

Spring 2012 IceBridge P-3 Flight Plans  
12 March 2012 Draft

*compiled by*

John Sonntag

# Introduction to Flight Plans

This document is a translation of the NASA Operation IceBridge (OIB) scientific objectives articulated in the Level 1 OIB Science Requirements, at the January IceBridge Greenland planning meeting held at NASA's Goddard Space Flight Center, through official science team telecons and through e-mail communication and iterations into a series of operationally realistic flight plans, intended to be flown by NASA's P-3 aircraft, beginning in mid- March and ending in late May 2012. The material is shown on the following pages in the distilled form of a map and brief text description of each science flight. Google Earth (KML) versions of these flight plans are available via anonymous FTP at the following address: <ftp://atm.wff.nasa.gov/outgoing/oibscienceteam/>. Note that some users have reported problems connecting to this address with certain browsers. Command-line FTP and software tools such as Filezilla may be of help in such situations.

For each planned mission, we give a map and brief text description for the mission, and in the page header we also list the base it is to be flown from. At the end of the document we add an appendix of supplementary information, such as more detailed maps of certain missions and composite maps where several missions are designed to work together. A careful reader may notice that some of the mission maps in the main part of the document highlight flightlines in green, yellow, and red colors, while other only show the black lines. The colors are a refinement added to the flight plans at a late stage of design which help the field team navigate the aircraft properly to achieve specific science goals. The colors represent the degree of “straightness” of each flight segment, where straight segments are steered using an automated technique and curved sections using a specialized manual method. Not all of the flight plans shown here have reached that mature stage of design.

In fact, as a general rule the flight plans depicted here are all at varying stages of completeness. For each mission we note “Remaining Issues” to be resolved, if any exist. In most cases these are minor. CryoSat underflights are a major exception, since these have to be re-planned for each potential flight day (for sea ice) or within a window of several potential flight days (for land ice).

Note that this document shows >60 planned missions totaling over 400 flight hours, which is far more than we expect to fly this year. The extra flight plans give us operational flexibility to fly as much as possible, and scientifically productive, while we are in the field.

This document does not include the flight plans for the OIB high-altitude flights to be conducted with the Land, Vegetation and Ice Sensor (LVIS) using a NASA Langley Falcon jet. Those missions are being designed under a separate effort.

## **IceBridge Mission Statement**

Operation IceBridge will employ aircraft to monitor the most sensitive and critical areas of sea ice, ice sheets and glaciers during the gap in satellite coverage caused by the failure of ICESat-1, in 2009, and the launch of ICESat-2, planned for late 2015. Sensitive and critical areas include coastal Greenland and especially its outlet glaciers, coastal Antarctica including the Antarctic Peninsula and ice shelves, the sea ice of the Arctic and Antarctic and the southeast Alaskan glaciers. Data collected by IceBridge will improve our knowledge of the contribution of the Greenland and Antarctic ice sheets to sea level rise and will make fundamental contributions to the understanding of changes occurring in the extent and thickness of the polar sea ice cover. Given the societal importance of understanding changes in sea level rise and sea ice extent, IceBridge data will monitor and improve modeling efforts for sea ice, ice sheet and glaciers. IceBridge will also prepare for the future of airborne monitoring efforts of the

cryosphere by adapting existing instruments for high altitude unmanned aerial systems such as the NASA Global Hawk.

### **IceBridge Science Objectives**

The following are the major science objectives of Operation IceBridge in priority order and are met by the following flight plans:

- 1) Make airborne laser altimetry measurements over the ice sheets and sea ice to fill in the data gap between the failure of ICESat-1 in 2009 and the launch of ICESat-2 planned for 2015.
- 2) Link measurements made by ICESat, ICESat-2, and CryoSat-2 to allow their comparison and the production of a long-term, ice sheet altimetry record.
- 3) Use airborne altimetry and radar to monitor key, rapidly changing areas of ice, including sea ice, ice sheets and glaciers, in the Arctic and Antarctic to maintain a long term observation record, improve understanding of glacial dynamics, and augment predictive models of sea level rise and sea ice cover.
- 4) In conjunction with altimetry measurements, collect other remotely sensed data to improve predictive models of sea level rise and sea ice cover, especially the following:
  - Ice sheet and sea ice thickness, structure and extent;
  - Bed topography underlying land-based ice;
  - Bathymetry beneath floating ice shelves;
  - Snow accumulation and firn structure; and
  - Other geophysical constraints that will improve estimates of the geothermal and oceanic heat flux
- 5) Adapt existing instruments for airborne remote sensing of ice by high altitude unmanned aerial systems such as the NASA Global Hawk.

# Sea Ice – North Basin Transect / Thule-Fairbanks

This mission is a near-exact repeat of the 20110322 Arctic basin transect from Thule to Fairbanks, although much of that flight had to be flown direct to Fairbanks at high altitude because of exceptionally strong headwinds at low altitude. We also include a pass over the main BROMEX line near Barrow. In addition to Level-1 Requirements 4.1.1.A.3a and b, the flight addresses sea ice level 1 baseline requirement 4.1.1.A.3c by providing data on the thickness gradient and distribution of perennial and seasonal ice across the Arctic Basin.

**Flight Priority:** High

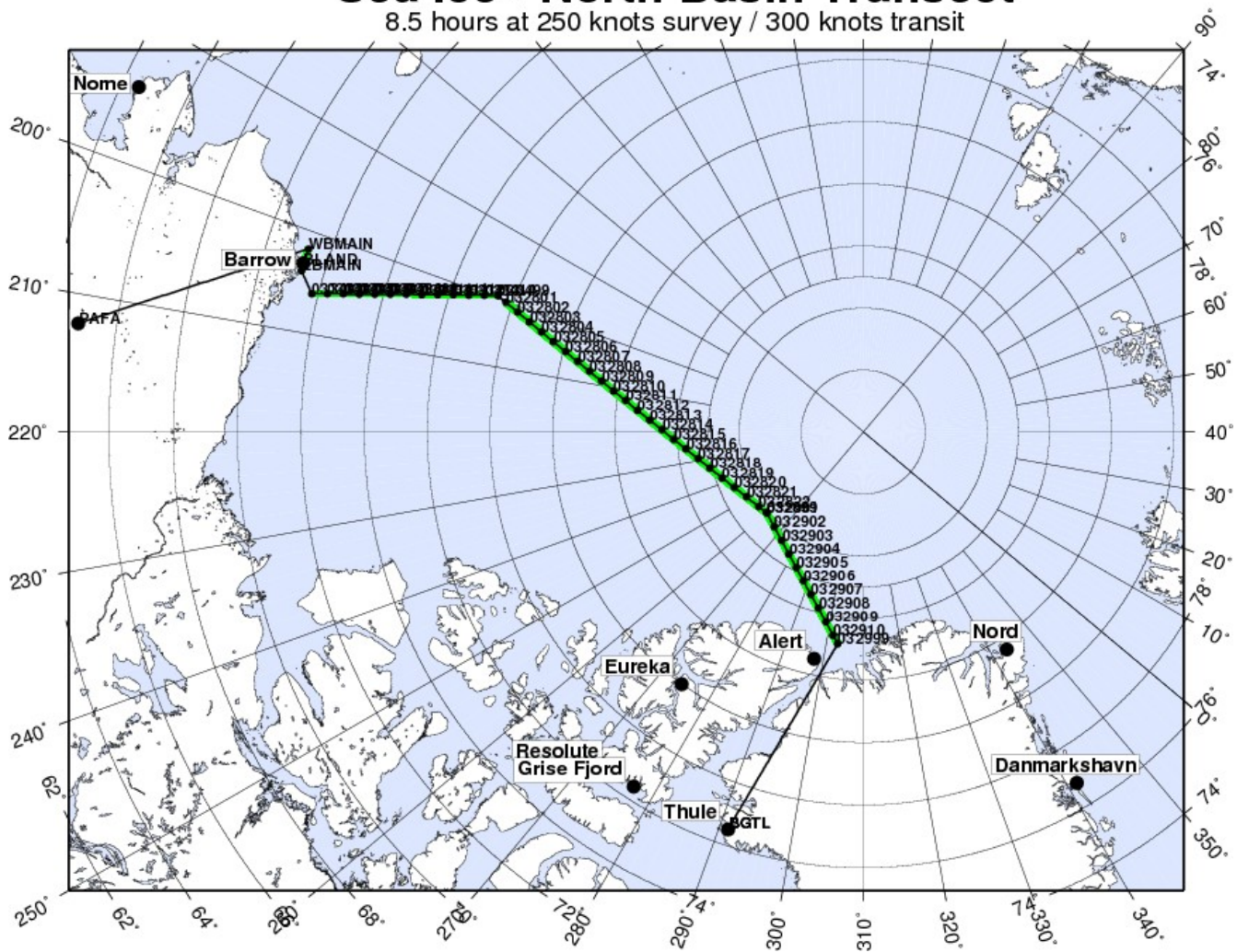
**Instrument Priority:** ATM/Snow/KU/DMS/Grav

**ICESat Tracks:** 0329, 0328,0334

**Remaining Issues:** none known

## Sea Ice - North Basin Transect

8.5 hours at 250 knots survey / 300 knots transit





# Sea Ice – South Basin Transect / Thule-Fairbanks

This mission is an exact repeat of the 20110325 flight. Timing on this flight is very tight because we prefer predawn twilight lighting conditions for VFR flight once off the northern Alaska coast, but also must land at Thule before the airfield closes at 1600 local time, which is five hours ahead of Fairbanks local time. In addition to Level-1 Requirements 4.1.1.A.3a and b, it addresses sea ice level 1 baseline requirement 4.1.1.A.3c by providing data on the thickness gradient and distribution of perennial and seasonal ice across the Arctic Basin.

**Flight Priority:** High

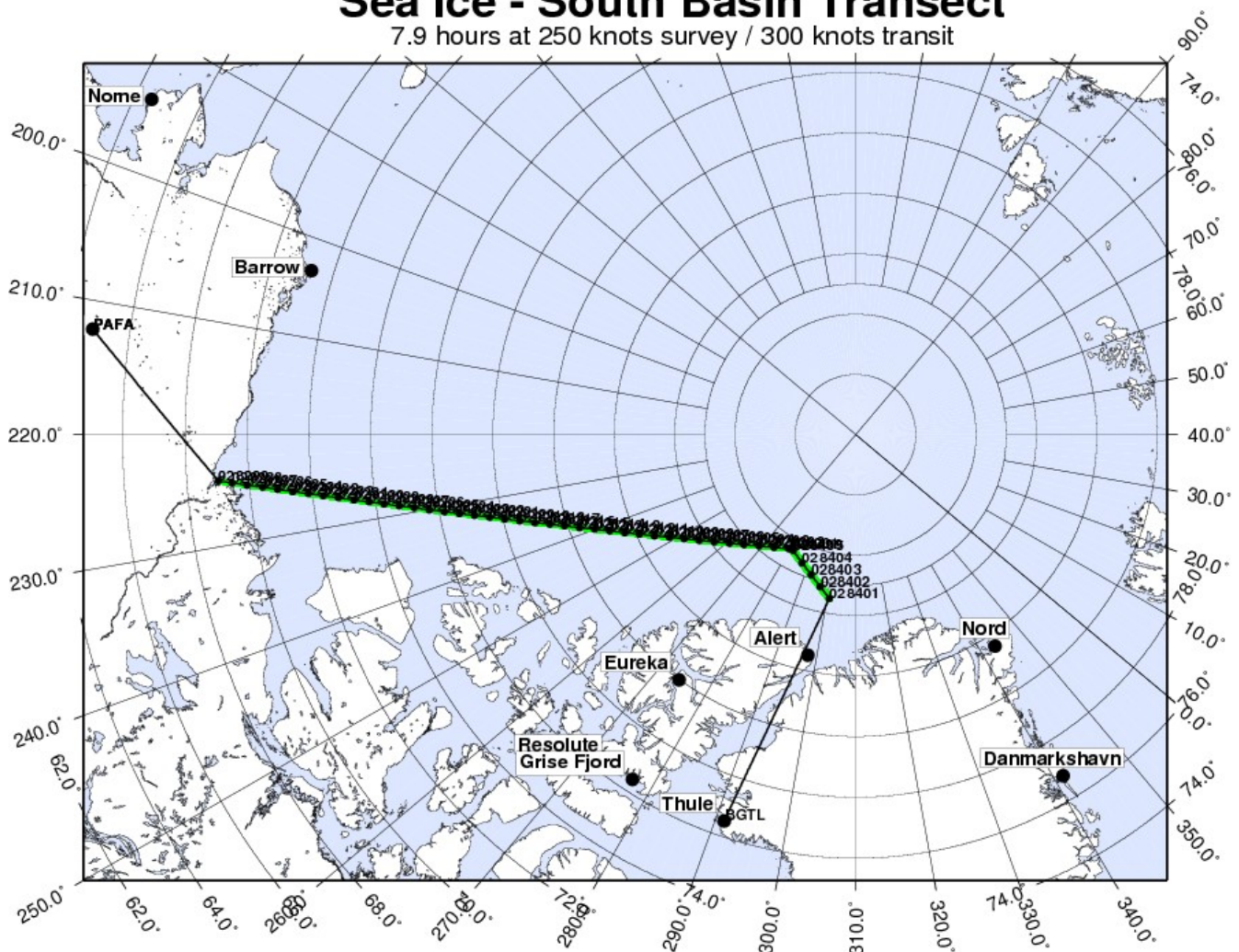
**Instrument Priority:** ATM/Snow/KU/DMS/Grav

**ICESat Track:** 0282,0284

**Remaining Issues:** none known

## Sea Ice - South Basin Transect

7.9 hours at 250 knots survey / 300 knots transit



# Sea Ice – Zigzag West / Thule

This mission is similar to the 20110318 mission, but that flight had to be shortened significantly for operational reasons on the day it was flown. This version is intended to sample thick multi-year ice immediately north of Ellesmere Island, and the gradient to thinner ice toward the pole. In addition to Level 1 requirements 4.1.1.A.3a and b, it addresses sea ice level 1 baseline requirement 4.1.1.A.3c by sampling thick multi-year ice immediately north of Ellesmere Island and the poleward gradient towards thinner ice.

**Flight Priority:** Medium

**Instrument Priority:** ATM/Snow/KU/DMS/Grav

**ICESat Track:** none

**Remaining Issues:** can be coordinated with CryoVex Alert ops

## Sea Ice - ZZ West

7.6 hours at 250 knots survey / 300 knots transit



# Sea Ice – Zigzag East / Thule

This mission is identical to the 20110326 flight. It is intended to sample the thick multi-year ice near the Greenland coast as well as the gradient to thinner ice closer to the pole. It also samples ICESat track 0414. In addition to Level 1 Requirements 4.1.1.A.3a and b, the mission addresses sea ice level 1 baseline requirement 4.1.1.A.3c by sampling thick multi-year ice near the northern coast of Greenland and the poleward gradient towards thinner ice.

**Flight Priority:** High

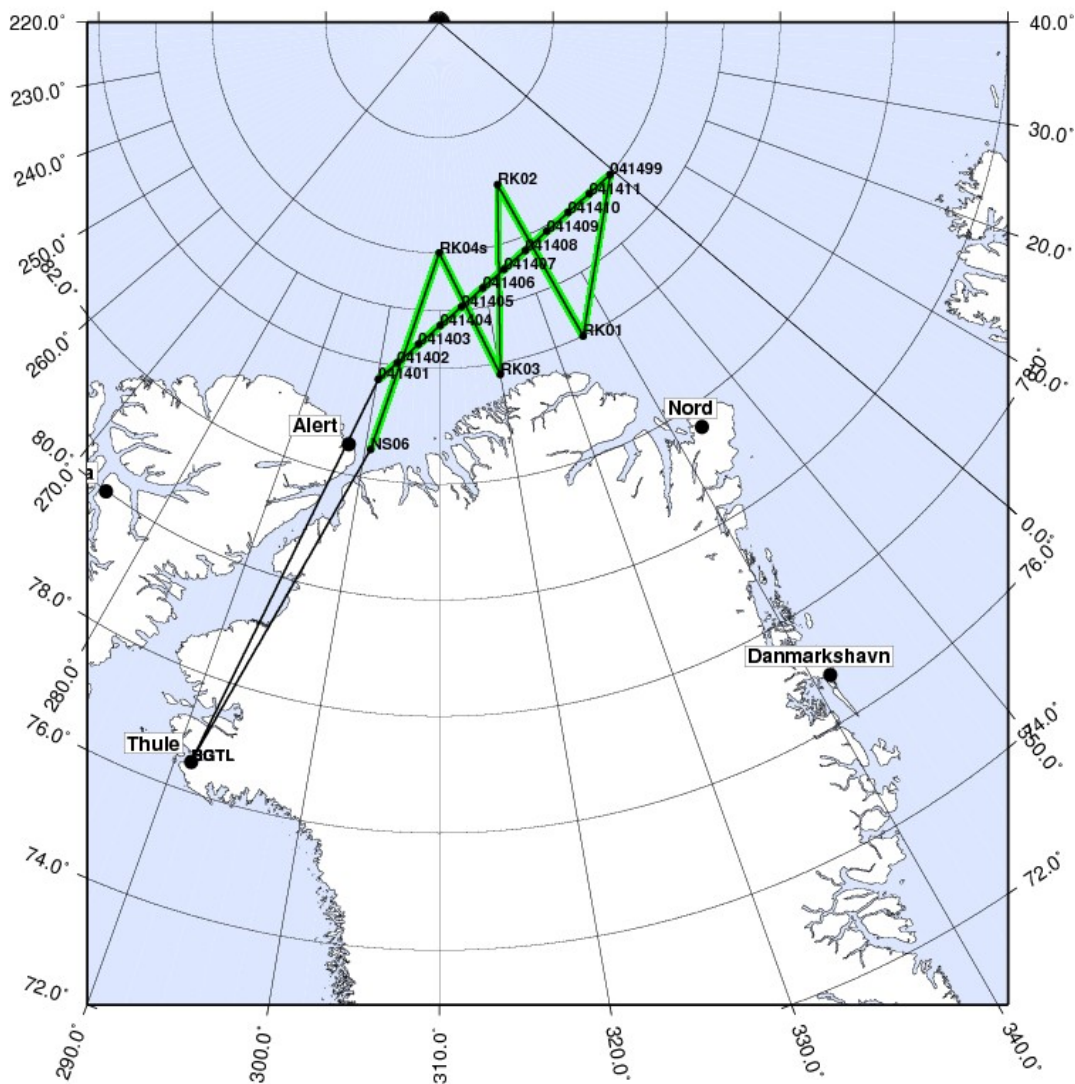
**Instrument Priority:** ATM/Snow/KU/DMS/Grav

**ICESat Track:** 0414

**Remaining Issues:** can be coordinated with CryoVex Alert ops

## Sea Ice - ZZ East

7.6 hours at 250 knots survey / 300 knots transit





# Sea Ice - Fram Gateway / Thule

This mission is identical to the 20110328 Fram Gateway mission. In addition to Level 1 Requirements 4.1.1.A.3a and b, it addresses sea ice level 1 baseline requirement 4.1.1.A.3c by sampling ice at the top of Nares Strait crossing the Lincoln Sea ice arch (if present) and sea ice north of Fram Strait. Also included in this flight plan is a line extending across the Gakkel Ridge, for collection of gravimetric data that will provide vital geoid information.

**Flight Priority:** Medium

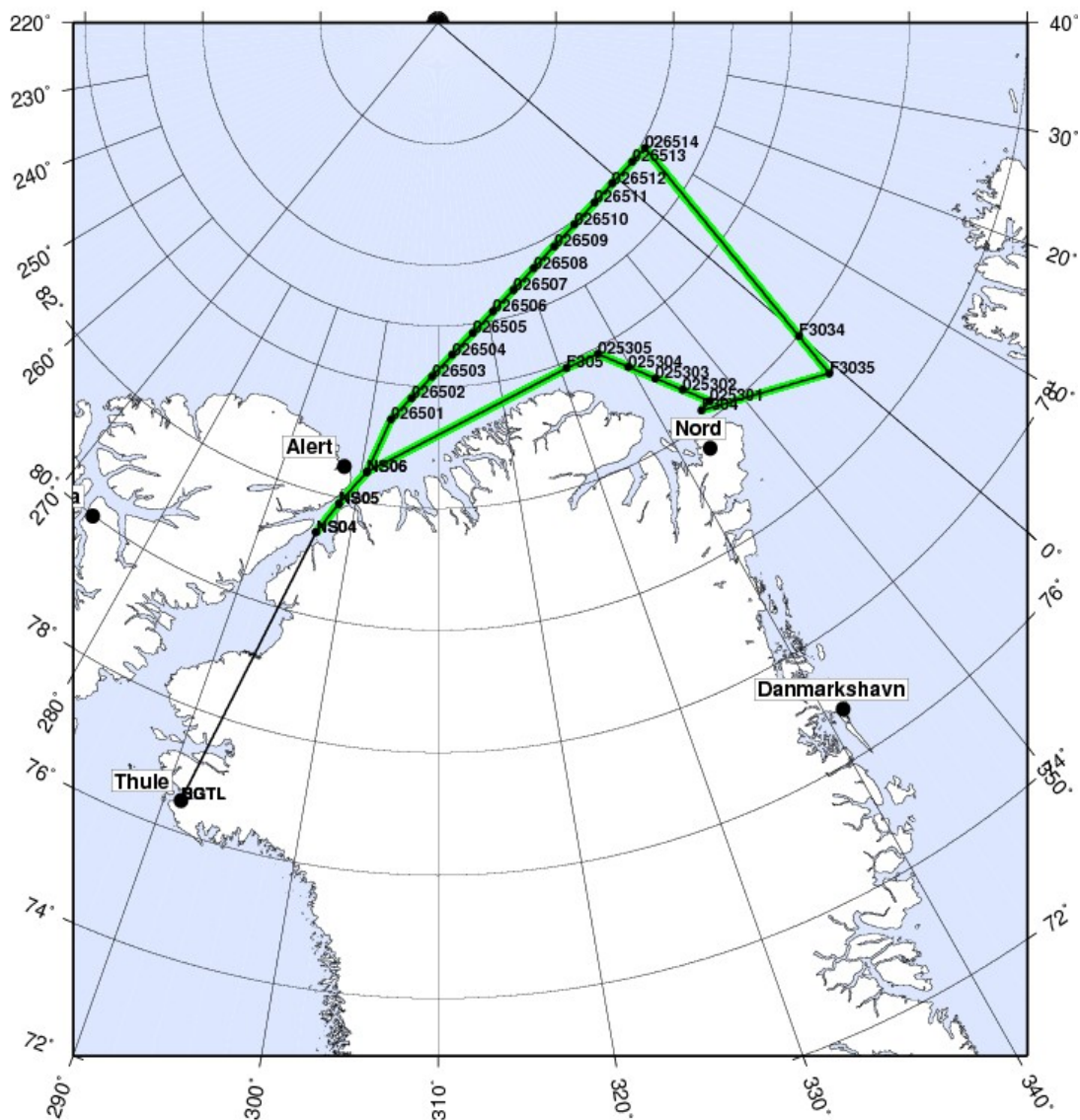
**Instrument Priority:** ATM/Snow/KU/DMS/Grav

**ICESat Track:** 0265, 0253

**Remaining Issues:** can be coordinated with CryoVex Alert ops; can be coordinated with MABEL flight from Keflavik on 1-2 April if possible

## Sea Ice - Fram Gateway

7.6 hours at 250 knots survey / 300 knots transit



# Sea Ice – CryoSat Underflight / Thule

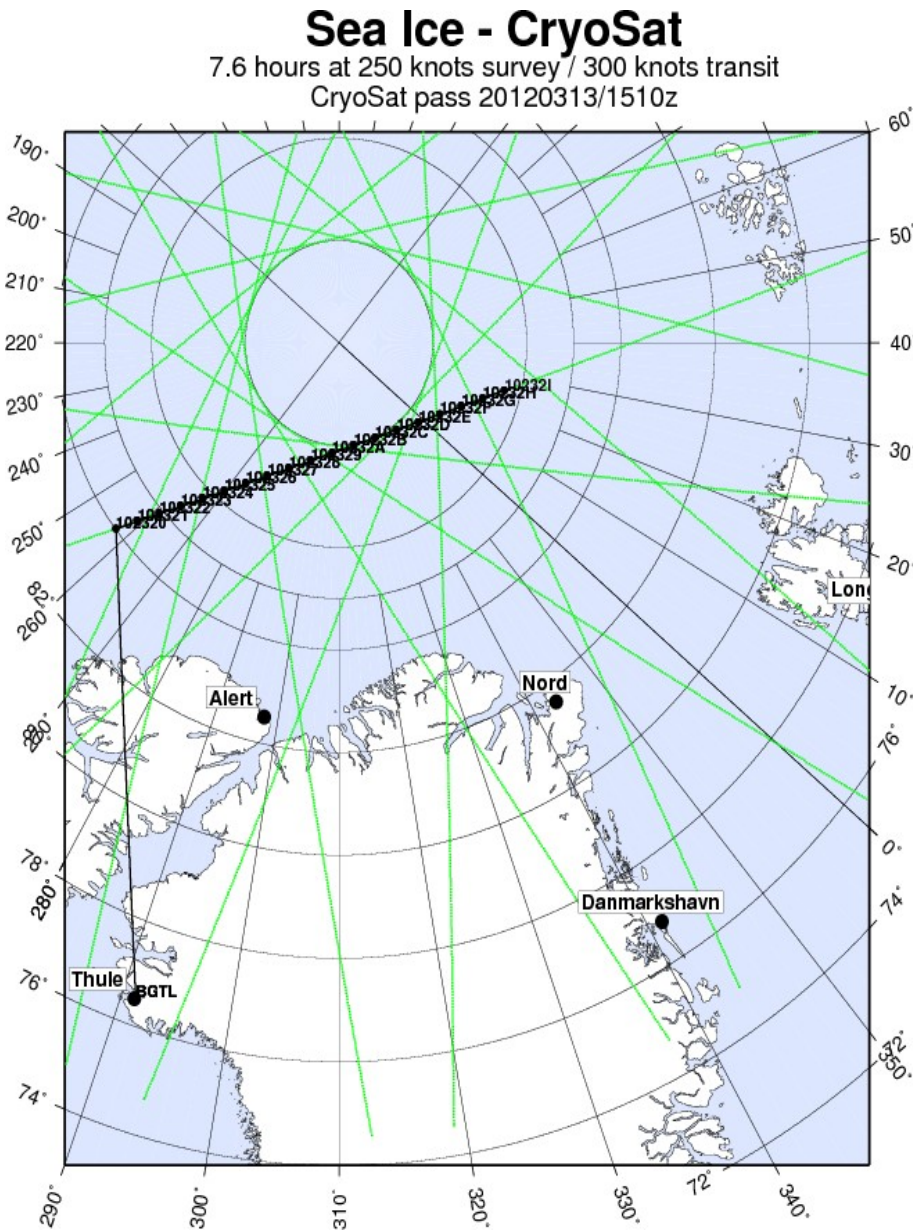
This mission is intended to underfly the Cryosat spacecraft, as nearly simultaneous with the spacecraft as possible. The field team will plot Cryosat orbits for each day we might fly the mission, and select the best combination of weather and geometry subject to all constraints and flight priorities. The Cryosat track will be flown out and back to enable estimation of ice drift, and it will be flown at 1500' in one direction (during the time closest to the Cryosat overpass) and at 15,000' in the other. In addition to Level 1 Requirements 4.1.1.A.3a and b, this mission addresses sea ice level 1 baseline requirement 4.1.1.A.3d by conducting a sampling mission that is time-coincident with a Cryosat track.

**Flight Priority:** Low if Wingham box flown, otherwise High

**Instrument Priority:** all

**ICESat Track:** none

**Remaining Issues:** must redesign mission using FOS predicted orbit for each potential flight day to underfly orbit





# Sea Ice – Connor Corridor / Thule

This mission is intended to sample sea ice along the Envisat ground track. As depicted here the mission is drafted for the Envisat pass occurring 13 March 2012. Other days with suitable Envisat orbits are 21 and 29 March, with 22 March as a somewhat less optimal day. We fly both the outbound and inbound legs at 1500' AGL. In addition to Level 1 Requirements 4.1.1.A.3a and b, the flight addresses sea ice level 1 baseline requirement 4.1.1.A.3d by conducting a sampling mission that is time-coincident with an Envisat track that extends southwesterly into the Arctic Basin.

**Flight Priority:** Medium

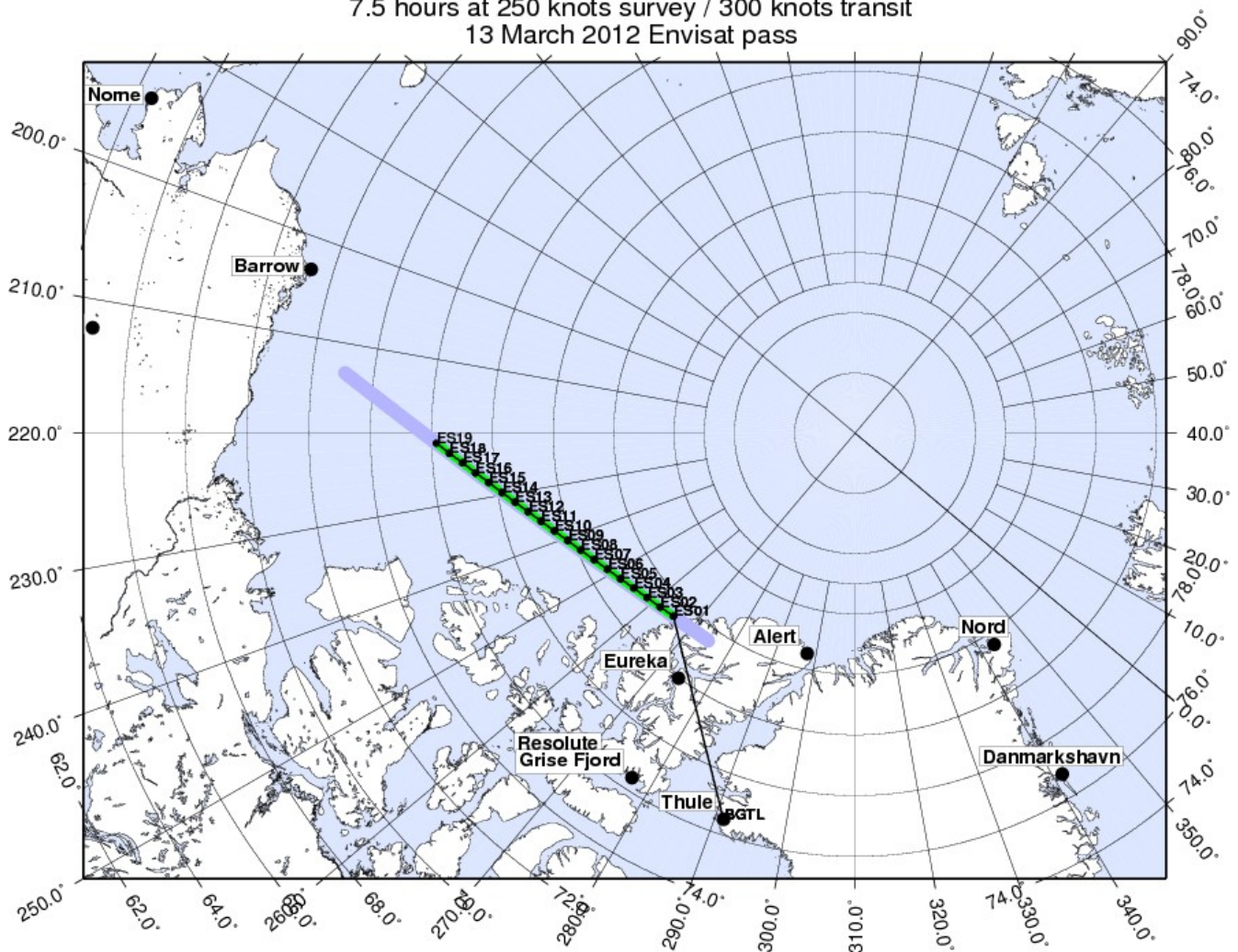
**Instrument Priority:** ATM/Snow/KU/DMS/Grav

**ICESat Track:** none

**Remaining Issues:** replan waypoints for other candidate days (21/22/29 March) if not flown on 13 March

## Sea Ice - Connor Corridor

7.5 hours at 250 knots survey / 300 knots transit  
13 March 2012 Envisat pass





# Sea Ice – Northwest Passage / Thule

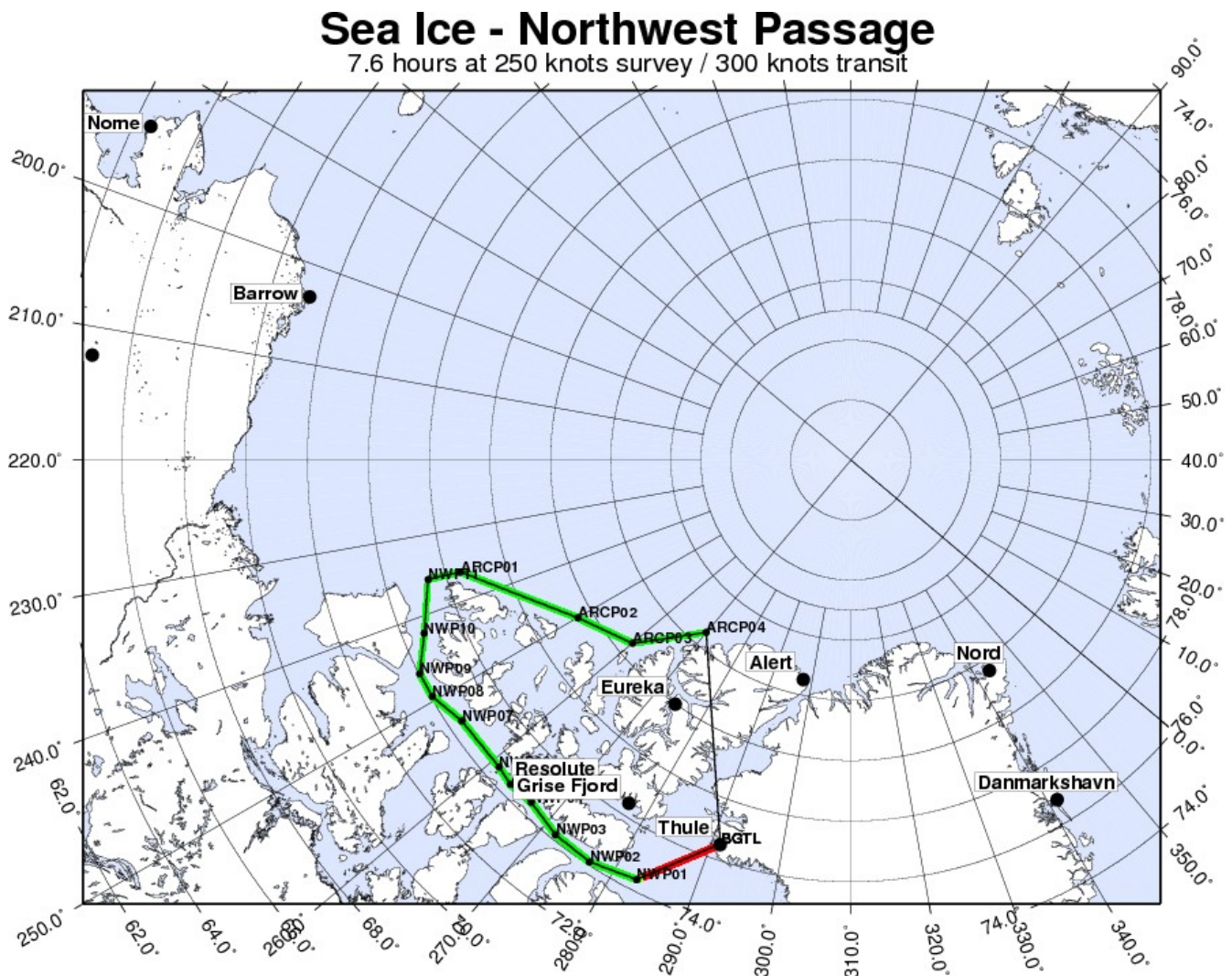
This mission is similar to the Sea Ice 08 flight from 2010, except that we now return to Thule by a path north of the Canadian Archipelago at low altitude. We return to Thule across Ellesmere Island at high altitude. This mission was not flown in 2011. In addition to Level 1 Requirements 4.1.1.A.3a and b, the flight addresses sea ice level 1 projected requirement 4.1.1.B.2b by conducting a sampling mission in the Canadian Archipelago in the region of the Northwest Passage route.

