Technical Report

Southeast Greenland Glaciers 2016

for

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1. EXECUTIVE SUMMARY

Sander Geophysics Limited (SGL) conducted a high resolution gravimetric survey over a number of glaciers in the southeastern part of Greenland for Eric Rignot, Chancellor Professor of Earth System Science at the University of California Irvine (UCI) and a Senior Research Scientist at NASA's Jet Propulsion Laboratory (JPL). Gravity data was acquired using SGL's airborne gravity system, Airborne Inertially Referenced Gravimeter (AIRGrav). Please refer to *Appendix I* for a Company Profile of SGL.

The survey was flown using a locally operated AS350-B3 Helicopter, registration C-FHCH rented from Heli-Greenland. Production flights commenced on the 27th of July, 2016 and data acquisition was completed on the 9th of August, 2016. A total of 8 (9001 and 1001 to 1007) flights were flown during the survey to complete 5445 line kilometres. Two additional flights were attempted (1008 and 1009) but poor weather prevented the acquisition of any data on these flights. Survey operations were conducted from Narsarsuaq Airport (BGBW) & Kulusuk Airport (BGKK), Greenland.

The survey was broken down into ten small blocks ranging from as far south as Narsarsuaq to just north of Sujunikajik. The flight line direction varied depending on the orientation of the glacier and the surrounding terrain, and all lines are spaced at 1,000 m. The survey was planned taking into account the terrain and the performance of the aircraft at the modelled altitudes and estimated temperature, and was flown with a target clearance of 80 m above ground level. The target average ground speed was 70 knots.

2. INTRODUCTION

This report describes the survey that Sander Geophysics Limited (SGL) flew for Eric Rignot of UCI and JPL in July and August of 2016 in southeastern Greenland.

Gravimetric (AIRGrav) data were gathered during this survey. The instruments used to collect the data are described in this report as well as the tests performed to ensure optimal data quality.

Picture 1: Typical scenery found in the survey area in sourtheastern Greenland

The Field Operations section contains all information relating to operations at the survey location including the airport used, reference station coordinates and any problems encountered during the survey. Field crew members are listed.

The Digital Data Compilation section details all processing performed from data acquisition to final product creation.

Picture 2: Local seabirds in southeastern Greenland

The following Project Brief gives a quick reference of the details of the survey.

Project Brief

Survey Title	Southeast Greenland Glaciers 2016
Client:	Eric Rignot, UCI and JPL
Survey Location:	Southeastern Greenland
Survey Start Date:	July 27, 2016
Survey End Date:	August 9, 2016
Contact:	Eric Rignot (Eric.J.Rignot@jpl.nasa.gov)
Technical Inspector:	Eric Rignot (Eric.J.Rignot@jpl.nasa.gov)
Field Office Location:	Narsarsuaq & Kulusuk, Greenland
Airport Used:	Narsarsuaq Airport (BGBW) & Kulusuk Airport (BGKK)
Aircraft Type:	AS350-B3 Helicopter
Total line kilometres:	5445
Survey Flying Particulars	
Block 1 Ikertivaq Glacier	
Line numbers:	1001 to 1015
Line direction:	northeast-southwest
Line spacing:	1,000 m
Block 2 Koge Bugt Glacier	
Line numbers:	2001 to 2027
Line direction:	northeast-southwest
Line spacing:	1,000 m
Block 3 Glaulv & Gyldenlove Fjord Glaciers	
Line numbers:	3001 to 3013
Line direction:	North/south
Line spacing:	1,000 m
Block 4 Bernstorff Gletscher Glacier	
Line numbers:	4001-4014
Line direction:	northeast-southwest
Line spacing:	1,000 m
Block 5 Skinfaxe & Rimfaxe Glaciers	
Set 1	
Line numbers:	5001, 5011, 5021, 5031, 5041, 5301, 5311, 5321, 5331, 5341, 5501, 5511, 5521, 5531, 5541
Line direction:	Variable
Line spacing:	1,000 m
Set 2	
Line numbers:	501 to 505 and 551 to 556
Line direction:	Variable
Line spacing:	1,000 m
Block 6 Tingmiarmiut Fjord & Mogens Heinesen Glaciers	
Line numbers:	6101 to 6105; 6201 to 6206; 6301 to 6314; 6401 to 6407
Line direction:	Variable
Line spacing:	1,000 m
Block 7 Puisortoq Glacier	
Line numbers:	7001 to 7019
Line direction:	North-northeast/South-southwest
Line spacing:	1,000 m
Block 8 Anorituup Kangerlua Glacier	
Line numbers:	8001 to 8018
Line direction:	North-northeast/South-southwest
Line spacing:	1,000 m

Block 9 Qajuuttap Sermia Glacier	
Line numbers:	9001, 9011, 9021, 9031, 9041, 9051, 9061, 9071, 9081, 9091, 9101, 9111, 9121, 9131
Line direction:	East-northeast/West-southwest
Line spacing:	1,000 m
Block 10 Eqalorutsit Killiit Sermiat Glacier	
Line numbers:	9521, 9531, 9541, 9551, 9561, 9571, 9581, 9591, 9601, 9611, 9621, 9631, 9641, 9651, 9661, 9671, 9681, 9691
Line direction:	Northwest/southeast
Line spacing:	1,000 m
Survey Altitude:	Radar guidance with target height of 80 m above ground.
Digital Terrain Source:	SRTM
Number of Flights (numbers):	8 (9001 and 1001 to 1007)
Aircraft Target Ground Speed	70 knots
Data	
Gravity Accuracy:	
Gravity Ties:	Narsarsuaq, Greenland (gravity point reference value) and Kulusuk, Greenland (calculated in 2012 during previous icefields project)
Survey Base Gravity Value:	981921.78 mGal at centre of gravimeter when aircraft parked at its designated parking area in Narsarsuaq. 982333.00 mGal at centre of gravimeter when aircraft parked at its designated parking area in Kulusuk.
Survey Base Parking Location (WGS-84):	Narsarsuaq: W45:24:59.60 N61:09:44.03 71.07 m (location of gravimeter centre, 1.2 m above the ground.) Kulusuk: W37:07:58.75 N65:34:25.55 86.70 m (location of gravimeter centre, 1.2 m above the ground
Base Station Locations (WGS-84)	GND1: W45.42073777 N61.15758160 60.427m GND2: W37.14916006 N65.57930809 68.269m GND3: W37.14916838 N65.57930659 68.271m
Delivery Datum:	WGS-84
Projection:	EPSG 3413

3. SURVEY AREA

The survey area compromises ten seperate blocks flown over glaciers in southeast Greenland. This is a remote region with only a handful of small towns in the vicinity of mountains in the survey area itself. The terrain is extremely rugged over most of the area, varying from sea level in some of the fjords to approximately 3000 m above Mean Sea Level (MSL) at the high peaks. The terrain mainly consists of barren, rocky coastline and glacial ice. The weather in the region was cold and humid, with temperatures averaging between 0-15°C during the survey period. Morning fog and thick cloud cover were not uncommon.

Picture 3: Local scenery in sourtheastern Greenland

Picture 4: View of the town of Kulusuk from the survey aircraft

Survey Area Map

The survey was flown in ten distinct blocks. *Figures 1* and *2* show the geographical location of the survey areas and the planned survey lines. The planned survey lines are listed in *Appendix II*. The flown lines are listed in *Appendix III*.

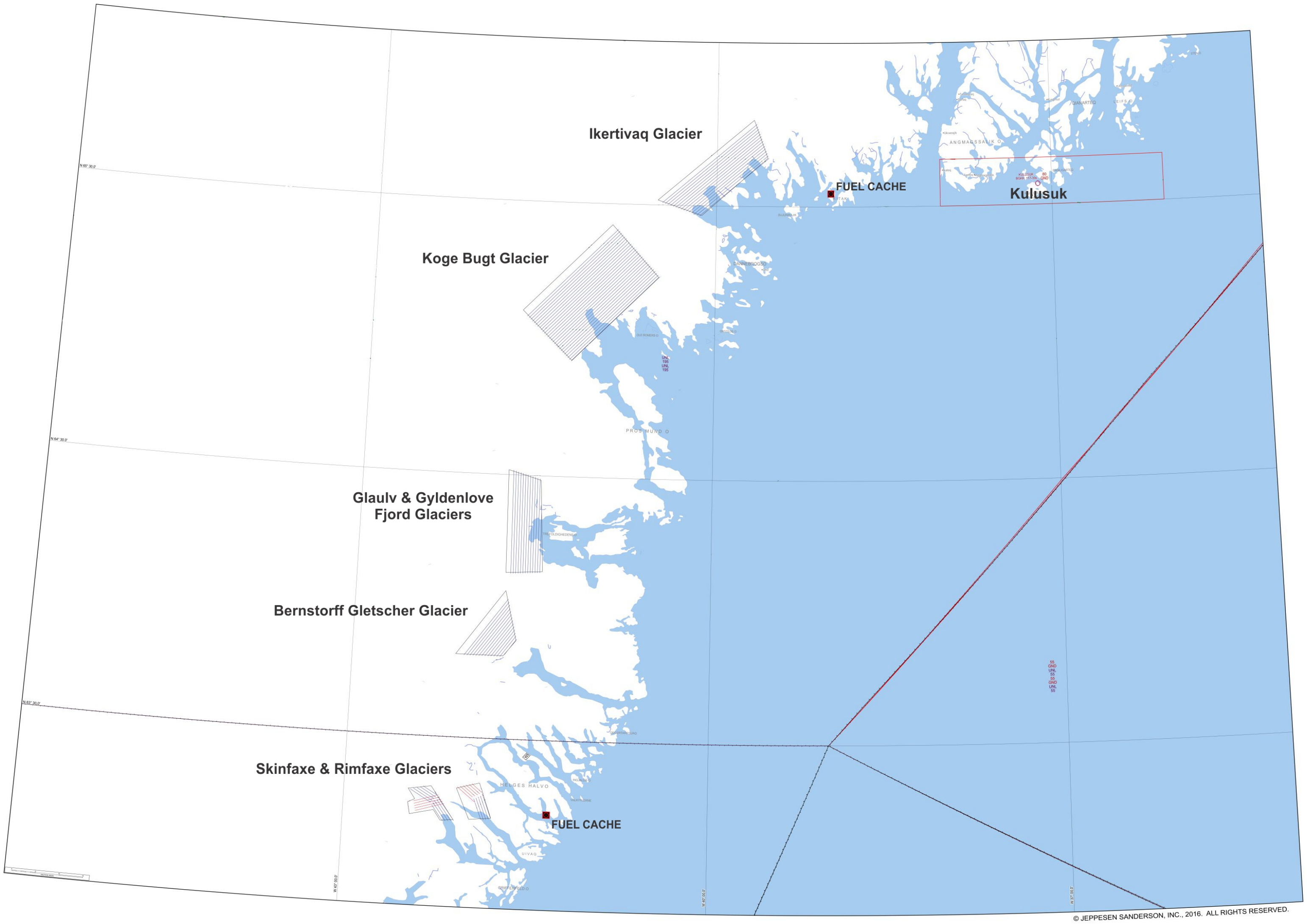


Figure 1: Survey Area and Flight Lines, Blocks one to five

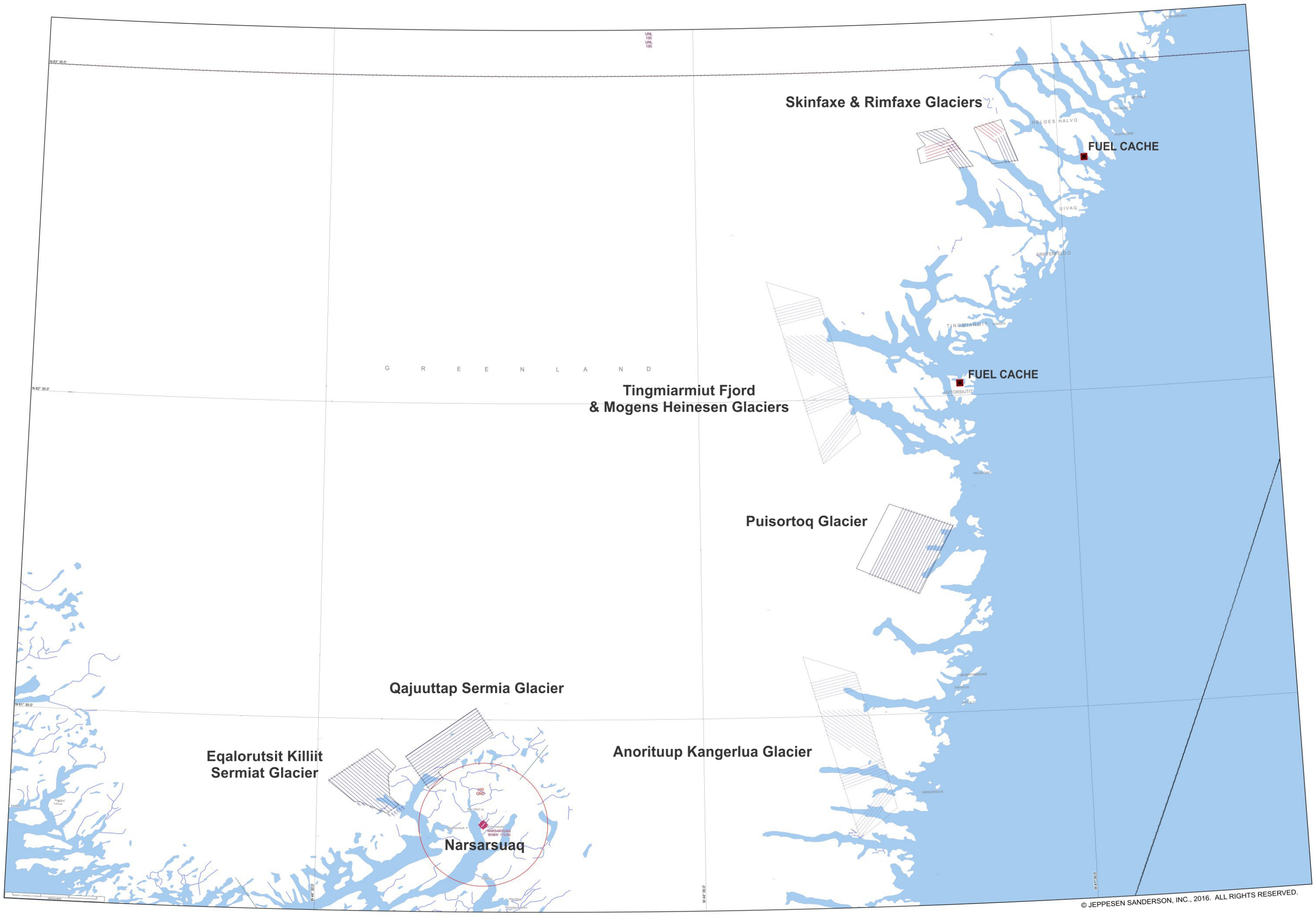


Figure 2: Survey Area and Flight Lines, Blocks five to ten

Survey Boundary

The blocks are bounded by the coordinates provided in *Tables 1* to *10.*

Table 1: Survey Boundary – Block 1 Ikertivaq Glacier (datum WGS-84)

