Storm Studies in the Arctic (STAR)
Data Report

Shannon Fargey[1], John Hanesiak[1], George Liu[1], Ronald Stewart[1], Klaus Hochheim[1], Mark Gordon[2], Peter Taylor[2], William Henson[3], Alex LaPlante[3], Gordon McBean[4], Walter Strapp[5], Zlatko Vukovic[5], Mengistu Wolde[6]

[1]Centre for Earth Observation Science (CEOS), Department of Environment and Geography, University of Manitoba
[2]Centre for Research in Earth and Space Science, York University
[3]Atmospheric and Oceanic Sciences Dept., McGill University
[4]Geography Department, University of Western Ontario
[5]Cloud Physics and Severe Weather Research Section, Environment Canada
[6]Convair Facility Flight Research Laboratory Institute for Aerospace Research National, Research Council Canada

Centre for Earth Observation Science (CEOS)
University of Manitoba
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STAR Project PI's
Dr. John Hanesiak (Manitoba)
Dr. Ronald Stewart (Manitoba)

Co-Investigators
Dr. David Barber (Manitoba)
Dr. Dylan Jones (Toronto)
Dr. Gordon McBean (Western Ontario)
Dr. Kent Moore (Toronto)
Dr. Peter Taylor (York)

Collaborators
Walter Strapp (Environment Canada)
Mengistu Wolde (National Research Council)
David Hudak (Environment Canada)
Jamal Shirley (Nunavut Research Institute at the time of STAR)
Mary-Ellen Thomas (Nunavut Research Institute)
Andrea Cull (INAC)
Ron Goodson (Environment Canada)
Ed Hudson (Environment Canada)
Rodica Nitu (Environment Canada)
Yvonne Bilan-Wallace (Environment Canada)
Bob Kochtubajda (Environment Canada)

STAR Network Manager
Teresa Fisico (Manitoba)

STAR Data Manager
Zhuo (George) Liu (Manitoba)

Research Associates
Klaus Hochheim (Manitoba)
Vlad Petrusevich (Manitoba)

Post Doctoral Fellows (PDFS)
William Henson (McGill)
Rebekah Martin (Manitoba)
Mark Gordon (Trent University)
Shunli Zhang (Toronto)

Students (PhD and Msc)
Shannon Fargey (Manitoba), Gabrielle Gascon (Mcgill), Robin Dyck (Manitoba)
Alex LaPlante (Mcgill), Sumita, Biswas (York), Danielle Desjardons (Manitoba)
Marna Albarran-Melzer (University), Carling Hay (Toronto), Robert Field (Toronto),
Heather Greene (McGill), Jadah Folliott (Western Ontario)

i. STAR Data Access Policy

i.i. INTRODUCTION

The Storm Studies in the Arctic (STAR) Data Access Policy has been established to promote and govern the access of data collected within the STAR research area by STAR Co-Investigators (Co-Is), STAR Collaborators, Partners, non-participants, and other Canadian and International groups during the lifetime of STAR (up to December 31, 2010).

STAR embraces as open an approach as possible to the exchange and access to data for scientific and noncommercial/non-profit uses. This approach must respect the rights of the data originators who have invested considerable effort in obtaining and/or generating data. For this reason, policies for those participating in STAR are different from those not participating or contributing to the project. These policies are described in the following sections. All relevant terms are defined in Section 7.

i.ii. REQUESTS FROM STAR INVESTIGATORS

Requests from STAR Co-Is, Collaborators and Partners will be given priority over non-participants in the project until December 31, 2010. Access to datasets for STAR research will be unrestricted to STAR Co-Is and Collaborators after the data have been quality-controlled and documented by the originating STAR Co-I. STAR Collaborators will direct their data requests through their associated STAR Co-I.

i.ii.i. Special STAR Datasets

Special STAR-funded datasets (observations and model results) can be obtained by STAR Co-Is through the STAR WWW site. To ensure that only STAR Co-Is and Collaborators have access, this portion of the STAR WWW site is password protected. Passwords will be supplied by the STAR Information Manager. STAR datasets can also be obtained directly from the originating STAR Co-I.

STAR Co-Is have a responsibility to make their STAR-funded datasets openly available to other STAR Co-Is and Collaborators after an initial reasonable period for quality control and documentation (following the STAR Data Documentation Guidelines). This period will nominally be no longer than one year unless there are special circumstances (for example, if early release of data would jeopardize a graduate thesis) and an extension is granted by the Science Committee. After this quality control period, use of the data

will be restricted to other STAR Co-Is and Collaborators up to and including December 31, 2010, after which time all data becomes publicly available.

i.ii.ii. Operational Datasets [MSC Climate Datasets]

Operational datasets from the Meteorological Service of Canada (MSC) climate archive will be made freely available to STAR Co-Is, Collaborators and Partners, only for use in their STAR research. Use of data obtained from the climate archive is governed by the MSC Data Product Licence Agreement (Appendix). STAR Co-Is and Collaborators are urged to read this agreement carefully. Access to the data will be available from the password protected portion of the STAR WWW site. This will ensure that only STAR Co-Is and Collaborators have free access to the operational datasets. Passwords will be assigned by the STAR Information Manager.

i.iii. REQUESTS FROM NON-PARTICIPANTS

Requests for data from the research community at large are invited, but requests by non-participants need to be approved on a case-by-case basis. Non-participants may become STAR Co-Is by teaming with a STAR Collaborator, who will subsequently apply to the STAR Science Committee for permission to allow the new STAR Collaborator. Alternately, non-participants may apply to the STAR Science Committee to become a STAR Partner (following the STAR Partnership Policy). All STAR data will be publicly available by December 2010, which coincides with the official end date of the STAR project.

i.iii.i. Special STAR Datasets

Special STAR datasets (Observational and Modeling results) will only be made available to nonparticipants after December 31, 2010, unless they have become a STAR collaborator.

i.iii.ii. Operational Datasets [EC/MSC Climate Datasets]

Operational datasets from the Environment Canada MSC climate archive will not be supplied to nonparticipants by STAR. These datasets can be obtained from the Climate Information Branch of Environment Canada. Similarly, archived model output data may be obtained from the Canadian Meteorological Centre. Charges for the data and additional data use restrictions may apply.

i.iv. REQUESTS FROM COMMERCIAL ENTITIES

Permission for anyone (STAR Co-Investigators, STAR Collaborators, Partners or non-participants) to use STAR datasets for commercial/profitable purposes must be given by the STAR Science Committee.

i.v. REQUESTS FROM OTHER NATIONAL AND INTERNATIONAL GROUPS

National and international commitments for sharing of STAR datasets before the data becomes public will be considered on a case-by-case basis by the STAR Science Committee.

i.vi. DATA ACKNOWLEDGMENT

Any use of STAR datasets, by STAR participants (Co-Is, Collaborators, or Partners) or non-participants, requires citation in any resulting publications of the STAR dataset and, when applicable, citation of earlier studies by the STAR Co-I responsible for which the data were obtained. Appropriate citations are included with many of the STAR datasets. If you would like to cite data for which a citation is not provided, please contact the STAR Information Manager for help in citing the data.

Acknowledgement of the use of STAR data should also be made using a statement with the following format: "The [***] data in this paper was provided by the Storm Studies in the Arctic (STAR), a Canadian Foundation for Climate and Atmospheric Science Network." where [***] refers to the actual STAR data used.

i.vii. DEFINITIONS

i.vii.i. STAR Dataset

A STAR dataset can be:
- observational, either station data or gridded data, resulting from STAR-funded work, or
- model derived output, either utilizing STAR special observations or resulting from STAR-funded work

i.vii.ii. STAR Co-Investigator (Co-I)

A STAR Co-Investigator (Co-I) is defined as one who:
- contributes scientifically to STAR, and
- has been recognized as such by the STAR Science Committee.

i.vii.iii. STAR Collaborator (Collaborator)

A STAR Collaborator (Collaborator) is defined as one who:
- is working with a STAR Co-I, and

- has been recognized as such by the STAR Science Committee.

i.vii.iv. STAR Partner

A STAR Partner is defined as one who:
- contributes scientifically to STAR, but is not a STAR Co-I or Collaborator,
- has been recognized as such by the STAR Science Committee.

i.vii.v. Non-Participant

Non-participating researchers include any researchers who are not STAR Co-Investigators, STAR Collaborators or STAR Partners. Non-Participants include the general public.

i.viii. Appendix

Limited use software and data product license agreement for Meteorological Service of Canada supported research projects.

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FOR FURTHER INFORMATION PLEASE CONTACT:

Climate and Water Products Division
Environment Canada
4905 Dufferin Street
Downsview, Ontario
M3H 5T4
Tel: (416)739-4328
Fax:(416)739-4446

ii. STAR Data Policy

The STAR Network data policy statement is intended to be used as a basis for establishing the national policy concerning access to STAR data, and to promote internationally the mutual access to STAR data where appropriate. The policy statement is as follows:

- The STAR Network requires an early and continuing commitment to the establishment, maintenance, validation, description, accessibility, and distribution of high-quality, long-term data sets.
- Full and open sharing of the full suite of global data sets for all STAR researchers is a fundamental objective.
- Preservation of all data needed to meet STAR research objectives is required. A clearinghouse process should be established to prevent the purging and loss of important data sets.
- Data archives must include easily accessible information about the data holdings, including quality assessments, supporting ancillary information, and guidance and aids for locating and obtaining the data.
- National and international standards should be used to the greatest extent possible for media and for processing and communication of global data sets.

- Data should be provided at the lowest possible cost to STAR researchers in the interest of full and open access. This cost should, as a first principle, be no more than the cost of reproduction and distribution. Agencies should act to streamline administrative arrangements for exchanging data among researchers.
- Data, whether standard network data or special data collected by projects supported by STAR, should be made openly available beyond an initial reasonable period for quality control.

iii. STAR Data Documentation Guidelines

To assist in meeting the objectives of STAR to understand severe weather and climate over southern Baffin Island, and to provide a useful and lasting legacy for further research, it is necessary that all data collected for STAR, both observational and significant model results, be properly documented.

It is the responsibility of the originating STAR Co-I to ensure that the data collected is properly documented. The STAR Data Access Policy provides for a time period after data collection for the STAR Co-I to quality-control and document his/her data. With respect to model output, the end of a data collection period is defined as the model run after a significant model revision (e.g. change of physics; improved routing; coupling). Data documentation should be complete enough to allow unfamiliar researchers to replicate and use the data in the future. The observational data documentation should contain the following headings:

iii.i. STAR Observational Data Documentation Guidelines

1. Title
2. Abstract -Name the dataset and describe why the measurement was undertaken and how it relates to STAR.

3. Contact Information -Give sufficient detail (name, affiliation, full address, telephone and fax numbers, e-mail, etc.) to contact those most knowledgeable about the dataset.

4. Site Description - including the following:
- Data Period(s) and Location(s)
- Equipment used -including manufacturer and model numbers.
  Methods/Software used - in acquiring the data.
- Data Format - including examples.

5. Data Processing/Quality Control - including the following:
- Methods/Software used - in acquiring and processing the data
- Post-Collection Data Processing -description of any processing done on the data.

- Quality Control Methods - give an indication as to the degree of quality control.
- Datasets Archived -original "raw" data should be one of the archived datasets in addition to any processed or QCed data.

6. References
- The model data documentation should contain the following headings:

iii.ii. STAR Model Data Documentation Guidelines

1. Title - Model name, version number.

2. Abstract -briefly describe the model and its properties and describe why the model run was undertaken and how it relates to STAR.

3. Contact Information -Give sufficient detail (name, affiliation, full address, telephone and fax numbers, e-mail, etc.) to contact those most knowledgeable about the model run.

4. Run Description - including the following (valid web links acceptable):
- Period(s) and Location(s)/Resolution/Map Projection
- Initialization and Boundary Data used
- Model used - complete description of the model, physics package, any coupling state, etc.
- Data Format - including examples.
- Archive Location/Media - online link or offline contact person.

5. References

Examples of documentation are available and the STAR Information Manager is available to assist with production of documentation. These guidelines must be reviewed on an annual basis. At that time, the guidelines may be modified to improve its usefulness.

1 Introduction

The Canadian Foundation for Climate and Atmospheric Sciences (CFCAS) funded, Storm Studies in the Arctic (STAR) project is a field based research network to study Arctic storms and extreme weather over the southern Baffin Island region. The overall objective of this 4-year (2007-2010) STAR project is to better understand severe Arctic storms and their associated hazardous conditions (e.g. blizzards, reduced visibility, wind chill, significant precipitation accumulation), and contribute to their better prediction. Field measurements were collected during two field campaigns, in fall 2007 (October 1 – Dec 2, 2007) and winter 2008 (February 2 – April 1, 2008).

1.1 Study Site Description

1.1.1 Geography

This research project is primarily concerned with southern Baffin Island, where Iqaluit - the capital and most populous city in Nunavut - is situated. Iqaluit is located at the head of Frobisher Bay in the Sylvia Grinnell River valley (Figure 1). Two mountain ranges dominate the area surrounding Frobisher Bay, the Meta Incognita Peninsula, west-southwest of Iqaluit, and the Hall Peninsula to the north and northwest of Iqaluit. The Meta Incognita Peninsula is characterized by low mountain ranges with a typical elevation of 600 m, with peaks to about 750 m within 50 of Iqaluit. On Hall Peninsula, the mountains are generally higher, reaching about 1,000 m within 100 km of the city, with a maximum elevation of 1,295 m close to the southwest coast of Cumberland Sound. The largest topography on Baffin Island is observed on the Cumberland Peninsula, north of Pangnirtung, where elevations are in excess of 2000 m.

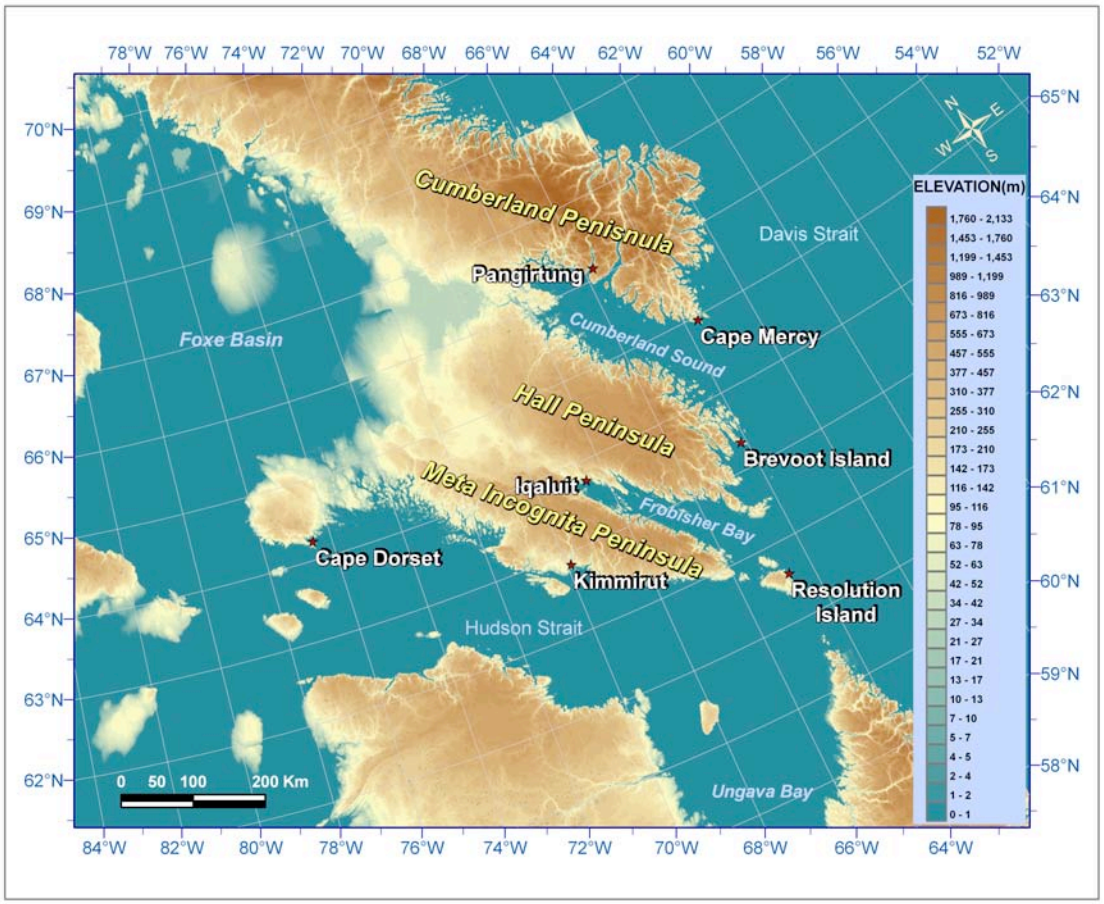


Figure 1: Topographic map of southern Baffin Island. Standard Environment Canada hourly surface weather reporting stations are marked in the white text

The topography surrounding Iqaluit strongly influences the prevailing winds; offshore winds are northwesterly while onshore winds southeasterly, following the topography outlined above (Nawri and Stewart, 2006). Nawri and Stewart (2006) reported that northwesterly winds are usually associated with cold temperatures, while winds from the southeast, are usually associated with warmer more humid conditions. Based on the 30-year Environment Canada climate normal, Iqaluit receives approximately 400 mm of total precipitation annually (EC, 2009). Precipitation in the region is generally distributed as snow, where October, November and April are the months with largest accumulations.

Rain is usually a summer phenomenon, where over 50% falls during the months of July and August (Environment Canada, 2006).

1.1.2 Sampling Locations

The STAR project collected meteorological data on southern Baffin Island within a 500 km radius of Iqaluit. The main sampling site was in the city of Iqaluit based out of the Environment Canada Weather Office. This was where special surface and upper air observations were collected. Additional surface and upper air observations were taken in the community of Pangnirtung during specific weather events during fall field campaign. Outside of these communities, observations were taken from an array of 10 automatic weather stations within a 100 km radius of Iqaluit, and from the NRC research flights, which collected data within a 500 km radius of Iqaluit.

1.2 Intensive Observation Periods (IOPs)

Sixteen IOPs (Intensive Observation Periods) took place between 10 October – 30 November 2007. Table 1 identifies the start/end dates and times, the number of special radiosonde releases (not including the regular operational), applicable aircraft flights and dropsondes as well as the purpose of each IOP. Multiple purposes and types of phenomena may have been sampled for any given IOP. It can be seen that a wide variety of weather/phenomena was observed during STAR, with two IOPs having multiple aircraft flights. Six closed surface low pressure systems crossed southern Baffin Island with two of them being major systems (central surface pressures < 990 hPa). In Table 1, YFB is Iqaluit, XVP is Pangnirtung, The column labeled as "# YFB sondes" shows the total number of "special" radiosondes (those released outside of 1200 UTC and 0000 UTC) released in Iqaluit as well as the total number released in Pangnirtung (in brackets). If "yes" appears in the column labeled as "aircraft flight", an aircraft mission took place for that IOP (note: sometimes multiple flights occurred – in brackets). The total number

of dropsondes for each IOP is indicated in column "# dropsondes". The last column states the purpose of the IOP with a brief description.

Table 1: IOP summary during the STAR fall field campaign

IOP	Start (UTC)	End (UTC)	# YFB sondes	Aircraft Flight	# Dropsondes	Mission Purpose
1	2100 15 Oct	1800 17 Oct	8			Low near south Baffin Island with significant snowfall (6-8 cm) in YFB
2	1800 20 Oct	0000 21 Oct	2			Low in N. Quebec with orographic snowfall on S. Baffin Island – upper flow regimes sampled
3	0600 26 Oct	0600 27 Oct	7			Low passing just south of Iqaluit – northern edge of system sampled
4	1200 29 Oct	1800 30 Oct	3			Low-level trough moved through S. Baffin. 3 cm of snow in YFB and strong winds behind system
5	1200 3 Nov	1200 4 Nov	4 (2 in XVP)			Upper trough with snow and strong winds in YFB and XVP
6	1600 5 Nov	0000 6 Nov	7 (4 in XVP)	yes	4	Remnants of Noel with moderate winds in YFB and XVP – aircraft into Noel
7	0000 6 Nov	0000 7 Nov	1	yes		aircraft CloudSat pass over Iqaluit with mesoscale convergence and snow in YFB
8	2100 7 Nov	0700 8 Nov	3	yes	13	Low to south of Baffin with upslope precipitation on south shores and weaker snow in YFB – aircraft for upslope processes
9	2100 9 Nov	0200 10 Nov	1	yes	6	Convection over Hudson Strait. Upslope snow on west coast of Baffin and unexpected snowfall in YFB – aircraft sampled convection and upslope processes

10	2100 11 Nov	1600 12 Nov	5	yes	6	Short-wave trough with snow in YFB/XVP and significant upslope in Cumberland Sound – aircraft
11	1900 16 Nov	0000 19 Nov	23 (12 at XVP)	yes (3 flights)	16	Most intense storm during STAR with significant snow in YFB and some in XVP - aircraft used for warm front, low center, mesoscale convergence and 2 CloudSat missions
12	1530 20 Nov	2230 20 Nov		yes (2 flights)		aircraft mission for CloudSat and convergence with snow near Ungava Bay
13	1600 22 Nov	1900 22 Nov		yes		aircraft CloudSat mission over Hudson Strait
14	1600 23 Nov	2000 23 Nov		yes	4	aircraft CloudSat misson into Foxe Basin upper low
15	1500 28 Nov	1830 28 Nov		yes	5	aircraft CloudSat mission near Cumberland Sound with low cloud
16	1900 28 Nov	0000 29 Nov	3	yes	1	Weak low tracked over S. Baffin with light snow in YFB – aircraft sampled low and upslope precipitation

The next section of this document a detailed description of the instrumentation used during the STAR project will be described.

2 Instrumentation

Research for the project was undertaken using ground and aircraft based meteorological field measurements as well as remotely sensed observations. The following section

outlines the meteorological equipment and the data that was collected during the fall and winter field campaigns of the STAR project.

Iqaluit was the home base for the STAR project and the permanent location of most of the observational and meteorological equipment used during the field campaigns. Instrumentation was set up at the Environment Canada Weather Office, which is located on the south side of the Iqaluit Airport runway. Figure 2 is rough diagram of STAR instrumentation with respect to existing Environment Canada equipment, and Table 2 displays the specific geographic locations of the instruments and the dates they were operating. Equipment location was based on space and power availability around the weather office.

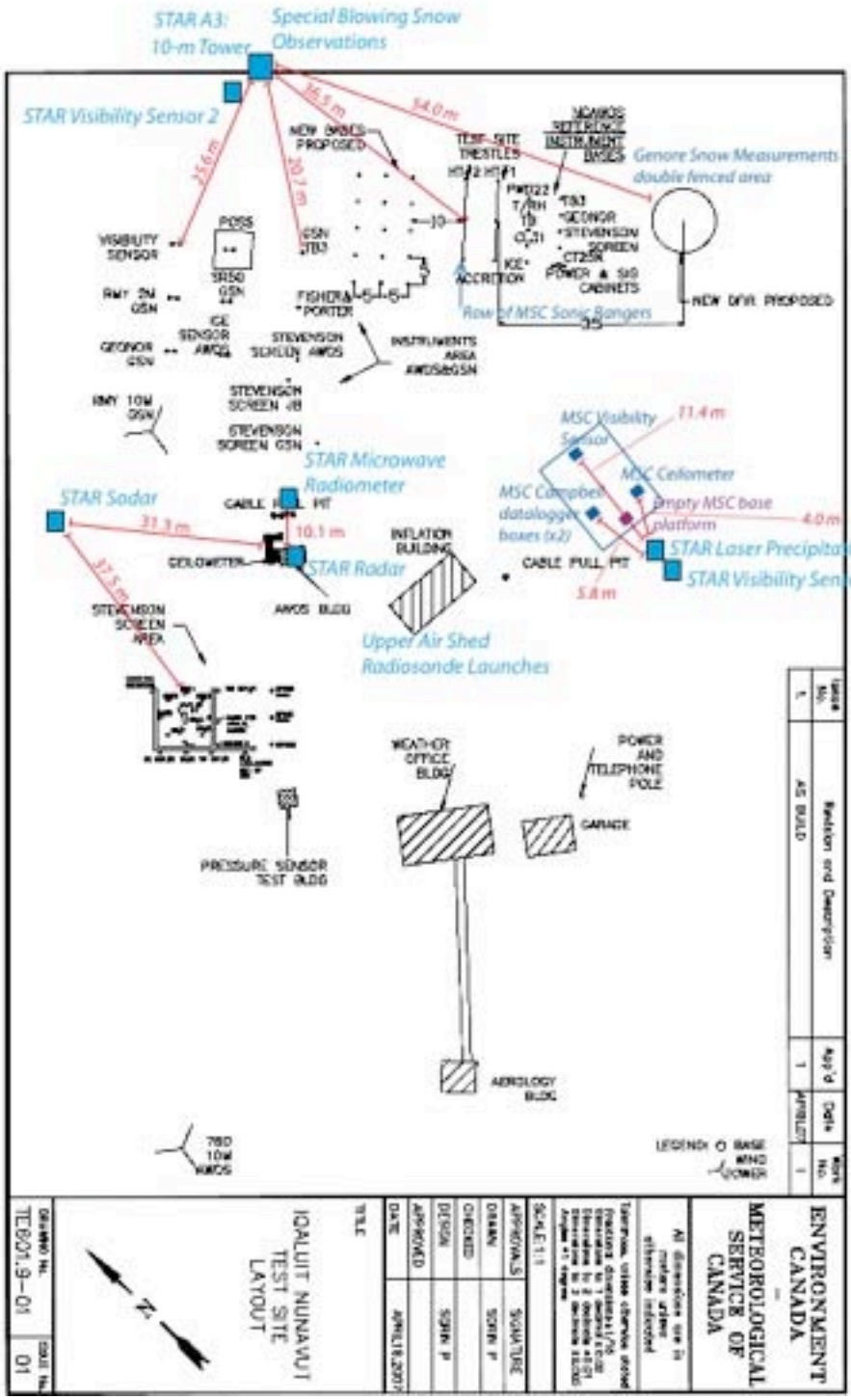


Figure 2: Location of STAR special instrumentation at the Environment Canada Weather Office in Iqaluit, NU.

Table 2: Location of STAR instrumentation at Iqaluit Environment Canada Weather

Instrument	*N*	*W*	*Elevation (m)*	*Start*	End
Radar	63˚44.843'	68˚32.670'	23	10-Oct-07	30-Nov-07
Radiometer	63˚44.850'	68˚32.668'	23		
Sodar	63˚44.860'	68˚32.698'	21		
Laser Precip. Sensor	63˚44.834'	68˚32.551'	23		
RADAR	63˚44.843'	68˚32.670'	21		
Radiosonde Launches	63˚44.830'	68˚32.657'	21		
Visibility Sensor 1	63˚44.834'	68˚32.551'	23		
	63˚44.847'	68˚32.611'	23	15-Feb-08	10-Apr-08
Visibility Sensor 2	63˚44.847'	68˚32.611'	23	10-Oct-07	10-Apr-08
5-min Camera Stills	63˚44.846'	68˚32.650'	23	10-Oct-07	28-Feb-08
Special Blowing Snow Obs	63˚44.851'	68˚32.611'	23	1-Feb-08	28-Feb-08

2.1 National Research Council Research Aircraft

The National Research Council of Canada's (NRC) Convair-580 research aircraft was instrumented by Environment Canada and NRC to collect internal storm measurements of cloud microphysics, thermodynamics, wind and the 4-D dynamic and precipitation structures of storms within a 500 km radius of Iqaluit from 5 – 30 November 2007 (Figure 3). Figure 3 shows the NRC Convair in flight (panel a) and the instrumentation was placed under the wings, and is shown in panels b and c). The aircraft enabled STAR scientists to probe storm events as they approached the region, and during their passage and departure over the study area. The aircraft also provided sensor validation flights for CloudSat overpasses in the Arctic. A list of all aircraft instrumentation appears in Table 3.

Three radars were onboard for remotely sensed measurements of clouds and precipitation: Ka-band (8.7 mm wavelength) upward/downward looking radar providing reflectivity, and the **N**RC **A**irborne **W**-band (3.2 mm wavelength) and **X**-band (3.2 cm wavelength) NAWX polarimteric Doppler radar (up/down/sideways looking) providing reflectivity, polarimetric characteristics and Doppler velocities. The W-band radar is

essentially a “cloud” radar, capable of detecting cloud droplets and/or cloud ice crystals, hence precipitation-sized particles are not required to be present within the cloud to obtain useful measurements, unlike standard surface-based weather radars. The X-band radar is generally less sensitive to cloud than the other radars, depending on hardware, operating configuration and processing capabilities. The combination of all radars provides an excellent way to study cloud dynamics and their microphysical structure, precipitation mapping (rates, location) and microphysics (sizes and composition) by looking at reflectivities, dual/triple frequency ratios, polarization and Doppler velocities as well as dual and triple frequency reflectivity all at the same time. More information about the NAWX radar can be found at http://www.nawx.nrc.gc.ca/nawx.html.

Figure 3: NRC Convair – 580. Photo provided by M. Wolde.

Table 3: Instrumentation list of the NRC research aircraft during the STAR project

NRC Convair - 580 & EC Aircraft Instrumentation	***Measurement***
Atmospheric State	
Rosemont 102 probe x 3	Temperature
NCAR Reverse Flow probe	Temperature
LICOR LIC2G2 water vapour/CO2 instrument	H20 mixing ratio, CO2 mixing ratio
EG7G chilled-mirror hygrometer	Humidity
Rosemount 858 gust probe	Vertical velocity
CR-2 water vapour measurement system	Humidity, low vapour concentrations
LWC and TWC	
Rosemount Icing (RICE) Probe	Detects supercooled water
Vibrameter	Detects supercooled liquid water content (LWC)
Nevzorov LWC/TWC probe	separate estimates of LWC and total water content (TWC)
PMS CSIRO King Probe	LWC
Cloud Microphysics	
DMT ConterFlow Virtual Impactor (CVI) for TWC	TWC
DMT Cloud, Aerosol, and Precipitation Spectrometer (CAPS)	T, LWC, Nd, cloud size distribution (0.5-1500 mm)
SPEC Cloud Particle Imager (CPI)	cloud particle images (15-2500 μm)
PMS FSSP-100X	small particle spectrum (3-45 μm)
PMS FSSP-100X	small particle spectrum (5-95 μm)
PMS FSSP-002	small particle spectrum (3-45 μm); without sample tube
PMS 2D2C	cloud particle images and spectra, nominally 25-800 μm
SPEC 2DS (10 micron config.)	cloud images and spectra 10-1280 μm, orthogonal channels
PMS 2DP	cloud particles images and spectra, nominally 200-6400 μm
PMS 2DC-grey	grey-scale images of cloud particles, nominally 15-960 um
Radiometers	
Heitronics KT19.85 Infrared Thermometer (IRT)	Cloud emissivity, surface temperature; Nadir view; Narrow field of view
Kipp and Zonen broadband visible radiometers	Broadband hemispheric visible radiation, zenith and nadir view, 305-2800 nm
Epply broadband Pyrgeometers	Broadband hemispheric infrared fluxes, zenith and nadir view, 3.5-50 μm
ProSensing up looking G-band radiometer	multichannel centered on 183.31 GHZ; derived parameters water vapour and liquid water paths above aircraft
Other Remote Sensing	
Ka-band up and down-looking radar	radar cross sections (reflectivity only)

NAWX X-band/W band radar, dual polarization, Doppler, up/down/side looking	radar cross sections, and side-looking reflectivity/Doppler fields

The NRC aircraft flew approximately 48 hours during the project. This time was divided over 14 missions, with variable objectives (Table 4). The first flight was into the remnants of Hurricane Noel, which was the most severe hurricane of 2007 in terms of casualties (> 150) (NOAA, 2007). While in contrast, the final flight had a very local focus, sampling the cloud system directly over Iqaluit for remote sensing validation purposes. Additional flights took the research aircraft into Foxe Basin, Hudson Strait, Ungava Bay, Davis Strait, Cumberland Sound Peninsula and locally in Frobisher Bay. Figure 4 is a set of maps of the regions around southern Baffin Island where the different missions occurred during STAR. During these missions, a total of 55 dropsondes were deployed from nine of the aircraft flights and 7 flights were coincident with Cloudsat overpasses (Table 4).

Table 4: Mission summary of the 15 flights of the NRC research aircraft during STAR

IOP	*Mission #*	*Date/Time*		*Dropsondes*	*Corresponding with a Cloudsat Pass*
		Start (UTC)	*End (UTC)*		
6	*1*	*Nov 5, 2007 - 13:55*	*Nov 5, 2007 - 18:15*	*4*	*-*
7	*2*	*Nov 6, 2007 - 16:53*	*Nov 6, 2007 - 19:38*	*-*	*yes*
8	*3*	*Nov 7, 2007 - 02:35*	*Nov 7, 2007 - 06:22*	*13*	*-*
9	*4*	*Nov 9, 2007 - 21:29*	*Nov 10, 2007 - 01:25*	*6*	*-*
10	*5*	*Nov 12, 2007 11:45*	*Nov 12, 2007 - 16:11*	*6*	*-*
11	*6*	*Nov 17, 2007 - 11:45*	*Nov 17, 2007 - 13:20*	*11*	*yes*
11	*7*	*Nov 18, 2007 - 13:00*	*Nov 18, 2007 - 15:30*	*-*	*-*
11	*8*	*Nov 18, 2007 - 16:32*	*Nov 18, 2007 - 22:00*	*5*	*yes*
12	*9*	*Nov 20, 2007 - 15:38*	*Nov 20, 2007 - 19:03*	*-*	*yes*
12	*10*	*Nov 20, 2007 –*	*Nov 20, 2007 –*	*-*	*-*

		20:25	*21:49*		
13	*11*	*Nov 22, 2007 - 16:11*	*Nov 22, 2007 - 18:43*	*-*	*yes*
14	*12*	*Nov 23, 2007 - 16:14*	*Nov 23, 2007 - 19:42*	*4*	*yes*
CBC media flight	*13*	*Nov 26, 2007 - 17:54*	*Nov 26, 2007 - 19:49*	*-*	*-*
15	*14*	*Nov 28, 2007 - 15:00*	*Nov 28, 2007 - 18:23*	*5*	*yes*
16	*15*	*Nov 28, 2007 - 20:03*	*Nov 28, 2007 - 21:23*	*1*	*-*

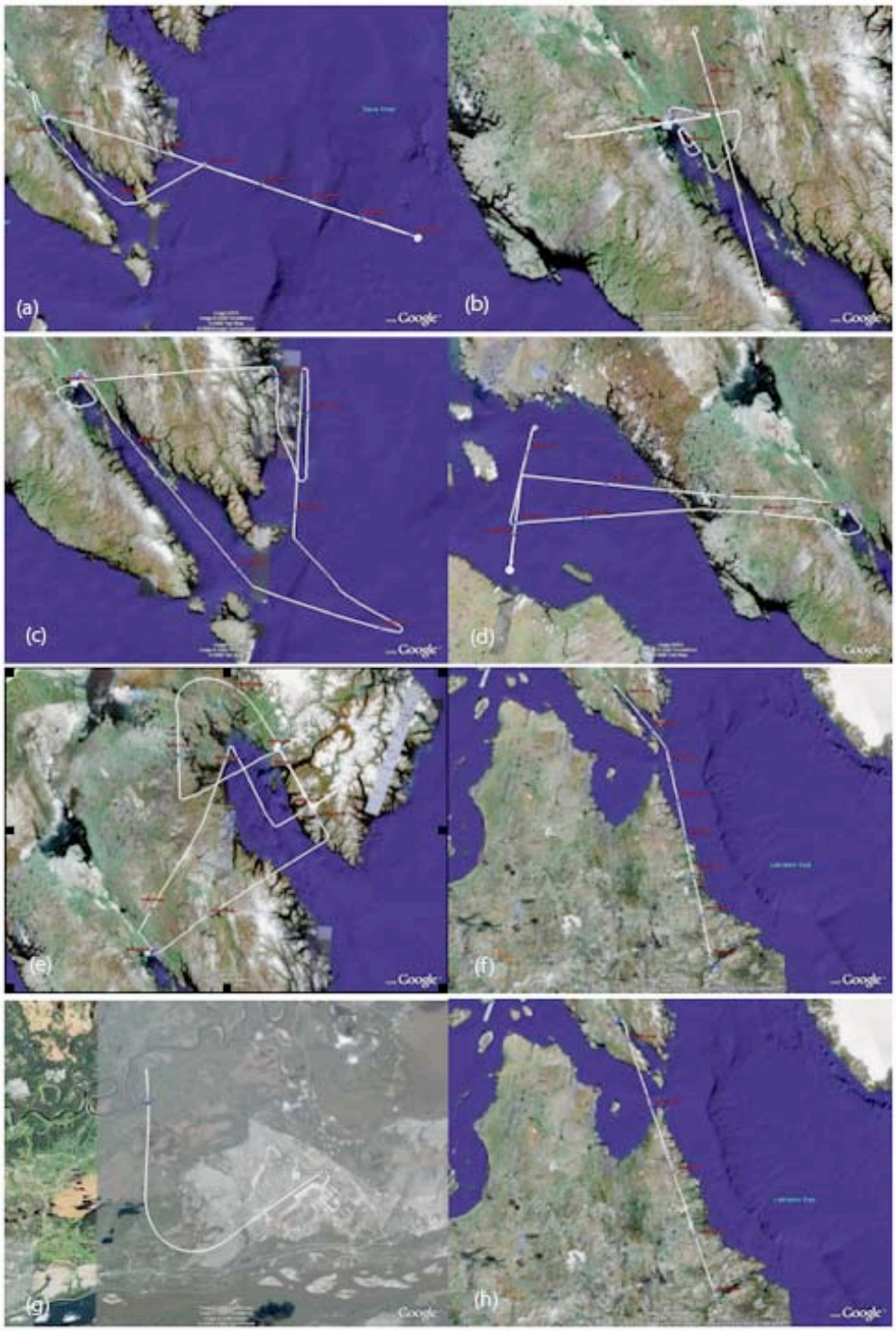


Figure 4a: NRC aircraft flights tracks (*part 1*). (a) F01-Nov05 (b) F02-Nov06 (c) F03-Nov08 (d) F04-Nov09 (e) F05-Nov12 (f) F06-Nov17 (g) F07-Nov18a1 (h) F07-Nov18a2

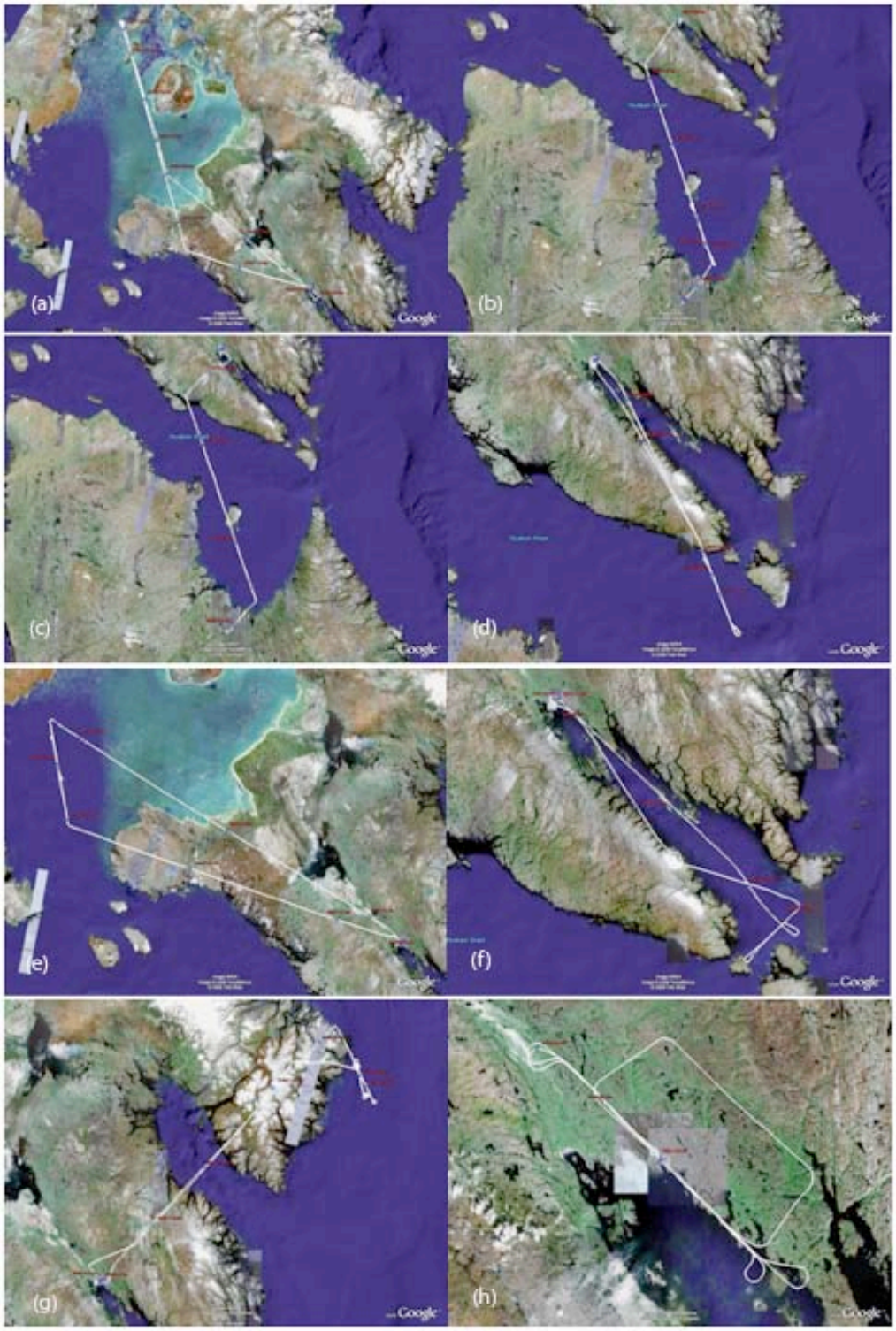


Figure 4b NRC aircraft flights tracks (*part 2*). (a) F08-Nov18b (b) F09-Nov20a (c) F10-Nov20b2 (d) F11-Nov22 (e) F12-Nov23 (f) F13-Nov26 (g) F14-Nov28a (h) F15-Nov28b

A quick summary of the research objective of each aircraft mission is presented in the following section. Refer to Appendix C, for flight notes taken during the aircraft missions by STAR persons.

2.1.1 Research Objective Flight Summary

1. Flight 1 - Nov 5, 2007 1355Z-1815Z
   Remnants of Hurricane Noel in Davis Strait

4 Drop Sondes - November 5, 2007	15:59:48
	16:10:24
	16:20:53
	16:29:31

2. Flight 2 - Nov 6, 2007 1653Z-1938Z
   CloudSat Pass over Iqaluit. Mesoscale Convergence with light precipitation observed in Iqaluit

3. Flight 3 - Nov 8, 2007 0235Z-0622Z
   Low pressure system in Hudson Strait. Travel into the Strait and along coastline to sample upslope precipitation.

13 Drop Sondes -November 8, 2007	04:27:10
	04:31:03
	04:35:02
	04:39:09
	04:43:09
	04:47:35
	05:31:51
	05:35:03
	05:38:03
	05:41:02
	05:44:09
	05:49:00
	05:54:12

4. Flight 4 - Nov 9, 2007 2129Z – Nov 10 0125Z
   Convection over Hudson Strait between Cape Dorset and Kimmirut, with unexpected snow showers in Iqaluit.

6 Drop sondes - November 9, 2007	22:08:02
	22:15:47
	22:23:46
	22:31:54
	22:39:55
	22:50:37

5. Flight 5 - Nov 12, 2007 11:45Z-16:11Z
   Pangnirtung precipitation event focus – and wind regime of Cumberland Sound, radar mapping of upslope precipitation along the coastline

6 Drop Sondes - November 12, 2007	12:08:54
	12:18:23
	12:25:12
	13:40:23
	13:59:29
	14:03:17

6. Flight 6 - Nov 17, 2007 1145Z-1320Z
   Flight through the warm front of the rapidly intensifying Low Pressure system. Flight started at Iqaluit, flying to Goose Bay, Nfld. The plane ended up being grounded in Goose Bay overnight because of the storm.

1 Drop Sondes - November 17, 2007	12:09:19
	12:21:33
	12:35:13
	12:47:50
	12:58:28
	13:10:10
	13:20:27
	17:53:29
	18:01:37
	18:19:21
	18:33:02

7. Flight 7 - Nov 18, 2007 1300Z-1530Z
   Staged out of Goose Bay, Nfld flying back to Iqaluit – CloudSat validation pass, traversed a deep Low Pressure system in Foxe Basin.

8. Flight 8 - Nov 18, 2007 1632Z-2200Z
   CloudSat pass east of Cape Dorset and just west of Prince Charles Island. Again this flight was sampling the deep low pressures system (965.4 mb lowest measure during flight)

5 Drop Sondes -November 18, 2007	17:53:29
	18:01:37
	18:10:28
	18:19:21
	18:33:02

9. Flight 9 - Nov 20, 2007 1538Z-1903Z
   Low pressure system over Baffin Island and Newfoundland there was an area of convergence in Ungava Bay, which also coincided with a CloudSat pass. Iqaluit (CYFB) to Kuujjuaq (CYVP)

10. Flight 10 - Nov 20, 2007 2015Z-2216Z
    Return flight from CYVP to CYFB was back along the CloudSat track to observe the area of convergence from above, no new meteorological features to sample.

11. Flight 11 - Nov 22, 2007 1611Z-1843Z
    CloudSat mission to Hudson Strait to sample the cloud and precipitation. Very localized system, shoreline was clear of cloud cover

12. Flight 12 - Nov 23, 2007 1614Z-1942Z
    CloudSat mission into Foxe Basin to sample cloud system

13. Flight 13 - Nov 26, 2007 1754Z-1949Z
    Local flight – observing cloud features in Frobisher Bay and out along the tip of the Peninsula. CBC on board for the flight,

4 Drop Sondes - November 23, 2007	16:26:10
	17:38:07
	17:48:29
	17:52:33

14. Flight 14 - Nov 28, 2007 1500Z-1823Z
    Flight into Davis Strait to sample a weak Low pressure system tracking from Greenland to the tip of the Cumberland Sound Peninsula. This also local feature with coincided with a CloudSat mission.

5 Drop Sondes - November 28, 2007	15:31:01
	15:55:15
	16:14:03
	16:26:27
	17:08:16

15. Flight 15 - Nov 28, 2007 2003Z-2123Z
    Local flight – observing cloud features in and around Iqaluit. Porpoising up and down along NW-SE track over the airport. Will use a lot of these measurements for remote sensing validations of instruments around the weather office

    1 Drop Sonde - November 28, 2007 21:00:20

2.1.2 Aircraft data

Aircraft data contains 1D and 2D data, Radar reflectivity data for Ka/W/X-band, W-band Doppler velocity data, dropsondes data as well as flight tracks.