**Flight Priority:** Low

**Instrument Priority:** ATM/Snow/KU/Grav/DMS

**ICESat Track:** none

**Remaining Issues:** none known



# Sea Ice – Wingham Box / Thule

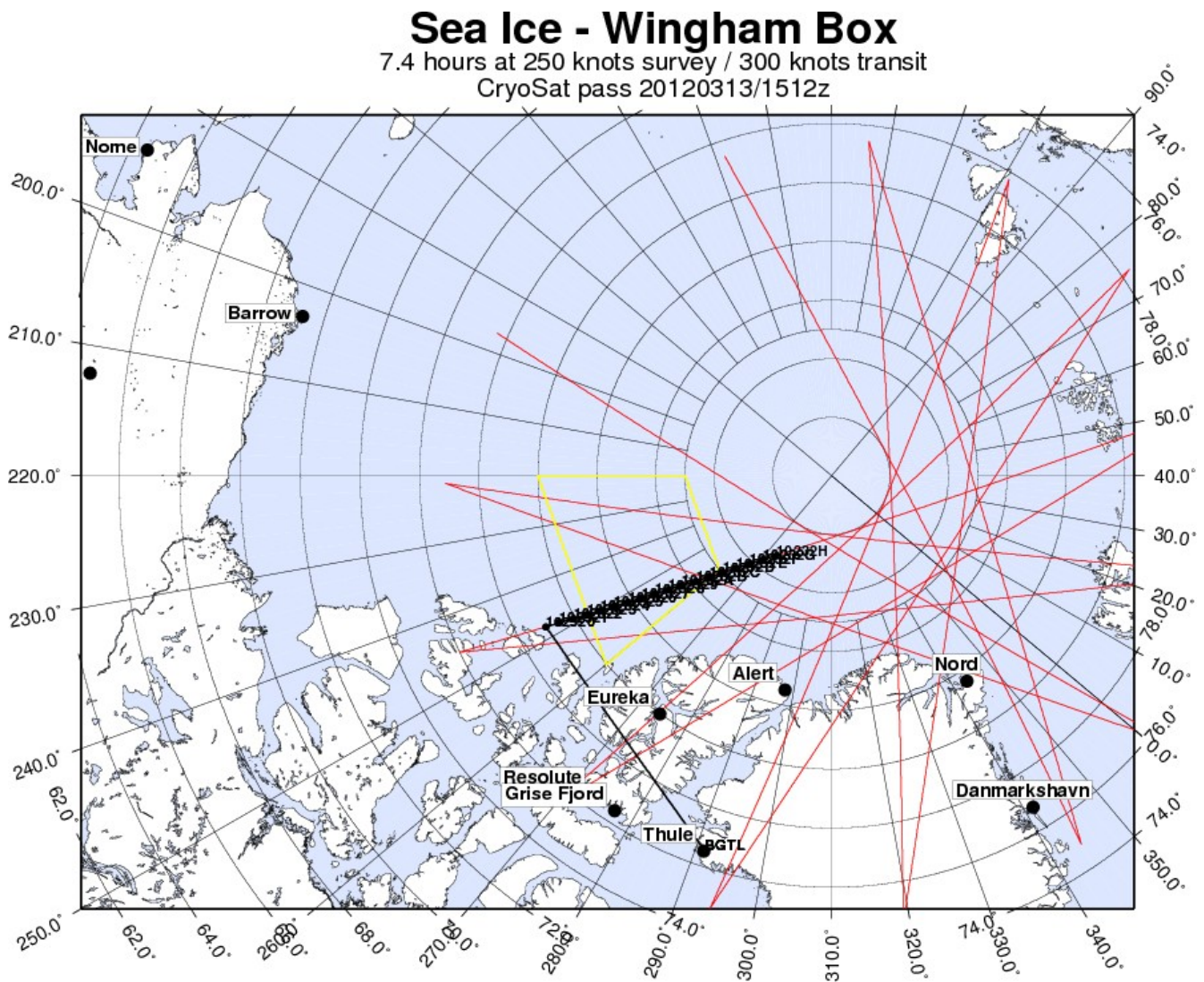
This is a new mission, and the draft below is simply a placeholder until precise orbital predictions become available. The draft shows an out-and-back flight path along a representative CryoSat orbit which passes through the SARin mode CryoSat region. The science team desires that we fly at least 100 km on each side of the Wingham “box” depicted in yellow, which defines the region where the spacecraft is operated in SARin mode. We fly one CryoSat leg at 1500' and the other at 15,000', with the low altitude leg being the one closest in time to the spacecraft overpass.

**Flight Priority:** High

**Instrument Priority:** ATM/Snow/KU/Grav/DMS

**ICESat Track:** none

**Remaining Issues:** Must be redesigned for daily CryoSat pass within the yellow box





# Sea Ice – North Pole Transect / Thule

This is a new mission, designed to sample sea ice far from the coastal areas, in areas which have undersampled in previous OIB campaigns.

**Flight Priority:** High

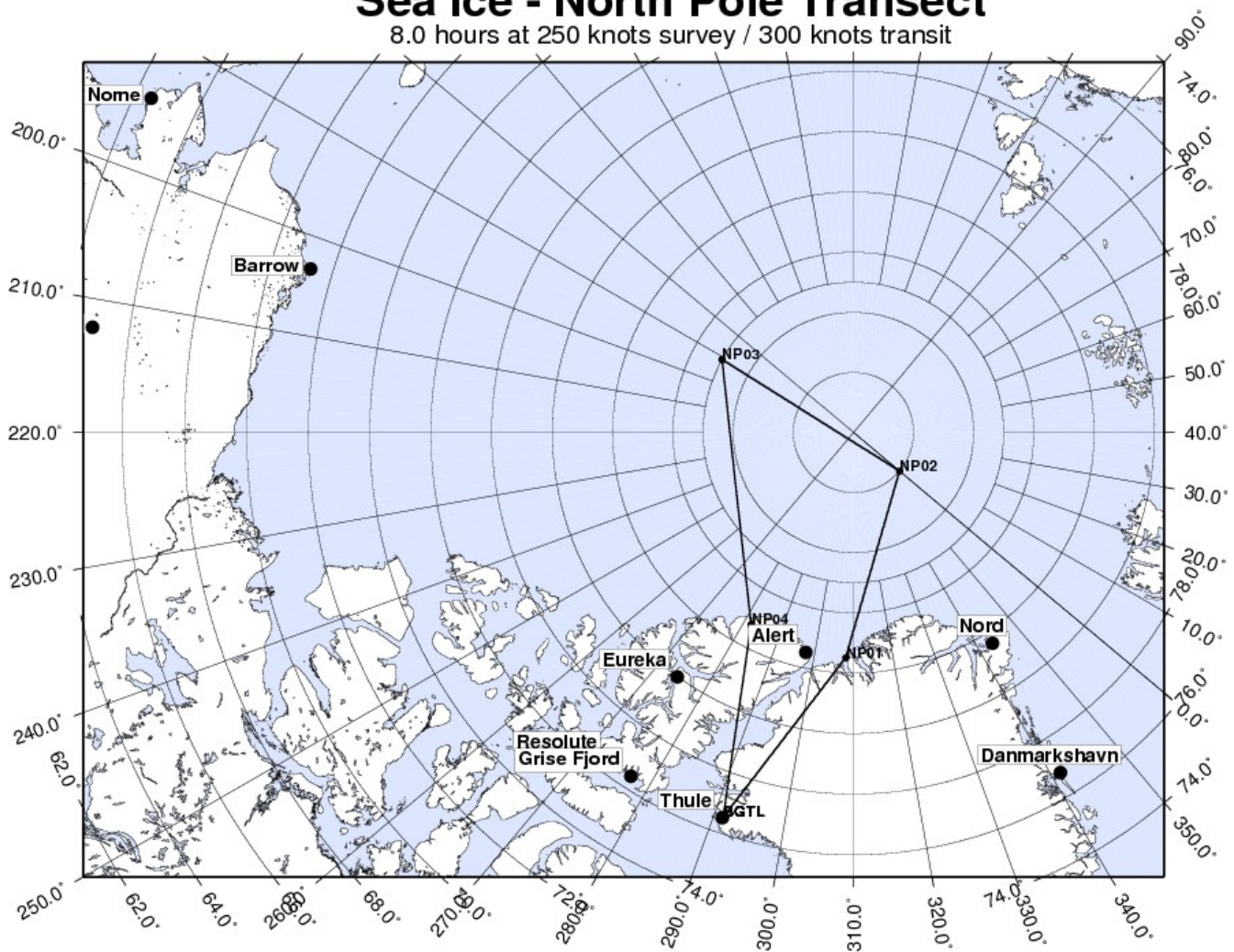
**Instrument Priority:** ATM/Snow/KU/Grav/DMS

**ICESat Track:** none

**Remaining Issues:** can be coordinated with CryoVex Alert ops; align leg(s) with coincident CryoSat orbits if they fall nearby

## Sea Ice - North Pole Transect

8.0 hours at 250 knots survey / 300 knots transit



# Sea Ice – Canada Basin / Thule

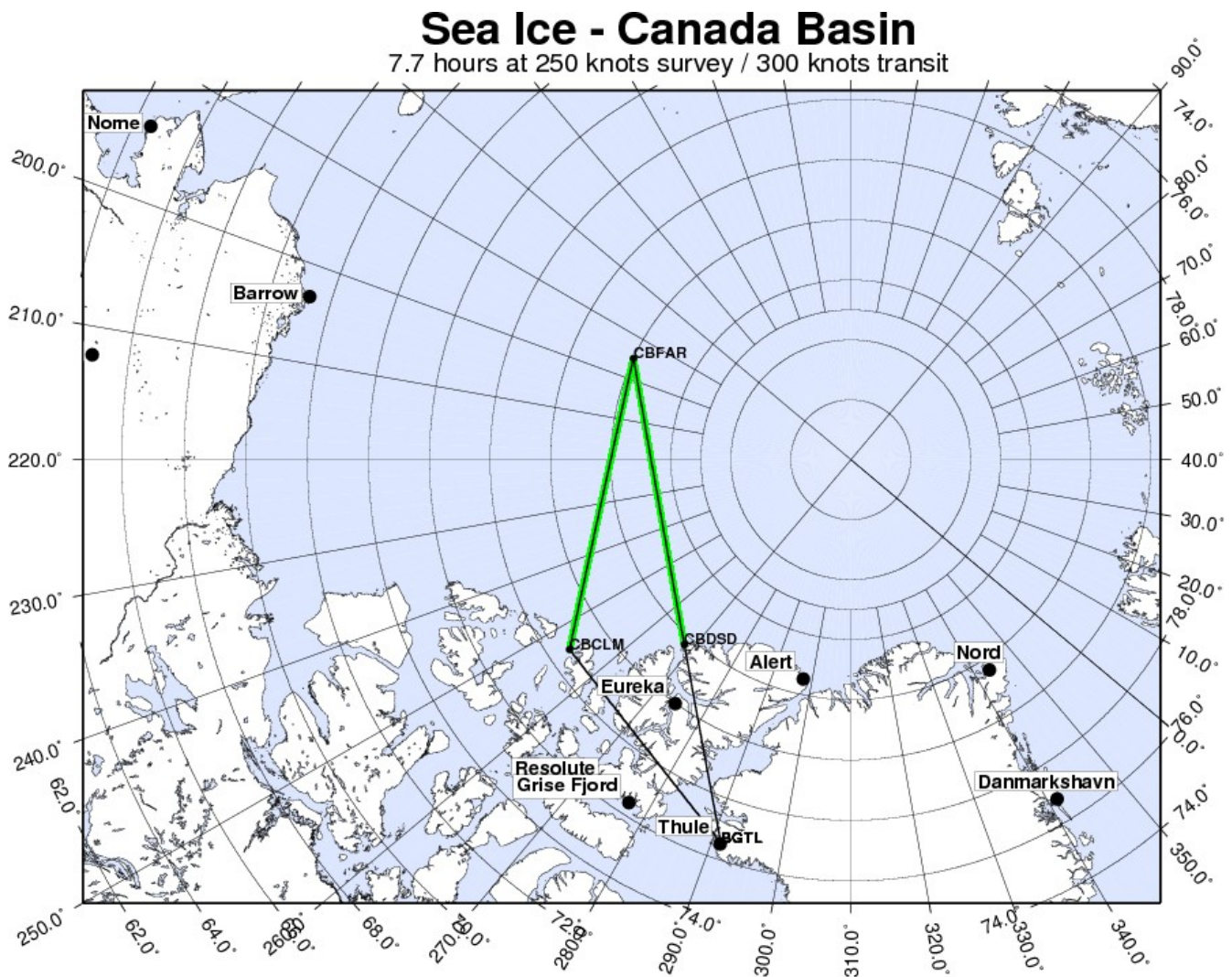
This is a new mission, designed to sample sea ice in a large region between the North Basin Transect and the Beaufort-Chukchi Diamond that has been poorly sampled by OIB in past campaigns.

**Flight Priority:** High

**Instrument Priority:** ATM/Snow/KU/Grav/DMS

**ICESat Track:** none

**Remaining Issues:** none known





# Sea Ice – Beaufort-Chukchi Diamond / Fairbanks

This is a new mission, designed to sample sea ice in the western Arctic Basin along north-south gradients in the Chukchi and Beaufort Seas.

**Flight Priority:** High

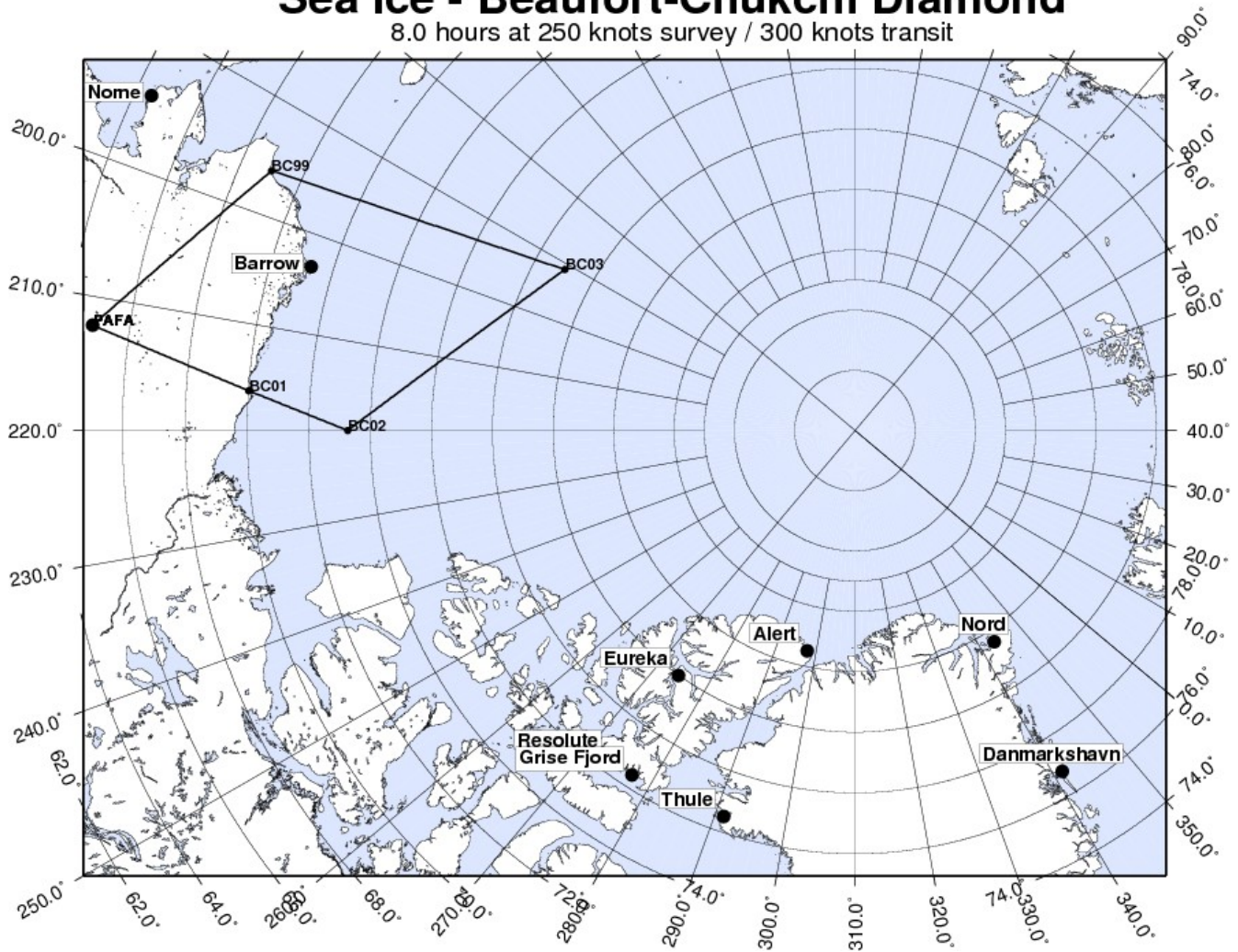
**Instrument Priority:** ATM/Snow/KU/Grav/DMS

**ICESat Track:** none

**Remaining Issues:** Align with CryoSat tracks if they fall nearby

## Sea Ice - Beaufort-Chukchi Diamond

8.0 hours at 250 knots survey / 300 knots transit



# Sea Ice – Beaufort-Chukchi Zigzag / Fairbanks

This is a new mission, designed to measure north-south and east-west gradients in western Arctic basin sea ice in the Beaufort and Chukchi Seas. We also include a single pass over the main BROMEX line near Barrow.

**Flight Priority:** High

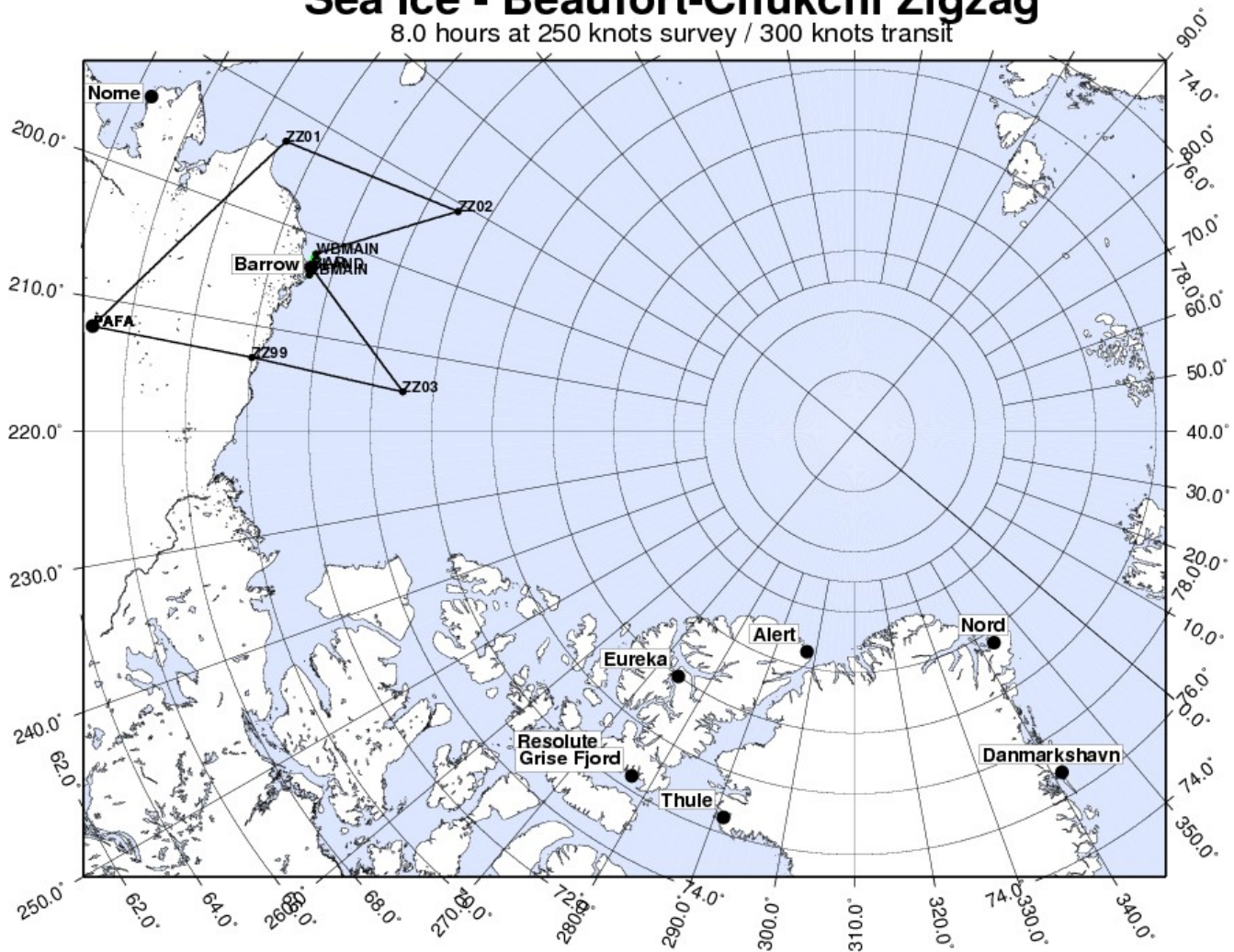
**Instrument Priority:** ATM/Snow/KU/Grav/DMS

**ICESat Track:** none

**Remaining Issues:** needs completed latlon file

## Sea Ice - Beaufort-Chukchi Zigzag

8.0 hours at 250 knots survey / 300 knots transit





# Sea Ice – Alaska Coastal Zigzag Option A / Fairbanks

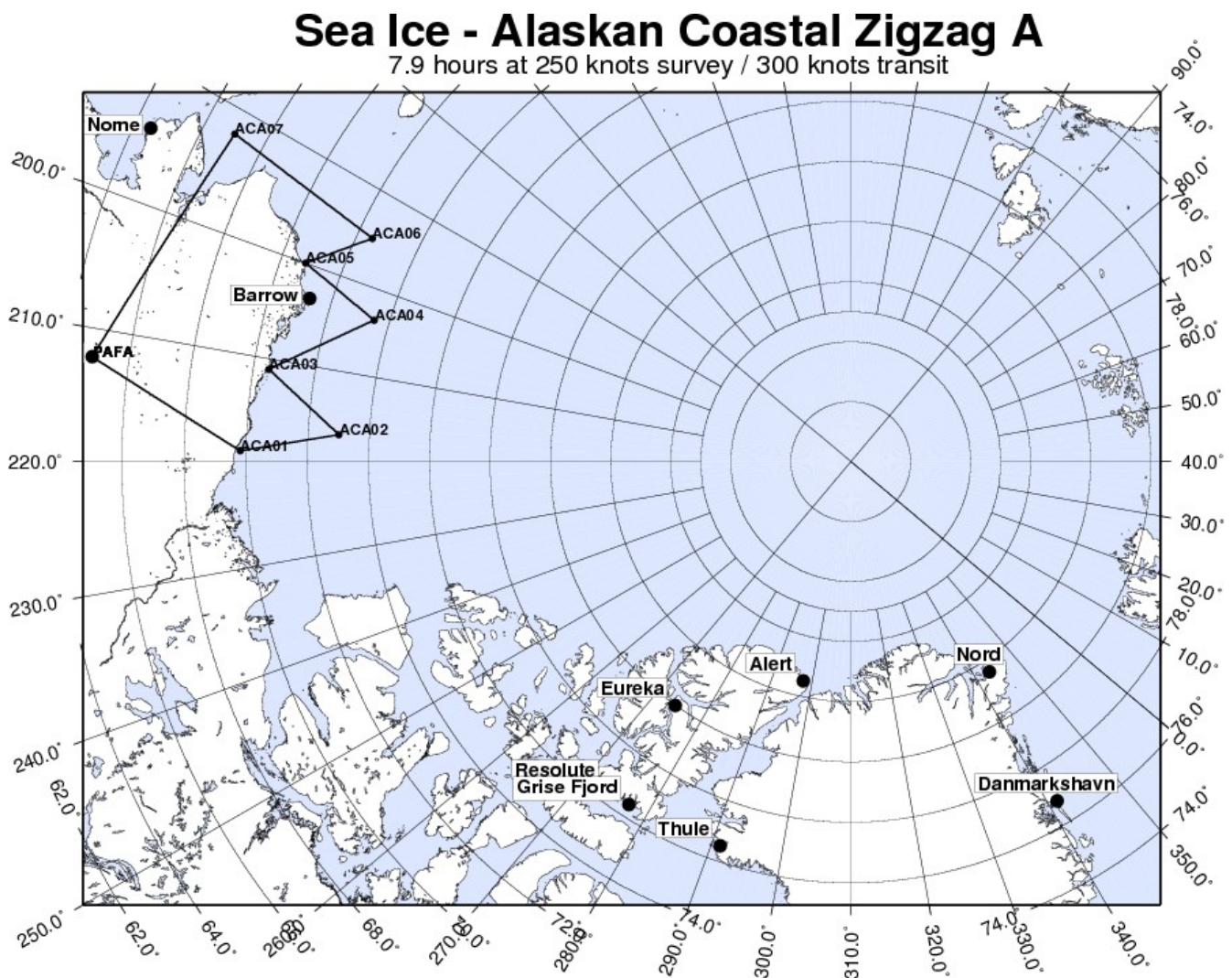
This is a new mission, designed to extensively sample first-year ice near the Alaskan coast, as well as the snow cover on it. This mission and the next one, Alaska Coastal Zigzag Option B, are alternate ideas for the same flight. This “Option A” plan does not overfly Barrow while Option B does. So if the Beaufort-Chukchi Zigzag (which does overfly Barrow) is flown, then we would fly this “A” version of this mission. If the Beaufort-Chukchi Zigzag is not flown, we would fly the Option B version of this mission.

**Flight Priority:** Low

**Instrument Priority:** ATM/Snow/KU/Grav/DMS

**ICESat Track:** none

**Remaining Issues:** needs latlon file



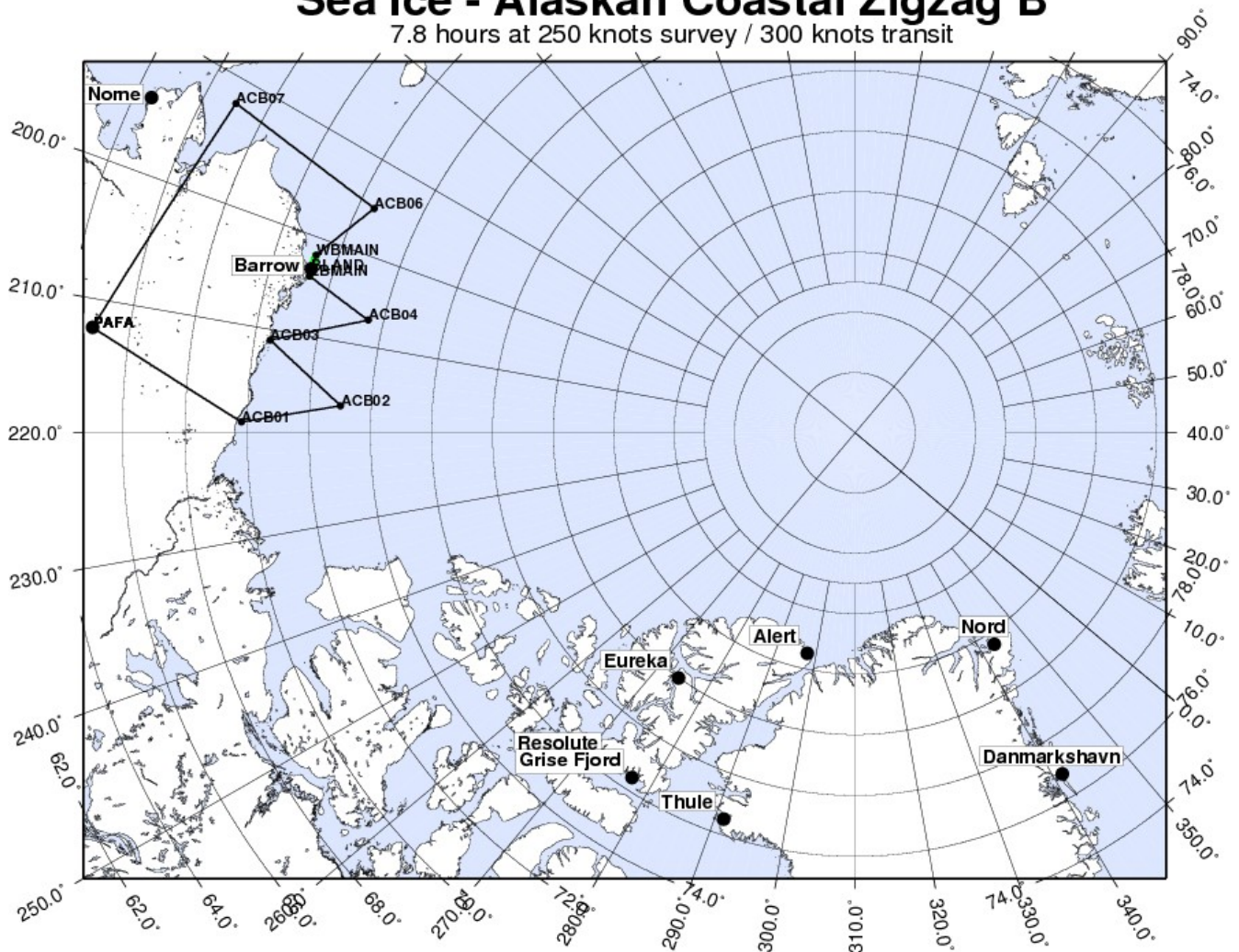
# Sea Ice – Alaska Coastal Zigzag Option B / Fairbanks

This is a new mission, designed to extensively sample first-year ice near the Alaskan coast, as well as the snow cover on it. This mission and the previous one, Alaska Coastal Zigzag Option A, are alternate ideas for the same flight. The Option A plan does not overfly Barrow while this Option B does. So if the Beaufort-Chukchi Zigzag (which does overfly Barrow) is flown, then we would fly the “A” version of this mission. If the Beaufort-Chukchi Zigzag is not flown, we would fly this Option B version. We also incorporate a flyover of the BROMEX main line near Barrow as part of this flight.

- Flight Priority:** Low unless Beaufort-Chukchi Zigzag not flown, otherwise High
- Instrument Priority:** ATM/Snow/KU/Grav/DMS
- ICESat Track:** none
- Remaining Issues:** needs completed latlon file

## Sea Ice - Alaskan Coastal Zigzag B

7.8 hours at 250 knots survey / 300 knots transit





# Sea Ice – MABEL Underflight / Kangerlussuaq

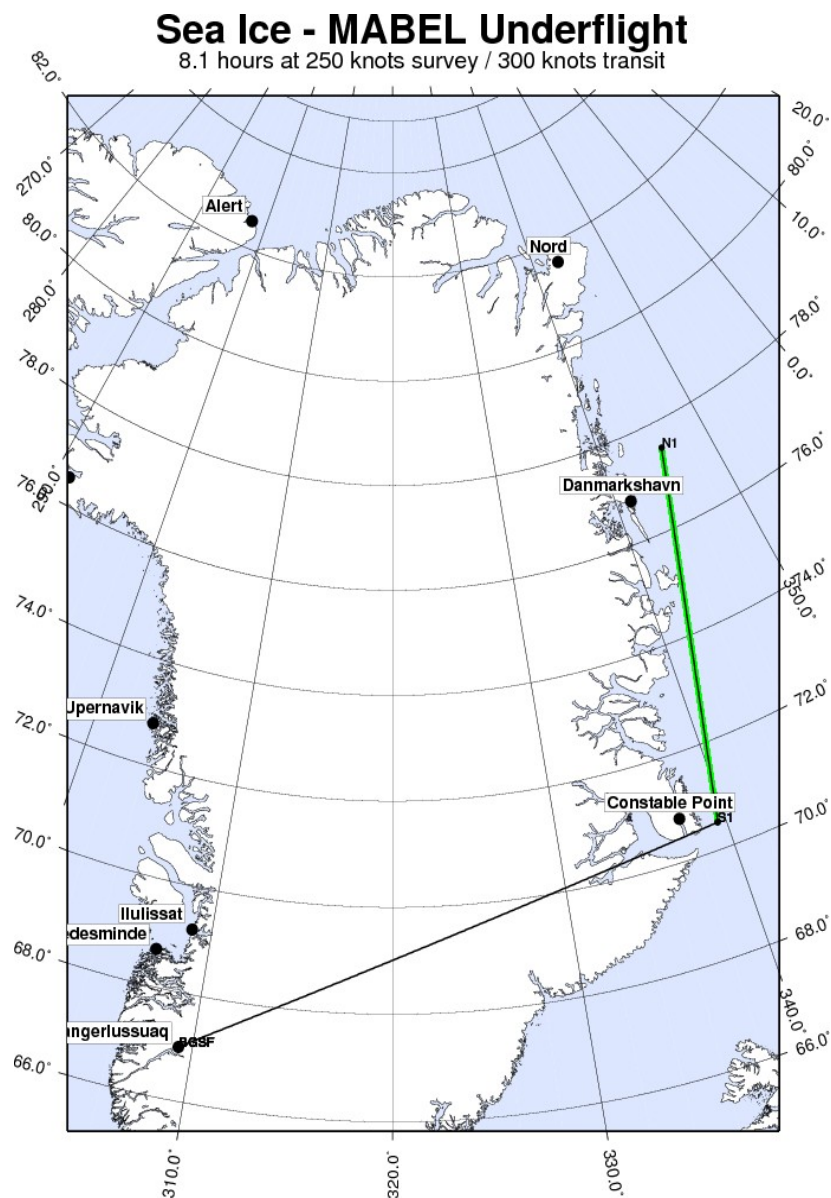
This is a new mission, intended to sample sea ice cover along the east coast of Greenland in conjunction with a MABEL overflight from Keflavik. The geometry of this line was selected by Ron Kwok based on an analysis of sea ice cover during April from 2003 to 2011. We transit from Kangerlussuaq to the sea ice off the east coast of Greenland at high altitude, conduct an out-and-back survey with the northbound segment at low altitude and the altitude of the southbound segment to be selected based on MABEL beam configuration, and return over the ice cap at high altitude.

**Flight Priority:** High unless Fram Straight mission coordinated with MABEL, otherwise low

**Instrument Priority:** ATM/Snow/KU/Grav/DMS

**ICESat Track:** none

**Remaining Issues:** select southbound altitude based on MABEL beam configuration; coordinate timing of flight with MABEL team



# Land Ice – Alaska Glaciers / Fairbanks

This mission repeats dh/dt survey lines over in the St. Elias mountains and in the Glacier Bay area which were surveyed by ATM in 2005, and by the University of Alaska a number of times. Specific glaciers we survey are Hubbard, Valerie, Variegated, Guyot, the Yakutat Icefield, Fisher, Lowell, and three glaciers in Glacier Bay National Park.

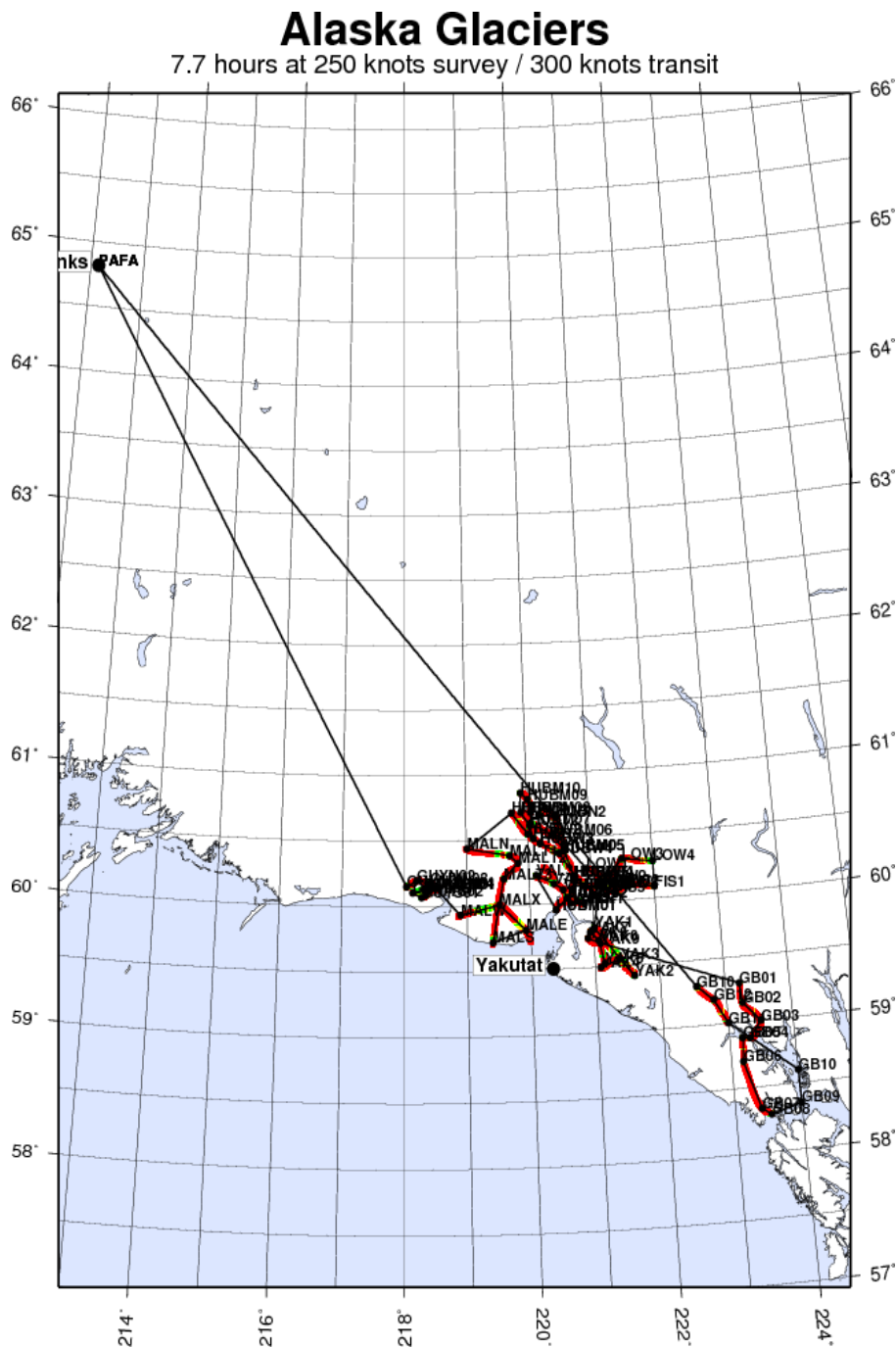
**Flight Priority:** Low

**ICESat Track:** none

**Remaining Issues:** none known

**Instrument Priority:** ATM

**Flown in 2011:** No



# Land Ice – Baffin 01 / Thule

This mission repeats survey lines over the Barnes and Devon Ice Caps previously surveyed by the ATM/KU teams in 1995, 2000, and 2005, and adds several new lines over the Barnes Ice Cap. We also overfly CryoVex field sites on the Devon Ice Cap. These include the “623” line, the May 3<sup>rd</sup> CryoSat overpass (corresponding to the May 1<sup>st</sup> pass from 2011), and the April 22<sup>nd</sup> pass (corresponding to April 20 2011). Of these two the May 3<sup>rd</sup> overpass is the primary line, per the Dave Burgess email from 20120227.