Longitude	Latitude
-39.66918870536646	65.81990062579472
-40.52368347517752	65.51830736145402
-40.13024322585190	65.46392070563718
-39.54473761724174	65.67941635404091

Table 2: Survey Boundary – Block 2 Koge Bugt Glacier (datum WGS-84)

Longitude	Latitude
-40.92029864332289	65.42183993390221
-41.68651703563251	65.09387738506317
-41.24479676506076	64.91410856555869
-40.50168577111665	65.23092683550703

Table 3: Survey Boundary – Block 3 Glaulv & Gyldenlove Glaciers (datum WGS-84)

Longitude	Latitude
-41.46997260025135	64.46488854666771
-41.75013904157838	64.49951260112159
-41.73945955215370	64.11774455403634
-41.43000594546520	64.12634347860474

Table 4: Survey Boundary – Block 4 Bernstorff Gletscher Glacier (datum WGS-84)

Longitude	Latitude
-41.73243304524185	64.05080378811640
-42.13190802804242	63.80872880679006
-41.73323477947420	63.80882065908494
-41.63031059402708	63.86685171564574

Table 5: Survey Boundary – Block 5 Skinfaxe & Rimfaxe Glaciers (datum WGS-84)

Longitude	Latitude
-41.83541870275268	63.29087192035234
-42.00703080797326	63.28757940165831
-41.95495717969223	63.23136293652891
-42.13620670789951	63.22782763620708
-42.21504942226978	63.29055445087533
-42.36777486062753	63.28795585358443
-42.28281093091231	63.1966456565803
-41.77904291336102	63.2043544926392
-41.83541870275268	63.29087192035234

Table 6: Survey Boundary – Block 6 Tingmiarmiut Fjord & Mogens Heinesen Glaciers (datum WGS-84)

Longitude	Latitude
-43.52792441024648	62.85423365883484
-43.17215290665116	62.28476210147823
-42.91873560803997	62.37663610566639
-43.17336046254967	62.79940727143936

Table 7: Survey Boundary – Block 7 Puisortoq Glacier (datum WGS-84)

Longitude	Latitude
-42.74542375669085	62.15367645198346
-42.97681234467214	61.95656123230464
-42.56482562967195	61.87259282448472
-42.32787657609342	62.07873685544245

Table 8: Survey Boundary – Block 8 Anorituup Kangerlua Glacier (datum WGS-84)

Longitude	Latitude
-43.31277254110855	61.79290566989184
-43.43516191599556	61.54542183006910
-43.10799937391850	61.50378137017280
-43.01028119349428	61.64227791279493
-43.04551993635893	61.75838767078663

Table 9: Survey Boundary – Block 9 Qajuuttap Sermia Glacier (datum WGS-84)

Longitude	Latitude
-45.86777728278502	61.35464649377502
-45.78790748846008	61.30901343714569
-45.52681107678463	61.40267335811544
-45.61665579684211	61.45456404278472
-45.86777728278502	61.35464649377502

Table 10: Survey Boundary – Block 10 Eqalorutsit Killiit Sermiat Glacier (datum WGS-84)

Longitude	Latitude
-46.12872802516228	61.22650751847498
-46.01917131314080	61.25763655029792
-46.04818154080718	61.31529030992027
-46.24538669934765	61.25512649268341
-46.12872802516228	61.22650751847498

4. SURVEY SPECIFICATIONS

Data Recording

In the aircraft:

- GPS positional data (time, latitude, longitude, altitude and raw range from each satellite being tracked) 10 readings per second (10 Hz);
- Terrain clearance as measured by the laser rangefinder at 3.3 readings per second (3.3 Hz);
- Gravimeter data recorded at 128 readings per second (128 Hz);

At the base GPS reference stations:

- GPS positional data (time, latitude, longitude, and raw range from each satellite being tracked) at 10 readings per second (10 Hz).

Technical Specifications

The following technical specifications were adhered to:

- Target ground clearance of 80 m
- Target average flying speed of 70 knots.

Flight Line Specifications

The survey flight lines were designed to capture the gravity signature of the bedrock below the glaciers. The flight line direction varied depending on the orientation of the glacier and the surrounding terrain. Due to the irregular shape of the survey area and the roughness of the terrain, the line directions vary. Line directions were carefully chosen to avoid steep terrain gradients, maximize glacier coverage, and to maintain uniform ground clearances as much as possible. The traverse line spacing and direction in *Table 2* represents the spacing and direction of the majority of the lines in the block. The line direction is with respect to the UTM zone 23N reference frame.

Table 11: Flight Lines Specification

Block	Traverse Line Spacing (m)	Traverse Line Direction
1	1,000	Northeast-Southwest
2	1,000	Northeast-Southwest
3	1.000	North/South
4	1.000	Northeast-Southwest
5	1.000	Variable
6	1.000	Variable
7	1.000	North-Northeast/South-Southwest
8	1.000	North-Northeast/South-Southwest
9	1.000	East-Northeast/West-Southwest
10	1.000	Northwest/Southeast

Terrain Clearance

Due to the lack of accurate digital terrain models for this area because of the changing ice elevation, a pre-planned drape surface was not deemed appropriate. Pilots employed real-time laser altimeter data for height guidance at a terrain clearance of 80 m.

Picture 5: Iceberg near the survey area in southeastern Greenland.

5. SURVEY EQUIPMENT

SGL provided the following instrumentation for this survey; see *Appendix IV* for further details:

Airborne Navigation and Data Acquisition System

Sander Geophysics Data Acquisition System (SGDAS)

The SGDAS is the latest version of airborne navigation and data acquisition computers developed by SGL. It is the data gathering core for all the different types of survey data. The computer incorporates an altimeter analog to digital converter and a NovAtel GPS multi-frequency receiver (see the GNSS and GPS Receivers section below for the details) which automatically provides the UTC time base for the recorded data. The system acquires the different data streams from the sensors and receives and processes GPS signals from the GPS antenna. Navigation information from the navigation side of the computer guides the pilots along the pre-planned flight path in all three dimensions. Profiles of the incoming data are displayed in real-time to the pilots for continuous monitoring. The data are recorded in database format on redundant solid-state data storage modules. The AIRGrav system incorporates an additional data acquisition system; Gravity DAS (GDAC). The GDAC controls the AIRGrav system records the data collected, and includes a separate user interface.

Airborne Gravity System

Sander Geophysics AIRGrav

SGL's AIRGrav (Airborne Inertially Referenced Gravimeter) uses a Schuler tuned inertial platform. This platform supports three orthogonal accelerometers, which remain fixed in inertial space, independent of the manoeuvres of the aircraft, allowing precise correction of the effects of the movement of the aircraft. Accelerometer data are recorded at 128 Hz and later down sampled to 2 Hz in processing. The gravity sensor used in AIRGrav is a very accurate accelerometer with a wide dynamic range. The system is not affected by the strong vertical motions of the aircraft, allowing the final gravity data to be almost completely unaffected by aircraft dynamics up to what is considered "moderate" turbulence. The instrument is also rendered as an inertial navigator, and as such the platform levelling is essentially unaffected by horizontal accelerations. Gravity data are consistently acquired with a noise level of less than 0.2 mGal with a half sine wave ground resolution of 1.8 to 2 km, given adequate line spacing.

Reference Station Acquisition System

Sander Geophysics SGRef

The SGRef reference (ground) station is a dual reference station. One half consists of a data acquisition computer with a cesium magnetometer interface and frequency counter to process the signal from the magnetometer sensor and from the GNSS/GPS receiver (see the GNSS and GPS Receivers section below for the details). The other half contains only a GNSS/GPS receiver. These two halves operate independently of each other. The time base (UTC) of both the ground and airborne systems is automatically provided by the GNSS/GPS receiver, ensuring proper merging of both data sets. All data are displayed on an LCD flat panel monitor. The magnetic data, sampled at 11 Hz and the GNSS/GPS data, sampled at 10 Hz, are recorded on solid state data storage modules. The entire reference data acquisition system was set for automatic, unattended recording. The noise level of the reference station magnetometer is less than 0.1 nT.

Reference Station and Airborne Acquisition System GPS Receivers

NovAtel OEM4 receiver boards

The OEM4 is a high performance, high accuracy, dual-frequency GPS receiver that is capable of receiving and tracking the L1 C/A code, L1 and L2 carrier phase, and L2 P-code (or encrypted Y-code) of up to 24 GPS satellites. The GPS data are recorded at 10 Hz. The OEM4 receiver was employed in the reference station (SGRef).

NovAtel OEMV-3 receiver board

The NovAtel OEMV-3, multi-frequency GNSS (Global Navigation Satellite System) receiver is configurable up to 72 channels with the tracking of GPS (L1, L2, L5), GLONASS (L1, L2), SBAS, and L-band satellites and signals. It provides averaged position and raw range information of all satellites in view. GNSS positional data are recorded at 10 Hz. This type of receiver was employed in the airborne SGDAS system.

Novatel DL-4

The GPS reference stations use a Novatel DL-4 integrated GPS receiver and data logger which records onto compact flash cards. The NovAtel Millennium, 12-channel GPS Satellites, 12-Channel GLONASS Satellites, 2-Channel SBAS, 1-Channel L-Band multi-frequency receiver forms an integral part of the DL-4 system. It provides averaged position and raw range information of all satellites in view, sampled every 0.1 s. The comparative navigation data supplied during all production flights allows for post-processed differential GPS (DGPS) corrections for every survey flight. This type of receiver was employed as backup to the reference station in Kulusuk.

Picture 6: GPS antennas on the roof in Kulusuk

Altimeters

SGLas-P - Riegl LD90-31K-HiP Laser Rangefinder

The Riegl laser altimeter uses a single optical laser beam to measure distance to the ground. It is effective over water and is eye safe. This profilometer has a range of 1,500 m, a resolution of 0.01 m with an accuracy of 5 cm and a 3.3 Hz data rate.

Survey Aircraft

Eurocopter AS350 B3 (C-FHCH)

Picture 7: Preparing for take-off

The AS350 B3's are a modern high performance light helicopter powered by Turbomeca Arriel turboshaft engines. These engines have an unrivalled safety record. The helicopter's endurance is between two and four hours depending on the survey. The helicopter, owned by HeliCarrier and contracted by HeliGreenland, was outfitted with SGL's low level airborne geophysical survey instruments. A survey GPS antenna was mounted on the tail fin, clear of the rotor. The gravimeter and the survey computers were installed in the rear cabin of the aircraft. A monitor was installed above the flight instruments dashboard allowing the pilot in command to use the SGL guidance display and the navigator to operate the navigation system and ensure the acquisition system was operating under optimum parameters. The B3's reliable and powerful turbine engine, long endurance and high altitude capability make it an excellent survey aircraft. All survey modifications are certified to meet the requirements of the Canadian Aviation Regulations (CARs). A complete description of all survey aircraft is given in *Appendix V*.

Data Processing Hardware and Software

Compilation of the data was performed on high performance desktop and laptop computers optimized for data processing tasks. SGL's proprietary geophysical software was used for data processing.

6. SYSTEM TESTS

Gravity System Tests

Gravimeter Calibration

Calibrations are performed on the gravimeter's accelerometers. The design of the platform is such that the sensor can be "tumbled" in the gravity field at a calibrated point to set the scale factor and offset. The gravimeter was calibrated at the survey base at the survey start, and then on a weekly basis to re-determine the accelerometer scale factors (which vary slightly with time) by rotating the platform through 180 degrees to measure ±1 g. The method for establishing the local gravity value used in calibrations at each survey location is given below.

On start-up before each flight, the AIRGrav system automatically aligns its platform. Before and after each flight, the consistency of the measured gravity was confirmed by recording data at a fixed location on the ground. The results, presented in *Figure 3*, are given as deviations from the local gravity value at the base of operation. The pre- and post-flight static values are used to help level the final data set (see the Line Adjustments and Gridding section of the gravity data processing) and to verify the operation of the system.

Kulusuk

The gravimeter was calibrated using a value determined from a previous survey which operated out of Kulusuk in 2012 using a Eurocopter AS-355 F2 aircraft. During that survey, the gravimeter was calibrated using a gravity tie from Kangerlussuaq calculated from the average of four BGI gravity reference stations (050201, 050202, 050204 and 050205) determined to be 982369.58 mGal, which when adjusted to the height of the gravimeter in the helicopter yielded a value of 982369.15 mGal. The helicopter was flown in operational mode to Kulusuk where the local gravity value was determined to be 982332.92 mGal. All flights from Kulusuk were referenced to this value.

Narsarsuaq

The local gravity value was determined from the Narsarsuaq Hangar gravity point established by René Forsberg of the Technical University of Denmark. The gravity value was determined to be 981921.778 mGal. All flights from Narsarsuaq were referenced to this value.

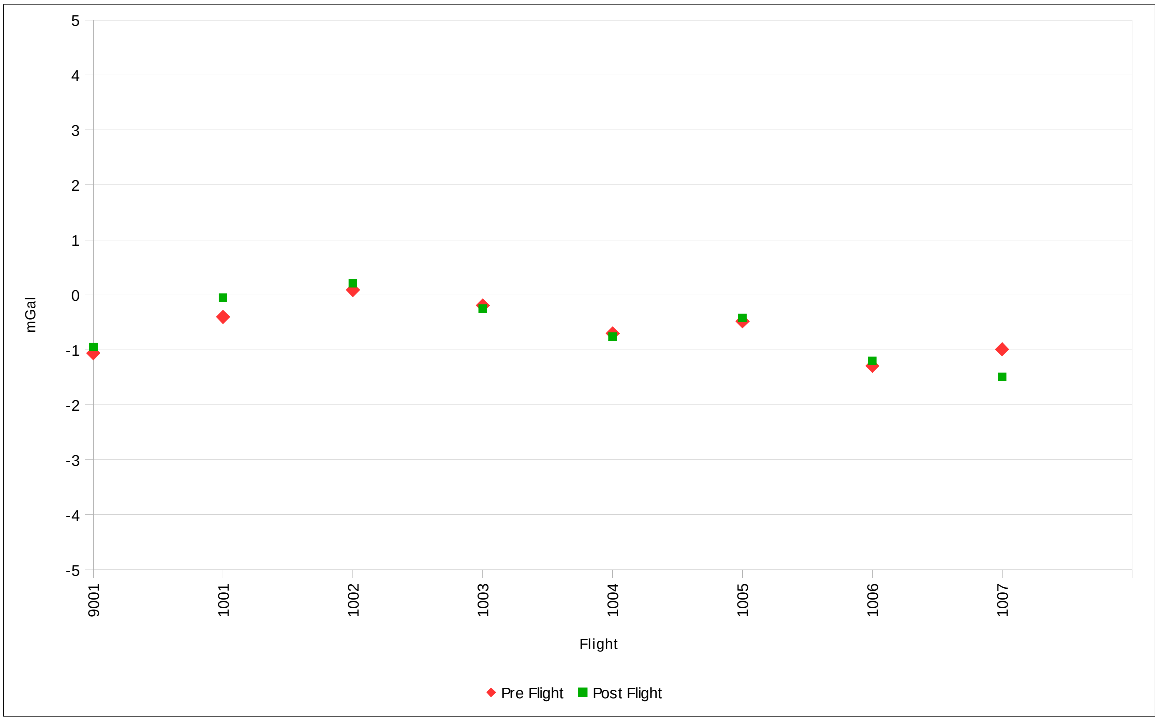


Figure 3: Pre and post flight ground gravity static measurements with respect to the local gravity value

Altimeter System, Position And Digital Terrain Model Tests

Laser Altimeter Calibration

A test flight to calibrate the laser altimeter was flown on the 31st of July, 2016 over the runway at Kangerlussuaq Airport. Five passes were conducted over the runway at heights from 50 to 700 m above ground at various levels. The altimeter values were compared to the post-flight differentially corrected GPS altitude information for calibration. An ideal altimeter would yield a slope of 1 and an intercept of 0. The laser altimeter slope was 0.9884 and the intercept 3.3397 m. These results are well within the expected accuracy of the altimeter. Please refer to *Figure 4* which illustrates the results of the altimeter test.

