expected. The problems with the backup system were sorted out on ground prior to the next flights.

The next two days were spent on a survey for the Bureau of Minerals and Petroleum, BMP, Greenland Homerule Government, monitoring the sea ice off the Greenland west coast near Upernavik. After this the EGIG line was surveyed April 20th on transit from Ilulissat to Constable Pynt on the east coast. En route, observations on a line near Ilulissat, both High Altitude and Low Altitude ASIRAS data were gathered.

Next the Twin Otter continued to St. Nord, northeast Greenland, where again observation was carried out for the BMP. On April 26th a coordinated flight was carried out near KV Svalbard, the coast guard vessel from Svalbard, which was on a scientific cruise in the Fram Strait. The ship was anchored to an ice floe that was surveyed with the airborne system as well as on the surface from the ship in coordination with the Norwegian Polar Institute. From St. Nord a second survey was done on April 27th in order to re-measure lines north of Greenland.
On April 28th the aircraft continued to CFS Alert to meet the ground teams there, who flew in from Canada and Qaanaaq, North Greenland, with dedicated Twin Otter flights (chartered from Ken Borek) on April 28th and 30th.

In the meantime the other Air Greenland Twin Otter reg. OY-ATY equipped with skies deployed the UK1 team, of Liz Morris and Martin Hignell, on the ice sheet in northern Greenland via Qaanaaq and Thule Air Base. These operations were delayed by poor weather and took place from April 23rd to 25th and consisted of transport from Kangerlussuaq to Qaanaaq on April 23rd and put in on the ice over the next two days including deployment of two depots with fuel and other supplies for the transect.

From Alert lines were surveyed in the Arctic Ocean on May 1st and 2nd. In addition the validation sites near the coast were observed on May 1st and on May 2nd a coordinated line was flown with the helicopter-borne EM bird system from Alfred Wegener Institute/University of Alberta, Edmonton.
A second coordinated helicopter and Twin Otter flight was cancelled in the last minute on May 5th due to poor visibility. The Twin Otter flew a few survey lines near the AUV (Autonomous Underwater Vehicle) camp just off the coast but this also had to be altered to a lower altitude due to low clouds. Afterwards, the aircraft-team continued to Thule Air Base via Grant Ice Cap and Mt. Oxford on Ellesmere Island to position the Twin Otter for operations over Devon Island. Initially it was planned to

use the small inuit settlement Grise Fiord as base for the Devon survey but the weather favoured operations out of the larger and better equipped airfield in Thule. The Devon ice cap was then surveyed on May 6th where the main lines N-S and E-W was flown repeatedly to ensure corner reflector hits and a few lines suggested by the Canadian team was also surveyed.

After the Devon flight the Twin Otter returned to Kangerlussuaq on May 7th to be used for a test campaign for the DTU Space P-Sounder instrument. The ASIRAS system was un-mounted and returned to RST.

Table 1 gives an overview of the specific flights in chronological order and below a short day-to-day description is found.

Day2day

April 15-17	Installation and test of ASIRAS and laser scanner system on Twin Otter
April 18	Survey of icebergs near Ilulissat for DMI and local flight for Danish Television reporters
April 19	Sea ice observations coordinated with helicopter in-situ measurements off the west coast near Upernavik
April 20	Transit to the east coast with survey of CryoSat line near Ilulissat and the EGIG line across the ice sheet
April 21	Transit to St. Nord after cancellation of helicopter operations near the east coast due to ice fog in survey area. Some observations with laser and ASIRAS en route with refuelling in Daneborg
April 22-23	No flights due to bad weather in St. Nord
April 24	Over-flight of KV Svalbard in the Fram Strait and survey of E-W lines between St. Nord and Danmarkshavn. Refueling in Danmarkshavn
April 25-26	No flights due to bad weather in St. Nord
April 27	Observation on lines north of Greenland
April 28	Transit to Alert with survey of sea ice near the coast and parts of the coast of northern Greenland
April 29	Survey of the UK1 site on the northern ice sheet
April 30	Dense fog at Alert – no flights
May 1	Survey of long lines north-east and survey of validation sites near Alert in the afternoon
May 2	Survey of square north-west and coordinated flight of N-S line in the afternoon
May 3	Snow and dense fog – no flights
May 4	Planned afternoon flight with helicopter but had to cancel due to bad weather
May 5	Planned coordinated helicopter flight cancelled due to low clouds. Survey of AUV site altered to low altitude followed by survey of Grant Ice Cap, Ellesmere Island, en route to Thule
May 6	Devon ice cap survey
May 7	Return to Kangerlussuaq with sea ice observations en route and survey over Disko Island
May 8-	Un-mount ASIRAS and P-sounder test

The airborne field team consisted of:
DTU Space: Sine M. Hvidegaard (SMH), Lars Stenseng (LS), and Henriette Skourup (HSK).
RST: Harald Lentz (HL).

Table 1. Flight details

Date/JD	Flight	Track	Off block UTC	Take off UTC	Landing UTC	On block UTC	Air-borne	Survey operators
108/Apr 17	Test/drop	SFJ-SFJ	1837	1842	1955	2000	1h18	SMH/LS/HL
109/Apr 18	ICB	JAV-SFJ	1448	1453	1616	1621	1h33	SMH/LS
109/Apr 18	Journalists	JAV-JAV	1756	1801	1835	1840	0h44	SMH/LS
110/Apr 19	K1-K4	JAV-JUV	1023	1028	1443	1448	4h25	SMH/LS
110/Apr 19	K5-HE-K8	JUV-JAV	1552	1557	2108	2113	5h21	SMH/LS
111/Apr 20	JAV-T-EG	JAV-CNP	1119	1124	1548	1553	4h34	SMH/LS
112/Apr 21	K9-K12	CNP-DNB	1009	1014	1410	1415	4h06	SMH/HSK
112/Apr 21	K13-K15	DNB-NRD	1505	1510	2000	2005	5h	SMH/HSK
115/Apr 24	K16-K19 KV Svalbard	NRD-DMH	1004	1009	1442	1447	4h43	SMH/HSK
115/Apr 24	K20-K23	DMH-NRD	1528	1533	1922	1927	3h59	SMH/HSK
118/Apr 27	F	NRD-NRD	1013	1018	1523	1528	5h15	SMH/HSK
119/Apr 28	E	NRD-YLT	1437	1442	1835	1840	4h03	SMH/HSK
120/Apr 29	ICE	YLT-YLT	1350	1355	1922	1927	5h37	SMH/HSK
122/May 1	F-S	YLT-YLT	1340	1345	1825	1830	4h50	SMH/HSK
122/May 1	MYI-FYI	YLT-YLT	1847	1852	2037	2042	1h55	SMH/HSK
123/May 2	H	YLT-YLT	1330	1335	1916	1921	5h51	SMH/HSK
123/May 2	A1-FUE-A2	YLT-YLT	2040	2045	2308	2313	2h33	SMH/HSK
126/May 5	M-cal-GM	YLT-THU	1322	1327	1803	1808	4h36	SMH/HSK
127/May 6	DEVON	THU-THU	1154	1159	1703	1708	5h14	SMH/HSK
128/May 7	DISKO	THU-SFJ	1211	1216	1653	1658	4h47	SMH/HSK
Total								72h00

2 Hardware Installation

The equipment was installed in the Twin Otter OY-POF in the Air Greenland hangar in Kangerlussuaq. The installation was similar to the setup certified in 2006 and used for the CryoVEx 2006 campaign. For this campaign a new laser scanner was used; the Riegl LMS Q240i. In addition the backup system consisting of a profiling laser altimeter and inertial measurement unit has been updated. Table 2 gives the offsets between the instruments and Figure 2 sketches the approximate position of the instruments in the aircraft.
Photographs of the installation are shown below.

Table 2. The (dx, dy, dz)' offsets. The lever arm from the GPS antennas to the origin of the laser scanner, and to the back centre of ASIRAS antenna frame (See arrow):

to laser scanner	**dx (m)**	**dy (m)**	**dz (m)**
from AIR1/AIR3 (front)	- 3.70	+ 0.52	+ 1.58
from AIR2/AIR4 (rear)	+ 0.00	- 0.35	+ 1.42
to ASIRAS antenna	**dx (m)**	**dy (m)**	**dz (m)**
from AIR1/AIR3 (front)	-3.37	+0.47	+2.005
from AIR2/AIR4 (rear)	+0.33	-0.40	+1.845

'Offset definition: x positive to the front, y positive to the right, and z positive down.

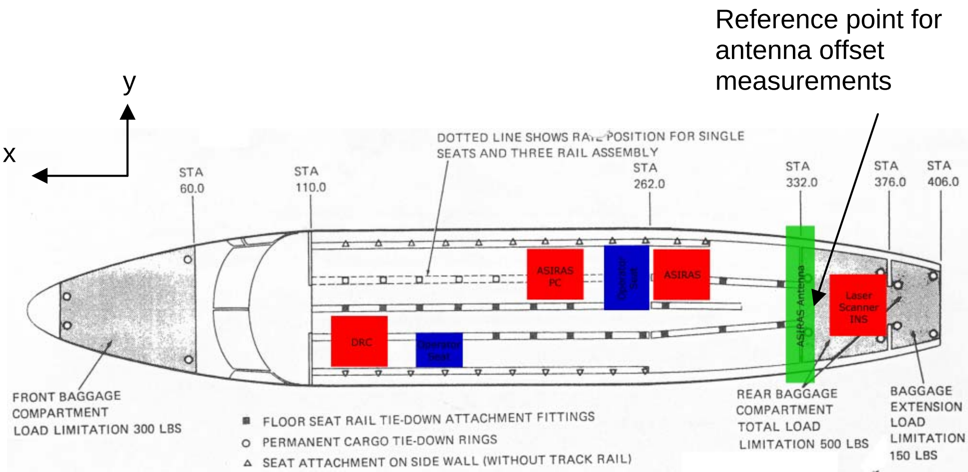


Figure 2. Sketch of instrument installation in the Air Greenland Twin Otter.

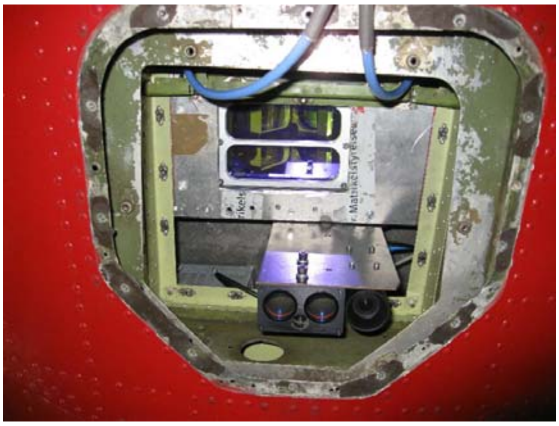


Figure 3. Photographs of the Twin Otter installation.

Table 3. Data holding from aircraft instruments and reference stations

JD/Date	AIR1	AIR2	AIR3	AIR4	ALT	EGI	IMU	SCAN-NER	GPS REF1	GPS REF2	GPS REF3	Ver cam	ASIRAS	REMARKS
108/Apr 17	X	X	X	X	n/a	!		X	KELY			(X)	HAM+LAMa	Test flight,
109/Apr 18	X	n/a	X	X	X	!	X	X	SFJ1			(X)		Iceberg obs
109/Apr 18	n/a	X	X	X	X	!	X	X	SFJ1			X		Fjord trip for journ
110/Apr 19	X	X	X	X	X	!	X	X	SFJ1	JAV		X''	LAMa	Scanner PC cold no start
110/Apr 19	X'	X	X	X	X	!	X	X	SFJ1	JAV	JUV	X''	LAMa	Pass over heli at 1620
111/Apr 20	n/a	X	X	X	X	!	X	X		CNP		X	HAM+LAMa	EGI difficult start up
112/Apr 21	X	X	X		X	!	X	X	SCO	NYA2		X'''	LAMa	EMAP probl with laptop
112/Apr 21	X	X	X		X	!		X	SCO	NYA2		X	LAMa	Changed survey lines
115/Apr 24	X	X	X		X	X	X	X	NRD1	NRD2		X	LAMa	
115/Apr 24	X	X	X		X	X	X	X		NRD2		X	LAMa	
118/Apr 27	X	X	X		X	X	X	X	NRD1	NRD2		X	LAMa	Perfect weather…
119/Apr 28		X	X		X	X	x	X	THU3	NYA		X	LAMa	IMU on late at 1707
120/Apr 29			X		X	X	X	X	YLT1	YLT2		X	LAMa	CR on ice sheet
122/May 1	X	X	X		X	X	X	X	YLT1	YLT2		X	LAMa	
122/May 1	X		X		X	X	X	X	YLT1	YLT2		X	LAMa	4 CR on MYI and FYI
123/May 2	X	x	X		X	X	X	X	YLT1	YLT2		X	LAMa	
123/May 2	X	X	X		X	X	X	X	YLT1	YLT2		X	LAMa	CR on site FUE, + heli
126/May 5	X	X	X		X	X	X	X	YLT2	THU2	THU3	X	LAMa	Poor vis near YLT
127/May 6	X	X	X		X	X	X	X	THU2	THU3		X	LAMa	
128/May 7	X	X	X		X	X	X	X	THU2	THU3	KELY	X		Disko in diff. alt.

' stopped after end of survey line

'' not adjusted – images not clear – adjusted just after heli pass

''' very cloudy

3 Acquired data

During the CryoVEx 2008 campaign DTU Space acquired approximately 50 hours of ASIRAS data and 70 hrs of laser scanner, GPS, INS, and downward looking photographs with the airborne system. After each flight data was stored on dedicated harddisks and backup copies were made. The harddisks with ASIRAS data was delivered to AWI for processing. The remaining data was uploaded to the DTU Space servers also for post-processing.
An overview of the collected data can be seen in Table 3 and a more detailed description is found along with processing details in the following paragraphs.

Nearly all data were recovered and stored except for at few cases of operator errors, one laser scanner file never started and a few incidents where the GPS receivers had a full memory, but no problems were encountered for the main validation sites. The full set of raw data is now stored at the DTU space server system (with tape backup) and copies are kept on dedicated harddisks.

4 Processing

4.1 GPS data processing

Kinematic differential GPS is the key positioning method of the aircraft. GPS dual-frequency phase data were logged at 1 Hz using 1-2 ground base receivers at one or more reference sites, and 4 aircraft receivers; one of these dedicated to the ASIRAS system.
The aircraft GPS receivers are named AIR1 (Trimble 4000-SSI), AIR2 (Ashtech Z-extreme), AIR3 (Javad, Lexon), and AIR4 (Trimble 4000-SSI, connected to ASIRAS). AIR1 and AIR2 share the front GPS antenna; AIR3 and AIR4 the rear antenna. Antenna offsets are given in Table 2. Data were logged in the receivers during flights and downloaded upon landing on laptop PCs. Most data were recovered and only a few files missing, see Table 3, but the redundancy of receivers meant that GPS data are available for all flights. The AIR4 receiver had a problem with the serial port and was not downloaded after April 20.

The GPS base stations to be used as reference stations for differential post processing of the GPS data are listed in Table 4. The stations were mounted on roofs or tripods in the field near the landing sites; the reference points were generally not marked. In addition data from permanent GPS stations were used for data processing.

GPS solutions are based on static processing of the reference stations and kinematic differential processing of the airborne data. In addition precise point positioning has been used for some of the solution where precise information of satellite clock and orbit errors are used along with information from permanent IGS stations.
First the position of the reference station is determined using SCOUT (Scripps Coordinate Update Tool) service operated by SOPAC (Scripps Orbit and Permanent Array Center) (http://sopac.ucsd.edu). SCOUT calculates the reference positions in ITRF 2005 using data from three nearest permanent GPS stations with a position accuracy of about 2 cm even in the Arctic with long distance to permanent stations. The reference stations used during CryoVEx 2008 are listed in Table 4 and coordinates are found in Appendix 8.2.

The kinematic differential GPS processing were performed with GPSurvey (version 2.35) using precise IGS orbits and the GOAD-Goodman tropospheric model. On each flight several solutions are made using different combinations of GPS reference stations and aircraft receivers. The best solution for each flight (see Table 5) is selected. For some of the flights GPSurvey showed to have problems delivering a stable solution and precise point positioning using the software Trip (X. Zhang 2006) gave a better solution and this was selected (*.kin in Table 5).

The GPS solution are used for further processing of INS and laser scanner data and also delivered to ESA and AWI for ASIRAS processing in the dedicated format documented by R. Cullen (2009).

Table 4. CryoVEx 2008 GPS reference stations

Name	Location	Hardware (antenna type)
SFJ1	Kangerlussuaq, on met hut roof	Javad Maxor, (RegAnt)
JAV0	On latter to roof, airport	Javad Maxor (int. ant, LegAnt)
JUV0	Upernavik near airport	Javad Legacy (MarAnt)
CNP0	On hotel roof	Javad Legacy (RegAnt)
NRD1	Station Nord, on snow next to apron	Javad Maxor (int. ant)
NRD2	Station Nord, on snow next to apron	Javad Legacy (RegAnt)
YLT1	On snow next to Spinnaker, small tripod	Javad Maxor (int. ant)
YLT2	Back side of Huricane, on stick	Javad Legacy (RegAnt)
THU2	Thule Air Base, permanent station	Javad Legacy
THU3	Thule Air Base, permanent station	Ashtech Z-XII3
SCOR	Scoresbysund, permanent station	Ashtech UZ-12

4.2 INS and GPS data merging

Similar to previous campaigns (e.g CryoVEx 2003, 04 and 06) a Honeywell medium grade inertial navigation system H764-G, EGI, was used throughout the surveys to record inertially integrated position, velocity and attitude information. Data were logged on a rack mounted PC with solid state hard-disks in binary format through a 1558 mil-spec communication bus. Data from all flights have been obtained. The data from April 17th to April 21st have not been initialised properly at the alignment but this will not affect the laser scanner processing as the files still contains the information needed about attitude changes. Recordings and comments can be found in Table 3.

The position and attitude information is extracted from the INS data packets and averaged to 10 Hz. The averaging to 10 Hz has proven to be a good balance between file size and resolution in time. To obtain a higher resolution in the time domain and preserve precision the post processed GPS and INS data is merged by draping the INS derived positions onto the GPS positions. This draping is done by modelling the function, found in equation (1), by a low pass smoothed correction curve, which is added to the INS.

$$\varepsilon (t) = P_{GPS}(t) - P_{INS}(t) \qquad (1)$$

This way a smooth GPS-INS solution is obtained, which can be used for geolocation of laser and camera observation. The full resolution INS data were also converted into binary format as specified in the ESA document for the ASIRAS processing by R. Cullen (2009).
Details about the INS processing is found in Table 5 and Figure 4 shows an example of the draping of high rate INS heights onto precise GPS heights.

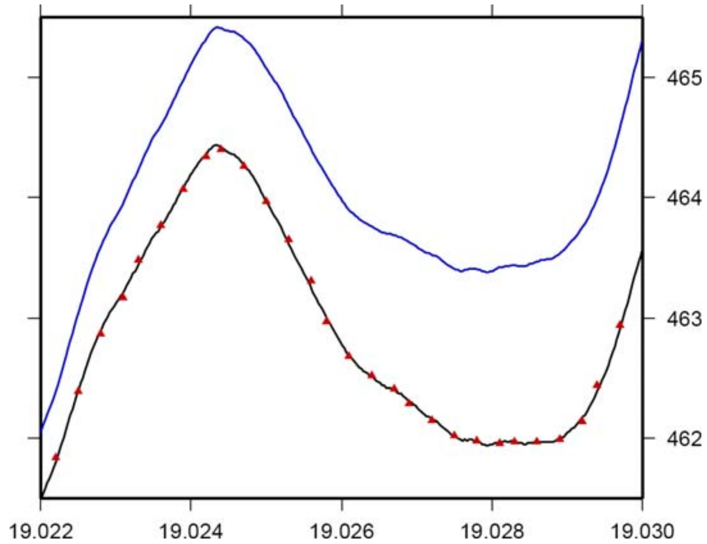


Figure 4. Draping of high rate INS derived heights (blue) onto precise GPS heights (red) to get high rate precise heights (black).

Table 5. GRL 2008 INS data processing

JD	Flight	Filename	GPS solution	Start	Stop	Receiver
108		gpsegi_108.pos	108Air3.kin	18.62	20.00	3
109		gpsegi_109.pos	109Air1.kin	14.80	16.35	1
110	a	gpsegi_110a.pos	110aa4ja.p	10.38	14.80	4
110	b	gpsegi_110b.pos	110ba2ja.p	15.87	21.14	2
111		gpsegi_111.pos	111Air2.kin	11.32	15.84	2
112	a	gpsegi_112a.pos	112aa3sc.p	10.15	14.25	3
112	b	gpsegi_112b.pos	112bAir3.kin	15.08	20.08	3
115	a	gpsegi_115a.pos	115aAir3.kin	10.07	14.73	3
115	b	gpsegi_115b.pos	115bAir3.kin	15.47	19.45	3
118		gpsegi_118.pos	118Air3.kin	10.22	15.46	3
119		gpsegi_119.pos	119Air2.kin	14.62	18.66	2
120		gpsegi_120.pos	120Air2.kin	13.62	19.45	2
122	a	gpsegi_122a.pos	122aAir3.kin	13.67	18.50	3
122	b	gpsegi_122b.pos	122ba3y2.p	18.65	20.65	3
123	a	gpsegi_123a.pos	123aAir3.kin	13.50	19.35	3
123	b	gpsegi_123b.pos	123ba2y2.p	20.67	23.21	2
126		gpsegi_126.pos	126a3y2.p	13.37	18.13	3
127		gpsegi_127.pos	Air3gnav.p	11.90	17.12	3
128		gpsegi_128.pos	128a1t3.p	12.18	16.96	1

4.3 Laser scanner data processing

The laser scanner system has been upgraded to the new Riegl LMS Q240i laser altimeter. This will provide similar measurements with near-infrared laser of the distance between the aircraft and the snow or ice surface as the old laser scanner previously used. The main difference is an improvement of the range; ranging up to 650 m over snow/ice and the smaller footprint; approximately 0.7x0.7 m at the nominal flying altitude of 300m.
The laser scanner data were logged as hourly files on a dedicated PC. The files are time-tagged by 1 PPS signal from the AIR1 GPS receiver and synchronised once per

flight by the operator and named with the start time. Table 7 shows the logged files with start /stop times. The data rate has been fixed to 250 observations per line and 40 lines per second throughout the campaign.
The synchronisation of the data failed for part of the flights which means that the synchronisation has to be checked for each of these files during processing. This will not affect the data quality as it can be verified visually by plotting the results.

Laser scanner data were recovered for most flights except minor parts with low clouds or fog. Some problems occurred with the laser scanner PC at start up of the system caused by the cold weather. This was solved by heating the PC or running it during night on external power.

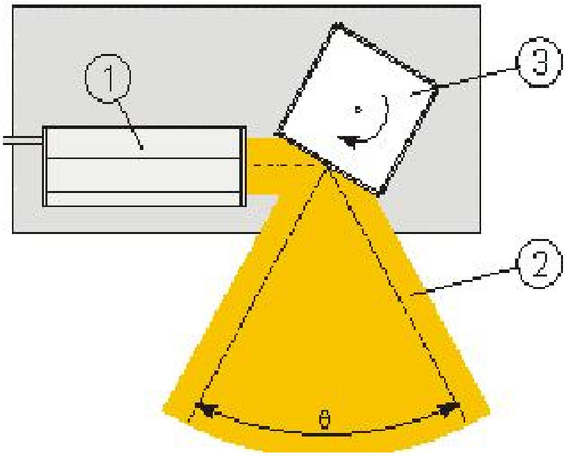


Figure 5. Sketch of laser scanner principle (1) Laser and photodiode assembly (2) Swath pattern (3) Rotating mirror.

The principle of the laser scanner can shortly be described as following:
1. The laser (1) emits a laser pulse and starts a timer, see Figure 5
2. The pulse is reflected in a direction dictated by the mirror (3)
3. If the pulse hits a target with suitable reflectance it is returned to the mirror (3) that reflects it into the photodiode (1) and hereby stops the timer
4 The mirror (3) is now rotated by a small angle before the process is repeated.

The geolocation of each point in the laser scanner data is performed with standard trigonometry in two steps. First all points are described as vectors (dX_{NWU}, dY_{NWU}, dZ_{NWU}) in a local Cartesian North East Up system using the lever arm between the laser scanner and the GPS (dX, dY, dZ), the range measured by the laser (r), the angle between the laser mirror (a) and the orientation of the laser in an earth fixed system (ω_r, ω_p, ω_h). Next these vectors are added with the position derived from GPS (φ_{GPS}, λ_{GPS}, h_{GPS}) to get the position of the reflector in an earth fixed system(φ, λ, h).

$$dX_{NWU} = \cos(\omega_h)\cos(\omega_p)dX + (\cos(\omega_h)\sin(\omega_p)\sin(\omega_r) - \sin(\omega_h)\cos(\omega_r))(-\sin(a)r + dY) + (\cos(\omega_h)\sin(\omega_p)\cos(\omega_r) - \sin(\omega_h)\sin(\omega_r))(\cos(a)r + dZ)$$

$$dY_{NWU} = -\sin(\omega_h)\cos(\omega_p)dX - (\sin(\omega_h)\sin(\omega_p)\sin(\omega_r) + \cos(\omega_h)\cos(\omega_r))(-\sin(a)r + dY) + (-\sin(\omega_h)\sin(\omega_p)\cos(\omega_r) + \cos(\omega_h)\sin(\omega_r))(\cos(a)r + dZ) \quad (2)$$

$$dz_{NWU} = \sin(\omega_P)\, dX$$

$- \cos(\omega_p)\sin(\omega_r)(-\sin(a)r + dY)$
$- \cos(\omega_p)\cos(\omega_r)(\cos(a)r + dZ)$

$$\varphi = \varphi_{GPS} + dX_{NWU}/degm$$
$$\lambda = \lambda_{GPS} + dY_{NWU}/(degm\cos(\varphi) \qquad (3)$$
$$h = h_{GPS} + dZ_{NWU}$$

where degm is meter per degree.

This geolocation process just described assumes perfect alignment between the laser scanner and the INS system, this is however not practically possible in this type of installation. To compensate for the imperfect installation several calibration manoeuvres are performed during the campaign. The purpose of these manoeuvres is to determine and monitor the offset angles between the laser scanner and the INS.

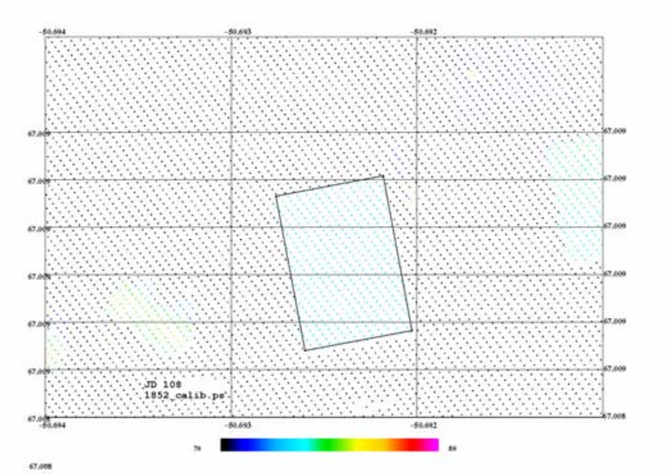


Figure 6. Laser scanner data from calibration site – building in Kangerlussuaq. Data from two passes overlaid displaying the match after calibration

The main calibration site for the laser is a building where the corners of the roof are known from a GPS survey. Using this building and two swaths of laser scanner data, one east-west and one north-south, one can estimate the offset angles through an iterative process. In Figure 6 points from the two swaths (heights in colour-coding) are plotted on top of the black outline of the building.

The calibration is monitored using similar methods over building (Station Nord and CFS Alert) and cross-overs during the surveys. Figure 7 shows the calibration flight at St. Nord on April 27.

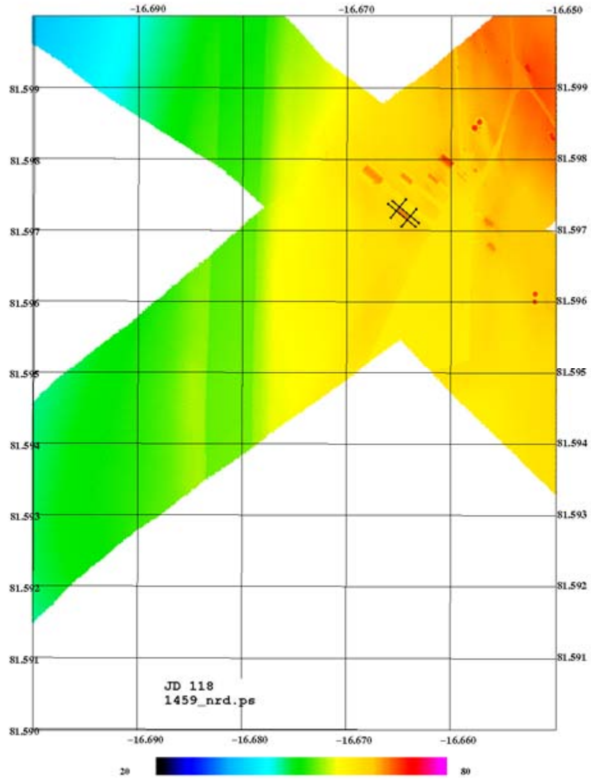


Figure 7. Laser scanner data from the calibration flight at St. Nord.

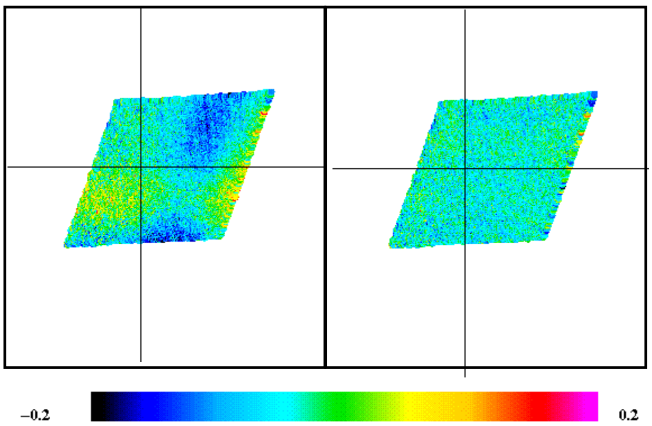


Figure 8. Differences(in meters) between two laser swaths from JD 115b before (left) and after (right) correction.

After the initial laser scanner processing it was discovered that the Riegl laser scanner has a hardware problem resulting in an error in the range determination. This is seen as a residual error across-track similar to a polynomial in each scan line. The error has been identified as constant for all scan lines and varying across the scan lines ranging from -10 to +20 cm. A regression procedure has been developed and used on data from a smooth flat area of newly formed thin ice to estimate the best correction for the error. This has been used to correct the dataset. An example of data before and after this correction is seen in Figure 8.

After the correction the laser scanner elevation data has been quality checked at crossovers to document the accuracy; the statistics is found in Table 6, which shows that the internal accuracy of the data is around 5 cm similar to previous campaigns.

Table 6. Laser scanner cross-over statistics

Flight	Mean	Std dev	Min	Max
115b	-0.05	0.05	-0.26	0.18
120	-0.02	0.03	-0.78	0.51
122b	-0.02	0.06	-0.95	0.99
122b	0.00	0.06	-1.20	1.20
127	0.01	0.05	-0.31	0.98

Note that the min and max in most cases represent single points or edges hit at different angles since observed at different directions

Table 7 gives the processed laser scanner files with offset angles and other processing parameters. An example is shown in Figure 9 from the coincident flight with the AWI helicopter EM system on May 2nd and Figure 10 shows an overview of the delivered laser scammer data, colour coded separately for sea ice and ice caps. Note that the sea ice data has been filtered to heights relative to local sea level.

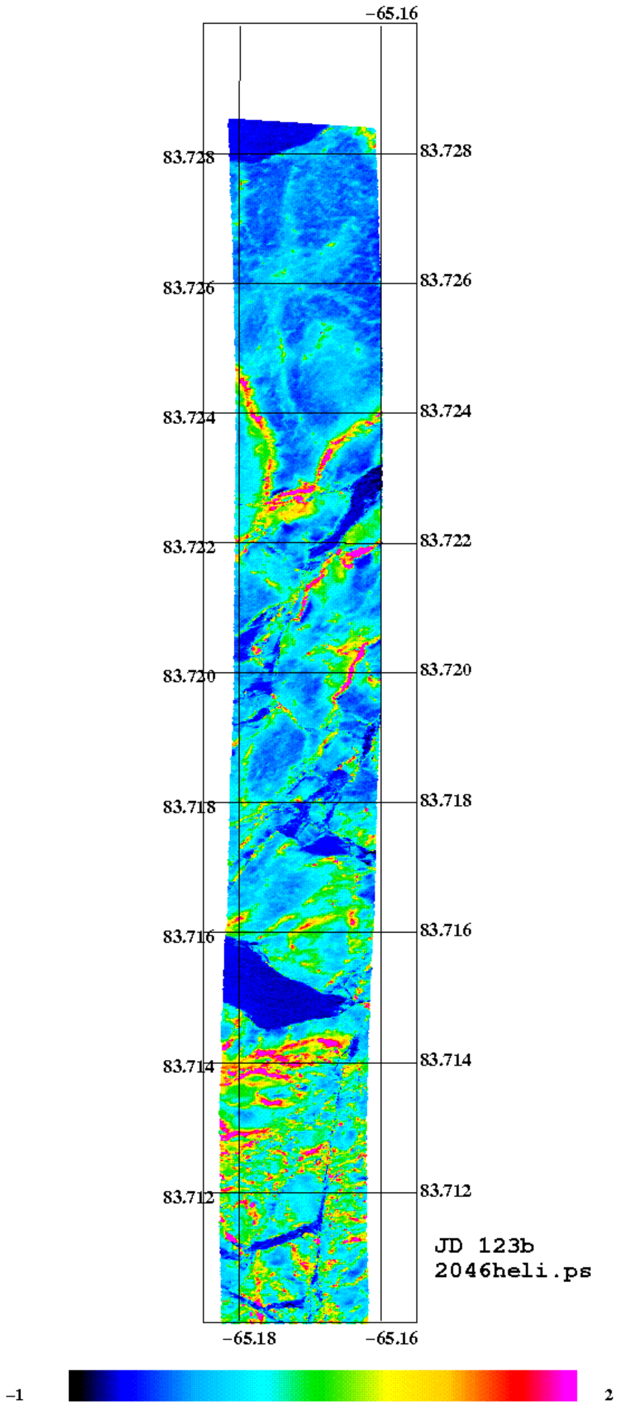


Figure 9. Example of laser scanner data over near the helicopter over-flight May 2nd.

Table 7. Processed laser scanner files

JD	File name	Timing	Timing	Start (dechr)	Stop (dechr)	Calibration angl.
108 17/4-08	GroundTest.2dd					-1.5 0.20 0
	108_185200.2dd	-1		18.83333	19.86874	
109 18/4-08	109_154800.2dd	-1		15.53333	16.28035	-1.5 0.19 0
110 19/4-08	110_105900.2dd	173		10.98333	11.98568	-1.5 0.16 0
	110_115430.2dd	173		11.90833	13.03057	
	110_130300.2dd	173		13.05000	13.98347	
	110_140000.2dd	173		14.00000	14.73355	
	110_155800.2dd	173		15.96667	16.76490	
	110_164700.2dd	173		16.78333	17.67876	
	110_174130.2dd	173		17.69167	18.53849	
	110_183300.2dd	173		18.55000	19.41839	
111 20/4-08	111_113715.2dd	176		11.62083	12.18098	-1.5 0.16 0
	111_121200.2dd	176		12.20000	12.93720	
	111_125700.2dd	176		12.95000	13.98334	
	111_140000.2dd	176		14.00000	14.86993	
112 21/4-08	112_101630.2dd	181		10.27500	11.13432	-1.5 0.16 0
	112_110900.2dd	181		11.15000	11.74556	
	112_115400.2dd	181		11.90000	12.17062	
	112_121300.2dd	181		12.21667	12.68043	
	112_134630.2dd	181		13.77500	14.20751	
	112_151530.2dd	181		15.25833	15.98591	
115 24/4-08	115_104200.2dd	-1		10.70039	11.61595	-1.5 0.16 0
	115_113730.2dd	-1		11.62539	12.57430	
	115_123500.2dd	-1		12.58377	13.40475	
	115_122500.2dd	-1		13.41702	14.26649	
	115_141630.2dd	-1		14.27542	14.48988	
	115_153600.2dd	-1		15.60043	16.54883	
	115_163330.2dd	-1		16.55869	17.65387	
	115_174000.2dd	-1		17.66705	18.81385	
118 27/4-08	118_102000.2dd	-1		10.33367	11.41592	-1.5 0.19 0
	118_112530.2dd	-1		11.42543	12.24841	
	118_121530.2dd	-1		12.25873	13.18812	
	118_131245.2dd	-1		13.21292	13.79712	
	118_134830.2dd	-1		13.80868	14.31342	
	118_142000.2dd			-	-	
	118_145900.2dd	-1		14.98377	15.40674	
119 28/4-08	119_144400.2dd	-1		14.73374	15.65350	-1.5 0.19 0
	119_154000.2dd	-1		15.66705	16.55936	
	119_163400.2dd	-1		16.56705	17.39945	
	119_172430.2dd	-1		17.40874	18.61004	
120 29/4-08	120_135330.2dd	-1		13.89212	14.64593	-1.5 0.19 0
	120_143930.2dd	-1		14.65883	16.21969	
	120_161330.2dd	-1		16.22645	17.22395	
	120_171400.2dd	-1		17.23375	17.97291	
	120_175900.2dd	-1		17.98373	18.92643	
	120_185615.2dd	-1		18.93793	19.10401	
122 1/5-08	122_134000.2dd	-1		13.66705	14.57000	-1.5 0.19 0
	122_143500.2dd	-1		14.58370	15.55050	
	122_153330.2dd	-1		15.55870	16.45018	
	122_162730.2dd	-1		16.45869	17.48911	
	122_173000.2dd	-1		17.50040	18.22298	
	122_184630.2dd	-1		18.77561	19.60370	
	122_193645.2dd	-1		19.61290	20.62406	

123 2/5-08	123_133030.2dd	-1		13.50888	14.50900	-1.5 0.19 0
	123_143100.2dd	-1		14.51708	15.24099	
	123_151500.2dd	-1		15.25039	16.23944	
	123_161500.2dd	-1		16.25038	17.44694	
	123_172730.2dd	-1		17.45870	18.62964	
	123_183830.2dd	-1		18.64210	19.29238	
	123_204600.2dd	-1		20.76706	21.99410	
	123_220030.2dd	-1		22.00874	22.86155	
	123_230100.2dd	-1		23.02184	23.14300	
126 5/5-08	126_131800.2dd	-1		13.30041	14.55898	-1.5 0.19 0
	126_143400.2dd	-1		14.56704	14.98449	
	126_145930.2dd	-1		14.99203	15.49834	
127 6/5-08	127_120015.2dd	-1		12.00458	13.18491	-1.5 0.19 0
	127_131200.2dd	-1		13.20036	13.49056	
	127_133000.2dd	-1		13.50038	14.25457	
	127_141600.2dd	-1		14.26708	14.99530	
	127_150030.2dd	-1		15.00874	15.84995	
128 7/5-08	128_121800.2dd	-1		12.30033	12.74411	-1.5 0.19 0
	128_124515.2dd	-1		12.75456	13.68720	
	128_134200.2dd	-1		13.70036	14.42977	
	128_142630.2dd	-1		14.44210	15.17147	
	128_151100.2dd	-1		15.18378	15.90188	

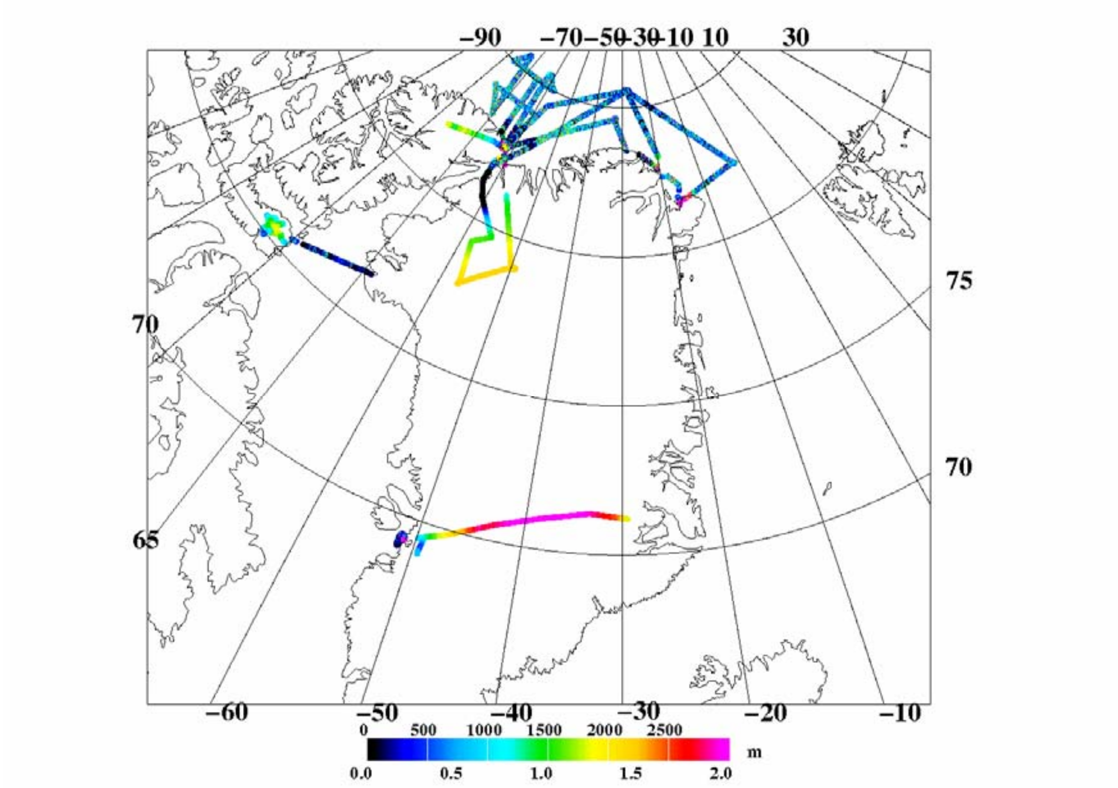


Figure 10. Overview of delivered laser scanner data, colour coded separately for sea ice and ice caps. Note that the sea ice data has been filtered to heights relative to local sea level.

4.4 ASIRAS radar data processing

The ASIRAS system was installed in the same manner as for the CryoVEx 2006 campaign. The new LAMa mode with reduced data rate was used for the surveys except for the CryoSat line near Ilulissat (April 20) where the HAM mode was used. The system was timed with PPS signal and ASCII datation string from the AIR4 Trimble GPS receiver.

Installation, ground test and test flight were performed with assistance from RST engineer H. Lentz in Kangerlussuaq. No problems occurred. The data were logged on the dedicated hard-disks in the ASIRAS PCs during flight and transferred to the PCs for backup after surveys. The data was backed up on hard-disk after the flights with a second copy on a spare set of disks.

Data were acquired continuously over the main sites and for parts of the other survey lines. The operator log files can be found in the Appendix together with a list of the recorded data files.

The data quality has been checked after each survey flight with the “Quicklook viewer” software from RST. Especially for the corner reflector sites the data were carefully checked. Examples can be found in the specific site descriptions, Section 5.

The processing of the acquired ASIRAS data was done by AWI with input of GPS position and INS attitude data from DTU Space. Figure 11 briefly outlines the processing of ASIRAS L1b data. Plots, showing ground track and height estimates from the OCOG retracker, of all processed ASIRAS profiles can be found in Appendix 8.6.

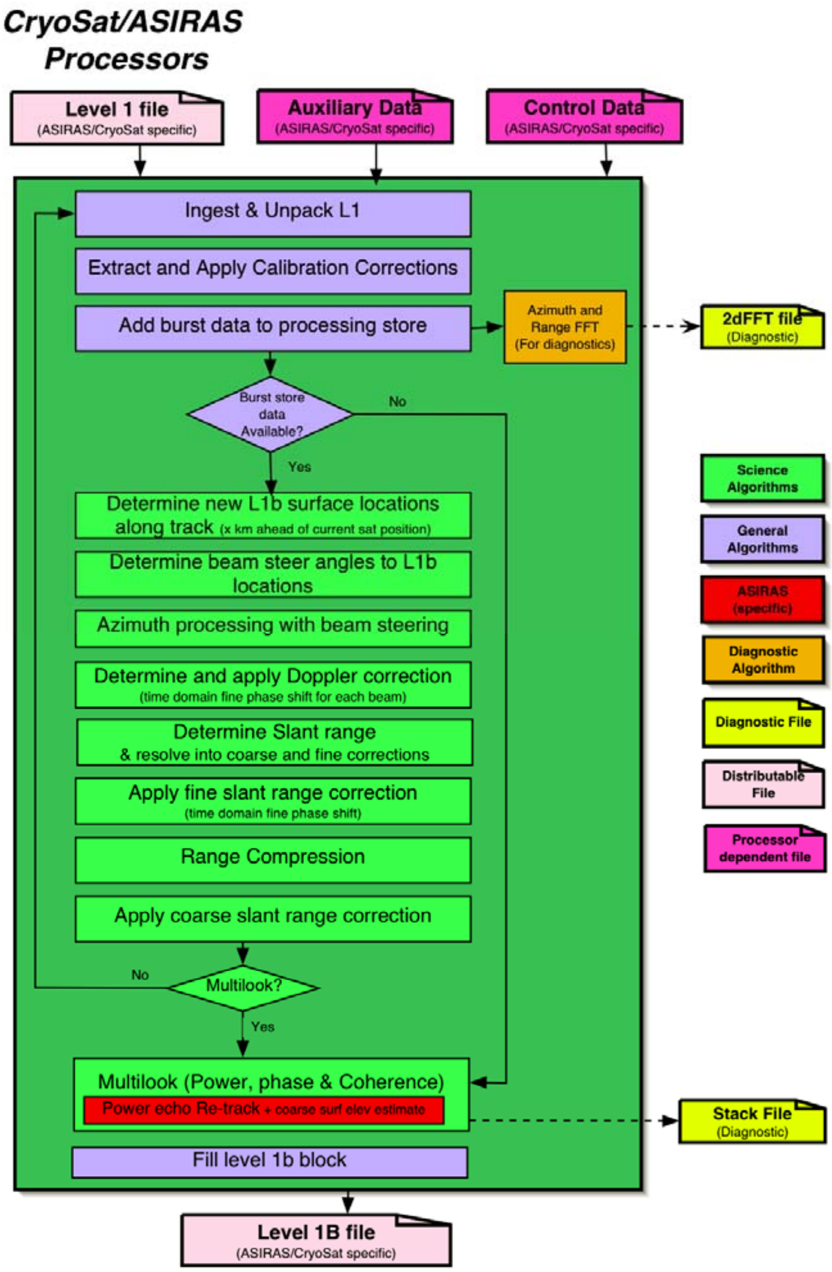


Figure 11. ASIRAS processing scheme.

4.4.1 CryoVEx 2008 ASIRAS processing results

The ASIRAS processing of the CryoVex2008 data is analogous to the concepts already presented in Helm et al. (2006). The full data set was processed with ESA's processor version ASIRAS_04_02. A summary of the processing is given in Appendix 8.6 and Appendix 8.7 gives plots of every single profile. A couple of tests were applied to address datation issues and to show the quality of the Level_l1b product (see Section 4.4.2, 4.4.5). In general the data shows no datation errors and in most cases good quality, however in some specific areas the re-tracked elevation shows a lack of quality. Similar results were obtained and highlighted in former reports (e.g. Helm et. al, 2006; Stenseng et al. 2007) and therefore are not shown here again, since the implemented OCOG retracker has not changed. The OCOG was developed to give a quick and rough estimate of surface elevation and not to be as precise as possible. Therefore it is up to the user of the data to apply different re-tracker algorithms instead of the OCOG.

4.4.2 Runway over flights and comparison with ALS-DEM

Runway over flights where performed at St. Nord at 27th April. Figure 12 shows the laser scanner elevation model of the St. Nord runway. ASIRAS profile A080427_26 was used to calibrate the system with the ALS-DEM. In Figure 13 the comparison is shown. The black line in the upper panel shows the ALS elevation, whereas the dark gray line shows the ASIRAS elevation. The light grey line shows the roll, which is close to -1.0° for this section. A difference of approx. 3.22 m and 3.47 between both elevations is determined with the TSRA and OCOG retracker respectively. The lower left panel shows the variation of the difference around the median value. Statistics of this variation is shown in the histogram. To mention, the above calibration was done with ASIRAS elevation values where the absolute value of the roll angle did not exceed 1.2°. Furthermore for this profile no time shift was determined.

Table 8: Runway calibration

Profile	Time start	Time stop	Tshift [s]	Mean [m]	Median [m]	Stddv [m]	Remark
A080427_26	54286	54311	0.0	3.47	3.47	0.02	OCOG
A080427_26	54286	54311	0.0	3.22	3.22	0.02	TSRA

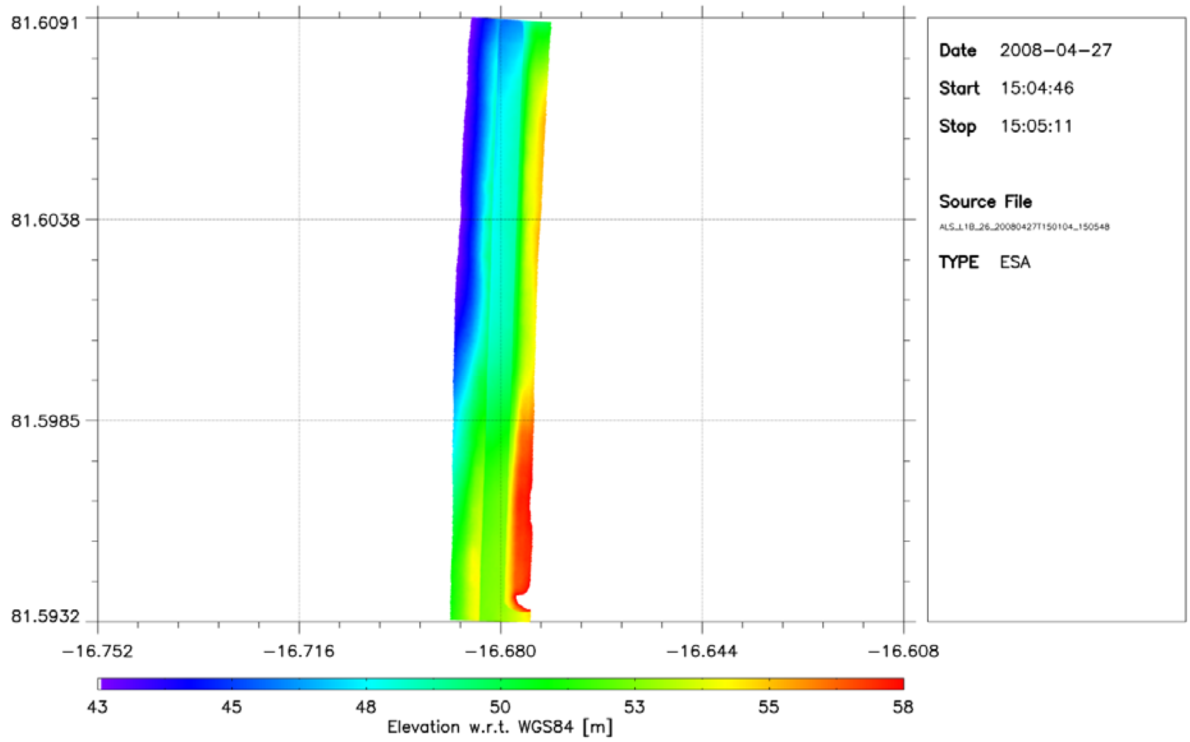


Figure 12: Laser scanner elevation model of runway in St. Nord

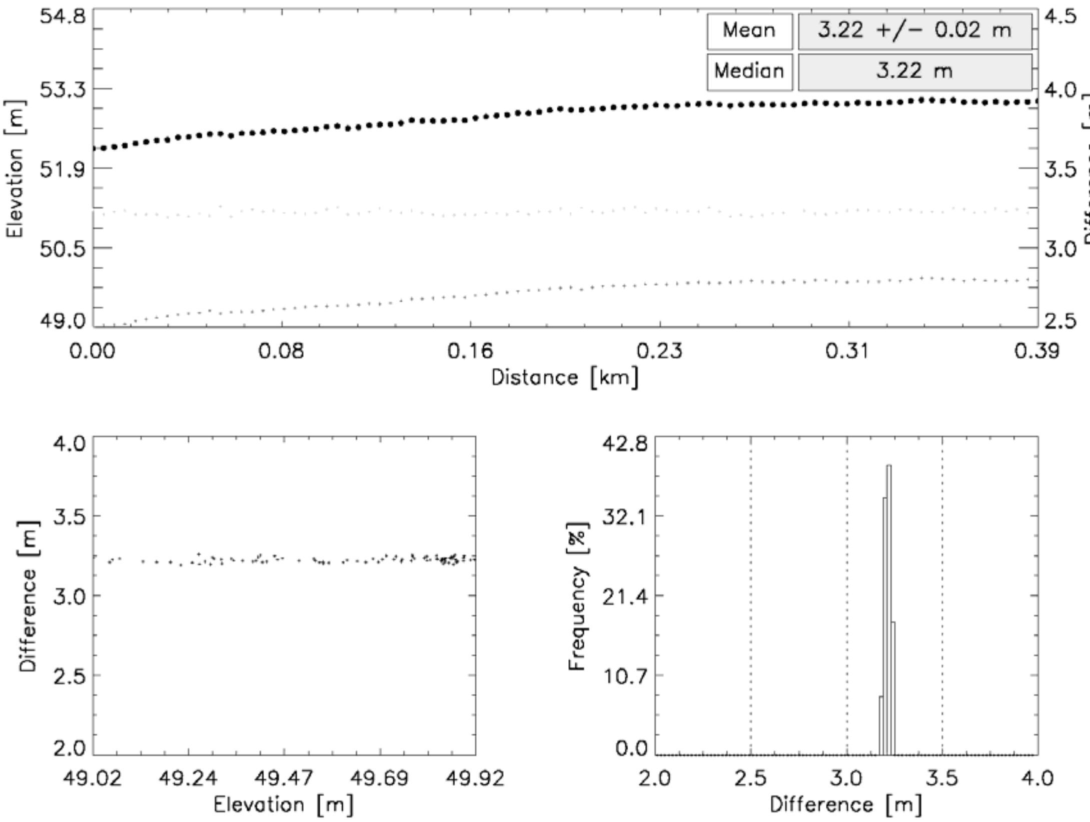


Figure 13: Comparison of ALS and ASIRAS elevations over runway. Top shows ALS elevation in black dots, ASIRAS elevation in grey dots and the light grey line shows the Roll angle. Bottom left shows the variation of the difference around the median and bottom left

4.4.3 Correction of elevation steps caused by frequency shifts in LAMA

During acquisition the operator has the possibility to steer the range window manually. This manual steering becomes necessary over steep terrain or great air turbulences where the signal might be migrating outside the range window. For HAM mode, where the range window is very small (24 m) this steering is necessary and window shifts can be handled by the processor. However for the LAM mode with its larger range window (360 m) this steering was not that necessary and therefore a correction was not implemented in the former processor versions.
However for LAMA the 90 m range window is sometimes not large enough to catch large topographic changes and therefore the signal migrates out of the window, which means data loss. The only way to avoid data loss is to steer the range window manually during the acquisition. Former processor versions were not able to handle this kind of window steering in LAMA and therefore elevation steps occurred. An example is given in Figure 14. In the new processor version ASIRAS_04_02 the correction for window steering is implemented. Figure 15 shows the same profile section processed with the updated processor version. Steps are corrected now and the data can be used for further analysis. Some areas (around 0.7 km and 1.3 km) still show data loss. This is caused by the migration of the signal out of the range window and is not a processing issue. All profiles with window steering are marked with Fcomp in the processing table in Appendix 8.5.

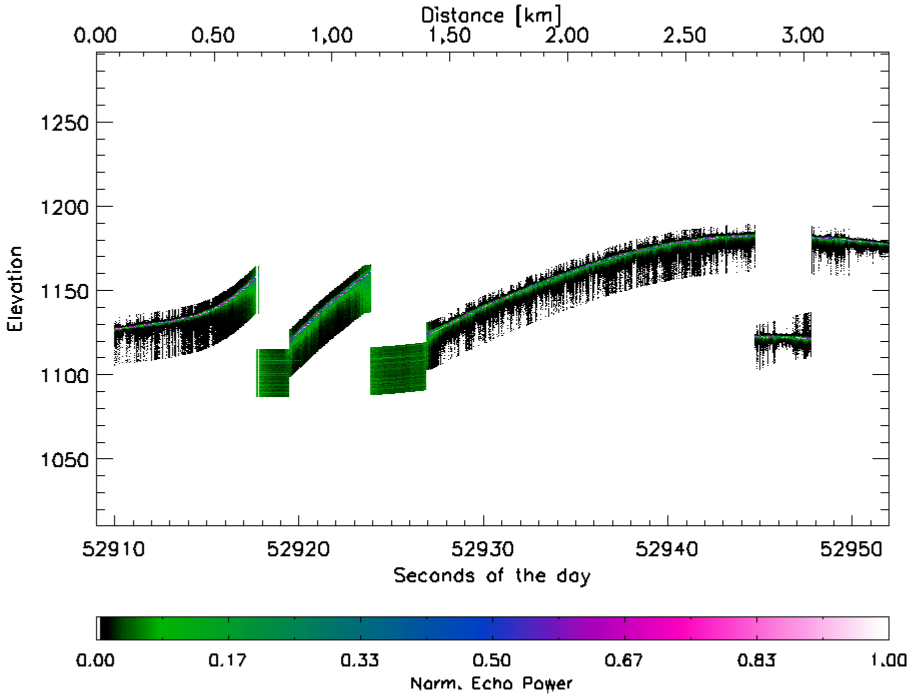


Figure 14: Elevation steps caused by window steering during operation in LAMA mode

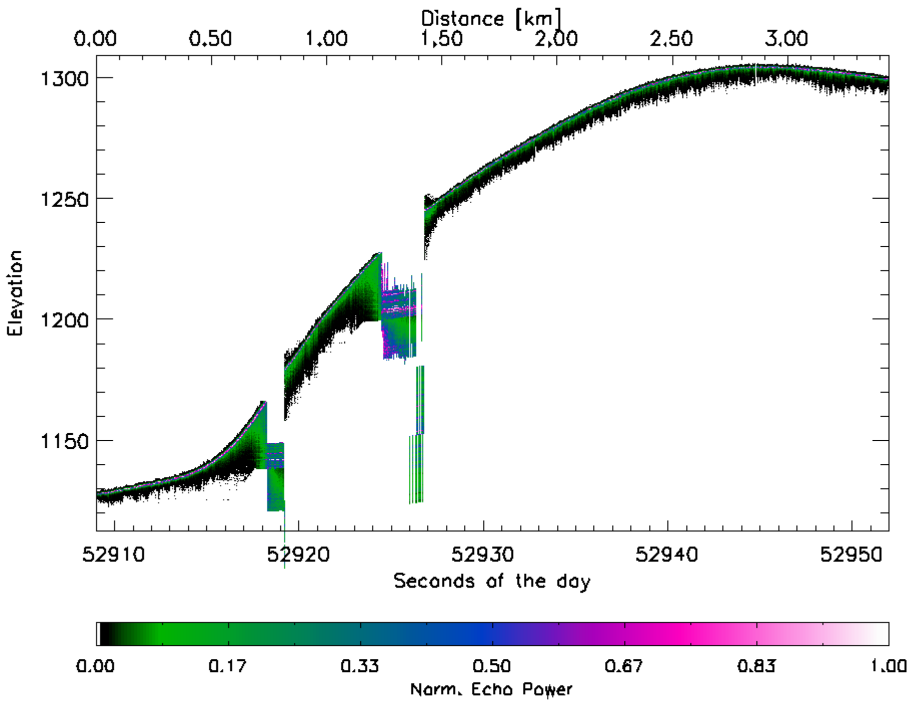


Figure 15: Corrected elevation steps reprocessed with the new processor version ASIRAS_04_02.

4.4.4 Corner reflector over flights

Throughout the campaign there have been over flights of the corner reflectors put out at the test sites. The positions of all the corner reflectors can be found in Table 12. All CR-passes were analysed and successful hits are listed in Table 9. It can be seen that all but one CR were hit at least one time. An example of Level_1b processed ASIRAS data of the CR pass over the Devon validation site is shown in Figure 16. The CR was hit around 0.45 km (49078.5 s) and appears after processing as point target roughly 2 m above the surface. Successful CR passes are used for datation issues, described in section 4.4.5.

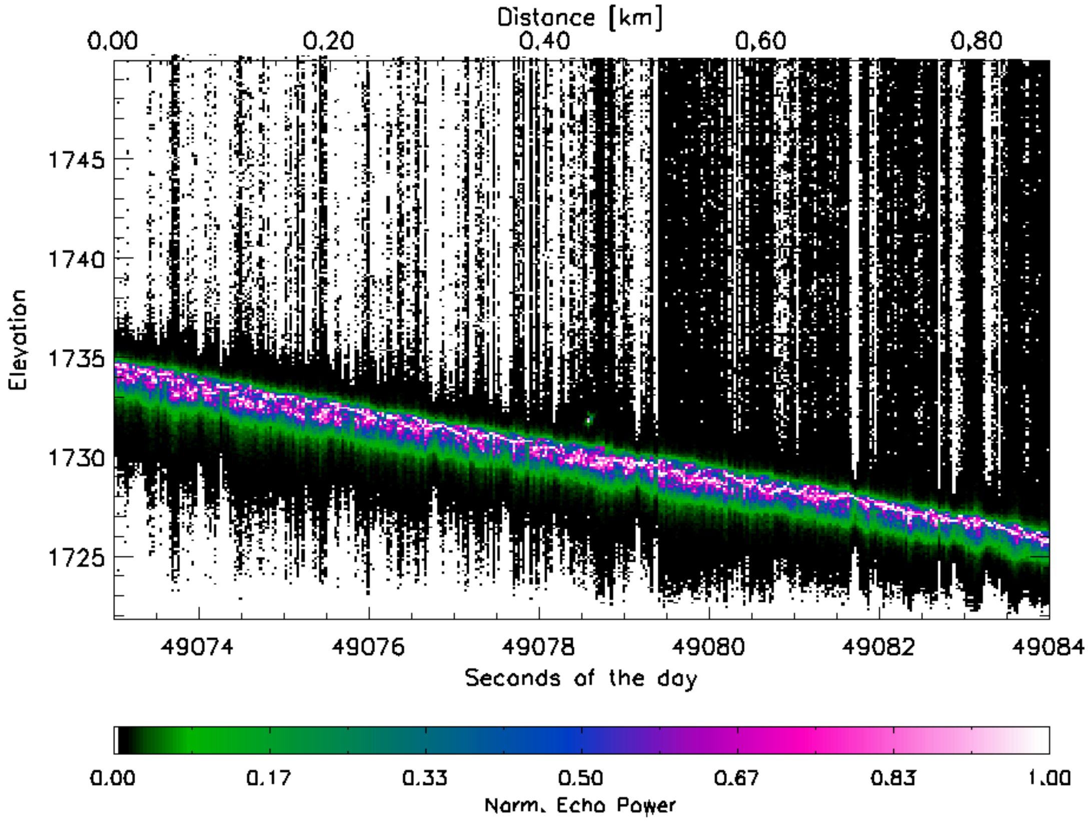


Figure 16. Example of a CR pass over the Devon validation site. The CR appears after processing as point target roughly 2 m above the surface at approx. 0.45 km (49078.5 s).

4.4.5 Datation tests

Two different types of tests were applied to investigate the datation issue. The first test uses ground positions of the corner reflector and compares them to the position derived from the analysis of raw ASIRAS echoes. Here we found small time shifts which are varying between
-0.02 s and -0.08 s, see Table 9. The reason for those small time shifts might be the positioning inaccuracy of the CR positions or the flight track itself. Assuming a positioning inaccuracy of around 5 m easily one gets time shifts of up to 0.08 s. This exactly reflects the range of time shift which is observed in our analysis. Furthermore

profiles A080501_25, A080501_26, A080501_30 show different time shifts for different CR, which is also an indication of imprecise CR positions.
Summarizing, the CR analysis can only be used when the CR position is known to better then 1 m. Otherwise the results are not reliable. Nevertheless, the results give an indication if instrument or processing based time shifts are present, which is not the case.
To verify this indication another procedure is necessary.

Table 9: ASIRAS time shifts determined by corner reflector analysis

CR	Profile	Closest approach	Time	Time shift
08FYIE	A080501_30	1.78	72087.37	-0.07
08FYIW	A080501_29	5.10	71594.41	-0.08
08FYIW	A080501_30	2.52	72082.88	-0.05
08FYIW	A080501_33	2.51	73505.17	-0.08
08MYIN	A080501_24	1.71	68986.41	-0.04
08MYIN	A080501_25	3.58	69452.46	-0.08
08MYIN	A080501_26	0.65	69986.50	-0.04
08MYIS	A080501_25	7.92	69446.10	-0.03
08MYIS	A080501_26	1.88	69992.85	-0.08
08MYIS	A080501_27	0.47	70452.92	-0.02
08MYIS	A080501_28	1.77	70938.78	-0.08
08DEV68	A080506_07	0.81	49078.49	-0.05
08DEV66	A080506_08	4.94	50824.25	-0.07
08DEV66	A080506_09	0.87	52215.54	-0.03
08DEV67	A080506_10	1.19	53272.56	-0.06

Therefore in the second test a comparison of the ASIRAS surface elevation with the laser scanner elevation model in small sections of some profiles were used. Details of the procedure are described in Helm et al. (2006). Table 10 show results from the comparison of profile sections around the corner reflector positions. Additional we tested 50 seconds long sections at the beginning and at the end of the profiles to exclude possible linear time shifts. In all test cases we did not find any indication for a time shift. An example of the ASIRAS-ALS comparison is given in Figure 17. It shows the comparison of ASIRAS and ALS elevations and its statistics. ALS and ASIRAS elevation match very good, which wouldn't be the case if a time shift exists. The difference of 0.08 m +/- 0.07 shows small penetration of the radar wave into the firn.
In summary we conclude that level_1B data measured with the upgraded ASIRAS instrument and processed with the ASIRAS processor version ASIRAS_04_02 shows no time shifts anymore.

Table 10: ASIRAS time shift determined by comparison with ALS elevation model

Profile	start	stop	tshift	Mean	Median	Stddev
A080501_24	68951	69001	0.00	0.02	0.02	0.13
A080501_25	69421	69471	0.00	0.03	0.03	0.11
A080501_26	69974	70014	0.00	0.04	0.04	0.12
A080501_28	70925	70965	0.00	0.18	0.17	0.13
A080501_29	71570	71620	0.00	0.20	0.20	0.10
A080501_30	72055	72105	0.00	0.17	0.17	0.09
A080501_33	73480	73530	0.00	0.05	0.05	0.06
A080506_07	49065	49115	0.00	0.14	0.13	0.10
A080506_08	50784	50834	0.00	0.07	0.07	0.06
A080506_09	52200	52250	0.00	0.12	0.11	0.08
A080506_10	53250	53300	0.00	0.08	0.07	0.08

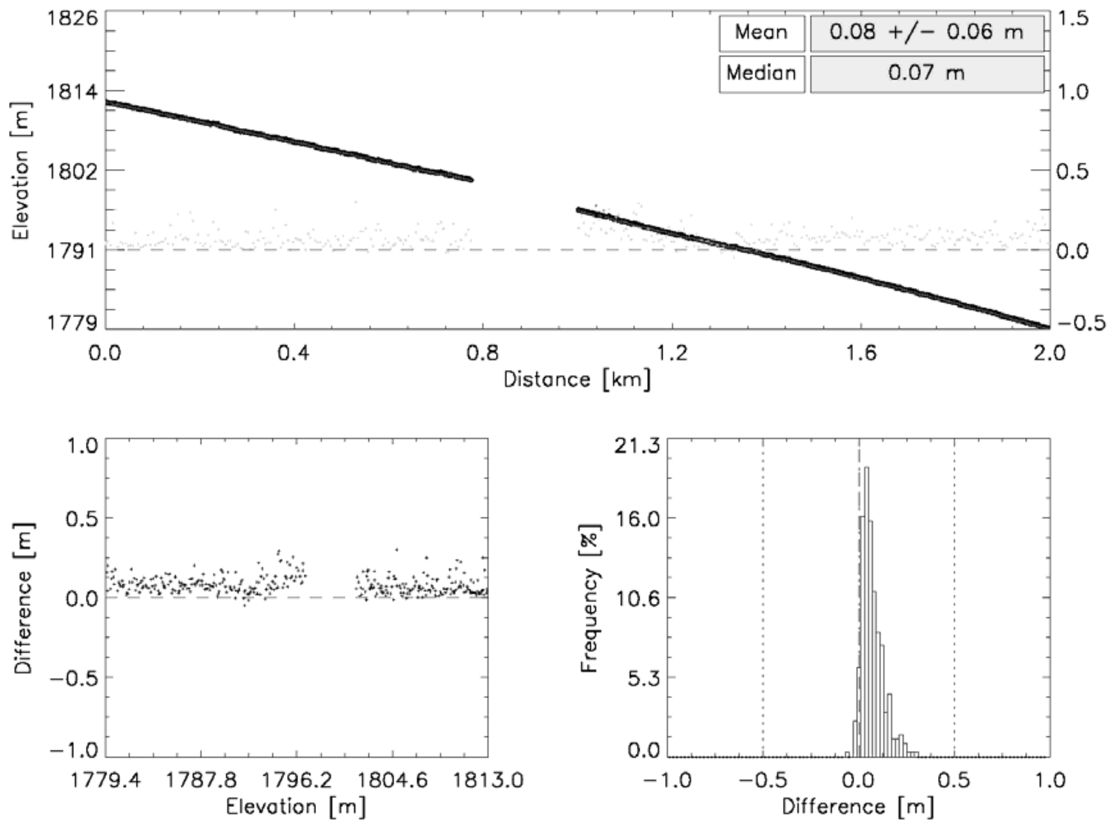


Figure 17: Comparison between ASIRAS elevation of profile A080506_10 and ALS elevation.

4.5 Auxilary data

During the survey flights operator logs were kept for both the DTU Space laser scanner and the ASIRAS radar system. These logs have been stored as separated files together with the data files and can also be found in the Appendix.

An extra inertial navigation unit was run as backup to the EGI instrument. These instruments were all timed by 1 PPS signals from GPS and data has been recorded on a dedicated PC and backed up post flight.

A downward looking camera was installed next to the laser scanner and operated during flights acquiring visual documentation of the surface. The camera, uEYE UI-2240RE-C (with KOWA LM4NCL 3.5 mm lense) with 1280x1024 resolution (see also http://www.ids-imaging.com/frontend/products.php?cam_id=60), were set to capture images every 2 seconds. The image files were stored on a laptop PC during flight and backed up on hard-disk after each flight.
The images from the downward looking camera were triggered by GPS pulse via the IMU datation system. This means that a precise time (better than 10 msec) can be assigned to each image. Geolocation is done using the airplane position at the time of image acquisition. The synchronisation of the timing between camera and GPS positioning is done by comparing images to the surface elevations from the laser scanner.

Table 11. Downward looking camera image synchronisation

Day of year	Offset (sec)
109	-7201
111	7
118	8
119	32
120	11
122	10
123a	19
123b	23
126	30
127	11

An example is shown in Figure 18 from the over-flight of the AWI helicopter EM bird on May 2nd.

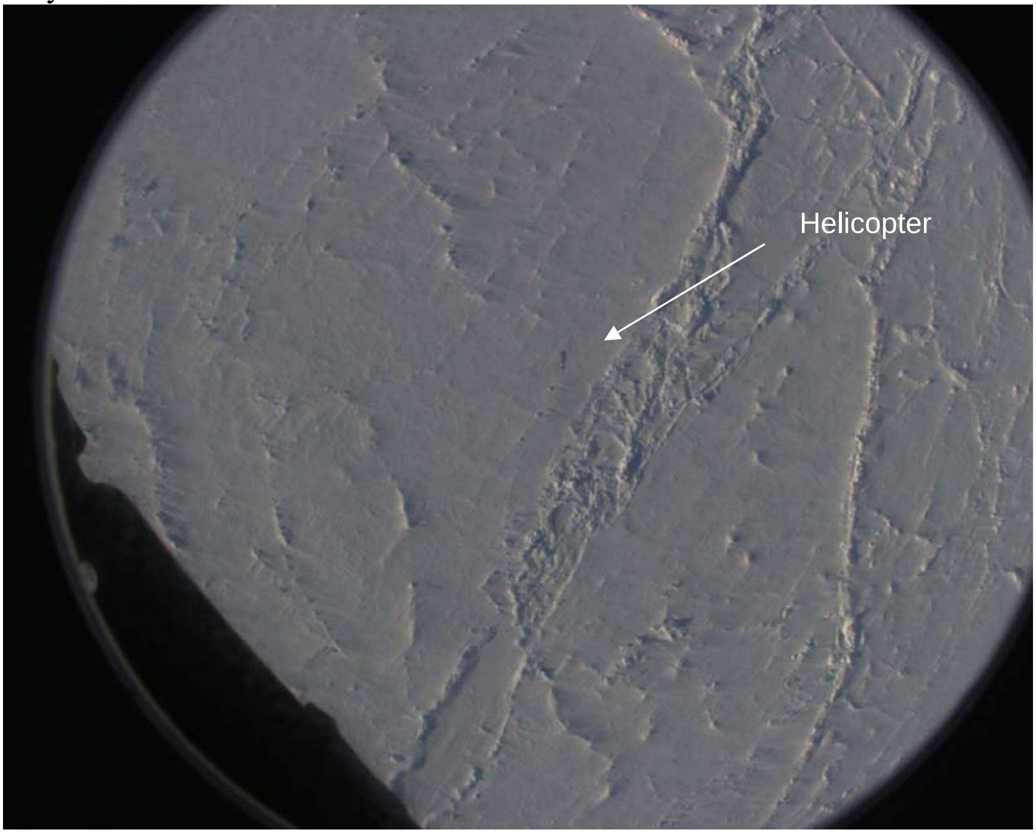


Figure 18. Image from downward looking camera of the helicopter over-flight at 21:26 UT on May 2nd 2008.

5 Validation Sites

One of the main goals of the CryoVEx 2008 campaign was to gather coincident laser scanner and ASIRAS data over specific validation sites with scientist doing in-situ observations on the surface. At these sites corner reflectors were raised and the positions are listed in Table 12.

Table 12. CryoVEx 08 Corner Reflector Positions

Name	Latitude (deg min sec)	Longitude (deg min sec)	Latitude	Longitude
ICE2	79 0 0.919 N	50 0 26.959 W	79.0002555	-50.0074887
FYIE	82 32 46.572 N	62 34 50.880W	82.54627	-62.56808
FYIW	82 32 52.008 N	62 35 8.340W	82.54778	-62.58565
MYIS	82 33 22.824 N	62 33 33.696 W	82.55634	-62.55936
MYIN	82 33 36.540 N	62 33 43.308 W	82.56015	-62.56203
CAMP	82 33 3.6 N	62 34 30 W	82.551	-62.575
DEV_066	75 20 17.803 N	82 40 40.599 W	75.33828	-82.67794
DEV_067	75 20 17.112 N	82 40 38.733 W	75.33809	-82.67739
DEV_068	75 20 16.485 N	82 40 37.002 W	75.33791	-82.67695

Note: DEV_067 is the central CR at the cross of lines at Devon Ice Cap
More details about each validation site are found in the next paragraphs.

5.1 Northern Greenland Ice Sheet - UK1

The UK1 team was positioned at the ice with the Air Greenland Twin Otter reg. OY-ATY from Thule Air Base. This “put-in” of the team was delay a few days caused by poor weather along the Greenland west coast but the UK team managed to be ready for the planned over-flight.
The UK1 site on the ice sheet was over-flown with the airborne laser and radar system on April 29. The reflector at the site (named ICE2) was passed from north and two times from east to west. The best hit of the reflector was the first pass from the north. Figure 19 shows a “Quicklook” image of the ASIRAS radar signal from the corner reflector at ICE2.
Thereafter the full transect was flown form ICE2 to ICE4 and the survey continued back to Alert over the Petermann glacier. Figure 20 shows the laser scanner elevation data acquired near ICE2.

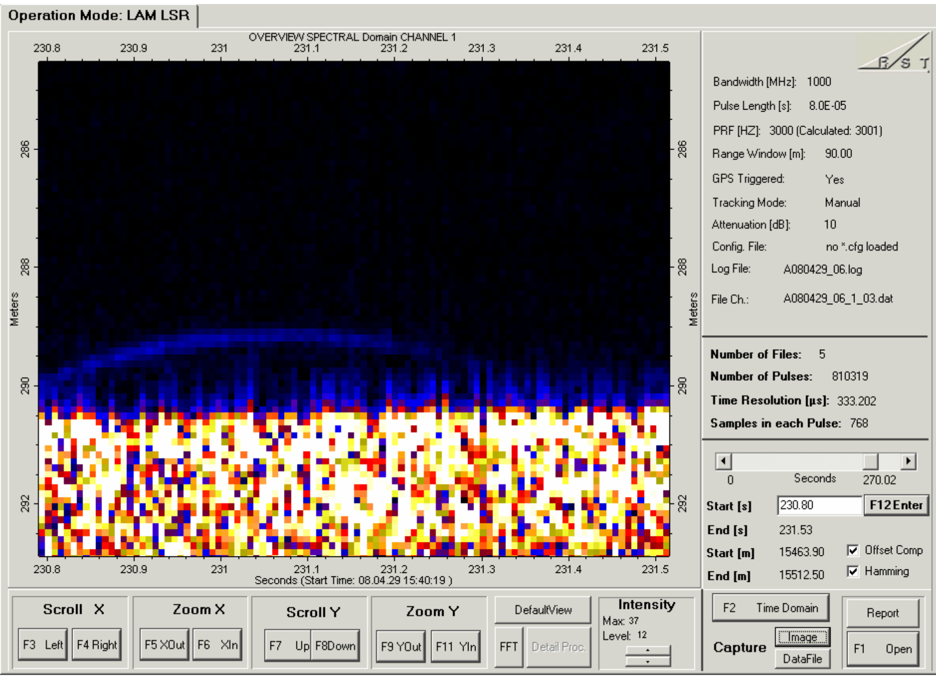


Figure 19. "Quicklook" image showing radar signal from the corner reflector at ICE2

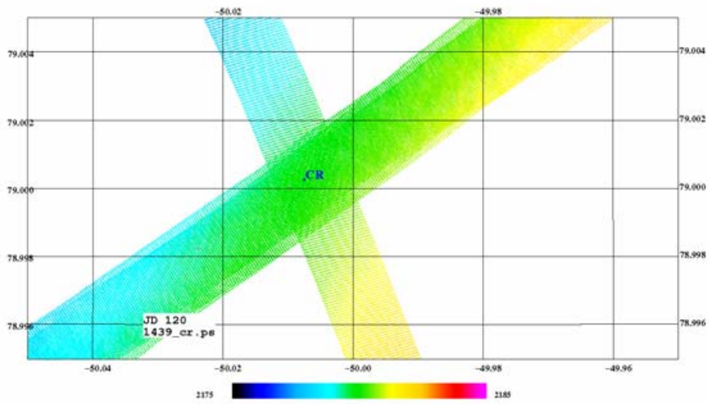


Figure 20.Stacked laser swaths of the over-flights of the ICE2 validation site April. 29.

5.2 Alert Sea Ice

The operations out of Alert focused on the validation sites near the coast on multiyear ice (MYI) and first year ice (FYI) and coordinated operations with the helicopter-borne EM bird system. In addition, longer surveys were carried out in the Arctic Ocean north-east and north-west of the station and a smaller survey near the AUV camp on the sea ice near Alert.

As describe in section 2 the flights were done on May 1st-2nd and May 5th. Figure 21 shows the details of the flight lines over the validation sites flown on May 1st. Both sites were over-flown repeatedly and in two altitudes 1000 ft and 1500 ft. At both sites two corner reflectors had been put up and these were hit more than once at each altitude.

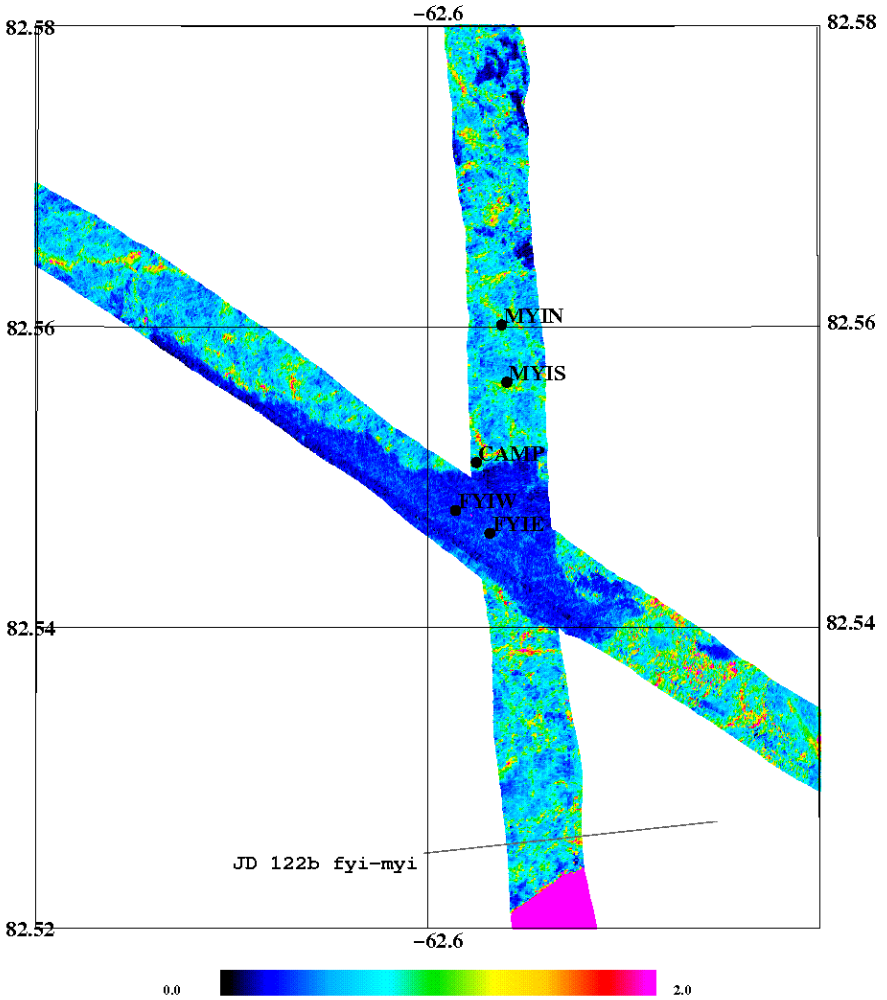


Figure 21.Stacked laser scanner swaths from sea ice validation sites near Alert (heights are freeboards relative to the local sea level). Over-flight performed on May 1.

A coordinated flight with laser/radar from Twin Otter and EM from a helicopter was done in the afternoon on May 2nd. The helicopter was over-flown near the fuel cache laid out to enable a longer operation. The helicopter was definitely hit within the footprint of ASIRAS as it is clearly seen on the radar return, see Figure 22.

