GEOLOGICAL SURVEY OF NORWAY (NGU)

TROMS-FINNMARK FIXED-WING AEROMAGNETIC SURVEY 2014 (TROFI-14)

FINAL SURVEY REPORT

Produced by:

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1. Introduction

This report describes in detail the field operations, as well as the acquisition, verification, and processing steps required to obtain high quality final data through an airborne magnetic survey flown by **EON Geosciences Inc.** (**EON**) for the **Geological Survey of Norway** (**NGU**) on the mainland of northern Norway, as part of their Troms-Finnmark Aeromagnetic Survey 2014 (TROFI-14) project.

The TROFI-14 survey was flown from Alta, Tromsø, and Lakselv Airports. Including initial calibrations and data acquisition, the airborne survey was realized between July 3rd and November 17th 2014. A total of 66,039 line kilometers were necessary to cover the TROFI-14 survey area.

2. Survey Specifications

2.1. Survey Area

The survey area, comprised of two (2) sub-areas (TROFI-14 West and TROFI-14 Central), is located in northern Norway. Its boundary is outlined in Figure 1. The boundaries for the survey area are defined by the coordinates found in Appendix A.

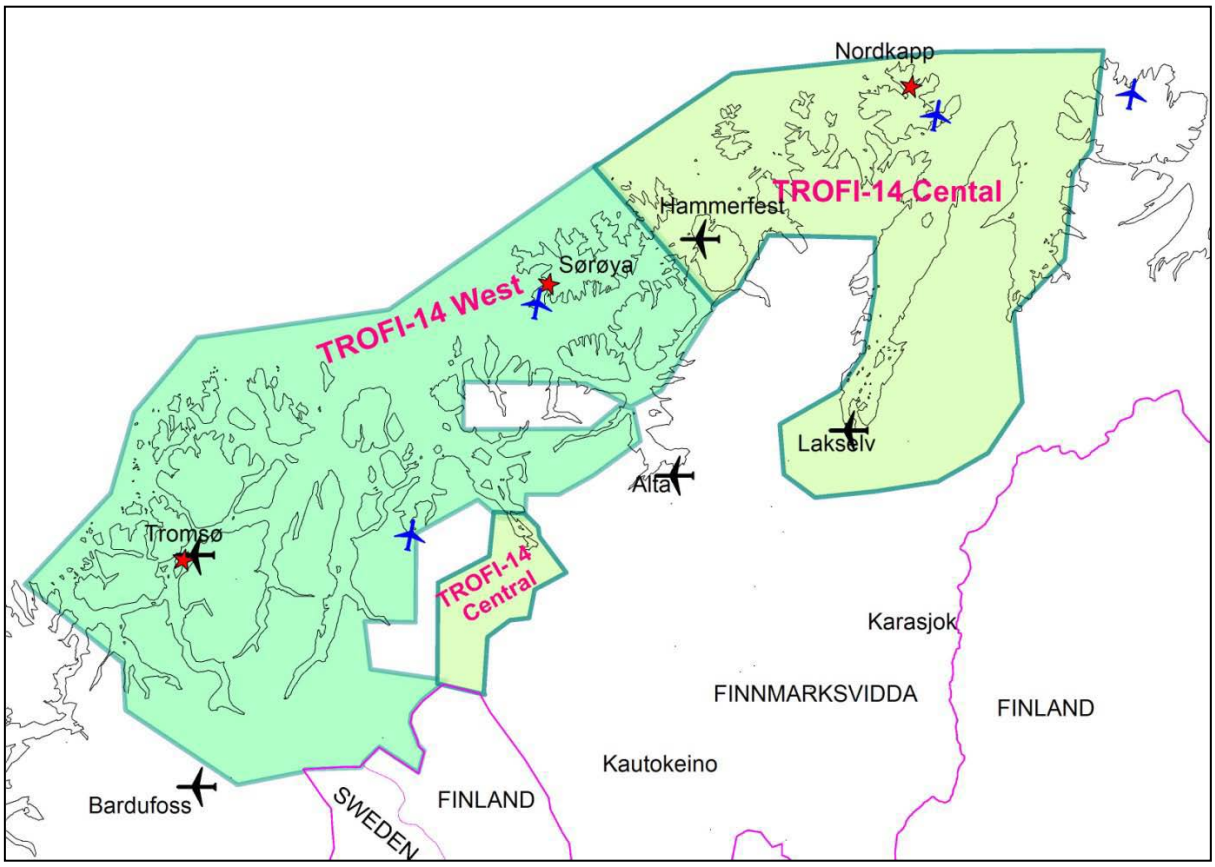


Figure 1: Location of the TROFI-14 Survey

In terms of altitude, terrain in the survey area may be described as severe. Specifically, the topography ranges from 0 meter (sea level) to approximately 1,816 meters, and drops rapidly over the fjords.

2.2. Flight Specifications

2.2.1. Line Spacing

	Traverse Lines	Tie Lines	Total
Spacing	1,000 m / 500 m	10 km / 5 km	
Heading	East-West	North-South	
Line-km	59,684 km	6,355 km	**66,039 km**

2.2.2. Altitude

The survey was flown at a nominal terrain clearance of 200 meters.

In order to ensure that traverse and tie lines were flown at equal altitude at intersections, and in turn ensure a higher quality of levelled data, a drape surface contouring the topography was used for navigation. This drape surface was computed using the topography supplied by **NGU** and a slope of 5%.

2.3. Technical Specifications

Throughout the survey, the following technical specifications, as defined in the contract, were considered for data acceptance.

2.3.1. Flight Plan

In the absence of required avoidances for safety or regulatory reasons, the following items were considered for potential re-flight, according to their impact on end-product quality:

- Horizontal deviation with respect to the planned flight path causing line separations in excess of ± 50 m from the planned flight line for distances continuously in excess of 5 km.
- Terrain clearance deviations, from the planned drape surface altitude, continuously for more than 3 km, except for where pilot's decision is due to safety reasons. Not more than 10 % of each line is allowed to be outside this limit.

2.3.2. Diurnal Activity

Tolerances for diurnal activity were:

- Maximum allowed diurnal variation is 100nT/h, 35nT/10 min, and 15 nT/2 min.

2.3.3. Airborne Magnetometer Noise

Tolerances for airborne total magnetic field (TMF) noise were:

- Intervals where airborne TMF data displayed sustained noise greater than an envelope of ±0.1nT, as determined by a 4th difference filter, were considered as potential re-flights.
- Standard figure of merit (FOM): better than 1.5 nT.

3. Survey Equipment and Personnel

3.1. Aircraft

EON provided a Piper Navajo PA-31 aircraft (registration C-FEON) for this project (see Figure 2 below). The aircraft is equipped with a tail stinger suitable for one magnetometer.

The technical specifications are:

Type:	Piper Navajo PA-31
Registration:	C-FEON
Range (km):	2,000
Survey speed (km/h):	288
Survey speed (m/s):	80
Rate of climb (%):	10
Aviation Fuel:	Avgas
Fuel consumption (L/hr):	135

Figure 2: C-FEON – Survey Aircraft

3.2. Airborne and Ground Systems

EON used the latest state-of-the-art technology instruments as described in the following sections.

3.2.1. Magnetometer

A Geometrics G822-A cesium-vapour split-beam sensor was used. The specifications are as follows:

Manufacturer:	Geometrics
Type and Model:	G822-A
Ambient Range (nT):	20,000 – 100,000
Sensitivity (nT):	± 0.0006
Absolute Accuracy (nT):	± 3
Sampling Interval (sec):	0.1
Heading Error (nT):	± 0.025

3.2.2. Data Acquisition System and Compensator

EON used RMS Instruments' Data Acquisition & Adaptive Aeromagnetic Real-Time Compensation (DAARC500) system. This data acquisition system integrates aeromagnetic real-time compensation with recording from analog and serial data sources. All data acquisition is synchronized in real-time to GPS time via a 1 second pulse. Since the GPS position and UTC time are related to the GPS pulse, a correlation precise to ±0.015 sec is maintained.

DAARC500 compensation uses a three-axis fluxgate magnetometer to monitor the aircraft's position and motion with respect to the ambient magnetic field. Resulting signals are compensated according to a calibration based on a set of standard manoeuvres of rolls, pitches, and yaws made along each survey heading. Aeromagnetic data are sampled at a rate of 10Hz.

Analog and serial inputs are sampled at the same rate as magnetometer data, or at sub-multiples of it. These data are recorded in the main data file as a sequence of blocks including system and GPS times, as well as PPS-correlation event tags, in order to allow an easy quality control of synchronization.

This system provides a high-resolution real-time graphical output to a built-in colour display that allows real-time monitoring of data acquisition by the operator.

3.2.3. Navigation

The following table describes the airborne differential GPS system that provided both real-time navigation and flight-path recovery:

GPS Manufacturer:	NovAtel
Model:	ProPak-V3
Differential System:	Omnistar
Frequencies:	2
Accuracy (m):	± 1
Number of Channels:	12
Navigation System:	Ag-Nav LiNav
Pilot Display:	LCD with up/down and left/right indicators
Sampling Interval (sec):	1

The main features of the positioning system are:

1) Real-time graphical and numerical display of flight path with survey-area and grid-line overlay using real-time differentially corrected GPS data.
2) Vertical navigation with respect to a drape surface.
3) Distance-from-line and distance-to-go indicators.
4) Operation in survey-grid or way-point navigation mode.
5) Recording of raw range-data for all satellites.

3.2.4. Radar Altimeter

The following table describes the two radar altimeters that were installed in the aircraft:

Manufacturer:	Honeywell	FreeFlight Systems
Model:	HG-7710AA01	RA-4000
Range (ft):	0 to 10,000 ft	0 to 2,500 ft
Accuracy:	± 3%	± 3 ft (0-100 ft) ± 3% (100-500 ft) ± 5% (500-2,500 ft)
Sampling Interval (sec):	0.1	0.1

3.2.5. Pressure and Temperature Sensor

The following table describes the pressure and temperature sensors that were installed in the aircraft:

Manufacturer:	Vaisala	Vaisala
Model:	PTB110	HMP155
Measured parameter	Real atmospheric pressure	Ambient air temperature
Accuracy:	± 0.3 hPa (mbar)	± 0.17 °C
Sampling Interval (sec):	0.1	0.1

3.2.6. Magnetic Base Station

The following table describes the base station magnetometers that were installed at two different locations in Alta, baseA and baseB. Figure 3 shows the baseA installation.

Manufacturer:	GEM Systems
Type:	Overhauser
Model:	GSM-19
Dynamic Range (nT):	10,000 – 120,000
Sensitivity (nT):	< 0.015
Absolute Accuracy (nT):	± 0.1
Sampling Interval (sec):	1
Noise level	< 0.1 nT

Figure 3: Magnetic Base Station A Installation

3.2.7. Field Data Quality Control System

The following list describes the main components of the in-field data verification system:

Computers:	PC and Mac laptops
Printer:	HP Photosmart C3180
Software:	Geosoft Oasis montaj, Waypoint GrafNav
Data transmission:	FTP site

Any calibrations or determinations that were carried out during the field operation were also processed on this system together with the daily quality control tests and checks.

3.3. Personnel

The following table lists the personnel of **EON** that were involved during this project:

Field Operation	
Project Manager	Khaled Moussaoui
Field Manager Operation Geophysicist Quality Control and Data Processing	Rick Bailey
Pilots / Co-pilots / Equipment Operators	Alain Charron Eric Robitaille Sebastian Albachiaro François-Xavier Pinte Hans Obas
Aircraft Maintenance Engineer	Alain Guillemette Jean-Philippe Perraton Hugo Meloche
Office Processing	
Final Data Processing	Rick Bailey
Survey Report	Khaled Moussaoui Rick Bailey
Final Products	Khaled Moussaoui Rick Bailey

4. Field Operations

4.1. Base of Operations

The survey was conducted from Alta, Norway. The Alta Airport was used as a base of operation. During the last month of the survey, the aircraft and crew relocated to Tromsø, thus minimizing ferry distance and maximizing production to complete the project. Lakselv and Hammerfest airports were also used for fueling during the survey.

4.2. Schedule

The table below displays the schedule of survey activities including tests, calibrations, and demobilization. Data acquisition was completed on November 17th, 2014, for a total accepted production of 66,039 line-km.