Data period:
Start date: 05nov2007
End date: 28nov2007
Data format: Variety of format, see the individual data type

2.1.2.1 1D data

Bulk parameter ASCII file: this is an ASCII file containing state parameter, position, winds, and bulk parameters like LWC, TWC, FSSP total concentration etc. the VIS and IR radiometer data are also include.
Data period:
Start date: 05nov2007
End date: 28nov2007
Data format: ascii (csv, chn)

Table 5 show the list of variables and explanation of 1D data

symbol	unit	tag	description	comment
YEAR	year	1	GMT Year	
Mo	month	2	GMT Month	
Da	day	3	GMT Day	
HH	hour	4	GMT Hour	
MM	minute	5	GMT Minute	
SS	second	6	GMT Second	
Altit	m	6019	ALTITUDE (m)	Calculated from pressure

Alt	kft	6015	ALTITUDE (Kft)	Calculated from pressure
GPS_Ht	m	6062	GPS Orthometric Height (m)	
MastrLAT	Deg	5164	Master Lattitude (Deg)	GPS
MastrLON	Deg	5165	Master Longitude (Deg)	GPS
NPres	mb	5039	NOSEBOOM PRESSURE CORR (mb)	
RSTem	Deg C	6013	AES WING STATIC RMNT TEMP (Deg C)	use as 1th choice
BmStTm	Deg C	6036	BOOM STATIC RMNT TEMP (Deg C)	use as 2nd choice
DewPt	Deg C	6014	DEWPOINT TEMP (Deg C)	
KT-19	Deg C	5252	KT-19 Surface Temperature (Deg C)	KT-19 Infrared Radiation Pyrometer
ROSIC1	mv	7010	Rosemount Ice Detector Signal (mv)	
NeLWzr	g/m3	7215	NEV LWC ZR (g/m3)	Nevzorov liquid water content
NTLWzr	g/m3	7212	NEV TWC ZR (g/m3)	Nevzorov total (liquid&ice) water content
KSzrLW	g/m3	7232	King Short zero-rem LWC (g/m3)	
CSITCW_p	g/m3	7327	CSI Pressure corrected Total Condensable Water Content (g/m3)	Cloud Spectrometer and Impactor (CSI) or Contraflow Virtual Impactor (CVI)
Track	Deg_Tr	5230	TRACK ANGLE (T)	TRUE HEADING, Heading of the aircraft relative to true north
IACHdg	Deg_Tr	5014	INS AIRCRAFT HEADING (Deg True)	inertial navigation system (INS)
PitAng	Deg	5015	INS PITCH ANGLE (Deg)	inertial navigation system (INS)
RolAng	Deg	5016	INS ROLL ANGLE (Deg)	inertial navigation system (INS)
VVEL	m/s	5020	INS VERTICAL VELOCITY (m/sec)	inertial navigation system (INS)
VNS	m/s	5021	INS N-S VELOCITY (m/sec)	inertial navigation system

			(INS)
VEW	m/s	5022 INS E-W VELOCITY (m/sec)	inertial navigation system (INS)
PoWSpd	m/s	6016 POD WIND SPEED (m/sec)	
PoWDir	Deg	6017 POD WIND DIR (Deg T)	
xVel	m/s	5233 CALCULATED X VELOCITY (m/sec)	
yVel	m/s	5234 CALCULATED Y VELOCITY (m/sec)	
zVel	m/s	5235 CALCULATED Z VELOCITY (m/sec)	
F6LWCu	g/m3	1323 FSSP 96 LWC (g/m3)	uncorrected
FS96CNC	#/cm3	1327 FS96 TOTAL CONC (/cm3)	FSSP 96, total concentration - uncorrected
F6YSF		1362 YSF DEADTime/COINCIDENCE CORRECTION FACTOR	
F9601	#/cm3	1328 FS96 CH01 CONC (/cm3)	FSSP 96, channel 1 concentration - uncorrected
F9602	#/cm3	1329 FS96 CH02 CONC (/cm3)	-II-
F9603	#/cm3	1330 FS96 CH03 CONC (/cm3)	-II-
F9604	#/cm3	1331 FS96 CH04 CONC (/cm3)	-II-
F9605	#/cm3	1332 FS96 CH05 CONC (/cm3)	-II-
F9606	#/cm3	1333 FS96 CH06 CONC (/cm3)	-II-
F9607	#/cm3	1334 FS96 CH07 CONC (/cm3)	-II-
F9608	#/cm3	1335 FS96 CH08 CONC (/cm3)	-II-
F9609	#/cm3	1336 FS96 CH09 CONC (/cm3)	-II-
F9610	#/cm3	1337 FS96 CH10 CONC (/cm3)	-II-
F9611	#/cm3	1338 FS96 CH11 CONC (/cm3)	-II-
F9612	#/cm3	1339 FS96 CH12 CONC (/cm3)	-II-
F9613	#/cm3	1340 FS96 CH13 CONC (/cm3)	-II-
F9614	#/cm3	1341 FS96 CH14 CONC (/cm3)	-II-
F9615	#/cm3	1342 FS96 CH15 CONC (/cm3)	-II-

096Sum	#	1353 FSSP 096 SEA SUM	FSSP 96, Total counts by summing all channels.
6MVD	um	1347 FS96 MVD (micro-m)	
F9Reff	um	1357 FS96 EFFECTIVE RADIUS (micro-m)	
MeVD	um	1363 FS96 MedVD (micro-m)	FSSP 96, Median Volume Diameter
F96Ext	/km	1356 FSSP 96 EXTINCTION (/km)	
R96		1325 FS96 RANGE	
F2LWCu	g/m3	1223 FSSP02 LWC (g/m3)	uncorrected
FS96CNC	#/cm3	1227 FS96 TOTAL CONC (/cm3)	FSSP 96, total concentration - uncorrected
YSF02		1262 FS02 YSF DEADTime/COINCIDENCE CORRECTION FACTOR	
FS201	#/cm3	1228 FS96 CH01 CONC (/cm3)	FSSP 02, channel 1 concentration - uncorrected
FS202	#/cm3	1229 FS02 CH02 CONC (/cm3)	-II-
FS203	#/cm3	1230 FS02 CH03 CONC (/cm3)	-II-
FS204	#/cm3	1231 FS02 CH04 CONC (/cm3)	-II-
FS205	#/cm3	1232 FS02 CH05 CONC (/cm3)	-II-
FS206	#/cm3	1233 FS02 CH06 CONC (/cm3)	-II-
FS207	#/cm3	1234 FS02 CH07 CONC (/cm3)	-II-
FS208	#/cm3	1235 FS02 CH08 CONC (/cm3)	-II-
FS209	#/cm3	1236 FS02 CH09 CONC (/cm3)	-II-
FS210	#/cm3	1237 FS02 CH10 CONC (/cm3)	-II-
FS211	#/cm3	1238 FS02 CH11 CONC (/cm3)	-II-
FS212	#/cm3	1239 FS02 CH12 CONC (/cm3)	-II-
FS213	#/cm3	1240 FS02 CH13 CONC (/cm3)	-II-
FS214	#/cm3	1241 FS02 CH14 CONC (/cm3)	-II-
FS215	#/cm3	1242 FS02 CH15 CONC (/cm3)	-II-

F2Au2	#	1253 FSSP 002 SEA SUM	FSSP 02, Total counts by summing all channels.
F02MVD	um	1247 FS02MVD (micro-m)	
F02Reff	um	1257 FS96 EFFECTIVE RADIUS (micro-m)	
Me02VD	um	1263 FS96 MedVD (micro-m)	FSSP 96, Median Volume Diameter
F02Ext	/km	1256 FSSP02 EXTINCTION (/km)	
R02		1225 FSSP02 RANGE	
2DP1ShdOr	/m3	3022 2D1 SHAOR-P (/m3)	2DP1 Shadow-or Concentration
DifRadU	W/m2	5087 DIFFUSE SOLAR RAD UP (W/m2)	
DifRadD	W/m2	5079 DIFFUSE SOLAR RAD DOWN (W/m)	
DifRadU	W/m2	5087 DIFFUSE SOLAR RAD UP (W/m2)	
EpIR_U	W/m2	10049 EPPLEY IR-UP (W/m2)	
EpIR_D	W/m3	10050 EPPLEY IR-DOWN (W/m2)	

These csv files contain the data more than STAR requests. For those data, which are not listed in the above table, please refer to the “files fmt_info.xls” and “tag info.xls”

The followings show the first couple of lines of 1D data file (F02_164901.csv), because there are too many columns (157 columns), it is showed every 27 columns.

1-27columns:

Project: 2007STAR(Convair580) Project: 2007STAR(Convair580) Project: 2007STAR(Convair580)
Flight Date: 2007/Nov/08 Aircraft: CONVAIR 580 Flight Date: 2007/Nov/08 Aircraft: CONVAIR 580 Flight Date: 2007/Nov/08 Aircraft: CONVAIR 580
Slicing Interval: 1 sec Creation Date: Thu Feb 11 07:41:15 2010 Slicing Interval: 1 sec Creation Date: Thu Feb 11 07:34:53 2010 Slicing Interval: 1 sec Creation Date: Thu Feb 11 07:36:34 2010

1 YEAR UTC	2 Mo	3 Da	4 HH	5 MM UT	6 SS C	6019 Altit m	6015 Alt kft	6062 GPS_Ht m	5164 MastrLAT Deg	5165 MastrLON Deg	5039 NPres mb	6013 RSTem Deg_C	6036 BmStTm C	6014 DewPt Deg_C	5252 KT-19 Deg C	5248 LICDew Deg_C	5249 LICFro Deg_C	7010 ROSIC1 mv	7209 NevLWC g/m3	7210 NevTWC g/m3	7215 NeLWzr g/m3	7212 NTLWzr g/m3	7231 KSPLWC g/m3	7232 KSzrLW g/m3	7325 CSI_TCWC g/m3	7327 CSITCW_p g/m3
2007	11	8	2	27	18	30	0.099	23.1	63.74886	68.53902	1018.5	-5.41	-7.11	-7.14	-5.4	-5.2	-4.58	1712	0	0	0	0	-8.888	-8.888	-8.8888	-8.8888
2007	11	8	2	27	19	30	0.099	23.1	63.74886	68.53902	1018.5	-5.39	-7.15	-7.12	-5.4	-5.2	-4.58	1712	0	0	0	0	-8.888	-8.888	-8.8888	-8.8888
2007	11	8	2	27	20	30	0.099	23.1	63.74886	68.53902	1018.5	-5.41	-7.15	-7.12	-5.3	-5.2	-4.58	1712	0	0	0	0	-8.888	-8.888	-8.8888	-8.8888
2007	11	8	2	27	21	30	0.099	23.1	63.74886	68.53902	1018.5	-5.41	-7.09	-7.1	-5.4	-5.2	-4.58	1714	0	0	0	0	-8.888	-8.888	-8.8888	-8.8888
2007	11	8	2	27	22	30	0.099	23.1	63.74886	68.53902	1018.5	-5.41	-7.09	-7.12	-5.7	-5.23	-4.6	1713	0	0	0	0	-8.888	-8.888	-8.8888	-8.8888
2007	11	8	2	27	23	30	0.099	23.1	63.74886	68.53902	1018.5	-5.41	-7.11	-7.1	-5.7	-5.2	-4.58	1713	0	0	0	0	-8.888	-8.888	-8.8888	-8.8888
2007	11	8	2	27	24	30	0.099	23.1	63.74886	68.53902	1018.5	-5.41	-7.11	-7.66	-5.8	-5.2	-4.58	1712	0	0	0	0	-8.888	-8.888	-8.8888	-8.8888
2007	11	8	2	27	25	30	0.099	23.1	63.74886	68.53902	1018.5	-5.41	-7.07	-9.1	-5.8	-5.15	-4.53	1714	0	0	0	0	-8.888	-8.888	-8.8888	-8.8888
2007	11	8	2	27	26	30	0.099	23.1	63.74886	68.53902	1018.5	-5.41	-7.05	-9.24	-5.9	-5.18	-4.56	1712	0	0	0	0	-8.888	-8.888	-8.8888	-8.8888
2007	11	8	2	27	27	30	0.099	23.1	63.74886	68.53902	1018.5	-5.41	-7.07	-9.18	-5.5	-5.18	-4.56	1712	0	0	0	0	-8.888	-8.888	-8.8888	-8.8888
2007	11	8	2	27	28	30	0.099	23.1	63.74886	68.53902	1018.5	-5.41	-7.05	-9.22	-5.5	-5.21	-4.58	1714	0	0	0	0	-8.888	-8.888	-8.8888	-8.8888

28-54columns:

7321 CSIF1VFl l/min	7365 CSIcnFlow l/min	5230 Track Deg_Tr	5014 IACHdg Deg_T	5015 PitAng Deg	5016 RolAng Deg	5020 VVEL m/s	5021 VNS m/s	5022 VEW m/s	5047 SyWSp m/se	5048 SyWDir deg	6016 PoWSpd m/sec	6017 PoWDir deg	5233 xVel m/s	5234 yVel m/s	5235 zVel m/s	6025 Bm_AS m/s	5034 WgTAS m/s	1323 F6LWCu g/m3	1327 FS96CNC N/cc	1362 F6YSF	1328 F9601 /cm3	1329 F9602 /cm3	1330 F9603 /cm3	1331 F9604 /cm3	1332 F9605 /cm3	1333 F9606 /cm3
0.088	-0.042	6	358	8.6	3.1	-382.3	133.6	-127.7	-8.8	-888.8	127.8	135.4	-99.9	24.5	-99.9	17.3	58.4	0	0	1	0	0	0	0	0	0
0.052	-0.064	6	358	8.6	3.1	-382.3	133.6	-127.7	-8.8	-888.8	127.8	135.4	-99.9	24.5	-99.9	17.3	58.4	0	0	1	0	0	0	0	0	0
0.035	-0.072	6	358	8.6	3.1	-382.3	133.6	-127.7	-8.8	-888.8	127.8	135.4	-99.9	24.5	-99.9	17	58.4	0	0	1	0	0	0	0	0	0
0.028	-0.075	6	358	8.6	3.1	-382.3	133.6	-127.7	-8.8	-888.8	127.8	135.4	-99.9	24.5	-99.9	17	58.4	0	0	1	0	0	0	0	0	0
0.056	-0.062	6	358	8.6	3.1	-382.3	133.6	-127.7	-8.8	-888.8	127.8	135.4	-99.9	24.5	-99.9	17	58.4	0	0	1	0	0	0	0	0	0
0.05	-0.085	6	358	8.6	3.1	-382.3	133.6	-127.7	-8.8	-888.8	127.8	135.4	-99.9	24.5	-99.9	17	58.4	0	0	1	0	0	0	0	0	0
0.028	-0.084	6	358	8.6	3.1	-382.3	133.6	-127.7	-8.8	-888.8	127.8	135.4	-99.9	24.5	-99.9	17	58.4	0	0	1	0	0	0	0	0	0
0.068	-0.04	6	358	8.6	3.1	-382.3	133.6	-127.7	-8.8	-888.8	127.8	135.4	-99.9	24.5	-99.9	16.7	58.4	0	0	1	0	0	0	0	0	0
0.024	-0.095	6	358	8.6	3.1	-382.3	133.6	-127.7	-8.8	-888.8	127.8	135.4	-99.9	24.5	-99.9	16.3	58.4	0	0	1	0	0	0	0	0	0
0.089	-0.014	6	358	8.6	3.1	-382.3	133.6	-127.7	-8.8	-888.8	127.8	135.4	-99.9	24.5	-99.9	16.7	58.4	0	0	1	0	0	0	0	0	0
0.064	-0.024	6	358	8.6	3.1	-382.3	133.6	-127.7	-8.8	-888.8	127.8	135.4	-99.9	24.5	-99.9	16.7	58.4	0	0	1	0	0	0	0	0	0
1334	1335	1336	1337	1338	1339	1340	1341	1342	1353	1347	1357	1363	1356	1325	1223	1227	1262	1228	1229	1230	1231	1232	1233	1234	1235	1236

55-81columns:

F9607 /cm3	F9608 /cm3	F9609 /cm3	F9610 /cm3	F9611 /cm3	F9612 /cm3	F9613 /cm3	F9614 /cm3	F9615 /cm3	096Sum	6MVD um	F9Reff um	MeVD um	F96Ext /km	R96 #	F2LWC g/m3	FS02CNC N/cc	YSF02	FS201 /cm3	FS202 /cm3	FS203 /cm3	FS204 /cm3	FS205 /cm3	FS206 /cm3	FS207 /cm3	FS208 /cm3	FS209 /cm3
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

82-108columns:

1237 FS210 /cm3	1238 FS211 /cm3	1239 FS212 /cm3	1240 FS213 /cm3	1241 FS214 /cm3	1242 FS215 /cm3	1247 F02MVD UM	1257 F02Reff um	1263 Me02VD um	1256 F02Ext /km	1225 R02	3022 2DP1ShdOr /m3	5087 DifRadU W/m2	5079 DifRadD W/m2	10049 EpIR_U W/m2	10050 EpIR_D W/m2	3002 2DC-EE01 mv	3003 2DC-EE32 mv	3010 2DP-EE01 mv	3011 2DP-EE32 mv	6012 RFTS Deg_C	5096 ReHuW %	5097 ReHuI %	5043 PTAS m/s	5001 ILt Deg	5002 ILat Min	5003 ILn Deg
0	0	0	0	0	0	0	0	0	0	0	0	35	17.8	268	346	0	0	0	0	-5	87.5	92.3	57.7	63	44.9313	68
0	0	0	0	0	0	0	0	0	0	0	0	35.5	18.1	266.5	347.2	0	0	0	0	-5	87.6	92.3	57.7	63	44.9313	68
0	0	0	0	0	0	0	0	0	0	0	0	35.1	18.1	265.6	348	0	0	0	0	-5	87.7	92.4	57.7	63	44.9313	68
0	0	0	0	0	0	0	0	0	0	0	0	34.8	18	267	345.7	1994	0	435	0	-5.01	87.8	92.6	57.7	63	44.9313	68
0	0	0	0	0	0	0	0	0	0	0	0	35	18	266.5	347.6	1994	1810	435	512	-5	87.7	92.4	57.7	63	44.9313	68
0	0	0	0	0	0	0	0	0	0	0	0	35.1	18	267	347.4	1994	1810	435	512	-4.98	87.8	92.6	57.7	63	44.9313	68
0	0	0	0	0	0	0	0	0	0	0	0	35	17.8	266.5	347.1	1994	1810	435	512	-5	84.1	88.6	57.7	63	44.9313	68
0	0	0	0	0	0	0	0	0	0	0	0	34.6	18	267	346.1	1994	1810	435	512	-4.98	75.1	79.2	57.7	63	44.9313	68
0	0	0	0	0	0	0	0	0	0	0	0	34.8	17.8	267.2	346.9	1994	1810	435	512	-4.97	74.3	78.3	57.7	63	44.9313	68
0	0	0	0	0	0	0	0	0	0	0	0	34.4	17.8	266.5	347.1	1994	1810	435	512	-4.98	74.7	78.7	57.7	63	44.9313	68
0	0	0	0	0	0	0	0	0	0	0	0	34.8	17.8	266.5	346.4	1994	1810	435	512	-4.97	74.4	78.5	57.7	63	44.9313	68

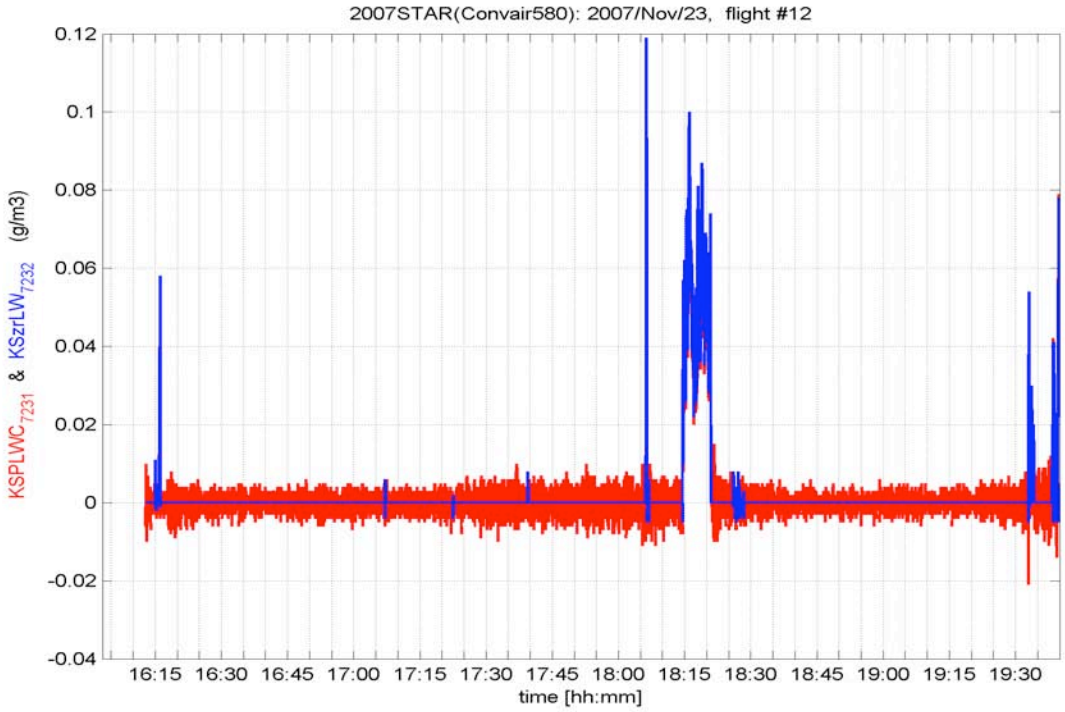
109-135columns:

5004 ILon Min	1427 F124CNC /cm3	1423 F4LWC-u g/m3	1457 FSExt /km	1425 R124 #	1447 4MVD um	3021 2DC0ShdOr /l	7312 CSIF1Set l/min	7362 csiRHp %	7302 CSITDLcn g/m3	5095 MixRA g/kg	5098 MixRT g/kg	10165 VisUpT Deg_C	10166 VisDnT Deg_C	7040 SJW_TWC g/m3	5046 PODwge m/s	10095 UPDmT Deg_K	10097 DNDmT Deg_K	7011 ROSIC2 mv	5000 RadrAltm ft	6059 BSPres mb	7047 SJWTWzr g/m3	7018 RIDLWC g/m3	5017 PRATE Deg/S	5018 RRATE Deg/S	5019 YRATE Deg/S	10024 MACH
32.3408	0	0	0	4	0	0	6.3	0.0014	2	2.238	-8.888	0.45	0.89	-8.8888	387.8	186.3	268.6	-9	20615.1	998.1	0	-8.888	-0.5	3.1	0.1	0.176
32.3408	0	0	0	4	0	0	6.3	0.0014	1.97	2.241	-8.888	0.27	0.8	-8.8888	387.8	186.4	268.5	-9	20615.1	998.1	0	-8.888	-0.5	3.1	0.1	0.176
32.3408	0	0	0	4	0	0	6.3	0.0014	2	2.241	-8.888	0.45	0.89	-8.8888	387.8	186.4	268.6	-9	20615.1	998.1	0	-8.888	-0.5	3.1	0.1	0.176
32.3408	0	0	0	4	0	0	6.3	0.0014	1.98	2.245	-8.888	0.45	0.89	-8.8888	387.8	186.4	268.6	-11	20615.1	998.1	0	-8.888	-0.5	3.1	0.1	0.176
32.3408	0	0	0	4	0	0	6.3	0.0014	1.98	2.241	-8.888	0.27	0.62	-8.8888	387.8	186.4	268.5	-9	20615.1	998.3	0	-8.888	-0.5	3.1	0.1	0.176
32.3408	0	0	0	4	0	0	6.3	0.0014	1.95	2.245	-8.888	0.45	0.89	-8.8888	387.8	186.3	268.5	-10	20615.1	998.1	0	-8.888	-0.5	3.1	0.1	0.176
32.3408	0	0	0	4	0	0	6.3	0.0014	1.99	2.15	-8.888	0.45	0.89	-8.8888	387.8	186.3	268.5	-10	20615.1	998.1	0	-8.888	-0.5	3.1	0.1	0.176
32.3408	0	0	0	4	0	0	6.3	0.0014	1.96	1.921	-8.888	0.45	0.71	-8.8888	387.8	186.4	268.5	-9	20615.1	998.1	0	-8.888	-0.5	3.1	0.1	0.176
32.3408	0	0	0	4	0	0	6.3	0.0014	1.96	1.9	-8.888	0.45	0.89	-8.8888	387.8	186.4	268.5	-9	20615.1	998.1	0	-8.888	-0.5	3.1	0.1	0.176
32.3408	0	0	0	4	0	0	6.3	0.0014	1.98	1.909	-8.888	0.53	0.8	-8.8888	387.8	186.3	268.5	-7	20615.1	998.1	0	-8.888	-0.5	3.1	0.1	0.176
32.3408	0	0	0	4	0	0	6.3	0.0014	1.97	1.903	-8.888	0.18	0.89	-8.8888	387.8	186.3	268.5	-9	20615.1	998.1	0	-8.888	-0.5	3.1	0.1	0.176

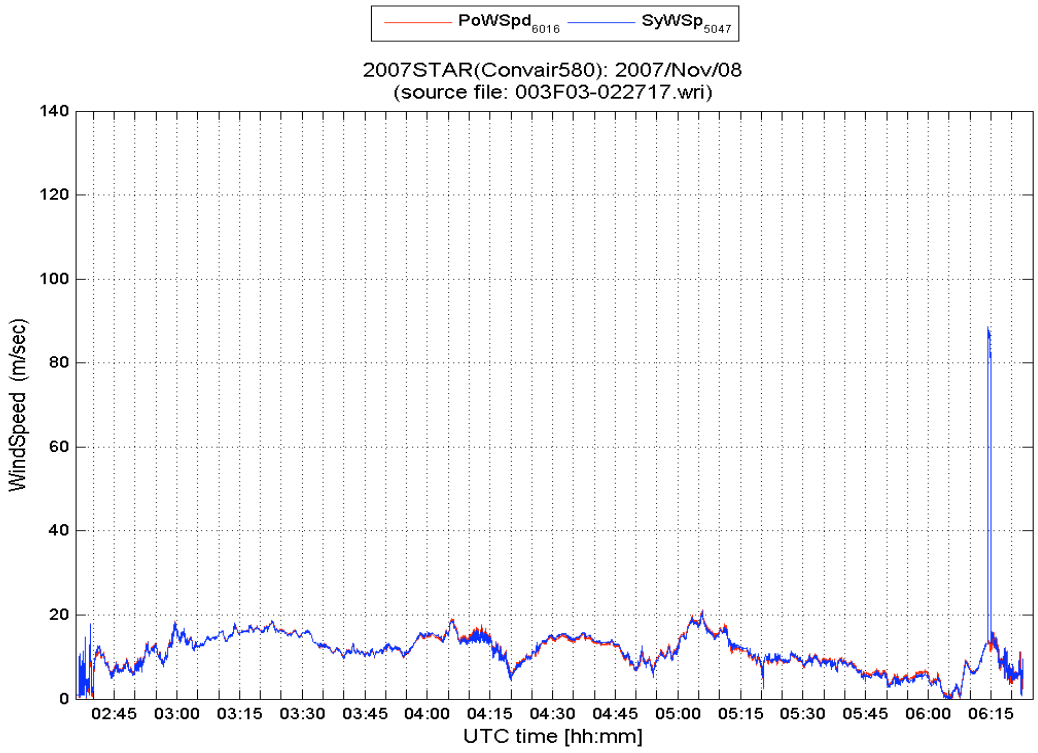
136-157columns:

5078 DirRadU W/m2	1324 F6LWC g/m3	1361 F6CONCY N/cc	1123 PCTcon /cm3	1124 PCcn01 /cm3	1125 PCcn02 /cm3	1126 PCcn03 /cm3	1127 PCcn04 /cm3	1128 PCcn05 /cm3	1129 PCcn06 /cm3	1130 PCcn07 /cm3	1131 PCcn08 /cm3	1132 PCcn09 /cm3	1133 PCcn10 /cm3	1134 PCcn11 /cm3	1135 PCcn12 /cm3	1136 PCcn13 /cm3	1137 PCcn14 /cm3	1138 PCcn15 /cm3	1139 PCmvd um	1140 Pmass ug/cm3	1141 P>15 /cm3
-8888.8	0	0	-8888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-8.888	-888.8	-888.8
-8888.8	0	0	-8888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-8.888	-888.8	-888.8
-8888.8	0	0	-8888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-8.888	-888.8	-888.8
-8888.8	0	0	-8888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-8.888	-888.8	-888.8
-8888.8	0	0	-8888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-8.888	-888.8	-888.8
-8888.8	0	0	-8888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-8.888	-888.8	-888.8
-8888.8	0	0	-8888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-8.888	-888.8	-888.8
-8888.8	0	0	-8888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-8.888	-888.8	-888.8
-8888.8	0	0	-8888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-8.888	-888.8	-888.8
-8888.8	0	0	-8888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-888.8	-8.888	-888.8	-888.8

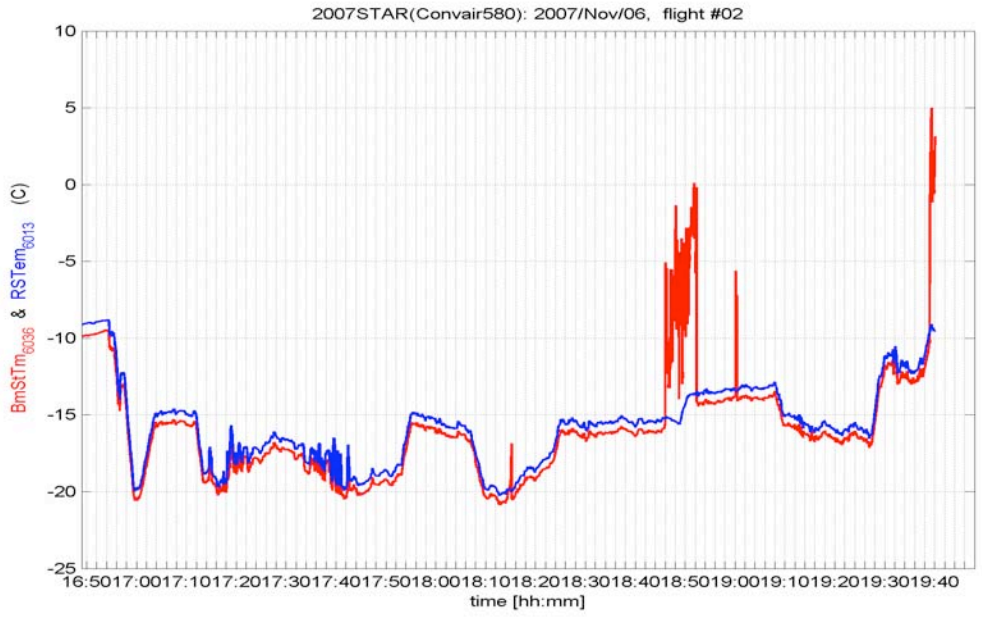
A sample of plot of LWC (B12_KSPLWC_KSzrLW_2007Nov23_1603to1942.tif):



A sample plot of wind speed (WindSpeed_Multi__03.tif)



A sample of Temperature (B02_BmStTm_RSTem_2007Nov06_1649to1940.tif):



2.1.2.2 FSSP spectrum file (ASCII): this contains the 15 channels of the FSSP probe, uncorrected for dead time/coincidence.

Data Period:
Start date: 05nov2007
End date: 28nov2007
Data format: ascii (chn)

There are two files, FSSP-100_VGC1.3.chn for flights 4 and 10; and FSSP-100_VGC1.2.chn for the rest of 15 flights.

2.1.2.3 2D analyses data

The data contains the following sub-folders:

- Aircft 1-second temperature and aircraft data for each flight
- Data030 30-second averaged aircraft, LWC, temperature and FSSP data for each flight
- Fssp096 1-second and 30-second averaged FSSP 096 data for each flight
- IntAnaC Summary of final analysis for each flight at 30, 60, 120 and 300-seconds
- Data030 CIN Integrated drop spectra for each flight at 30-seconds resolution
- DatI030 CIN Integrated ice crystal spectra for each flight at 30-seconds resolution
- King 1-second LWC data for each flight
- LatLon 10-second raw and analysed latitude and longitude data for each flight
- Rid 1-second RID data for each flight
- Summ030 30-second FSSP, 2D, LWC, RID, aircraft data for in-cloud cases for each flight
- Summary Times of 30-second in-cloud periods for each flight
- Text 2D The 30-second averaged aircraft 2D data for each flight

Data Period:
Start date: 05nov2007
End date: 28nov2007
Data format: ascii (dat), image (tif, pdf)

Abbreviations:

- CIN Centre in processing technique for 2D images
- DEE Double edge element processing technique for 2D images
- Rid Rosemount Icing Detector
- STAR **S**torm S**t**udies in the **Ar**tic
- TIF TIF image files
- ### The three-digit flight number from 001 to 999
- FSSP Forward scattering spectrometer probe
- 096 FSSP serial number 096 with 3-45 micron range
- 124 FSSP serial number 124 with 5-95 micron range
- 2D-C PMS 2D imaging mono scale cloud probe with 25-800 micron range
- 2D-G PMS 2D imaging grey scale cloud probe with 25-1600 or 15-960 range
- 2D-P PMS 2D imaging mono scale precipitation probe with 200-6400 micron range
- LWC Liquid water content
- IWC Ice water content

2.1.2.3.1 The data analysis sequence:

2.1.2.3.1.1 The 1-second data are processed and quality controlled and put into the following data files:

Data File Name	Directory	Description
AIRC###.dat	Aircft	1-second temperature and aircraft data for flight ###
F0SP###.dat	Fssp096	1-second FSSP 096 data for flight ###
KING###.dat	King	Raw LWC data at 1-second resolution for flight ###
WFCAL###.dat	King	Processed LWC data at 1-second resolution for flight ###
ICEDT###.dat	Rid	Raw RID data at 1-second resolution for flight ###
DETEC###.dat	Rid	Processed RID data at 1-second resolution for flight ###
POSN###.dat	Latlon	Latitude and longitude data at 10-second resolution for flight ###

2.1.2.3.1.2 The data are averaged at 30 second resolution and put in the following data files:.

Data File Name	Directory	Description
AVG###.dat	Data030	30-second averaged aircraft data for flight ###
TEM###.dat	Data030	30-second averaged temperature data for flight ###

F0S###.dat	Data030	30-second averaged FSSP 096 data for flight ###

2.1.2.3.1.3 The in-cloud periods are identified using LWC, FSSP and 2D probe measurements, the 2D cloud phase is identified and this information is recorded in the following data files:

Data File Name	Directory	Description
STAR###Z.dat	Summary	In-cloud times for each flight at 30-second resolution (Z = 30 s)

The data files in the Summary directory include only periods of time during which the aircraft was assessed to be in-cloud. The in-cloud periods were identified using several instruments and the following screening criteria:

- LWC must be >= 0.0 g m-3
- TWC must be >= 0.001 g m-3
- FSSP concentrations must be >= 0.001 cm-3
- FSSP counts must be >= 5
- Regions with bad 2D data are screened out

The 2D based phase estimation is encoded as follows:

- -1 = no indication was made
- 0 = nothing, or insufficient 2D images for phase identification
- 1 = small drizzle
- 2 = large drizzle
- 3 = drizzle and rain
- 4 = drizzle with the occasional crystal
- 5 = mixed rain and ice crystals
- 6 = mixed drizzle and ice crystals
- 7 = semi circular ice crystals
- 8 = unclear, probably ice
- 9 = irregular ice crystals dominate
- 10 = needles dominate
- 11 = dendrites dominate
- 12 = shedding dominates
- 13 = no images
- 14 = bad data

2.1.2.3.1.4 The data are processed for in-cloud periods at 30 second resolution and put in the following data files:

Data File Name	Directory	Description
IC###Z.dat	Summ030	Analysis of icing data for in-cloud portions at 30-s resolution

F0###Z.dat		Analysis of FSSP 096 data for in-cloud portions at 30-s resolution
DC###Z.dat		Analysis of 2D-C data for in-cloud portions at 30-s resolution
DG###Z.dat		Analysis of 2D-G data for in-cloud portions at 30-s resolution
DP###Z.dat		Analysis of 2D-P data for in-cloud portions at 30-s resolution
RI###Z.dat		Analysis of RID data for in-cloud portions at 30-s resolution
LL###Z.dat		Analysis of position data for in-cloud portions at 30-s resolution

2.1.2.3.1.5 The drop data as measured from FSSP and 2D probes are integrated together to create a single integrated drop spectrum for each in-cloud period. Similarly, the ice crystal data as measured from 2D probes are integrated together to create a single integrated ice crystal spectrum for each in-cloud period. The integrated spectra are put in the following data files:

Data File Name	**Directory**	**Description**
F###Z.dat	IntAnaC/Data030	Normalized probe data with combined bins for drops at 30-s
S###Z.dat		Summary of analysis of integrated drop spectra at 30-s
N###Z.dat		Normalized integrated drop spectra at 1 micron resolution at 30-s
R###Z.dat		Raw probe data for drops at 30-s
F###Z.dat	IntAnaC/DatI030	Normalized probe data with combined bins for ice crystals at 30-s
S###Z.dat		Summary of analysis of integrated ice crystal spectra at 30-s
N###Z.dat		Normalized integrated ice crystal spectra at 1 micron resolution
R###Z.dat		Raw probe data for ice crystals at 30-s

2.1.2.3.1.6 The analysis for all flights in the STAR project is summarized in six data files as follows:

Data File Name	Directory	Description
STAA030Z.dat	IntAnaC	Summary of FSSP analysis for all project flights at 30-s
STAB030Z.dat		Summary of 2D analysis for all project flights at 30-s
STAC030Z.dat		Summary of LWC and aircraft analysis for all project flights (30-s)
STAD030Z.dat		Summary of integrated spectra analysis for all project flights (30-s)
STAE030Z.dat		Summary of RID analysis for all project flights at 30-s

These summary files contain a final analysis/assessment of the cloud phase. Cloud phase is recorded as follows:

- 0 = Unknown phase
- 1 = Liquid phase
- 2 = Mixed phase
- 3 = Ice phase

These five summary data files are in a format that allows them to be easily incorporated into Matlab or Excel. The files are all exactly the same length so that they can be easily combined into a single spreadsheet.

2.1.2.3.2 List of variables in each file

*2.1.2.3.2.1 Data files **AIRC###.dat** have 1 second data for flight ###.*

- TIME or hms = Time hhmmss (hour-hour-minute-minute-second-second)
- Alt or alt = Altitude in kft (1000 feet)
- NPres or pres = Nose pressure in mb
- RFTD or tdyn = Reverse flow dynamic temperature in C
- RFTS or tsta = Reverse flow static temperature in C
- WRSTm or tsta = AES Rosemount static temperature in C
- DewPt or tdew = Dew point temperature in C
- ROSIC1 or rid-c1 = Rosemount icing detector raw voltage in mV
- PCTcon or pccon = PCASP total concentration in cm-3
- PCmvd or pcmvd = PCASP mean volume diameter in microns
- WgTAS or tas = Wing true air speed in m s-1
- SWSpd or wspd = Wind speed in knots
- SWDr or wdir = Wind direction in degrees
- 2 columns of 2D probe total counting information

*2.1.2.3.2.2 Data files **F0SP###.dat** have 1 second data for FSSP 3-45 micron for flight ###.*

- TIME = Time in hhmmss format
- R96 = Range

- FSCALE = Scale factor
- FS96CNC = Total concentration in cm-3
- Concentration for channels 1-15 in cm-3
- F6XSF = Dead time correction factor
- Counts for channels 1-15
- Diameters for channels 1-15
- FSSP LWC in g m-3
- FSSP data system LWC in g m-3
- FSSP data system concentration in cm-3
- Activity

*2.1.2.3.2.3 Data files **KING###.dat** for Convair-580 flights have 1 second data for LWC probes for flight ###.*

- TIME = Time in hhmmss format
- WRSTm = AES boom static temperature probe in C
- NPres = Nose pressure in mb
- WgTAS = True air speed in m s-1
- F96Cn = FSSP 096 3-45 microns concentration in cm-3
- 6MVD = FSSP 096 3-45 microns mean volume diameter in microns
- KLVlt = King long voltage in mV
- KLAmp = King long current in mV
- KLPwr = King long power in mV
- KSVlt = King short voltage in mV
- KSAmp = King short current in mV
- KSPwr = King short power in mV
- NLWC = Nevzorov LWC in g m-3
- NTWC = Nevzorov TWC in g m-3
- TAS_Bm = LWC boom true air speed in m s-1
- NPres = Corrected nose pressure in mb
- NLWCc = Nevzorov modified LWC in g m-3 (not used)
- NTWCc = Nevzorov modified TWC in g m-3 (not used)
- NLWzr = Nevzorov zero removed LWC in g m-3 (not used)
- TLWzr = Nevzorov zero removed TWC in g m-3 (not used)

*2.1.2.3.2.4 Data files **WFCAL###.dat** have 1 second processed LWC data for flight ###.*

- n = Interval number
- hms = Time in hhmmss format
- kswf = King short LWC in g m-3
- kszr = King short zero removed LWC in g m-3
- nlwc = Nevzorov LWC in g m-3
- ntwc = Nevzorov TWC in g m-3
- nlwcc = Nevzorov modified LWC in g m-3
- ntwcc = Nevzorov modified TWC in g m-3
- btas or tas = LWC boom true air speed in m s-1
- 1s-a = 1 second running a coefficient
- 10s-a = 10-second running a coefficient
- taes = Static temperature in C
- klwc = Data system King LWC in g m-3

2.1.2.3.2.5 *Files **ICEDT###.dat** contain the following 1 second raw RID data for each flight:*

- Time or hms = time in hhmmss format
- Npres or pres = Nose pressure in mb
- RFTD or tdyn = reverse flow dynamic temperature in C
- RFTS or tsta = reverse flow static temperature in C
- WRSTm or tsta = Rosemount static temperature in C
- Alt or alt = altitude in kft
- WgTAS or tas = wing TAS in m s-1
- TAS_Bm or tasb = Boom TAS in m s-1
- ROSIC1 or rid = Rosemount icing detector voltage in mv
- ROSIC2 or heat = Rosemount icing detector heater voltage in mv
- Vibsig or vib = Vibrometer icing detector signal 1 in mV
- VibSta or VibroT' or vheat = Vibrometer icing detector signal 2 in mV
- IACHdg = Aircraft heading in degrees (not all projects)

2.1.2.3.2.6 *Files **DETEC###.dat** contain the following 1 second processed RID data for each flight:*

- n = line number
- hms = hour minute and second
- rid = rid voltage (adjusted for zero level)
- ind = indicator code for RID data
  - -3000 = good RID data point
  - -1900 = bad RID data point
  - -1500 = poor RID data point following trip
  - -1000 = minimum RID voltage point following trip
  - 0 = zero RID signal point
  - 2000 = maximum RID voltage point at start of trip
- zero = original rid value compared to zero level
- heat = heater voltage in mv
- tript = duration of current RID trip

2.1.2.3.2.7 *Data files **LATLO###.dat** have 10 second position data for flight ###. (not all projects)*

- TIME = Time in hhmmss format
- ILa = INS Latitude in degrees
- ILat = INS Latitude in minutes
- ILo = INS Longitude in degrees
- ILon = INS Longitude in minutes
- Same four for Loran
- Same four for North Star
- Same four (from best system)
- Alt = Altitude in kft
- NPres = Nose pressure in mb
- NPres = Corrected nose pressure in mb

*2.1.2.3.2.8 Data files **POSN###.dat** have 10 second position data for flight ###.*

- n = Line number
- hms = Time in hhmmss format
- longitude = Longitude in degrees with fraction
- latitude = Latitude in degrees with fraction
- alt = Altitude in kft
- pres = Nose pressure in mb

*2.1.2.3.2.9 Data files **AVG###.dat** have 30 second averaged data for flight ###.*

- n = Interval number starting at beginning of flight
- hms = Time in hhmmss format
- pts = Number of 1 second good data points in average
- zer = Number of 1 second data points with zero LWC
- kszr = King short zero removed LWC in g m-3
- kswf = King short LWC in g m-3
- nlwc = Nevzorov LWC in g m-3
- ntwc = Nevzorov TWC in g m-3
- wspd = Wind speed in knots
- wdir = Wind direction in degrees
- taes or tsta = AES Rosemount static temperature in C
- trfd or tdyn = Reverse flow dynamic temperature in C
- trfs or tsta = Reverse flow static temperature in C
- tdp or tdew = Dew point temperature in C
- tas = True air speed in m s-1
- tasb or tas = LWC boom true air speed in m s-1
- pres = Nose pressure in mb
- alt = Altitude in kft
- pccon = PCASP concentration in cm-3

*2.1.2.3.2.10 Data files **TEM###.dat** have 30 second averaged data for flight ###.*

- n = Interval number starting at beginning of flight
- hms = Time in hhmmss format
- pts = Number of 1 second good data points in average
- ntwc = Nevzorov total water content average
- tamin or tsmin = Minimum AES Rosemount static temperature in the interval
- taes or tsta = Average AES Rosemount static temperature in the interval
- tamax or tsmax = Maximum AES Rosemount static temperature in the interval
- trmin or tsmin = Minimum AES Reverse flow temperature in the interval
- trfs or tsta = Average AES Reverse flow temperature in the interval
- trmax or tsmax = Maximum AES Reverse flow temperature in the interval
- tdp or tdew = Dew point temperature in C
- tas = True air speed in m s-1
- pres = Nose pressure in mb
- alt = Altitude in kft

*2.1.2.3.2.11 Data files **F0S###.dat** have 30 second averaged data for FSSP 3-45 microns for flight ###.*

- n = Interval number
- hms = Time in hhmmss format
- conc = Total concentration
- md = Mean diameter in microns
- mvd = Mean volume diameter in microns
- effd = Effective diameter in microns
- medvd = Median volume diameter in microns
- pkd = Peak diameter in microns
- pkmd = Peak mass diameter in microns
- lwc = LWC in g m-3
- kurto = Kurtosis (not used)
- width = Width of spectra in bins (not used)
- slope = Slope of spectra (not used)
- rang = Range
- Percent mass in channels 1-3, 4-6, 6-9, 9-12, 12-15
- tot = Number of 1 second points with non zero FSSP data
- fgt50 = Concentration of drops greater than 50 microns
- wf5_32 = LWC in range 5-32 microns
- count = Total particle count for 30 second interval

2.1.2.3.2.12 Time data for project STAR flights (as given in paragraph 4c) are files

- **STAR###Z.dat** which contain 30-s time and phase data where ### is the flight number.
- The third line in the file is the number of time intervals for analysis
- STime = Start time for each 30-second in-cloud interval
- ETime = End time for each 30-second in-cloud interval
- ID = Best estimate of the 2D cloud phase following the code in paragraph 5c
- PB = Probe that was used to determine the best phase estimate
  - 1 = 2D-C probe
  - 2 = 2D-G probe
  - 3 = 2D-P probe
- C = Estimate of the 2D cloud phase using the 2D-C probe
- G = Estimate of the 2D cloud phase using the 2D-G probe
- P = Estimate of the 2D cloud phase using the 2D-P probe
- Case = Original case number from start of file

*2.1.2.3.2.13 Files **F0###Z.dat** contain FSSP 096 (3-45 micron) data for each in-cloud interval in flight ### where Z represents 30-s interval.*

- Interval number
- Start and end times for interval
- Table of spectra information including:
  - n = Channel number
  - dia = Diameter in microns
  - conc = Concentration in m-3
  - lwc = LWC in g m-3
  - count = Particle counts for the interval
  - nconc = Normalized concentration in m-3 micron-1
- rng = Range, zero = FSSP zero threshold
- pts = Number of 1 second data points, bad = Number of bad data points

- md = Mean diameter, mvd = mean volume diameter, medvd = median volume diameter, mas80 = 80% mass diameter
- pkd = Peak diameter, pkmd = peak mass diameters in microns
- conc = Concentration in cm-3
- lwc = LWC in g m-3

*2.1.2.3.2.14 Files **IC###Z.dat** contain LWC and other data for each in-cloud interval in flight ### where Z represents 30-s interval.*

- Interval number
- Start and end times for interval
- Number of 1 s data points and number of zero LWC points
- Table with mean, maximum, minimum, standard deviation and number of points for 1 second data for the following variables:

  - King_S_LWC = King short zero removed LWC in g m-3
  - King_S_PWF = King short LWC in g m-3
  - Russn_LWC = Nevzorov LWC in g m-3
  - Russn_TWC = Nevzorov TWC in g m-3
  - WSPD = Wind speed in knots
  - WDIR = Wind direction in degrees
  - Taes = AES Rosemount static temperature in C
  - Trfd = Reverse flow dynamic temperature in C
  - Trfs = Reverse flow static temperature in C
  - Tdew = Dew point temperature in C
  - Tas = True air speed in m s-1
  - Tasb = LWC boom true air speed in m s-1
  - Pres = Pressure in mb
  - alt = Altitude in kft
  - PCASP = PCASP concentration in cm-3
  - 2DC = 2DC shadow concentration (not used)
  - 2DP = 2DP shadow concentration (not used)

*2.1.2.3.2.15 Files **RI###Z.dat** contain the following averaged RID data for each in-cloud interval in flight ### Z represents 30-s interval.*

- Int = Interval number
- Stime = start time in hhmmss
- Etime = end time in hhmmss
- Response = average RID response for interval in mv
- Trip = number of RID trips in interval
- Good = number of 1 second good RID data in interval
- Bad = number of 1 second bad RID data in interval
- Min = number of good 1 second RID data below 400 mv
- Pts = number of 1 second points during interval
- MaxDel = maximum 1 second RID change in interval
- MinHea = minimum aircraft heading in interval in degrees
- MaxHea = maximum aircraft heading in interval in degrees

*2.1.2.3.2.16 Files **LL###Z.dat** contain the following position data for each in-cloud interval in flight ### where Z represents 30-s interval.*

- Int = Interval number
- Stime = start time in hhmmss
- Etime = end time in hhmmss
- Lat-00s = latitude at the start of the 30-s interval
- Lon-00s = longitude at the start of the 30-s interval
- Lat-10s = latitude at the 10 second point of the 30-s interval
- Lon-10s = longitude at the 10 second point of the 30-s interval
- Lat-20s = latitude at the 20 second point of the 30-s interval
- Lon-20s = longitude at the 20 second point of the 30-s interval
- Alt-00s = altitude at start of 30-s interval in kft
- Alt-10s = altitude at 10-second point of 30-s interval
- Alt-20s = altitude at 20-second point of 30-s interval

*2.1.2.3.2.17 Files **C###Z.dat** contain 2D-C data for each for each in-cloud interval in flight ### Z represents 30-s interval.*

- Interval number
- Start and end times
- Start and end times in raw seconds since 000000 GMT
- 2D Ident = 2D identification indicator
- Circle and Crystal ratio
- CirCon L-1 = Concentration of circles in L-1
- Totl Count = Total count of particles
- Processed = Count of processed particles
- Sam Length = Sample length in m
- ZeroArea R = Rejects from zero area
- Min Diam R = Rejects from minimum diameter
- Max Diam R = Rejects from maximum diameter
- Circles >4 = Count of circles > 4 pixels
- Irregul >4 = Counts of irregular > 4 pixels
- Needles >4 = Counts of needles > 4 pixels
- Good Images = Counts of acceptable images that were processed
- Bln Line R = Rejects from embedded blank slice
- Time Bar R = Rejects from time bar errors
- NotFocus R = Rejects from not in focus
- Complete P = Number of complete images that were processed
- CenNotIn R = Rejects from centre not in
- Dendrite = Counts of dendrites
- LWC >=5 = LWC for circles >= 5 pixels
- Partial P = Number of partial images that were processed
- CConc = Concentration of circles in m-3
- IConc = Concentration of irregular in m-3
- NConc = Concentration of needles in m-3
- DConc = Concentrations of dendrites in m-3
- 64 channels of CIN counts for circular particles only
- 64 channels of CIN concentrations for circular particles only
- 64 channels of CIN counts for non-circular particles only
- 64 channels of CIN concentrations for non-circular particles only.