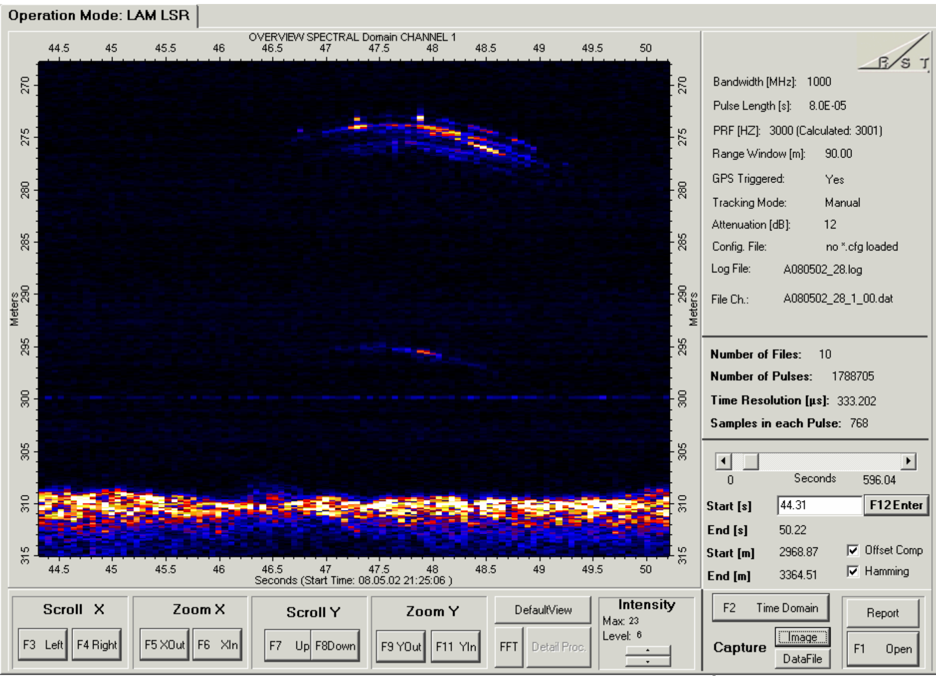


Figure 22. "Quicklook" image of helicopter over-flight on May 2nd. Note the reflection from both the helicopter itself and the EM bird below it

5.3 Devon Ice Cap

The Devon site was surveyed on May 6th. It was planned to base the survey in the local settlement Grise Fiord but the weather did not favour this very small airfield and the base was moved to Thule Air Base. The main survey lines (E-W and N-S), see Figure 23, were observed twice to ensure good alignment over corner reflectors put up at the line crossing and at a handful other sites along the lines.

The reflectors were hit and also two additional lines were measured, as requested by the Canadian team on the Devon Ice Cap, before returning the aircraft to Thule.

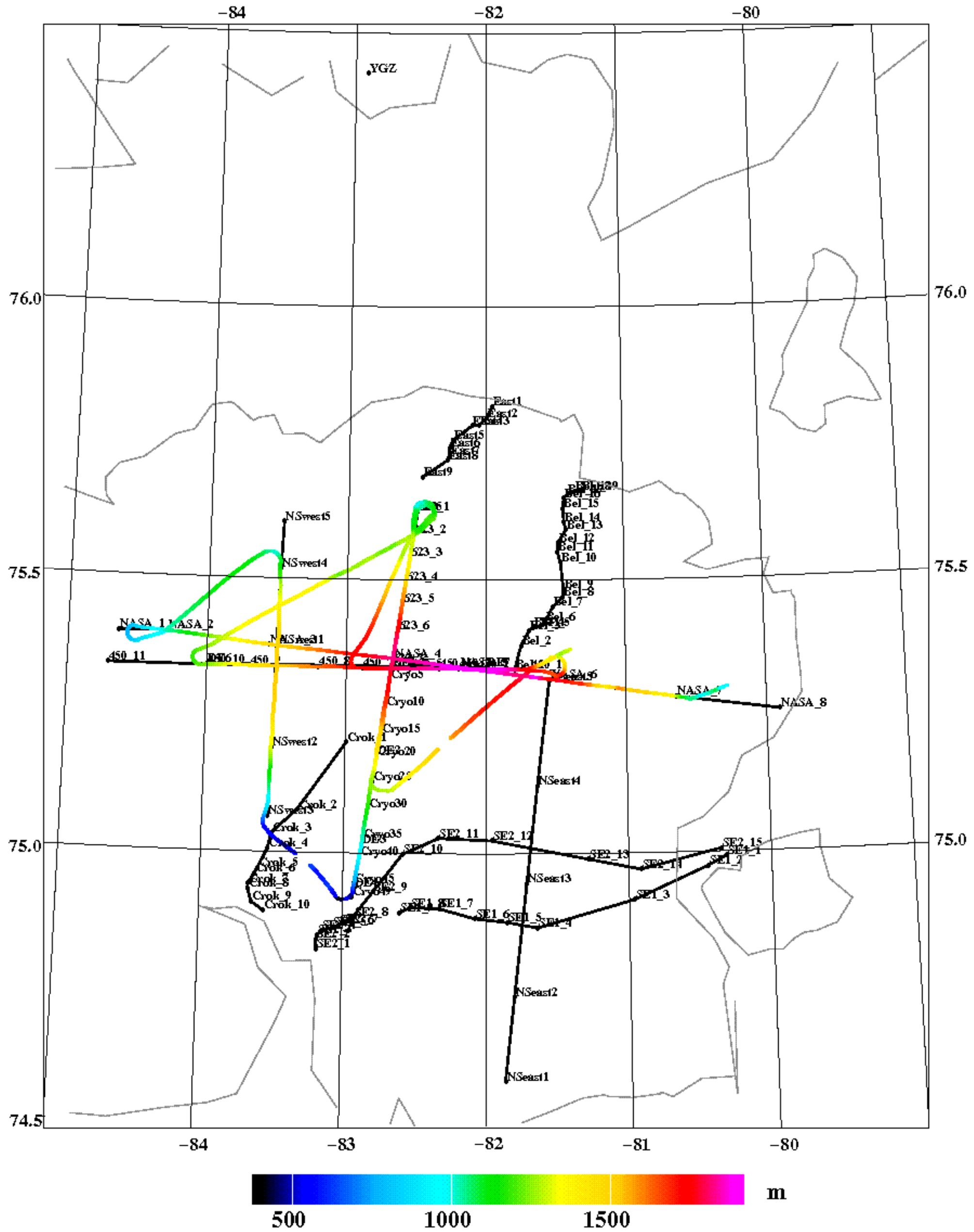


Figure 23. Laser scanner swaths of the Devon Ice Cap survey on May 6th(colour coded heights relative to the WGS84 ell.). (In black: The planned lines – some on opportunity basis and not all observed)

5.4 Others: Ilulissat and Fram Strait

On April 20th the EGIG line crossing the Greenland ice sheet between 70 and 72 N was surveyed. A line, similar to the future CryoSat tracks, was also flown on this flight over the inner part of Jakobshavn Isbræ near Ilulissat. This line almost heading N-S was measured both at high altitude (approx. 1100 m above the ice) in HAM mode and at 300 m in LAMa mode together with laser scanner observations (See Figure 10).

The Norwegian coastguard vessel KV Svalbard (see photograph) was on a scientific cruise for the Norwegian Polar Institute in April and May 2008. During the first part of the cruise the ship anchored to an ice floe in the Fram Strait between Greenland and Svalbard. Surface observations were done on this floe from the ship. A survey line on the floe was over flown with the airborne system on April 24th together with sea ice observations on east-west lines along the Greenland coast. The sea ice team on KV Svalbard also erected a corner reflector on the line but it was not hit with the ASIRAS. Figure 25 shows the laser scanner data; note the sea ice drift between over-flights.

Figure 24. KV Svalbard in the Fram Strait (77N25, 7W22) on April 24th 2008

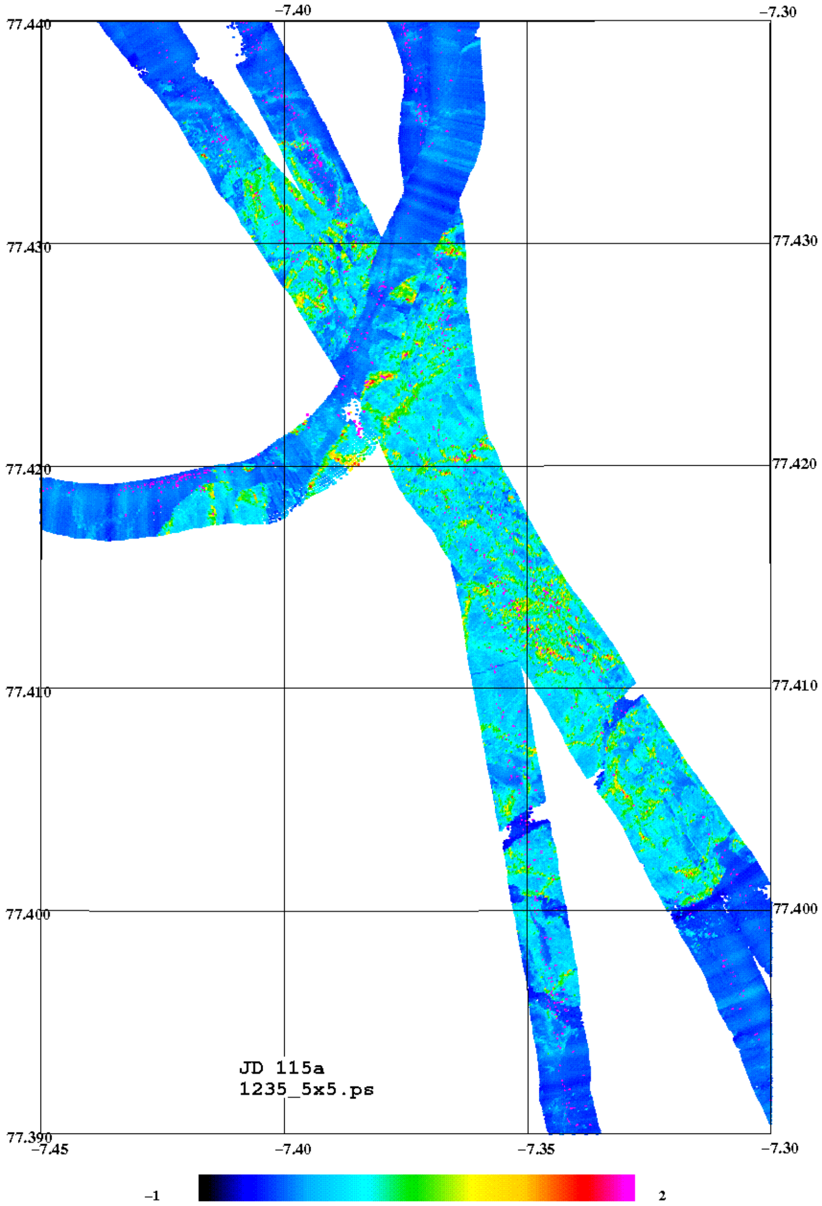


Figure 25. Laser scanner data from the KV Svalbard over-flight. Note that the sea ice has moved significantly during the survey (the crossing track has been observed last).

5.5 EM-bird ice thickness surveys

Two main objectives had to be completed during the Airborne EM (AEM) measurements of the CryoVEx 2008 field campaign:

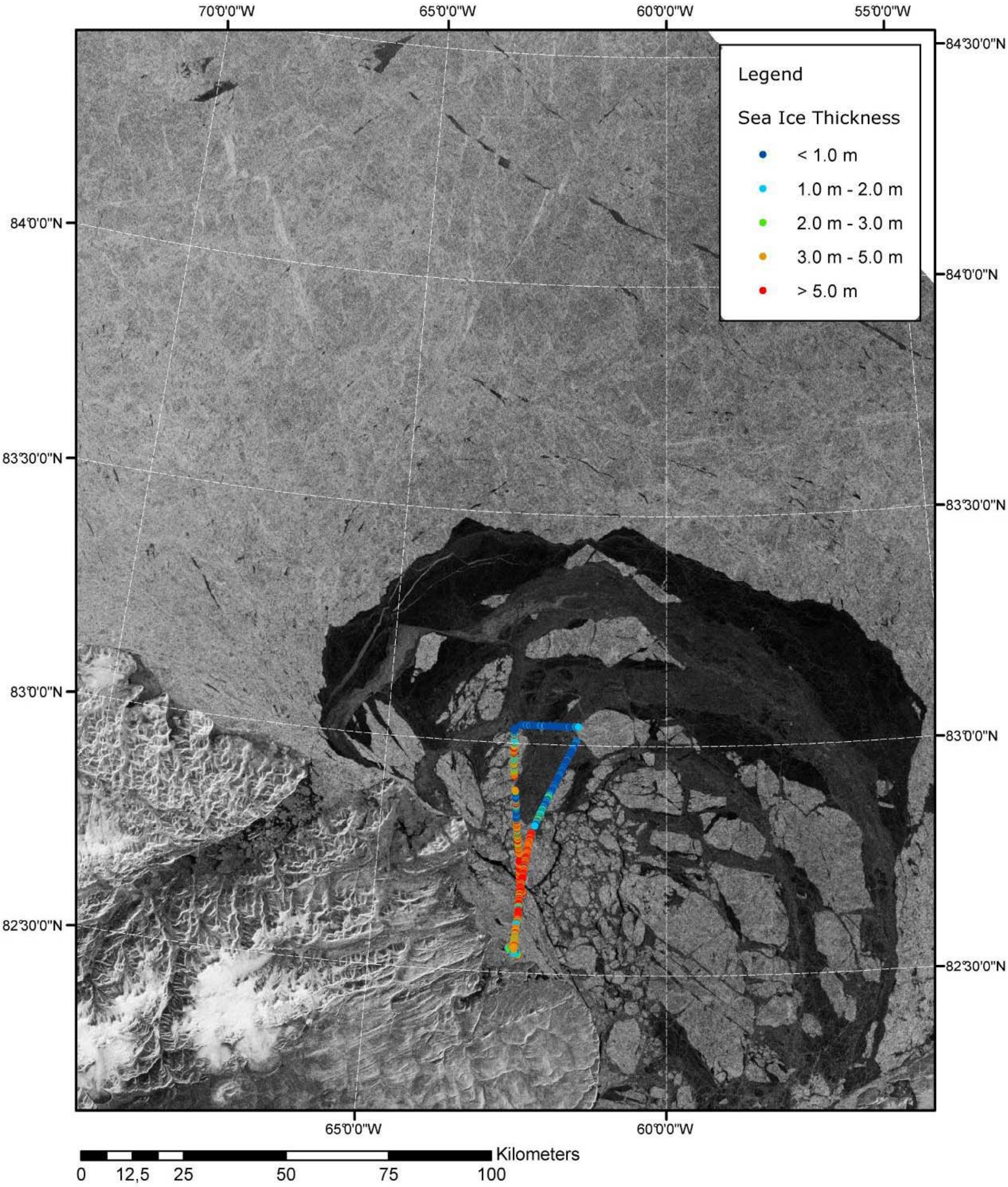
- Sea ice thickness retrieval of two distinct validation sites on FYI and MYI at a scale of several hundred of meters
- Sea ice thickness retrieval coincident with airborne radar and laser altimetry with a length only limited by helicopter range

During the field campaign four dedicated AEM flights were performed, two of them were data collecting flight, while the other two have been used for instrument testing.

Table 13: AEM Flights performed during CryoVEx 2008 sea ice field campaign

Date	#	Description	Data
2008/05/01	1	Short test flight for test of pilot altimeter display	✗
2008/05/01	2	Flight north over mixed FYI/MYI zone, Survey of CryoVEx validation sites	✓
2008/05/02	1	Coincident flight with aircraft in MYI zone along northward profile. Refuelling stop for range increase	✓
2008/05/07	1	Test flight to check sensor behaviour under bad weather conditions (precipitation)	✗

An overview of the data flights is given in the following figures 26a-c. The flight on May 2nd is displayed in two parts because of identical waypoints for the north- and southbound track.

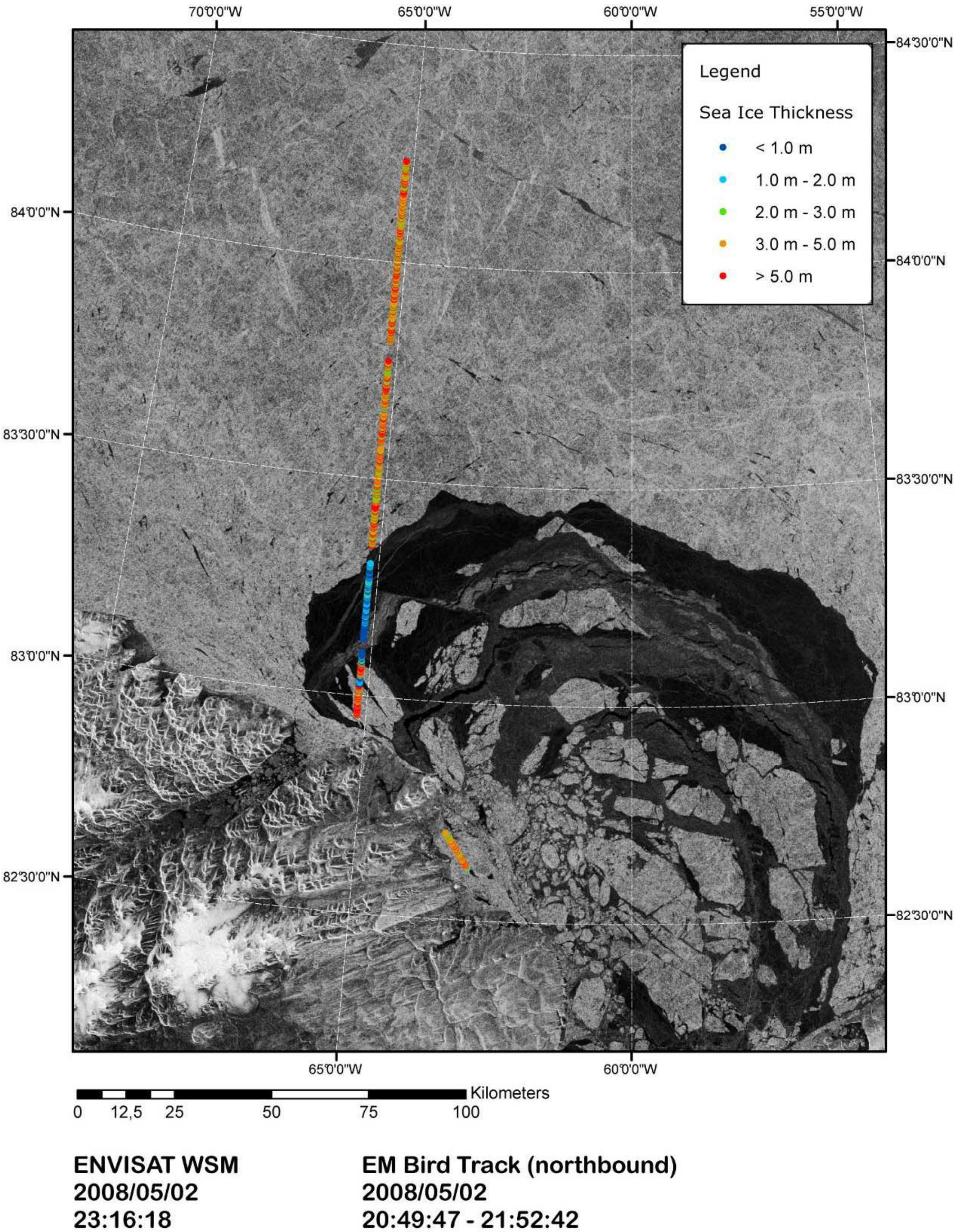


ENVISAT WSM
2008/05/01
17:09:28

EM Bird Track
2008/05/01
19:25:31 - 21:00:01

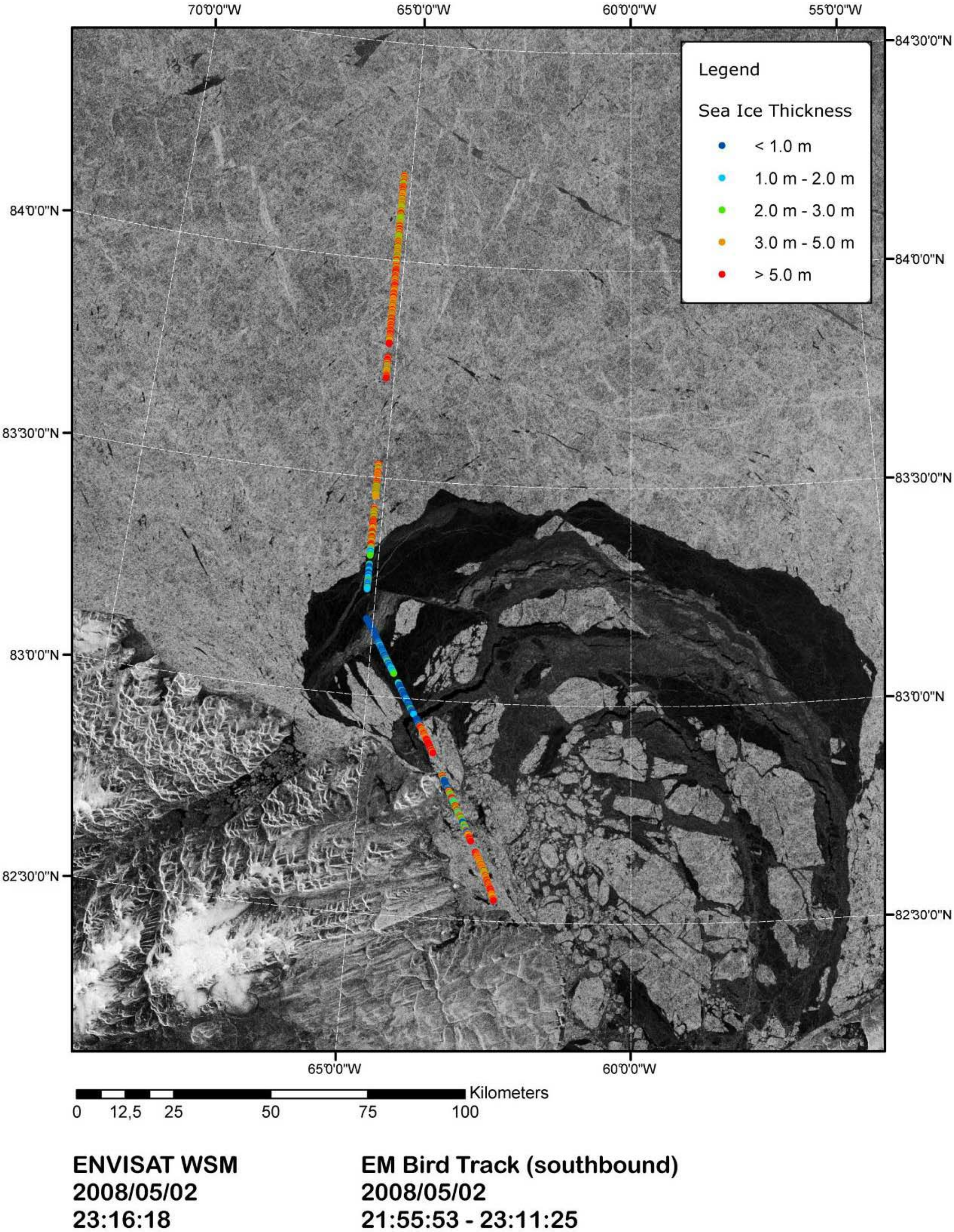
AWI
Sea Ice Physics

Figure 26a. EM Bird data from May 1 2008



AWI Sea Ice Physics

Figure 26b. EM Bird data from May 2 2008



AWI
Sea Ice Physics

Figure 26c. EM Bird data from May 2 2008

5.5.1 Sea Water Conductivity

For data processing the conductivity of the sea water is assumed to be 2500 mS/m based on the experience of previous AEM field campaigns. A check of Inphase altitude dependence over a lead and a analytical solution (Figure 27) confirms the chosen conductivity value.

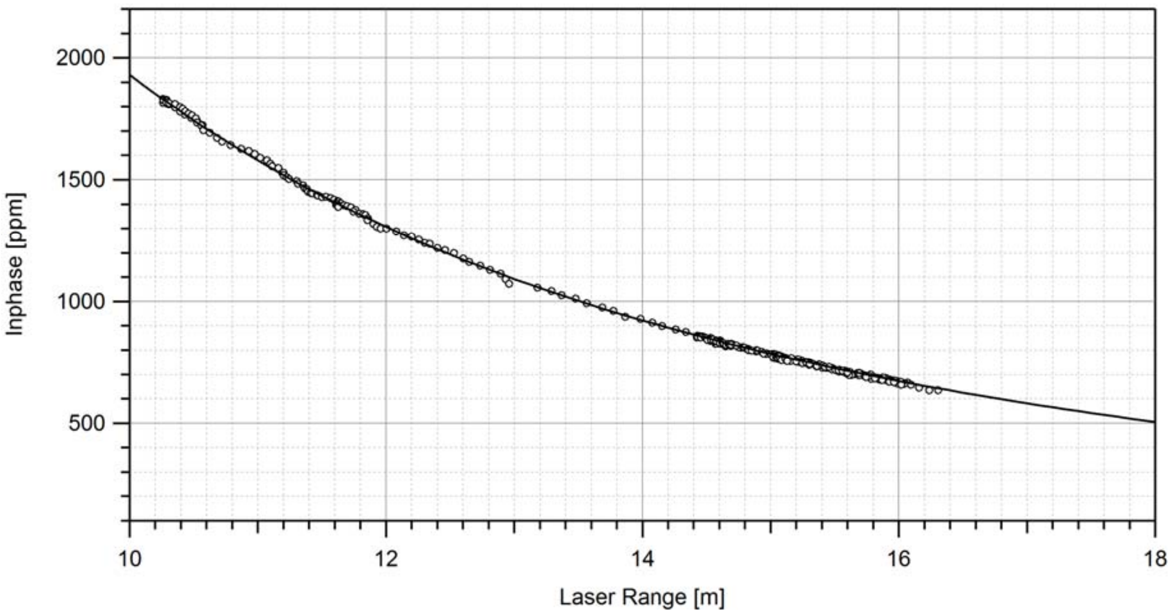


Figure 27: Measured Inphase samples over open water in comparison with analytical response for a 2500 mS/m halfspace model

The purpose of the validation line was to validate radar penetration into different types of snow. Consequently one line way placed on FYI, one on MYI, with both in snow scooter distance to Alert. The lines are defined by radar reflectors at each beginning and end respectively. Along the line ice and snow thickness, freeboard and information of snow properties (snow pits) were measured.
The coincident flight with the ASIRAS Twin Otter aircraft took place along a strict north-south transect. Both aircraft and helicopter surveyed the profile twice with a northbound and southbound leg. During the first northbound leg both sensors met in the middle of the profile. The helicopter turned back at lower latitude than the aircraft, which continued the line northwards. On the southbound leg the helicopter stopped for refuelling on a fuel cache on the line. During the refuelling stop of roughly half an hours the aircraft passed over the helicopter again. Due to the stop the continuous northward profile gives a better temporal agreement of the altimetry and thickness measurements.

5.5.2 FYI Validation Line

The validation line on first year ice had a length of roughly 300 meters. The positions of the corner reflectors were calculated from ground GPS data assuming that the GPS receivers were placed 4.5 meters away from the individual corner reflectors in the elongation of the line.

Table 14: Calculated positions of radar reflectors of the FYI validation site

CR East	62.56834157°E	82.54628932°N
CR West	62.58539133°E	82.54776069°N

Figure 28 shows the repeated overpasses over the validation line. The centre line was surveyed 4 times with high navigational accuracy while two additional passes to the sides (Figure 29) sampled the ice at a distance of 30 to 60 meters to the centre line. Within the validation line sea ice thickness showed only small variations (Figure 30). No significant thickness variations were observed to sides either.

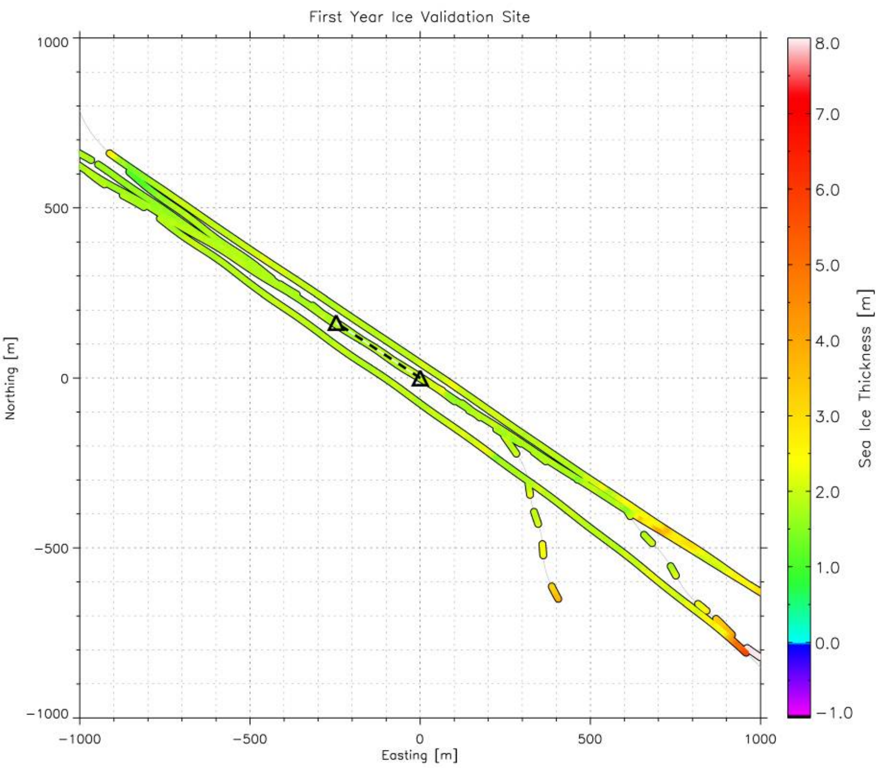


Figure 28: Map of FYI validation site with AEM sea ice thickness measurements. Triangles denote corner reflector positions

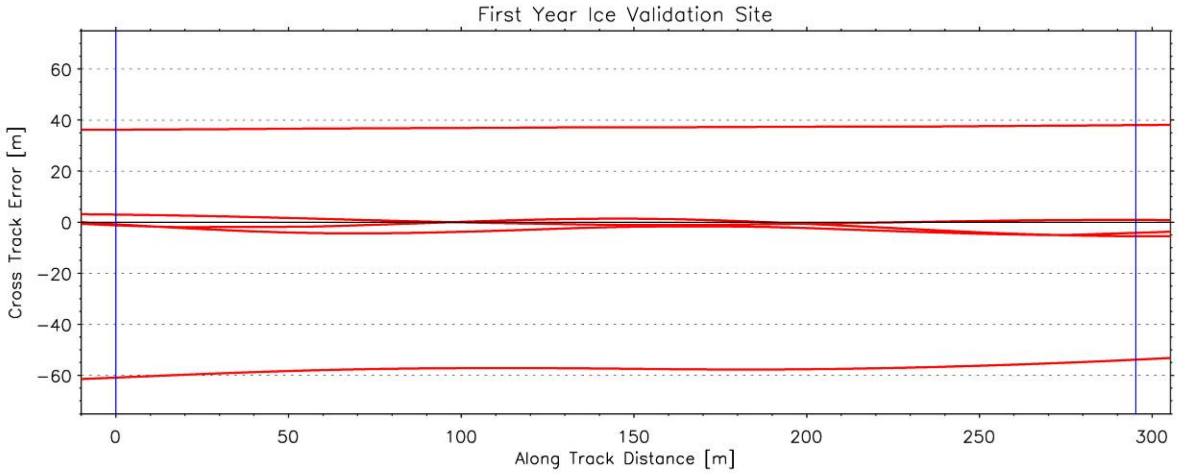


Figure 29: Navigational accuracy over repeated surveys of the FYI validation site. Vertical lines mark corner reflector positions

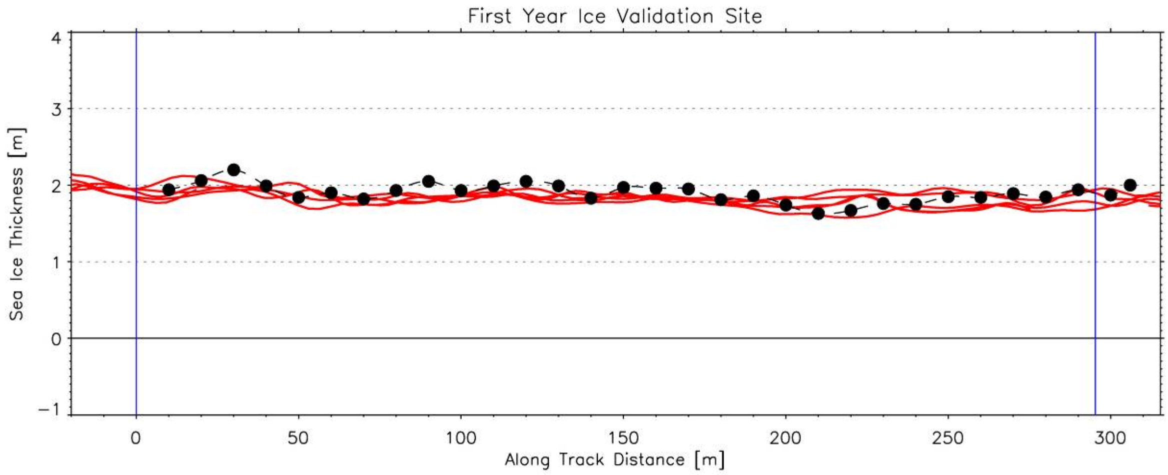


Figure 30: Ground truthing of AEM sea ice thickness with onsite drill hole measurements along the FYI validation site. Continuous line: AEM data, Black dots: Drill hole measurements (snow depth+ice thickness). Vertical lines mark corner reflector positions

5.5.3 MYI Validation Line

The validation line on the multiyear ice showed significantly higher ice thickness and thickness variations. On this site overpasses with an offset to the centre line were omitted leaving 4 repeated surveys. The length of the line amounts to roughly 430 meters with a more north-south orientation (Figure 31). Again navigational accuracy was better than 5 meters, yielding good agreement between the thickness results of the different overpasses (Figure 32 and Figure 33).

Table 15: Calculated positions of radar reflectors of the MYI validation site

CR South	62.55937823°E	82.55638013°N
CR North	62.56200374°E	82.56010987°N

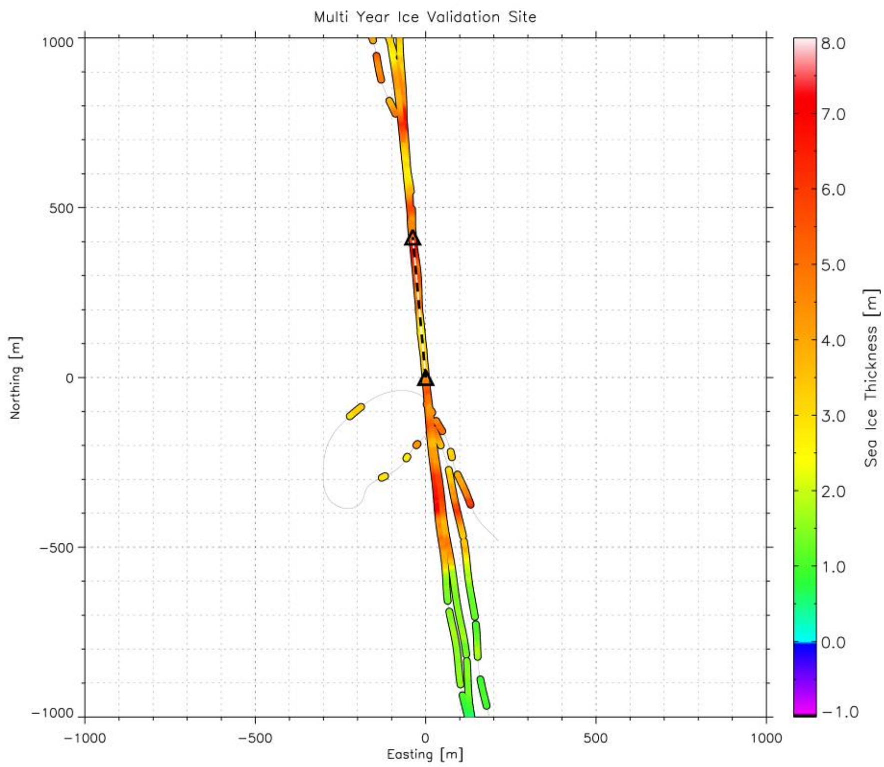


Figure 31: Map of MYI validation site with AEM sea ice thickness measurements. Triangles denote corner reflector positions

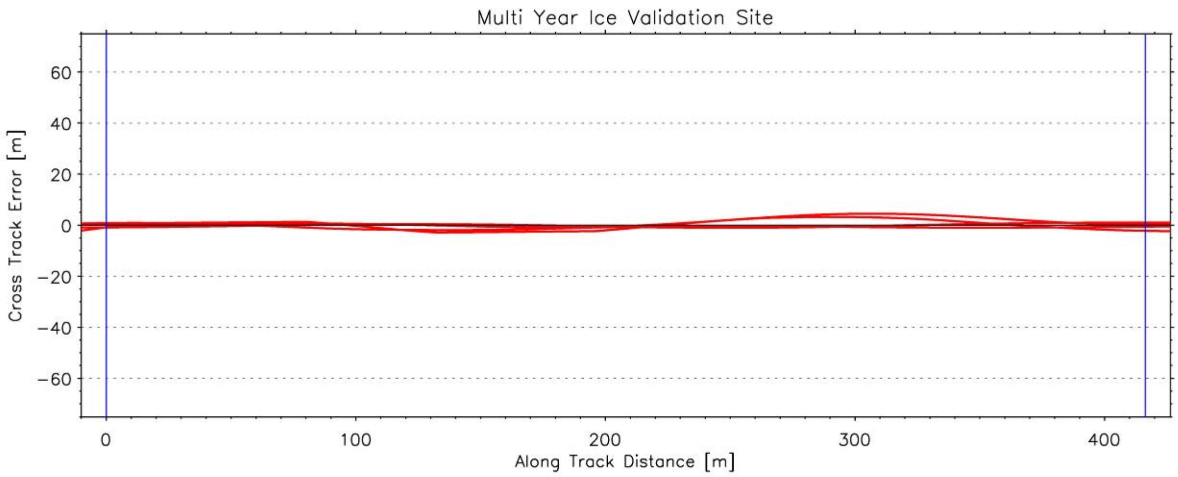


Figure 32: Navigational accuracy over repeated surveys of the MYI validation site. Vertical lines mark corner reflector positions

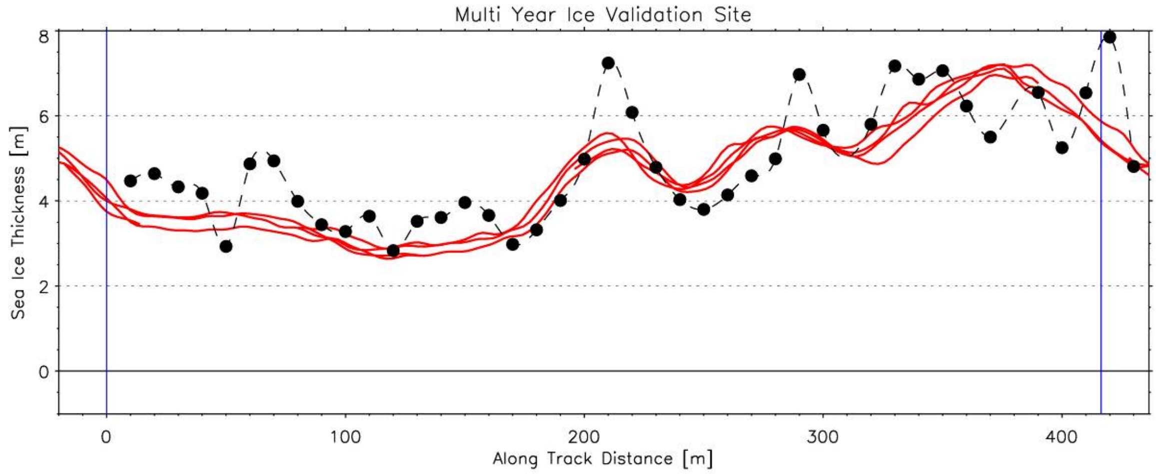


Figure 33: Ground truthing of AEM sea ice thickness with onsite drill hole measurements along the MYI validation site. Continous line: AEM data, Black dots: Drill hole measurements (snow depth+ice thickness). Vertical lines mark corner reflector positions

5.5.4 ASIRAS flight

A main goal of the validation activities was the alignment of different sensors (AEM and altimetry) over the same ice. Common waypoints for both helicopter and airplane were used pointing straight north at a longitude of 65.1697°E. The helicopter was overtaken by the airplane roughly at the middle of the profile which ensures the best temporal coincident coverage of both sensors over the drifting sea ice. In addition the cross track error (XTE) of the helicopter was monitored by the operators all the time during measurements. This procedure allowed the quick corrections of the helicopter heading if the XTE exceeded a threshold of 20 or more meters. Accordingly the data acquisitions remained very close to the planned line roughly 95\% within 40 meters (see Figure 34 and Figure 35). These value lies well within the swath of the altimeter measurements.

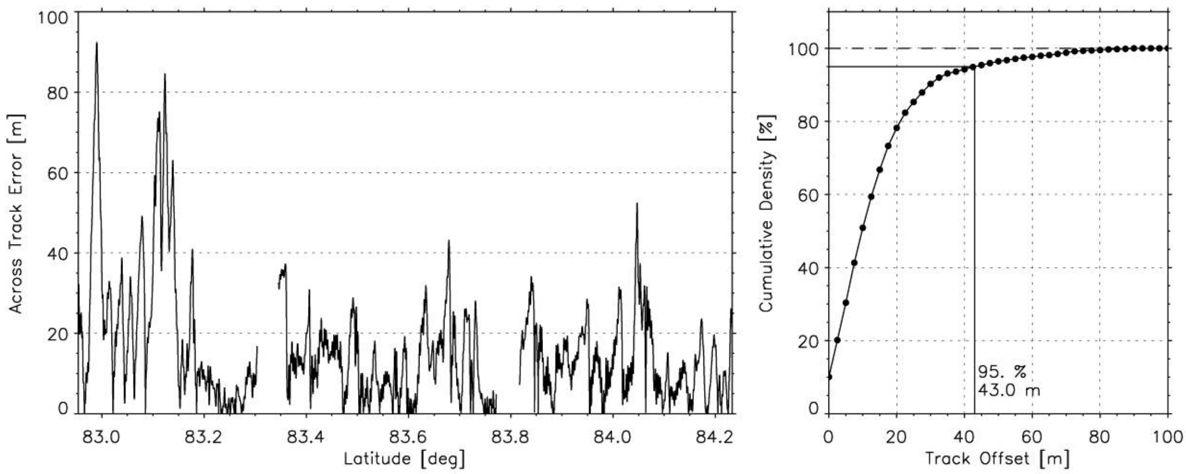


Figure 34: Right: Cross track error (XTE) of northbound coincident ASIRAS flight. Left: Cumulative histogram of XTE with 95\% threshold

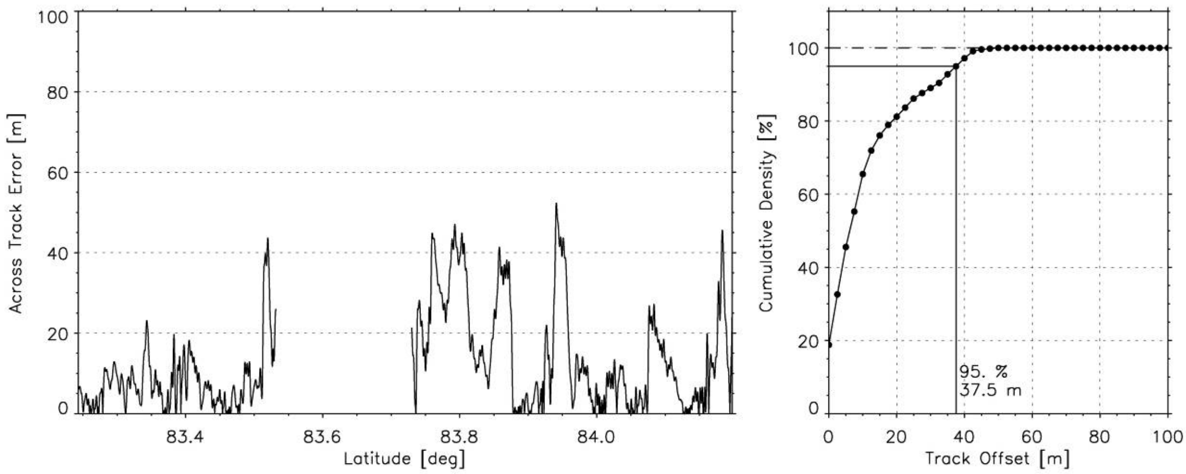


Figure 35: Right: Cross track error (XTE) of southbound coincident ASIRAS flight. Left: Cumulative histogram of XTE with 95\% threshold

5.6 List of Profiles

One EM data file is delivered for each flight. A more detailed description of the EM data is given in Cullen (2009).
One flight is separated into several profiles with a calibration at the beginning and the end. The distance flown is calculated for this individual profiles and therefore not cumulative for the entire flight. The fiducial number can be discontinuous if a reboot of the system was necessary during the flight.

Table 16: List of AEM ice thickness profiles

HEM_CR08_20080501T192540_20080501T210002
Date : 2008/05/01
Profile north of Alert in FYI/MYI mixed zone. At the end of the profile repeated overpasses over FYI val-line (× 6), MYI val-line (× 4) and ice camp with AUV (× 8). Individual overpasses are delimited by ascends (data gaps)
HEM_CRV08_20080502T202755_20080502T234555
Date : 2008/05/02
Profile north-west of Alert. Coincident flight track with Twin-Otter (ASIRAS \& Laser scanner) all along the strict north-south pointing section. First overpass (northbound) of aircraft over helicopter at fid 36258, 83.685115°N, 65.168518°E. Second overpass (southbound) during refuelling stop of helicopter

6 Conclusions

The airborne part of CryoVEx 2008 has successfully been carried out by DTU Space and the gathered data sets are now secured at DTU Space on central servers backed up on magnetic tapes. A total of 72 hr were flown with the Air Greenland Twin Otter plus additional 15 hrs for the transport of the UK1 team to the ice sheet. Laser scanner data has been gathered on most lines and ASIRAS data was recorded over test sites and on large parts of the other lines. In addition helicopter EM data and in-situ sea ice measurements have been collected.

The laser scanner, INS, and GPS data has been processed by DTU Space and the ASIRAS and EM Bird data by AWI. Data have been delivered to ESA. This report has outlined the airborne system, campaign, and processing together with short descriptions of the main validation sites. This should aid the user in understanding and correct use of the datasets.
Appendices include operator logs, processing details and the field report of the in-situ sea ice measurements. Data format descriptions are found in Cullen (2009).

7 References

Cullen, R.: CryoVEx: Airborne data products description, CS-LI-ESA-GS-0371, issue: 2.6. European Space Agency, 2009.

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Helm, V., S. Hendricks, S. Goebell, W. Rack, C. Haas, U. Nixdorf, and T. Boebel: CryoVEx 2004 and 2005 (bob) data acquisition and final report. Technical Report 1.0, Alfred Wegener Institute, 2006.

Stenseng, L., S. M. Hvidegaard, H. Skourup, R. Forsberg, C. J. Andersen, S. Hanson, R. Cullen, and V. Helm: Airborne Lidar and Radar Measurements in and around Greenland, CryoVEx 2006, Technical Report 9, Danish National Space Center, 2007.

Zhang, X.: Precise Point Positioning – Evaluation and Airborne Lidar Calibration. Technical Report No. 4, Danish National Space Center, pp. 44, 2006.

8 Appendix

8.1 Operator logs

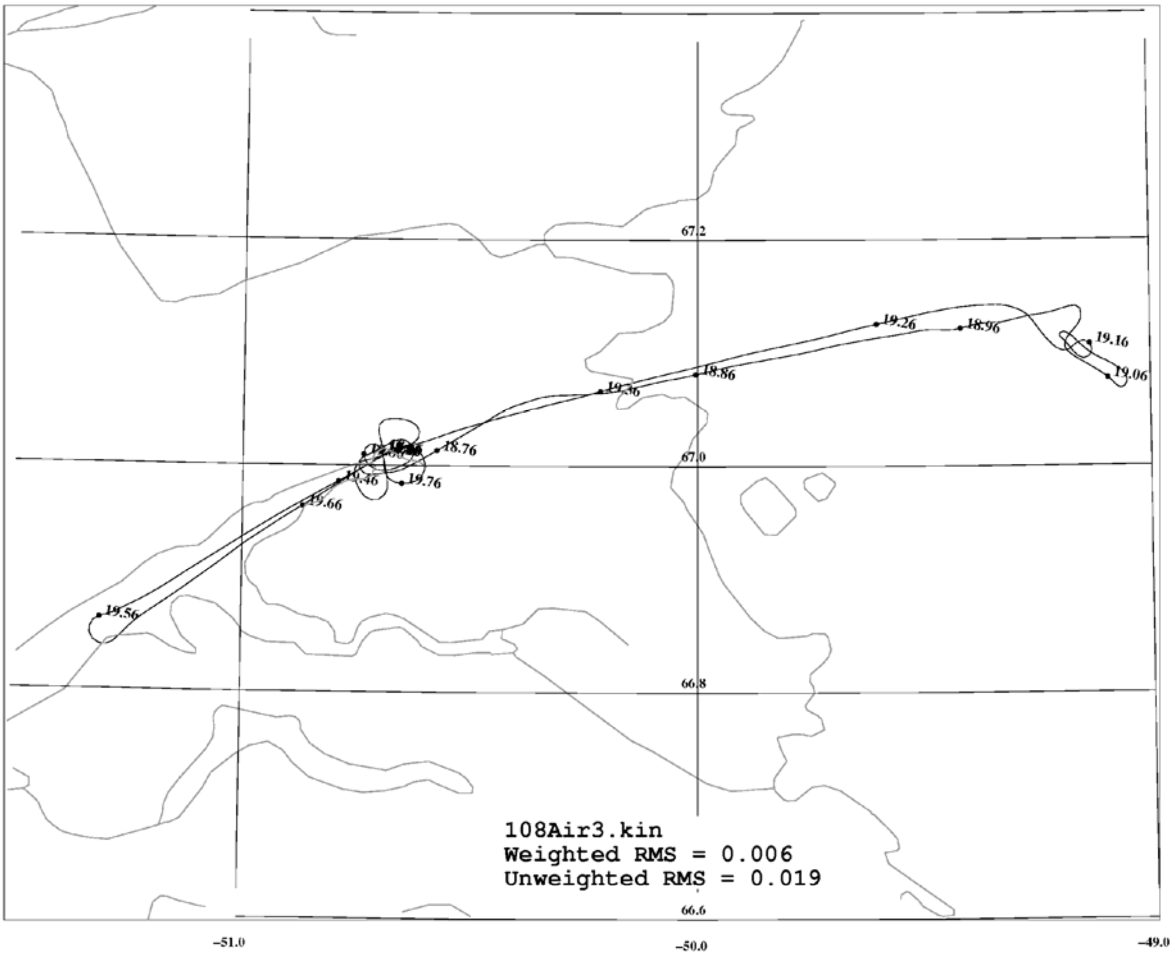
Operator logs for laser scanner system (left) and ASIRAS (right). Track plots also shown:

JD 108 17/4-08 SFJ-drop-test-SFJ

1842	Take off
185200?	New scanner file
	Tent dropped on the ice
	Climb to 6000ft
	Decent to approx. 900m
	Decent slowly to 1000ft in fjord
	Return at 1000ft
1941	Over blue building 1
	Cross over building at 1000ft
1955	Landing

Asiras CryoVEx 2008
JD 108 - 17 04 08
SFJ -> SFJ testflight

2038 take off
2155 landed



JD 109 18/4-08 SFJ-ICB-JAV

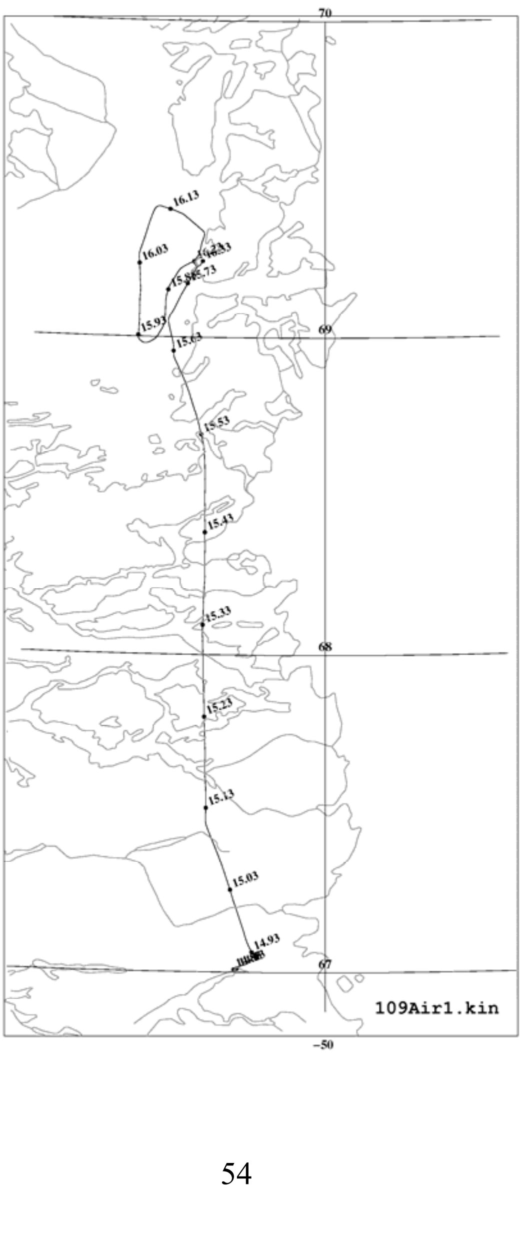
1453	Take off
	Image capture off for adjusting
153200	Scanner sync
	No power on Air2 cable
remounted	
1541	Air2 restarted
154800	New scanner file, +1sec?
1556	ICB1; Alt 230m/800ft
	Deviate line to obs icebergs
1616	Landing

JAV-fjord-JAV for journalists

1758	Taxi
1801	Take off
180800	Scanner sync
180953	New scanner file, file name
181000	
	Started 181057
1818	Turn over Isbræ edge
1828	IMU restart logging
1835	Landing

Asiras CryoVEx 2008
JD 109 - 18 04 08
JAV -> JAV flight for DR journalists

1800 take off
1802 system on
1807 IRF calibration
1810 LAM mode
1812 record on (sea ice)
1818 record off (turn)
1820 record on
1825 record off
1827 record on
1830 record off
1830 IRF calibration
1834 system off
1835 landed

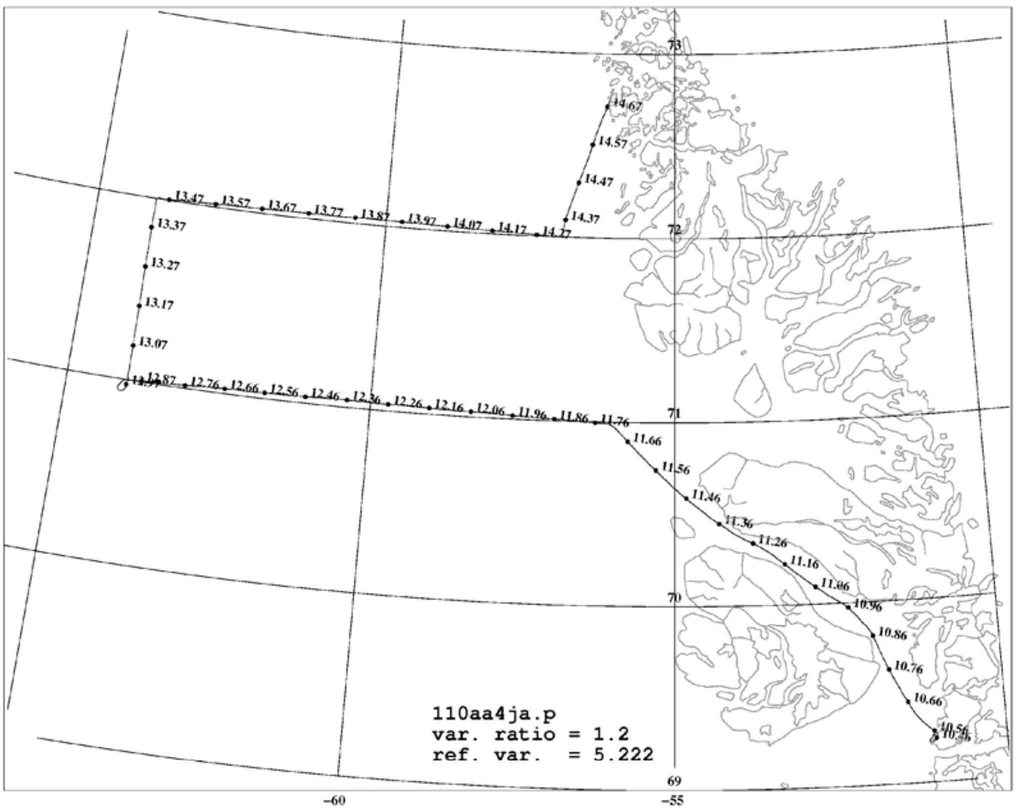


<u>JD 110 19/4-08 JAV-K-JUV-HELI-K-JAV</u>

	Scanner pc down – too cold
	Try to shift to laptop not ok
1028	Take off
	Pass over runway for journalists
103500	Scanner sync, scanner start no signal
	problem with logging on Lars' pc
104600	Scanner sync
105700	Scanner sync, scanner pc up
105900	New scanner file
1104	Image capture started
1120	Xtra monitor tested ok
	Some clouds JAV-K1
1147	K1
115430	New scanner file
1300	K2, tear drop turn
130300	New scanner file
1326	K3, direct turn
140000	New scanner file
1419	K4, open water and thin ice
1443	Landing JUV

<u>Asiras CryoVEx 2008</u>
JD 110 - 19 04 08
JAV -> UPERNAVIK

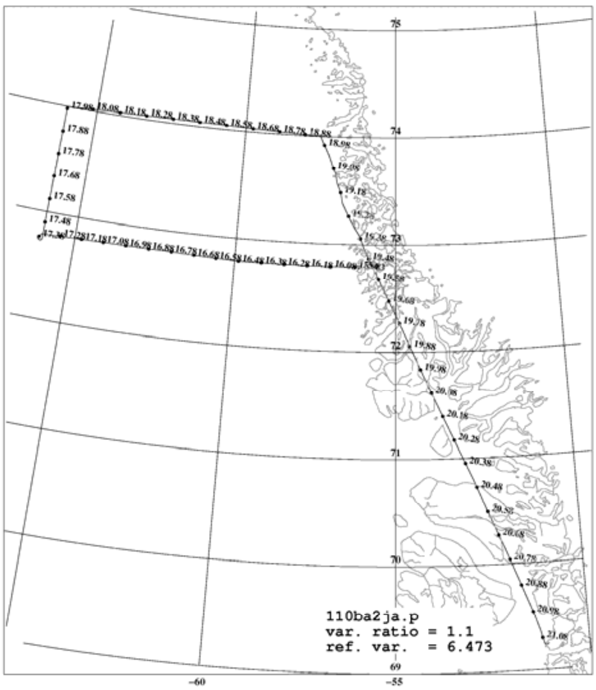
1032 system on
1035 IRF calibration
1058 record on (test)
1103 record off
1145 record on (sea ice)
1220 record off
1220 record on
1255 record off (turn)
1300 record on
1325 record off (turn)
1328 record on
1407 record off
1407 record on
1419 record off (turn)
1424 IRF calibration
1425 system off



Coordinate with helicopter
1510 Take off helicopter
Download 1st part
1557 Take off
155800 New scanner file
1604 HE2
1616 HE5
1620 HE6, overflight of heli on ground
Perfectly coordinated
1633 Light fog
164700 New scanner file
1721 K6, tear drop turn
174130 New scanner file
1800 K7
183200 (183300?) New scanner file
1856 K8, end of line
Obs of icebergs
1922 Start climb
1925 Stop logging scanner + alt
Stop logging Air1 to download
2108 Landing

UPERNAVIK -> JAV

1601 system on
1603 IRF calibration
1605 record on (thin sea ice)
1620 overhead helicopter
1635 record off
1635 record on
1705 record off
1705 record on
1721 record off (turn)
1724 record on
1745 record off (switch to PC2)
1746 record on
1758 record off (turn)
1759 record on
1830 record off
1830 record on
1855 record off (turn)
1856 record on
1923 record off
1924 IRF calibration
1927 system off

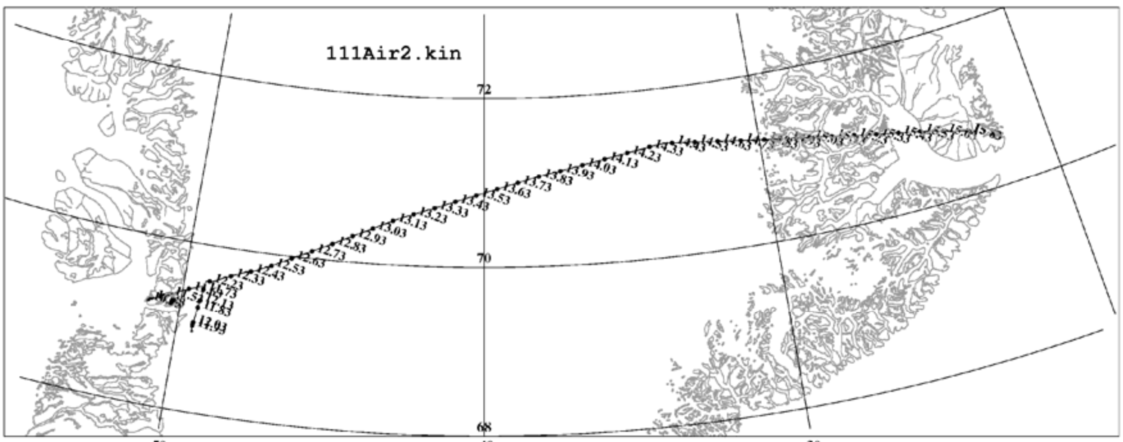


JD 111 20/4-08 JAV-EGIG-CNP

	Hard to start up EGI
	Perhaps Air1 was started after EGI
	No lock on sat, fixed height align
1113	NavRdy finally
1115	Engine start up
1125	Take off
11??	Scanner sync
113718	New scanner file called 113715
	JAV line 1-10, 1000ft south
1150	JAV5 1st time, some low clouds
1156	Return north, aprox 1100m above ice
121200	New scanner file
121230	JAV10, decent to 1000ft
1223	T1
1227	T3
123130	T5
125700	New scanner file
140000	New scanner file
1452	Scanner file closed
1548	Landing CNP

Asiras CryoVEx 2008
JD 111 - 20 04 08
JAV -> CNP

1130 system on
1132 IRF calibration
1135 record on
1142 record off
1144 record on
???? record off
12?? record on (HAM)
1213 record off
1215 record on (LAM)
1246 record off
1246 record on
1313 record off
1313 record on
1330 record off
1330 record on
1400 record off
1400 record on
1430 record off
1430 record on
1451 record off
1455 IRF calibration
1458 system off

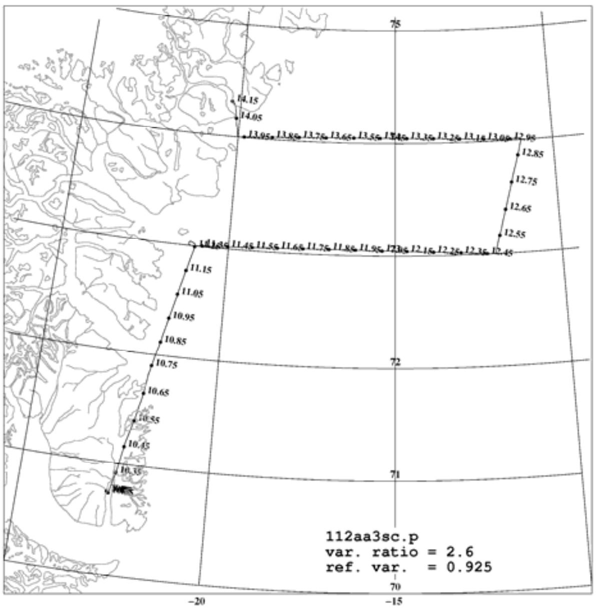


<u>JD 112 21/4-08 CNP-K-DNB-Krev-NRD</u>

	Scanner sync on ground
	Pobl with EMAP start up
	Perhaps problems with seriel port on laptop
1000	Engine start
1010	Taxi
1014	Take off
101630	New scanner file
1030	EMAP up on smh laptop
1040	Decent to 1000ft
1045	End of fast ice
110900	New scanner file
1115	K9 tear drop turn
1123	Low clouds
1130	Climb to 460m
1144	Scanner file closed
115400	New scanner file (start 04)
	Clouds partly broken
1201	Decent, try to get under clouds
1204	Icing, climb
1220	Broken clouds, 660m alti, some scanner
1228	K10, 750m, only ASIRAS
1238	800m
1254	K11, clouds, only little sea ice
134630	New scanner file still in clouds
1358	K12
1407	Overflight runway DNB

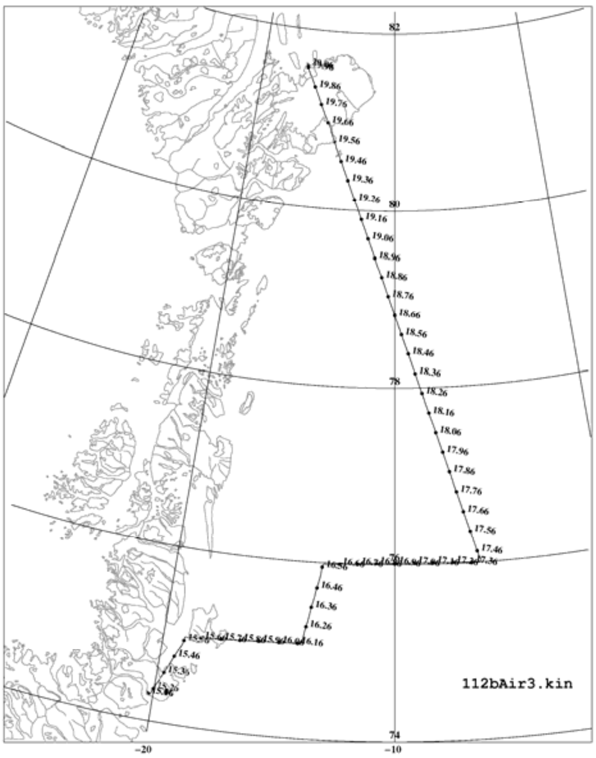
<u>ASIRAS log: 21/4-2008, JD 112:</u>
Operator: HSK
Flight: CNP-DNB, DNB-NRD:

	Take off Constable Pynt
1116	start log file A080421_00, flight altitude 300m
1130	Ascend to 480m
1142	Ascend to 540m
1200	Descend to 300m
1203	new log file A080421_01
	Climb to 660m
1222	climb to 720m
1227	turn – stop logging
1254	new log file A080421_02
1301	climb to 900m
	climb to 960m
1309	descend to 900m
1311	descend to 840m
1333	descend to 660m
1337	descend to 540m
1340	descend to 420m
1350	descend to 360m
1309	descend to 300m
1356	stop logging
1357	calibration
	Landing Daneborg



1410	Landing DNB
	Fueling, 1 engine running for instruments
1507	Taxi
1510	Take off
1540	After Shannon Island in fog again
1610	Deviate line, direct north
163130	New scanner file
1634	1000ft, turn towards K15
1642	Long leads and large patches without leads
1723	K15, turn direct towards NRD
172500	New scanner file
181400	New scanner file fog/low clouds – some broken
1843	Scanner logging stopped
185900	New scanner file
1935	Flade isblink start
2000	Landing NRD

	Take off Daneborg
1533	new log file A080421_03, 300m
1544	climb to 600m
1601	new log file A080421_04
1615	new log file A080421_05
1635	new log file A080421_06
1652	new log file A080421_07, 300m
1714	new log file A080421_08
1721	turn
	new log file A080421_10
1735	new log file A080421_11
1749	new log file A080421_12
	frostflowers
1812	PC1 full change to PC2
	new log file A080421_13
1829	new log file A080421_14
1843	new log file A080421_15
1859	new log file A080421_16
1914	new log file A080421_17
1929	stop radar
	Calibration
	Shut down system
	Landing St. Nord

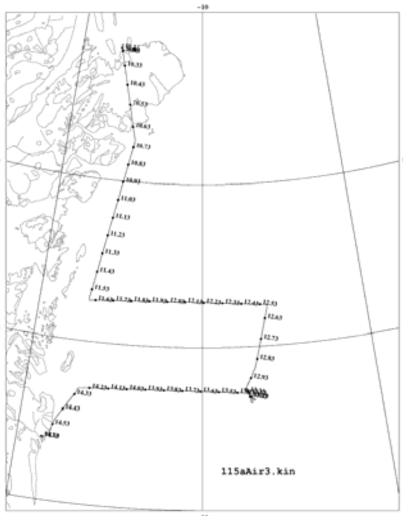


<u>JD 115 24/4-08 NRD-K-KV Svalbard-DMH-K-NRD</u>

	Problems with scanner start up
	PC restarted several times – without scanner on
	Connected but no data in
1000	Taxi
1009	Take off
	Scanner restarted 1000 times, check of net-connection
	Finally receives data + sync
104200	New scanner file
1047	Image capture started
1130?	EGI input stopped, program restarted
1135	K20, turn
113730	New scanner file
1233	K21
123500	New scanner file
1248	KV Svalbard, 77 25N 7 22W, VHF 130.5
	200 m line east of ship
1300	Overhead KV Svalbard
1322	3 passes and overhead ship into line
132500	New scanner file
141630	New scanner file, end of line
1442	Landing DMH
	6 drums of fuel

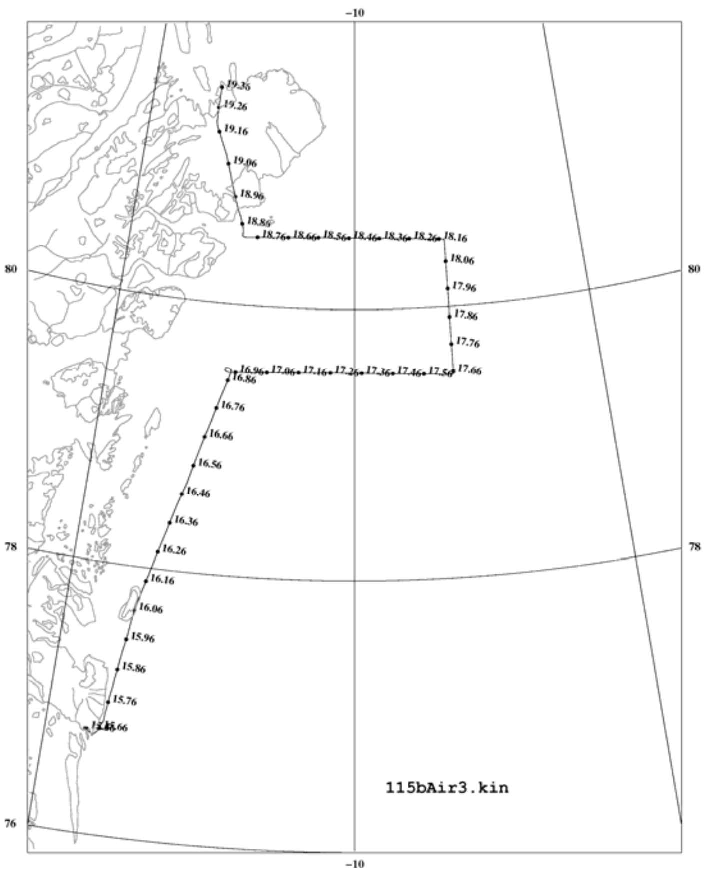
<u>ASIRAS log: 24/4-2008, JD 115:</u>
Operator: HSK
Flight: NRD-KV Svalbard-DMH, DMH-NRD:

0830	Take off NRD
1015	ASIRAS startup, int. calibration
1019	Ready
1136	new log file A080424_00, 300m
1150	new log file A080424_01
1205	new log file A080424_02
1220	new log file A080424_03
1233	log stopped, turn
1235	new log file A080424_04
1250	new log file A080424_05
1259	new log file A080424_06
1300	KV Svalbard
1303	stop file
1304	new log file A080424_07
1307	KV Svalbard
1309	stop log file
1310	new log file A080424_08
1312	KV Svalbard
1314	stop log file
1315	new log file A080424_09
13	KV Svalbard
1319	stop log file
1323	new log file A080424_11
1333	new log file A080424_12
1344	new log file A080424_13
1355	new log file A080424_14
1405	new log file A080424_15
1415	new log file A080424_16
1417	stop file
1418	stop radar, int. calibration
	Landing DMH



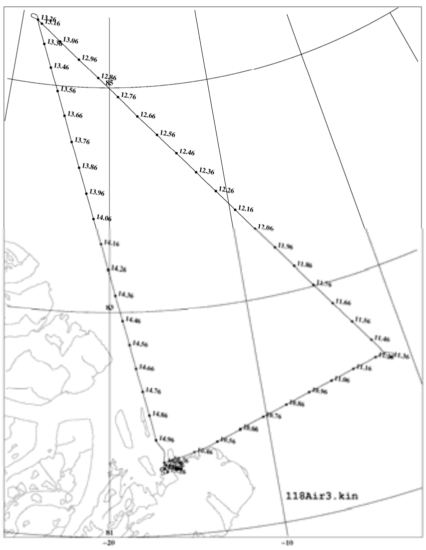
	EGI restarted and aligned
153045	Taxi
1533	Take off
153600	New scanner file
1553	Air1 start logging
1612	Image capture restarted
163330	New scanner file
1652	K21, tear drop turn
170620	End of fast ice
1718	Some clouds
1738	K22, direct turn
174000	New scanner file
1808	K23
1848	End of line, K24
	Scanner file closed
1922	Landing

	Take off DMH
1541	ASIRAS startup, int. calibration
1556	test PC1 55% A080424_18
1655	new log file A080424_19
1705	new log file A080424_20
1716	new log file A080424_21 clouds
1725	new log file A080424_22
1735	new log file A080424_23
1737	stop file
1808	new log file A080424_24
1818	new log file A080424_25
1828	new log file A080424_26
1838	new log file A080424_27
1847	stop file
1848	stop radar, int. calibration
	Landing NRD



JD 118 27/4-08 NRD-F-NRD

	Problems with scanner start up
	PC lost all settings
100230	Scanner sync
1006	Engine start
1013	Taxi
1018	Take off
1020	New scanner file
103430	End of fast ice
1040	Large lead
1124	Start new line after F1 tear drop turn
112530	New scanner file
1159	Image capture restarted
	Scanner logging stopped?
121530	New scanner file
131245	New scanner file
1312	F2 tear drop turn
	Scanner logging slow, stopped again
134830	New scanner file
142000	New scanner file – logging never started!
143640	Large open lead, shear zone
	Very thick fast ice edge
145900	New scanner file
1505	Runway pass
1509->	Building over-flight
1523	Landing



ASIRAS log: 27/4-2008, JD 118:
Operator: HSK
Flight: NRD-trekant-NRD:

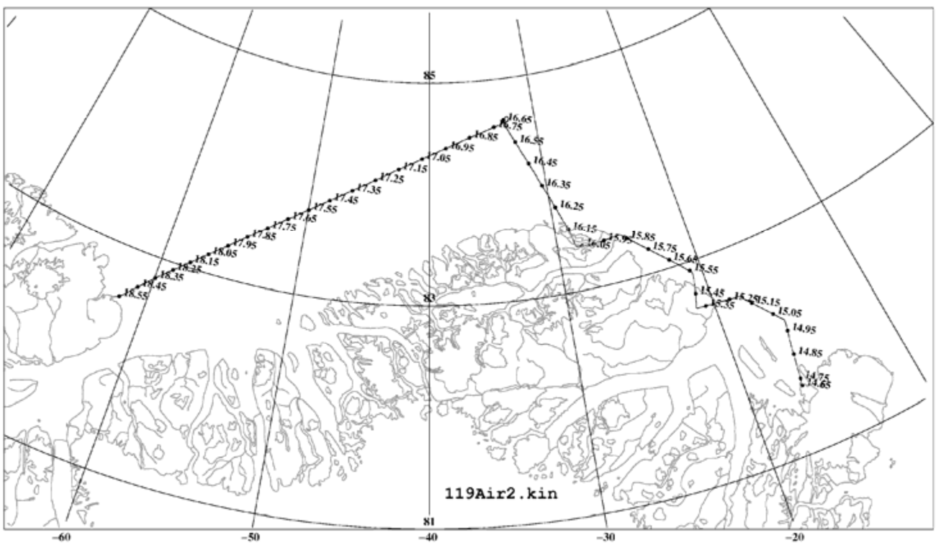
	Take off NRD
1018	startup system
1020	int. calibration
1026	new log file A080427_01
1035	new log file A080427_02
1045	new log file A080427_03
1059	new log file A080427_04
1110	new log file A080427_05
1116	stop log file, teardrop
1120	new log file A080427_06
1130	new log file A080427_07
1140	new log file A080427_08
1151	new log file A080427_09
1200	new log file A080427_10
1210	new log file A080427_11
1220	new log file A080427_12
1230	new log file A080427_13
1242	new log file A080427_14
1300	new log file A080427_15
1308	stop log file, teardrop
1313	new log file A080427_16
1325	new log file A080427_17
1335	new log file A080427_18
1346	new log file A080427_19
1358	new log file A080427_20
1410	new log file A080427_21
1425	new log file A080427_22
1432	refrozen lead
1435	new log file A080427_23
1445	new log file A080427_24
1455	new log file A080427_25
1458	new log file A080427_26
1502	overflight runway NRD
1503	stop log files
1505	new log file A080427_27
1505	turn
1507	overflight building NRD
1508	stop log file
1508	new log file A080427_28
1510	stop log file
1511	new log file A080427_29
1514	overflight building NRD
1515	stop log file
1516	new log file A080427_30
1517	overflight building NRD
1518	stop log file, int. calibration
	Landing NRD

<u>JD 119 28/4-08 NRD-E-YLT</u>

	Problems with IMU start up
	No network connection, no data in
142300	Scanner sync
1439	Taxi
1442	Take off
144400	New scanner file
1458	E3
150430	ALT restarted, IMU still off
	R4-R1 (off E3-E2 at 1512)
153130	Back on E3-E2 shear zone, lead
154000	New scanner file
1554	T4-T1
1558	T1-S4 over glacier
1607	S4-S1
161245	Fast ice edge
161650	E2
163400	New scanner file
163740	E1, tear drop turn
1704	ALT stop logging, try to restart IMU by power off
1707	IMU+ALT restarted!
172430	New scanner file
1835	Landing

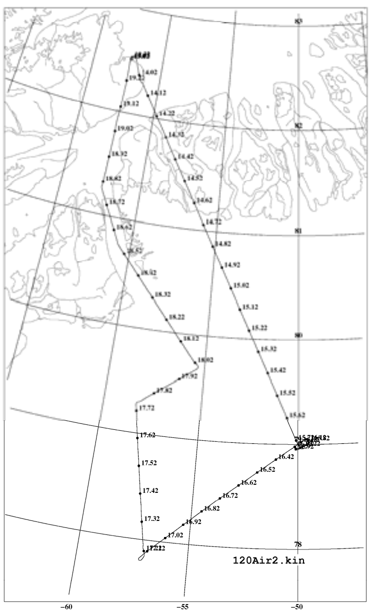
<u>ASIRAS log: 28/4-2008, JD 119:</u>
Operator: HSK
Flight: NRD-YLT

1442	Take off NRD
1621	ASIRAS startup, int. calibration
1625	new log file A080428_00, test
1638	new log file A080428_01
1651	new log file A080428_02
1700	new log file A080428_03
1710	new log file A080428_04
1720	new log file A080428_05
1731	new log file A080428_06
1737	open lead, event mark 1
1740	new log file A080428_07
1751	new log file A080428_08
1756	FY ice
1800	new log file A080428_09
1810	new log file A080428_10
1812	rubled ice, pix 215/216
1813	FYI
1820	new log file A080428_11
1826	stop file
1827	int. calibration, shut down system
	Landing YLT



<u>JD 120 29/4-08 YLT-ICE-A-YLT</u>

	Scanner PC too cold
	Problems with scanner PC connection
	PC restarted several times
134000	Scanner sync
1352	Taxi
135330	New scanner file
1355	Take off
143930	New scanner file, start of ice sheet
154400	CR from north ~0m
155330	CR from east ~10m
160210	CR from east ~15m
161040	CR from east ~-13m
161330	New scanner file (started 161334)
1618	CR from east ~-25m
	Continue on line to ICE3
1641	ICE3
1710	ICE4
171400	New scanner file
1744	A2
175900	New scanner file
1800	A3
1844	End of glacier
184730	A5
185615	New scanner file
1922	Landing

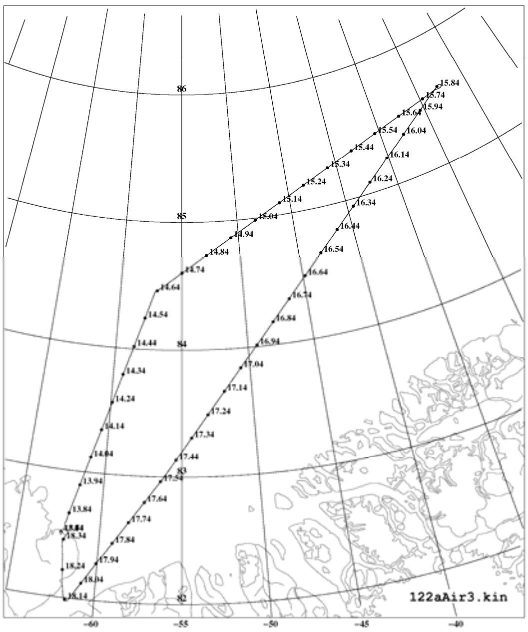


<u>ASIRAS log: 29/4-2008, JD 120:</u>
Operator: HSK
Flight: YLT-ICESHEET-PETERMAN GL.-YLT

	Take off YLT
1355	ASIRAS startup, int. calibration
1439	new log file A080429_00, 240m
1440	climb to 300m
1449	new log file A080429_01
1459	new log file A080429_02
1509	new log file A080429_03
1520	new log file A080429_04
1530	new log file A080429_05
1540	new log file A080429_06
1544	stop log file, tear drop
1551	new log file A080429_07
15535	reflector, event mark 1
1554	stop log file
1600	new log file A080429_08
1602	stop log file
1608	new log file A080429_09
1611	stop log file
1616	new log file A080429_10
1626	new log file A080429_11
1636	new log file A080429_12
1646	new log file A080429_13
1656	new log file A080429_14
1708	end of line, stop log file
1714	new log file A080429_15
1725	new log file A080429_16
1735	new log file A080429_17
1744	end of line, stop log file
1745	new log file A080429_18
1759	end of line, stop log file
1800	new log file A080429_19
1810	new log file A080429_20
1820	new log file A080429_21
1832	new log file A080429_22
1841	new log file A080429_23
1844	event marker 1, end of glacier
1852	new log file A080429_24
1900	new log file A080429_25
	Climbing to 1020m
1906	stop file, internal calibration
	Shut down system
	Landing YLT

<u>JD 122 1/5-08 YLT-F-S-YLT-MYI-FYI-YLT</u>

	Problems with POF HF radio
1331	EGI logging restarted (program restarted)
133530	Scanner sync
134000	New scanner file, still on ground
1343	Taxi
1345	Take off
143500	New scanner file
1437	F3
153330	New scanner file
1547	F2, tear drop turn
162730	New scanner file
	Loose connection in power in to rack, running on batteries for a while, look out for the plug
173000	New scanner file
1807	End of line
1825	Landing

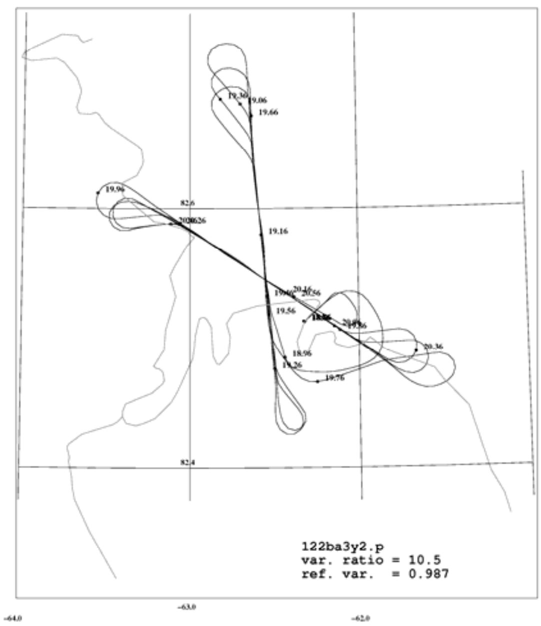


<u>ASIRAS log: 1/5-2008, JD 122:</u>
Operator: HSK
Flight: YLT-triangle-YLT, YLT-MYI-FYI-YLT

	Take off YLT
1350	ASIRAS startup, int. calibration
1352	new log file A080501_00, 300m
1402	new log file A080501_01
1412	new log file A080501_02
1422	new log file A080501_03
1433	new log file A080501_04
1437	stop log file, end of line
1445	new log file A080501_05
1456	new log file A080501_06
1505	new log file A080501_07
1515	new log file A080501_08
1526	new log file A080501_09
1535	new log file A080501_10
1547	stop file, teardrop
1551	new log file A080501_11
1600	new log file A080501_12
1610	new log file A080501_13
1620	new log file A080501_14
1630	system down, power failure
1642	start up, int. calibration
1643	new log file A080501_15
1655	new log file A080501_16
1705	new log file A080501_17
1715	new log file A080501_18
1725	new log file A080501_19
1736	new log file A080501_20
1746	new log file A080501_21
1756	new log file A080501_22
1807	stop file
1808	int. calibration, shut down
	On ground YLT

Pick up MD
1000ft over CR and then 2000ft

183630	New scanner file
1850	Taxi
1852	Take off, heading towards MY
185920	CR ~30-40m
190945	CR ~4m
191730	CR ~-6m, from south
192630	CR ~-1m
	Climb to 2000ft
1934	CR ~0m!
193645	New scanner file
194210	CR ~-3m
195150	Crossing runway, heading for FYI
195310	CR ~10m
200127	CR ~-2m
	Decent to 1000ft
200240	Crossing runway
200828	Crossing runway
200950	CR ~-5m
2017	CR ~6m
2025	CR ~3m
203225	CR ~6m
2037	Landing

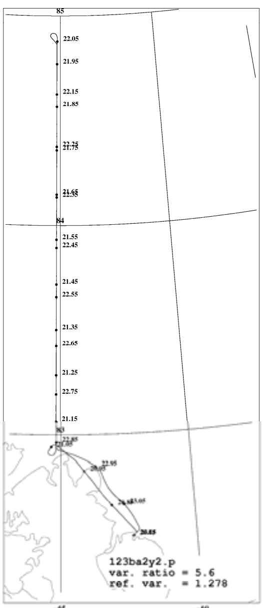


Take off YLT

1854	turn on system, int. calibration
1858	new log file A080501_23, PC2
	MYI S → N 1,000ft
1901	stop file
190551	new log file A080501_24
	MYI N → S 1,000ft
1911	stop file
191523	new log file A080501_25
191730	MYI S → N 1,000ft
1919	stop file
192302	new log file A080501_26
192630	MYI N → S 1,000ft
1927	stop file
	Climb to 2,000ft
193120	new log file A080501_27
193400	MYI S → N 2,000ft
193536	stop file
193915	new log file A080501_28
194206	MYI N → S 2,000ft
194315	stop file
194945	new log file A080501_29
195248	FYI E → W 2,000ft
195456	stop file
195832	new log file A080501_30
200127	FYI W → E 2,000ft
200145	stop file
	Descend to 1,000ft
200636	new log file A080501_31
200945	FYI E → W 1,000ft
201134	stop file
201426	new log file A080501_32
201710	FYI W → E 1,000ft
201812	stop file
202205	new log file A080501_33
202457	FYI E → W 1,000ft
202619	stop file
202925	new log file A080501_34
203204	FYI W → E 1,000ft
203234	stop file
2033	int, calibration, shut down system
	Landing YLT

JD 123 2/5-08 YLT-H-YLT-A-FUE-A-YLT

	Problems with scanner PC start up
132800	Scanner sync
133030	New scanner file
1335	Take off
	Local patches of fog
143100	New scanner file
1500	H1
151500	New scanner file, fog
1608	H3
161500	New scanner file
1720	Air2 stopped logging, card full, restarted
1720	H5
172730	New scanner file
1747	H6
1837	H7
183830	New scanner file
1916	Landing
	Fuel
	New start up
Coincident flight with helicopter	
2020	Heli take off
202800	Scanner sync
2045	Take off
204600	New scanner file
2105	A1 after turn to align on track
2127	FUE ~0m
2126	Heli over-flight
21??	Air1 stop logging, disc full
215905	A2
220030	New scanner file
220310	A2
223058	FUE ~6m, heli on ground
2251	A1, end of survey line
	Low level in to YLT
2308	Landing

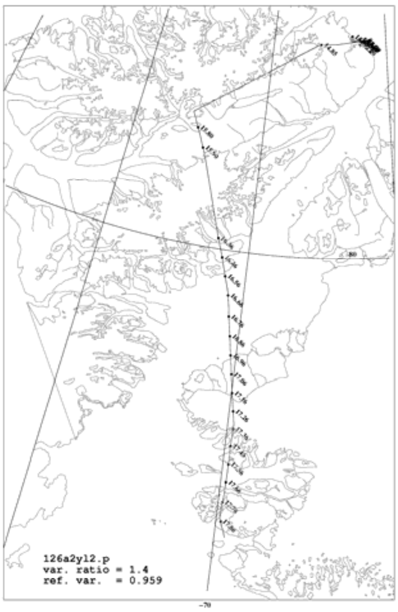


ASIRAS log: 2/5-2008, JD 123:
Operator: HSK
Flight: YLT-H-YLT, YLT-A1-A2-A1-YLT

	Take off YLT
1336	ASIRAS startup
1343	int. calibration
1344	new log file A080502_00, 300m
1355	new log file A080502_01
1405	new log file A080502_02
1415	new log file A080502_03
1425	new log file A080502_04
1435	new log file A080502_05
1445	new log file A080502_06
1455	new log file A080502_07
1501	stop file, end of line
1518	new log file A080502_08
1530	new log file A080502_09
1540	new log file A080502_10
1550	new log file A080502_11
1600	new log file A080502_12
1608	stop log file, end of line
1626	new log file A080502_13
1636	new log file A080502_14
1645	new log file A080502_15
1655	new log file A080502_16
1705	new log file A080502_17
1715	new log file A080502_18
1722	stop file, end of line
1751	new log file A080502_19
1800	new log file A080502_20
1810	new log file A080502_21
1820	new log file A080502_22
1830	new log file A080502_23
1837	stop line
1840	int. calibration
	Landing YLT/Take off YLT
2045	system startup
2050	int. calibration
2051	new log file A080502_24, test
2058	new log file A080502_25 (NW)
2100	stop log file
210525	new log file A080502_26, A1
2115	new log file A080502_27
212500	new log file A080502_28
212643	reflector, helicopter
213500	new log file A080502_29
214500	new log file A080502_30
215500	new log file A080502_31
215915	stop log file, A2
220240	new log file A080502_32
221200	new log file A080502_33
222200	new log file A080502_34
222700	new log file A080502_35
223058	over airstrip, fuelcache
223700	new log file A080502_36
224700	new log file A080502_37
225126	stop log file, end of survey
2252	int. calibration, shut down
	On ground YLT

JD 126 5/5-08 YLT-M-cal-GM-THU

	Scanner PC reconnected
	Power loss on ground cable
	Restart with engine on
	Scanner sync
130700	New scanner file, on ground
	Start with Mow-the-lawn
1327	Take off
	Poor visibility, change alt to 200m
	Only chose central lines and add more close to camp
	+-150m of camp approx.
1416	End of survey lines E-W
1420	Start calib over Spinnaker
1432	End of calib
143400	New scanner file, up through clouds
	Heading for GM1-GM8
145930	New scanner file
152930	GM8, end of survey
1803	Landing



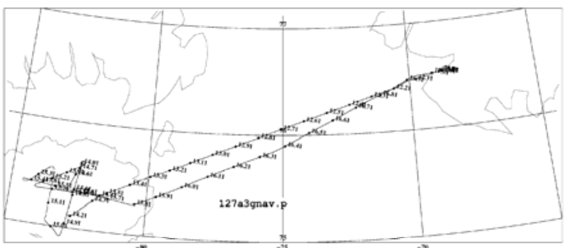
ASIRAS log: 5/5-2008, JD 126:
Operator: HSK
Flight: YLT-AUV-ice on Ellesmere Island-THU

	Take off YLT
1327	ASIRAS startup
1333	int. calibration
133455	new log file A080505_00, 300m
	AUV M1-M2
1338	stop file, end of line
134644	new log file A080505_01, 240m
135108	stop file, end of line
	AUV M5-M6
135510	new log file A080505_02, 240m
135928	stop file, end of line
	AUV M7-M8
140314	new log file A080505_03, 240m
	AUV
140745	stop file, end of line
141241	new log file A080505_04, 240m
	AUV
141708	stop file, end of line
142009	new log file A080505_05
	Overflight Runway+Spinaker building YLT
142105	stop file
142308	new log file A080505_06
	Overflight Spinaker
142400	stop file
1426	new log file A080505_07
	Overflight Spinaker
142740	stop file
143030	new log file A080505_08
	Overflight Spinaker
143208	stop file
144930	new log file A080505_09*
145939	stop file
151140	new log file A080505_10*
152100	new log file A080505_11*
1529	stop file
1533	int. calibration, shut down system
	Landing Thule AB

* Survey on Ellesmere Island, various heights due to changing surface heights.