Schedule – TROFI-14 Survey – Norway		
Aircraft	**Date**	**Description**
Piper Navajo PA-31 (C-FEON)	July 3rd – 4th, 2014	Pre-mobilization tests (altimeter and FOM) flown in Montreal.
	July 5th, 2014	C-FEON begins ferry flight from Montreal.
	July 9th, 2014	C-FEON arrives in Alta.
	July 10th, 2014	Base stations installed in Alta. Successful FOM test, flown offshore, northern Norway.
	July 13th, 2014	Production flying begins.
	July 14th, 2014	Primary radar unit A fails. Flights restricted to eastern section of TROFI-14 Central block, where terrain is less severe and within range of secondary radar unit B.
	July 15th, 2014	Radar altimeter test flown over Alta airport runway.
	August 29th, 2014	High-altitude radar A installed in C-FEON. Radar altimeter test flown over Alta airport runway.
	October 29th, 2014	C-FEON and crew re-locate to Tromsø. Base stations and geophysicist remain in Alta.
	November 17th, 2014	Data acquisition completed.
	November 18th, 2014	Demobilization begins.

4.3. Operational Issues

Production was operationally efficient from early July through August 2014, when two (2) sorties per day could often be performed. The first half of September was non-productive, owing largely to low-lying cloud in the mountains of the remaining TROFI-14 West block. Mid-September through mid-October again saw increased production. Two sorties per day were common during this time, often spanning all daylight hours. Mid-October to the end of data acquisition in mid-November was characterized by long idle periods without production, due to weather conditions and vastly reduced daylight hours. The major factors affecting production were:

- Weather, including low ceilings, fog, rain, snow, frost, and high winds, most notably toward the end of the fall season.
- Weather was also a large cause of re-flights due to deviation from drape and/or flight path, and of the breaking of some survey lines into multiple overlapping segments.
- Reduced daylight hours into the fall season.
- National security authorities designated as no-fly zones several segments of the original survey area, with the following coverage disruptions:
  - 4 shortened traverses: 1050, 2070, 2150, and 2730.
  - 31 traverses broken into two (2) sections: 1150, 1270, 1330, 1350, 1370, 1410, 1430, 1470, 1490, 1510, 1610, 1710, 1730, 1850, 2190, 2210, 2230, 2350, 2390, 2450, 2470, 2490, 2510, 2730, 2970, 4690, 5510, 5560, 5570, 5580, and 5950.
  - 3 traverses broken into three (3) sections: 1530, 1590, and 2290.
  - 1 displaced tie: 8050.
- Failure of the primary radar unit A at beginning of survey, limiting data acquisition to the eastern section of the TROFI-14 Central block, where terrain is mostly within range of the secondary radar unit B.

These issues are identified in the daily operational report found in Appendix D.

4.4. Tests and Calibrations

Prior to production flights, the following tests and calibrations were performed by the Piper Navajo PA-31 aircraft (C-FEON) in the Montreal area and in Norway:

- Altimeter calibration
- Figure of Merit (FOM)

Detailed compilations for those tests are presented in Appendix B.

5. Data Processing

The key objective of this survey was the acquisition and processing of airborne total field magnetic (TMF) data. Preliminary field quality control and final data processing were performed using Geosoft Oasis montaj. In the following text, final database *channel names* are printed in *italics*, and a description of these channels may be found in Appendix C.

5.1. Map Projection

The following mapping projection was used throughout the project for navigation, data processing, and mapping purposes:

- Projection: UTM Zone 34N
- Type: Transverse Mercator
- Datum: WGS-84
- Reference ellipsoid: WGS-84
- Local datum transform: WGS-84 World
- Length unit: Meters

5.2. Field Processing and Quality Control

The field crew provided the field processor with backups of ground-based and airborne data files, either after each flight or on a daily basis, allowing for immediate quality control (QC) and initial data processing as described in the following. Field processing was entirely reviewed by the senior processor on a daily basis.

Acquired data files were first merged into Oasis data files (GDB) in full flight format, on which the following basic QC and processing operations were performed:

- Inspection of the flight path for completeness of coverage and compliance to line-spacing and altitude specifications.
- Trimming of the *line* channel in order to provide four (4) seconds of extension outside of the survey boundary and preserve a maximal length of usable overlapping data, in-spec or not, useful for the determination and assessment of final processing parameters.
- Statistical analysis and inspection, both in profile and grids, of key channels in order to ascertain compliance to diurnal and noise specifications (as described in Section 2.3), as well as to detect eventual operational issues requiring immediate action, such as missing data or hardware problems.
- Logging of lines or segments of line possibly requiring re-flight, evaluation of their impact on general end-product quality via periodic preliminary processing of available data.

Full flight GDBs were separated into survey lines and gradually concatenated into the field line database, for a total of 848 lines at the end of acquisition. This updated line GDB allowed for more advanced QC processing (such as effectiveness of lag and diurnal corrections), optimization of flight planning, and periodic deliveries of preliminary field data to **NGU**.

5.3. Positioning Data

The NovAtel ProPak-V3 GPS unit transmitted real-time RT-DGPS data to the RMS Instruments DAARC500 acquisition system for data recording and synchronization, as well as to the Ag-Nav LiNav navigation system for line and drape navigation. The ProPak-V3 used Omnistar broadcast data for real-time differential corrections. The synchronization of GPS data with respect to geophysical data consists in the proper alignment of serial RT-DGPS data with respect to a PPS pulse transmitted by the ProPak-V3 specifying the corresponding RMS system time of these data at a precision of

0.015 sec. Synchronization was verified through an analysis of the differences between available clocks (RMS system, Ag-Nav, and ProPak-V3) and of the lag between GPS, barometric, and radar altitudes, in order to detect and correct possible improper alignment caused by occasional spurious serial transmission delays. Gridding and intersection levelling of TMF data provided a final validation of synchronization and instrumental lags.

Recorded airborne raw GPS data were used for DGPS post-processing, using the NovAtel Waypoint software. Waypoint PP-DGPS computations were made either in differential mode, using raw data of the GPS base station, or in precise point positioning (PPP) mode, using CSRS precise clocks and ephemeris data available at the Natural Resource Canada web site. Base station positioning was performed in PPP mode. Mean sea level (MSL) elevations were referenced to the EGM-96-World ellipsoidal-to-orthometric model. Daily and final PP-DGPS quality control, based on the analysis of velocity profiles and on comparison of PP-DGPS, RT-DGPS, and barometric altitudes, ascertained that RT-DGPS precision remained suitable for navigation (< 5 m) and that Waypoint post-processing improved positioning precision to the order of 1m.

PPP-DGPS final data were used to finalize QC of flight path and drape following (channel *drape*) during field operations, to complete radar QC and edits through computation of a digital terrain model (DTM), and to compute altitude differences at intersections, allowing for a precise flagging of line segments displaying excessive deviations and requiring re-flight.

5.4. Altimetry Data and Digital Terrain Model

It is good to first note that the height difference of the GPS antenna with respect to the instrumental platform, which was +2.5 m for C-FEON, was taken into account for all computations involving GPS, barometric, radar, and digital terrain model (DTM) elevations. As an example, the formula used to determine the final DTM elevation is (*DTMf* = *z* – 2.5 – *raltlf*).

Raw radar altitude (*raltl*) is first obtained by a linear transformation from raw readings using parameters determined via the acquisition of an altimeter calibration flight (refer to Section 4.4). Edition of radar data (*raltlc*) is performed via LP filtering against discrete spikes and noise, and by levelling of the resulting DTM elevation, where DTM errors are considered as radar corrections. Flt001-flt005 and flt007-flt043 use data from the secondary radar unit B. Flt006 had no working radar. Flt044 through flt090 use data from the high-altitude radar unit A, installed on August 29th, 2014.

The method used for DTM levelling was dictated by the mostly very rugged terrain (0-1816m, prevalence of steep-sided fjords) and its impact on acquired radar data. Saturation of the secondary radar unit B occurred over 7.4% of the area where altitudes above ground level (AGL) were in excess of its 660m maximal range. These saturation areas, as well as flt006 in full, require replacement with data derived from the published DTM supplied by **NGU** (*topoSRTM*, *raltSRTM*) in order to obtain seamless final radar and DTM channels (*raltlf*, *DTMf*). Water surfaces were observed over 45.3% of the area at sometimes marginally high altitudes, causing drifty level-jumps of varying amplitude due to reflectance discontinuity at shores and increasing impact of platform-swing with higher altitudes. Also, significant tidal shifts affect the DTM, depending on the time of day the data is acquired.

Processing of the radar data consisted of the following steps to produce the digital terrain model (*DTMf*):

- Merger of radarA and radarB data into *raltl* channel.
- Application of de-spiking and noise filters.
- Nullification of saturated data from flt002-flt043 (above 660m AGL).
- Trend0 correction based on intersection statistics.
- Computation of a *raltSRTM* channel.
- Modelization of DTM (*topoSRTM)* differences using LP filters on flights requiring substantial substitution of *raltSRTM*.
- Adjustment of 'over-water' data via an LP filter of 1.0 sec (all flights).
- Substitution of *raltSRTM* data into *raltlc* channel for all saturated regions (flt002-flt043), creating *raltlf*.

Note that the raw *raltl* channel was not dummied and includes saturated readings. The final digital terrain model *DTMf* was then computed (*z*-2.5-*raltlf*) and put at the 1Hz sampling rate of the GPS data.

Raw barometric altitude (*baltl*) is computed from recorded pressure and temperature channels. Edited barometric data (*baltlc*) are obtained by application of non-linear de-spiking and LP 6.0 sec filtering. The difference between barometric and GPS altitudes could then be used to control proper synchronization of GPS, as well as the respective quality of real-time and post-processed GPS elevation data (refer to Section 5.3). Finally, the final barometric altitude *baltlf* was obtained by applying a correction based on a modelization of the difference between *baltlc* and GPS altitude *z*, using spatial LP filtering of 3000m (35 sec).

5.5. Ground-Based Magnetic Data

Two (2) base stations were installed in the Alta area, the main baseA (forest near Skodevarre) used for computation of the diurnal correction, and the backup baseB (field near Alta Airport) which was located at some distance from baseA in order to assist in the detection of transient cultural signal. Magnetic base station profiles were verified daily to reduce the probability that data be collected during periods with diurnal variations above the project specifications. Although the base stations were installed at magnetically quiet locations, away from moving steel objects, vehicles, and power lines, base data were monitored and occasionally edited for signal of cultural origin. All flights are corrected using base station A, excluding flights 004, 016, 043, 085, 086, and 090, which are corrected using base B. A DC shift of -46.67 nT is applied to base B on those flights, to bring both base stations to the same average value. Data is then merged into a channel called *Base* to be used in the diurnal correction.

5.6. Airborne Magnetic Data

5.6.1. Compensation and Edition against Transient Cultural Signal

The removal of magnetic signals related to the heading and manoeuvring of the aircraft was applied by the RMS Instruments DAARC500 real-time compensator, based on a compensation solution acquired and validated during an FOM test flight (refer to Appendix B). Real-time compensation allows for in-flight quality control, as the operator may determine when turbulence level becomes detrimental to data quality and abort the acquisition when advisable. Following the application of the lag correction, uncompensated (*um3l*) and compensated (*m3l*) raw TMF profiles were monitored on a daily basis to further assess compensation effectiveness.

The edited TMF channel (*maglc*) is obtained via two distinct correction phases:

1) Removal of discrete transient cultural signals (the object of this section), performed on a daily basis whenever possible and during final processing.
2) Removal of residual compensation noise from de-cultured *maglc*.

Transient cultural signals originate either from the operation of the aircraft or from external sources such as radar towers, and are observable, on both uncompensated and compensated channels, as spikes, level-shifts, and/or bursts of high-frequency noise of varying length and amplitudes. Their manual removal is mostly straight-forward and consists in adjustment of constant level-shifts, minimum curvature re-interpolation over short intervals, and/or local filtering. The main difficulty resides in their detection, especially in high-gradient TMF, and requires a meticulous inspection of a battery of QC channels, including 4th difference, noise channels of 1.5 to 5.0 seconds wavelengths, as well as high-pass versions of the *um3l*, *m3l*, and preliminarily edited *maglc* channels. Sources of discrete noise include:

- Radio transmissions from the aircraft, unavoidable in an inhabited and developed area comprising several airports and significant conflicting traffic, by far the most frequent transient

source, and observable as negative spikes or level-shifts of amplitude ranging from 0.05 to 5.0 nT.

- Most other avionics operations (fuel pumping, de-icing, ON/OFF switching of heaters, etc.) could mostly be performed during the turns, but occasionally occurred on-line.
- Sinusoidal noise, possibly from an external radar source, requiring additional filtering. Observable on lines 1671, 2832, 4940, 4980, 5000, 5020, 5040, 5360, 5370, 5380, 5390, 5510, 5570, 5580, 5900, 5910, 5920, and 5930.