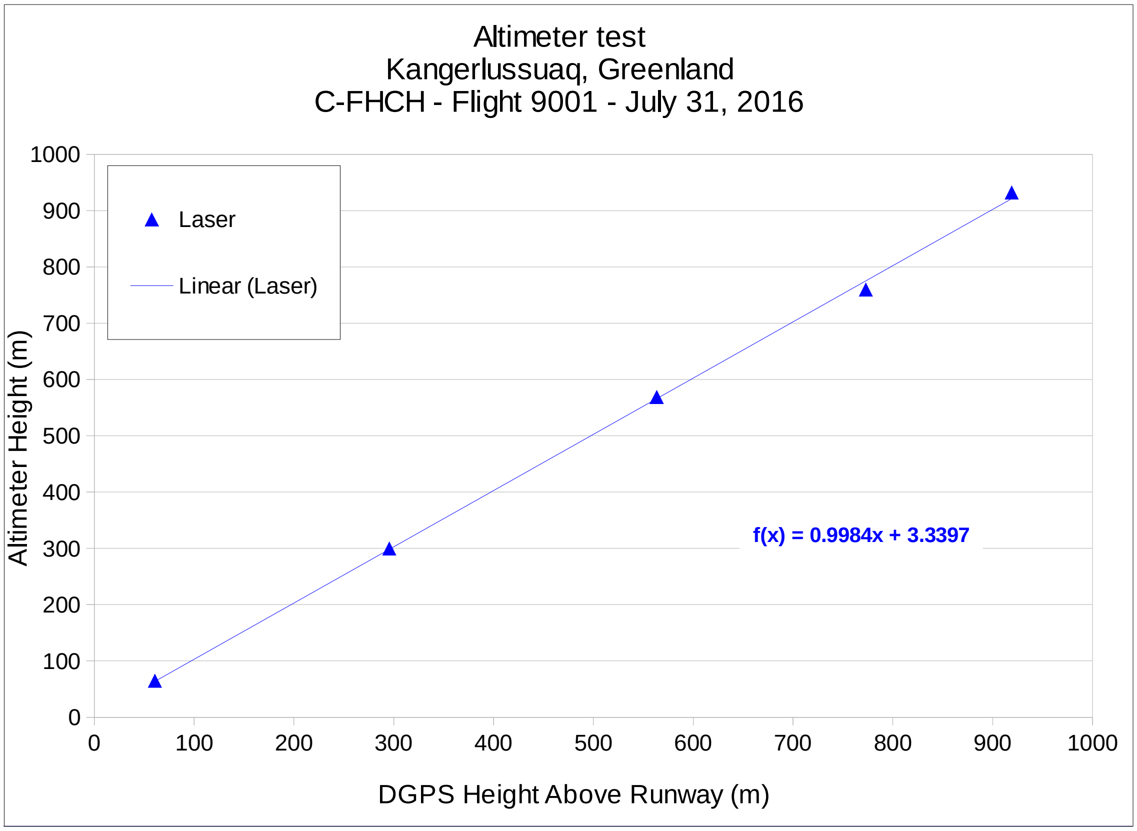


Figure 4: Altimeter test

7. FIELD OPERATIONS

The survey helicopter registration C-FHCH was provided by Hélicoptère Hélicarrier Inc. under a sub-contract with HeliGreenland, arranged by Eric Rignot of UCI and JPL. Mobilization of the SGL crew and equipment to Greenland began with the arrival of the field crew chief and the technician in Kangerlussuaq, western Greenland on the 27th of July 2016. The aircraft, C-FHCH, arrived on 29th July and installation of SGL's survey equipment took place on the 29th and 30th of July 2016. A radar altimeter test was carried out over the Kangerlussuaq Airport runway on the 31st of July. The helicopter ferried from Kangerlussuaq to Narsarsuaq on the 1st of August. The field office and the first GPS reference station was set up in the Narsarsuaq Hotel on 29th of July. Operations were conducted from Narsarsuaq Airport (BGBW), Narsarsuaq, Greenland for flights 1001 to 1005. Operations were moved during flight 1005 on the 5th of August and the rest of the operations were conducted from Kulusuk Airport (BGKK), Kulusuk, Greenland for flights 1006 to 1009. Due to weather restrictions, the last two flights (1008 and 1009) were unsuccessful in attaining any production. A total of 7 production flights were flown, from the 2nd of August to the 7th of August, 2016.

Picture 8: The survey helicopter landing in Narsarsuaq

Narsarsuaq Airport features one main concrete runway of 6,000 ft. When not flying survey, the helicopter was parked in front of the Narsarsuaq Airport hangar (the former Danish Meteorological Institute hangar). Each survey flight departed and returned to this location. The gravimeter was calibrated at this parking spot daily to the local gravity value as established by the initial gravimeter calibration (see section 6 System Tests). *Table 12* shows the position of the aircraft in the WGS-84 datum.

Table 12: Aircraft parking locations

Parking Location	Latitude	Longitude	Elevation (m)
1 - Narsarsuaq	N61:09:44.02756	W45:24:59.60070	71.0739m
2 – Kulusuk	N65:34:25.55119	W37:07:58.75117	86.7041m

Survey flights were flown from Narsarsuaq from 2nd of August to the 5th of August at which point the base was moved to Kulusuk. Production flight 1005 was combined with the ferry from Narsarsuaq to Kulusuk. The survey crew was split over the two bases so that operations were uninterrupted by the move. The field office was set up in Hotel Kulusuk. Kulusuk Airport features a 3,934 ft gravel runway.

When not survey flying, the aircraft was parked on the eastern side of the airport ramp. Survey flights were flown from Kulusuk from the 6th of August to the 9th of August. Production flights were hindered by poor weather and the 9th of August marked the last day of the survey due to budget limitations. Equipment was packed and the aircraft awaited a weather window in order to depart the survey area. The Weekly Reports are in *Appendix V*.

Reference Stations

The first reference station (REF1) was set-up at the office location, Hotel Narsarsuaq, in Narsarsuaq on 29th of July. The second reference station (REF2) was set up in Kulusuk on the 26th of May', 2016 during a previous survey flown by SGL in Greenland. The GPS antenna was affixed to the roof of a small shed next to the Kulusuk Hotel. The position of REF2 was modified very slightly on the 1st of June (REF3). *Table 13* shows the WGS-84 coordinates of each reference station.

Table 13: Locations of reference stations

Station #	Location	Latitude	Longitude	Elevation
REF1	Narsarsuaq	N61.15758160	W45.42073777	60.427m
REF2	Kulusuk	N65.57930809	W37.14916006	68.269m
REF3	Kulusuk	N65.57930659	W37.14916838	68.271m

The position of the REF1 reference station GPS antenna was corrected using precise point positioning (PPP). Differential corrections using the International GPS Service (IGS) reference station KELY (Kellyville, Greenland), was used to verify the PPP results using data recorded on days 211, 212, 213 and 216. Base station REF2's position was differentially corrected using data from three International GPS Service (IGS) reference stations: FLRS (Santa Cruz das Flores, Portugal); KELY (Kellyville, Greenland); and QIKI (Qikiqtarjuaq, Canada), using data recorded on days 148, 149 and 150. Base station REF3's position used the same three reference stations for days 154 and 155.

Re-flights

No reflights were required for this survey.

Field Personnel

Table 14 shows a list of technical personnel who participated in the field operations.

Table 14: Survey field crew

	Name	Dates in Field
SGL Project Manager	Al Pritchard	N/A
SGL Crew Chief	Andrew Palmer	27/07/2016 – 12/08/2016
SGL Data Processor	Stefan Elieff	28/07/2016 – 09/08/2016
SGL Technician	Paul Langlois	27/07/2016 – 17/08/2016
HeliCarrier AME	Ben Lambert	29/07/2016 – 13/08/2016
HeliCarrier Pilot	Jean-Michel Dumont	29/07/2016 – 13/08/2016
HeliCarrier Pilot	German Ratte	30/07/2016 – 10/08/2016
HeliCarrier Operator	Henrik Fosness	30/07/2016 – 13/08/2016
HeliGreenland Operator	Tore Sivertsen	30/07/2016 – 13/08/2016

8. DIGITAL DATA COMPILATION

Preliminary processing for on-site quality control was performed in the field as each flight was completed. This included verifying the data on the computer screen, profiling all of the data channels, and creating preliminary data grids.

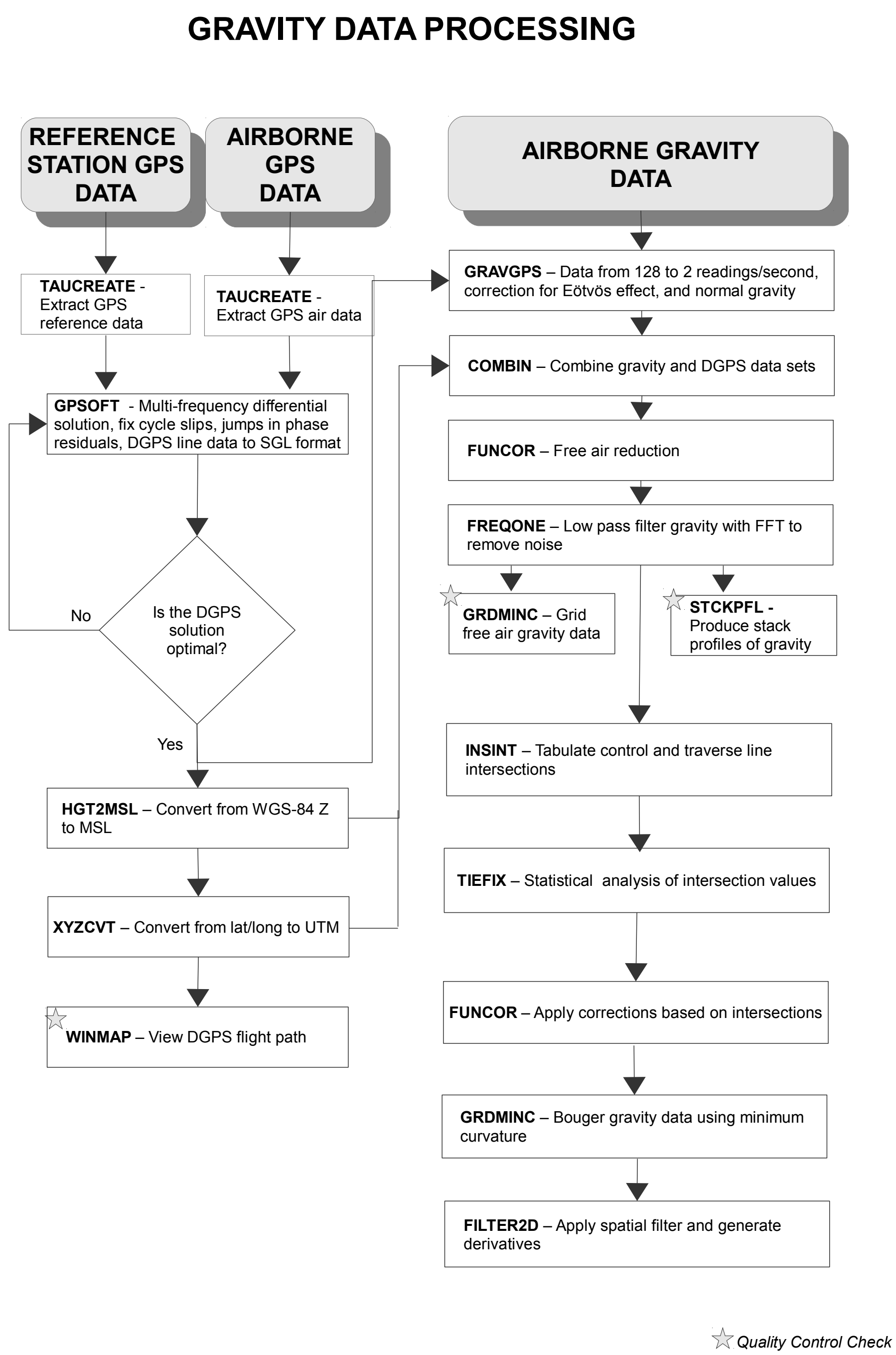


Figure 5: Gravity data processing flowchart

Gravity Data

A gravity data processing flowchart is presented in *Figure 5*. Gravity data are recorded at 128 Hz. Accelerations are filtered and down sampled to match GPS measurements using specially designed filters to avoid biasing the data. Gravity is calculated by subtracting the GPS derived aircraft accelerations from the inertial accelerations. In survey flying, accelerations in an aircraft can reach 0.1 G, equivalent to 100,000 mGal. Data processing must extract gravity data from this very noisy environment. This is achieved by modelling the movements of the aircraft in flight by extremely accurate GPS measurements. The calculated gravity is corrected for the Eötvös effect and normal gravity and the sample interval is reduced to 2 Hz. These operations are all performed by SGL's proprietary GravGPS software.

Advances in gravity processing allow for the generation of enhanced gravity data. These advances involve the use of GPS phase angle corrections, the integration of GPS processing with inertial data from the gravimeter and the advanced analysis of system states and uncertainties. This processing helps reduce system noise and allows for the generation of high quality, low noise raw gravity data through a wider range of survey conditions than was previously possible. The following standard corrections were applied to the gravity data:

a) Eötvös correction,

$$\delta g_{Eötvös} = -\frac{v_x^2}{\frac{r}{(1-e_2\sin^2\Phi)^{1/2}} + h} - 2\,W_s\,v_x\cos\Phi - \frac{v_y^2}{\frac{r\,(1-e_2)}{(1-e_2\sin^2\Phi)^{3/2}} + h}$$

where, Φ = is the latitude of the aircraft,

v_x and v_y = the velocities of the aircraft in the *x* (east) and *y* (north) direction,

r = the Earth's radius at the equator (6,378,137 m)

e_2 = a correction for Earth's flattening towards the poles (6.69437999013 × 10^{-3}),

W_s = the angular velocity of Earth's rotation (7.2921158553 × 10^{-5} rad/s),

h = the altitude of the plane above the GRS-80 ellipsoid.

b) Normal gravity,

$$g_{Normal} = \frac{9.7803267714\,(1+0.00193185138639\,\sin^2\Phi)}{\sqrt{1-0.00669437999013\,\sin^2\Phi}}$$

where Φ is the latitude of the aircraft;

c) Free air correction,

$$g_{fa} = -(0.3087691-0.0004398\sin^2\Phi)\,h + 7.2125*10^{-8}\,h^2,$$

where h is height of the aircraft in metres above the GRS-80 ellipsoid;

d) Static correction, g_{sc}, based on static ground recordings and repeat lines;

e) Level correction, g_{lc}, based on line intersections.