<u>JD 127 6/5-08 THU-DEVON-THU</u>

	Normal start up with engine on
114500	Scanner sync
1159	Take off
120015	New scanner file
1225	EMAP restarted Cy1, Cy5 deleted
	Too close to CR
131200	New scanner file
133000	New scanner file
1336	45_4 ~6m
	CR ~18m
1345	End of 45_1-45_10
1401	62_2 after tear drop turn into line
	CR ~17m
140830	Cy10 ~-4m
	Cy19 ~-8m
141600	New scanner file
	Repeat 45_1-45_9
142440	45_1, start line
1428	45_4 ~12m
	CR ~-20m
1440	N-S line repeated
1447	CR ~-2m
1456	Cy45, turn towards NSw1
150030	New scanner file
150250	NSw1
1514	NSw4, turn towards NASA line
1524	NA2
1547	NA7, end of line
1550	End of survey, scanner logging off
	Direct THU
1703	Landing

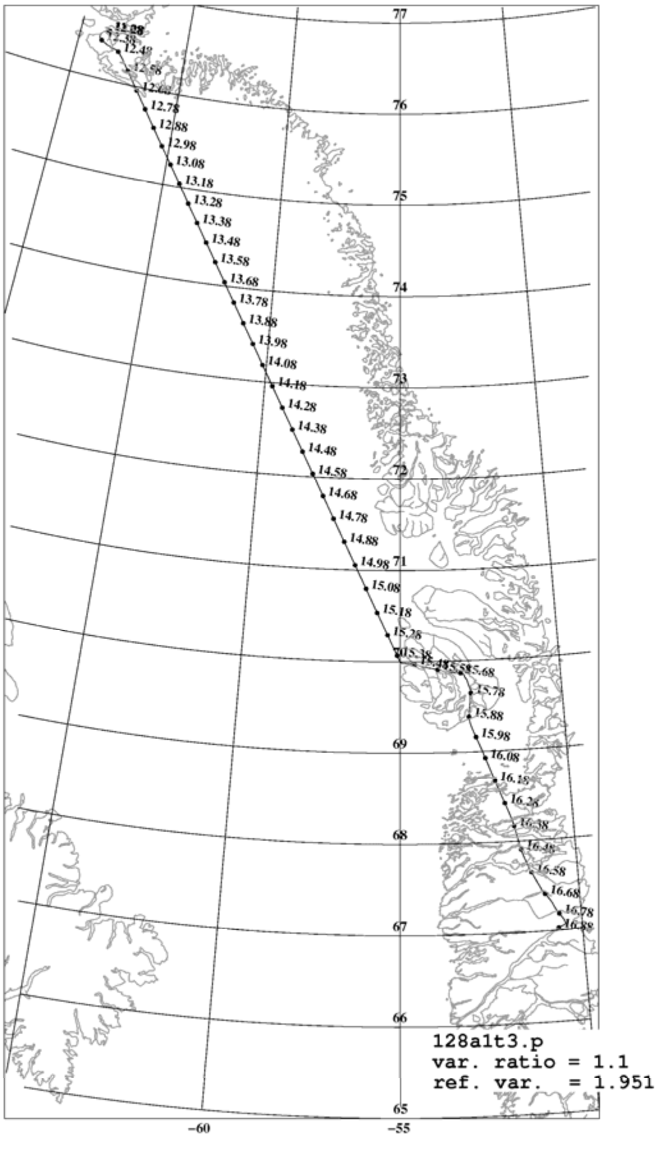


<u>ASIRAS log: 6/5-2008, JD 127:</u>
Operator: HSK
Flight: THU-Devon icecap-THU

	Take off THU
1202	ASIRAS startup
1204	int. calibration
1205	new log file A080506_00, 300m
1222	new log file A080506_01
1232	new log file A080506_02
1242	new log file A080506_03
1252	new log file A080506_04
1302	new log file A080506_05
1312	new log file A080506_06
1318	stop file
	Devon icecap
133228	new log file A080506_07
133745	reflector/camp
134534	stop file, end of line
140047	new log file A080506_08, 420m
140115	300m
140656	reflector
140820	360m
140838	300m
141109	stop file
142408	new log file A080506_09
143009	camp/reflector
143102	stop file
144128	new log file A080506_10, 480m
144258	360m
144346	300m
144747	reflector
145208	360m
145225	300m
145628	PC1 record stopped
1457	new log file A080506_11, test
1458	new log file A080506_12, test
	Stopped again
1459	change to PC2
1500	new log file A080506_13, test
1501	stop file - OK
150305	new log file A080506_14
1506	try 360m back to 300m
151425	stop file
152330	new log file A080506_15, 420m
152358	360m
152425	300m
153130	new log file A080506_16
153500	camp on starboard
154100	new log file A080506_17, 300m
154240	360m
154340	420m
154724	stop file, end of survey
1548	int. calibration
1550	shut down system
	Landing Thule AB

JD 128 7/5-08 THU-DISKO-SFJ

	Normal start up with engine on
120000	Scanner sync
1204	IMU+ALT restarted, IMU input stopped
1207	Taxi
1216	Take off
121800	New scanner file
1228	EMAP restarted – new map on screen
124515	New scanner file
	Melville Bay open water in northern part
134200	New scanner file
142630	New scanner file
151100	New scanner file
1552	End of Disko survey
	Direct SFJ
1653	Landing



8.2 GPS reference coordinates

Reference GPS station coordinates in ITRF 2005.

Table A.1 GPS reference coordinates

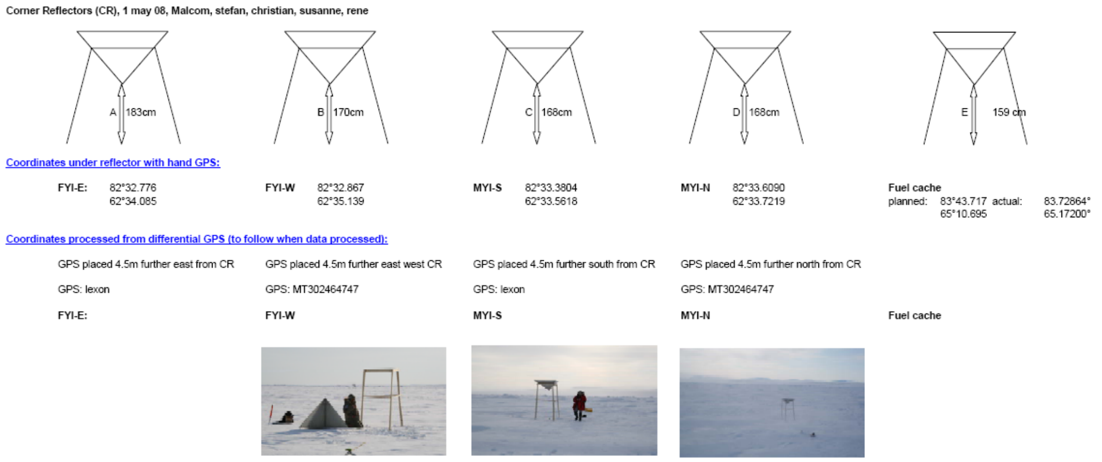
Name	Day	Lat (DMS)			Lon (DMS)			Ellipsoidal Height (m)
SFJ1	109	67	0	21.6428	-50	42	9.7167	71.8670
	110	67	0	21.6429	-50	42	9.7166	71.8663
	131	67	0	21.6429	-50	42	9.7167	71.8626
	134	67	0	21.6430	-50	42	9.7169	71.8605
	135	67	0	21.6429	-50	42	9.7168	71.8675
	133	67	0	21.6430	-50	42	9.7167	71.8573
SCOR	111	70	29	7.1998	-21	57	1.2123	128.4871
NRD1	115	81	35	47.4178	-16	39	50.9411	61.4741
	118	81	35	47.3958	-16	39	51.5421	61.8364
NRD2	118	81	35	47.7708	-16	39	51.2947	62.0200
YLT1	120	82	30	40.1035	-62	19	7.8670	44.0638
	122	82	30	42.1338	-62	19	56.2566	51.6529
	123	82	30	42.1340	-62	19	56.2577	51.6501
YLT2	120	82	30	39.5054	-62	19	13.9806	45.3253
	122	82	30	39.5053	-62	19	13.9794	45.3350
	123	82	30	39.5053	-62	19	13.9793	45.3347
	126	82	30	39.5053	-62	19	13.9805	45.3381
JAV0	110	69	14	25.3716	-51	3	56.7004	58.9223
JUV0	110	72	47	16.2809	-56	7	45.1428	159.0137

Mean values used for processing:

	Lat	Lon	E. Height
SFJ1	67 0 21.6429	-50 42 9.7167	71.8635
NRD1	81 35 47.4068	-16 39 51.2416	61.6552
YLT1 (120+122+123)	82 30 41.4571	-62 19 40.1271	49.1223
YLT1 (122+123)	82 30 42.1339	-62 19 56.2572	51.6515
YLT2	82 30 39.5053	-62 19 13.9799	45.3333

8.3 Corner reflector details from sea ice in-situ observations

Details of corner reflectors on the sea ice near CFS Alert:



See also the field report from the ground validation work by Haas, Hanson, and Hendricks, CryoVEx 2008 Field report of in-situ validation measurements, 2008 (App. 8.7).

8.4 Recorded ASIRAS files

List of recorded ASIRAS files with start/stop times, range window and number of pulses:

TableA.2. Recorded ASIRAS files

File name [AYYMMDD]	Start time	Stop time	Range Window [m]	# Pulses
A080417_00.log	16:02:40	16:02:45	18.00	5783
A080417_01.log	16:04:14	16:04:19	90.00	9419
A080417_02.log	16:06:56		90.00	
A080417_03.log	16:09:30	16:09:36	18.00	7500
A080417_04.log	21:13:03	21:15:12	18.00	375148
A080417_05.log	21:24:23	21:26:44	90.00	347498
A080417_06.log	21:28:37	21:30:33	90.00	284998
A080417_07.log	21:33:09	21:36:15	90.00	459998
A080418_00.log	20:07:07	20:13:34	90.00	1152455
A080418_01.log	20:15:45	20:21:31	90.00	1032407
A080418_02.log	20:22:29	20:25:12	90.00	483191
A080419_00.log	12:52:16	12:58:17	90.00	1074424
A080419_01.log	13:40:34	14:15:01	90.00	6194438
A080419_02.log	14:15:02	14:49:44	90.00	6242456
A080419_03.log	14:54:35	15:21:34	90.00	4855910
A080419_04.log	15:23:28	16:03:00	90.00	7112798
A080419_05.log	16:03:02	16:14:22	90.00	2034802
A080419_06.log	16:05:44	16:35:25	90.00	5339104
A080419_07.log	16:35:37	17:05:39	90.00	5402127
A080419_08.log	17:05:40	17:21:16	90.00	2800102
A080419_09.log	17:24:41	17:45:19	90.00	3706460
A080419_10.log	17:46:17	17:58:36	90.00	2208870
A080419_11.log	17:59:36	18:30:59	90.00	5642220
A080419_12.log	18:31:01	18:55:50	90.00	4459755
A080419_13.log	18:56:50	19:23:32	90.00	4801889
A080420_00.log	11:35:44	11:42:10	90.00	1152454

A080420_01.log	11:44:09	11:56:25	90.00	2202868
A080420_02.log	12:00:37	12:12:31	18.00	2136858
A080420_03.log	12:15:03	12:46:23	90.00	5636219
A080420_04.log	12:46:24	13:13:43	90.00	4906931
A080420_05.log	13:13:45	13:29:32	90.00	2839118
A080420_06.log	13:29:33	14:00:05	90.00	5492161
A080420_07.log	14:00:07	14:30:14	90.00	5414130
A080420_08.log	14:30:26	14:51:40	90.00	3817502
A080421_00.log	11:16:29	12:02:24	90.00	8262252
A080421_01.log	12:02:29	12:27:01	90.00	4408735
A080421_02.log	12:54:30	13:56:27	90.00	11149385
A080421_03.log	15:33:41	16:01:27	90.00	4993966
A080421_04.log	16:01:28	16:15:40	90.00	2551004
A080421_05.log	16:15:42	16:33:22	90.00	3175249
A080421_06.log	16:33:25	16:52:52	90.00	3499377
A080421_07.log	16:52:54	17:14:23	90.00	3862520
A080421_08.log	17:14:25	17:21:40	90.00	1299511
A080421_09.log	17:22:15	17:22:44	90.00	81032
A080421_10.log	17:23:24	17:35:29	90.00	2169854
A080421_11.log	17:35:32	17:49:16	90.00	2469972
A080421_12.log	17:49:18	18:11:48	90.00	4042590
A080421_13.log	18:12:30	18:29:50	90.00	3115226
A080421_14.log	18:29:54	18:43:23	90.00	2421953
A080421_15.log	18:43:27	18:59:16	90.00	2839118
A080421_16.log	18:59:17	19:14:26	90.00	2722071
A080421_17.log	19:14:27	19:29:35	90.00	2719070
A080424_00.log	11:35:59	11:50:12	90.00	2554005
A080424_01.log	11:50:14	12:05:36	90.00	2761087
A080424_02.log	12:05:39	12:20:08	90.00	2602024
A080424_03.log	12:20:10	12:33:23	90.00	2373934
A080424_04.log	12:35:10	12:50:58	90.00	2839117
A080424_05.log	12:51:03	12:59:06	90.00	1443569
A080424_06.log	12:59:07	13:03:10	90.00	723285
A080424_07.log	13:04:14	13:09:31	90.00	945372
A080424_08.log	13:10:53	13:14:08	90.00	579228
A080424_09.log	13:15:48	13:19:38	90.00	684270
A080424_10.log	13:21:03	13:21:42	90.00	111044
A080424_11.log	13:23:18	13:33:19	90.00	1797716
A080424_12.log	13:33:20	13:44:42	90.00	2040803
A080424_13.log	13:44:43	13:55:07	90.00	1866735
A080424_14.log	13:55:09	14:05:21	90.00	1830721
A080424_15.log	14:05:23	14:15:32	90.00	1821717
A080424_16.log	14:15:39	14:16:57	90.00	225090
A080424_17.log	15:55:48	15:56:01	90.00	33014
A080424_18.log	16:53:28	16:53:39	90.00	27011
A080424_19.log	16:55:14	17:05:10	90.00	1779702
A080424_20.log	17:05:11	17:16:22	90.00	2004789
A080424_21.log	17:16:23	17:25:44	90.00	1674659
A080424_22.log	17:25:45	17:35:20	90.00	1716675
A080424_23.log	17:35:21	17:37:49	90.00	438173
A080424_24.log	18:08:09	18:18:31	90.00	1857731
A080424_25.log	18:18:32	18:28:31	90.00	1788704
A080424_26.log	18:28:33	18:38:56	90.00	1860732
A080424_27.log	18:38:57	18:47:17	90.00	1494589

A080427_00.log	10:21:42	10:21:54	90.00	27011
A080427_01.log	10:26:30	10:35:58	90.00	1698670
A080427_02.log	10:35:59	10:45:49	90.00	1761695
A080427_03.log	10:45:50	10:59:38	90.00	2475976
A080427_04.log	10:59:39	11:11:09	90.00	2064814
A080427_05.log	11:11:10	11:16:01	90.00	864341
A080427_06.log	11:20:47	11:30:22	90.00	1716676
A080427_07.log	11:30:24	11:40:19	90.00	1779701
A080427_08.log	11:40:19	11:51:23	90.00	1983782
A080427_09.log	11:51:25	12:00:56	90.00	1707673
A080427_10.log	12:00:57	12:10:21	90.00	1686664
A080427_11.log	12:10:21	12:20:51	90.00	1878740
A080427_12.log	12:20:51	12:31:10	90.00	1848728
A080427_13.log	12:31:10	12:42:12	90.00	1977779
A080427_14.log	12:42:13	13:00:09	90.00	3220268
A080427_15.log	13:00:09	13:08:44	90.00	1536605
A080427_16.log	13:13:30	13:25:36	90.00	2172855
A080427_17.log	13:25:37	13:35:09	90.00	1713675
A080427_18.log	13:35:11	13:46:27	90.00	2022796
A080427_19.log	13:46:29	13:58:33	90.00	2163852
A080427_20.log	13:58:33	14:10:24	90.00	2127837
A080427_21.log	14:10:26	14:25:20	90.00	2680055
A080427_22.log	14:25:21	14:34:53	90.00	1707672
A080427_23.log	14:34:54	14:45:03	90.00	1821717
A080427_24.log	14:45:05	14:55:53	90.00	1938763
A080427_25.log	14:55:58	14:58:29	90.00	447176
A080427_26.log	14:58:52	15:03:34	90.00	840331
A080427_27.log	15:05:27	15:07:57	90.00	444175
A080427_28.log	15:08:42	15:10:52	90.00	384152
A080427_29.log	15:11:34	15:15:01	90.00	615243
A080427_30.log	15:16:09	15:18:19	90.00	384151
A080428_00.log	16:25:27	16:27:02	90.00	276110
A080428_01.log	16:38:10	16:51:57	90.00	2472974
A080428_02.log	16:51:57	17:00:18	90.00	1491588
A080428_03.log	17:00:19	17:10:11	90.00	1767697
A080428_04.log	17:10:11	17:20:37	90.00	1872737
A080428_05.log	17:20:39	17:31:21	90.00	1914754
A080428_06.log	17:31:21	17:40:14	90.00	1593628
A080428_07.log	17:40:15	17:51:08	90.00	1953769
A080428_08.log	17:51:09	18:00:08	90.00	1605632
A080428_09.log	18:00:09	18:10:22	90.00	1833722
A080428_10.log	18:10:23	18:20:06	90.00	1743686
A080428_11.log	18:20:07	18:26:56	90.00	1218480
A080429_00.log	14:38:26	14:49:22	90.00	1962774
A080429_01.log	14:49:24	14:59:26	90.00	1800709
A080429_02.log	14:59:40	15:09:19	90.00	1731682
A080429_03.log	15:09:21	15:20:01	90.00	1914754
A080429_04.log	15:20:03	15:30:16	90.00	1833722
A080429_05.log	15:30:17	15:40:15	90.00	1788704
A080429_06.log	15:40:16	15:44:49	90.00	810319
A080429_07.log	15:51:42	15:54:11	90.00	441175
A080429_08.log	16:00:36	16:02:45	90.00	378149
A080429_09.log	16:08:06	16:11:07	90.00	537212
A080429_10.log	16:16:36	16:26:48	90.00	1827719

A080429_11.log	16:26:49	16:36:38	90.00	1761694
A080429_12.log	16:36:39	16:46:25	90.00	1752690
A080429_13.log	16:46:26	16:56:16	90.00	1761694
A080429_14.log	16:56:17	17:08:45	90.00	2238881
A080429_15.log	17:14:09	17:25:28	90.00	2028798
A080429_16.log	17:25:29	17:35:13	90.00	1746688
A080429_17.log	17:35:15	17:43:58	90.00	1563616
A080429_18.log	17:45:28	17:59:23	90.00	2499984
A080429_19.log	18:00:50	18:10:18	90.00	1698669
A080429_20.log	18:10:19	18:20:08	90.00	1761693
A080429_21.log	18:20:09	18:33:07	90.00	2328917
A080429_22.log	18:33:08	18:41:26	90.00	1488586
A080429_23.log	18:41:27	18:52:45	90.00	2028799
A080429_24.log	18:52:46	18:59:52	90.00	1272501
A080429_25.log	18:59:56	19:06:06	90.00	1104435
A080501_00.log	13:51:54	14:02:07	90.00	1773699
A080501_01.log	14:02:09	14:12:07	90.00	1791706
A080501_02.log	14:12:08	14:22:19	90.00	1827720
A080501_03.log	14:22:32	14:33:37	90.00	1989784
A080501_04.log	14:33:39	14:45:15	90.00	2085822
A080501_05.log	14:45:17	14:56:29	90.00	2010792
A080501_06.log	14:56:33	15:05:30	90.00	1605633
A080501_07.log	15:05:31	15:15:05	90.00	1716676
A080501_08.log	15:15:06	15:26:33	90.00	2055810
A080501_09.log	15:26:35	15:35:39	90.00	1626641
A080501_10.log	15:35:41	15:47:17	90.00	2082820
A080501_11.log	15:51:22	16:00:38	90.00	1662654
A080501_12.log	16:00:39	16:10:47	90.00	1818716
A080501_13.log	16:10:48	16:20:36	90.00	1758693
A080501_14.log	16:20:37		90.00	
A080501_15.log	16:43:32	16:55:54	90.00	2220874
A080501_16.log	16:55:54	17:05:09	90.00	1656652
A080501_17.log	17:05:10	17:15:41	90.00	1887743
A080501_18.log	17:15:41	17:25:10	90.00	1698669
A080501_19.log	17:25:11	17:36:54	90.00	2103828
A080501_20.log	17:36:55	17:46:42	90.00	1755691
A080501_21.log	17:46:42	17:56:05	90.00	1680662
A080501_22.log	17:56:05	18:07:28	90.00	2040803
A080501_23.log	18:58:44	19:00:54	90.00	381150
A080501_24.log	19:05:49	19:11:16	90.00	975384
A080501_25.log	19:15:19	19:19:09	90.00	684270
A080501_26.log	19:23:00	19:27:04	90.00	726287
A080501_27.log	19:31:18	19:35:30	90.00	750295
A080501_28.log	19:39:11	19:43:12	90.00	714281
A080501_29.log	19:49:45	19:54:58	90.00	933368
A080501_30.log	19:58:30	20:01:45	90.00	579228
A080501_31.log	20:06:40	20:11:34	90.00	876345
A080501_32.log	20:14:23	20:18:11	90.00	678267
A080501_33.log	20:22:03	20:26:20	90.00	765302
A080501_34.log	20:29:25	20:32:41	90.00	582230
A080502_00.log	13:44:29	13:55:04	90.00	1833723
A080502_01.log	13:55:06	14:05:07	90.00	1800710
A080502_02.log	14:05:09	14:15:26	90.00	1845728
A080502_03.log	14:15:27	14:25:12	90.00	1749690

A080502_04.log	14:25:14	14:35:42	90.00	1878741
A080502_05.log	14:35:43	14:45:13	90.00	1704671
A080502_06.log	14:45:15	14:55:11	90.00	1782702
A080502_07.log	14:55:12	15:01:02	90.00	1044411
A080502_08.log	15:18:20	15:30:03	90.00	2106830
A080502_09.log	15:30:05	15:40:43	90.00	1908752
A080502_10.log	15:40:44	15:50:02	90.00	1668657
A080502_11.log	15:50:04	16:00:02	90.00	1788704
A080502_12.log	16:00:03	16:08:39	90.00	1542608
A080502_13.log	16:26:52	16:36:05	90.00	1653651
A080502_14.log	16:36:06	16:45:02	90.00	1602631
A080502_15.log	16:45:03	16:55:02	90.00	1791706
A080502_16.log	16:55:03	17:05:03	90.00	1794706
A080502_17.log	17:05:04	17:15:06	90.00	1800709
A080502_18.log	17:15:07	17:22:47	90.00	1374542
A080502_19.log	17:51:42	18:00:03	90.00	1497590
A080502_20.log	18:00:04	18:10:02	90.00	1788704
A080502_21.log	18:10:03	18:20:21	90.00	1848728
A080502_22.log	18:20:22	18:30:19	90.00	1785703
A080502_23.log	18:30:20	18:37:23	90.00	1263497
A080502_24.log	20:51:41	20:51:58	90.00	42017
A080502_25.log	20:57:56	21:00:58	90.00	540213
A080502_26.log	21:05:21	21:15:19	90.00	1788705
A080502_27.log	21:15:20	21:25:03	90.00	1743688
A080502_28.log	21:25:04	21:35:02	90.00	1788705
A080502_29.log	21:35:03	21:45:05	90.00	1800709
A080502_30.log	21:45:06	21:55:04	90.00	1788705
A080502_31.log	21:55:05	21:59:17	90.00	750296
A080502_32.log	22:02:35	22:12:02	90.00	1695668
A080502_33.log	22:12:03	22:22:02	90.00	1788704
A080502_34.log	22:22:03	22:27:02	90.00	891352
A080502_35.log	22:27:03	22:37:02	90.00	1791705
A080502_36.log	22:37:04	22:47:02	90.00	1788704
A080502_37.log	22:47:03	22:51:18	90.00	759300
A080505_00.log	13:34:44	13:38:28	90.00	663262
A080505_01.log	13:46:44	13:51:10	90.00	789311
A080505_02.log	13:55:08	13:59:33	90.00	789312
A080505_03.log	14:03:17	14:07:48	90.00	804317
A080505_04.log	14:12:41	14:17:12	90.00	807319
A080505_05.log	14:20:07	14:21:06	90.00	171068
A080505_06.log	14:23:08	14:24:02	90.00	153061
A080505_07.log	14:26:55	14:27:39	90.00	123050
A080505_08.log	14:30:30	14:32:12	90.00	300119
A080505_09.log	14:49:31	14:59:42	90.00	1827720
A080505_10.log	15:11:40	15:21:10	90.00	1701670
A080505_11.log	15:21:10	15:29:49	90.00	1551611
A080506_00.log	12:05:40	12:22:44	90.00	2872132
A080506_01.log	12:22:46	12:32:07	90.00	1680663
A080506_02.log	12:32:08	12:42:08	90.00	1794707
A080506_03.log	12:42:09	12:52:04	90.00	1779701
A080506_04.log	12:52:05	13:02:17	90.00	1830721
A080506_05.log	13:02:18	13:12:03	90.00	1749689
A080506_06.log	13:12:04	13:18:16	90.00	1110437
A080506_07.log	13:32:26	13:45:36	90.00	2364931

A080506_08.log	14:00:47	14:11:11	90.00	1866736
A080506_09.log	14:24:08	14:31:23	90.00	1299512
A080506_10.log	14:41:29	14:56:19	90.00	2665049
A080506_11.log	14:56:42	14:56:57	90.00	39015
A080506_12.log	14:58:36	14:59:26	90.00	144057
A080506_13.log	15:00:22	15:02:04	90.00	300119
A080506_14.log	15:03:06	15:14:27	90.00	2037802
A080506_15.log	15:23:30	15:31:32	90.00	1437566
A080506_16.log	15:31:33	15:41:04	90.00	1707672
A080506_17.log	15:41:05	15:47:26	90.00	1137448

8.5 Summary of ASIRAS processing

The following summarises the processing status and available data products. All profiles were processed with the ESA processor version ASIRAS_03_09. The Fcomp remark shows profiles were a frequency shift within the profile has occurred.

PROFILE	LABEL	L1	L1B	GPS	INS	TSHIFT (s)	REMARK
A080417_00	HAMO2500	/	/	X	X	0.00	Logfile error
A080417_01	LAMA2500	/	/	X	X	0.00	Logfile error
A080417_02	LAMA2500	/	/	X	X	0.00	Logfile error
A080417_03	HAMO2500	X	X	X	X	0.00	
A080417_04	HAMO3001	X	X	X	X	0.00	
A080417_05	LAMA2500	X	X	X	X	0.00	
A080417_06	LAMA2500	X	X	X	X	0.00	FComp
A080417_07	LAMA2500	X	X	X	X	0.00	
A080418_00	LAMA3001	/	/	/	/	0.00	
A080418_01	LAMA3001	/	/	/	/	0.00	
A080418_02	LAMA3001	/	/	/	/	0.00	
A080419_00	LAMA3001	/	/	/	/	0.00	
A080419_01	LAMA3001	/	/	/	/	0.00	
A080419_02	LAMA3001	/	/	/	/	0.00	
A080419_03	LAMA3001	/	/	/	/	0.00	
A080419_04	LAMA3001	/	/	/	/	0.00	
A080419_05	LAMA3001	/	/	/	/	0.00	
A080419_06	LAMA3001	/	/	/	/	0.00	
A080419_07	LAMA3001	/	/	/	/	0.00	
A080419_08	LAMA3001	/	/	/	/	0.00	
A080419_09	LAMA3001	/	/	/	/	0.00	
A080419_10	LAMA3001	/	/	/	/	0.00	
A080419_11	LAMA3001	/	/	/	/	0.00	
A080419_12	LAMA3001	/	/	/	/	0.00	
A080419_13	LAMA3001	/	/	/	/	0.00	
A080420_00	LAMA3001	X	X	X	X	0.00	FComp
A080420_01	LAMA3001	X	X	X	X	0.00	FComp
A080420_02	HAMO3001	X	X	X	X	0.00	
A080420_03	LAMA3001	X	X	X	X	0.00	FComp
A080420_04	LAMA3001	X	X	X	X	0.00	
A080420_05	LAMA3001	X	X	X	X	0.00	
A080420_06	LAMA3001	X	X	X	X	0.00	
A080420_07	LAMA3001	X	X	X	X	0.00	
A080420_08	LAMA3001	X	X	X	X	0.00	
A080421_00	LAMA3001	/	/	/	/	0.00	FComp
A080421_01	LAMA3001	/	/	/	/	0.00	FComp

A080421_02	LAMA3001	/	/	/	/	0.00	FComp
A080421_03	LAMA3001	/	/	/	/	0.00	FComp
A080421_04	LAMA3001	/	/	/	/	0.00	FComp
A080421_05	LAMA3001	/	/	/	/	0.00	
A080421_06	LAMA3001	/	/	/	/	0.00	FComp
A080421_07	LAMA3001	/	/	/	/	0.00	
A080421_08	LAMA3001	/	/	/	/	0.00	
A080421_09	LAMA3001	/	/	/	/	0.00	
A080421_10	LAMA3001	/	/	/	/	0.00	
A080421_11	LAMA3001	/	/	/	/	0.00	
A080421_12	LAMA3001	/	/	/	/	0.00	
A080421_13	LAMA3001	/	/	/	/	0.00	
A080421_14	LAMA3001	/	/	/	/	0.00	FComp
A080421_15	LAMA3001	/	/	/	/	0.00	FComp
A080421_16	LAMA3001	/	/	/	/	0.00	
A080421_17	LAMA3001	/	/	/	/	0.00	
A080424_00	LAMA3001	X	X	X	X	0.00	
A080424_01	LAMA3001	X	X	X	X	0.00	
A080424_02	LAMA3001	X	X	X	X	0.00	
A080424_03	LAMA3001	X	X	X	X	0.00	
A080424_04	LAMA3001	X	X	X	X	0.00	
A080424_05	LAMA3001	X	X	X	X	0.00	
A080424_06	LAMA3001	X	X	X	X	0.00	
A080424_07	LAMA3001	X	X	X	X	0.00	
A080424_08	LAMA3001	X	X	X	X	0.00	
A080424_09	LAMA3001	X	X	X	X	0.00	
A080424_10	LAMA3001	X	X	X	X	0.00	
A080424_11	LAMA3001	X	X	X	X	0.00	
A080424_12	LAMA3001	X	X	X	X	0.00	
A080424_13	LAMA3001	X	X	X	X	0.00	
A080424_14	LAMA3001	X	X	X	X	0.00	
A080424_15	LAMA3001	X	X	X	X	0.00	
A080424_16	LAMA3001	X	X	X	X	0.00	
A080424_17	LAMA3001	X	X	X	X	0.00	
A080424_18	LAMA3001	X	X	X	X	0.00	
A080424_19	LAMA3001	X	X	X	X	0.00	
A080424_20	LAMA3001	X	X	X	X	0.00	
A080424_21	LAMA3001	X	X	X	X	0.00	
A080424_22	LAMA3001	X	X	X	X	0.00	
A080424_23	LAMA3001	X	X	X	X	0.00	
A080424_24	LAMA3001	X	X	X	X	0.00	
A080424_25	LAMA3001	X	X	X	X	0.00	
A080424_26	LAMA3001	X	X	X	X	0.00	
A080424_27	LAMA3001	X	X	X	X	0.00	
A080427_00	LAMA3001	X	X	X	X	0.00	
A080427_01	LAMA3001	X	X	X	X	0.00	
A080427_02	LAMA3001	X	X	X	X	0.00	
A080427_03	LAMA3001	X	X	X	X	0.00	
A080427_04	LAMA3001	X	X	X	X	0.00	
A080427_05	LAMA3001	X	X	X	X	0.00	
A080427_06	LAMA3001	X	X	X	X	0.00	
A080427_07	LAMA3001	X	X	X	X	0.00	
A080427_08	LAMA3001	X	X	X	X	0.00	
A080427_09	LAMA3001	X	X	X	X	0.00	
A080427_10	LAMA3001	X	X	X	X	0.00	

A080427_11	LAMA3001	X	X	X	X	0.00	
A080427_12	LAMA3001	X	X	X	X	0.00	
A080427_13	LAMA3001	X	X	X	X	0.00	
A080427_14	LAMA3001	X	X	X	X	0.00	
A080427_15	LAMA3001	X	X	X	X	0.00	
A080427_16	LAMA3001	X	X	X	X	0.00	
A080427_17	LAMA3001	X	X	X	X	0.00	
A080427_18	LAMA3001	X	X	X	X	0.00	
A080427_19	LAMA3001	X	X	X	X	0.00	
A080427_20	LAMA3001	X	X	X	X	0.00	
A080427_21	LAMA3001	X	X	X	X	0.00	
A080427_22	LAMA3001	X	X	X	X	0.00	
A080427_23	LAMA3001	X	X	X	X	0.00	
A080427_24	LAMA3001	X	X	X	X	0.00	
A080427_25	LAMA3001	X	X	X	X	0.00	
A080427_26	LAMA3001	X	X	X	X	0.00	
A080427_27	LAMA3001	X	X	X	X	0.00	
A080427_28	LAMA3001	X	X	X	X	0.00	
A080427_29	LAMA3001	X	X	X	X	0.00	
A080427_30	LAMA3001	X	X	X	X	0.00	
A080428_00	LAMA3001	X	X	X	X	0.00	
A080428_01	LAMA3001	X	X	X	X	0.00	
A080428_02	LAMA3001	X	X	X	X	0.00	
A080428_03	LAMA3001	X	X	X	X	0.00	
A080428_04	LAMA3001	X	X	X	X	0.00	
A080428_05	LAMA3001	X	X	X	X	0.00	
A080428_06	LAMA3001	X	X	X	X	0.00	
A080428_07	LAMA3001	X	X	X	X	0.00	
A080428_08	LAMA3001	X	X	X	X	0.00	
A080428_09	LAMA3001	X	X	X	X	0.00	
A080428_10	LAMA3001	X	X	X	X	0.00	
A080428_11	LAMA3001	X	X	X	X	0.00	
A080429_00	LAMA3001	X	X	X	X	0.00	FComp
A080429_01	LAMA3001	X	X	X	X	0.00	
A080429_02	LAMA3001	X	X	X	X	0.00	
A080429_03	LAMA3001	X	X	X	X	0.00	
A080429_04	LAMA3001	X	X	X	X	0.00	
A080429_05	LAMA3001	X	X	X	X	0.00	
A080429_06	LAMA3001	X	X	X	X	0.00	
A080429_07	LAMA3001	X	X	X	X	0.00	
A080429_08	LAMA3001	X	X	X	X	0.00	
A080429_09	LAMA3001	X	X	X	X	0.00	
A080429_10	LAMA3001	X	X	X	X	0.00	
A080429_11	LAMA3001	X	X	X	X	0.00	
A080429_12	LAMA3001	X	X	X	X	0.00	
A080429_13	LAMA3001	X	X	X	X	0.00	
A080429_14	LAMA3001	X	X	X	X	0.00	
A080429_15	LAMA3001	X	X	X	X	0.00	
A080429_16	LAMA3001	X	X	X	X	0.00	
A080429_17	LAMA3001	X	X	X	X	0.00	
A080429_18	LAMA3001	X	X	X	X	0.00	
A080429_19	LAMA3001	X	X	X	X	0.00	
A080429_20	LAMA3001	X	X	X	X	0.00	
A080429_21	LAMA3001	X	X	X	X	0.00	FComp
A080429_22	LAMA3001	X	X	X	X	0.00	

A080429_23	LAMA3001	X	X	X	X	0.00	
A080429_24	LAMA3001	X	X	X	X	0.00	
A080429_25	LAMA3001	X	X	X	X	0.00	FComp
A080501_00	LAMA3001	X	X	X	X	0.00	
A080501_01	LAMA3001	X	X	X	X	0.00	
A080501_02	LAMA3001	X	X	X	X	0.00	
A080501_03	LAMA3001	X	X	X	X	0.00	
A080501_04	LAMA3001	X	X	X	X	0.00	
A080501_05	LAMA3001	X	X	X	X	0.00	
A080501_06	LAMA3001	X	X	X	X	0.00	
A080501_07	LAMA3001	X	X	X	X	0.00	
A080501_08	LAMA3001	X	X	X	X	0.00	
A080501_09	LAMA3001	X	X	X	X	0.00	
A080501_10	LAMA3001	X	X	X	X	0.00	
A080501_11	LAMA3001	X	X	X	X	0.00	
A080501_12	LAMA3001	X	X	X	X	0.00	
A080501_13	LAMA3001	X	X	X	X	0.00	
A080501_15	LAMA3001	X	X	X	X	0.00	
A080501_16	LAMA3001	X	X	X	X	0.00	
A080501_17	LAMA3001	X	X	X	X	0.00	
A080501_18	LAMA3001	X	X	X	X	0.00	
A080501_19	LAMA3001	X	X	X	X	0.00	
A080501_20	LAMA3001	X	X	X	X	0.00	
A080501_21	LAMA3001	X	X	X	X	0.00	
A080501_22	LAMA3001	X	X	X	X	0.00	
A080501_23	LAMA3001	X	X	X	X	0.00	
A080501_24	LAMA3001	X	X	X	X	0.00	
A080501_25	LAMA3001	X	X	X	X	0.00	
A080501_26	LAMA3001	X	X	X	X	0.00	GPS gap?
A080501_27	LAMA3001	X	X	X	X	0.00	FComp
A080501_28	LAMA3001	X	X	X	X	0.00	
A080501_29	LAMA3001	X	X	X	X	0.00	
A080501_30	LAMA3001	X	X	X	X	0.00	
A080501_31	LAMA3001	X	X	X	X	0.00	FComp
A080501_32	LAMA3001	X	X	X	X	0.00	
A080501_33	LAMA3001	X	X	X	X	0.00	
A080501_34	LAMA3001	X	X	X	X	0.00	
A080502_00	LAMA3001	X	X	X	X	0.00	
A080502_01	LAMA3001	X	X	X	X	0.00	
A080502_02	LAMA3001	X	X	X	X	0.00	FComp
A080502_03	LAMA3001	X	X	X	X	0.00	
A080502_04	LAMA3001	X	X	X	X	0.00	
A080502_05	LAMA3001	X	X	X	X	0.00	
A080502_06	LAMA3001	X	X	X	X	0.00	FComp
A080502_07	LAMA3001	X	X	X	X	0.00	FComp
A080502_08	LAMA3001	X	X	X	X	0.00	
A080502_09	LAMA3001	X	X	X	X	0.00	FComp
A080502_10	LAMA3001	X	X	X	X	0.00	FComp
A080502_11	LAMA3001	X	X	X	X	0.00	FComp
A080502_12	LAMA3001	X	X	X	X	0.00	
A080502_13	LAMA3001	X	X	X	X	0.00	
A080502_14	LAMA3001	X	X	X	X	0.00	
A080502_15	LAMA3001	X	X	X	X	0.00	
A080502_16	LAMA3001	X	X	X	X	0.00	
A080502_17	LAMA3001	X	X	X	X	0.00	

A080502_18	LAMA3001	X	X	X	X	0.00	
A080502_19	LAMA3001	X	X	X	X	0.00	
A080502_20	LAMA3001	X	X	X	X	0.00	
A080502_21	LAMA3001	X	X	X	X	0.00	
A080502_22	LAMA3001	X	X	X	X	0.00	
A080502_23	LAMA3001	X	X	X	X	0.00	
A080502_24	LAMA3001	X	X	X	X	0.00	
A080502_25	LAMA3001	X	X	X	X	0.00	
A080502_26	LAMA3001	X	X	X	X	0.00	
A080502_27	LAMA3001	X	X	X	X	0.00	
A080502_28	LAMA3001	X	X	X	X	0.00	
A080502_29	LAMA3001	X	X	X	X	0.00	
A080502_30	LAMA3001	X	X	X	X	0.00	
A080502_31	LAMA3001	X	X	X	X	0.00	
A080502_32	LAMA3001	X	X	X	X	0.00	
A080502_33	LAMA3001	X	X	X	X	0.00	
A080502_34	LAMA3001	X	X	X	X	0.00	
A080502_35	LAMA3001	X	X	X	X	0.00	
A080502_36	LAMA3001	X	X	X	X	0.00	
A080502_37	LAMA3001	X	X	X	X	0.00	
A080505_00	LAMA3001	X	X	X	X	0.00	
A080505_01	LAMA3001	X	X	X	X	0.00	
A080505_02	LAMA3001	X	X	X	X	0.00	
A080505_03	LAMA3001	X	X	X	X	0.00	
A080505_04	LAMA3001	X	X	X	X	0.00	
A080505_05	LAMA3001	X	X	X	X	0.00	
A080505_06	LAMA3001	X	X	X	X	0.00	
A080505_07	LAMA3001	X	X	X	X	0.00	GPS gap?
A080505_08	LAMA3001	X	X	X	X	0.00	
A080505_09	LAMA3001	X	X	X	X	0.00	
A080505_10	LAMA3001	X	X	X	X	0.00	
A080505_11	LAMA3001	X	X	X	X	0.00	
A080506_00	LAMA3001	X	X	X	X	0.00	
A080506_01	LAMA3001	X	X	X	X	0.00	
A080506_02	LAMA3001	X	X	X	X	0.00	
A080506_03	LAMA3001	X	X	X	X	0.00	
A080506_04	LAMA3001	X	X	X	X	0.00	
A080506_05	LAMA3001	X	X	X	X	0.00	
A080506_06	LAMA3001	X	X	X	X	0.00	FComp
A080506_07	LAMA3001	X	X	X	X	0.00	Fcomp, SIGSEGV
A080506_08	LAMA3001	X	X	X	X	0.00	FComp
A080506_09	LAMA3001	X	X	X	X	0.00	
A080506_10	LAMA3001	X	X	X	X	0.00	FComp
A080506_11	LAMA3001	X	X	X	X	0.00	
A080506_12	LAMA3001	X	X	X	X	0.00	FComp
A080506_13	LAMA3001	X	X	X	X	0.00	Fcomp, GPS gap?
A080506_14	LAMA3001	X	X	X	X	0.00	FComp
A080506_15	LAMA3001	X	X	X	X	0.00	FComp
A080506_16	LAMA3001	X	X	X	X	0.00	
A080506_17	LAMA3001	X	X	X	X	0.00	FComp

8.6 Processed ASIRAS profiles

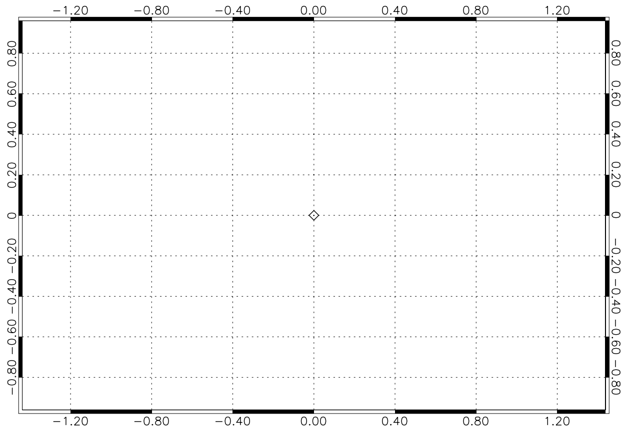
Following plots show all processed ASIRAS profiles. Each profile plot consists of four parts.

1. Header composed of daily profile number and the date and a sub-header with the filename.
2. Geographical plot of the profile (diamond indicates the start of the profile)
3. Rough indication of the height as determined by the OCOG retracker plotted versus time of day in seconds.
4. Info box with date, start and stop times in hour, minute, seconds, and in square brackets seconds of the day, acquisition mode etc.

It should be emphasized that the surface height determined by the OCOG retracker is a rough estimate and not a true height.

A03_20080417

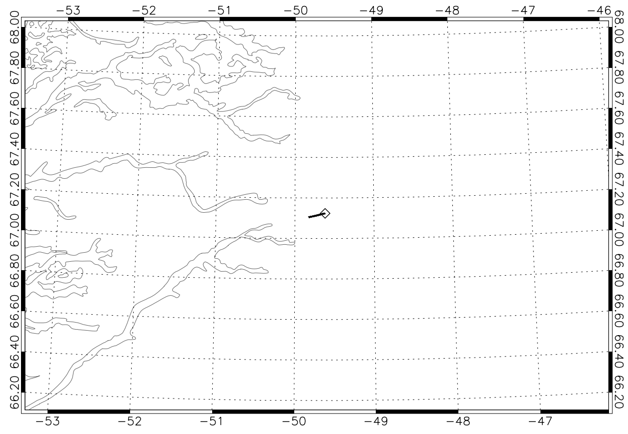
AS3TA03_ASIHL1B030920080417T141156_20080417T141159_0001.DBL

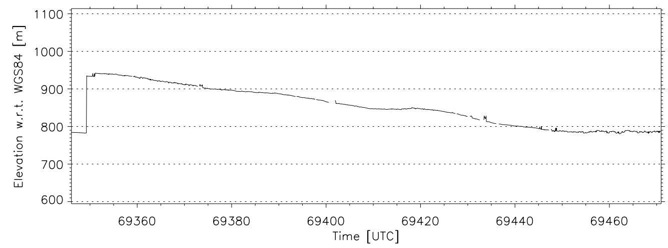


Date	2008-04-17	**Instrument Mode**	High Altitude
Start Time	**:59:27 (*****)	**Aircraft**	DNSC Twin Otter
Stop Time	**:59:27 (*****)	**Retracker**	OCOG
Distance	-NaN km	**INS Resolution**	50 Hz
Duration	00 h 00 m 00 s	**Processor Version**	0309

A04_20080417

AS3TA04_ASIHL1B030920080417T191546_20080417T191751_0001.DBL

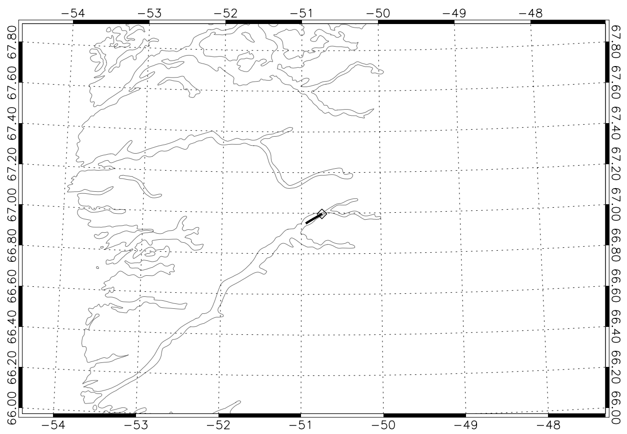


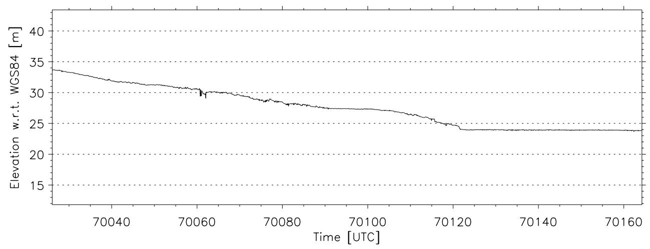


Date	2008-04-17	**Instrument Mode**	High Altitude
Start Time	19:15:46 (69346)	**Aircraft**	DNSC Twin Otter
Stop Time	19:17:50 (69470)	**Retracker**	OCOG
Distance	9.314 km	**INS Resolution**	50 Hz
Duration	00 h 02 m 05 s	**Processor Version**	0309

A05_20080417

AS3TA05_ASIAL1B030920080417T192706_20080417T192925_0001.DBL

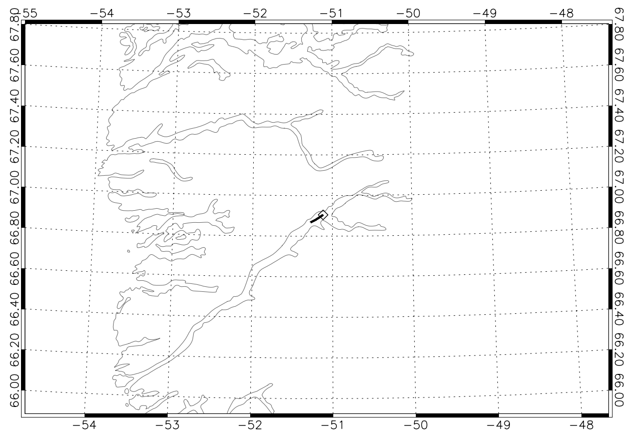




Date	2008-04-17	**Instrument Mode**	Adv. Low Altitude
Start Time	19:27:06 (70026)	**Aircraft**	DNSC Twin Otter
Stop Time	19:29:24 (70164)	**Retracker**	OCOG
Distance	10.240 km	**INS Resolution**	50 Hz
Duration	00 h 02 m 18 s	**Processor Version**	0309

A06_20080417

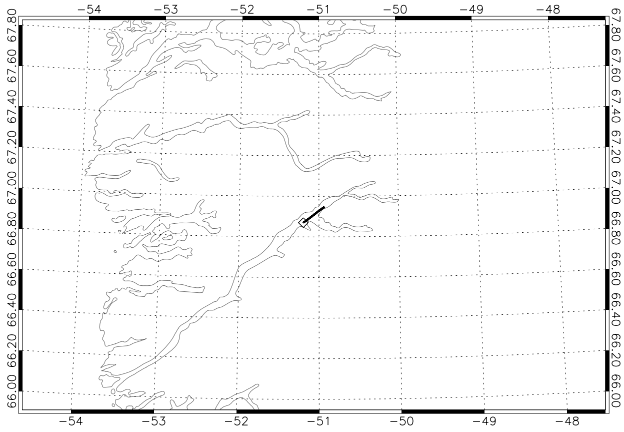
AS3TA06_ASIAL1B030920080417T193120_20080417T193314_0001.DBL

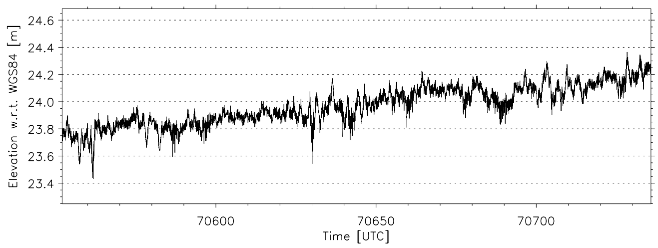


Date	2008-04-17	**Instrument Mode**	Adv. Low Altitude
Start Time	19:31:20 (70280)	**Aircraft**	DNSC Twin Otter
Stop Time	19:33:13 (70393)	**Retracker**	OCOG
Distance	8.019 km	**INS Resolution**	50 Hz
Duration	00 h 01 m 54 s	**Processor Version**	0309

A07_20080417

AS3TA07_ASIAL1B030920080417T193552_20080417T193856_0001.DBL

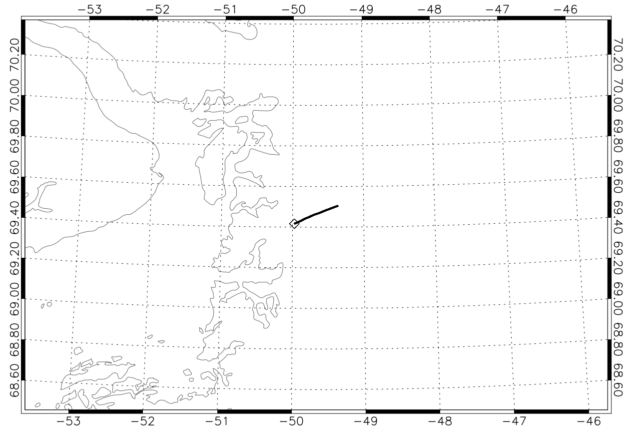


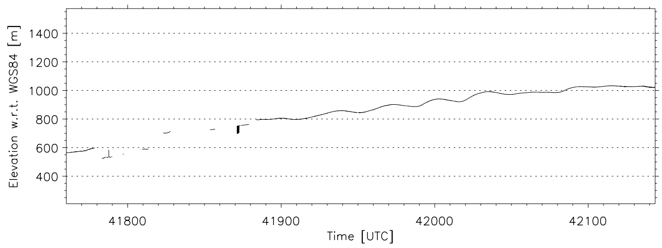


Date	2008-04-17	**Instrument Mode**	Adv. Low Altitude
Start Time	19:35:52 (70552)	**Aircraft**	DNSC Twin Otter
Stop Time	19:38:55 (70735)	**Retracker**	OCOG
Distance	14.425 km	**INS Resolution**	50 Hz
Duration	00 h 03 m 04 s	**Processor Version**	0309

A00_20080420

AS3TA00_ASIAL1B030920080420T113600_20080420T114224_0001.DBL

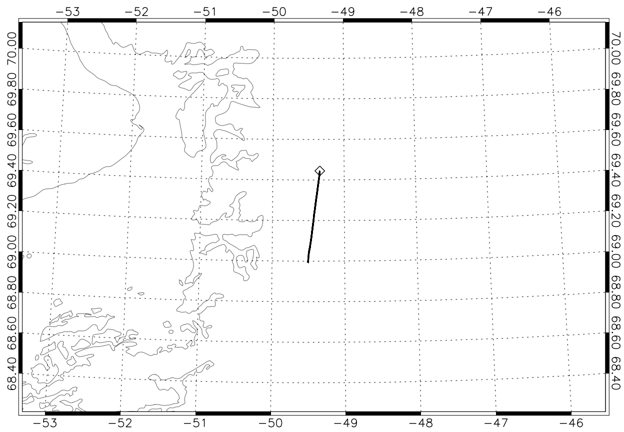


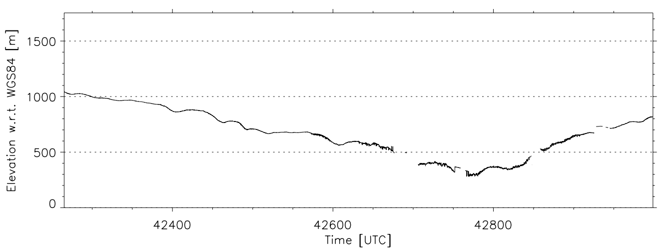


Date	2008-04-20	**Instrument Mode**	Adv. Low Altitude
Start Time	11:36:00 (41760)	**Aircraft**	DNSC Twin Otter
Stop Time	11:42:23 (42143)	**Retracker**	OCOG
Distance	25.995 km	**INS Resolution**	50 Hz
Duration	00 h 06 m 24 s	**Processor Version**	0309

A01_20080420

AS3TA01_ASIAL1B030920080420T114425_20080420T115639_0001.DBL

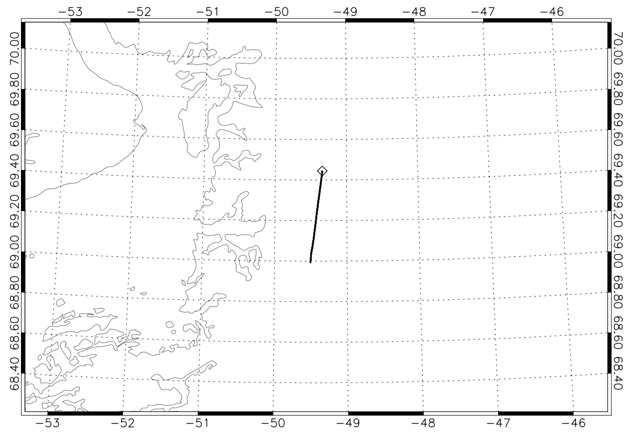


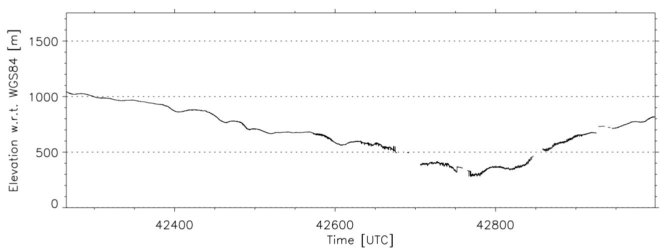


Date	2008-04-20	**Instrument Mode**	Adv. Low Altitude
Start Time	11:44:25 (42265)	**Aircraft**	DNSC Twin Otter
Stop Time	11:56:38 (42998)	**Retracker**	OCOG
Distance	50.763 km	**INS Resolution**	50 Hz
Duration	00 h 12 m 14 s	**Processor Version**	0309

A01_20080420

AS3TA01_ASIAL1B030920080420T114425_20080420T115639_0001.DBL

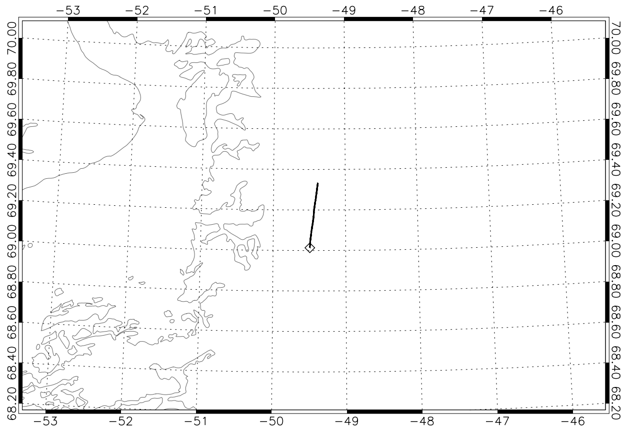


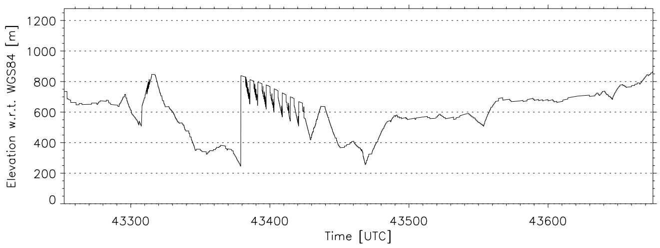


Date	2008-04-20	**Instrument Mode**	Adv. Low Altitude
Start Time	11:44:25 (42265)	**Aircraft**	DNSC Twin Otter
Stop Time	11:56:38 (42998)	**Retracker**	OCOG
Distance	50.763 km	**INS Resolution**	50 Hz
Duration	00 h 12 m 14 s	**Processor Version**	0309

A02_20080420

AS3TA02_ASIAL1B030920080420T120052_20080420T121244_0001.DBL

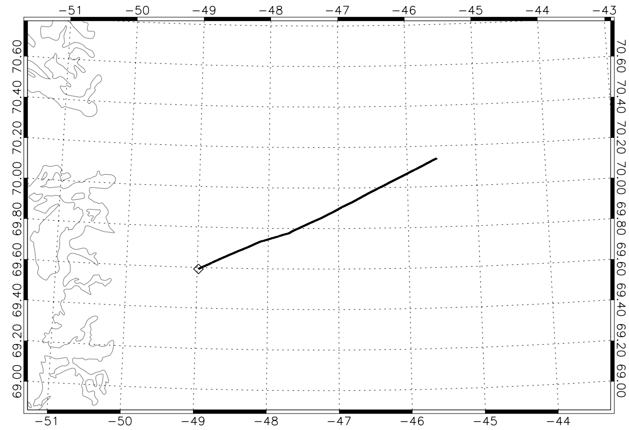


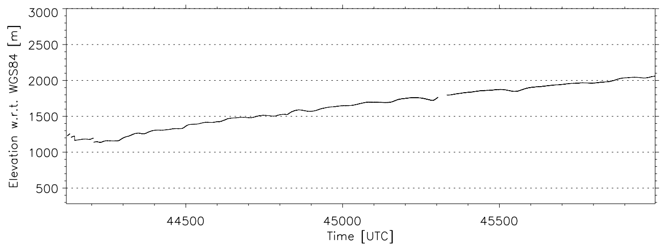


Date	2008-04-20	**Instrument Mode**	Adv. Low Altitude
Start Time	12:00:52 (43252)	**Aircraft**	DNSC Twin Otter
Stop Time	12:07:55 (43675)	**Retracker**	OCOG
Distance	35.975 km	**INS Resolution**	50 Hz
Duration	00 h 07 m 03 s	**Processor Version**	0309

A03_20080420

AS3TA03_ASIAL1B030920080420T121519_20080420T124637_0001.DBL

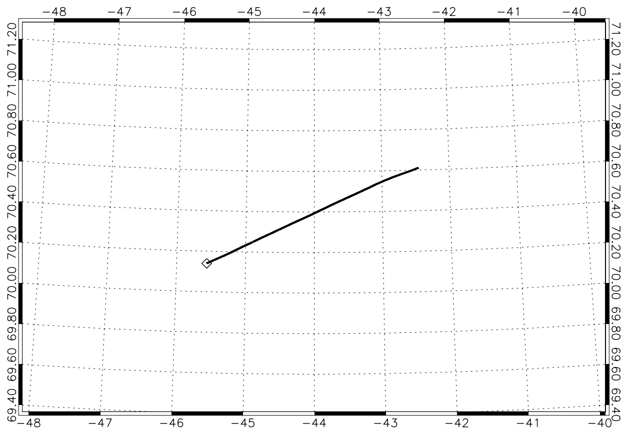


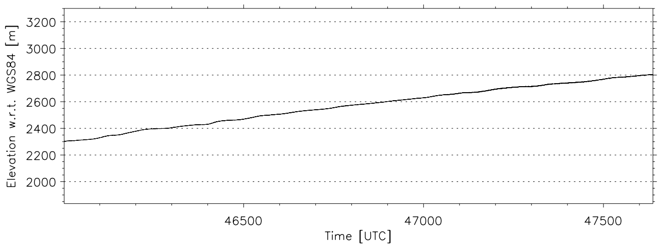


Date	2008-04-20	**Instrument Mode**	Adv. Low Altitude
Start Time	12:15:19 (44119)	**Aircraft**	DNSC Twin Otter
Stop Time	12:46:36 (45996)	**Retracker**	OCOG
Distance	144.151 km	**INS Resolution**	50 Hz
Duration	00 h 31 m 18 s	**Processor Version**	0309

A04_20080420

AS3TA04_ASIAL1B030920080420T124641_20080420T131357_0001.DBL

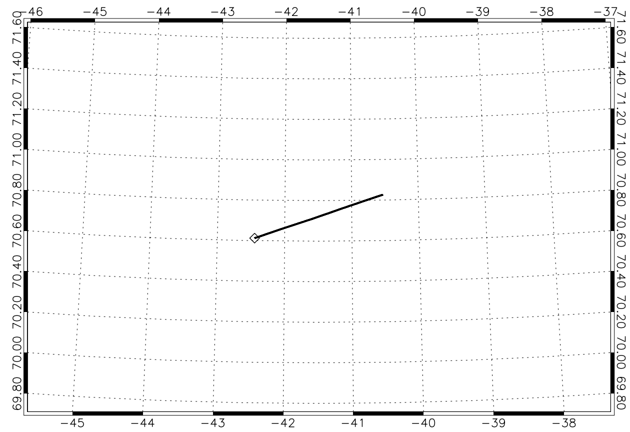


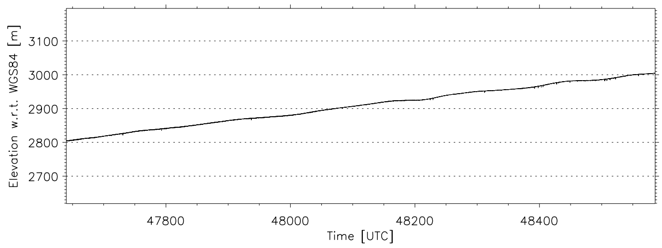


Date	2008-04-20	**Instrument Mode**	Adv. Low Altitude
Start Time	12:46:41 (46001)	**Aircraft**	DNSC Twin Otter
Stop Time	13:13:57 (47637)	**Retracker**	OCOG
Distance	127.619 km	**INS Resolution**	50 Hz
Duration	00 h 27 m 17 s	**Processor Version**	0309

A05_20080420

AS3TA05_ASIAL1B030920080420T131400_20080420T132946_0001.DBL

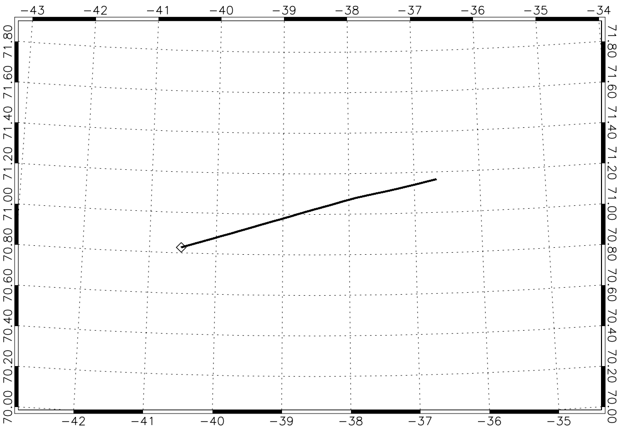


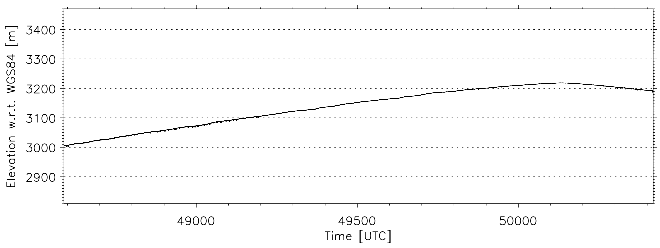


Date	2008-04-20	**Instrument Mode**	Adv. Low Altitude
Start Time	13:14:00 (47640)	**Aircraft**	DNSC Twin Otter
Stop Time	13:29:45 (48585)	**Retracker**	OCOG
Distance	74.353 km	**INS Resolution**	50 Hz
Duration	00 h 15 m 46 s	**Processor Version**	0309

A06_20080420

AS3TA06_ASIAL1B030920080420T132949_20080420T140019_0001.DBL

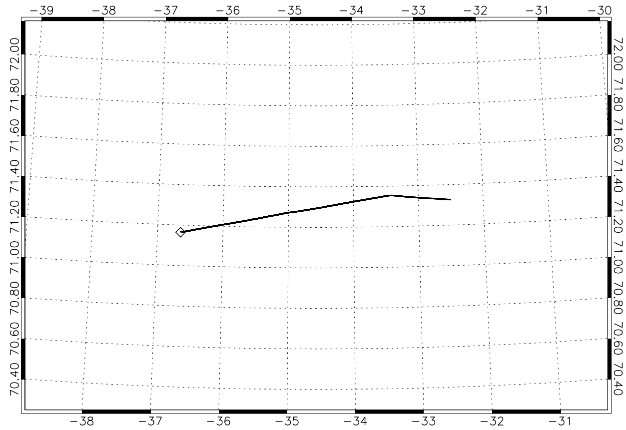


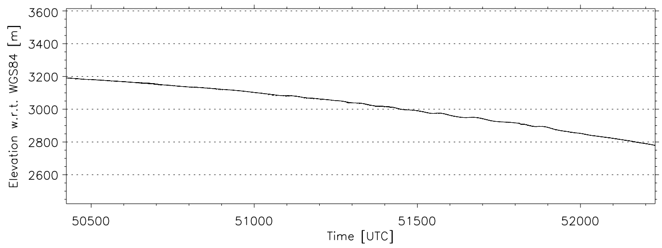


Date	2008-04-20	**Instrument Mode**	Adv. Low Altitude
Start Time	13:29:49 (48589)	**Aircraft**	DNSC Twin Otter
Stop Time	14:00:18 (50418)	**Retracker**	OCOG
Distance	144.979 km	**INS Resolution**	50 Hz
Duration	00 h 30 m 30 s	**Processor Version**	0309

A07_20080420

AS3TA07_ASIAL1B030920080420T140024_20080420T143028_0001.DBL

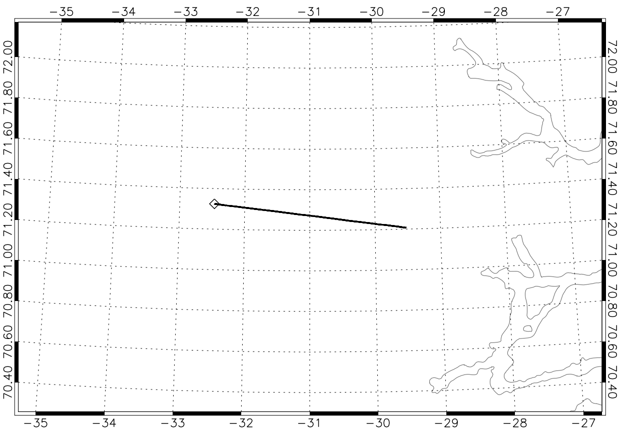


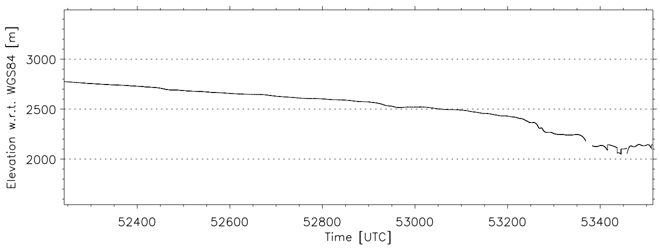


Date	2008-04-20	**Instrument Mode**	Adv. Low Altitude
Start Time	14:00:24 (50424)	**Aircraft**	DNSC Twin Otter
Stop Time	14:30:28 (52228)	**Retracker**	OCOG
Distance	150.236 km	**INS Resolution**	50 Hz
Duration	00 h 30 m 05 s	**Processor Version**	0309

A08_20080420

AS3TA08_ASIAL1B030920080420T143042_20080420T145154_0001.DBL

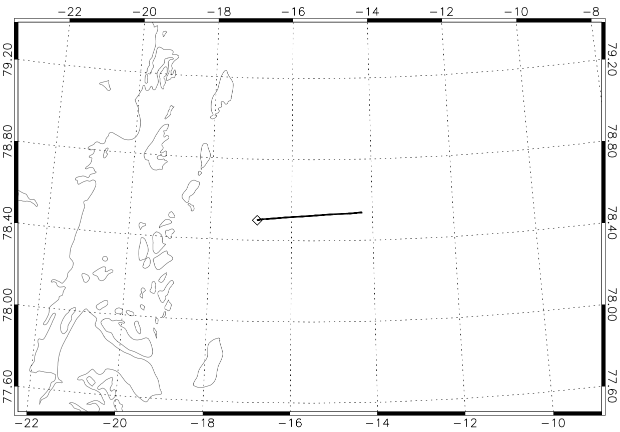


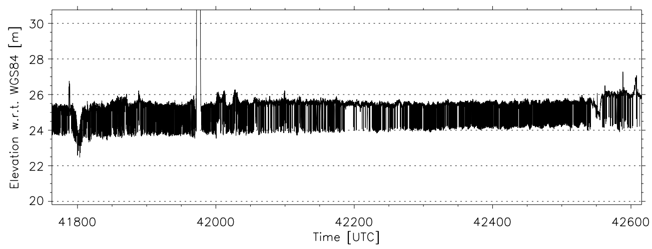


Date	2008-04-20	**Instrument Mode**	Adv. Low Altitude
Start Time	14:30:42 (52242)	**Aircraft**	DNSC Twin Otter
Stop Time	14:51:54 (53514)	**Retracker**	OCOG
Distance	106.013 km	**INS Resolution**	50 Hz
Duration	00 h 21 m 12 s	**Processor Version**	0309

A00_20080424

AS3TA00_ASIAL1B030920080424T113603_20080424T115014_0001.DBL

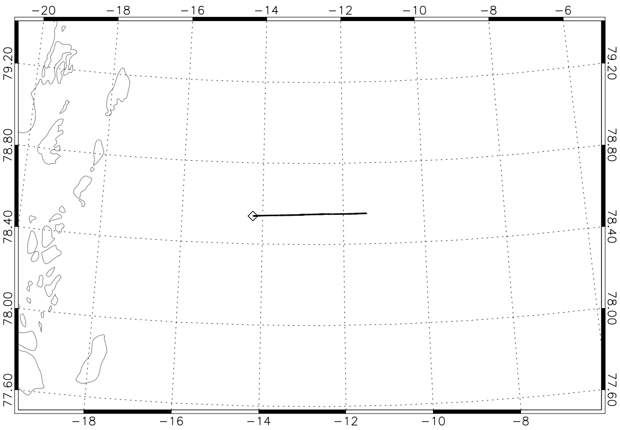


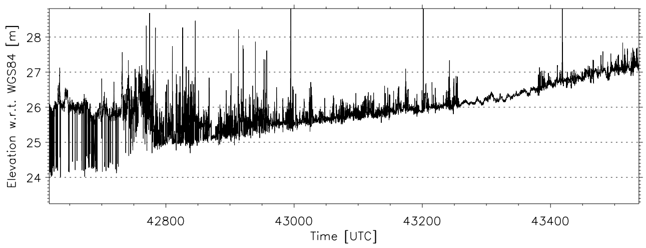


Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	11:36:03 (41763)	**Aircraft**	DNSC Twin Otter
Stop Time	11:50:15 (42615)	**Retracker**	OCOG
Distance	57.590 km	**INS Resolution**	50 Hz
Duration	00 h 14 m 12 s	**Processor Version**	0309

A01_20080424

AS3TA01_ASIAL1B030920080424T115018_20080424T120538_0001.DBL

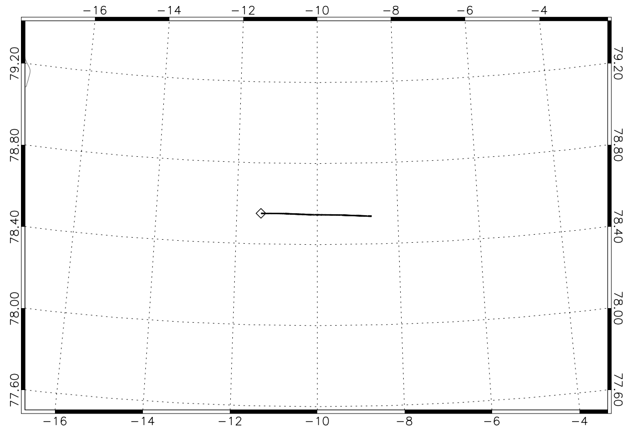


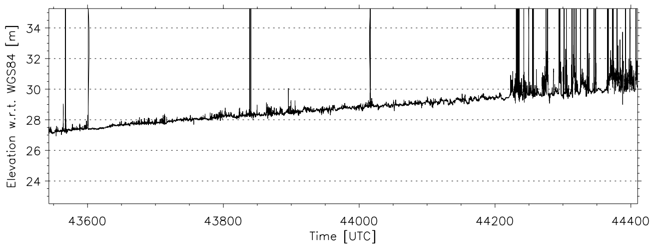


Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	11:50:18 (42618)	**Aircraft**	DNSC Twin Otter
Stop Time	12:05:37 (43537)	**Retracker**	OCOG
Distance	62.323 km	**INS Resolution**	50 Hz
Duration	00 h 15 m 20 s	**Processor Version**	0309

A02_20080424

AS3TA02_ASIAL1B030920080424T120543_20080424T122010_0001.DBL

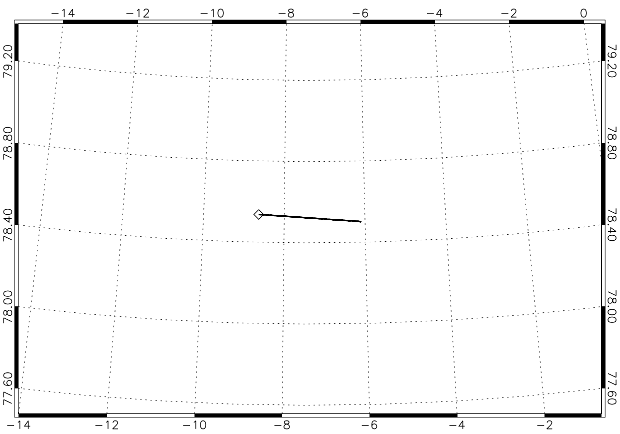


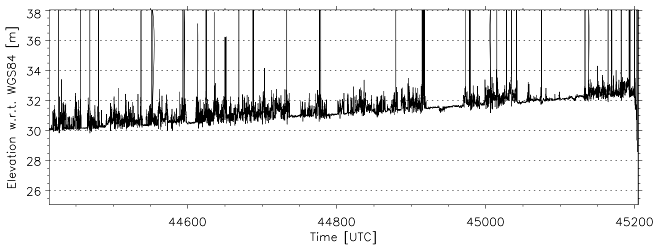


Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	12:05:43 (43543)	**Aircraft**	DNSC Twin Otter
Stop Time	12:20:09 (44409)	**Retracker**	OCOG
Distance	60.691 km	**INS Resolution**	50 Hz
Duration	00 h 14 m 27 s	**Processor Version**	0309