**Flight Priority:** High

**ICESat Track:** none

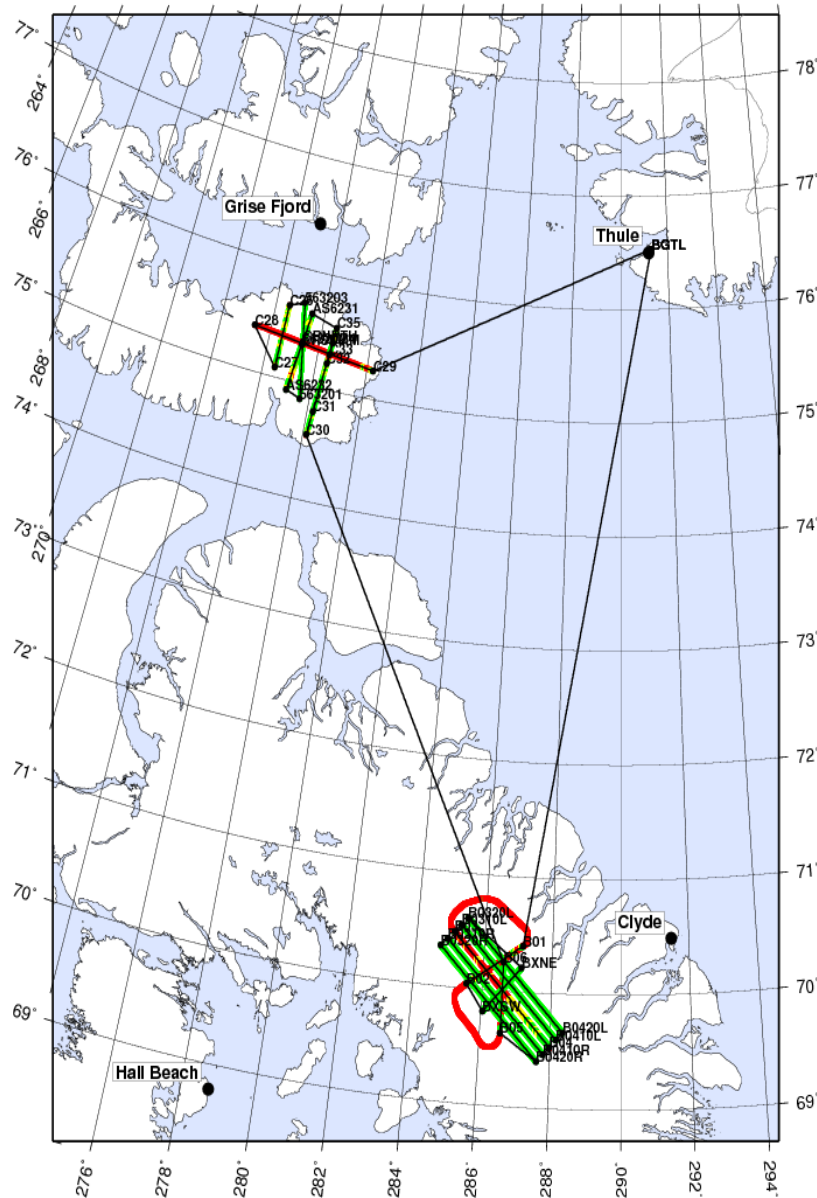
**Remaining Issues:** Add CryoSat line(s) per above

**Instrument Priority:** ATM/KU

**Flown in 2011:** Yes

## Baffin 01

7.7 hrs at 250 knots survey / 300 knots transit



# Land Ice – Ellesmere 01 / Thule

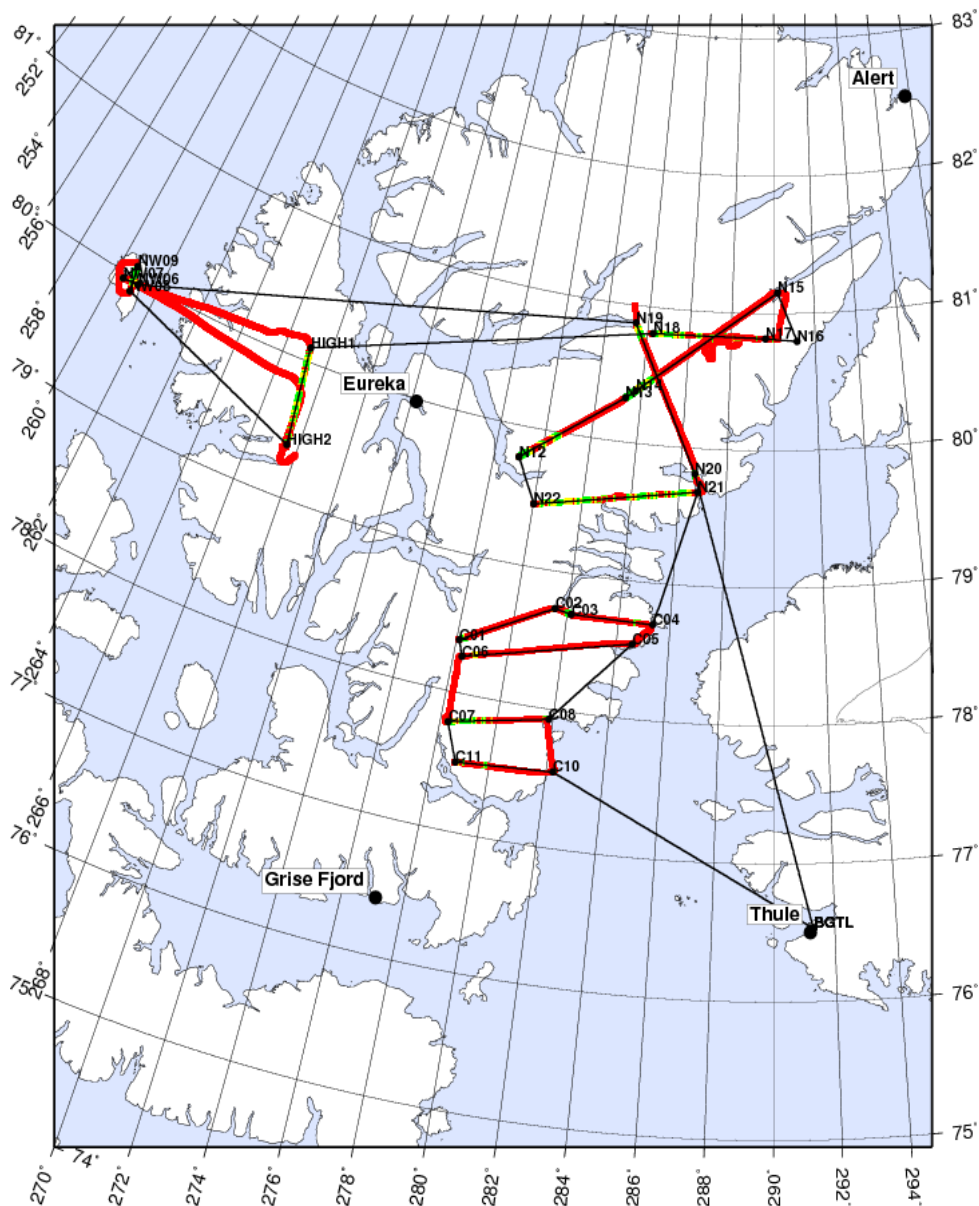
This mission repeats survey lines over Ellesmere, Axel Heiberg and Meighen Islands previously surveyed by the ATM/KU teams in 1995, 2000, and 2005. Two lines over northern Ellesmere Island flown in those years were removed in order to shorten this mission to an acceptable length.

**Flight Priority:** Medium  
**ICESat Track:** none  
**Remaining Issues:** none known

**Instrument Priority:** ATM  
**Flown in 2011:** Yes

## Ellesmere 01

7.6 hrs at 250 knots survey / 300 knots transit





# Land Ice – Northwest Fjords 01 / Thule

This is a new mission which extends the 2010 Northwest Coastal coast-parallel grid to seaward at 5 km increments. The purpose of the mission is to obtain fjord geometry using the gravimeter. Tie line locations were selected to overfly relatively non-dynamic ice in order to provide the best possible sounding radar returns, and to connect with shipborne bathymetry offshore. See the Appendix for a composite map which shows all the 2010 and 2011 NW Coastal flights in context.

**Flight Priority:** High

**ICESat Track:** none

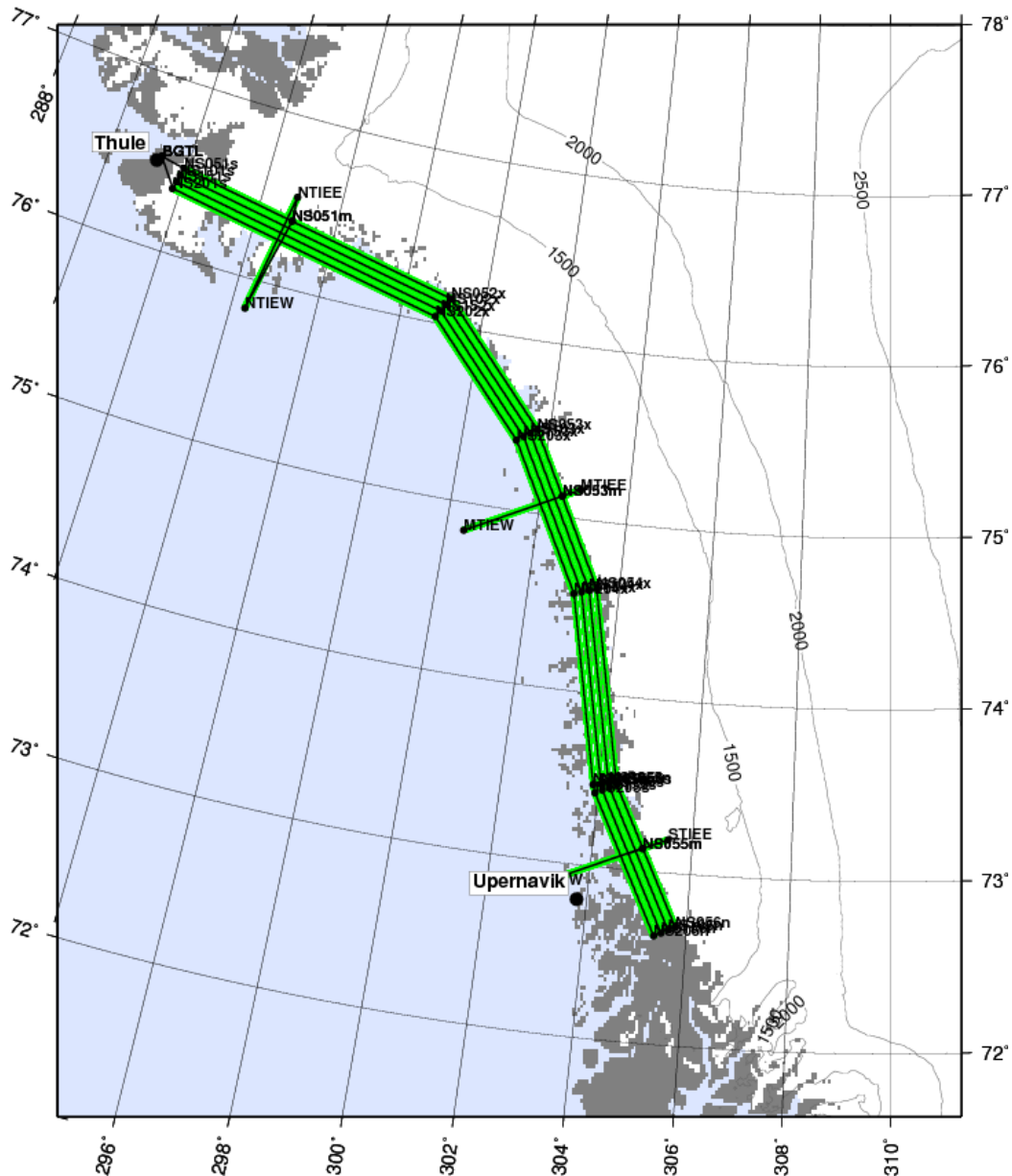
**Remaining Issues:** none known

**Instrument Priority:** Grav

**Flown in 2011:** No

## NW Fjords 01

7.5 hrs at 250 knots groundspeed



# Land Ice – Northwest Coastal 06 / Thule

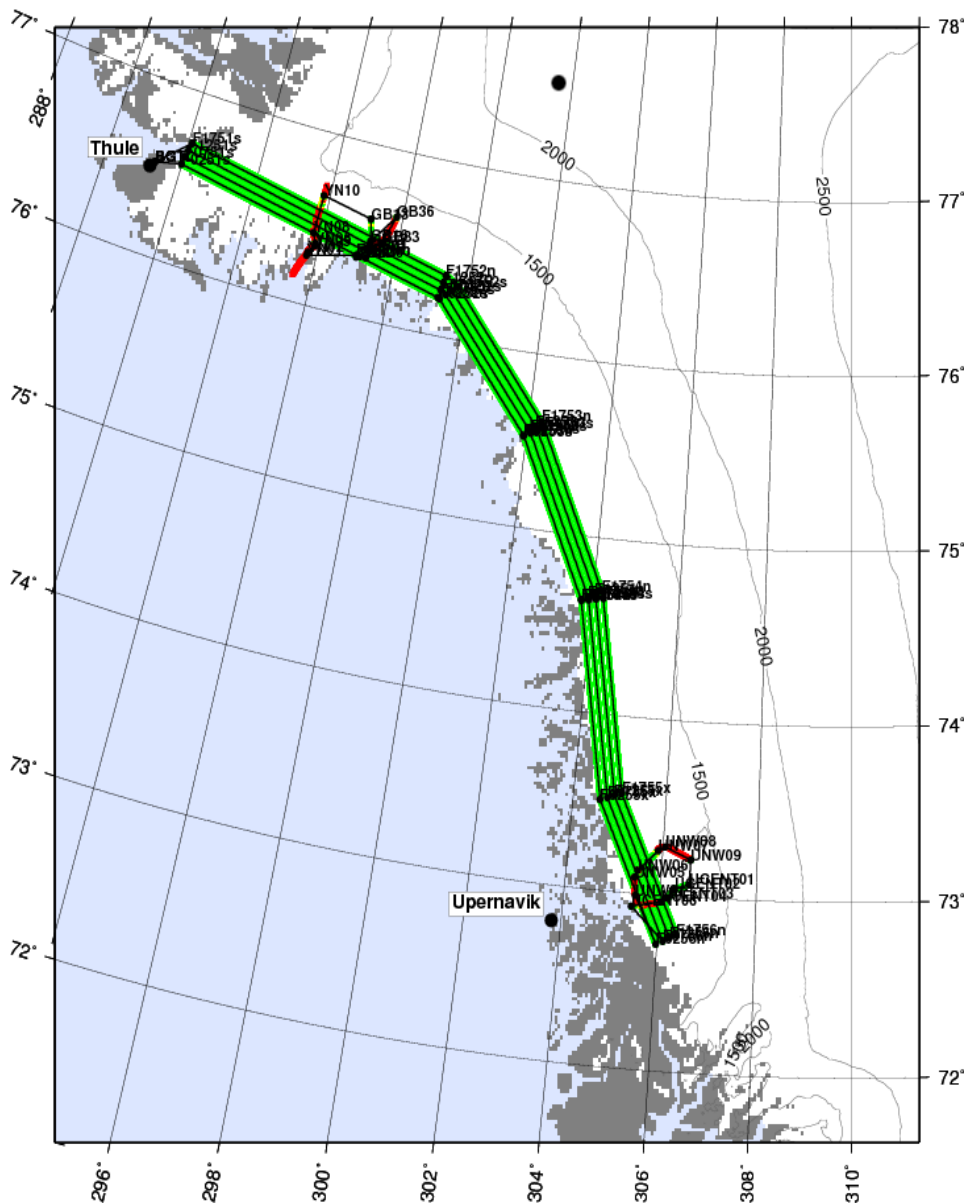
This is a new mission which interlaces the 2010-2011 Northwest Coastal coast-parallel grid, which had a spacing of 5 km, to 2.5 km. This flight also reoccupies the centerlines of the Upernavik Northwest and Yngvar Nielsen glaciers, and establishes new centerlines along the Upernavik middle ice stream, and both branches of the wishbone-shaped Gades Brae glacier. The companion Northwest Coastal 07 mission performs the same interlace strategy but farther inland. See the Appendix for a composite map which shows all the 2010-2011-2012 NW Coastal flights in context.

**Flight Priority:** Medium  
**ICESat Track:** none  
**Remaining Issues:** none known

**Instrument Priority:** MCoRDS/ATM  
**Flown in 2011:** No

## NW Coastal 06

7.5 hrs at 250 knots groundspeed



# Land Ice – Northwest Coastal 07 / Thule

This is a new mission which interlaces the 2010-2011 Northwest Coastal coast-parallel grid, which had a spacing of 5 km, to 2.5 km. The companion Northwest Coastal 06 mission does the same but farther to seaward. We also re-fly the centerline of the Sverdrup Glacier, and fly new centerlines on Dietrichson, Steenstrups, and a pair of centerlines on Kjaer Glacier. Finally we overfly a field site near Thule which will be occupied by Dartmouth colleagues in August 2012. See the Appendix for a composite map which shows all the 2010-2011-2012 NW Coastal flights in context.

**Flight Priority:** Low

**ICESat Track:** none

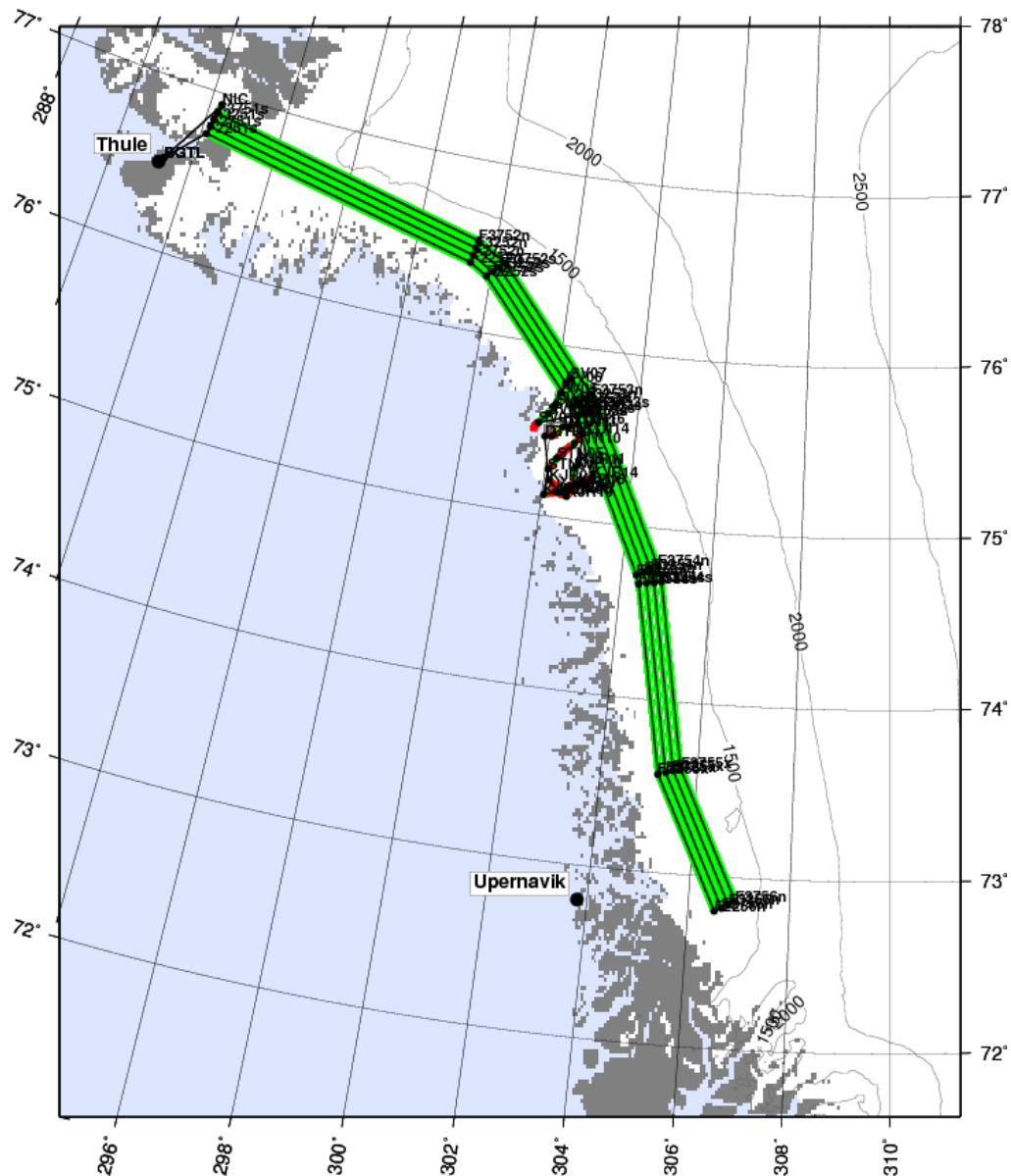
**Remaining Issues:** none known

**Instrument Priority:** MCoRDS/ATM

**Flown in 2011:** No

## NW Coastal 07

7.4 hrs at 250 knots groundspeed



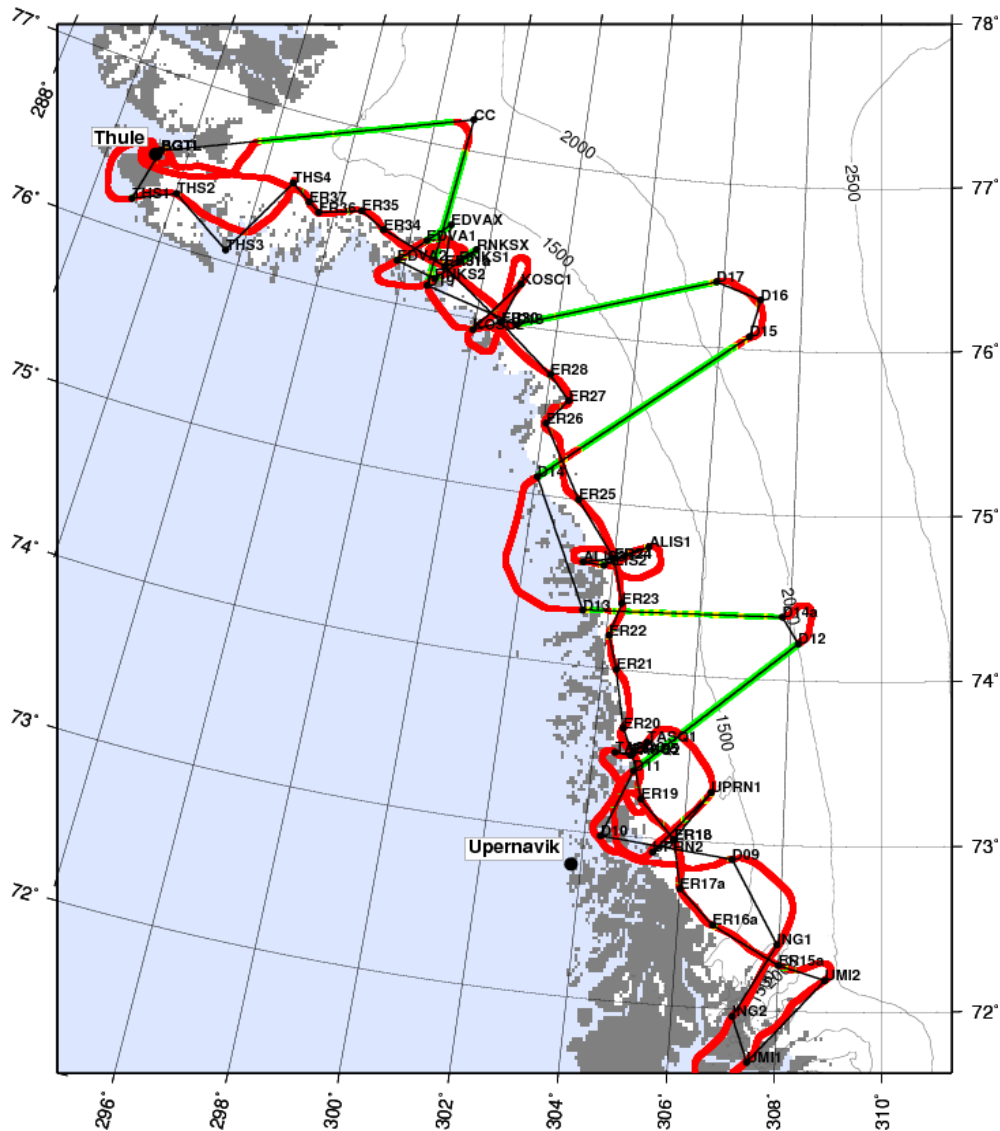
# Land Ice – Northwest Glaciers / Thule

This mission is a repeat of a 2009 and 2010 ICEBridge mission. It focuses on the upper Baffin Bay coast, with targeted longitudinal surveys of 12 glaciers in the region and repeats of long-established ATM dh/dt lines which were not targeted at outlet glaciers. We fly the glacier surveys in the reverse direction from 2010, in the hope that this will augment the recovery of useful gravity data when combined with the 2010 flights. See the Appendix for a composite map which shows all the 2010 and 2011 NW Coastal flights in context.

**Flight Priority:** Medium  
**ICESat Track:** none  
**Remaining Issues:** none known

**Instrument Priority:** ATM/MCORDS  
**Flown in 2011:** Yes

**NW Glaciers**  
7.9 hrs at 250 knots groundspeed



# Land Ice – Cape Alexander 01 / Thule

This is a new mission, designed for three purposes. First, we re-fly the centerlines of the Tracy and Heilprin Glaciers, and we fly a new centerline up the Melville Glacier. Second, we fly a coastal flux line on the south side of the Cape Alexander ice lobe, where a number of marine-terminating glaciers drain the ice lobe. Finally we fly an extensive grid of both ascending and descending ICESat ground tracks over the entire ice lobe.

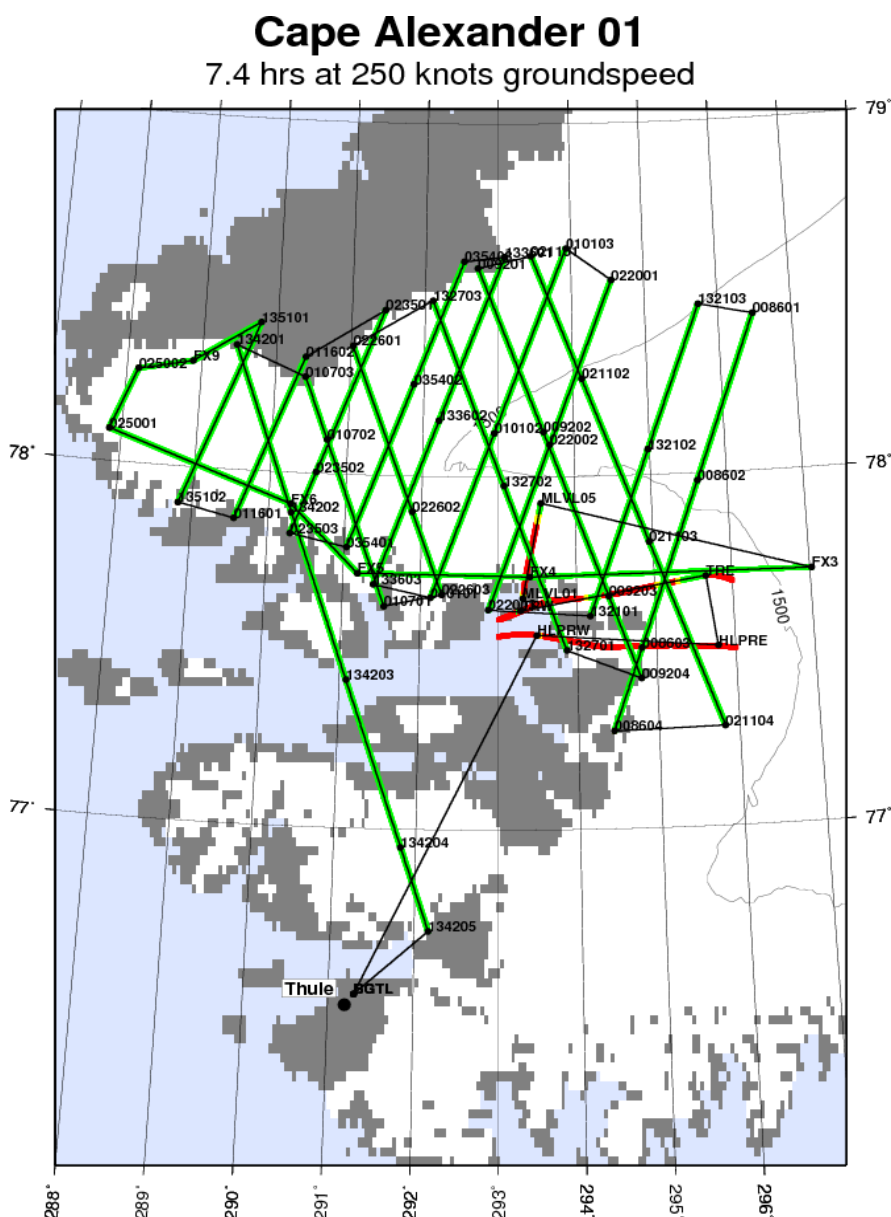
**Flight Priority:** High

**ICESat Track:** 0250,1351,0116,0235,0354,1336,0101,  
0220,1321,0086,0211,0092,1327,0226,0107,1342

**Remaining Issues:** none known

**Instrument Priority:** all

**Flown in 2011:** No



# Land Ice – Humboldt 01 / Thule

This is a new mission, designed to repeat two historical ATM lines which follow flowlines down the Humboldt Glacier, and several descending ICESat tracks which parallel the terminus. We also fly the GrIT traverse route between Thule and Camp Century, as well as an associated and collocated field site known as “2 Barrels”. See the Appendix for a composite map which shows both Humboldt missions in context.

**Flight Priority:** Medium

**Instrument Priority:** all

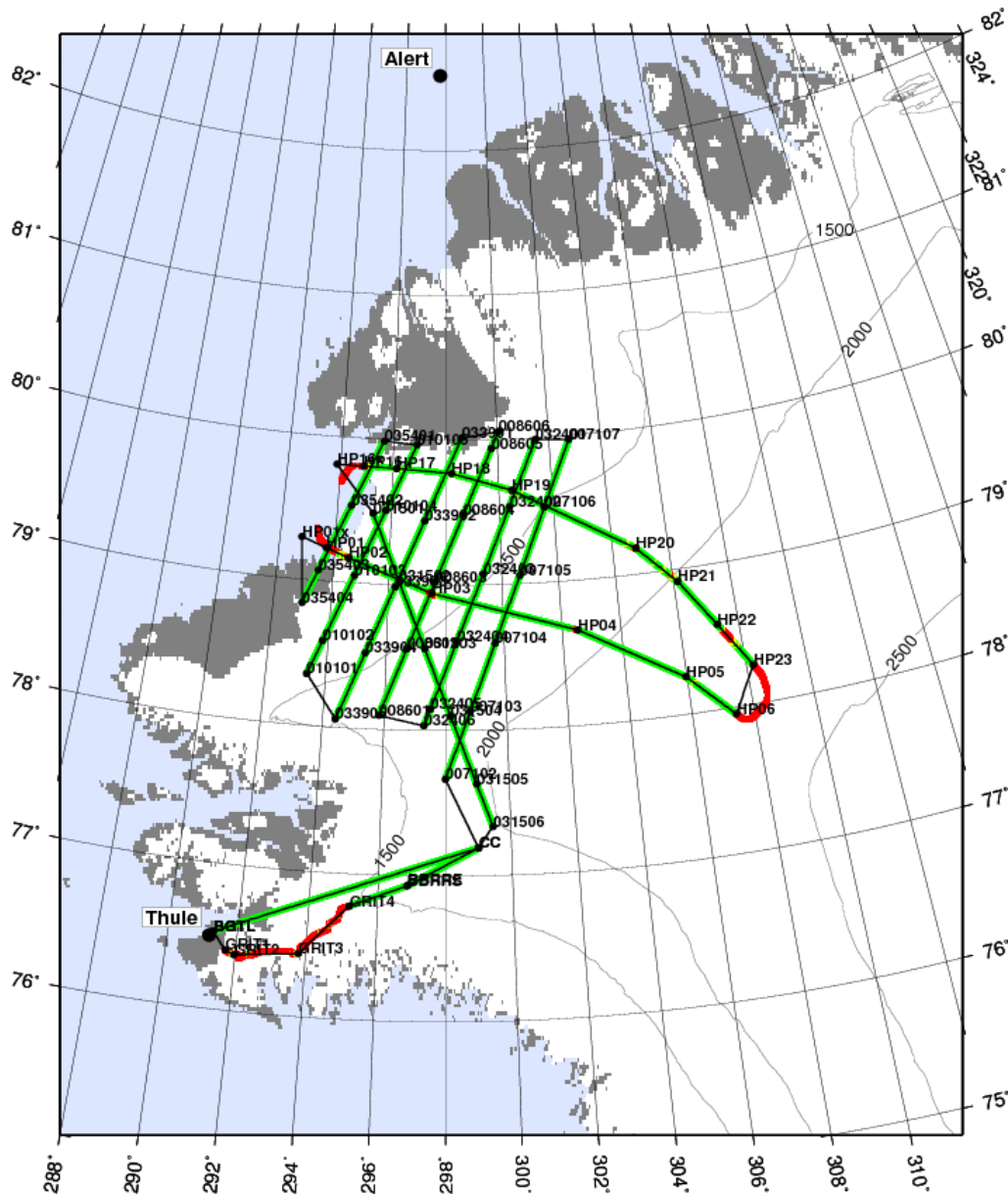
**ICESat Track:** 0071,0324,0086,0339,0101,0354,0315

**Flown in 2011:** No

**Remaining Issues:** none known

## Humboldt 01

7.4 hrs at 250 knots groundspeed





# Land Ice – Humboldt 02 / Thule

This is a new mission, designed to establish two new along-flow lines and interlace the ICESat lines flown in Humboldt 01 with the intervening ICESat tracks. See the Appendix for a composite map which shows both Humboldt missions in context.