5.6.2. Partial IGRF Correction from Flight to Drape Surfaces

A partial IGRF signal (*pmigrfz*) was then used in order to minimize the effect of drape deviations between adjacent lines. The 2010 IGRF fields were first computed for the flight (*migrfz*) and drape (*migrfd*) surfaces and low-pass filtered by 3 seconds. The partial IGRF signal was then computed (*pmigrfz=migrfz-migrfd*) and removed from the edited TMF (*maglc*) to obtain an altitude-corrected TMF (*mreslc=maglc-pmigrfz*).

5.6.3. Diurnal Correction

A diurnal-removal correction was calculated by removing the survey base A reading average of all on-line data (53,563.3 nT) from the edited magnetic base profiles. Subsequently, a Butterworth 20,000m '1-D FFT' spatial filter was applied on profile data. The length of the filter was determined by the tie line spacing and effectiveness of the correction in minimizing intersection differences between traverses and ties.

Removal of the diurnal signal was performed as follows:

- Computation of the final diurnal signal to remove: (*baseA* - average 53,563.330nT (all on-line data)) re-interpolated (minimum curvature) at 10Hz and low-pass filtered at a length of 20,000m.
- Subtraction of the diurnal signal from the preliminarily edited and altitude-corrected TMF (*mreslcb* = *mreslc* - diurnal signal).

5.6.4. Intersection Leveling

The method of iterative intersection leveling aims at the proper statistical re-distribution of TMF differences at tie-traverse intersections (misties). It was planned according to nine (9) iterative passes, with parameters designed to fit the present line spacing geometry, as described in Table 1 below. Each pass, applied first on ties, then on traverses, modelizes the updated *mreslvl* misties left by the previous correction by using LP filter models of gradually decreasing wavelengths. This ensures a progressive reduction of misties eventually resulting in the smoothest possible levelling corrections with minimal line-to-line correlation (often referred to as "tie-pull"). Results of each iterative modelization are further optimized by the proper re-selection of the misties that are actually used in computation, by removing aberrant misties that excessively influence the current model. Typically, as little as 85-90% of misties are selected at the initial passes, since several of the intersecting lines are not yet properly modelized. The selection rate gradually increases as leveling progresses to shorter wavelengths, eventually leading to a selection rate of 98% or better at the final pass.

Ties	Correction filter model	Traverses	Correction filter model
Pass 1a	polynomial degree 0	Pass 1b	polynomial degree 0
Pass 2a	polynomial degree 1	Pass 2b	polynomial degree 1
Pass 3a	50,000m Butterworth LP	Pass 3b	50,000m Butterworth LP
Pass 4a	25,000m Butterworth LP	Pass 4b	25,000m Butterworth LP
Pass 5a	15,000m Butterworth LP	Pass 5b	15,000m Butterworth LP

Pass 6a	10,000m Butterworth LP	Pass 6b	10,000m Butterworth LP
Pass 7a	5,000m Butterworth LP	Pass 7b	5,000m Butterworth LP
Pass 8a	Tensioned Spline/2500m BW LP	Pass 8b	1,000m Butterworth LP
Pass 9a	Spline	Pass 9b	Spline/1000m BW LP

Table 1: Parameters of Iterative Intersection Leveling of TMF

Manual intersection adjustments were performed in a few areas still exhibiting signs of corrugation, as determined by inspection of the first and second vertical derivative of the leveled TMF grid. 150 'pseudo' intersection correction values were placed between tie lines, where interpolated leveling models are likely to be less effective. This also helped to reduce the degree of micro-leveling necessary in the next stage. A spline or 1000m Butterworth LP filter correction was applied on pseudo corrections, depending on which filter better modeled the necessary correction.

5.6.5. Micro-leveling

Micro-leveling, a process based on the application of directional grid filters, was performed, aiming at removal of residual leveled TMF corrugations (visible on the first vertical derivative) observed mostly in the traverse intervals between tie lines. Such corrections were inherent due to the 10:1 network ratio, and also from altitude deviations from drape. Micro-leveling was applied using parameters specific to the two (2) line spacing condition, 1000m in the West Block and 500m in the Central Block, by calculating the error grid on the TMF:

- TROFI-14 West Block (1000m survey line spacing) – applying a Butterworth high-pass filter (cut-off wavelength=4,000m, order=8) and a directional cosine filter (direction=000°, degree of cosine function=1.5).

- TROFI-14 Central Block (500m survey line spacing) – applying a Butterworth high-pass filter (cut-off wavelength=2,000m, order=8) and a directional cosine filter (direction=000°, degree of cosine function=1.5).

For each line spacing condition, the error grid is removed from the tie line leveled TMF to produce a corrected grid. Each corrected grid is then re-sampled into the database and the error channels created from the subtraction of the tie line leveled profiles. The error channels are then clipped and filtered, which becomes the micro-leveling correction. A clip of 2nT and 1nT and a 700 second and 350 second low-pass filter were used for the West Block and Central Block, respectively.

Applying the micro-leveling correction involved flagging the survey lines as occurring in either the West, Central or both blocks. For survey lines crossing into both blocks, the appropriate micro-leveling correction is applied according to the block in which the segment of line belongs. The correction is then filtered with a 10s low-pass filter to smooth the transition between the 1000m and 500m line spacing micro-leveling correction.

This allows the dataset to be processed and presented as one block, as it was designed, without cutting lines into their subset blocks.

5.6.6. Final Line Selection

The previous processing steps were performed on all acquired survey lines, including re-flights and overlap of the lines flown in multiple segments. The final kilometreage to be kept in the final database is determined by the proper selection among overlapping full survey lines and/or trimming of line segments so as to obtain a minimal overlap over an intersecting line. In order to preserve data of the best overall quality, selection and trimming criteria were, in order of priority:

1) Minimal level of TMF noise.
2) Minimal diurnal activity.

3) Minimal drape deviation and/or altitude difference at intersections.
4) Minimal flight path deviation.

Selected lines and/or line segments were exported to the final survey database. Final line selection is based primarily on maximizing the quality of the resultant magnetic data. In all cases of re-flown lines, except for two (2) line segments L4717 and L5572, the re-flown lines improved the overall magnetic data quality. Both re-flown lines L4717 and L5572 had poorly correlated base and air magnetic data, evident in the first vertical derivative of the TMI grid. As a result, the originally flown L4716 and L5570 were brought back and L4717 and L5572 were removed.

Lines were inspected and extended in a few cases at the survey boundary to ensure complete coverage. National security lines were inspected and re-trimmed to increase data coverage. Consecutive partial traverse lines were trimmed at alternating tie lines to improve the grid network and decrease the probability for 'tie-pull'.

5.6.7. IGRF Residual of TMF

Finally, the IGRF residual of the micro-leveled TMF (*mreslvldi*) was computed as follows:

- Computation of the IGRF field using the 2010 model, a fixed date of 2014/09/18, and a fixed acquisition altitude of 684.6m.
- Subtraction of the IGRF field from micro-leveled TMF (*mreslvldi* = *mreslvld* - IGRF).

5.6.8. Gridded Data

The following grids were delivered with the final Oasis GDB database described in Appendix C. They were computed according to a GSC method designed to very significantly alleviate the aspect of grids of vertical derivatives obtained directly from Oasis magmap1 GX, which are typically very noisy and filled with artefacts between survey lines. Additional processing consisted in three (3) phases of masking, first outside and then inside of the contractual survey boundary, and thirdly inside areas where traverse coverage was prohibited by national security authorities.

• Micro-leveled TMF	channel *mreslvld*	mreslvld_tmf.grd
• IGRF residual of micro-leveled TMF	channel *mreslvldi*	mreslvld_igrf.grd
• 1st vertical derivative of micro-leveled TMF	channel *mreslvld_vg1*	mreslvld_vg1.grd
• 2nd vertical derivative of micro-leveled TMF	channel *mreslvld_vg2*	mreslvld_vg2.grd

The gridding method was as follows:

- Gridding of *mreslvld* and *mreslvldi* channels using traverse lines only.
- Preliminary computation of VG1 and VG2 grids with the magmap1 GX.
- Sampling of the derivative grids into database channels (*mreslvld_vg1*, *mreslvld_vg2*), again for traverse lines only.
- Re-gridding of *mreslvld_vg1* and *mreslvld_vg2* with a high number of iterations.
- Application of masking (survey boundary, prohibited survey).

6. Final Deliverables

6.1. Digital Data

The following digital data were delivered to **NGU** in two (2) DVD copies:

Final Digital Data		
Product	**Data**	**Format and projection**
Database	Magnetic survey data	Geosoft GDB, WGS-84
Grids	Total magnetic field	Geosoft GRD, WGS-84
	Residual magnetic field	Geosoft GRD, WGS-84
	First vertical derivative of the total magnetic field	Geosoft GRD, WGS-84
	Second vertical derivative of the total magnetic field	Geosoft GRD, WGS-84
	Digital terrain model	Geosoft GRD, WGS-84
Report	Logistics, processing, and documentation of products	WORD and PDF

A description of the fields delivered in the final processed database is given in Appendix C.

6.2. Other Products

- Two (2) paper copies of the final report

7. Conclusion

Data acquisition was completed using a Piper Navajo PA-31 aircraft, registration C-FEON, with a single magnetometer installed in a tail stinger.

Once at the base of operation, approximately four and a half (4.5) months were necessary to acquire the total of 66,039 line-kilometers of data, including tests and calibrations on-site. At the end of October, the aircraft and pilots re-located from Alta to Tromsø until the survey was completed.

Major delays were due primarily to bad weather and reduced sunlight hours in late fall.

Re-flights were mostly selected on the basis of deviations from drape due to inclement weather conditions and diurnal deviations from contract specifications. All final accepted data were of high quality, and final products were delivered as required by **NGU**.

Submitted by: _____

Khaled Moussaoui, B.Eng., MBA
President
EON Geosciences Inc.

Appendix A – TROFI-14 Survey Area Coordinates

Boundaries – Aeromagnetic Survey – TROFI-14 West Area – Norway, 2014 (WGS84 Zone 34N)				
Corner #	**X**	**Y**	**Longitude °E**	**Latitude °N**
1	364621.21	7732439.71	17.507634	69.665484
2	374547.19	7732483.05	17.763103	69.670770
3	374633.88	7742495.72	17.751610	69.760456
4	384429.83	7742539.07	18.004927	69.765333
5	384473.17	7753505.33	17.992056	69.863556
6	394572.53	7753461.98	18.254665	69.867435
7	394615.88	7783499.99	18.220155	70.136497
8	404585.20	7783499.99	18.482792	70.140382
9	404585.20	7795506.53	18.469638	70.247940
10	414641.22	7795506.53	18.736043	70.251490
11	414641.22	7807469.72	18.724182	70.358679
12	424610.54	7807426.37	18.989801	70.361439
13	424697.23	7810503.86	18.989400	70.389043
14	434623.21	7810503.86	19.254259	70.391790
15	434623.21	7811500.79	19.253495	70.400726
16	444419.16	7811457.45	19.515096	70.402670
17	444462.50	7814534.93	19.514245	70.430266
18	464574.53	7814534.93	20.052169	70.433874
19	464617.88	7817525.73	20.052081	70.460694
20	484513.19	7817482.39	20.585073	70.462305
21	484556.53	7820473.19	20.585688	70.489125
22	494612.55	7820473.19	20.855465	70.489539
23	494612.55	7827451.71	20.855019	70.552113
24	504581.87	7827451.71	21.123302	70.552129
25	504625.22	7834430.24	21.124855	70.614702
26	514637.89	7834430.24	21.395135	70.614318
27	514637.89	7841495.46	21.396380	70.677667
28	524563.87	7841452.11	21.665135	70.676500
29	524520.52	7848473.99	21.666048	70.739462
30	534576.54	7848517.33	21.939176	70.738658
31	534576.54	7855409.17	21.942082	70.800445
32	544589.21	7855452.51	22.214846	70.799238
33	544545.86	7862474.39	22.217504	70.862192
34	554515.19	7862431.04	22.489846	70.859809
35	554471.84	7868629.36	22.492831	70.915376
36	565914.89	7868716.05	22.806326	70.913362
37	565958.24	7866505.46	22.805709	70.893539
38	575884.22	7866462.12	23.077197	70.890302
39	575884.22	7855539.20	23.067012	70.792427
40	585896.89	7855582.55	23.339523	70.789556
41	585810.20	7843576.01	23.324645	70.682018
42	595866.21	7843532.67	23.596684	70.677977
43	595866.21	7832523.07	23.584004	70.579359
44	605792.20	7832523.07	23.851154	70.575380
45	605835.54	7806559.47	23.819889	70.342838
46	595822.87	7806516.13	23.553413	70.346413
47	595822.87	7791518.80	23.536766	70.212065
48	585766.85	7791518.80	23.270827	70.215624
49	585810.20	7784583.61	23.265147	70.153470
50	564527.86	7784583.61	22.703717	70.159686
51	564571.20	7789481.59	22.708487	70.203576
52	554601.88	7789524.93	22.444851	70.206279
53	554645.22	7793425.97	22.448453	70.241239
54	517802.06	7793425.97	21.471955	70.246450
55	517802.06	7777388.36	21.468683	70.102645
56	554645.22	7777388.36	22.438416	70.097475
57	554645.22	7779468.92	22.439710	70.116126
58	564614.55	7779468.92	22.702232	70.113821
59	564571.20	7784540.27	22.704828	70.159287
60	578875.02	7784540.27	23.082197	70.155300
61	578831.67	7770453.18	23.068436	70.029076
62	575797.53	7770453.18	22.988885	70.029981
63	575754.18	7763431.31	22.981762	69.967065
64	565958.24	7763431.31	22.725653	69.969735
65	565958.24	7757579.75	22.721334	69.917286
66	556162.29	7757536.40	22.465773	69.919192
67	556118.95	7754458.91	22.462717	69.891613