A03_20080424

AS3TA03_ASIAL1B030920080424T122014_20080424T123325_0001.DBL

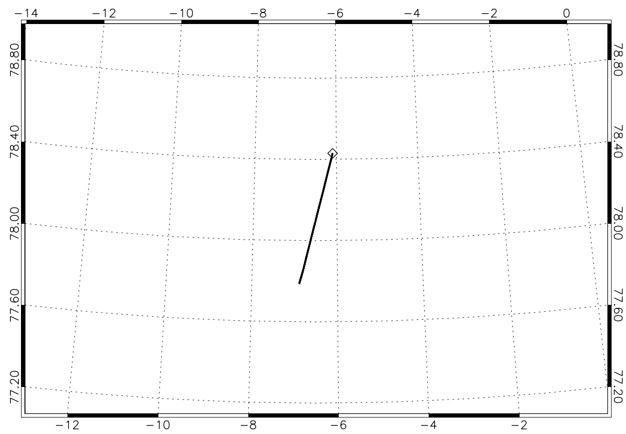


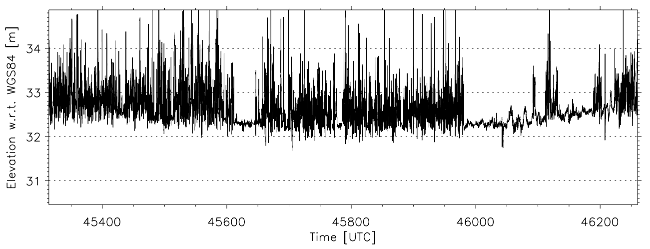


Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	12:20:14 (44414)	**Aircraft**	DNSC Twin Otter
Stop Time	12:33:24 (45204)	**Retracker**	OCOG
Distance	56.228 km	**INS Resolution**	50 Hz
Duration	00 h 13 m 11 s	**Processor Version**	0309

A04_20080424

AS3TA04_ASIAL1B030920080424T123514_20080424T125100_0001.DBL

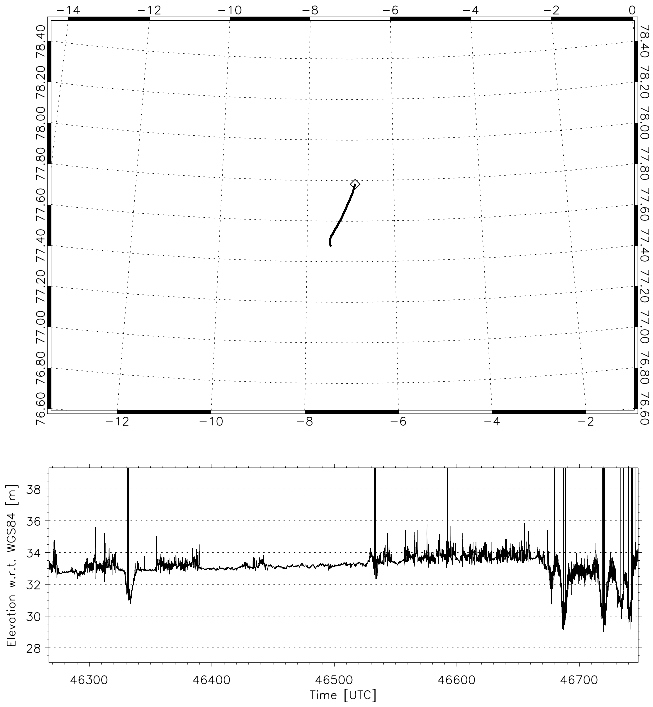




Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	12:35:14 (45314)	**Aircraft**	DNSC Twin Otter
Stop Time	12:51:00 (46260)	**Retracker**	OCOG
Distance	73.695 km	**INS Resolution**	50 Hz
Duration	00 h 15 m 46 s	**Processor Version**	0309

A05_20080424

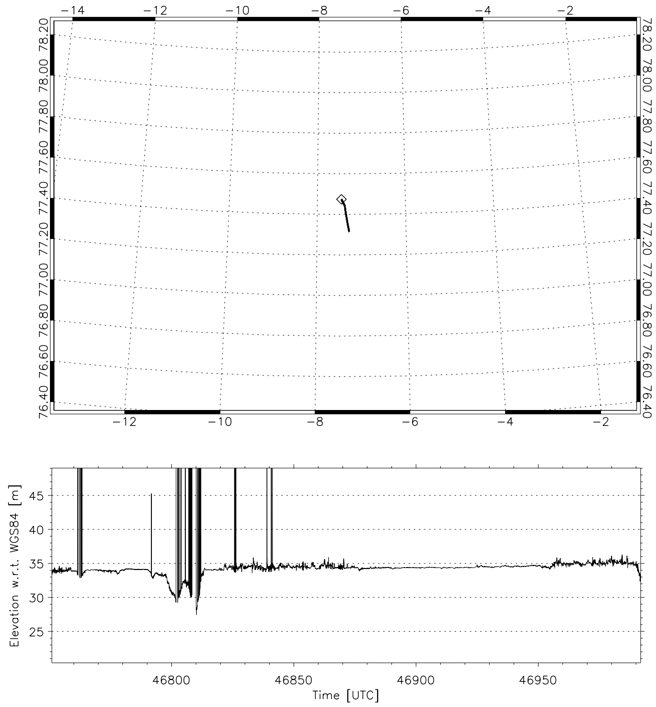
AS3TA05_ASIAL1B030920080424T125107_20080424T125908_0001.DBL



Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	12:51:07 (46267)	**Aircraft**	DNSC Twin Otter
Stop Time	12:59:07 (46747)	**Retracker**	OCOG
Distance	37.186 km	**INS Resolution**	50 Hz
Duration	00 h 08 m 01 s	**Processor Version**	0309

A06_20080424

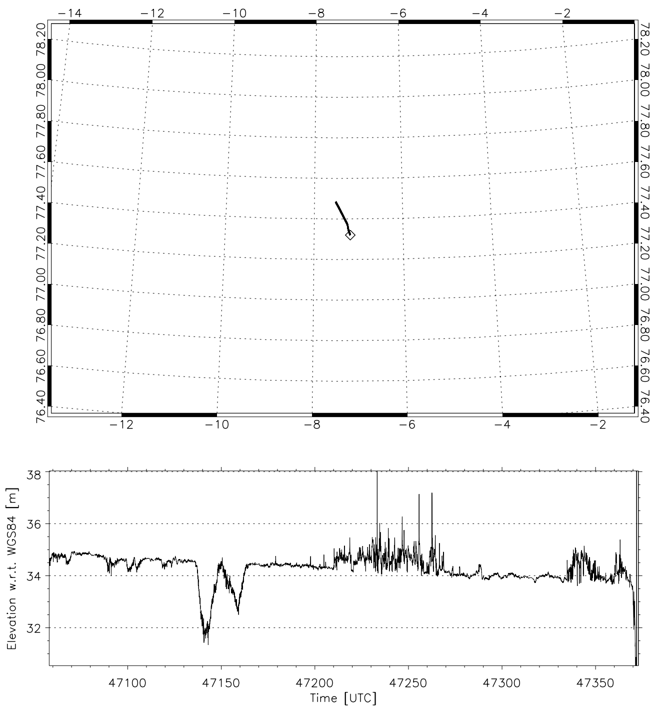
AS3TA06_ASIAL1B030920080424T125911_20080424T130312_0001.DBL



Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	12:59:11 (46751)	**Aircraft**	DNSC Twin Otter
Stop Time	13:03:11 (46991)	**Retracker**	OCOG
Distance	18.498 km	**INS Resolution**	50 Hz
Duration	00 h 04 m 01 s	**Processor Version**	0309

A07_20080424

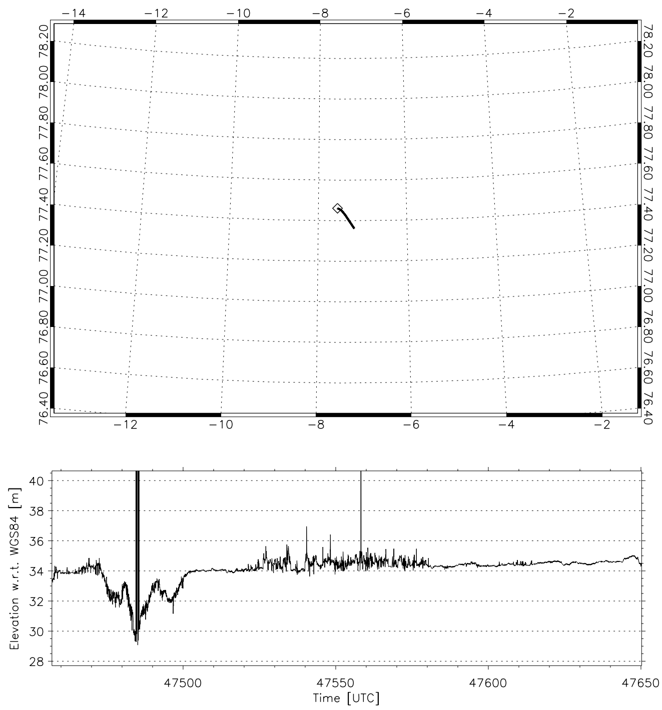
AS3TA07_ASIAL1B030920080424T130418_20080424T130933_0001.DBL



Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	13:04:18 (47058)	**Aircraft**	DNSC Twin Otter
Stop Time	13:09:32 (47372)	**Retracker**	OCOG
Distance	20.118 km	**INS Resolution**	50 Hz
Duration	00 h 05 m 15 s	**Processor Version**	0309

A08_20080424

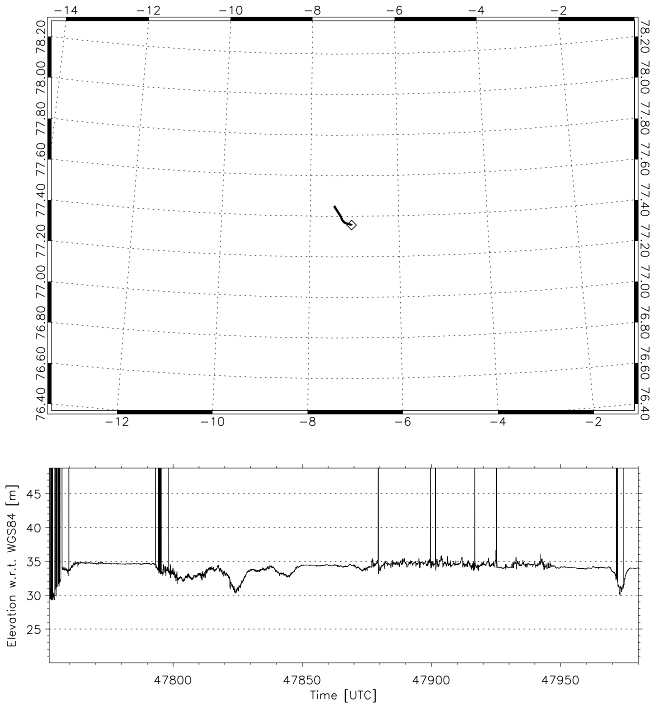
AS3TA08_ASIAL1B030920080424T131057_20080424T131410_0001.DBL



Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	13:10:57 (47457)	**Aircraft**	DNSC Twin Otter
Stop Time	13:14:10 (47650)	**Retracker**	OCOG
Distance	14.601 km	**INS Resolution**	50 Hz
Duration	00 h 03 m 13 s	**Processor Version**	0309

A09_20080424

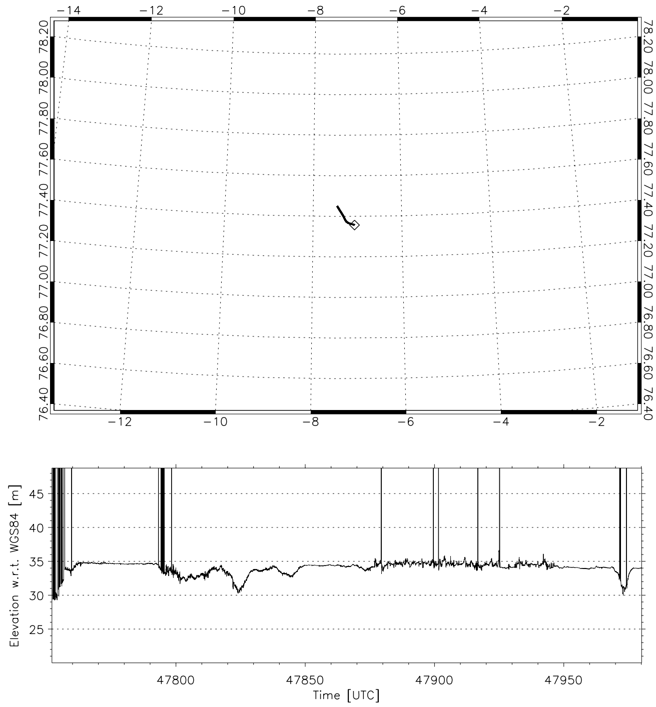
AS3TA09_ASIAL1B030920080424T131552_20080424T131940_0001.DBL



Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	13:15:52 (47752)	**Aircraft**	DNSC Twin Otter
Stop Time	13:19:40 (47980)	**Retracker**	OCOG
Distance	14.814 km	**INS Resolution**	50 Hz
Duration	00 h 03 m 48 s	**Processor Version**	0309

A09_20080424

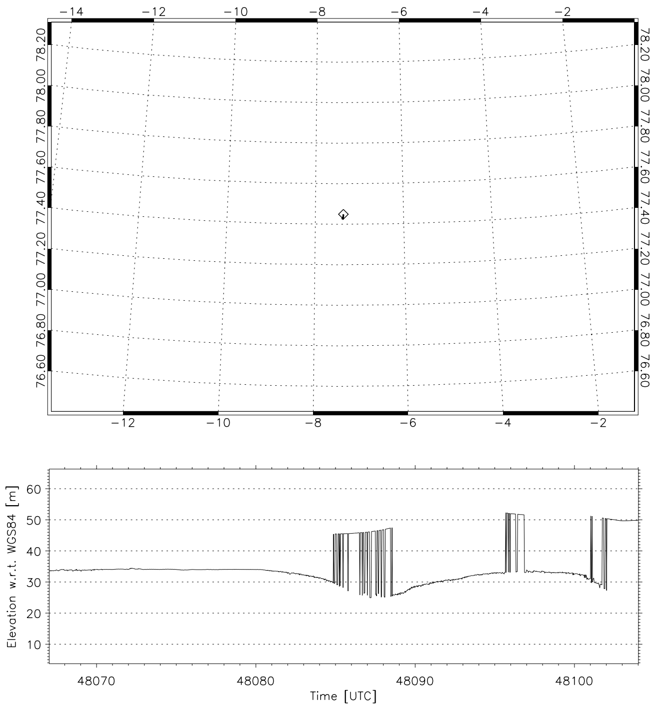
AS3TA09_ASIAL1B030920080424T131552_20080424T131940_0001.DBL



Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	13:15:52 (47752)	**Aircraft**	DNSC Twin Otter
Stop Time	13:19:40 (47980)	**Retracker**	OCOG
Distance	14.814 km	**INS Resolution**	50 Hz
Duration	00 h 03 m 48 s	**Processor Version**	0309

A10_20080424

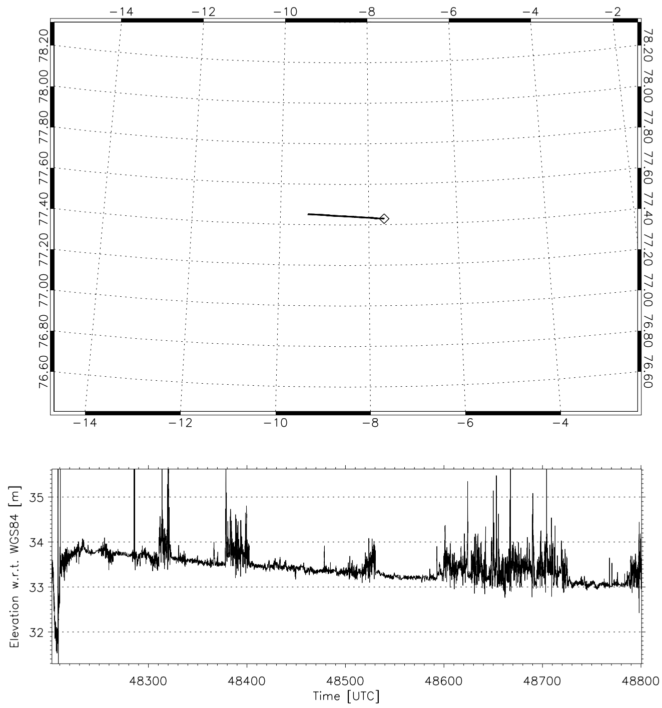
AS3TA10_ASIAL1B030920080424T132107_20080424T132144_0001.DBL



Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	13:21:07 (48067)	**Aircraft**	DNSC Twin Otter
Stop Time	13:21:44 (48104)	**Retracker**	OCOG
Distance	2.833 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 37 s	**Processor Version**	0309

A11_20080424

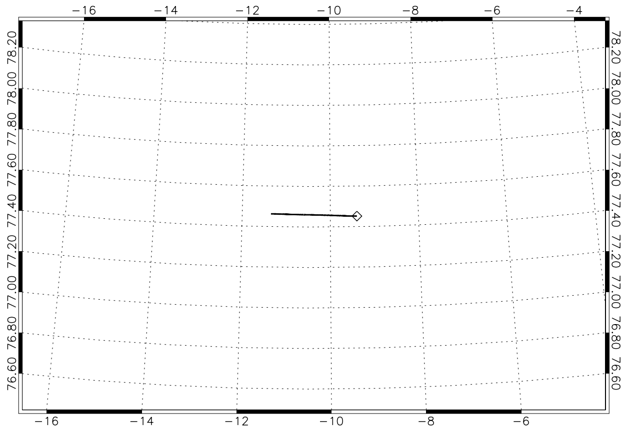
AS3TA11_ASIAL1B030920080424T132322_20080424T133321_0001.DBL

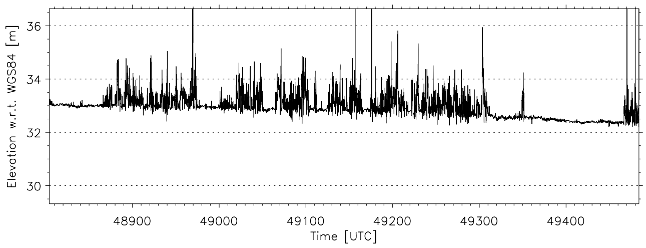


Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	13:23:22 (48202)	**Aircraft**	DNSC Twin Otter
Stop Time	13:33:20 (48800)	**Retracker**	OCOG
Distance	42.031 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 59 s	**Processor Version**	0309

A12_20080424

AS3TA12_ASIAL1B030920080424T133324_20080424T134444_0001.DBL

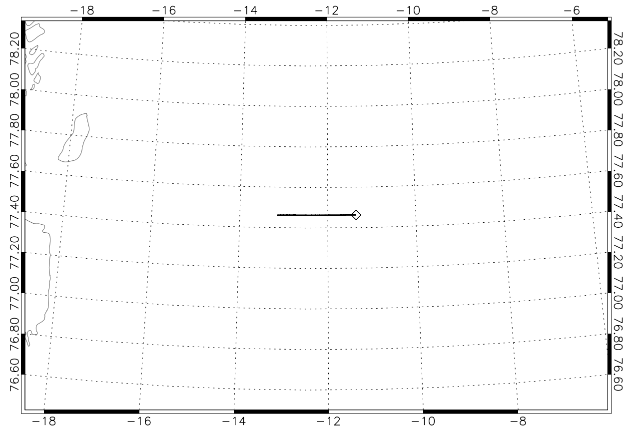


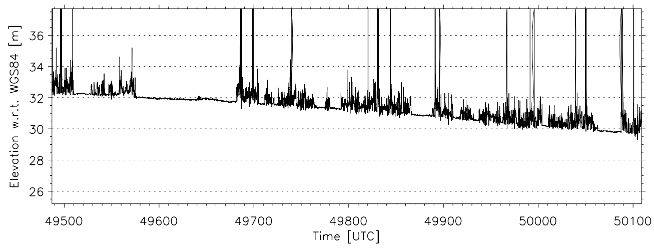


Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	13:33:24 (48804)	**Aircraft**	DNSC Twin Otter
Stop Time	13:44:44 (49484)	**Retracker**	OCOG
Distance	47.197 km	**INS Resolution**	50 Hz
Duration	00 h 11 m 20 s	**Processor Version**	0309

A13_20080424

AS3TA13_ASIAL1B030920080424T134447_20080424T135509_0001.DBL

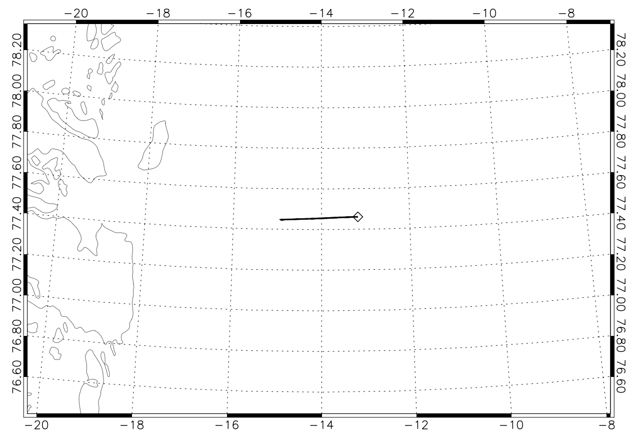


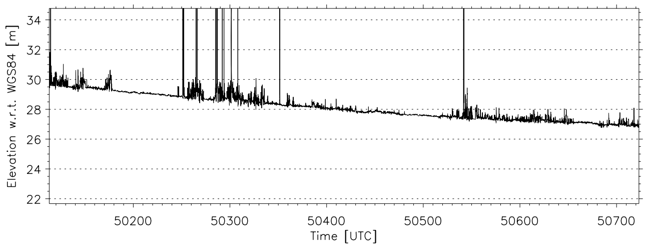


Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	13:44:47 (49487)	**Aircraft**	DNSC Twin Otter
Stop Time	13:55:08 (50108)	**Retracker**	OCOG
Distance	43.612 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 22 s	**Processor Version**	0309

A14_20080424

AS3TA14_ASIAL1B030920080424T135513_20080424T140523_0001.DBL

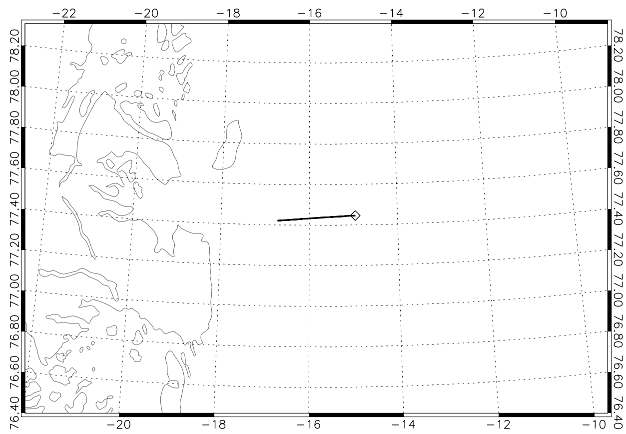


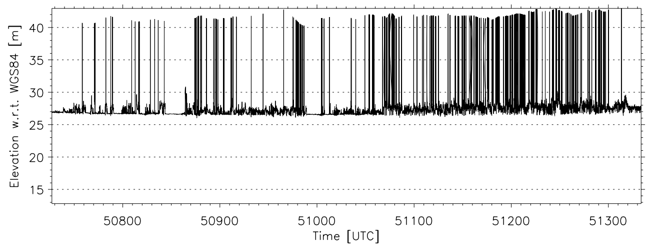


Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	13:55:13 (50113)	**Aircraft**	DNSC Twin Otter
Stop Time	14:05:23 (50723)	**Retracker**	OCOG
Distance	42.826 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 10 s	**Processor Version**	0309

A15_20080424

AS3TA15_ASIAL1B030920080424T140527_20080424T141534_0001.DBL

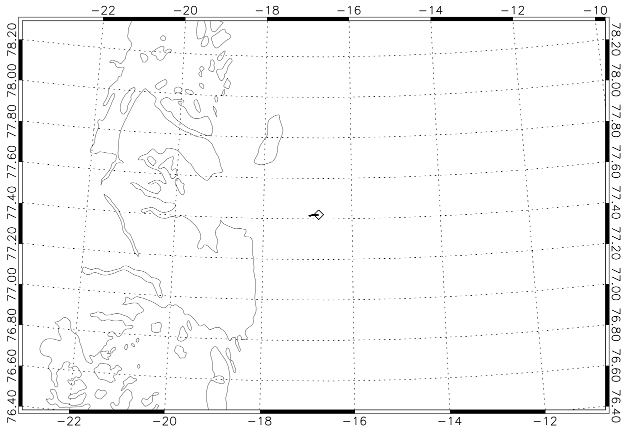


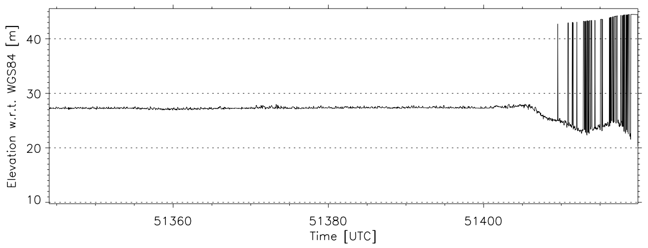


Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	14:05:27 (50727)	**Aircraft**	DNSC Twin Otter
Stop Time	14:15:33 (51333)	**Retracker**	OCOG
Distance	42.841 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 07 s	**Processor Version**	0309

A16_20080424

AS3TA16_ASIAL1B030920080424T141544_20080424T141659_0001.DBL

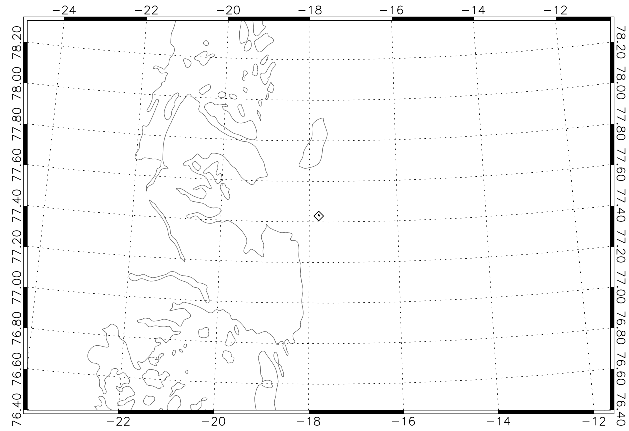


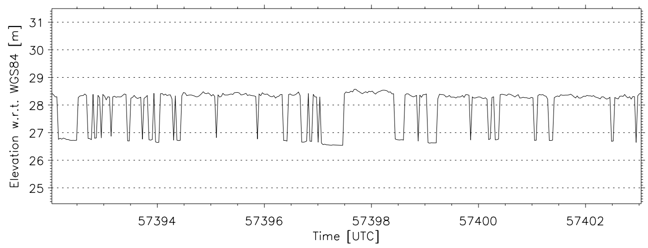


Date	2008-04-24	Instrument Mode	Adv. Low Altitude
Start Time	14:15:44 (51344)	Aircraft	DNSC Twin Otter
Stop Time	14:16:59 (51419)	Retracker	OCOG
Distance	5.285 km	INS Resolution	50 Hz
Duration	00 h 01 m 16 s	Processor Version	0309

A17_20080424

AS3TA17_ASIAL1B030920080424T155632_20080424T155643_0001.DBL

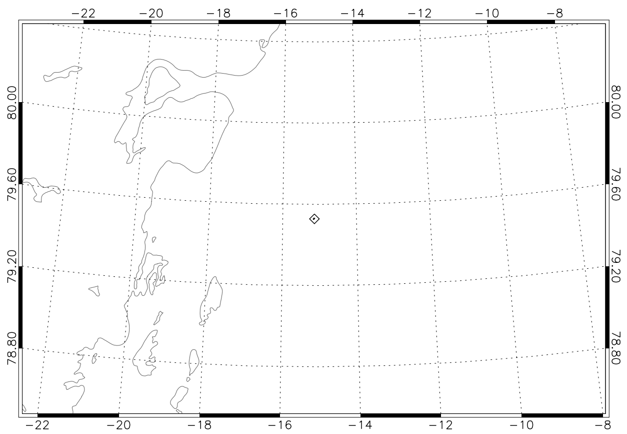


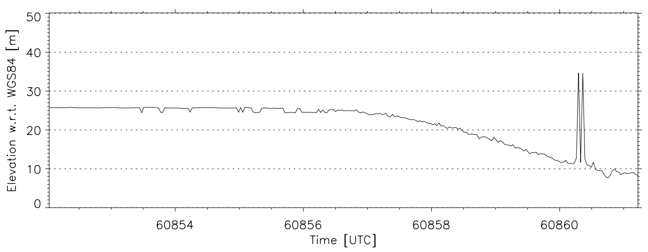


Date	2008-04-24	Instrument Mode	Adv. Low Altitude
Start Time	15:56:32 (57392)	Aircraft	DNSC Twin Otter
Stop Time	15:56:43 (57403)	Retracker	OCOG
Distance	0.770 km	INS Resolution	50 Hz
Duration	00 h 00 m 11 s	Processor Version	0309

A18_20080424

AS3TA18_ASIAL1B030920080424T165412_20080424T165421_0001.DBL

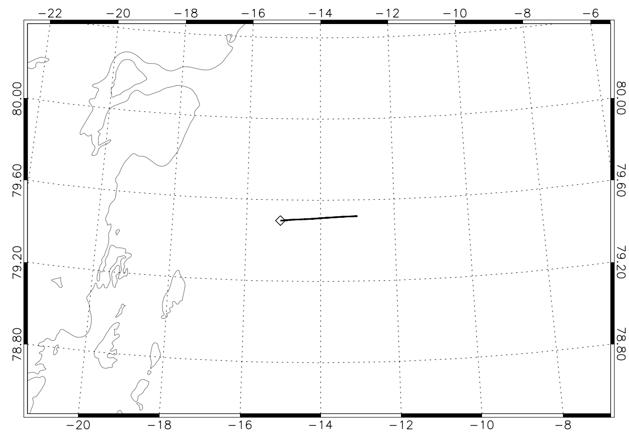


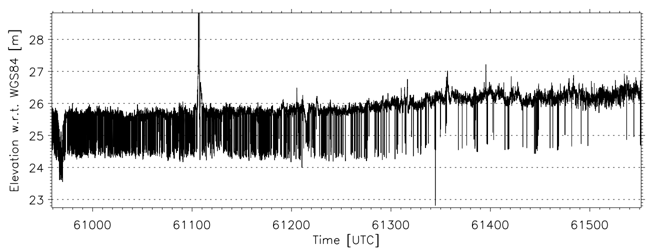


Date	2008-04-24	Instrument Mode	Adv. Low Altitude
Start Time	16:54:12 (60852)	Aircraft	DNSC Twin Otter
Stop Time	16:54:21 (60861)	Retracker	OCOG
Distance	0.619 km	INS Resolution	50 Hz
Duration	00 h 00 m 09 s	Processor Version	0309

A19_20080424

AS3TA19_ASIAL1B030920080424T165559_20080424T170552_0001.DBL

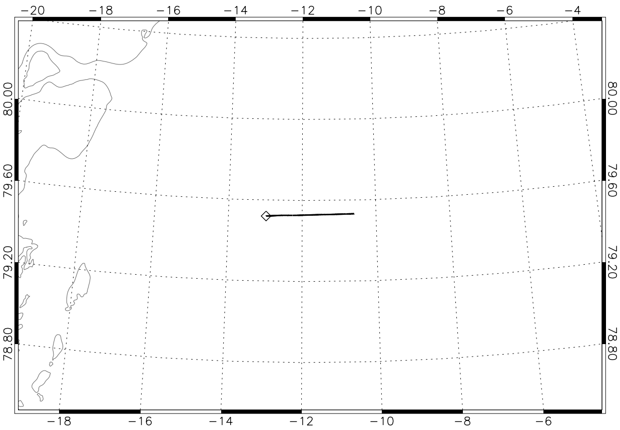


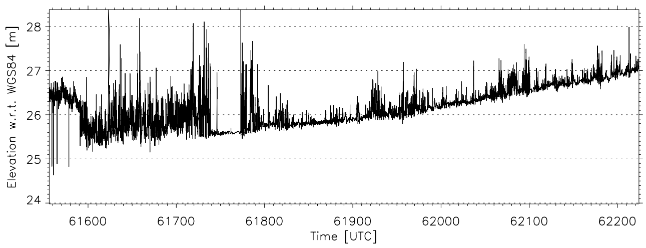


Date	2008-04-24	Instrument Mode	Adv. Low Altitude
Start Time	16:55:59 (60959)	Aircraft	DNSC Twin Otter
Stop Time	17:05:51 (61551)	Retracker	OCOG
Distance	42.404 km	INS Resolution	50 Hz
Duration	00 h 09 m 53 s	Processor Version	0309

A20_20080424

AS3TA20_ASIAL1B030920080424T170556_20080424T171704_0001.DBL

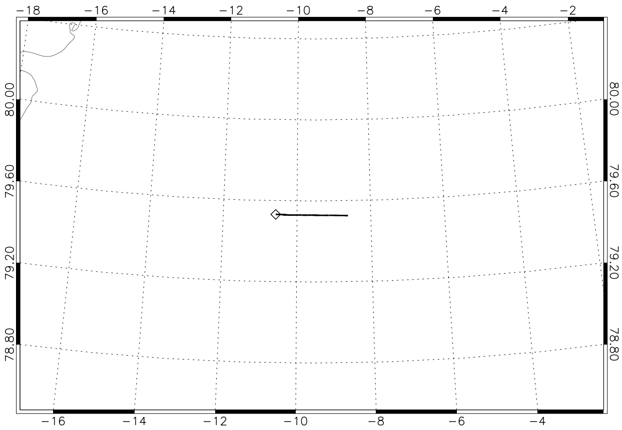


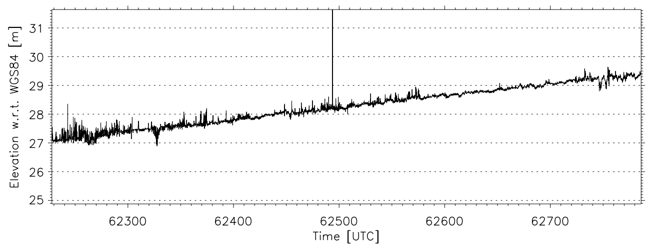


Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	17:05:56 (61556)	**Aircraft**	DNSC Twin Otter
Stop Time	17:17:04 (62224)	**Retracker**	OCOG
Distance	48.277 km	**INS Resolution**	50 Hz
Duration	00 h 11 m 08 s	**Processor Version**	0309

A21_20080424

AS3TA21_ASIAL1B030920080424T171708_20080424T172626_0001.DBL

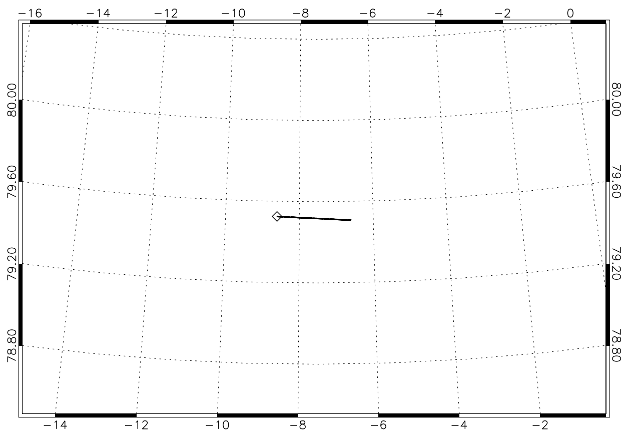


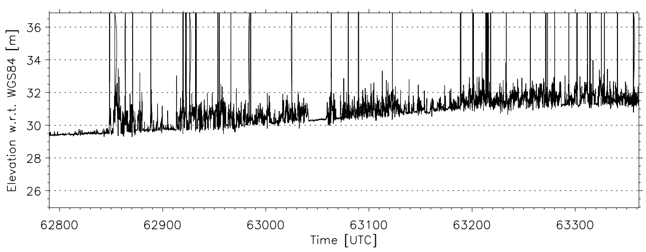


Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	17:17:08 (62228)	**Aircraft**	DNSC Twin Otter
Stop Time	17:26:25 (62785)	**Retracker**	OCOG
Distance	39.597 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 18 s	**Processor Version**	0309

A22_20080424

AS3TA22_ASIAL1B030920080424T172630_20080424T173602_0001.DBL

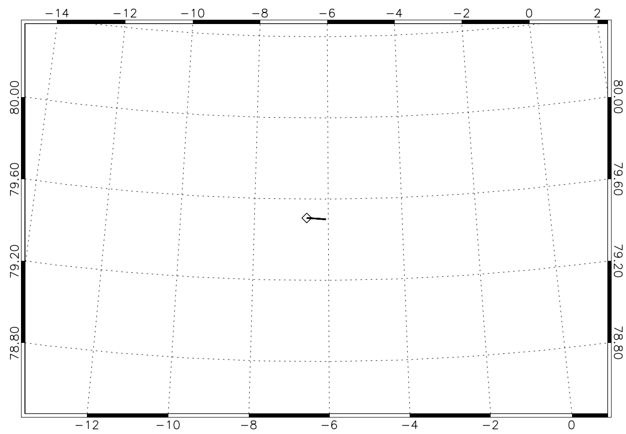


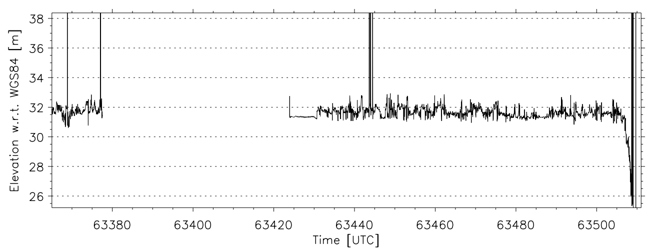


Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	17:26:30 (62790)	**Aircraft**	DNSC Twin Otter
Stop Time	17:36:01 (63361)	**Retracker**	OCOG
Distance	40.737 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 32 s	**Processor Version**	0309

A23_20080424

AS3TA23_ASIAL1B030920080424T173605_20080424T173831_0001.DBL

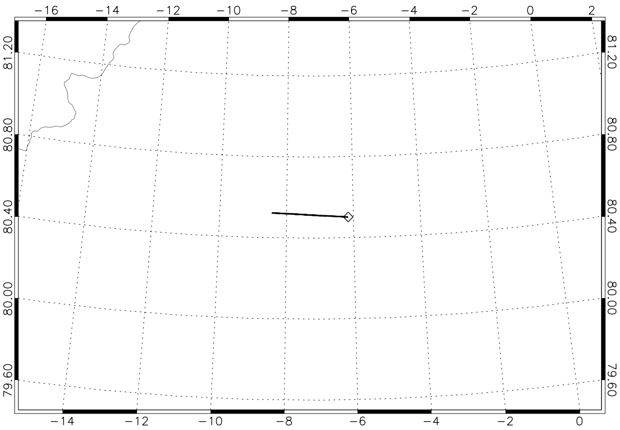


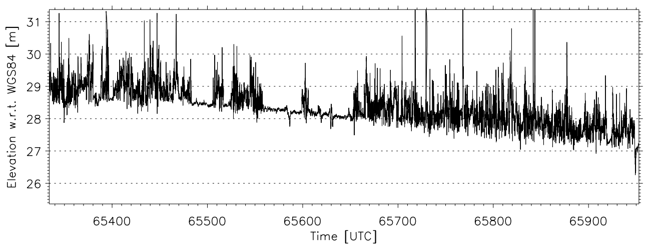


Date	2008-04-24	**Instrument Mode**	Adv. Low Altitude
Start Time	17:36:05 (63365)	**Aircraft**	DNSC Twin Otter
Stop Time	17:38:31 (63511)	**Retracker**	OCOG
Distance	10.505 km	**INS Resolution**	50 Hz
Duration	00 h 02 m 26 s	**Processor Version**	0309

A24_20080424

AS3TA24_ASIAL1B030920080424T180854_20080424T181913_0001.DBL

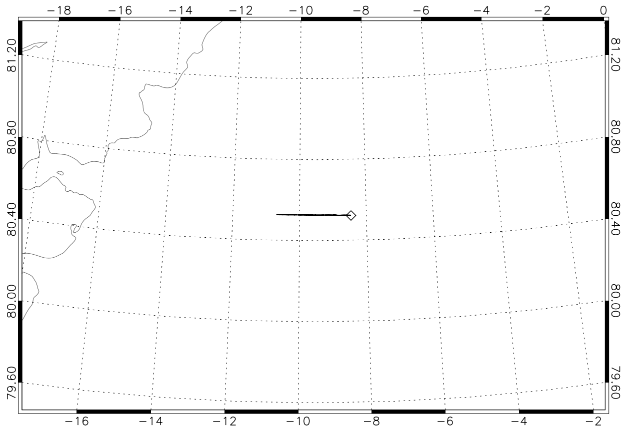


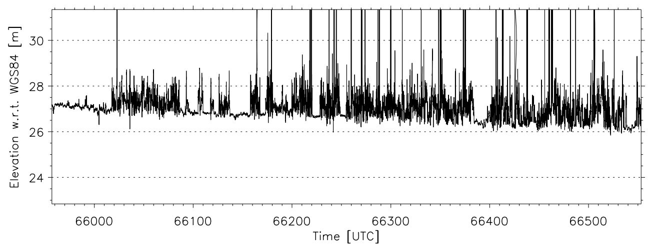


Date	2008-04-24	Instrument Mode	Adv. Low Altitude
Start Time	18:08:54 (65334)	Aircraft	DNSC Twin Otter
Stop Time	18:19:12 (65952)	Retracker	OCOG
Distance	41.979 km	INS Resolution	50 Hz
Duration	00 h 10 m 19 s	Processor Version	0309

A25_20080424

AS3TA25_ASIAL1B030920080424T181917_20080424T182913_0001.DBL

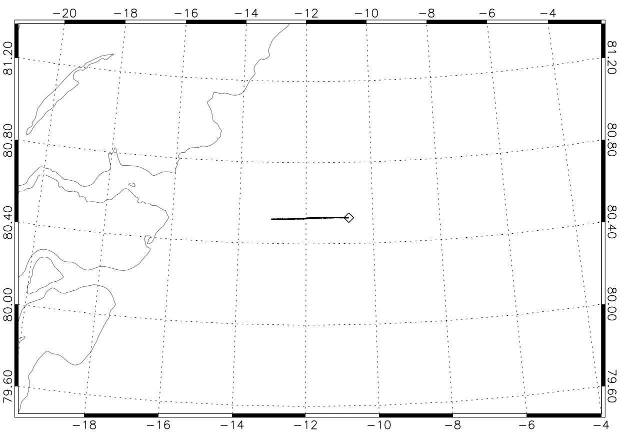


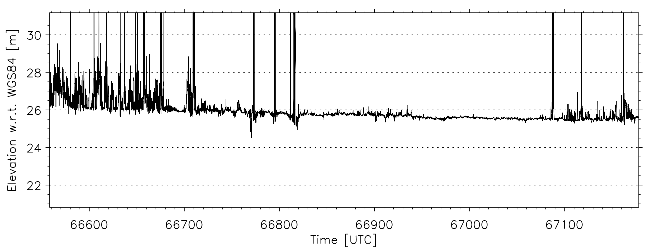


Date	2008-04-24	Instrument Mode	Adv. Low Altitude
Start Time	18:19:17 (65957)	Aircraft	DNSC Twin Otter
Stop Time	18:29:13 (66553)	Retracker	OCOG
Distance	41.040 km	INS Resolution	50 Hz
Duration	00 h 09 m 56 s	Processor Version	0309

A26_20080424

AS3TA26_ASIAL1B030920080424T182918_20080424T183938_0001.DBL

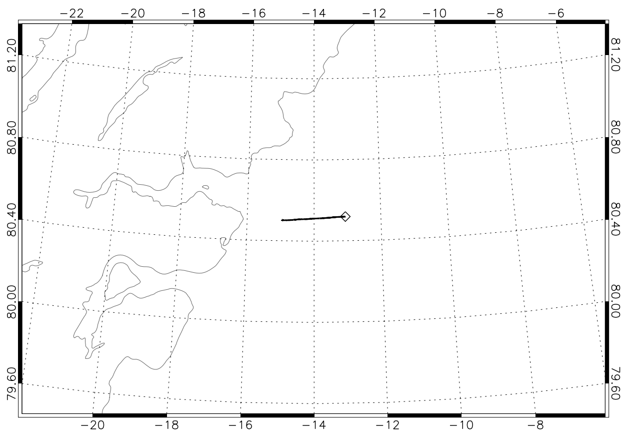


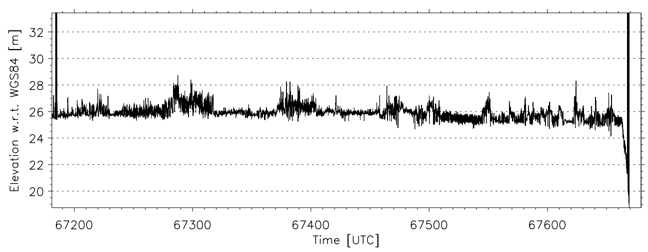


Date	2008-04-24	Instrument Mode	Adv. Low Altitude
Start Time	18:29:18 (66558)	Aircraft	DNSC Twin Otter
Stop Time	18:39:37 (67177)	Retracker	OCOG
Distance	42.770 km	INS Resolution	50 Hz
Duration	00 h 10 m 20 s	Processor Version	0309

A27_20080424

AS3TA27_ASIAL1B030920080424T183941_20080424T184759_0001.DBL

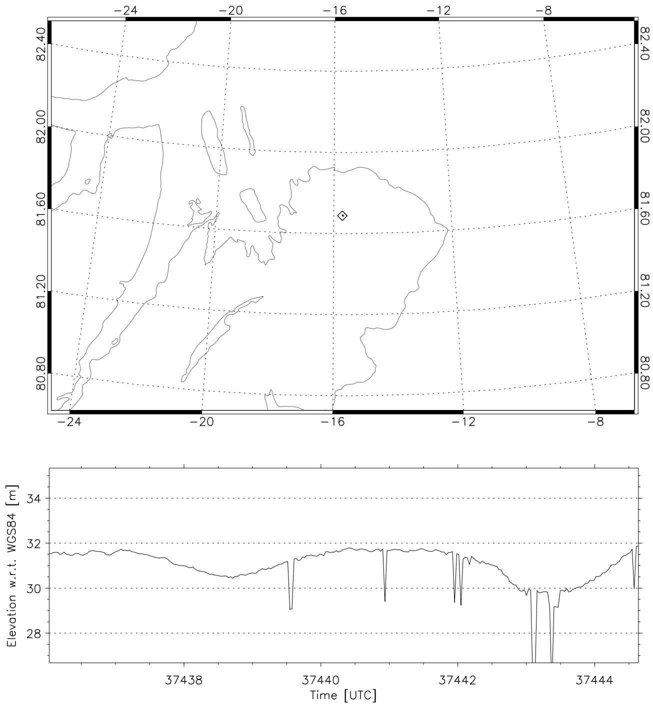




Date	2008-04-24	Instrument Mode	Adv. Low Altitude
Start Time	18:39:41 (67181)	Aircraft	DNSC Twin Otter
Stop Time	18:47:59 (67679)	Retracker	OCOG
Distance	34.970 km	INS Resolution	50 Hz
Duration	00 h 08 m 18 s	Processor Version	0309

A00_20080427

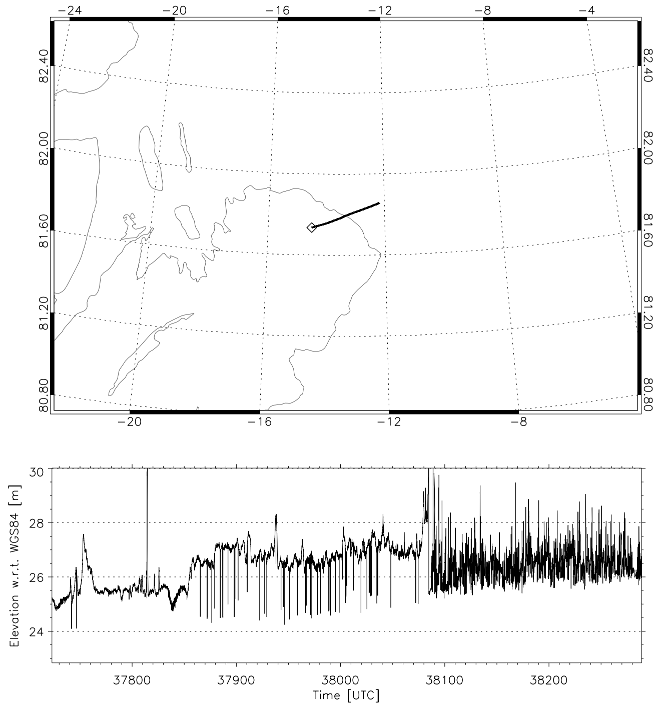
AS3TA00_ASIAL1B030920080427T102356_20080427T102405_0001.DBL



Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	10:23:56 (37436)	**Aircraft**	DNSC Twin Otter
Stop Time	10:24:04 (37444)	**Retracker**	OCOG
Distance	0.600 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 09 s	**Processor Version**	0309

A01_20080427

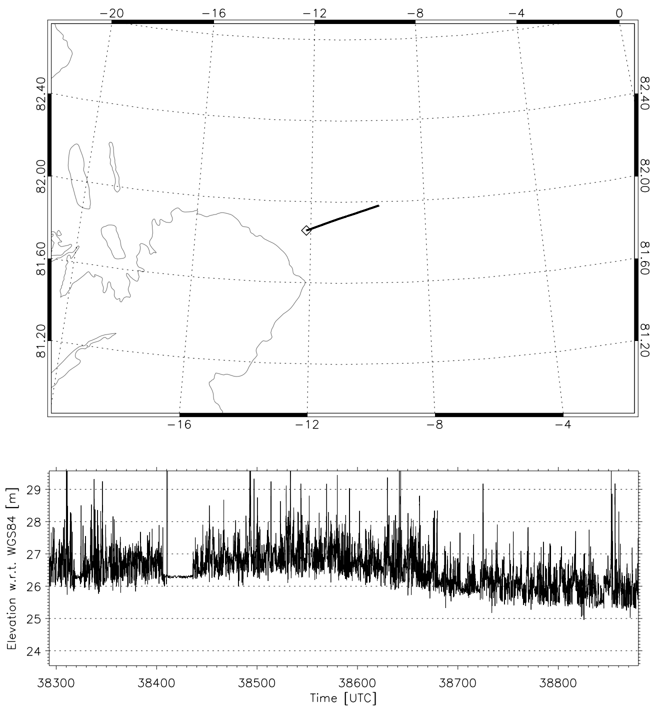
AS3TA01_ASIAL1B030920080427T102843_20080427T103809_0001.DBL



Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	10:28:43 (37723)	**Aircraft**	DNSC Twin Otter
Stop Time	10:38:08 (38288)	**Retracker**	OCOG
Distance	39.434 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 26 s	**Processor Version**	0309

A02_20080427

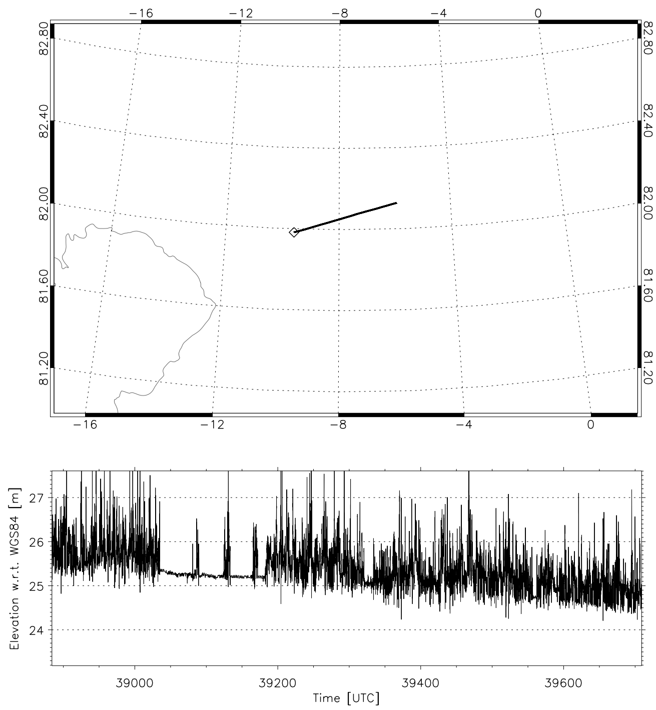
AS3TA02_ASIAL1B030920080427T103813_20080427T104800_0001.DBL



Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	10:38:13 (38293)	**Aircraft**	DNSC Twin Otter
Stop Time	10:47:59 (38879)	**Retracker**	OCOG
Distance	41.916 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 47 s	**Processor Version**	0309

A03_20080427

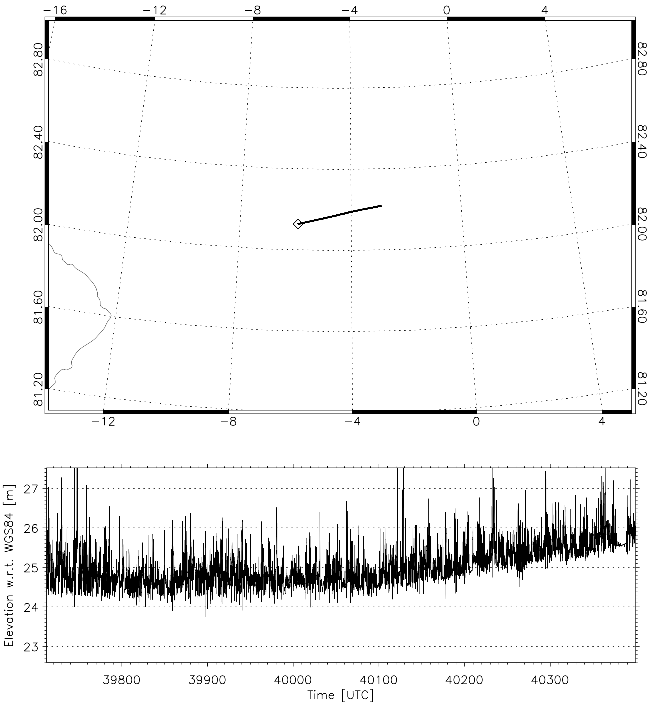
AS3TA03_ASIAL1B030920080427T104804_20080427T110149_0001.DBL



Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	10:48:04 (38884)	**Aircraft**	DNSC Twin Otter
Stop Time	11:01:49 (39709)	**Retracker**	OCOG
Distance	58.472 km	**INS Resolution**	50 Hz
Duration	00 h 13 m 45 s	**Processor Version**	0309

A04_20080427

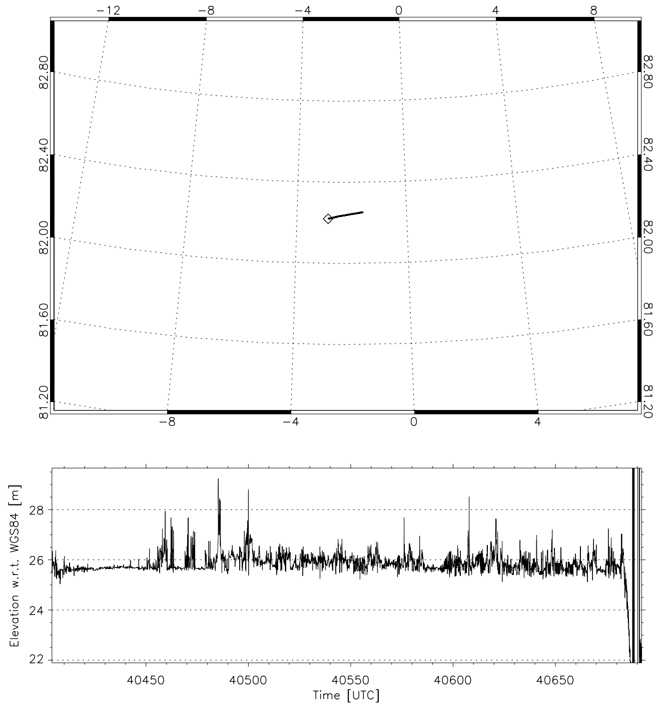
AS3TA04_ASIAL1B030920080427T110152_20080427T111320_0001.DBL



Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	11:01:52 (39712)	**Aircraft**	DNSC Twin Otter
Stop Time	11:13:19 (40399)	**Retracker**	OCOG
Distance	46.948 km	**INS Resolution**	50 Hz
Duration	00 h 11 m 28 s	**Processor Version**	0309

A05_20080427

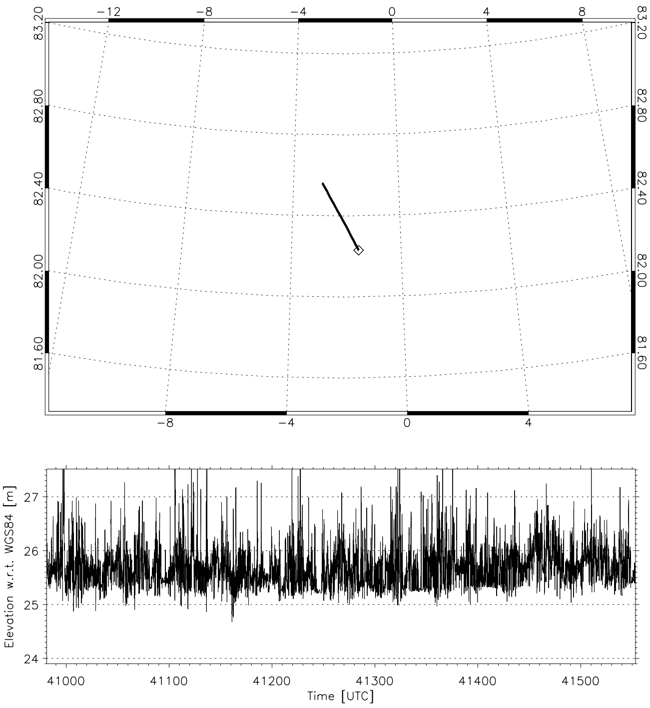
AS3TA05_ASIAL1B030920080427T111324_20080427T111812_0001.DBL



Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	11:13:24 (40404)	**Aircraft**	DNSC Twin Otter
Stop Time	11:18:12 (40692)	**Retracker**	OCOG
Distance	19.683 km	**INS Resolution**	50 Hz
Duration	00 h 04 m 48 s	**Processor Version**	0309

A06_20080427

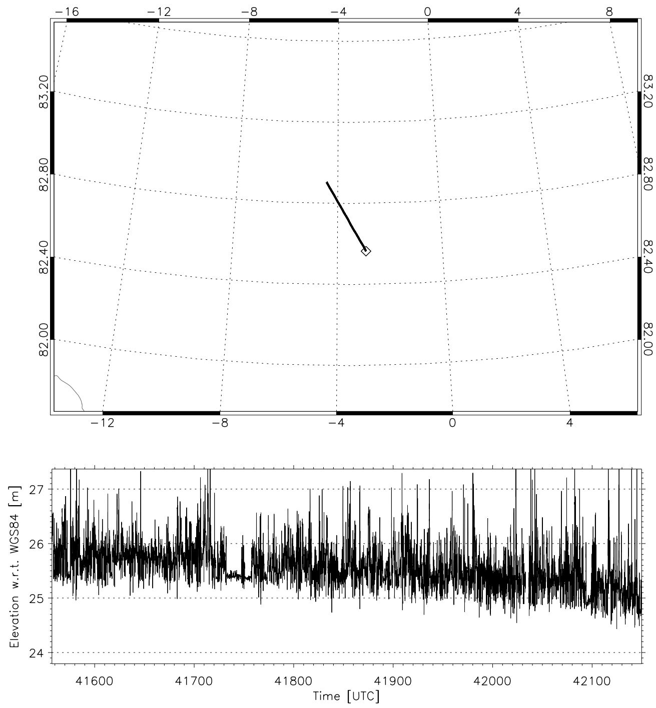
AS3TA06_ASIAL1B030920080427T112301_20080427T113233_0001.DBL



Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	11:23:01 (40981)	**Aircraft**	DNSC Twin Otter
Stop Time	11:32:33 (41553)	**Retracker**	OCOG
Distance	41.857 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 32 s	**Processor Version**	0309

A07_20080427

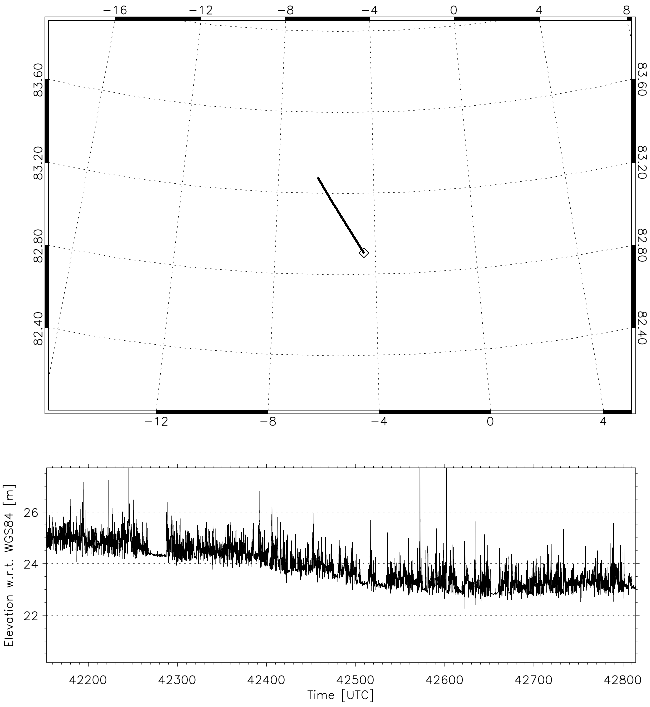
AS3TA07_ASIAL1B030920080427T113237_20080427T114230_0001.DBL



Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	11:32:37 (41557)	**Aircraft**	DNSC Twin Otter
Stop Time	11:42:29 (42149)	**Retracker**	OCOG
Distance	43.646 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 53 s	**Processor Version**	0309

A08_20080427

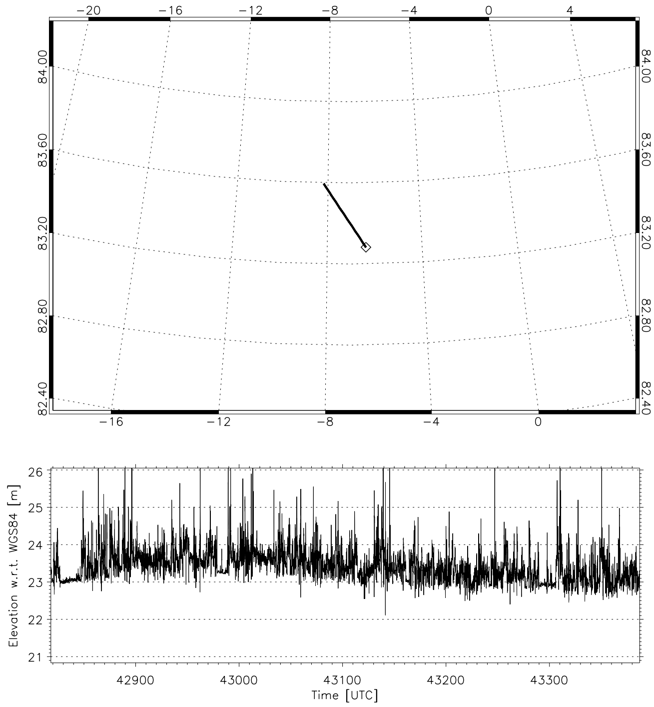
AS3TA08_ASIAL1B030920080427T114233_20080427T115334_0001.DBL



Date	2008-04-27	Instrument Mode	Adv. Low Altitude
Start Time	11:42:33 (42153)	Aircraft	DNSC Twin Otter
Stop Time	11:53:34 (42814)	Retracker	OCOG
Distance	48.658 km	INS Resolution	50 Hz
Duration	00 h 11 m 01 s	Processor Version	0309

A09_20080427

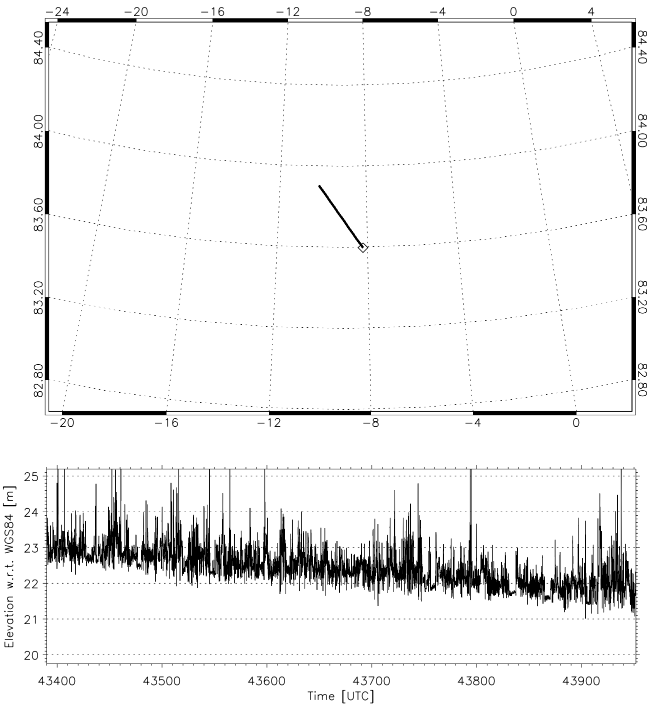
AS3TA09_ASIAL1B030920080427T115338_20080427T120307_0001.DBL



Date	2008-04-27	Instrument Mode	Adv. Low Altitude
Start Time	11:53:38 (42818)	Aircraft	DNSC Twin Otter
Stop Time	12:03:07 (43387)	Retracker	OCOG
Distance	41.971 km	INS Resolution	50 Hz
Duration	00 h 09 m 29 s	Processor Version	0309

A10_20080427

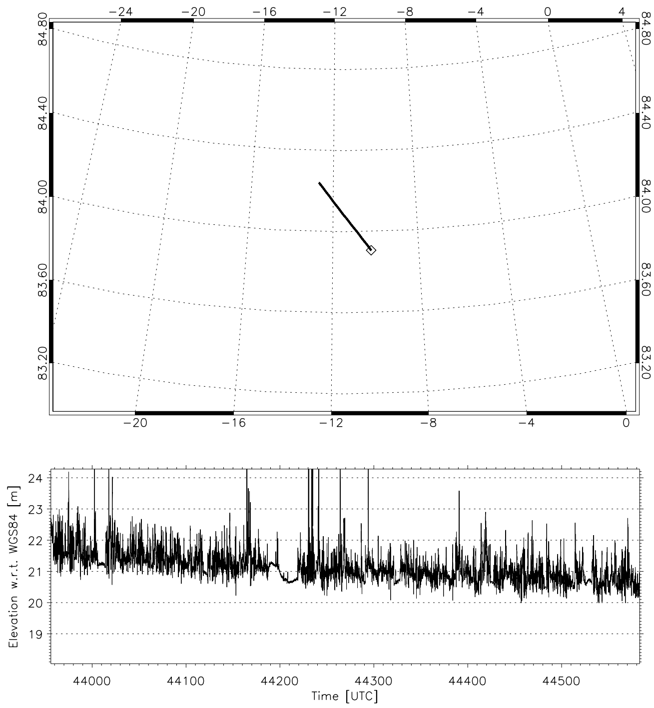
AS3TA10_ASIAL1B030920080427T120310_20080427T121232_0001.DBL



Date	2008-04-27	Instrument Mode	Adv. Low Altitude
Start Time	12:03:10 (43390)	Aircraft	DNSC Twin Otter
Stop Time	12:12:31 (43951)	Retracker	OCOG
Distance	41.899 km	INS Resolution	50 Hz
Duration	00 h 09 m 22 s	Processor Version	0309

A11_20080427

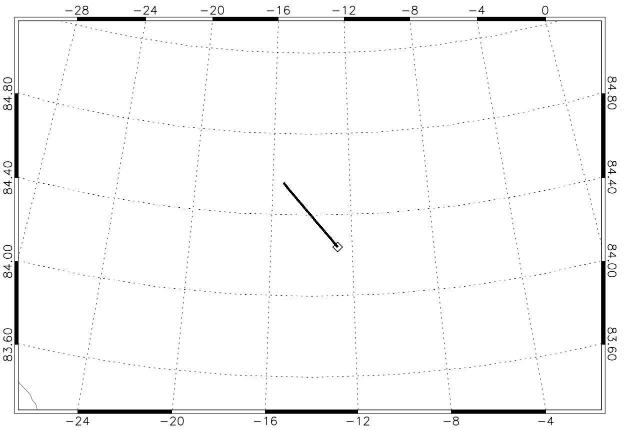
AS3TA11_ASIAL1B030920080427T121236_20080427T122302_0001.DBL

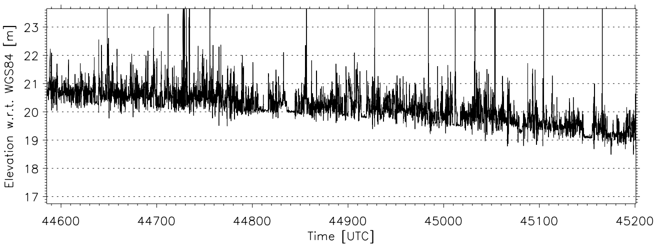


Date	2008-04-27	Instrument Mode	Adv. Low Altitude
Start Time	12:12:36 (43956)	Aircraft	DNSC Twin Otter
Stop Time	12:23:03 (44583)	Retracker	OCOG
Distance	46.814 km	INS Resolution	50 Hz
Duration	00 h 10 m 27 s	Processor Version	0309

A12_20080427

AS3TA12_ASIAL1B0309200804277T122305_20080427T123321_0001.DBL

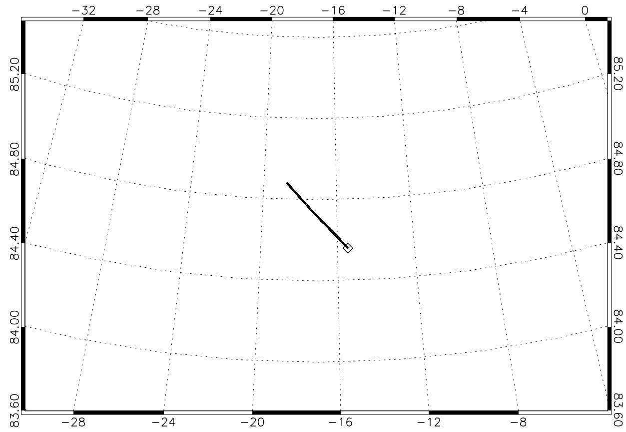


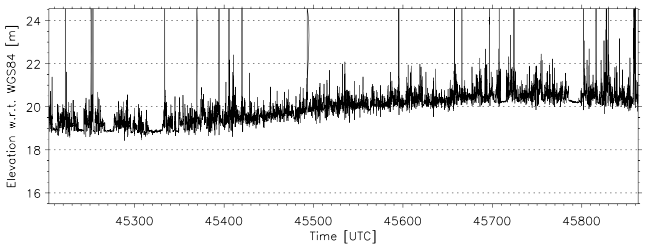


Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	12:23:05 (44585)	**Aircraft**	DNSC Twin Otter
Stop Time	12:33:20 (45200)	**Retracker**	OCOG
Distance	45.880 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 16 s	**Processor Version**	0309

A13_20080427

AS3TA13_ASIAL1B0309200804277T123324_20080427T124423_0001.DBL

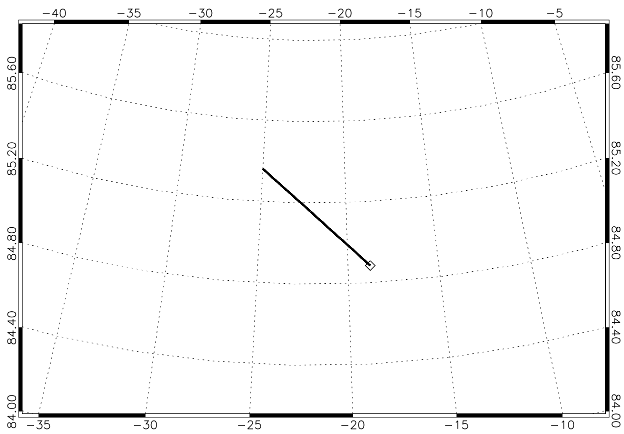


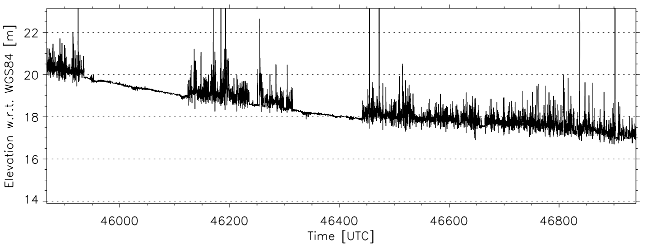


Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	12:33:24 (45204)	**Aircraft**	DNSC Twin Otter
Stop Time	12:44:22 (45862)	**Retracker**	OCOG
Distance	49.118 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 59 s	**Processor Version**	0309

A14_20080427

AS3TA14_ASIAL1B0309200804277T124427_20080427T130220_0001.DBL

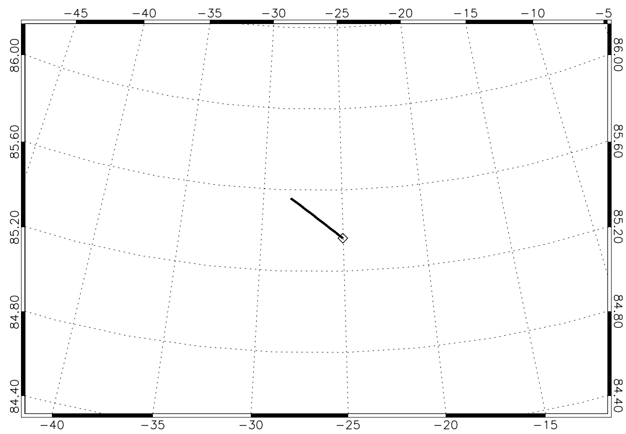


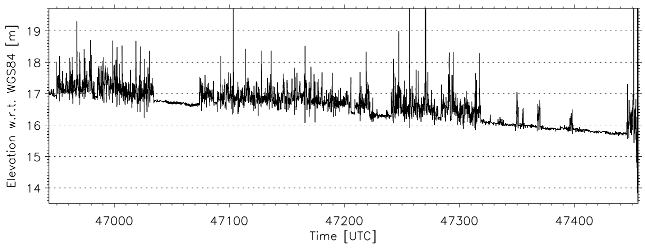


Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	12:44:27 (45867)	**Aircraft**	DNSC Twin Otter
Stop Time	13:02:19 (46939)	**Retracker**	OCOG
Distance	79.107 km	**INS Resolution**	50 Hz
Duration	00 h 17 m 53 s	**Processor Version**	0309

A15_20080427

AS3TA15_ASIAL1B0309200804277T130223_20080427T131055_0001.DBL

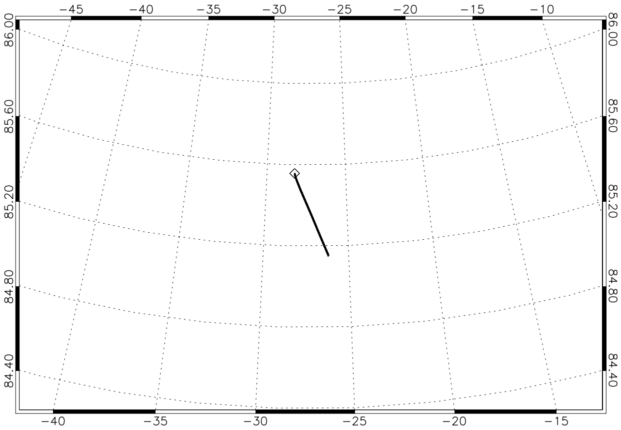


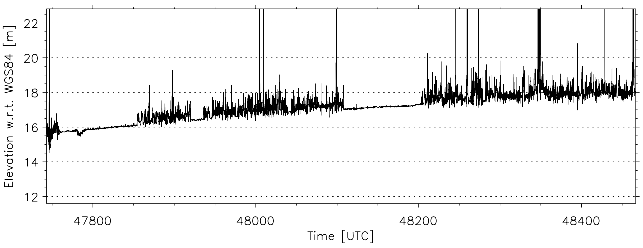


Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	13:02:23 (46943)	**Aircraft**	DNSC Twin Otter
Stop Time	13:10:55 (47455)	**Retracker**	OCOG
Distance	35.832 km	**INS Resolution**	50 Hz
Duration	00 h 08 m 32 s	**Processor Version**	0309

A16_20080427

AS3TA16_ASIAL1B030920080427T131543_20080427T132747_0001.DBL

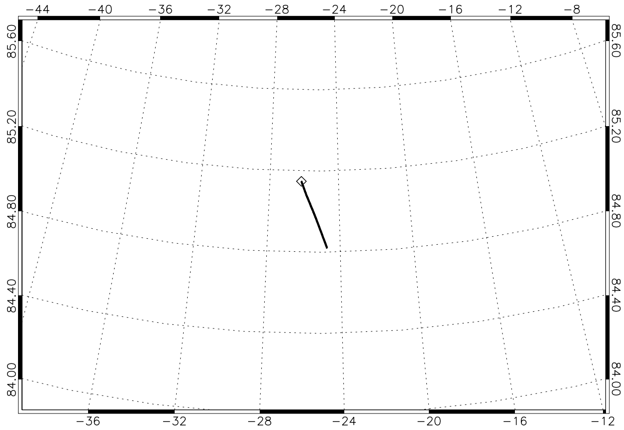


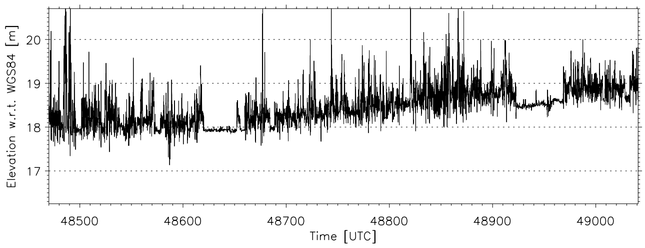


Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	13:15:43 (47743)	**Aircraft**	DNSC Twin Otter
Stop Time	13:27:46 (48466)	**Retracker**	OCOG
Distance	48.866 km	**INS Resolution**	50 Hz
Duration	00 h 12 m 04 s	**Processor Version**	0309

A17_20080427

AS3TA17_ASIAL1B030920080427T132750_20080427T133721_0001.DBL

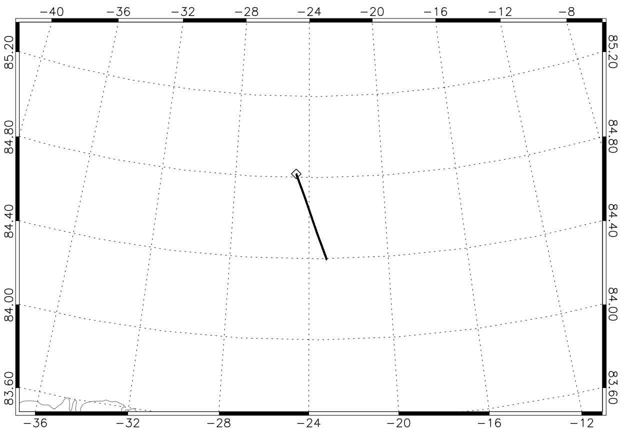


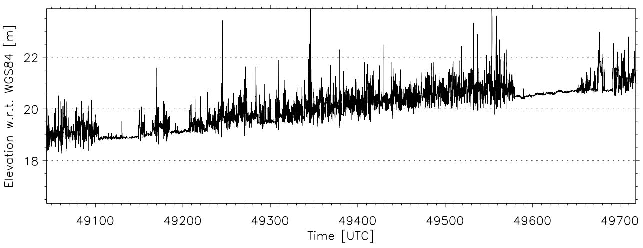


Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	13:27:50 (48470)	**Aircraft**	DNSC Twin Otter
Stop Time	13:37:21 (49041)	**Retracker**	OCOG
Distance	39.148 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 31 s	**Processor Version**	0309

A18_20080427

AS3TA18_ASIAL1B030920080427T133724_20080427T134838_0001.DBL

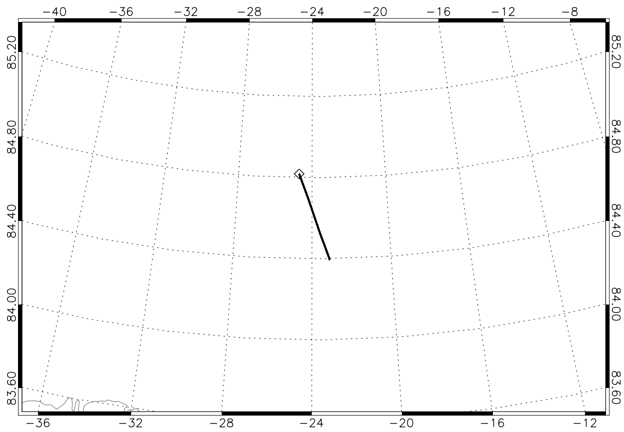


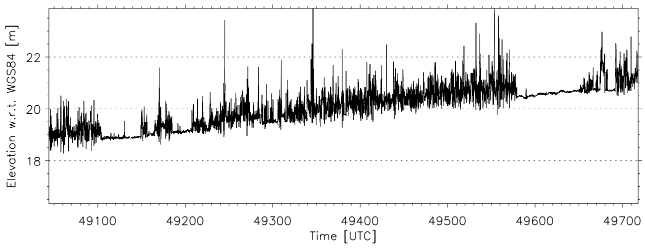


Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	13:37:24 (49044)	**Aircraft**	DNSC Twin Otter
Stop Time	13:48:37 (49717)	**Retracker**	OCOG
Distance	49.850 km	**INS Resolution**	50 Hz
Duration	00 h 11 m 14 s	**Processor Version**	0309

A18_20080427

AS3TA18_ASIAL1B030920080427T133724_20080427T134838_0001.DBL

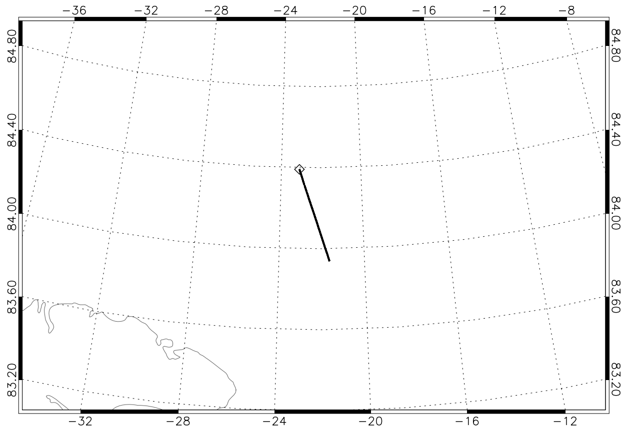


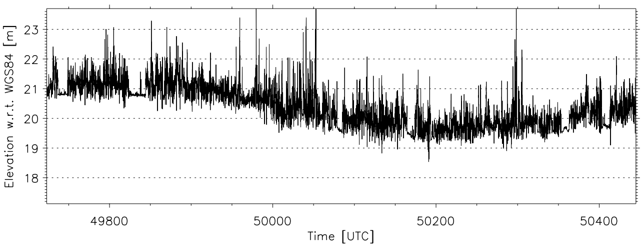


Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	13:37:24 (49044)	**Aircraft**	DNSC Twin Otter
Stop Time	13:48:37 (49717)	**Retracker**	OCOG
Distance	49.850 km	**INS Resolution**	50 Hz
Duration	00 h 11 m 14 s	**Processor Version**	0309