*2.1.2.3.2.18 Files **G###Z.dat** contain 2D-G data for each for each in-cloud interval in flight ### Z represents 30-s interval.*

- Interval number
- Start and end times
- Start and end times in raw seconds since 000000 GMT
- 2D Ident = 2D identification indicator
- Circle and Crystal ratio
- CirCon L-1 = Concentration of circles in L-1
- Totl Count = Total count of particles
- Processed = Count of processed particles
- Sam Length = Sample length in m
- ZeroArea R = Rejects from zero area
- Min Diam R = Rejects from minimum diameter
- Max Diam R = Rejects from maximum diameter
- Circles >4 = Count of circles > 4 pixels
- Irregul >4 = Counts of irregular > 4 pixels
- Needles >4 = Counts of needles > 4 pixels
- Good Images = Counts of acceptable images that were processed
- Bln Line R = Rejects from embedded blank slice
- Time Bar R = Rejects from time bar errors
- NotFocus R = Rejects from not in focus
- Complete P = Number of complete images that were processed
- CenNotIn R = Rejects from centre not in
- Dendrite = Counts of dendrites
- LWC >=5 = LWC for circles >= 5 pixels
- Partial P = Number of partial images that were processed
- CConc = Concentration of circles in m-3
- IConc = Concentration of irregular in m-3
- NConc = Concentration of needles in m-3
- DConc = Concentrations of dendrites in m-3
- 64 channels of CIN counts for circular particles only
- 64 channels of CIN concentrations for circular particles only
- 64 channels of CIN counts for non-circular particles only
- 64 channels of CIN concentrations for non-circular particles only

*2.1.2.3.2.19 Files **P###Z.dat** contain 2DP data for each in-cloud interval in flight ### where Z represents 30-s interval.*

- Interval number
- Start and end times
- Start and end times in raw seconds since 000000 GMT
- 2D Ident = 2D identification indicator
- Circle and Crystal ratio
- CirCon L-1 = Concentration of circles in L-1
- Totl Count = Total count of particles
- Processed = Count of processed particles
- Sam Length = Sample length in m
- ZeroArea R = Rejects from zero area
- Min Diam R = Rejects from minimum diameter

- Max Diam R = Rejects from maximum diameter
- Circles >4 = Count of circles > 4 pixels
- Irregul >4 = Counts of irregular > 4 pixels
- Needles >4 = Counts of needles > 4 pixels
- Good Images = Counts of acceptable images that were processed
- Bln Line R = Rejects from embedded blank slice
- Time Bar R = Rejects from time bar errors
- NotFocus R = Rejects from not in focus
- Complete P = Number of complete images that were processed
- CenNotIn R = Rejects from centre not in
- Dendrite = Counts of dendrites
- LWC >=5 = LWC for circles >= 5 pixels
- Partial P = Number of partial images that were processed
- CConc = Concentration of circles in m-3
- IConc = Concentration of irregular in m-3
- NConc = Concentration of needles in m-3
- DConc = Concentrations of dendrites in m-3
- 64 channels of CIN counts for circular particles only
- 64 channels of CIN concentrations for circular particles only
- 64 channels of CIN counts for non-circular particles only
- 64 channels of CIN concentrations for non-circular particles only

*2.1.2.3.2.20 Files **N###Z.dat** contain normalized drop data for each in-cloud interval in flight ### where Z represents 30-s*

- Interval.
- Case number for that flight
- Start and end time
- Dia = Diameter at 1 micron resolution
- Nconc = Normalized concentration in m-3 micron-1 at 1 micron resolution
- Nlwc = Normalized LWC in g m-3 micron-1 at 1 micron resolution
- Cmass = Cumulative mass from 0 to 1
- MassDlogD = DlogD (LWC) for a specific type of LWC plotting
- Ref = Reflectivity of the droplet spectra in mm6 m-3 for each 1 micron
- Crefl = Cumulative reflectivity from 0 to 1

*2.1.2.3.2.21 Files **N###Z.dat** contain normalized ice crystal data for each in-cloud interval in flight ### where Z represents 30-s interval.*

- Case number for that flight
- Start and end time
- Dia = Diameter at 1 micron resolution
- Nconc = Normalized concentration in m-3 micron-1 at 1 micron resolution
- Niwc = Normalized LWC in g m-3 micron-1 at 1 micron resolution
- Cmass = Cumulative mass from 0 to 1
- MassDlogD = DlogD (LWC) for a specific type of LWC plotting
- Ref = Reflectivity of the droplet spectra in mm6 m-3 for each 1 micron
- Crefl = Cumulative reflectivity from 0 to 1
- MeltDia = Equivalent melted diameter for ice crystal spectra following Cunningham

*2.1.2.3.2.22 Files **R###Z.dat** contain the normalized raw data (diameter and concentration) for drops for each in-cloud interval for each instrument for flight ### where Z represents 30-s interval.*

- FSSP 3-45 microns (15 channels)
- FSSP 5-95 microns (15 channels)
- 2DC 25-800 microns (32 channels)
- 2DG 25-1600 microns (64 channels)
- 2DP 200-6400 microns (32 channels)

*2.1.2.3.2.23 Files **R###Z.dat** contain the normalized raw data (diameter and concentration) for ice crystals for each in-cloud interval for each instrument for flight ### where Z represents 30-s interval.*

- 2DC 25-800 microns (32 channels)
- 2DG 25-1600 microns (64 channels)
- 2DP 200-6400 microns (32 channels)

*2.1.2.3.2.24 Files **F###Z.dat** contain the normalized binned data (diameter and concentration) for drops for each in-cloud interval for each instrument for flight ### where Z represents 30-s interval. Binned data combine bins so that there are no bins with zero concentrations.*

- FSSP 3-45 microns (15 channels)
- FSSP 5-95 microns (15 channels)
- 2DC 25-800 microns (32 channels)
- 2DG 25-1600 microns (64 channels)
- 2DP 200-6400 microns (32 channels)

*2.1.2.3.2.25 Files **F###Z.dat** contain the normalized binned data (diameter and concentration) for ice crystals for each in-cloud interval for each instrument for flight ### where Z represents 30-s interval. Binned data combine bins so that there are no bins with zero concentrations.*

- 2DC 25-800 microns (32 channels)
- 2DG 25-1600 microns (64 channels)
- 2DP 200-6400 microns (32 channels)

*2.1.2.3.2.26 Files **S###Z.dat** contain the averages for each instrument and an analysis of the drop spectrum LWC and concentration for specific diameter intervals (based on the 1 micron normalized analysis). Data includes all in-cloud intervals for flight ### where Z represents 30-s interval.*

- Case number for that particular flight
- FSSP 096 analysis (7 lines identical to F0###L.dat information)
- FSSP 124 analysis (7 lines identical to F1###L.dat information)
- 2D-C analysis (10 lines identical to DC###L.dat information)
- 2D-G analysis (10 lines identical to DG###L.dat information)
- 2D-P analysis (10 lines identical to DP###L.dat information)
- LWC and aircraft analysis (21 lines identical to IC###L.dat)
- Phase indicator = Phase estimation (based on the 2D probes)
- Probe indicator = 2D probe used for the phase estimation
- RID LWC value = RID LWC calculation in g m-3
- Original case number starting from the beginning of the file
- Reflectivity = Total reflectivity of the droplet spectrum in mm6 m-3 and dBZ
- Rain rate in mm hour-1
- Ice Conc Estimate = Ice crystal concentration estimate in m-3
- Analysis of the integrated spectra over specific diameter ranges (11 lines)
- Analysis of Jeck LWC/Concentration bins over distinct diameter ranges (13 lines)

*2.1.2.3.2.27 Files **S###Z.dat** contain the averages for each instrument and an analysis of the ice crystal IWC and concentration for specific diameter intervals (based on the 1 micron normalized analysis). Data includes all in-cloud intervals for flight ### where Z represents 30-s interval.*

- Case number for that particular flight
- Flight number
- Start and end times
- Phase indicator = Phase estimation (based on the 2D probes)
- Probe indicator = 2D probe used for the phase estimation
- Ice LWC calculation in g m-3 following Cunningham
- Original case number based on 30-s data points starting at beginning of file
- Reflectivity = Total reflectivity of the ice crystal spectrum in mm6 m-3 and dBZ following Cunningham
- Heymsfield IWC = Ice LWC calculation in g m-3 following Heymsfield et al
- Reflectivity = Total reflectivity of the ice crystal spectrum in mm6 m-3 and dBZ following Heymsfield
- Locatelli IWC = Ice LWC calculation in g m-3 following Locatelli and Hobbs
- Reflectivity = Total reflectivity of the ice crystal spectrum in mm6 m-3 and dBZ following Locatelli and Hobbs

*2.1.2.3.2.28 File **STAA030Z.dat** contains the following FSSP data columns for all flights in project STAR where Z corresponding to 30-s interval.*

- n = interval number
- time = hour minute second in hhmmss format

- f0p = FSSP 096 number of points in the interval
- f0b = FSSP 096 number of bad points in the interval
- f0md = FSSP 096 mean diameter in microns
- f0mvd = FSSP 096 mean volume diameter in microns
- f0med = FSSP 096 median volume diameter in microns
- f0pkd = FSSP 096 peak diameter in microns
- f0pkm = FSSP 096 peak mass diameter in microns
- f0conc = FSSP 096 concentration cm-3
- f0lwc = FSSP 096 LWC g m-3
- f1p = FSSP 124 number of points in the interval
- f1b = FSSP 124 number of bad points in the interval
- f1md = FSSP 124 mean diameter in microns
- f1mvd = FSSP 124 mean volume diameter in microns
- f1med = FSSP 124 median volume diameter in microns
- f1pkd = FSSP 124 peak diameter in microns
- f1pkm = FSSP 124 peak mass diameter in microns
- f1conc = FSSP 124 concentration cm-3
- f1lwc = FSSP 124 LWC g m-3
- f0m80 = FSSP 096 80% mass diameter in microns
- f1m80 = FSSP 124 80% mass diameter in microns
- m80vd = Integrated droplet spectra 80% mass diameter in microns
- reflmm6m-3 = Droplet spectrum total reflectivity in mm6 m-3
- DrefdBz = Droplet spectrum total reflectivity in dBZ
- reflmm6m-3 = Ice crystal total reflectivity in mm6m-3 following Cunningham
- IrefdBz = Ice crystal total reflectivity in dBZ following Cunningham
- IceLWC = computed ice crystal water content based on 2D spectrum following Cunningham
- Hrefmm6m-3 = Ice crystal total reflectivity in mm6m-3 following Heymsfield et al.
- HrefdBZ = Ice crystal total reflectivity in dBZ following Heymsfield et al.
- HeyLWC = computed ice crystal water content following Heymsfield et al.
- Lrefmm6m-3 = Ice crystal total reflectivity in mm6m-3 following Locatelli and Hobbs
- LrefdBZ = Ice crystal total reflectivity in dBZ following Locatelli and Hobbs
- LocLWC = computed ice crystal water content following Locatelli and Hobbs
- m95md = integrated spectra 95% mass diameter in microns
- m99vd = integrated spectra 99% mass diameter in microns

*2.1.2.3.2.29 File **STAB030Z.dat** contains the following 2D data columns for all flights in project STAR where Z corresponding to 30-s interval.*

- n = interval number
- time = hour minute and second in hhmmss format
- Csampl = 2D-C sample length
- Cconcn = 2D-C concentration
- Ctotal = 2D-C total counts
- Cproce = 2D-C processed particle count
- Csmall = 2D-C particles 1-4 pixels count
- Ccryst = 2D-C ice crystal counts
- Cother = 2D-C rejected count

- Ccircl = 2D-C circle counts
- Csrat = 2D-C circle ratio
- Ccrat = 2D-C crystal ratio
- Gsampl = 2D-G sample length
- Gconcn = 2D-G concentration
- Gtotal = 2D-G total counts
- Gproce = 2D-G processed particle counts
- Gsmall = 2D-G 1-4 pixel particle count
- Gcryst = 2D-G ice crystal counts
- Gother = 2D-G rejected count
- Gcircl = 2D-G circle counts
- Gsrat = 2D-G circle ratio
- Gcrat = 2D-G crystal ratio
- Psampl = 2D-P sample length
- Pconcn = 2D-P concentration
- Ptotal = 2D-P total counts
- Pproce = 2D-P processed particle count
- Psmall = 2D-P 1-4 pixel count
- Pcryst = 2D-P crystal counts
- Pother = 2D-P rejected count
- Pcircl = 2D-P circle count
- Psrat = 2D-P circle ratio
- Pcrat = 2D-P crystal ratio
- CCConc = 2D-C circle concentration in m-3
- CIConc = 2D-C irregular concentration in m-3
- CNConc = 2D-C needle concentration in m-3
- GCConc = 2D-G circle concentration in m-3
- GIConc = 2D-G irregular concentration in m-3
- GNConc = 2D-G needle concentration in m-3
- PCConc = 2D-P circle concentration in m-3
- PIConc = 2D-P irregular concentration in m-3
- PNConc = 2D-P needle concentration in m-3
- PDConc = 2D-P dendrite concentration in m-3
- Cqc = 2D-C quality control indicator
- Gqc = 2D-G quality control indicator
- Pqc = 2D-P quality control indicator

*2.1.2.3.2.30 File **STAC030Z.dat** contains the following data columns for STAR flights:*

- n = interval number
- time = hour minute and second in hhmmss format
- kszr = King probe final LWC measurement in g m-3
- kswf = king probe LWC (initial estimate) in g m-3
- nlwc = Nevzorov LWC measurement in g m-3
- ntwc = Nevzorov total WC measurement in g m-3
- wspd = wind speed in knots
- wdir = wind direction in degrees
- taes = Rosemount static temperature in C
- tamin = minimum static temperature for interval in C
- trfd = reverse flow dynamic temperature in C
- trfs = reverse flow static temperature in C
- trmin = reverse flow minimum temperature in C

- tdew = dew point in C
- tas = true air speed in m s-1
- pres = pressure in mb
- alt = altitude in kft
- pccon = aerosol concentration in cm-3
- conc = droplet concentration for integrated spectra in cm-3
- tlwc = spectra LWC integrated over integrated spectra in g m-3
- king = king probe estimated LWC (using spectra) in g m-3
- md = mean diameter for integrated spectra in microns
- mvd = mean volume diameter for integrated spectra in microns
- medvd = median volume diameter for integrated spectra in microns
- pkd = integrated spectra peak diameter in microns
- pkmd = integrated spectra peak mass diameter in microns
- dmax = maximum diameter for integrated spectra in microns
- flt = flight number
- case = case number for a specific flight
- C = class = identification of classical or non-classical
    - 0 = non-classical formation, 1 = classical formation, 2 = unknown (not yet assessed)
- P2D = identification of 2D based cloud phase (from –1 to 14)
- Pro = ident of probe used for phase recognition (1 = 2D-C, 2 = 2D-G, 3 = 2D-P)
- Almax = maximum altitude in interval in kft
- Almin = minimum altitude in interval in kft
- Lpts = number of LWC values used for average
- Lzer = number of zero LWC values in average
- tamax = rosemount static temp maximum in interval in C
- trmax = reverse flow static temp maximum in interval in C
- LwcSD = standard deviation for 1 sec LWC measurement in g m-3
- TwcSD = standard deviation for 1 sec TWC measurements in g m-3
- RIDlwc = Rosemount icing detector calculated LWC in g m-3
- OCase = Original case number based on 30-s data points from start of file
- RainRate = Rain rate in mm hour-1
- IceCon_L = Ice concentration in L-1

*2.1.2.3.2.31 File **STAD030Z.dat** contains the following integrated spectra columns for STAR flights:*

- n = interval number
- time = hour minute and second in hhmmss format
- c1-50 = concentration for 1 to 50 microns in cm-3
- c51-100 = concentration for 51 to 100 microns in cm-3
- c101-200 = concentration for 101 to 200 microns in cm-3
- c201-300 = concentration for 201 to 300 microns in cm-3
- c301-400 = concentration for 301 to 400 microns in cm-3
- c401-500 = concentration for 401 to 500 microns in cm-3
- c501-1000 = concentration for 501 to 1000 microns in cm-3
- c1000-1500 = concentration for 1000 to 1500 microns in cm-3
- c1500-2000 = concentration for 1500 to 2000 microns in cm-3
- L1-50 = LWC for 1 to 50 microns in g m-3
- L51-100 = LWC for 51 to 100 microns in g m-3

- L101-200 = LWC for 101 to 200 microns in g m-3
- L201-300 = LWC for 201 to 300 microns in g m-3
- L301-400 = LWC for 301 to 400 microns in g m-3
- L401-500 = LWC for 401 to 500 microns in g m-3
- L501-1000 = LWC for 501 to 1000 microns in g m-3
- L1000-1500 = LWC for 1000 to 1500 microns in g m-3
- L1500-2000 = LWC for 1500 to 2000 microns in g m-3

*2.1.2.3.2.32 File **STAE030Z.dat** contains the following RID data columns for all flights in project STAR where Z corresponding to 30-s interval.*

- n = interval number
- time = hour minute and second in hhmmss format
- Response = average response in mv s-1 for the period
- Trip = number of trips in the period
- Good = number of seconds of good data
- Bad = number of seconds of bad data
- Min = number of seconds of good data below 400 mv
- Pts = number of points in the interval
- Case = case number for flight
- MaxDel = maximum 1 second RID voltage change in interval
- MinHea = minimum aircraft heading in degrees in interval
- MaxHea = maximum aircraft heading in degrees in interval

*2.1.2.3.2.33 File **STAF030Z.dat** contains the following data columns for STAR flights:*

- flt = Flight number
- hms = hour minute and second in hhmmss format
- Case = in-cloud case number for the flight
- Phase = final assessed cloud phase
  - 1 = liquid phase
  - 2 = mixed phase
  - 3 = glaciated phase
- P2D = phase estimated with only 2D data (from –1 to 14 as discussed in Para 22)
- LWC = final calculated LWC used with IWC (LWC + IWC = TWC) in g m-3
- IWC = calculated IWC used with LWC (LWC + IWC = TWC) in g m-3
- IWCCor = final corrected IWC accounting for latent heat of fusion correction in g m-3
- TWCCor = final corrected TWC accounting for latent heat of fusion correction in g m-3
- Lat-00s = latitude at start of 30-s interval
- Lon-00s = longitude at start of 30-s interval
- Lat-10s = latitude at 10-second point of 30-s interval
- Lon-10s = longitude at 10-second point of 30-s interval
- Lat-20s = latitude at 20-second point of 30-s interval
- Lon-20s = longitude at 20-second point of 30-s interval
- Alt-00s = altitude at start of 30-s interval in kft
- Alt-10s = altitude at 10-second point of 30-s interval
- Alt-20s = altitude at 20-second point of 30-s interval
- TAS – m/s = true air speed in m s-1 for the 30-s interval
- IConcL-1 = ice crystal concentration in L-1

- lwc>50 = LWC incorporated in drops > 50 microns
- lwc>100 = LWC incorporated in drops > 100 microns
- lwc>500 = LWC incorporated in drops > 500 microns

2.1.2.3.3 2D Images

2.1.2.3.3.1 MonoImages.

This will be a 2DC pdf file and a 2DP pdf file for each flight containing images of the probes, with a maximum of one record per second. Each file contains multi pages. This is intended as a quick-look product. The images are also refered to "2D monoImages".

Data Period:

Start date: 05nov2007

End date: 28nov2007

Data format: image (pdf)

Sample plot of 2DC (page 8 of 071030F2_2MC.pdf):

* 2D IMAGES - Date: 2007/10/31 * 2D-Cg are pseudo grey representations * 2D-C/P are mono representations * Aircraft: * Convair 580

2.1.2.3.3.2 2DC and 2DP images

For each flight, we have extracted the 2DC and 2DP images from the complicated aircraft data buffer, and put them out as fixed record length records for easy access, in case you want to do your own image analysis. There will be one 2DC and one 2DP file for each flight.

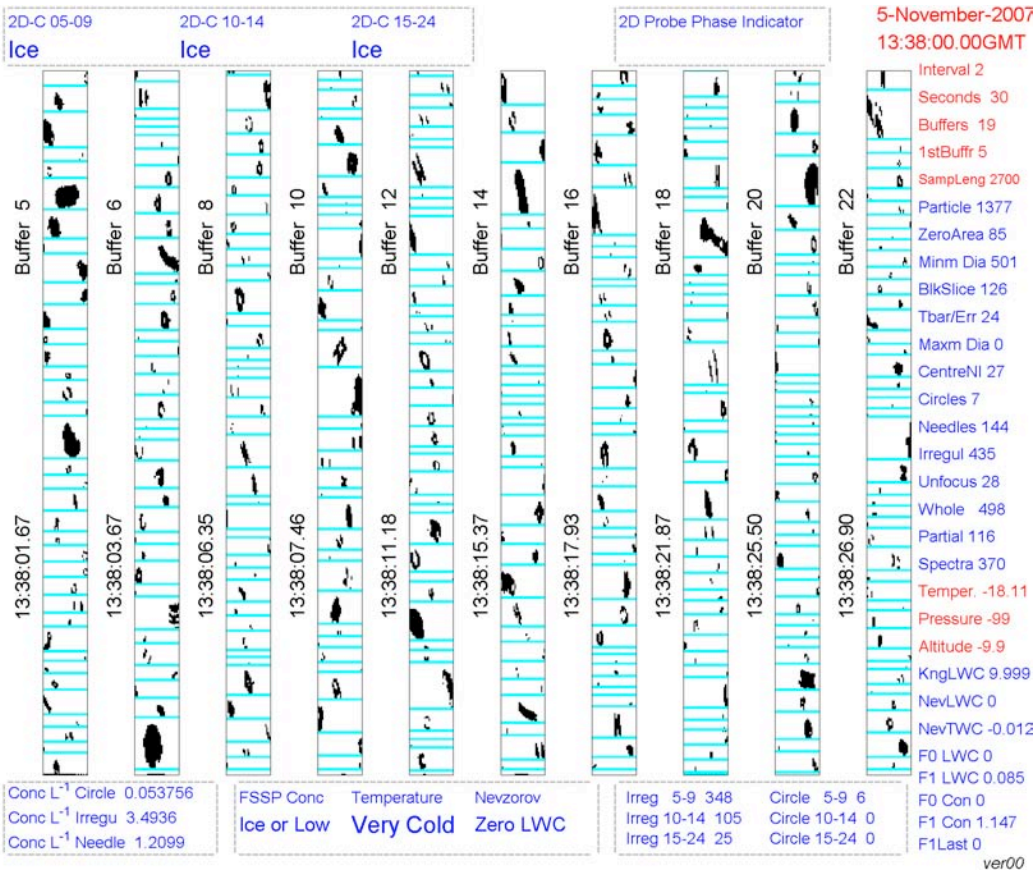
Data Period:

Start date: 05nov2007

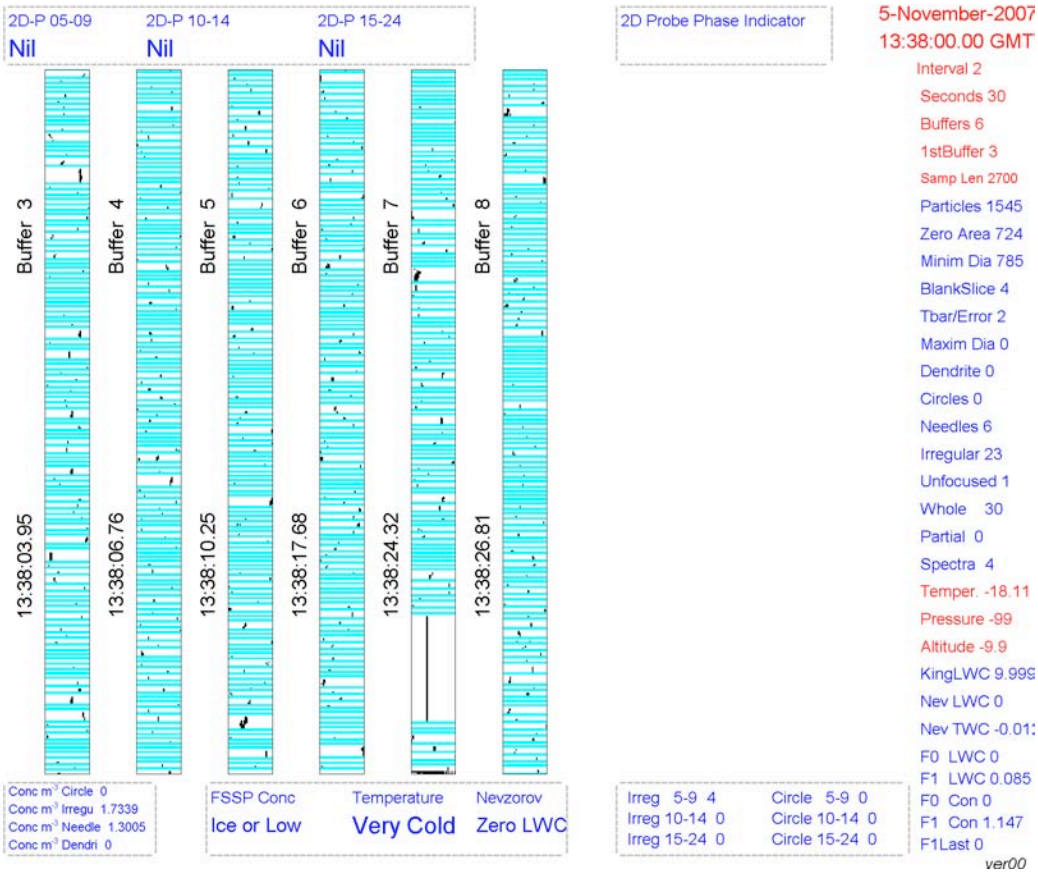
End date: 28nov2007

Data format: image (tif)

Sample plot of 2DC (C01_133800.tif)



Sample plot of 2DP (P01_133800.tif)



2.1.2.3.3.3 2DC and 2DP spectra – Cober 2D 30-second average product.

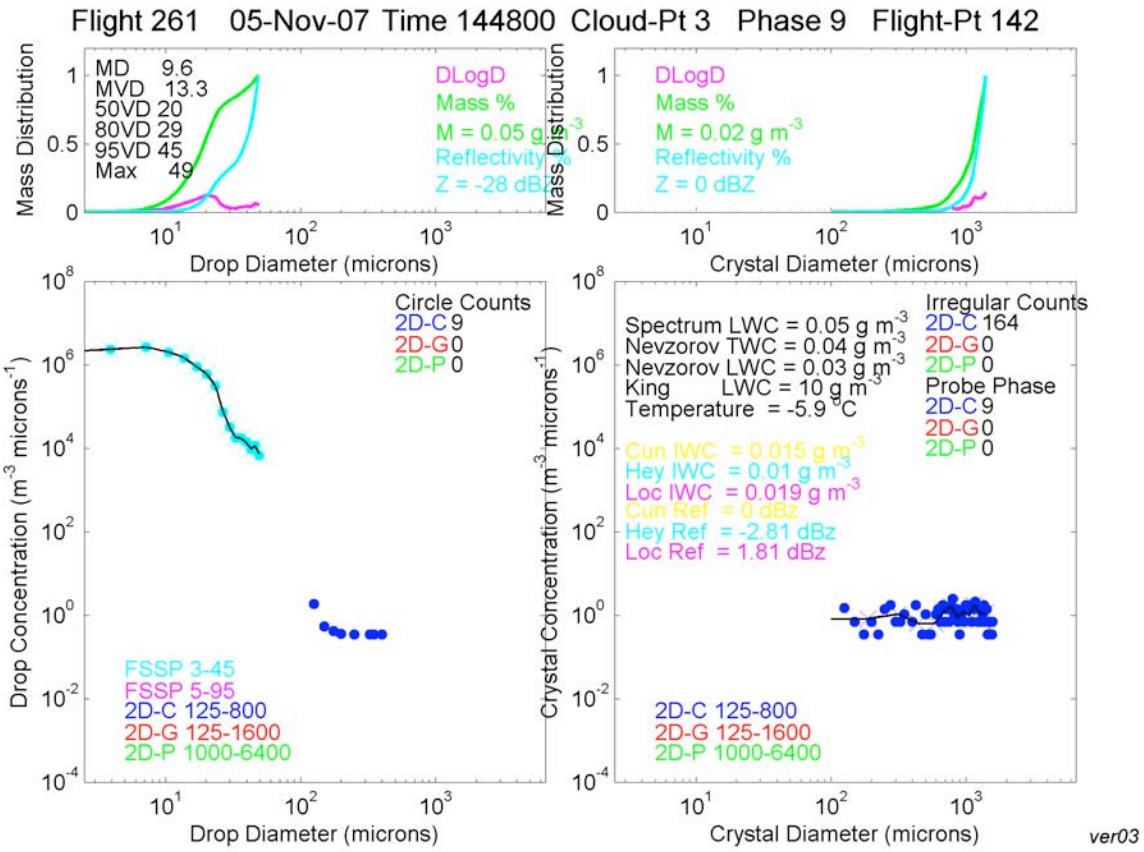
This is a more sophisticated 2D analysis that is described in many pages of documentation along with the data set. It is currently available only in 30-second averages.
Data Period:

Start date: 05nov2007

End date: 28nov2007

Data format: image (tif)

A sample plot of the images (S261_144800.tif):



2.1.2.4 Ka-band radar.

2.1.2.4.1 Ka-band radar reflectivities (digital):

These files contain the up and down looking radar range bin reflectivities as digital values.

Data Period:

Start date: 05Nov2007

End date: 28nov2007

Data format: ascii (asc)

There 6 ASCII output files which are Reflectivity Up & Down, Power Up & Down and Range Up & Down. The format is:

Date, Time, Alt(m), followed by 512 values.

2007/11/06, 16:59:05, 2006.21, -14.23, -7.22, -27.22, -19.62, -34.65, ,,,,,,,,,,,,,,,

2007/11/06, 16:59:06, 2013.57, -14.23, -7.23, -27.96, -19.72, -34.58, ,,,,,,,,,,,,,,,

… …

2.1.2.4.2 Reflectivity Images

These are images of the Ka-band radar with approximately 20 minute cross sections per frame. The altitude of the aircraft has been set using the GPS altitude, so an altitude on this display is the height above the earth's ellipsoid. They are intended as a quick-look product.

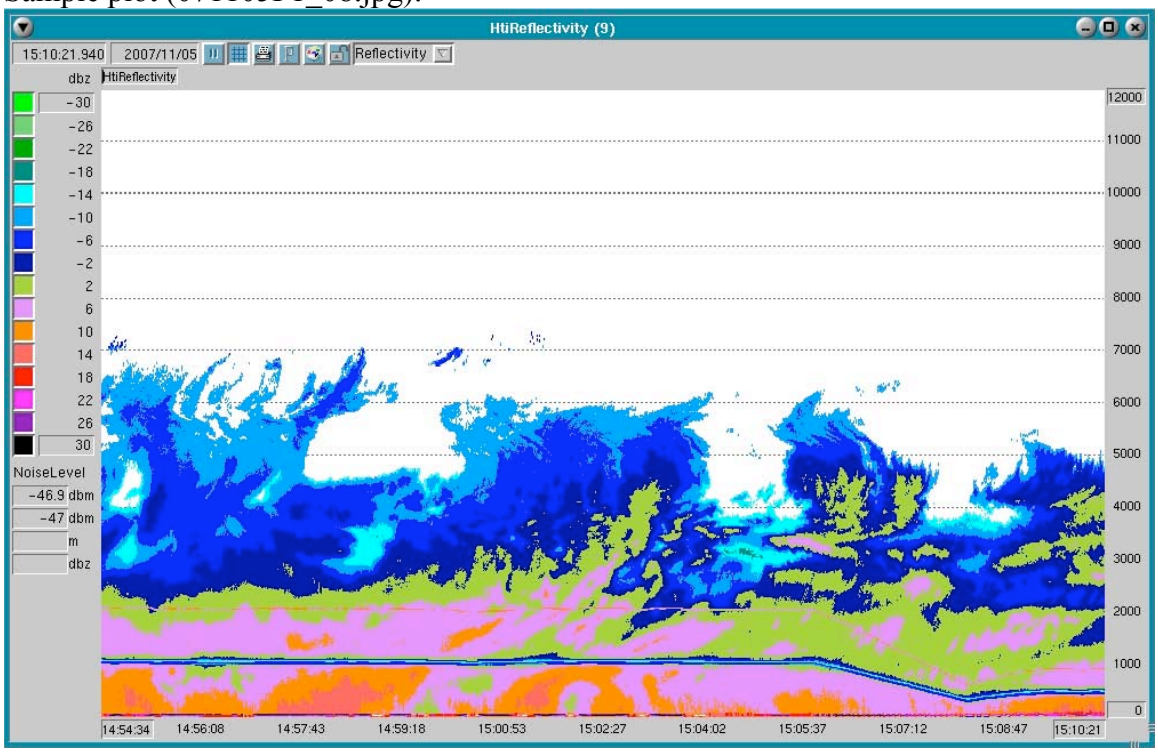
Data Period:

Start date: 30Oct2007

End date: 28nov2007

Data format: image (jpg)

Sample plot (071105F1_08.jpg):



2.1.2.5 Dropsonde data:

These files contain the time, location, altitude of dropsonde, it provide measurements of air pressure, temperature, relative humidity, wind speed and direction.

Data Period:

Start date: 05Nov2007

End date: 28nov2007

Data format: text

The file name start with "D" followed by date and time, e.g., "D20071105_155948_P.1", the format is:

```
AVAPS-T01 STA 070349136 071105 155737.14
AVAPS-T01 COM          UTC    UTC      Air   Air    Rel   Wind   Wind   Vert      GPS       GPS      Geopoten GPS  Sonde  Sonde GPS Wind    GPS
AVAPS-T01 COM  Sonde   Date   Time     Press Temp   Humid Dir    Spd    Veloc     Longitude Latitude Altitude Wnd   RH1    RH2  Snd Error Altitude
AVAPS-T01 COM  ID     yymmdd hhmmss.ss (mb)  (degC)  (%)   (deg)  (m/s)  (m/s)     (deg)     (deg)    (m)    Sat   (%)    (%)  Sat (m/s)    (m)
```

```
AVAPS-T01 COM
--------- ------ --------- ------- ------ ------ ------ ------ ------ ---------- ---------- --------- --- ------ ------ --- ----- --------
AVAPS-T01 LAU 070349136 071105 155948.34
AVAPS-D01 A00 070349136 071105 155948.00  548.50 -20.90 116.77 337.00  16.60   0.00  -56.179600  62.034200  4837.20   0 116.77 116.77   0  0.00  4837.20
AVAPS-D01 S00 070349136 071105 155948.80  553.69  -0.06  16.52 117.71  34.38   1.20  -56.126058  62.023906  4306.61   9  16.52  17.80   9 99.00   466.74
AVAPS-D01 S00 070349136 071105 155949.30  554.13  -2.76  18.99 117.26  25.20  -5.40  -56.160270  62.031161  4300.26   8  18.99  19.84   8 99.00 99999.00
AVAPS-D01 S00 070349136 071105 155949.80  554.58  -4.61  21.21  41.54   8.65 -16.92  -56.114041  62.018698  4293.88   7  21.21  21.59   7 99.00   153.86
AVAPS-D01 S00 070349136 071105 155950.30  555.03  -6.32  23.67  64.80  15.20  -9.30  -56.130298  62.016154  4287.48   9  23.67  23.89   9 99.00 99999.00
… …
```

2.1.2.6 Flight track.

These files contain the time, location, and altitude of flight.

Data Period:
Start date: 05Nov2007
End date: 28nov2007
Data format: text

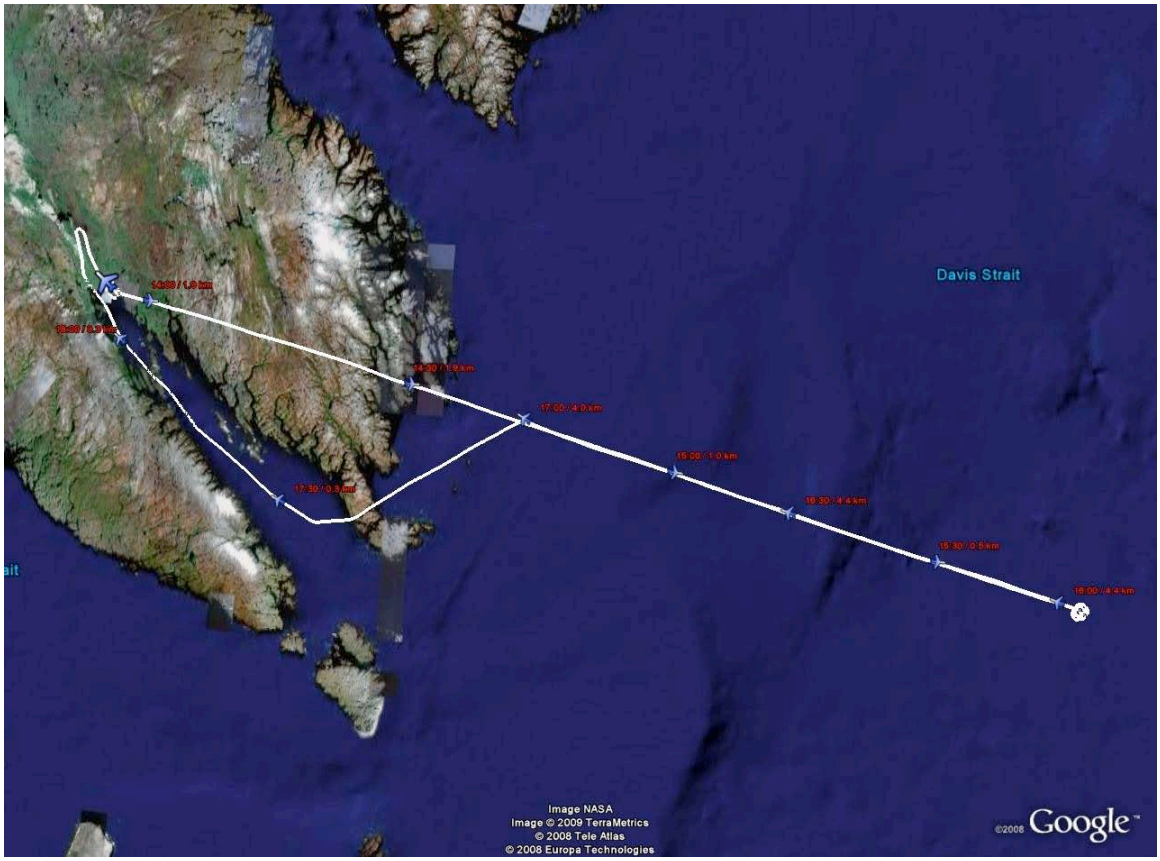
The text file format is as following (e.g., F01-Nov-05.txt):

STAR - NRC Convair - 05-Nov-2007 - PF #1

SEC	TIME(UTC)	Lat (deg)	Lon (deg)	Palt (m)	Ps (mb)	T (C)	wdir_n	wspd_n	wdir_h	wspd_h
49919.5	135159.5	63.74839	-68.53482	96.9	1001.7	-17.3	65.6	2.7	58.7	2.6
49921.1	135201.1	63.74837	-68.53488	96.6	1001.7	-17.4	66.9	2.8	60.5	2.7
49922.6	135202.7	63.74836	-68.53493	98.8	1001.4	-17.4	67.9	3.0	62.9	2.7
49924.2	135204.2	63.74834	-68.53498	98.0	1001.5	-17.4	69.1	3.0	63.6	2.8
49925.8	135205.8	63.74833	-68.53504	98.0	1001.5	-17.4	67.9	3.0	64.4	3.0
49927.4	135207.4	63.74831	-68.53510	96.9	1001.7	-17.5	68.0	3.1	64.5	3.1

… …

The images and kml files of flight track are also provided. The following is an example (F01-Nov-05.jpg):



2.1.2.7 W/X-band data.

These files contain NRC Airborne W/X-band radar data.

Data Period:
Start date: 05Nov2007
End date: 28nov2007
Data format: NetCDF

Zhp - Radar reflectivity factor - dBZ - Horizontal profile

Zvp - Radar reflectivity factor - dBZ - Vertical profile

The file format is Netcdf. The head information of a sample file is as following (NAW-20071105-Zhp):

```
netcdf NAW-20071105-Zhp-135511-143523 {
dimensions:
        time = UNLIMITED ; // (26573 currently)
        range = 382 ;
        number_of_files = 3 ;
        max_string_length = 19 ;
        max_vertical_files = 2 ;
variables:
        char file_names(number_of_files, max_string_length) ;
```

```
        file_names:info = "List of data files used" ;
double file_times(number_of_files, max_vertical_files) ;
        file_times:info = "Start and end time of each file" ;
char channel_directions(number_of_files, max_vertical_files, max_string_length) ;
        channel_directions:info = "Directions of channels" ;
float channel_calibrations(number_of_files, max_vertical_files) ;
        channel_calibrations:info = "Calibration values used for each file and channel" ;
char channels_used(number_of_files, max_vertical_files, max_string_length) ;
        channels_used:info = "Channels used from each file" ;
int pulse_lengths(number_of_files) ;
        pulse_lengths:info = "Pulse lengths of data files used" ;
char modes(number_of_files, max_string_length) ;
        modes:info = "Operation mode of data files used" ;
int mask(time, range) ;
        mask:info = "Bit legend" ;
        mask:Bit_0 = "Noise" ;
        mask:Bit_1 = "Cloud" ;
        mask:Bit_2 = "Ground" ;
        mask:Bit_3 = "Below ground" ;
        mask:Bit_4 = "Ground contamination" ;
        mask:Bit_5 = "Leakage from down channel" ;
        mask:Bit_6 = "Leakage from side channel" ;
        mask:Bit_7 = "Near-field range gates" ;
        mask:Bit_8 = "Noise estimate" ;
        mask:Bit_9 = "Blocked transmission" ;
        mask:Bit_16 = "X-Band data" ;
        mask:Bit_17 = "W-Band data" ;
        mask:Bit_18 = "Aft H channel" ;
        mask:Bit_19 = "Aft V channel" ;
        mask:Bit_20 = "Side H channel" ;
        mask:Bit_21 = "Side V channel" ;
        mask:Bit_22 = "Nadir channel" ;
        mask:Bit_23 = "Up channel" ;
double timestamp(time) ;
        timestamp:units = "Time (host_ts)" ;
float range_scale(range) ;
        range_scale:units = "Range (m)" ;
double host_time(time) ;
        host_time:units = "second" ;
double VME_time(time) ;
        VME_time:units = "second" ;
float h_altitude(time) ;
        h_altitude:units = "metre" ;
float h_roll(time) ;
        h_roll:units = "degree" ;
float h_pitch(time) ;
        h_pitch:units = "degree" ;
float h_heading(time) ;
        h_heading:units = "degree" ;
float h_longitude(time) ;
        h_longitude:units = "degree" ;
float h_latitude(time) ;
        h_latitude:units = "degree" ;
float l_altitude(time) ;
        l_altitude:units = "metre" ;
float l_roll(time) ;
```

```
                l_roll:units = "degree" ;
        float l_pitch(time) ;
                l_pitch:units = "degree" ;
        float l_heading(time) ;
                l_heading:units = "degree" ;
        float l_longitude(time) ;
                l_longitude:units = "degree" ;
        float l_latitude(time) ;
                l_latitude:units = "degree" ;
        float aft_vertical_angle(time) ;
                aft_vertical_angle:units = "degree" ;
        float z_side_image(time, range) ;
                z_side_image:units = "dBz" ;

// global attributes:
                :project = "STAR" ;
                :radar = "NAWX W-band" ;
                :range = 7680.f ;
                :rgs = 34.28571f ;
                :profile_spacing = 0.09066574f ;
                :start_time = "13:55:11" ;
                :end_time = "14:35:23" ;
                :flight_date = "Mon Nov  5 2007" ;
                :contact = "Mengistu Wolde" ;
                :organization = "National Research Council Canada" ;
                :website = "www.nawx.nrc.gc.ca" ;
                :version = "1" ;
                :creation_date = "January 18, 2009" ;
}
```

2.1.2.8 W-band Doppler Velocity - Vertical profile (VDvp).

These data Provide vertical profile of wind speed.

Data Period:
Start date: 05Nov2007
End date: 28nov2007
Data format: NetCDF

The file format is Netcdf. The head information of a sample file is as following (NAW-20071117-VDvp-103501-111941.nc):

```
netcdf NAW-20071117-VDvp-103501-111941 {
dimensions:
        time = UNLIMITED ; // (29117 currently)
        range = 352 ;
        number_of_files = 5 ;
        max_string_length = 19 ;
        max_vertical_files = 2 ;
variables:
        char file_names(number_of_files, max_string_length) ;
                file_names:info = "List of data files used" ;
        double file_times(number_of_files, max_vertical_files) ;
```

```
        file_times:info = "Start and end time of each file" ;
char channel_directions(number_of_files, max_vertical_files, max_string_length) ;
        channel_directions:info = "Directions of channels" ;
float channel_calibrations(number_of_files, max_vertical_files) ;
        channel_calibrations:info = "Calibration values used for each file and channel" ;
char channels_used(number_of_files, max_vertical_files, max_string_length) ;
        channels_used:info = "Channels used from each file" ;
int pulse_lengths(number_of_files) ;
        pulse_lengths:info = "Pulse lengths of data files used" ;
char modes(number_of_files, max_string_length) ;
        modes:info = "Operation mode of data files used" ;
int mask(time, range) ;
        mask:info = "Bit legend" ;
        mask:Bit_0 = "Noise" ;
        mask:Bit_1 = "Cloud" ;
        mask:Bit_2 = "Ground" ;
        mask:Bit_3 = "Below ground" ;
        mask:Bit_4 = "Ground contamination" ;
        mask:Bit_5 = "Leakage from down channel" ;
        mask:Bit_6 = "Leakage from side channel" ;
        mask:Bit_7 = "Near-field range gates" ;
        mask:Bit_8 = "Noise estimate" ;
        mask:Bit_9 = "Blocked transmission" ;
        mask:Bit_16 = "X-Band data" ;
        mask:Bit_17 = "W-Band data" ;
        mask:Bit_18 = "Aft H channel" ;
        mask:Bit_19 = "Aft V channel" ;
        mask:Bit_20 = "Side H channel" ;
        mask:Bit_21 = "Side V channel" ;
        mask:Bit_22 = "Nadir channel" ;
        mask:Bit_23 = "Up channel" ;
double timestamp(time) ;
        timestamp:units = "Time (host_ts)" ;
float range_scale(range) ;
        range_scale:units = "Altitude (m)" ;
double host_time(time) ;
        host_time:units = "second" ;
double VME_time(time) ;
        VME_time:units = "second" ;
float h_altitude(time) ;
        h_altitude:units = "metre" ;
float h_roll(time) ;
        h_roll:units = "degree" ;
float h_pitch(time) ;
        h_pitch:units = "degree" ;
float h_heading(time) ;
        h_heading:units = "degree" ;
float h_longitude(time) ;
        h_longitude:units = "degree" ;
float h_latitude(time) ;
        h_latitude:units = "degree" ;
float l_altitude(time) ;
        l_altitude:units = "metre" ;
float l_roll(time) ;
        l_roll:units = "degree" ;
float l_pitch(time) ;
```

```
                l_pitch:units = "degree" ;
        float l_heading(time) ;
                l_heading:units = "degree" ;
        float l_longitude(time) ;
                l_longitude:units = "degree" ;
        float l_latitude(time) ;
                l_latitude:units = "degree" ;
        float aft_vertical_angle(time) ;
                aft_vertical_angle:units = "degree" ;
        float vd_vertical_image(time, range) ;
                vd_vertical_image:units = "m/s" ;

// global attributes:
                :project = "STAR" ;
                :radar = "NAWX W-band" ;
                :range = 10080.f ;
                :rgs = 34.28571f ;
                :profile_spacing = 0.0920352f ;
                :start_time = "10:35:01" ;
                :end_time = "11:19:41" ;
                :flight_date = "Sat Nov 17 2007" ;
                :contact = "Dr. Mengistu Wolde" ;
                :organization = "National Research Council Canada" ;
                :website = "www.nawx.nrc.gc.ca" ;
                :version = "1" ;
                :creation_date = "February 5, 2009" ;
}
```

2.2 Upper Air Observations

Instrumentation supplied by: Environment Canada

Atmospheric profiles of temperature, pressure, humidity, wind speed, and direction were obtained using an MW 15 unit in Iqaluit and Pangnirtung, NU. All sondes were Vaisala RS92 GPS type, and were flown by both 300 gm and 800 gm balloons.