**Flight Priority:** Low

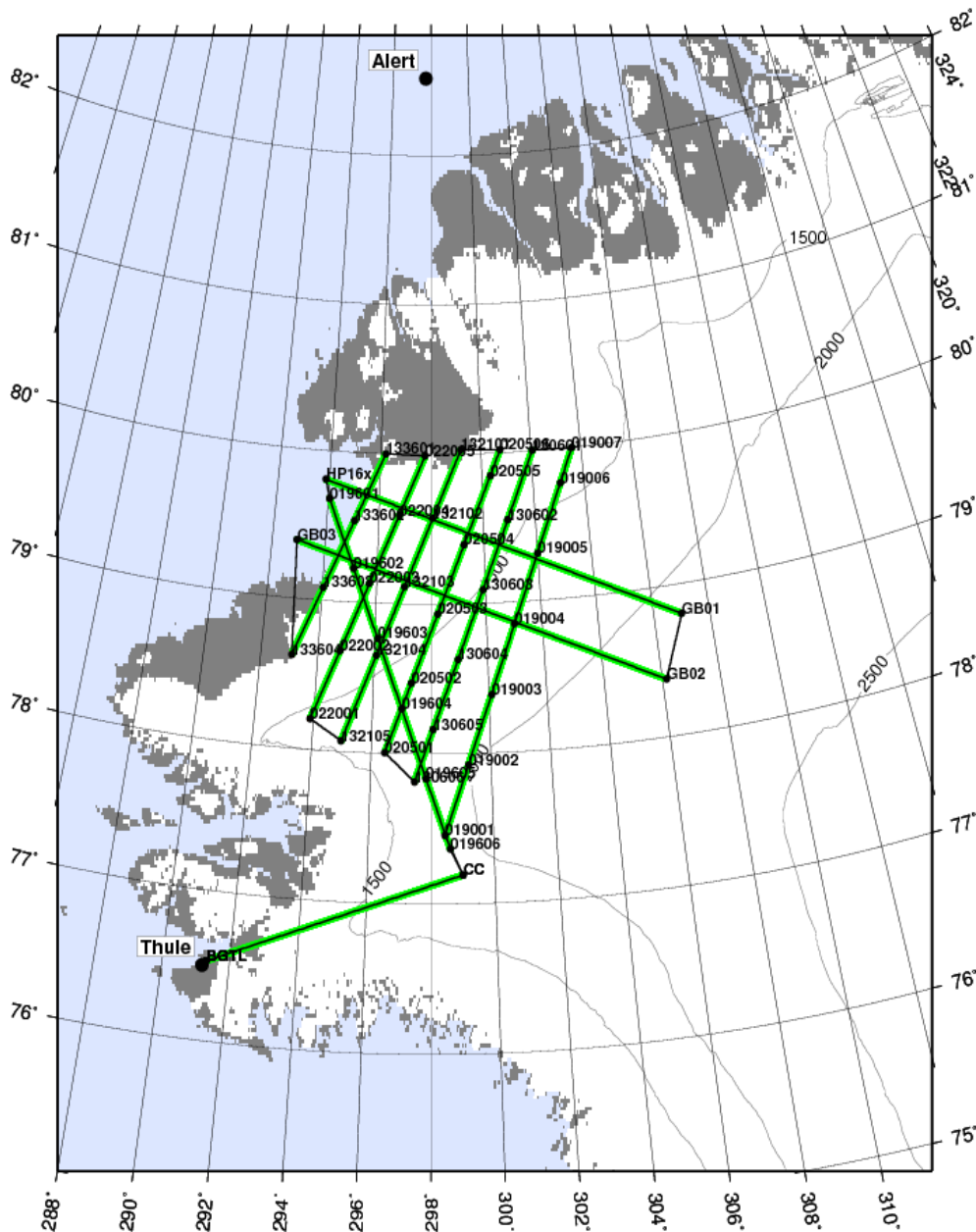
**ICESat Track:** 0190,1306,0205,1321,0220,1336,0196

**Remaining Issues:** none known

**Instrument Priority:** all

**Flown in 2011:** No

## Humboldt 02 7.4 hrs at 250 knots groundspeed



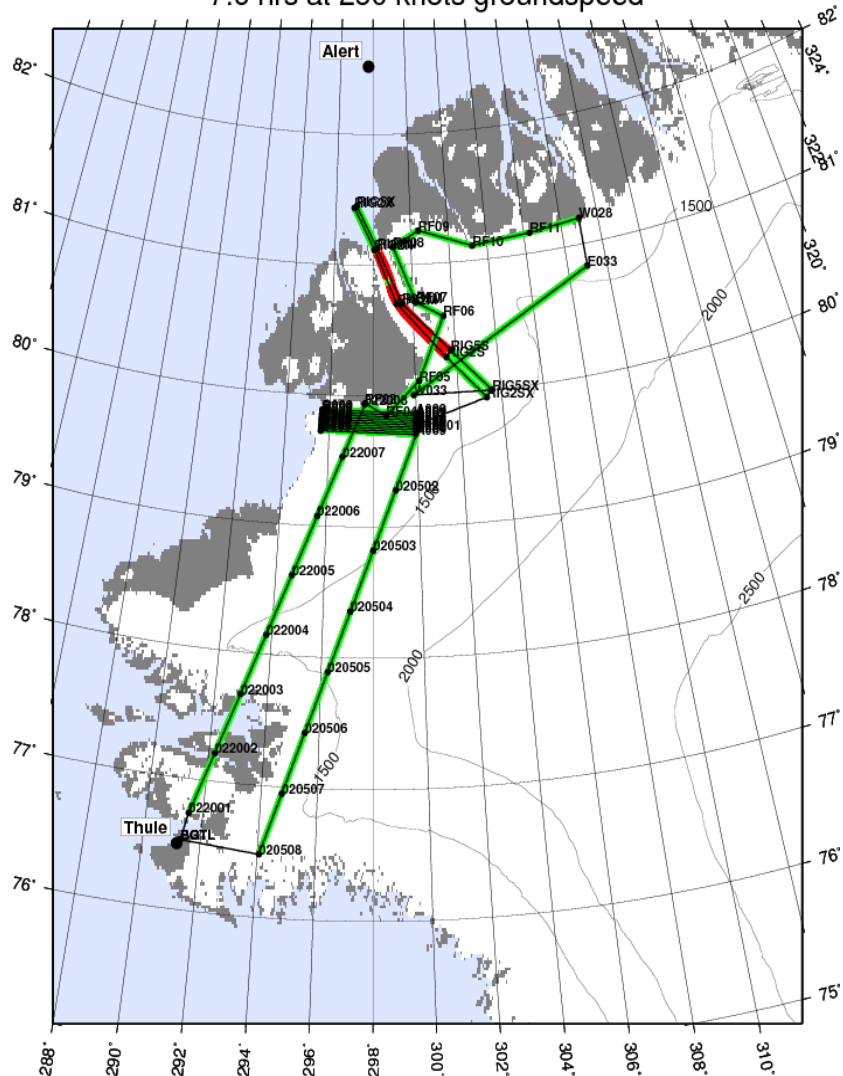
# Land Ice – Humboldt-Petermann 01 / Thule

This is a new mission, designed to accomplish a number of goals. First, it flies a radar tomography grid on the fast-flowing part of the Humboldt Glacier trunk, with 10 lines spaced at 2 km. We also fly a part of a coastal flux line which connects with and is continued by the North Flux 01 mission. Third, we fly a pair of historical ATM longitudinal lines down the trunk of the Petermann Glacier for dh/dt purposes. The central-most of these two was flown in 2010 and 2011, while the western line was last flown in 2002 and was selected based on a request from the gravity team. The Petermann trunk lines are extended well into the Hall Basin for connection with shipborne bathymetry data, and they are extended 50 km farther inland than flown previously as well. We transit between Thule and between the survey areas on a combination of ICESat ground tracks and one master grid line immediately to the north of the Petermann grid established in 2010 and 2011. The MCoRDS radar should be configured in tomographic mode for the Humboldt grid, and in normal profiling mode for the rest of this flight.

**Flight Priority:** Low  
**ICESat Track:** 0220,0205  
**Remaining Issues:** none known

**Instrument Priority:** all  
**Flown in 2011:** Portions

## Humboldt-Petermann 01 7.6 hrs at 250 knots groundspeed



# Land Ice – North Glaciers 01 / Thule

This is a new mission, designed to resurvey historical ATM longitudinal surveys of several glaciers in northern Greenland, including Steensby, Ryder, and Hagen Glaciers. The maneuver connecting lower Steensby and Ryder glaciers has been modified to collect straight-line data over the fjords for better gravity data. It also re-occupies ATM lines on the Flade Ice Cap, near Station Nord, and returns to Thule along the British North Greenland Expedition traverse line, which was also flown by ATM in 2002.

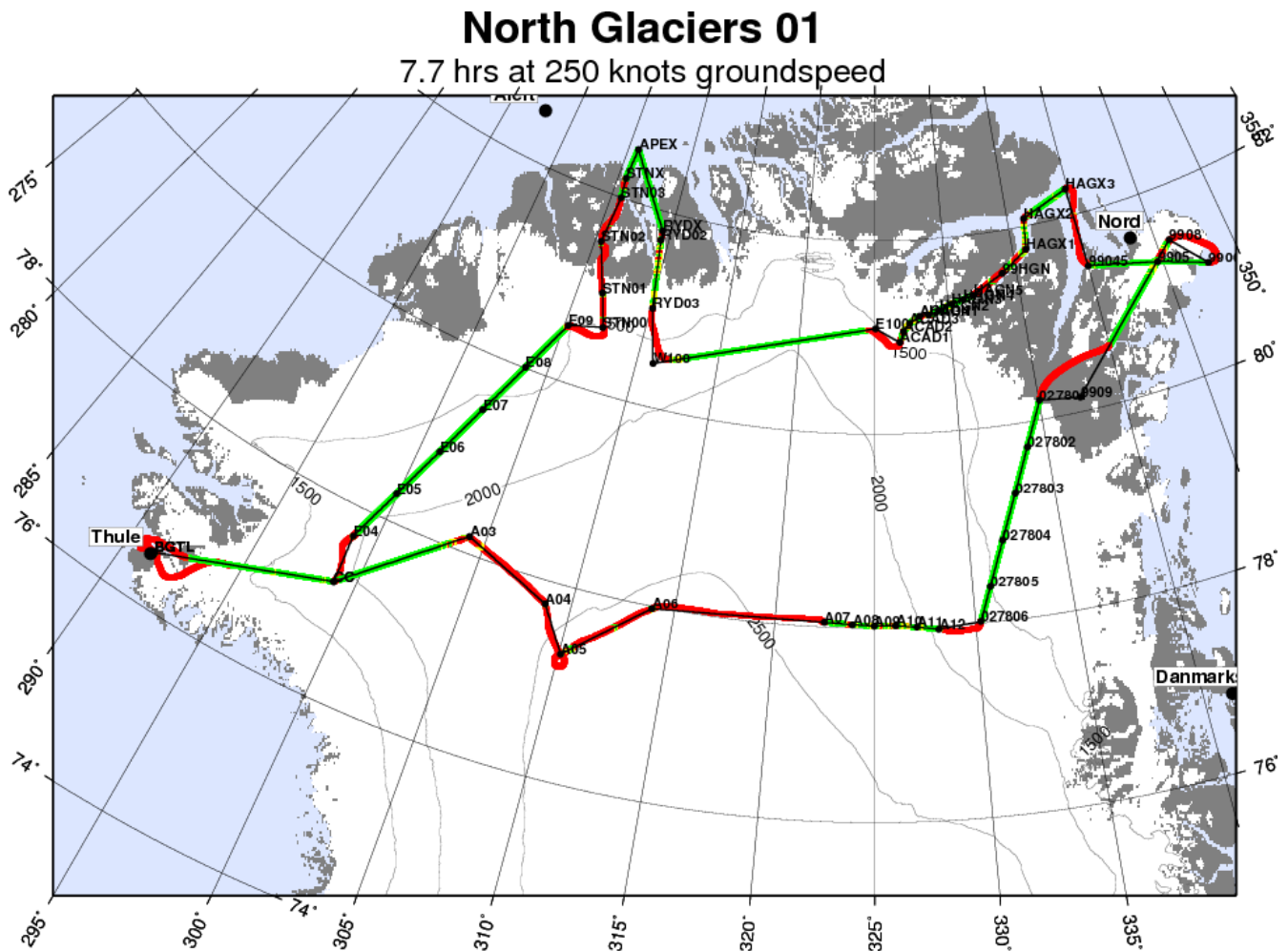
**Flight Priority:** Low

**ICESat Track:** 0278

**Remaining Issues:** none known

**Instrument Priority:** ATM/MCORDS

**Flown in 2011:** Yes



# Land Ice – North Glaciers 02 / Thule

This is a new mission, designed to resurvey a historical ATM longitudinal survey of Academy Glacier, plus several new glaciers. These include Ostfjord, Maria Sophia, and a (possibly unnamed) glacier emptying into Newman Bay. We also survey a coast-parallel grid on the far northeastern flank of the ice sheet, whose main purpose is to fill in a gap in existing ice-sounding radar coverage. The grid lines are made up of four ICESat tracks. We return to Thule along the 2000m contour line. The mission is slightly too long at 7.9 hrs, but it can be readily shortened if necessary by shortening two of the upstream grid lines. This decision can be made in real-time to account for conditions on the particular day of the flight.

**Flight Priority:** High

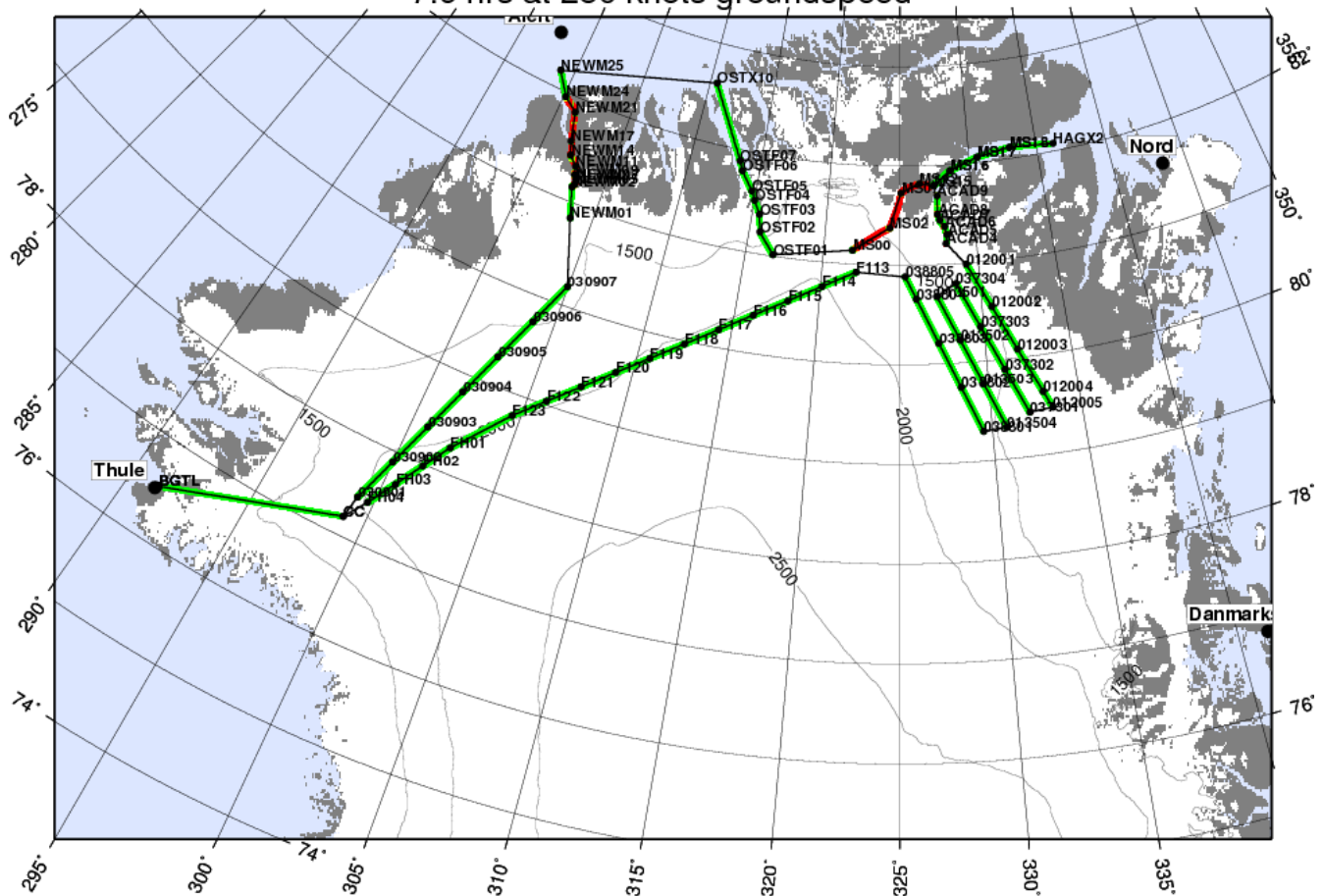
**ICESat Track:** 0309,0120,0373,0135,0388

**Remaining Issues:** can we shorten mission by shortening the Independence Fjord line?

**Instrument Priority:** ATM/MCORDS

**Flown in 2011:** No

**North Glaciers 02**  
7.9 hrs at 250 knots groundspeed

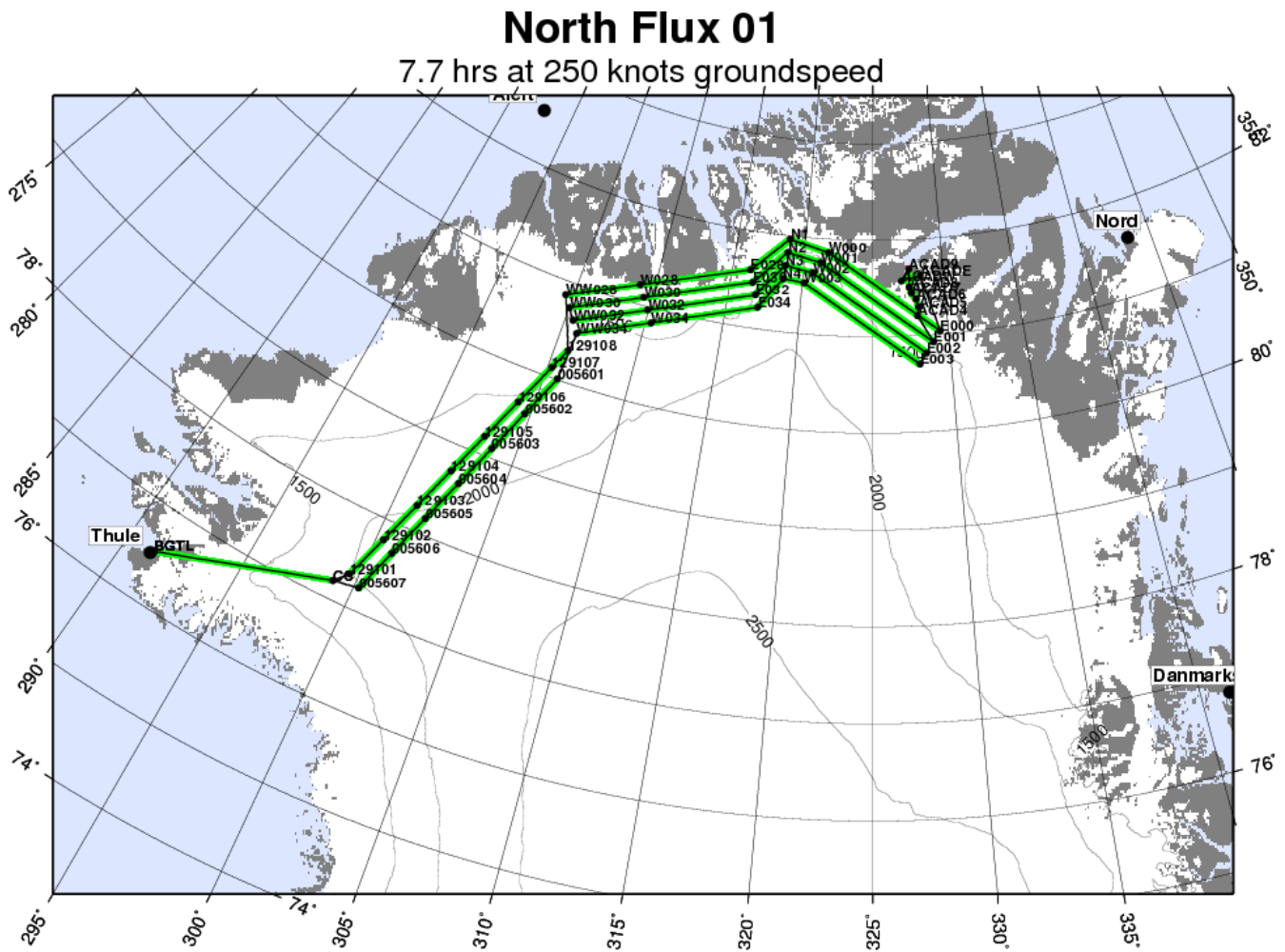


# Land Ice – North Flux 01 / Thule

This is a new mission, designed to connect with and continue the coastal flux line in the Humboldt-Petermann 01 flight to the east. It also augments this line with a pair of coast-parallel grids situated on the upstream areas of large outlet glaciers in the area, including Ryder, Ostenfeld, Academy and Hagen Glaciers. We also make a crossing pass of Academy Glacier nears its terminus and a centerline pass as well. The north coastal grid is continued in the east in the North Glaciers 02 mission. We transit to and from the area along ICESat ground tracks.

**Flight Priority:** Medium  
**ICESat Track:** 1291,0056  
**Remaining Issues:** none known

**Instrument Priority:** MCORDS  
**Flown in 2011:** No





# Land Ice – NEIS ICESat / Thule

This is a new mission which extends the coverage of the Northeast Ice Stream along ascending ICESat ground tracks over Zacharaie and 79N glaciers, which will connect a combined IceBridge/ICESat time series over a very dynamic region and be useful for ICESat-2 simulation as well as science. In addition to this, we reoccupy an east-west master grid line last flown in 2010 for dh/dt purposes over the central ice sheet, and this combined with three other master grid lines over the upper Petermann catchment should help to better understand potentially widespread basal melt characteristics in this part of the ice sheet.

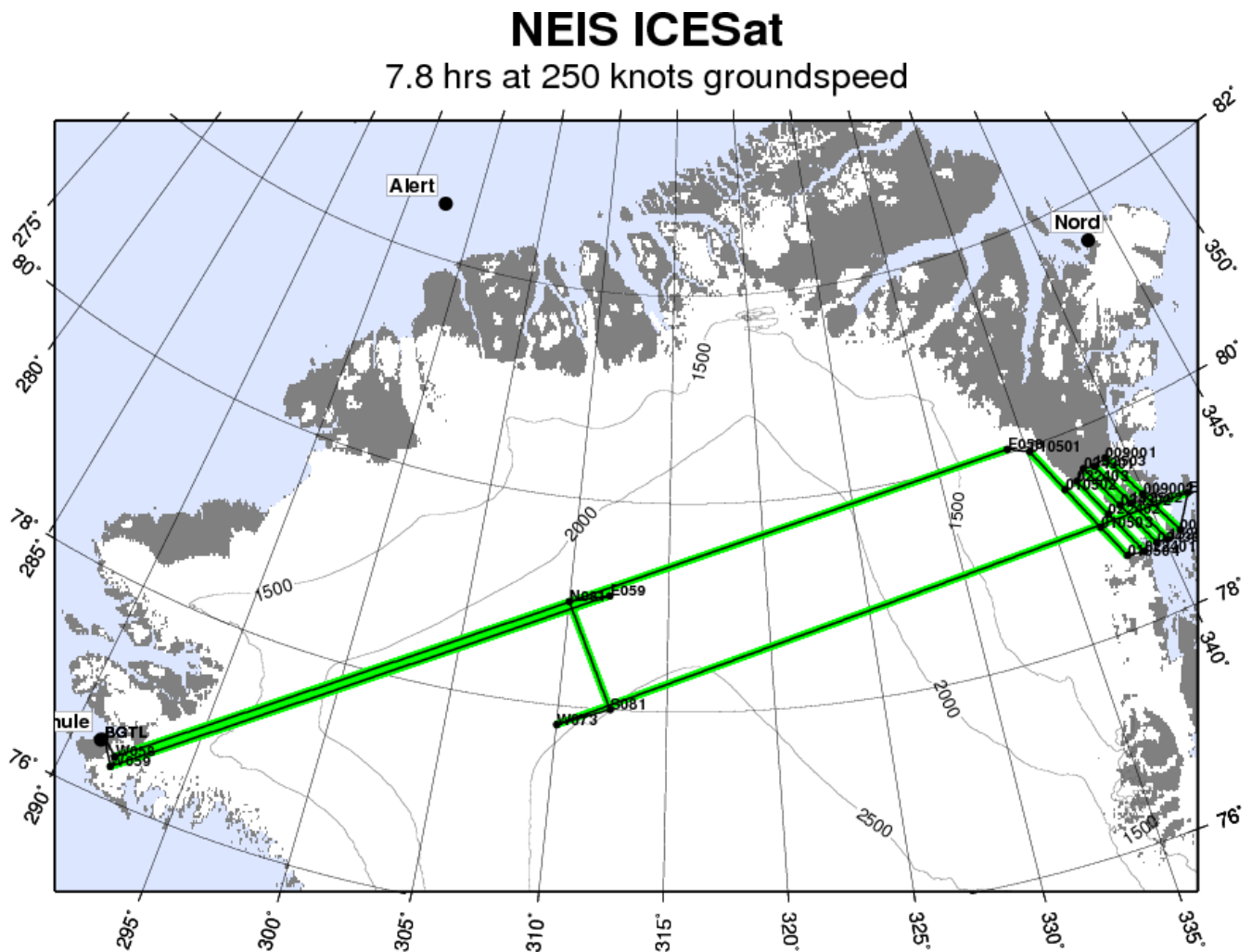
**Flight Priority:** High

**ICESat Track:** 0105,0224,0343,1325,0090

**Remaining Issues:** none known

**Instrument Priority:** ATM/MCoRDS/Grav/Mag

**Flown in 2011:** No



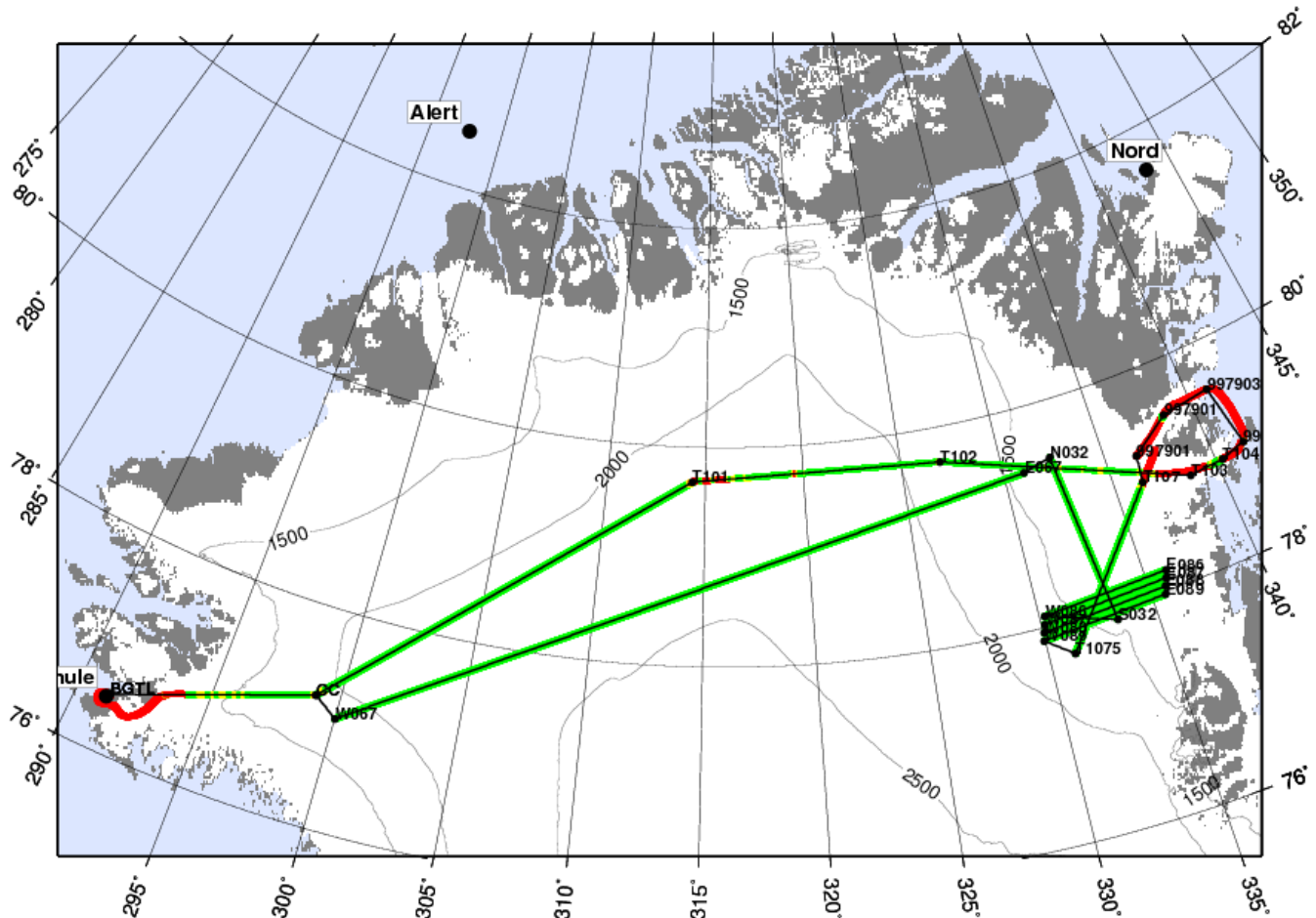
# Land Ice – NEIS 05 / Thule

This is a new mission which extends the coverage of the Northeast Ice Stream 10 km grid upstream. It also resurveys the ATM centerlines of Zacharaie and 79N glaciers. One of the east-west transit lines from Thule also resurveys an old ATM line, which crosses through an area of the central ice cap which may be thickening slightly. We fly the centerlines of Zacharaie and 79N Glaciers in the reverse direction from the 2010 flight, to aid in the recovery of gravity data on these sinuous flightlines. We also fly the 1999 ATM centerline of 79N Glacier, which avoids a “kink” which caused the upper part of the 2010 flightline to miss the glacier centerline, and the resulting straightening of the centerline also improves gravity data collection there. See the Appendix for a composite map which shows all the 2010 and planned 2011 flights over the Northeast Ice Stream in context with each other.

**Flight Priority:** Medium  
**ICESat Track:** none  
**Remaining Issues:** none known

**Instrument Priority:** MCORDS/ATM  
**Flown in 2011:** No

## NEIS 05 7.9 hrs at 250 knots groundspeed



# Land Ice – NEIS 06 Prime / Thule

This is a new mission which extends the coverage of the Northeast Ice Stream 10 km grid upstream. It also resurveys the ATM centerlines of Bistrup and Storstrommen Glaciers. One of the east-west transit lines from Thule also resurveys an old ATM line, which crosses through an area of the central ice cap which may be thickening slightly. This mission differs from the original NEIS 06 designed for 2011 because the Northeast Grid suite of missions included all of the east-west grid lines on the southern approaches to Zacharaie glacier, so here we have replaced these with north-south lines to fill in what would otherwise be a gap in coast-parallel coverage in this area.

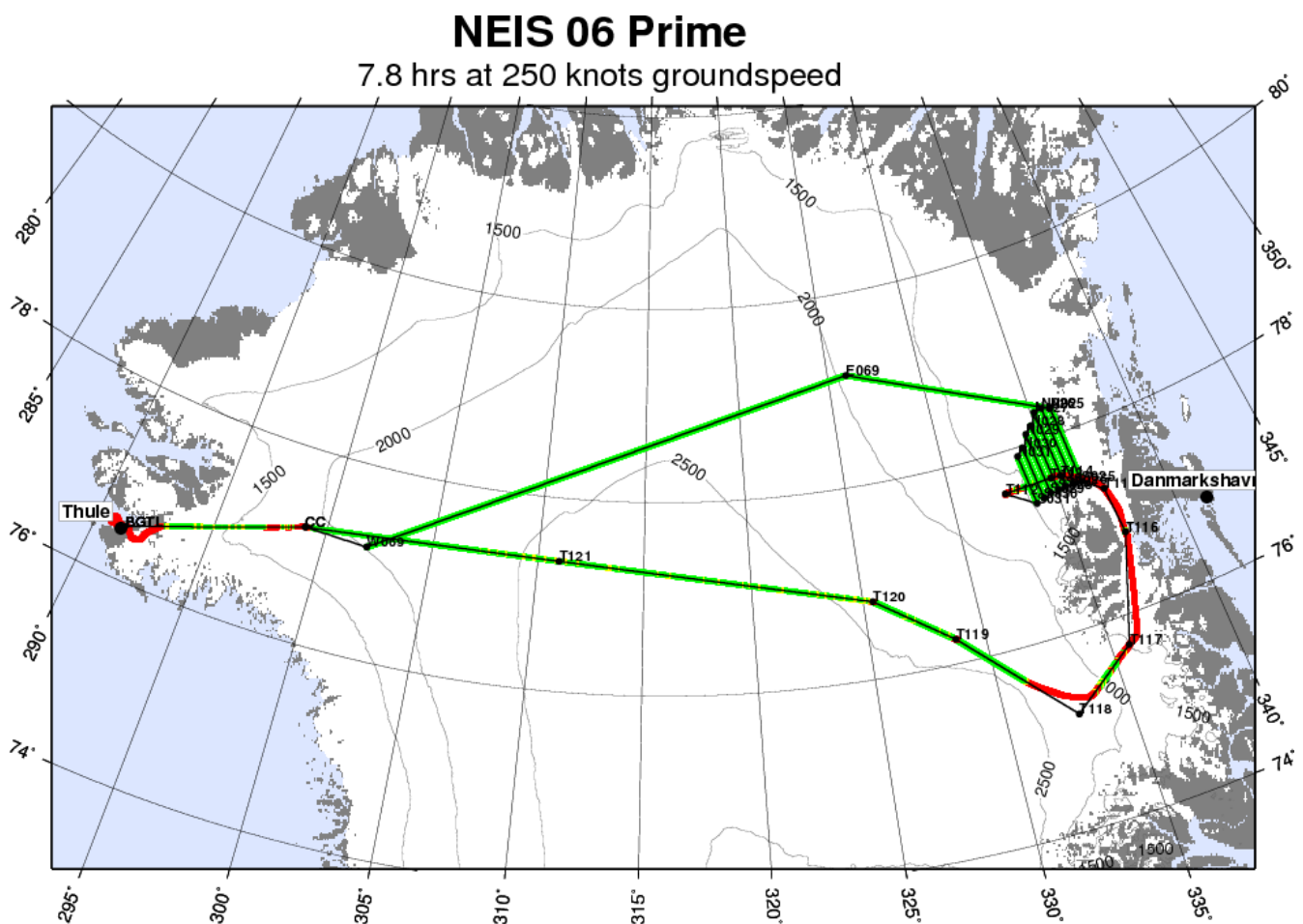
**Flight Priority:** Low

**ICESat Track:** none

**Remaining Issues:** none known

**Instrument Priority:** MCORDS/ATM

**Flown in 2011:** No

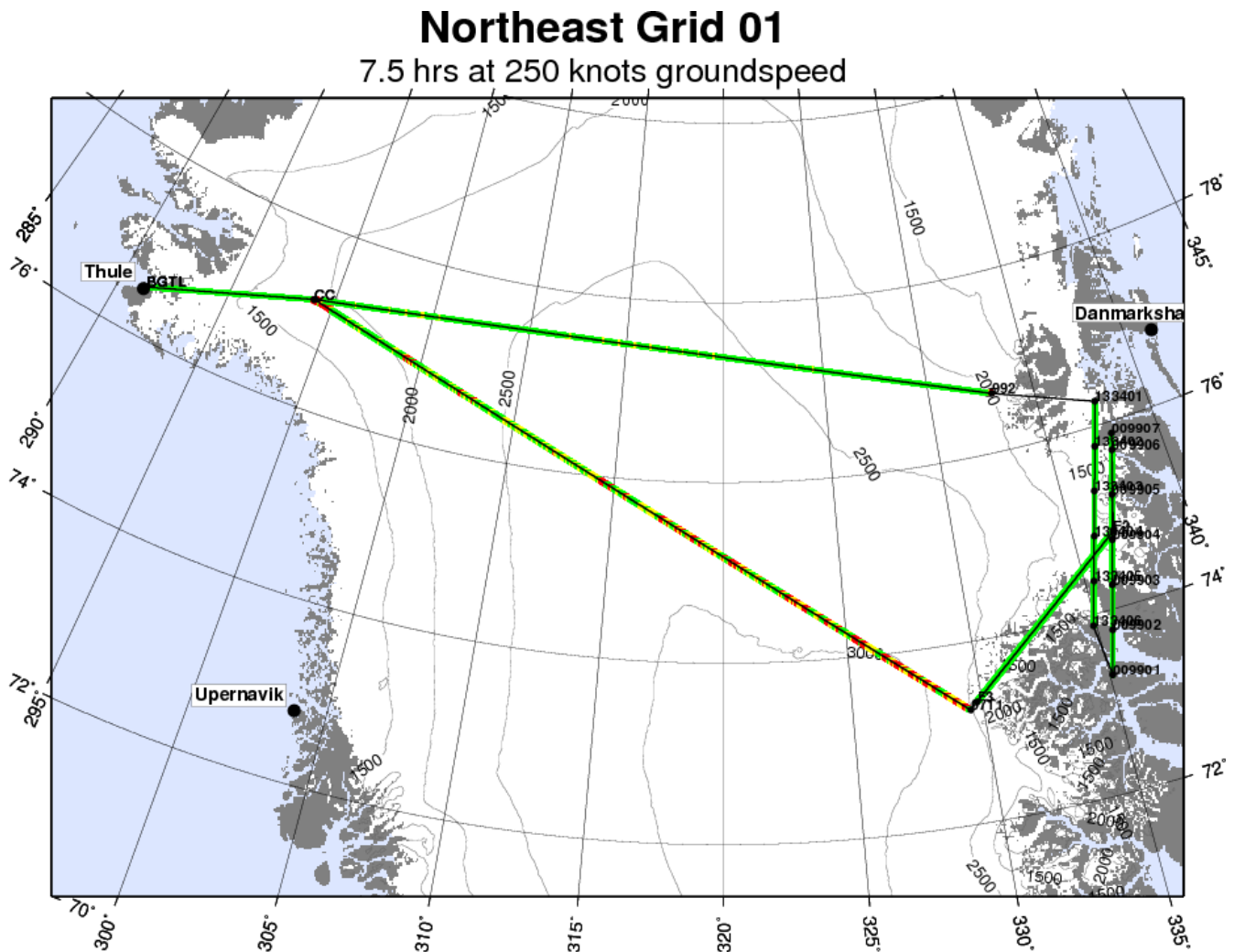


# Land Ice – Northeast Grid 01 / Thule

This is a new mission, one of a suite of six flights intended to thoroughly sample the bedrock topography of northeast Greenland along a series of nearly coast-parallel ICESat lines. At the same time we obtain altimetry measurements along the ICESat tracks which will enable the calculation of  $dh/dt$  over a broad area and a significant time span. This particular mission focuses on the easternmost of the coast-parallel lines, and it also samples a pair of 1990s ATM altimetry tracks over north central Greenland, which should yield an even longer  $dh/dt$  record over ice which may be thickening in the central part of the ice sheet.