Boundaries – Aeromagnetic Survey – TROFI-14 West Area – Norway, 2014 (WGS84 Zone 34N)				
Corner #	X	Y	Longitude °E	Latitude °N
68	545759.52	7754458.91	22.192784	69.893635
69	545802.86	7745616.56	22.189422	69.814352
70	524650.56	7745529.87	21.640171	69.816417
71	524607.21	7749474.25	21.640119	69.851789
72	515721.51	7749474.25	21.408981	69.852474
73	515764.85	7743536.00	21.409073	69.799222
74	505752.18	7743536.00	21.149262	69.799633
75	505752.18	7710420.50	21.147192	69.502668
76	486463.71	7710420.50	20.653624	69.502387
77	486463.71	7694599.62	20.655900	69.360511
78	495869.55	7694556.27	20.895002	69.360432
79	495912.89	7693472.65	20.896151	69.350714
80	506098.94	7693472.65	21.154967	69.350676
81	506142.29	7691478.78	21.155940	69.332795
82	515894.89	7691478.78	21.403532	69.332395
83	515894.89	7685497.19	21.402534	69.278754
84	505795.53	7685497.19	21.146772	69.279160
85	505795.53	7658536.67	21.145156	69.037377
86	494569.20	7658536.67	20.863979	69.037384
87	494569.20	7663521.33	20.863702	69.082087
88	485770.19	7663477.98	20.642881	69.081381
89	485813.53	7659533.60	20.644542	69.046010
90	465744.85	7659533.60	20.141749	69.044230
91	465788.19	7657496.39	20.143547	69.025967
92	455775.52	7657539.73	19.892924	69.024919
93	455775.52	7655459.18	19.893863	69.006264
94	445719.51	7655502.52	19.642399	69.004843
95	445762.85	7654418.90	19.644081	68.995136
96	434623.21	7654462.25	19.365693	68.993091
97	434666.56	7657539.73	19.364726	69.020690
98	424610.54	7657539.73	19.113186	69.018102
99	424653.89	7664561.61	19.108855	69.081053
100	414381.15	7664518.26	18.851266	69.077631
101	414381.15	7671496.79	18.845115	69.140172
102	404541.86	7671496.79	18.597734	69.136893
103	404585.20	7677521.73	18.592873	69.190893
104	394615.88	7677521.73	18.341689	69.187200
105	394615.88	7700494.52	18.316316	69.392995
106	384213.10	7700494.52	18.051821	69.388705
107	384083.07	7709510.26	18.037411	69.469393
108	374373.81	7709553.60	17.789673	69.465390
109	374243.78	7717485.72	17.775682	69.536350
110	364664.56	7717529.06	17.530557	69.532039

Boundaries – Aeromagnetic Survey – TROFI-14 Central 1 Area – Norway, 2014 (WGS84 Zone 34N)				
Corner #	X	Y	Longitude °E	Latitude °N
1	562967.44	7868802.74	22.725669	70.914908
2	564527.86	7868802.74	22.768408	70.914505
3	564527.86	7872270.33	22.771184	70.945582
4	569642.55	7872226.99	22.911441	70.943800
5	569729.24	7875781.27	22.916903	70.975627
6	574713.91	7875737.92	23.053787	70.973774
7	574757.25	7879248.86	23.058254	71.005221
8	579698.57	7879292.20	23.194222	71.004055
9	579741.91	7882239.66	23.198357	71.030449
10	584423.16	7882239.66	23.327281	71.028882
11	584466.51	7885707.25	23.332153	71.059932
12	589537.86	7885707.25	23.472015	71.058129
13	589494.52	7889261.53	23.474827	71.089984
14	594652.56	7889261.53	23.617281	71.088040
15	594739.25	7892729.12	23.623827	71.119065
16	599680.57	7892815.81	23.760591	71.117872
17	599680.57	7895763.26	23.764315	71.144269
18	604448.50	7895763.26	23.896330	71.142271
19	604361.81	7899274.20	23.898588	71.173747
20	609563.20	7899274.20	24.042802	71.171460
21	609519.86	7900747.93	24.043657	71.184674

Boundaries – Aeromagnetic Survey – TROFI-14 Central 1 Area – Norway, 2014 (WGS84 Zone 34N)				
Corner #	**X**	**Y**	**Longitude °E**	**Latitude °N**
22	619315.80	7900704.58	24.315277	71.179675
23	619272.46	7902265.00	24.316448	71.193664
24	634183.10	7902265.00	24.730000	71.185887
25	634226.44	7903738.72	24.733726	71.199048
26	648660.29	7903738.72	25.133970	71.190644
27	648660.29	7905255.80	25.136849	71.204210
28	663180.83	7905255.80	25.539389	71.194888
29	663224.18	7906252.73	25.542668	71.203769
30	672976.78	7906296.07	25.813011	71.197406
31	673020.12	7907726.45	25.817373	71.210154
32	735740.18	7907726.45	27.551179	71.157427
33	735740.18	7891250.00	27.502213	71.010654
34	730740.00	7891250.00	27.365381	71.015404
35	730740.00	7886750.00	27.352415	70.975305
36	725740.00	7886750.00	27.215794	70.979944
37	725740.00	7876750.00	27.187786	70.890806
38	730740.00	7876750.00	27.323801	70.886190
39	730740.00	7876250.00	27.322378	70.881734
40	735740.18	7876250.00	27.458301	70.877019
41	735740.18	7869279.53	27.438107	70.814915
42	730798.87	7869279.53	27.304198	70.819558
43	730712.18	7842752.46	27.227779	70.583204
44	725814.20	7842752.46	27.096515	70.587651
45	725814.20	7831266.06	27.065665	70.485235
46	720742.85	7831222.72	26.930256	70.489328
47	720699.51	7825804.61	26.914982	70.441042
48	715714.84	7825804.61	26.782252	70.445334
49	715671.50	7820733.25	26.768242	70.400128
50	710773.53	7820733.25	26.638049	70.404239
51	710686.84	7779252.19	26.535158	70.034117
52	705702.17	7779208.85	26.404840	70.037735
53	705702.17	7771753.53	26.387576	69.971178
54	700760.86	7771753.53	26.258849	69.975040
55	700717.51	7767245.66	26.247585	69.934820
56	695776.19	7767245.66	26.119053	69.938580
57	695776.19	7764775.00	26.113650	69.916513
58	691355.01	7764818.34	25.998819	69.920182
59	691355.01	7761740.86	25.992255	69.892690
60	685936.90	7761697.51	25.851457	69.896218
61	685893.56	7759270.20	25.845312	69.874560
62	681732.45	7759226.85	25.737235	69.877099
63	681775.79	7758273.26	25.736435	69.868547
64	676444.37	7758273.26	25.598086	69.872199
65	676401.03	7756799.54	25.594075	69.859056
66	667168.56	7756756.19	25.354444	69.864732
67	667211.91	7755239.12	25.352756	69.851140
68	655855.55	7755282.47	25.058172	69.858538
69	655812.20	7753245.26	25.053529	69.840341
70	634573.20	7753288.60	24.502447	69.852510
71	634573.20	7756799.54	24.507693	69.883935
72	629631.89	7756842.88	24.379245	69.886822
73	629675.23	7760310.47	24.385383	69.917842
74	624647.22	7760310.47	24.254390	69.920294
75	624647.22	7780769.26	24.283126	70.103454
76	629631.89	7780812.61	24.414196	70.101387
77	629631.89	7783760.06	24.418547	70.127770
78	634616.55	7783803.41	24.549754	70.125603
79	634616.55	7786750.86	24.554283	70.151982
80	639601.21	7786794.20	24.685627	70.149716
81	639644.56	7789741.66	24.691478	70.176067
82	644629.22	7789741.66	24.822885	70.173312
83	644672.56	7795246.46	24.833174	70.222539
84	649657.23	7795246.46	24.964855	70.219679
85	649657.23	7804262.20	24.980451	70.300328
86	654598.54	7804262.20	25.111458	70.297385
87	654598.54	7824764.33	25.148590	70.480747
88	659409.83	7824720.98	25.277171	70.477372
89	659279.79	7842795.80	25.308023	70.639070
90	649570.54	7842795.80	25.046269	70.645053
91	649613.88	7843272.60	25.048296	70.649292
92	625817.54	7843272.60	24.405975	70.662379

Boundaries – Aeromagnetic Survey – TROFI-14 Central 1 Area – Norway, 2014 (WGS84 Zone 34N)				
Corner #	**X**	**Y**	**Longitude °E**	**Latitude °N**
93	625774.19	7839761.66	24.399490	70.630975
94	620702.84	7839761.66	24.262704	70.633468
95	620746.18	7831179.37	24.251468	70.556617
96	615761.52	7831222.72	24.117556	70.559347
97	615761.52	7824244.19	24.107953	70.496865
98	610820.20	7824244.19	23.975519	70.499081
99	610776.86	7819736.32	23.968452	70.458734
100	599593.88	7819736.32	23.669217	70.463381
101	599593.88	7825284.47	23.675758	70.513076
102	594609.21	7825284.47	23.542007	70.514993
103	594565.87	7830789.27	23.547040	70.564321
104	589537.86	7830789.27	23.411771	70.566160
105	589537.86	7836770.86	23.418181	70.619747
106	584466.51	7836770.86	23.281358	70.621506
107	584423.16	7842752.46	23.286268	70.675112
108	579611.88	7842795.80	23.156135	70.677078
109	579568.54	7848257.26	23.160223	70.726028
110	574540.53	7848300.61	23.023867	70.727970
111	574583.87	7853762.06	23.030001	70.776896
112	569599.21	7853762.06	22.894427	70.778341
113	569599.21	7859743.66	22.899523	70.831945
114	564614.55	7859787.00	22.763599	70.833683
115	564657.89	7865291.80	22.769163	70.883006
116	563010.79	7865291.80	22.724121	70.883431

Boundaries – Aeromagnetic Survey – TROFI-14 Central 2 Area – Norway, 2014 (WGS84 Zone 34N)				
Corner #	**X**	**Y**	**Longitude °E**	**Latitude °N**
1	524737.25	7748303.94	21.643181	69.841283
2	545716.17	7748303.94	22.188530	69.838460
3	545716.17	7737727.78	22.183202	69.743640
4	550744.18	7737771.13	22.313318	69.743107
5	550744.18	7730792.60	22.309447	69.680543
6	552347.94	7730835.95	22.350842	69.680619
7	552347.94	7727238.32	22.348793	69.648366
8	550744.18	7727238.32	22.307485	69.648678
9	550744.18	7724247.52	22.305838	69.621865
10	545802.86	7724290.87	22.178737	69.623154
11	545759.52	7719739.65	22.175370	69.582357
12	540818.20	7719739.65	22.048476	69.583163
13	540818.20	7711244.06	22.044748	69.506990
14	535746.85	7711244.06	21.914969	69.507718
15	535746.85	7708773.40	21.914024	69.485565
16	530762.19	7708773.40	21.786585	69.486186
17	530718.84	7705262.46	21.784326	69.454709
18	525994.25	7705262.46	21.663707	69.455210
19	525994.25	7685237.12	21.658210	69.275638
20	519535.86	7685237.12	21.494684	69.276183
21	519579.20	7686754.19	21.496092	69.289784
22	514377.82	7686754.19	21.364305	69.290112
23	514377.82	7688227.92	21.364527	69.303328
24	509393.15	7688227.92	21.238151	69.303547
25	509479.84	7725764.59	21.244146	69.640161
26	514551.20	7725764.59	21.374752	69.639931
27	514594.54	7728278.60	21.376267	69.662472
28	519579.20	7728278.60	21.504773	69.662150
29	519622.55	7730749.26	21.506418	69.684302
30	524390.49	7730749.26	21.629461	69.683904

Appendix B – Calibration Tests Results

B.1. Figure of Merit (FOM)

EON Geosciences Inc.