Thus, the Free-Air anomaly in mGal is determined:

$$Free - Air\ Anomaly = g_{Measured} - g_{Normal} - g_{Eötvös} - g_{fa} - g_{sc} - g_{lc}$$

where $g_{Measured}$ is the measured gravitational acceleration in mGal. No Bouguer corrections are applied in the processing of this data.

Line Adjustments and Gridding

The gravimetric data were levelled to compensate for instrument variations in two steps. A single constant shift determined from ground static recordings (described above in Section 6 – SYSTEM TESTS) was applied on a flight-by-flight basis. The pre- and post-flight readings were averaged for each flight and the difference between the average value and the local gravity value was removed. This acts as a simple but effective coarse levelling of the data.

Intersection statistics were then used to adjust individual survey lines. Unlike magnetic levelling, individual intersections are not used to make corrections. Instead, intersection differences from whole lines are averaged and a single adjustment is applied to each survey line and each control line. Minor adjustments were calculated for sections of each line based on statistics from groups of intersections.

The adjustments were smoothed and applied to line data that has been filtered as described below. Grids of adjusted data were inspected to determine that the adjustments were appropriate.

Gridding and Filtering

Statistical noise in the data is reduced by applying a cosine tapered low pass filter to the time series line data. For this survey, a 20 second half wavelength filter was employed. The data were gridded using a minimum curvature algorithm that averages all values within any given grid cell and interpolates the data between survey lines to produce a smooth grid. The algorithm produces a smooth grid by iteratively solving a set of difference equations minimizing the total second horizontal derivative while attempting to honour the input data (Briggs, I.C, 1974, Geophysics, v 39, no. 1). Grids were generated using a 200 m grid cell size.

Low pass filtering is applied to the grid to reduce residual noise, reconcile data at intersections of cross cutting lines, and to reduce aliasing effects from sub-sampling the gravity signal perpendicular to survey lines. A range of grid filters are used and evaluated for noise levels and signal content. Two sets of final data are available for this survey. The first set was filtered with a 750 m half-wavelength low-pass filter and the second set was filtered with a 1,000 m half-wavelength low-pass filter.

Positional Data

A positional data flowchart is presented in *Figure 6.* A number of programs were executed for the compilation of navigation data in order to reformat and recalculate positions in differential mode. SGL's GPS data processing package, GPSoft, was used to calculate DGPS positions from raw 10 Hz range data obtained from the moving (airborne) and stationary (ground) receivers using combinations of L1 and L2 phase signal.

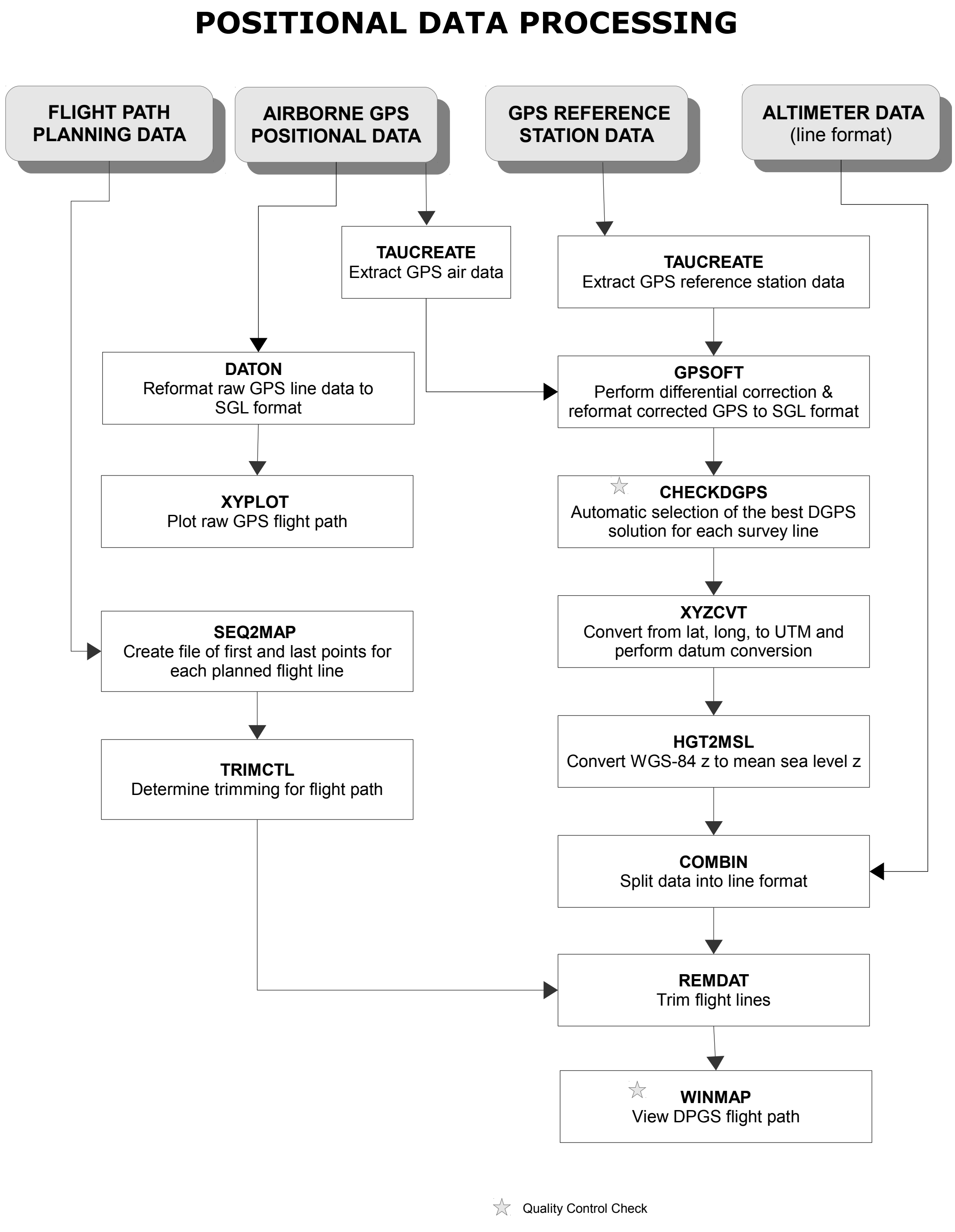


Figure 6: Positional data processing flowchart

Accurate locations of the GPS antenna were determined by differentially correcting the SGL reference station position data using permanent GPS reference stations and through Precise Point Positioning (PPP) corrections using the algorithm developed by the Natural Resources Canada (NRCAN) (http://webapp.geod.nrcan.gc.ca/geod/tools-outils/ppp.php) adapted to run under SGL's suite of software. These techniques provide a final receiver location with an accuracy of better than 5 cm. The entire airborne data set was processed differentially using the calculated reference station location.

Positional data (x, y, z) were recorded and all data processing was performed in the WGS-84 datum. The delivered data were provided in X, Y locations in the EPSG 3413 projection, with respect to the WGS-84 datum. See *Table 15* for the ellipsoid parameters. Refer to *Table 16* for EPSG 3413 Projection parameters. Elevation data were recorded relative to the GRS-80 ellipsoid and transformed to mean sea level (MSL) using the Earth Gravitational Model 2008 (EGM2008).

Table 15: Ellipsoid parameters for WGS-84

Ellipsoid	GRS-80
Semi-major axis	6378137.0
1/flattening	298.257222

Table 16: Projection parameters for EPSG 3413

Projection	Polar Stereographic
Latitude of the origin	90°
Longitude of the origin (central meridian)	-45°
Standard parallel	70°
False Eastings	0
False Northings	0

Laser Altimeter Data

The laser altimeter recorded terrain clearance at 3.3 Hz. Even though the laser altimeter can record returns from more than 700 m above the ground with a high degree of certainty, some laser data dropouts occurred while flying over the mountainous parts of the survey area. The laser data shows the presence of crevasses in the ice which resulted in a high frequency variation of recorded altitude. The raw laser data were processed with an iterative de-spiking routine designed to remove false returns.

A digital elevation model (DEM) was derived by subtracting the laser altimeter data from the differentially corrected DGPS altitude with respect to mean sea level. DEM data is provided as a grid with a 200 m cell size.

9. FINAL PRODUCTS

Gravity Line Data Format

A listing of the data channels delivered in ASCII format with a sampling rate of 2 Hz can be found in *Table 17*.

Table 17: Gravity line data channels and format

Name	Units	Field Length	Null	Description
LINE	-	8	-	Line Number XXXX.YY where XXXX is line number and YY is segment number
FLT	-	6	-	Flight Number
YEAR	-	5	-	Year
DOY	-	5	-	Day of year
TIME	s	10	*	Seconds Past Midnight UTC
PSX	m	13	*	X coordinate, WGS-84 Polar Stereographic, EPSG 3413
PSY	m	13	*	Y coordinate, WGS-84 Polar Stereographic, EPSG 3413
WGS-84-Z	m	10	*	GPS Elevation (above WGS-84 Ellipsoid)
MSL-Z	m	10	*	GPS Elevation (above EGM2008 Geoid)
LAT	degree	13	*	Latitude, WGS-84
LONG	degree	13	*	Longitude, WGS-84
LASER	m	9	*	Laser Altimeter
DEM	m	10	*	Digital Elevation Model (above WGS-84 Ellipsoid - source: GIMP)
DEM_MSL	m	10	*	Digital Elevation Model (above EGM2008 Geoid - source: GIMP)
LTER	m	10	*	Topography Derived from Laser Altimeter (above EGM2008 Geoid)
FX	mGal	12	*	X Acceleration
FY	mGal	12	*	Y Acceleration
FZ	mGal	12	*	Z Acceleration
STATCOR	mGal	12	*	Static Correction (based on pre/post flight static recordings)
ACC_Z_STAT	mGal	12	*	Z acceleration with static correction applied
GPS_ACC_Z	mGal	12	*	Aircraft GPS Z acceleration
RAWGRAV	mGal	12	*	Raw Gravity (FZ_S - AZ)
LATCOR	mGal	12	*	Latitude Correction
EOTCOR	mGal	12	*	Eötvös Correction
FACOR	mGal	10	*	Free Air Correction
FA20	mGal	10	*	Free Air Corrected Gravity, 20 s half-wavelength filter
FA28	mGal	10	*	Free Air Corrected Gravity, 28 s half-wavelength filter
FA36	mGal	10	*	Free Air Corrected Gravity, 36 s half-wavelength filter
FA42	mGal	10	*	Free Air Corrected Gravity, 42 s half-wavelength filter
FA_20_750	mGal	10	*	Free Air Corrected Gravity, 20 s half-wavelength filter, 750 m half-wavelength spatial filter (sampled from grid)
FA_20_1km	mGal	10	*	Free Air Corrected Gravity, 20 s half-wavelength filter, 1000 m half-wavelength spatial filter (sampled from grid)

Digital Grids

The following are provided as digital grids:

Formats:	Grid Exchange (GXF)
Grid Cell Size:	200 m
Datum:	WGS-84
Projection:	EPSG 3413

Table 18: Delivered digital grids

Grid File Name	Units	Description
FRA-750-BlockNumber	mGal	Free-Air Gravity (20 s half-wavelength filtered data gridded, followed by 750 m half-wavelength spatial filter applied to the grid)
FRA-1000-BlockNumber	mGal	Free-Air Gravity (20 s half-wavelength filtered data gridded, followed by 1000 m half-wavelength spatial filter applied to the grid)
FVDFRA-750-BlockNumber	Eötvös	First Vertical Derivative of Free-Air Gravity (20s half-wavelength line filter, 750 m half-wavelength spatial filter)
FVDFRA-1000-BlockNumber	Eötvös	First Vertical Derivative of Free-Air Gravity (20s half-wavelength line filter, 1000 m half-wavelength spatial filter)
TER-BlockNumber	m	Topography from processed altimeter

Appendix I

Company Profile

ABOUT US

Sander Geophysics Limited (SGL) provides worldwide airborne geophysical surveys for petroleum and mineral exploration, and geological and environmental mapping. Services offered include high resolution airborne gravity, magnetic, electromagnetic, and radiometric surveys, using fixed-wing aircraft and helicopters.

SGL head office in Ottawa, Canada

Dr. George W. Sander (1924-2008) founded SGL in 1956 to provide ground geophysical surveys. The first airborne surveys were performed as early as 1958, and by 1967 airborne geophysical surveys were the company's main focus. Operations have expanded steadily since SGL was founded more than 50 years ago. The company is led by co-Presidents Luise Sander and Stephan Sander.

WORLDWIDE OPERATIONS

SGL's head office and aircraft maintenance hangar are located at the International Airport in Ottawa, Canada. Sander Geophysics has operated on every continent including Antarctica, over diverse conditions ranging from the tropics to deserts, mountains and offshore.

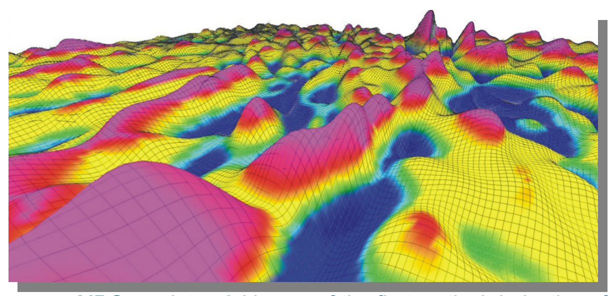
Facilities at the head office include a state of the art data processing department with an integrated digital cartographic department and a fully equipped electronics workshop for research, development and production of geophysical instruments. A Transport Canada Approved Maintenance Organization (AMO) for fixed-wing aircraft and helicopters allows most aircraft maintenance and modifications to be performed in-house.

SERVICES

AIRBORNE SURVEYS

- **Gravity (AIRGrav)**
- **Magnetic Total Field**
- **Magnetic Gradient**
- **Electromagnetic**
- **Gamma-ray Spectrometer**
- **Scanning LiDAR**

SGL offers gravity surveys with **AIRGrav** (Airborne Inertially Referenced Gravimeter), which was designed specifically for the unique characteristics of the airborne environment and is the highest resolution airborne gravimeter available. **AIRGrav** can be flown in an efficient survey aircraft during normal daytime conditions and is routinely flown in combination with magnetometer systems in SGL's airplanes and helicopters.