**Flight Priority:** Medium  
**ICESat Track:** 0099,1334  
**Remaining Issues:** none known

**Instrument Priority:** MCoRDS/ATM  
**Flown in 2011:** No



# Land Ice – Northeast Grid 02 / Thule

This is a new mission, one of a suite of six flights intended to thoroughly sample the bedrock topography of northeast Greenland along a series of nearly coast-parallel ICESat lines. At the same time we obtain altimetry measurements along the ICESat tracks which will enable the calculation of  $dh/dt$  over a broad area and a significant time span. This particular mission complements the Northeast Grid 01 mission with the next two tracks in the inland direction. It transits to the area along short ICESat tracks in the west and new east-west master grid lines. This is a particularly long mission, but it may be possible to fly the lines significantly faster than 250 knots since they are straight, and we have several options to shorten the mission in real-time if necessary, including completing part of the return transit direct at high-altitude if necessary.

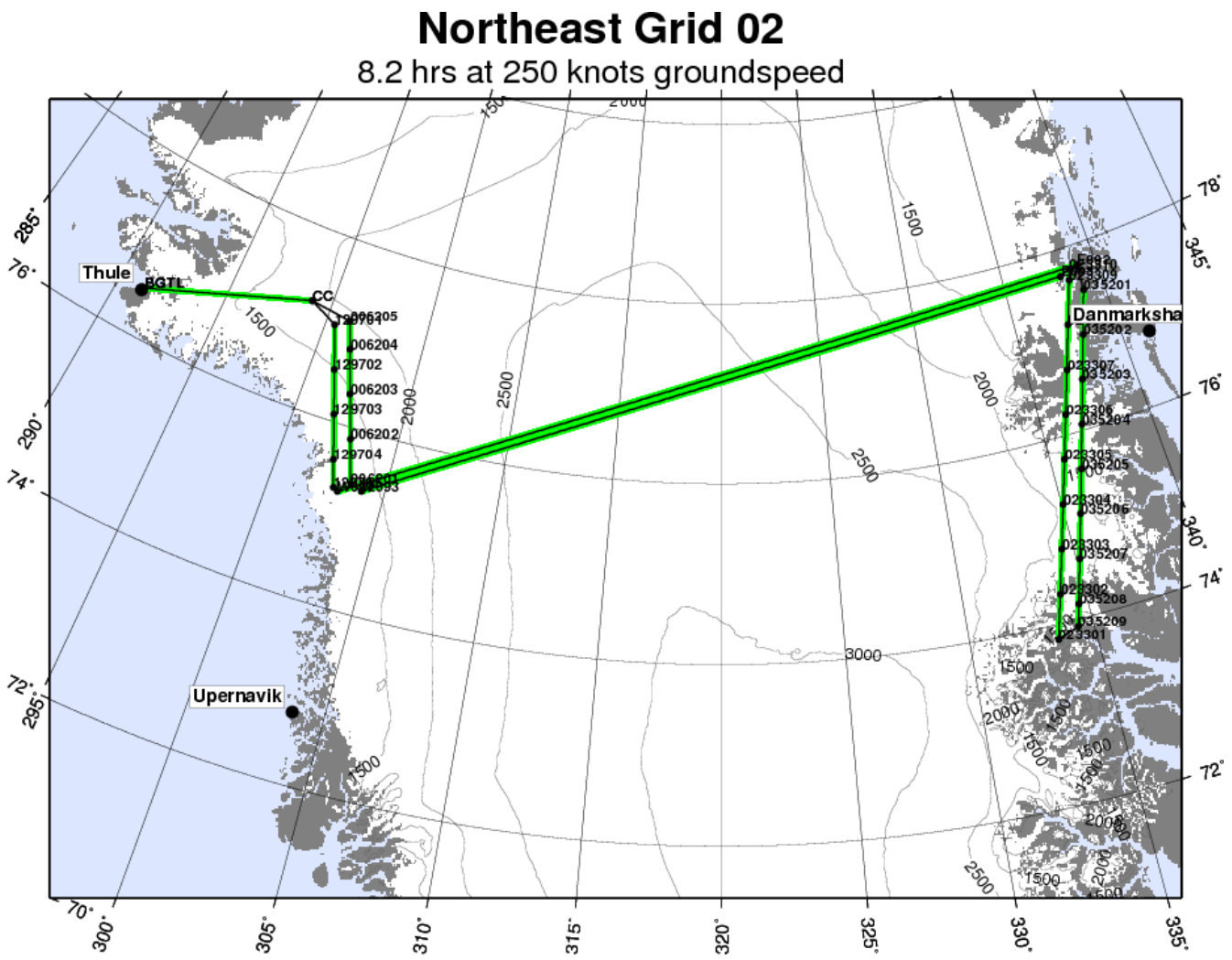
**Flight Priority:** High

**ICESat Track:** 1297,0352,0233,0062

**Remaining Issues:** none known

**Instrument Priority:** MCoRDS/ATM

**Flown in 2011:** No





# Land Ice – Northeast Grid 03 / Thule

This is a new mission, one of a suite of six flights intended to thoroughly sample the bedrock topography of northeast Greenland along a series of nearly coast-parallel ICESat lines. At the same time we obtain altimetry measurements along the ICESat tracks which will enable the calculation of  $dh/dt$  over a broad area and a significant time span. This particular mission complements the Northeast Grid 01 and 02 missions with the next two tracks in the inland direction. It transits to the area along short ICESat tracks in the west and new east-west master grid lines. Like Northeast Grid 02, this is a long mission, but we have several options to shorten the mission in real-time if necessary, including completing part of the return transit direct at high-altitude.

**Flight Priority:** High

**ICESat Track:** 0181,1349,0114,0300

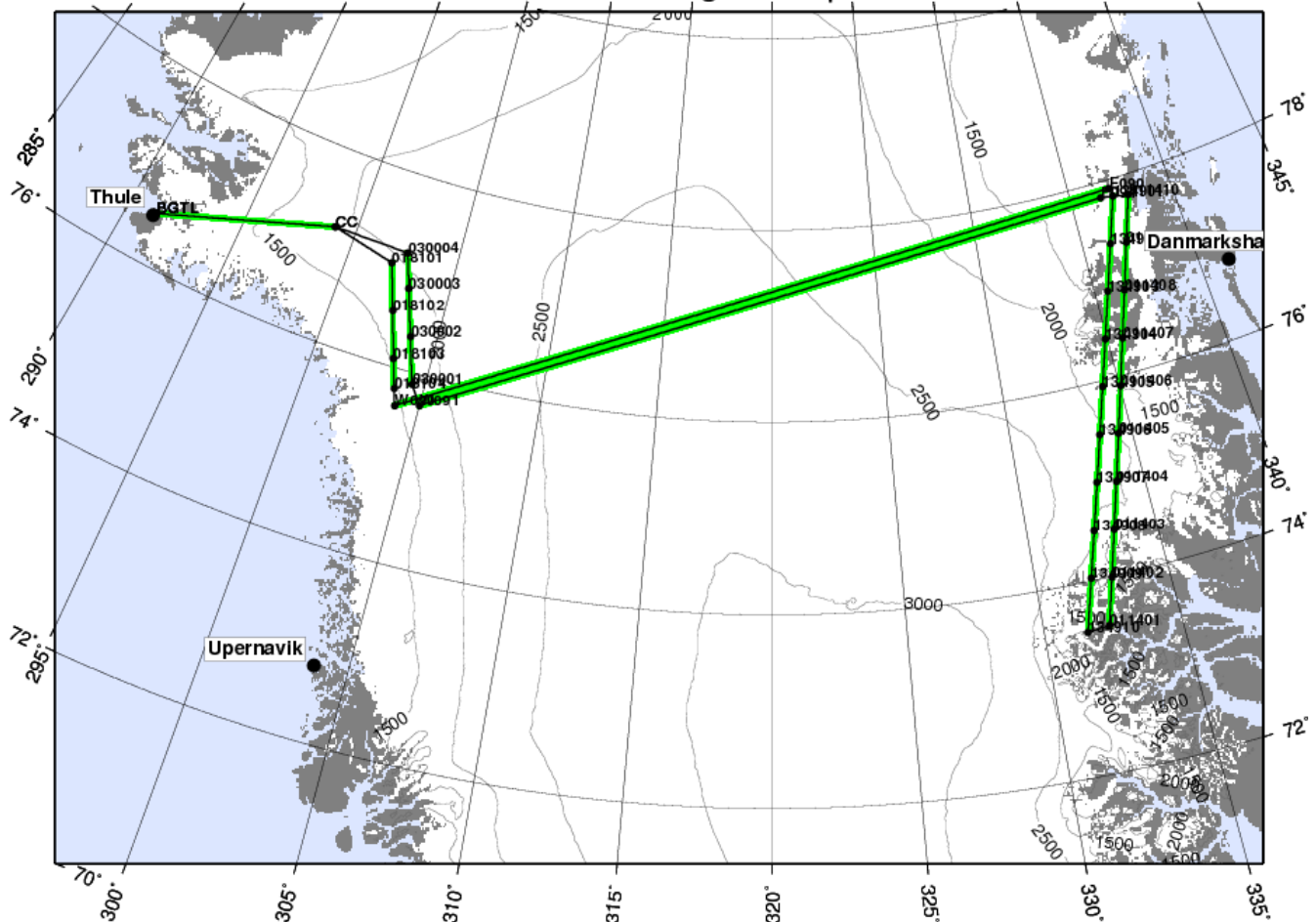
**Remaining Issues:** none known

**Instrument Priority:** MCoRDS/ATM

**Flown in 2011:** No

## Northeast Grid 03

8.1 hrs at 250 knots groundspeed

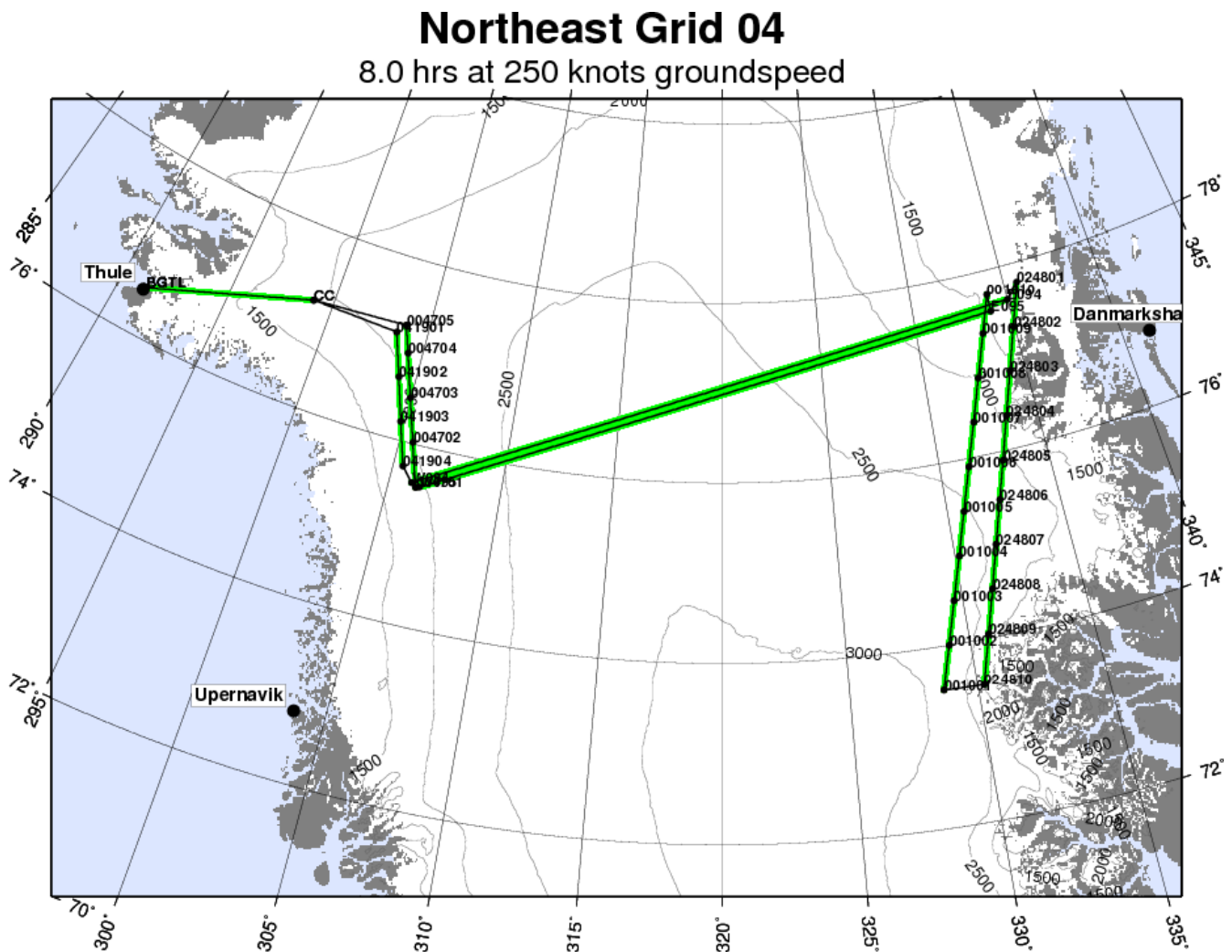


# Land Ice – Northeast Grid 04 / Thule

This is a new mission, one of a suite of six flights intended to thoroughly sample the bedrock topography of northeast Greenland along a series of nearly coast-parallel ICESat lines. At the same time we obtain altimetry measurements along the ICESat tracks which will enable the calculation of  $dh/dt$  over a broad area and a significant time span. This particular mission complements the Northeast Grid 01/02/03 missions with the next two tracks in the inland direction. It transits to the area along short ICESat tracks in the west and new east-west master grid lines. Again this is a long mission, but we have several options to shorten the mission in real-time if necessary, including completing part of the return transit direct at high-altitude.

**Flight Priority:** Medium  
**ICESat Track:** 0419,0248,0010,0047  
**Remaining Issues:** none known

**Instrument Priority:** MCoRDS/ATM  
**Flown in 2011:** No



# Land Ice – Northeast Grid 05 / Thule

This is a new mission, one of a suite of six flights intended to thoroughly sample the bedrock topography of northeast Greenland along a series of nearly coast-parallel ICESat lines. At the same time we obtain altimetry measurements along the ICESat tracks which will enable the calculation of  $dh/dt$  over a broad area and a significant time span. This particular mission complements the Northeast Grid 01/02/03/04 missions with the next two tracks in the inland direction. It transits to the area along short ICESat tracks in the west and new east-west master grid lines.

**Flight Priority:** Low

**Instrument Priority:** MCoRDS/ATM

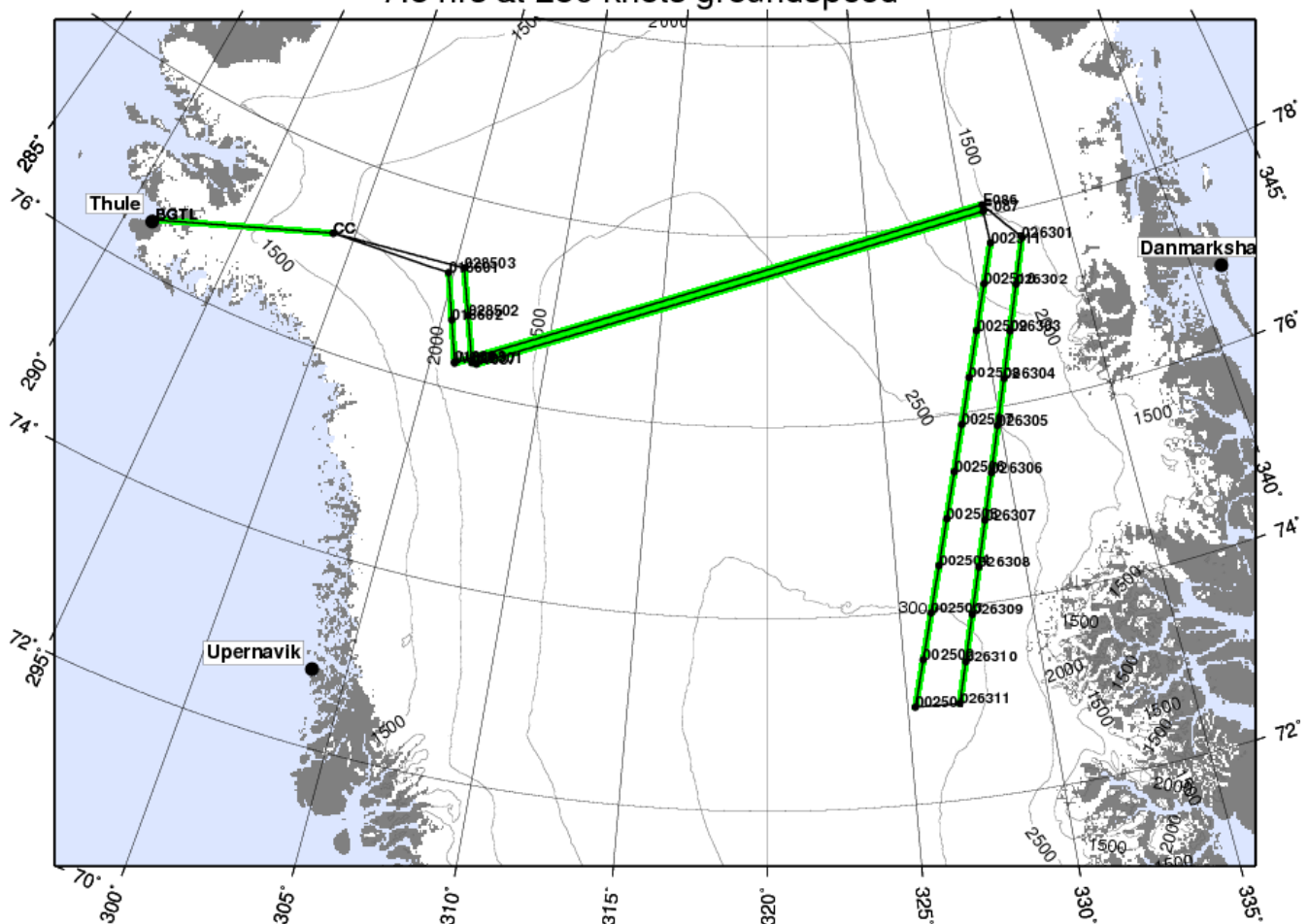
**ICESat Track:** 0166,0263,0025,0285

**Flown in 2011:** No

**Remaining Issues:** none known

## Northeast Grid 05

7.5 hrs at 250 knots groundspeed



# Land Ice – Northeast Grid 06 / Thule

This is a new mission, one of a suite of six flights intended to thoroughly sample the bedrock topography of northeast Greenland along a series of nearly coast-parallel ICESat lines. At the same time we obtain altimetry measurements along the ICESat tracks which will enable the calculation of  $dh/dt$  over a broad area and a significant time span. This particular mission complements the Northeast Grid 01/02/03/04/05 missions with the next two tracks in the inland direction. It transits to the area along short ICESat tracks in the west and new east-west master grid lines.

**Flight Priority:** Low

**Instrument Priority:** MCoRDS/ATM

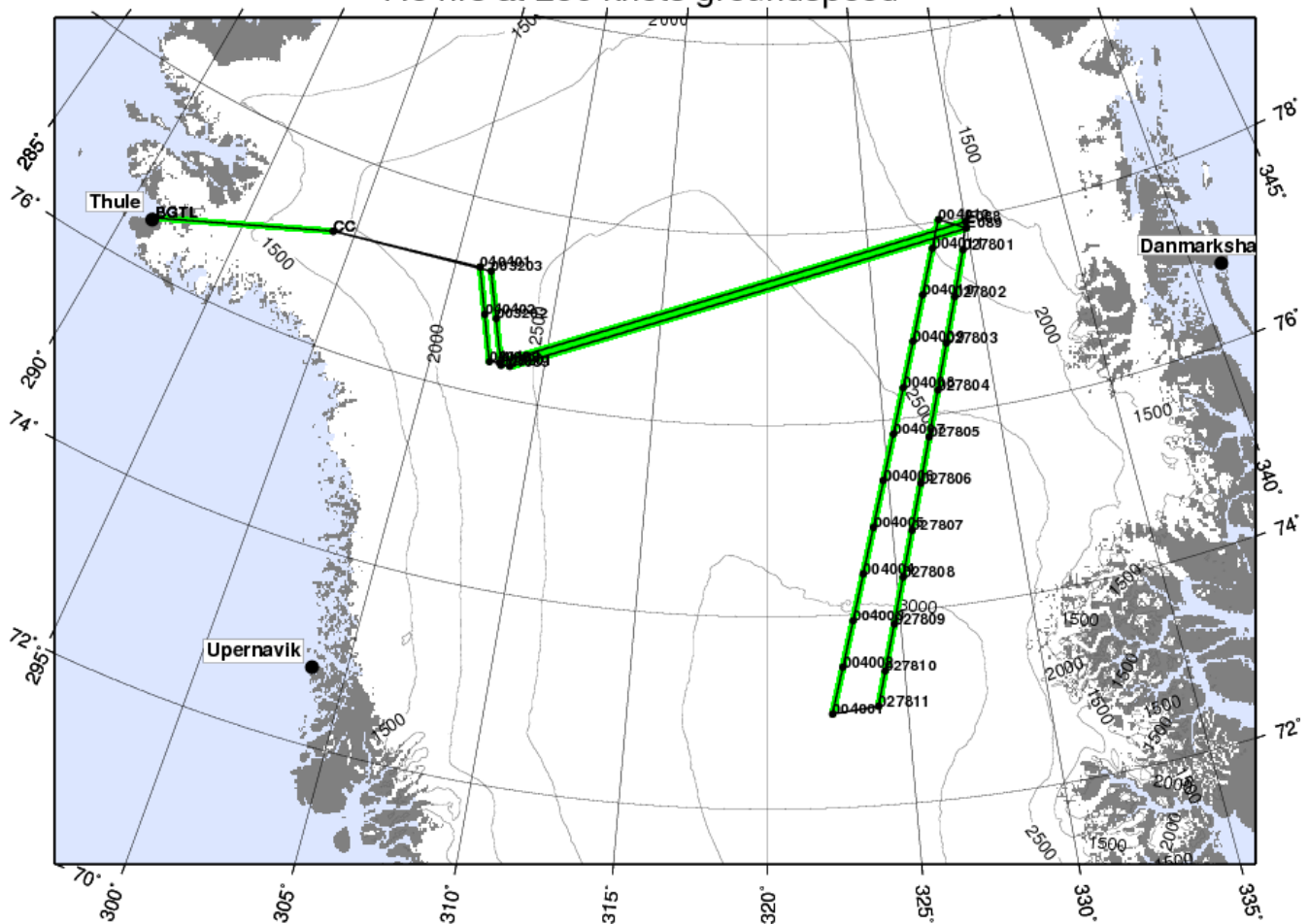
**ICESat Track:** 0404,0278,0040,0032

**Flown in 2011:** No

**Remaining Issues:** none known

## Northeast Grid 06

7.5 hrs at 250 knots groundspeed





# Land Ice – CryoSat Land / Thule

This is a new mission which occupies a CryoSat ground track over northern Greenland, an ICESat track, and the northern portion of a CreSIS-requested line connecting the GRIP, NGRIP, NEEM and Camp Century drill sites. We choose this area for the CryoSat track because the ground track is approximately orthogonal to the contour lines of the ice sheet, making cross-track placement of the CryoSat footprint more likely to fall at an easily predictable place – nadir. The exact CryoSat track will be selected to be contemporaneous with our flight to within a few days.

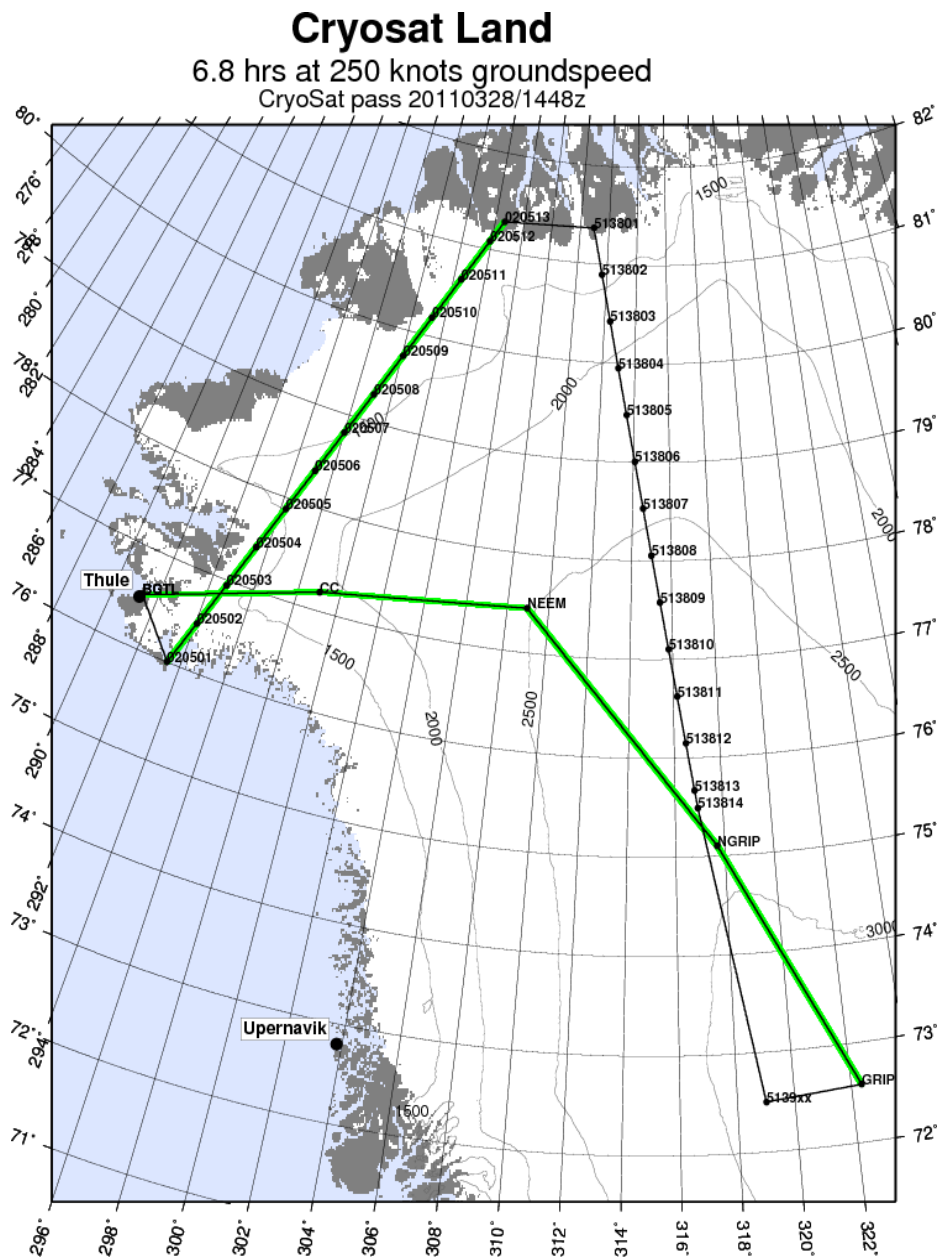
**Flight Priority:** High

**Instrument Priority:** ATM/KU

**ICESat Track:** 0205

**Flown in 2011:** Yes

**Remaining Issues:** must select CryoSat track to be overflowed within a few days of IceBridge AND remain approximately orthogonal to contour lines



# Land Ice – Jakobshavn 02 / Thule-Kangerlussuaq

This is a new mission which serves to reposition the P-3 between Thule and Kangerlussuaq. It is similar to a 2009 and a 2010 ICEBridge flight. The primary science objectives are to (a) complete the basic Jakobshavn grid, specifically the east-west lines, (b) repeat longitudinal surveys of the Rink and Kangerdlugssup Glaciers, and (c) occupy ICESat ground track 0300. We also occupy a line connecting Swiss Camp and a pair of Eric Lutz-requested points nearby. See the Appendix for a composite map which shows all the planned flights over the Jakobshavn basin in context with each other.

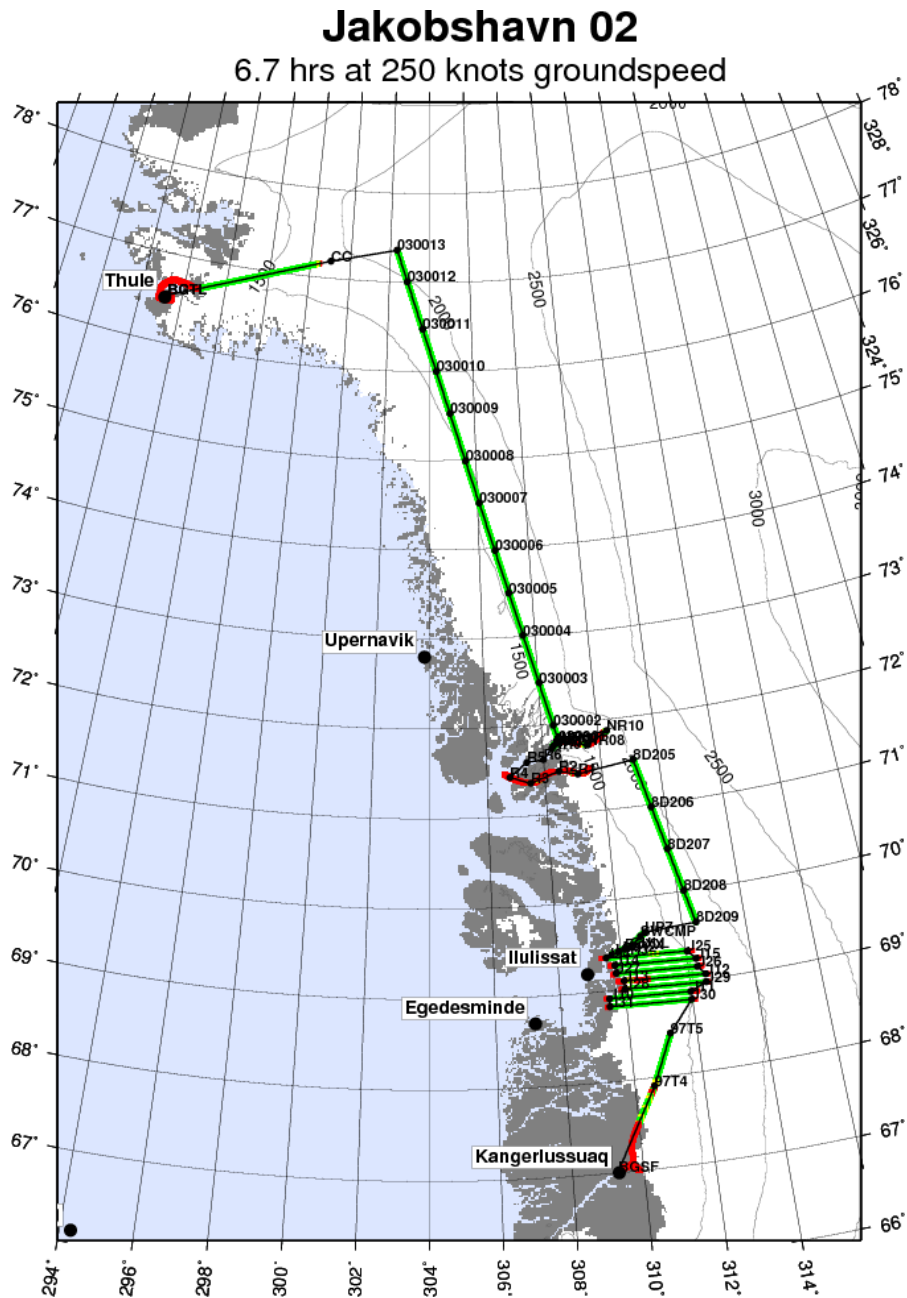
**Flight Priority:** High

**ICESat Track:** 0300

**Remaining Issues:** none known

**Instrument Priority:** ATM

**Flown in 2011:** Yes

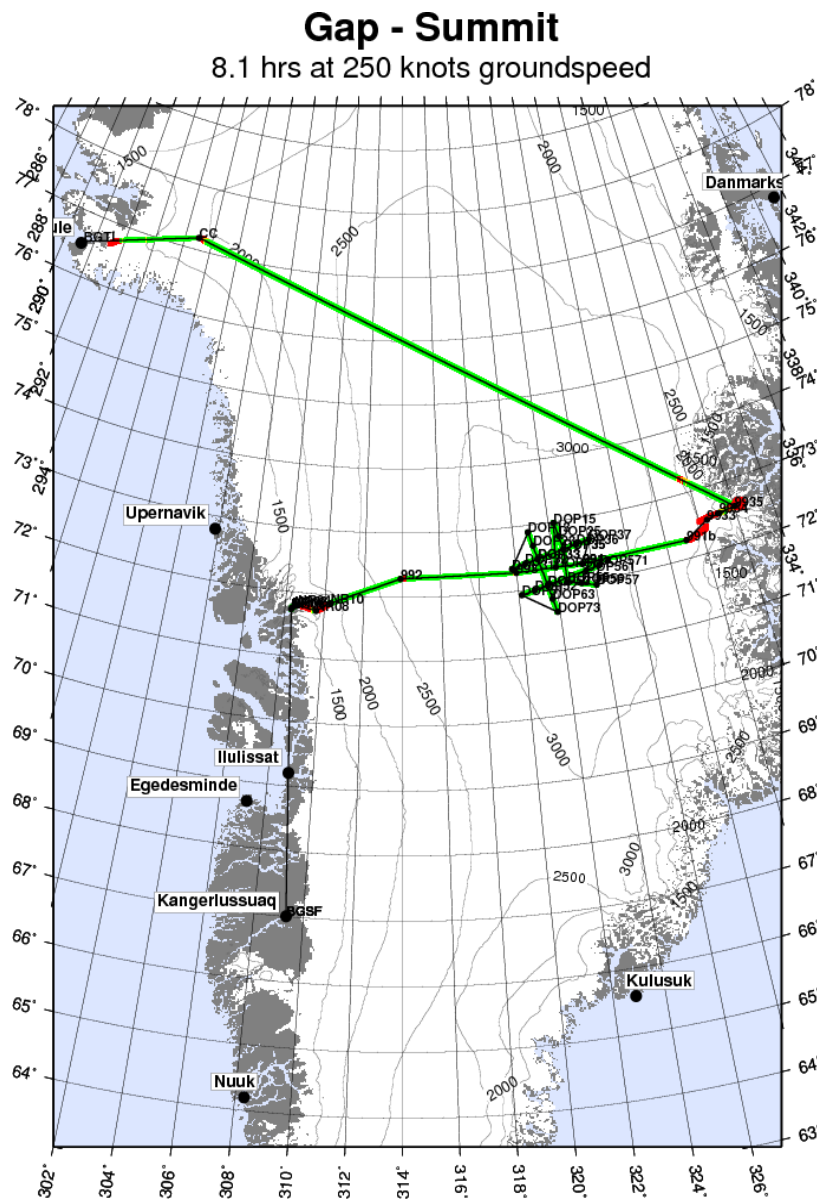


# Land Ice – Gap-Summit / Kangerlussuaq-Thule

This is a new mission which serves to reposition the P-3 between Thule and Kangerlussuaq. Its primary purposes are twofold. First, we fly an east-west line all the way across the ice sheet from Rink Glacier in the west to Cecilia Nunatak in the east. This line also covers a gap in OIB coverage in central Greenland, and does so along a series of 1999 ATM lines to yield a lengthy dh/dt history. Second, we overfly a series of Doppler in-situ sites surveyed in 1987 near Summit, which again will yield an exceptionally long dh/dt history over these sites. We transit between Kangerlussuaq and Rink Glacier at high-altitude to save time, and we transit from Cecilia Nunatak to Thule along a 1999 ATM line. While this flight is currently configured as a repositioning flight, it could also be flown round-trip from Kangerlussuaq with minor restructuring.