FOM Test:	**MAG3: tail stinger**	Date:	July 10th, 2014
Slot:		Flight:	901
Project:	14001	Location:	Alta, Norway
Client:	NGU	Aircraft:	C-FEON
Pilot:	Hans Obas	Sensors:	1 tail stinger
Operator	Eric Robitaille	Altitude:	3215m
Processor:	Rick Bailey	Comp:	DAARC500

Special: 4-5 sec oscillations.
Notes: **12 seconds** high pass filter used to determine amplitudes.

MAG 3 Results	ucomp	comp	IR
Total	**9.145**	**0.721**	**12.684**

East (N090)	Line	start	Fid range end	ucomp	comp	IR
Pitch	99090	44896	44908	1.232	0.096	12.833
Roll		44910	44923	1.258	0.036	34.944
Yaw		44925	44943	0.401	0.064	6.266
Total				**2.891**	**0.196**	**14.750**

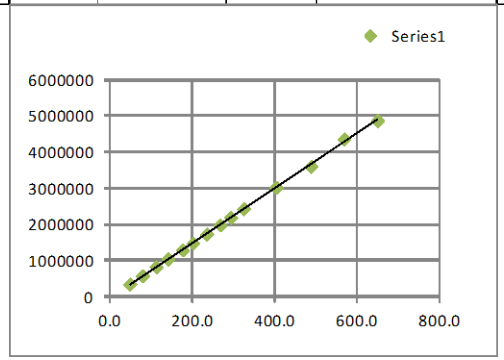
North (N360)	Line	start	Fid range end	ucomp	comp	IR
Pitch	99360	44989	45006	2.010	0.043	46.744
Roll		45008	45024	0.828	0.027	30.667
Yaw		45021	45040	0.243	0.026	9.346
Total				**3.081**	**0.096**	**32.094**

West (N270)	Line	start	Fid range end	ucomp	comp	IR
Pitch	99270	45086	45106	0.442	0.086	5.140
Roll		45107	45122	0.689	0.032	21.531
Yaw		45121	45136	0.123	0.029	4.241
Total				**1.254**	**0.147**	**8.531**

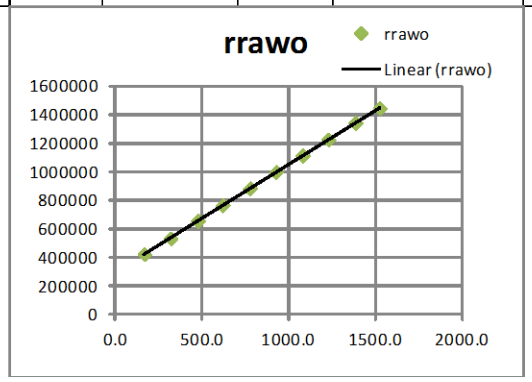
South (N180)	Line	start	Fid range end	ucomp	comp	IR
Pitch	99180	45181	45201	0.271	0.177	1.531
Roll		45202	45217	1.530	0.060	25.500
Yaw		45218	45231	0.118	0.045	2.622
Total				**1.919**	**0.282**	**6.805**

B.2. Altimeter Calibration

C-FEON July 15th 2014			Altimeter calibration(Radar B, Bendix King)							Alta	RunwayH	3.0 mMSL		Alta, ENAT, 10', 3.0m		
EON Geosciences Inc.			Aircraft: C-FEON							ENAT	AntH	2.5 m				
		Units	mMSL	uV	m	m	mMSL	mbar	C	mMSL	mMSL	mMSL	m	Constants and formulaes below are valid under 11000m		
Line		fid range	z	rrawBo	raltBo	*raltAerr*	DTM	PrawBo	TrawBo	bstpBo	brawBo	baltBo	*baltBerr*	**Baro**	**Constants (sea level)**	**units**
90000	33990.0	34110.0	3.8	0	-6.6	*-4.9*	7.9	1010.1	22.2	26.7	26.9	-17.4	*-21.2*	8314.32	**R** - Universal Gas Constant	kmol-1
90100	34380.0	34412.0	48.7	359781	41.6	*-1.6*	4.6	1002.9	22.6	87.9	88.7	45.3	*-3.4*	273.15	**T** - Celsius zero in Kelvin	K
90200	34536.0	34576.0	79.5	590920	72.5	*-1.5*	4.5	999.0	22.5	121.4	122.4	79.4	*-0.1*	28.96442	**M** - Molecular Weight of Air	kg*kmol-1
90300	34861.0	34899.0	112.4	834425	105.1	*-1.8*	4.8	995.2	23.2	154.0	155.7	113.2	*0.8*	9.80665	**g** - acceleration of gravity	m*s-2
90400	35317.0	35350.0	141.1	1050001	134.0	*-1.6*	4.6	991.1	23.9	190.0	192.5	150.5	*9.4*	0.00	**H** - Datum Height	m
90500	35728.0	35759.0	176.1	1302770	167.8	*-2.8*	5.8	988.0	23.4	216.5	219.0	177.4	*1.3*	1013.25	**P** - Datum Pressure	mbar
90600	35880.0	35913.0	201.8	1495300	193.6	*-2.7*	5.7	985.1	23.2	241.7	244.4	208.1	*1.3*	20.00	**st** - Standard Temperature	Celsius
90700	36045.0	36075.0	234.9	1739206	226.3	*-3.1*	6.1	981.5	23.4	273.4	276.5	235.7	*0.8*			
90800	36280.0	36309.0	267.3	1994823	260.5	*-1.3*	4.3	977.8	23.8	305.9	309.8	269.4	*2.1*			
90900	36444.0	36472.0	293.4	2203225	288.4	*0.5*	2.5	974.9	23.8	331.1	335.4	295.3	*1.9*			
91000	36565.0	36594.0	324.4	2439622	320.0	*1.1*	1.9	971.2	24.4	363.5	369.0	329.4	*5.0*	Formula for **MSL** baro altitude from pressure and temperature		
91250	36711.0	36746.0	403.6	3029908	399.1	*1.0*	2.0	962.5	23.7	440.8	446.4	407.8	*4.2*			
91500	36873.0	36902.0	487.6	3609513	476.7	*-5.4*	8.4	953.3	23.7	523.6	530.2	492.8	*5.2*	brawBo= **H** + (**R***(TrawBo+**T**)/**M***g)*ln(**P**/PrawBo)		
91750	37016.0	37045.0	568.3	4367956	578.2	*15.4*	-12.4	944.4	22.6	604.2	609.6	573.2	*4.9*			
92000	37154.0	37190.0	649.7	4888153	647.9	*3.7*	-0.7	935.8	22.7	682.4	688.7	653.4	*3.7*			
								983.4						Formula for **STP** baro altitude from pressure and STP temperature		
	Statistics					***0.0***	**3.0**						***2.4***	bstpBo= **H** + (**R***(st+**T**)/**M***g)*ln(**P**/PrawBo)		
	Calibrations		raltAo	a	b						baltBo	a	b			
			linest	0.0001338908	0.50						linest	1.0009885	-43.54			
→			**used**	**0.0001338908**	**-6.60**						**used**	**1.0135771**	**-44.62**			



C-FEON Aug 29th 2014			Altimeter calibration(Radar A, high-alt)							Alta	RunwayH	3.9 mMSL		Alta, ENAT, 13', 3.9m		
EON Geosciences Inc.			Aircraft: C-FEON							ENAT	AntH	2.5 m				
		Units	mMSL	uV	m	m	mMSL	mbar	C	mMSL	mMSL	mMSL	m	Constants and formulaes below are valid under 11000m		
Line	fid range		z	rrawAo	raltAo	*raltAerr*	DTM	PrawBo	TrawBo	bstpBo	brawBo	baltBo	*baltBerr*	**Baro**	**Constants (sea level)**	**units**
90000	62280.0	62400.0	3.9	300757	-2.5	*0.0*	3.9	1017.7	12.9	-37.6	-36.7	-13.6	*-17.5*	8314.32	**R** - Universal Gas Constant	kmol-1
90500	62975.0	63005.0	169.0	424367	161.3	*-1.3*	5.2	996.4	13.4	143.9	140.7	166.0	*-3.0*	273.15	**T** - Celsius zero in Kelvin	K
91000	63135.0	63169.0	320.6	534414	307.1	*-7.1*	11.0	978.5	12.4	299.5	291.7	319.0	*-1.6*	28.96442	**M** - Molecular Weight of Air	kg*kmol-1
91500	63280.0	63314.0	476.6	656749	469.2	*-1.0*	4.9	960.3	11.7	460.6	447.5	476.8	*0.2*	9.80665	**g** - acceleration of gravity	m*s-2
92000	63424.0	63456.0	619.5	765129	612.8	*-0.3*	4.2	943.8	10.5	609.3	589.5	620.6	*1.1*	0.00	**H** - Datum Height	m
92500	63624.0	63655.0	776.8	885485	772.3	*1.9*	2.0	926.0	9.4	772.7	744.7	777.7	*0.9*	1013.25	**P** - Datum Pressure	mbar
93000	63899.0	63934.0	926.1	998929	922.7	*3.0*	0.9	909.1	8.9	930.7	895.5	930.4	*4.3*	20.00	**st** - Standard Temperature	Celsius
93500	64142.0	64175.0	1079.7	1115604	1077.3	*4.0*	-0.1	892.2	7.6	1091.7	1045.5	1082.4	*2.7*			
94000	64386.0	64421.0	1228.2	1226468	1224.2	*2.4*	1.5	876.1	6.8	1248.0	1191.8	1230.5	*2.3*	Formula for **MSL** baro altitude from pressure and temperature		
94500	64615.0	64645.0	1383.9	1341970	1377.2	*-0.3*	4.2	859.5	5.4	1412.1	1341.8	1382.4	*-1.5*			
95000	64900.0	64939.0	1523.3	1446270	1515.5	*-1.4*	5.3	844.9	4.3	1559.1	1475.6	1517.9	*-5.4*	brawBo= **H** + (**R***(TrawBo+**T**)/**M***g)*ln(**P**/PrawBo)		
														Formula for **STP** baro altitude from pressure and STP temperature		
	Statistics					*0.0*	3.9						*0.0*	bstpBo= **H** + (**R***(st+**T**)/**M***g)*ln(**P**/PrawBo)		
	Calibrations		raltAo	a	b						baltBo	a	b			
			linest	0.0013251772	-395.74						linest	1.0126927	23.57			
→			**used**	**0.0013251772**	**-401.10**						**used**	**1.0126927**	**23.57**			



Appendix C – Final Processed Database Field Description

14001 Geological Survey of Norway, Troms-Finnmark Aeromagnetic Survey 2014 (TROFI-14)

Notes: -All data acquired from Piper Navajo PA-31 aircraft, registration C-GFEON.
-Data channels were kept are their original field sampling rate.
-All proper lags have been applied to raw and processed data channels.