2.2.1 Iqaluit, NU

Iqaluit is the only location with 12h regular upper air observations on southern Baffin Island. Environment Canada contract employees performed these launches at 0Z and 12Z intervals. These flights were done using the larger sized balloons and hydrogen fill. During storms and special weather events, STAR personal supplemented the standard upper air releases with additional radiosondes, released at three-hourly or six-hourly intervals (Figure 5). These flights were done using the smaller sized balloons and helium fill. For all launches, a 12 channel uncoded GPS receiver in each sonde transmitted to the

ground every 10 seconds. Technical specifications of the sensors of the radiosondes are presented in Table 5.

Figure 5: Photo of Robyn Dyck (UofM), preparing to launch radiosonde from the Upper Air shed at YFB Environment Canada Weather Office (photo by Shannon Fargey)

Table 5: Technical Data Summary for the RS92-SGP Vaisala Radiosonde. Modified from Vaisala Radiosonde RS92-SGP brochure, (2006).

Sensor	*Type*	*Measurement Range*	*Resolution*	*Accuracy*	
Temperature	Capacitive Wire	+60 C to -90 C	0.1 C	-	0.5 C
Relative Humidity	Thin-Film Capacitor, Heated Twin Sensor	0 to 100%	1%	-	5% RH
Pressure	Silicon	1080 hpa to 3 hpa	0.1 hpa	1080-100 hPa 100-3 hPa	1 hPa 0.6 hPa
Wind	Correlating 12 channel GPS receiver	-	-	Horizontal position uncertainty Velocity measurement uncertainty Directional measurement uncertainty	10 m 0.1 m/s 2 degrees

2.2.1.1 Sounding data at Iqaluit

This data provides upper air observation, atmospheric thermodynamic and wind profiles.
Data Period:
Start date: 01Oct2007
End date: 30nov2007
Data format: txt

All raw data from the sounding, was archived after the flight. Archived files were then opened in Sounding Workbench software to extract the ascii text data reports. Each launch file produced four text data files:

- ptu (pressure, temp, RH, dewpoint) – 10 second data
- wind (speed, direction) – 10 second data
- add edit (temp, RH, virtual temp, DPD, LRate, Ascent, Rate) – 10 second data
- audit (summary and significant level data)

Due to power outages at the Environment Canada weather office, there are two upper air data files that are missing from the STAR data set. No data is available for the 12Z flight on day 306 (Nov 2) and 21Z flight on day 311 (Nov 7). From the period of October 10 – November 30, 2007, a total of 49 additional radiosondes were released by the STAR

project (Table 6). Data is also available for the regular 00Z and 12Z soundings between Oct 1 – Nov 30, 2007.

Table 6: Date and times of the STAR Upper Air Soundings performed in Iqaluit

Date	*Julian Day*	*Launch Time(s) (UTC)*	*IOP*
6-Oct-2007	276	20:00	
15-Oct-2007	288	21:00	1
16-Oct-2007	289	3:00, 6:00, 9:00, 15:00, 18:00	
17-Oct-2007	290	6:00, 18:00	
20-Oct-2007	293	18:00, 21:00	2
26-Oct-2007	299	6:00, 9:00, 15:00, 18:00, 21:00	3
27-Oct-2007	300	3:00, 6:00	
29-Oct-2007	302	18:00	4
30-Oct-2007	303	6:00, 18:00	
3-Nov-2007	307	6:00	5
4-Nov-2007	308	6:00	
5-Nov-2007	309	16:00, 18:00, 21:00	6
6-Nov-2007	310	18:00	7
7-Nov-2007	311	21:00	8
8-Nov-2007	312	3:00, 6:00	
9-Nov-2007	313	21:00	9
11-Nov-2007	315	21:00	10
12-Nov-2007	316	3:00, 6:00, 9:00, 15:00	
17-Nov-2007	321	6:00, 9:00, 15:00, 18:00, 21:00	11
18-Nov-2007	322	3:00, 6:00, 9:00, 15:00, 18:00, 21:00	
28-Nov-2007	332	15:00, 18:00, 21:00	16

2.2.2 Pangnirtung, NU

A portable MW 15 unit rawinsonde unit was taken to the community of Pangnirtung to conduct simultaneous launches with Iqaluit during selected severe weather events. Like Iqaluit, all sondes were Vaisala RS92 GPS type, and were flown by 300 gm balloons, with helium fill. Technical specifications for the Pangnirtung launches are the same as the Iqaluit upper air program and can be found in Table 5. The only difference was that the MW15 unit was set to transmit data to the ground every 2 seconds.

2.2.2.1 Sounding data at Pangnirtung

This data provides upper air observation, atmospheric thermodynamic and wind profiles.

Data Period:
Start date: 02.Nov.07
End date: 18.Nov.07
Data format: txt

All raw data from the sounding, was archived after the flight. Archived files were then opened in Sounding Workbench software to extract the ascii text data reports. The launch produces four text data files:

- ptu (pressure, temp, RH, dewpoint) – 2 second data
- wind (speed, direction) – 2 second data
- add edit (temp, RH, virtual temp, DPD, LRate, Ascent, Rate) – 2 second data
- audit (summary and significant level data)

The upper air data was made available to Environment Canada at the Winnipeg office in near real-time to be integrated into the model runs. This was the first time that upper air observations from Pangnirtung. A total of 18 radiosondes were released in Pangnirtung between the dates of November 2 –18, 2007 (Table 7).

Table 7: Date and Time of Upper Air soundings released from Pangnirtung.

Date	*Julian Day*	*Launch Time (UTC)*	*IOP*
2-Nov-2007	308	16:00	5
3-Nov-2007	309	18:00	
5-Nov-2007	311	14:00, 16:00, 18:00, 21:00	6
17-Nov-2007	321	12:00, 15:00, 17:00, 21:00	11
18-Nov-2007	322	0:00, 03:00, 06:00, 9:00, 12:00, 15:00, 18:00, 21:00	

2.2.3 Other stations surrounding Iqaluit

The upair sounding data for multiple stations surrounding Iqaluit were uploaded to ftp://clientservices.pnr.ec.gc.ca/ by Ed Hudson during STAR period. The data were archived twice a day.

2.2.3.1 Sounding data at other stations

This data provides the profiles of thermodynamic and wind of the atmosphere for upper air.

Data Period:
Start date: 05.Oct.07
End date: 31.Oct.08
Data format: TXT.

2.3 Remotely Sensed Observation

2.3.1 X-band Surface Doppler RADAR

Instrument provided by: Environment Canada – King City Radar Group

A portable X-band Doppler radar was deployed at the Environment Canada Weather Office in Iqaluit (October 10 - December 5, 2007) since no operational radars exist in northern Canada (Figure 6). This instrument was used in real-time to map and validate precipitation and wind fields within a radius of approximately 50 km of Iqaluit.

Figure 6: Portable X-band surface Doppler Radar at YFB Environment Canada Weather Office (photo by Robyn Dyck)

The radar used in this study has the following features: peak transmitted power 25 kW, beam width 2.5°, pulse width 0.4μs and a pulse repetition frequency of 2000 s^{-1} (Hudak et al., 1996). The radar was run in a series four scan modes, PPI (set elevation, 360 scan), volume scan (series of elevations, 360 scan at each elevation series), RHI (consistent azimuth, range of elevations), and manual stare (vertical stare mode). The sampling strategy was dictated by current weather conditions, but the general data collection sequence included all scan modes, repeated once every 12-minutes.

2.3.1.1 Radar data

Data Period:

Start date: 08Oct.07

End date: 05Dec.07

Data format: gif, iris (raw)

Data files were stored in iris format. Corresponding .gif files were created from the iris files. Initial processing of the radar data has been completed by Will Henson, using Matlab programs that he wrote based on IDL programs written by Paul Joe and also from Sigmet documentation.

The radar was fully operational during the entire fall field campaign, which means that there is a continuous data set from Oct 1-Nov 30. Table 8 reports the intervals where radar data was collected at the weather office site. No radar data was collected during times that fall outside these intervals, for reasons of data downloading, general maintenance or data quality issue.

Table 8: Time intervals where Radar data was collected at the YFB Environment Canada Weather Office

Start		*End*	
Date	***Time (UTC)***	***Date***	***Time (UTC)***
8-Oct-07	16:16	9-Oct-07	0:03
9-Oct-07	12:23	9-Oct-07	15:04
9-Oct-07	20:00	10-Oct-07	15:18
10-Oct-07	21:00	11-Oct-07	15:13
14-Oct-07	20:40	17-Oct-07	14:58
17-Oct-07	16:00	18-Oct-07	14:43
19-Oct-07	16:49	24-Oct-07	15:04
25-Oct-07	16:58	25-Oct-07	18:33
27-Oct-07	1:05	29-Oct-07	14:32
29-Oct-07	16:56	1-Nov-07	16:22
1-Nov-07	19:15	2-Nov-07	16:07
2-Nov-07	17:26	8-Nov-07	18:36
8-Nov-07	20:09	9-Nov-07	16:05
9-Nov-07	16:51	12-Nov-07	18:21
12-Nov-07	19:45	14-Nov-07	14:22
14-Nov-07	16:20	15-Nov-07	15:43
15-Nov-07	17:45	19-Nov-07	15:13
19-Nov-07	18:00	24-Nov-07	16:54
24-Nov-07	18:49	5-Dec-07	13:42

2.3.2 Passive Microwave Radiometer

Instrument provided by: University of Manitoba (CEOS)

A passive microwave radiometer (Radiometrics WVR-1100) was used to measure total column integrated water vapor and liquid water content. The WVR-1100 is a dual frequency radiometer operating at 23.8 GHz and 31.4 GHz. This allows simultaneous measures of integrated water vapor and integrated liquid water measures in the scan path. Figure 7 is a photo the radiometer at the weather office site.

Figure 7: Microwave Radiometer at YFB Environment Canada Weather Office (photo by Robyn Dyck)

2.3.2.1 Radiometer data

This data provides column-integrated water vapor and liquid water content.
Data Period:
Start date: 23.Sep.07
End date: 30.Nov.07
Data format: ascii(sav,los,err,log)

The STAR radiometer had a sampling resolution of about 1-minute, with vertical profiles ranging up to 10 km in the atmosphere. The data was automatically stored in two types of files *.los, *.sav, *.err and ND_calib.log. The *.los data file contains line of sight information, including date and time, brightness temperatures, total integrated water vapour and liquid water, phase delay, opacities, and azimuth and elevation observations. The *.sav data file contains all data collected by the instrument, including raw data files so that the user can post-process with different retrieval coefficients. The *.err file contains the radiometer fault messages, if any occurred during the data collection period. The ND_calib.log is a log of the calibration results.

The radiometer was only operational during the fall field campaign. Refer to Table 2 for the dates of operation of this instrument. During specific time periods, the radiometer

stopped working and/or there were problems with the data files. There is some missing data as a result.

- No data is available between day 296 (Oct 23) and day 300 (Oct 27)
- Intermittent data is available between 300 (Oct 27) and 302 (Oct 29)
- No data is available between day 316 (Nov 12) 14:30 and day 317 (Nov 13) because of a power outage.

Refer to Table A.1 in Appendix A, field notes, for time the times where the radiometer was being cleaned and the data quality may have been affected.

2.3.3 Doppler SODAR

Instrument provided by: University of Manitoba (CEOS).

An acoustic Doppler SODAR (sound detection and ranging) system (Remtech PA1-NT) was also used to assess the three component winds between 0 – 1.2 km AGL with a 30 m vertical resolution every 30 minutes. It operates by transmitting a short pulse of sound, which is refracted by the small-scale turbulence in the atmosphere. The range of the turbulence is determined from the delay between the transmission of the acoustic pulse, and the reception of the refracted signal. By repeating this process in three different directions, each direction having a large component being orthogonal to the other two directions, the 3-dimensional wind field can be calculated (Peters et al., 1996).

The Doppler sodar has a horizontal wind speed range of 30 m/s with an accuracy of 0.2 m/s and a 3° horizontal direction accuracy for winds faster than 2 m/s Its vertical speed range is -4 to +4 m/s, with and accuracy of 5 cm/s or better. Figure 8 is a photo of the Sodar installed that the Iqaluit Environment Canada Weather Office site.

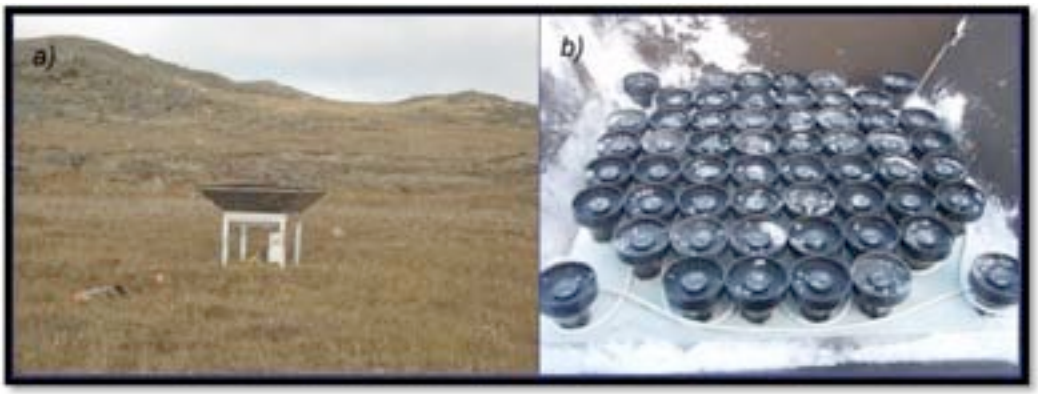


Figure 8: Pictures of Sodar at YFB Environment Canada Weather Office: a) Exterior of instrument (Photo by John Hanesiak), b) transducers (interior of instrument) (Photo by Robyn Dyck)

The sodar was only operational during the fall field campaign. Refer to Table 2 for the dates of operation of this instrument. During the field project, snowfall accumulation on the sodar was major concern with respect to data quality. Regular checks and maintenance were conducted on the instruments during this research project to maximize data quality. Refer to Table A.2 Appendix A, for field notes about the times where the sodar was being cleaned and the data quality may have been affected.

2.3.3.1 Doppler sodar dataset

This data provides wind profile measurements over study area; boundary layer evolution measurements.
Data Period:
Start date: 23.Sep.07
End date: 30.Nov.07
Data format: ascii(dat)

There were intervals where data was not collected because the GPA window was accidentally closed, or the system needed to be rebooted.

- Rebooted: 19:30 Nov 14 (UTC date = 318)
- Rebooted: 18:45 Nov 15 (UTC date = 319)

2.4 Automatic Weather Stations

Instrumentation collectively provided by: York University, Environment Canada, University of Manitoba (CEOS), Indian and Northern Affairs Canada, McGill University

2.4.1 Southern Baffin Island Mesonet

A small mesonet of 10 automatic weather stations, within a 100 km radius of Iqaluit where installed at the end of September (Figure 9). The weather stations were positioned over various forms of topography to assess storm influences on surface weather. By collaborating with the local northern groups, Indian and Northern Affairs Canada (INAC) and Qulliq Energy Corp., four of the mesonet weather stations (indicated in red on Figure 9) provided real-time weather data. Nine of these stations measured 3m wind velocity, pressure, 2m temperature, and 2m humidity every 10-minutes. One of the ten stations was

a 10-m tower installation at the Environment Canada site in Iqaluit. This 10-m tower was equipped with similar instrumentation as the other mesonet stations, but also included anemometers sampling at 10 m, 4 m, 3 m, 2 m and 1 m and a visibility sensor. The Sentry visibility sensor has a maximum range up to 16 km, and was set to record data at one-minute sampling intervals (refer to section '2.5.2. for a detailed description of the visibility sensors). In addition to the ten southern Baffin Island weather station sites, an additional automatic weather station was setup in the community of Pangnirtung, October 13 – November 18, 2007.

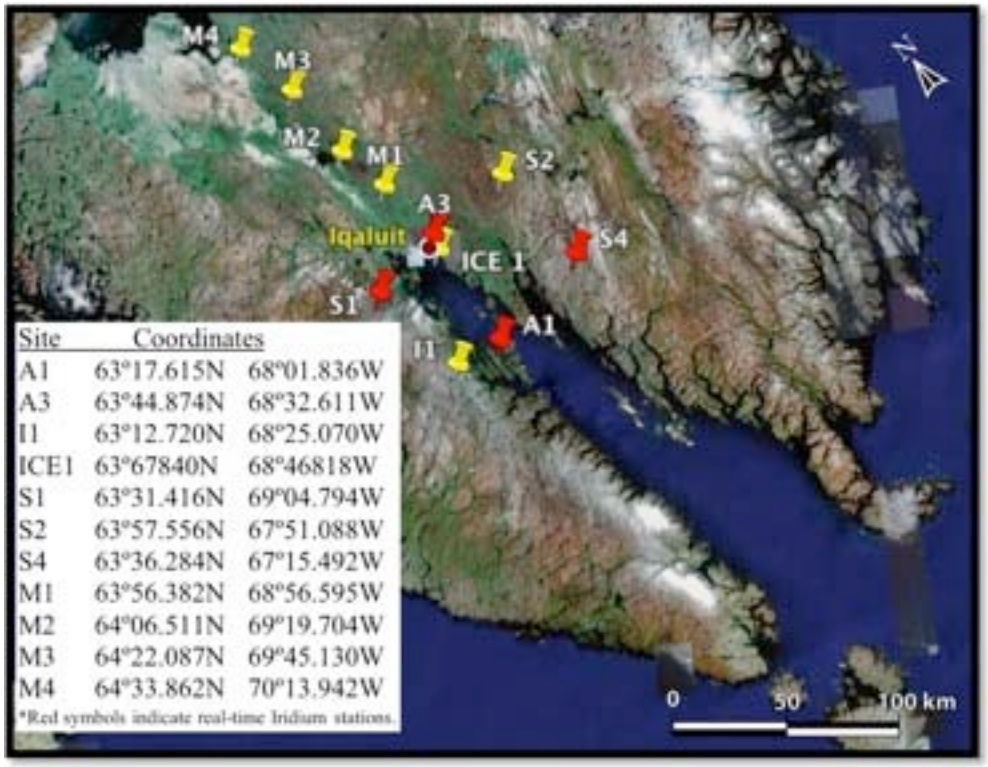


Figure 9: Map of the STAR automatic weather stations. Red markers indicate real-time Iridium stations, while yellow markers indicate standard automatic weather stations with dataloggers.

The nomenclature of the STAR stations:
A---ArcticNet;
I---INAC;
M---Mesonet - sites along the Sylvia Grinnel valley originally chosen by Kent Moore for a microbaragraph (pressure sensor) array
S---Sites - no special meaning.

The mesonet weather stations were operational during both fall and winter field campaigns. As part of STAR's support for northern communities and long turn research, the four real-time stations were left for INAC and Qulliq Energy for their continued use and monitoring. Tables 9, 10 and 11 are equipment lists for the mesonet stations. The information has been separated into three separate tables: standard stations, iridium stations and the last for the 10-m tower because of size constraints. Note that all heights given here are from the ground, and do not include the height of the snow pack.

Table 9: Equipment List of the standard weather station. Stations M1, M2, M3, M4, S2 of the mesonet.

Stn/Instrument	*Type*	*Height (m)*	*Units*	*Start*	*End*	*Notes*
STATION M1						Wires were chewed by foxes, no data collected after Oct.23, 2007
Wind Anemometer	5103	3	ms-1	01-Oct-07	10-Apr-08	
Pressure	PTB210	1.5	Pa	01-Oct-07	10-Apr-08	
Temp/Humidity	HMP45C212	2	C / %	01-Oct-07	10-Apr-08	
Temp	44212	2	C	01-Oct-07	10-Apr-08	
STATION M2						Data good
Wind Anemometer	5103	3	ms-1	24-Sep-07	10-Apr-08	
Pressure	PTB210	1.5	Pa	24-Sep-07	10-Apr-08	
Temp/Humidity	HMP45C212	2	C / %	24-Sep-07	10-Apr-08	
Temp	44212	2	C	24-Sep-07	10-Apr-08	
STATION M3						Data were missing between Dec.1,2007-Feb.2, 2008
Wind Anemometer	5103	3	ms-1	26-Sep-07	10-Apr-08	
Pressure	61205V	1.5	Pa	26-Sep-07	10-Apr-08	
Temp/Humidity	HMP45C	2	C / %	26-Sep-07	10-Apr-08	
Temp	44212	2	C	26-Sep-07	10-Apr-08	
STATION M4						Data good
Wind Anemometer	5103	3	ms-1	26-Sep-07	10-Apr-08	
Pressure	PTB210	1.5	Pa	26-Sep-07	10-Apr-08	
Temp/Humidity	HMP45C212	2	C / %	26-Sep-07	10-Apr-08	
Temp	44212	2	C	26-Sep-07	10-Apr-08	
STATION S2						No data from this site, either problem with program or battery
Wind Anemometer	WS502	2.5	ms-1	24-Sep-07	10-Apr-08	
Temp	HMP45D	1.5	C	24-Sep-07	10-Apr-08	
Humidity	HMP45D	1.5	%	24-Sep-07	10-Apr-08	
Net Radiation	QMN101	1.25	W	24-Sep-07	10-Apr-08	
Pressure	PMT16A	1.25	Pa	24-Sep-07	10-Apr-08	

Table 10: Equipment List of the Real-time Iridium weather stations. Station S1,S4, I1,and A1 of the mesonet.

Stn/Instrument	*Type*	*Height (m)*	*Units*	*Start*	*End*	*Notes*
STATION S1						Iridium – data available until April 10, 2008 for STAR
Wind Anemometer	05103-10A	3	ms-1	25-Sep-07	To Stay	
Pressure	PTB210	1.5	Pa	25-Sep-07	To Stay	
Temp/Humidity	HMP45C212	2	C / %	25-Sep-07	To Stay	
Temp	44212	2	C	25-Sep-07	To Stay	
STATION S4						Iridium – data available until April 10, 2008 for STAR
Wind Anemometer	05103-10A	3	ms-1	25-Sep-07	To Stay	
Pressure	PTB210	1.5	Pa	25-Sep-07	To Stay	
Temp/Humidity	HMP45C212	2	C / %	25-Sep-07	To Stay	
Temp	44212	2	C	25-Sep-07	To Stay	
STATION I1						Iridium, Station provided by INAC – data available until April 10, 2008 for STAR
Wind Anemometer	5103	3	ms-1	27-Sep-07	To Stay	
Temp/Humidity	HMP45CF	2	C / %	27-Sep-07	To Stay	
Radiation	NR-LITE	2	Wm-2	27-Sep-07	To Stay	
STATION A1						Iridium – data available until April 10, 2008 for STAR
Wind Anemometer	05103-10A	3	ms-1	25-Sep-07	To Stay	
Pressure	PTB210	1.5	Pa	25-Sep-07	To Stay	
Temp/Humidity	HMP45C	2	C / %	25-Sep-07	To Stay	
Temp	44212	2	C	25-Sep-07	To Stay	

Table 11: Equipment List of the Airport weather station. Station A3 of the mesonet.

Stn/Instrument	*Type*	*Height (m)*	*Units*	*Start*	*End*	*Notes*
STATION A3						
Wind Anemometer	5103	10	ms-1	28-Sep-07	10-Apr-08	Data missing from this station for Nov 14/15 only
Pressure	61205	1.5	Pa	28-Sep-07	10-Apr-08	
Temp/Humidity	HMP45C	1.5	C / %	28-Sep-07	10-Apr-08	
Delta T Thermocouples	N/A	1.5 and 9	C	28-Sep-07	10-Apr-08	
Particle Counter		0.5	Hz	23-Oct-07	10-Apr-08	The counters record the number flux of blowing snow particles
Particle Counter		1	Hz	23-Oct-07	10-Apr-08	
Particle Counter		2	Hz	23-Oct-07	10-Apr-08	
Cup Anemometer	Cup #2	1	ms-1	28-Sep-07	10-Apr-08	
Cup Anemometer	Cup #4	2	ms-1	28-Sep-07	10-Apr-08	
Cup Anemometer	Cup #1	3	ms-1	28-Sep-07	10-Apr-08	
Visibility 1		2	km	28-Sep-07	10-Apr-08	
Visibility 2		2	km	14-Feb-08	10-Apr-08	The second faces a different direction because of directional bias of the instrument
Electric Field Mill	0.5	Vm-1		4-Feb-08	10-Apr-08	
Blowing Snow Camera	0.5			3-Feb-08	18-Feb-08	Used during blowing snow episodes to recor size distribution and number density of blowing snow particles
Snow Traps		Var.		3-Feb-08	28-Feb-08	Used during blowing snow episodes to record mass flux of blowing snow

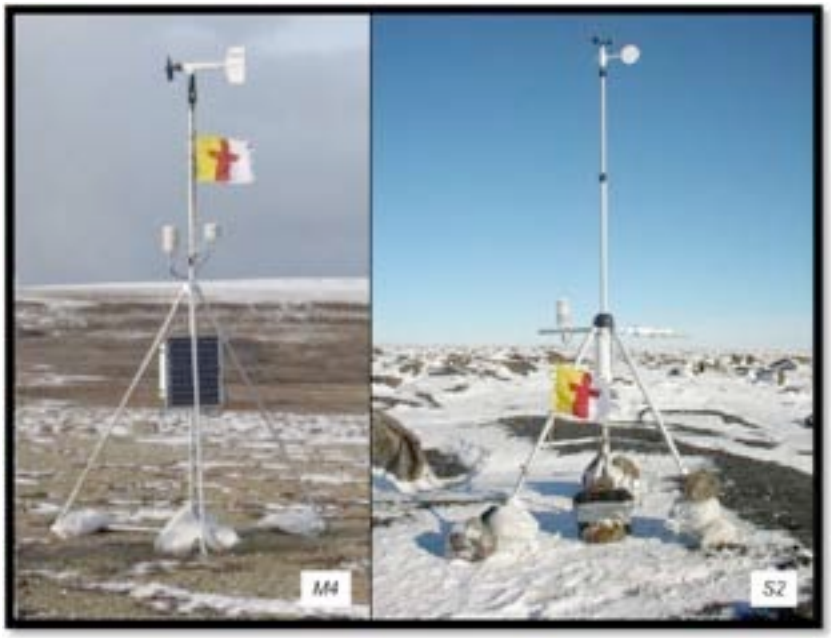


Figure 10: Example photos of the mesonet automatic weather station

The tower consisted of a main 10-m mast, a 3-m stand-off mast located 1.5 m south 1of the main mast, and a smaller 1 m, short mast located 1 m northeast of the stand-off mast. In addition to the standard meteorological measurements on A3, which included wind speed at heights of 1 m, 2 m, 3 m, and 10 m. On the 10-m mast, a propeller anemometer measured wind speed and direction at the 10-m height, and a cup anemometer was mounted at a 3-m height. Cup anemometers were mounted at 1-m and 2-m heights on the stand-off mast. Air and snow temperature (Ta and Ts), pressure, and relative humidity, were measured on the main mast at a height of 1.5 m. The temperature difference, between the heights of 1.5 m and 9.5 m was measured. Visibility was also measured. A logger recorded data every 2 seconds, and output averages, and standard deviations every 10 minutes. Additional special instrumentation was added for blowing snow measurements in February 2008. A description of the instruments can be found in section 1.9 'Blowing Snow Observations'.

Due to a mistake in the program, the wind speeds at heights of 1 m, 2 m, and 3 m and visibility sensor #1 were recorded as instantaneous measurements every 10 minutes, as opposed to 10-minute averages. The error was fixed on Feb. 22, after which all values were recorded as 10-minute average.

2.4.2 Instrumentation of the Mesonet

This section will present information about the instrumentation used for the mesonet stations. With respect to A3, the 10-m tower site, additional information regarding the special blowing snow instrumentation can be found in section 1.3.5.4 Blowing Snow Observations, of this document.

The temperature and humidity measurements from M1, M2, M3, M4, S1, S4, A1, A3 were conducted HMP- series sensors from Vaisala. The accuracy of the humidity sensors are ± 3 in the 90-100 range of RH, and ± 2 in the 0-90 RH range. The accuracy of the temperature sensor is from ± 3-5% in the range of 0˚C to -40˚C. Station S2 used a slightly newer model of the HMP-series and therefore the accuracy of the temperature sensor for station S2 is < ± 0.2˚C. All temperature and humidity sensors were incased in a 6 plate count radiation shield.

Wind measurements from M1, M2, M3, M4, S1, S4, A1, A3 where collected by R.M Young – 050103 Wind Monitors. The manufacturer guarantees an accuracy of ± 0.3 ms-1 for wind speed and 3˚ for wind direction. The wind profile measurements on A3 where collected using Gill Cup Anemometers. Station S2 wind data was collected by a WS502 by Vaisala. The accuracy reported by the manufacturer for this instrument is ± 0.3 ms-1 for winds ≤ 10 ms-1 and < 2% for winds > 10 ms-1. The accuracy of the wind vane is reported to be better than ± 3˚. For all mesonet stations, the accuracy of wind measurements was also dependent on external factors. During blowing snow and snowfall events, snow has a tendency to accumulate in the cups and produce inaccurate results. In calm or ice fog conditions, hoarfrost accumulation on the surface of the instruments can also be a problem. The remote locations of the mesonet stations meant that maintenance could not regularly be performed on the instrumentation. Quality control of these measurements will have to be assessed before used in analysis.

Pressure measurements from M1, M2, M3, M4, S1, S4, A1, were collected with PTB210 instruments manufactured by Vaisala with an accuracy of ± 0.6 hPa. Station A3 used a RM Yonge 61205V pressure sensor, with an accuracy of +/- 0.5 hPa. Pressure

measurements from S2 were conducted with PMT16A from Vaisala. The measuring range for this instrument is between 600-1100 hPa, its resolution is 0.1 hPa. The accuracy of this instrument is ± 0.3 hPa.

The thermocouples are Cu/Co type, referenced against the thermistor in CR23X data logger (only used at A3 to measure 0.5m/9.5m temp difference and also snow temperature)

2.4.2.1 Mesonet data

Data for the stations A1, A3, I1, M1, M2, M3, M4, S1, S4 were provided, which provide measurements of temperature, humidity, wind and etc. for every 10 minutes.

Data Period:
Start date: 01.Oct.07
End date: 31.Mar.08
Data format: excel
Please refer to the note Table 11 for missing data.

2.4.3 Pangnirtung Automatic Weather Station

An MAWS201 automatic weather station manufactured by Vaisala was set up ~100 m west of the weather station at the Pangnirtung airport on Oct 13, 2007. This weather station was only operational between the dates of October 13 – November 18, 2007, during the time periods were STAR personal were in Pangnirtung.

The weather station was set up at N 66 deg 8.625, W 65 deg 42.794 min, elevation 35m (Figure 11). Table 12 is an equipment list for the Pangnirtung weather station. The weather station was set-up to sample once every hour.

Figure 11: Picture of the Pangnirtung MAWS201 automatic weather station.

Table 12: Equipment list from the Pangnirtung automatic weather station

Stn/ Instruments	*Type*	*Height (m)*	*Units*	*Notes*
Pang 1				
Wind Anemometer	A423	2.72	ms-1	Considerable battery problems. Limited reliable data available
Pressure	PTB210	1.5	Pa	
Temp/Humidity	HMP45C212	1.7	C / %	

Accuracy of the instrumentation can be found within section 2.4.1.1 'Instrumentation of the Mesonet'.

2.4.3.1 Automatic weather station for Pangnirtung data

This data provides measurements of temperature, humidity, wind and etc. for every hour.
Data Period:
Start date: 13.Oct.07
End date: 18.Nov.07
Data format: excel

There were considerable battery problems with this weather station over the fall field campaign and there are only limited time intervals where data is available. Table 13 describes the time periods where reliable data was collected.

Table 13: Time periods of data collection for the automatic weather station positioned in the community of Pangnirtung. Time is in UTC.

Start		*End*		*Sampling interval*
Date	*Time*	*Date*	*Time*	
285	18:00	287	2:00	1-hour
289	10:00	289	22:00	~ 5-hours
290	1:00	292	1:00	Appears random, only 20 measurement intervals over the time period
307	8:00	309	3:00	1-hour
320	14:00	321	1:00	1-hour

2.5 Special Surface Observations

In addition to standard measurements taken by Environment Canada, special surface observations were taken by STAR at the Iqaluit weather office. Specifically additional precipitation measurements were taken, along with several different types of visual data such as snowflake photography, blowing snow measurements, and visibility sensors. These instruments and their data are described below.

2.5.1 Precipitation Measurements

Historically, accurate precipitation measurements during storm events in Iqaluit are difficult to acquire because of the strong winds that usually accompany the event. To remedy this problem, STAR collaborated with Environment Canada to construct a double fence facility with a Geonor snow measurement system so that accurate snow quantity measurements with a traditional gauge could be made. In conjunction with gauge precipitation measurements, a Thies Clima laser precipitation sensor was used for providing 1-minute averaged precipitation type, size distribution, and fall velocity of the precipitation. Further analysis of precipitation was conducted using a high-resolution digital microphotography camera. A description of the data from these instruments is described in the following sections

2.5.1.1 Geonor Snow Measurements

Instrument provided by: Environment Canada/ STAR research funds

The Geonor Snow Measurements are taken with a T-200B series weighing bucket precipitation gauge. This type of gauge is used by national weather services. It weighs the precipitation using a precision load cell with a vibrating wire transducer, which gives frequency output. The frequency is a function of the applied tension on the wire, from which the amount of precipitation can be computed.

For solid precipitation the catch is melted in the collection bucket to which antifreeze has been added. No electrical heating is required, thus eliminating a common source of error. A thin layer of oil is added to impede any evaporation and data loss.

This technical specification of this model of precipitation gauge is summarized in Table 14.

Table 14: Technical Specifications of the Geonor Snow Measurements. Modified from Geonor T-200B series brochure

Technical Specifications T-200B Precipitation Gauge	
Capacity	0 - 600 mm
Collecting area	200 cm^2
Sensitivity	0.1 mm
Accuracy	0.1% FS
Temp. Range	-25 C to 60 °C
Temp. Drift	0.001% FS/°C

In an attempt to mitigate the effect that strong winds have on accuracy of gauge measurements In Iqaluit, a double fenced enclosure was constructed in August 2007 (Figure 12).

Figure 12: Double fence enclosure for the Geonor Snow Measurements at the Iqaluit Environment Canada Weather Office (photo by Gabrielle Gascon).

This instrument is now a stationary instrument at the Environment Canada weather office site in Iqaluit. There are three T-200B series precipitation gauges collecting simultaneous data at the Iqaluit site. Only one however, is in the double fenced enclosure seen in Figure 12.

2.5.1.1.1 Double fence data

This data contains snow measurement. It is included in Environment Canada Iqaluit sensor data.
Data Period:
Start date: 12.Oct.07
End date: 03.Dec.07
Data format: excel

Data is available throughout the fall and winter field campaigns: October 10 – December 3, 2007. Data is in Excel workbook format, with accumulation measurements reported in 1-minute intervals.

2.5.1.2 Laser Precipitation Sensor

Instrument provided by: University of Manitoba (CEOS)

In conjunction with gauge precipitation measurements, a Thies Clima Laser Precipitation sensor was used for providing 1-minute averaged precipitation type, size distribution, and fall velocity of the precipitation. An optical laser beam source produces a parallel light

beam (780 nm) while a photo diode with a lens is situated on the receiver side in order to measure the optical intensity by transforming it into an electrical signal. When precipitation particles fall through the light beam the receiving signal is reduced. The diameter of the particle is calculated from the amplitude of the reduction. The fall speed of the particle is determined from the duration of the reduced signal.

The instrument has a particle diameter class range of 0.125 mm to 8.00 mm, with class widths of 0.125 mm between 0.125 mm - < 0.500 mm, 0.250 mm between 0.500 mm - < 2.0 mm, 0.500 mm between 2.0 mm – ≥ 8.00 mm. The particle speed class range is between of 0.00 m/s to 10 m/s, with class widths of 0.200 m/s between 0.000 m/s - < 1.000 m/s, 0.400 m/s between 1.000 m/s – < 3.400 m/s, 0.800 m/s between 3.4000 m/s - < 9.000 m/s, 1.000 m/s between 9.000 m/s – < 10.000 m/s, and 10.00 m/s for values ≥ 10.000 m/s. Figure 13 are photos of the instrument at the Weather Office site.

Figure 13: Laser Precipitation Sensor at YFB Environment Canada Weather Office (photos by Shunli Zhang (l) and John Hanesiak (r))

The data files were logged using an Acumen Data Logger, and stored on a compact flash card. Data is in *.dat format where they contain over 500 columns of data for each averaged one-minute sampling interval. An Excel macro was used to process the raw data files so that they could be stored in weekly files and read into Excel over a spread of 3 worksheets. This processing was completed in the field. An offset was also applied to the date and time in these files so that they match the standard UTC format of the STAR project.

The laser precipitation sensor was only operational during the fall field campaign. Refer to Table 2 for the dates of operation of this instrument.

2.5.1.2.1 Laser Precipitation data

This data provides 1-minute averaged precipitation type, size distribution, and fall velocity of the precipitation.
Data Period:
Start date: 12.Oct.07
End date: 03.Dec.07
Data format: excel

Data from this instrument was downloaded daily from the compact flash card, so there are some days where data is missing over 1-5 minutes intervals while compact flash cards were being swapped out. Refer to Table A.3 Appendix A, for field notes about the laser precipitation are presented.

The data requires time formatting. There was an issue with the date/time in the logger during setup. To use the data you must add 1 year, 8 months, 13 days, 16 hours and 44 minutes to the logger time given. A reference time is provided here: logger 17/01/06 - 21:16, actual 09/11/07 - 14:08.

2.5.1.3 Snowflake Microphotography

Instrument provided by: McGill University

Photos of precipitation particles were taken using a Nikon D1x camera during six precipitation events over the fall field campaign. Table 15 is a summary of the observation periods where precipitation particles were photographed. Temporal resolution of the photographs varied from five-minutes to one-hour. An example of an array of photos taken during a sampling period is presented in Figure 14. Files are stored in a *.jpg format with average individual file sizes of >2 MB per photo. During the observation periods, coincident photos were taken of sizing scale before a photo of precipitation. If the zoom was ever adjusted, a new photo of the sizing scale was taken.

Table 15: Observation periods where precipitation particles were photographed. All times are in UTC.

IOP	*Date (Julian Day)*	*Sampling Period*	*Resolution*	*Photos taken by:*
1	290	02:00 - 04:00	1-hour	Gabrielle Gascon

7	310	08:30 - 20:40	10-minutes	Shannon Fargey
9	313	20:10 - 20:40	5-minutes	Shannon Fargey
9		20:40 - 22:10	1-hour	
11	320	19:00 - 21:30	1-hour	Robyn Dyck, Shunli Zhang
11	321	13:15 – 17:45	1-hour	Robyn Dyck, Shunli Zhang
11		20:30 – 21:00	10-minutes	Robyn Dyck, Shunli Zhang
11		21:00 – 23:00	1-hour	Robyn Dyck, Shunli Zhang
11	332	15:30 - 15:50	20-minutes	Gabrielle Garscon

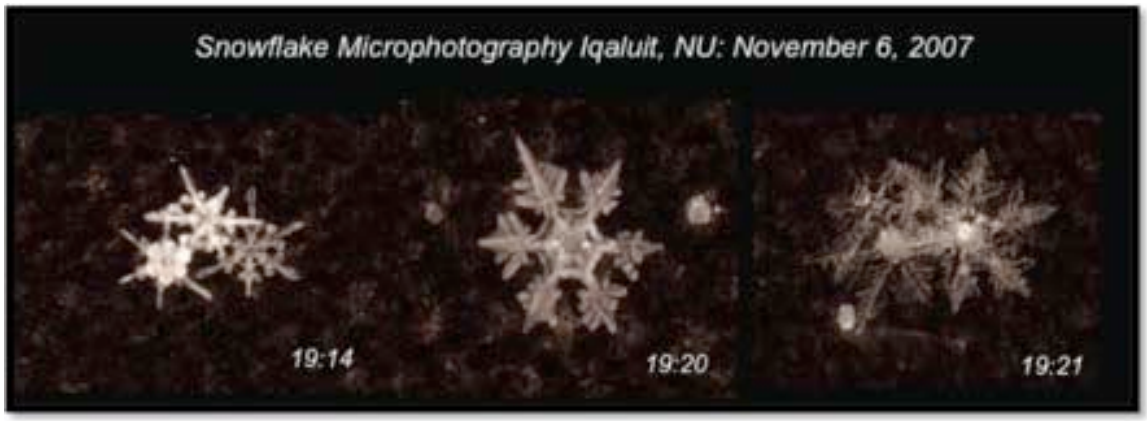


Figure 14: Example photographs of the snowflake microphotography. All times are in UTC.

2.5.1.4 Snowflake image data

This data provides detailed precipitation characteristics that occurred in Iqaluit.

Data Period:
Start date: 12.Oct.07
End date: 03.Dec.07
Data format: excel

2.5.2 Visibility Sensors

Instruments provided by: University of Manitoba (CEOS)

Two Sentry SVS-1 visibility sensors were installed at the Iqaluit Weather Office site. One instrument was an RS-232 Output version (Visibility 1), while the second was Analog version (Visibility 2) of the instrument. The Sentry visibility sensors measured the atmospheric visibility or the meteorological optical range. The instrument operates by determining the amount of light scattered by particles in the air through a known sample volume. Both sensors used an 880 nm LED as its source. The instruments have

measurement ranges of 30 m to 16 km with an accuracy of ± 10%. Both sensors were set to sample once every minute, and mounted at a height of 1.5 m.

Visibility 1 (RS-232 output) was positioned on the east side of the Upper Air shed at the Weather Office (Figure 15) during the fall field campaign. The data files were logged using an Acumen Data Logger, and stored on a compact flash card. Data files are in *.dat format where they contain date, time, sensor output voltage (VDC), visibility in (km). To derive the visibility from the VDC the following formula was used: visibility (km) = 20* (0.150/VDC). Data from this instrument was downloaded daily from the compact flash card, During the downloading process data is missing for periods between 1-5 minutes while compact flash cards were swapped out. This instrument operated at two locations during the field campaign (fall and winter). Refer to Table 2 for data collection dates at the two different locations during STAR.

Visibility 2 (Analog output), was positioned with the 10-m tower automatic weather station (A3) and the Weather Office site (Figure 16). A Campbell Scientific CR23X data logger was used to log the data. Data files are in a simple *.csv format where they contain date, time, visibility (km).

Previous studies (e.g. Huang et al., 2008) have shown that the housing of this model of visibility sensor can obstruct blowing snow from some directions, resulting in an inaccurate visibility measurement. Visibility 2 is oriented so that the housing will obstruct blowing snow from approximately 210°. The other visibility sensor (Visibility 1) was added to A3 measurements to collect data in the shadow of the housing unit of Visibility 2. It was oriented so that the housing will obstruct blowing snow from approximately 118° (Figure 16). Refer to TableA.4 Appendix A for field note about visibility sensor.

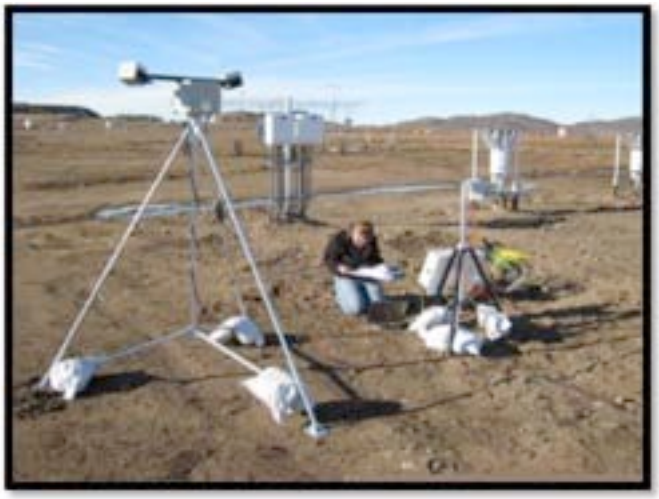


Figure 15: Visibility Sensor 1 RS-232 Output version at YFB Environment Canada Weather Office (left side of image).

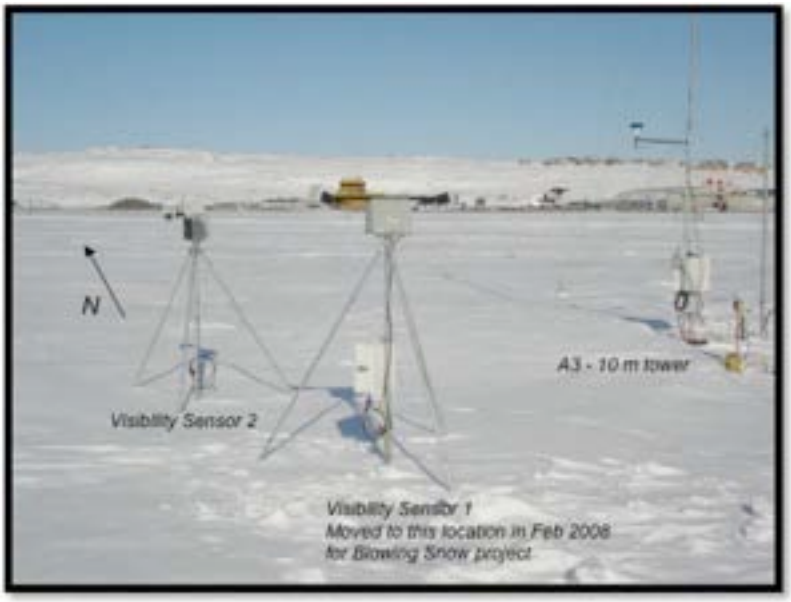


Figure 16: Visibility Sensor 2, Analog Output version at the YFB Environment Canada Weather Office. This photo also shows the location of Visibility Sensor 1 during the blowing snow winter field project. (Photos by Shannon Fargey)

2.5.2.1 Visbility sensors data

This data provides visibility measurements (max range 16 km).

2.5.2.1.1 For Visibility Sensor 1 during fall:

Data Period:

Start date: 23.Sep.07

End date: 30.Nov.07

Data format: dat

2.5.2.1.2 For Visibility Sensor 2:

Data Period:
Start date: 23.Oct.07
End date: 31.Mar.08
Data format: excel
The data are extracted from MESONET data A3.

2.5.2.1.3 Visibility Sensor 1 during winter:

Data Period:
Start date: 21.Feb.08
End date: 31.Mar.08
Data format: excel
The data are extracted from MESONET data A3.

2.5.3 5-Minute Camera Stills

Instrument provided by: Environment Canada

A Campbell Scientific CC680 still imaging camera was also installed during the STAR field project. Camera stills were taken every 5 minutes, providing images of the sky and current surface conditions over the duration of the project. The camera was facing north and had a direct view of the 10-m tower weather station (A3) (Figure 17). An overnight light was installed so that conditions could still be monitored during darkness, which was the norm for much of the project.