***AIRGrav** data: 3d image of the first vertical derivative of terrain corrected Bouguer gravity*

DATA PROCESSING

Immediate data processing is part of SGL's standard quality control procedure, and provides clients with rapid results for evaluation while a survey is in progress. Sander Geophysics offers a full range of data enhancement programs and integrated interpretation services by experienced geoscientists. Available products in digital and/or hard copy include:

- **Contour, colour or shaded relief maps of any parameter or combination of parameters**
- **NASVD processed gamma-ray spectrometer data**
- **Filtered line or grid products such as vertical or horizontal gradients, frequency slices,**

high/low-pass or band-pass filtered, amplitude of the analytic signal, reduction to the pole, upward or downward continuation

- **Computed depth to basement**
- **Calculated digital terrain models**
- **Two- or three-dimensional modelling**
- **Cultural editing**
- **Complete geophysical interpretative reports**

ENVIRONMENTAL MONITORING

The company also provides environmental monitoring services using gamma-ray spectrometers and specialized processing to detect and quantify natural and anthropogenic radiation.

HEALTH & SAFETY

Sander Geophysics is a founding and active executive member of the International Airborne Geophysics Safety Association (IAGSA), which promotes the safe operation of helicopters and fixed-wing aircraft on airborne geophysical surveys.

SGL has developed and implemented a Safety Management System (SMS) and comprehensive Health, Safety and Environment (HSE) policies that govern all aspects of company operations. Safety initiatives include:

- **Project-specific Aviation Risk Analysis (ARA) and Personnel Risk Analysis (PRA) for all surveys**
- **Real-time satellite tracking of SGL aircraft**
- **HSE and first aid training for all field personnel**
- **Low-level flight and aircraft simulator training for pilots**
- **Advanced safety training appropriate to the survey location, such as water-egress, wilderness survival, etc.**

SGL's excellent safety record reflects the quality and experience of its survey crews. This, combined with management's ongoing commitment to safety, helps to ensure that Sander Geophysics is a safe and reliable choice for airborne geophysical surveys.

PERSONNEL

Sander Geophysics has over 160 experienced permanent employees, including geophysicists, software and hardware engineers, aircraft maintenance engineers and pilots.

AIRCRAFT

SGL owns and operates seventeen aircraft, including eight Cessna Grand Caravans and a Twin Otter all equipped for geophysical surveys.

The Grand Caravans have been modified to allow the installation of a tri-axial magnetic gradiometer system. The company's fleet also includes three all composite Diamond DA42 Twin Stars, modified for gravity and horizontal magnetic gradient surveys, and two AS350 B3 helicopters equipped for gravity, magnetic and radiometric surveys. Extensive modifications have been made to all of the survey aircraft to accommodate geophysical instruments and to reduce the aircraft's magnetic field. Typical Figures of Merit (FOM) for Sander Geophysics' fixed-wing aircraft are less than 1 nT. The company's aircraft are flown and maintained by licensed and experienced permanent employees of Sander Geophysics.

SGL aircraft

RESEARCH & DEVELOPMENT

Nearly one-third of the company's resources are devoted to developing new and more efficient instrumentation for airborne geophysical surveying, and to further refine its full suite of software for geophysical data processing.

Appendix II

Block 1 Ikertivaq Glacier - PLANNED SURVEY LINES
WGS-84

SEGMENT NO	START LAT	START LONG	END LAT	END LONG	LENGTH NM	LENGTH KM
1001.0	N65:27.93	W040:08.52	N65:40.58	W039:32.53	19.62	36.33
1002.0	N65:28.13	W040:09.95	N65:41.12	W039:33.00	20.14	37.30
1003.0	N65:28.33	W040:11.38	N65:41.67	W039:33.44	20.68	38.30
1004.0	N65:28.53	W040:12.81	N65:42.20	W039:33.95	21.18	39.22
1005.0	N65:28.73	W040:14.24	N65:42.74	W039:34.42	21.70	40.19
1006.0	N65:28.93	W040:15.67	N65:43.27	W039:34.90	22.22	41.15
1007.0	N65:29.13	W040:17.10	N65:43.81	W039:35.37	22.74	42.11
1008.0	N65:29.33	W040:18.53	N65:44.35	W039:35.85	23.26	43.07
1009.0	N65:29.52	W040:19.96	N65:44.89	W039:36.33	23.78	44.04
1010.0	N65:29.72	W040:21.39	N65:45.43	W039:36.80	24.30	45.00
1011.0	N65:29.92	W040:22.82	N65:45.97	W039:37.28	24.82	45.96
1012.0	N65:30.12	W040:24.25	N65:46.50	W039:37.76	25.34	46.92
1013.0	N65:30.30	W040:25.72	N65:47.04	W039:38.24	25.88	47.92
1014.0	N65:30.51	W040:27.12	N65:47.58	W039:38.70	26.38	48.86
1015.0	N65:30.71	W040:28.55	N65:48.12	W039:39.19	26.90	49.81

Total length of all lines = 348.91 nautical miles
= 646.18 kilometers.

Block 2 Koge Bugt Glacier - PLANNED SURVEY LINES
WGS-84

SEGMENT	START		END		LENGTH	
NO	LAT	LONG	LAT	LONG	NM	KM
2001.0	N64:54.86	W041:14.49	N65:13.84	W040:29.85	26.84	49.70
2002.0	N64:55.19	W041:15.52	N65:14.19	W040:30.83	26.86	49.75
2003.0	N64:55.56	W041:16.43	N65:14.59	W040:31.70	26.89	49.80
2004.0	N64:55.94	W041:17.34	N65:15.04	W040:32.43	26.99	49.99
2005.0	N64:56.31	W041:18.25	N65:15.42	W040:33.34	27.00	50.00
2006.0	N64:56.68	W041:19.16	N65:15.81	W040:34.25	27.00	50.00
2007.0	N64:57.06	W041:20.08	N65:16.19	W040:35.15	27.00	50.01
2008.0	N64:57.43	W041:20.99	N65:16.58	W040:36.03	27.03	50.05
2009.0	N64:57.80	W041:21.90	N65:16.98	W040:36.90	27.05	50.10
2010.0	N64:58.18	W041:22.82	N65:17.38	W040:37.76	27.08	50.15
2011.0	N64:58.55	W041:23.73	N65:17.77	W040:38.63	27.11	50.20
2012.0	N64:58.93	W041:24.65	N65:18.17	W040:39.50	27.14	50.25
2013.0	N64:59.30	W041:25.56	N65:18.57	W040:40.37	27.16	50.31
2014.0	N64:59.67	W041:26.48	N65:18.97	W040:41.24	27.19	50.36
2015.0	N65:00.05	W041:27.39	N65:19.36	W040:42.11	27.22	50.41
2016.0	N65:00.42	W041:28.31	N65:19.76	W040:42.98	27.24	50.46
2017.0	N65:00.79	W041:29.23	N65:20.16	W040:43.85	27.27	50.51
2018.0	N65:01.16	W041:30.15	N65:20.55	W040:44.73	27.30	50.56
2019.0	N65:01.54	W041:31.06	N65:20.95	W040:45.60	27.33	50.61
2020.0	N65:01.91	W041:31.98	N65:21.35	W040:46.47	27.35	50.66
2021.0	N65:02.28	W041:32.90	N65:21.74	W040:47.34	27.38	50.71
2022.0	N65:02.66	W041:33.82	N65:22.14	W040:48.22	27.41	50.76
2023.0	N65:03.03	W041:34.74	N65:22.54	W040:49.09	27.44	50.81
2024.0	N65:03.40	W041:35.66	N65:22.93	W040:49.96	27.46	50.86
2025.0	N65:03.77	W041:36.58	N65:23.33	W040:50.84	27.49	50.92
2026.0	N65:04.14	W041:37.50	N65:23.73	W040:51.71	27.52	50.97
2027.0	N65:04.52	W041:38.42	N65:24.12	W040:52.59	27.55	51.02

Total length of all lines = 734.30 nautical miles
= 1359.93 kilometers.

Block 3 Glaulv & Gyldenlove Fjord Glaciers - PLANNED SURVEY LINES
WGS-84

SEGMENT	START		END		LENGTH	
NO	LAT	LONG	LAT	LONG	NM	KM
3001.0	N64:07.54	W041:27.13	N64:20.91	W041:27.37	13.41	24.83
3002.0	N64:07.51	W041:28.37	N64:27.96	W041:28.74	20.52	37.99
3003.0	N64:07.48	W041:29.60	N64:28.12	W041:29.99	20.70	38.35
3004.0	N64:07.44	W041:30.83	N64:28.27	W041:31.24	20.89	38.70
3005.0	N64:07.41	W041:32.06	N64:28.43	W041:32.49	21.08	39.05
3006.0	N64:07.38	W041:33.29	N64:28.58	W041:33.74	21.27	39.40
3007.0	N64:07.34	W041:34.52	N64:28.74	W041:34.99	21.46	39.75
3008.0	N64:07.31	W041:35.75	N64:28.89	W041:36.24	21.65	40.10
3009.0	N64:07.27	W041:36.98	N64:29.05	W041:37.49	21.84	40.45
3010.0	N64:07.24	W041:38.21	N64:29.20	W041:38.75	22.03	40.80
3011.0	N64:07.21	W041:39.44	N64:29.36	W041:40.00	22.22	41.15
3012.0	N64:07.17	W041:40.68	N64:29.51	W041:41.25	22.41	41.51
3013.0	N64:07.14	W041:41.91	N64:29.66	W041:42.50	22.60	41.86

Total length of all lines = 272.11 nautical miles
= 503.94 kilometers.

Block 4 Bernstorff Gletscher Glacier - PLANNED SURVEY LINES
WGS-84

SEGMENT	START		END		LENGTH	
NO	LAT	LONG	LAT	LONG	NM	KM
4001.0	N63:48.99	W041:43.05	N63:52.11	W041:37.88	3.88	7.19
4002.0	N63:48.53	W041:45.33	N63:52.80	W041:38.25	5.30	9.82
4003.0	N63:48.53	W041:46.83	N63:53.48	W041:38.63	6.15	11.39
4004.0	N63:48.53	W041:48.34	N63:54.16	W041:39.01	7.00	12.96
4005.0	N63:48.53	W041:49.84	N63:54.85	W041:39.39	7.84	14.53
4006.0	N63:48.53	W041:51.35	N63:55.53	W041:39.76	8.69	16.10
4007.0	N63:48.53	W041:52.86	N63:56.22	W041:40.14	9.54	17.66
4008.0	N63:48.53	W041:54.36	N63:56.90	W041:40.52	10.38	19.23
4009.0	N63:48.53	W041:55.87	N63:57.58	W041:40.90	11.23	20.80
4010.0	N63:48.52	W041:57.40	N63:58.27	W041:41.28	12.10	22.41
4011.0	N63:48.53	W041:58.88	N63:58.95	W041:41.66	12.92	23.94
4012.0	N63:48.53	W042:00.39	N63:59.63	W041:42.04	13.77	25.51
4013.0	N63:48.53	W042:01.89	N64:00.32	W041:42.42	14.62	27.07
4014.0	N63:48.53	W042:03.40	N64:01.00	W041:42.80	15.47	28.64

Total length of all lines = 138.90 nautical miles
= 257.25 kilometers.

Block 5 Skinfaxe & Rimfaxe Glaciers - PLANNED SURVEY LINES
WGS-84

SEGMENT	START		END		LENGTH	
NO	LAT	LONG	LAT	LONG	NM	KM
0501.0	N63:14.99	W042:10.63	N63:13.27	W042:23.65	6.14	11.36
0502.0	N63:15.45	W042:11.37	N63:13.80	W042:23.88	5.89	10.92
0503.0	N63:15.92	W042:12.10	N63:14.33	W042:24.10	5.65	10.47
0504.0	N63:16.38	W042:12.84	N63:14.86	W042:24.33	5.41	10.02
0505.0	N63:16.84	W042:13.58	N63:15.39	W042:24.55	5.17	9.57
0551.0	N63:17.93	W041:51.60	N63:19.60	W041:56.21	2.67	4.95
0552.0	N63:17.59	W041:52.58	N63:19.43	W041:57.65	2.94	5.45
0553.0	N63:17.29	W041:53.65	N63:19.26	W041:59.08	3.15	5.84
0554.0	N63:17.05	W041:54.90	N63:19.09	W042:00.52	3.26	6.03
0555.0	N63:16.82	W041:56.16	N63:18.92	W042:01.96	3.36	6.22
0556.0	N63:15.90	W041:55.55	N63:18.75	W042:03.39	4.54	8.42
5001.0	N63:11.59	W042:05.27	N63:16.51	W042:13.24	6.11	11.31
5011.0	N63:11.54	W042:06.66	N63:15.98	W042:13.87	5.53	10.23
5021.0	N63:11.48	W042:08.04	N63:15.59	W042:14.71	5.10	9.45
5031.0	N63:11.43	W042:09.43	N63:15.11	W042:15.41	4.58	8.47
5041.0	N63:11.37	W042:10.82	N63:14.63	W042:16.10	4.05	7.49
5301.0	N63:18.63	W042:20.26	N63:16.86	W042:13.61	3.49	6.46
5311.0	N63:18.37	W042:21.62	N63:16.43	W042:14.34	3.81	7.06
5321.0	N63:18.18	W042:23.28	N63:16.06	W042:15.28	4.19	7.76
5331.0	N63:18.03	W042:25.04	N63:15.60	W042:15.91	4.79	8.87
5341.0	N63:17.79	W042:26.49	N63:15.17	W042:16.65	5.17	9.57
5501.0	N63:12.26	W041:46.80	N63:17.58	W041:51.33	5.72	10.59
5511.0	N63:12.20	W041:48.04	N63:17.14	W041:52.24	5.30	9.82
5521.0	N63:12.15	W041:49.27	N63:16.90	W041:53.32	5.10	9.45
5531.0	N63:12.10	W041:50.50	N63:16.61	W041:54.35	4.85	8.98
5541.0	N63:12.05	W041:51.73	N63:16.42	W041:55.47	4.71	8.71

Total length of all lines = 120.68 nautical miles
= 223.49 kilometers.