Channel Description:

Channel Name	Sampling Rate	Units	Description	Comments
date	01Hz	yyyy/mm/dd	Acquisition date	Start of acquisition, UTC
flt	01Hz		Flight number	
line	01Hz	llln	Line number	lll: planned line number, n: segment code
fid10	10Hz	s	Fiducial	UTC seconds past midnight
hgps	01Hz	hh:mm:ss.ss	Time	UTC
x	01Hz	m	UTM Easting	WGS-84, Z34N, Waypoint PP-DGPS
y	01Hz	m	UTM Northing	WGS-84, Z34N, Waypoint PP-DGPS
z	01Hz	m MSL	GPS altitude	Waypoint PP-DGPS
drape	01Hz	m MSL	Drape altitude	Planned flight surface
raltl	10Hz	m AGL	Radar altitude, raw	Transformed from raw readings
raltlc	10Hz	m AGL	Radar altitude, edited	Corrected for noise, drift, nulled at saturation
raltSRTM	10Hz	m AGL	Radar altitude, published	Aircraft AGL altitude above topoSRTM
raltlf	10Hz	m AGL	Radar altitude, final	Merge of raltSRTM into raltlc at saturation
DTMf	01Hz	m MSL	Digital terrain model, final	DTM model, [z-2.5m-raltlf]
topoSRTM	01Hz	m MSL	Digital terrain model, published	DTM model, NGU source
baltl	01Hz	m MSL	Baro altitude, raw	Computed from raw pressure & temperature
baltlc	01Hz	m MSL	Baro altitude, edited	Corrected for noise
baltlf	01Hz	m MSL	Baro altitude, final	Corrected for drift w.r.t. GPS altitude
baseA	01Hz	nT	Main magnetic base, edited	Corrected for noise, cultural signal
baseB	01Hz	nT	Backup magnetic base, edited	Corrected for noise, cultural signal
base	01Hz	nT	Merger of BaseA, BaseB	baseB shifted to average baseA background
mfluxX	10Hz	nT	Fluxgate MF-X, raw	Longitudinal vector sensor
mfluxY	10Hz	nT	Fluxgate MF-Y, raw	Transverse vector sensor
mfluxZ	10Hz	nT	Fluxgate MF-Z, raw	Vertical vector sensor
um3l	10Hz	nT	Uncompensated TMF, raw	Cesium sensor 3, lower tail stinger
m3l	10Hz	nT	Compensated TMF, raw	Cesium sensor 3, lower tail stinger
maglc	10Hz	nT	TMF, edited	Corrected for noise, aircraft & cultural signal
mreslc	10Hz	nT	TMF, partial IGRF corrected	Partial IGRF to drape surface removed
mreslcb	10Hz	nT	TMF, diurnal corrected	Zero-average & filtered diurnals removed
mreslvl	10Hz	nT	TMF, levelled	Iterative intersection levelling correction
mreslvld	10Hz	nT	TMF, micro-leveled	Micro-levelling correction applied on mreslvl
mreslvld_vg1	10Hz	nT/m	1^{st} vertical gradient of TMF	Traverses only (Oasis magmap1.gx)
mreslvld_vg2	10Hz	nT/m^2	2^{nd} vertical gradient of TMF	Traverses only (Oasis magmap1.gx)
mreslvldi	10Hz	nT	IGRF residual of TMF	Model: 2010, date: 2014/09/18, elev: 684.6m

Appendix D – Daily Operational Report

EON GEOSCIENCES INC
Daily report

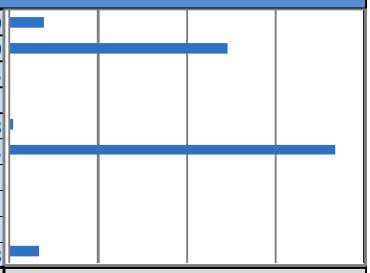
2021 Côte-de-Liesse, St-Laurent, QC, Canada H4N 2M5
Tel: +1-514-341-3366, Cell: +1-514-651-6391, Fax: +1-514-341-5366
info@eongeosciences.com

Aircraft		Projects	Area & Client	Crew chiefs:	Richard Bailey
Code:	C-FEON	14001	Norway TROFI-14, NGU	Pilots:	A. Charon, E. Robitaille, S. Albachiaro, FX Pinte, H. Obas
Type:	Piper Navajo			Engineers:	A. Guillemette, JP Perraton, H. Meloche
FBO:	EON Airborne			Operators:	E. Robitaille, S. Albachiaro
Inst:	Tail Mag			Processors:	R. Bailey, K. Moussaoui

						Total Project
Project		14001				
Block		A				
Planned Kms		65809.91				65809.91
Total flown Kms		67133.94				67133.94
Total accepted Kms		65809.91				65809.91
Total survey hours		288.30				288.30
Total test-training hours		5.31				5.31
Total ferry hours		96.50				96.50
Total hours		390.11				390.11
Total days						
Average kms/day (total)						
Average kms/hour (survey)		228.27				228.27
Project Completion		100.0%				100.0%

Activity Histogram

Set-up (SE)	8.0
Production (P)	49.0
Maintenance (M)	0.3
Electronics (E)	
Diurnals (D)	0.8
Weather (W)	73.3
Training (TR)	
Safety (SAF)	
Crew (CR)	
Other (X)	6.8



Flight information					Aircraft hours				Kilometreage		Daily activity report				
Date	Project no.	Blk	Flt	Crew (initials)	Ferry	Test Train	Sur-vey	Total	Flown	Accepted	Activity Code (per 1/4 days)				Comments
3-Jul-14	14001	A	801	ac,sa,pb	0.2	0.9		1.1			SE	SE	SE	SE	Altimeter test flown.
4-Jul-14	14001	A	802	er,ho	0.9	0.8		1.7			SE	SE	SE	SE	FOM test flown.
5-Jul-14	14001	A		er,ho	8.3			8.3			SE	SE	SE	SE	C-FEON and crew begin mobilization to survey site (Montreal to La Grande to Iqaluit)
6-Jul-14	14001	A		er,ho	3.1			3.1			SE	SE	SE	SE	C-FEON and crew continue mobilization to survey site (Iqaluit to Kangerlussuaq).
7-Jul-14	14001	A		er,ho	4.2			4.2			SE	SE	SE	SE	C-FEON and crew continue mobilization to survey site (Kangerlussuaq to Reykjavik).
8-Jul-14	14001	A		er,ho	5.1			5.1			SE	SE	SE	SE	C-FEON and crew continue mobilization to survey site (Reykjavik to Bergen).
9-Jul-14	14001	A		er,ho	4.4			4.4			SE	SE	SE	SE	C-FEON and crew arrived in Alta. R. Bailey arrived in Alta.
10-Jul-14	14001	A	901	er,ho		2.1		2.1			SE	SE	SE	SE	Successful compensator calibration flight. A. Charon and S. Albachiaro arrive in Alta.
11-Jul-14	14001	A									W	W	W	W	No flight due to low cloud cover.
12-Jul-14	14001	A	001	er,sa	0.8			0.8			P	P	X	X	Flight terminated due to low cloud. Airport closed in afternoon.
13-Jul-14	14001	A	002	er,sa	0.3		2.7	3.0	724.72	724.72	P	P	P	P	**flt002**: lines 3210, 3230, 3250, 3270. **flt003**: lines 3290, 3310, 3330, 3350, 3370, 3390. FX Pinte arrives in Alta.
	14001	A	003	er,sa	0.2		4.1	4.3	1099.35	1099.35					
14-Jul-14	14001	A	004	ac,fp	0.6		4.1	4.7	1107.20	1107.20	P	P	P	P	**flt004**, lines 3790, 3810, 3830, 3850, 3870, 3890. **flt005**, lines 3410, 3430, 3450, 3470, 3490, 3510, 3530, 3550.
	14001	A	005	er,sa	0.4		4.1	4.5	1062.58	1062.58					
15-Jul-14	14001	A	902	er,fp		0.8		0.8			X	X	W	W	Radar altimeter test in morning. Low cloud in afternoon.
16-Jul-14	14001	A	006	er,fp	0.9		3.5	4.4	706.27	706.27	P	P	W	W	**flt006**: lines 5680 (xy dev due to power transmission towers), 5690, 6010, 6020, 6030, 6050, 6060, 6061 (accidental re-flight), tie 8450* (flown as partial, due to cloud)*.
17-Jul-14	14001	A									W	W	W	W	No flight due to cloud and rain.
18-Jul-14	14001	A									W	W	W	W	No flight due to cloud and rain. Alain Guillemette (AME) arrives in Alta.
19-Jul-14	14001	A									W	W	X	X	No flight due to fog. Airport closed in afternoon.
20-Jul-14	14001	A	007	er,sa	1.1		4.4	5.5	1191.89	1191.89	W	W	P	P	Fog in morning. **flt007**, lines 3820, 3835, 3840, 3855, 3860, 3915, 3920, 3935, 3940, 3955, 3960, 3975, 3980, 3995, 4000, 4015, 4020, 4035, 4040, 4055.
21-Jul-14	14001	A	008	er,sa	0.8		3.1	3.9	653.24	601.16	P	P	P	P	**flt008**: lines 2980, 2995, 3000, 3015, 3020, 3035, 3040, 3055, 3060, 3075, 3080, 3095, 3096* (accidental re-flight)*, 3100, 3115, 3120.
	14001	A	009	er,fp	0.8		4.6	5.4	1106.71	1106.71					**flt009**: lines 3135, 3140, 3155, 3160, 3175, 3180, 3195, 3200, 3215, 3220, 3235, 3240, 3255, 3260, 3275, 3280.
22-Jul-14	14001	A	010	fp,sa	0.5		4.0	4.5	942.93	942.93	P	P	P	P	**flt010**: lines 3295, 3300, 3315, 3320, 3335, 3340, 3355, 3360, 3375, 3380, 3395, 3400. **flt011**: lines 3415, 3420, 3436, 3440, 3456, 3460* (flown as partial due to cloud)*, 3476, 3480. Flight ended due to rain in block.
	14001	A	011	fp,sa	0.5		2.8	3.3	633.49	633.49					

Flight information					Aircraft hours				Kilometreage		Daily activity report				Comments
Date	Project no.	Blk	Flt	Crew (initials)	Ferry	Test Train	Sur-vey	Total	Flown	Accepted	Activity Code (per 1/4 days)				
23-Jul-14	14001	A	012	er,sa	0.4		4.7	5.1	1129.85	1129.85	P	P	P	P	**flt012**: lines 3496, 3500, 3516, 3520, 3536, 3540, 3556, 3560, 3576, 3580, 3596, 3600, 3616, 3620. **flt013**: lines 3636, 3640, 3656, 3660, 3676, 3680, 3696, 3700, 3716, 3720, 3736, 3740. **flt014**: lines 3756, 3760. Flight ended due to rain in block.
	14001	A	013	er,fp	0.4		3.5	3.9	842.97	842.97					
	14001	A	014	fp,sa	0.8		0.5	1.3	132.13	132.13					
24-Jul-14	14001	A	015	fp,sa	0.8		4.0	4.8	967.60	967.60	P	P	P	P	**flt015**: lines 3776, 3780, 3795, 3800, 3815, 3875, 3880, 3895, 3900, 4060, 4075, 4080, 4095, 4100, 4115, 4120. **flt016**: lines 4135, 4140, 4155, 4160, 4175, 4180, 4195, 4200, 4215, 4220, 4235, 4240.
	14001	A	016	er,sa	0.8		3.0	3.8	673.93	673.93					
25-Jul-14	14001	A	017	fp,sa	0.9		4.1	5.0	632.60	632.60	P	P	P	W	**flt017**: lines 4255, 4260, 4275, 4280, 4295, 4300, 4315, 4316*, 4325, 4326*, 4335, 4336*, 4345, 4346*, 4355, 4356* (accidental re-flight)*. **flt018**: No production due to cloud cover in block.
	14001	A	018	fp,sa	0.6			0.6							
26-Jul-14	14001	A									W	W	X	X	No flight due to cloud in morning. Airport closed in afternoon.
27-Jul-14	14001	A	019	er,sa	0.6		4.7	5.3	1092.83	1092.83	P	P	P	P	**flt019**: lines 4365, 4375, 4385, 4395, 4405, 4415, 4425, 4435, 4445, 4455, 4465, 4475, 4485, 4495, 4505, 4515, 4525, 4535. **flt020**: lines 4545, 4555, 4565, 4575, 4585, 4595, 4605, 4615, 4625, 4635, 4645, 4655, 4665, 4675, 4685, 4695.
	14001	A	020	er,sa	0.7		4.5	5.2	1063.68	1063.68					
28-Jul-14	14001	A									W	W	W	W	No flight due to rain and fog.
29-Jul-14	14001	A	021	fp,sa	0.9		2.4	3.3	446.04	409.64	W	W	P	P	Low cloud in morning. **flt021**: lines 4705*, 4715*, 4725, 4735*, 4745*, 4755*, 4765*, 4775 (flown as partial, due to cloud)*. **Field Delivery 001** uploaded to ftp site.
30-Jul-14	14001	A	022	fp,sa	1.2		3.5	4.7	783.46	783.46	W	W	P	P	Low cloud in morning. **flt022**: lines 5940, 5960, 5970, 5980, 5990, 6000, 6040, 8590*, 8600*, 8755 (flown as partial)*. C-FEON lands in Hammerfest due to fog in Alta.
31-Jul-14	14001	A									W	W	W	W	C-FEON ferries to Alta in morning. No production flight due to low cloud cover.
1-Aug-14	14001	A	023	er,sa	0.2		0.6	0.8	41.90	41.90	P	P	W	W	**flt023**: ties 8460*, 8470* (flown as partials due to cloud)*.
2-Aug-14	14001	A	024	er,sa	0.6		3.9	4.5	866.21	826.01	P	P	X	X	**flt024**: ties 8530, 8540, 8550, 8560, 8570, 8580, 8591** (full tie flown)**, 8595*, 8601*, 8610*, 8620*, 8630*, 8640* (flown as partial due to cloud over sea)*. Airport closed in afternoon.
3-Aug-14	14001	A									W	W	W	W	No flight due to cloud cover in survey block.
4-Aug-14	14001	A	025	er,fp	0.5		4.8	5.2	1053.21	1053.21	P	P	P	P	**flt025**: ties 8430, 8440; lines 5590, 5880, 5890, 5900, 5910, 5920, 5930, 5991* (accidental re-flight). **flt026**: lines 4320, 4340, 4360, 4380, 4400, 4420, 4440, 4460, 4480, 4500, 4520, 4540, 4560, 4580, 4600. Marc Richard, technician, arrives in Alta.
	14001	A	026	er,sa	0.6		1.7	2.3	312.83	312.83					
5-Aug-14	14001	A	027	fp,sa	1.3		1.0	2.2	212.48	212.48	P	W	W	W	**flt027**: lines 4620, 4640, 4660, 4680, 4700, 4720. Flight terminated due to rain.
6-Aug-14	14001	A									W	W	W	W	No flight due to cloud.
7-Aug-14	14001	A	028		0.8		3.5	4.3	921.88	921.88	W	P	P	W	Fog in morning. **flt028**: lines 4780*, 4800*, 4820*, 4840, 4860, 4880, 4900* (flown as partial due to fog)*. Rain in evening.
8-Aug-14	14001	A									W	W	W	W	No flight due to cloud.
9-Aug-14	14001	A									W	W	W	W	No flight due to cloud.
10-Aug-14	14001	A	029	fp,sa	0.9		3.8	4.8	938.40	938.40	P	P	P	P	**flt029**: (delayed in morning, due to cloud) lines 4920*, 4940*, 4960, 4980, 5000, 5020, 5040 (flown as partial due to cloud)*. **flt030**, lines, 5060, 5080, 5100, 5120, 5140, 5160, 5180, 5200. JP Perraton (AME) arrives in Alta.
	14001	A	030	er,sa	0.8		5.3	6.1	1314.20	1314.20					
11-Aug-14	14001	A	031	er,sa	0.5		4.8	5.3	1231.59	1231.59	W	P	P	P	**flt031**: (delayed in morning ,due to cloud) lines 5800, 5810, 5820, 5830, 5840, 5850, 5860, 5870; ties 8480, 8490. **flt032**: lines 5770, 5780, 5790; ties 8500, 8611* (completed partial)*.
	14001	A	032	er,fp	0.5		2.3	2.8	526.10	526.10					
12-Aug-14	14001	A	033	fp,sa	0.5		4.5	5.0	1070.03	1070.03	P	P	P	W	**flt033**: lines 5220, 5240, 5260, 5280, 5300; ties 8395, 8650.
13-Aug-14	14001	A									W	W	W	W	No flight due to rain.
14-Aug-14	14001	A									W	W	W	W	No flight due to rain.
15-Aug-14	14001	A									W	W	W	W	No flight due to cloud.
16-Aug-14	14001	A									W	W	X	X	No flight due to cloud. Airport closed in afternoon.
17-Aug-14	14001	A									W	W	W	W	No flight due to cloud and rain.