A19_20080427

AS3TA19_ASIAL1B030920080427T134843_20080427T140044_0001.DBL

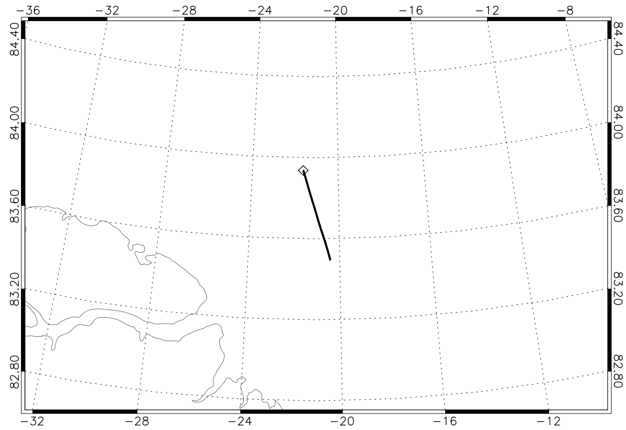


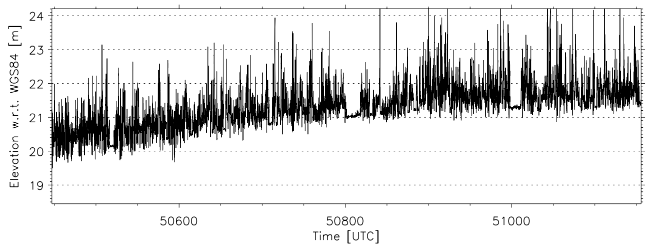


Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	13:48:43 (49723)	**Aircraft**	DNSC Twin Otter
Stop Time	14:00:44 (50444)	**Retracker**	OCOG
Distance	52.979 km	**INS Resolution**	50 Hz
Duration	00 h 12 m 02 s	**Processor Version**	0309

A20_20080427

AS3TA20_ASIAL1B030920080427T140047_20080427T141236_0001.DBL

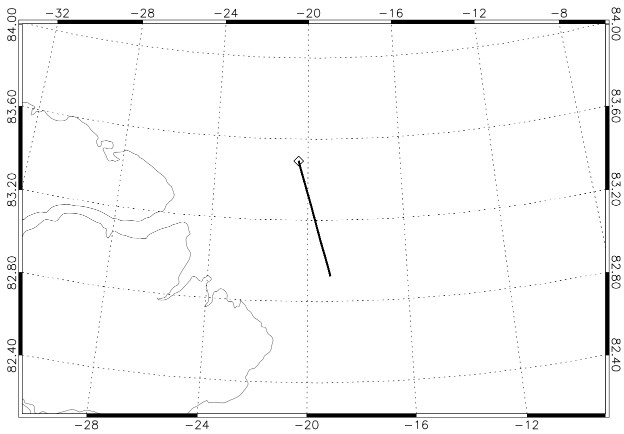


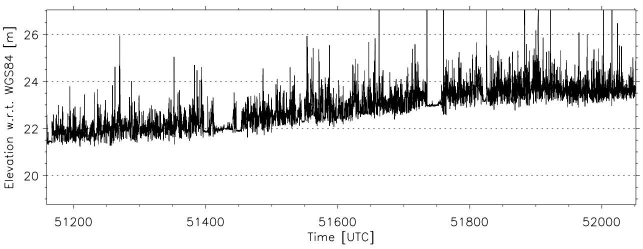


Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	14:00:47 (50447)	**Aircraft**	DNSC Twin Otter
Stop Time	14:12:35 (51155)	**Retracker**	OCOG
Distance	51.391 km	**INS Resolution**	50 Hz
Duration	00 h 11 m 49 s	**Processor Version**	0309

A21_20080427

AS3TA21_ASIAL1B030920080427T141239_20080427T142732_0001.DBL

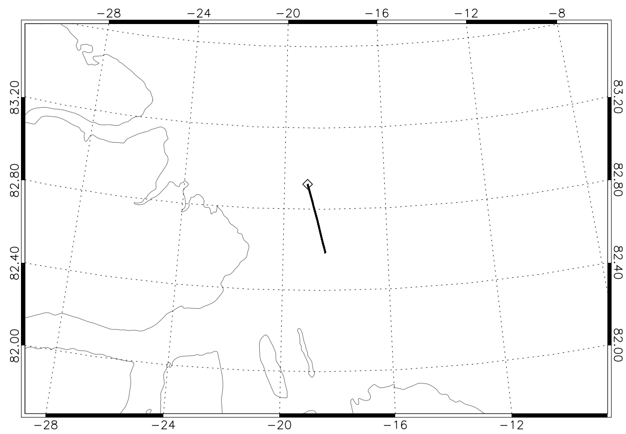


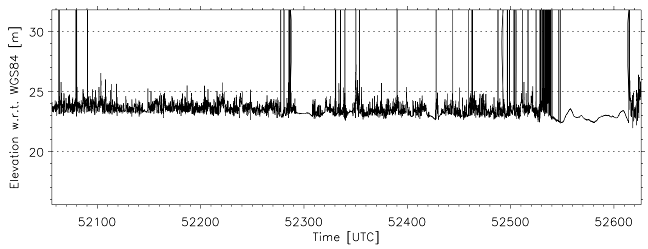


Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	14:12:39 (51159)	**Aircraft**	DNSC Twin Otter
Stop Time	14:27:31 (52051)	**Retracker**	OCOG
Distance	65.406 km	**INS Resolution**	50 Hz
Duration	00 h 14 m 53 s	**Processor Version**	0309

A22_20080427

AS3TA22_ASIAL1B030920080427T142736_20080427T143705_0001.DBL

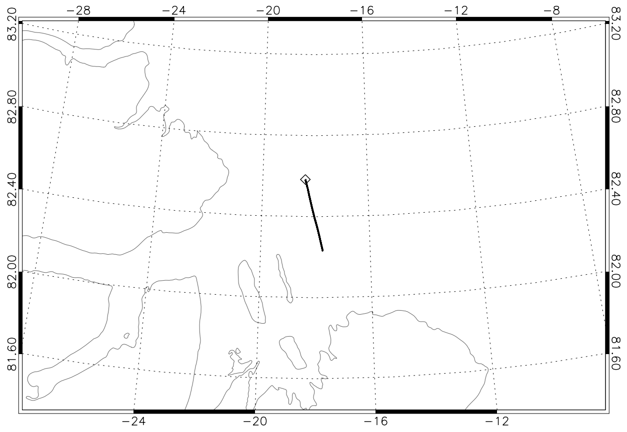


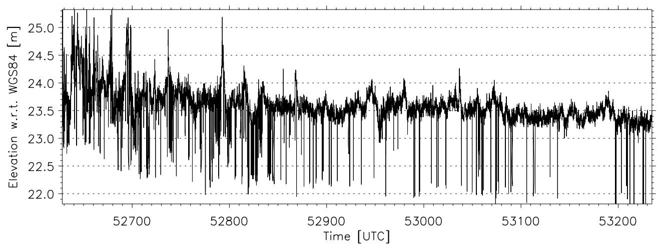


Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	14:27:36 (52056)	**Aircraft**	DNSC Twin Otter
Stop Time	14:37:06 (52626)	**Retracker**	OCOG
Distance	38.962 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 30 s	**Processor Version**	0309

A23_20080427

AS3TA23_ASIAL1B030920080427T143708_20080427T144715_0001.DBL

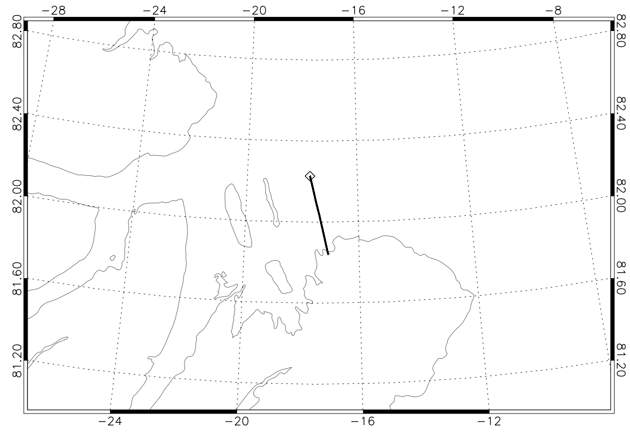


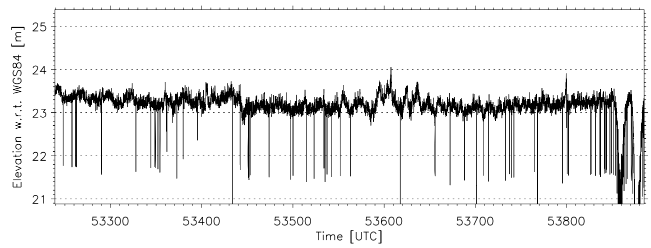


Date	2008-04-27	Instrument Mode	Adv. Low Altitude
Start Time	14:37:08 (52628)	Aircraft	DNSC Twin Otter
Stop Time	14:47:14 (53234)	Retracker	OCOG
Distance	40.440 km	INS Resolution	50 Hz
Duration	00 h 10 m 07 s	Processor Version	0309

A24_20080427

AS3TA24_ASIAL1B030920080427T144719_20080427T145805_0001.DBL

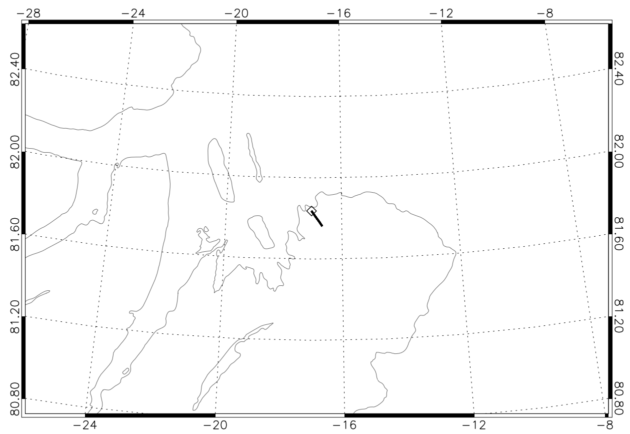


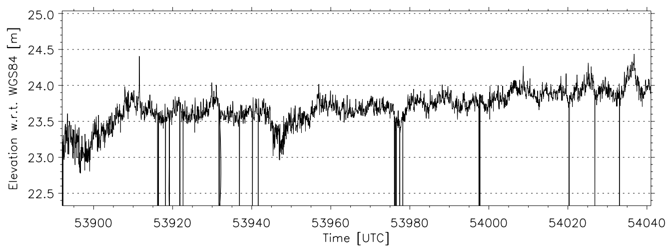


Date	2008-04-27	Instrument Mode	Adv. Low Altitude
Start Time	14:47:19 (53239)	Aircraft	DNSC Twin Otter
Stop Time	14:58:05 (53885)	Retracker	OCOG
Distance	44.172 km	INS Resolution	50 Hz
Duration	00 h 10 m 46 s	Processor Version	0309

A25_20080427

AS3TA25_ASIAL1B030920080427T145812_20080427T150041_0001.DBL

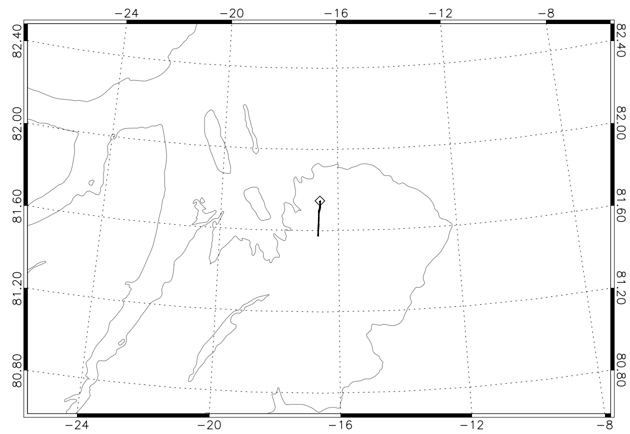


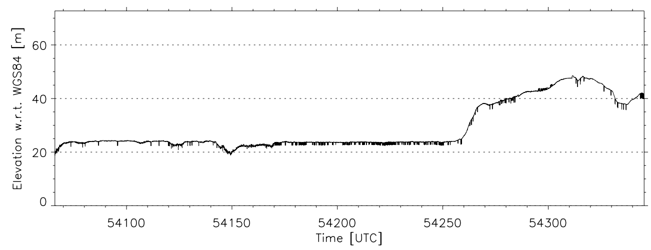


Date	2008-04-27	Instrument Mode	Adv. Low Altitude
Start Time	14:58:12 (53892)	Aircraft	DNSC Twin Otter
Stop Time	15:00:41 (54041)	Retracker	OCOG
Distance	10.246 km	INS Resolution	50 Hz
Duration	00 h 02 m 29 s	Processor Version	0309

A26_20080427

AS3TA26_ASIAL1B030920080427T150106_20080427T150546_0001.DBL

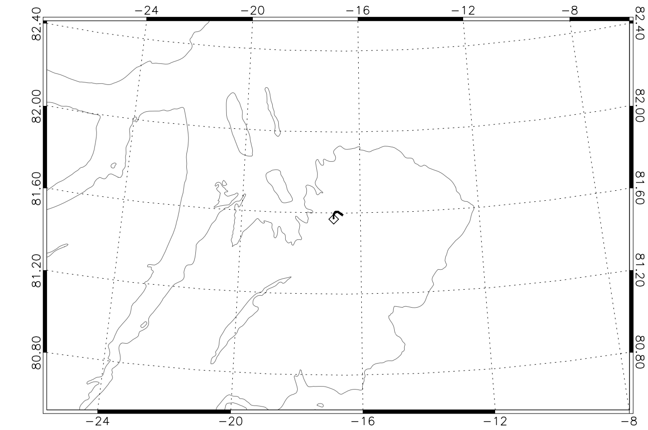


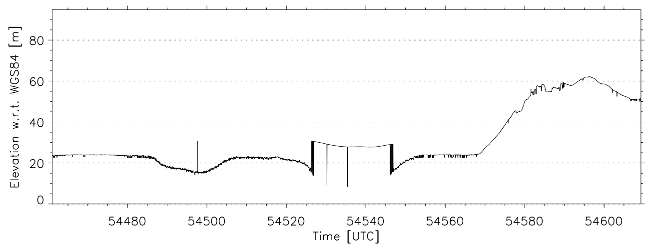


Date	2008-04-27	Instrument Mode	Adv. Low Altitude
Start Time	15:01:06 (54066)	Aircraft	DNSC Twin Otter
Stop Time	15:05:45 (54345)	Retracker	OCOG
Distance	19.530 km	INS Resolution	50 Hz
Duration	00 h 04 m 39 s	Processor Version	0309

A27_20080427

AS3TA27_ASIAL1B030920080427T150741_20080427T151009_0001.DBL

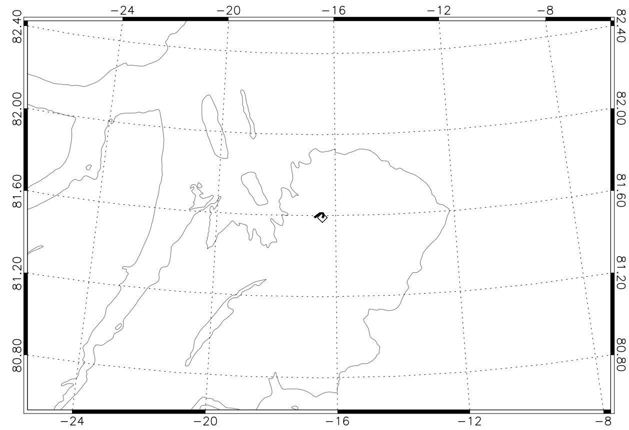


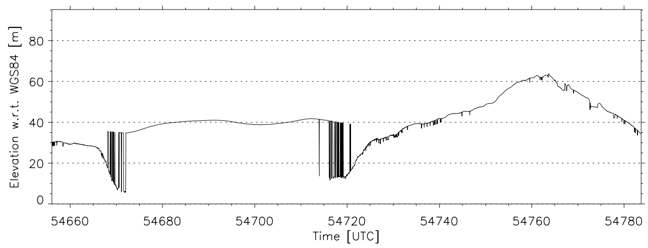


Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	15:07:41 (54461)	**Aircraft**	DNSC Twin Otter
Stop Time	15:10:09 (54609)	**Retracker**	OCOG
Distance	8.976 km	**INS Resolution**	50 Hz
Duration	00 h 02 m 28 s	**Processor Version**	0309

A28_20080427

AS3TA28_ASIAL1B030920080427T151056_20080427T151304_0001.DBL

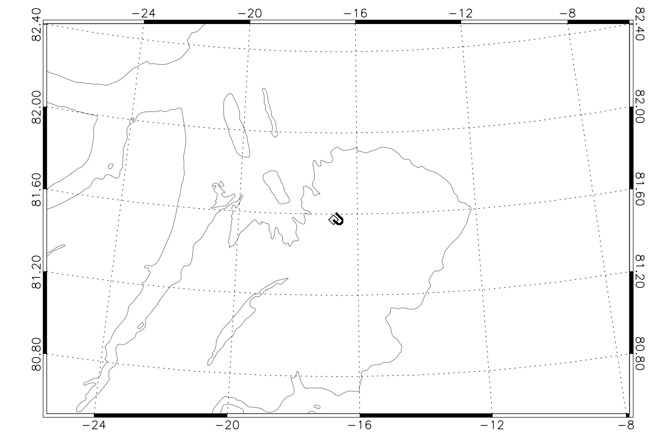


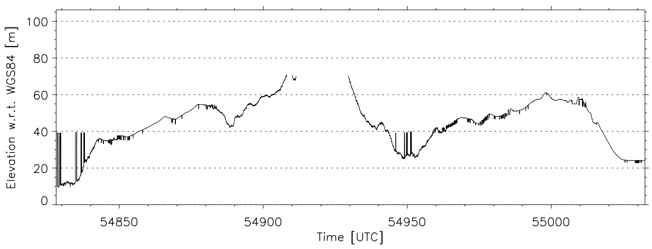


Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	15:10:56 (54656)	**Aircraft**	DNSC Twin Otter
Stop Time	15:13:03 (54783)	**Retracker**	OCOG
Distance	8.019 km	**INS Resolution**	50 Hz
Duration	00 h 02 m 08 s	**Processor Version**	0309

A29_20080427

AS3TA29_ASIAL1B030920080427T151348_20080427T151713_0001.DBL

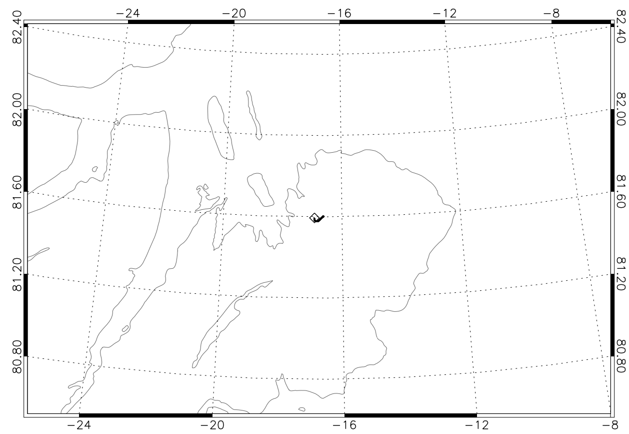


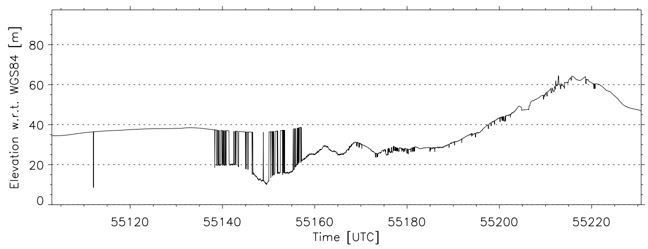


Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	15:13:48 (54828)	**Aircraft**	DNSC Twin Otter
Stop Time	15:17:12 (55032)	**Retracker**	OCOG
Distance	12.777 km	**INS Resolution**	50 Hz
Duration	00 h 03 m 24 s	**Processor Version**	0309

A30_20080427

AS3TA30_ASIAL1B030920080427T151823_20080427T152031_0001.DBL

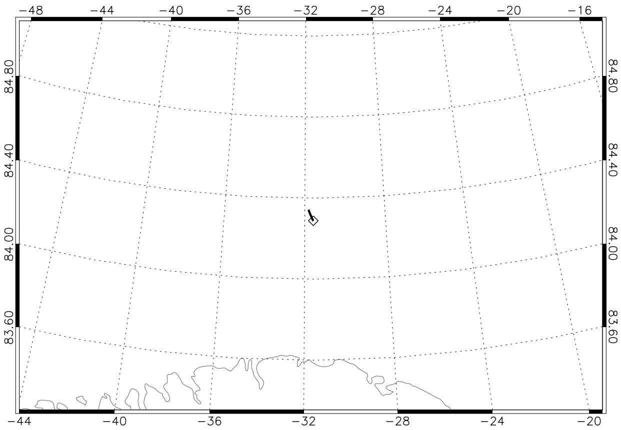


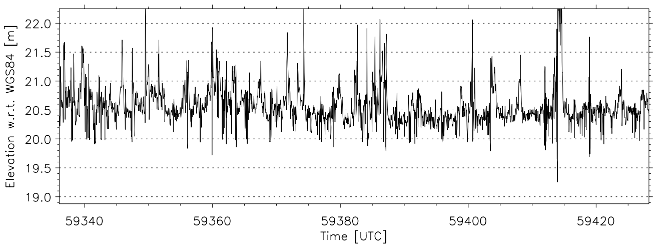


Date	2008-04-27	**Instrument Mode**	Adv. Low Altitude
Start Time	15:18:23 (55103)	**Aircraft**	DNSC Twin Otter
Stop Time	15:20:30 (55230)	**Retracker**	OCOG
Distance	7.766 km	**INS Resolution**	50 Hz
Duration	00 h 02 m 08 s	**Processor Version**	0309

A00_20080428

AS3TA00_ASIAL1B030920080428T162856_20080428T163028_0001.DBL

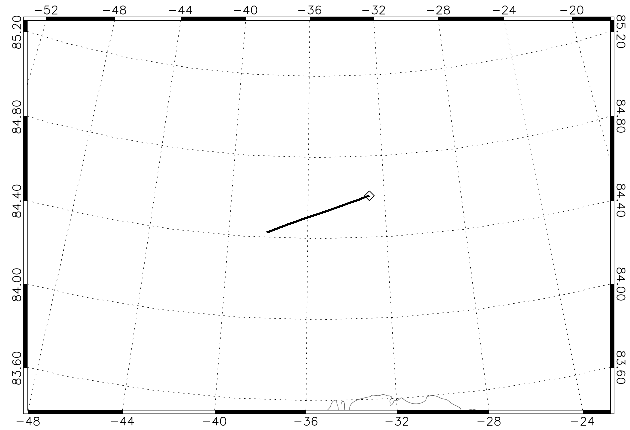


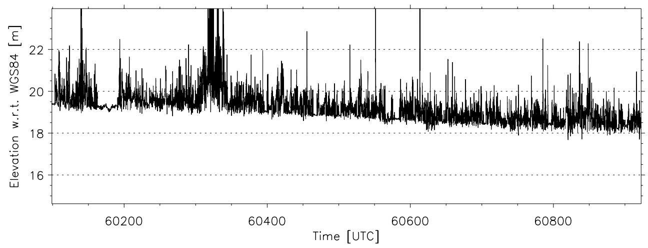


Date	2008–04–28	**Instrument Mode**	Adv. Low Altitude
Start Time	16:28:56 (59336)	**Aircraft**	DNSC Twin Otter
Stop Time	16:30:28 (59428)	**Retracker**	OCOG
Distance	6.493 km	**INS Resolution**	50 Hz
Duration	00 h 01 m 32 s	**Processor Version**	0309

A01_20080428

AS3TA01_ASIAL1B030920080428T164139_20080428T165523_0001.DBL

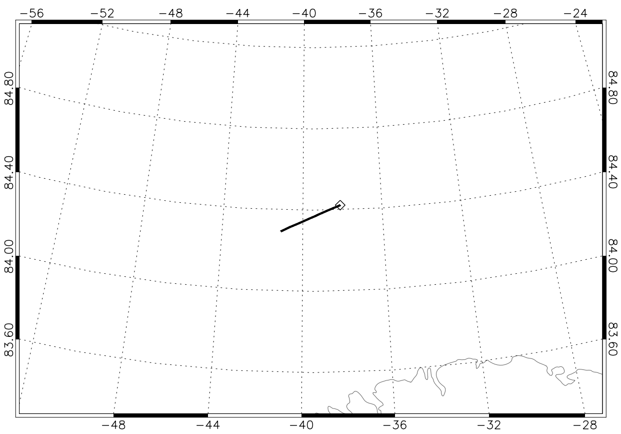


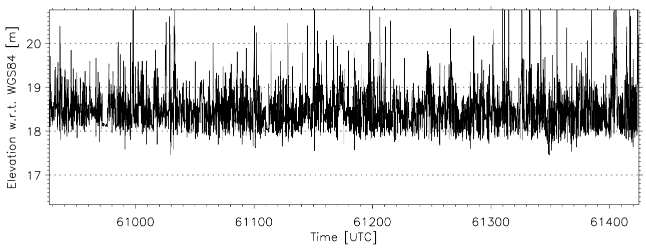


Date	2008–04–28	**Instrument Mode**	Adv. Low Altitude
Start Time	16:41:39 (60099)	**Aircraft**	DNSC Twin Otter
Stop Time	16:55:22 (60922)	**Retracker**	OCOG
Distance	59.755 km	**INS Resolution**	50 Hz
Duration	00 h 13 m 44 s	**Processor Version**	0309

A02_20080428

AS3TA02_ASIAL1B030920080428T165527_20080428T170344_0001.DBL

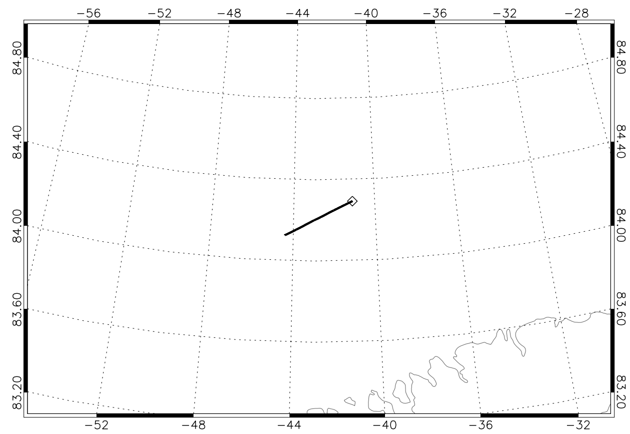


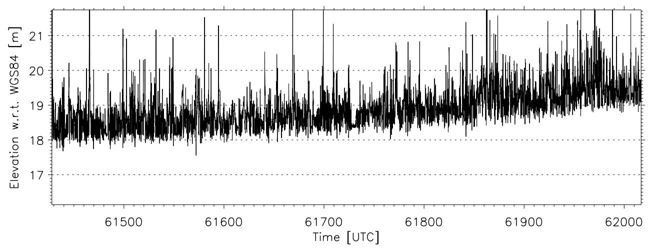


Date	2008–04–28	**Instrument Mode**	Adv. Low Altitude
Start Time	16:55:27 (60927)	**Aircraft**	DNSC Twin Otter
Stop Time	17:03:44 (61424)	**Retracker**	OCOG
Distance	35.495 km	**INS Resolution**	50 Hz
Duration	00 h 08 m 18 s	**Processor Version**	0309

A03_20080428

AS3TA03_ASIAL1B030920080428T170348_20080428T171337_0001.DBL

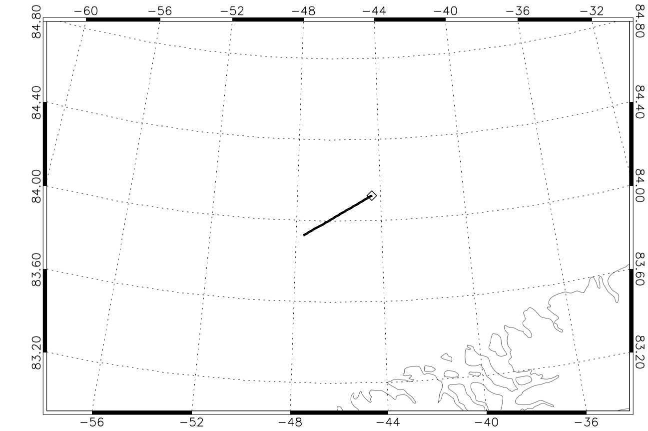


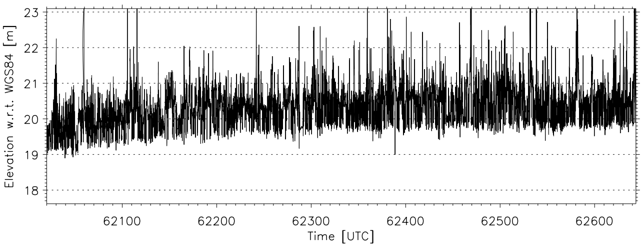


Date	2008–04–28	**Instrument Mode**	Adv. Low Altitude
Start Time	17:03:48 (61428)	**Aircraft**	DNSC Twin Otter
Stop Time	17:13:36 (62016)	**Retracker**	OCOG
Distance	41.408 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 49 s	**Processor Version**	0309

A04_20080428

AS3TA04_ASIAL1B030920080428T171340_20080428T172404_0001.DBL

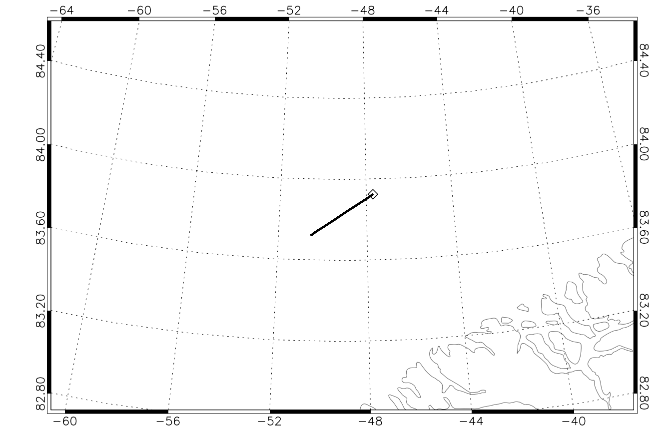


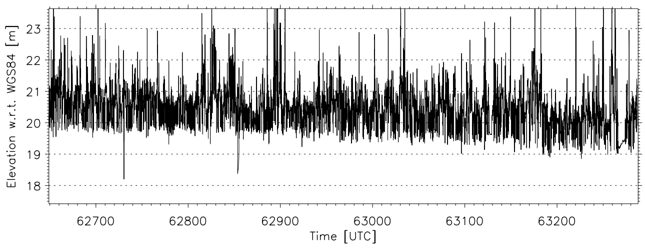


Date	2008-04-28	**Instrument Mode**	Adv. Low Altitude
Start Time	17:13:40 (62020)	**Aircraft**	DNSC Twin Otter
Stop Time	17:24:03 (62643)	**Retracker**	OCOG
Distance	43.423 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 24 s	**Processor Version**	0309

A05_20080428

AS3TA05_ASIAL1B030920080428T172409_20080428T173447_0001.DBL

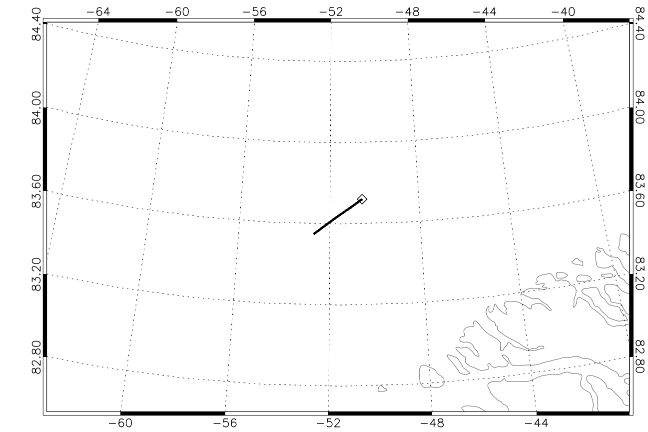


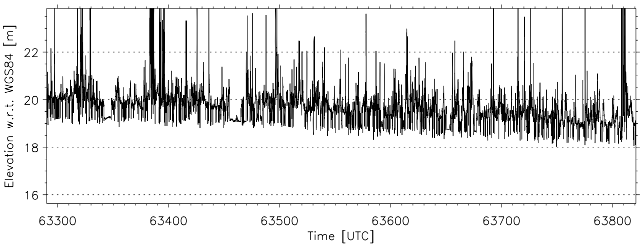


Date	2008-04-28	**Instrument Mode**	Adv. Low Altitude
Start Time	17:24:09 (62649)	**Aircraft**	DNSC Twin Otter
Stop Time	17:34:47 (63287)	**Retracker**	OCOG
Distance	41.001 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 39 s	**Processor Version**	0309

A06_20080428

AS3TA06_ASIAL1B030920080428T173450_20080428T174341_0001.DBL

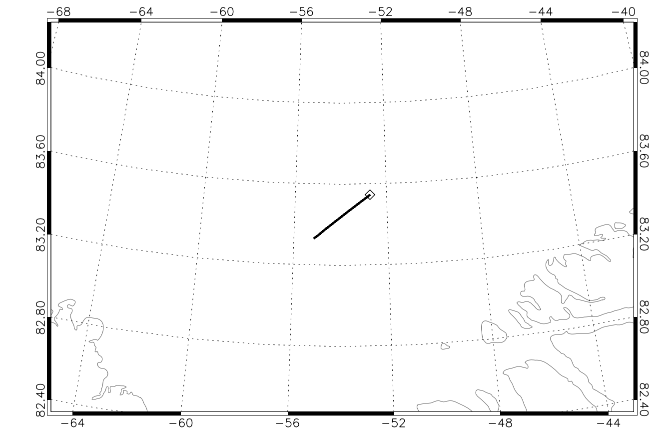


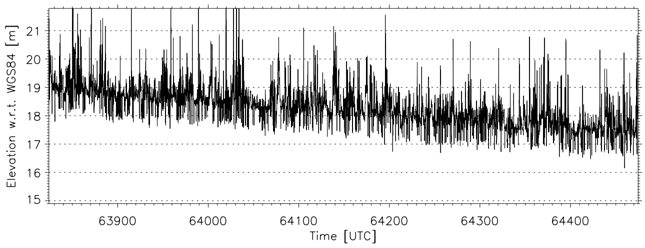


Date	2008-04-28	**Instrument Mode**	Adv. Low Altitude
Start Time	17:34:50 (63290)	**Aircraft**	DNSC Twin Otter
Stop Time	17:43:40 (63820)	**Retracker**	OCOG
Distance	32.864 km	**INS Resolution**	50 Hz
Duration	00 h 08 m 51 s	**Processor Version**	0309

A07_20080428

AS3TA07_ASIAL1B030920080428T174344_20080428T175435_0001.DBL

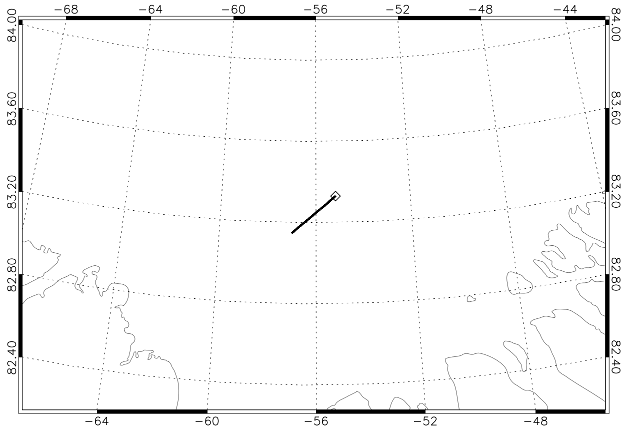


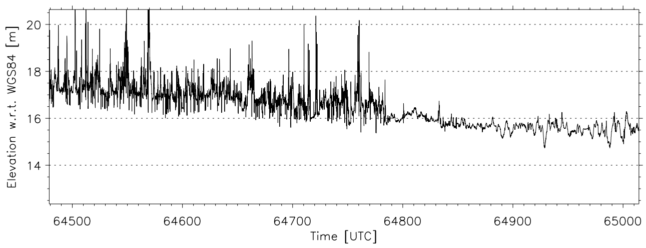


Date	2008-04-28	**Instrument Mode**	Adv. Low Altitude
Start Time	17:43:44 (63824)	**Aircraft**	DNSC Twin Otter
Stop Time	17:54:34 (64474)	**Retracker**	OCOG
Distance	39.112 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 51 s	**Processor Version**	0309

A08_20080428

AS3TA08_ASIAL1B030920080428T175439_20080428T180334_0001.DBL

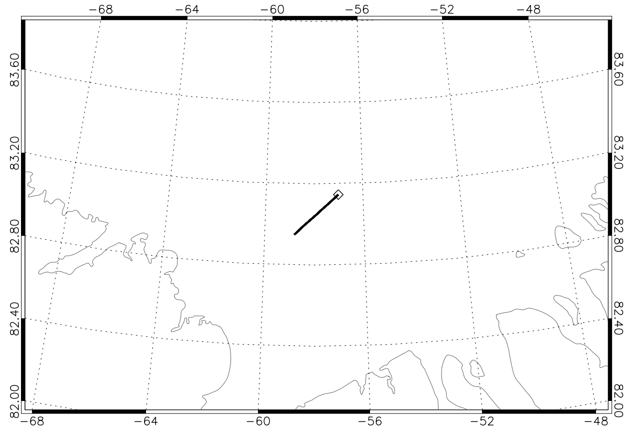


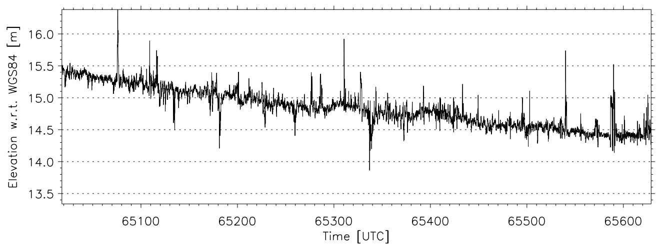


Date	2008-04-28	**Instrument Mode**	Adv. Low Altitude
Start Time	17:54:39 (64479)	**Aircraft**	DNSC Twin Otter
Stop Time	18:03:34 (65014)	**Retracker**	OCOG
Distance	31.527 km	**INS Resolution**	50 Hz
Duration	00 h 08 m 55 s	**Processor Version**	0309

A09_20080428

AS3TA09_ASIAL1B030920080428T180338_20080428T181349_0001.DBL

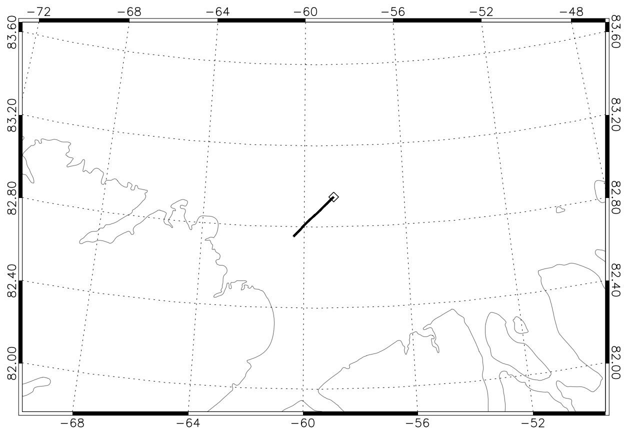


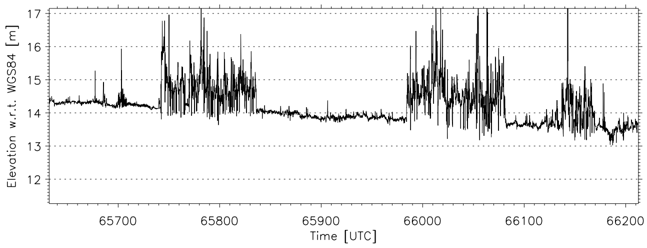


Date	2008-04-28	**Instrument Mode**	Adv. Low Altitude
Start Time	18:03:38 (65018)	**Aircraft**	DNSC Twin Otter
Stop Time	18:13:48 (65628)	**Retracker**	OCOG
Distance	32.683 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 11 s	**Processor Version**	0309

A10_20080428

AS3TA10_ASIAL1B030920080428T181352_20080428T182333_0001.DBL

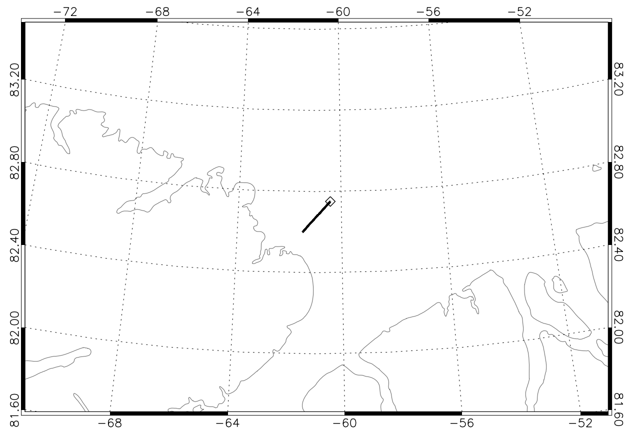


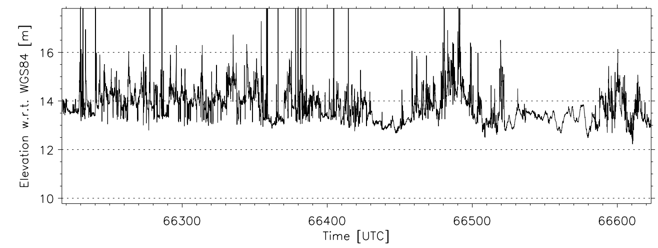


Date	2008-04-28	**Instrument Mode**	Adv. Low Altitude
Start Time	18:13:52 (65632)	**Aircraft**	DNSC Twin Otter
Stop Time	18:23:32 (66212)	**Retracker**	OCOG
Distance	30.948 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 40 s	**Processor Version**	0309

A11_20080428

AS3TA11_ASIAL1B030920080428T182337_20080428T183023_0001.DBL

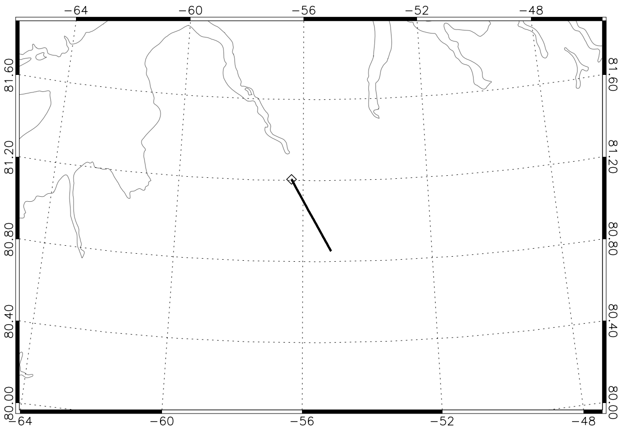


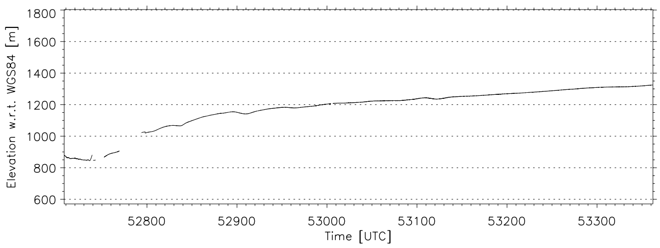


Date	2008-04-28	**Instrument Mode**	Adv. Low Altitude
Start Time	18:23:37 (66217)	**Aircraft**	DNSC Twin Otter
Stop Time	18:30:23 (66623)	**Retracker**	OCOG
Distance	22.733 km	**INS Resolution**	50 Hz
Duration	00 h 06 m 46 s	**Processor Version**	0309

A00_20080429

AS3TA00_ASIAL1B030920080429T143828_20080429T144922_0001.DBL

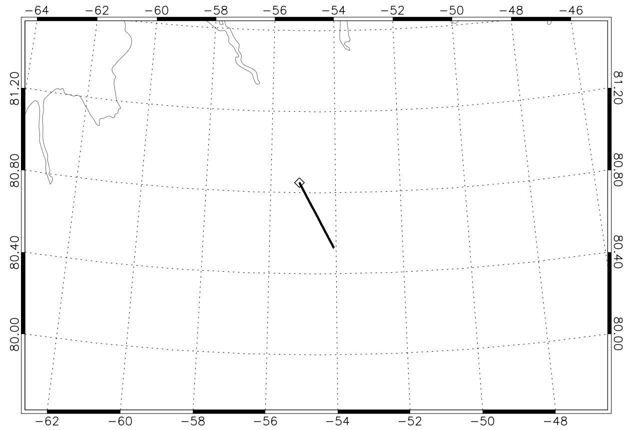


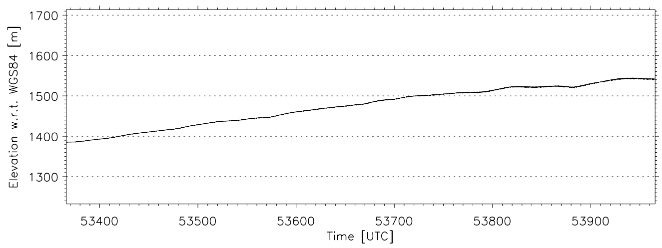


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	14:38:28 (52708)	**Aircraft**	DNSC Twin Otter
Stop Time	14:49:22 (53362)	**Retracker**	OCOG
Distance	44.880 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 54 s	**Processor Version**	0309

A01_20080429

AS3TA01_ASIAL1B030920080429T144926_20080429T145926_0001.DBL

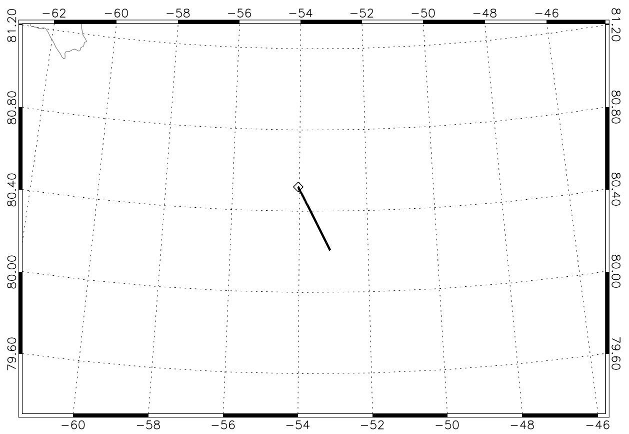


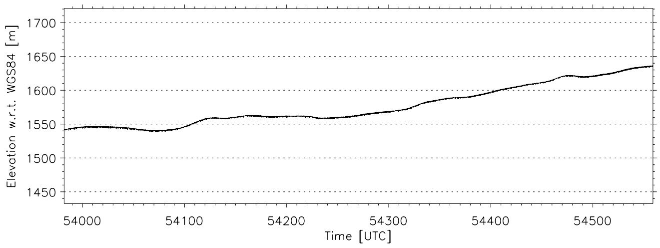


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	14:49:26 (53366)	**Aircraft**	DNSC Twin Otter
Stop Time	14:59:25 (53965)	**Retracker**	OCOG
Distance	40.484 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 60 s	**Processor Version**	0309

A02_20080429

AS3TA02_ASIAL1B030920080429T145942_20080429T150919_0001.DBL

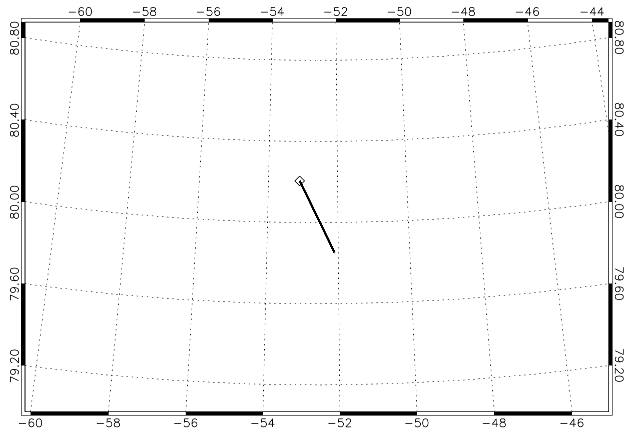


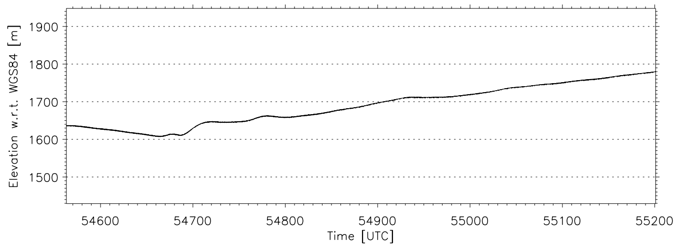


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	14:59:42 (53982)	**Aircraft**	DNSC Twin Otter
Stop Time	15:09:18 (54558)	**Retracker**	OCOG
Distance	38.839 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 37 s	**Processor Version**	0309

A03_20080429

AS3TA03_ASIAL1B030920080429T150923_20080429T152001_0001.DBL

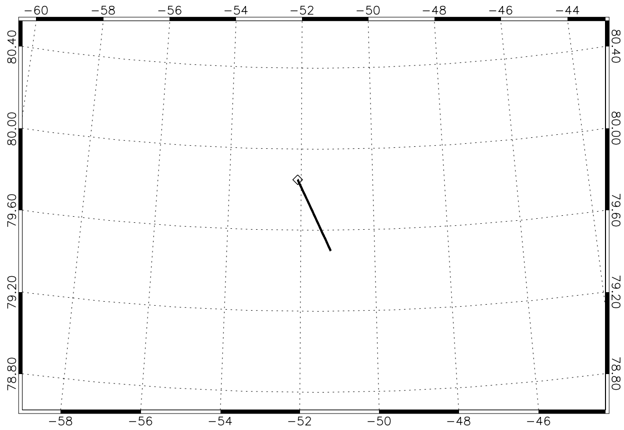


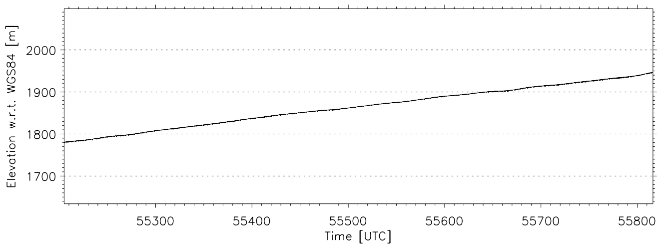


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	15:09:23 (54563)	**Aircraft**	DNSC Twin Otter
Stop Time	15:20:00 (55200)	**Retracker**	OCOG
Distance	43.831 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 38 s	**Processor Version**	0309

A04_20080429

AS3TA04_ASIAL1B030920080429T152005_20080429T153016_0001.DBL

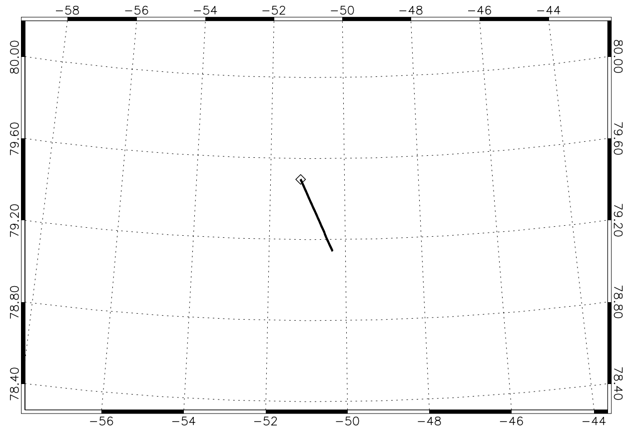


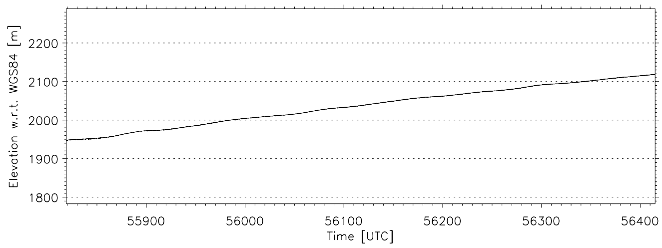


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	15:20:05 (55205)	**Aircraft**	DNSC Twin Otter
Stop Time	15:30:16 (55816)	**Retracker**	OCOG
Distance	43.000 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 11 s	**Processor Version**	0309

A05_20080429

AS3TA05_ASIAL1B030920080429T153019_20080429T154015_0001.DBL

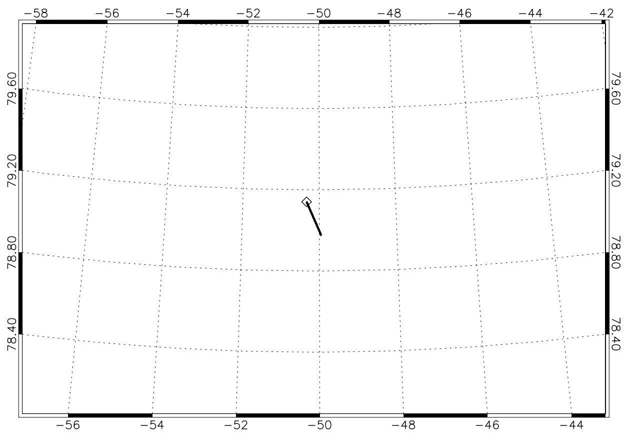


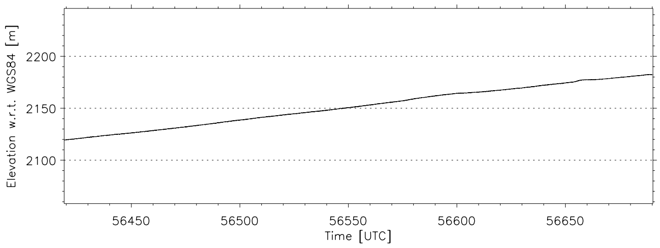


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	15:30:19 (55819)	**Aircraft**	DNSC Twin Otter
Stop Time	15:40:15 (56415)	**Retracker**	OCOG
Distance	43.070 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 56 s	**Processor Version**	0309

A06_20080429

AS3TA06_ASIAL1B030920080429T154019_20080429T154449_0001.DBL

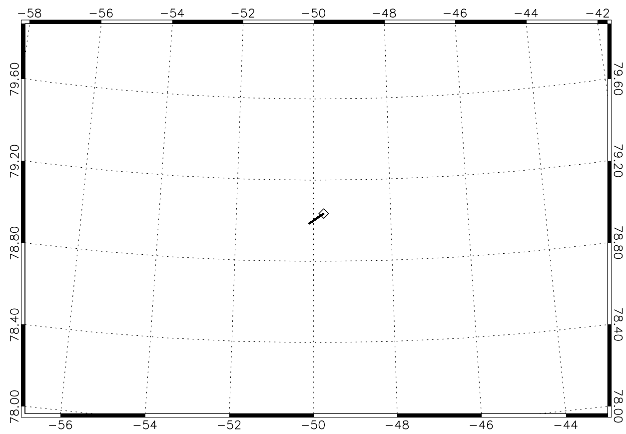


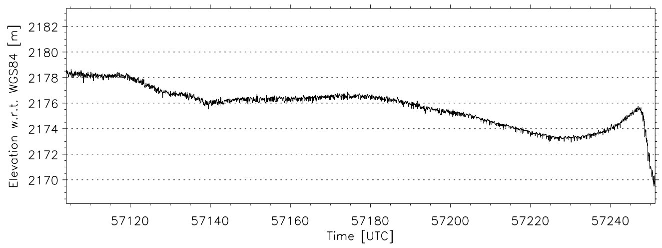


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	15:40:19 (56419)	**Aircraft**	DNSC Twin Otter
Stop Time	15:44:50 (56690)	**Retracker**	OCOG
Distance	20.061 km	**INS Resolution**	50 Hz
Duration	00 h 04 m 31 s	**Processor Version**	0309

A07_20080429

AS3TA07_ASIAL1B030920080429T155144_20080429T155411_0001.DBL

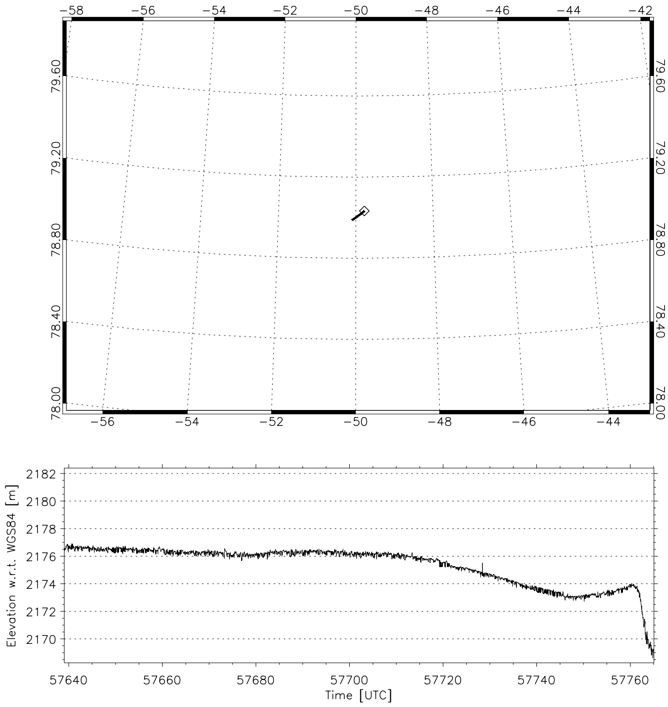




Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	15:51:44 (57104)	**Aircraft**	DNSC Twin Otter
Stop Time	15:54:11 (57251)	**Retracker**	OCOG
Distance	9.866 km	**INS Resolution**	50 Hz
Duration	00 h 02 m 27 s	**Processor Version**	0309

A08_20080429

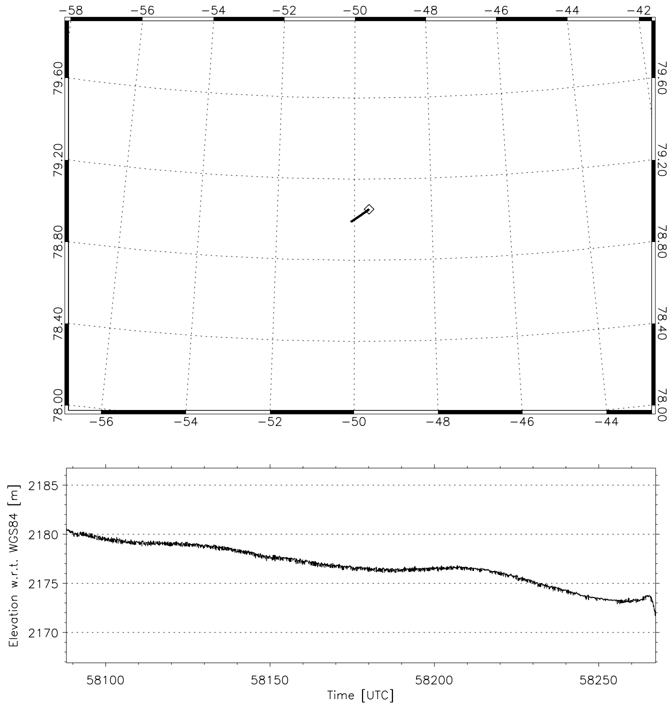
AS3TA08_ASIAL1B030920080429T160039_20080429T160245_0001.DBL



Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	16:00:39 (57639)	**Aircraft**	DNSC Twin Otter
Stop Time	16:02:45 (57765)	**Retracker**	OCOG
Distance	8.474 km	**INS Resolution**	50 Hz
Duration	00 h 02 m 06 s	**Processor Version**	0309

A09_20080429

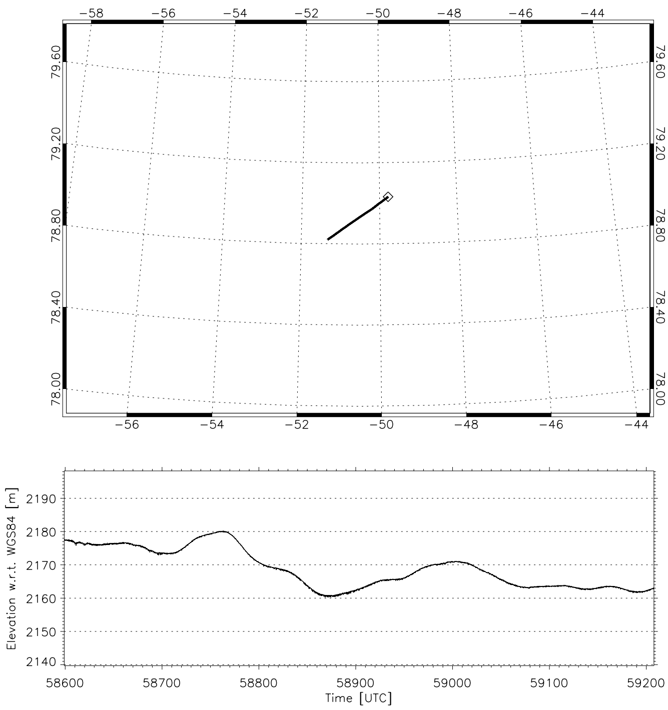
AS3TA09_ASIAL1B030920080429T160808_20080429T161107_0001.DBL



Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	16:08:08 (58088)	**Aircraft**	DNSC Twin Otter
Stop Time	16:11:07 (58267)	**Retracker**	OCOG
Distance	12.038 km	**INS Resolution**	50 Hz
Duration	00 h 02 m 59 s	**Processor Version**	0309

A10_20080429

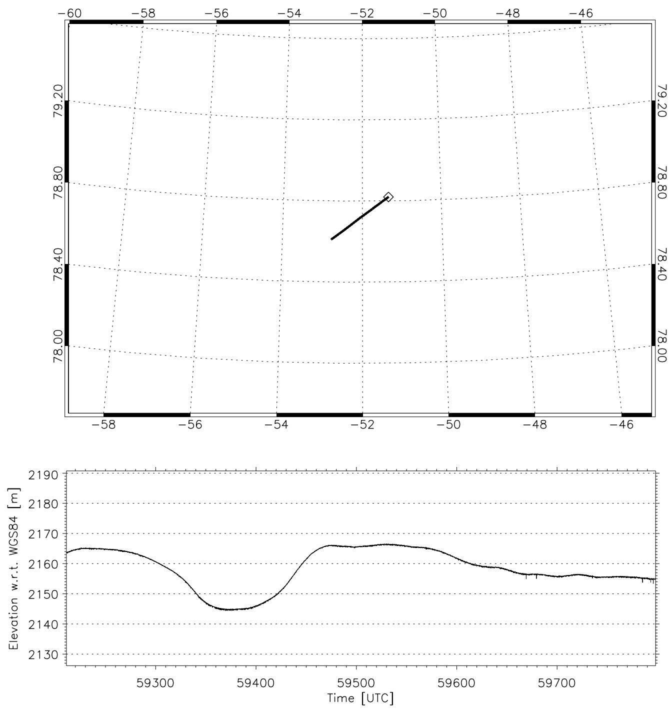
AS3TA10_ASIAL1B030920080429T161639_20080429T162648_0001.DBL



Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	16:16:39 (58599)	**Aircraft**	DNSC Twin Otter
Stop Time	16:26:47 (59207)	**Retracker**	OCOG
Distance	40.555 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 09 s	**Processor Version**	0309

A11_20080429

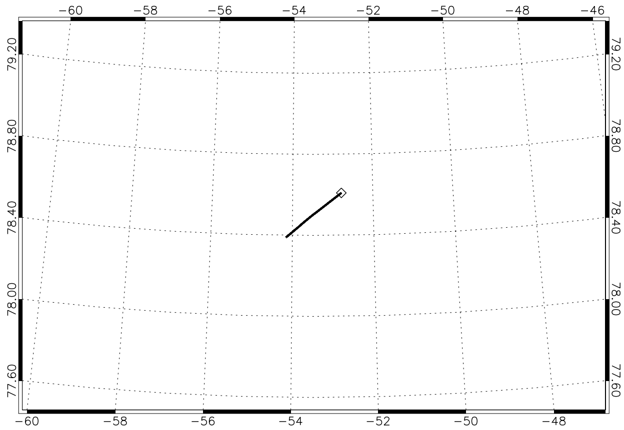
AS3TA11_ASIAL1B030920080429T162651_20080429T163638_0001.DBL

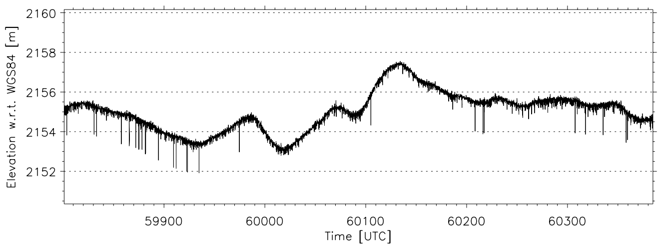


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	16:26:51 (59211)	**Aircraft**	DNSC Twin Otter
Stop Time	16:36:38 (59798)	**Retracker**	OCOG
Distance	39.037 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 47 s	**Processor Version**	0309

A12_20080429

AS3TA12_ASIAL1B030920080429T163641_20080429T164625_0001.DBL

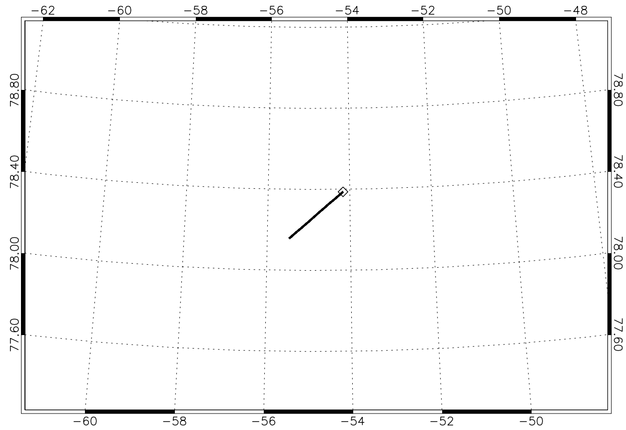


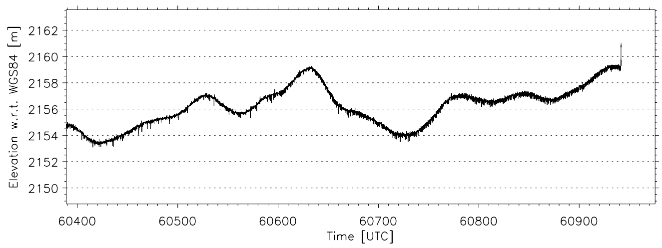


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	16:36:41 (59801)	**Aircraft**	DNSC Twin Otter
Stop Time	16:46:24 (60384)	**Retracker**	OCOG
Distance	38.876 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 44 s	**Processor Version**	0309

A13_20080429

AS3TA13_ASIAL1B030920080429T164629_20080429T165616_0001.DBL

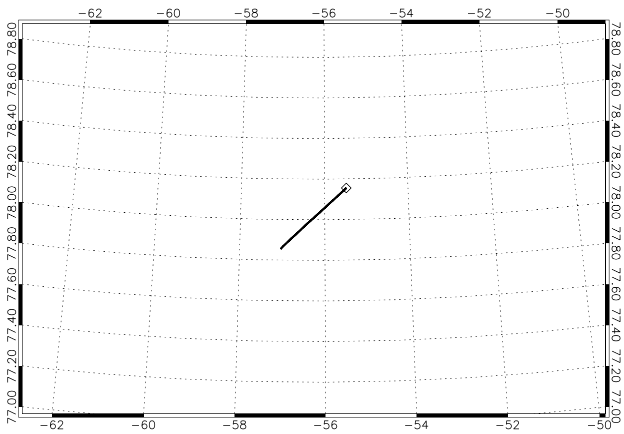


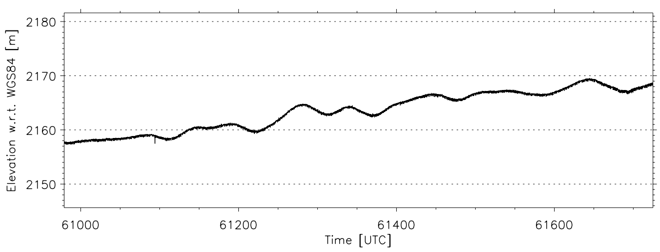


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	16:46:29 (60389)	**Aircraft**	DNSC Twin Otter
Stop Time	16:56:15 (60975)	**Retracker**	OCOG
Distance	39.056 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 47 s	**Processor Version**	0309

A14_20080429

AS3TA14_ASIAL1B030920080429T165619_20080429T170845_0001.DBL

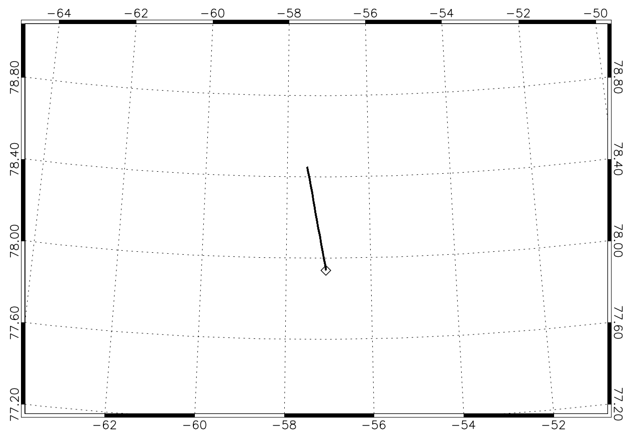


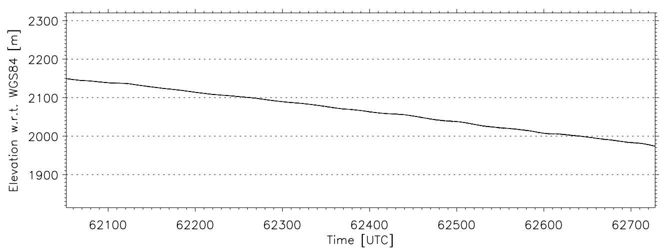


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	16:56:19 (60979)	**Aircraft**	DNSC Twin Otter
Stop Time	17:08:44 (61724)	**Retracker**	OCOG
Distance	48.989 km	**INS Resolution**	50 Hz
Duration	00 h 12 m 26 s	**Processor Version**	0309

A15_20080429

AS3TA15_ASIAL1B030920080429T171412_20080429T172528_0001.DBL

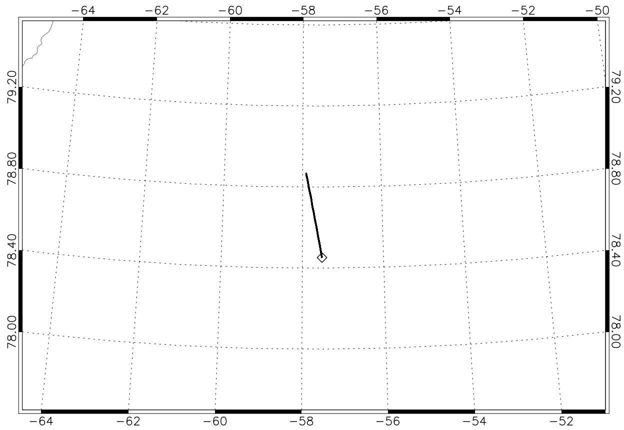


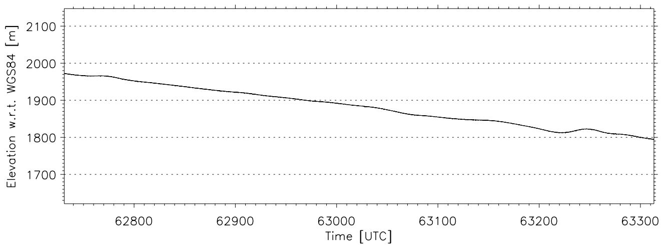


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	17:14:12 (62052)	**Aircraft**	DNSC Twin Otter
Stop Time	17:25:27 (62727)	**Retracker**	OCOG
Distance	57.555 km	**INS Resolution**	50 Hz
Duration	00 h 11 m 16 s	**Processor Version**	0309

A16_20080429

AS3TA16_ASIAL1B030920080429T172531_20080429T173513_0001.DBL

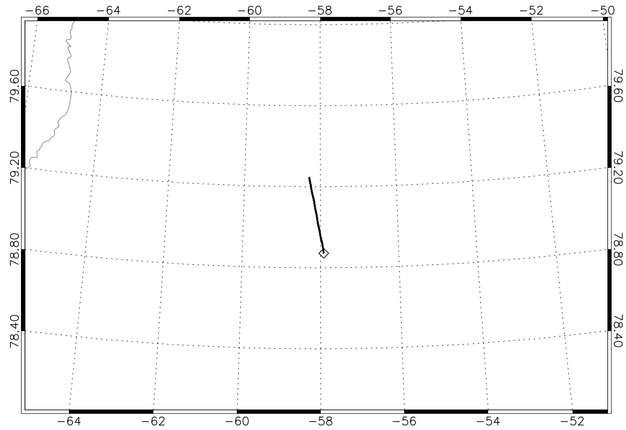


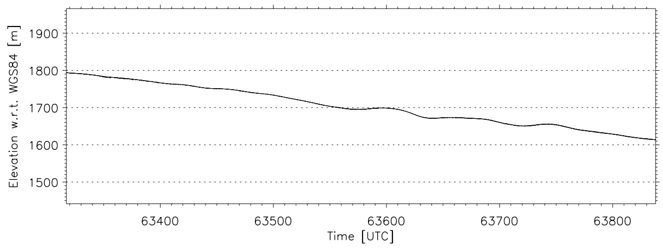


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	17:25:31 (62731)	**Aircraft**	DNSC Twin Otter
Stop Time	17:35:13 (63313)	**Retracker**	OCOG
Distance	47.136 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 42 s	**Processor Version**	0309

A17_20080429

AS3TA17_ASIAL1B030920080429T173517_20080429T174358_0001.DBL

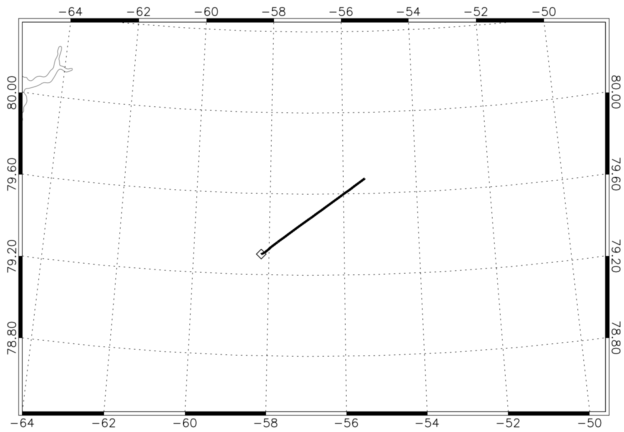


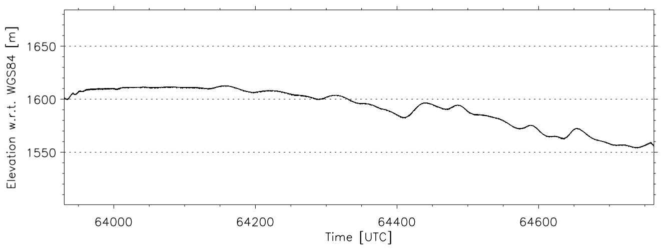


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	17:35:17 (63317)	**Aircraft**	DNSC Twin Otter
Stop Time	17:43:57 (63837)	**Retracker**	OCOG
Distance	42.416 km	**INS Resolution**	50 Hz
Duration	00 h 08 m 41 s	**Processor Version**	0309

A18_20080429

AS3TA18_ASIAL1B030920080429T174530_20080429T175923_0001.DBL

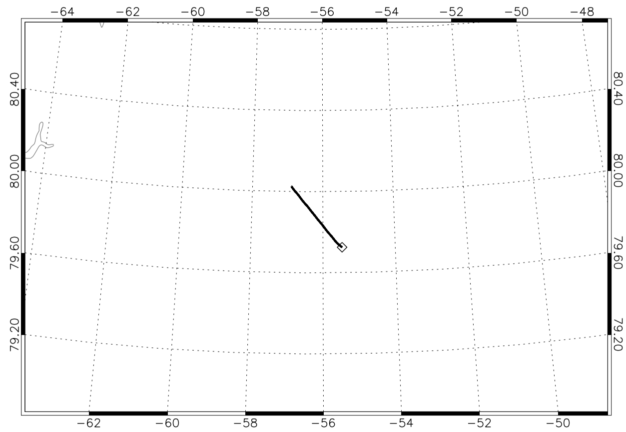


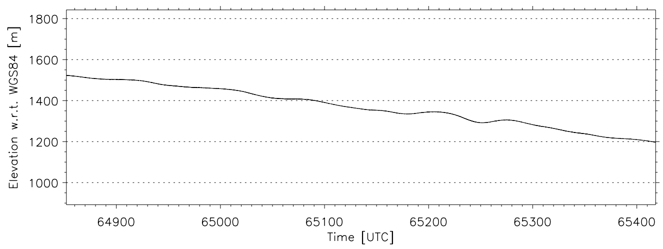


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	17:45:30 (63930)	**Aircraft**	DNSC Twin Otter
Stop Time	17:59:22 (64762)	**Retracker**	OCOG
Distance	70.302 km	**INS Resolution**	50 Hz
Duration	00 h 13 m 53 s	**Processor Version**	0309

A19_20080429

AS3TA19_ASIAL1B030920080429T180052_20080429T181018_0001.DBL

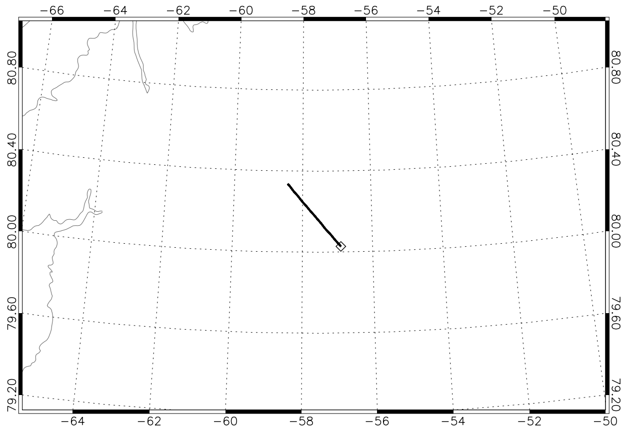


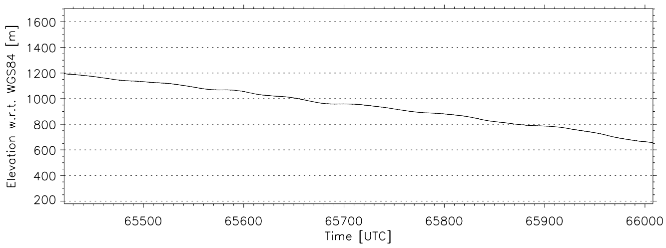


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	18:00:52 (64852)	**Aircraft**	DNSC Twin Otter
Stop Time	18:10:18 (65418)	**Retracker**	OCOG
Distance	43.653 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 26 s	**Processor Version**	0309

A20_20080429

AS3TA20_ASIAL1B030920080429T181021_20080429T182008_0001.DBL

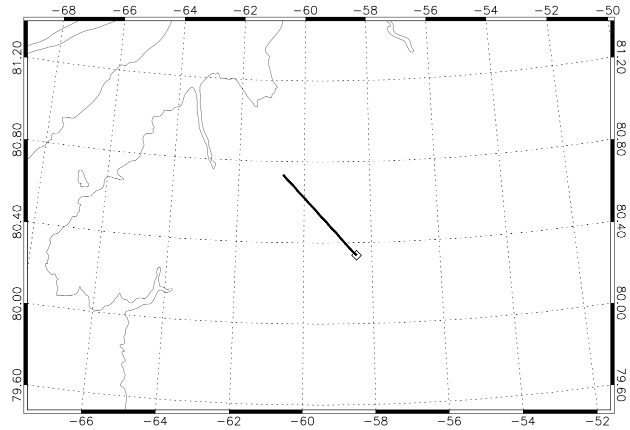


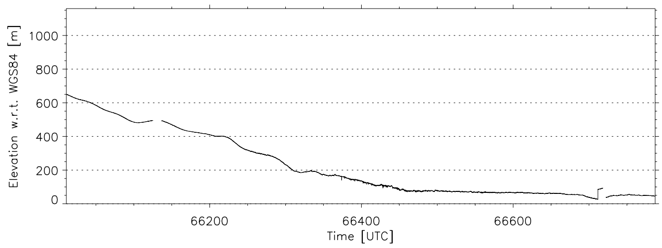


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	18:10:21 (65421)	**Aircraft**	DNSC Twin Otter
Stop Time	18:20:07 (66007)	**Retracker**	OCOG
Distance	45.108 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 47 s	**Processor Version**	0309

A21_20080429

AS3TA21_ASIAL1B030920080429T182011_20080429T183307_0001.DBL

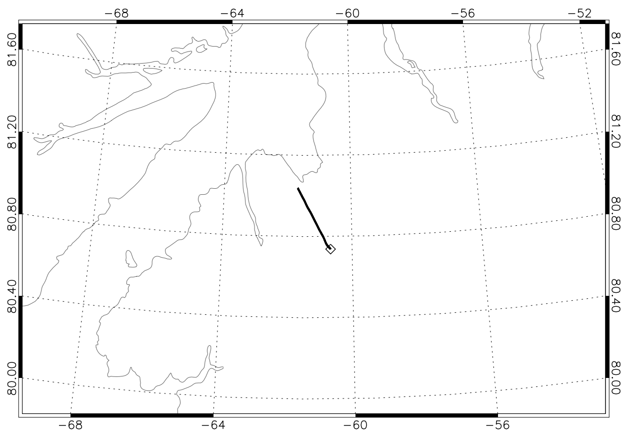


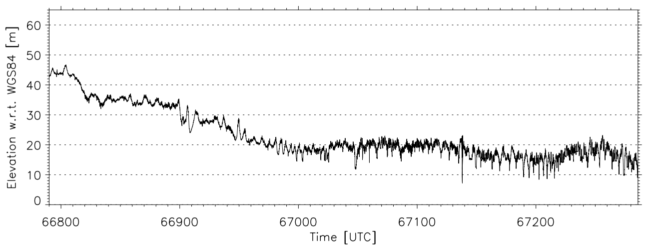


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	18:20:11 (66011)	**Aircraft**	DNSC Twin Otter
Stop Time	18:33:07 (66787)	**Retracker**	OCOG
Distance	59.896 km	**INS Resolution**	50 Hz
Duration	00 h 12 m 56 s	**Processor Version**	0309

A22_20080429

AS3TA22_ASIAL1B030920080429T183310_20080429T184126_0001.DBL

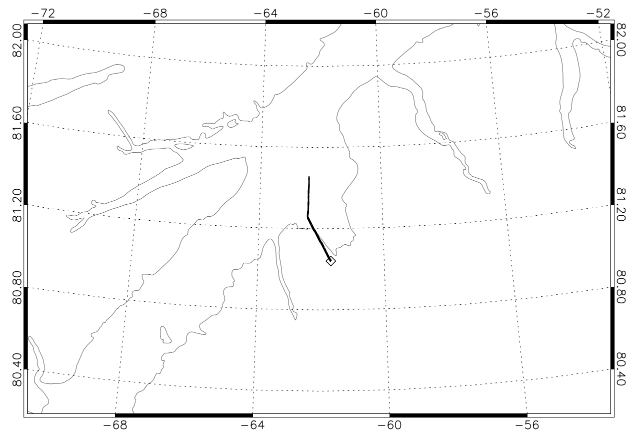


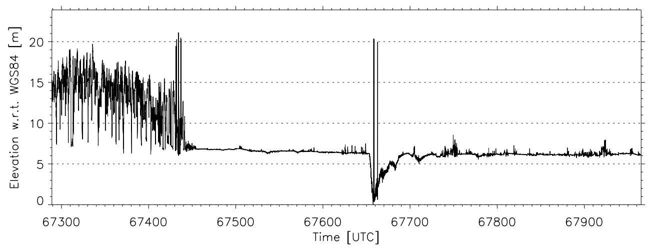


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	18:33:10 (66790)	**Aircraft**	DNSC Twin Otter
Stop Time	18:41:25 (67285)	**Retracker**	OCOG
Distance	38.083 km	**INS Resolution**	50 Hz
Duration	00 h 08 m 16 s	**Processor Version**	0309