2.5.3.1 5-Minutes Camera still images

This data provides the 5-Minutes Camera images of the sky and current surface conditions over the duration of the project.

Data Period:
Start date: 10.Oct.07
End date: 29.Feb.08
Data format: jpeg

Data was continuously written to a compact flash card in *.jpg format. Each image was > 200 kb in size. Based on the image size, and card memory, the card reached its capacity every 5 days. Instead of letting to card fill, the compact flash was downloaded daily, which means that each day of data there might be one or two missing photographs in succession during the time when the card was downloaded.

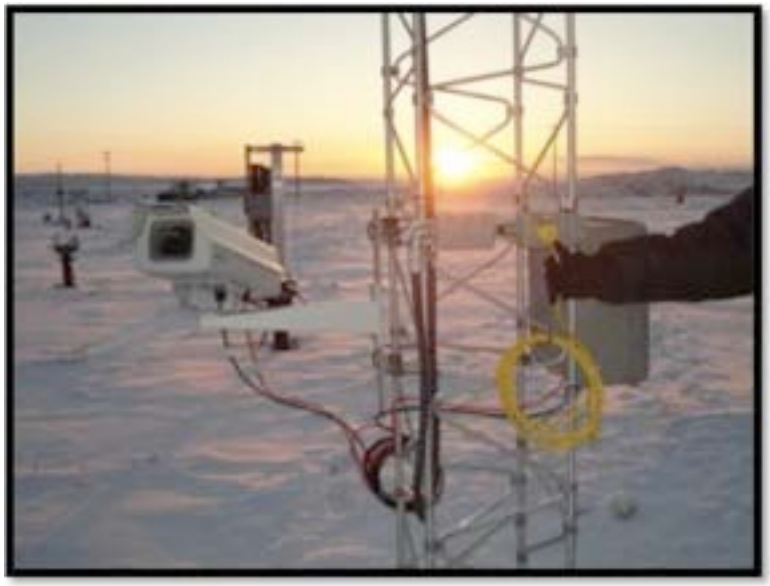


Figure 17: The camera was positioned facing north, this is a photo looking south at the camera (Photo by Robyn Dyck).

During the Winter Blowing Snow Project the cameras sampling resolution was adjusted so that it could be left without downloading for longer periods. Between February 24-April 10, photos were taken every 30 minutes.

Images taken with the 5-min camera have a time stamp on the actual photo. Time is in local standard, and was not adjusted for daylight savings (Nov 4 - 2:00am). Users should be aware of this when using at data files. Example output of the data can be seen in Figure 18.

Figure 18: Example photos from the 5-minute still camera located at the YFB Environment Canada Weather Office. Orientation NNW.

There are no overnight photos with the light on day 309 (Nov 5) and 316 (Nov 12) during the fall field campaign.

2.5.4 Blowing Snow Observations

Instrumentation provided by: York University

During the month of February, a team from York University set up instruments at the Iqaluit weather office used for blowing snow measurements. The base of operations was the 10-m tower site (A3), installed at the weather office at the end of September 2007, on the west side of Iqaluit Airport. Table 11 provides a description of the standard meteorological instruments on the tower. A description of the special blowing snow instrumentation that was added to the station can be found in the following section and is diagrammed in Figure 19.

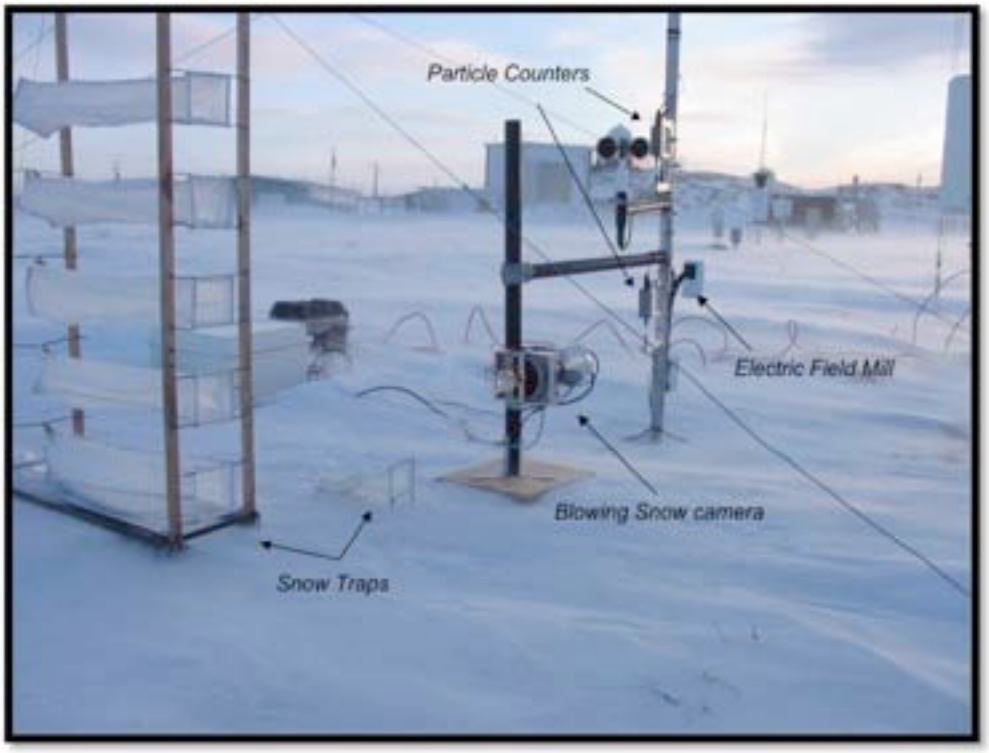


Figure 19: Instrumentation used for Special Blowing Snow Observations. (photo by Peter Taylor)

2.5.4.1 Particle Counters

Blowing Snow particles detectors were used based on the design of Brown and Pomeroy (1989). Three separate instruments, mounted to an extension of A3, were used to monitor blow snow at 0.5 m, 1 m and 2 m heights. Detection of particles is based on the drop in

voltage generated by a photodiode illuminated by an infrared beam when a particle gets into the path of the light. As particles pass between the light emitting diode and the detector, which is placed behind a small pinhole (200 µm diameter), the voltage output of the detector is reduced. When the voltage is reduced below a set threshold, a pulse count is generated. The total particle counts are output to a data logger every second. Estimations of the area of beam interruption required to produce a particle count are between $3x10^{-10}$ and $2x10^{-9}$ m^2. This is equivalent to the cross-sectional area of a particle with diameter between 20 and 50 µm. However, experiments have shown that this value can also depend on the wind speed. Hence, the minimum detectable particle diameter is not known precisely. For additional information, particle counters are discussed in great detail in Savelyev et al. (2006).

2.5.4.2 Electronic Field Mill

An electric field mill (manufactured by Mission Instruments) was installed at the base of the stand-off mast. The field mill, primarily designed as a lightning warning system, measures the magnitude, but not the direction, of the electric field strength. The field mill uses a rotating probe that faces downward through a 7 cm diameter opening. The accuracy of the field mill is given as ±5% for $E > 500$ V m^{-1} and the response time is approximately 1 s. The operating range is divided into 256 intervals, and the normalized output ($0 \leq Ifm < 1$) is converted to electric field strength as $E = CfmIfm$, where Cfm [V m^{-1}] is a coefficient of calibration. The opening was mounted at a height of 0.5 m from the snow surface.

2.5.4.3 Blowing Snow Camera

A camera system used a similar method to the particle counters to also measure the size distribution of blowing snow particles. A computer controlled digital camera was used to record images of blowing snow. A camera system, described in Gordon and Taylor (2008), was mounted on the short mast to measure the size and number flux of blowing snow particles. The camera system records the shadows of blowing snow particles as they pass between a halogen lamp and the camera. Because each row of pixels in the image array is exposed sequentially, the system measures the dimension of the particle perpendicular to the direction of particle motion, referred to here as the particle width. The system used here differs from the system described in Gordon and Taylor (2008), as

a lens extension is used to increase the resolution to 2.9 µm per pixel. A more powerful lamp (50 W) is used to compensate for reduced light at the image array due to the use of the lens extension. Further, an entrance passageway replaces the slot of the previous design. For particles to be recorded by the camera, they must pass through this 10mm long passageway, which has a 1mm wide x 3mm long rectangular opening. This effectively eliminates the possibility of particles passing outside the camera's depth of field, a problem that is discussed in Gordon and Taylor. The rectangular entrance also limits the maximum size of blowing snow particles that can be measured. The use of the passageway makes the measurement of velocity unreliable, as particle velocity may be reduced due to friction if the particle collides with the walls of the passageway. The minimum detectable particle size is related to the recorded particle speed, Up, and exposure time, te = 65 µ s, as wmin = 0:1teUp, where wmin is the dimension of the particle in the direction of motion.

2.5.4.4 Snow Density Measurements and Snow Traps

Blowing snow mass flux was measured using an array of snow traps and density measurements of the snow surface were made throughout the study. Surface level snow samples were taken with samplers constructed following John Iacozza's design. Sample volume, 6.0 x 5.5 x 2.0 cm = 66.0 cm^3. Snow samples were stored in plastic bags, then allowed to melt and the water volume measured and assumed to have density of x103 kg m^{-3}. Snow density = [Water Vol (ml)/N/66.0] x103 kg m^{-3}, where N is number of scoops that constitute the sample.

A snow trap stand was assembled and installed near A3 tower. It allowed individual traps (10 x 10 cm catchment area) to be deployed at 0.04 m through 1.14 m height from the snow surface, up to 5 levels at a time. In addition, four mobile traps were made with the possibility to catch snow up to 0.25 m height. Their catchments areas were 10.1 x 5.2 cm, 10.3 x 5.2 cm, 9.1 x 4.9 cm and 8.4 x 7.9 cm.

2.5.4.5 Blowing Snow Observations pictures

This data provides the blowing snow images and movies.

Data Period:

Start date: 17.Oct.07
End date: 05.Nov.07
Data format: multi-media (jpeg, mov)
During blowing snow event Oct.17, 2007 and Nov. 5, 2007, Some photos and movies were taken. Time stamps on actual picture are UTC reported time minus 1 (because of daylight savings). The camera was set to the wrong time. This has been corrected for future photos.

Sample image:

2.6 Sea-ice Observations

Instrument provided by: University of Manitoba (CEOS)

2.6.1 Sea-Ice Meteorological Station

As part of the STAR program the Sea Ice Team established a Sea Ice Meteorological station 8.2 km outside of Iqaluit, Figure 20. The station was set up January 9 and was recovered May 28, these dates represented the period were it was safe to access the sea ice as deemed by our local partners at the Nunavut Arctic College (NAC) and Nunavut Research Institute (NRI) who serviced the station for CEOS and gathered additional ground confirmation data.

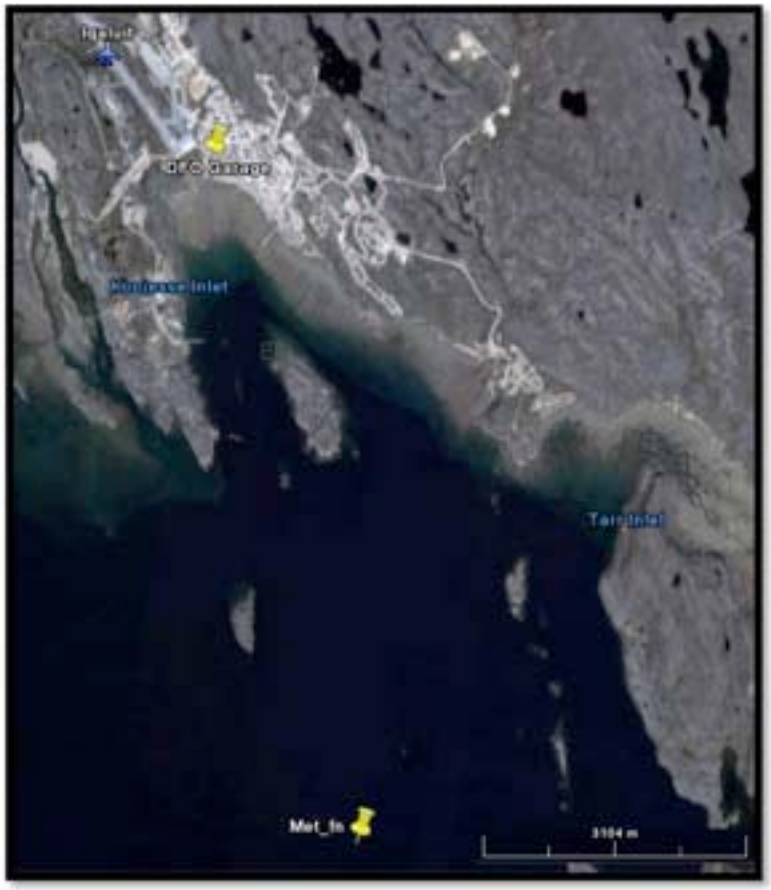


Figure 20: Location of sea ice meteorological station (Met_fn) at N 63.67840, W 68.46818.

The station recorded typical parameters including mean air temperature, relative humidity, wind speed, wind direction, maximum (3 second) wind gusts at 10 minute intervals. Additional sensors included two Silicon Pyranometers measuring downwelling and upwelling solar radiation (W/m2; 300-1100 nm) (Figure 22).

As part of the sea ice met station, an ice temperature dowel was placed adjacent to the tower. The ice temperature dowel consisted of 8 temperature probes. Seasonal temperature profiles were obtained at ten minute intervals at 10cm above the ice surface, at the ice surface (0 cm), and below the ice surface at; 15, 30, 50, 100, 200 and 250cm. The snow and ice temperature dowel was made using PVC pipe with temperature sensors mounted with thermal epoxy. The pipe was filled with foam for thermal insulation and flotation.

The data was logged on site and downloaded at regular intervals via a line of site modem to the DFO Garage in Iqaluit (Figure 21), with the cooperation of Jamal Shirley of NRI. Lithium batteries were used to power the logger and lasted well through the season, while to power the modem a separate circuit was installed with solar panels, charge controller (that also switched on safety beacon on top of the solar panels) and car battery. This design worked well through the season and provided steady logging and good communication between the site and the base station even when it started melting. So it was almost maintenance free through the season.

The wind direction data might be not as accurate after month of May due to the fact that the mast of the station started shifting and it might affect accuracy of the anemometer. This issue will need to be looked into before data is used from this portion of the observation period.

Figure 21: DFO garage where line of sight receiving antenna was located to data transfer.

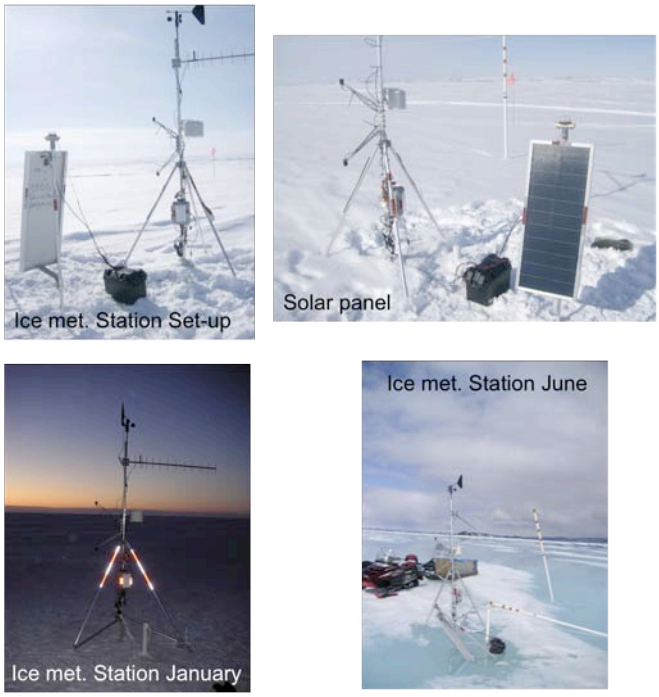


Figure 22: Sea-ice meteorological station for STAR. (photos by Vlad Petrusevich)

In addition to the logged station data, the Nunavut Arctic College with the cooperation of instructors Jason Carpenter and Markus Dyck, serviced the site with their students to ensure station integrity, and collect additional data weather /time permitting, Figure 22.

Figure 23: NAC students conducting a snow thickness transect

Snow depth transects were conducted, these were 100m in length oriented parallel and perpendicular to the dominate wind direction. Snow density measurements were also made, the snow pit data was obtained at 2cm vertical interval.

2.6.2 Ice Drift Beacons

Two Oceanetic 703 Ice Tracker Beacons were deployed in the Iqaluit area to track sea ice during the spring breakup period (Figure 24). The 703 Ice Tracker is designed to stand on an ice floe and send its GPS coordinates at a pre-programmed interval. One was located at the met station, the other was deployed in Frobisher Bay at location N63^{o} 31.876 W68^{o} 23.598'.

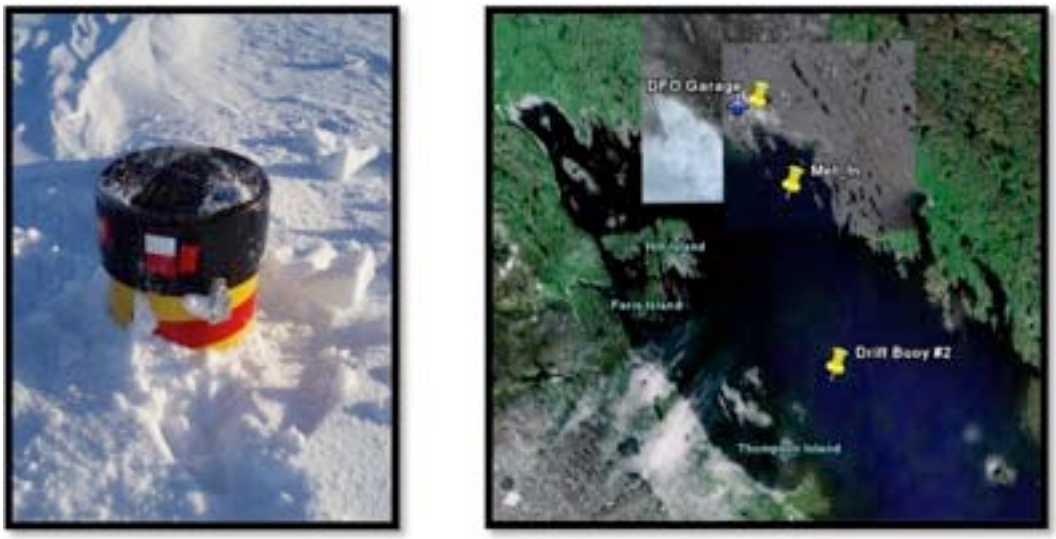


Figure 24: a) Oceanetic 703 Ice Tracker Beacon, b) deployment locations

Unfortunately there were problems with both beacons. One was retrieved by locals during the spring melt period and returned to NRI. The second was opened by someone and left in a melt pond. Satellite data will be used to document breakup. This indicates more explicit signage in Inuktitut is needed in the future; such are the trails of field work.

2.7 Archived Images and Model Outputs

The following images and data were downloaded from website and archived throughout the observational period. Where possible an example of the data is presented below the description.

2.7.1 NOAA HRPT satellite imagery over Baffin Island.

The domain covers southern Baffin Island. Ed Hudson uploaded the satellite images to CEOS ftp site during STAR period. A script file was set to download the data once there were new data.

2.7.1.1 HRPT imagery data

This data provides High Resolution Pictures transmission (HRPT) images.

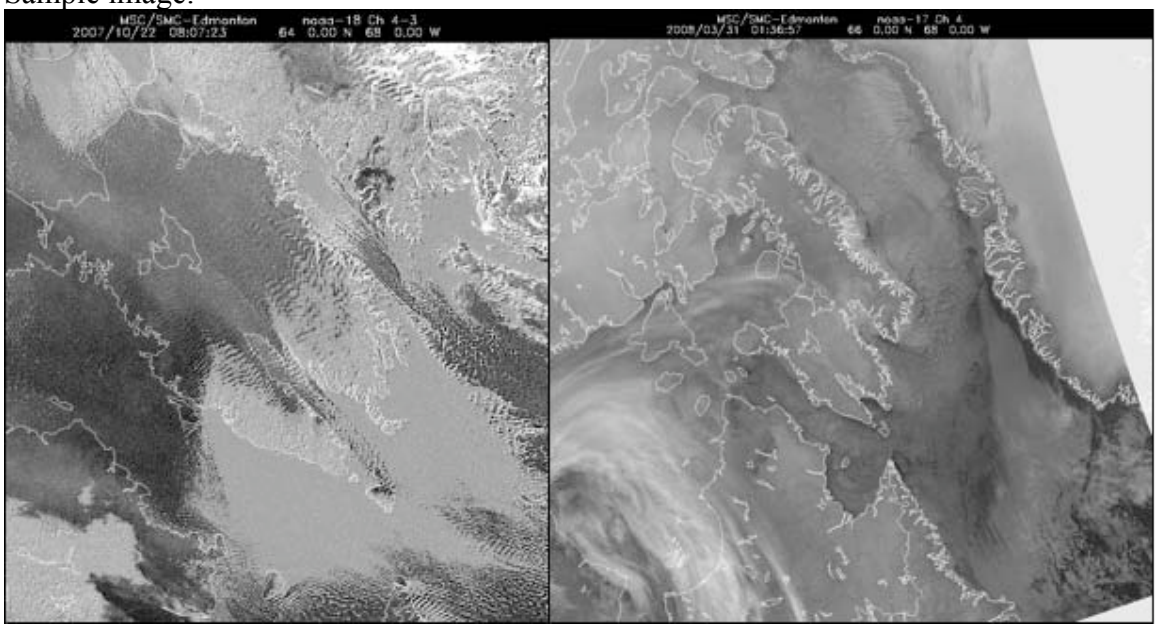
Data Period:

Start date: 20.Sep.07

End date: 16.Apr.08

Data format: gif.

Sample image:



2.7.2 Weather charts from Canadian Meteorological Centre-Environment Canada

Hundreds of weather stations, ships, and aircraft across Canada, the US, and the rest of the world report readings of temperature, pressure, wind, moisture and precipitation. These reports are received at the CMC, and used to improve the picture of the current state of the atmosphere. The analyses made available four times daily providing the latest

snapshots of the state of the atmosphere over Canada and the Northern Hemisphere. We archived part of the data twice a day.
Website: http://www.weatheroffice.gc.ca/canada_e.html

2.7.2.1 Surface analyses

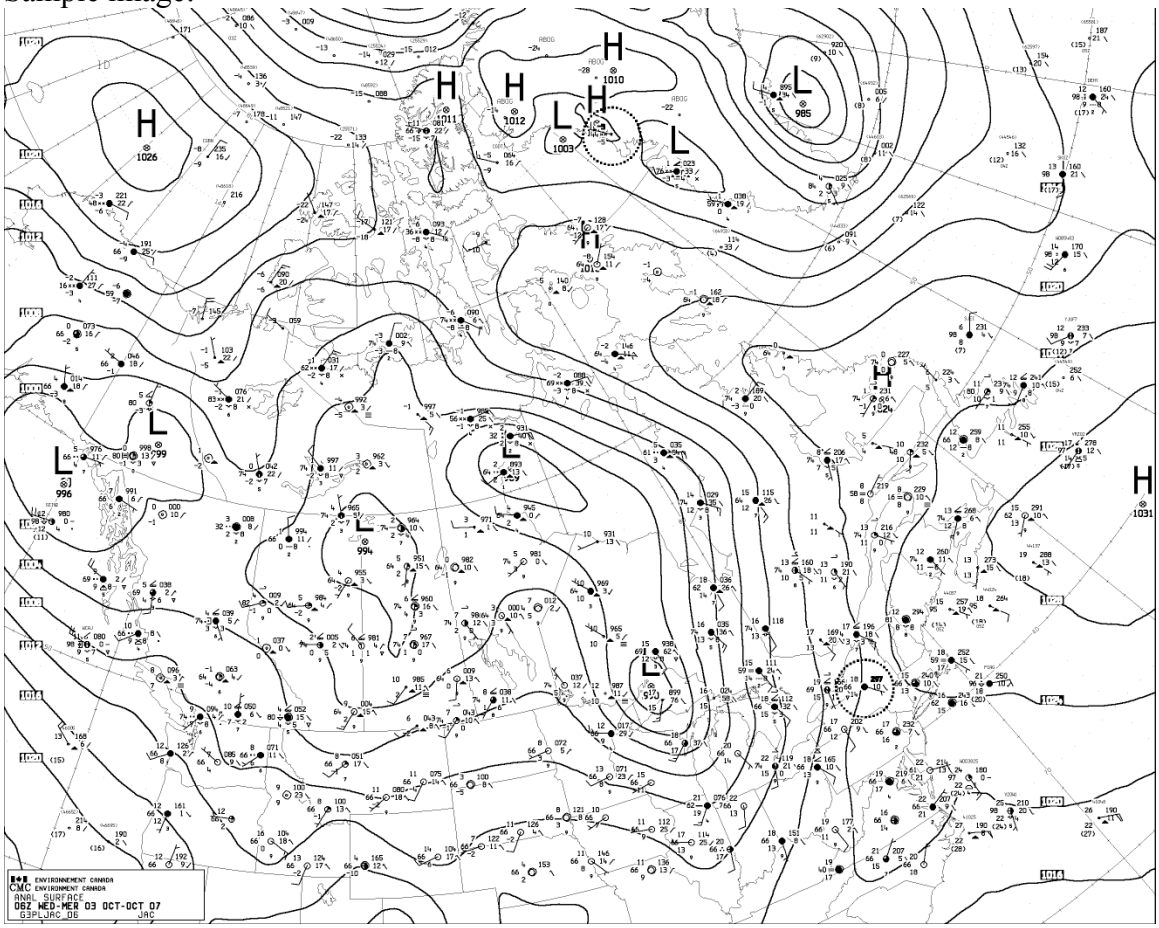
The surface analyses show plots of surface station readings, lines of equal Mean Sea Level air pressure (called isobars), fronts (as drawn in by CMC meteorologists) and centres of high and low pressure. The graphical depiction of weather conditions used in the station plots follows the standards of the World Meteorological Organization. From March 7, 2008, the surface analysis chart for snow, ice and SST were archived.
Data Period:

Start date: 19.Sep.07
End date: 20.Oct.08

Data format: image (gif)
Website: http://www.weatheroffice.gc.ca/analysis/index_e.html

Due to network problem, the data in the following date were missing:
20080427, 20080908-10, 20080918, 20080926, 20081016, 20081018.

Sample image:



2.7.2.2 Northern Hemisphere Upper Air analysis

The upper air analyses depict the conditions at various standard altitude levels. They use a different convention than the surface analysis, In addition to the main parameter of height; the upper air charts also contain secondary fields in dashed lines. The followings are a brief explanation of each field:(1) 850 hPa, 700 hPa: Secondary field is temperature in degrees Celsius; (2) 500 hPa preliminary: Secondary field is 1000 Hpa to 500 Hpa thickness; (3) 250 hPa: Secondary field is wind speed. This reveals the location of Jet Streams.

Data Period:

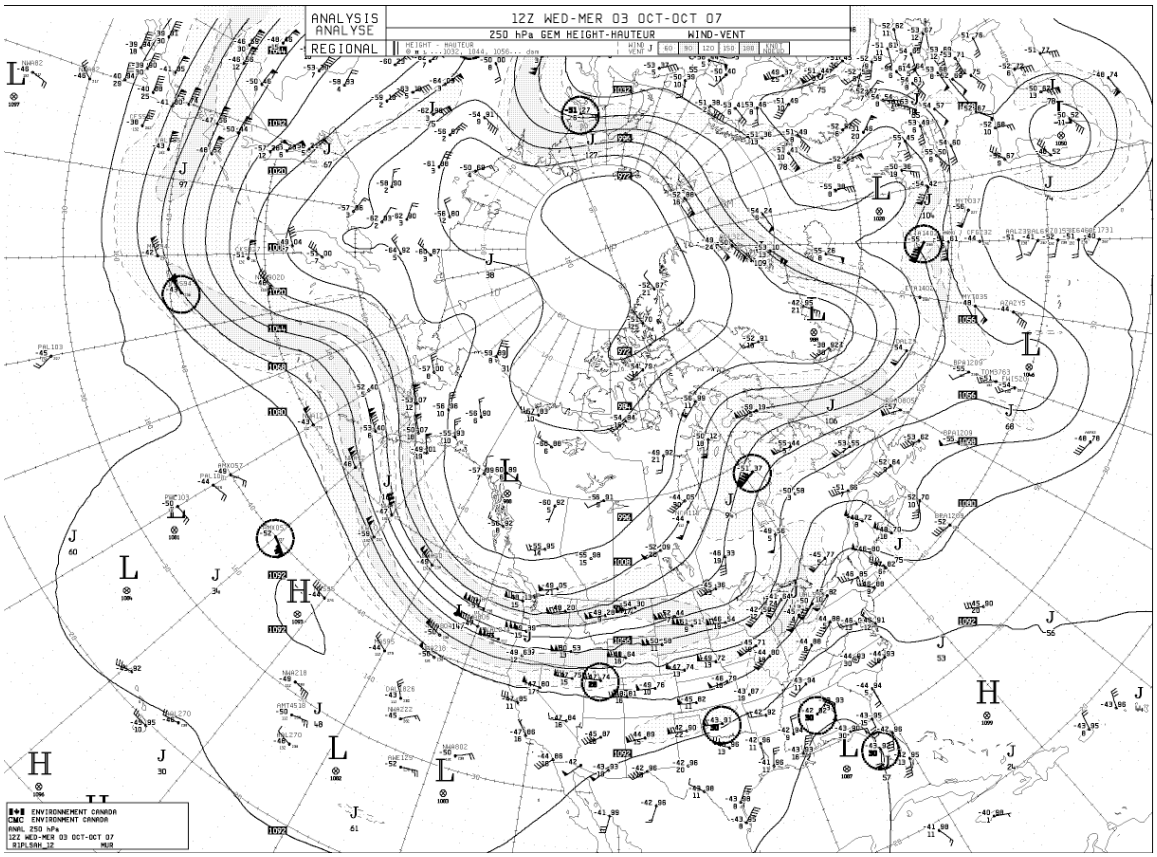
Start date: 19.Sep.07

End date: 20.Oct.08

Data format: image (gif)

Website: http://www.weatheroffice.gc.ca/analysis/index_e.html

Sample image:



2.7.2.3 Regional model charts (Classic 4-Panel, Precip type)

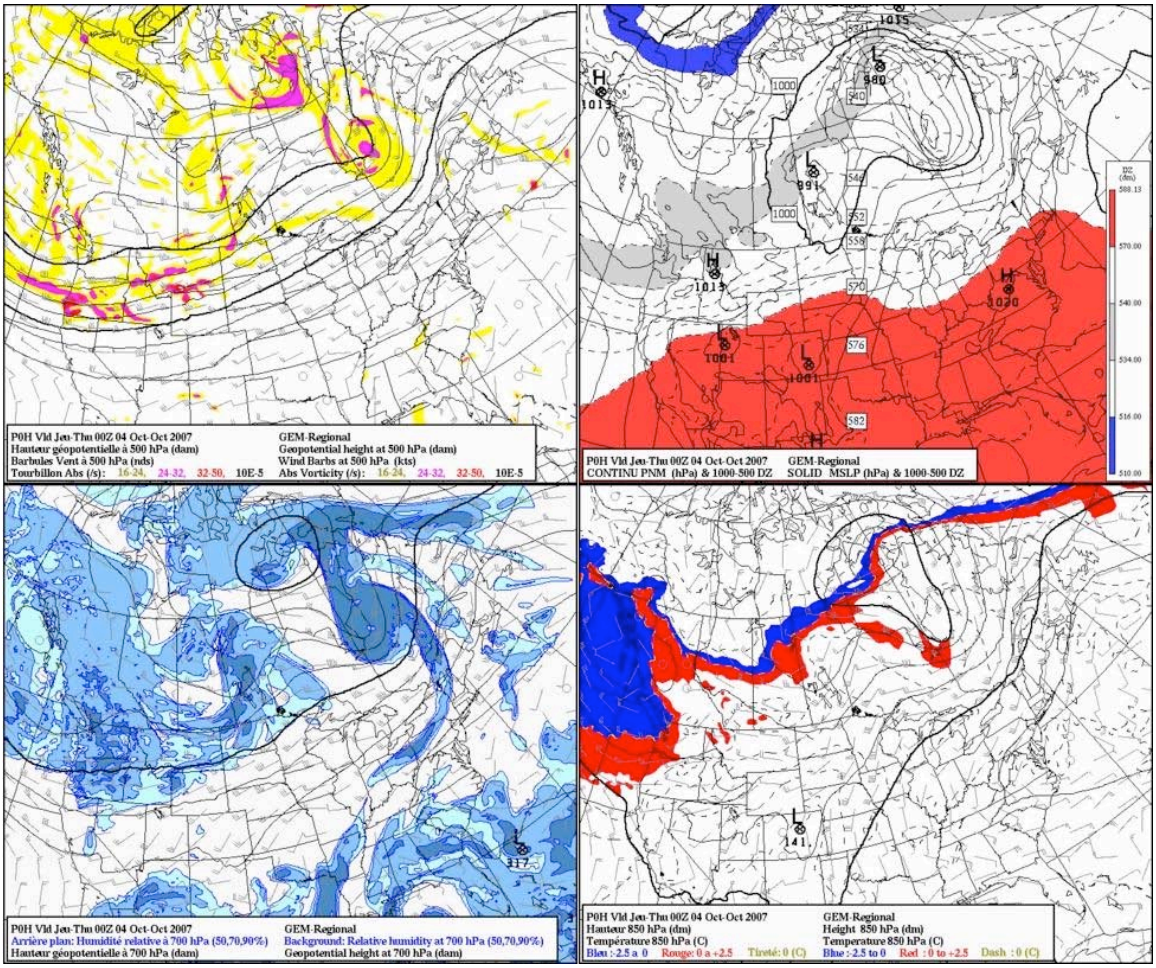
The products that are made available here originate from the regional runs of the GEM model. Traditionally, model forecast output has been processed into raster graphics as four-panel charts that can be printed out on large sheets of paper. In the course of the forecast process, meteorologists often like to annotate these charts, compare them with previous ones, and with the output from other models. The oldest and most familiar of these products is the classic four-panel chart, which depicts several of the traditional parameters used in general meteorology. Precipitation type was also archived.
Data Period:

Start date: 18.Sep.07

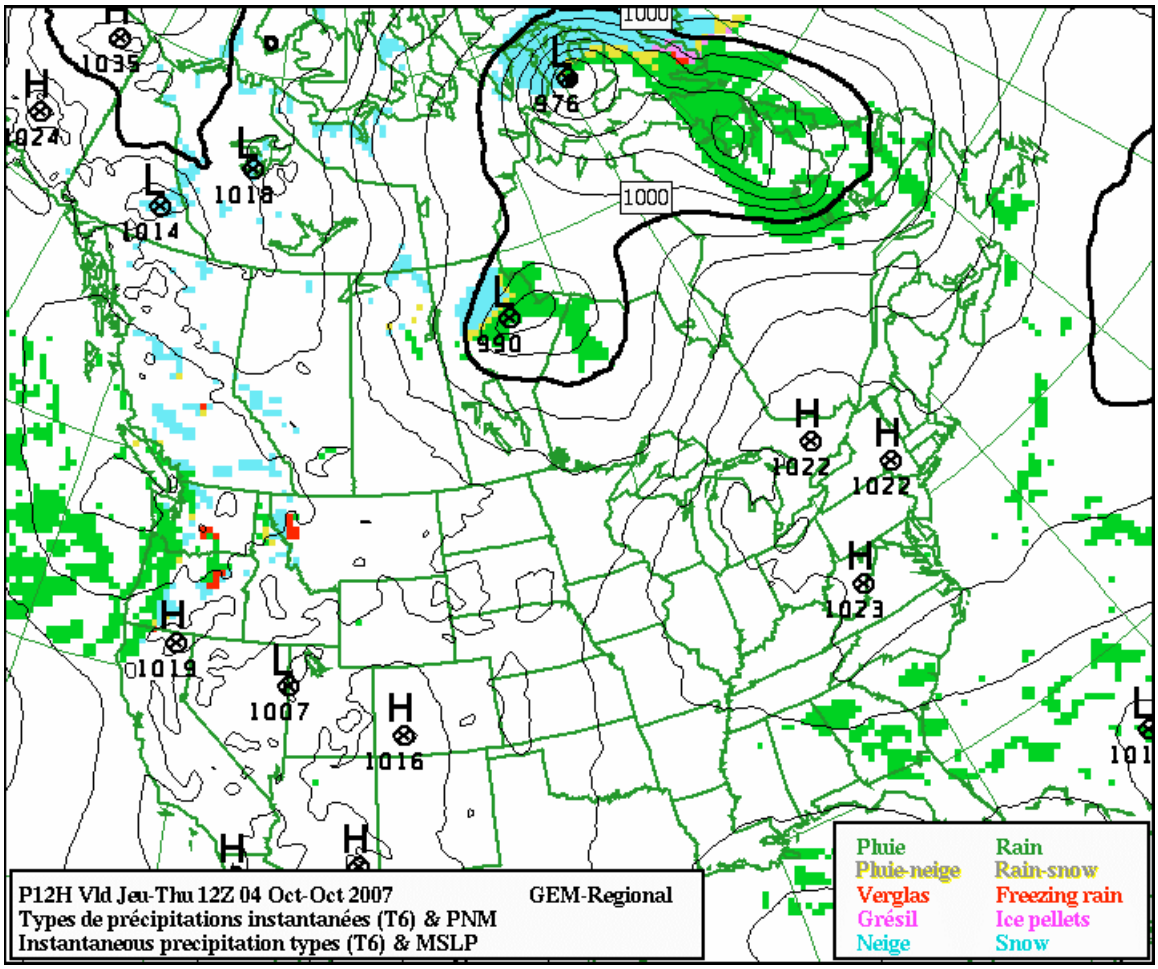
End date: 20.Oct.08

Data format: image (jpg, png)
Website: http://www.weatheroffice.gc.ca/model_forecast/index_e.html

Sample image (4-panel):



Sample image(precipitation type):



2.7.3 Surface Observations

2.7.3.1 Surface observations archived from Environment Canada

The data was prepared by Edward Hudson. There were about 15-17 stations data. They were archived once a day. This data provides surface weather condition for the stations surrounding STAR location.

Data Period:

Start date: 05.Nov.07

End date: 18.Apr.08

Data format: ascii (METARS)

Website: ftp://clientservices.pnr.ec.gc.ca/

The data for the following dates are missing: 2008-04-04

The sample file is as following:

CYPX 301300Z 07003KT 1/4SM FZFG SKC -26.9/-29.7 A2975 RMK RIME SNWCVR/TRLOOSE SLP079 SKY00=

CYPX 301346Z 09002KT 12SM BCFG SKC RMK RIME VIS S - N 11/2 FOG SKY00=

CYPX 301400Z 00000KT 12SM BCFG FEW055 FEW230 -27.2/-30.0 A2976 RMK SC1CI0 SLP083 SKY01=
CYPX 301500Z 00000KT 15SM FEW220 -26.9/-31.1 A2978 RMK CS1 SLP087 53007 SKY00=
CYPX 301600Z 08002KT 15SM FEW030 FEW220 -27.3/-31.6 A2978 RMK SC1CI0 SLP090 SKY01=
CYPX 301700Z 00000KT 15SM FEW220 -27.5/-31.8 A2980 RMK CS1 SLP094 SKY00=
CYPX 301800Z 00000KT 15SM FEW220 -27.4/-31.7 A2980 RMK CS1 SLP096 51009 SKY00=
CYPX 301900Z 00000KT 15SM FEW220 -27.9/-29.5 A2981 RMK CS1 SLP099 SKY00=
CYPX 302000Z 00000KT 15SM FEW180 -27.9/-32.3 A2983 RMK AC1 SLP106 SKY11=
CYPX 302100Z 10003KT 15SM FEW030 -27.9/-32.3 A2986 RMK SC1 SLP114 53018 SKY00=
CYPX 302200Z 10004KT 15SM FEW030 -28.7/-33.2 A2987 RMK SC1 SNWCVR/NIL LAST OBS/NEXT 011300UTC SLP120 SKY00=
… …

2.7.3.2 Surface observations archived from University of Wyoming

Surface observations for the following stations that surrounding Iqaluit were downloaded:

Station	Location	Country	Station	Location	Country
WFD	CAPE DYER,	Canada	YFB	FROBISHER IQALUIT,	Canada
WFP	NAIN,	Canada	YGT	IGLOOLIK AIRPORT,	Canada
WHO	HOPEDALE,	Canada	YHA	QUAQTAQ AIRPORT,	Canada
WKW	CAPE KAKKIVIAK,	Canada	YIK	IVUJIVIK AIRPORT,	Canada
WLX	LONGSTAFF BLUFF,	Canada	YIO	POND INLET AIRPORT,	Canada
WOB	BREVOORT ISLAND,	Canada	YKG	KANGIQSUJUAQ SAWR,	Canada
WRF	PELLY BAY 1,	Canada	YKO	AKULIVIK AIRPORT,	Canada
WRH	RESOLUTION ISLAND,	Canada	YLC	LAKE HARBOUR AIRPORT,	Canada
WRX	ROWLEY ISLAND,	Canada	YLU	KANGIKSUALUJJUAQ,	Canada
WTU	TUKIALIK BAY,	Canada	YPX	POVUNGNITUQ,	Canada
WUP	CAPE HOOPER,	Canada	YTE	CAPE DORSET AIRPORT,	Canada
WUW	DEWAR LAKES,	Canada	YTQ	TASIUJAQ AIRPORT,	Canada
WVD	BROUGHTON ISLAND,	Canada	YUT	REPULSE BAY AIRPORT,	Canada
WYM	CAPE MERCY,	Canada	YUX	HALL BEACH AIRPORT,	Canada
WZZ	SAGLEK (BAY),	Canada	YVP	KUUJJUAQ AIRPORT,	Canada
XAT	ARCTIC BAY CS,	Canada	YXP	PANGNIRTUNG AIRPORT,	Canada
YAS	KANGIRSUK (SAWR),	Canada	YZG	SALLIUT AIRPORT,	Canada
YBB	PELLY BAY AIRPORT,	Canada	YZS	CORAL HARBOUR AIRPORT,	Canada
YCY	CYLDE AIRPORT,	Canada	YVM	QIKIQTARJUAQ,	Canada

Data Period:

Start date: 01.Oct.07

End date: 15.Apr.08

Data format: ascii (METARS, Listig)

Website: http://weather.uwyo.edu/surface/meteogram/

The data with format METARs were archived daily. Part of the data is overlaid with above data. From Nov.16, 2007, the data with both format METARs and Listing were archived.

Due to network problem, metar data in 2007-11-15 were missing; listing data in 2008-01-25 to 30 were missing.
The sample file of METARS is as following:

The following data are for 2007100123z

<H3>Observations for POVUNGNITUQ, Canada (YPX)</H3>

CYPX 012100Z CCA 28025G35KT 6SM -SHRA OVC025 02/M00 A2976 RMK SC8 RA MXD WITH RA TCU EMBD LAST OBS/NEXT 021200UTC SLP079
CYPX 012000Z 28020G30KT 5SM -SHRA OVC015 03/00 A2973 RMK SC8 TCU EMBD SLP070
CYPX 011900Z 29020G35KT 4SM -SHRA OVC015 02/M00 A2970 RMK SC8 VIS 1- 6 TCU ASOCT SLP058
CYPX 011800Z 29025G38KT 5SM -SHRA BKN015 04/M00 A2965 RMK ST7 TCU ASOCT SLP043
CYPX 011700Z 30023G32KT 10SM -SHRA BKN013 04/01 A2962 RMK SC7 RA MXD WITH SN TCU ASOCT SLP031
CYPX 011600Z 30018G30KT 10SM -SHRA FEW012 BKN025 03/01 A2959 RMK ST2SC5 TCU ASOCT SLP021
CYPX 011500Z 31020G30KT 8SM -SHRA BKN014 03/01 A2955 RMK SC6 RA MXD WITH SN SLP010
CYPX 011400Z CCC 31018G30KT 12SM SCT014 02/01 A2952 RMK SC4 ISOLDT SHRA SLP997
CYPX 011400Z 31018G30KT 12SM SCT014 02/02 A2952 RMK SC4 ISOL SHRA VIA CYQB SLP997
CYPX 011341Z 31017G25KT 5SM -RA BKN014 RMK ST5 RA MXD WITH SN
CYPX 011300Z 32015G25KT 12SM FEW008 BKN012 02/00 A2949 RMK ST2ST5 VIA YQB FIC SLP989
CYPX 011200Z CCA 33020G29KT 12SM OVC012 02/M00 A2946 RMK ST8 SLP979
CYPX 011200Z 33020G29KT 12SM OVC012 02/M00 A2946 RMK ST8 SLP979
CYPX 011200Z 33020G29KT 12SM OVC012 02/M00 A2946 RMK ST8 VIA YQB FIC SLP979
… …

The sample file of Listing is as following:

The following data are for 2007111623z

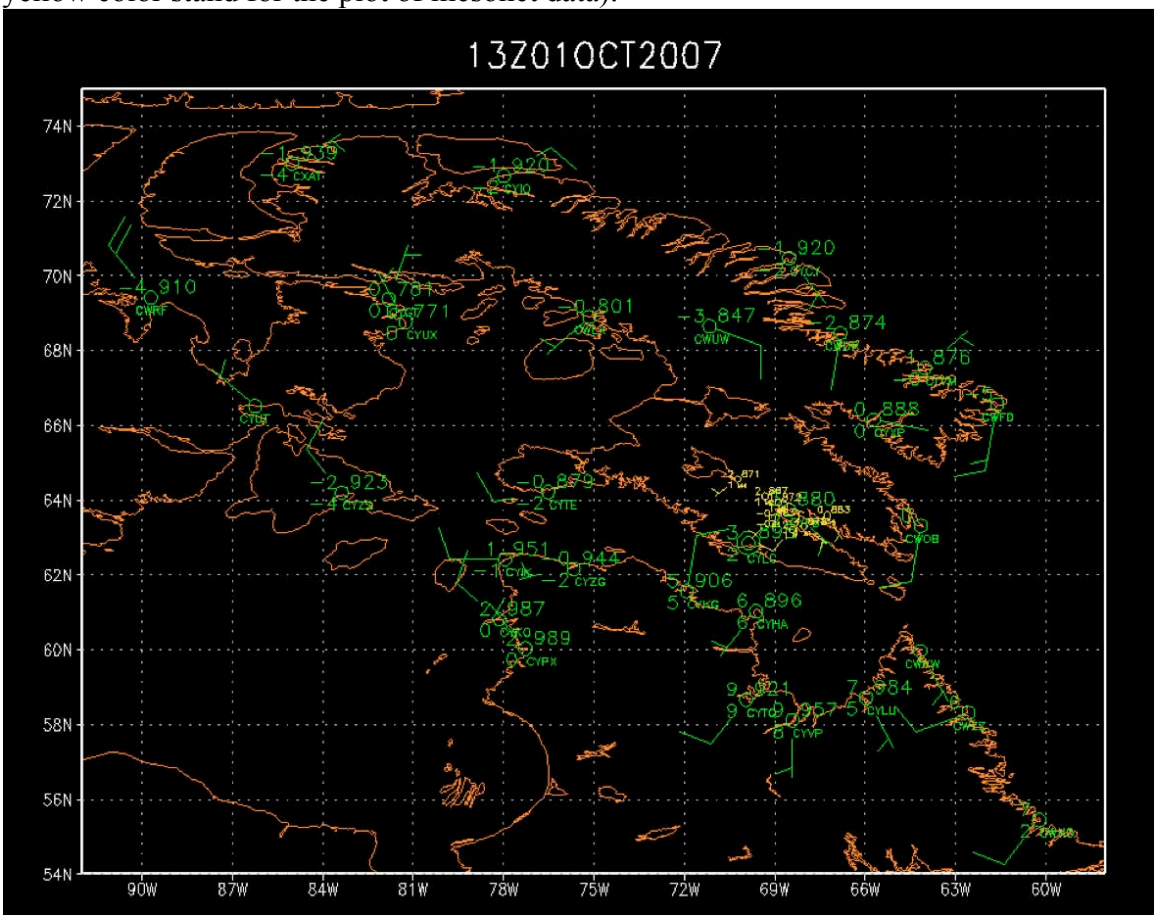
<H3>Observations for POVUNGNITUQ, Canada (YPX)</H3>
<I>2200Z 15 Nov 2007 to 2200Z 16 Nov 2007</I>
<PRE>

STN	TIME DD/HHMM	PMSL hPa	ALTM hPa	TMP C	DEW C	RH %	DIR deg	SPD m/s	VIS km	CLOUDS	Weather
YPX	16/2200	1009.0	1008.8	-5	-7	86	360	7	24.1	OVC027	
YPX	16/2100	1008.3	1008.1	-5	-7	86	350	5	24.1	OVC015	
YPX	16/2000	1007.8	1007.8	-5	-7	86	360	6	24.1	BKN015	BKN030
YPX	16/1900	1007.6	1007.5	-5	-7	86	360	6	24.1	BKN015	BKN030
YPX	16/1800	1007.2	1007.1	-5	-7	86	360	4	24.1	FEW015	BKN035
YPX	16/1700	1007.2	1007.1	-6	-8	86	350	4	24.1	FEW015	BKN035
YPX	16/1600	1007.2	1007.1	-7	-9	86	10	3	24.1	BKN015	BKN035
YPX	16/1500	1007.1	1006.8	-6	-8	86	20	3	9.7	BKN015	ZL-
YPX	16/1400	1006.4	1006.1	-6	-7	93	30	7	6.4	BKN015	ZL-
YPX	16/1300	1006.3	1006.1	-6	-8	86	10	7	24.1	OVC017	

YPX 15/2200 1001.6 1001.4 -3 -6 80 50 6 24.1 OVC048

… …

A station plot for the surface onservations including mesonet is showed as following (the yellow color stand for the plot of mesonet data):



2.7.4 Ocean Surface Winds Derived from QuickSCAT. The domain covers regions surrounding Baffin Island.

The image of ocean surface winds at a 10m height from satellite passes were processed by NOAA/NESDIS, from near real-time data collected by NASA/JPL's SeaWinds Scatterometer aboard the QuikSCAT. For additional information about SeaWinds or QuikSCAT, please visit JPL's Scatterometer web site. The current empirically derived model function being used by to relate normalized radar cross-section with wind speed and direction is referred to as QSCAT1. The image has been divided into 30x20 degree bins for closer examination between latitudes 80N to 80S and longitudes 180W to 180E. We downloded and archived 15 bins of them that cover the Southern Baffin Island and surrounding. Each bin contains the images up to 22 hours previous from update time for both ascending and desending pass.