Block 6 Tingmiarmiut Fjord & Mogens Heinesen Glaciers - PLANNED SURVEY LINES
WGS-84

SEGMENT	START		END		LENGTH	
NO	LAT	LONG	LAT	LONG	NM	KM
6101.0	N62:24.99	W042:56.55	N62:17.26	W043:10.43	10.10	18.70
6102.0	N62:25.62	W042:56.92	N62:17.88	W043:10.82	10.10	18.71
6103.0	N62:26.25	W042:57.30	N62:18.51	W043:11.20	10.11	18.72
6104.0	N62:26.88	W042:57.67	N62:19.14	W043:11.59	10.11	18.73
6105.0	N62:27.51	W042:58.05	N62:19.77	W043:11.97	10.12	18.73
6201.0	N62:29.16	W042:59.03	N62:26.45	W043:16.09	8.37	15.51
6202.0	N62:29.68	W042:59.34	N62:26.96	W043:16.41	8.38	15.51
6203.0	N62:30.20	W042:59.66	N62:27.48	W043:16.74	8.38	15.52
6204.0	N62:30.72	W042:59.97	N62:28.00	W043:17.06	8.38	15.52
6205.0	N62:31.24	W043:00.28	N62:28.52	W043:17.38	8.39	15.53
6206.0	N62:31.76	W043:00.59	N62:29.04	W043:17.70	8.39	15.53
6301.0	N62:33.72	W043:13.83	N62:36.57	W043:22.40	4.89	9.05
6302.0	N62:34.24	W043:13.39	N62:37.41	W043:22.93	5.43	10.07
6303.0	N62:30.33	W042:59.73	N62:38.25	W043:23.45	13.54	25.08
6304.0	N62:31.17	W043:00.23	N62:39.09	W043:23.98	13.55	25.09
6305.0	N62:32.00	W043:00.73	N62:39.92	W043:24.50	13.56	25.10
6306.0	N62:32.83	W043:01.24	N62:40.76	W043:25.03	13.56	25.12
6307.0	N62:33.67	W043:01.74	N62:40.91	W043:23.46	12.38	22.93
6308.0	N62:34.50	W043:02.24	N62:41.02	W043:21.80	11.15	20.64
6309.0	N62:35.34	W043:02.74	N62:40.98	W043:19.66	9.64	17.86
6310.0	N62:36.17	W043:03.24	N62:40.93	W043:17.53	8.14	15.07
6311.0	N62:37.01	W043:03.75	N62:41.04	W043:15.86	6.90	12.78
6312.0	N62:37.84	W043:04.25	N62:41.06	W043:13.92	5.51	10.20
6313.0	N62:38.67	W043:04.75	N62:41.02	W043:11.78	4.00	7.41
6314.0	N62:39.51	W043:05.26	N62:41.06	W043:09.93	2.66	4.92
6401.0	N62:45.02	W043:08.60	N62:43.18	W043:26.56	8.46	15.67
6402.0	N62:45.54	W043:08.92	N62:43.70	W043:26.88	8.46	15.67
6403.0	N62:46.06	W043:09.24	N62:44.22	W043:27.21	8.47	15.68
6404.0	N62:46.58	W043:09.55	N62:44.73	W043:27.54	8.47	15.68
6405.0	N62:47.10	W043:09.87	N62:45.25	W043:27.86	8.47	15.69
6406.0	N62:47.62	W043:10.19	N62:45.77	W043:28.19	8.47	15.69
6407.0	N62:48.07	W043:11.11	N62:46.29	W043:28.52	8.19	15.18

Total length of all lines = 284.73 nautical miles
= 527.31 kilometers.

Block 7 Puisortoq Glacier - PLANNED SURVEY LINES
WGS-84

SEGMENT	START		END		LENGTH	
NO	LAT	LONG	LAT	LONG	NM	KM
7001.0	N61:52.46	W042:34.38	N62:04.74	W042:19.78	14.12	26.14
7002.0	N61:52.67	W042:35.43	N62:04.94	W042:20.86	14.09	26.10
7003.0	N61:52.89	W042:36.48	N62:05.14	W042:21.94	14.07	26.05
7004.0	N61:53.10	W042:37.53	N62:05.33	W042:23.03	14.04	26.00
7005.0	N61:53.32	W042:38.58	N62:05.53	W042:24.11	14.02	25.96
7006.0	N61:53.54	W042:39.64	N62:05.72	W042:25.19	13.99	25.91
7007.0	N61:53.75	W042:40.69	N62:05.92	W042:26.28	13.97	25.86
7008.0	N61:53.97	W042:41.74	N62:06.11	W042:27.36	13.94	25.82
7009.0	N61:54.18	W042:42.79	N62:06.31	W042:28.44	13.92	25.77
7010.0	N61:54.40	W042:43.85	N62:06.50	W042:29.53	13.89	25.72
7011.0	N61:54.61	W042:44.90	N62:06.70	W042:30.61	13.87	25.68
7012.0	N61:54.83	W042:45.95	N62:06.89	W042:31.69	13.84	25.63
7013.0	N61:55.04	W042:47.01	N62:07.09	W042:32.78	13.82	25.59
7014.0	N61:55.26	W042:48.06	N62:07.28	W042:33.86	13.79	25.54
7015.0	N61:55.47	W042:49.11	N62:07.48	W042:34.95	13.76	25.49
7016.0	N61:55.68	W042:50.17	N62:07.67	W042:36.03	13.74	25.45
7017.0	N61:55.90	W042:51.22	N62:07.87	W042:37.12	13.71	25.40
7018.0	N61:56.11	W042:52.28	N62:08.06	W042:38.21	13.69	25.35
7019.0	N61:56.33	W042:53.33	N62:08.25	W042:39.29	13.66	25.31

Total length of all lines = 263.91 nautical miles
= 488.77 kilometers.

Block 8 Anorituup Kangerlua Glacier - PLANNED SURVEY LINES
WGS-84

SEGMENT NO	START LAT	START LONG	END LAT	END LONG	LENGTH NM	LENGTH KM
8001.0	N61:33.92	W043:04.63	N61:40.62	W043:01.25	6.91	12.80
8002.0	N61:34.07	W043:05.72	N61:42.06	W043:01.68	8.24	15.26
8003.0	N61:34.23	W043:06.80	N61:43.50	W043:02.12	9.56	17.71
8004.0	N61:34.38	W043:07.88	N61:44.94	W043:02.56	10.89	20.16
8005.0	N61:33.29	W043:09.59	N61:45.67	W043:03.36	12.77	23.64
8006.0	N61:30.94	W043:11.92	N61:45.73	W043:04.50	15.25	28.23
8007.0	N61:31.08	W043:13.01	N61:45.88	W043:05.59	15.25	28.24
8008.0	N61:31.22	W043:14.10	N61:46.02	W043:06.69	15.25	28.25
8009.0	N61:31.36	W043:15.19	N61:46.16	W043:07.79	15.26	28.26
8010.0	N61:31.49	W043:16.28	N61:46.30	W043:08.88	15.26	28.26
8011.0	N61:31.63	W043:17.38	N61:46.44	W043:09.98	15.26	28.27
8012.0	N61:31.77	W043:18.47	N61:46.59	W043:11.08	15.27	28.28
8013.0	N61:31.91	W043:19.56	N61:46.73	W043:12.18	15.27	28.28
8014.0	N61:32.04	W043:20.65	N61:46.87	W043:13.27	15.27	28.29
8015.0	N61:32.18	W043:21.74	N61:47.01	W043:14.37	15.28	28.30
8016.0	N61:32.32	W043:22.83	N61:47.15	W043:15.47	15.28	28.30
8017.0	N61:32.39	W043:23.96	N61:47.29	W043:16.57	15.35	28.43
8018.0	N61:32.59	W043:25.02	N61:47.43	W043:17.67	15.29	28.32

Total length of all lines = 246.91 nautical miles
= 457.28 kilometers.

Block 9 Qajuuttap Sermia Glacier - PLANNED SURVEY LINES
WGS-84

SEGMENT	START		END		LENGTH	
NO	LAT	LONG	LAT	LONG	NM	KM
9001.0	N61:23.03	W045:55.69	N61:32.10	W045:28.67	15.83	29.32
9011.0	N61:22.60	W045:55.02	N61:31.65	W045:28.04	15.81	29.28
9021.0	N61:22.16	W045:54.35	N61:31.21	W045:27.41	15.79	29.25
9031.0	N61:21.73	W045:53.69	N61:30.76	W045:26.78	15.78	29.22
9041.0	N61:21.29	W045:53.02	N61:30.31	W045:26.15	15.76	29.18
9051.0	N61:20.86	W045:52.36	N61:29.87	W045:25.51	15.74	29.15
9061.0	N61:20.43	W045:51.69	N61:29.42	W045:24.88	15.72	29.11
9071.0	N61:19.99	W045:51.02	N61:28.98	W045:24.25	15.70	29.08
9081.0	N61:19.56	W045:50.36	N61:28.53	W045:23.62	15.68	29.05
9091.0	N61:19.13	W045:49.70	N61:28.08	W045:22.99	15.67	29.01
9101.0	N61:18.69	W045:49.03	N61:27.64	W045:22.36	15.65	28.98
9111.0	N61:18.26	W045:48.37	N61:20.09	W045:42.94	3.20	5.92
9121.0	N61:17.82	W045:47.70	N61:19.66	W045:42.27	3.20	5.93
9131.0	N61:17.39	W045:47.04	N61:19.23	W045:41.60	3.20	5.93

Total length of all lines = 182.73 nautical miles
= 338.41 kilometers.

Block 10 Eqalorutsit Killiit Sermiat Glacier - PLANNED SURVEY LINES
WGS-84

SEGMENT	START		END		LENGTH	
NO	LAT	LONG	LAT	LONG	NM	KM
9521.0	N61:20.57	W046:00.77	N61:23.79	W046:08.82	5.04	9.33
9531.0	N61:20.17	W046:01.52	N61:23.47	W046:09.78	5.17	9.57
9541.0	N61:19.77	W046:02.28	N61:23.16	W046:10.75	5.30	9.82
9551.0	N61:19.15	W046:02.47	N61:22.84	W046:11.72	5.79	10.72
9561.0	N61:18.39	W046:02.33	N61:22.53	W046:12.69	6.48	12.01
9571.0	N61:17.63	W046:02.19	N61:22.21	W046:13.65	7.18	13.29
9581.0	N61:16.88	W046:02.05	N61:21.89	W046:14.62	7.87	14.58
9591.0	N61:16.12	W046:01.91	N61:21.58	W046:15.58	8.57	15.86
9601.0	N61:13.98	W045:58.34	N61:21.26	W046:16.55	11.42	21.15
9611.0	N61:13.66	W045:59.28	N61:20.95	W046:17.51	11.44	21.18
9621.0	N61:13.33	W046:00.21	N61:20.63	W046:18.48	11.45	21.21
9631.0	N61:13.01	W046:01.15	N61:20.32	W046:19.44	11.47	21.24
9641.0	N61:12.69	W046:02.09	N61:20.00	W046:20.41	11.48	21.27
9651.0	N61:12.60	W046:03.62	N61:19.68	W046:21.37	11.13	20.61
9661.0	N61:13.27	W046:07.04	N61:19.37	W046:22.33	9.58	17.74
9671.0	N61:13.95	W046:10.47	N61:19.05	W046:23.30	8.03	14.87
9681.0	N61:14.48	W046:13.57	N61:18.73	W046:24.26	6.69	12.39
9691.0	N61:14.49	W046:15.33	N61:18.42	W046:25.22	6.19	11.47

Total length of all lines = 150.28 nautical miles
= 278.32 kilometers.

SGL

Appendix III

FLOWN LINES
WGS 84, UTM Zone 23N

LINE	TIME	TIME	MIN X	MAX X	MIN Y	MAX Y	FLIGHT	DAY	YEAR
501.00	5149350	5183400	63087656	64181554	701286915	701656748	1005	218	2016
502.00	5105950	5136900	63063741	64116380	701383366	701740011	1005	218	2016
503.00	5062950	5094250	63041061	64051622	701481471	701824993	1005	218	2016
504.00	5016150	5048850	63018981	63986327	701579481	701908099	1005	218	2016
505.00	4975350	5001450	62995499	63920423	701677106	701991037	1005	218	2016
551.00	4014700	4029150	65328815	65746746	702266528	702571173	1005	218	2016
552.00	4045800	4061550	65209937	65668099	702200577	702535277	1005	218	2016
553.00	4070150	4086950	65091023	65580935	702140498	702497740	1005	218	2016
554.00	4098000	4114850	64973589	65479454	702089635	702459163	1005	218	2016
555.00	4125600	4145550	64854221	65375494	702043056	702424372	1005	218	2016
556.00	4160750	4188500	64736777	65434402	701873712	702385594	1005	218	2016
1001.00	6719500	6816850	72482522	75068956	726893136	729481910	1006	219	2016
1002.00	6829500	6931350	72369193	75024568	726920844	729579154	1006	219	2016
1003.00	6941750	7044550	72255868	74983188	726949305	729677428	1006	219	2016
1004.00	7057200	7166400	72143701	74934187	726978241	729771227	1006	219	2016
1005.00	7176450	7289900	72031014	74890463	727007382	729868164	1006	219	2016
1006.00	7301100	7416450	71918423	74845198	727035692	729965199	1006	219	2016
1007.00	7665200	7779700	71804069	74800588	727063570	730061753	1006	219	2016
1008.00	7793300	7911100	71692677	74754511	727092834	730157332	1006	219	2016
1009.00	7920850	8040300	71578320	74710205	727120716	730254552	1006	219	2016
1010.00	8052450	8179550	71466051	74665170	727148998	730350760	1006	219	2016
1011.00	2857150	2976450	71353756	74620676	727177973	730448278	1007	220	2016
1012.00	4683050	4811550	71238048	74575041	727205631	730543641	1007	220	2016
1013.00	6208400	6341450	71124831	74531864	727231586	730641376	1007	220	2016
1014.00	7038050	7175600	71013976	74487225	727262972	730738662	1007	220	2016
1015.00	7432600	7570300	70901380	74441751	727291523	730834166	1007	220	2016
2001.00	3040500	3182650	67763379	71043180	720409368	724177412	1007	220	2016
2002.00	3197500	3346150	67680356	70962290	720465212	724236358	1007	220	2016
2003.00	3740200	3878400	67603923	70889908	720530167	724305976	1007	220	2016
2004.00	3903350	4051150	67529827	70825650	720596415	724384926	1007	220	2016
2005.00	4062050	4204150	67451622	70752187	720660728	724451606	1007	220	2016
2006.00	4217200	4364350	67377792	70675856	720725938	724517294	1007	220	2016
2007.00	4864500	5006000	67300925	70600028	720791274	724582592	1007	220	2016
2008.00	5016950	5162800	67225014	70527720	720855951	724650452	1007	220	2016
2009.00	6384850	6523550	67149495	70454154	720922137	724719510	1007	220	2016
2010.00	6534950	6675500	67073235	70381922	720986441	724788633	1007	220	2016
2011.00	6685550	6825800	66997210	70308383	721051879	724856930	1007	220	2016
2012.00	6837050	6980350	66922359	70236499	721117647	724926262	1007	220	2016
2013.00	7613250	7754800	66845426	70164295	721182352	724995506	1007	220	2016
2014.00	7766200	7908900	66770045	70092116	721247999	725064838	1007	220	2016
2015.00	7918050	8059400	66693970	70018061	721312918	725133441	1007	220	2016
2016.00	8070300	8213950	66618411	69947483	721378112	725203322	1007	220	2016
3001.00	4997500	5071250	67110667	67268545	711573982	714071407	1006	219	2016
3002.00	5847350	5957150	66927670	67168970	711563611	715372557	1005	218	2016
3003.00	2975850	3088250	66825758	67070084	711551839	715396102	1006	219	2016
3004.00	5124650	5235150	66722432	66969924	711539551	715420088	1006	219	2016
3005.00	5732600	5843550	66622013	66870511	711528878	715442105	1006	219	2016
4001.00	3156800	3183850	66148299	66555125	708062865	708683757	1006	219	2016
4002.00	3583400	3615500	65967062	66517585	707967858	708808751	1006	219	2016
4003.00	3627200	3660000	65843337	66479337	707962267	708933401	1006	219	2016
4004.00	3672550	3714150	65720531	66442653	707955574	709059242	1006	219	2016
4005.00	3727300	3772500	65596374	66404887	707949594	709184302	1006	219	2016
4006.00	3786350	3833150	65473686	66366575	707943927	709308673	1006	219	2016
4007.00	3846900	3900100	65349698	66329381	707937407	709434085	1006	219	2016
4008.00	3916550	3974850	65225856	66292136	707931565	709559466	1006	219	2016
4009.00	4002200	4063650	65102937	66254142	707926379	709684148	1006	219	2016
4010.00	4078650	4142550	64976570	66218356	707916262	709810276	1006	219	2016
4011.00	4158600	4230100	64855156	66177662	707913412	709934246	1006	219	2016
4012.00	4241850	4315750	64731990	66141634	707907753	710059794	1006	219	2016
4013.00	4774000	4851650	64609226	66104013	707902696	710184691	1006	219	2016
4014.00	4865250	4949650	64485030	66067010	707896008	710310916	1006	219	2016
5001.00	5368350	5404600	63932036	64657991	701034760	701936338	1005	218	2016
5011.00	5328200	5358150	63886606	64543125	701019090	701836769	1005	218	2016
5021.00	5286200	5315350	63818899	64425858	701003392	701760519	1005	218	2016
5031.00	5250500	5277850	63764745	64310206	700987888	701668667	1005	218	2016
5041.00	5214450	5236850	63711245	64192715	700972956	701575566	1005	218	2016