A23_20080429

AS3TA23_ASIAL1B030920080429T184129_20080429T185245_0001.DBL

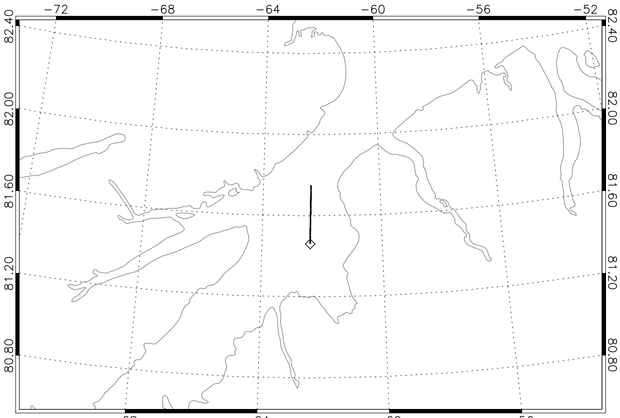


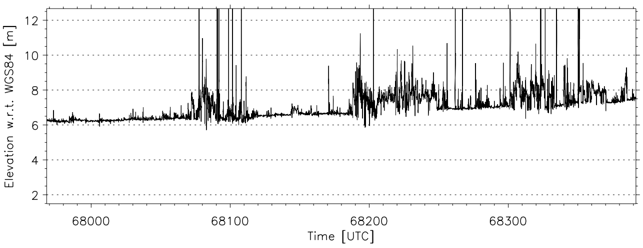


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	18:41:29 (67289)	**Aircraft**	DNSC Twin Otter
Stop Time	18:52:45 (67965)	**Retracker**	OCOG
Distance	49.636 km	**INS Resolution**	50 Hz
Duration	00 h 11 m 16 s	**Processor Version**	0309

A24_20080429

AS3TA24_ASIAL1B030920080429T185248_20080429T185952_0001.DBL

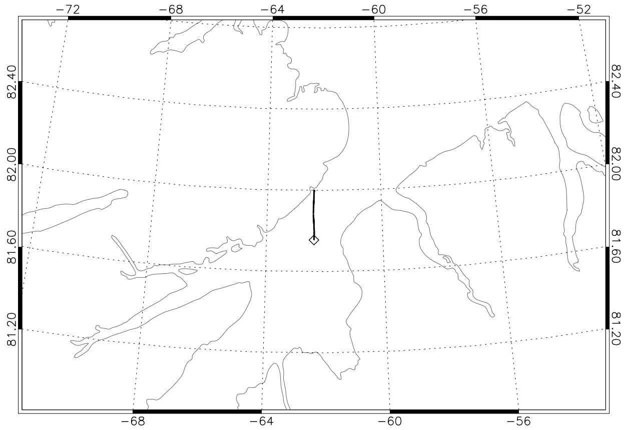


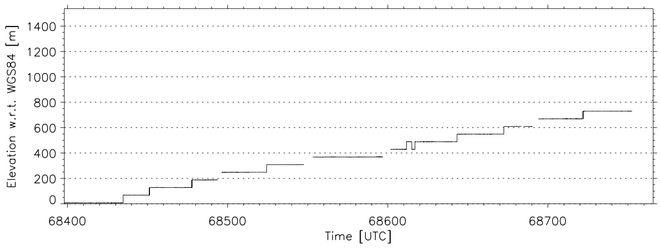


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	18:52:48 (67968)	**Aircraft**	DNSC Twin Otter
Stop Time	18:59:51 (68391)	**Retracker**	OCOG
Distance	32.242 km	**INS Resolution**	50 Hz
Duration	00 h 07 m 04 s	**Processor Version**	0309

A25_20080429

AS3TA25_ASIAL1B030920080429T185958_20080429T190606_0001.DBL

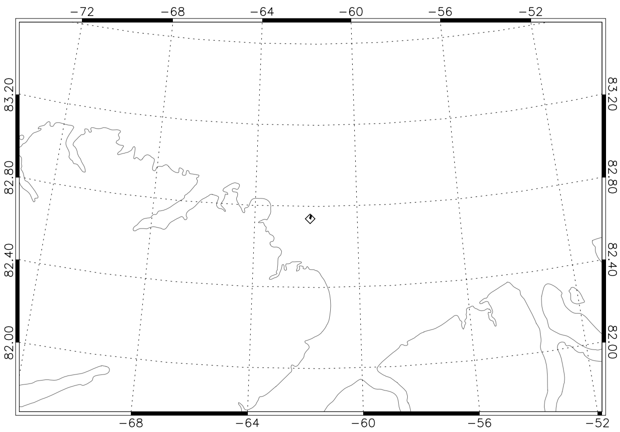


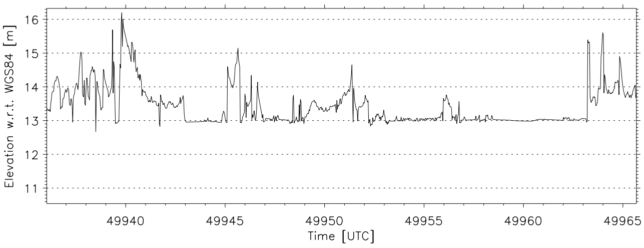


Date	2008-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	18:59:58 (68398)	**Aircraft**	DNSC Twin Otter
Stop Time	19:06:05 (68765)	**Retracker**	OCOG
Distance	27.585 km	**INS Resolution**	50 Hz
Duration	00 h 06 m 08 s	**Processor Version**	0309

A00_20080501

AS3TA00_ASIAL1B030920080501T135216_20080501T140207_0001.DBL

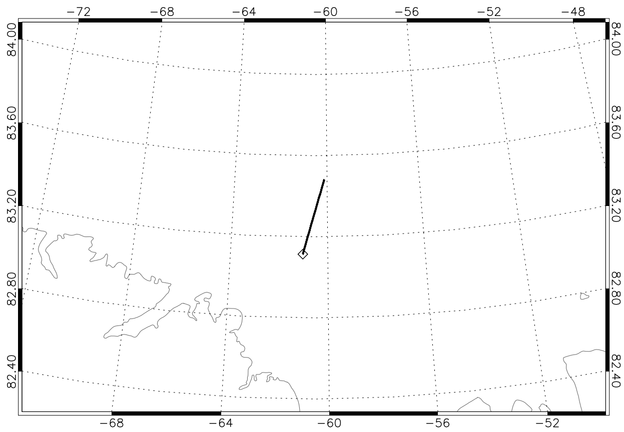


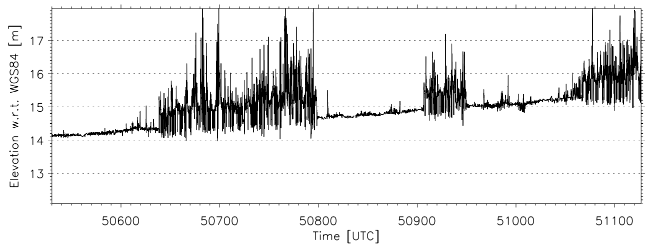


Date	2008-05-01	**Instrument Mode**	Adv. Low Altitude
Start Time	13:52:16 (49936)	**Aircraft**	DNSC Twin Otter
Stop Time	13:52:45 (49965)	**Retracker**	OCOG
Distance	2.152 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 30 s	**Processor Version**	0309

A01_20080501

AS3TA01_ASIAL1B030920080501T140210_20080501T141207_0001.DBL

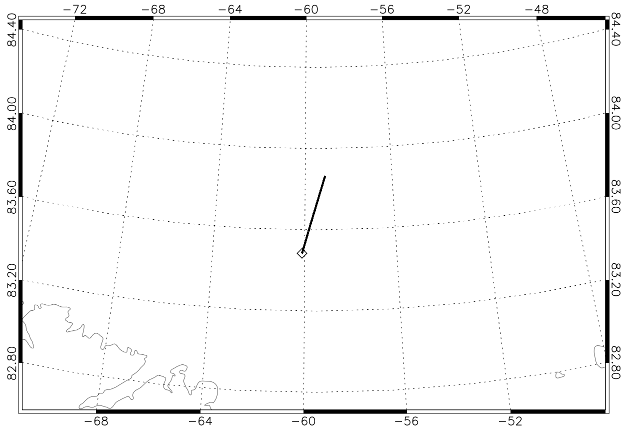


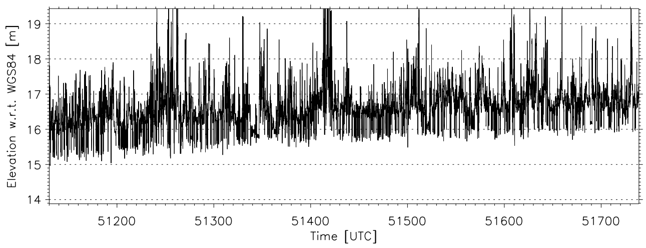


Date	2008-05-01	**Instrument Mode**	Adv. Low Altitude
Start Time	14:02:10 (50530)	**Aircraft**	DNSC Twin Otter
Stop Time	14:12:06 (51126)	**Retracker**	OCOG
Distance	42.616 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 57 s	**Processor Version**	0309

A02_20080501

AS3TA02_ASIAL1B030920080501T141210_20080501T142219_0001.DBL

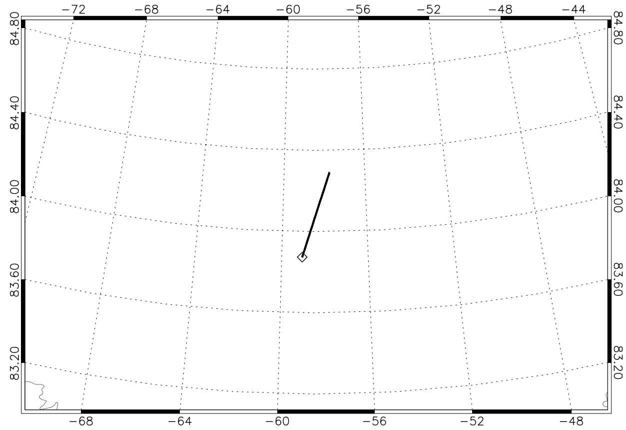


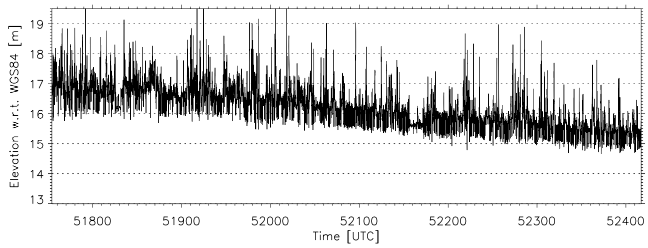


Date	2008-05-01	Instrument Mode	Adv. Low Altitude
Start Time	14:12:10 (51130)	Aircraft	DNSC Twin Otter
Stop Time	14:22:19 (51739)	Retracker	OCOG
Distance	44.163 km	INS Resolution	50 Hz
Duration	00 h 10 m 09 s	Processor Version	0309

A03_20080501

AS3TA03_ASIAL1B030920080501T142234_20080501T143337_0001.DBL

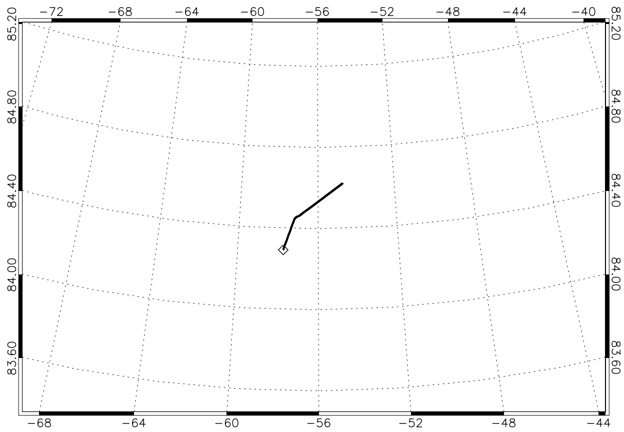


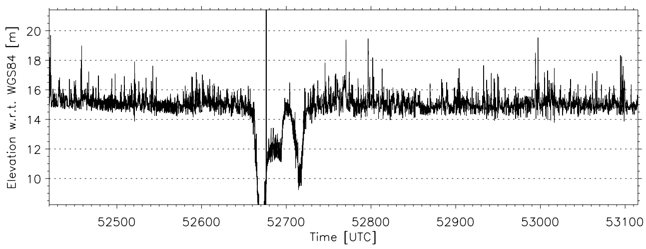


Date	2008-05-01	Instrument Mode	Adv. Low Altitude
Start Time	14:22:34 (51754)	Aircraft	DNSC Twin Otter
Stop Time	14:33:37 (52417)	Retracker	OCOG
Distance	48.792 km	INS Resolution	50 Hz
Duration	00 h 11 m 03 s	Processor Version	0309

A04_20080501

AS3TA04_ASIAL1B030920080501T143340_20080501T144515_0001.DBL

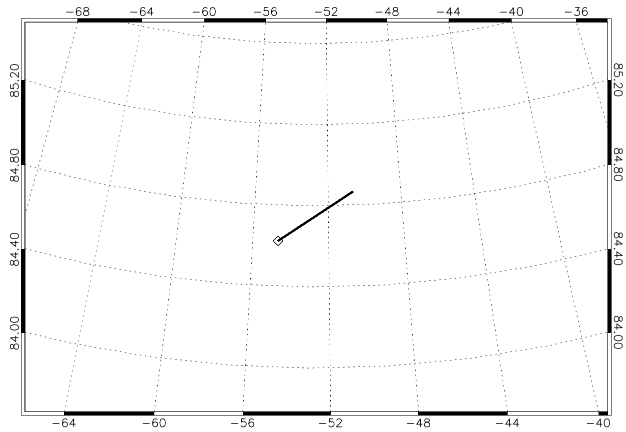


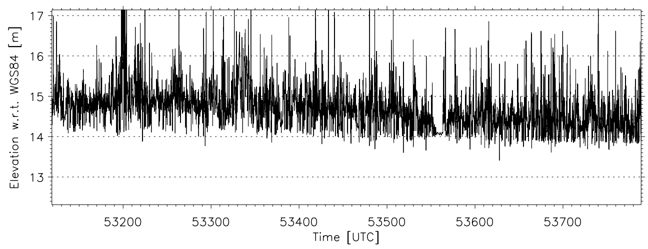


Date	2008-05-01	Instrument Mode	Adv. Low Altitude
Start Time	14:33:40 (52420)	Aircraft	DNSC Twin Otter
Stop Time	14:45:15 (53115)	Retracker	OCOG
Distance	51.008 km	INS Resolution	50 Hz
Duration	00 h 11 m 35 s	Processor Version	0309

A05_20080501

AS3TA05_ASIAL1B030920080501T144519_20080501T145629_0001.DBL

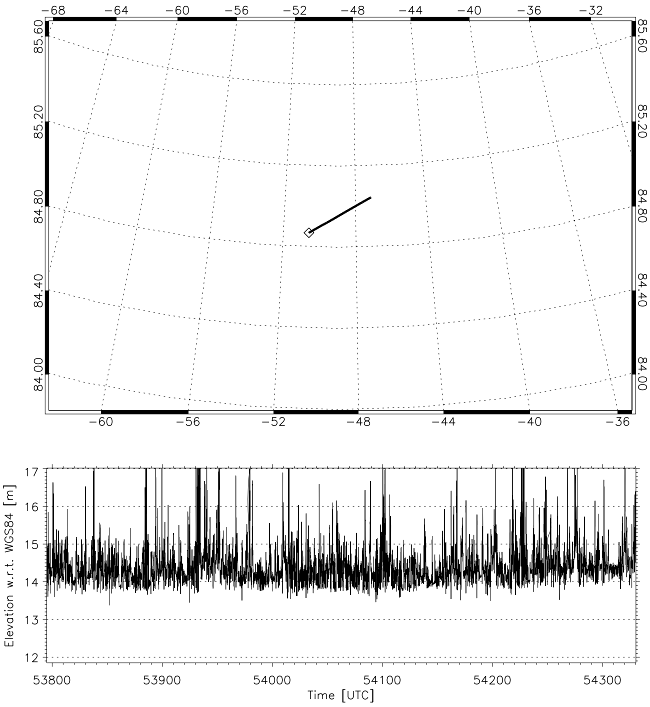




Date	2008-05-01	Instrument Mode	Adv. Low Altitude
Start Time	14:45:19 (53119)	Aircraft	DNSC Twin Otter
Stop Time	14:56:28 (53788)	Retracker	OCOG
Distance	49.085 km	INS Resolution	50 Hz
Duration	00 h 11 m 10 s	Processor Version	0309

A06_20080501

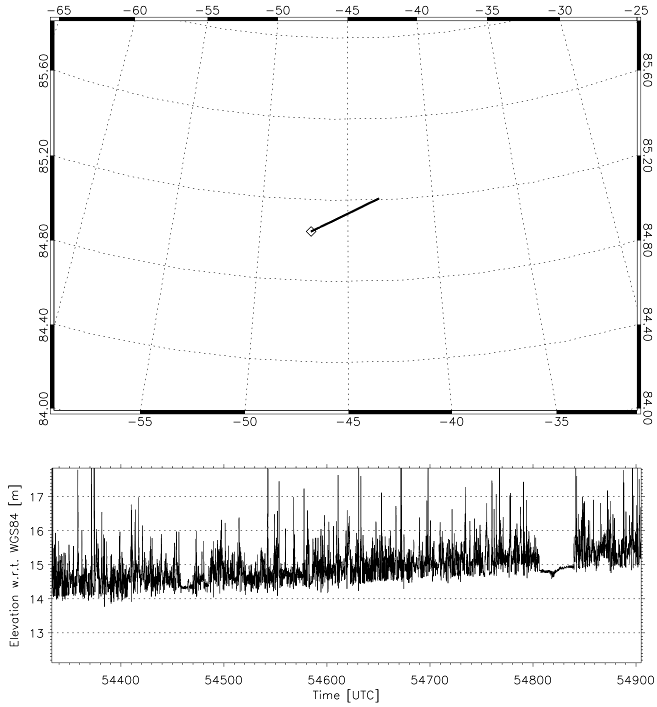
AS3TA06_ASIAL1B030920080501T145635_20080501T150530_0001.DBL



Date	2008-05-01	**Instrument Mode**	Adv. Low Altitude
Start Time	14:56:35 (53795)	**Aircraft**	DNSC Twin Otter
Stop Time	15:05:30 (54330)	**Retracker**	OCOG
Distance	38.984 km	**INS Resolution**	50 Hz
Duration	00 h 08 m 55 s	**Processor Version**	0309

A07_20080501

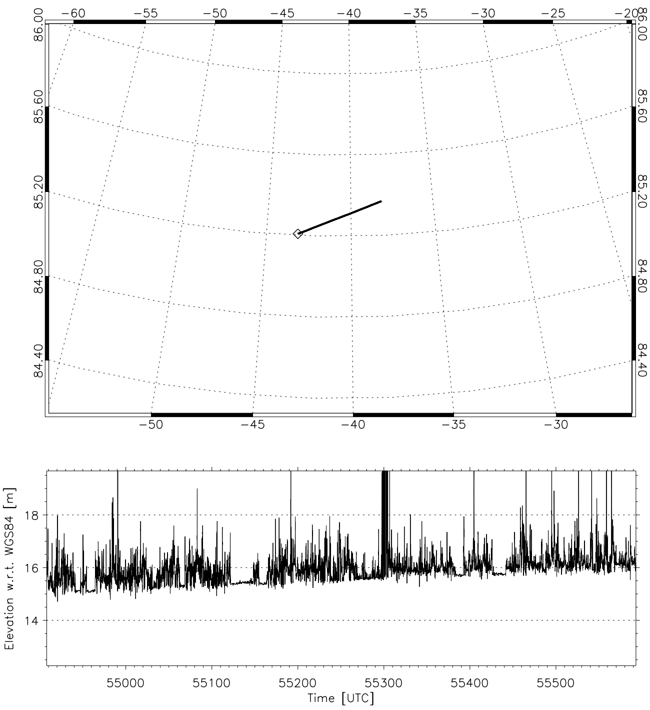
AS3TA07_ASIAL1B030920080501T150533_20080501T151505_0001.DBL



Date	2008-05-01	**Instrument Mode**	Adv. Low Altitude
Start Time	15:05:33 (54333)	**Aircraft**	DNSC Twin Otter
Stop Time	15:15:04 (54904)	**Retracker**	OCOG
Distance	41.239 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 32 s	**Processor Version**	0309

A08_20080501

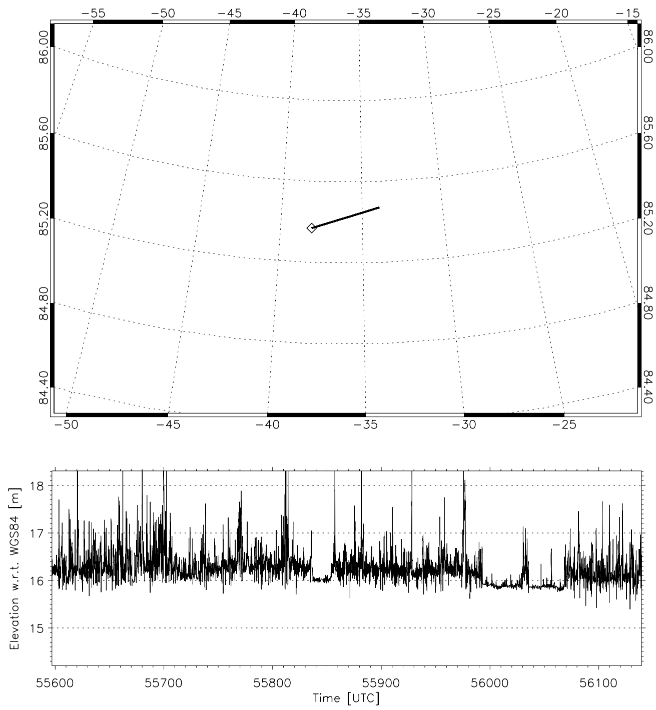
AS3TA08_ASIAL1B030920080501T151508_20080501T152633_0001.DBL



Date	2008-05-01	**Instrument Mode**	Adv. Low Altitude
Start Time	15:15:08 (54908)	**Aircraft**	DNSC Twin Otter
Stop Time	15:26:32 (55592)	**Retracker**	OCOG
Distance	49.097 km	**INS Resolution**	50 Hz
Duration	00 h 11 m 25 s	**Processor Version**	0309

A09_20080501

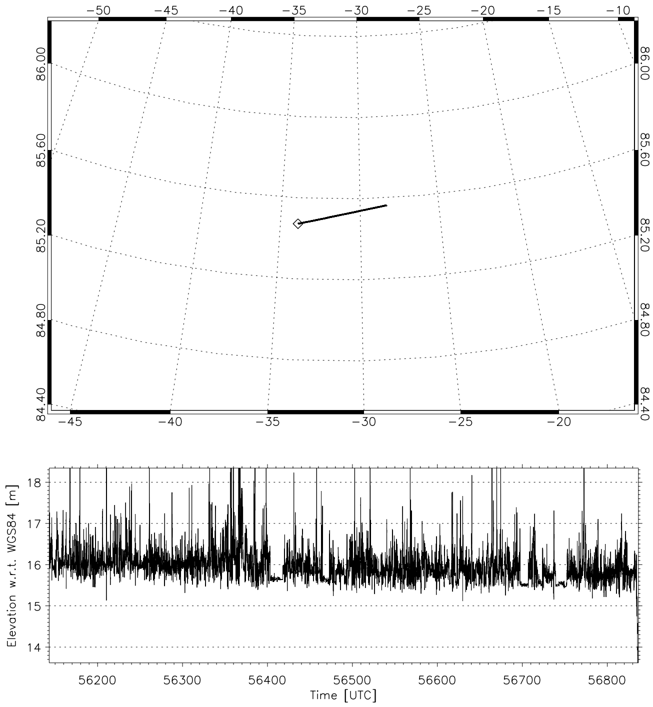
AS3TA09_ASIAL1B030920080501T152637_20080501T153539_0001.DBL



Date	2008-05-01	**Instrument Mode**	Adv. Low Altitude
Start Time	15:26:37 (55597)	**Aircraft**	DNSC Twin Otter
Stop Time	15:35:39 (56139)	**Retracker**	OCOG
Distance	38.668 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 02 s	**Processor Version**	0309

A10_20080501

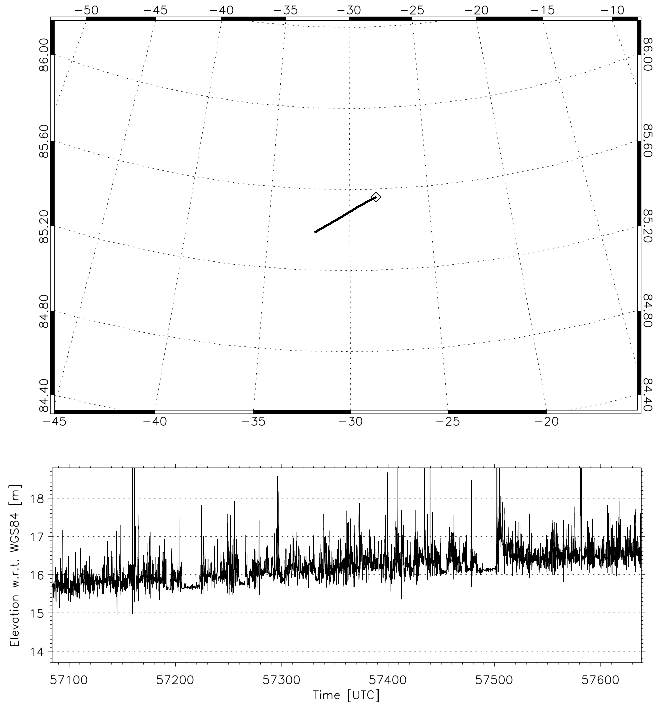
AS3TA10_ASIAL1B030920080501T153543_20080501T154717_0001.DBL



Date	2008-05-01	**Instrument Mode**	Adv. Low Altitude
Start Time	15:35:43 (56143)	**Aircraft**	DNSC Twin Otter
Stop Time	15:47:16 (56836)	**Retracker**	OCOG
Distance	49.724 km	**INS Resolution**	50 Hz
Duration	00 h 11 m 34 s	**Processor Version**	0309

A11_20080501

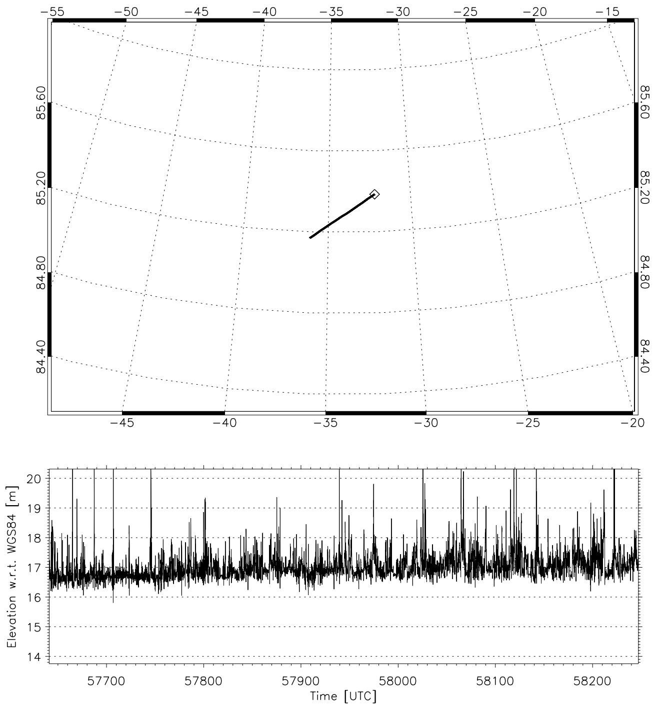
AS3TA11_ASIAL1B030920080501T155124_20080501T160038_0001.DBL



Date	2008-05-01	**Instrument Mode**	Adv. Low Altitude
Start Time	15:51:24 (57084)	**Aircraft**	DNSC Twin Otter
Stop Time	16:00:38 (57638)	**Retracker**	OCOG
Distance	38.968 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 14 s	**Processor Version**	0309

A12_20080501

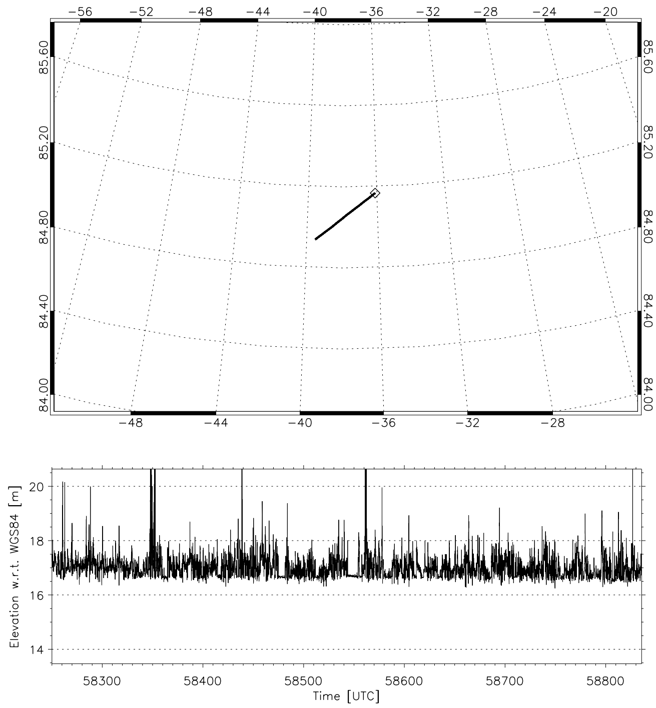
AS3TA12_ASIAL1B030920080501T160041_20080501T161047_0001.DBL



Date	2008-05-01	**Instrument Mode**	Adv. Low Altitude
Start Time	16:00:41 (57641)	**Aircraft**	DNSC Twin Otter
Stop Time	16:10:47 (58247)	**Retracker**	OCOG
Distance	42.944 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 06 s	**Processor Version**	0309

A13_20080501

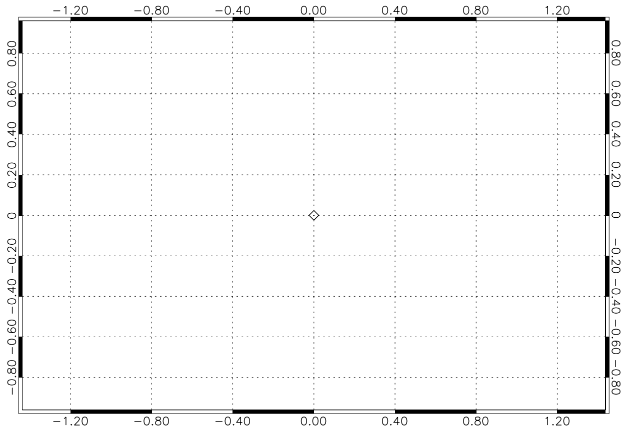
AS3TA13_ASIAL1B030920080501T161050_20080501T162036_0001.DBL



Date	2008-05-01	**Instrument Mode**	Adv. Low Altitude
Start Time	16:10:50 (58250)	**Aircraft**	DNSC Twin Otter
Stop Time	16:20:35 (58835)	**Retracker**	OCOG
Distance	41.480 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 46 s	**Processor Version**	0309

A14_20080501

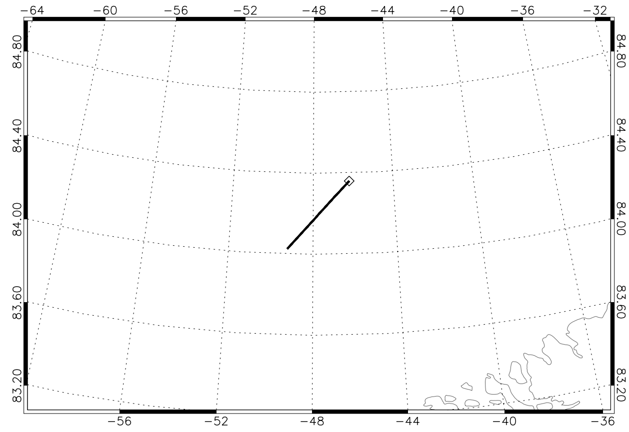
AS3TA14_ASIAL1B030920080501T162039_20080501T162039_0001.DBL

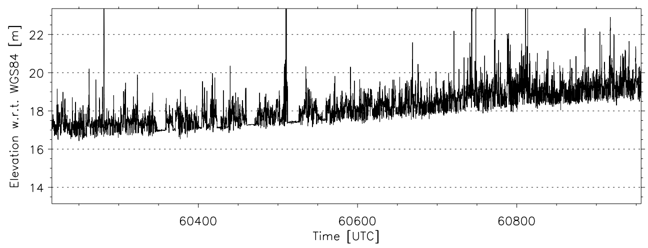


Date	2008-05-01	Instrument Mode	Adv. Low Altitude
Start Time	**:59:27 (*****)	Aircraft	DNSC Twin Otter
Stop Time	**:59:27 (*****)	Retracker	OCOG
Distance	-NaN km	INS Resolution	50 Hz
Duration	00 h 00 m 00 s	Processor Version	0309

A15_20080501

AS3TA15_ASIAL1B030920080501T164336_20080501T165556_0001.DBL

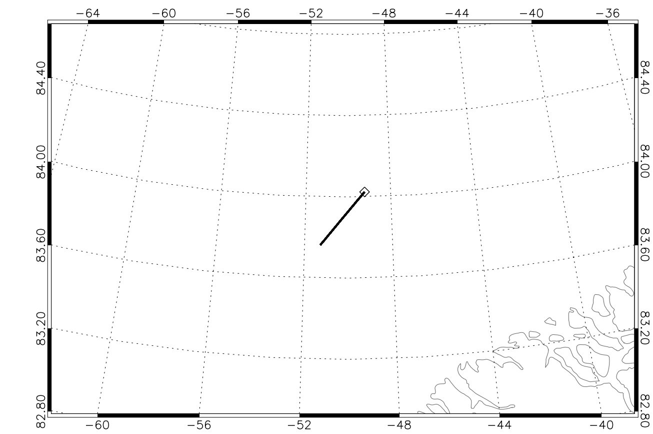


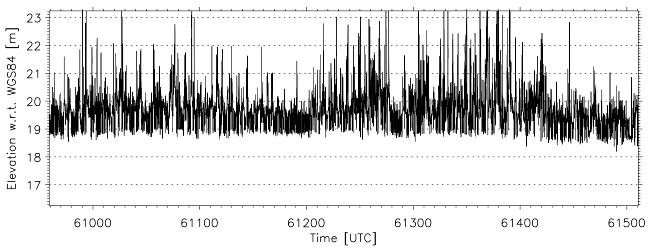


Date	2008-05-01	Instrument Mode	Adv. Low Altitude
Start Time	16:43:36 (60216)	Aircraft	DNSC Twin Otter
Stop Time	16:55:56 (60956)	Retracker	OCOG
Distance	50.369 km	INS Resolution	50 Hz
Duration	00 h 12 m 20 s	Processor Version	0309

A16_20080501

AS3TA16_ASIAL1B030920080501T165559_20080501T170511_0001.DBL

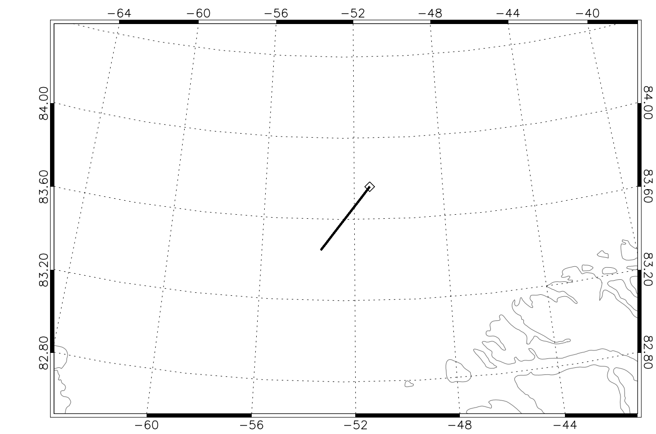


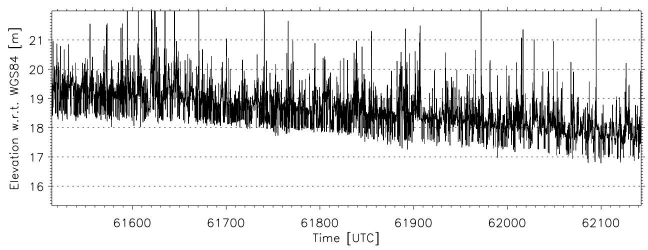


Date	2008-05-01	Instrument Mode	Adv. Low Altitude
Start Time	16:55:59 (60959)	Aircraft	DNSC Twin Otter
Stop Time	17:05:10 (61510)	Retracker	OCOG
Distance	37.887 km	INS Resolution	50 Hz
Duration	00 h 09 m 12 s	Processor Version	0309

A17_20080501

AS3TA17_ASIAL1B030920080501T170514_20080501T171543_0001.DBL

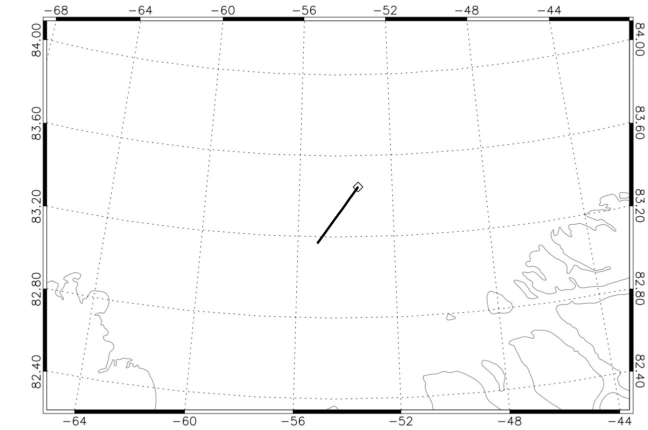


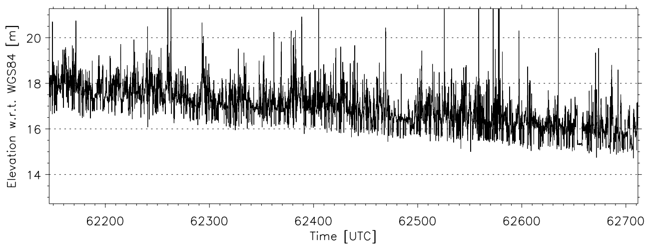


Date	2008-05-01	Instrument Mode	Adv. Low Altitude
Start Time	17:05:14 (61514)	Aircraft	DNSC Twin Otter
Stop Time	17:15:42 (62142)	Retracker	OCOG
Distance	43.885 km	INS Resolution	50 Hz
Duration	00 h 10 m 29 s	Processor Version	0309

A18_20080501

AS3TA18_ASIAL1B030920080501T171546_20080501T172512_0001.DBL

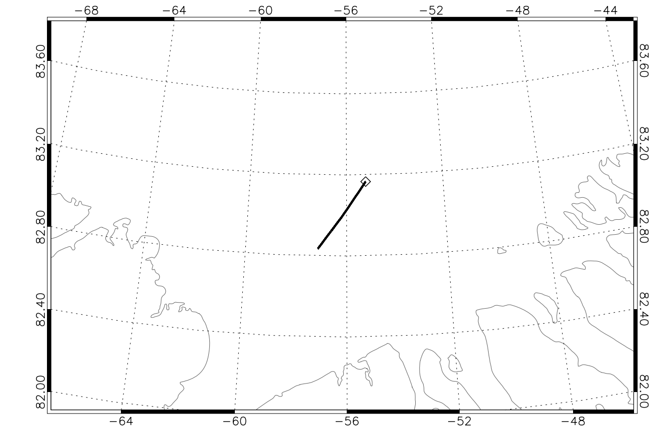


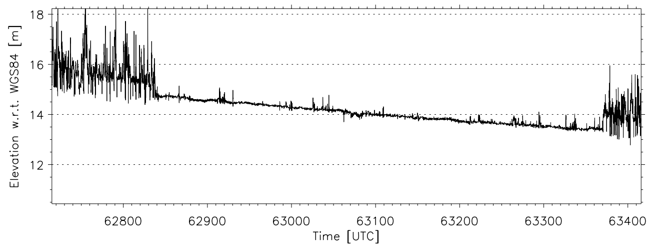


Date	2008-05-01	**Instrument Mode**	Adv. Low Altitude
Start Time	17:15:46 (62146)	**Aircraft**	DNSC Twin Otter
Stop Time	17:25:11 (62711)	**Retracker**	OCOG
Distance	38.236 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 26 s	**Processor Version**	0309

A19_20080501

AS3TA19_ASIAL1B030920080501T172515_20080501T173656_0001.DBL

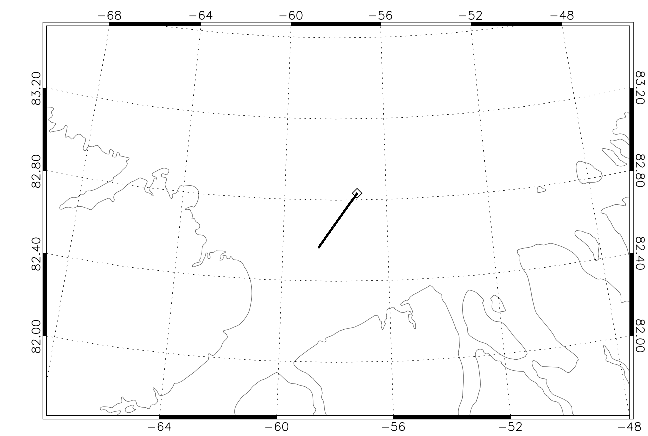


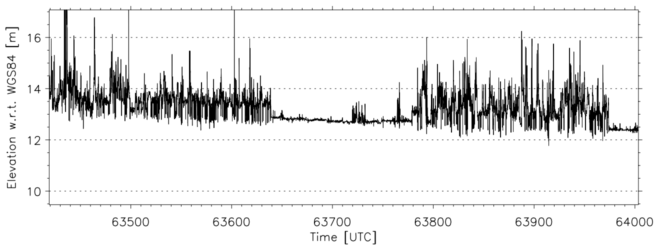


Date	2008-05-01	**Instrument Mode**	Adv. Low Altitude
Start Time	17:25:15 (62715)	**Aircraft**	DNSC Twin Otter
Stop Time	17:36:55 (63415)	**Retracker**	OCOG
Distance	45.260 km	**INS Resolution**	50 Hz
Duration	00 h 11 m 41 s	**Processor Version**	0309

A20_20080501

AS3TA20_ASIAL1B030920080501T173659_20080501T174644_0001.DBL

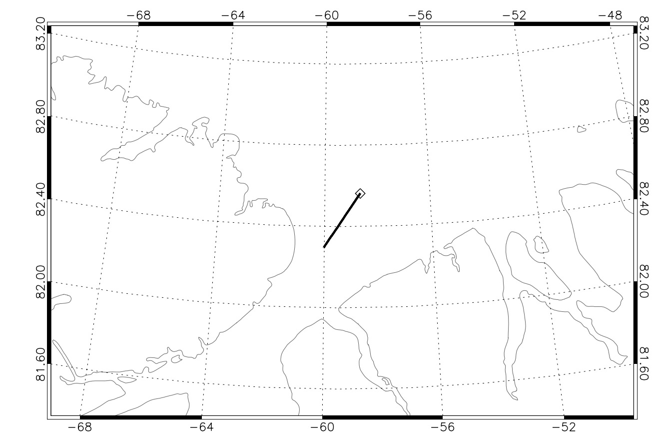


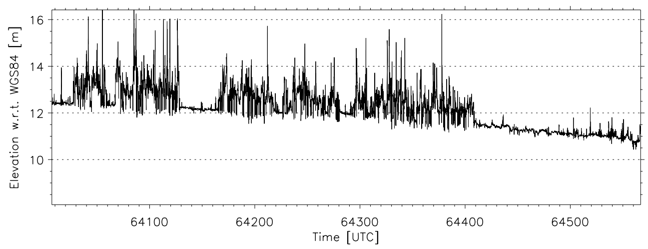


Date	2008-05-01	**Instrument Mode**	Adv. Low Altitude
Start Time	17:36:59 (63419)	**Aircraft**	DNSC Twin Otter
Stop Time	17:46:43 (64003)	**Retracker**	OCOG
Distance	36.635 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 44 s	**Processor Version**	0309

A21_20080501

AS3TA21_ASIAL1B030920080501T174647_20080501T175607_0001.DBL

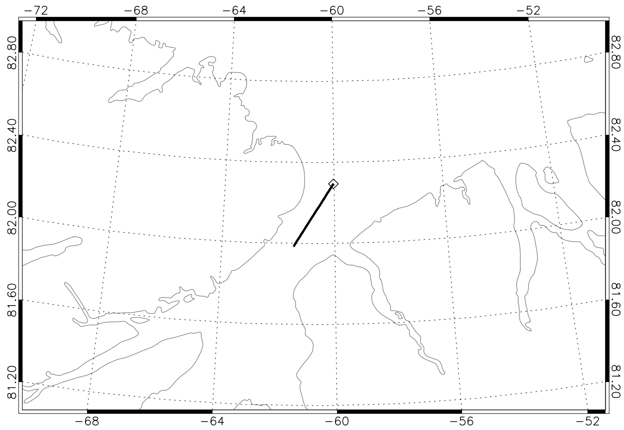


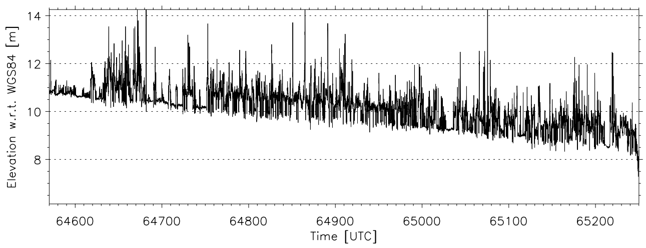


Date	2008-05-01	**Instrument Mode**	Adv. Low Altitude
Start Time	17:46:47 (64007)	**Aircraft**	DNSC Twin Otter
Stop Time	17:56:06 (64566)	**Retracker**	OCOG
Distance	35.767 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 20 s	**Processor Version**	0309

A22_20080501

AS3TA22_ASIAL1B0309200805O1T175610_20080501T180730_0001.DBL

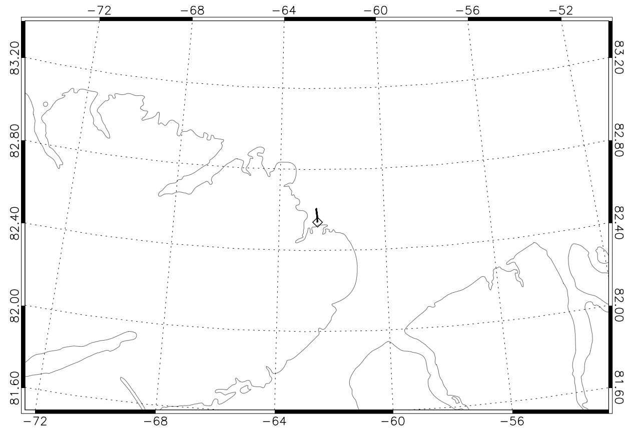


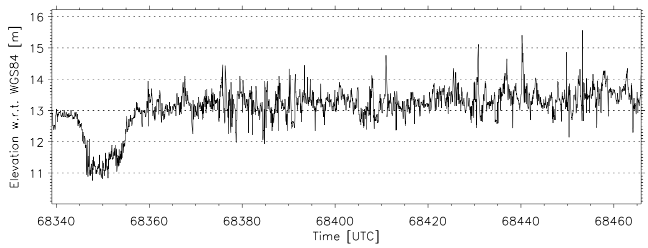


Date	2008-05-01	Instrument Mode	Adv. Low Altitude
Start Time	17:56:10 (64570)	Aircraft	DNSC Twin Otter
Stop Time	18:07:30 (65250)	Retracker	OCOG
Distance	40.664 km	INS Resolution	50 Hz
Duration	00 h 11 m 20 s	Processor Version	0309

A23_20080501

AS3TA23_ASIAL1B0309200805O1T185859_20080501T190106_0001.DBL

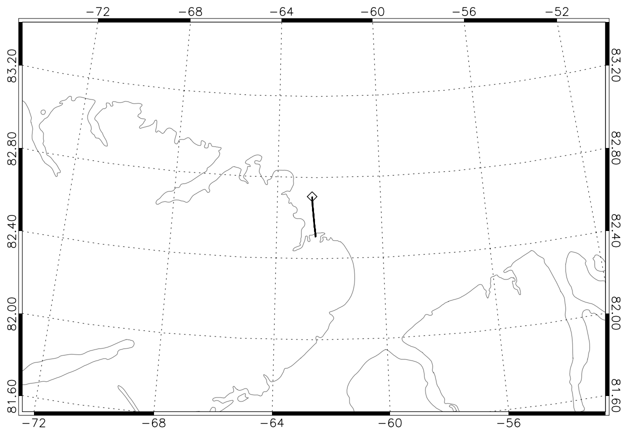


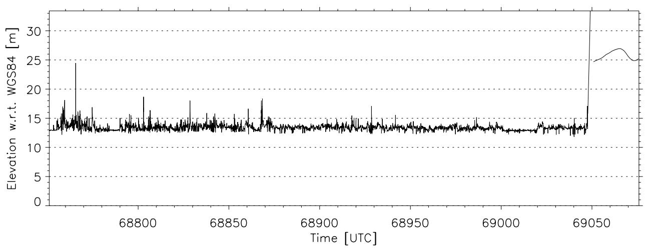


Date	2008-05-01	Instrument Mode	Adv. Low Altitude
Start Time	18:58:59 (68339)	Aircraft	DNSC Twin Otter
Stop Time	19:01:05 (68465)	Retracker	OCOG
Distance	7.658 km	INS Resolution	50 Hz
Duration	00 h 02 m 07 s	Processor Version	0309

A24_20080501

AS3TA24_ASIAL1B0309200805O1T190551_20080501T191116_0001.DBL

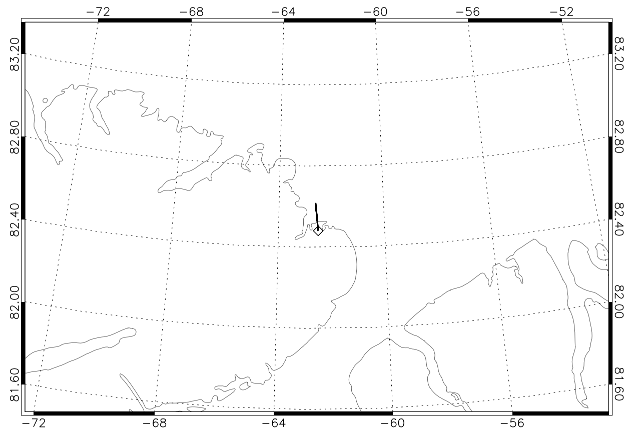


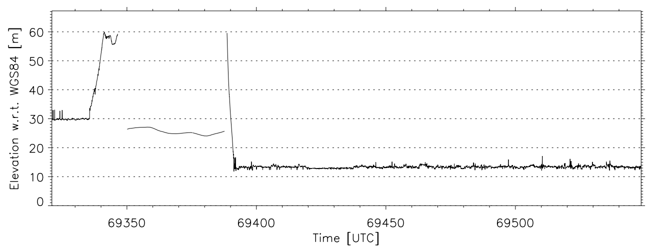


Date	2008-05-01	Instrument Mode	Adv. Low Altitude
Start Time	19:05:51 (68751)	Aircraft	DNSC Twin Otter
Stop Time	19:11:15 (69075)	Retracker	OCOG
Distance	22.357 km	INS Resolution	50 Hz
Duration	00 h 05 m 25 s	Processor Version	0309

A25_20080501

AS3TA25_ASIAL1B0309200805O1T191521_20080501T191909_0001.DBL

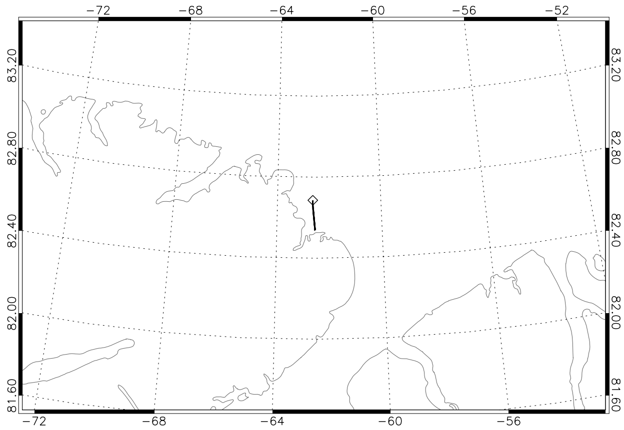


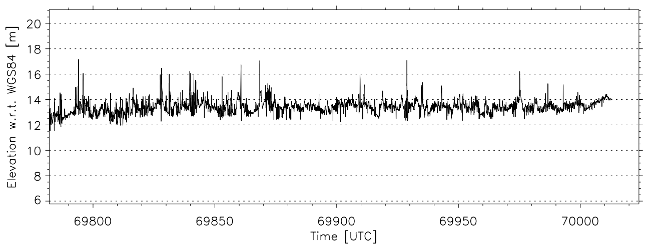


Date	2008-05-01	Instrument Mode	Adv. Low Altitude
Start Time	19:15:21 (69321)	Aircraft	DNSC Twin Otter
Stop Time	19:19:08 (69548)	Retracker	OCOG
Distance	15.326 km	INS Resolution	50 Hz
Duration	00 h 03 m 48 s	Processor Version	0309

A26_20080501

AS3TA26_ASIAL1B030920080501T192302_20080501T192704_0001.DBL

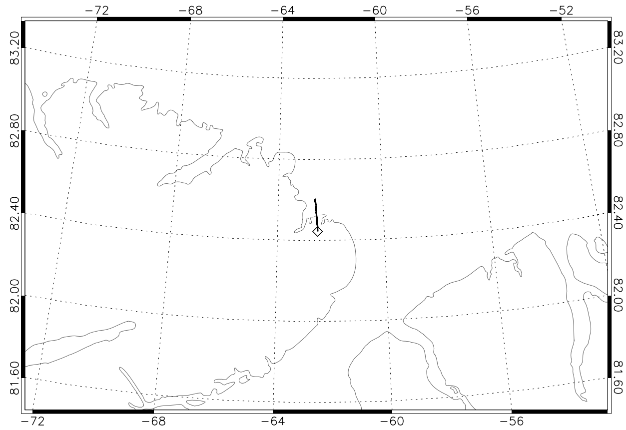




Date	2008-05-01	Instrument Mode	Adv. Low Altitude
Start Time	19:23:02 (69782)	Aircraft	DNSC Twin Otter
Stop Time	19:27:04 (70024)	Retracker	OCOG
Distance	16.579 km	INS Resolution	50 Hz
Duration	00 h 04 m 02 s	Processor Version	0309

A27_20080501

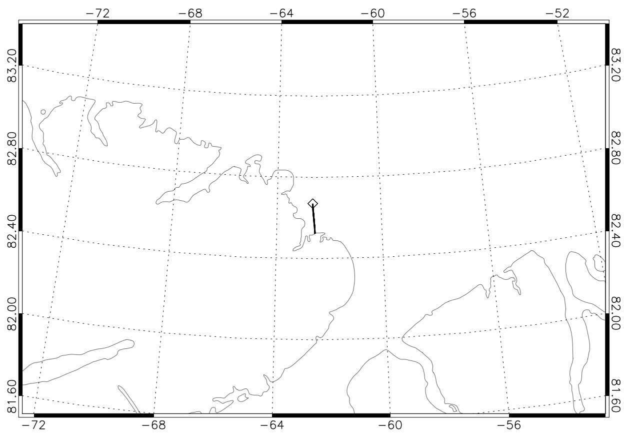
AS3TA27_ASIAL1B030920080501T193120_20080501T193530_0001.DBL

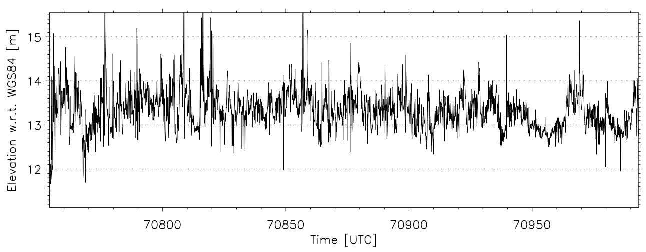


Date	2008-05-01	Instrument Mode	Adv. Low Altitude
Start Time	19:31:20 (70280)	Aircraft	DNSC Twin Otter
Stop Time	19:35:29 (70529)	Retracker	OCOG
Distance	17.825 km	INS Resolution	50 Hz
Duration	00 h 04 m 10 s	Processor Version	0309

A28_20080501

AS3TA28_ASIAL1B030920080501T193914_20080501T194312_0001.DBL

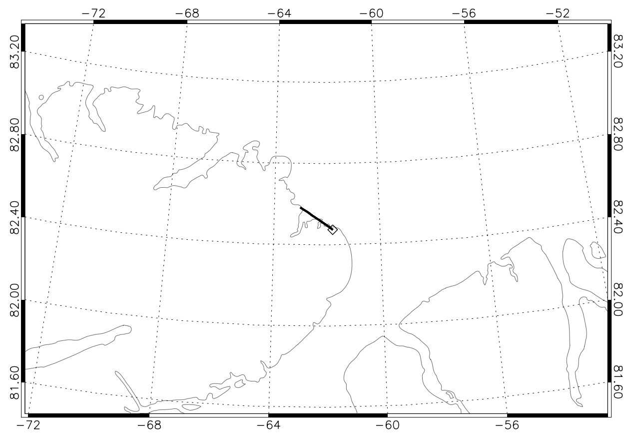


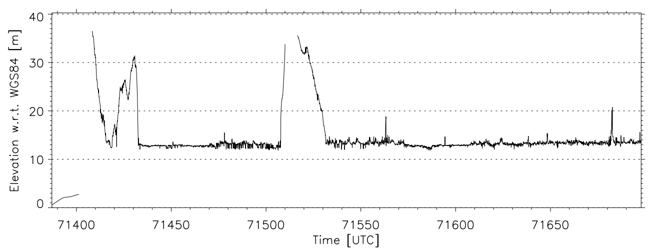


Date	2008-05-01	Instrument Mode	Adv. Low Altitude
Start Time	19:39:14 (70754)	Aircraft	DNSC Twin Otter
Stop Time	19:43:13 (70993)	Retracker	OCOG
Distance	16.555 km	INS Resolution	50 Hz
Duration	00 h 03 m 59 s	Processor Version	0309

A29_20080501

AS3TA29_ASIAL1B030920080501T194947_20080501T195458_0001.DBL

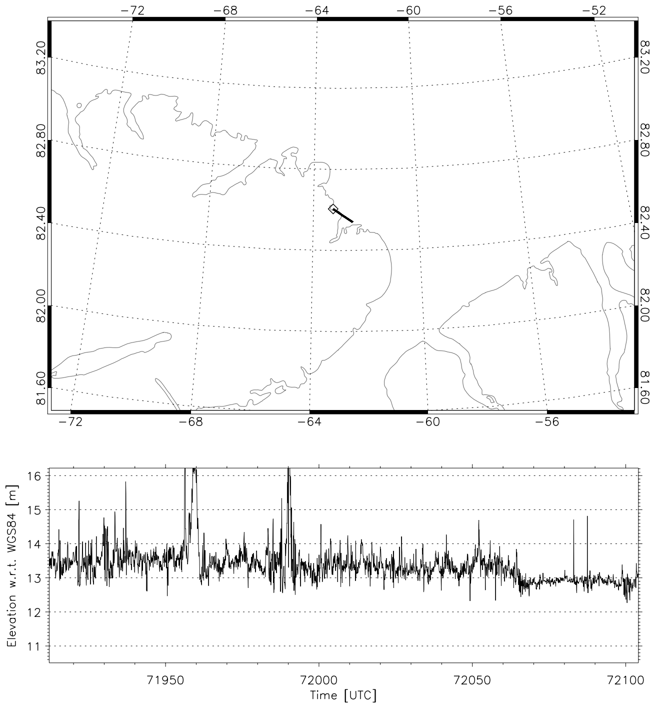




Date	2008-05-01	Instrument Mode	Adv. Low Altitude
Start Time	19:49:47 (71387)	Aircraft	DNSC Twin Otter
Stop Time	19:54:57 (71697)	Retracker	OCOG
Distance	21.586 km	INS Resolution	50 Hz
Duration	00 h 05 m 11 s	Processor Version	0309

A30_20080501

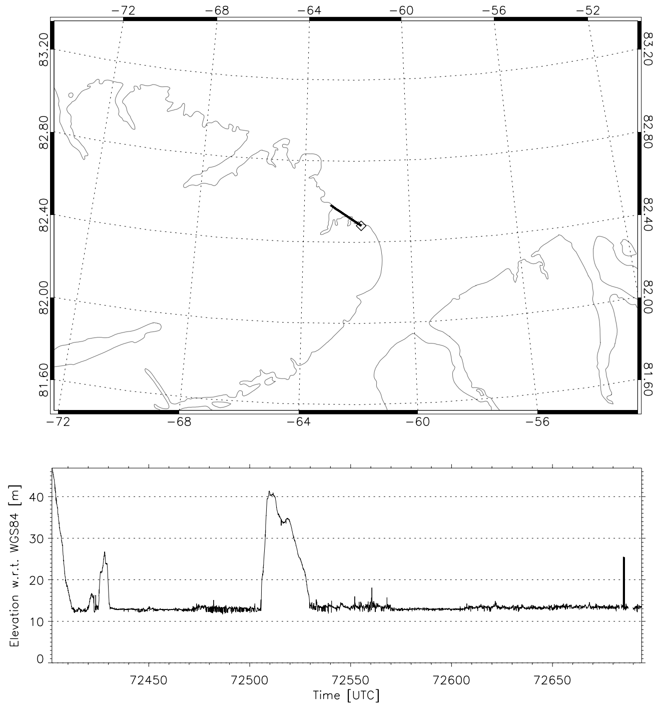
AS3TA30_ASIAL1B030920080501T195832_20080501T200145_0001.DBL



Date	2008-05-01	**Instrument Mode**	Adv. Low Altitude
Start Time	19:58:32 (71912)	**Aircraft**	DNSC Twin Otter
Stop Time	20:01:44 (72104)	**Retracker**	OCOG
Distance	12.917 km	**INS Resolution**	50 Hz
Duration	00 h 03 m 12 s	**Processor Version**	0309

A31_20080501

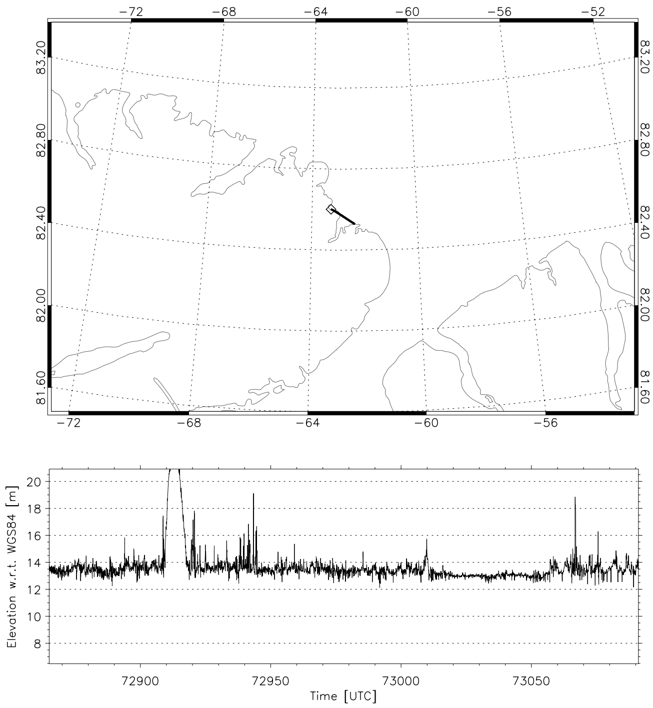
AS3TA31_ASIAL1B030920080501T200642_20080501T201134_0001.DBL



Date	2008-05-01	**Instrument Mode**	Adv. Low Altitude
Start Time	20:06:42 (72402)	**Aircraft**	DNSC Twin Otter
Stop Time	20:11:34 (72694)	**Retracker**	OCOG
Distance	20.151 km	**INS Resolution**	50 Hz
Duration	00 h 04 m 52 s	**Processor Version**	0309

A32_20080501

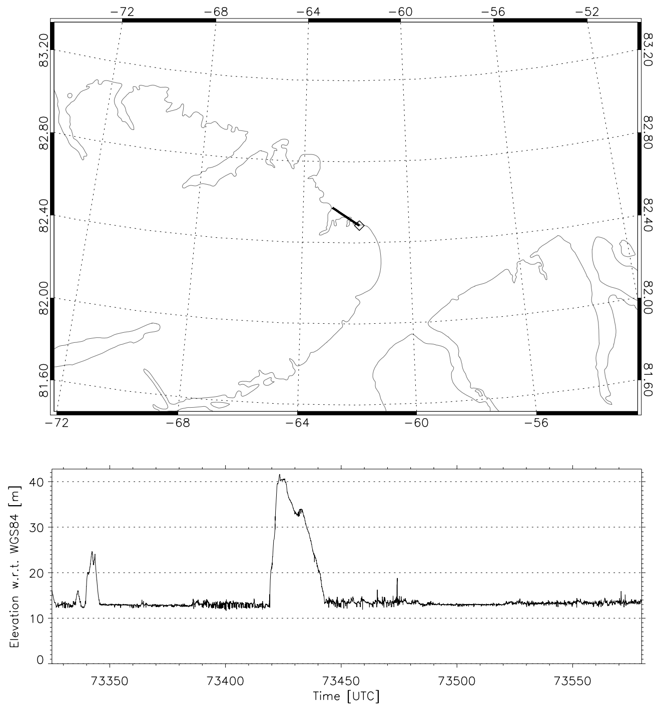
AS3TA32_ASIAL1B030920080501T201425_20080501T201811_0001.DBL



Date	2008-05-01	**Instrument Mode**	Adv. Low Altitude
Start Time	20:14:25 (72865)	**Aircraft**	DNSC Twin Otter
Stop Time	20:18:11 (73091)	**Retracker**	OCOG
Distance	15.403 km	**INS Resolution**	50 Hz
Duration	00 h 03 m 46 s	**Processor Version**	0309

A33_20080501

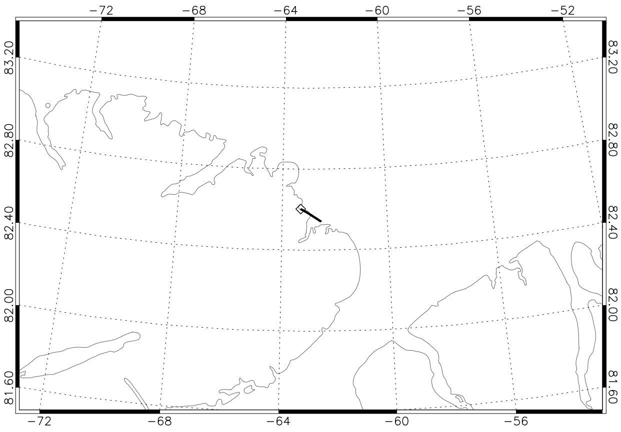
AS3TA33_ASIAL1B030920080501T202205_20080501T202620_0001.DBL

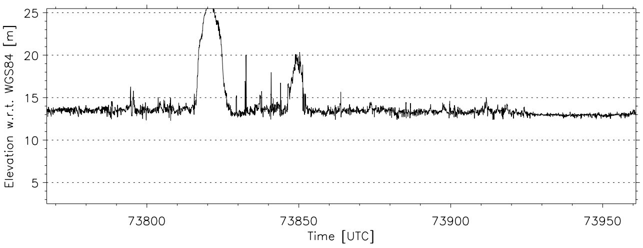


Date	2008-05-01	**Instrument Mode**	Adv. Low Altitude
Start Time	20:22:05 (73325)	**Aircraft**	DNSC Twin Otter
Stop Time	20:26:19 (73579)	**Retracker**	OCOG
Distance	17.664 km	**INS Resolution**	50 Hz
Duration	00 h 04 m 15 s	**Processor Version**	0309

A34_20080501

AS3TA34_ASIAL1B030920080501T202927_20080501T203241_0001.DBL

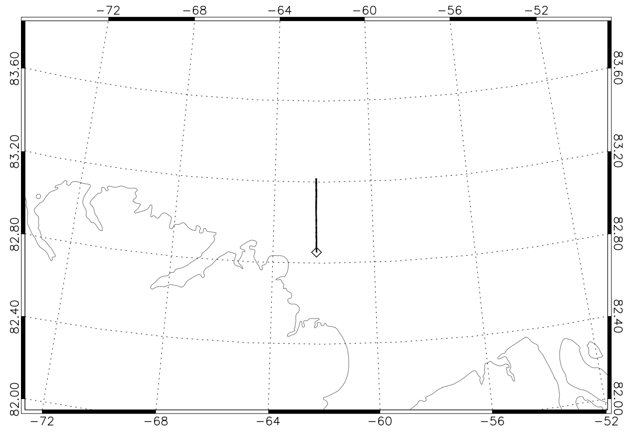


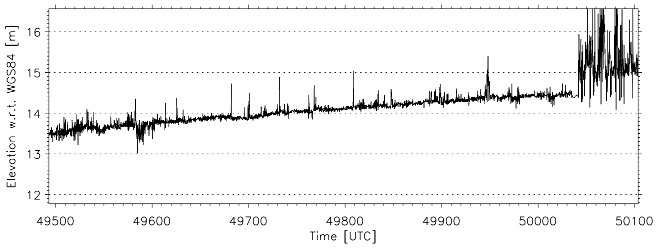


Date	2008-05-01	Instrument Mode	Adv. Low Altitude
Start Time	20:29:27 (73767)	Aircraft	DNSC Twin Otter
Stop Time	20:32:40 (73960)	Retracker	OCOG
Distance	13.124 km	INS Resolution	50 Hz
Duration	00 h 03 m 14 s	Processor Version	0309

A00_20080502

AS3TA00_ASIAL1B030920080502T134453_20080502T135504_0001.DBL

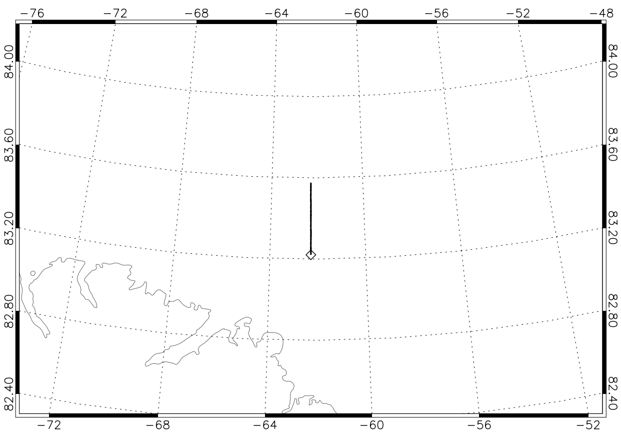


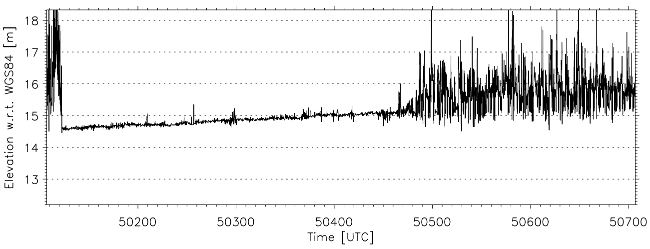


Date	2008-05-02	Instrument Mode	Adv. Low Altitude
Start Time	13:44:53 (49493)	Aircraft	DNSC Twin Otter
Stop Time	13:55:03 (50103)	Retracker	OCOG
Distance	40.619 km	INS Resolution	50 Hz
Duration	00 h 10 m 11 s	Processor Version	0309

A01_20080502

AS3TA01_ASIAL1B030920080502T135507_20080502T140507_0001.DBL

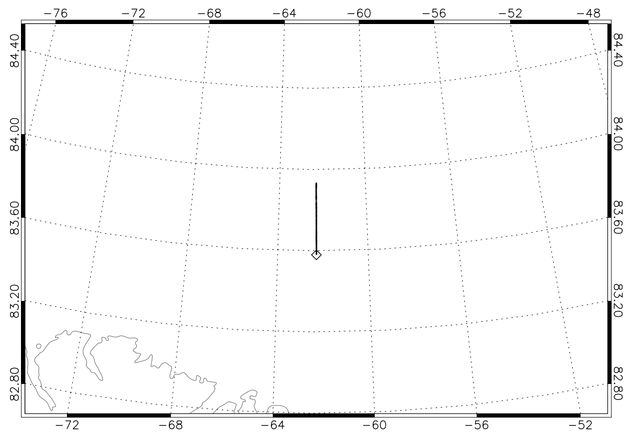


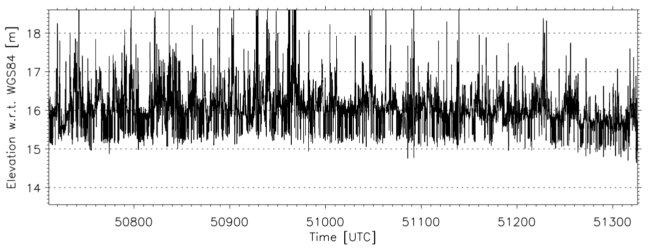


Date	2008-05-02	Instrument Mode	Adv. Low Altitude
Start Time	13:55:07 (50107)	Aircraft	DNSC Twin Otter
Stop Time	14:05:06 (50706)	Retracker	OCOG
Distance	39.680 km	INS Resolution	50 Hz
Duration	00 h 09 m 60 s	Processor Version	0309

A02_20080502

AS3TA02_ASIAL1B030920080502T140511_20080502T141526_0001.DBL

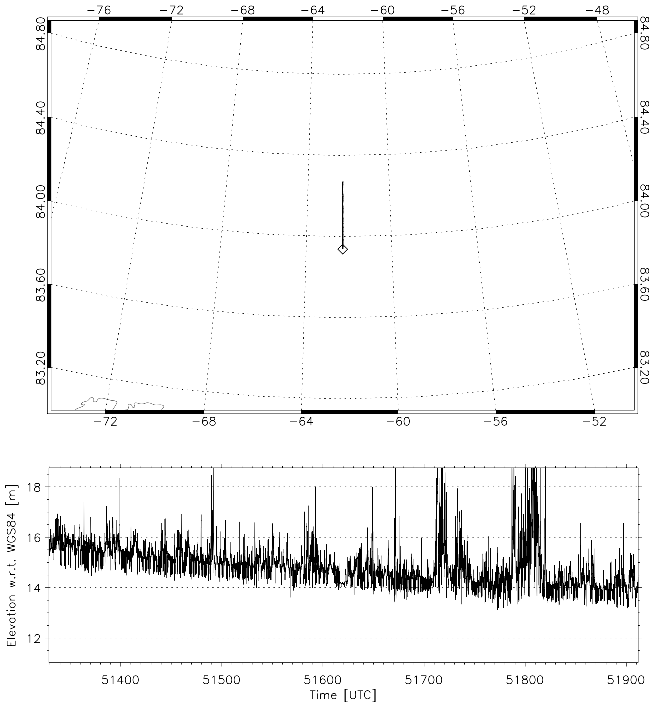




Date	2008-05-02	Instrument Mode	Adv. Low Altitude
Start Time	14:05:11 (50711)	Aircraft	DNSC Twin Otter
Stop Time	14:15:25 (51325)	Retracker	OCOG
Distance	39.658 km	INS Resolution	50 Hz
Duration	00 h 10 m 15 s	Processor Version	0309

A03_20080502

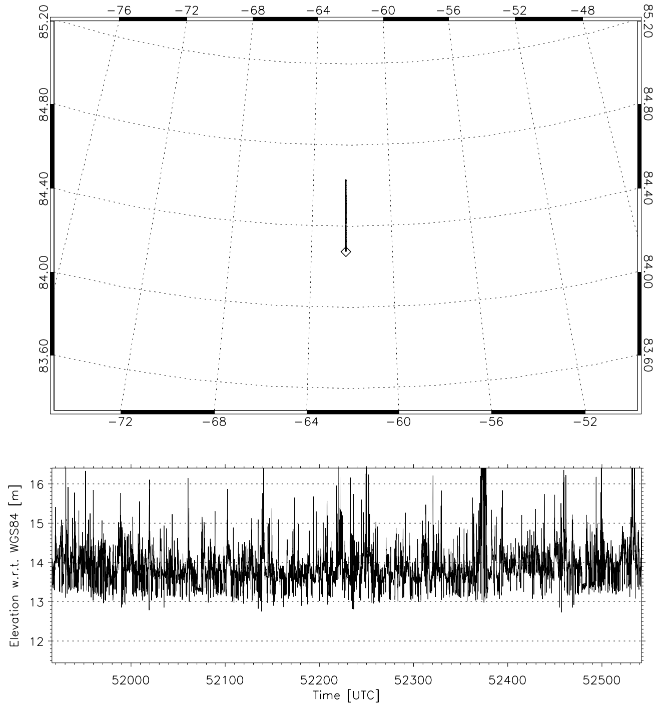
AS3TA03_ASIAL1B030920080502T141529_20080502T142512_0001.DBL



Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	14:15:29 (51329)	**Aircraft**	DNSC Twin Otter
Stop Time	14:25:11 (51911)	**Retracker**	OCOG
Distance	37.153 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 43 s	**Processor Version**	0309

A04_20080502

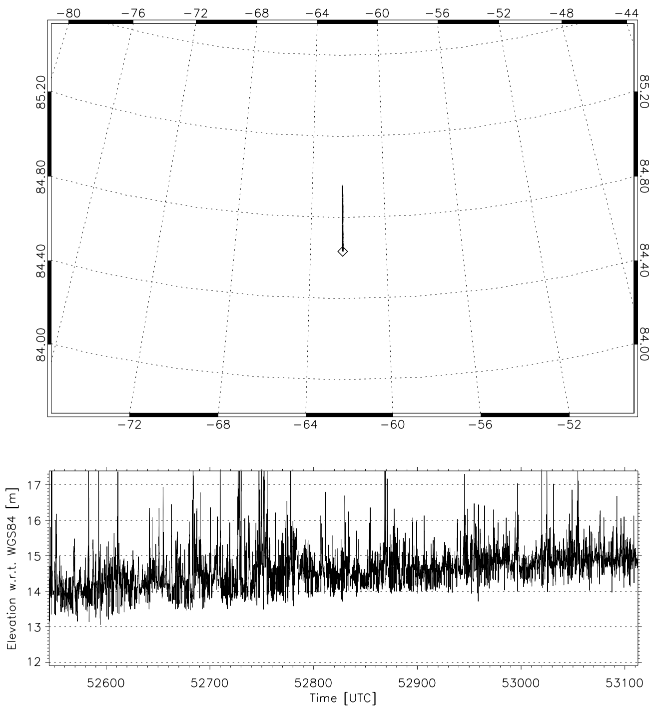
AS3TA04_ASIAL1B030920080502T142516_20080502T143542_0001.DBL



Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	14:25:16 (51916)	**Aircraft**	DNSC Twin Otter
Stop Time	14:35:42 (52542)	**Retracker**	OCOG
Distance	39.592 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 26 s	**Processor Version**	0309

A05_20080502

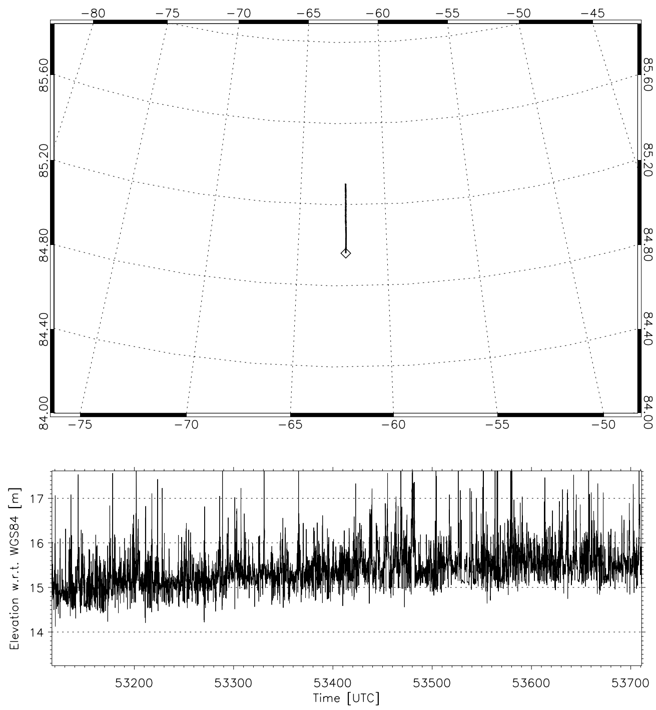
AS3TA05_ASIAL1B030920080502T143545_20080502T144513_0001.DBL



Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	14:35:45 (52545)	**Aircraft**	DNSC Twin Otter
Stop Time	14:45:12 (53112)	**Retracker**	OCOG
Distance	36.162 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 28 s	**Processor Version**	0309

A06_20080502

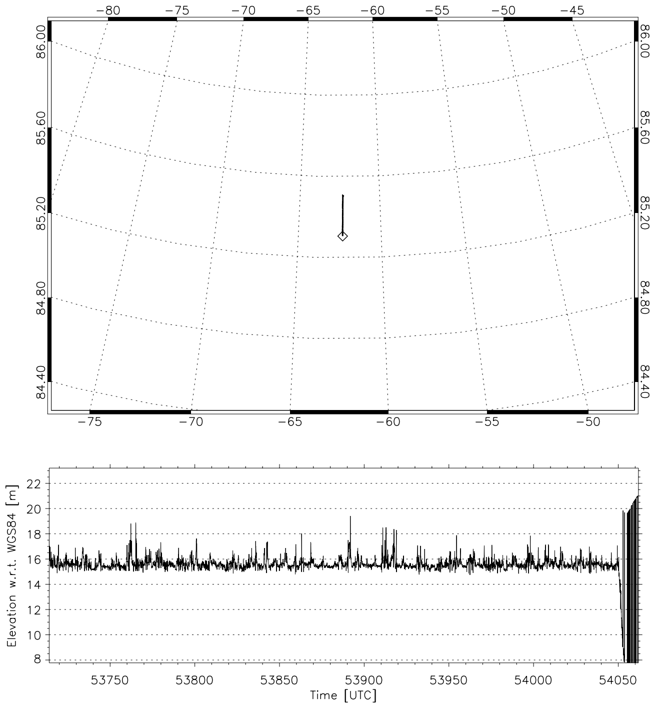
AS3TA06_ASIAL1B030920080502T144517_20080502T145511_0001.DBL



Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	14:45:17 (53117)	**Aircraft**	DNSC Twin Otter
Stop Time	14:55:10 (53710)	**Retracker**	OCOG
Distance	38.130 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 54 s	**Processor Version**	0309

A07_20080502

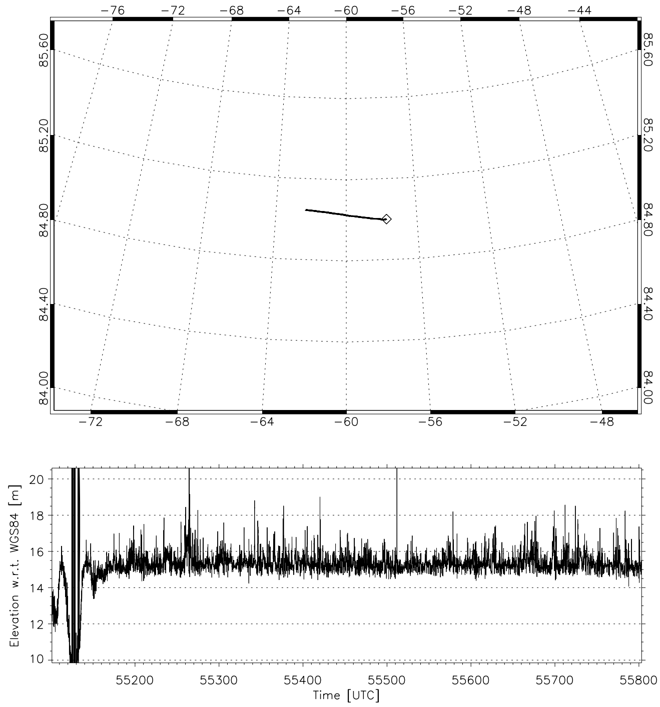
AS3TA07_ASIAL1B030920080502T145514_20080502T150102_0001.DBL



Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	14:55:14 (53714)	**Aircraft**	DNSC Twin Otter
Stop Time	15:01:01 (54061)	**Retracker**	OCOG
Distance	22.538 km	**INS Resolution**	50 Hz
Duration	00 h 05 m 48 s	**Processor Version**	0309