**Flight Priority:** Medium  
**ICESat Track:** none  
**Remaining Issues:** none known

**Instrument Priority:** ATM  
**Flown in 2011:** No





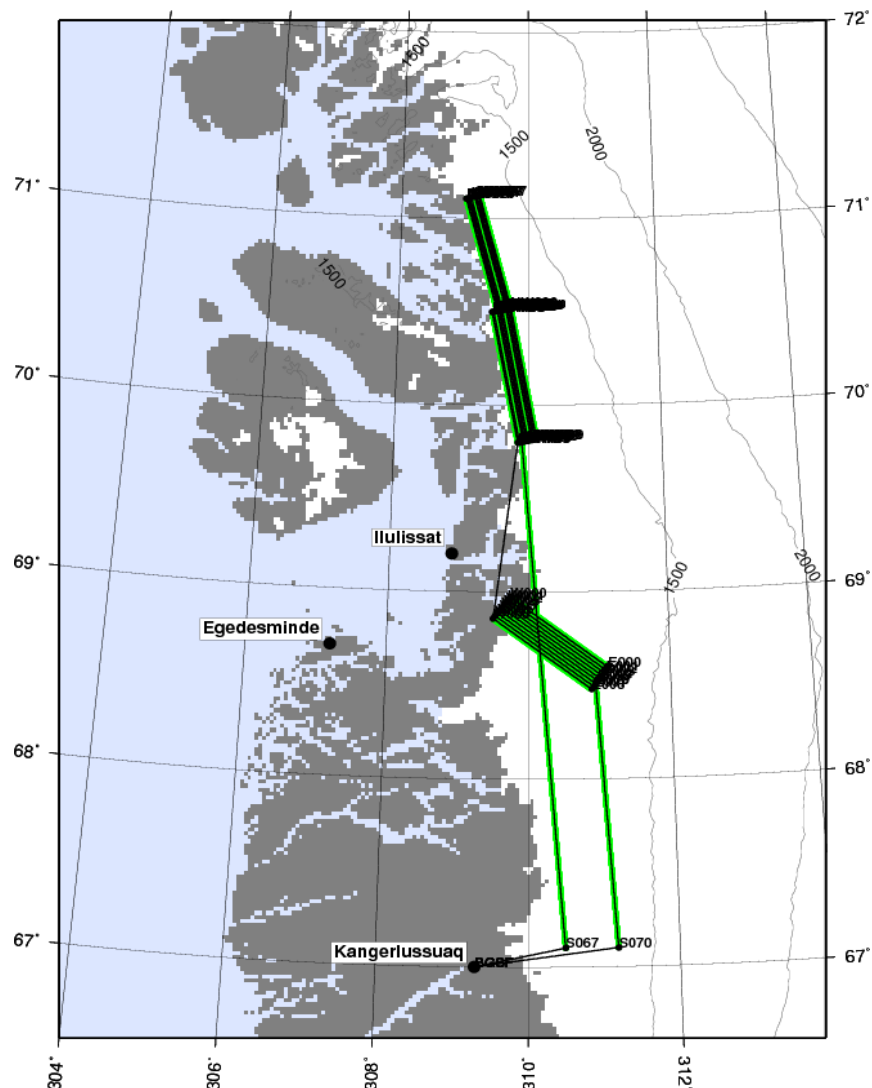
# Land Ice – Umanaq-Sarqardliupsermia / Kangerlussuaq

This is a new mission, with two goals. First, we supplement the 2011 Umanaq 01/02 flights with an offset grid in the coastal area, which densifies the coverage in that region from 5 km to 1 km. The purpose of these lines is to map the bedrock of this area, which includes Store Glacier and several other outlet glaciers, in detail. The second goal is to conduct a tomographic mapping of the Sarqardliupsermia glacier on a 2 km grid. The MCoRDS radar should be configured in tomographic mode for the Sarqardliupsermia lines and in normal profiling mode for the rest of this flight. We transit to and from these two experiment areas along central Greenland north-south master grid lines. See the appendix for a detailed map of the Umanaq-area flightlines in context with previous missions.

**Flight Priority:** High  
**ICESat Track:** none  
**Remaining Issues:** none known

**Instrument Priority:** MCoRDS  
**Flown in 2011:** No

## Umanaq-Sarqardliupsermia 7.7 hrs at 250 knots groundspeed



# Land Ice – Disko Bay 01 / Kangerlussuaq

This is a new mission, built around many ATM lines and several new lines in the Jakobshavn Basin and other sites around Disko Bay. First, we reoccupy the north-south lines of the 10 km lower Jakobshavn grid flown almost every year since 1997 to track inland migration of Jakobshavn thinning. Next we occupy the central flowline of Jakobshavn itself, which in this case is an improved design of that difficult-to-fly line, first flown in 2011. From there we proceed into Disko Bay along a straight line intended to provide a solid tie with shipborne bathymetry for gravity inversion purposes. Next we fly transects of small ice caps on Disko Island and the Nuusuaq Peninsula for the first time. Then we reoccupy center flowlines of Eqip Sermia, Kangilerngata Sermia, Sermeq Kujalleq and Store Glaciers, which were all last flown in 2009, and Sermeq Avangnardleq, which has not previously been flown. Finally we re-fly several ICESat tracks in the upstream area of these glaciers. This mission is intended to be flown if the LVIS occupies the ICESat lines across the large basin in missions Jakobshavn 01 and Jakobshavn-Eqip-Store; otherwise we would fly those two missions.

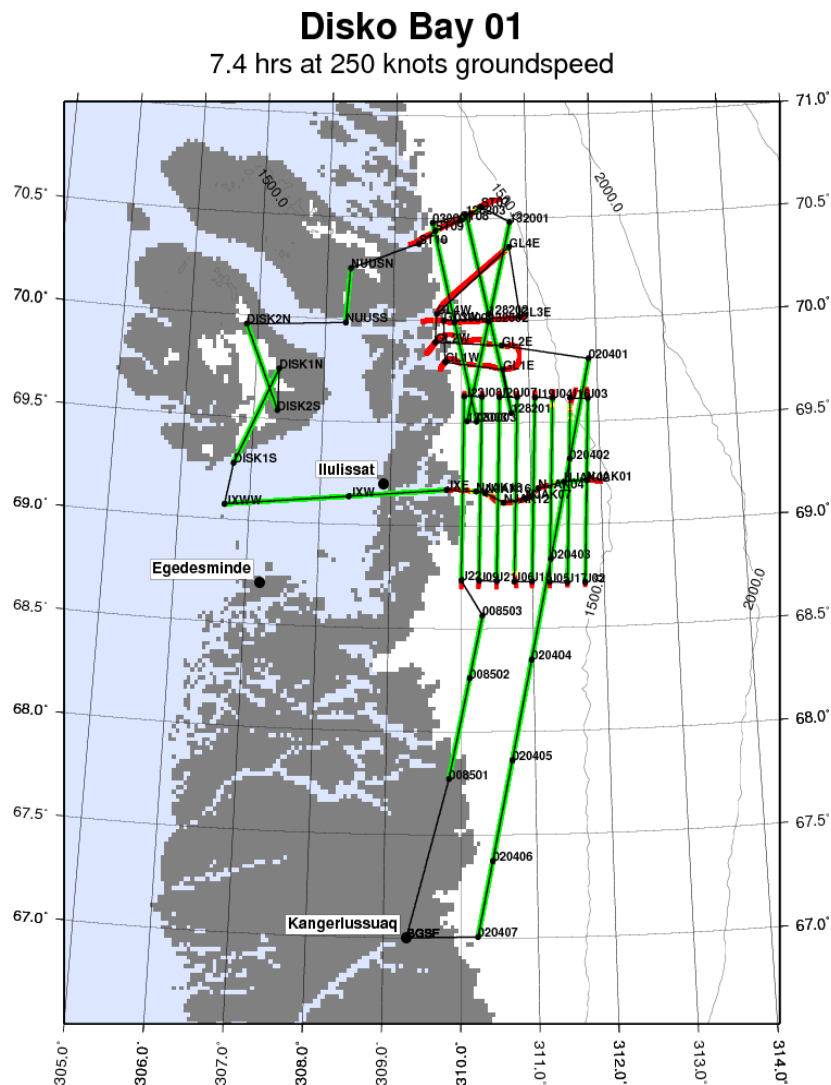
**Flight Priority:** High

**ICESat Track:** 0085,1320,0300,1282,0204

**Remaining Issues:** none known

**Instrument Priority:** ATM

**Flown in 2011:** Portions



# Land Ice – Jakobshavn 01 / Kangerlussuaq

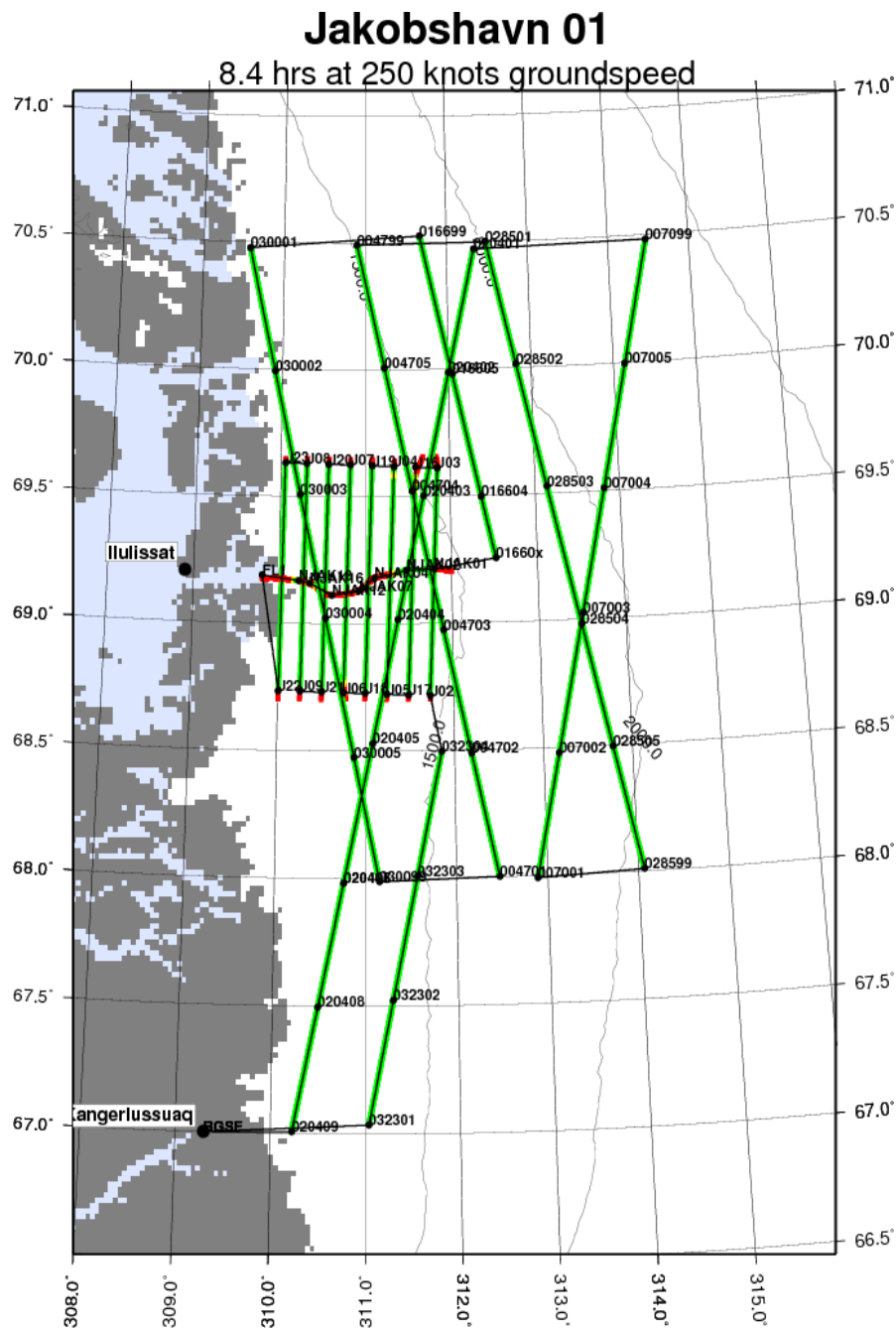
This is a repeat of 2009 and 2010 IceBridge missions. Its purpose is to re-survey the highest-priority lines of the historical ATM 10-km Jakobshavn grid, the main flowline of Jakobshavn. It also extends that grid with a broader array of ICESat ground tracks over the larger Jakobshavn basin. This mission is intended to be flown if LVIS does not occupy the long ICESat tracks in this mission; otherwise we intend to fly the Disko Bay 01 flight.

**Flight Priority:** Low if LVIS flies ICESat lines, otherwise High

**Instrument Priority:** ATM

**ICESat Track:** 0323,0166,0300,0047,0285,0070,0204      **Flown in 2011:** Yes

**Remaining Issues:** none known



# Land Ice – Jakobshavn-Eqip-Store/ Kangerlussuaq

This is a modified version of the 2011 Jakobshavn-Lake mission, whose main purpose it to extend the ICESat grid begun with Jakobshavn 01 farther upstream. The “lake” portion of the 2011 flight is covered in the Umanaq-Sarqardliupsermia flight above. We also densify the ICESat grid over the Eqip Sermia catchment area north of Jakobshavn, and we fly the centerlines of Eqip Sermia, Kangilemgata Sermia, Sermeq Kujalleq and Store Glaciers, which were all last flown in 2009, and Sermeq Avangnardleq, which has not previously been flown. This mission is intended to be flown if LVIS does not occupy the long ICESat tracks in this mission; otherwise we intend to fly the Disko Bay 01 flight.

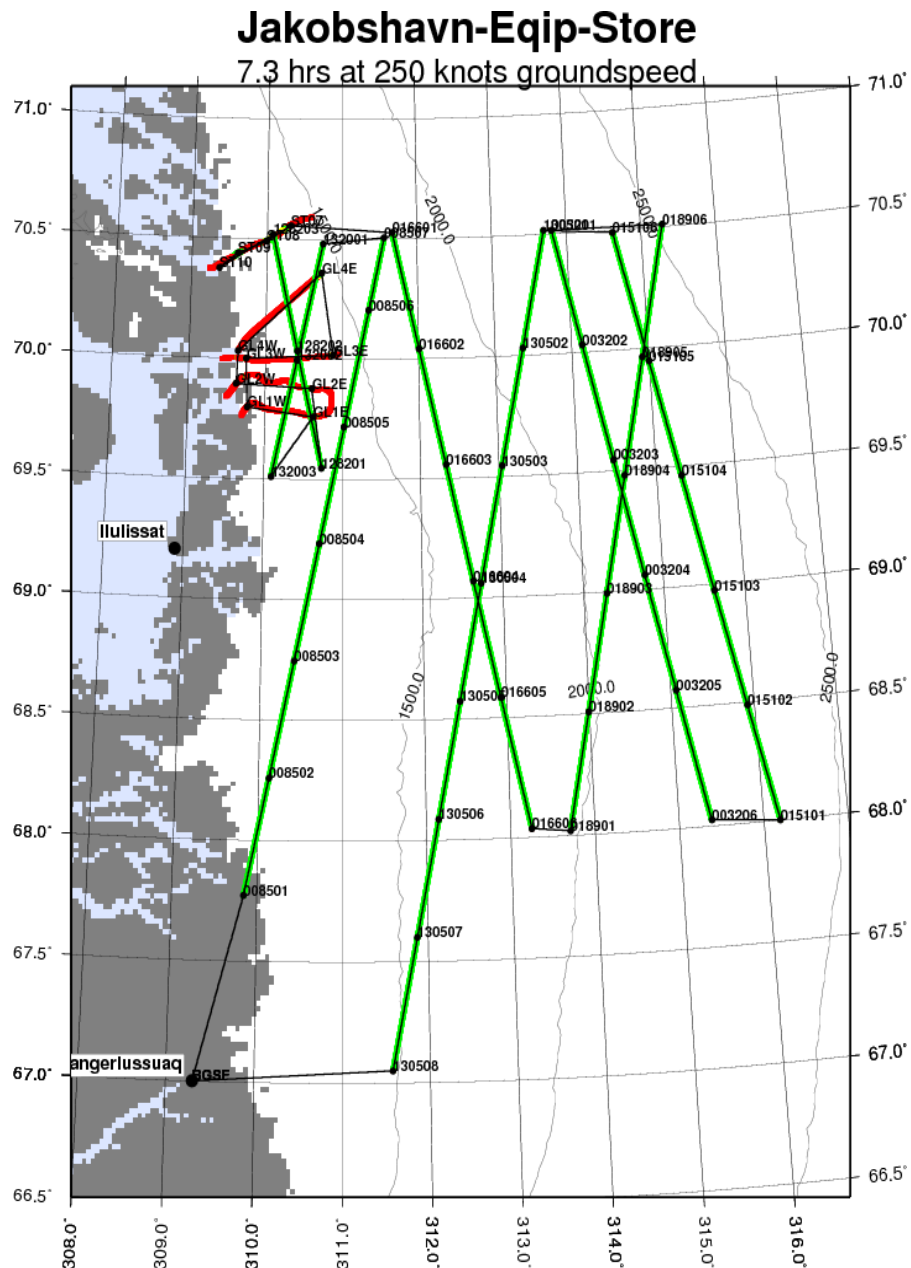
**Flight Priority:** Low if LVIS flies ICESat lines, otherwise Medium

**Instrument Priority:** ATM/MCORDS

**ICESat Track:** 0085,1320,1282,0166,0189,0032,0151,1305

**Flown in 2011:** Portions

**Remaining Issues:** none known





# Land Ice – East Glaciers 01 / Kangerlussuaq

This is a new mission. It satisfies a suggestion to map the centerlines of several glaciers on the central east coast of Greenland. This particular draft captures the centerlines of six glaciers: DeGeer, Jaette, Nordenskiold, Wahlenberg, Violin and Nord Glaciers. The first two were also mapped during the 2009 OIB campaign, so this flight would yield immediate dh/dt for these glaciers. We transit to the area along a line connecting the DYE2 and GRIP drill sites, make a pass over the Summit Camp ICESat track 0412 experiment site (requested by Eric Lutz of Dartmouth), and we return along the EGIG traverse line.

**Flight Priority:** Medium

**ICESat Track:** none

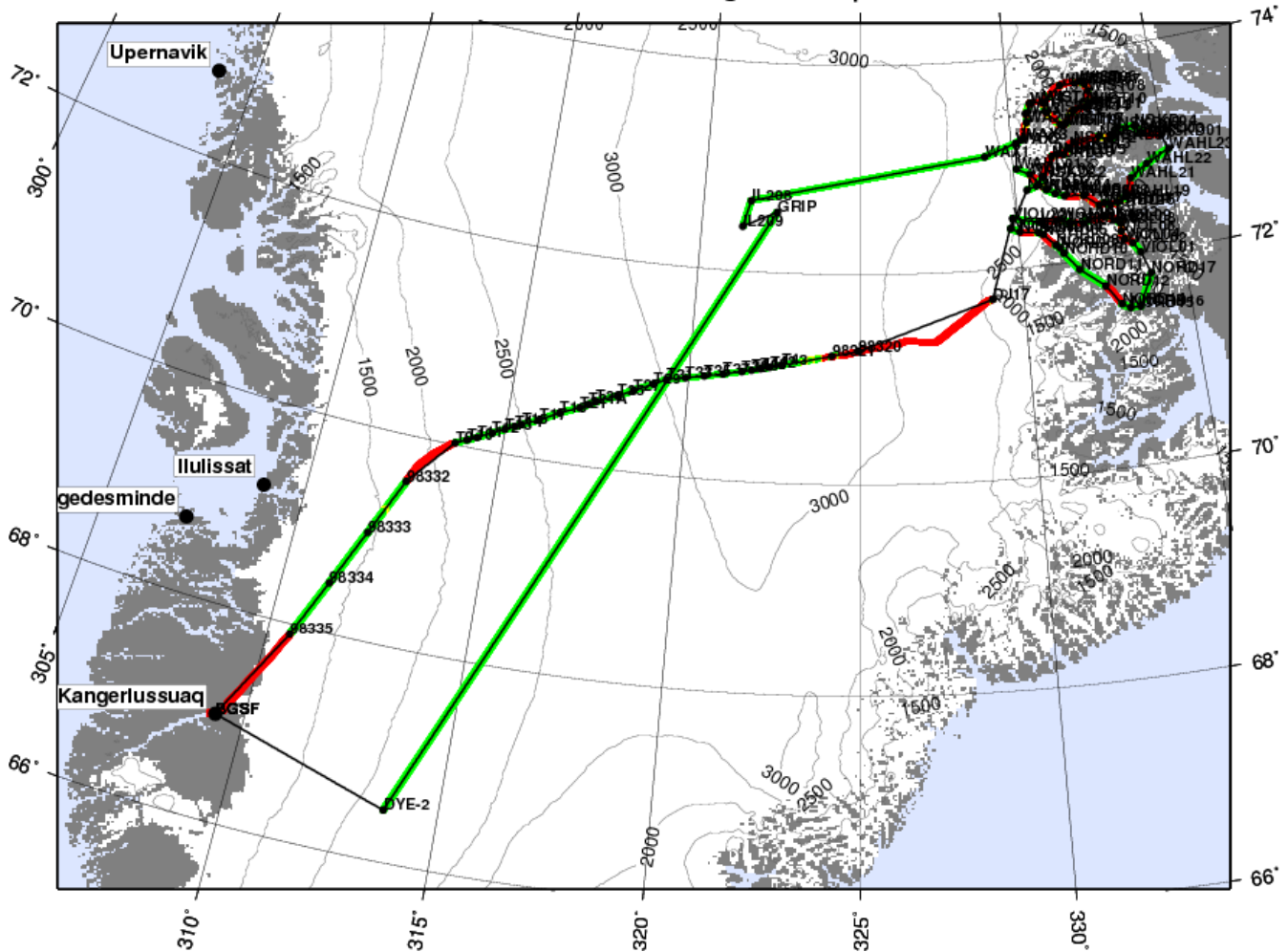
**Remaining Issues:** none known

**Instrument Priority:** MCoRDS/ATM

**Flown in 2011:** No

## East Glaciers 01

7.7 hrs at 250 knots groundspeed



# Land Ice – East Central Grid 01 / Kangerlussuaq

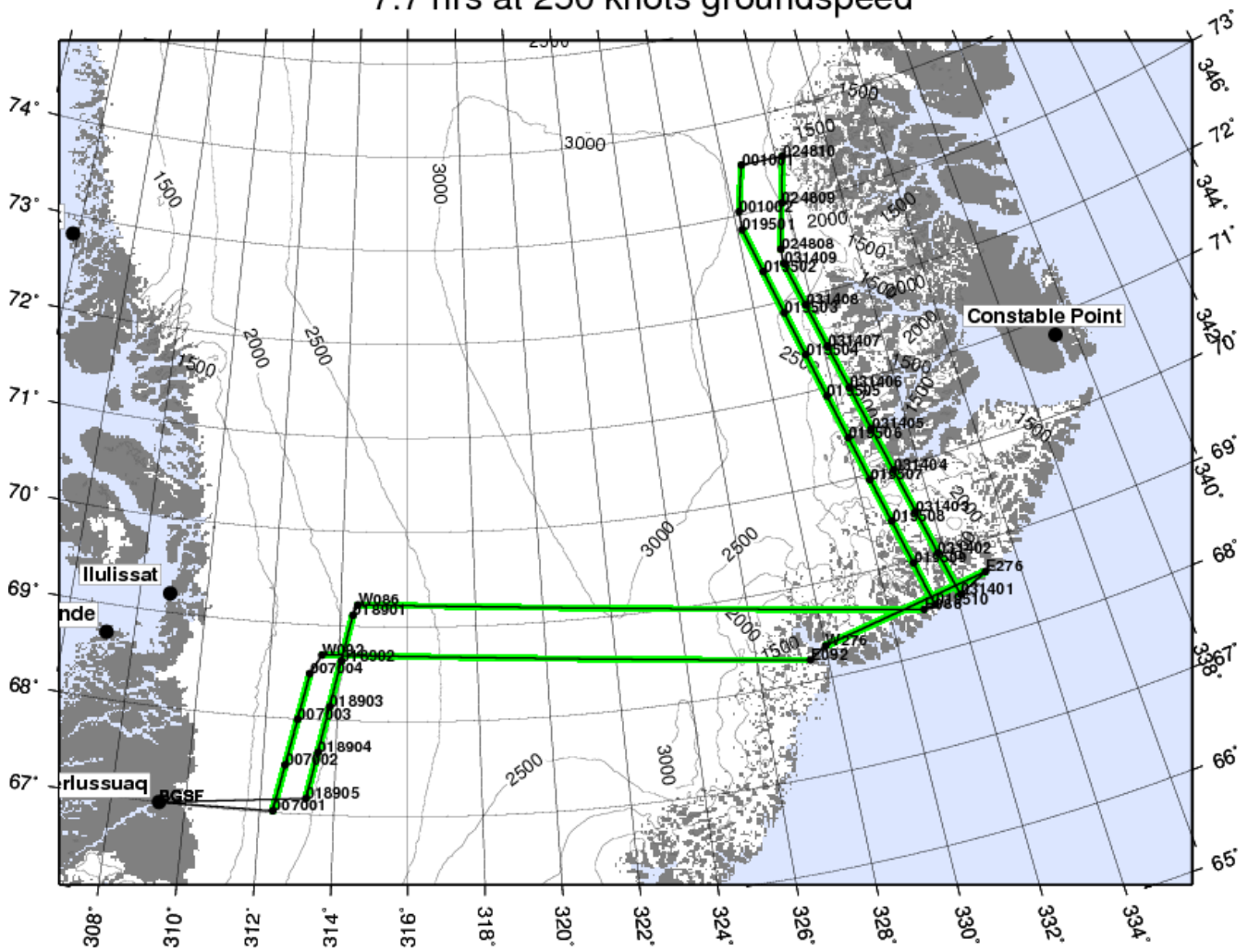
This is a new mission, one of a series of three intended to connect with and continue the east Greenland coast-parallel grid along ICESat lines to the south from the suite of Northeast Grid missions. This particular flight also supplements the Geikie 03/04 missions with one additional east-west master grid line along the southern side of the Geikie peninsula.

**Flight Priority:** High  
**ICESat Track:** 0070,0314,0195,0189  
**Remaining Issues:** none known

**Instrument Priority:** MCoRDS/ATM  
**Flown in 2011:** No

## East Central Grid 01

7.7 hrs at 250 knots groundspeed



# Land Ice – East Central Grid 02 / Kangerlussuaq

This is a new mission, one of a series of three intended to connect with and continue the east Greenland coast-parallel grid along ICESat lines to the south from the suite of Northeast Grid missions.

**Flight Priority:** Low

**Instrument Priority:** MCoRDS/ATM

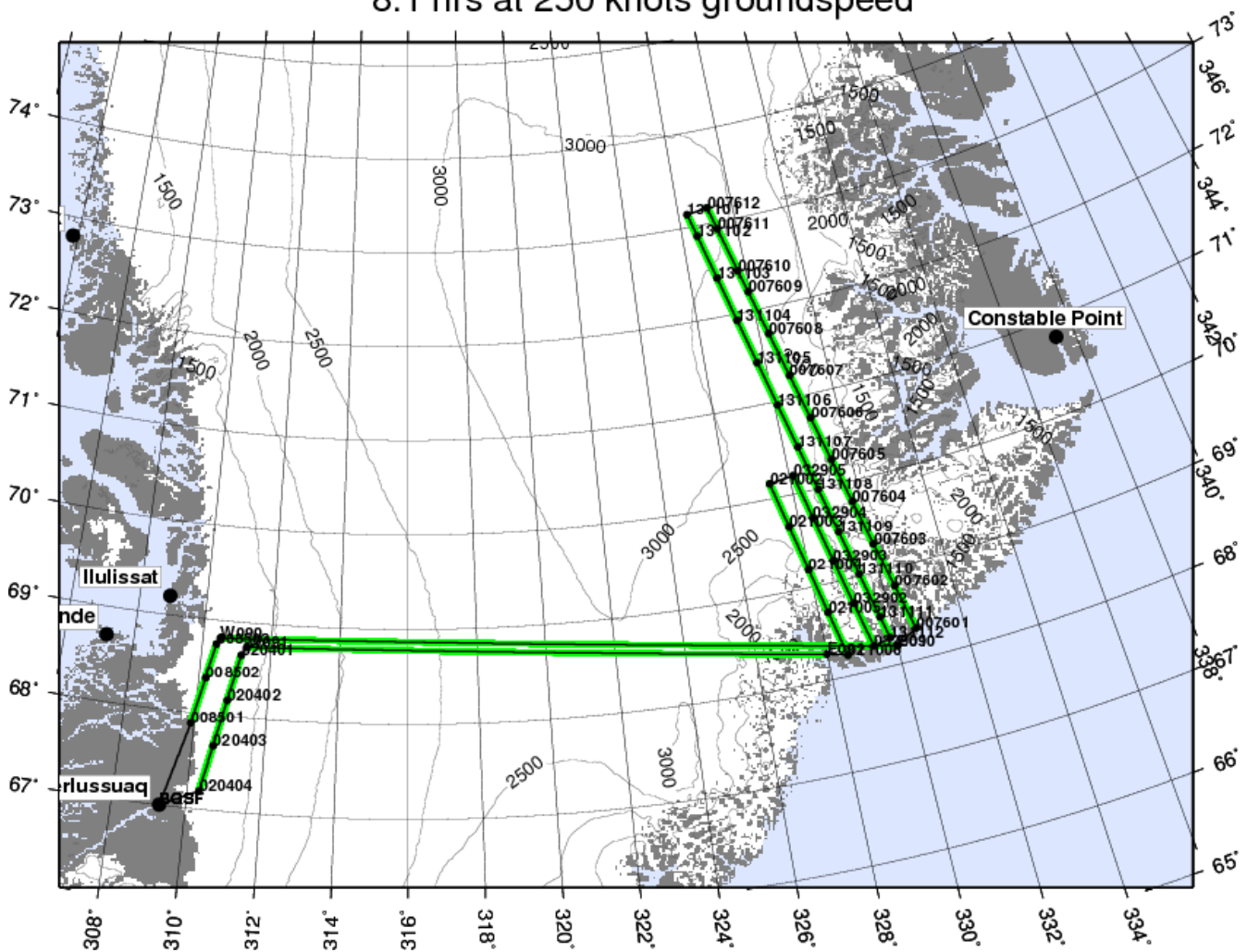
**ICESat Track:** 0085,0076,1311,0329,0210,0204

**Flown in 2011:** No

**Remaining Issues:** none known

## East Central Grid 02

8.1 hrs at 250 knots groundspeed



# Land Ice – East Central Grid 03 / Kangerlussuaq

This is a new mission, one of a series of three intended to connect with and continue the east Greenland coast-parallel grid along ICESat lines to the south from the suite of Northeast Grid missions.

**Flight Priority:** High

**Instrument Priority:** MCoRDS/ATM

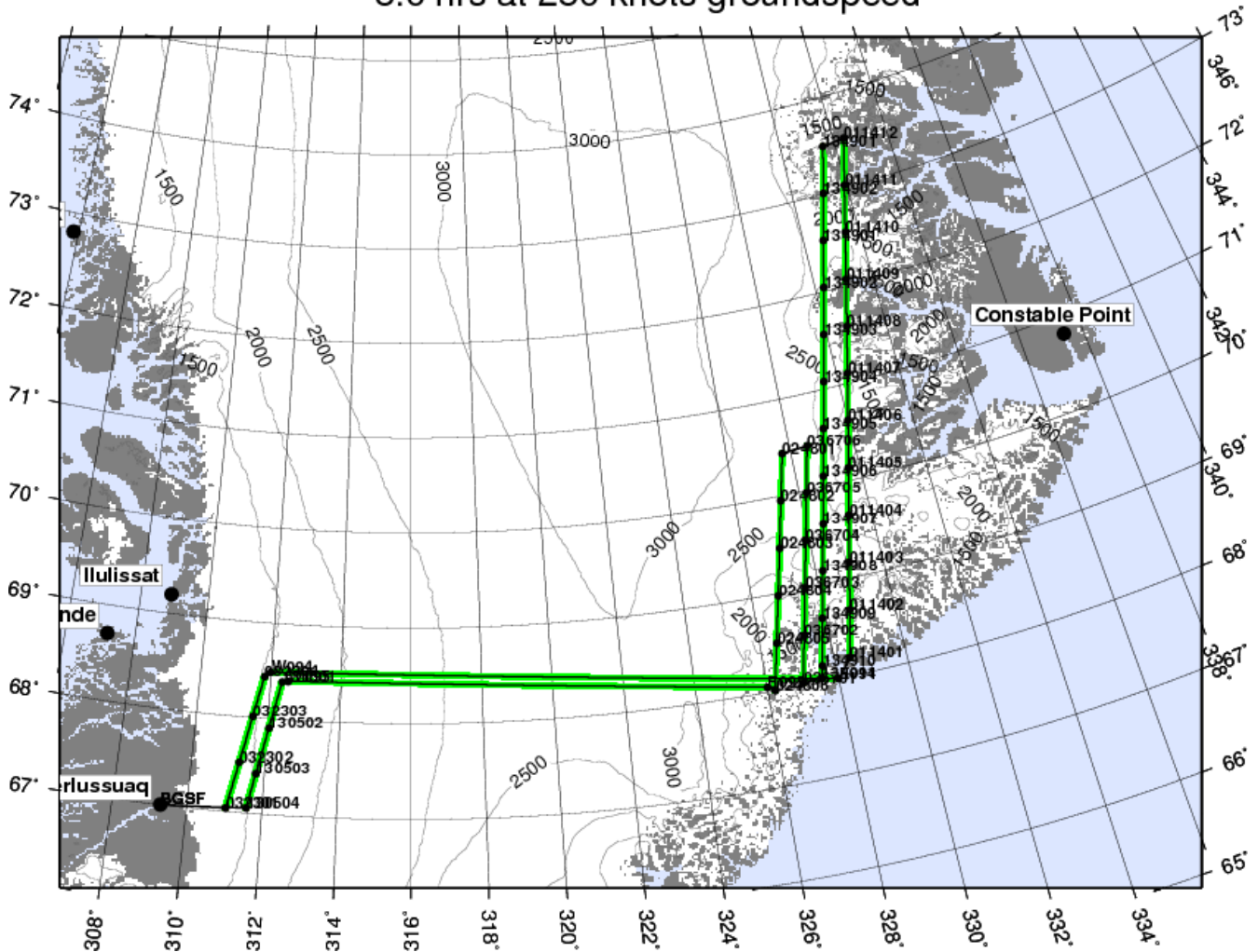
**ICESat Track:** 0323,0114,1349,0367,0248,1305

**Flown in 2011:** No

**Remaining Issues:** none known

## East Central Grid 03

8.0 hrs at 250 knots groundspeed





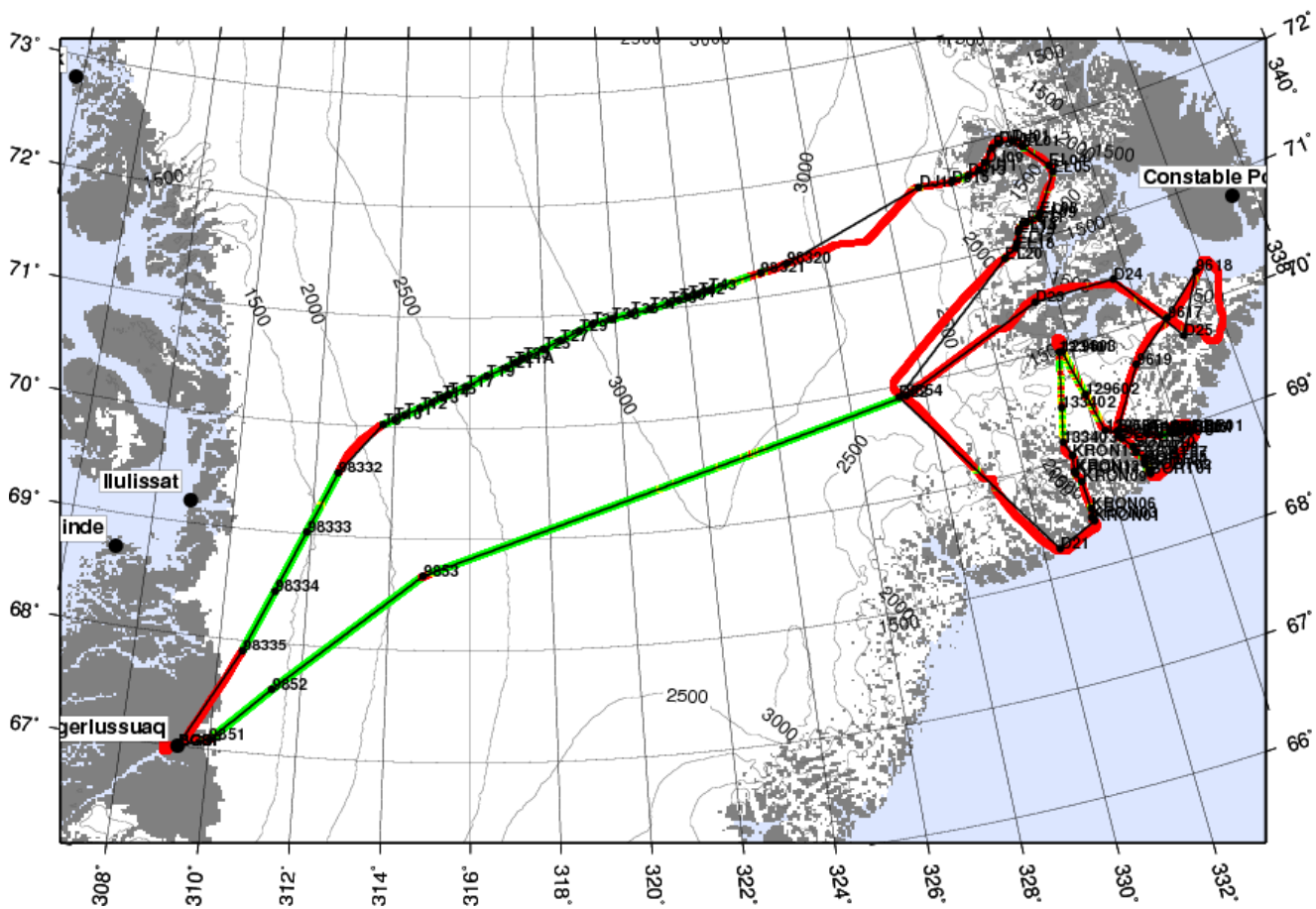
# Land Ice – Geikie 01 / Kangerlussuaq

This mission is a repeat of a 2010 IceBridge mission. It includes reflights of the Daugard-Jensen, Vestfjord and Kong Christian IV glaciers, and the “X” pattern over the Geikie Plateau, all of which have pre-IceBridge altimetry from ATM. It also reflies the Eielson, De Reste Bugt, Sortebrae and Kronborg glaciers, first flown in 2010. Finally, the northern transit line across the ice sheet is the EGIG line, part of the 2011 CryoVex validation effort for CryoSat. The waypoints for the EGIG line were provided by Liz Morris. The glacier centerlines are flown in the reverse direction from the 2010 flight in order to assist in the recovery of gravity data for these sinuous lines. See the Appendix for a composite map which shows all the planned flights over the Geikie region in context with each other.