FLOWN LINES
WGS 84, UTM Zone 23N

LINE	TIME	TIME	MIN X	MAX X	MIN Y	MAX Y	FLIGHT	DAY	YEAR
5301.00	4454500	4474600	63319803	63914163	701981305	702305728	1005	218	2016
5311.00	4491250	4512650	63208535	63868381	701899050	702251876	1005	218	2016
5321.00	4523350	4548400	63071899	63792947	701825349	702212121	1005	218	2016
5331.00	4562750	4588650	62926907	63745552	701738329	702176367	1005	218	2016
5341.00	4600200	4632250	62807298	63685795	701656306	702127531	1005	218	2016
5501.00	4377450	4409950	65759220	66195211	701231621	702218214	1005	218	2016
5511.00	4332700	4362900	65686798	66092173	701216458	702133547	1005	218	2016
5521.00	4292250	4322150	65598994	65989748	701201485	702084505	1005	218	2016
5531.00	4255750	4281500	65515720	65886139	701186849	702027175	1005	218	2016
5541.00	4214100	4244850	65423219	65784047	701172530	701988641	1005	218	2016
6101.00	4011250	4061250	59463913	60637652	690743901	692239002	1004	217	2016
6102.00	4284550	4334250	59427982	60602137	690860295	692355797	1004	217	2016
6103.00	4344850	4394450	59391061	60565342	690974748	692470686	1004	217	2016
6104.00	4410250	4462050	59354429	60529267	691090348	692586538	1004	217	2016
6105.00	4471900	4522350	59317933	60494041	691205213	692703837	1004	217	2016
6201.00	4533200	4575750	58930426	60399882	692444964	692998019	1004	217	2016
6202.00	4586500	4628050	58898412	60369243	692540210	693093309	1004	217	2016
6203.00	4636550	4679950	58869696	60339129	692635545	693190073	1004	217	2016
6204.00	4689250	4731200	58838038	60309941	692732142	693285467	1004	217	2016
6205.00	4740750	4783950	58808465	60280696	692826335	693380699	1004	217	2016
6206.00	4793000	4835200	58779343	60250343	692921252	693475349	1004	217	2016
6301.00	4937950	4962150	58339195	59105099	693798580	694320933	1004	217	2016
6302.00	4971250	4998500	58290674	59140024	693895627	694475121	1004	217	2016
6303.00	4855650	4922200	58242222	60332476	693203648	694629307	1004	217	2016
6304.00	5014250	5079950	58193295	60284142	693357660	694783475	1004	217	2016
6305.00	5100400	5165500	58144282	60236206	693511289	694937710	1004	217	2016
6306.00	5181000	5245900	58094809	60189124	693664819	695092143	1004	217	2016
6307.00	5636650	5696350	58228126	60140884	693818474	695122092	1004	217	2016
6308.00	5707150	5759950	58369554	60094421	693970484	695146812	1004	217	2016
6309.00	5772950	5822000	58551638	60045424	694125753	695144024	1004	217	2016
6310.00	5835100	5876250	58734536	59998754	694278001	695139866	1004	217	2016
6311.00	5886900	5922800	58875750	59950470	694432378	695164664	1004	217	2016
6312.00	5932700	5960600	59042708	59903518	694584828	695172525	1004	217	2016
6313.00	5584750	5605300	59224340	59856047	694738120	695169306	1004	217	2016
6314.00	5557050	5570700	59382437	59808111	694892153	695182587	1004	217	2016
6401.00	3169650	3219350	57954106	59491960	695529247	695916274	1005	218	2016
6402.00	3228350	3269100	57924237	59461951	695625200	696011763	1005	218	2016
6403.00	3280100	3326050	57894732	59432599	695720915	696107607	1005	218	2016
6404.00	3336350	3380550	57863810	59403505	695815723	696202641	1005	218	2016
6405.00	3389850	3440450	57832995	59374208	695911721	696298228	1005	218	2016
6406.00	3451850	3499000	57802741	59343638	696006861	696394187	1005	218	2016
6407.00	3511200	3561250	57773878	59264295	696102807	696477558	1005	218	2016
7001.00	7496450	7563650	62757178	63952376	686246100	688595836	1003	216	2016
7002.00	7571650	7640350	62663256	63855499	686283054	688627193	1003	216	2016
7003.00	7650700	7719150	62570467	63761576	686320412	688660532	1003	216	2016
7004.00	7727600	7795850	62476401	63665203	686356531	688692114	1003	216	2016
7005.00	7807500	7875950	62383932	63569407	686394073	688725072	1003	216	2016
7006.00	7885200	7955350	62289410	63474256	686429324	688757456	1003	216	2016
7007.00	7967850	8036150	62196144	63378221	686466043	688789903	1003	216	2016
7008.00	7106100	7177750	62102999	63283074	686503813	688823609	1003	216	2016
7009.00	7021500	7094400	62009057	63187281	686539382	688855950	1003	216	2016
7010.00	6936100	7008400	61915498	63091511	686576480	688887710	1003	216	2016
7011.00	6852600	6924500	61822274	62995476	686614123	688919841	1003	216	2016
7012.00	6774250	6844700	61728598	62900982	686650773	688953475	1003	216	2016
7013.00	6690250	6761750	61635603	62804028	686687200	688985254	1003	216	2016
7014.00	6612050	6681950	61541960	62708628	686723206	689018311	1003	216	2016
7015.00	6527500	6599500	61447641	62612829	686759728	689050309	1003	216	2016
7016.00	6450200	6518950	61354099	62516894	686796505	689083447	1003	216	2016
7017.00	6366800	6438050	61262209	62421566	686833807	689115660	1003	216	2016
7018.00	6287700	6355800	61167643	62326466	686870485	689149179	1003	216	2016
7019.00	6206300	6273950	61074434	62230774	686907506	689181321	1003	216	2016
8001.00	3004100	3045800	60210980	60475822	682716671	683988934	1003	216	2016
8002.00	3051700	3095200	60115542	60418199	682742724	684085294	1003	216	2016
8003.00	3106650	3163350	60016797	60383233	682768289	684520470	1003	216	2016
8004.00	3171400	3227900	59920639	60324737	682794260	684626384	1003	216	2016
8005.00	3255250	3331500	59776383	60263253	682587737	684919634	1003	216	2016

FLOWN LINES
WGS 84, UTM Zone 23N

LINE	TIME	TIME	MIN X	MAX X	MIN Y	MAX Y	FLIGHT	DAY	YEAR
8006.00	3347000	3428250	59581056	60162310	682145713	684928558	1003	216	2016
8007.00	3453900	3549200	59485734	60065138	682169284	684952027	1003	216	2016
8008.00	3563050	3648050	59387121	59968080	682192875	684975064	1003	216	2016
8009.00	3662550	3757950	59289104	59871214	682215407	685000222	1003	216	2016
8010.00	3770650	3858400	59191292	59765162	682237970	685023663	1003	216	2016
8011.00	4219600	4307900	59094639	59677908	682260603	685047128	1003	216	2016
8012.00	4318750	4408050	58997146	59572332	682285224	685069886	1003	216	2016
8013.00	4419600	4512850	58899902	59482484	682306763	685093195	1003	216	2016
8014.00	4524750	4621100	58803165	59385467	682329569	685116961	1003	216	2016
8015.00	4635950	4732600	58705233	59287703	682353377	685141591	1003	216	2016
8016.00	4743700	4828800	58608055	59190795	682375478	685165370	1003	216	2016
8017.00	4842250	4927800	58509542	59091816	682387064	685188470	1003	216	2016
8018.00	4941000	5025200	58411676	58995855	682421730	685211284	1003	216	2016
9001.00	5425450	5502850	45027339	47472277	680579945	682256616	1002	215	2016
9011.00	5511400	5591250	45085001	47527331	680498204	682173237	1002	215	2016
9021.00	5598600	5679950	45139303	47584180	680416713	682090726	1002	215	2016
9031.00	5687900	5768950	45202265	47638971	680335656	682007584	1002	215	2016
9041.00	5778100	5861350	45254754	47694573	680254018	681924301	1002	215	2016
9051.00	5873750	5955850	45318648	47750312	680172908	681840943	1002	215	2016
9061.00	5966150	6048550	45376523	47805631	680091844	681757295	1002	215	2016
9071.00	6061650	6143900	45435327	47860718	680010632	681673846	1002	215	2016
9081.00	6156600	6236500	45494384	47915946	679929156	681591002	1002	215	2016
9091.00	6249850	6331000	45552715	47971588	679848399	681507919	1002	215	2016
9101.00	6444300	6522000	45612547	48027873	679766727	681424825	1002	215	2016
9111.00	6345050	6363450	45670496	46184339	679685008	680039460	1002	215	2016
9121.00	6375050	6392600	45726390	46242067	679604020	679958382	1002	215	2016
9131.00	6401400	6418900	45784777	46301674	679522565	679877346	1002	215	2016
9521.00	4890550	4916150	43863203	44591767	680130932	680757717	1001	215	2016
9531.00	4853350	4880550	43775652	44519888	680057683	680701073	1001	215	2016
9541.00	4818650	4845350	43687420	44455901	679984478	680643984	1001	215	2016
9551.00	4780450	4810150	43601508	44435644	679868977	680587067	1001	215	2016
9561.00	4735200	4768800	43514083	44448378	679727324	680529608	1001	215	2016
9571.00	4687450	4726150	43427707	44456016	679587296	680472610	1001	215	2016
9581.00	4633850	4675000	43339322	44467178	679445977	680416383	1001	215	2016
9591.00	4576400	4620750	43253912	44476099	679306032	680359012	1001	215	2016
9601.00	4494950	4554750	43164091	44791102	678903642	680302630	1001	215	2016
9611.00	4418450	4480550	43078593	44704158	678845275	680245156	1001	215	2016
9621.00	3893350	3948950	42992545	44620657	678786503	680187865	1001	215	2016
9631.00	3961850	4017650	42906263	44537481	678727250	680131112	1001	215	2016
9641.00	4040350	4099800	42817654	44451678	678668599	680075124	1001	215	2016
9651.00	4111250	4167750	42731405	44315133	678653957	680017941	1001	215	2016
9661.00	4184450	4233200	42642384	44010347	678784209	679961347	1001	215	2016
9671.00	4245050	4284750	42556092	43705016	678915472	679903993	1001	215	2016
9681.00	4305600	4338950	42467907	43429080	679020209	679847418	1001	215	2016
9691.00	4347750	4379200	42374985	43272227	679023178	679789823	1001	215	2016

SGL

Appendix IV

Equipment List

Part	Serial No.	Description	Manufacturer
AirGrav Control Computer	GEER-04	AirGrav Control Computer	SGL
CP306 Computer	143342024	Kontron 306V Computer	Kontron
Data acquisition computer	CDAC-12	CPCI Data Acquisition computer	SGL
GPS Antenna	NZT07180017	Model 702L	Novatel
GPS Receiver	NYB07460001	DL4+ RT2W	Novatel
GPS Receiver	DAB08400076	OEMV-3, 72-ch, L1/L2	Novatel
Laser Profilometer	9995929	LD90-31K-HiP, 11-28VDC laser rangefinder.	Riegl

Appendix V

Sander Geophysics Ltd.

SANDER GEOPHYSICS AIRBORNE GEOPHYSICAL SURVEY

260 Hunt Club Road, Ottawa, ON K1V 1C1 Canada Tel: +1 613-521-9626 Fax: +1 613-521-0215 www.sgl.com

SURVEY DETAILS

Survey Name	Southeast Greenland Glaciers	**Client Name**	Eric Rignot
Survey Location	Southeastern Greenland	**Contact Name**	Eric Rignot
Project Code	Rignot15.GRL	**Contact Phone**	
Total km	5080.88	**Client Address**	
Line Spacing	1km		
Survey Type	Gravity / Radar	**Email**	eric.j.rignot@jpl.nasa.gov

SURVEY PRODUCTION SUMMARY

	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Block 8	Block 9	Block 10
Production This Week (km)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Remaining (km)	646.2	1359.9	503.9	257.3	223.5	527.3	488.8	457.3	338.4	278.3
Percent Complete (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prod km/Day This Week	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total km Flown to Date	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
km Reflown This Week	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flight Time This Week (h)	1.1									
Prod km/Flt Hour This Week	0.0									

WEEKLY PRODUCTION

Week 1			Flight No.	Flight Time	No. of Lines Flown	No. Reflight Lines Flown	Production (km) Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Block 8	Block 9	Block 10	Reflown (km) Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Block 8	Block 9	Block 10
TOTALS				1.1	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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25-Jul	**Mon**	C-FHCH		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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weather																										
Geomag					**Remarks**																					
26-Jul	**Tue**	C-FHCH		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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weather																										
Geomag					**Remarks**																					
27-Jul	**Wed**	C-FHCH		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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weather	clear																									
Geomag					**Remarks**		Andrew Palmer and Paul Langlois arrive in Kangerlussuaq.																			
28-Jul	**Thu**	C-FHCH		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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weather	clear																									
Geomag					**Remarks**		Geophysical equipment shipment delayed. Stefan Elieff arrives in Narsarsuaq.																			
29-Jul	**Fri**	C-FHCH		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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weather	clear																									
Geomag					**Remarks**		Geophysical equipment shipment arrives in Kangerlussuaq in evening. Helicopter arrives in Kangerlussuaq.																			
30-Jul	**Sat**	C-FHCH		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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weather	clear																									
Geomag					**Remarks**		Installation of survey system into helicopter and ground tests.																			
31-Jul	**Sun**	C-FHCH	9001	1.1	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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weather	clear																									
Geomag					**Remarks**		Survey of helicopter. Altimeter and Gravimeter test flight. Equipment confirmed to be in full working order.																			