Flight information					Aircraft hours				Kilometreage		Daily activity report				Comments
Date	Project no.	Blk	Flt	Crew (initials)	Ferry	Test Train	Sur-vey	Total	Flown	Accepted	Activity Code (per 1/4 days)				
18-Aug-14	14001	A	034	er,sa	0.9		3.3	4.2	853.25	853.25	W	W	P	P	Cloud in morning. **flt034**: lines 5710, 5720, 5730, 5740, 5750, 5760; tie 8420.
19-Aug-14	14001	A									W	W	W	W	No flight due to cloud and rain.
20-Aug-14	14001	A									W	W	W	W	No flight due to cloud. Jomar Gellein (NGU) visits crew in Alta and completes inspection on C-FEON.
21-Aug-14	14001	A	035	fp,sa	1.2		0.8	2.0	178.80	178.80	W	W	P	P	Cloud in morning. **flt035**: lines 5650*, 5670* (large xy dev. due to electrical tower), 5680* (flown as partial, due to cloud)*.
22-Aug-14	14001	A	036	er,sa	0.7		4.9	5.6	1072.36	1072.36	W	P	P	P	Cloud in morning. **flt036**: lines, 4740, 4760, 4781*, 4801*, 4821*, 5600, 5610, 5620, 5630, 5640, 5700; ties 8461, 8471*. (completed 2nd segment of partial)*.
23-Aug-14	14001	A	037	fp,sa	0.9		2.7	3.5	684.84	684.84	W	P	P	X	Fog and cloud in morning. **flt037**: lines 5310*, 5320, 5330, 5340 (drape deviation at eastern end of line, due to close proximity with Novatem aircraft)*. Airport closed in afternoon.
24-Aug-14	14001	A	038	er,sa	0.3		4.2	4.5	1028.64	1028.64	P	P	P	P	**flt038**: lines 5490, 5500, 5520, 5530, 5540, 5550; ties 8510, 8520.
	14001	A	039	er,sa	0.5		5.0	5.5	1253.09	1253.09					**flt039**: lines 5410, 5420, 5430, 5440, 5450, 5460, 5470, 5480.
25-Aug-14	14001	A	040	er,fp	0.8		5.2	6.0	1354.17	1354.17	P	P	P	P	**flt040**: lines 5220, 5240, 5260, 5280, 5300; ties 8390, 8650.
	14001	A	041	fp,sa	0.9		3.1	4.0	676.68	676.68					**flt041**: line 5190; ties 8690*, 8700, 8710, 8720, 8730 (flown as partial due to cloud)*.
26-Aug-14	14001	A	042	fp,sa	0.9		3.3	4.2	682.62	682.62	P	P	P	P	**flt042**: lines 5030, 5050, 5070; ties 8680*, 8740, 8745. **flt043**: lines 5110*, 5130*; ties, 8535, 8545, 8555, 8565, 8575, 8585 (flown as partial due to cloud)*.
	14001	A	043	fp,sa	0.8		3.2	4.0	677.66	677.66					
27-Aug-14	14001	A									W	W	W	W	No flight due to cloud and rain. **Field Delivery 002** uploaded to ftp site.
28-Aug-14	14001	A									W	W	W	W	No flight low cloud.
29-Aug-14	14001	A	905	er,sa		0.7		0.7			W	W	X	X	Low ceiling in morning. High altitude radar altimeter test flown over Alta airport runway in afternoon.
30-Aug-14	14001	A									W	W	X	X	No flight due to fog/low cloud. Airport closed in afternoon. JP Perraton (AME) leaves Alta in morning.
31-Aug-14	14001	A	044	er,sa	0.5		5.5	6.0	1135.06	1040.97	P	P	P	P	**flt044**: lines 2040, 2055, 2060, 2075, 2080, 2095, 2100, 2115, 2120, 2135, 2140*, 2155, 2160, 2175, 2180, 2195, 2200, 2215, 2220, 2235, 2240*, 2255*, 2260, 2275, 2280, 2295, 2300, 2315, 2320, 2335, 2340, 2355, 2360, 2375, 2380, 2395; tie 8360.
	14001	A	045	er,sa	0.6		3.8	4.4	902.72	863.19					**flt045**: lines 1735, 1750, 1770, 1790, 1810, 1830, 1870, 1890, 1910; ties 8330, 8350* (diurnal dev 15nT/2min)*.
1-Sep-14	14001	A	046	fp,sa	4.5		0.9	5.4	723.60	723.60	P	P	P	W	**flt046**: lines 1010, 1030, 1070, 1090, 1095, 1110, 1190*, 1630*, 2930, 2950, 2990 (flown as partial due to cloud)*.
	14001	A	047	fp,sa	1.2			1.2							**flt047**: no production due to low clouds.
2-Sep-14	14001	A	048	er,fp	2.6		0.2	2.8	491.72	491.72	P	P	W	W	**flt048**: lines 3433, 3453, 3473, 3493, 3513, 3533, 3553, 3573, 3593, 3613, 3633, 3653, 3673, 3693, 3713, 3733, 3753, 3773, 3910, 3930. Flight cut short due to cloud.
3-Sep-14	14001	A									W	W	W	W	No flight due to cloud and rain.
4-Sep-14	14001	A									W	W	W	W	No flight due to broken cloud at low altitude.
5-Sep-14	14001	A									W	W	W	W	No flight due to cloud and rain.
6-Sep-14	14001	A									W	W	W	W	No flight due to low cloud.
7-Sep-14	14001	A	049	fp,sa	0.3			0.3			P	W	W	W	**flt049**: terminated due to cloud. No production.
8-Sep-14	14001	A	050	fp,sa	0.9		3.6	4.5	505.72	505.72	W	W	P	P	Delay in morning due to clouds at survey altitude. **flt050**: lines 4706*, 4736*, 4746*, 4756*, 4901*, 4921*, 5651*, 5661*, 5671* (completed 2nd segment of partial)*. Eric Robitaille leaves Alta.
9-Sep-14	14001	A									W	W	W	W	No flight due to rain. Hugo Meloche (AME) arrives in Alta.
10-Sep-14	14001	A	051	fp,sa	0.3			0.3			P	W	W	W	**flt051**: returned to base shortly after takeoff, due to cloud and rain. No production.
11-Sep-14	14001	A									W	W	W	W	No flight due to cloud and rain.
12-Sep-14	14001	A	052	fp,sa	0.9		1.1	2.0	54.87	24.76	W	P	P	W	Low cloud throughout block. Clearing in some areas of Eastern section of block. **flt052**: lines 3461*, 4716* (drape dev at end of line due to cloud), 8691* (completed 2nd segment of partial)*. Returned to base due to cloud at survey altitude.

Flight information					Aircraft hours				Kilometreage		Daily activity report				Comments
Date	Project no.	Blk	Flt	Crew (initials)	Ferry	Test Train	Sur-vey	Total	Flown	Accepted	Activity Code (per 1/4 days)				
13-Sep-14	14001	A									D	D	X	X	No flight due to active diurnals in morning. Airport closed in afternoon.
14-Sep-14	14001	A									W	W	W	W	No flight due to high winds and cloud at survey altitude.
15-Sep-14	14001	A	053	fp,sa							W	P	W	W	**flt053**: returned due to high turbulence. No production.
16-Sep-14	14001	A	054	fp,sa	0.6		4.9	5.5	1212.11	1212.11	P	P	P	P	**flt054**: lines 5010, 5090, 5150, 5170, 5210, 5230; tie 8410.
17-Sep-14	14001	A	055	fp,sa	1.0		2.2	3.2	412.06	412.06	P	P	W	W	**flt055**: lines 4850*, 4870*, 4890*; ties 8351 (re-flight of 8350), 8353 (flown as partial due to cloud)*. Returned to base due to front moved in from northwest.
18-Sep-14	14001	A	056	fp,sa	0.8			0.8			W	W	P	W	**flt056**: afterrnpted lines in southwestern section of block. Returned to base due to low cloud. No production.
19-Sep-14	14001	A	057	fp,sa	0.2		4.0	4.2	1028.24	956.39	D	P	P	P	Active diurnals in morning. **flt057**: lines 3090, 3110, 3130, 3150, 3170, 3190* (2 brief diurnal dev. 35nT/10min - flagged)*.
	14001	A	058	fp,sa	1.6		0.6	2.2	171.38	171.38					**flt058**: line 3070. Eric Robitaille arrives in Alta.
20-Sep-14	14001	A	059	er,sa	0.6		5.4	6.0	1439.46	1439.46	P	P	X	X	**flt059**: lines 3950, 3970, 3990, 4010, 4030, 4050, 4070, 4090. Airport closed in afternoon. F.X. Pinte leaves Alta.
21-Sep-14	14001	A									W	W	W	W	No flight due to cloud at survey altitude.
22-Sep-14	14001	A									W	W	W	W	No flight due to snow in morning, cloud and fog in afternoon.
23-Sep-14	14001	A	060	er,sa	1.0		4.0	5.0	816.66	780.54	P	P	P	P	**flt060**: lines 5510/5511**, 5560/5561**, 5570/5571** (drape and minor xy dev due to cloud at mountaintops), 5580/5581**, 5950/5951**; ties 8596*, 8621*, 8631*, 8641*, 8750. (Completed 2nd segment of partial)*. (Partial - national security lines)**.
	14001	A	061	er,sa	0.7		3.7	4.4	935.09	929.08					**flt061**: lines 3670, 3690, 3710, 3730, 3750, 3770, 3911*, 3931* (completed 2nd segment of partial)*.
24-Sep-14	14001	A									W	W	W	W	No production due to cloud.
25-Sep-14	14001	A									W	W	W	W	No production due to cloud.
26-Sep-14	14001	A	062	er,sa	0.5		5.2	5.7	1263.62	1263.62	P	P	P	W	**flt062**: lines 2910*, 2911* (flown as partial due to air-traffic), 2970/2971**, 3010, 3030, 3050, 3570, 3590, 3610; ties 8336, 8356. Storm pushed in from southwest toward afternoon (partial - national security line)**.
27-Sep-14	14001	A	063	er,sa	1.0		4.5	5.5	1042.81	1042.81	P	P	X	X	**flt063**: lines 4830, 4910*, 4930*, 4950, 4970, 4990*, 5111**, 5131**, 5290; tie 8376. (Flown as partial due to cloud)*. (Completed 2nd segment of partial)**. Airport closed in afternoon.
28-Sep-14	14001	A									W	W	W	W	No flight due to cloud and fog.
29-Sep-14	14001	A									W	W	W	W	No flight due to cloud at survey altitude.
30-Sep-14	14001	A	064	er,sa	0.9		2.4	3.3	630.95	630.95	W	P	P	P	Broken cloud in morning. **flt064**: lines 4810*, 4790*, 4770, 4750, 4730. (Flown as partial due to cloud)*.
1-Oct-14	14001	A	065	er,sa	0.4		5.0	5.4	1024.52	963.12	P	P	P	P	**flt065**: lines 2635, 2640, 2655, 2660, 2675, 2680, 2695, 2700, 2715, 2720, 2735, 2740, 2755, 2760, 2775, 2780, 2795, 2800, 2815, 2820, 2830*, 2833, 2840, 2850, 2853, 2860, 2870, 2873, 2890, 2895. (Flown as partial - cloud)*.
	14001	A	066	er,sa	0.4		3.7	4.1	748.17	748.17					**flt066**: lines 2400, 2415, 2420, 2435, 2440, 2455, 2460, 2475, 2480, 2495, 2500, 2515, 2520, 2535, 2540, 2555, 2560, 2575, 2580, 2595, 2600, 2615, 2620; tie 8380.
2-Oct-14	14001	A	067	er,sa	0.8		4.2	5.0	717.90	717.90	P	P	P	W	**flt067**: lines 4766*, 4791*, 4811*, 4941*, 4971*, 4991*; ties 8451*, 8660**, 8670**, 8681**. (Completed 2nd segment of partial)*. (Flown as partial due to cloud)**. Raining in afternoon. **Field Delivery 003** uploaded to ftp site.
3-Oct-14	14001	A	068	er,sa	0.6		3.6	4.2	826.27	695.15	P	P	P	W	**flt068**: lines 2750*, 2770, 2790, 2810, 3630, 3650. Ties 8333, 8373, 8390. (Briefly flew below drape due to turbulence)*. Returned to base as turbulence became too strong.
4-Oct-14	14001	A	069	er,sa	0.8		5.0	5.8	1321.62	1321.62	W	P	P	P	Strong winds in the morning. **flt069**: lines 2550, 2570, 2590, 2610, 2630, 2650, 2670, 2690, 2710, 2730/2731* (National security line)*. Extended airport operating hours.
5-Oct-14	14001	A									W	W	W	W	No flight due to very high winds.
6-Oct-14	14001	A	70	er,sa	0.4		4.9	5.2	1260.26	1260.26	P	P	P	P	**flt070**: lines 4110, 4130, 4150, 4170, 4190, 4210, 4230, 4250.
	14001	A	71	er,sa	0.5		3.7	4.2	954.77	954.77					**flt071**: lines 4270, 4290, 4310, 4330, 4350, 4370, 4390, 4410.