**Flight Priority:** Low  
**ICESat Track:** 1296,1334  
**Remaining Issues:** none known

**Instrument Priority:** ATM/KU/Snow/MCORDS  
**Flown in 2011:** Yes

## Geikie 01 8.1 hrs at 250 knots groundspeed



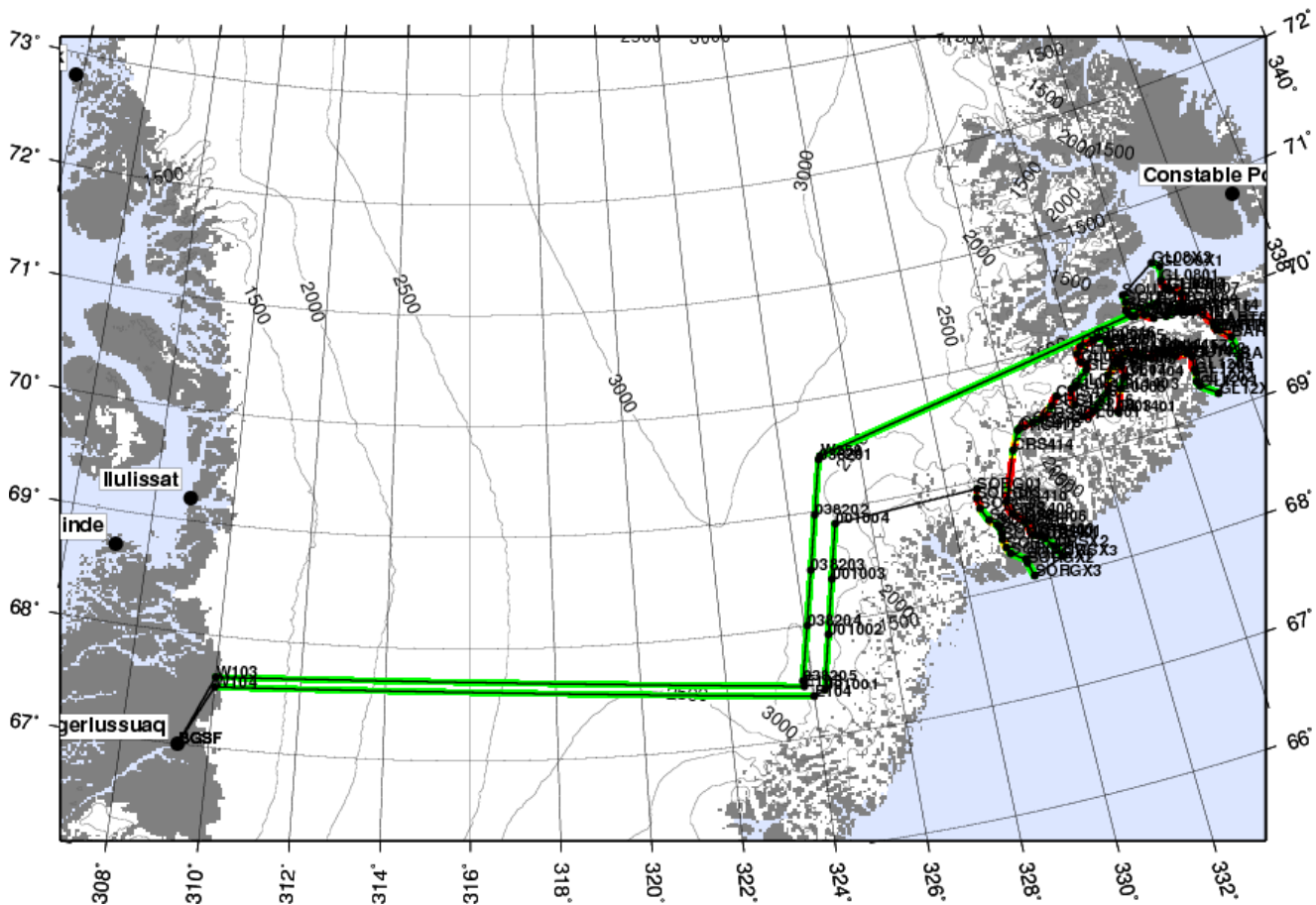
# Land Ice – Geikie 02 / Kangerlussuaq

This is a new mission. It flies the centerlines of eight Geikie peninsula glaciers for the first time. These are Sorgenfri, Christian IV, Bartholins, and South glaciers, plus five more glaciers with unknown names. Where practical we extend the glacier centerlines past the coast to open water to enable the gravimeter to detect possible sills in the fjords. See the Appendix for a composite map which shows all the planned flights over the Geikie region in context with each other.

**Flight Priority:** High  
**ICESat Track:** 0010,0382  
**Remaining Issues:** none known

**Instrument Priority:** MCORDS/Grav/ATM  
**Flown in 2011:** No

## Geikie 02 7.7 hrs at 250 knots groundspeed



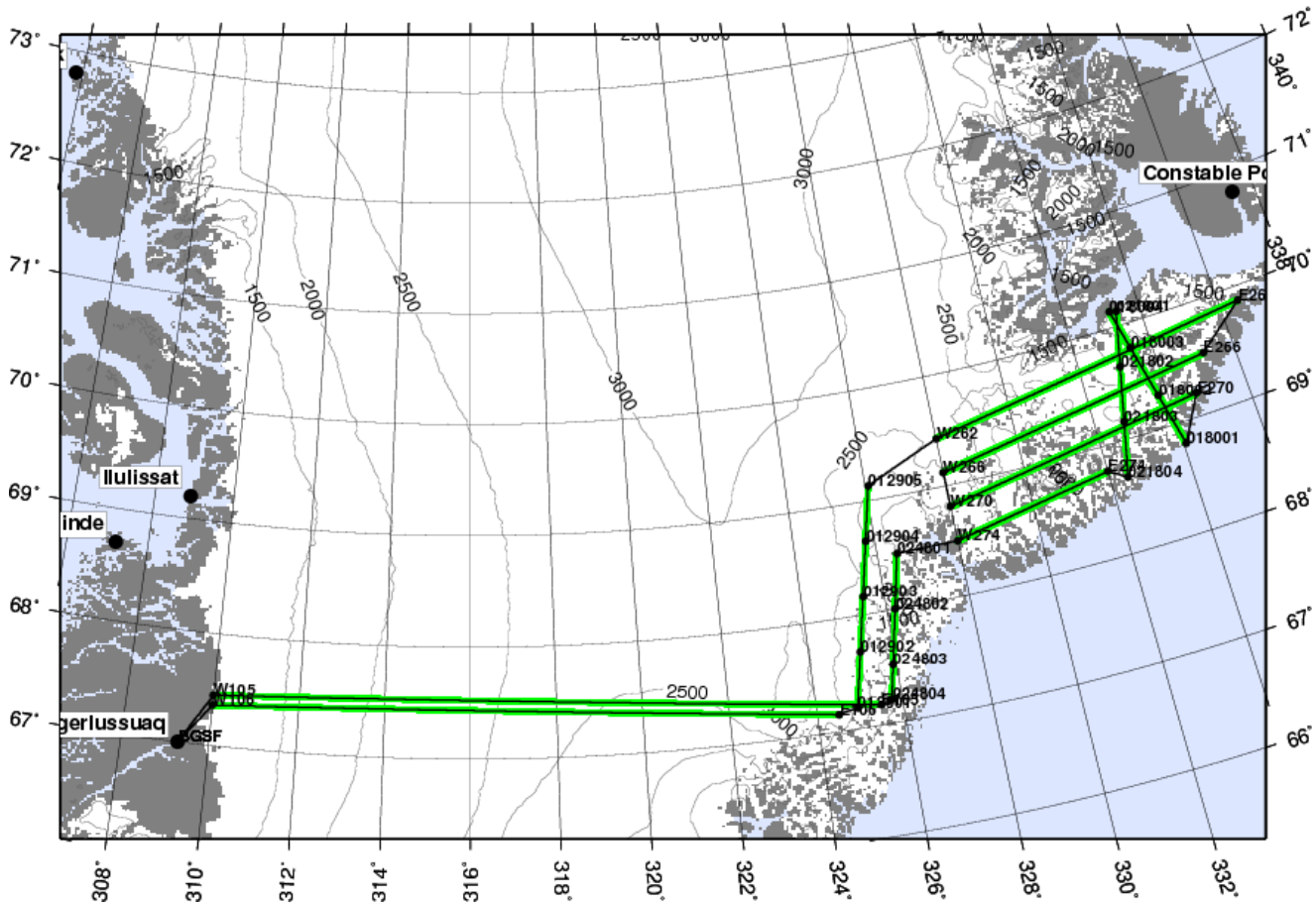
# Land Ice – Geikie 03 / Kangerlussuaq

This is a new mission. It flies a 40 km east-west grid pattern over the Geikie Peninsula, which are an extension of the north Greenland master grid pattern. It also flies an inverted V pattern of ICESat tracks, to complement the one farther west flown in Geikie 01. See the Appendix for a composite map which shows all the planned flights over the Geikie region in context with each other.

**Flight Priority:** High  
**ICESat Track:** 0129,0180,0218,0248  
**Remaining Issues:** none known

**Instrument Priority:** MCORDS/Grav  
**Flown in 2011:** No

## Geikie 03 8.0 hrs at 250 knots groundspeed



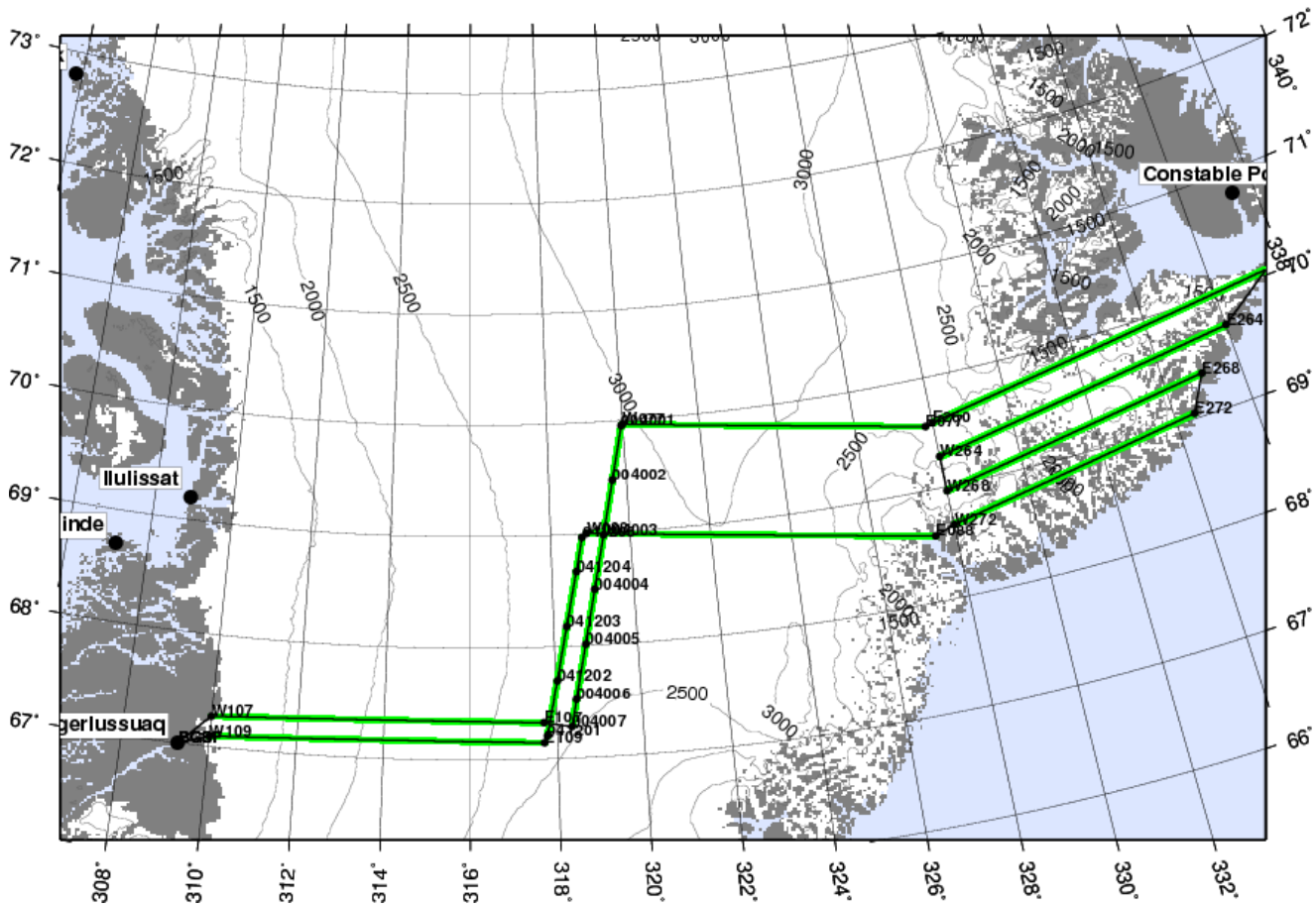
# Land Ice – Geikie 04 / Kangerlussuaq

This is a new mission. It flies a 40 km east-west grid pattern over the Geikie Peninsula, which are an extension of the north Greenland master grid pattern. This grid is offset by 20 km from the grid in Geikie 03 and thus complements that mission by densifying the coverage. See the Appendix for a composite map which shows all the planned flights over the Geikie region in context with each other.

**Flight Priority:** Low  
**ICESat Track:** 0412,0070  
**Remaining Issues:** none known

**Instrument Priority:** MCORDS/Grav  
**Flown in 2011:** No

## Geikie 04 7.5 hrs at 250 knots groundspeed





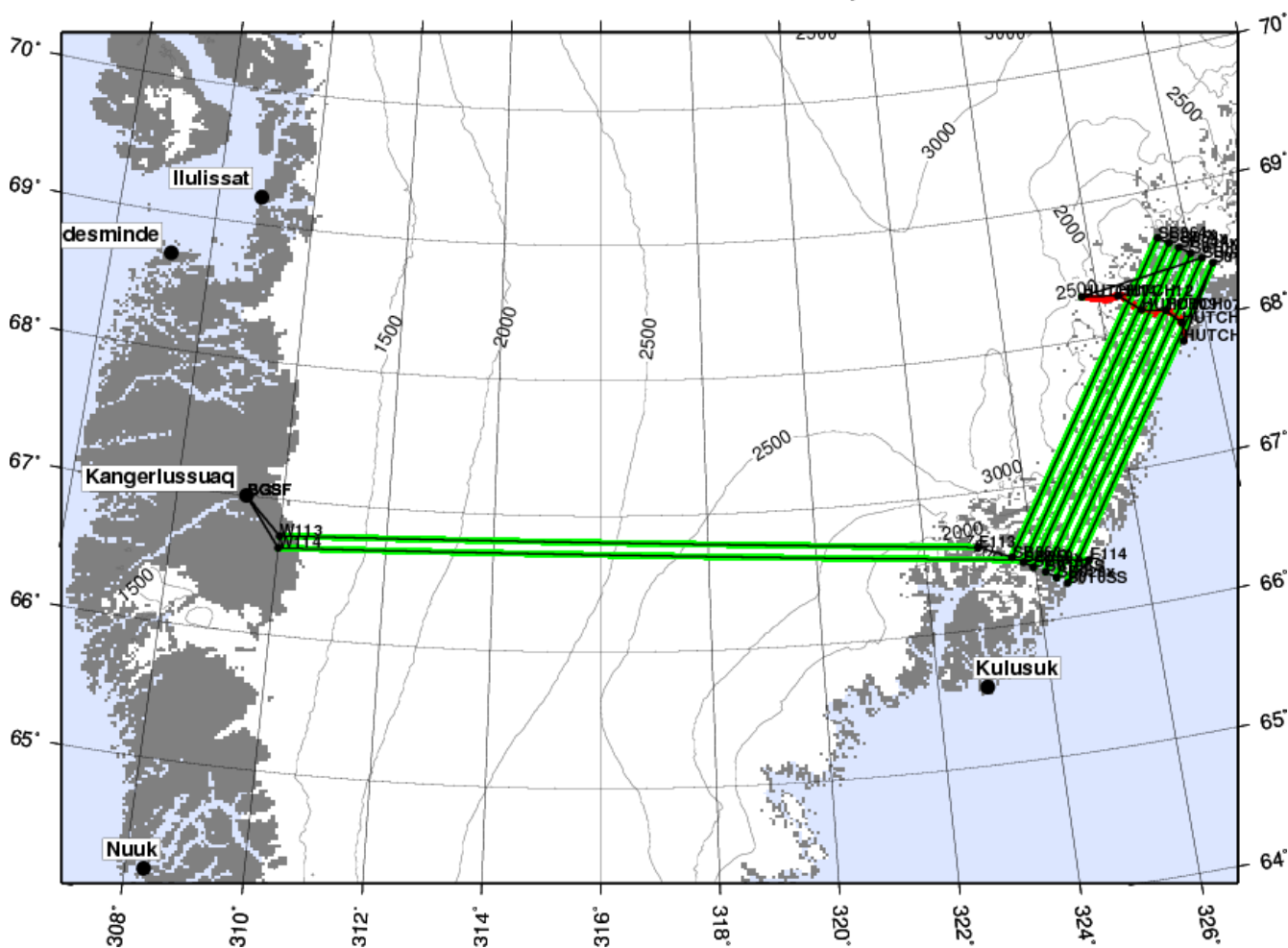
# Land Ice – Helheim-Kangerdlugssuaq Gap 01 / Kangerlussuaq

This is a new mission, designed primarily to map the bedrock of the ice sheet in the space between Helheim and Kangerdlugssuaq Glaciers. The grid is spaced at approximately 10 km, and it conforms to the 2010 LVIS grid flown here in that several of these lines are designed to repeat the 2010 lines, for dh/dt purposes. These lines also extend across Kangerdlugssuaq fjord in the north end and across the Glacier de France fjord in the south, in order to provide gravity constraints on exposed rock. We also fly the centerline of the Hutchinson glacier for the first time. We transit to and from the area along central Greenland master grid lines.

**Flight Priority:** High  
**ICESat Track:** none  
**Remaining Issues:** none known

**Instrument Priority:** MCoRDS/ATM  
**Flown in 2011:** No

## Helheim-Kangerdlugssuaq Gap 01 8.1 hrs at 250 knots groundspeed



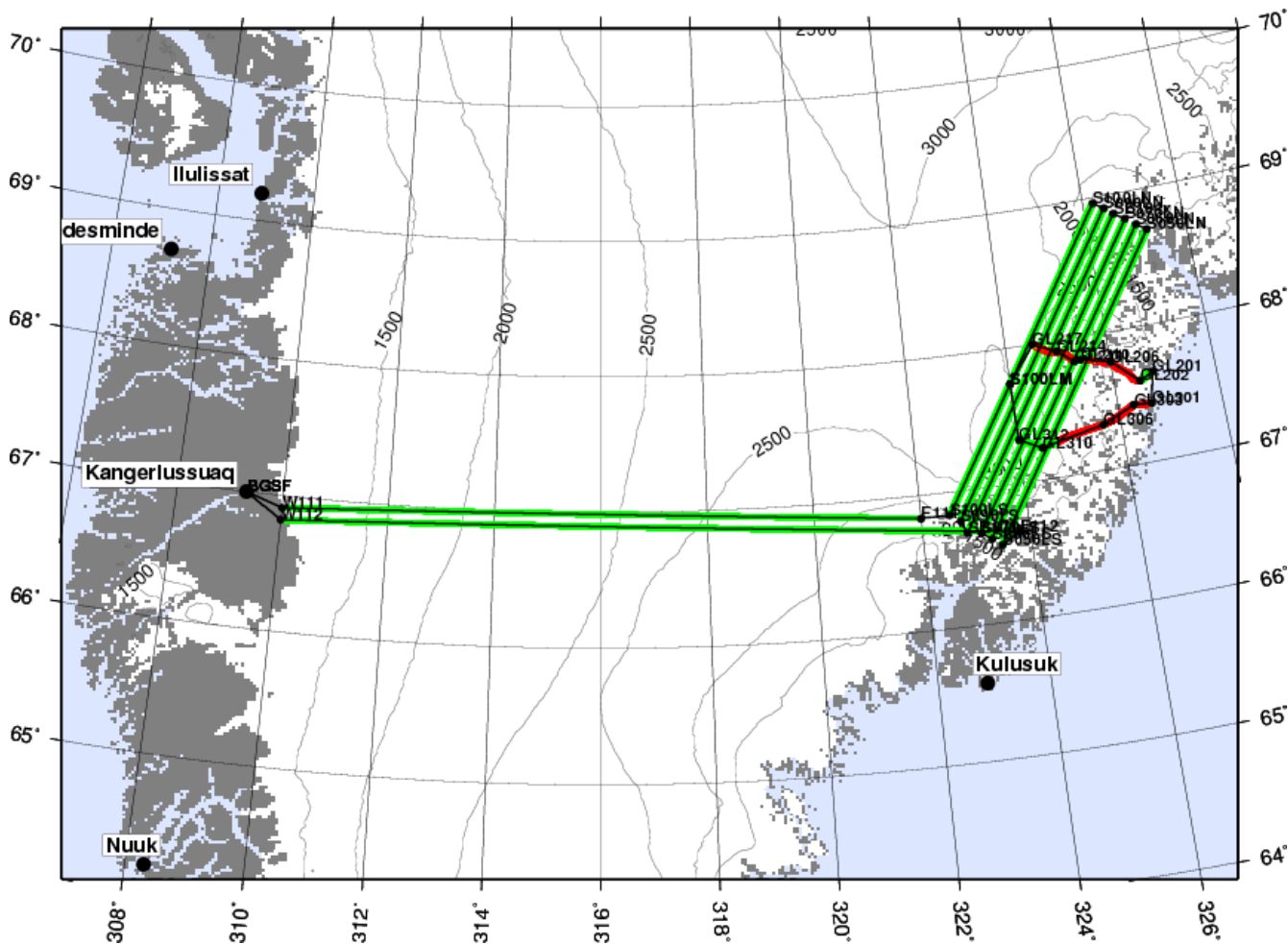
# Land Ice – Helheim-Kangerdlugssuaq Gap 02 / Kangerlussuaq

This is a new mission, designed primarily to map the bedrock of the ice sheet in the space between Helheim and Kangerdlugssuaq Glaciers. The grid is spaced at approximately 10 km, and it conforms to the 2010 LVIS grid flown here in that one of these lines is designed to repeat the 2010 lines, for dh/dt purposes. This mission is designed to complement the Helheim-Kangerdlugssuaq Gap 01 mission by continuing that grid in the upslope direction. We also fly the centerline of two glaciers in the area (names unknown) for the first time. We transit to and from the area along central Greenland master grid lines.

**Flight Priority:** Medium  
**ICESat Track:** none  
**Remaining Issues:** none known

**Instrument Priority:** MCoRDS/ATM  
**Flown in 2011:** No

## Helheim-Kangerdlugssuaq Gap 02 7.9 hrs at 250 knots groundspeed



# Land Ice – Helheim-Kangerdlugssuaq / Kangerlussuaq

This is a new mission, based on the 2010 “Hel-Kang” mission but with considerable changes. It captures centerline surveys of the two main branches of Helheim, of Kangerdlugssuaq, Fenris and of several branches of Midgard glaciers. It also overflies the 2011 Forster traverse from Raven to the southeastern coast. For all of the longitudinal glacier surveys, we extend the centerline segments as far as practical down the fjords to enable the gravimeter to detect the presence of sills. We also fly all of the sinuous glacier centerlines which were flown in 2010 in the reverse direction, for the purpose of improving recovery of gravity data in these instances. See the Appendix for a detail map which shows the extensive coverage of Midgard Glacier and its surroundings.

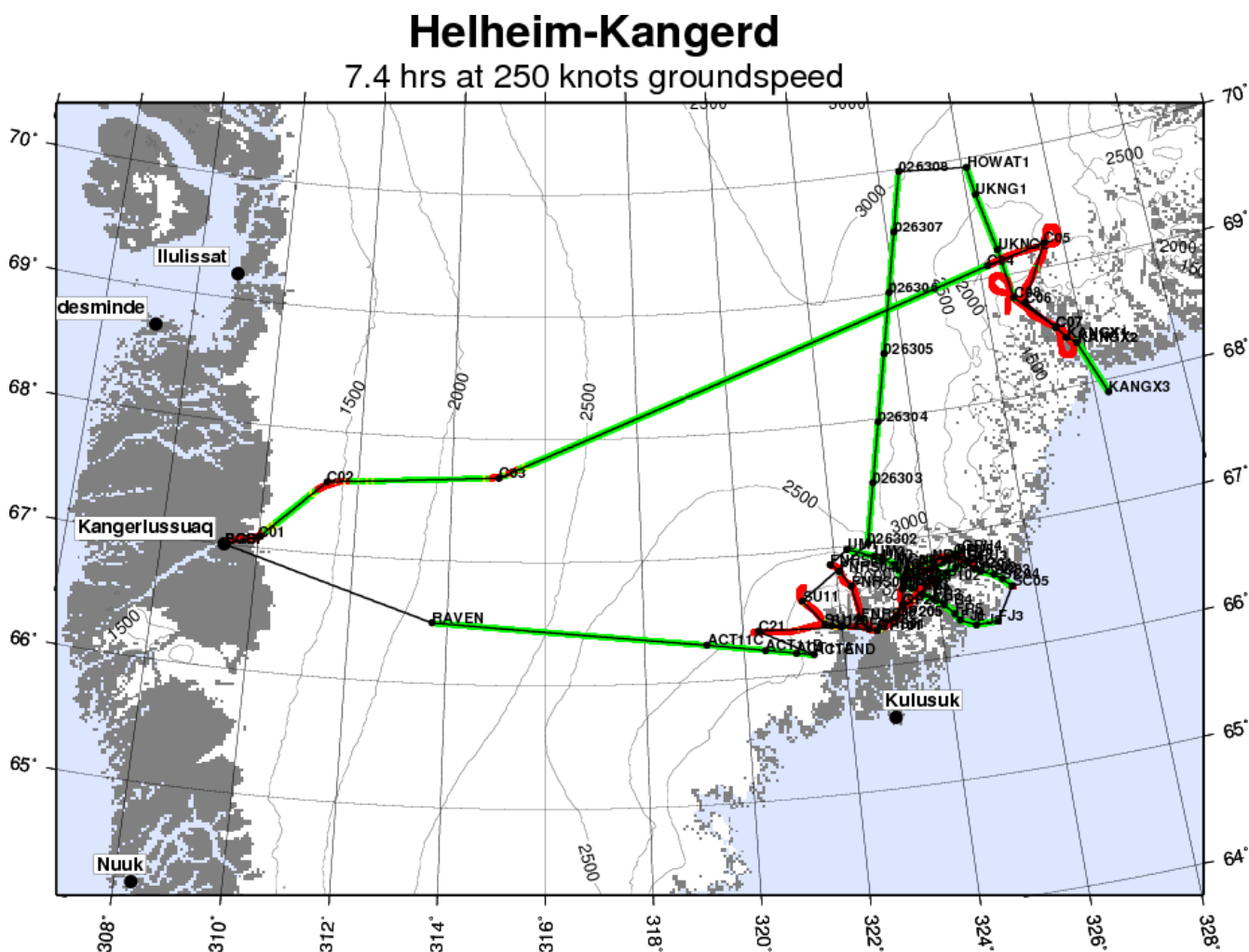
**Flight Priority:** High

**ICESat Track:** 0263

**Remaining Issues:** none known

**Instrument Priority:** ATM/KU

**Flown in 2011:** Yes



# Land Ice – Southeast Glaciers 01 / Kangerlussuaq

This mission is in part a repeat of the 2011 Southeast Glaciers mission. Its primary purpose is to continue dh/dt monitoring of 8 glaciers in the southeast which have been flown each year since 2008, two more not flown since 2010, and two additional glaciers in the south near the Pursortoq peninsula which have not been previously flown. We extend the centerline runs of most of the glaciers past the seaward ends of their fjords, to enable the gravimeter to detect possible sills in the fjords. We also intend to occupy a CryoSat ascending ground track to transit between southeastern Greenland and Kangerlussuaq. The ground track shown below is a placeholder – we will select an ascending CryoSat track on the day the mission is flown which is as nearly contemporaneous as possible.

**Flight Priority:** Medium

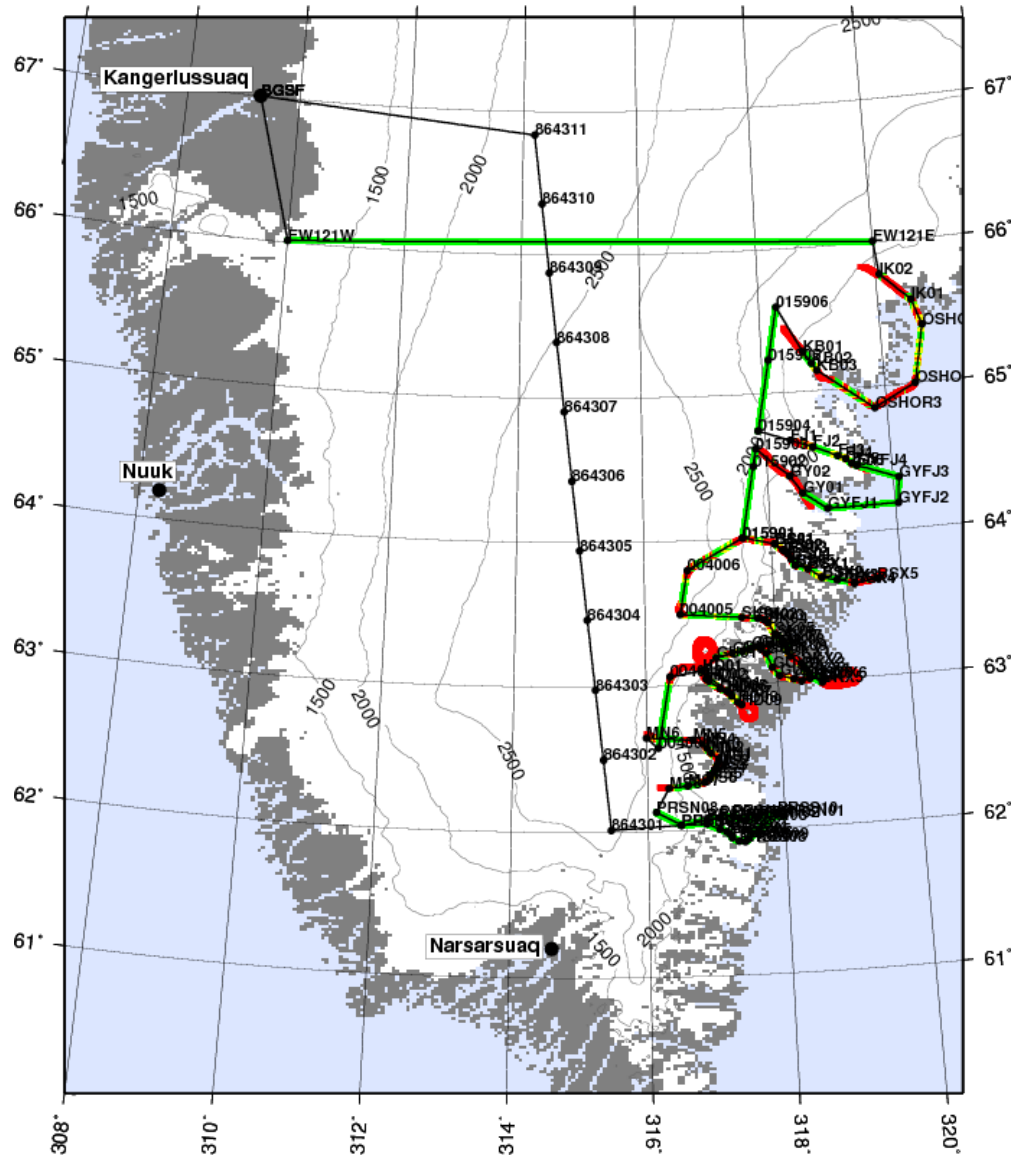
**ICESat Track:** 0040,0159

**Remaining Issues:** needs updated Cryosat ground track

**Instrument Priority:** ATM

**Flown in 2011:** Portions

## Southeast Glaciers 01 7.5 hrs at 250 knots groundspeed



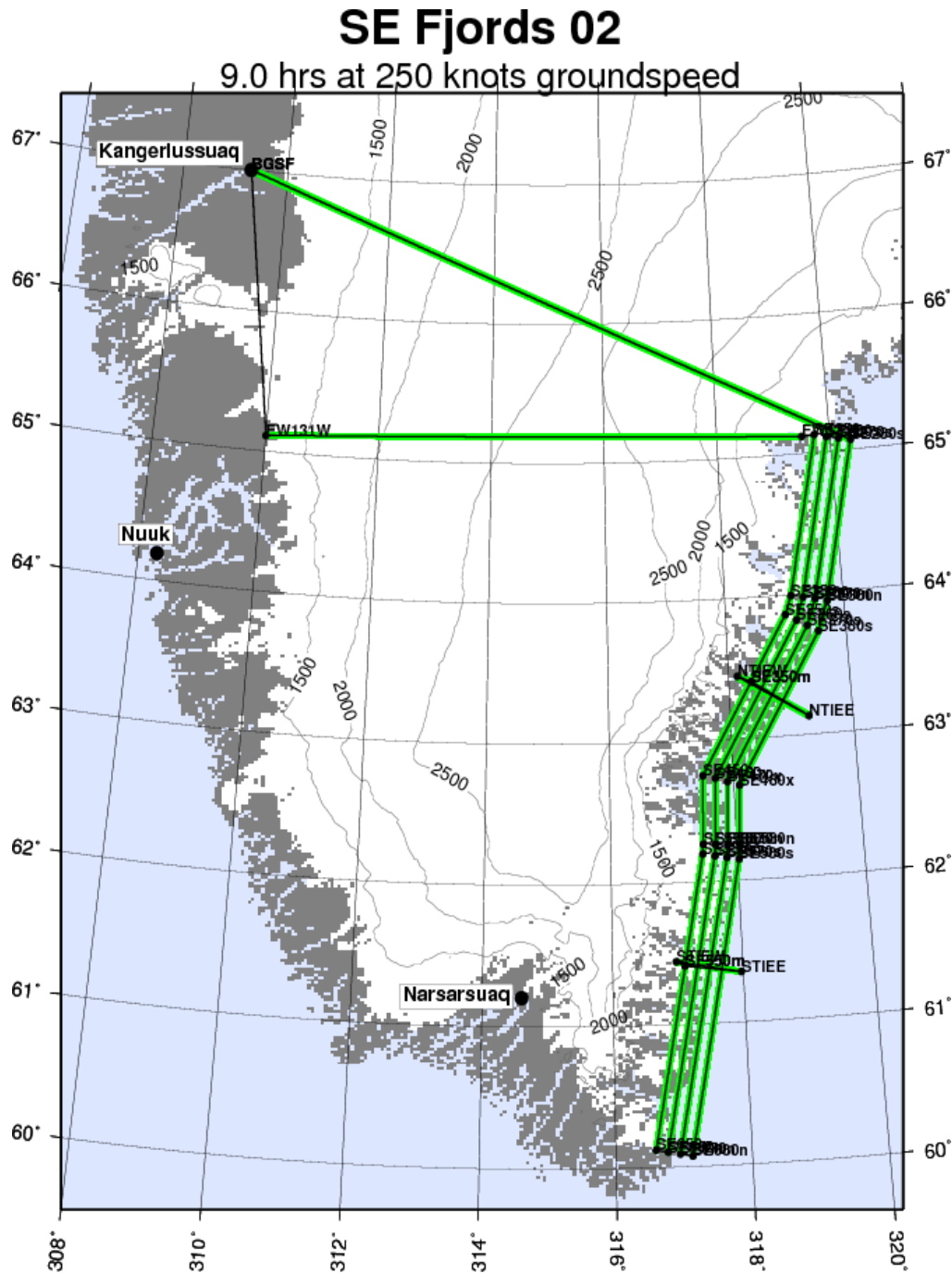


# Land Ice – Southeast Fjords 02 / Kangerlussuaq

This is a new mission, which extends the Southeast Coastal grid to the seaward and to the south. The grid lines are spaced at 10 km, and the lines are placed to seaward of the Southeast Fjords 01 mission. See the Appendix for a composite map which shows all five southeast Greenland missions in context with each other, and with the 2010 flights.