A08_20080502

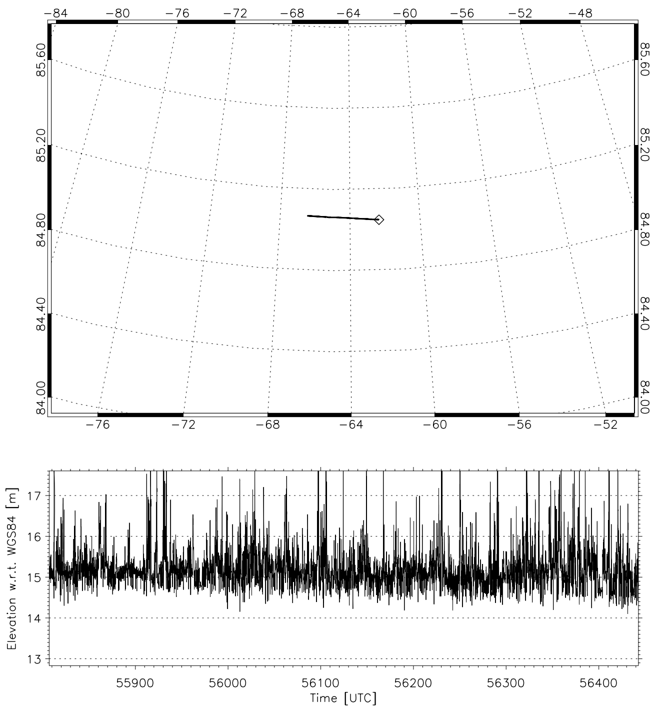
AS3TA08_ASIAL1B030920080502T151821_20080502T153003_0001.DBL



Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	15:18:21 (55101)	**Aircraft**	DNSC Twin Otter
Stop Time	15:30:03 (55803)	**Retracker**	OCOG
Distance	44.658 km	**INS Resolution**	50 Hz
Duration	00 h 11 m 42 s	**Processor Version**	0309

A09_20080502

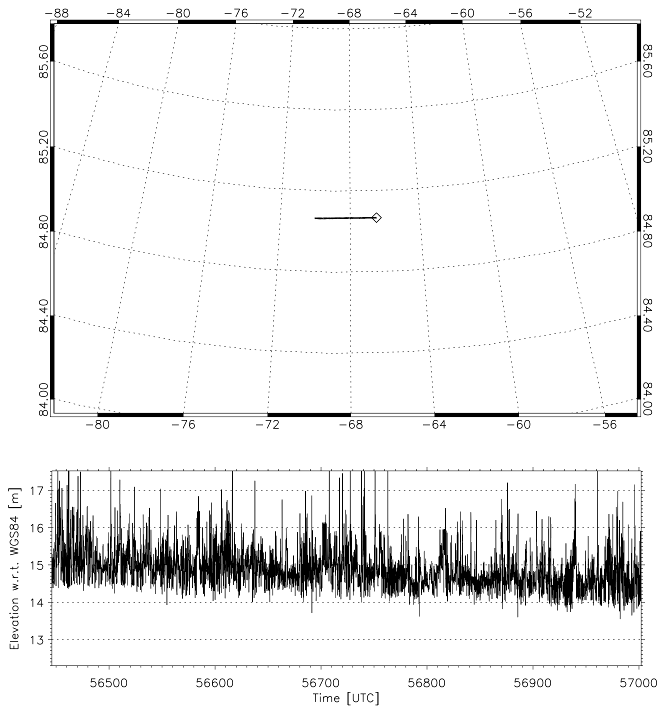
AS3TA09_ASIAL1B030920080502T153007_20080502T154043_0001.DBL



Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	15:30:07 (55807)	**Aircraft**	DNSC Twin Otter
Stop Time	15:40:42 (56442)	**Retracker**	OCOG
Distance	39.470 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 36 s	**Processor Version**	0309

A10_20080502

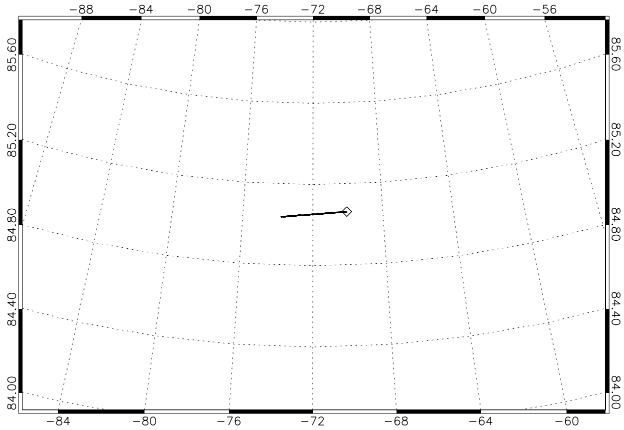
AS3TA10_ASIAL1B030920080502T154046_20080502T155002_0001.DBL

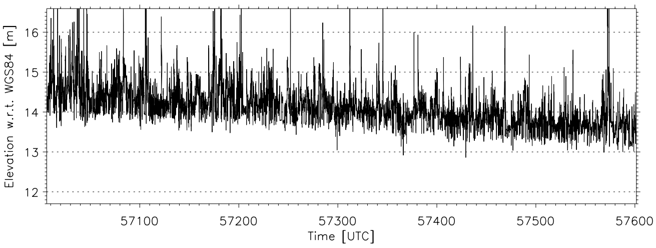


Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	15:40:46 (56446)	**Aircraft**	DNSC Twin Otter
Stop Time	15:50:02 (57002)	**Retracker**	OCOG
Distance	33.840 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 16 s	**Processor Version**	0309

A11_20080502

AS3TA11_ASIAL1B030920080502T155006_20080502T160002_0001.DBL

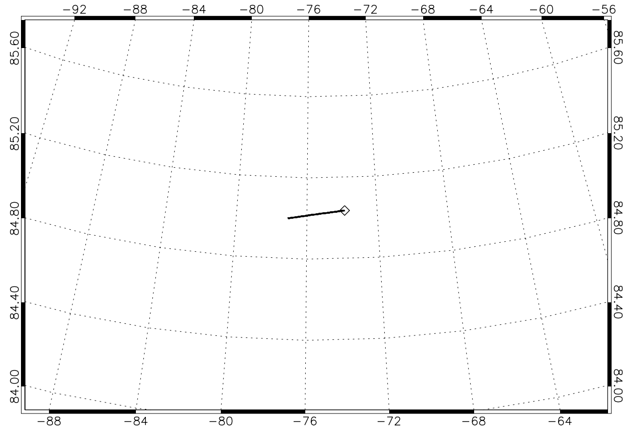


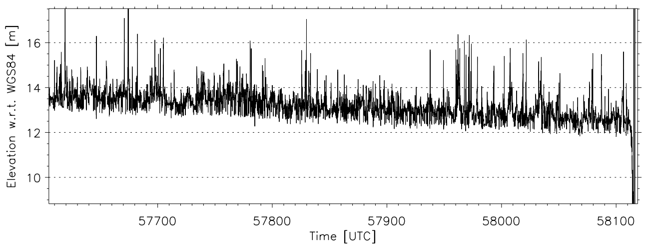


Date	2008-05-02	Instrument Mode	Adv. Low Altitude
Start Time	15:50:06 (57006)	Aircraft	DNSC Twin Otter
Stop Time	16:00:01 (57601)	Retracker	OCOG
Distance	36.220 km	INS Resolution	50 Hz
Duration	00 h 09 m 56 s	Processor Version	0309

A12_20080502

AS3TA12_ASIAL1B030920080502T160005_20080502T160839_0001.DBL

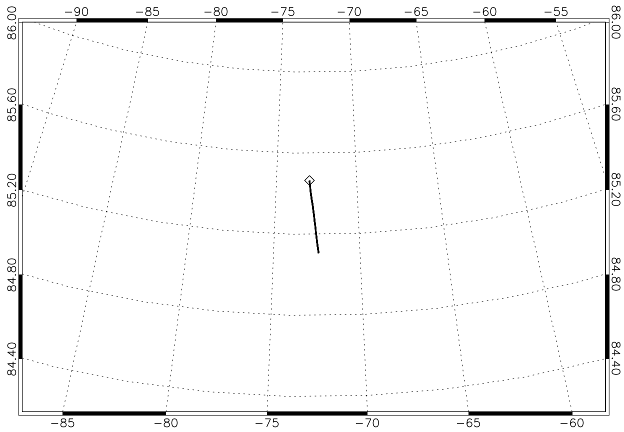


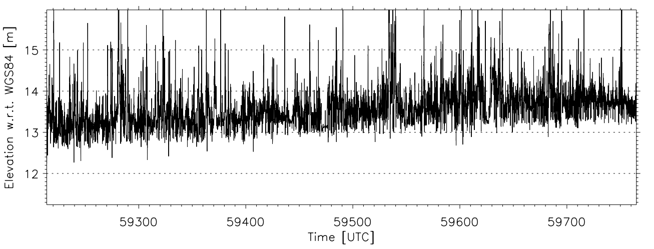


Date	2008-05-02	Instrument Mode	Adv. Low Altitude
Start Time	16:00:05 (57605)	Aircraft	DNSC Twin Otter
Stop Time	16:08:38 (58118)	Retracker	OCOG
Distance	31.424 km	INS Resolution	50 Hz
Duration	00 h 08 m 34 s	Processor Version	0309

A13_20080502

AS3TA13_ASIAL1B030920080502T162654_20080502T163605_0001.DBL

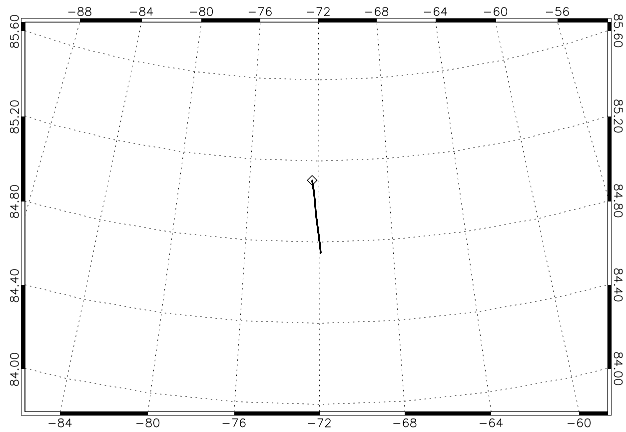


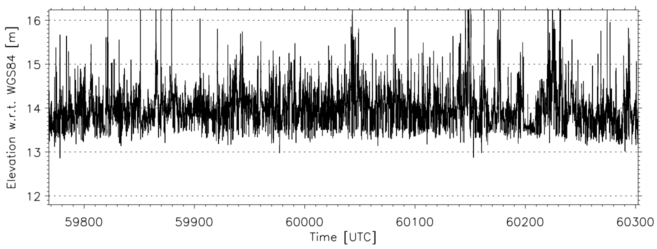


Date	2008-05-02	Instrument Mode	Adv. Low Altitude
Start Time	16:26:54 (59214)	Aircraft	DNSC Twin Otter
Stop Time	16:36:04 (59764)	Retracker	OCOG
Distance	40.229 km	INS Resolution	50 Hz
Duration	00 h 09 m 11 s	Processor Version	0309

A14_20080502

AS3TA14_ASIAL1B030920080502T163608_20080502T164502_0001.DBL

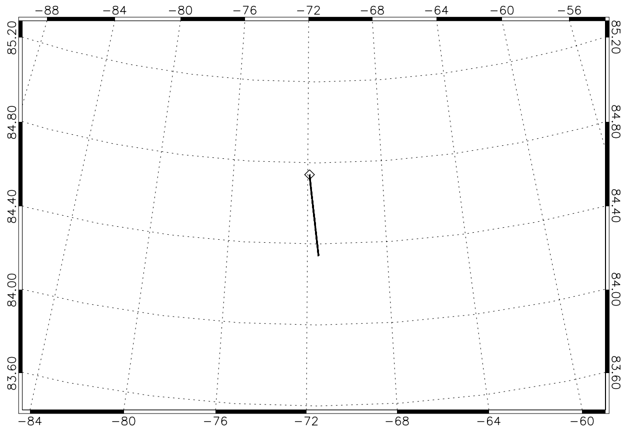


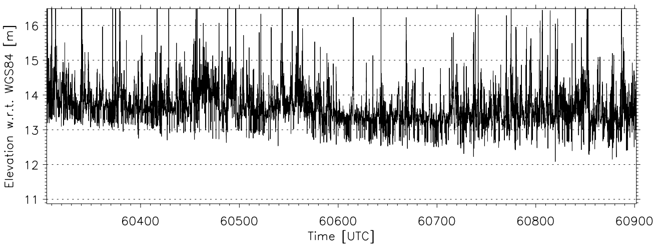


Date	2008-05-02	Instrument Mode	Adv. Low Altitude
Start Time	16:36:08 (59768)	Aircraft	DNSC Twin Otter
Stop Time	16:45:02 (60302)	Retracker	OCOG
Distance	40.321 km	INS Resolution	50 Hz
Duration	00 h 08 m 54 s	Processor Version	0309

A15_20080502

AS3TA15_ASIAL1B030920080502T164505_20080502T165502_0001.DBL

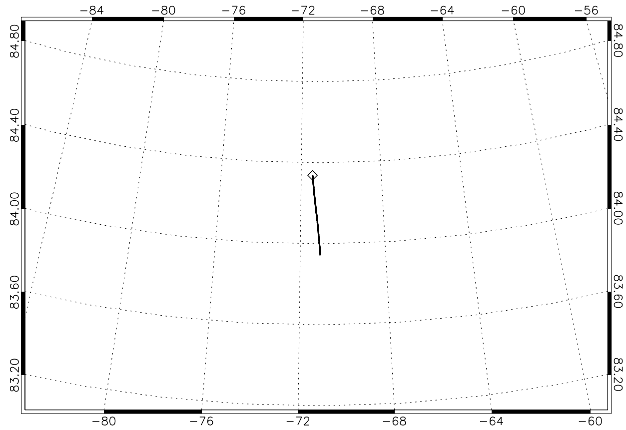


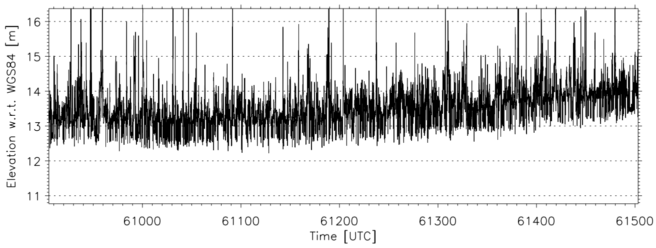


Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	16:45:05 (60305)	**Aircraft**	DNSC Twin Otter
Stop Time	16:55:01 (60901)	**Retracker**	OCOG
Distance	44.844 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 57 s	**Processor Version**	0309

A16_20080502

AS3TA16_ASIAL1B030920080502T165505_20080502T170503_0001.DBL

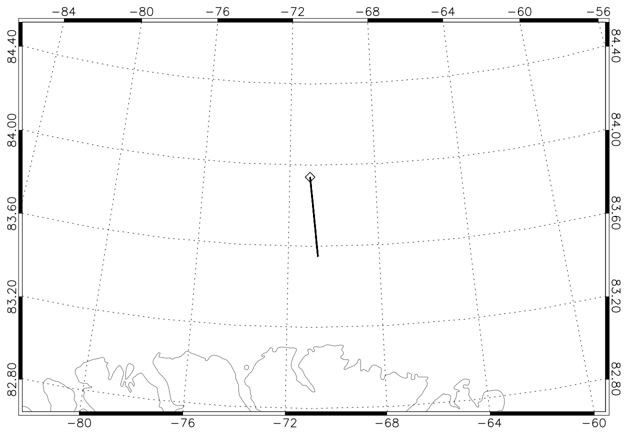


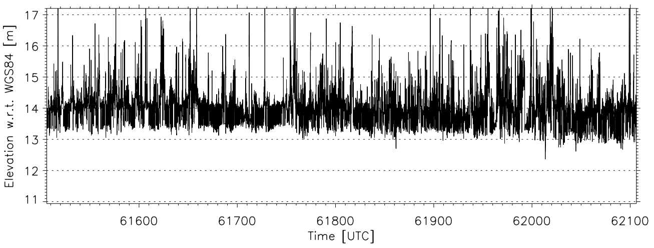


Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	16:55:05 (60905)	**Aircraft**	DNSC Twin Otter
Stop Time	17:05:03 (61503)	**Retracker**	OCOG
Distance	44.161 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 58 s	**Processor Version**	0309

A17_20080502

AS3TA17_ASIAL1B030920080502T170506_20080502T171506_0001.DBL

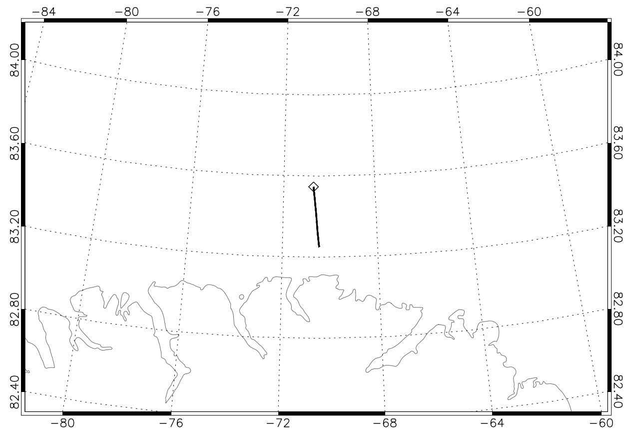


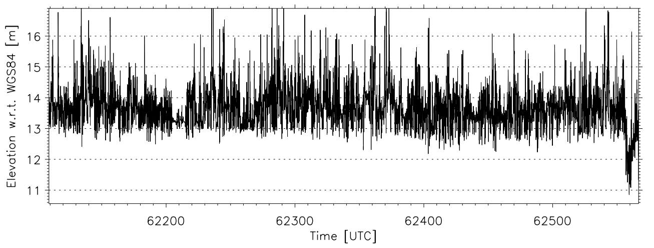


Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	17:05:06 (61506)	**Aircraft**	DNSC Twin Otter
Stop Time	17:15:06 (62106)	**Retracker**	OCOG
Distance	43.819 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 00 s	**Processor Version**	0309

A18_20080502

AS3TA18_ASIAL1B030920080502T171509_20080502T172247_0001.DBL

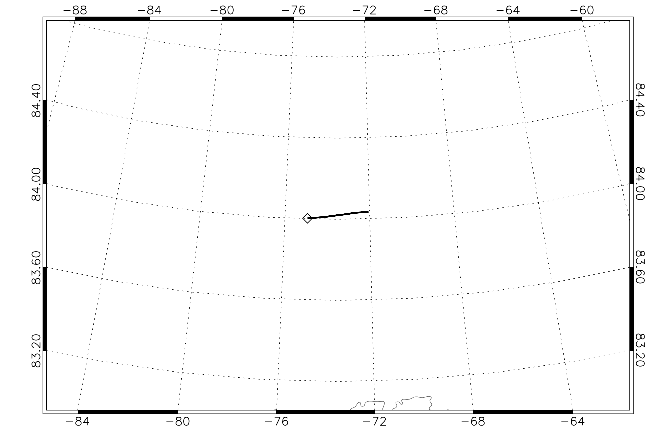


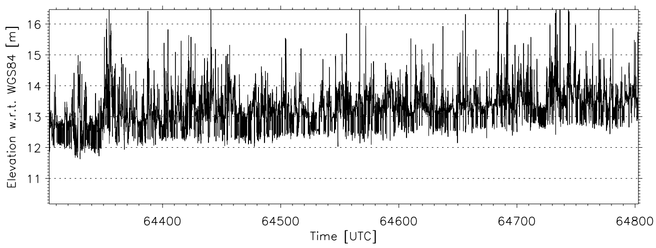


Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	17:15:09 (62109)	**Aircraft**	DNSC Twin Otter
Stop Time	17:22:46 (62566)	**Retracker**	OCOG
Distance	33.173 km	**INS Resolution**	50 Hz
Duration	00 h 07 m 38 s	**Processor Version**	0309

A19_20080502

AS3TA19_ASIAL1B030920080502T175144_20080502T180003_0001.DBL

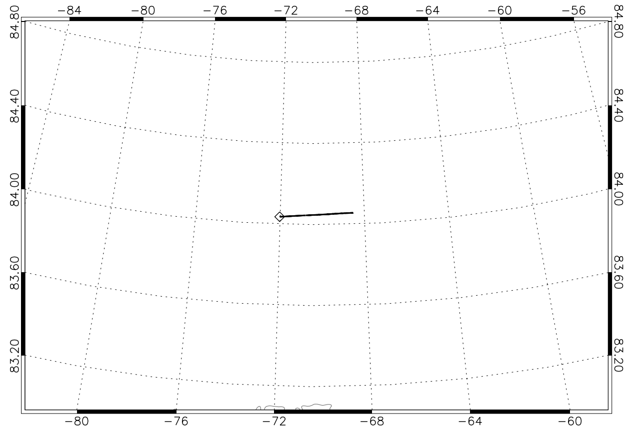


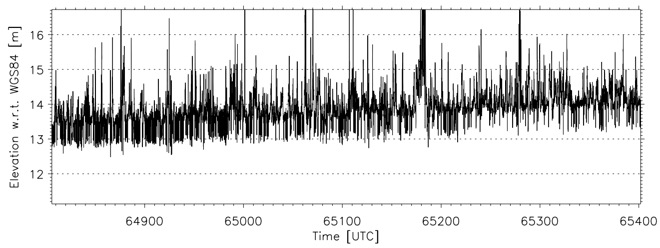


Date	2008-05-02	Instrument Mode	Adv. Low Altitude
Start Time	17:51:44 (64304)	Aircraft	DNSC Twin Otter
Stop Time	18:00:02 (64802)	Retracker	OCOG
Distance	33.724 km	INS Resolution	50 Hz
Duration	00 h 08 m 19 s	Processor Version	0309

A20_20080502

AS3TA20_ASIAL1B030920080502T180006_20080502T181002_0001.DBL

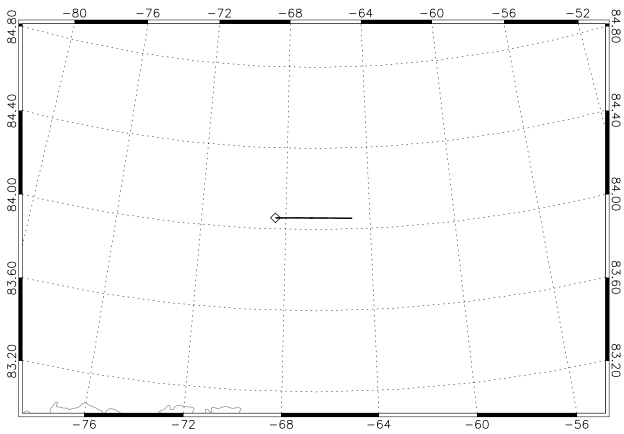


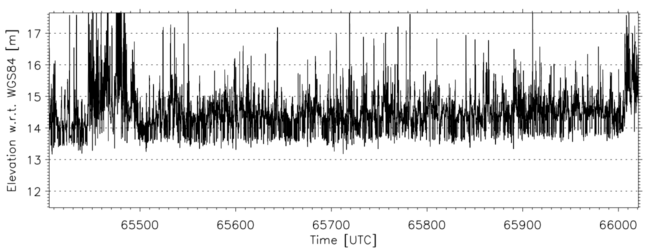


Date	2008-05-02	Instrument Mode	Adv. Low Altitude
Start Time	18:00:06 (64806)	Aircraft	DNSC Twin Otter
Stop Time	18:10:01 (65401)	Retracker	OCOG
Distance	40.467 km	INS Resolution	50 Hz
Duration	00 h 09 m 56 s	Processor Version	0309

A21_20080502

AS3TA21_ASIAL1B030920080502T181005_20080502T182021_0001.DBL

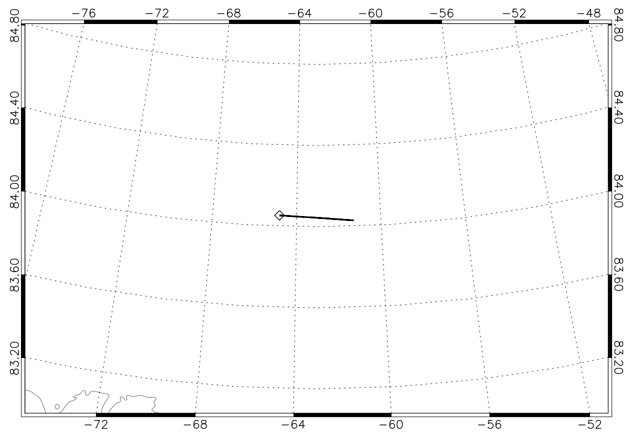


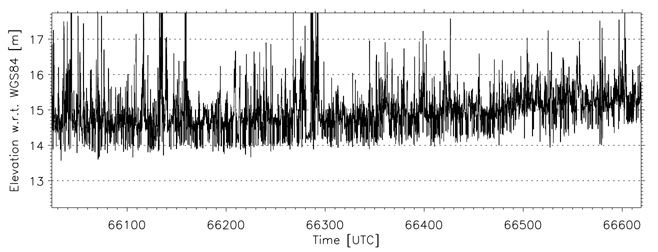


Date	2008-05-02	Instrument Mode	Adv. Low Altitude
Start Time	18:10:05 (65405)	Aircraft	DNSC Twin Otter
Stop Time	18:20:20 (66020)	Retracker	OCOG
Distance	42.182 km	INS Resolution	50 Hz
Duration	00 h 10 m 16 s	Processor Version	0309

A22_20080502

AS3TA22_ASIAL1B030920080502T182024_20080502T183019_0001.DBL

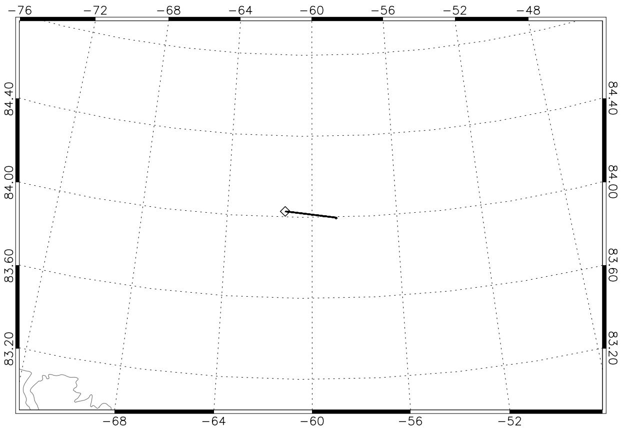


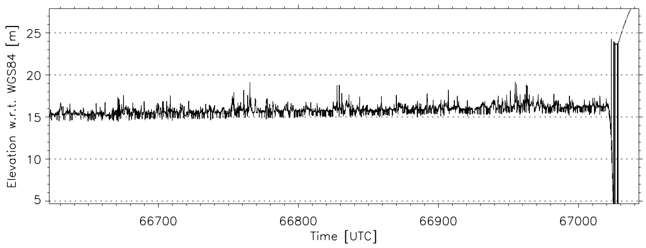


Date	2008-05-02	Instrument Mode	Adv. Low Altitude
Start Time	18:20:24 (66024)	Aircraft	DNSC Twin Otter
Stop Time	18:30:19 (66619)	Retracker	OCOG
Distance	40.803 km	INS Resolution	50 Hz
Duration	00 h 09 m 55 s	Processor Version	0309

A23_20080502

AS3TA23_ASIAL1B030920080502T183022_20080502T183723_0001.DBL

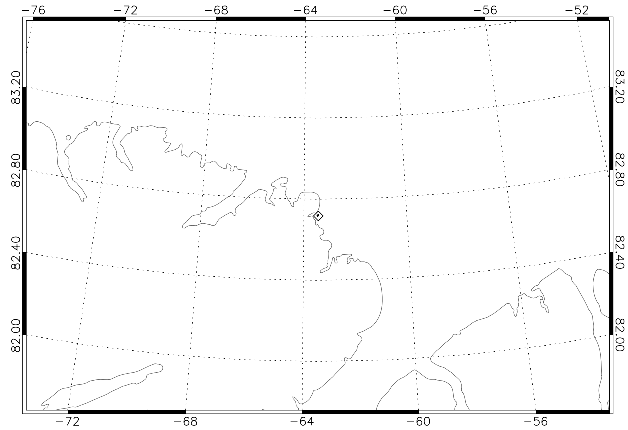


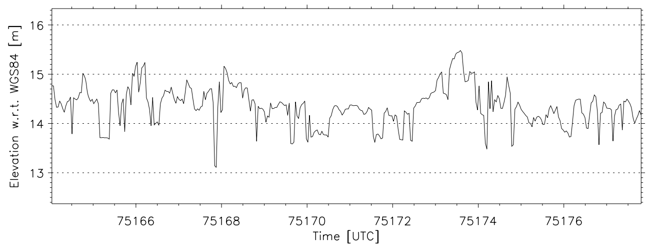


Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	18:30:22 (66622)	**Aircraft**	DNSC Twin Otter
Stop Time	18:37:23 (67043)	**Retracker**	OCOG
Distance	28.696 km	**INS Resolution**	50 Hz
Duration	00 h 07 m 01 s	**Processor Version**	0309

A24_20080502

AS3TA24_ASIAL1B030920080502T205244_20080502T205258_0001.DBL

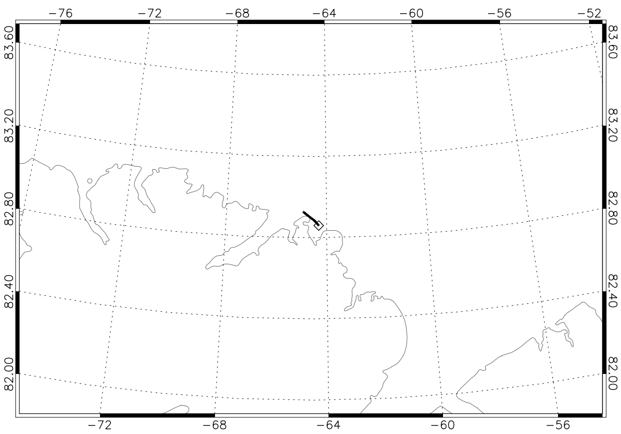


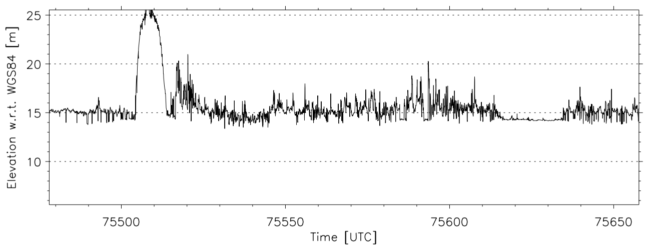


Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	20:52:44 (75164)	**Aircraft**	DNSC Twin Otter
Stop Time	20:52:57 (75177)	**Retracker**	OCOG
Distance	0.885 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 14 s	**Processor Version**	0309

A25_20080502

AS3TA25_ASIAL1B030920080502T205758_20080502T210058_0001.DBL

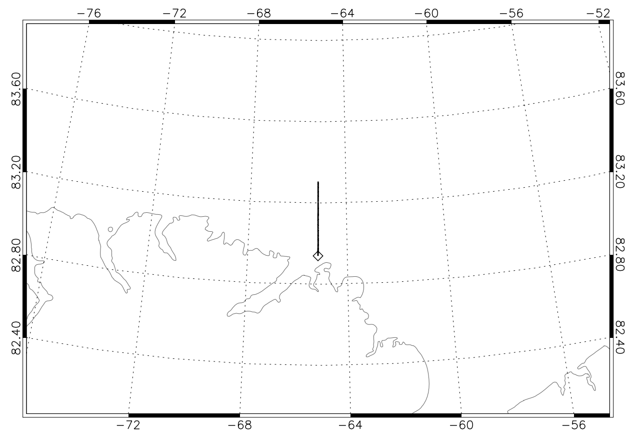


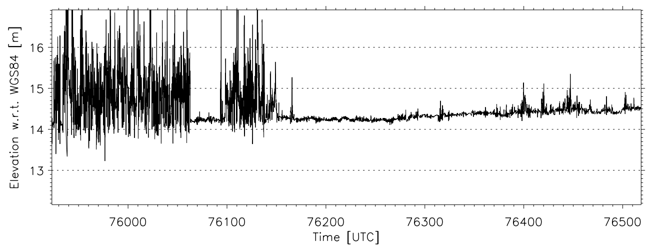


Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	20:57:58 (75478)	**Aircraft**	DNSC Twin Otter
Stop Time	21:00:57 (75657)	**Retracker**	OCOG
Distance	11.471 km	**INS Resolution**	50 Hz
Duration	00 h 02 m 60 s	**Processor Version**	0309

A26_20080502

AS3TA26_ASIAL1B030920080502T210523_20080502T211519_0001.DBL

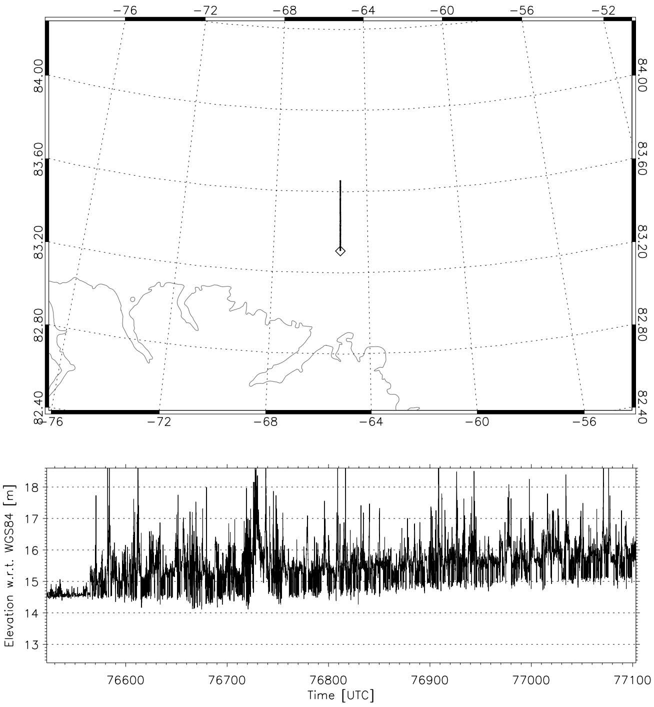




Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	21:05:23 (75923)	**Aircraft**	DNSC Twin Otter
Stop Time	21:15:18 (76518)	**Retracker**	OCOG
Distance	40.868 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 56 s	**Processor Version**	0309

A27_20080502

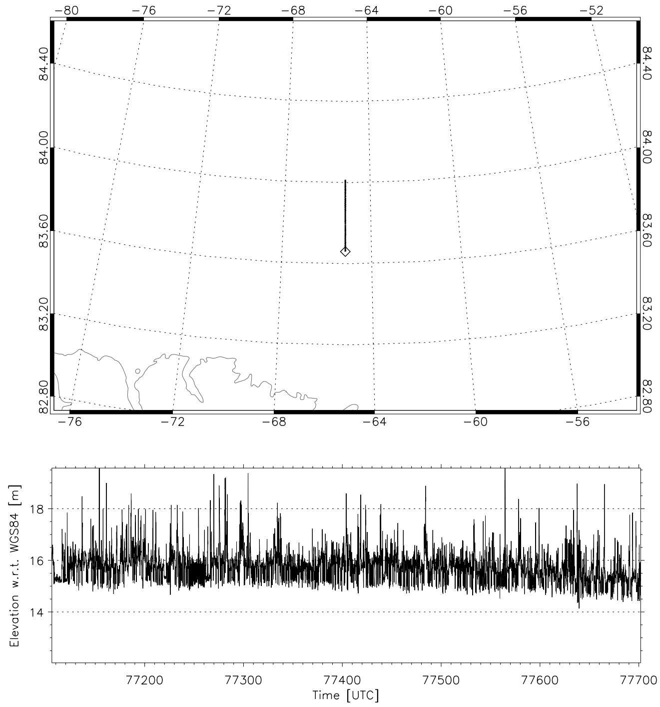
AS3TA27_ASIAL1B030920080502T211522_20080502T212503_0001.DBL



Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	21:15:22 (76522)	**Aircraft**	DNSC Twin Otter
Stop Time	21:25:03 (77103)	**Retracker**	OCOG
Distance	38.942 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 41 s	**Processor Version**	0309

A28_20080502

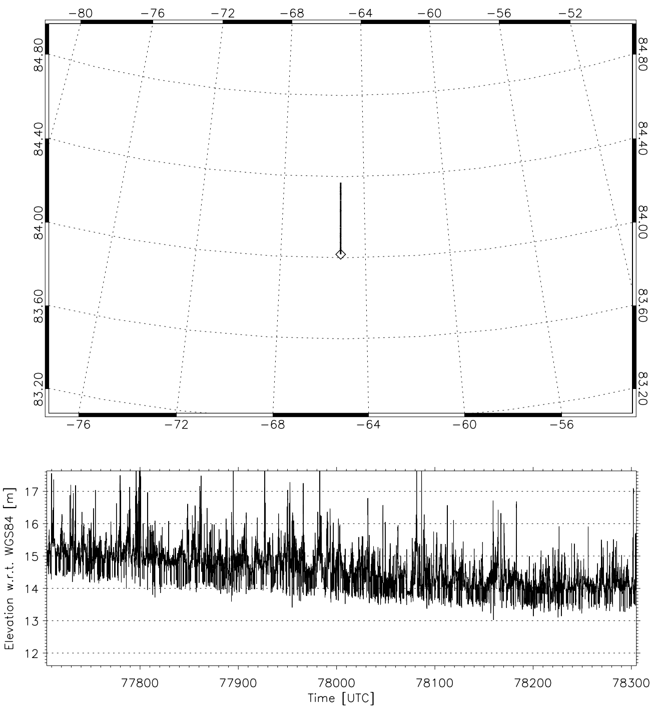
AS3TA28_ASIAL1B030920080502T212506_20080502T213502_0001.DBL



Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	21:25:06 (77106)	**Aircraft**	DNSC Twin Otter
Stop Time	21:35:01 (77701)	**Retracker**	OCOG
Distance	39.489 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 56 s	**Processor Version**	0309

A29_20080502

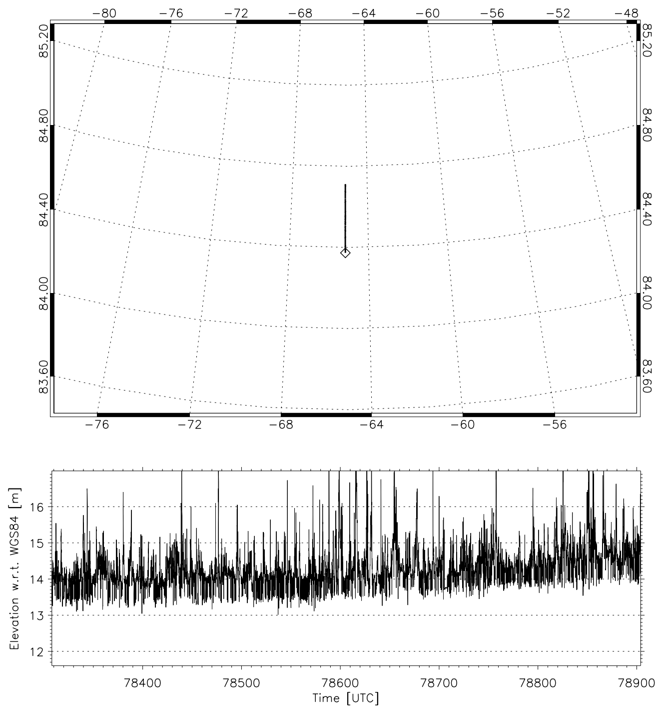
AS3TA29_ASIAL1B030920080502T213505_20080502T214505_0001.DBL



Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	21:35:05 (77705)	**Aircraft**	DNSC Twin Otter
Stop Time	21:45:05 (78305)	**Retracker**	OCOG
Distance	39.382 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 00 s	**Processor Version**	0309

A30_20080502

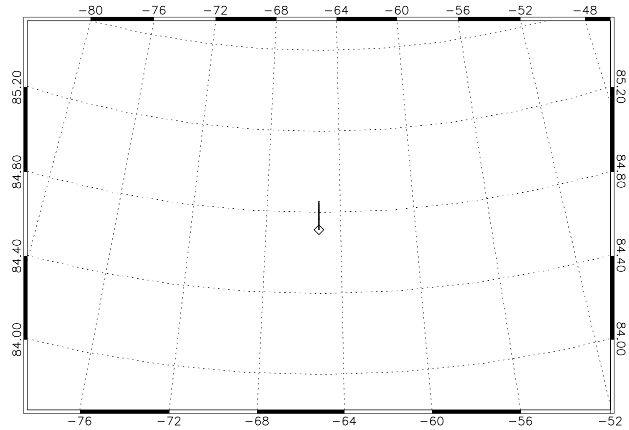
AS3TA30_ASIAL1B030920080502T214508_20080502T215504_0001.DBL

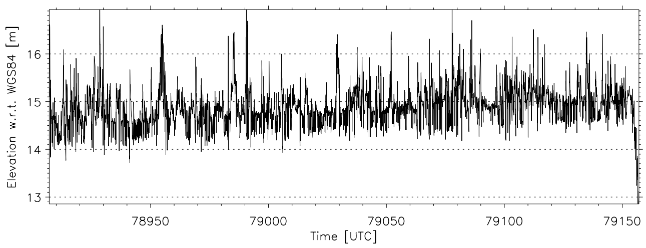


Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	21:45:08 (78308)	**Aircraft**	DNSC Twin Otter
Stop Time	21:55:03 (78903)	**Retracker**	OCOG
Distance	37.731 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 56 s	**Processor Version**	0309

A31_20080502

AS3TA31_ASIAL1B030920080502T215507_20080502T215917_0001.DBL

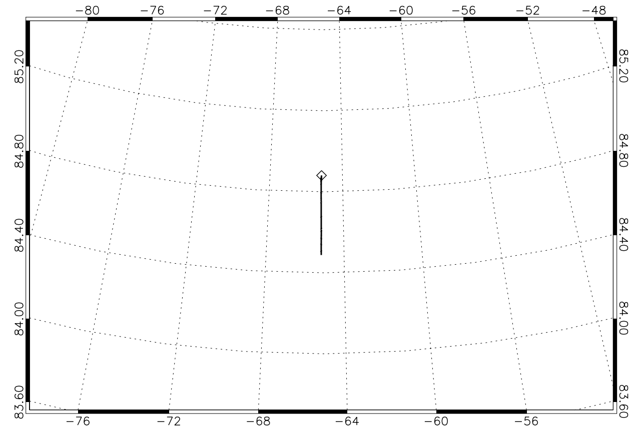


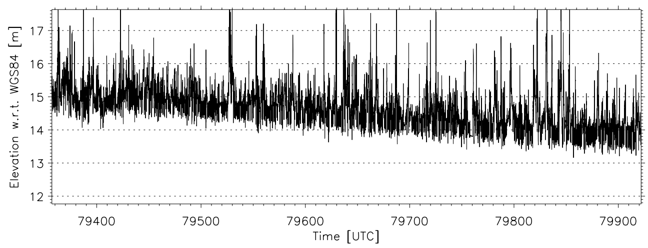


Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	21:55:07 (78907)	**Aircraft**	DNSC Twin Otter
Stop Time	21:59:17 (79157)	**Retracker**	OCOG
Distance	15.790 km	**INS Resolution**	50 Hz
Duration	00 h 04 m 10 s	**Processor Version**	0309

A32_20080502

AS3TA32_ASIAL1B030920080502T220237_20080502T221202_0001.DBL

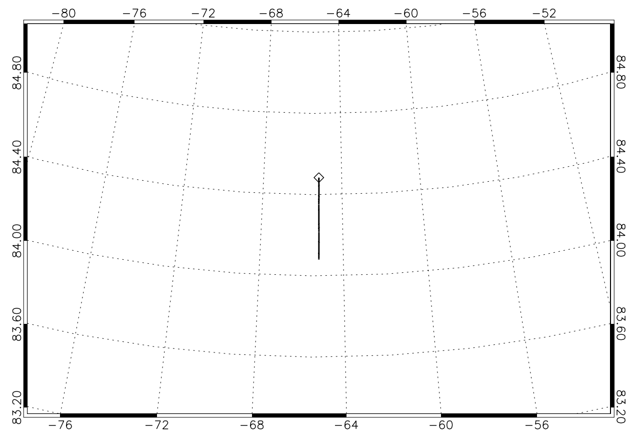


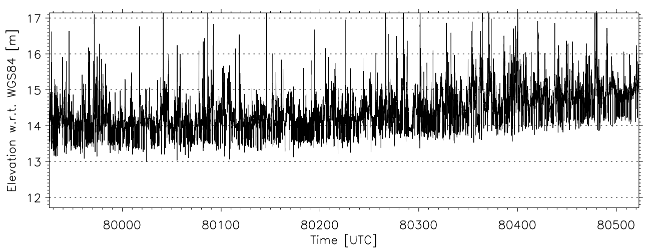


Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	22:02:37 (79357)	**Aircraft**	DNSC Twin Otter
Stop Time	22:12:01 (79921)	**Retracker**	OCOG
Distance	43.695 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 25 s	**Processor Version**	0309

A33_20080502

AS3TA33_ASIAL1B030920080502T221206_20080502T222202_0001.DBL

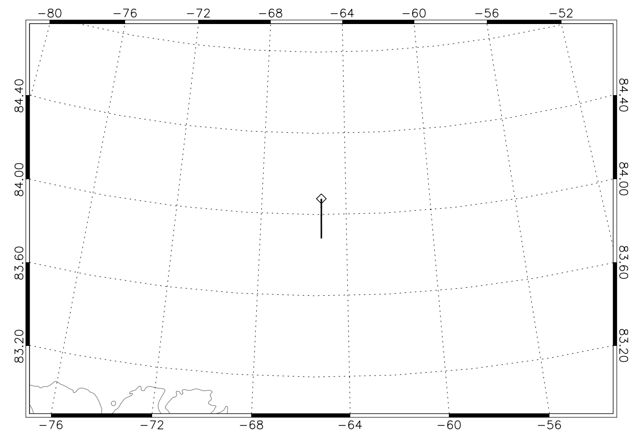


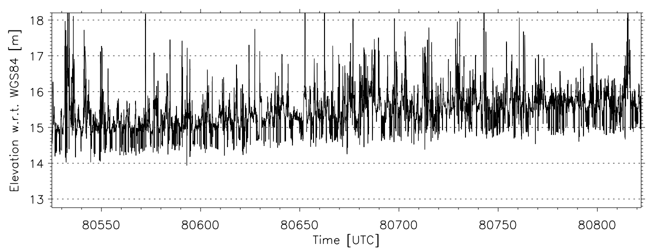


Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	22:12:06 (79926)	**Aircraft**	DNSC Twin Otter
Stop Time	22:22:02 (80522)	**Retracker**	OCOG
Distance	44.918 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 57 s	**Processor Version**	0309

A34_20080502

AS3TA34_ASIAL1B030920080502T222205_20080502T222702_0001.DBL

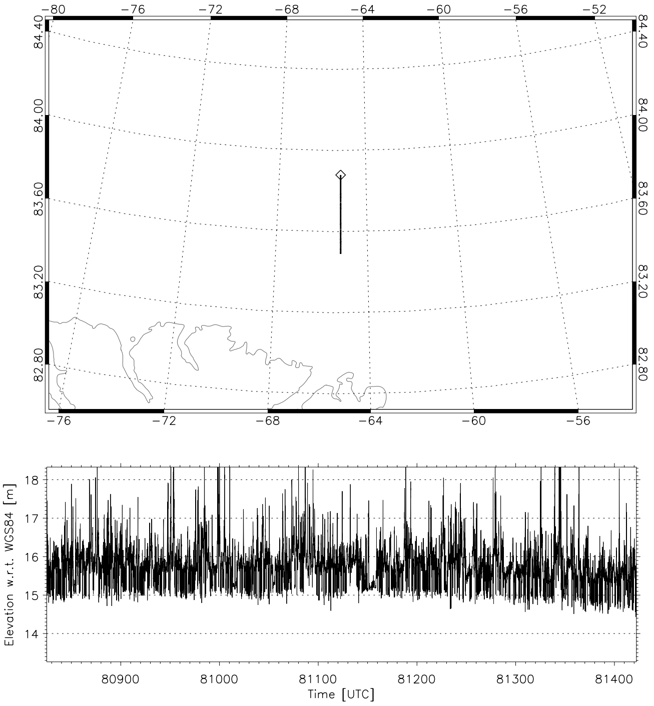




Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	22:22:05 (80525)	**Aircraft**	DNSC Twin Otter
Stop Time	22:27:02 (80822)	**Retracker**	OCOG
Distance	21.830 km	**INS Resolution**	50 Hz
Duration	00 h 04 m 57 s	**Processor Version**	0309

A35_20080502

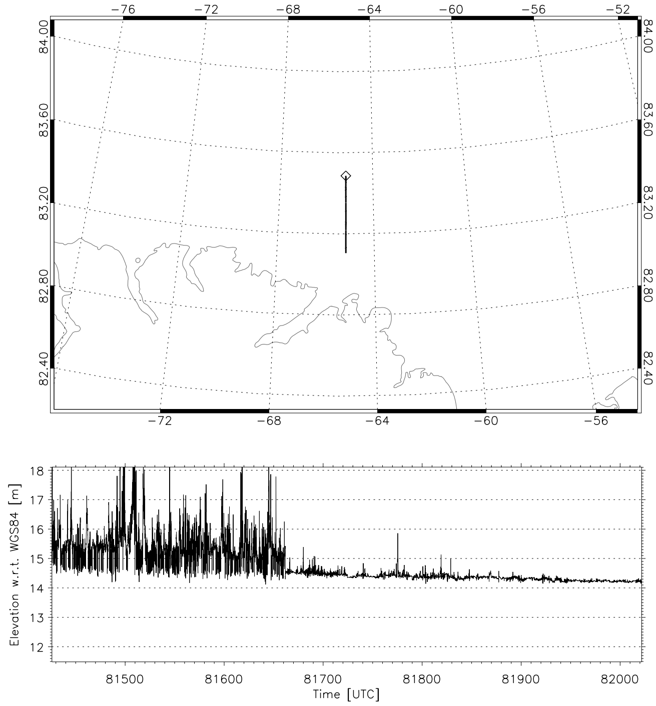
AS3TA35_ASIAL1B030920080502T222705_20080502T223702_0001.DBL



Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	22:27:05 (80825)	**Aircraft**	DNSC Twin Otter
Stop Time	22:37:02 (81422)	**Retracker**	OCOG
Distance	43.463 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 57 s	**Processor Version**	0309

A36_20080502

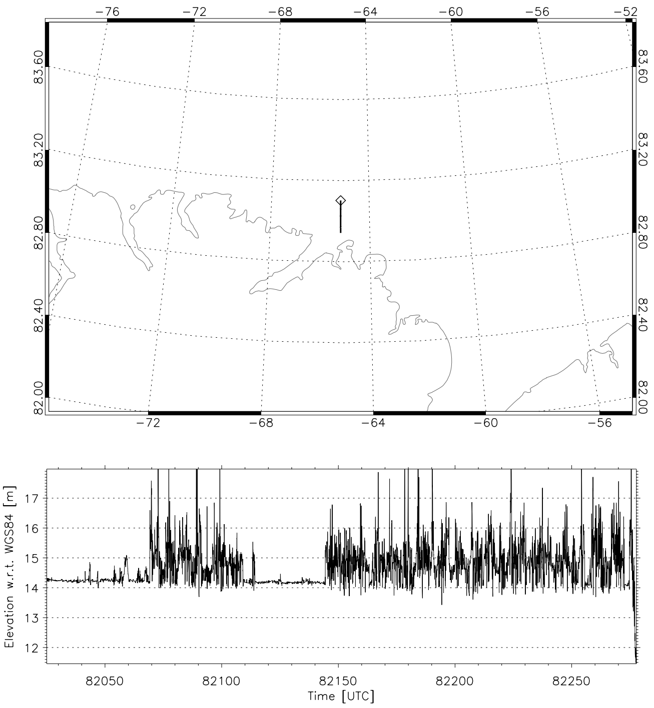
AS3TA36_ASIAL1B030920080502T223706_20080502T224702_0001.DBL



Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	22:37:06 (81426)	**Aircraft**	DNSC Twin Otter
Stop Time	22:47:01 (82021)	**Retracker**	OCOG
Distance	42.540 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 56 s	**Processor Version**	0309

A37_20080502

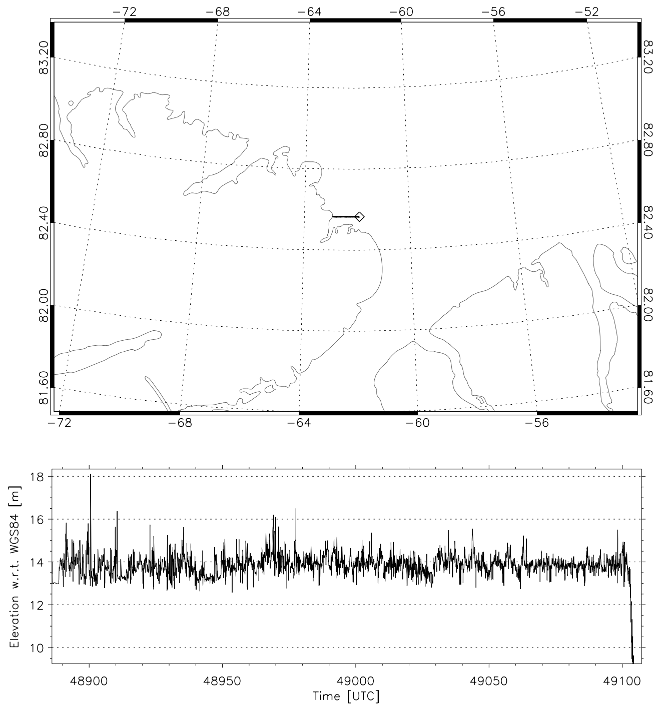
AS3TA37_ASIAL1B030920080502T224705_20080502T225118_0001.DBL



Date	2008-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	22:47:05 (82025)	**Aircraft**	DNSC Twin Otter
Stop Time	22:51:17 (82277)	**Retracker**	OCOG
Distance	17.856 km	**INS Resolution**	50 Hz
Duration	00 h 04 m 13 s	**Processor Version**	0309

A00_20080505

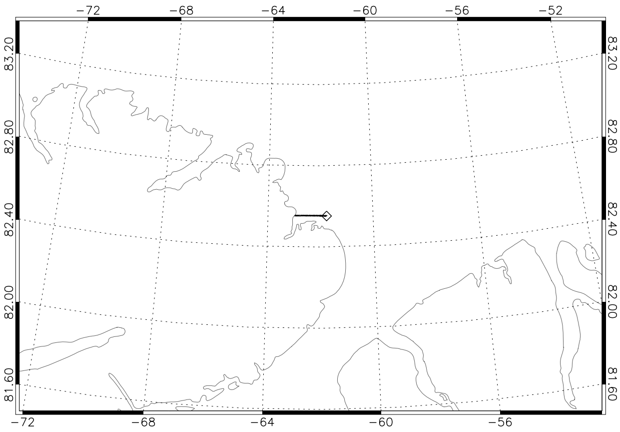
AS3TA00_ASIAL1B030920080505T133446_20080505T133827_0001.DBL

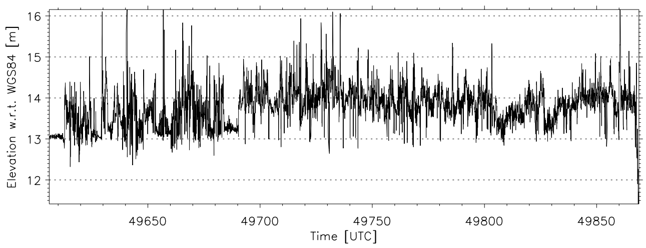


Date	2008-05-05	**Instrument Mode**	Adv. Low Altitude
Start Time	13:34:46 (48886)	**Aircraft**	DNSC Twin Otter
Stop Time	13:38:27 (49107)	**Retracker**	OCOG
Distance	14.879 km	**INS Resolution**	50 Hz
Duration	00 h 03 m 41 s	**Processor Version**	0309

A01_20080505

AS3TA01_ASIAL1B030920080505T134646_20080505T135109_0001.DBL

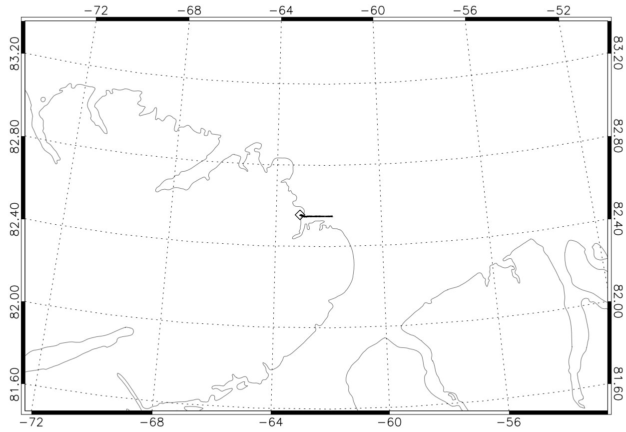


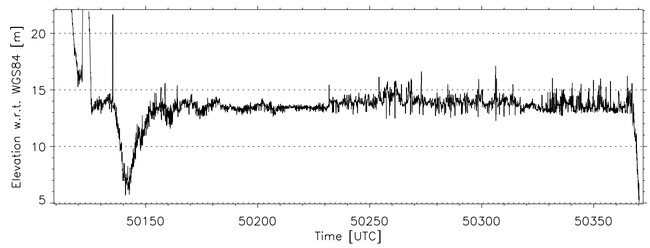


Date	2008-05-05	**Instrument Mode**	Adv. Low Altitude
Start Time	13:46:46 (49606)	**Aircraft**	DNSC Twin Otter
Stop Time	13:51:08 (49868)	**Retracker**	OCOG
Distance	17.521 km	**INS Resolution**	50 Hz
Duration	00 h 04 m 23 s	**Processor Version**	0309

A02_20080505

AS3TA02_ASIAL1B030920080505T135509_20080505T135932_0001.DBL

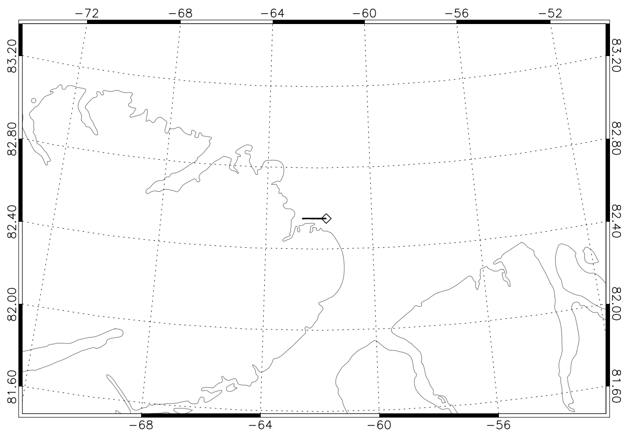


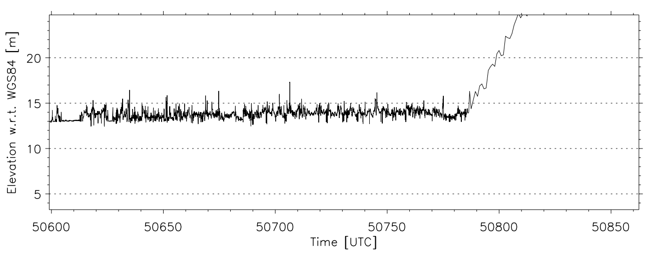


Date	2008-05-05	**Instrument Mode**	Adv. Low Altitude
Start Time	13:55:09 (50109)	**Aircraft**	DNSC Twin Otter
Stop Time	13:59:32 (50372)	**Retracker**	OCOG
Distance	18.107 km	**INS Resolution**	50 Hz
Duration	00 h 04 m 23 s	**Processor Version**	0309

A03_20080505

AS3TA03_ASIAL1B030920080505T140319_20080505T140747_0001.DBL

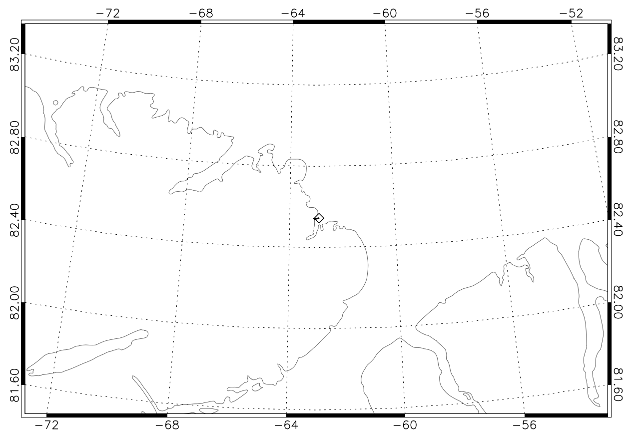


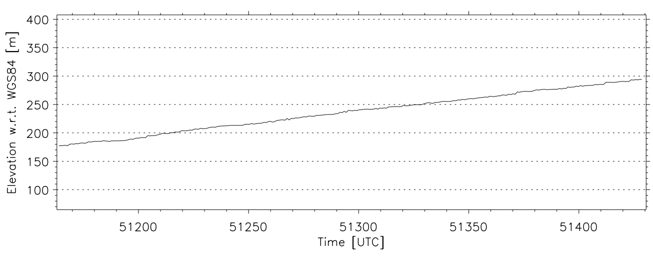


Date	2008-05-05	**Instrument Mode**	Adv. Low Altitude
Start Time	14:03:19 (50599)	**Aircraft**	DNSC Twin Otter
Stop Time	14:07:42 (50862)	**Retracker**	OCOG
Distance	13.306 km	**INS Resolution**	50 Hz
Duration	00 h 04 m 23 s	**Processor Version**	0309

A04_20080505

AS3TA04_ASIAL1B030920080505T141242_20080505T141711_0001.DBL

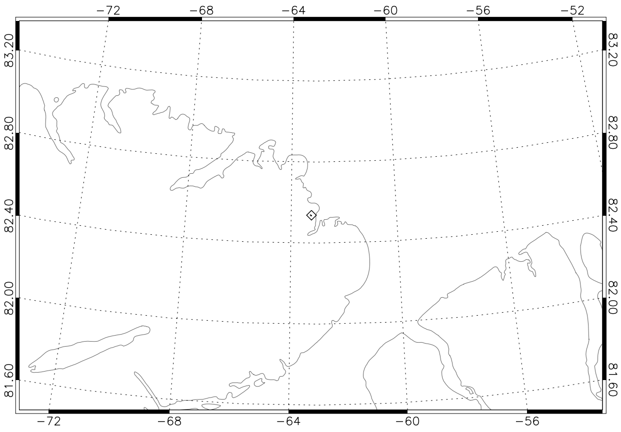


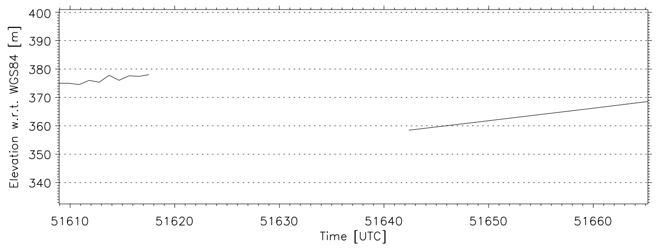


Date	2008-05-05	**Instrument Mode**	Adv. Low Altitude
Start Time	14:12:42 (51162)	**Aircraft**	DNSC Twin Otter
Stop Time	14:17:10 (51430)	**Retracker**	OCOG
Distance	3.020 km	**INS Resolution**	50 Hz
Duration	00 h 04 m 28 s	**Processor Version**	0309

A05_20080505

AS3TA05_ASIAL1B030920080505T142008_20080505T142105_0001.DBL

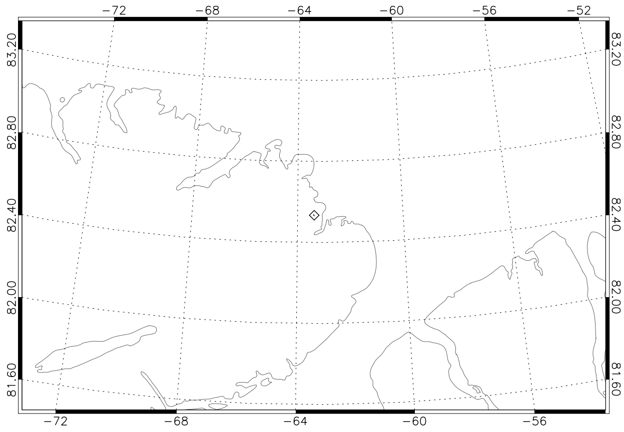


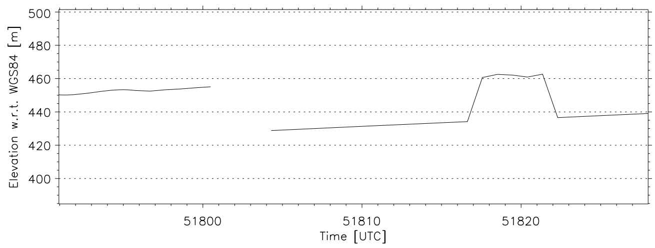


Date	2008-05-05	**Instrument Mode**	Adv. Low Altitude
Start Time	14:20:08 (51608)	**Aircraft**	DNSC Twin Otter
Stop Time	14:21:05 (51665)	**Retracker**	OCOG
Distance	0.636 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 56 s	**Processor Version**	0309

A06_20080505

AS3TA06_ASIAL1B030920080505T142310_20080505T142401_0001.DBL

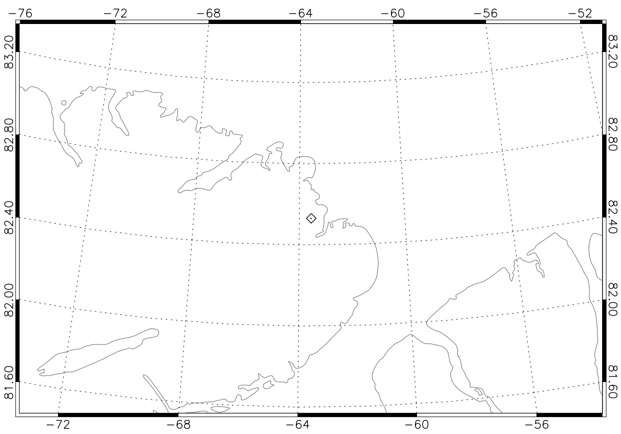


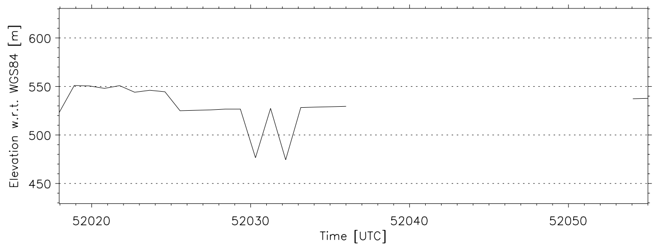


Date	2008-05-05	**Instrument Mode**	Adv. Low Altitude
Start Time	14:23:10 (51790)	**Aircraft**	DNSC Twin Otter
Stop Time	14:23:47 (51827)	**Retracker**	OCOG
Distance	0.419 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 37 s	**Processor Version**	0309

A07_20080505

AS3TA07_ASIAL1B030920080505T142657_20080505T142738_0001.DBL

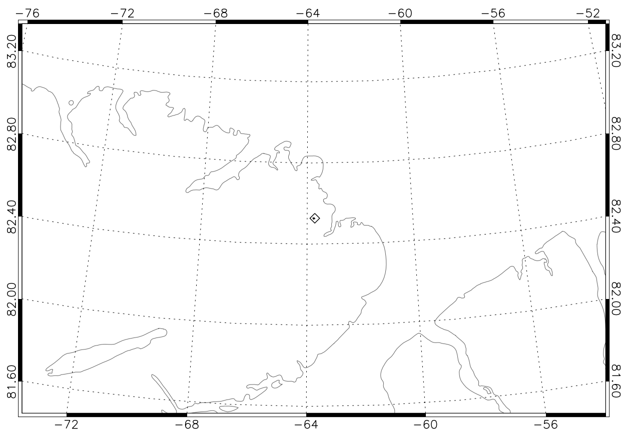


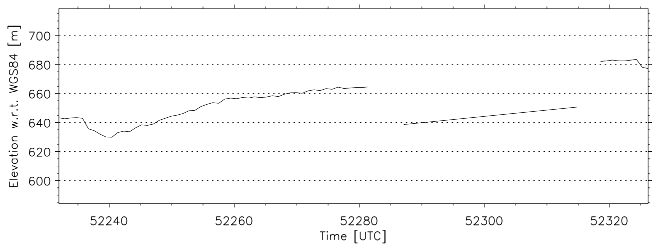


Date	2008-05-05	**Instrument Mode**	Adv. Low Altitude
Start Time	14:26:57 (52017)	**Aircraft**	DNSC Twin Otter
Stop Time	14:27:35 (52055)	**Retracker**	OCOG
Distance	0.419 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 37 s	**Processor Version**	0309

A08_20080505

AS3TA08_ASIAL1B030920080505T143031_20080505T143211_0001.DBL

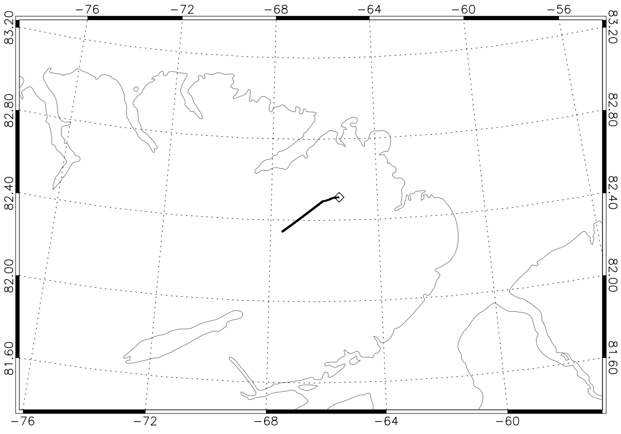


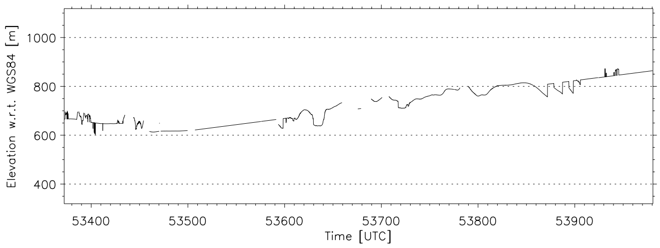


Date	2008-05-05	**Instrument Mode**	Adv. Low Altitude
Start Time	14:30:31 (52231)	**Aircraft**	DNSC Twin Otter
Stop Time	14:32:06 (52326)	**Retracker**	OCOG
Distance	1.068 km	**INS Resolution**	50 Hz
Duration	00 h 01 m 34 s	**Processor Version**	0309

A09_20080505

AS3TA09_ASIAL1B030920080505T144932_20080505T145941_0001.DBL

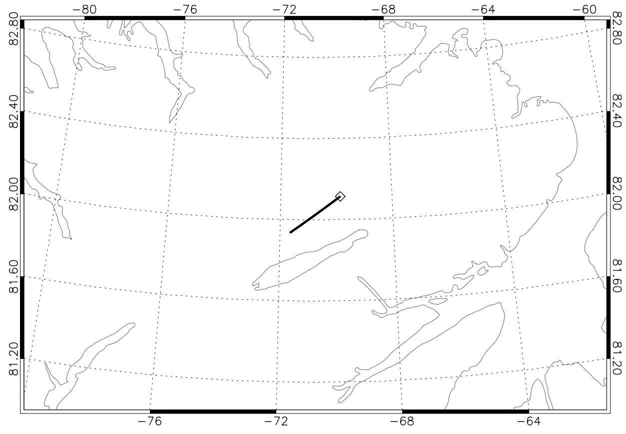


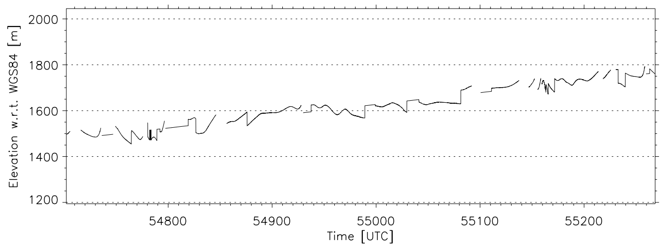


Date	2008-05-05	**Instrument Mode**	Adv. Low Altitude
Start Time	14:49:32 (53372)	**Aircraft**	DNSC Twin Otter
Stop Time	14:59:40 (53980)	**Retracker**	OCOG
Distance	37.176 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 09 s	**Processor Version**	0309

A10_20080505

AS3TA10_ASIAL1B030920080505T151142_20080505T152109_0001.DBL

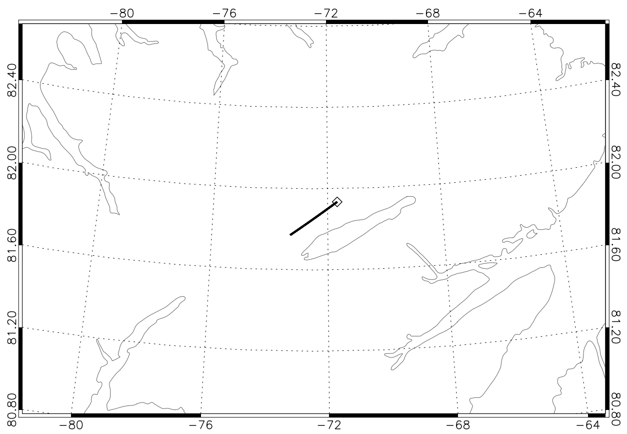


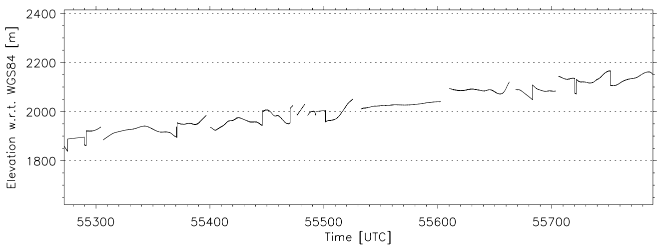


Date	2008-05-05	**Instrument Mode**	Adv. Low Altitude
Start Time	15:11:42 (54702)	**Aircraft**	DNSC Twin Otter
Stop Time	15:21:08 (55268)	**Retracker**	OCOG
Distance	34.013 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 26 s	**Processor Version**	0309

A11_20080505

AS3TA11_ASIAL1B030920080505T152112_20080505T152949_0001.DBL

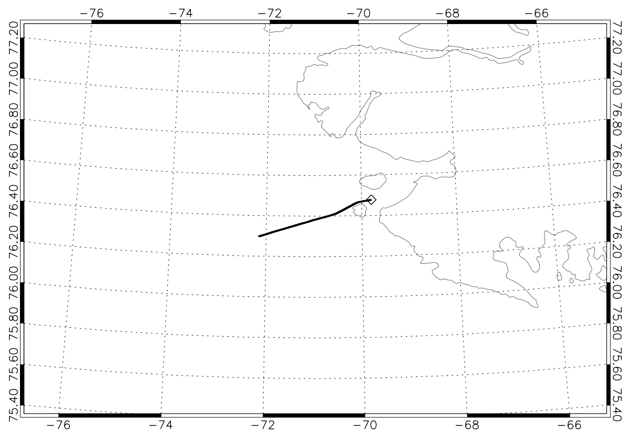


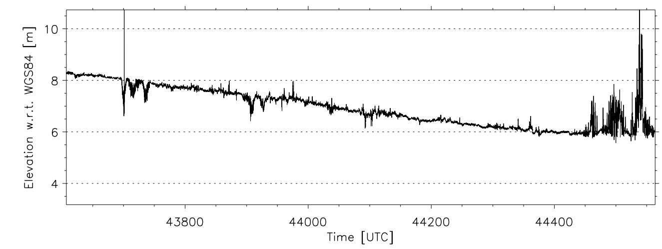


Date	2008-05-05	**Instrument Mode**	Adv. Low Altitude
Start Time	15:21:12 (55272)	**Aircraft**	DNSC Twin Otter
Stop Time	15:29:48 (55788)	**Retracker**	OCOG
Distance	31.477 km	**INS Resolution**	50 Hz
Duration	00 h 08 m 37 s	**Processor Version**	0309

A00_20080506

AS3TA00_ASIAL1B030920080506T120647_20080506T122244_0001.DBL

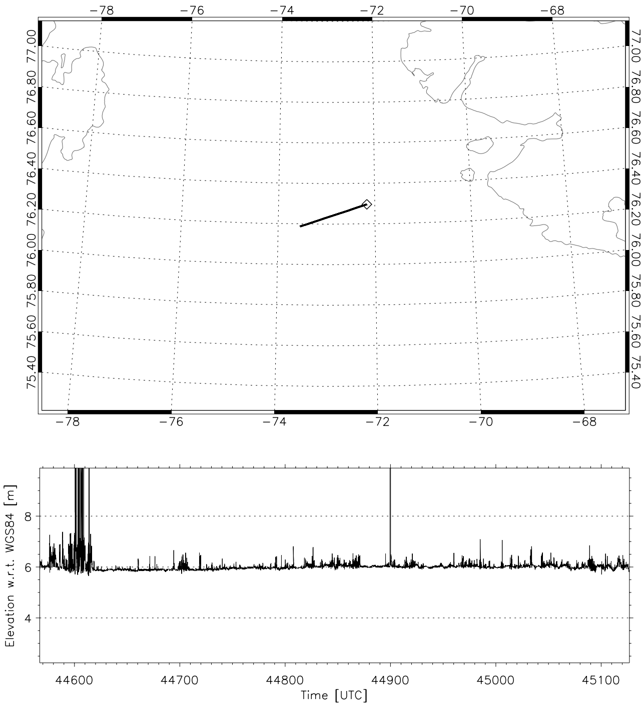




Date	2008-05-06	**Instrument Mode**	Adv. Low Altitude
Start Time	12:06:47 (43607)	**Aircraft**	DNSC Twin Otter
Stop Time	12:22:43 (44563)	**Retracker**	OCOG
Distance	65.274 km	**INS Resolution**	50 Hz
Duration	00 h 15 m 57 s	**Processor Version**	0309

A01_20080506

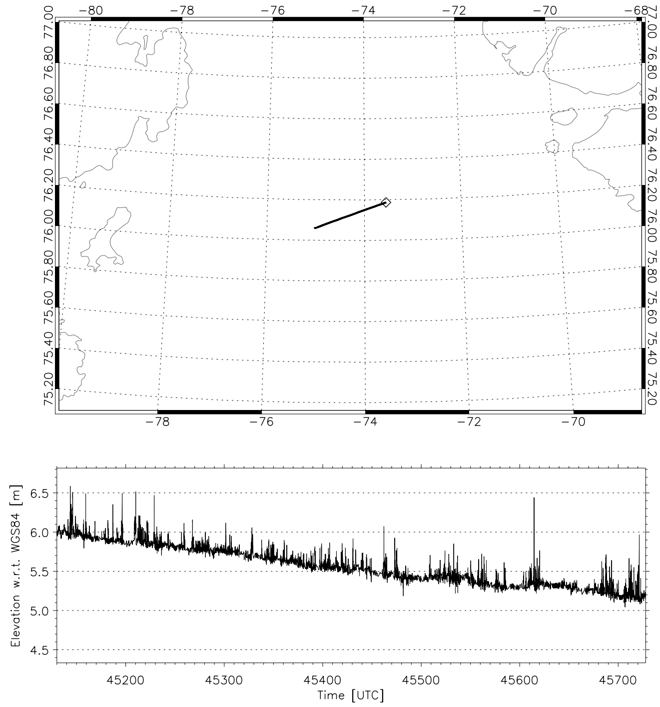
AS3TA01_ASIAL1B030920080506T122247_20080506T123207_0001.DBL



Date	2008-05-06	**Instrument Mode**	Adv. Low Altitude
Start Time	12:22:47 (44567)	**Aircraft**	DNSC Twin Otter
Stop Time	12:32:06 (45126)	**Retracker**	OCOG
Distance	38.486 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 20 s	**Processor Version**	0309

A02_20080506

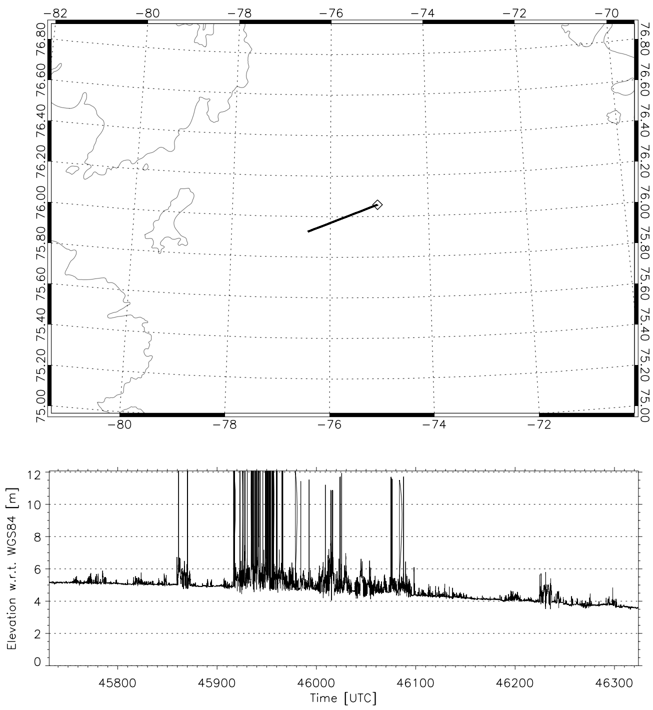
AS3TA02_ASIAL1B030920080506T123210_20080506T124208_0001.DBL



Date	2008-05-06	**Instrument Mode**	Adv. Low Altitude
Start Time	12:32:10 (45130)	**Aircraft**	DNSC Twin Otter
Stop Time	12:42:07 (45727)	**Retracker**	OCOG
Distance	41.782 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 58 s	**Processor Version**	0309

A03_20080506

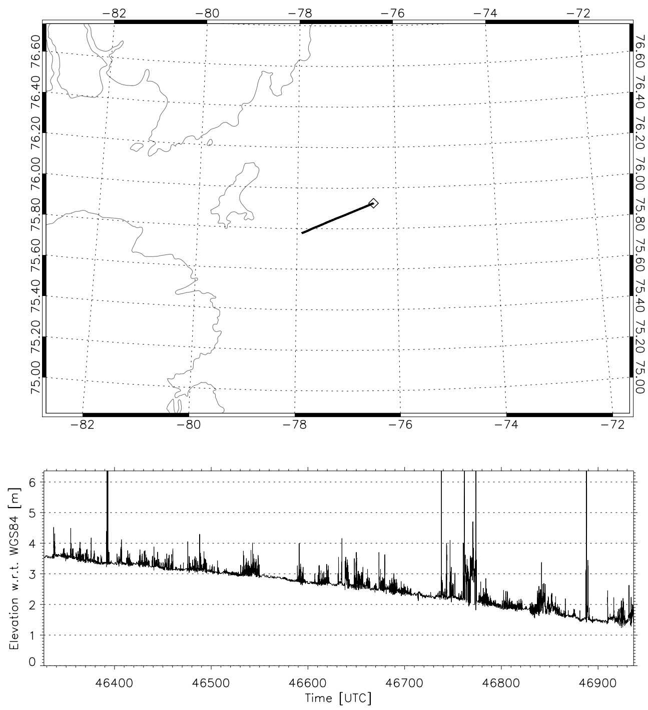
AS3TA03_ASIAL1B030920080506T124211_20080506T125204_0001.DBL



Date	2008-05-06	**Instrument Mode**	Adv. Low Altitude
Start Time	12:42:11 (45731)	**Aircraft**	DNSC Twin Otter
Stop Time	12:52:04 (46324)	**Retracker**	OCOG
Distance	40.869 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 53 s	**Processor Version**	0309