Flight information					Aircraft hours				Kilometreage		Daily activity report				Comments
Date	Project no.	Blk	Flt	Crew (initials)	Ferry	Test Train	Sur-vey	Total	Flown	Accepted	Activity Code (per 1/4 days)				
7-Oct-14	14001	A	72	er,sa	0.7		4.3	5.0	1128.94	1128.94	P	P	P	P	**flt072**: lines 2390*, 2410, 2430, 2450*, 2470*, 2490*, 2510*, 2530. (National security lines)*.
	14001	A	73	er,sa	0.9		3.1	4.0	846.57	846.57					**flt073**: lines 2270, 2290/2291/2292*, 2310, 2330, 2350/2351*, 2370. (National security lines)*.
8-Oct-14	14001	A									W	W	W	W	No flight due to rain.
9-Oct-14	14001	A	74	er,sa	0.7		5.3	6.0	1353.58	1242.42	P	P	P	P	**flt074**: lines 4430, 4450, 4470, 4490, 4510, 4530*, 4550, 4570, 4590, 4610, 4630, 4650. (Out of diurnal spec - 15nT/2min and 35nT/10min)*. Hugo Meloche (AME) leaves Alta.
	14001	A	75	er,sa	0.7		2.6	3.3	382.83	279.98					**flt075**: lines 2831*, 4670; ties 8010, 8030*, 8050**, 8070. (Drape and xy dev. due to cloud, to be re-flown)*. (National security line, moved 500m to the east)**.
10-Oct-14	14001	A	76	er,sa	0.8		3.9	4.7	657.70	657.70	P	P	P	W	**flt076**: lines 4690/4691* (National security line)*, 4710, 4851**, 4871**, 4891**, 4911**, 4931**, 4961***. (Completed 2nd segment of partial)**. (Re-flight of 4960)***. High turbulence in afternoon.
11-Oct-14	14001	A	77	er,sa	0.7		4.2	4.9	1060.81	1060.81	P	P	P	P	**flt077**: lines 2110, 2130, 2150**, 2170, 2190**, 2210**, 2230**, 2250; tie 8370. (National security line)**.
	14001	A	78	er,sa	0.9		2.5	3.4	614.02	409.35					**flt078**: lines 1990, 2010, 2030*, 2050*, 2070**, 2090***. (Exceeds 35nT/10min on western segment of line)*. (National security line)**. (Drape dev. due to turbulence)***
12-Oct-14	14001	A	79	er,sa	0.5		5.1	5.6	882.50	882.50	P	P	P	P	**flt079**: lines 1620, 1635, 1640, 1655, 1660, 1675, 1680, 1695, 1700, 1715, 1720, 1740, 1755, 1760, 1775, 1780, 1795, 1800, 1815, 1820, 1835, 1840, 1855, 1860, 1875, 1880, 1895, 1900, 1915, 1920, 1935, 1940, 1955, 1960, 1975, 1980, 1995, 2000, 2015, 2020, 2035; ties 8270, 8290, 8300, 8313, 8320, 8340. **Field Delivery 004** uploaded to ftp site.
13-Oct-14	14001	A									W	W	W	W	No flight due to low cloud.
14-Oct-14	14001	A									W	W	W	W	No flight due to cloud at survey altitude.
15-Oct-14	14001	A									W	W	W	W	No flight due to cloud at survey altitude.
16-Oct-14	14001	A	080	er,sa	1.8		1.6	3.4	249.76	156.96	P	P	W	W	**flt080**: lines 1550* (to be re-flown, drape deviation), 1570*; ties 8031 (re-flight of 8030 from flt075), 8090. (Flown as partial due to cloud)*. Returned due to cloud at survey altitude.
17-Oct-14	14001	A									W	W	W	W	No flight due to low cloud.
18-Oct-14	14001	A									W	W	W	W	No flight due to cloud at survey altitude.
19-Oct-14	14001	A									X	X	X	X	No flight. C-FEON covered with frost preventing takeoff.
20-Oct-14	14001	A	081	er,sa	1.4		4.3	5.7	790.03	770.03	P	P	P	P	**flt081**: 2751*, 2832*, 3191*, 3932* (diurnal dev. 35nT/10min), 4531*, 4717*, 5572*; ties 8295, 8316. (Re-flights)*.
21-Oct-14	14001	A									W	W	W	W	No flight due to high winds.
22-Oct-14	14001	A									W	W	W	W	No flight due to high winds.
23-Oct-14	14001	A									W	W	W	W	No flight due to high winds.
24-Oct-14	14001	A									W	W	W	W	No flight due to high winds.
25-Oct-14	14001	A	082	er,sa	1.3		3.9	5.2	868.82	807.62	P	P	P	P	**flt082**: lines 1610*, 1650*, 1670*, 1690*, 1710*, 1730*, 1850/1851**, 1930*, 1950*, 1970*, 2031***, 2051***. (Flown as partial due to cloud)*. (National Security Line)**. (Re-flights)***.
26-Oct-14	14001	A									W	W	W	W	No flight due to low ceilings.
27-Oct-14	14001	A									W	W	W	W	No flight due to low broken cloud.
28-Oct-14	14001	A									W	W	W	W	No flight. Clear skies in Alta, but low cloud in block.
29-Oct-14	14001	A									W	W	W	W	No flight due to rain, snow, and low cloud. C-FEON and crew move to Tromsø.
30-Oct-14	14001	A									W	W	W	W	No flight due to cloud.
31-Oct-14	14001	A									W	W	W	W	No flight due to cloud and snow.
1-Nov-14	14001	A	083	er,sa	0.5		4.2	4.7	919.45	848.65	P	P	P	P	**flt083**: lines 1490/1491*/**, 1510/1511**, 1530/1531/1532**, 1551, 1571, 1590/1591/1592**, 1611/1612**, 1651, 2141***, 2241***, 2256***; tie 8310. (Flown as partial due to turbulence)*. (National security line)**. (Re-flight lines)***.
2-Nov-14	14001	A									W	W	W	W	No flight due to low cloud and freezing rain.
3-Nov-14	14001	A									W	W	W	W	No flight due to rain.
4-Nov-14	14001	A									W	W	W	W	No flight due to freezing rain.
5-Nov-14	14001	A									W	W	W	W	No flight due to low cloud. Alain Guillemette (AME) arrives in Tromsø.
6-Nov-14	14001	A									W	W	W	W	No flight due to low cloud. Maintenance inspection performed on C-FEON.
7-Nov-14	14001	A	084	er,sa	0.8		1.6	2.4	476.22	476.22	M	P	P	P	Maintenance completed on C-FEON. **flt084**: ties 8150, 8170, 8190.

Flight information					Aircraft hours				Kilometreage		Daily activity report				Comments
Date	Project no.	Blk	Flt	Crew (initials)	Ferry	Test Train	Sur-vey	Total	Flown	Accepted	Activity Code (per 1/4 days)				
8-Nov-14	14001	A	085	er,sa	0.5		4.5	5.0	1085.48	1085.48	P	P	P	P	**flt085**: lines 1330/1331**, 1350/1351**, 1370/1371**, 1390, 1410/1411**, 1430/1431**, 1450*, 1470*, 1492*/***; ties 8110, 8130. (Flown as partial - C-FEON unable to establish communication with Finland ATC)*. (National security line)**. (2nd segment of partial)***. Alain Guillemette (AME) leaves Tromsø.
9-Nov-14	14001	A									W	W	W	W	No flight due to low cloud and snow.
10-Nov-14	14001	A									W	W	W	W	No flight due to cloud. **Field Delivery 005** uploaded to ftp site.
11-Nov-14	14001	A									W	W	W	W	No flight due to cloud and snow.
12-Nov-14	14001	A									W	W	W	W	No flight due to low cloud.
13-Nov-14	14001	A	086	er,sa	0.6		4.3	4.8	917.53	917.53	P	P	P	P	**flt086**: lines 1050**, 1110, 1130, 1135, 1150/1151**, 1155, 1170, 1175, 1191*, 1210, 1211*, 1230, 1250, 1270/1271**, 1290, 1310, 1451*, 1471*. (Completed 2nd segment of partial)*. (National security line)**. All lines completed in both military zones **END406 GND-FL360** and **END407 GND-FL300**.
14-Nov-14	14001	A	087	er,sa	0.5			0.5			P	W	W	W	**flt087**: no production. Returned to base due to cloud and snow.
15-Nov-14	14001	A	088	er,sa	0.5		4.7	5.2	1068.27	1027.61	P	P	P	P	**flt088**: lines 1631*, 1651*, 1671*, 1691*, 1711*/**, 1731/1732*/**, 1931(out of diurnal spec 35nT/10min)*, 1951*, 1971*; ties 8210, 8230, 8250, 8275. (Completed 2nd segment of partial)*. (National security line)**.
16-Nov-14	14001	A	089	er,sa	1.3		0.6	1.9	103.56	82.58	P	P	P	W	**flt089**: lines 1932* (re-flight of 1931), 2836, 2856, 2876**. (Completed 2nd segment of partial)*. (Diurnal deviation 35nT/10min)**. Returned to base due to low ceilings.
17-Nov-14	14001	A	090	er,sa	0.9		1.7	2.6	163.88	163.88	P	P	P	P	**flt090**: lines 3933*, 2877*; ties 8661**, 8671**, 8682**. (Re-flight lines)*. (Last segment of partial)**. **Field Delivery 006** uploaded to ftp site. **TROFI-14 data acquisition complete.**