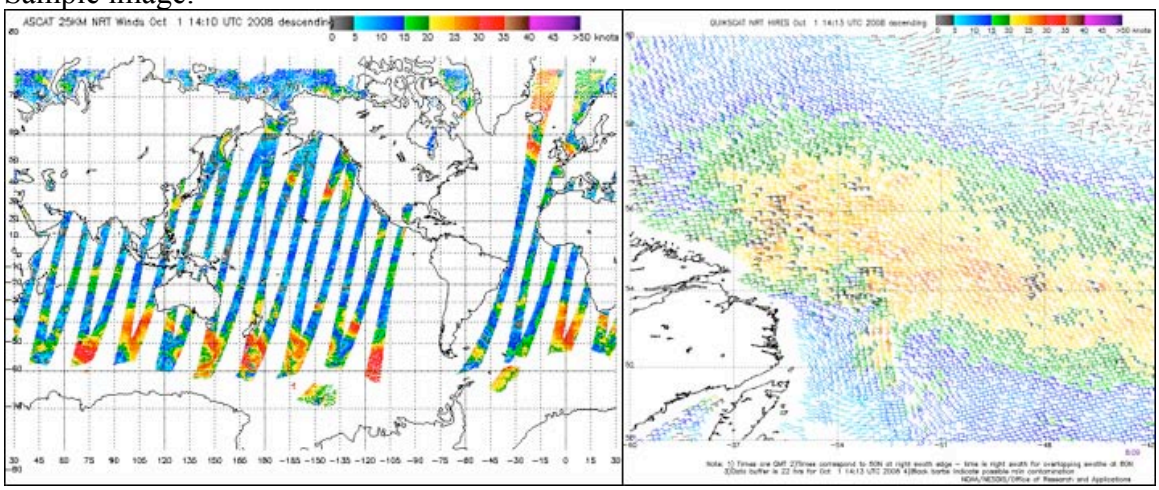
Data Period:

Start date: 03.Oct.07

End date: 31.Oct.08
Data format: image (png)

Website: http://manati.orbit.nesdis.noaa.gov/hires/.

Sample image:



2.7.5 Model surface analysis, wind cross-sections and weather analysis charts.

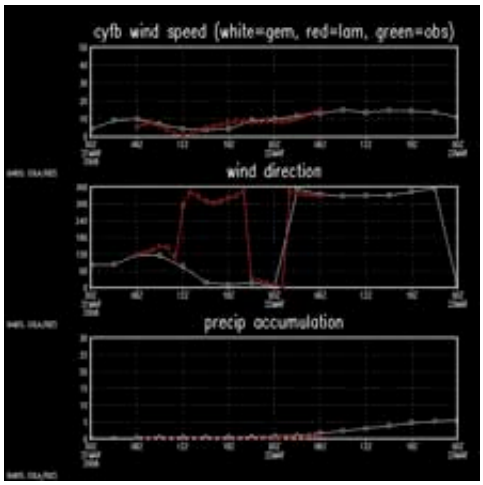
During STAR observation period, Ron Goodson at Hydrometeorology and Arctic Lab, Environment Canada uploaded the analysis of GEM model operational run products and weather charts to CEOS ftp site. These are helpful for the people who are interested in improving the numerical forecast over Southern Baffin Island.

2.7.5.1 Model surface analysis:

This data provides the plots of model surface analysis which including wind speed and direction, precipitation accumulation for the stations: YXP, YVM, YTE, YLC, YFB (station abbreviations are listed in table B in Appendix B)

Data Period:
Start date: 05.Nov.07
End date: 04.Apr. 08
Data format: image (gif)
The data were missing for the following dates: 20080129-20080207, 20080401

Sample plot:



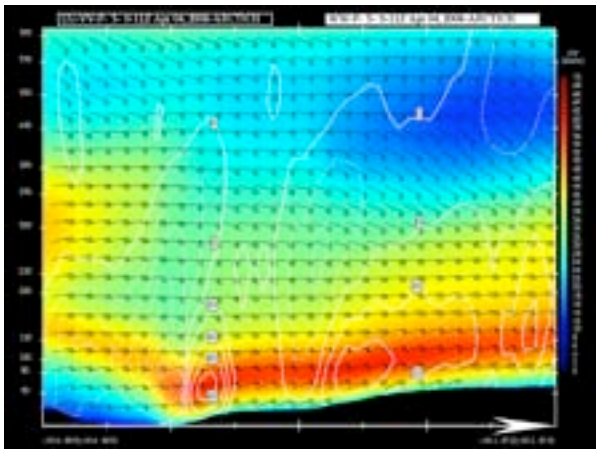
2.7.5.2 Wind Cross Section

This data provides the plots of wind cross-section for YFB - nesw, YFB – nwse, YXP_ew
Data Period:

Start date: 05.Nov.07
End date: 04.Apr. 08

Data format: image (gif)
The data were missing for the following dates: 20071118-19, 20071205-12, 20080103, 20080130,20080206, 20080215-26, 20080330, 20080401

Sample plot:



2.7.5.3 Surface weather analysis charts (from Environment Canada)

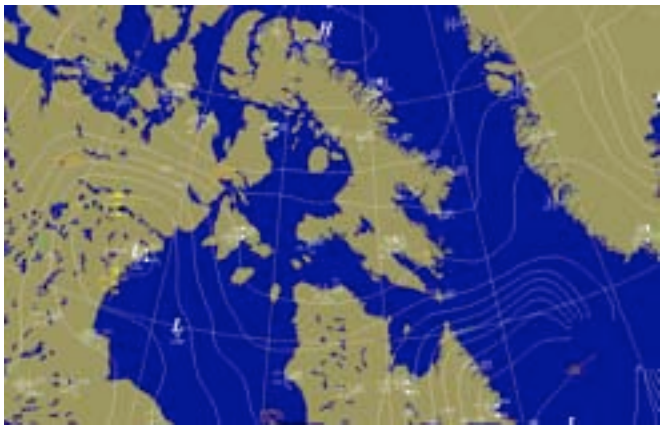
This data provides hourly surface analysis charts
Data Period:

Start date: 05.Nov.07
End date: 04.Apr. 08

Data format: image (gif, djv)

20071221- 20080206 weather chart were missing, instead substituted the regular maps which
- cover the entire country (so you'll have a much bigger area than you want)
- don't have the pretty colours
- are in DjVu format
- 3 hours interval

Sample images:

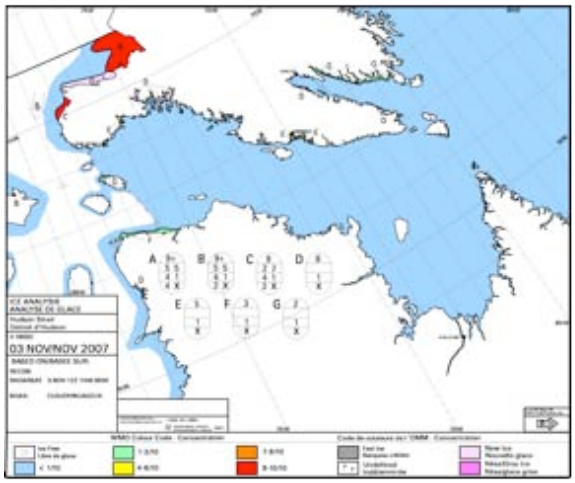


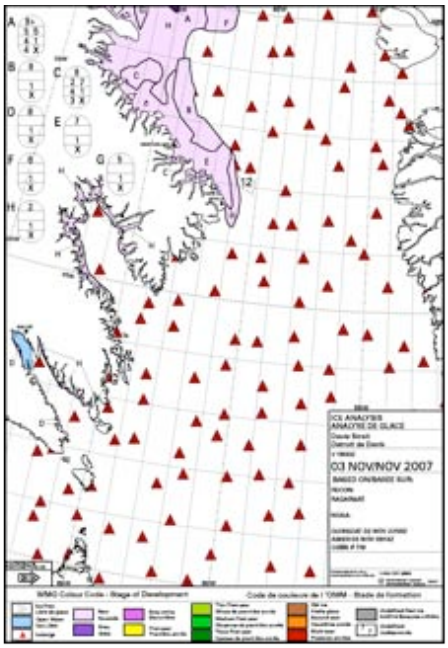
2.7.6 Sea-ice daily analysis charts for Hudson strait & Davis Strait

Sea-ice analysis charts were archived from Canadian Ice Service Web site during STAR observation period. The data were not available every day; A script was seted up to monitor the update of the website at all the time, once there was a new update, we would download and archive the new data.

Data Period:
Start date: 29.Oct.07
End date: 29.Sep.08
Data format: image (gif)
Website: http://ice-glaces.ec.gc.ca/app/WsvPrdCanQry.cfm?CanID=11092&Lang=eng.

Sample images:





2.7.7 Vizaweb images

Vizaweb is an interface to access, view & compare CMC colour images via the web. It helps people load and animate single panel or 4 panel colour images. From here we downloaded and archived the images of GEM-Regional model forecast for the domain ARCTIC-EAST and GEM-LAM2.5km model forecast for the domain ARCTIC and Iqaluit. All of the domains cover Southern Baffin Island.

The archived data includ the images of QPFtypes, QPF, FLUX-outgoing, temperature and wind and etc. of GEM-REGIONAL forecast for the domain ARCTIC-EAST, and also wind, FLUX_outgoing of GEM-LAM2.5km forecast for the domain LAM-ARCTIC as well as wind for the domain Iqaluit

Data Period:

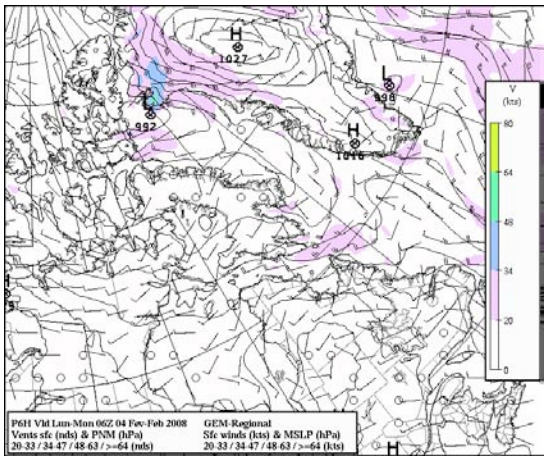
Start date: 05.Jan.08

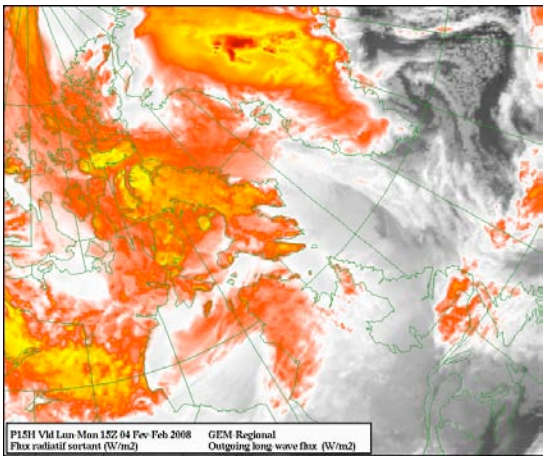
End date: 20.Oct.08

Data format: image (png)

Website: http://weatheroffice.ec.gc.ca/vizaweb/

Sample images:

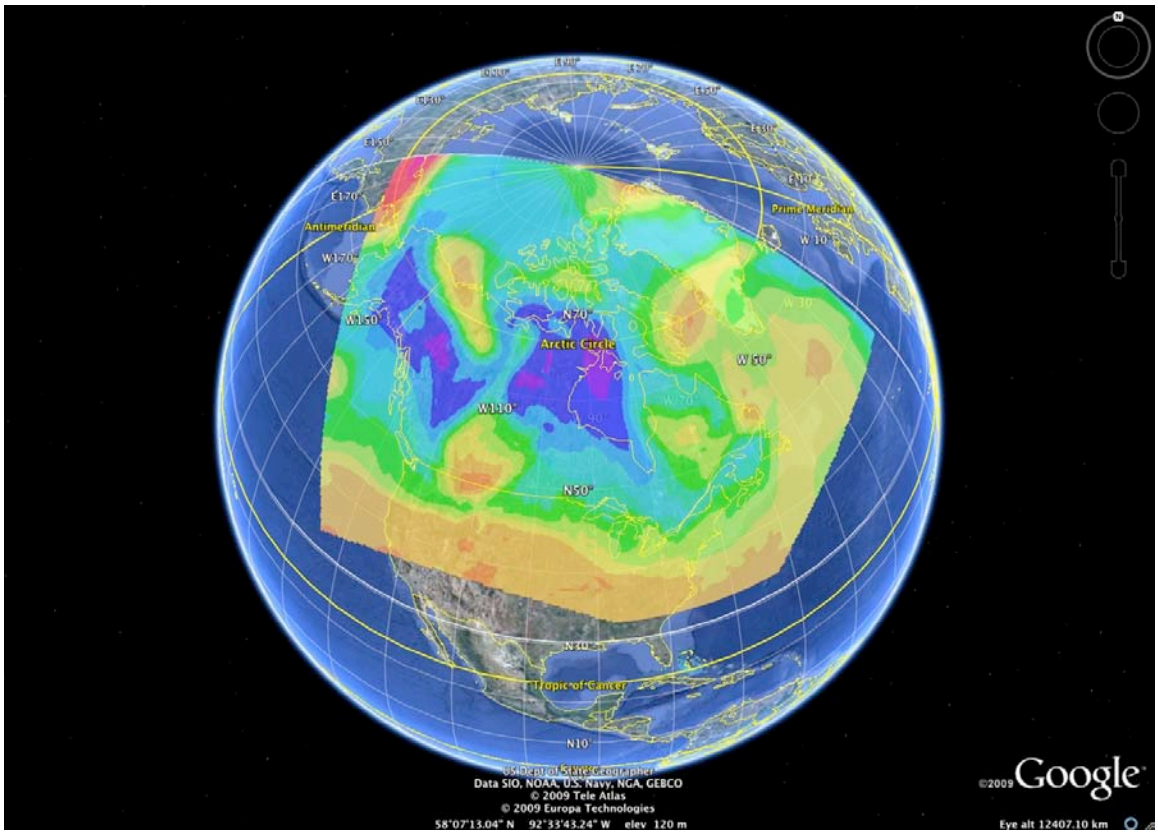




2.7.8 GEM-Regional model forecast

The GEM-Regional model output was archived throughout the observational period. A script was written to access the Environment Canada website and download the associated files every 3 hours up to 48 hours forecast for the 00Z run and 12Z run. High-resolution (15km) data was archived. The temperature, geopotential height, wind components specific humidity for upper air (1015 1000 985 970 950 925 900 875 850 800 700 500 250 200 150 100 50) were archived. Wind speed (module), vertical velocity, absolute vorticity for 4 isobaric levels (250 500 700 850) were also archived. Surface wind, dew point temperature, Sea level surface pressure and etc. were also archived.

Description of GEM regional forecast: 15km central core resolution; 17 isobaric levels; 313x249 Polar-Stereographic grid covering North America and adjacent waters with a 24 km resolution at 60 N. The following figure shows the region of GEM-Regional:



Data Period:

Start date: 18.Oct.07

End date: 20.Oct.08

Data format: grib

Website: http://dd.weatheroffice.ec.gc.ca/grib/public/hires/

Data on 2008042712 is missing; Due to a bug, the temperature at upper level for the forecast were not archived till March 13, 2008.

2.7.9 MODIS

The MODIS instrument is operating on both the Terra and Aqua spacecraft. It has a viewing swath width of 2,330 km and views the entire surface of the Earth every one to two days. Its detectors measure 36 spectral bands between 0.405 and 14.385 µm, and it acquires data at three spatial resolutions -- 250m, 500m, and 1,000m.

Along with all the data from other instruments on board the Terra spacecraft and Aqua Spacecraft, MODIS data are transferred to ground stations in White Sands, New Mexico, via the Tracking and Data Relay Satellite System (TDRSS). The data are then sent to the EOS Data and Operations System (EDOS) at the Goddard Space Flight Center. The Level 1A, Level 1B, geolocation and cloud mask products and the Higher-level MODIS land and atmosphere products are produced by the MODIS Adaptive Processing System (MODAPS), and then are parceled out among three DAACs for distribution. The many data products derived from MODIS observations describe features of the land, oceans and the atmosphere that can be used for studies of processes and trends on local to global

scales. As just noted, MODIS products are available from several sources. MODIS Level 1 and atmosphere products are available through the LAADS web.

This document specifies the format for the MODIS Level 1B 1km earth-view (EV) product. The product is implemented in an HDF file.

The original idea to download these data is to create visible satellite images over Southern Baffin Islands; we only had few images during STAR field campaign. Satellite images can be downloaded from various websites, but it's hard to find images over Southern Baffin Island during STAR period.

So we downloaded the HDF files from http://ladsweb.nascom.nasa.gov/. With some of freeware software, one can produce its own visible satellite images over Southern Baffin Islands.

There is much software that can deal with this HDF format file of MODIS data. Here we used HDFLook, which is freeware and can be download from http://www-loa.univ-lille1.fr/Hdflook/hdflook_gb.html. Currently, It supports IBM, Linux32/64, and MAC OSX. The installation is trivial.

With HDFLook, one can produce visualization of

- Level1B A RGB standard atmospheric corrected image or a single plane.
- Level1B A RGB thermal anomalies corrected image.
- Level1B A RGB thermal image.
- Level1B RGB SWIR composite.
- Mod09 A RGB standard atmospheric corrected image or single plane.
- Other products (with latitude, longitude SDS records) a single plane.
- Other products (reprojected SDS records) a single plane.

With command lines of HDFLook, one can also

- Extract the ancillary data of a SDS
- Print a postscript RGB image
- Export (raw or calibrated) SDS records to binary files or HDF files
- Build reprojected SDS mosaic to binary files or HDF files
- Export RGB images to jpeg files
- Export RGB images to hdf files
- Build reprojected RGB mosaic to binary files or HDF files

Because these HDF files contain not only visible information, but also some other information like thermal anomalies, we keep archiving these HDF MODIS data.

The details can be refer to:
http://ladsweb.nascom.nasa.gov/data/filespecs.html

2.7.9.1 MODIS visible images

Currently, we have created KMZ files for MODIS data; one can use these files to display MODIS visible images over Google Earth. Data were archived during STAR IOPs.

Data Period:

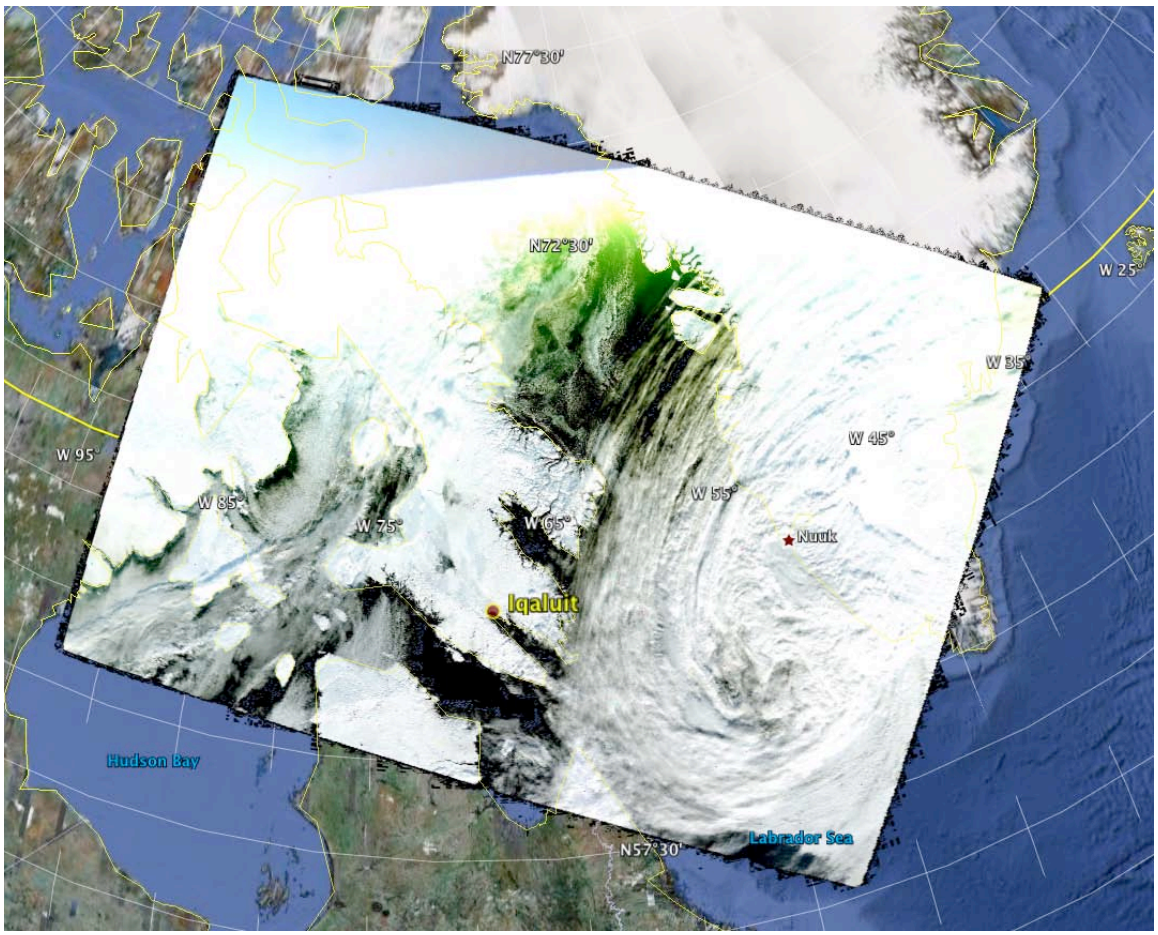
Start date: 15.Oct.07

End date: 28.Nov.07

Data format: grib

Website: http://ladsweb.nascom.nasa.gov/

A sample image was showed as following



2.8 CloudSat

The main component of CloudSat, the Cloud Profiling Radar (CPR), is a 94-GHz (W-band) nadir-pointing radar measuring the backscattering power of clouds as a function of distance from the radar. The main feature of this type of satellite is its ability to measure cloud and precipitation features along its orbital track at a horizontal resolution of approximately 1.1 km and vertical resolution of 500 m, providing an

internal view of the hydrometeor layers of surface storm systems. One of the main limiting factors for the CPR, though, is retrieving data on thin cirrus cloud as the minimum reflectivity threshold is approximately -28 dBZ with a calibration accuracy of 2 dBZ. This in turn underestimates complete cloud coverage as interpreted by the CPR whereby approximately 90 – 95% of radiatively significant ice clouds and 80% of the water clouds could be detected. Furthermore, the W-band CPR is susceptible to attenuation from large cloud particles and high precipitation rates (L'Ecuyer, 2002), resulting in reflectivity values that seldom exceed 20 dBZ. Additional technical details of the CPR are described by Im et al. (2005) and Mace (2007).

During the STAR field campaign, CloudSat performed daily overpasses of the southern Baffin Island region, usually yielding two passes per day (one in the early morning and another shortly after noon of the same day, both local). In total, while discounting for missing data due to intermittent technical issues, there were 104 CloudSat overpasses that fell within the region of interest (Table 16). The data collected by CloudSat is HDF formatted and can be read by a variety of computer software, which includes but is not limited to IDL and Matlab.

The HDF data can be found on the CloudSat Data Processing Center (CDPC) website (http://www.cloudsat.cira.colostate.edu), which is jointly administered by Colorado State University and NASA. The data processing center produces nine Level 1B and Level 2B standard data products, which includes radar reflectivities (2B-GEOPROF) and cloud optical depth (2B-TAU). Each data product (listed in Table 17) provides a unique perspective on clouds and precipitation that cannot be normally observed by conventional surface radar sites. Examples of some of the data products obtainable at the CDPC are shown in the figure below.

Oct-01	Oct-02	Oct-03	Oct-04	Oct-05	Oct-06	Oct-07	Oct-08	Oct-09	Oct-10	Oct-11	Oct-12	Oct-13	Oct-14	Oct-15	Oct-16	Oct-17	Oct-18	Oct-19	Oct-20	Oct-21
631	535	618	523			554	637	541	624	529	612		600	643	547	630	535	618	523	606
1624	1528	1612		1559	1643	1547	1630	1534	1618	1522	1605		1553		1541	1624	1528	1611		1559

Oct-22	Oct-23	Oct-24	Oct-25	Oct-26	Oct-27	Oct-28	Oct-29	Oct-30	Oct-31		Nov -01	Nov -02	Nov -03	Nov -04	Nov -05	Nov -06	Nov -07	Nov -08	Nov -09	Nov -10
	553	637	541	624	529	612		600	643		547	631	535	618	523	606		554	637	541
1642	1547	1630	1534	1618	1522	1605		1553	1636		1541	1624	1528	1612		1559	1642	1547	1630	1534

Nov -11	Nov -12	Nov -13	Nov -14	Nov -15	Nov -16	Nov -17	Nov -18	Nov -19	Nov -20	Nov -21	Nov -22	Nov -23	Nov -24	Nov -25	Nov -26	Nov -27	Nov -28	Nov -29	Nov -30	
624	529	612		600	643	547	631	535	618	523	606		554	637	541	624	529	612		
1618	1522	1605		1553	1636	1541	1624	1528	1612		1559	1642	1547	1630	1535	1618	1522	1605		

Table 16: Date and time (UTC) of CloudSat orbits which intersected the southern Baffin Island region (500 km of Iqaluit) during the STAR field campaign. Times indicated are the start time of the granule. Overpasses which intersected the region of interest occurred 1.33 hours after the start of the granule in the morning whereas afternoon overpasses occurred 1 hour after the start of the granule. Note that some overpasses, indicated in red, are not available due to intermittent technical issues.

Table 17: Standard data products produced by the CloudSat Data Processing center.

1B-CPR	Level 1B Received echo powers
2B-GEOPROF	Cloud mask and radar reflectivities
2B-CLDCLASS	Cloud Classification
2B-CWC-RO	Radar-only liquid-ice water content
2B-TAU	Cloud optical depth
2B-CWC-RVOD	Radar + visible optical depth liquid/ice water content
2B-FLXHR	Radiative fluxes and heating rates
2B-GEOPROF-Lidar	CloudSat CPR + CALIPSO Lidar Cloud Mask

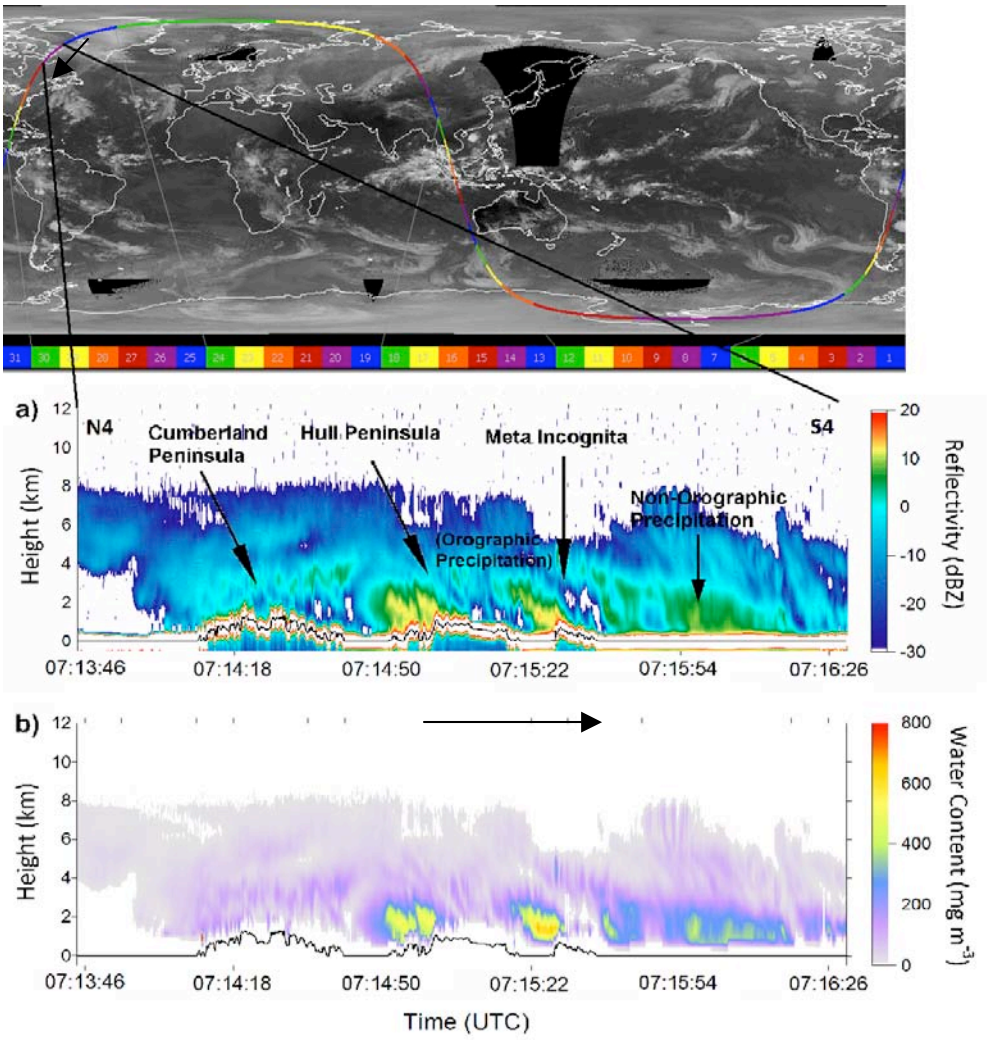


Figure 25: Sample CloudSat radar image (a) of clouds and precipitation over the southern Baffin Island region on 8 November 2007. Total water content (b) is also shown. The start of the granule for this case is 0554 UTC whereby the actual CloudSat pass over southern Baffin Island occurred between 0713 UTC and 0716 UTC (approximately 1 hour and twenty minutes after the start of the granule).

2.8.1 CloudSat data

CloudSat data were archived by Alex Laplante. Data contain

- CloudSat_Lidar pertaining to the cloud top height, occurrence, and number of layers for clouds observed, Matlab script was used to read and process HDF data;
- CloudSat_Radar pertaining to the radar reflectivity, Matlab script was used to read and process HDF data;
- CloudSat_Water_Content pertaining to water content, concentration, particle sizes, and water path for clouds observed. Matlab script was used to read and process HDF data;

- DEM pertains to the digital elevation maps along the CloudSat orbital path were also archived. It has been truncated to encompass the southern Baffin Island region;
- Orbital Path pertains to the latitude and longitude of the CloudSat orbital path (links profile number to lat/long coordinates). It has been truncated to encompass the southern Baffin Island region; and
- Surfer Prog pertaining to the use of Surfer to create the figures found in this directory (Matlab can be used as an alternative).

Data Period:

Start date: 01.oct.07

End date: 30.Nov.07

Data format: HDF, TXT, DEM

References

Environment Canada. April 18, 2006. 1970-2000 Climate Normals Online Database. Assessed from: http://www.climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html. Last assessed on October 29, 2007.

Gordon, M. and Taylor, P.A., 2009. Measurements of blowing snow, part I: particle shape, size distribution, velocity, and number flux at Churchill, Manitoba, Canada. *Cold Regions Science and Technology. 55*(1), 63-74 .

Huang, Q., Hanesiak, J.M., Savelyev, S., Papakyriakou, T., and Taylor, P.A., 2008. Visibility during blowing snow events over arctic sea ice. *Weather and Forecasting, 23*, 741-751

Hudak. D.R, and R. Nissen. 1996. Doppler radar application in major winter snowstorms. *Atmospheric Research. 41*, 109-130.

Nawri, N. and R. Stewart. 2006. Climatological Features of Orographic Low-Level Jets within Frobisher Bay. *Atmosphere-Ocean. 44* (4), 397-413.

NOAA 2007 Hurricane Info

Peters, G., Fischer, B. and H.J. Kirtzel. 1996. One-year Operational Measurements with a Sonic Anemometer-Thermometer and a Doppler Sodar. *Journal of Atmospheric and Oceanic Technology. 15*, 18-29.

Vaisala brochure 2006

Savelyev, S.A., Gordon, M., Hanesiak, J., Papakyriakou, T. and Taylor, P.A., 2006. Blowing snow studies in CASES (Canadian Arctic Shelf Exchange Study) 2003-04. *Hydrological Processes, 20*(4): 817-827.

Appendix A – Field Notes

Table A.1: Radiometer notes and manual observations

Date (UTC)	*Time (UTC)*	*Field Notes*
271	14:23-14:30	Tipped radiometer to its side to measure the bolt size for mounting on radio. Stand. Data will need to be removed during this time period
290	21:20-21:15	Brushed snow from window
292	13:40-13:56	Tried to put radiometer on stand – would not have been level during this period. Data will need to be removed during this time period
293	14:00-14:20	Tried to put radiometer on stand – would not have been level during this period. Data will need to be removed during this time period
296	12:26	Program stopped
296	-	Complete power down of laptop and radiometer
297	-	Restarted program on laptop and rebooted radiometer
298	-	Still not working
299	6:45	Radiometer was running need to check output to verify
299	12:56	From download file – it ran between 6:42Z-7:10Z, then stopped. At 12:56Z, there was an error file, saying that the calibration was not passed.
299	14:05	Restarted program on laptop and rebooted radiometer
299	17:45	Radiometer software does not seem to be working: calibration passed, but no data recorded on the laptop, but could be due to precip, will check later
300	13:49	Calibration passed but no data recorded
300	16:25	Rebooted laptop – got an error message that said ND_CALIB file cannot be read
300	17:20	Used a new ND_CALIB file and restarted the program – working now
317	14:30	Noticed that the power to the radiometer laptop had been disconnected, so there will be some data loss between 14:30 Nov 12- and 14:30 Nov 13. Restarted the program – working fine

Table A.2: Sodar notes and manual observations

Date (UTC)	*Time (UTC)*	*Field Notes*
290	21:01-21:30	Scrapped off snow and ice
291	17:30-18:00	Scrapped off snow and ice
292	13:58-14:00	Cleaned snow off sodar
296	12:23-12:25	Cleaned light snow off sodar
298	12:50-12:53	Cleaned blowing snow off sodar
299	17:30-17:37	Cleaned snow off sodar
304	14:11-14:35	Cleaned snow off sodar
308	15:08-15:10	Cleaned snow off sodar
314	14:30-14:39	Cleaned sodar – covered with snow
317	14:46-14:48	Cleaned sodar – covered with snow
317	17:29-17:33	Cleaned snow off sodar
320	19:12-19:16	Cleaned snow off sodar
321	14:34-14:40	Cleaned snow off sodar
321	20:00-20:05	Cleaned snow off sodar
322	18:40-18:50	Sodar completely iced up - cleaned
325	17:52-17:58	Sodar completely iced up - cleaned
333	15:12-15:20	Cleaned light snow off sodar

Table A.3: Laser Precipitation Sensor notes and manual observations

Date (UTC)	*Time (UTC)*	*Field Notes*
314	14:22	Data logger box for the acumen logger was blown open and the inside of the box was completely covered in snow! Acumen logger appears unharmed.
315	14:30	Failure light was on for the acumen logger, 3 hours of data was collected from time of download previous day. Brought logger inside to dry out.
316	14:04	Downloaded the data, failure light was on, unplugged power and plugged back in. That seemed to correct the problem, checked the compact flash cards, data was fine.
317	14:14	Downloaded while snowing, will have missed 1-minute of data.

Table A.4: Visibility Sensor notes and manual observations

Date (UTC)	***Time (UTC)***	***Field Notes***
314	14:22	Data logger box for the acumen logger was blown open and the inside of the box was completely covered in snow! Acumen logger appears alright.
315	14:30	Failure light was on for the acumen logger, no data was collected. Brought logger inside to dry out.

Appendix B: Abbreviated Station name reference

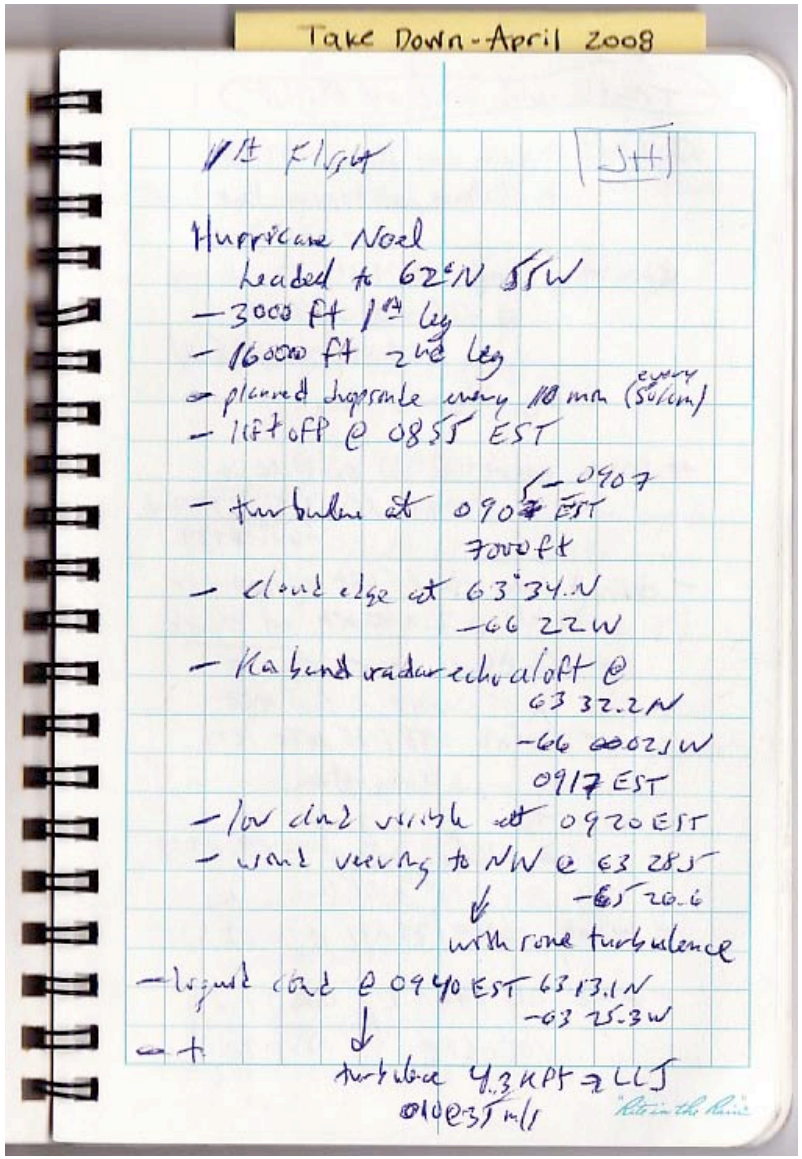
Table B: Station reference names

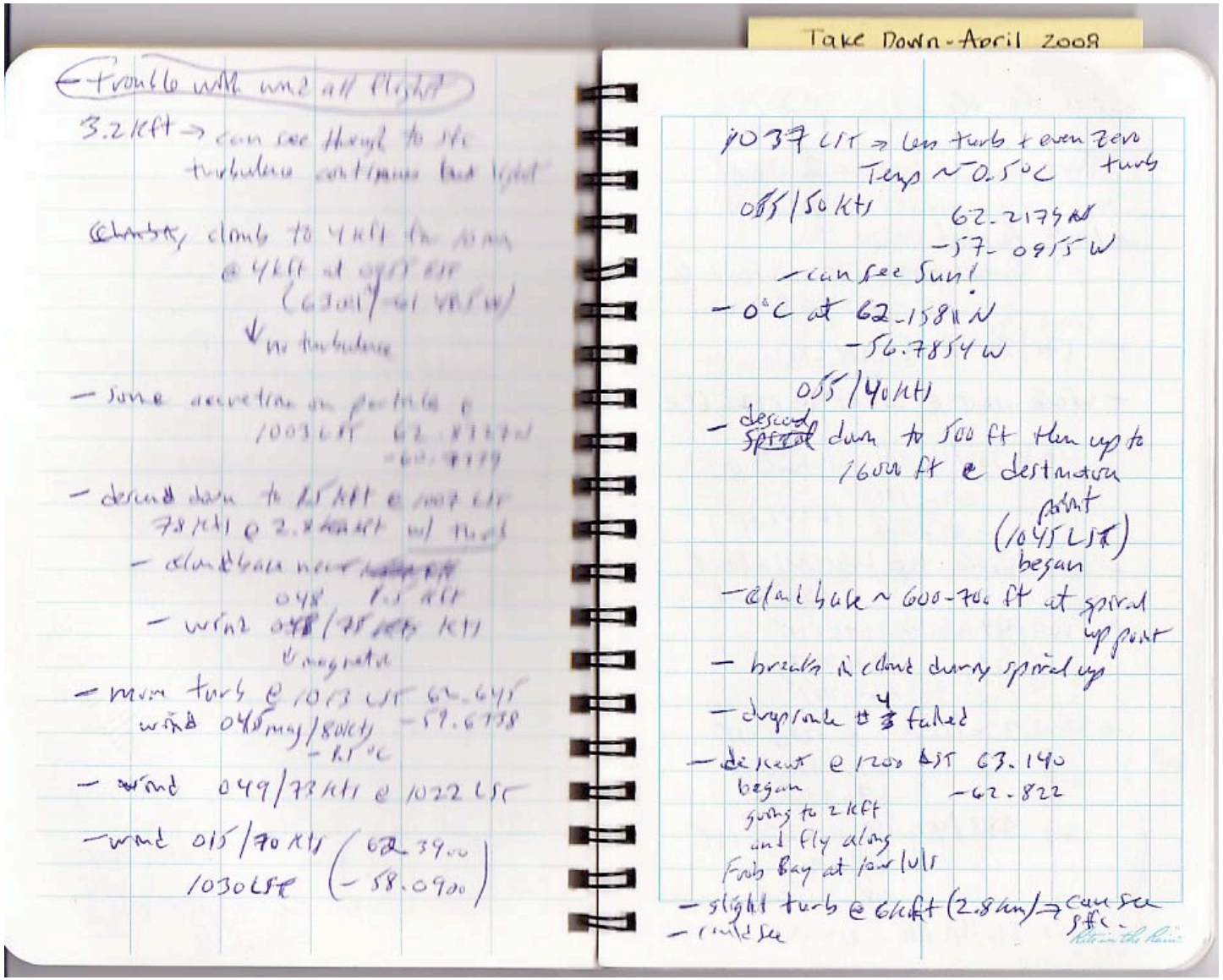
Station Reference Code	Station Name	Station Reference Code	Station Name
WFD	Caper Dyer, NU	YGT	Igloolik, NU
WFP	Nain, NL	YHA	Quaqtaq, QC
WHO	Hopedale, NL	YIK	Ivujivik, NU
WKW	Cape Kakkiviak, NL	YIO	Pond Inlet, NU
WLX	Longstaff Bluff, NU	YKG	Kangiqsujuaq, QC
WOB	Brevoort Island, NU	YKO	Akulivik, QC
WRF	Pelly Bay 1, NU	YLC	Lake Harbour, NU
WRX	Rowley Island, NU	YLU	Kangiuksualujjuaq, QC
WTU	Tukialik Bay, NL	YPX	Pouvungnituq, QC
WUP	Cape Hooper, NU	YTE	Cape Dorset, NU
WUW	Dewar Lakes, NU	YTQ	Tasiujaq, QC
WVD	Broughton Island, NU	YUT	Repulse Bay, NU
WZZ	Saglek, NL	YUX	Hall Beach, NU
XAT	Arctic Bay, NU	YVP	Kuujjuaq, QC
YAS	Kangirsuk, QC	YXP	Pangnirtung, NU
YBB	Pelly Bay, NU	YZG	Salliut, QC
YCY	Clyde, NU	YZS	Coral Harbour, NU
YFB	Iqaluit, NU	YVM	Broughton, NU
-	-	WYM	Cape Mercy, NU

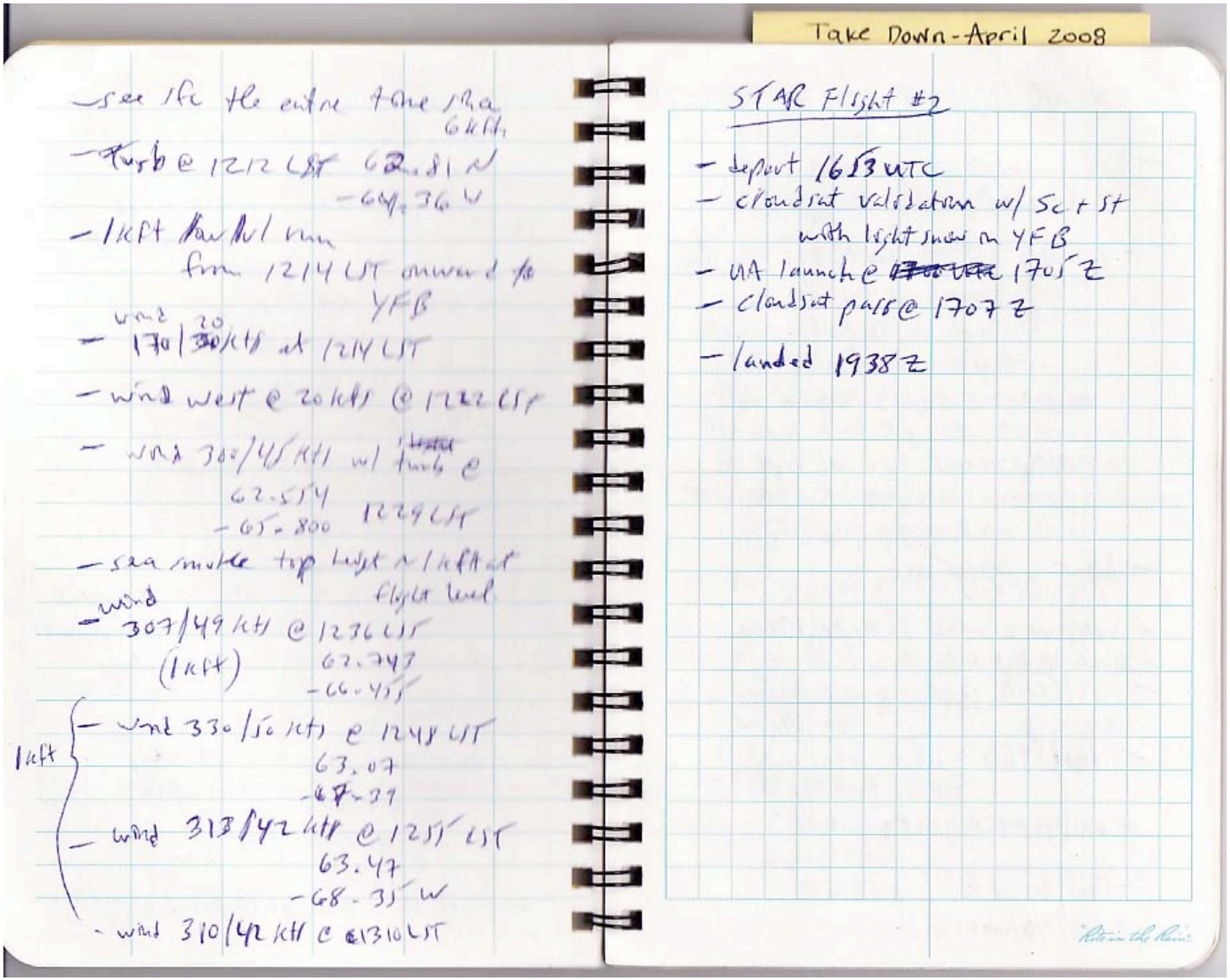
Appendix C – Flight Notes from STAR personal on the Convair-580