A04_20080506

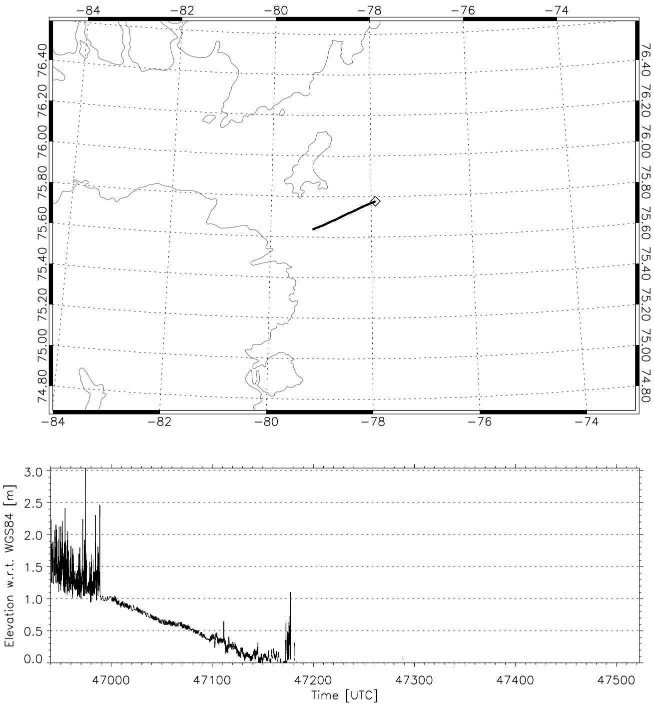
AS3TA04_ASIAL1B030920080506T125207_20080506T130217_0001.DBL



Date	2008-05-06	**Instrument Mode**	Adv. Low Altitude
Start Time	12:52:07 (46327)	**Aircraft**	DNSC Twin Otter
Stop Time	13:02:16 (46936)	**Retracker**	OCOG
Distance	42.535 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 10 s	**Processor Version**	0309

A05_20080506

AS3TA05_ASIAL1B030920080506T130220_20080506T131203_0001.DBL



Date	2008-05-06	**Instrument Mode**	Adv. Low Altitude
Start Time	13:02:20 (46940)	**Aircraft**	DNSC Twin Otter
Stop Time	13:12:02 (47522)	**Retracker**	OCOG
Distance	37.759 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 43 s	**Processor Version**	0309

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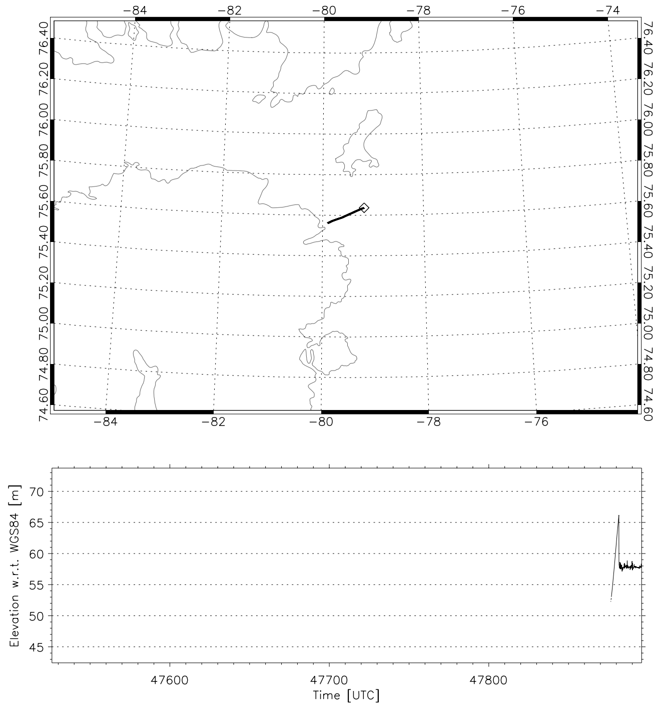

Date	2008-05-06	**Instrument Mode**	Adv. Low Altitude
Start Time	13:12:06 (47526)	**Aircraft**	DNSC Twin Otter
Stop Time	13:18:15 (47895)	**Retracker**	OCOG
Distance	21.766 km	**INS Resolution**	50 Hz
Duration	00 h 06 m 10 s	**Processor Version**	0309

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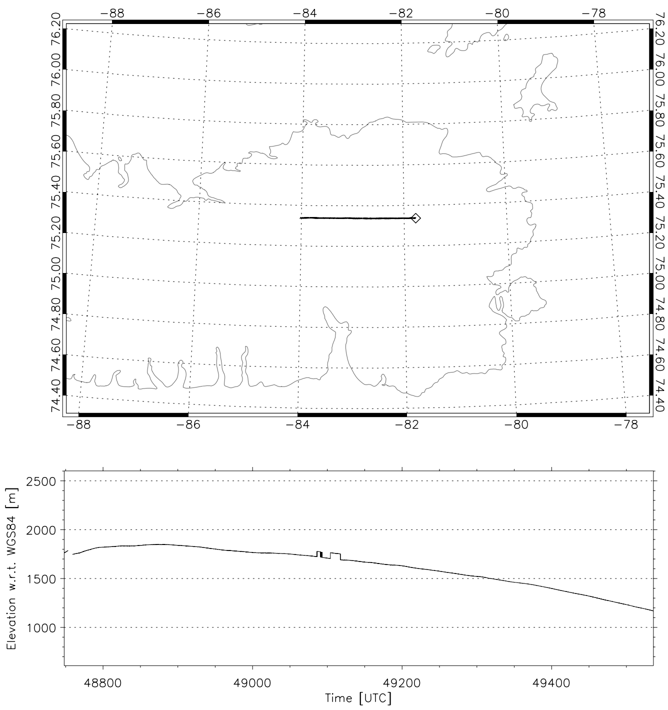

Date	2008-05-06	**Instrument Mode**	Adv. Low Altitude
Start Time	13:32:28 (48748)	**Aircraft**	DNSC Twin Otter
Stop Time	13:45:36 (49536)	**Retracker**	OCOG
Distance	63.313 km	**INS Resolution**	50 Hz
Duration	00 h 13 m 08 s	**Processor Version**	0309

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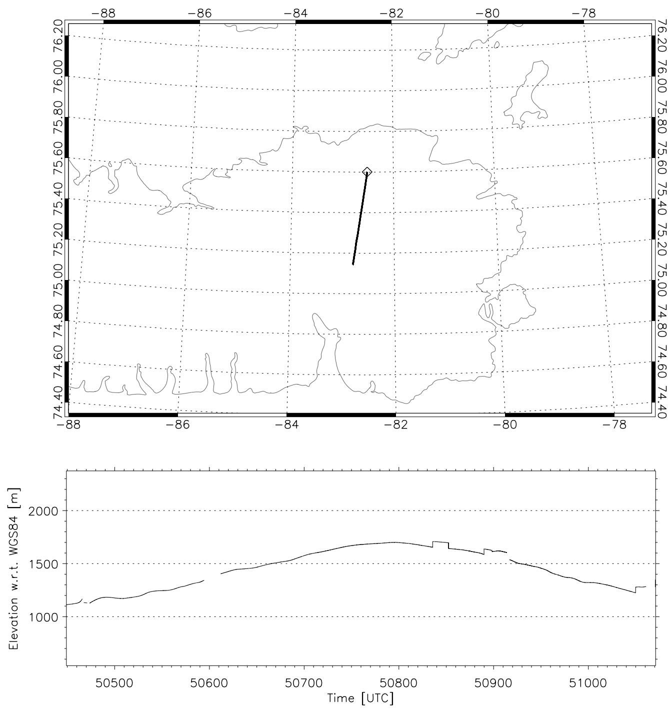

Date	2008-05-06	**Instrument Mode**	Adv. Low Altitude
Start Time	14:00:49 (50449)	**Aircraft**	DNSC Twin Otter
Stop Time	14:11:11 (51071)	**Retracker**	OCOG
Distance	51.428 km	**INS Resolution**	50 Hz
Duration	00 h 10 m 22 s	**Processor Version**	0309

A09_20080506

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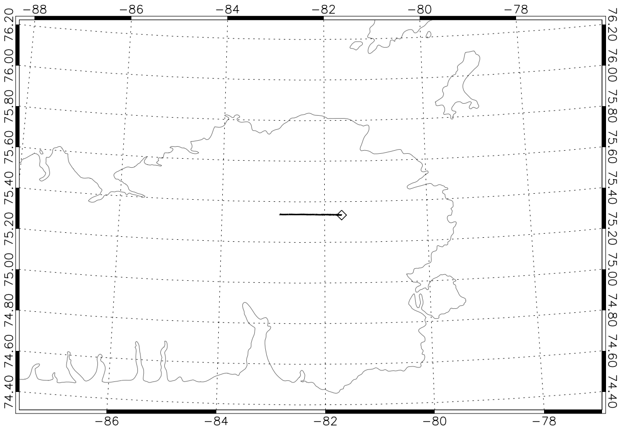

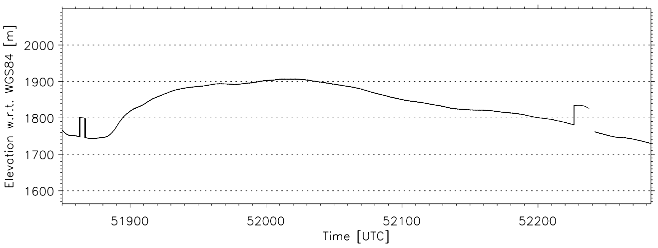

Date	2008-05-06	**Instrument Mode**	Adv. Low Altitude
Start Time	14:24:10 (51850)	**Aircraft**	DNSC Twin Otter
Stop Time	14:31:23 (52283)	**Retracker**	OCOG
Distance	33.943 km	**INS Resolution**	50 Hz
Duration	00 h 07 m 13 s	**Processor Version**	0309

A10_20080506

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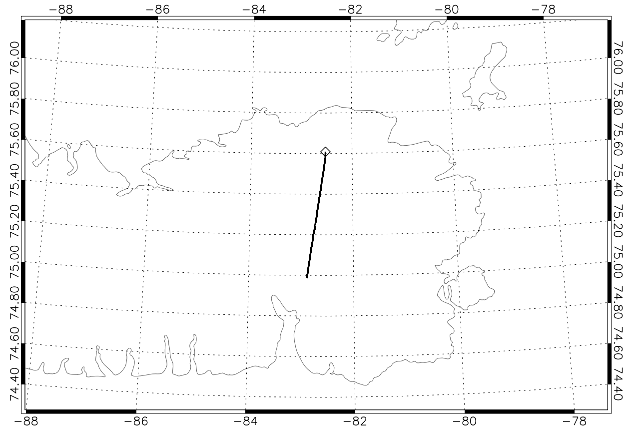

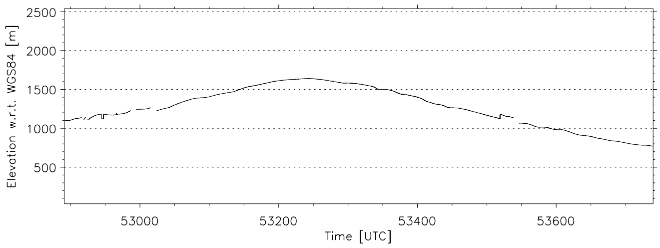

Date	2008-05-06	**Instrument Mode**	Adv. Low Altitude
Start Time	14:41:31 (52891)	**Aircraft**	DNSC Twin Otter
Stop Time	14:55:39 (53739)	**Retracker**	OCOG
Distance	69.650 km	**INS Resolution**	50 Hz
Duration	00 h 14 m 09 s	**Processor Version**	0309

A11_20080506

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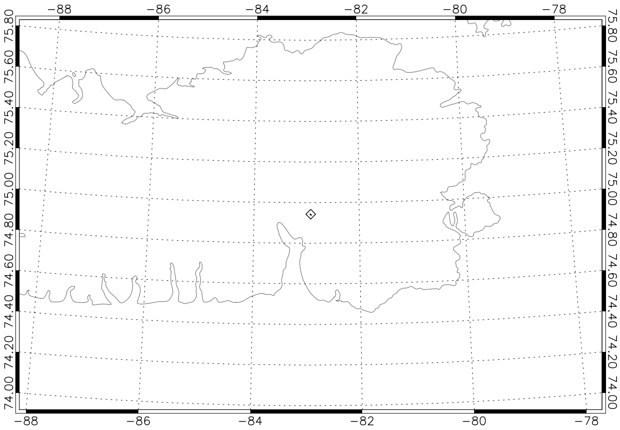

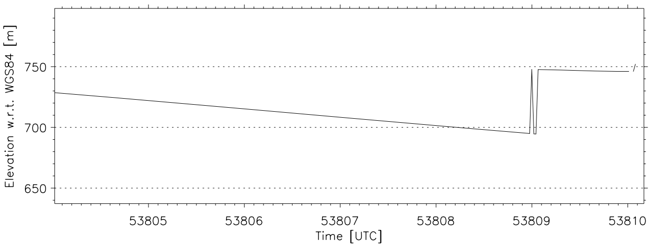

Date	2008-05-06	**Instrument Mode**	Adv. Low Altitude
Start Time	14:56:44 (53804)	**Aircraft**	DNSC Twin Otter
Stop Time	14:56:50 (53810)	**Retracker**	OCOG
Distance	0.509 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 06 s	**Processor Version**	0309

A12_20080506

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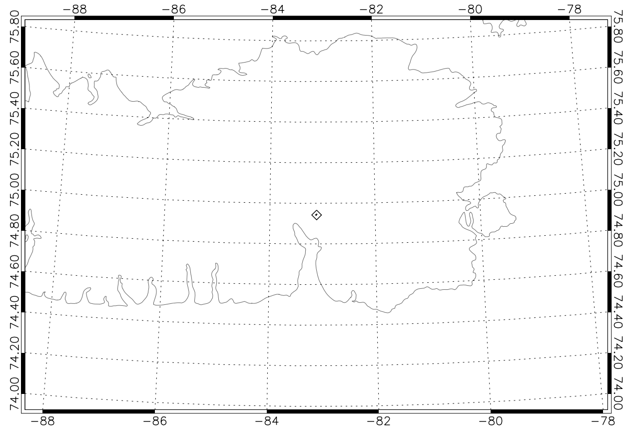

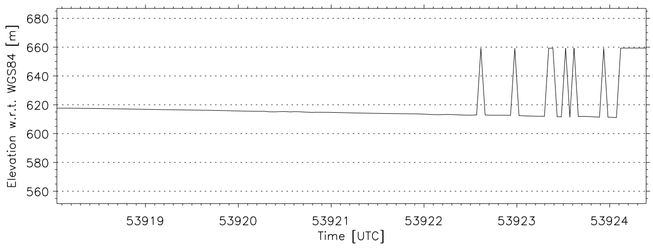

Date	2008-05-06	**Instrument Mode**	Adv. Low Altitude
Start Time	14:58:38 (53918)	**Aircraft**	DNSC Twin Otter
Stop Time	14:58:44 (53924)	**Retracker**	OCOG
Distance	0.492 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 06 s	**Processor Version**	0309

A13_20080506

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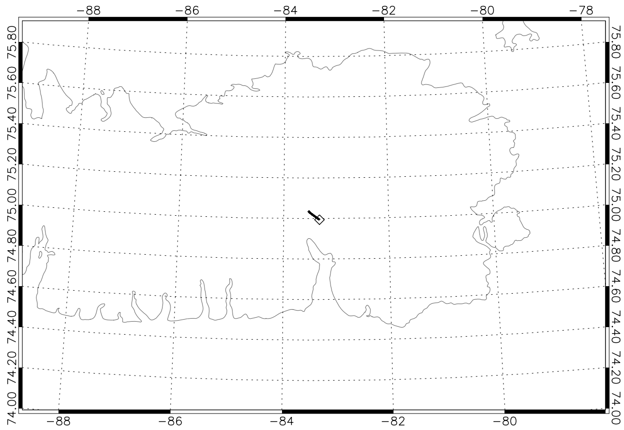
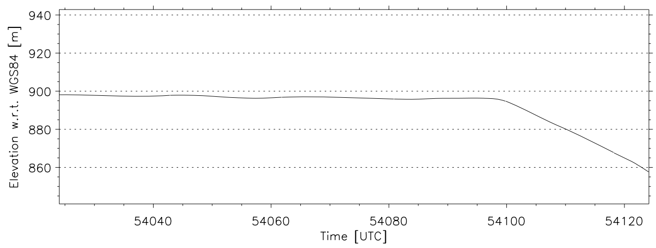
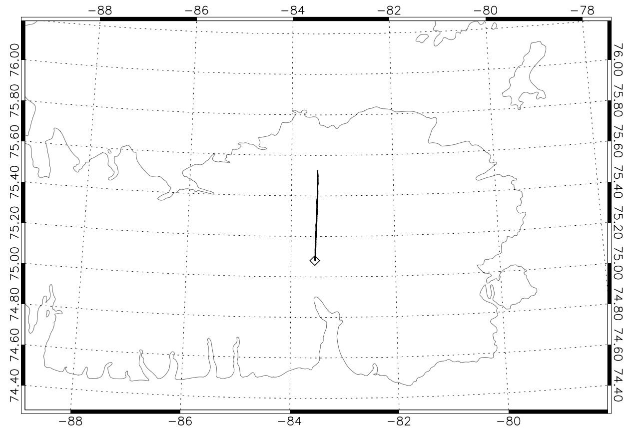


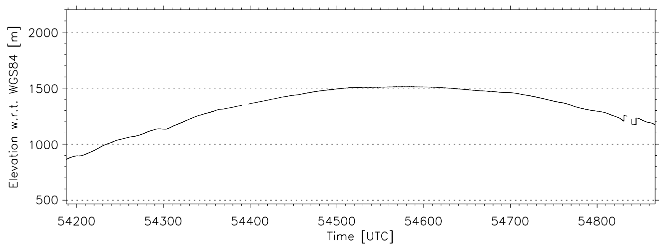


Date	2008-05-06	**Instrument Mode**	Adv. Low Altitude
Start Time	15:00:24 (54024)	**Aircraft**	DNSC Twin Otter
Stop Time	15:02:04 (54124)	**Retracker**	OCOG
Distance	7.813 km	**INS Resolution**	50 Hz
Duration	00 h 01 m 40 s	**Processor Version**	0309

A14_20080506

AS3TA14_ASIAL1B030920080506T150308_20080506T151427_0001.DBL





Date	2008-05-06	**Instrument Mode**	Adv. Low Altitude
Start Time	15:03:08 (54188)	**Aircraft**	DNSC Twin Otter
Stop Time	15:14:26 (54866)	**Retracker**	OCOG
Distance	49.681 km	**INS Resolution**	50 Hz
Duration	00 h 11 m 19 s	**Processor Version**	0309

A15_20080506

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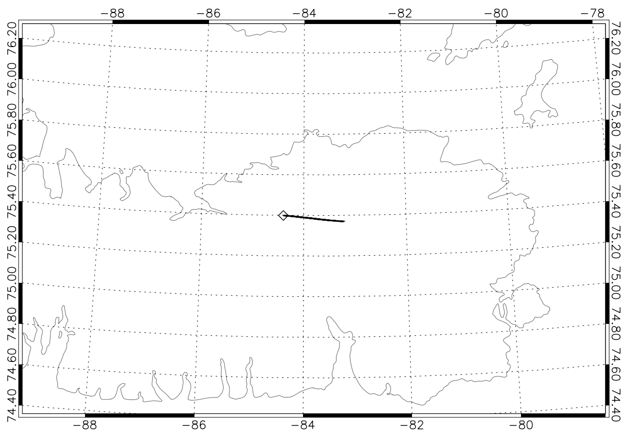

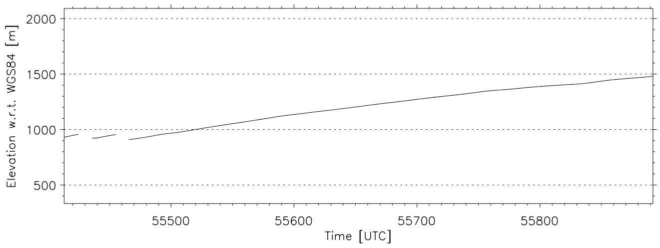

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Start Time	15:23:33 (55413)	**Aircraft**	DNSC Twin Otter
Stop Time	15:31:32 (55892)	**Retracker**	OCOG
Distance	33.591 km	**INS Resolution**	50 Hz
Duration	00 h 07 m 59 s	**Processor Version**	0309

A16_20080506

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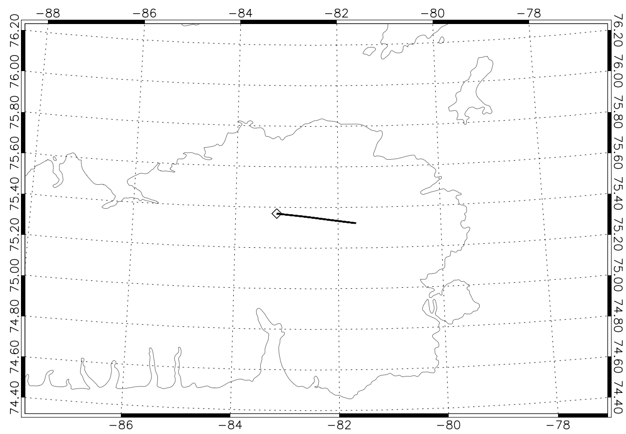

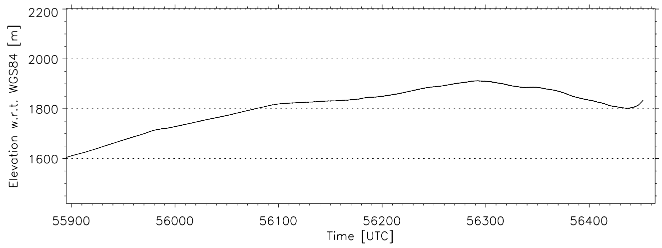

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Start Time	15:31:35 (55895)	**Aircraft**	DNSC Twin Otter
Stop Time	15:41:03 (56463)	**Retracker**	OCOG
Distance	43.692 km	**INS Resolution**	50 Hz
Duration	00 h 09 m 29 s	**Processor Version**	0309

A17_20080506

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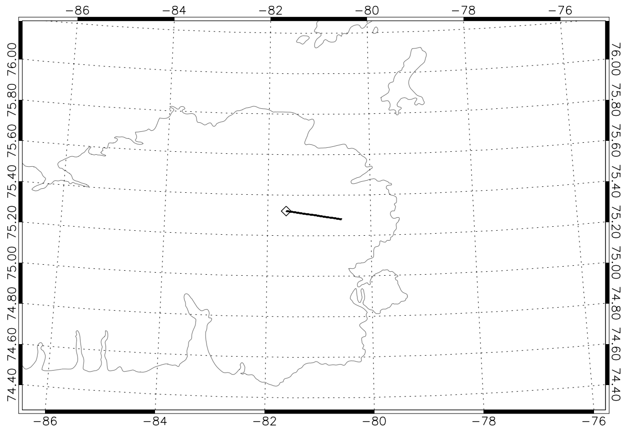
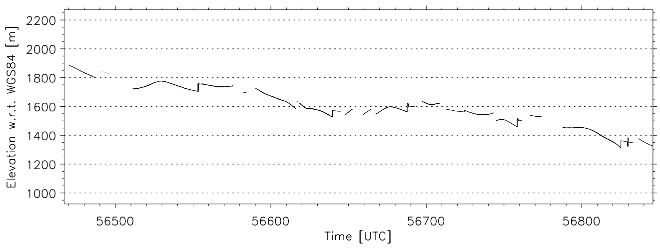
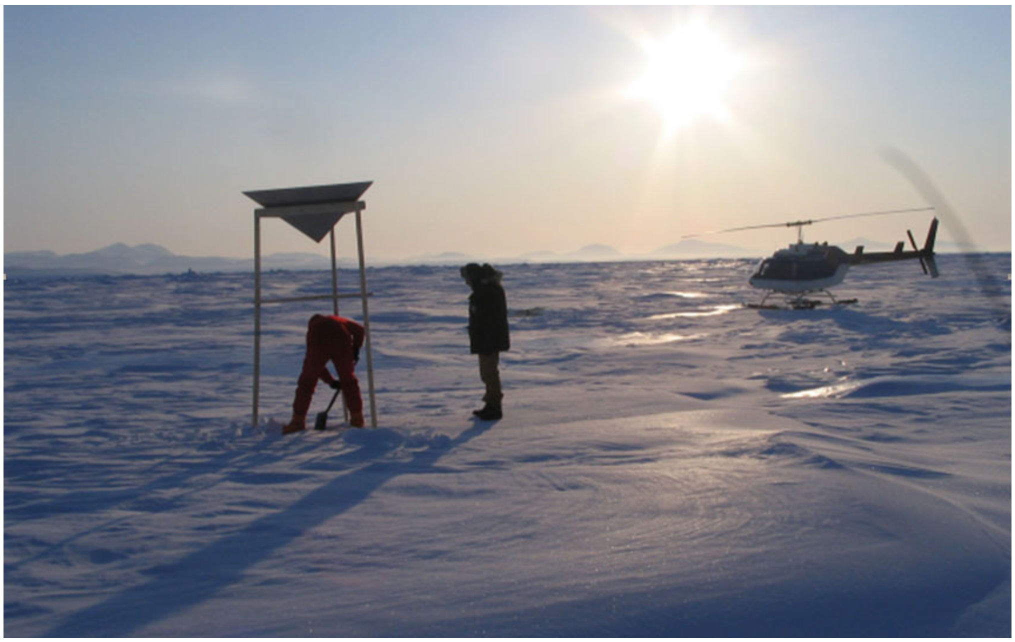




Date	2008-05-06	**Instrument Mode**	Adv. Low Altitude
Start Time	15:41:07 (56467)	**Aircraft**	DNSC Twin Otter
Stop Time	15:47:25 (56845)	**Retracker**	OCOG
Distance	30.718 km	**INS Resolution**	50 Hz
Duration	00 h 06 m 19 s	**Processor Version**	0309

CryoVex 2008

Field report of in-situ validation measurements



Compiled by Christian Haas[1,2], Susanne Hanson[3], Stefan Hendricks[1]

ESA/ESTEC contract 18677/04/NL/GS, CCN 4

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Table of Contents

Executive Summary

This report summarizes the ground activities of the Spring 2008 CryoSat Sea Ice validation campaign (CryoVEx 2008), which was performed between April 30 and May 7, 2008, at CFS Alert on Ellesmere Island, Nunavut, Canada. The campaign addressed major uncertainties of the ice thickness retrievals of the upcoming CryoSat mission. Measurements included the detailed gathering of ice and snow property data on selected first-year and multiyear sites, which were then overflown by ESA's ASIRAS airborne radar altimeter. This report discusses ice and snow thickness data obtained by drilling and helicopter-borne electromagnetic sounding, snow properties from snow pits, buoy deployments, as well as the erection of radar corner reflectors, which were all part of the CryoSat Calibration and Validation Concept.

Acknowledgement

The work was only possible through the strong support by the Canadian Polar Continental Shelf Project and Canadian Forces Station Alert, as well as by Jim Milne and Alain Tremblay. In addition to support by ESA, we acknowledge funding by national CryoSat Cal/Val programs as well as by the European Union Damocles project.

1. Introduction

This report summarizes the ground activities of the Spring 2008 CryoSat Sea Ice validation campaign (CryoVEx 2008), which was performed between April 30 and May 7, 2008, at CFS Alert on Ellesmere Island, Nunavut, Canada.

CryoVEx 2008 addressed most uncertainties of CryoSat sea ice freeboard retrievals over both first-year and multiyear ice as discussed in detail in ESA's CryoSat Calibration and Validation Concept (CVC; Wingham et al., 2001). It was undertaken by investigators from AWI, DNSC, the University of Alberta, Norwegian Polar Institute, and Scottish Association of Marine Sciences in the region of the Lincoln Sea, using Canadian Forces Station Alert as a logistical base (Figure 1). This campaign was the second pre-launch campaign in this region, after a successful first campaign in 2006. However, the 2008 campaign focused in particular on open issues remaining from the first campaign. Therefore, overall goals were as follows:

A) High Priority Goals

Assessment of

i) The validity of the overall validation concept of overlapping ground, helicopter, aircraft and satellite tracks over moving ice. This allowed to address uncertainties related to the conversion of freeboard to ice thickness, to variable footprint sizes of methods, and to preferential sampling of larger floes.

ii) the influence of deep snow cover and variable ice properties (first-year versus multiyear ice, rough surface due to ridges) on CryoSat waveforms and freeboard retrievals, in particular over deformed ice.

To meet these objectives the following actions were required.

For objective 1-i) (validation concept)

- Perform coincident surveys of sea ice freeboard, surface elevation, and ice thickness by means of simultaneous flights of ASIRAS and a laser scanner with a Twin Otter, and an EM instrument towed with a helicopter.
- Install some GPS buoys on the mobile ice to characterise drift and permit post-campaign simulation of validation concept
- Simulate a validation line for ASIRAS/Laser and EM acquisitions compensating for drift

For objective 1-ii) (snow influence)

- Identification of deep snow area overlaying ice (more than 30 cm) preferably in static/non-moving ice zone, and including snow over level and adjacent deformed ice
- Installation of corner reflectors and detailed characterization of snow/ice properties including ice thickness for the area beneath the flight tracks.

- Acquisition of joint helicopter and ASIRAS/Laser data over the validation lines demarcated by corner reflectors.

B) Lower Priority Goals
Assessing in detail the three dimensional structure of ridges in a small area, to study its density characteristics and its representation in ASIRAS and HEM data.

This objective required
- Characterisation of ridge properties on ground.
- Over flying with ASIRAS/laser and the helicopter EM system.

This activity was primarily addressed by the operation of an Autonomous-Underwater-Vehicle (AUV) by DAMPT, which gathered extensive data of the three-dimensional underwater morphology at a specific site close to the other main validation sites. Those activities and results are not discussed here, but will be available elsewhere.

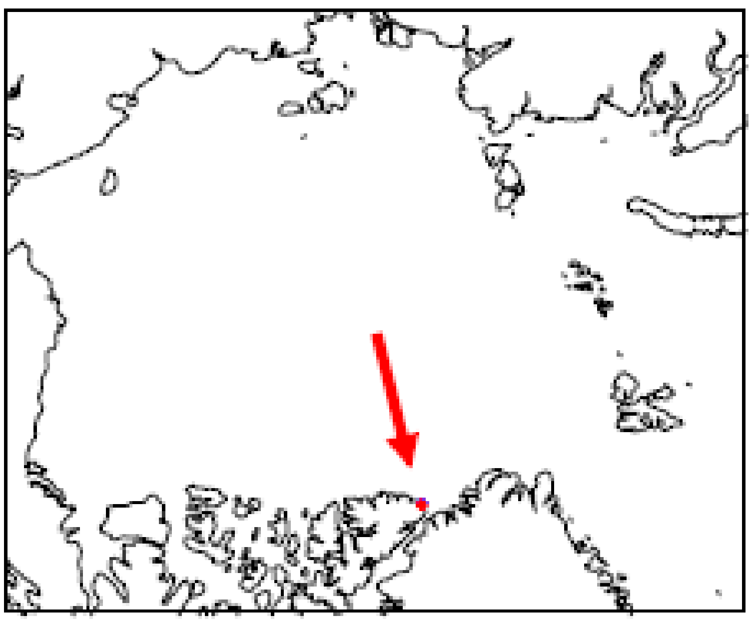


Figure 1: Map of the Arctic Ocean, showing the location of the CryoVex2008 ground measurements north of Ellesmere Island as red dot.

2. Validation sites

As in 2006, a region of fast ice had developed to the west of Alert, primarily composed of immobile multi-year ice floes, with some locally formed, level first year ice in between (Figure 2). This region was accessible by skidoos, and a large patch of first-year ice and an adjacent, virtually level patch of multiyear ice were chosen as main validation sites for the erection of corner reflectors and in-situ study of snow and ice properties (Figure 3).

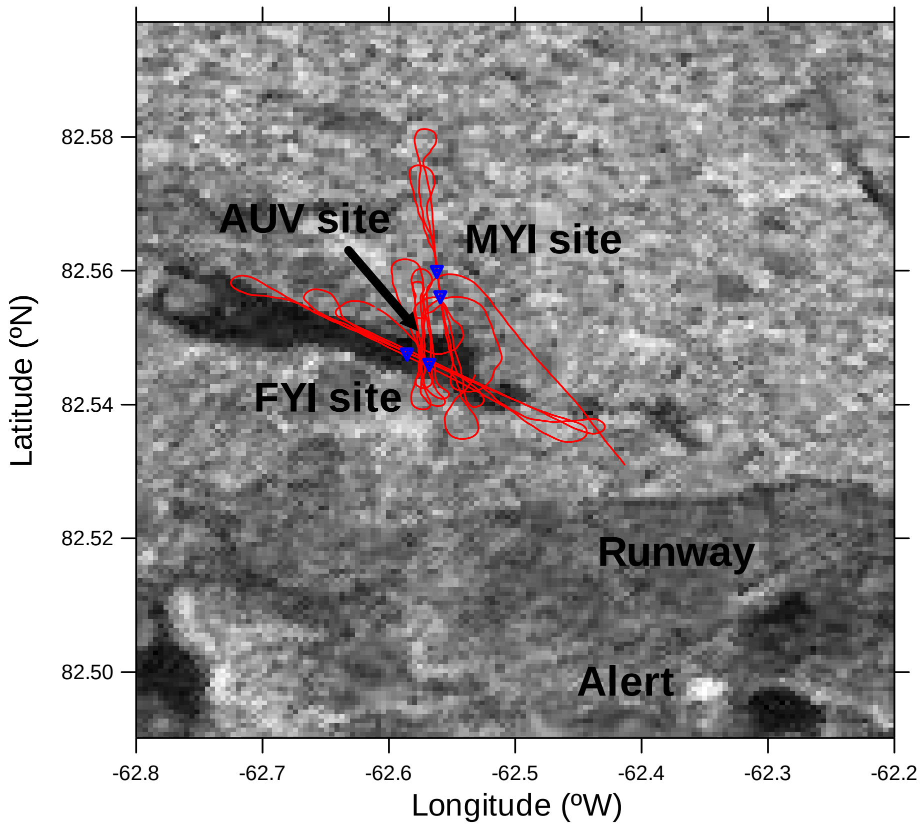


Figure 2: Envisat WSM SAR image (May 2, 2008) of fast ice region showing the two validation sites. Corner reflector locations are indicated by blue triangles, and HEM flight tracks are shown by red lines.

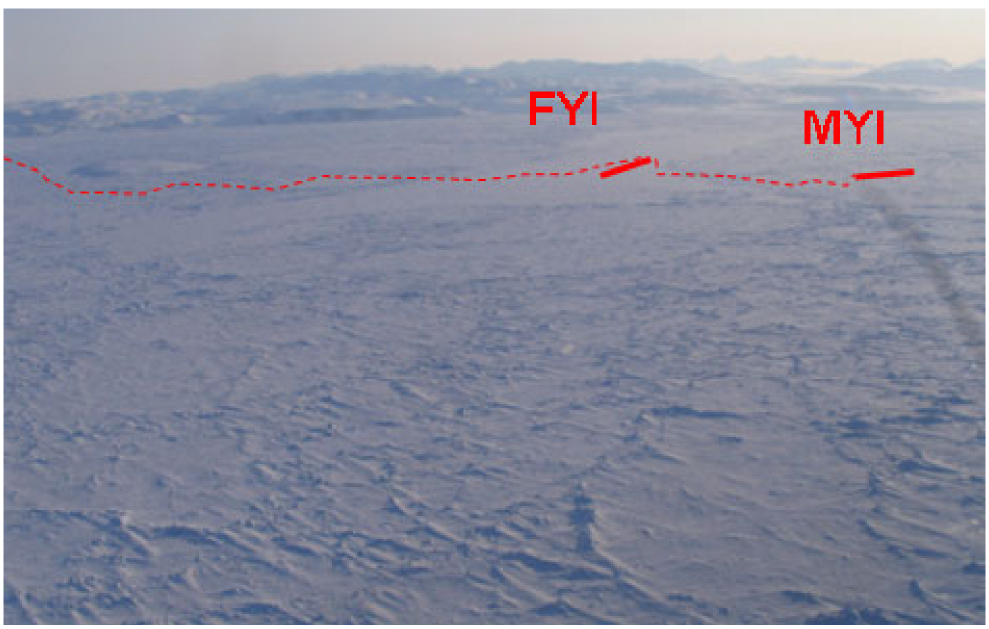


Figure 3: Aerial overview of first-year and multiyear ice validation sites of CryoVex 2006 on the fast ice at Alert. Stippled line indicates skidoo access route.

3. Measurements

On the validation sites, the following snow and ice properties were measured:

- Ice thickness profiles were obtained by means of drilling with cordless power drills and 5 cm diameter ice augers. Additional snow thickness measurements were performed with a 0.5 cm diameter metal meter stick with a pointed end. This metal stick was expected to be able to penetrate the high-density snow which caused a bias in the CryoVex2006 observations.
- Snow temperature, stratigraphy, density, grain size, and salinity were measured in few snow pits by standard glaciological means.
- Freeboard and surface elevation were measured by means of airborne surveys with a laser scanner and ASIRAS. All validation sites have been extensively overflown by ASIRAS on May 1, 2008 (Figure 4). Those flights are described in more detail and summarized in another report by S. M. Hvidegaard, H. Skourup, L. Stenseng, and R. Forsberg (2008), CryoVex 2008, Data acquisition report, DTU Space, July 2008, 33pp.
- Total ice thickness was measured by means of a helicopter-borne electromagnetic induction (HEM) sounder (Haas et al., 2008).

In addition, corner reflectors were erected at the endpoints of the validation lines and at a site on the drifting pack ice to provide reference and calibration of the radar altimeter measurements.

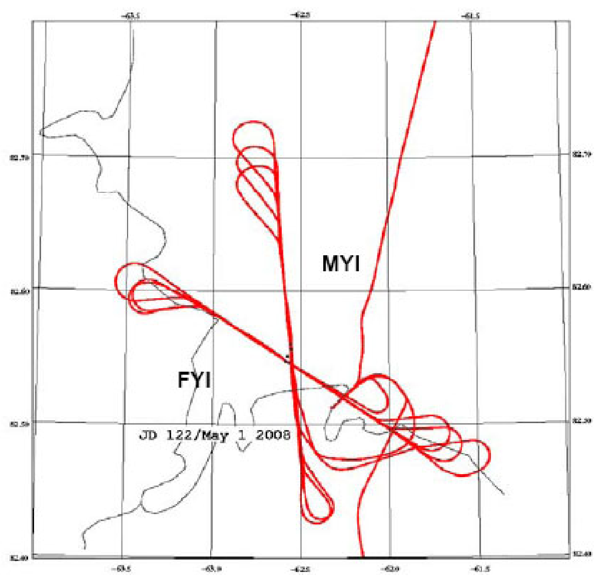


Figure 4: ASIRAS flight tracks over validation sites, obtained on May 1, 2008.

4. Properties of FYI

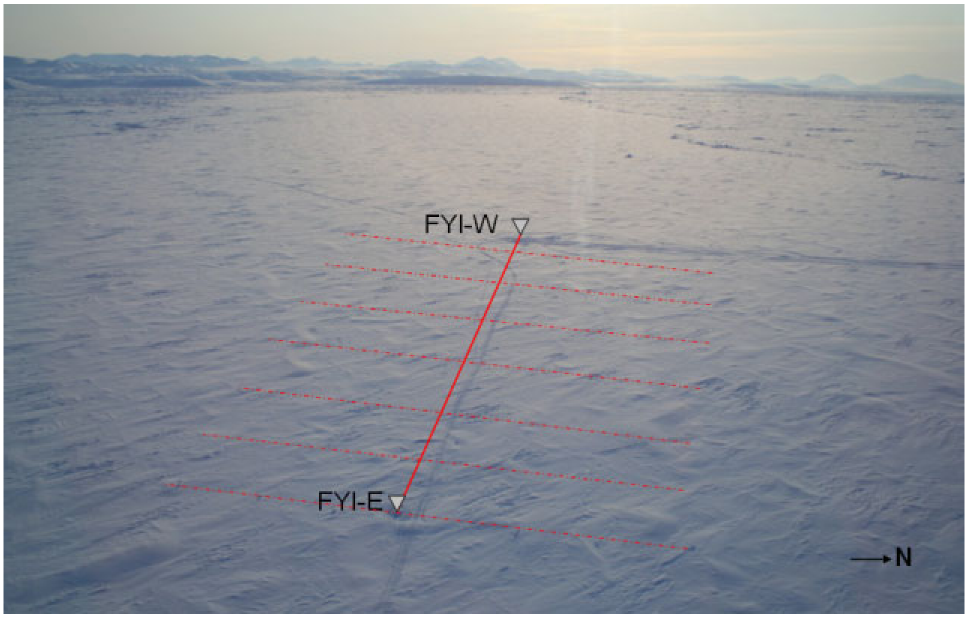


Figure 5: Aerial photo of the first-year ice validation site (view to the West), showing the location of the main line (solid) and cross-lines (stipled), and corner reflectors (triangles). Photo: Susanne Hanson.

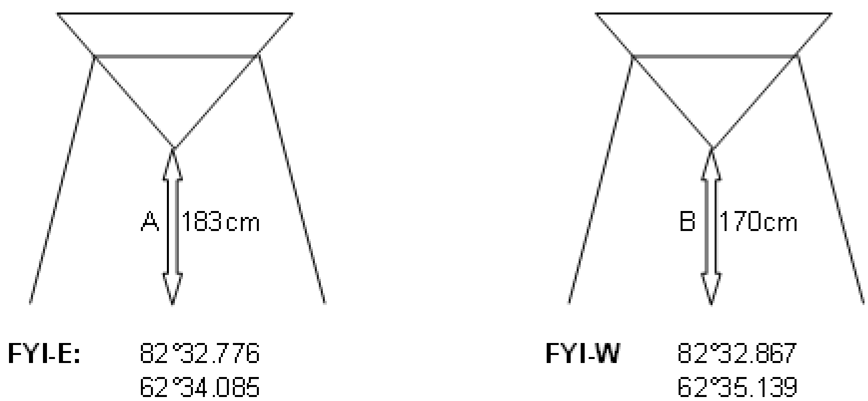


Figure 6: Locations and characteristics of the FYI corner reflectors

Ice thickness along the FYI validation line was very uniform with a clear mode of 1.5 m, and a mean ice thickness of 1.57±0.12 m (Figure 7). Mean snow thickness and freeboard amounted to 0.33±0.09 and 0.03±0.04 m. Figure 8 shows the resulting freeboard distribution. The modal freeboard was 0.08 m, and there were few locations with negative freeboard. As shown in Figure 5, ice and snow thickness have also been measured along 60 m long lines crossing the main line perpendicularly at X = 0, 50, 100, 150, 200, 250, and 306 m. Mean ice and snow thickness, and freeboard for all those measurements amounted to 1.51 ± 0.12, .34 ± 0.10, and 0.02 ± 0.05 m, showing the uniformity of the FYI patch.

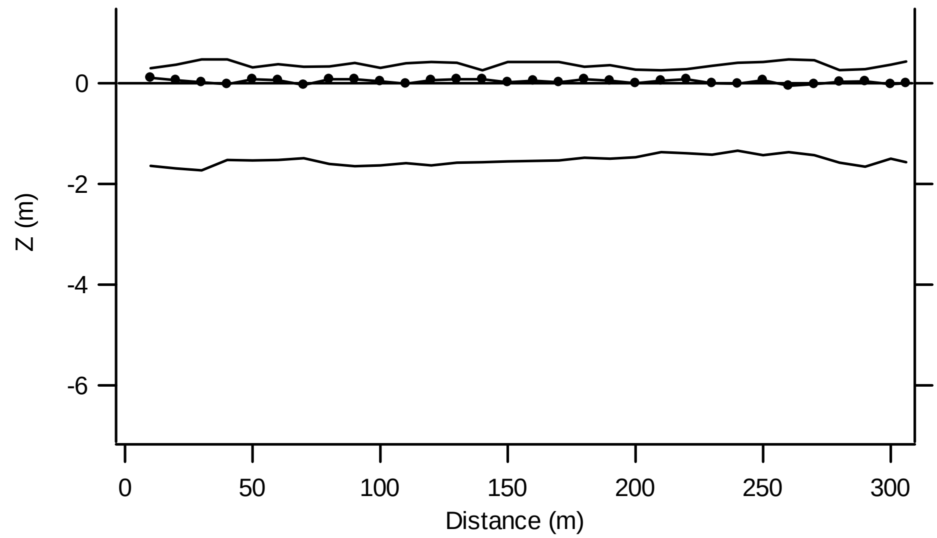


Figure 7: Drill-hole ice thickness profile along FYI validation line between eastern (at x = 0 m) and western (at x = 306 m). From top to bottom, surface elevation, freeboard, and draft are shown. Z = 0 m indicates the vertical location of the water level.

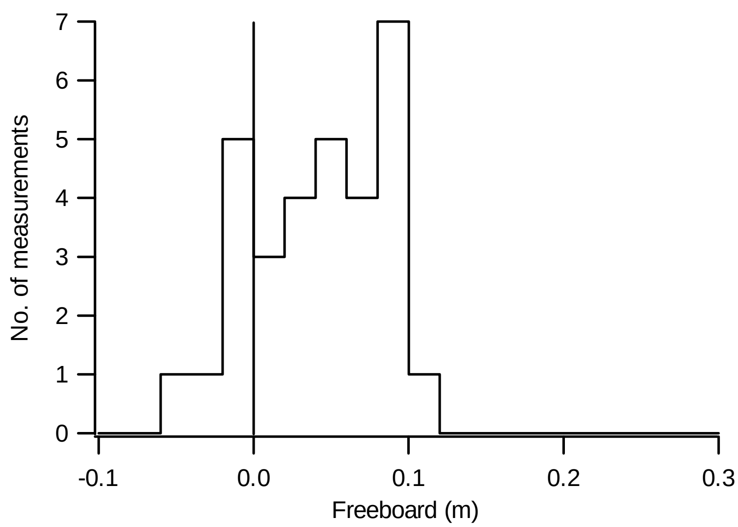
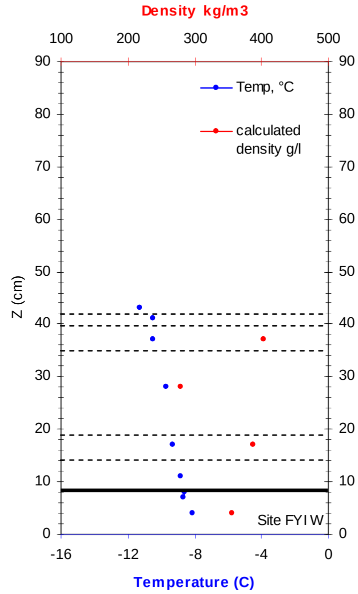


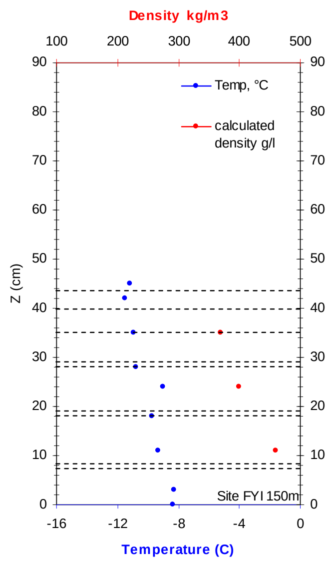
Figure 8: Freeboard distribution at FYI validation site (bin width 0.02 m).

Snow pit at western corner reflector:



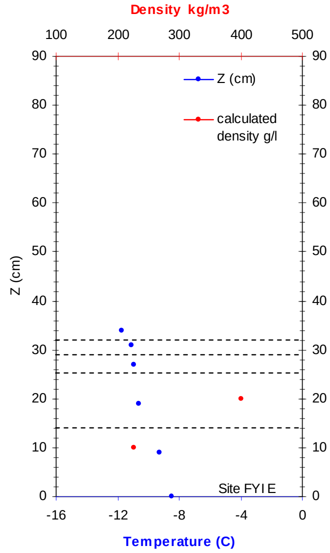
Notes:
Top: < 1 mm; II-A-2
40-35 cm: <1.5 mm; II-B-2; pencil
35-19 cm: 2-4mm; III-A-2 ; fist
19-14 cm: 1-5mm; III-A-2 ;finger
14-11: 1-3 mm:III-A-2 : finger
11-8 cm:1-3mm; III-B-2; pencil
8 cm: icy layer, individual grain recognizable, IV-A
8-0 cm: 2-5mm; III-A-2 ;
Surface wet, transition clear

Snow pit at 150 m along center thickness profile



Notes:
Top: < 1 mm; II-A-2
44-40 cm; 1 mm; II-B-2
40-29 cm: < 1mm; III-A-1 ; pecil
29-28 cm: 1-3mm;IV-A ; finger
28-19: 1-3mm; II-A-1; pencil
19-18 cm: 1-5 mm; III-A-1 -> III-A-2
18-7 cm: 1-2 mm; III-A-1 -> III-A-2 ; knife
7-0 cm: 1-5 mm; III-A-1 -> III-A-2 ; pencil
surface wet but well defined

Snow pit at eastern corner reflector



Note:
Top: <1mm; II-A-2
29-25cm: 1-2mm; III-A-1 ; finger
25-14cm: 0,5-2mm; III-A-2; pencil
14-0cm:1-7mm; III-A-3;fist
surface dry and clear

Table 2: Summary of data files for first-year ice site.

File name	Description
icethickness_snowdepth_FB.xls	Ice and snow thickness drill-hole data
snowpits_FYI.xls	Snow property data, photos, and plots
Cornerreflectors_sha.xls	Corner reflector information

5. Properties of MYI

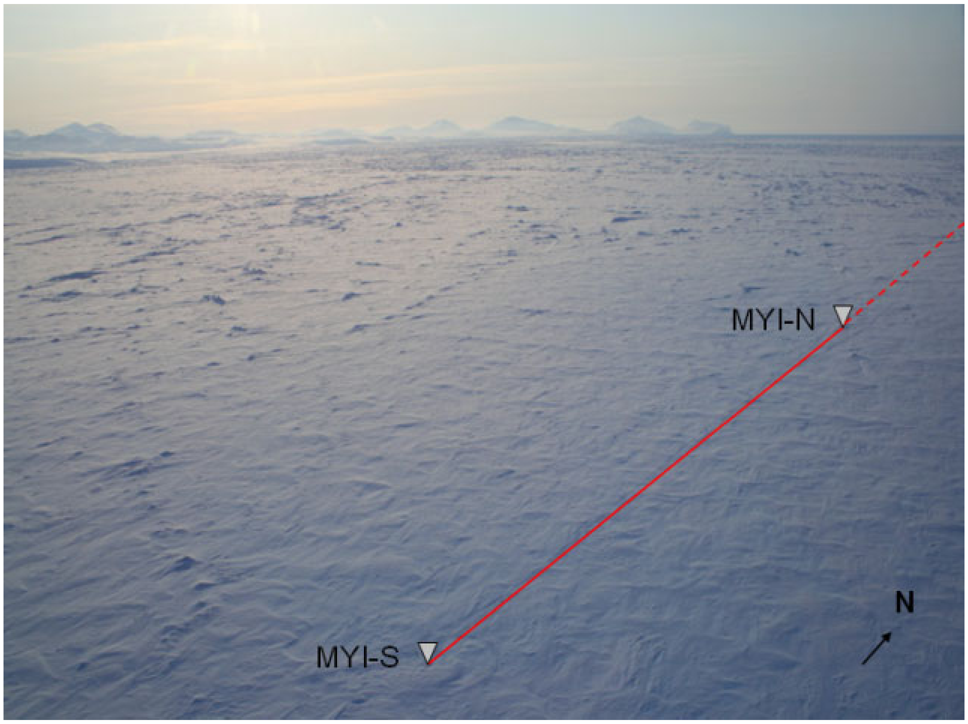


Figure 9: Aerial photo of the multiyear ice validation site (view to the Northwest), showing the location of the main line (solid) and cross-lines (stippled), and corner reflectors (triangles). Photo: Susanne Hanson.

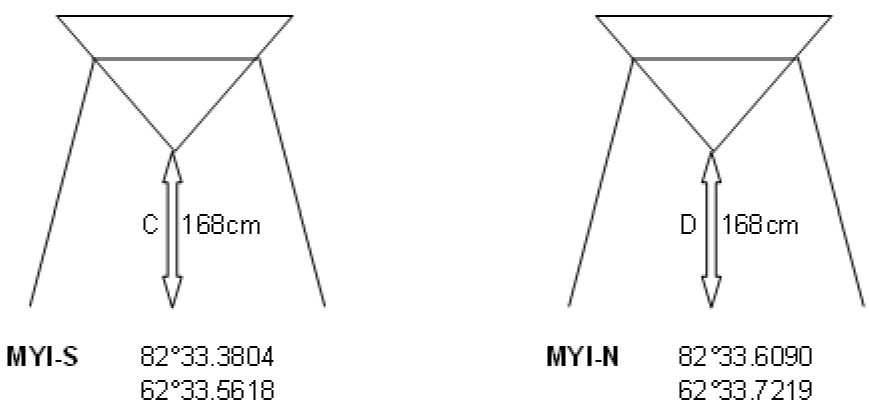


Figure 10: Locations and characteristics of the MYI corner reflectors.

There are too few measurements to calculate reliable statistics for the validation profile. However, the thickness distribution had two modes of 3.0 and 4.4 m, with a mean ice thickness of 4.47±1.45 m (Figure 11). Mean snow thickness and freeboard amounted to 0.43±0.19 and 0.39±0.29 m. Figure 12 shows the resulting freeboard distribution. The modal freeboard was 0.3 m, and there were even few locations with negative freeboard.

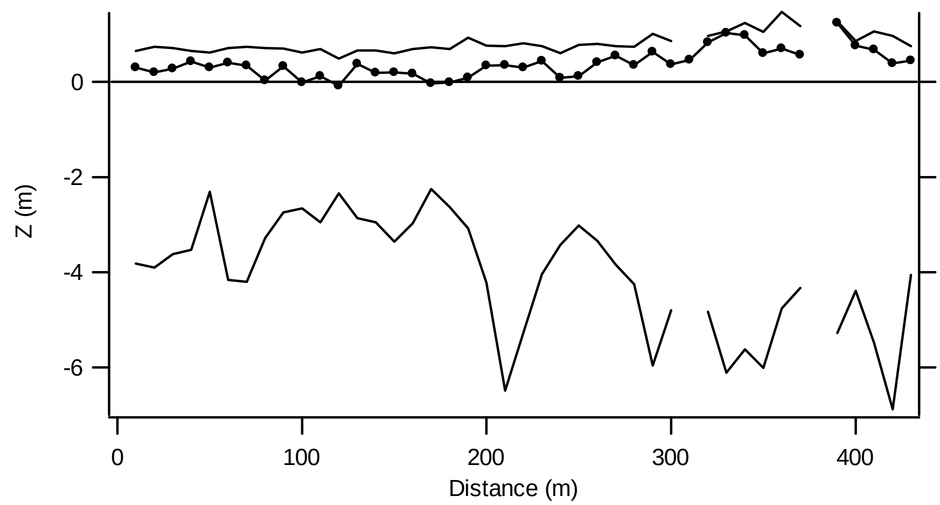


Figure 11: Drill-hole ice thickness profile along MYI validation line between southern (at x = 0 m) and northern (at x = 430 m). From top to bottom, surface elevation, freeboard, and draft are shown. Z = 0 m indicates the vertical location of the water level.

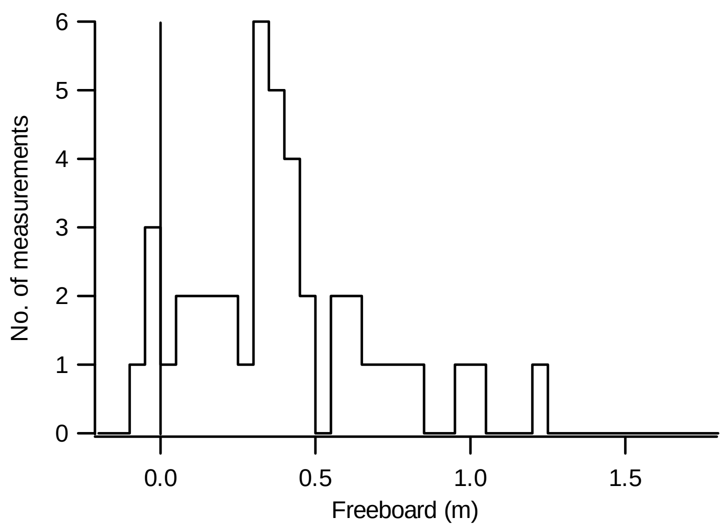


Figure 12: Freeboard distribution at MYI validation site (bin width 0.05 m).

During CryoVex2006, later analysis of ASIRAS data revealed that it would have been advantageous if snow thickness data would also have had been measured over the deformed ice regions. Therefore, here we extended the snow thickness measurements beyond the main validation line, including regions of more deformed multiyear ice to the north of the northern corner reflector, which were also overflown by the aircrafts. Figure 13 shows the snow thickness profile this obtained, and Figure 14 summarizes the snow thickness distribution. The mean snow thickness along this line was 0.58 ± 0.32 m, with several modes at 0.3, 0.4, and 0.7 m. Note that this snow thickness is lager than the 0.43 m thick snow on the relatively level main validation site.

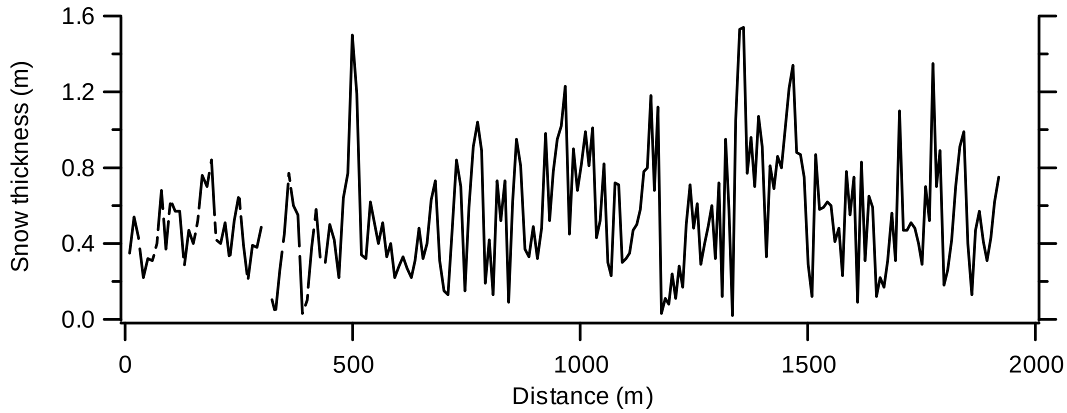


Figure 13: Snow thickness profile on the multiyear site. Stippled line shows measurements along main validation line (cf. Fig. 11), and solid line extends north from the northern corner reflector at x=0 m, in the same direction as the main line and aircraft surveys.

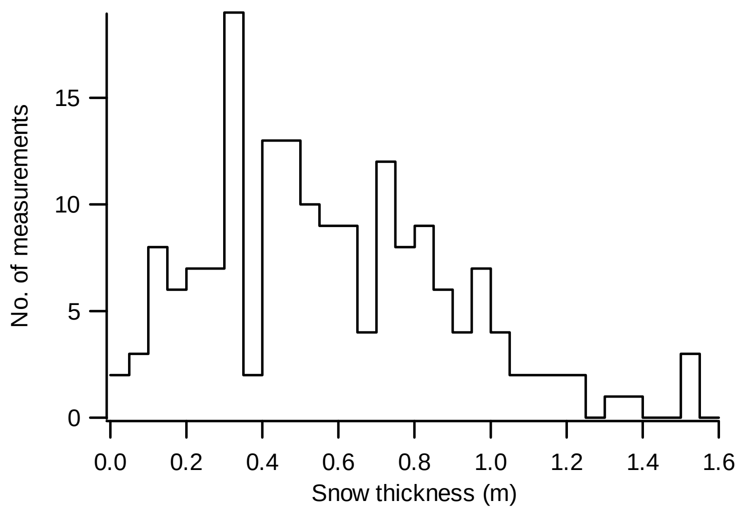
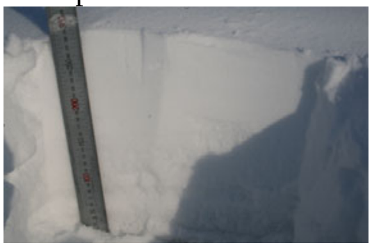
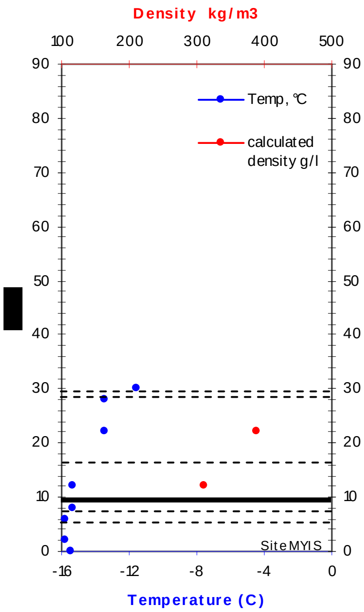


Figure 14: Snow thickness distribution along long snow profile on multiyear ice (cf. Figure 13).

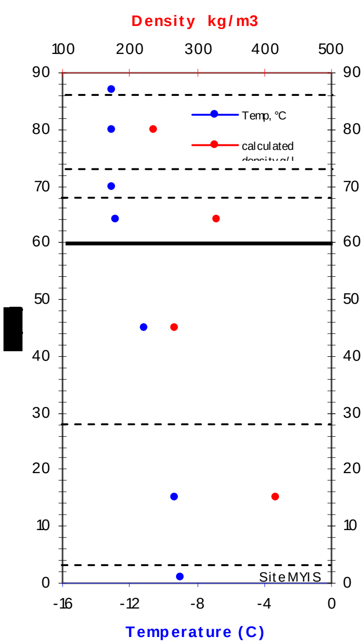
Snow pit at southern corner reflector





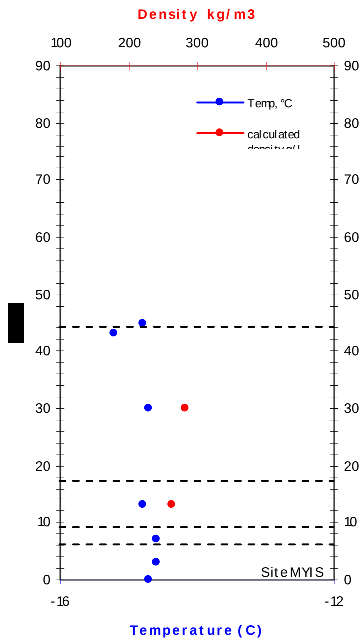
Note:
29-28cm:< 1 mm; II-A-2
28-16cm: < 1mm; II-B-2 ; fist
16-9cm: 1 mm; II-B-1 -> II-B-2 ; finger
9-7 cm: 2-3mm; III-A-1 ;fist?
7-5 cm; 1-3mm; III-A-1; knife
5-0 cm; 1-5mm; III-A-3 medium grained ; fist
Note:
29-28cm:< 1 mm; II-A-2
28-16cm: < 1mm; II-B-2 ; fist

Snow pit at 200 m along MYI thickness profile



Note:
86-73cm: <1m; I-B;finger
73-68 cm: <1mm; I-B;knife
68-60 cm:1 mm; II-B-2;finger
60 cm : ice lense
60-28 cm:1-6mm;III-A-2;fist
18-3cm:1-4 mm;III-A-3 medium grained;pencil
3-0 cm:1-8mm; III-A-3 mature
surface:dry

Snow pit at northern corner reflector



Note
44-17,5 cm: <1 mm;II-B-2;finger
17,5-9 cm: 1-6mm;III-A-2;fist
9-6cm: 1-3mm;III-A-2; knife
1-6 cm: 1-5mm;III-A-3 medium grained;fist

Table 2: Summary of data files for multiyear ice site.

File name	Description
icethickness_snowdepth_FB_allData.xls	Ice and snow thickness data
snowpits_MYI.xls	Snow property data, photos, and plots
Cornerreflectors_sha.xls	Corner reflector information

6. Fuel cache

A fifth corner reflector was deployed at a fuel cache at 83.73ºN, 65.17ºW, and was overflown by ASIRAS and HEM on the long, coincident flight on May 2, 2008. Information about the corner reflector is summarized in Figure 15. The corner reflector was located on a refrozen lead with very uniform ice conditions. Eight snow and ice thickness measurements revealed a mean snow thickness of 0.069 ± 0.02 m, mean ice thickness of 1.28 ± 0.02 m, and freeboard of 0.11 ± 0.01 m.

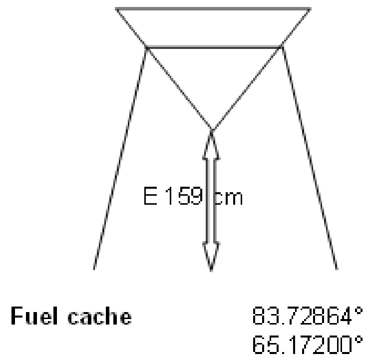


Figure 15: Locations and characteristics of the corner reflector deployed on FYI at the fuel cache.

13 drill-hole measurements were also performed over an approximately 180 m long, North-South profile over multiyear ice due south of the corner reflector, which lay directly over the coincident flight tracks of ASIRAS and the HEM surveys. Results are shown in Figure 16. In summary, mean ice and snow thickness, and freeboard were 2.31±0.28, 0.31±0.15, and 0.17±0.09 m, respectively. Note that this was significantly less than on the MYI validation site.

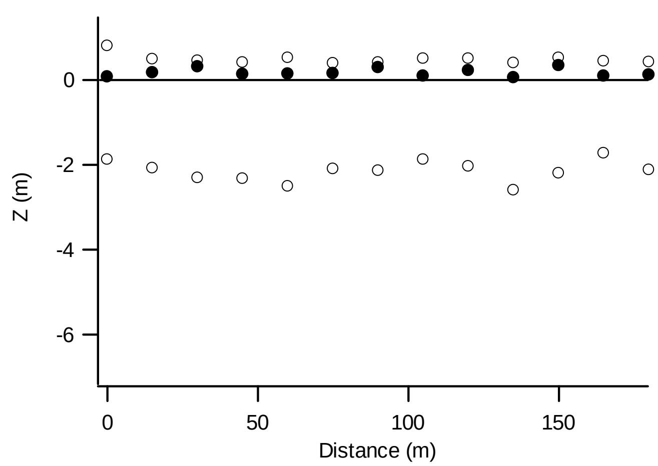


Figure 16: Drill-hole ice thickness measurements of multiyear ice south of the corner reflector location at the fuel cache. Symbols indicate surface elevation (top), freeboard, and draft (bottom), and have not been connected as distances are approximate. Z = 0 m indicates the vertical location of the water level.

Table 3: Summary of data files for fuel cache site.

File name	Description
Fuel_cashe_icethickness_snowdepth_FB_sha.xls	Ice and snow thickness data under corner reflector on FYI
fuel_cache_ice_rf.doc	Ice and snow thickness data of multiyear ice south of corner reflector

7. Buoy deployment sites

Snow thickness measurements with a spacing of ca. 8 m were also performed on three sites along the South-North coincident flight track. The sites were reached by helicopter and were also visited for the deployment of three GPS buoys to track the ice motion (see Section 9). Table 4 summarizes the results.

Table 4: Overview of snow thickness measurements at buoy deployment sites along South-North coincident flight track.

Buoy No.	Latitude	Longitude		N	Mean snow thickness (m)	Modal snow thickness (m)
6	83.2121	-65.0736	Level grey ice with uniform snow	19	0.05±0.00	0.05
8	83.4541	-65.0853	Heavily deformed MYI	53	0.50±0.16	0.35
4	84.2027	-65.5247	Heavily deformed MYI	47	0.40±0.18	0.2 & 0.35

Filename: SnowThickness bouy deployment_Haas.xls

8. HEM surveys

The validation lines were surveyed on May 1, 2008, after corner reflectors had been erected. Navigation was performed visually by the pilot aiming to over fly the corner reflectors as closely as possible.

8.1 First-year ice validation site

Figure 17 shows the repeated overpasses over the FYI validation line. The center line was surveyed 4 times with high navigational accuracy while two additional passes to the sides (Figure 18) sampled the ice at a distance of 30 to 60 meters to the center line. Within the validation line sea ice thickness showed only small variations (Figure 19). No significant thickness variations were observed to both sides of the line either.

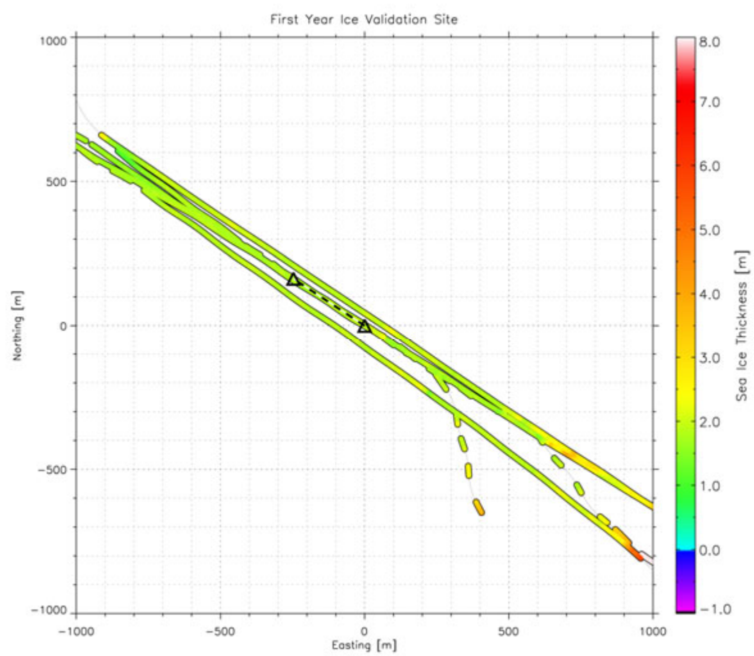


Figure 17: Map of FYI validation site with AEM sea ice thickness measurements. Triangles denote corner reflector positions.

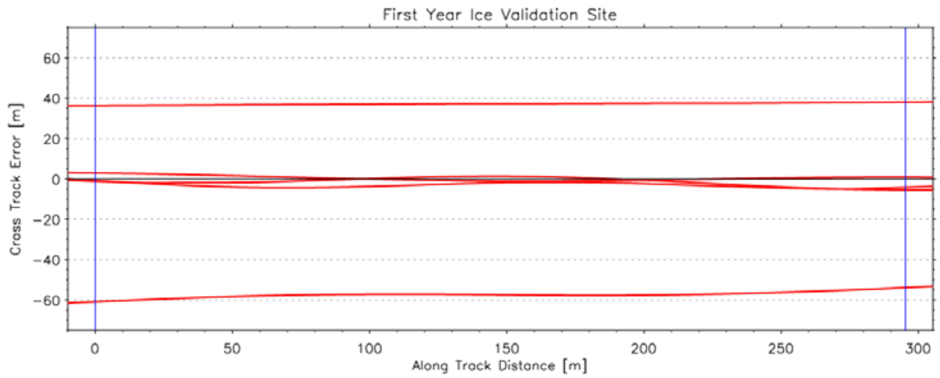


Figure 18: Navigational accuracy over repeated surveys of the FYI validation site. Vertical lines mark corner reflector positions

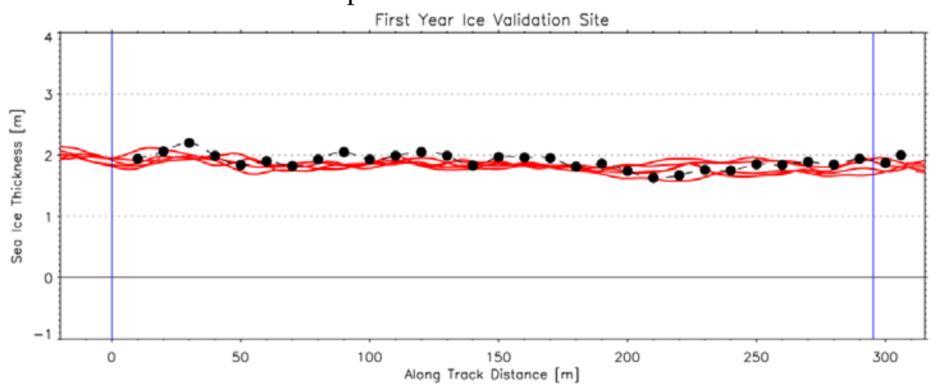


Figure 19: Ground truthing of AEM sea ice thickness with onsite drill hole measurements along the FYI validation site. Continous line: AEM data, Black dots: Drill hole measurements (snow depth+ice thickness). Vertical lines mark corner reflector positions.

8.2 Multiyear ice validation site

The validation line on the multiyear ice showed significantly higher ice thickness and thickness variations. On this site overpasses with an offset to the center line were omitted leaving 4 repeated surveys. The length of the line amounts to roughly 430 meters with a more north-south orientation (Fig. 20). Again navigational accuracy was better than 5 meters, yielding good agreement between the thickness results of the different overpasses (Figs 21 and 22).

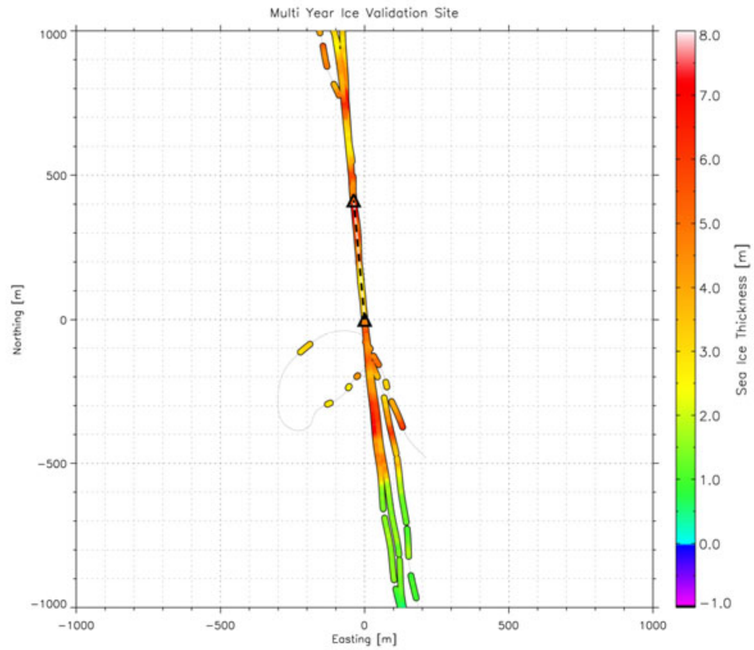


Figure 20: Map of MYI validation site with AEM sea ice thickness measurements. Triangles denote corner reflector positions.

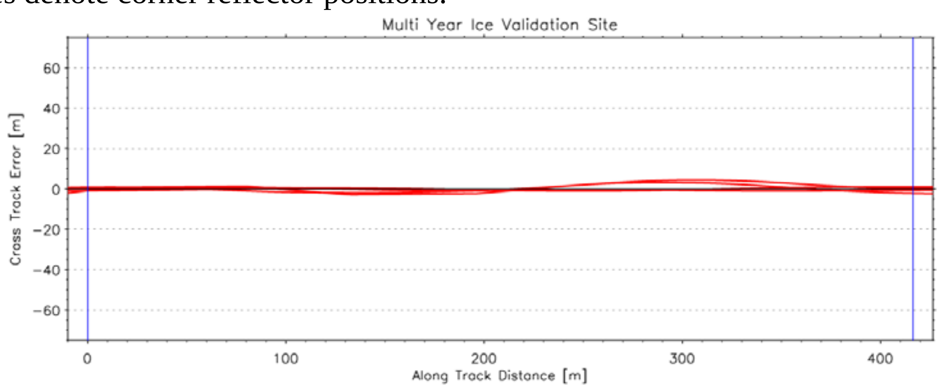


Figure 21: Navigational accuracy over repeated surveys of the MYI validation site. Vertical lines mark corner reflector positions.

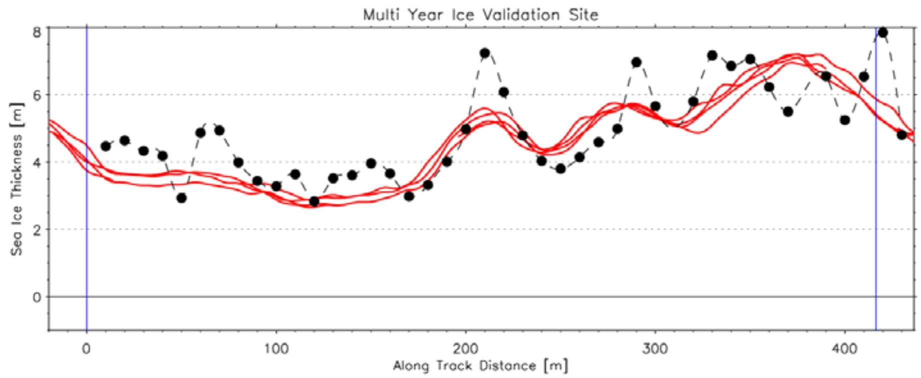


Figure 22: Ground truthing of AEM sea ice thickness with onsite drill-hole measurements along the MYI validation site. Continous line: AEM data, Black dots: Drill hole measurements (snow depth+ice thickness). Vertical lines mark corner reflector positions.

8.3 Coincident flight with ASIRAS

On May 2, 2008, a long northward HEM flight was performed to obtain ice thickness data together with ASIRAS. It was agreed to fly a straight line between two GPS waypoints defined by two buoys at the end point of the profile. The profile had been laid over the thicker multiyear ice to the west because the helicopter was not allowed to fly over the thin ice of the polynya. Preliminary analysis shows that coordination between the helicopter and the Twin Otter functioned very well, and the Twin Otter was overtaking the helicopter halfway along the profile. Navigation of the helicopter was controlled by monitoring the deviation of the helicopter from the predefined flight track by means of a handheld GPS. Whenever the helicopter deviated more than 50 m from the line, the pilot was instructed to change his heading accordingly. With this procedure, it was possible to keep the helicopter within 75 m of the center line throughout the profile, and well within the swath covered by the laser scanner on the Twin Otter. Figure 23 shows the ice thickness profile thus obtained.

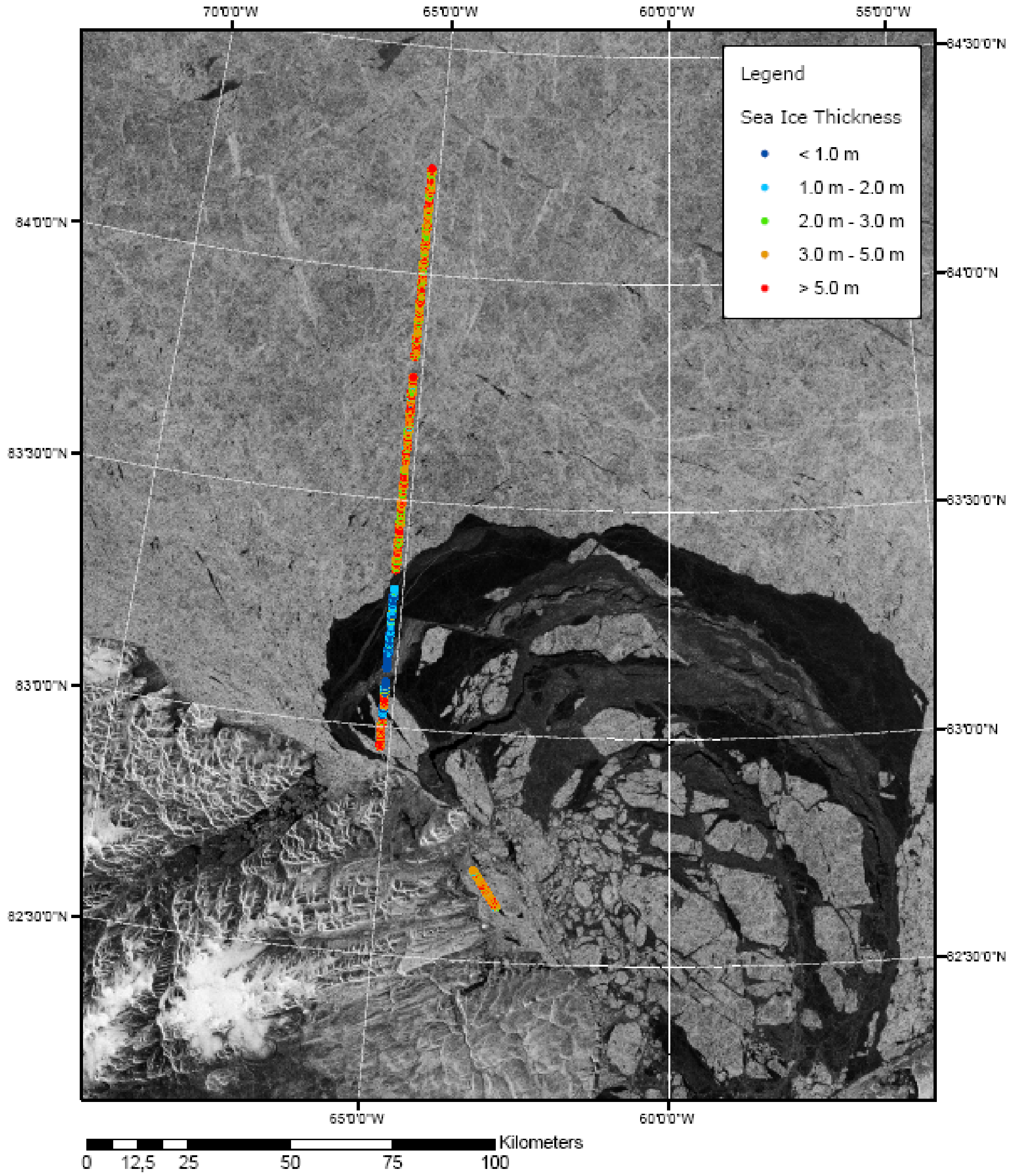


Figure 23: Envisat WSM SAR image of the Lincoln Sea (May 2, 2008, 23:16 UTC), showing ice thickness along the coincident flight track of ASIRAS and the HEM system surveyed on May 2, 2008, between 20:49 and 21:52 UTC.

9. Buoy operation

To ascertain that ASIRAS and the HEM were profiling the same ice, ice motion along the South-North coincident ASIRAS and HEM profile was monitored by means of four GPS buoys operated by Jeremy Wilkinson of SAMS. Buoys were deployed on the following positions:

	Latitude (º)	Longitude (º)
Buoy 4	84.2028	-65.5167
Buoy 1	83.7285	-65.1694
Buoy 8	83.4539	-65.0879
Buoy 6	83.2119	-65.0717

Figure 24 shows the relative buoy tracks between 19:00 and 24:00 UTC on May 2, 2008, during which period the flights were performed. The figure shows that ice drift was minimal, and amounted to less than 20 m of s-N and E-W displacement, respectively. It was hardly distinguishable from the noise inherent in the GPS measurements.

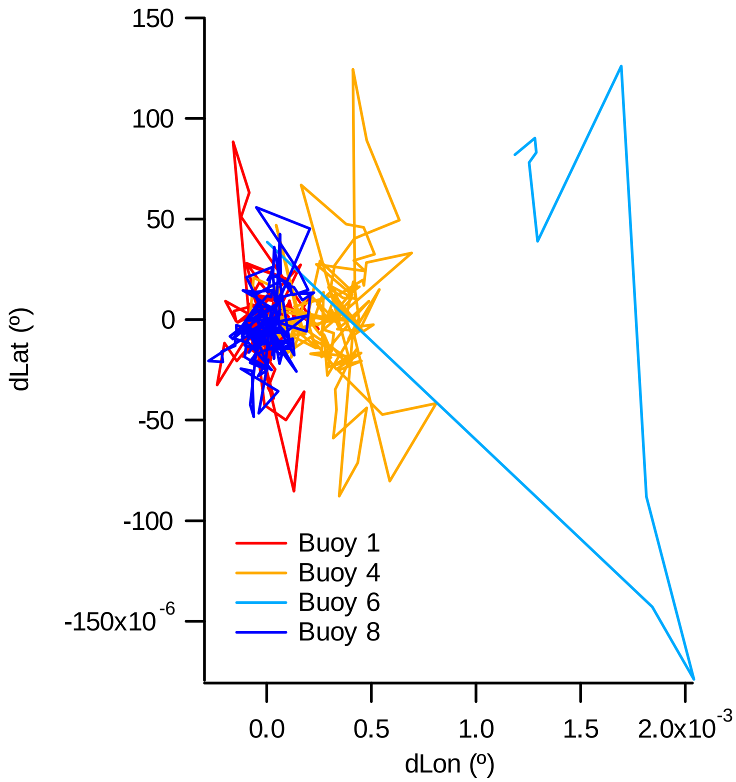


Figure 24: Displacements of buoys relative to their deployment position between 19:00 and 24:00 on May 2, 2008, along the ASIRAS/HEM coincident profile. The length of the abscissa and ordinate are approximately 25 and 30 m, respectively.

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