Comments Andrew Palmer and Paul Langlois arrive in Kangerlussuaq; Stefan Elieff in Narsarsuaq. Geophyscial equipment arrives in Kangerlussuaq after delays. Installation of geo equipment, helicopter survey and altimeter+gravity test flight completed.

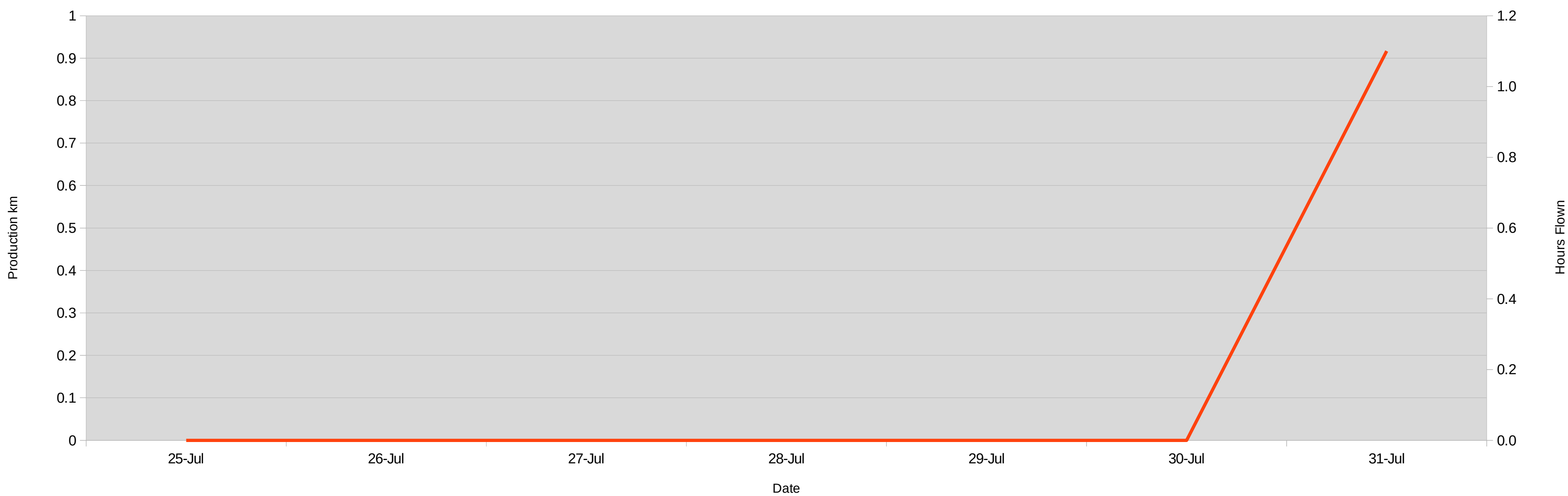
Signed Andrew Palmer

Sander Geophysics Ltd.

Week 1 **Page 2**

PERSONNEL ON SITE THIS WEEK						
Name	**Position**	**Arrival This Week**	**Departure This Week**	**On Site?**	**No. of Days On Site This Week**	**No. of Days on Site To Date**
Andrew Palmer	Geophysicist	27-Jul-16		ON SITE	5	5
Stefan Elieff	Geophysicist	26-Jul-16		ON SITE	6	6
Paul Langlois	Technician	27-Jul-16		ON SITE	5	5

WEEKLY PRODUCTION KILOMETRES AND HOURS FLOWN



SANDER GEOPHYSICS AIRBORNE GEOPHYSICAL SURVEY

260 Hunt Club Road, Ottawa, ON K1V 1C1 Canada Tel: +1 613-521-9626 Fax: +1 613-521-0215 www.sgl.com

SURVEY DETAILS

Survey Name	Southeast Greenland Glaciers	**Client Name**	Eric Rignot
Survey Location	Southeastern Greenland	**Contact Name**	Eric Rignot
Project Code	Rignot15.GRL	**Contact Phone**	
Total km	5080.88	**Client Address**	
Line Spacing	1km		
Survey Type	Gravity / Radar	**Email**	eric.j.rignot@jpl.nasa.gov

SURVEY PRODUCTION SUMMARY

	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Block 8	Block 9	Block 10
Production This Week (km)	646.2	801.5	178.9	257.3	223.5	527.3	488.8	457.3	338.4	278.3
Total Remaining (km)	0.0	558.4	325.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent Complete (%)	100.0	58.9	35.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Prod km/Day This Week	92.3	114.5	25.6	36.8	31.9	75.3	69.8	65.3	48.3	39.8
Total km Flown to Date	646.2	801.5	178.9	257.3	223.5	527.3	488.8	457.3	338.4	278.3
km Reflown This Week	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flight Time This Week (h)	76.3									
Prod km/Flt Hour This Week	55.0									

WEEKLY PRODUCTION

Week 2			Flight No.	Flight Time	No. of Lines Flown	No. Reflight Lines Flown	Production (km)										Reflown (km)									
							Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Block 8	Block 9	Block 10	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Block 8	Block 9	Block 10
TOTALS				**76.3**	**177.0**	**0.0**	**646.2**	**801.5**	**178.9**	**257.3**	**223.5**	**527.3**	**488.8**	**457.3**	**338.4**	**278.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
1-Aug	**Mon**	C-FHCH	Ferry	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Weather	Clear in Kangerlussuaq				**Remarks**	Helicopter ferries from Kangerlussuaq to Narsarsuaq. Paul Langlois and Ben Lambert (Helicarrier AME) depart Kangerlussuaq for Narsarsuaq, overnighting in Nuuk.																			
	Geomag	n/a																								
2-Aug	**Tue**	C-FHCH	1001,1002	7.0	32.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	338.4	278.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Weather	Low clouds clearing in morning and coming in again in evening				**Remarks**	First two production flights. Blocks 9 and 10 completed. Further production flights were prevented by incoming low clouds.																			
	Geomag																									
3-Aug	**Wed**	C-FHCH	1003	16.3	37.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	488.8	457.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Weather	Clear, low winds				**Remarks**	Blocks 7 and 8 completed.																			
	Geomag	n/a																								
4-Aug	**Thu**	C-FHCH	1004	7.5	25.0	0.0	0.0	0.0	0.0	0.0	0.0	418.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Weather	Clear, low winds				**Remarks**	Block 6 partially completed.																			
	Geomag	n/a																								
5-Aug	**Fri**	C-FHCH	1005	10.1	34.0	0.0	0.0	0.0	38.0	0.0	223.5	109.3	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	0.0
	Weather	Clear, low winds				**Remarks**	C-FHCH ferries from Narsarsuaq to Kulusuk, completing block 5, finishing off block 6 and flying a line from block 3.																			
	Geomag	n/a																								
6-Aug	**Sat**	C-FHCH	1006	15.9	28.0	0.0	406.7	0.0	140.9	257.3	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	0.0	0.0	0.0
	Weather	Clear, low winds				**Remarks**	Block 4 completed, block 3 finished off, and block 1 partially completed.																			
	Geomag	n/a																								
7-Aug	**Sun**	C-FHCH	1007	15.5	21.0	0.0	239.5	801.5	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	0.0	0.0	0.0	0.0	0.0
	Weather	Clear, low winds				**Remarks**	Block 1 finished off and block 2 partially completed.																			
	Geomag	n/a																								

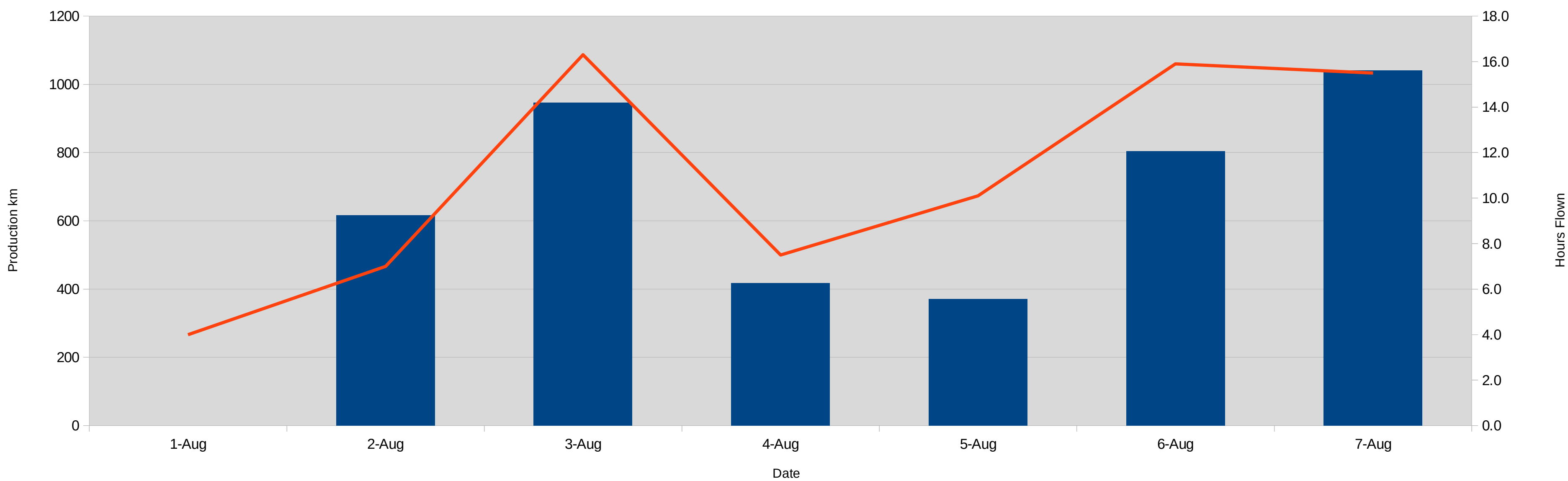
Comments C-FHCH ferried from Kangerlussuaq to Narsarsuaq. Flying from Narsarsuaq completed and helicopter is now in Kulusuk. Blocks 1 and 4-10 complete, Blocks 2 and 3 partially completed. Eric Rignot has secured addtional funding to increase survey hours to >77.5 hours.

Signed Andrew Palmer

Sander Geophysics Ltd.

Week 2 Page 2

PERSONNEL ON SITE THIS WEEK						
Name	**Position**	**Arrival This Week**	**Departure This Week**	**On Site?**	**No. of Days On Site This Week**	**No. of Days on Site To Date**
Andrew Palmer	Geophysicist			ON SITE	7	12
Stefan Elieff	Geophysicist		6-Aug-16	ON SITE	6	12
Paul Langlois	Technician			ON SITE	7	12



SANDER GEOPHYSICS AIRBORNE GEOPHYSICAL SURVEY

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SURVEY DETAILS

Survey Name	Southeast Greenland Glaciers	**Client Name**	Eric Rignot
Survey Location	Southeastern Greenland	**Contact Name**	Eric Rignot
Project Code	Rignot15.GRL	**Contact Phone**	
Total km	5080.88	**Client Address**	
Line Spacing	1km		
Survey Type	Gravity / Radar	**Email**	eric.j.rignot@jpl.nasa.gov

SURVEY PRODUCTION SUMMARY

	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Block 8	Block 9	Block 10
Production This Week (km)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Remaining (km)	0.0	558.4	325.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent Complete (%)	100.0	58.9	35.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Prod km/Day This Week	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total km Flown to Date	646.2	801.5	178.9	257.3	223.5	527.3	488.8	457.3	338.4	278.3
km Reflown This Week	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flight Time This Week (h)	2.0									
Prod km/Flt Hour This Week	0.0									

WEEKLY PRODUCTION

Week 3			Flight No.	Flight Time	No. of Lines Flown	No. Reflight Lines Flown	Production (km)										Reflown (km)									
							Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Block 8	Block 9	Block 10	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Block 8	Block 9	Block 10
TOTALS				**2.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
8-Aug	**Mon**	C-FHCH	1008	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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weather	Cloud over ice cap				**Remarks**		Survey flight attempted but subsequently aborted with no production due to bad weather.																			
Geomag	n/a																									
9-Aug	**Tue**	C-FHCH	1009	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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weather					**Remarks**		Survey flight attempted but subsequently aborted with no production due to bad weather. Eric Rignot specified that today would be the last day of flying due to budgetary reasons.																			
Geomag																										
10-Aug	**Wed**	C-FHCH		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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weather	Cloud over ice cap				**Remarks**		Pack of equipment in Kulusuk. Shipment prepared, weighed and left with Fleming Johansen at Kulusuk airport, who will assist with shipping using IcelandAir. Paul Langlois departs for Kangerlussuaq where he will uninstall the equipment and ship out, when the helicopter arrives in Kangerlussuaq. Bad weather prevents departure of C-FHCH from Kulusuk.																			
Geomag	n/a																									
11-Aug	**Thu**	C-FHCH		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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weather	Cloud over ice cap				**Remarks**		Andrew leaves Kulusuk. C-FHCH attemps to leave Kulusuk but bad weather over ice-cap forces return and heliocpter lands in Tasiilaq.																			
Geomag																										
12-Aug	**Fri**	C-FHCH		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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weather	Cloud over ice cap				**Remarks**		C-FHCH remains in Tasiilaq due to bad weather.																			
Geomag	n/a																									
13-Aug	**Sat**	C-FHCH		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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weather	Clear				**Remarks**		C-FHCH completes ferry flight to Tasiilaq. Equipment uninstalled from helicopter and packed up.																			
Geomag	n/a																									
14-Aug	**Sun**	C-FHCH		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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weather	Clear				**Remarks**		Paul Langlois remains in Kangerlussuaq to organize shipment back to Canada.																			
Geomag	n/a																									

Comments No flying was possible on Monday and Tuesday due to bad weather over the ice-cap. Eric Rignot had specified that Tuesday would be the last day of attempted flying for budgetary reasons. Survey concluded with 8 of 10 planned blocks completed, 60% of block 2 and 35% of block 3. After a 3 day delay due to bad weather, C-FHCH ferried to Kangerlussuaq, where Paul and Helicarrier crew deinstalled survey equipment and packed-up.

Signed Andrew Palmer

Sander Geophysics Ltd.

Week 3 Page 2

PERSONNEL ON SITE THIS WEEK

Name	Position	Arrival This Week	Departure This Week	On Site?	No. of Days On Site This Week	No. of Days on Site To Date
Andrew Palmer	Geophysicist		11-Aug-16	ON SITE	4	16
Stefan Elieff	Geophysicist				0	12
Paul Langlois	Technician			ON SITE	7	19

WEEKLY PRODUCTION KILOMETRES AND HOURS FLOWN