Flight 1 - Nov 5, 2007 1355Z-1815Z

STAR persons onboard: John Hanesiak, Ron Stewart


Take Down - April 2008
1st Flight
JH
Hurricane Noel
headed to 62°N 55W
- 3000 ft 1st leg
- 16000 ft 2nd leg
- planned dropsonde every 10 mm (50 km)
- liftoff @ 0855 EST
- turbulence at 0907 EST
7000 ft
- cloud edge at 63°34.N
-66 22W
- Ka band radar echo aloft @
63 32.2N
-66 00 21W
0917 EST
- low cloud visible at 0920 EST
- start veering to NW @ 63 28.5
-65 26.6
with some turbulence
- liquid cloud @ 0940 EST 63 13.1N
-63 25.3W
turbulence 4.3 KFT → LLJ
@ 100 @ 35 m/s
"Rain in the Rain"


Take Down - April 2008
trouble with wind all flight
3.2 kft → can see through to the turbulence continues but lighter
climb to 4 kft
@ 4 kft at 0917 EST
(62.301 / -61.785 W)
↓ no turbulence
- some accretion on portside
1003 LST 62.
-60.
- descend down to 2.5 kft @ 1007 LST
73 kts @ 2.
- climb back never
048 kts
- wind 048 / 75 kts
↓ magnetic
- more turb @ 1013 LST 62.645
wind 048 mag / 80 kts -59.6738
-1.1 °C
- wind 049 / 73 kts @ 1022 LST
- wind 015 / 70 kts (62.39.00
1030 LST (-58.0900
1037 LST → less turb + even zero turb
Temp ~ 0.5°C
055 / 50 kts
62.2179 N
-57.0915 W
- can see Sun!
- 0°C at 62.158 N
-56.7854 W
055 / 40 kts
- descend spiral down to 500 ft then up to 1600 ft @ destination point (1045 LST) began
- climb back ~ 600-700 ft at spiral up point
- breaks in cloud during spiral up
- drysuit # 4/3 failed
- descent @ 1200 EST 63.140
began -62.822
going to 2 kft
and fly along
Frob Bay at four kts
- slight turb @ 6 kft (2.8 km) → can see Sfc.
- cant see
Rain in the Rain

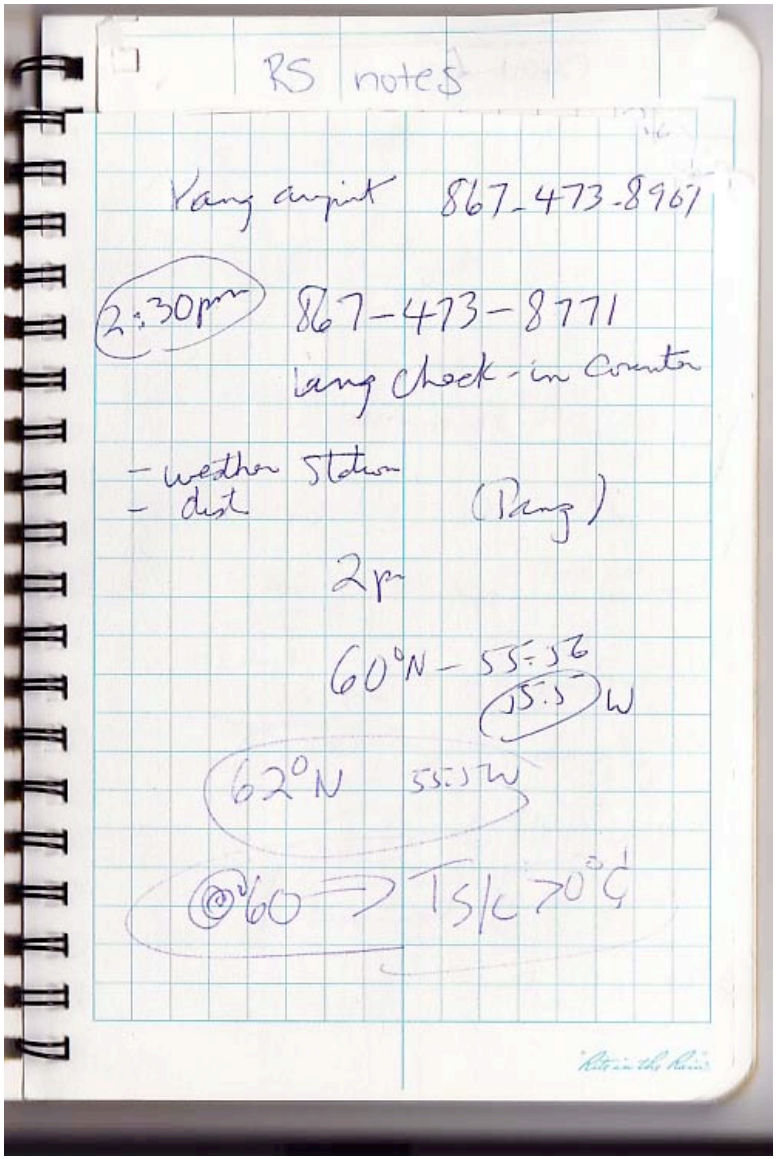


Take Down - April 2008

- see if the entire flight can be 6kft.
- turb @ 1212 CST 62.81 N
  -64.36 W
- 1kft low level run from 1214 CST onward to YFB
- wind 170/20 kts at 1214 CST
- wind west @ 20 kts @ 1222 CST
- wind 300/45 kts w/ turb @ 62.57 N -65.800 1229 CST
- see smoke top layer 1kft at flight level
- wind 307/49 kts @ 1236 CST (1kft) 62.743 -66.455
- wind 330/50 kts @ 1245 CST 63.07 -67.39
- wind 313/42 kts @ 1251 CST 63.47 -68.35 W
- wind 310/42 kts @ 1310 CST

STAR Flight #2

- depart 1613 UTC
- cloudsat validation w/ Sc + St with light snow in YFB
- UA launch @ 1705 Z
- cloudsat pass @ 1707 Z
- landed 1938 Z



RS notes

Yang airport 867-473-8961

2:30pm 867-473-8771
Yang check-in counter

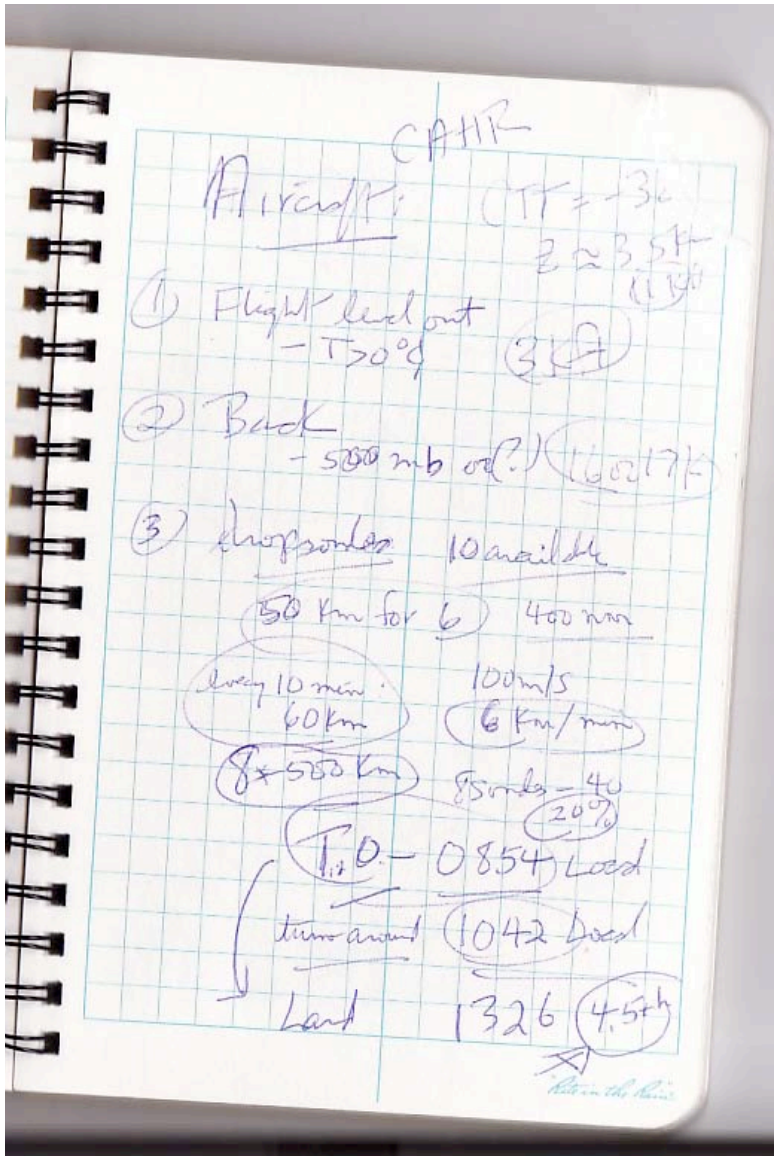
- weather station
- dist (Yang)

2pm

60°N - 55:56
15:5 W

62°N 55:57W

@60 ⇒ TS/C >0°C



CATF-

Aircraft:

① Flight level out
- T>0°C (3K ft)

② Back
- 500 mb or (?) (16,017 ft)

③ Transponder 10 available

50 km for 6 400 nm

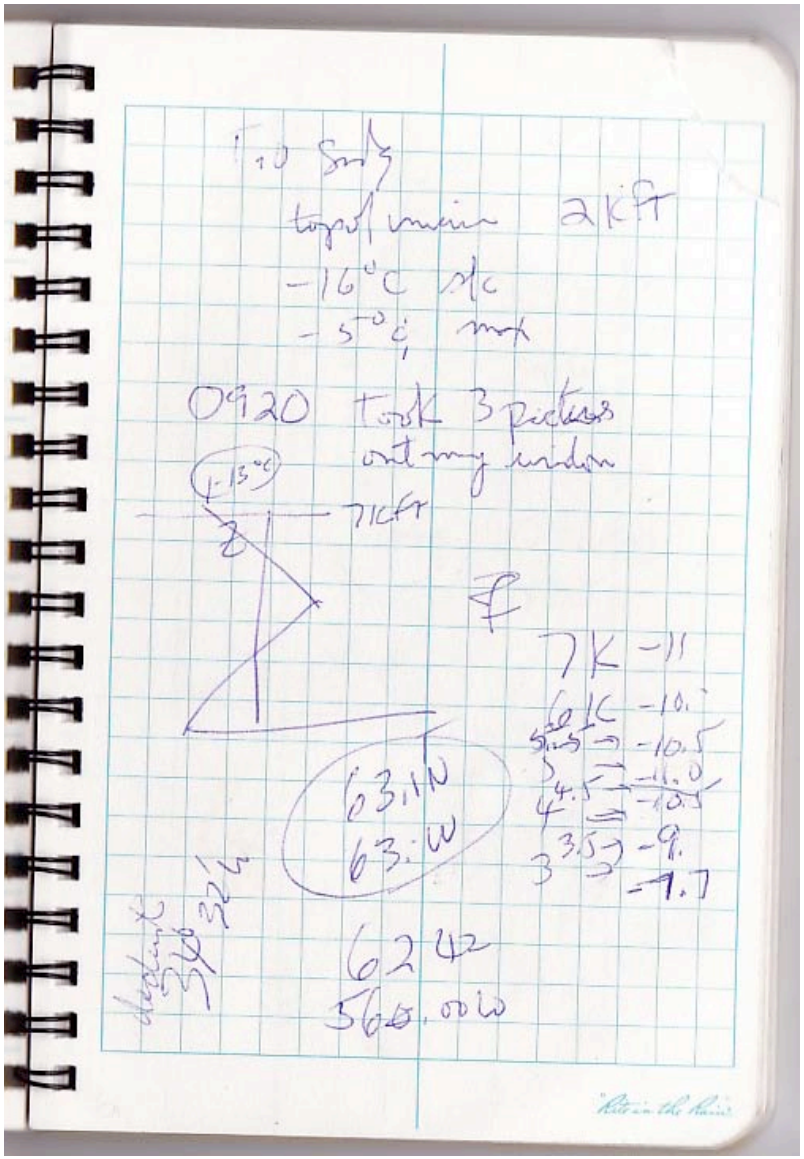
every 10 min 100 m/s
60 km 6 km/min

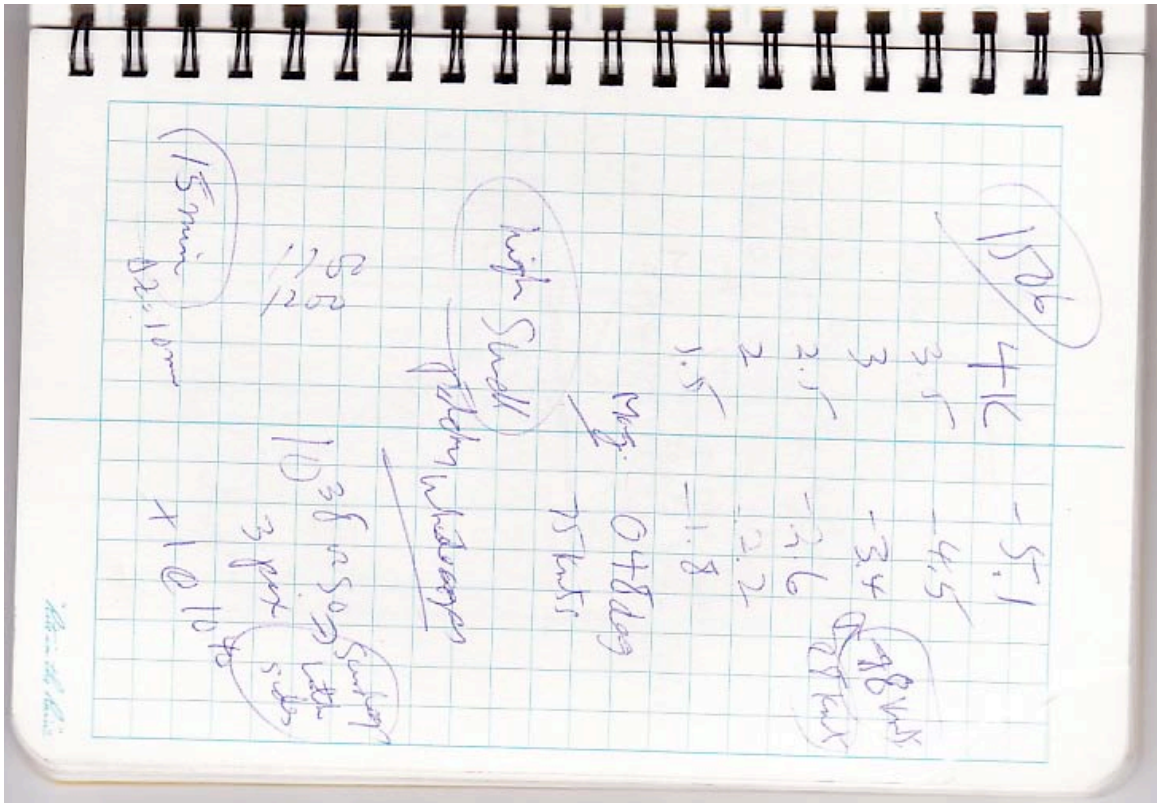
8 x 500 km 850 mb - 40
20%

T.O. - 0854 Load

turn around 1042 Load

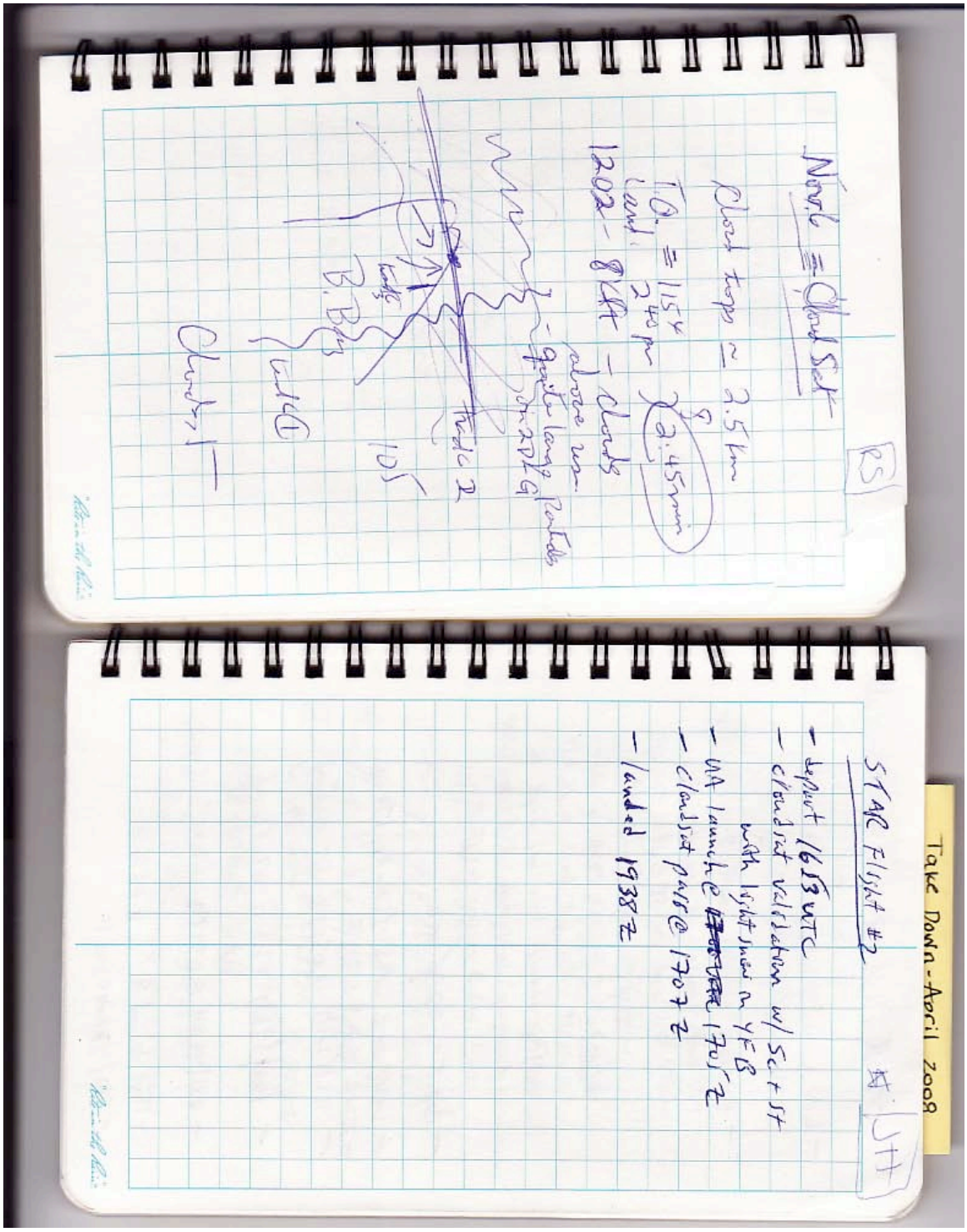
Land 1326 (4.5 hr)


10 Sm
top of main 2kft
-16°C s/c
-5°C mx
0920 Took 3 pictures out my window
-13°C
7kft
7K -11
6K -10.
5.5 → -10.5
5 → -11.0
4.5 → -10.5
4 → -10.
3.5 → -9.
3 → -9.7
63.1N
63.W
62 42
565.0W



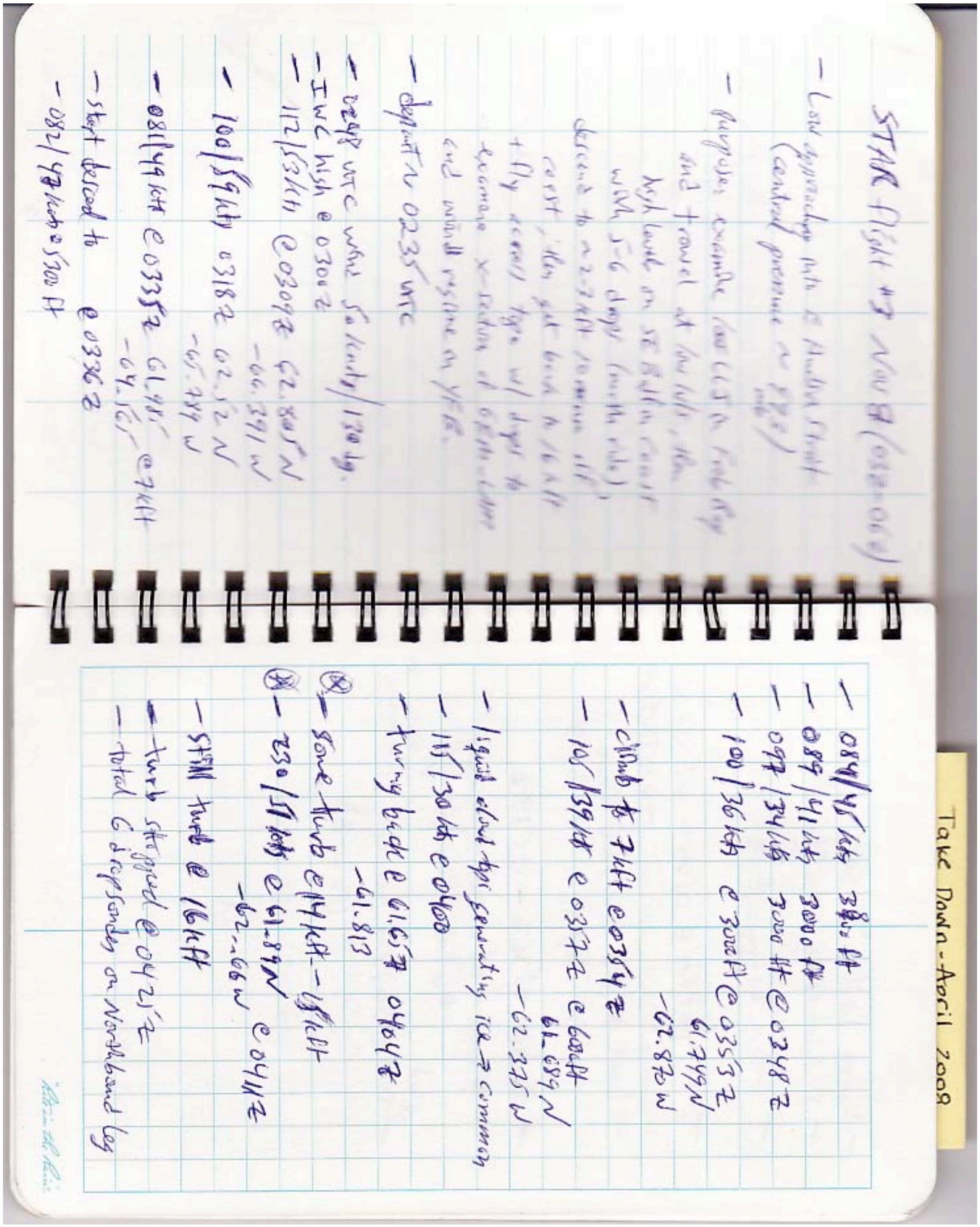
Flight 2 - Nov 6, 2007 1653Z-1938Z

STAR persons onboard: John Hanesiak, Ron Stewart, Robert Field



Flight 3 - - Nov 8, 2007 0235Z-0622Z

STAR persons onboard: John Hanesiak, Kent Moore, Shannon Fargey



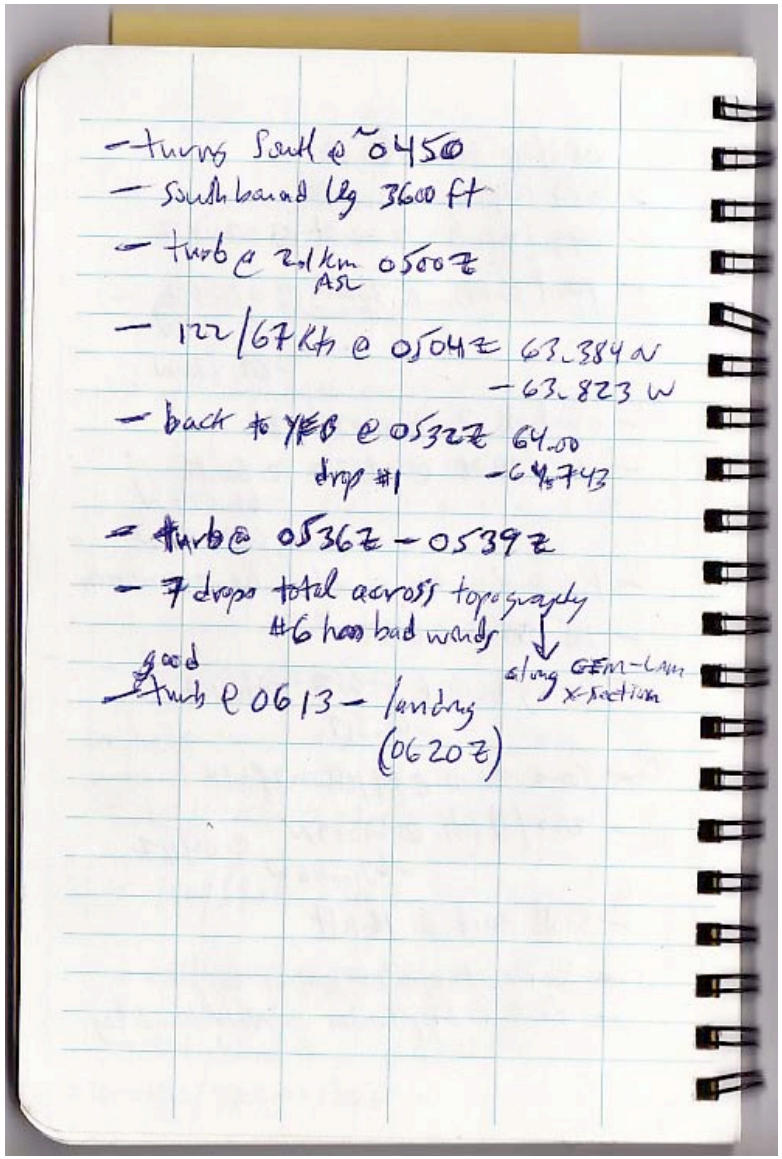
Take Down - April 2008

STAR flight #3 Nov 8 (03Z-06Z)

- Low approaching into E Hudson Strait (central pressure ~ 978 mb)
- purpose: examine low LLJ in Frob Bay and travel at low lvls, then high levels on SE Baffin coast with 5-6 drops (north side), descend to ~2-3 kft 10 nm off coast, then get back to 16 kft + fly across topo w/ drops to examine x-section of GEM-LAM and wind regime on YFB.
- depart ~ 0235 UTC
- 0248 UTC wind 50 knots/130 deg.
- IWC high @ 0300 Z
- 112/53 kts @ 0309 Z 62.805 N -66.391 W
- 100/59 kts 0318 Z 62.52 N -65.789 W
- 081/49 kts @ 0335 Z 61.985 -64.565 @ 7 kft
- start descend to @ 0336 Z
- 082/47 kts @ 5300 ft

- 084/45 kts 3800 ft
- 089/41 kts 3000 ft
- 097/34 kts 3000 ft @ 0348 Z
- 100/36 kts @ 3000 ft @ 0353 Z 61.749 N -62.870 W
- climb to 7 kft @ 0354 Z
- 105/39 kt @ 0357 Z @ 6000 ft 61.689 N -62.375 W
- liquid cloud tops generating ice → common
- 115/30 kts @ 0400
- turning back @ 61.657 0404 Z -61.813
- (X) some turb @ 14 kft - 15 kft
- (X) 230/51 kts @ 61.89 N -62.66 W @ 0411 Z
- still turb @ 16 kft
- turb stopped @ 0425 Z
- total 6 dropsondes on Northbound leg

"Rite in the Rain"


- turns South @ ~0450
- southbound leg 3600 ft
- turb @ 2.1 km ASL 0500Z
- 122/67 Kts @ 0504Z 63.384 N
-63.823 W
- back to YEB @ 0532Z 64.00
drop #1 -64.743
- turb @ 0536Z - 0539Z
- 7 drops total across topography
#6 had bad winds
strong GEM-LAM x-section
good
turb @ 0613 - landing
(0620Z)

Mission Scientist's Log

Flight No **B**..... Date Nov 7 Name Kent-Moore Page 1 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
02:39				YFB	take-off.
02:44		7Kft			level off.
					nice upslope precip
02:49				63 46N	on radar (over land
				-68W	to the N of F.B.)?
03:03		7Kft		63N	precip below
				-67W	terminated
03:12		7Kft		62.7N	precip now
				-66.3W	reaching ground
					again
03:13		7Kft		62.7N	some turbulence
				-66.2W	
03:22		7Kf		62.4N	much heavier
				-65.6W	precipitation
					below aircraft
03:24		7Kft		62.3N	anomaly in
				-65.4W	precip below a/c
03:29		7Kft.			strong precip only
					near ground
03:36				61.9N	descend to 5Kft
				64.5W	attempt to find
					jet core

Mission Scientist's Log

Flight No **B**..... Date Nov 7107 Name moore..... Page 2 ~~2~~. of 2.

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
03:39				61.9N 64.16W	descend to 3 Kft.
					scattered precip below
03:40				61.9N 64W	more turbulence @ 4.5 Kft
03:46		3Kft		61.8N 63.5W	more turbulence.
03:50		3Kft			more turbulence
03:52		3Kft		61 45N 63 W	solid precip ~~turbulence~~
03:54				61 43N 62 41W	started to climb / turn
					precip ended below
03:58		6-3Kft		61 41N 62 23W	moderate turbulence
					another band of
					precip below
04:00		7Kft		61 34N 62 7W	ice streamers above.
04:05					started to climb
04:14		15Kft			turbulence.
04:13		16Kft.			not quite out of cloud
					turbulence

take off - 02:39 Z
Light winds, snowfall @ Iqaluit
w r magnetic; offset 32° deg.

Mission Scientist's Log

* in notes. winds are 5 number sequence 107 50 (deg) (knots)

Flight No **B**..... Date Nov 8/07 Z Name SF..... Page 1 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
~~3:48:56~~					winds 107 50 (knots) ~~[illegible]~~, snow
3:04					10551 ice particles
3:09					11253 true air speed 198 knots
3:18					10059
3:20					• CVI 0.5-0.6 • lots of snow, ice particles
3:38		going down and up to find the jet max			08247 5300 ft
3:39					08445 4900 ft ? not sure of height
3:41					08648 4700 ft
3:43		43?? ft		2420	08949 lowest level ~4000ft ?
3:47					09734
3:51					10036
3:54					climbing back up to 7000ft
3:55					maintaining 7000ft.
3:56					0539
4:00					11530 ver, decreasing
4:03					turning and continuing to ascend to 16000ft, heading to the coast
4:11					23051
4:13			planned location N	62.30N 62.30W	220
4:27					# 1st drop sonde
4:31					2nd drop sonde. pilots say precip has cleared.
4:35					3rd drop sonde.
4:39					4th sonde.
4:43					5th sonde
4:47					6th sonde.
4:49					descending to 3600-ft. 3 64° 10mn.

* XV landing on land not water (sea ice?)

Mission Scientist's Log

Sondes (+) total released.

Flight No **B**..... Date Nov 8, 2007 Name SF Page 2 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
4:53					132 56 Walter noticed that the dropsonde wind speeds match the instruments on plane 130 15, so plane & sondes/aircraft not matching.
5:11					beginning climb up to 17000ft past 63.30N. N 63.45 N
5:14					350 13
5:19					330 8 15 miles vis.
5:31					2nd run at altitude 1st sonde (7)
5:34					2nd sonde (8)
5:38					3rd sonde. 1st sonde hit ground too on this run.
5:41					4th Sonde 2nd hit ground.
5:44					5th sonde. *landed on mtn W69.013 transmit same altitude 968m
5:49					6th Sonde. *winds no good! @ 05:51
5:54					7th sonde
				*	13 Sondes total release during mission. 6th (12th) sonde on second drops *
09:56					207 38
06:19					Pilots report wind shift, gust 5 kn (+)
06:22	landing!				

Flight 4 – Nov 9, 2007 2129Z – Nov 10 0125Z

STAR persons onboard: John Hanesiak, Kent Moore, Robyn Dyck, Gabriellle Gascon

Mission Scientist's Log

Convective rolls in Hudson Strait + upslope on SW coast / unexpected accums of snow in YFB due to convection + upslope

Flight No B 4 Date Nov 9/07 Name Haneseik Page 1 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
2135		10 (12) kft			turb @ near cloud-top w/ light @ top (-30°C)
					precip on radar the entire way
					heavy squalls and in middle of top 2 and
					dimmish on descent to YFB slightly
2152		16 kft			liquid water tops all the way
					cloud top 17 kft below aircraft level
					ice generating cell visible on Ka band radar
2208					drop #1 / some radar echos down low
					5.5 kft returned layer in drop #1
					cloud tops @ 2.5 km
					drop #2 - sat layer @ 6.2 kft
					large cell @ 2242 Z (10 min from 2255 Z)
				63.233 -75.929	cells visible on S bound leg
					- 63.172 / -75.912 (huge cell)
2317.2		2 km		62.508 -75.77	turbs @ starts
		1.8 km			liquid water @ cld top
2326		4 kft		62.68 -75.79	nice cell / good turb
				63.358 -75.96	turbs but no radar echoes for 1-2 min
2349		4 kft		63.89 -75.998	nice cell
					nothing in shadow of islands?
				64.00 -75.95	turn South again to porpoise over
					same cell Southbound @ 3.7 kft porpoises
				63.005 -75.908	nice cell - same area as north leg?
					aircraft data at top of cells

Mission Scientist's Log

Flight No **B** 4 Date 9/A Name Haresnah Page 2 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
0021 – 0022=20				63.08 -75.414	good turb
				63.13 -75.079	nice cell / good turb
				63.22 -74.5	nice cell / ~~turb, only turb~~ good turb, but only on red ~~fx~~ echoes
					-14°C at ~~base of~~ 600 m AGL
					base of porpoise
				63.46 -72.~~47~~	Nice convection just offshore (cells)
					(onshore convergence ?)
					we were too high to sample but got
					tops where liquid water was measured
					- flying through small Bay
0055:40					- hit shore
					- upslope precip more stratiform
					with leading edge convective!!
					- radar onshore echoes tilted to
					east with height (convective towers
					tilted over)
					- precip over peninsula weaker than
					when we departed
					- precip at 2.7 km the entire way
					into YFB coast
					- how do you separate downslope
					effect from moisture loss to
					account for less precip on downslope side ?
0112		2.1km		63.496 -68.579	FZDZ at cloud tops into YFB
Touch down @ 0125Z					- cells in the Bay !! ground ~~truth~~ ? waves ??

V

Mission Scientist's Log

Flight No **B**..... Date Nov 9 Name Moore Page 1 of 3

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
21:29					take-off
21:32		5Kft			no cloud
21:34		7.5Kft			light turbulence
21:36		10Kft			light to mod turbulence
					~~(no cloud)~~
21:36		11.9			cloud top some
					liquid water
21:50					streamer appeared to
					stop at start of
					downslope @ 21:42
22:08					1st sonde
					streamer ended
					on upslope 21:54
22:13					cellular convection
					started
22:14					2nd sonde saturated at
					6Kft
22:56					big cell
22:59					big cell
23:11					NS gradient in cells
23:18		5.4Kft			~~start NB leg @3Kft~~
					turbulence moderate
					in cloud
22:21		3Kft			start NB leg

Mission Scientist's Log

Flight No **B**..... Date Nov 4 Name Moore Page 2 of 3

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
23:24		4Kft			climb to 4Kft to
					get into cloud
23:25		4Kft			nice cell
					moderate turbulence
23:32		4Kft			moderature turbulence
23:39		4Kft			moderature turbulence
23:40		4Kft			out of cloud
23:43		4Kft			back in cloud
					moderate turbulence
23:45		4Kft			moderate turbulence
23:46					moderate / heavy turbulence
					islands appear to
					break up convection
23:52					start porpoise
23:57		4Kft			moderate turbulence
					in cell
24:00		2Kft			end of 1st porpoise
					upto 6Kft.
					quite turbulence
00:07		6Kft			start 2nd porpoise
00:12		2Kft			end 2nd porpoise
00:16		6Kft.			start 3rd porpoise
00:20		2Kft			end 3rd porpoise

Mission Scientist's Log

Flight No **B**..... Date Nov 9..... Name Moore..... Page 3... of ...3

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
00:24		6KFt			start 4th purpuise
00:38		2.8 KFt			moderate turbulence
00:29		2.1KFt			heavy turbulence
00:30					end 4th purpuise
00:33		8 KFt			start 5th purpuise
00:40		2KFt			end of 5th purpuise

Mission Scientist's Log

Flight No **B**..... Date ..Nov.9,2007 Name Gabrielle Gascon Page ...1... of ...1...

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
1900					Enter the plane + security briefing
1930					Learn backup GPS is broken. Need to replace it
2045					GPS fixed. Drive in the airport to make sure it's OK
2115					Prepare for takeoff
2128					Takeoff
2136					~~Turning right... Instrument be turned!!~~
2145					16000ft ~ 4.5km ~500mb; cruising altitude
2150					Change in radar reflectivity (John's) heavier precip
2152					Less heavy precip: Cloud top ~3km
2153					A bits bits of turbulence
2200					A bits of turbulence
2207					1st dropsonde DT's taken ~ 90min for a sonde to go down
2215					2nd dropsonde
2230					3rd dropsonde
2232					A bits of turbulence
2235					Slight change of flight plan: Instead of just going up and down we do up and down
2238					4th dropsonde
2243					5th sonde
2249					6th sonde
2305					Auto suite on
2312					Turbulence starts
2318					Quite bumpy -- well for me!! For terrified 1st cell actually it's not bad
2331					Bumpy!! I have to stay at my seats, but I don't hope any scream. So I don't really know what's going on or where we are headed
0040					Done with the up and downs
0125					Landing

Mission Scientist's Log

Flight No **B**..... Date Nov 9 07 Name Robyn D. Page 1 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
Preflight:					heavy convection causing
					first granular snow @
					153 pm, lger dendritic &
					aggregate snow started once
					on plane (snow squalls) a lot
					upslope
(425) 2 1425Z					Seat belt & headphones on
					taking off backwards
2130Z					runway 32g TAKEOFF
35					liquid layer @ top (scruffy looking)
36					turb going through cloud tops
45					16000ft ~ 4.5Km
					Td greater then T due to
					super saturation
					SW flow blowing instability
					from over water to Iqaluit
Kabord					particle display not displaying
50					flying W from Iqaluit
John's radar 52					Stronger radar return near ground
					squalls from higher terrain
					petering out when terrain
					gets lower, convection to 43
					cloud tops ~ 4 Km
					Stronger headwind 6 drops
					8 min apart. 30m/s @ 16000ft
					very good.
2203					radar showing precip ending/
10					more choppy
					first drop
16					#2 @ 550 mb sondes take
					4 min

Mission Scientist's Log

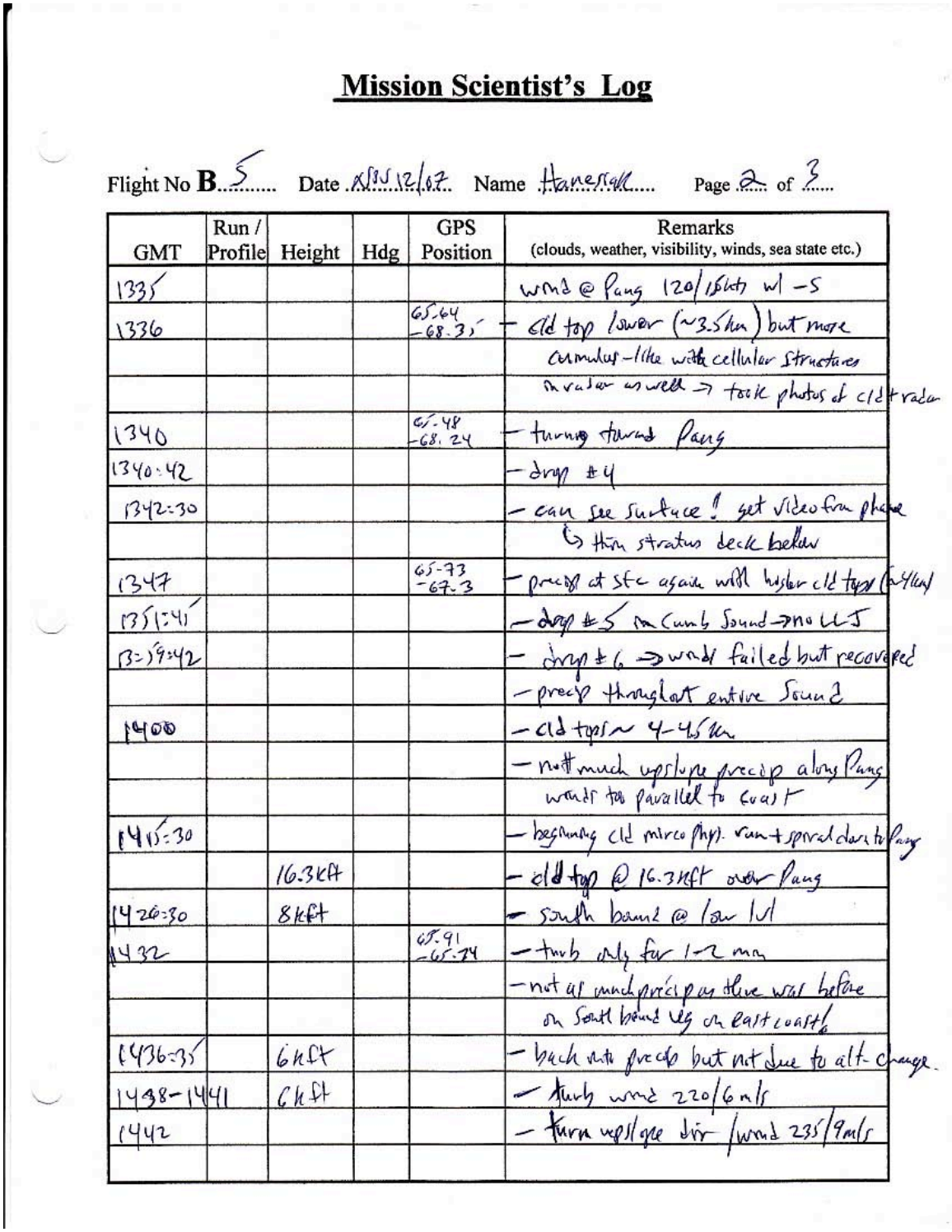
CONVAIR

Flight No **B**..... Date Nov 9/07 Name Robyn..... Page 2 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
2225					Td≅T = cloudtop (dropsonde)
26					2nd hit ground
28					3rd launch
30					8k Td warms to melt T
34					4th drop
					changed flight path to up & down going S to get good sampling of convection
40					4th hit ground
					JVR?
43					5th drop
50					5 finished
51					6th drop (last)
					turn (left) S ⊥ to streamers
					starting gradual decent
					3800-3000m constant after gradual decent.
					Suited up
					turb started once we hit cells
					liquid water present. 3000m
					~4000 tops = bright red = turb
					ice/water content went up 1g/m3
					2 1000ft descent
					big fluffy Shav
					precip water lower on cells w/ less turbulence
					convection @ coastline d over due to winds
1:30Z					landed

Flight 5 - Nov 12, 2007 11:45Z-16:11Z

STAR persons onboard: John Hanesiak, Kent Moore, Ron Stewart



Mission Scientist's Log

Flight No B...5..... Date ..12/12/07.. Name ..Hanesiak..... Page ..2.. of ..3.....

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
1335					wind @ Pang 120/15kts w/ -5
1336				65.64 -68.31	- old top lower (~3.5km) but more
					cumulus-like with cellular structures
					in radar as well → took photos of old radar
1340				65.48 -68.24	- turning toward Pang
1340:42					- drop #4
1342:30					- can see surface! get video from plane
					↳ thin stratus deck below
1347				65.73 -67.3	- precip at sfc again with higher old tops (~4km)
1351:41					- drop #5 in Cumb Sound → no LLJ
13:59:42					- drop #6 → wind failed but recovered
					- precip throughout entire Sound
1400					- old tops ~ 4-4.5km
					- not much upslope precip along Pang
					winds too parallel to coast
1415:30					- beginning old mirco phys. run + spiral dive to Pang
		16.3kft			- old top @ 16.3kft over Pang
1420:30		8kft			- south bound @ low lvl
1432				65.91 -65.74	- turb only for 1-2 min
					- not as much precip as there was before
					on South bound leg on east coast
1436:35		6kft			- back into precip but not due to alt. change
1438-1441		6kft			- turb wind 220/6m/s
1442					- turn upslope dir / wind 235/9m/s

Mission Scientist's Log

Flight No B..5..... Date Nov 12/07 Name Haneseth Page 3 of 3

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
1503					turb at coast low towards middle of Sound
1508		2.2kft			may have gone into trough line or leading edge
					wind now ~180/10m/s
					- turb outside trough line
1519:20		2.2kft		65.78 -66.55	- wind 180-185 @ 13 m/s
					- no icing at all
1524					- Pang wx -5/BS
1526:40		climbing			- headed back to YFB
					- ~~descending~~
1534					- cld top ~3.0km on west coast of
					Cumberland Sound on ~~descent~~ ascent
					wind 200/15m/s
1537				65.27 -67.5	- ~~clear~~ mostly clear skies w/ some Sc below
1544-		terrain alt ~700-900m			- sporadic low lvl cloud/precip
					- wind 250/16m/s @ 16kft
1547		terrain ~1km → incr		part to YFB	- heavier continuous precip btwn 1-2km ASL
1552:30				64.64 -68.25	- wind 255/20 m/s (terrain top)
					- heavier precip continues (1-2km ASL)
		9.5-9.6kft			- a/c measured cld top ~~and~~ turb! (Sc)
1606					- some ice/mod @ 8kft
1602					- weaker precip on lower terrain
1604					- multiple layer clouds in YFB - not much snow below now on YFB approach
1611					- touch down at YFB

cld top ~ 2.0km 3.2 top layer

Mission Scientist's Log

Flight No **B**..... Date Nov12..... Name Moore..... Page 1 of 3

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
11:40					take off.
11:48		4KFt			moderate turbulence
11:44		5KFL			in cloud
11:51		8KFL			some liquid water/icing
12:02					↑ sonde
13:09					deeper cells
					perhaps associated
					with low?
13:35					wx @ pang
					ceiling @ 2000 ft-
					light snow, blowing snow
					on mtn 15 knots, 120
13:38					cellular convection on
					south side of
					Cumberland sound
13:34					turn towards pang
					drop sonde
13:43					clear sky can
					see river
13:53					clard over Cumberland
					sound deeper than
					cellular clouds over
					the land

Mission Scientist's Log

Flight No **B**..... Date Nov 12..... Name Moore..... Page 2 of 3

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
14:00					sonde over pang
					winds failed
14:05					turn north of Pang
					no evidence of
					upslope precip !!
14:18					spiral over pang
14:25		8.3Kft			moderate turbulence
					over pang
14:35		6.9Kft			moderate. turbulence
14:41		6 Kft			northbound leg
14:48					trying to find
					upslope precip
					climbs to 8Kft.
					moderate turbulence
14:50					Complete NB leg
					no evidence of
					upslope
					clear sky near
					turnaround point
					see photo @14:48

Mission Scientist's Log

Flight No **B**..... Date Nov 12 Name Moore Page 3 of 3

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
15:01		5Kft			moderate turbulence
					better upslope
					on leg into center
					of Bay
15:06					turn for northbound
					leg up Cumberland
					Sound
15:09		2Kft			can see sea
					surface
					~~pang wx~~
15:11		2.2Kft			moderate turbulence
					back in cloud
15:16		2.2Kft			moderate turbulence
					pang wx
					light snow
					blowing snow
15:33					mod turbulence
15:26					Finish leg climb
					for return to
					YFB

phone # 867-979-1291

Ed Hudson 780-951-8878
780-435-8586
16kft ~ +1.6K
3.5K? 0.8K

Mission Scientist's Log

Flight No **B**.......... Date Nov 17/07 Name RS .... Page .... of ....

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
Local 6:45					
		all "good" sondes			
					18 sondes left (today) = 11+5 → (16)
excellent case		63.0	front	12kft	south of front (dropsondes)
		62.5		10kft	
		62.8	front	7kft	
up/down polarization	*	61.5	—	Semi-melted layer	T>0°C !! inversion
		61.0	front 3kft		
		60.5			N — South of sfc warm front
		60.0			Cold air near surface - South of sfc warm front
9+5=14 land @ 14UTC				Not Kugjuk today	
land ≡ 16 UTC					
	1340				
1630	1648		13 stations		
9:30 AM	No!	do the coast!!			flow & coast
		vert. profile 970mb low?			

Nov 17 - warm front (Run 5)

1/3

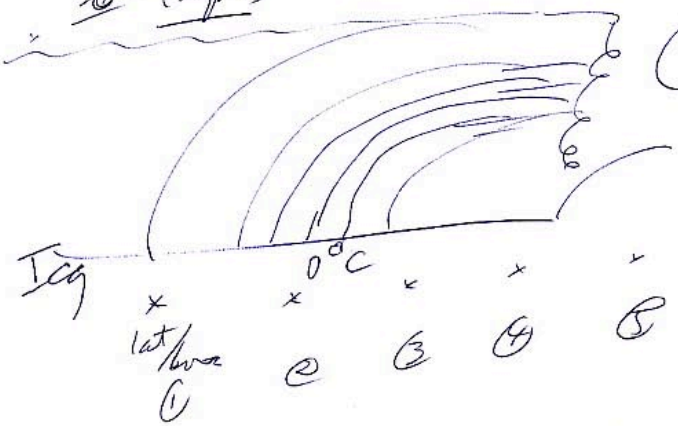
① Pang - Photos ? aircraft in Arr ?

②

5-8 soundings

38K (highest)

3h flight ?



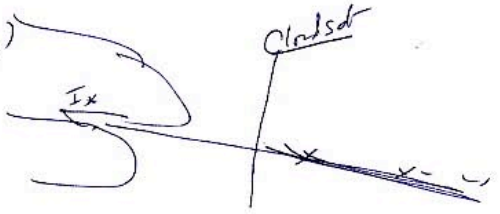
③ along CloudSat (0709 UTC)

- does snow start @ Igaluit by 0709 UTC
- of virga over ocean + land ! ⇒ Reykjavik

④ 4h. mission
- what is the latest for departure ?

⑤ Photos!
here - photos here & Pang!
- esp. especially around CloudSat passe times

⑥ Soundings
Pang: 08 UTC (flight rep.)
12 UTC



200 mi/h.

2/3

High = 2°C (07C)

ZR < 4000 feet

go out now!

→ deep cloud now comes 07UTC clouds

12UTC 7AM

05-06 local

06UTC cloud

① ZR pkt to the SE of Iqaluit

Biggest event ≈ noon

② afternoon – T > 0°C

– Pang

– Pang Ice cap

icing ≈ 06UTC

– 5AM launch ⇒ Goose as destination

– front X-section

Clouds at pass

12UTC

06UTC

Coral Harbour not an alternate

Knight 70°

Flight 6 - Nov 17, 2007 1145Z-1320Z

STAR persons onboard: Will Henson, Ron Stewart

Mission Scientist's Log

Flight No B...6..... Date 17 Nov..... Name W.H..... Page 1.... of 2.....

GMT	Run / Profile	(RET) Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
1145Z					WHEELS UP
		UP TO 16	~135 130		
					16kft @ 11:59
					STEADY @ 16.4k, 140-145
1209					DROP 1
		UP TO 20			(63)/59.5 -67/52.6
					62? 66?
1222					DROP 2
					62/30.0 -65/53.0
					20k @
1227					STEADY @ 19.9 145-147
1230		20k	150		
1235					DROP 3
					62/0.1 -64/53.3
1247		20k	168		DROP 4
					61/30.1 -64/1.6
1259		20k	169		DROP 5
					61/0.0 -63/43.9
1316					DROP 6
		20	168		60/28.4 -63/26.8

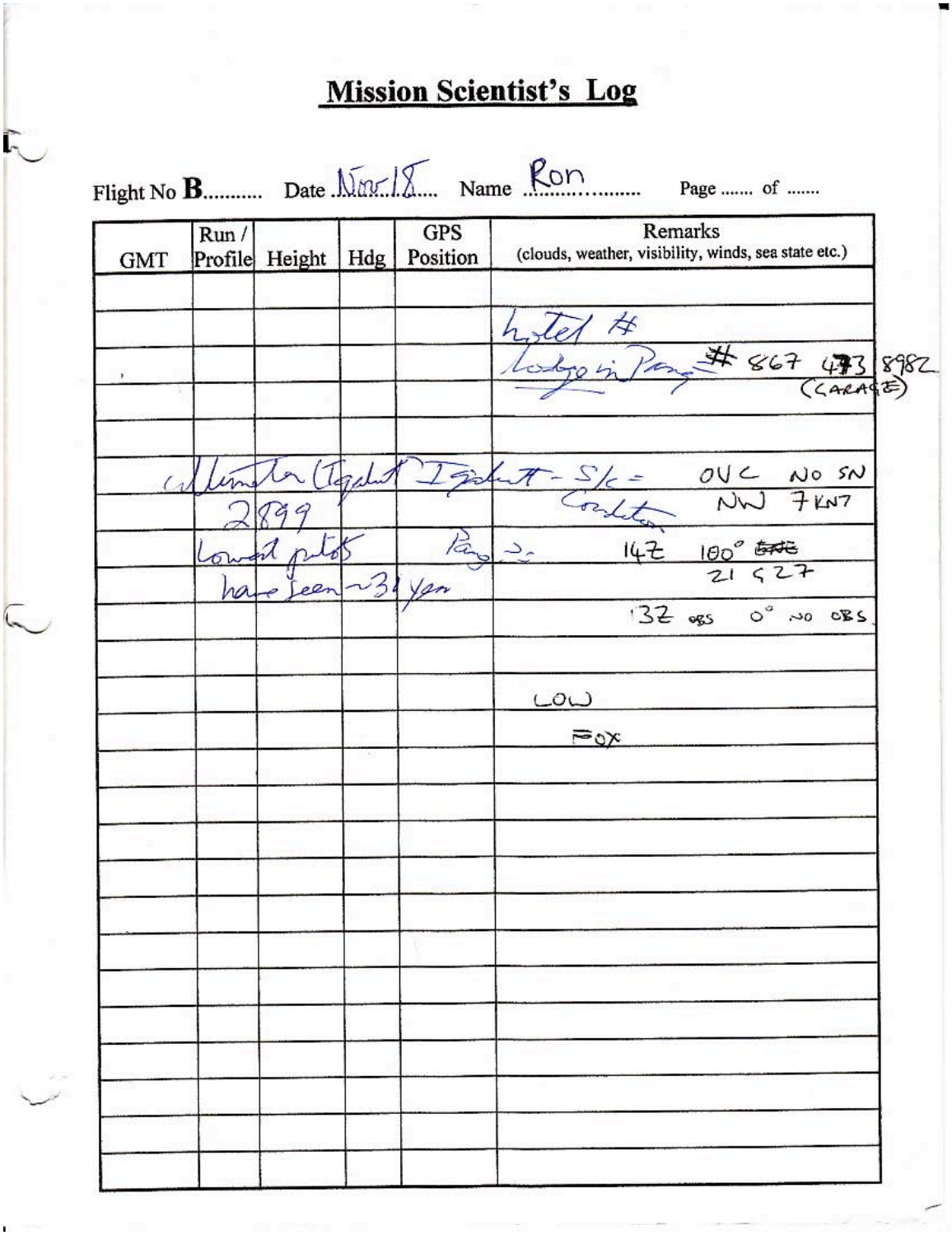
Mission Scientist's Log

Flight No **B** 6 Date 17 Nov Name WH Page 2 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
					Drop 7
~1320		30	166		60/ 0.1 -63/ 13.1

Flight 7- Nov 18, 2007 1300Z-1530Z

STAR persons onboard: Will Henson, Ron Stewart



Mission Scientist's Log

Flight No **B**..... Date Nov 18..... Name Ron..... Page ..... of .....

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
					hytel #
					lodge in Pang # 867 473 8982 (GARAGE)
					Alternate Flight Flight - S/C = OVC NO SN
	2899				Condition NW 7 KNT
	lowest pitot			Pang	14Z 100° ~~BAE~~
	have been ~3 yrs				21 ≤ 27
					13Z OBS 0° NO OBS
					LOW
					FOX

Flight 8 - Nov 18, 2007 1632Z-2200Z

STAR persons onboard: Will Henson, Ron Stewart

Mission Scientist's Log

Flight No **B** 8 Date 18 Nov Name WH Page 1 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
1632					WHEELS UP
1643		~16k7			63°57.5 / -69° 53.0
~1700					PICTURES BY RS, MOHAMMED
1720					1ST WAY POINT
1732					CLOUDSAT
					65° 7.6 / -75° 15.2
1753		20k			PROF 1 @ 66° 15' 971 mb @ SURF
1754					PHOTOS BY RON
1801					DROP 2 @ 66° 45 968 mb @ SURF
					-76 52.8
1810					DROP 3 @ 67° 15 966 mb @ SURF
					-77° 27.7
1819					DROP 4 @ 67° 45
					-78° 4.1
~1815					RS PICS OF LOW CLOUD
~~1820~~		~1645			2 WP POINT 965.4 @ SURF
		Rain heard in pilot's area			
1822-3					PICS BY RS
1833					DROP 5 @ 65° 30.5
					-79 3 972 @ SURF
1838					975 mb @ HALL B.

Mission Scientist's Log

Flight No B.8..... Date 18 Nov Name WH Page 2 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
1901					2000 RADALT
1909					" "
1914					2040
1919					2010
1922					2400
1924					RS PICS OF CLOUD DECK
1930					2510
1932					RS PICS OF LOW - NO CLOUD
1935	C				WINDS DIED OF
					+ RS PICS
1960					2515 G20
1945					2520
1950					2510
1955					2500
					↳ CLIMB TO 20K
1958/9					RS PIC OF MOON

Flight 9 - Nov 20, 2007 1538Z-1903Z

STAR persons onboard: Will Henson, Shannon Fargey, Shunli Zhang

Mission Scientist's Log

NOTE LAT/LON IN DEC DEGREES

Flight No **B**.9..... Date 20 Nov..... Name WH..... Page 1 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
1528					WHEELS UP
					TO POINT ① S OF Ice
					CLOUDS TOPS ONLY Ice @ ~~25000~~ 55000ft
					BASS @ 43000ft
1545					~22 kft
~~1600~~	1555				REACH PT 1
					LOW CLOUD ~ 1500~
					BY RADAR *
1608					HIGH CLOUD REACHED
					LOW CLOUD DIMINISHES
					~ 62° LAT, -69°½ 30' LON
					~60° LAT HIGH CLOUD THICKENS
1707					DROP DOWN TO 15 ~~21~~ kft
~~1~~ 1721					TURN @ 58.84
					~15 kft -67.36
1743					TURN SOUTH TO 18 kft
					59.92 -68.5

* NOTE OFF SOT

Mission Scientist's Log

Flight No **B** 9 Date 20 NOV Name WH Page 1 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
1802					TURN NORTH
					~59.25 , -67.71
1815					TURN SOUTH SPIRAL DOWN
					TO MIN ALT 2300 box
					59.97 -68.18
					2000 RAD ALT.
1824					LEVEL @ MIN ALT
1849					TO KUUJJUAQ
					CLIMBING TO 6 kft
1903					DOWN

cloudsat time of overpass 17:18

Mission Scientist's Log

* Noticed my clock before cloudsat pass was 2 min slow from pilots. corrected after that

Flight No B.....9(1)..... Date Nov. 20 2009 Name Shannon Fergey..... Page 1 of 3

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
15:25	[redacted]	32 m	1	YFB airport	take-off
15:30	—				~ 3500 Top, base 4300ft cloud above during take-off
					- cloud stretches as far as pilots can see.
					• just to north of satellite pass point originally planned - (Paul informed will)
15:40				63° 14.6 -69° 32.8	-189.6 Dewpoint ~ 6600 m noticed that dewpoint does not warm at
15:48				62° 57.9 -69° 37.8	photo (left side) window. cold temps. can see topography on the edge of cloud
15:52				63° 47.1 -70° 9.7	* joined last track line, heading south.
					can see topography to the east, edge of low level clouds (photo @ 15:53)
15:58					• topography is the southern edge of Baffin. photos
16:01				62 23.7 -69° 51.4	can see Baffin. open water, photos - and clouds at multiple levels
16:06					transition zone between big low cloud to high cloud (1)
					• tops of high cloud estimated @ 21000 ft right side 25 ft
				62° 7.1 -69° 13.1	• Slopping transition zone for cloud heights (photo)
16:14				61° 51.2 -69° 26.9	photo (E)
16:23				61° 27 -69° 8.8	photo (E) twice
					mission plan: fly along cloudtop, head to ungava bay, pass back
					twice a different lower heights, to refuel Kuujjuaq
16:30				61° 2.3 -68° 51	skimming cloud tops along track ~ 6600m. particle measurements coming in
16:37	—				- still a little bit of cloud above us. photo (E)
16:45				60° 23 -68° 24	Paul (pilot) informs will that cloud thickness is reaching max at this point
16:48					• photo (E) can see different cloud layers again, no more particle data coming in
16:51					• another band of high level cloud in ~15 min. Probably thicker, higher than first wave, pilot noted. ... will approach cloud at this time.
16:59				59° 44.5 -67° 55	re-entering high level cloud (leading edge) particle data coming in, will be completely in in 1-2 min.

Mission Scientist's Log

Flight No **B** 9 Date Nov 20 Name Shannon Page 2 of 3

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
17:02					band up ahead, high level cloud will be to rear aft - reported by pilot
17:04		6600m 21 000ft		~~59°38.5~~ ~~-139°49.4~~	photo (E) break can see lower level clouds (photo)
17:05		6100m 20 000ft			descending 1000ft from 21000ft
					clouds broken, looks like can see ocean
17:07					between cloud levels, need to either descend or ascend to get initiated.
17:10					descending to 18000ft - between cloud levels!
17:13					descending 15-16000ft - descending to get into cloud crop
17:14					- we may not be included for cloudsat pass? (photo (E))
				approximate ~ 58°53 -63°26	
17:18		17000ft			cloudsat overpass!
17:20					clouds broken can see ocean & low level clouds
17:21		@ 5000m			reversing track @ 15000ft
17:~~25~~		15000			can see ice channels, wave movements a considerable amount of open water
17:~~27~~		15000			Inuvava Bay → no more open ocean, covered by low level clouds
17:30		just below 5000m			entering cloud. (photo N)
17:31					flight plan change: try to get composite in one area rather than spreading
					so instead of flying South, we will track this out back and forth,
17:~~36~~		15000 next			maybe at finer resolution (height scale) (more traverses back forth)
17:39					Walter + Will comment front looks wider
					than the first pass, upper cloud is gone.
17:43					notice full halo around sun
17:44					reversing track, ascending to 18000ft to sample cloud tops
17:45					approaching cloud tops, blue sky. (photo E)
17:47					skimming cloud tops, still some above through
17:49		5500m			photos point up from window to show
					wisps of cloud above us. still (E)

Mission Scientist's Log

Flight No **B**....9..... Date ..Nov.20/07 Name ....~~Jennifer~~ Shannon..... Page ..3.. of ..3.. (see back of page TOO -)

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
17:55				59°26.2 -69°47.5	radar showing that there is a band of clouds above us now, no longer
17:57					skimming cloud tops (pilot) out of cloud, level above still but not really sampling cell any more. lower level cloud below now invisible.
	from 18000ft.				photo (E)
18:01				59°11.2 -69°39.0	reversing track to 17000ft.
18:03					in cloud.
18:08					Sun halo. tried to take photo.
18:11					noticed cloud is weakening, going 100ft/min 170 knots to sample lower levels
18:13					descending spiral @ clouds "comes back to life" Wealth.
18:14				59°36.8 -68.8	~~begin~~ reached end point beginning spiral descent (right)
18:18					Paul noticed then there will be increased drag, may cause icing, will limit our height level we can fly to... storm we came from can see low level cloud and coast (photo)
18:20					
18:23					clear ocean view, heading to 1200ft
18:24					pilots note clouds dissipating (27000ft)
18:24					light turbulence
18:26					in cloud, ~~heavy~~
18:27		900m.			light turbulence. (photo E)
				59.45.9 -69.0	very fine particles of moisture reported by pilots
18:30					light turbulence, clear views through (photos)
18:35					~~Poor cloud~~ just went through section of liquid water content 1-2 min duration
18:37					wings clear of icing, turned props on thicker low level clouds, still bouncy out there, when you feel the ocean, can see waves breaking
18:38					decision to terminate this research flight & decide what to do for the next flight from Kelly Head
18:41					light turbulence.
18:43					photos (E)

more notes on back ...

18:49 - descending to 6000m approaching Kuujjuaq for landing
- in cloud
18:53 - in cloud.
18:55 - clouds thinning, can see some sea ice formation in bay.
19:12 - landing Kuujjuaq! ... trees!

3.45 min. flight time.

end flight.

Mission Scientist's Log

Flight No **B**..... Date Nov. 20, 2007 Name Shunli Zhang Page 1 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
PM 3:24	take off	31m		68.85W 62.74N	cloudy.
3:30		1651.0		68.80W 62.73N	above clouds
3:36		4000.		69.21W 63.46N	above clouds with flat top (~~all~~ floor)
3:42		5784.0		69.55W 63.92N	~~all~~ full of clouds
3:45		6135		69.71W 65.11N	above clouds (something is wrong with Humidity sensor?)
3:55		6079		70.15W 62.77N	above clouds
3:59		6125.8		70.00W 62.57N	Clouds (pilot says seeing some water)
4:10		6151.0		69.62W 62.07N	clouds, see water (more clouds on west)
4:16		6174.0		69.45W 61.85N	organised clouds on the west, see water, cirrus underneath.
4:20		6181.0		69.32W 61.67N	High clouds underneath
4:31		6251.7		68.83W, 61.45N	full of high clouds
4:39		6222.8		68.67W, 61.70N	High clouds
4:44		6239.0		68.50W 60.52N	High clouds
4:50		6247.9		68.30W 60.26N	more high clouds
4:57		6258.4		68.12W 59.96N	High clouds. (front of us)
5:03		6262.1		67.91W 59.65N	High clouds, (Pilot saying another band in
5:10		6045.9		67.71W 59.32N	between clouds high clouds are thin
5:11					lowing altitude down to 15,000 ft
5:22		4102.5		-67.34W 58.79N	Aircraft turning back, 50% of clouds
5:29		4750		67.60W 59.16N	between clouds.
5:36		4264		67.81W 59.62N	in the clouds. go up to 18,000ft
5:47		5162		68.04W 59.78N	in the clouds, seeing Sun
5:57		5556		67.73W 59.34N	between clouds, upper clouds are thin, can see Sun
6:01		4938.0		67.62W 59.17N	turning back lowing down to 18,000
6:05		423		67.76W 59.40N	in clouds

Mission Scientist's Log

Flight No **B**........... Date Nov 20, 2007 Name Shunli Zhang Page 2 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
PM 6:13		3412		68.10W 59.9N	in the clouds about to turn around
6:09		[illegible]944		68.18W 60N	[illegible]lowing down to [illegible] ft. fog
6:21		1000		68.22W 58.98N	cloudy
6:22		609		68.12W 57.96	in clouds
6:50		1355		67.44W 58.77N	between clouds upper clouds are thick
6:57		1701		67.83W 58.05N	in clouds
7:00		1402		68.04W 58.03N	seeing ~~[illegible]~~ snow on the Ground
7:12	Landing	22.8		68.42W 58.09N	~~[illegible]~~ we're in KUUJJUAQ
PM [illegible]:15	Take off				KUUJJUAQ, cloudy
8:30					cloudy

Mission Scientist's Log

Flight No **B**..10.... Date 20/11..... Name W.H..... Page ..1.. of ..1....

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
1825					WHEELS UP
					CLIMB TO 15 kft
					AND TO POINT ①
2041					MAKE POINT ①
					② 15 kft
2124					DESCENDING TO 5 kft (—IN ALT)
2132					5 kft (CORRECTED)
2149					POINT 2 → BACK TO IQALUIT
					~~WHEELS DOWN~~
2152					UP TO 7000 ft
					WHEELS DOWN

Flight from Kuujjuaq to YFB - traversing along cloudsat track from previous flight to view changes, then back to YFB

Mission Scientist's Log

Flight No **B** 9(2) Date Nov. 20/07 Name Shannon Fargey Page 1 of 1

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
20:15					CYVP - calm, low ceiling, to moderate visibility, light flurries
20:24					take off - YVP
20:27					low ceiling, ground visibility limited
20:33					light turbulence, in cloud particles collected
20:36					almost dark.
20:42		[illegible]		4900m	
20:45		←	←	15000 ft	NE towards Iqaluit, dark!
20:58					cruzing along @ 15000ft along
21:00					earlier flight track.
21:06					cloud tops appear higher along track than earlier flight traverse;
21:18					clear of cloud, speeding up to 280 knots
21:23		5350 ~~ft~~		•	descending to 5000ft or as low
		8700m			as possible for the rest of the flight, reduced speed to microphysic collection speed.
21:38					• Will & Walter noted that clouds below us had liquid tops but
					it would not be able to fly low enough to sample. This was
					near the waypoint where we started the cloudsat traverse on flight 9
21:45		5350ft			leaving cloudsat track to direct to YFB
21:52				180.240° 60 miles	climbing to ~~[illegible]~~ 7000ft
				from YFB	
22:16					land in YFB!
		flight time 2 hours			

Flight 10 - Nov 20, 2007 2015Z-2216Z

STAR persons onboard: Ron Stewart, Will Henson, Gabrielle Gascon

Mission Scientist's Log

WS: Comment - his radar has often indicated higher precip over even "low" terrain!

Flight No **B**..... Date Nov 22 Name RES Page 1 of .....

Local GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
		Mission - Cloudsat/ocean clouds with			
					some precipitation
altimeter working		29.85"		- fly	① below cld base (precip)
					② ascend @ end
					③ fly just near cld top
1101		T.O.		(15) 10 min apart	④ a few (2?) vertical profiles
1102		2400 ft	-	cloud	base
				Some	icing on screen
1102		3300	ft	cloud	top
1105				reading	photo out my window
1107				←	above clouds on the
					way to the descent point
					over the water
1135				Mengistu	taking a photo of the lower
				clouds	over the ocean (abrupt cloud edge (staircase -- very abrupt)
1136				I took a picture	of this out my window (engine in foreground)
1142				picture	- ground along shore is visible
				" "	- another picture mainly cloud
1148		2300'	-	min.	altitude over the water
1151		slight		onshore breeze	→ cloud higher here than ahead of us
1156		LWC	&	some ice	

1156 climb above cld until just before Cloudsat pass

Mission Scientist's Log

Flight No **B**..... Date ..... Name ..... Page ..... of .....

Local GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
	(preparing)				
1212		5.1 Kft		cloud top	
		3.1		ragged base	predicted cloud tops ~6 Kft
		3.8		solid base	
		4.8 Kft			
1215				cloud	thickening nearer the coast
1215				sign	precip (Some may be "snow grains")
	near coast -			mainly	precip clouds (Supercooled transition)
	- feather out			- less	precip →
1225	- head back	South		3500 feet	(in cloud)
1229		drop		conc < 100 cm^{-3} / $\bar{d} \approx 15\mu m$	
1240		out of		cloud	@ ~61°N
1241		Marquette		lake	pix of precip shafts
1242				I look	pic of precip shaft
1243		pilot		report virga ahead (any Marquette → take a pass)	
1243		min		altitude to the coast	
1248		2D-C		mostly covered in ice	
1258		finished		last run → head home!	
1309		picture		of glory	
1331		drama		ends!!	(amazing!
1339		360°/4		vis ½ mile min	1400 ft alt 29.85
1343		land!			

Nov 22/07 RES.

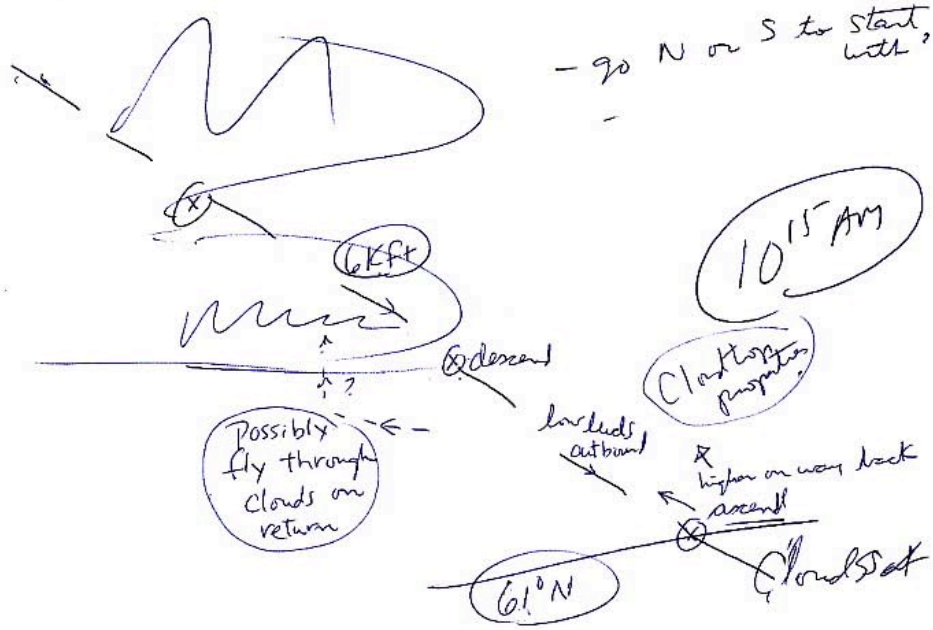
1240 UTC

Cloud base ht ~ 2800 ft

out
- min flight level ~~out~~ over terrain
- descend to ~~low~~ over ocean (→ min level.
- come back over water until need to climb at higher level (chosen from radar)

1707 ~1700] done
- (unless ... wipe) ...
- spiral in it ...

doors closed. 1530 =



Mission Scientist's Log

Flight No **B**..... Date 22 mar.... Name Gabrielle..... Page 1 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
1610	Have to double check time				Takeoff in jump seat
1620					Can see a glory
1633					Can see mountains from near, glory still there
1650					Descent; glory is gone
1653					At our lowest
1654					Decide to return above cloud base and wait for satellite to make sure the probes avoid ice
1700					Descent back → set up for cloudsat
1705					Cloudsat pass;
1706					Go up more above cloud base
					↳ Finally not, we are making a U-turn at low-level
~~1708~~					
1708					Finally, we are deciding to porpoising between here and the coast, ascent to be ready
1711					Descent
1713					~~Constant alt below 1000 ft~~ Go up
1716					Descent
1719					Go up
1720					Descent
1722					Go up ~~and turn around~~
1725					Turn around again and fly in cloud 3500 ft
~~1739~~					
1736					Turn around, we are still at 3500 feet
1739					Say there is a bit of icing on the wings
					Start to descend

jump time

Mission Scientist's Log

Flight No **B**..... Date 22 nov. Name Gabrielle..... Page 2 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
1741					Back at our lowest again
1742					There is still a bit of icing on one of the probes
1741-1746; 1748-1757					It's a bit bumpy (1 one has stopped working)
					More turbulence during the first interval, but it's not really turbulent
1757					Go up to 5000 feet
					We plan on staying at that height
					for almost the rest of the run
1758					We now see the sun again, we are on a (wavy track)
1801					Just the probe, the one that had stopped working
1822					A tiny bit of turbulence

Flight 11 - Nov 22, 2007 1611Z-1843Z

STAR persons onboard: Will Henson, Shannon Fargey, Robyn Dyck

Flight No **B**..... Date Nov. 23/07 Name Robyn Page 1 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
1615					take off
		~~19,000~~			~~radiometer passes different~~
1618		20,000 ft			Glory - (took pictures) / halo
					edge of ~~cirrus~~ altostratus cloud
					shield very defined, thick,
					tops all sheared (looked almost
					like upside down manatus
		6000 ~~ft~~ m			variable cloud previs, rugged
~~1650~~					looking tops (water content)
1650		6 km			2dc started detecting particles
					could not see them - looked like frost
					on window (pict)
				difference	btwn 2DC & 3DC?
					2DP
1710		6K			defined ~~bounded~~ banded cloud (pict)
					hit ~~top~~ thin cirrus = multi layered cloud
					approaching Hudson Straight.
1730		4K			descending
34-45		(hit ground)			1st / 3 drops: ~~wispy~~ wispy
					cloud - really low visibility
1750					cloud sat pass on radar
~~1751~~					turned around, ~~over~~ decre to 5K
1754					2nd drop hit ground
1805					turbulence right after spiral
				down	(turn & descend to 2K)

Flight No **B**..... Date Nov 23/67 Name Robyn Page 2 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
1815					turbulence due to boundary
					of cu, with liquid water.
1820					climbing / turning to head back
					↳ 21 000 ft → turned on
					Probe that starts on fire.

Flight No **B**..11.... Date ..Nov.23.2007 Name ..Shannon Fergey... Page ..1.. of ..2

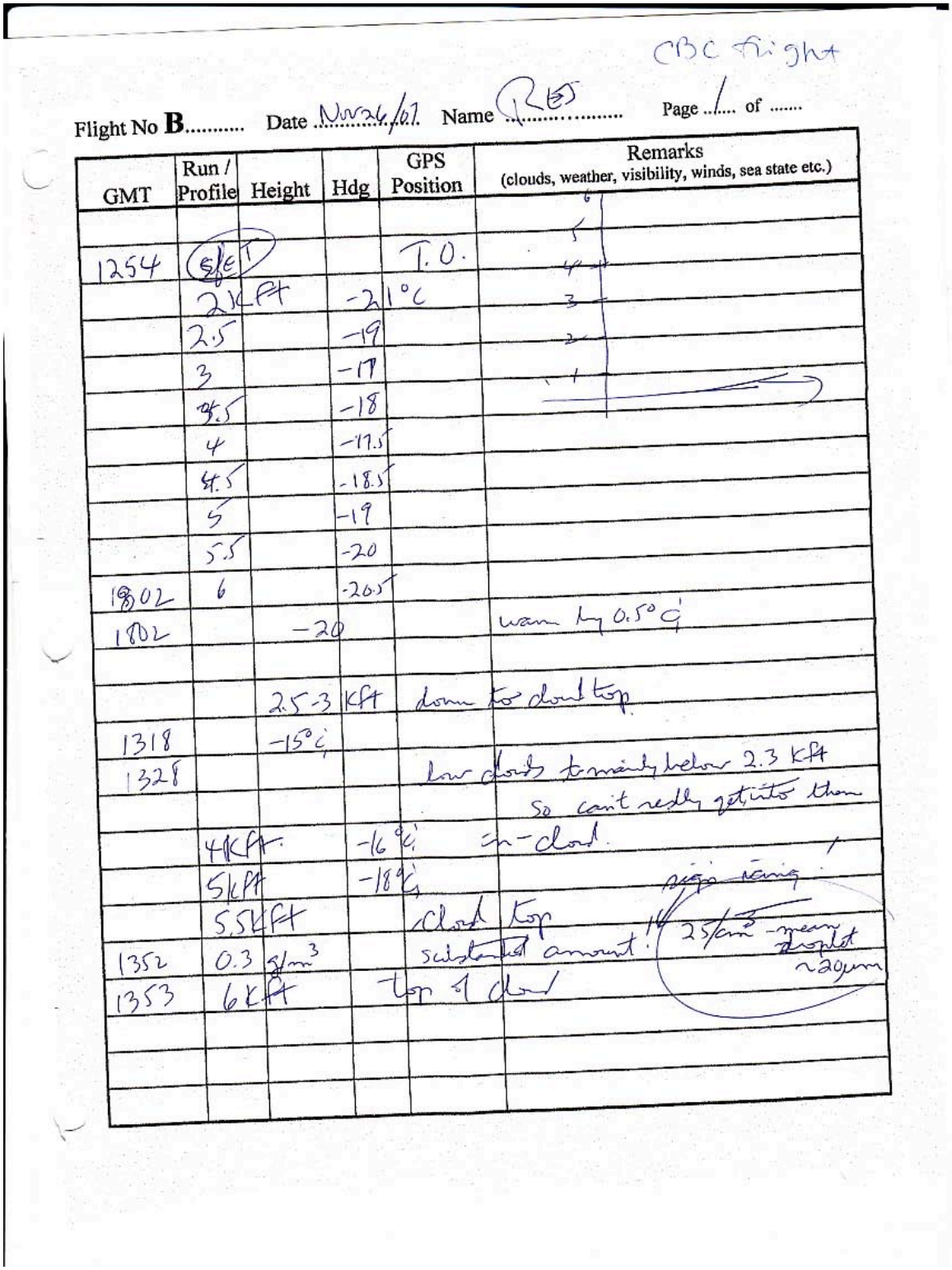
GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
16:04		32m		YFB	blowing snow on runway.
16:13					take-off.
16:15					broke through cloud @ ~ 5000 mean-ft
					very thin level cloud, some
16:25		20000ft			broken areas where you can see topography, some sparse upper level
16:27		20040ft			clouds. can see glory on broken pixels window(N)
16:49					report ice crystals upper deck.
17:00					can see sparse mid level cloud over
17:08					lower cloud wits. still broken in areas photo (N)
17:12					pilots observe 3 layers of cloud - could see topography through cloud breaks
					research plan - descend to 10000ft for first
17:15					time. upper level cloud (near our flying height
17:17					is very thin at times, very transparent
					sea ice, broken clouds
17:28		12000ft			research speeds (turn onto flight track
17:32					descending to 10500ft.
17:34					passing through light cloud layer
17:37		10500ft			photo (swish) - passing through may cause turbulence
17:37					drop sonde #1
17:39					photo (swish)
17:41					pilots report clusting on spinner.
17:43					photo (swish)
17:43					drop sonde #1 hit sea-ice - still transmitting
17:48					drop sonde #2
17:51					cloud-free pass!

Flight No **B**...11..... Date Nov. 23, 2007 Name S.F..... Page 2 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
17:52					turning back down traverse @ 5000ft
17:53					2nd drop sonde hit sea ice - still transmitting
18:04					turning northbound @ 2500ft
18:06	18:08				light turbulence.
18:14		2300 ft ~~2500ft~~			enter boundary low level cumulus - light turbulence
18:15					Liquid water reported in cloud by 2 pilots
18:18	18:20				moderate turbulence - constant
18:20					climbing ... 2000ft plan to fly back to YFB now
19:50					photo (sourmish)
19:12					roll with wings, so much fun!!!
19:22					bit of ice
19:42					landing @ YFB

Flight 12 - Nov 23, 2007 1614Z-1942Z

STAR persons onboard: Ron Stewart, Heather Greene



CBC flight

Flight No **B**..... Date Nov 24/07 Name RS Page 1 of .....

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
					6 5 4 3 2 1
1254	S/C T			T.O.	
	2 KFt		-21°C		
	2.5		-19		
	3		-17		
	3.5		-18		
	4		-17.5		
	4.5		-18.5		
	5		-19		
	5.5		-20		
1802	6		-20.5		
1802		-20			warm by 0.5°C
		2.5-3	Kft		down to cloud top
1318		-15°C			
1328					Low clouds to mainly below 2.3 kft
					so can't really get into them
	4KFt		-16°C		in-cloud
	5KFt		-18°C		
	5.5KFt			Cloud top	
1352	0.3 g/m³			scistated amount	25/cm³ - mean droplet ~20μm
1353	6KFt			top of cloud	

Flight No **B**..... Date ..... Name REG Page 2 of .....

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
1358	-19°C	very little			ice in the cloud
1449	land				
		1.5 hr min			

CBC Flight

Flight No **B**..... Date Mar26 Name HG Page 1 of .....

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
18 15		3000			
18:20		2300		62 44.5N 66 W	descending to cloud cumulus, stratocumulus (or just above cloud)
18:30		4000			Ascend to highest level cloud, turbulence, light showers
18:35		4900			~~Stratus~~, end of the bay, snow column crystals
		5200 to 3400			Climb to top of cloud & back down through it
18:38					180° turn to do cross sect of the bay
18:42		4300			transect through cloud @ constant elevation
18:47		3400 to 6000			descend turn around & porpise through cloud during transect
					3400 no cloud
					4600 cloud
		5500		~~2000~~	LWC (Ran on radio)
		~~6000~~			Top of cloud
		3500			CB
18:55 ?		2300			Descend & then rise again
		5100			Top of cloud
19:05		8000			stumble drop sonde heading NW

Flight 13 - Nov 26, 2007 1754Z-1949Z

No Flight notes

Flight 14 - Nov 28, 2007 1500Z-1823Z

STAR persons onboard: Shannon Fargey, Robyn Dyck, Gabrielle Gascon, Heather Greene

Flight No **B**...~~14~~... Date Nov. 28.. Name Shannon Forgey Page 1 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
15:00		32 m			take off YFB - light flurries, overcast low ceiling, low visibility.
15:02					ascent - pilots report ice on nose cone
					- entering cloud.
15:03		7700ft	~ 2000m		- pilots report cloud tops
					* precip in Iqaluit may have been upslope, S winds up topography,
15:15					· cloud tops appear to be consistent at 8000ft, some broken areas where
					you can see topography
15:26					· clouds over cumberland sound. (wsidc)
15:30-45					· clear over mountain range.
15:55					#1 drop sonde. - over mountains,
16:00					drop sonde hit topography
16:03					turning SE onto cloudsat track
					· plan #1 point (mid) to #3 south point back up to #2
16:14					#2 drop sonde - over ocean
16:16					descending to 12000ft @ 66 23 -61 0.9
16:20					· cloud tops variable, and dissipating and the
↓					*plan proceed for 5min turn early
					and will be back heading north on the cloudsat track at overpass time.
16:23					turning around heading north on the
					cloudsat pass time. @ 66 44 -60 39 along
16:26					#3 drop sonde - southern point track.
16:26					descending to 6000ft
16:28					turbulence, in cloud now, level with cloudsat track
16:29					· snow + icing, pilots report in and out of wispy tops reported by Wanda
16:29					#3 drop sonde hit ground

Flight No **B**...14.... Date ...Nov..29..... Name ..... Page ...2... of ...2...

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
16:30		2000 ft.		66.12.5 -60.50.5	CloudSat Pass
16:35					orbit turn to N 9000ft back along track south.
16:48				-	right spiral down TO 2000ft
16:48				-	light turbulence.
16:49				-	Walter reports liquid drops in cloud.
				-	beautiful dendrites as we go along
16:51					... turbulence continues ...
16:52			along shore→		~40 knot (NE) wind. No winds really prior to this point → Paul reports.
					· Still beautiful crystals
16:55					· pilots warn turbulence for next 8 min (it was light.
17:01					right spiral up to 8000ft (a bit before turnaround spot
17:08		8000ft			#4 drop, N part of track
17:11					#4 drop sonde hit water.
17:14				→	entering edge of cloud we tracked towards the land, away from the CloudSat track
					· winds variable, upslope. ~20 knots
					· orographic cloud ~ observe for about 6 min and then return to YFB.
18:07					· descending to YFB, i.
18:08					in cloud - turbulence.
18:23					landing @ YFB

Flight No **B**..... Date Nov 28 Name Robyn..... Page 1 of 3

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
157				▶	takeoff
				▶	ow cloud (stratocu)
					thin-ish layer
* 1525				▶	looked @ radiometer=
					brightness warmth,
					@ sfc looking up, 100k
					in air 280K
				▶	winds SE @ ~5-10KNTS
					@ 483mb @ coast switched to
					SW ~W, once over
					Cumberland, cloud started
					to dissipate, could see ice.
					more alto cu.
35				▶	over Penny Ice cap
					AMAZING!!
42					thin altocirrus formes
					over cap, whispy (almost fog)
					rugged & higher terrain
		4000m			& whispy clouds reflected
					in radar → 4000m
					just SE of Pang, heading @ Ikiktarjuaq
50				▶	South track looks better
					(cloud build up according to Paul)
				▶	cloud bases below peaks
					(peaks coming out of cloud).
55					1st drop
58	66.36 lat 62.26 long				grnd speed 200 ~~turning South @ point~~ call to Edm 25miles frm turn

INITIAL PLAN

(Northeast)

[1] Flight to tip of Cumberland Sound then fly either North/south ~~to catch~~ @ higher levels to drop a sonde then fly either north/south @ low levels to catch Cloud Sat, then back to YFB light LL winds, ~~in~~ should be upslope

[2] depending on sat pict, do cross-sections of Frobisher Bay to get sample of precip & cloud moving in frm south. No cloud sat, as a Low moves in.

— cont frm pg 1 — 2/3 —

heading 65.21 N
16Z 60 W

16Z

1st drop hit ground (must be high terrain)

1605

1610

turn

radars give intense return

we are @ 6000m, after plateau in terrain

V. strong returns due to forcing over ridges ~2000m, towards Qik, X band was showing additional peaks in signal

Radar: ~~[illegible]~~, cloud was solid right to ground, due to high peaks then broke up.

1615

drop #2

drop to 12,000 ft for cloud sat.

~ 20

cloud tops @ 10,000

down to 10,000

Flight No **B**..... Date Nov. 28.. Name Robyn..... Page 3 of 3

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
1628		10000 ft			drop # 3 in clouds
					-17 warm
1630		10000			~~Saw the~~ pass cloud sat pass, in cloud. saw it on w band (flash)
35		10000			wind had sharp change from ~~SW~~ to W E SE, could be ice edge
35		6000			on radiometer 100min Sharp spike to 600K?
45		2000			spiral decent
					8000 ft min (6000peaks)
					looking @ thicker cloud being blown into shore like what the Sat shot showed.
1648					liquid, very nice crystals dendrites
1702					right spiral to 8000 ft. for drop.
1710					4th drop, hit ground @ 13
					In cloud
		8500			

Flight No **B**..... #1 Date 28 mar 2007 Name Gabrielle..... Page 1 of .....

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
1458					Take-off
1503					7900 feet. Cloud top (icing rate encountering cloud)
Passed the Arctic Circle					19000 feet → cruising altitude
1615					Go down to 12000 feet
					↳ now 8000 feet
1623					Turn around to be in thicker part
					during CloudSat pass
					↳ now 6000 feet
					because the clouds seem to be thinner
1625					Entering clouds + 2nd drop
1626					6000 feet
1630					CloudSat pass
1635					Climb to be able to be 500 feet
					below cloud top → ~8000 feet
1645					Go down to 2000 feet in spirals
1649					Bit of turbulence ↳ 2500 feet → Wind turbulence
1702					Spirals up to 8000 feet
1809					at 8450 feet
1821					Landing

Goal of the flights: Validate CloudSat
Microphysics properties of clouds
4 dropsondes

Flight 15 - Nov 28, 2007 2003Z-2123Z

STAR persons onboard: Shannon Fargey, Gabrielle Gascon, Shunli Zhang, Heather Greene

* remote sensing validation flight. start in YFB area

Flight No B...~~B~~15 Date ...Nov.28.... Name ...SE..... Page ...1... of ..2..

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
20:03		32m.			take-off YFB - winds calm
20:07		6000ft			right turn.
20:09				•	climbing to 10000ft to sample
					liquad tops of clouds.
20:10		8000ft	170	•	above 8000 we are out of cloud.
					15 kmiles - BILKU, EMKEL from YFB
					then porpoise up/down 3 times left of we turn around - middle porpoise @ YFB airport
20:20					turn right to BILKU. ~~start of track~~ heading to EMKEL
20:21					descent
20:21		7500			in cloud
20:22		6000			cloud bottom, ascending ↑
20:23		7400			through tops
		8000			descent
20:25		7500			in cloud
:27		6100			base cloud, starting ascent
29		7700			cloud top
:30		6000			in cloud, ascending
		7760			cloud top
:32		8000			reached EMKEL - turning around. heading to BILKU
:33					in descent
:34		7450			in cloud. * liquad water is 0.1
:35		6000			going up! - very light turbulence.
:37		7400			out of cloud
:38		7600			descent - in cloud,
:39		6020			climb
:40		7440			cloud tops

Flight No **B**...~~15~~ 15 Date ..NOV.28 Name ..~~SH~~..... Page 2 of 2

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
:41		8000			descent (7300 - in cloud)
:42		6900			- light turbulence
42:30					- started ascent
43		7700			reached Bilku - right turn towards EMICEL.
46		5000	347		descent
:48		6000			ascent.
:49		7300			cloud top
:50		7400			descent (7440 - cloud top)
:52		6100			ascent (7400 cloud top @ 20:53)
:54		7380	351		descent, cloud top height
55		6100			starting climb to 10000ft
56		7400			approaching EMICEL cloud tops
57					turning plane around to right. *can see stars now.
20:59					# drop sonde - 3 miles from EMICEL
21:01					descending. light turbulence
21:02		6000			ascent
03		7500			cloud top) #1: drop hit ground
04.					very light turbulence
06		6200			climb!
07		8000			leveling
09		6000	2_		descending to 6000ft
11		6000	330		
20					snowing lightly as we approach runway
23					landing @ YFB

Flight No **B**..... Date Nov 28 #2 Name Heather Page 1 of 1 BKV Mixed

GMT	Run / Profile	(ft) Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
20:05					Takeoff
20:12		8000			Reach cloud top
20:21		-			start 1st descent (porpoise)
		7500			cloud top
20:23		6000			cloud base, start ascent
		7400			cloud top
		8000			start descent over airport
20:26		6000			CB, start ascent again
20:28		8000			descent
					winds 8-10 knots
20:31		6000			ascent
20:33		8000			turn around & do same track
					over again over airport.
					& porpase again b/w 6-8000 ft. & again
					LWC 0.1
20:56		10000			spiral up turn around
21:00		10,000			Dropsonde heading SE
					turn around
21:22					land

Flight No **B**..... Date #2 23 mars 2007 Name Gabrielle..... Page ...1... of .....

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
2003					Take off
2022					First descend → Cloud top 7500 feet } ①
2023					Go up
2025					Go down } ②
2027					Go up
2028					Go down } ③
2030					Go up
2031					turn around
2035					Go down } ④
2036					Go up
2038					Go down } ⑤
2040					Go up
2041					Go down } ⑥
2043					Go up
2045					Turn around
2047					Go down } ⑦
2049					Go up
2051					Go down } ⑧
2052					Go up
2054					Go down } ⑨
2056					Go up this time up to 10000 feets for the dropsonde
2100					Dropsonde
2100					Go down (from 10000) } 10
2103					Go up

Goal of the flights: Remote sensing validation
for radar, radiometer, sodar and GPS at Iqaluit
Since those instruments measure vertical profiles of the atmosphere, we are doing ups and downs (porpoising) all between 6000 and 8000 feet

Location: Around Iqaluit

#2

Flight No **B**..... Date 23 MAY 2017 Name Gabrielle..... Page 2 of .....

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
2105					Go down 2 11
2106					Going around done
2109					Turn around done, prepare for real approach
2122					Landing

Flight No **B**..... Date Nov. 28, 2007 Name Shunli Zhang Page 1 of 1

GMT	Run / Profile	Height	Hdg	GPS Position	Remarks (clouds, weather, visibility, winds, sea state etc.)
8:03PM	Take off	29.0m		68.53W 63.75N	overcast
8:10		1883		68.59W 63.76N	bumping.
8:14		2203.7m		68.72W 63.86N	over clouds, pretty sunset.
8:20		2182.4m		68.01W 63.6N	over clouds, (decent in 30s)
8:22		2190m		68.00W 63.57N	decending to 1700 m in clouds
8:30		1830		68.82W 63.98N	bumping
8:31		2167		69.00W 63.93N	turning around, ~~[illegible]~~
8:35		2029.5		68.93W 63.92N	over clouds
8:36		1650		68.78W 63.86N	in clouds
8:37		2097		68.73W 63.83N	over clouds
					dropsonde 1