**Flight Priority:** Low  
**ICESat Track:** none  
**Remaining Issues:** none known

**Instrument Priority:** Grav  
**Flown in 2011:** No



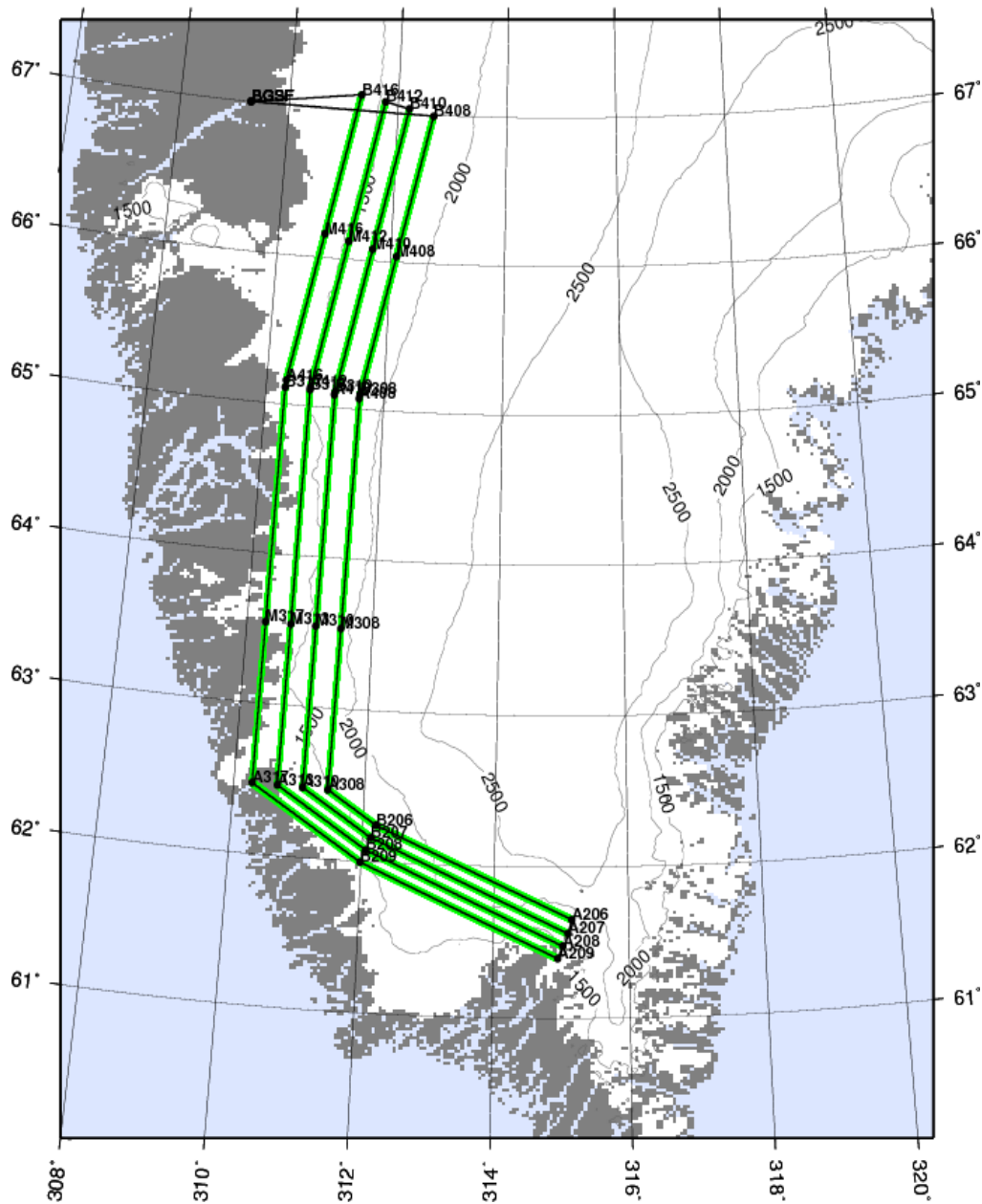
# Land Ice – Southwest Coastal 01 / Kangerlussuaq

This is a new mission, one of a set of four which mirrors the coast-parallel coverage of the 2010-2011 Southeast Coastal missions in the southwest. All of the flightlines of all four missions replicate LVIS flight lines from 2011. This particular mission establishes a roughly 20 km grid along the west coast, decreasing to a spacing of approximately 10 km on the south coast.

**Flight Priority:** High  
**ICESat Track:** none  
**Remaining Issues:** none known

**Instrument Priority:** MCoRDS/ATM  
**Flown in 2011:** yes, by LVIS

## Southwest Coastal 01 7.5 hrs at 250 knots groundspeed



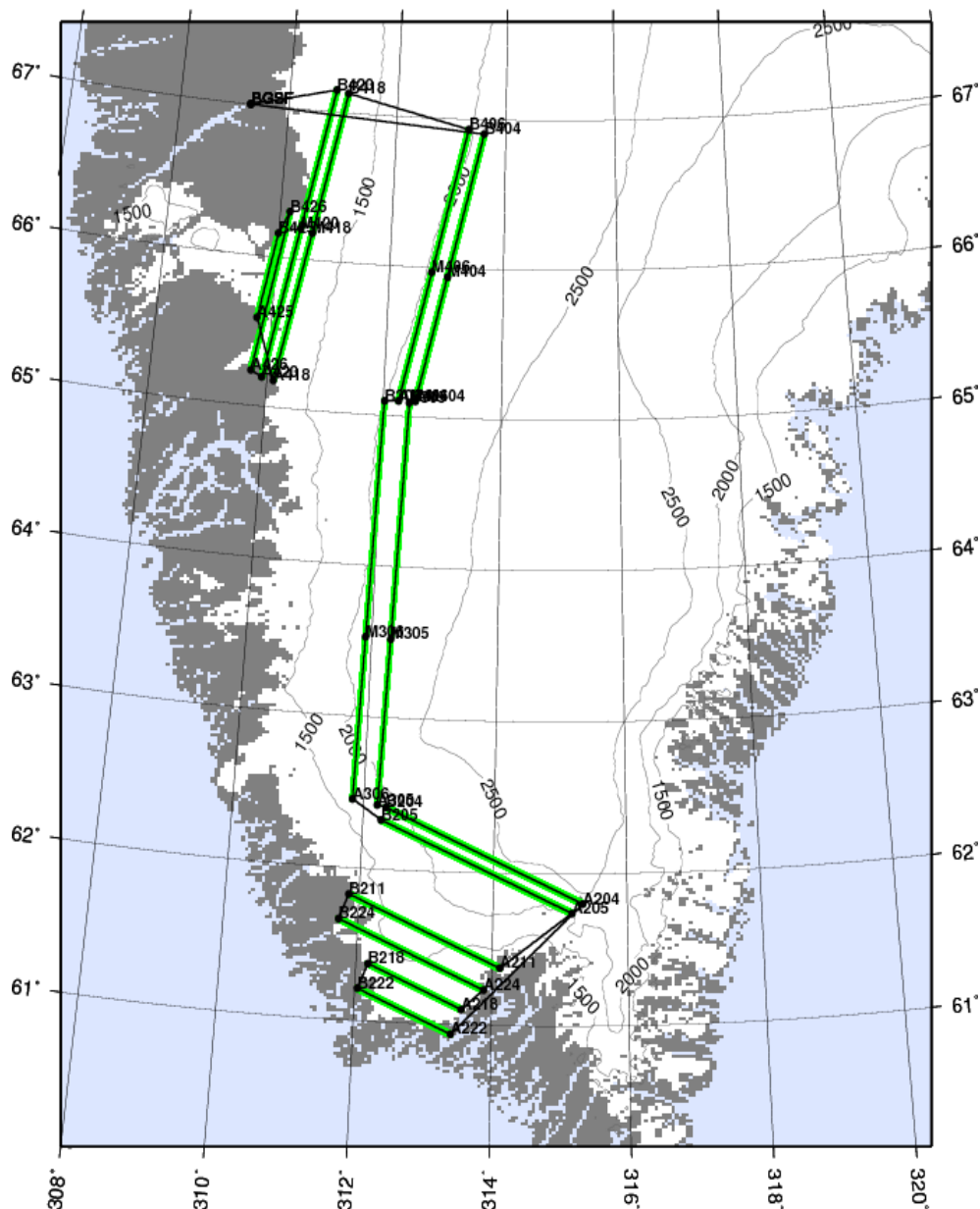
# Land Ice – Southwest Coastal 02 / Kangerlussuaq

This is a new mission, one of a set of four which mirrors the coast-parallel coverage of the 2010-2011 Southeast Coastal missions in the southwest, along 2011 LVIS flight lines. This particular mission extends the main grid inland, and also extends the grid outward on smaller ice lobes just south of Kangerlussuaq and at the southern end of the ice sheet.

**Flight Priority:** Medium  
**ICESat Track:** none  
**Remaining Issues:** none known

**Instrument Priority:** MCoRDS/ATM  
**Flown in 2011:** yes, by LVIS

## Southwest Coastal 02 7.7 hrs at 250 knots groundspeed



# Land Ice – Southwest Coastal 03 / Kangerlussuaq

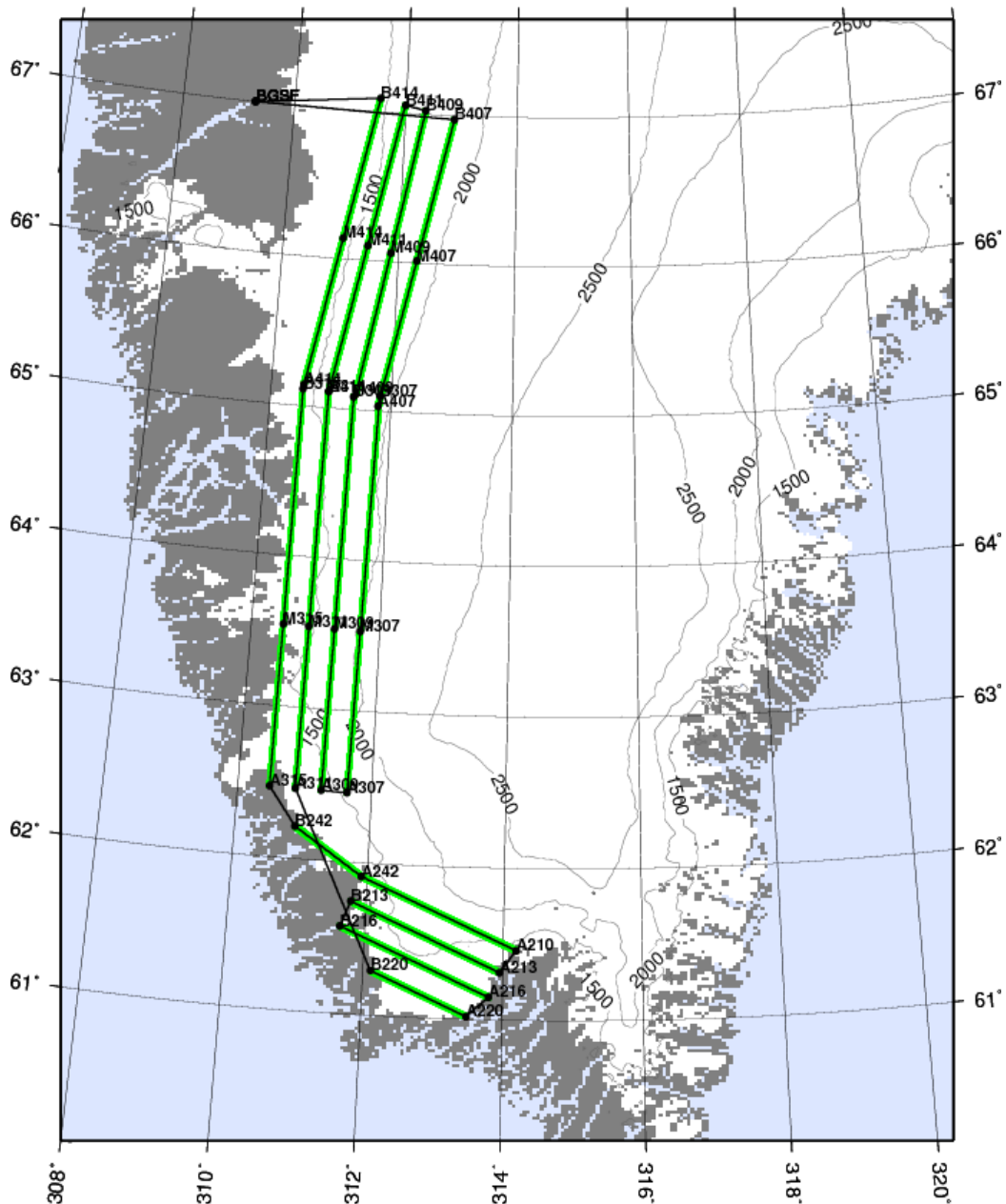
This is a new mission, one of a set of four which mirrors the coast-parallel coverage of the 2010-2011 Southeast Coastal missions in the southwest. This particular mission interlaces the ~20 km grid established with Southwest Coastal 01 to a combined spacing of ~10 km.

**Flight Priority:** Low  
**ICESat Track:** none  
**Remaining Issues:** none known

**Instrument Priority:** MCoRDS/ATM  
**Flown in 2011:** yes, by LVIS

## Southwest Coastal 03

7.3 hrs at 250 knots groundspeed





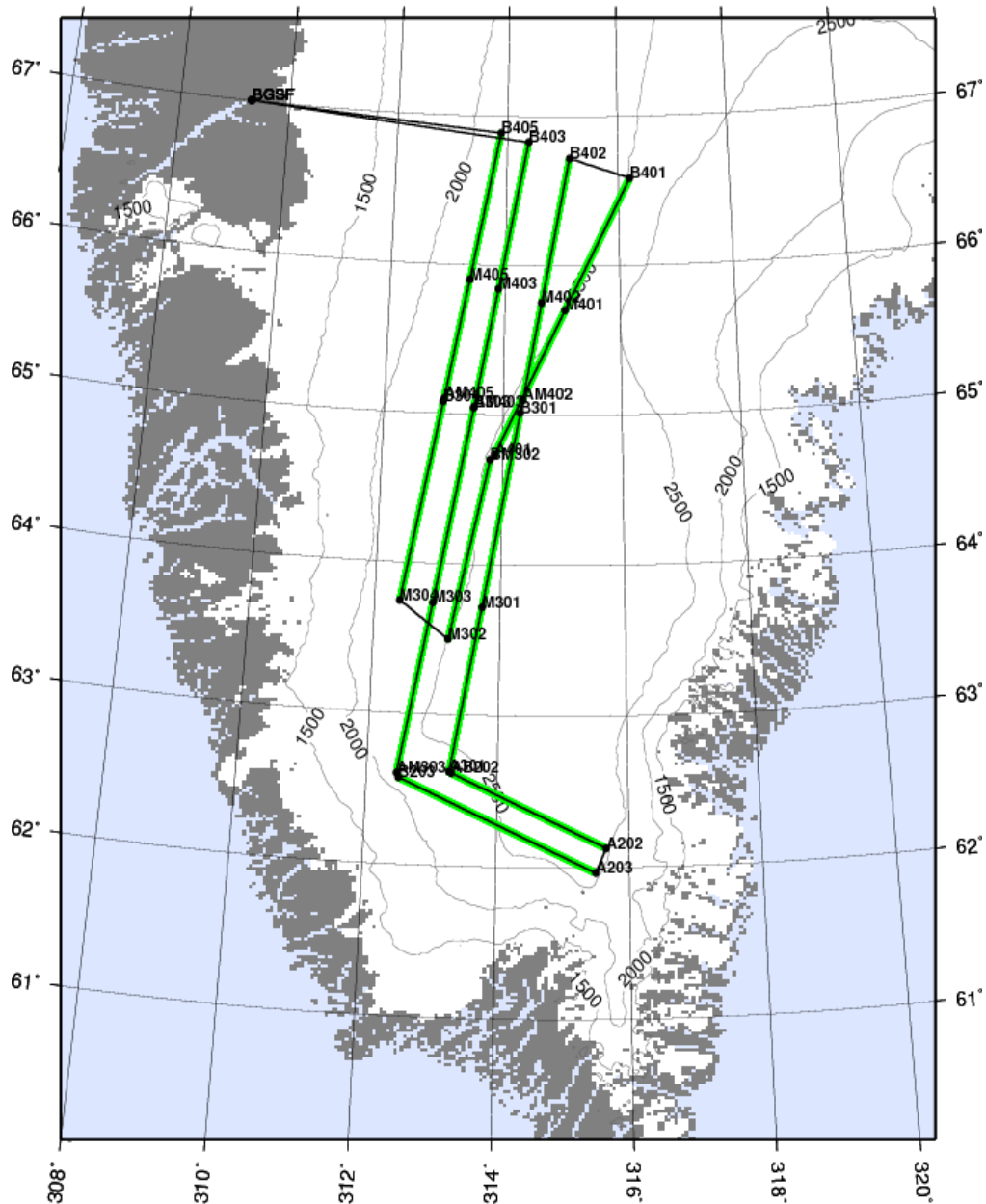
# Land Ice – Southwest Flank 01 / Kangerlussuaq

This is a new mission, one of a set of four which mirrors the coast-parallel coverage of the 2010-2011 Southeast Coastal missions in the southwest. This particular mission extends the grid inland toward the ice divide.

**Flight Priority:** Low  
**ICESat Track:** none  
**Remaining Issues:** none known

**Instrument Priority:** MCoRDS/ATM  
**Flown in 2011:** yes, by LVIS

## Southwest Flank 01 5.8 hrs at 250 knots groundspeed



# Land Ice – Southwest Glaciers 01 / Kangerlussuaq

This is a new mission, which incorporates previously-flown lines over Sukkertoppen Ice Cap and over four glaciers near Nuuk, including Kangiata Nunaata Sermia. We also fill in a coverage gap over the extreme southern lobe of the Greenland Ice Sheet on a series of ICESat lines, which connect with the Southeast Coastal grid lines flown in 2010 and 2011. We return to Kangerlussuaq along a lengthy ICESat track over southern Greenland.

**Flight Priority:** High

**ICESat Track:** 0040,0412,0047,0159,0300

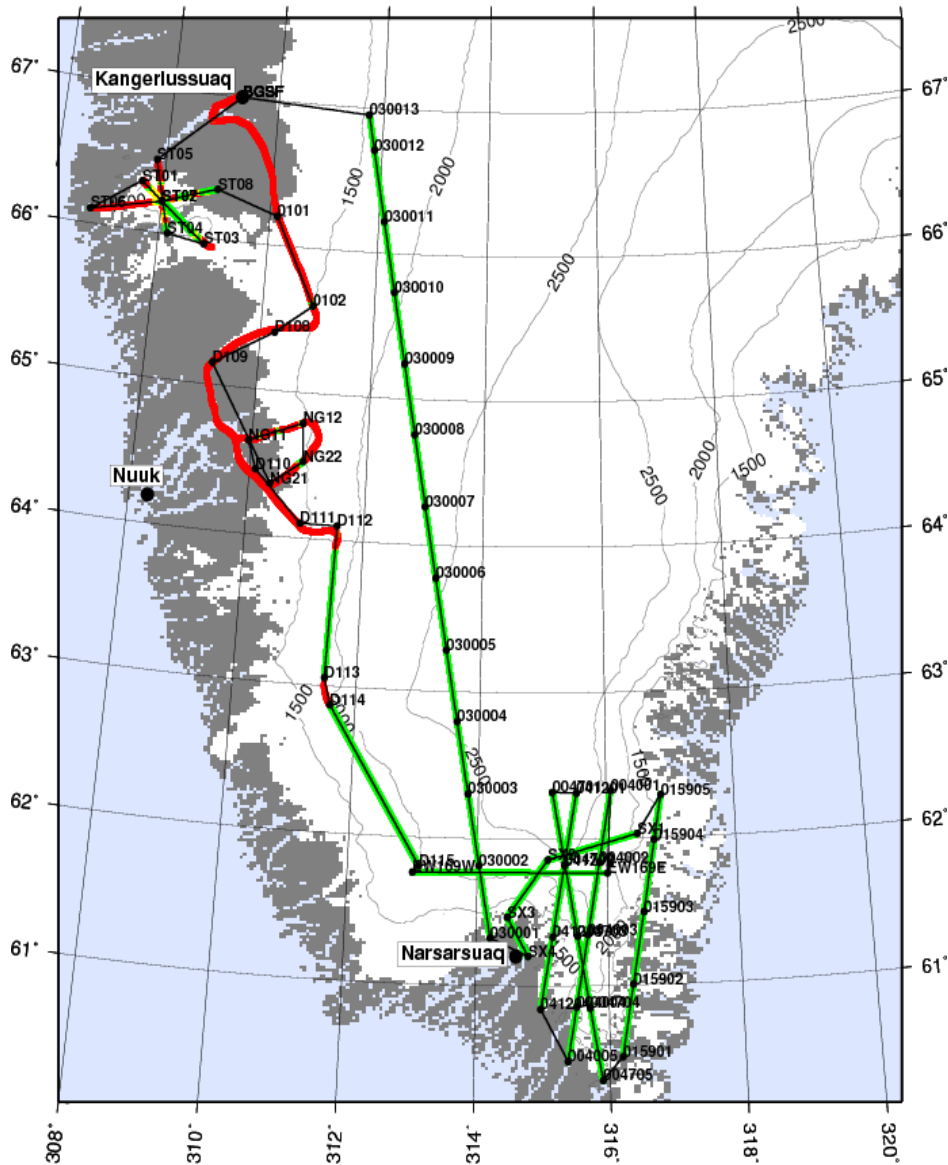
**Remaining Issues:** none known

**Instrument Priority:** ATM/MCoRDS

**Flown in 2011:** Portions

## Southwest Glaciers 01

8.1 hrs at 250 knots groundspeed

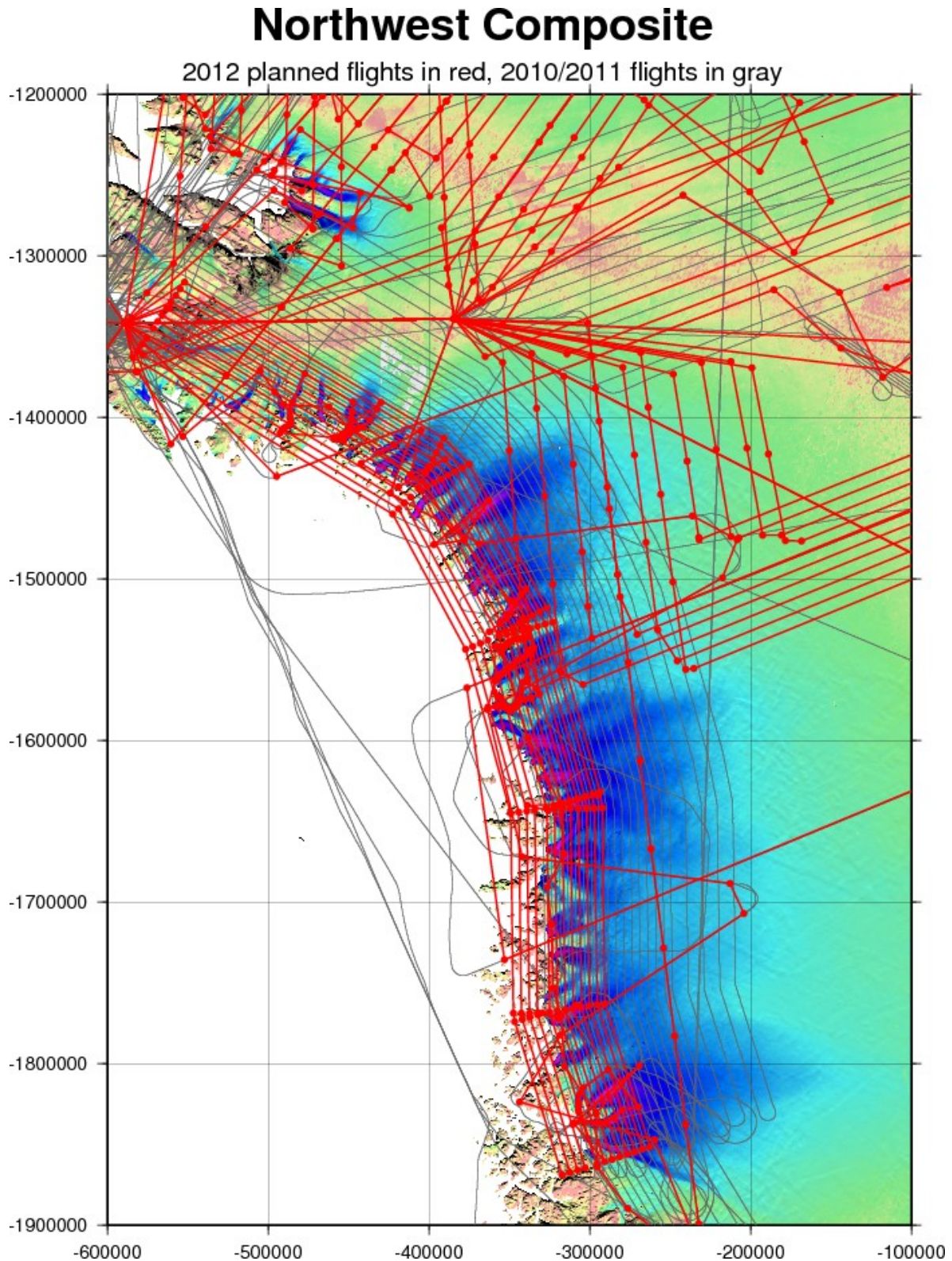


# Supplementary Information

Supplementary maps and other information follow.

# Composite Map of Northwest Greenland Missions

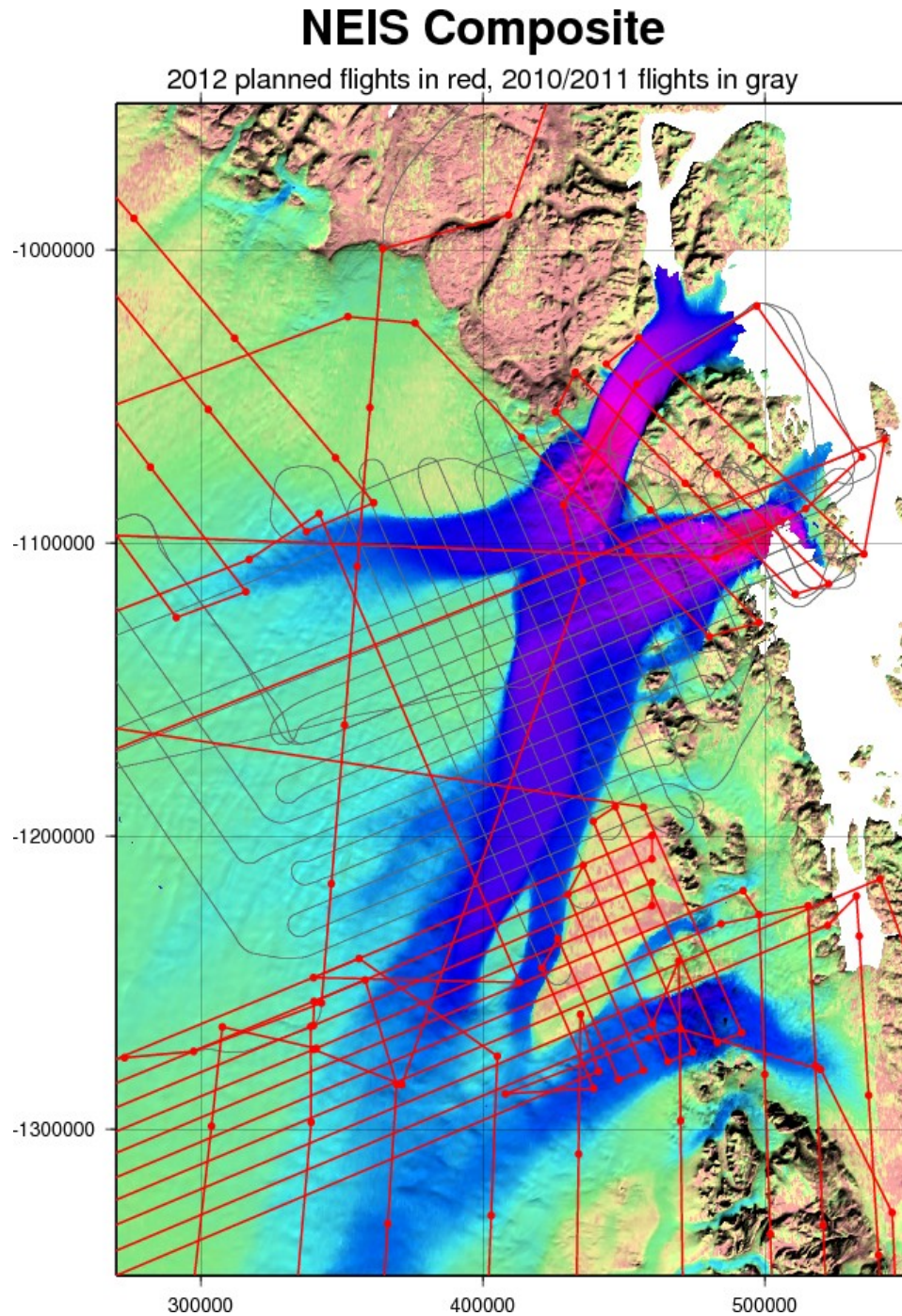
This map shows the all of the planned 2012 flights in northwest Greenland. The background image is the Rignot et al InSAR velocity map.





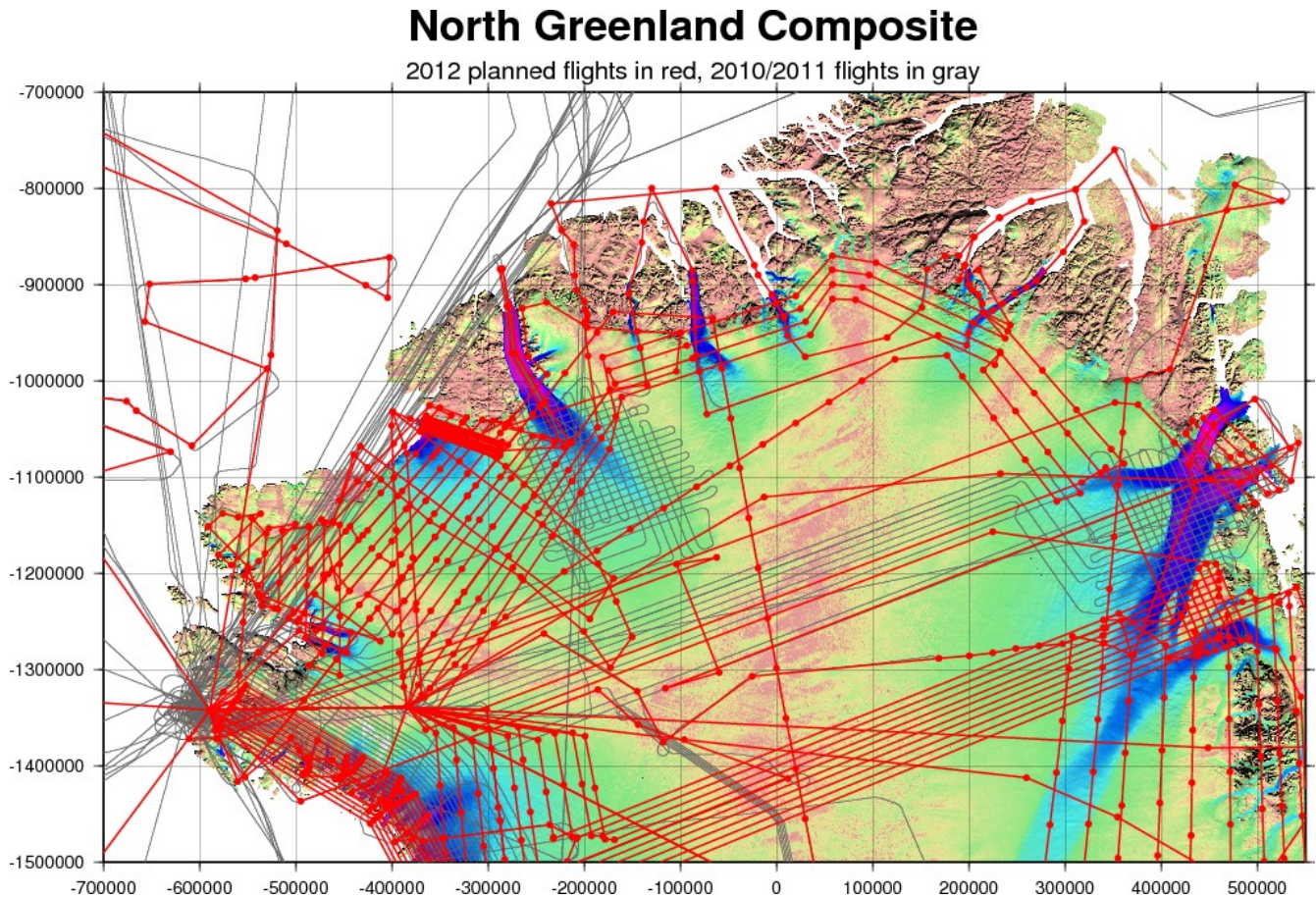
# Composite Map of Northeast Ice Stream Missions

This map shows the all of the planned 2012 flights in the vicinity of the Northeast Ice Stream. The background image is the Rignot et al InSAR velocity map.



# Composite Map of North Greenland Missions

This map shows the all of the planned 2012 flights in North Greenland. The background image is the Rignot et al InSAR velocity map.



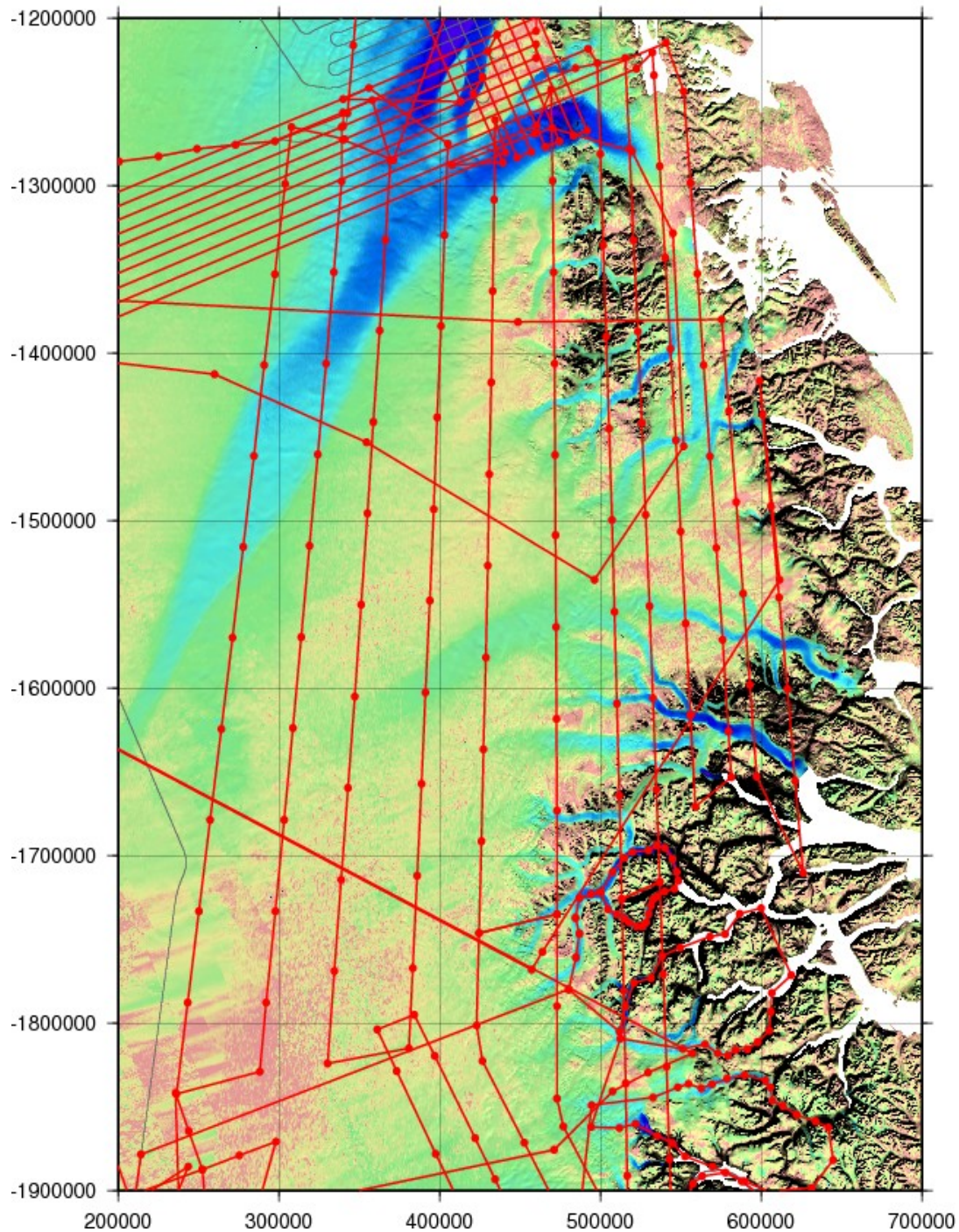


# Composite Map of Northeast Greenland Missions

This map shows the all of the planned 2012 flights in Northeast Greenland. The background image is the Rignot et al InSAR velocity map.

## Northeast Greenland Composite

2012 planned flights in red, 2010/2011 flights in gray



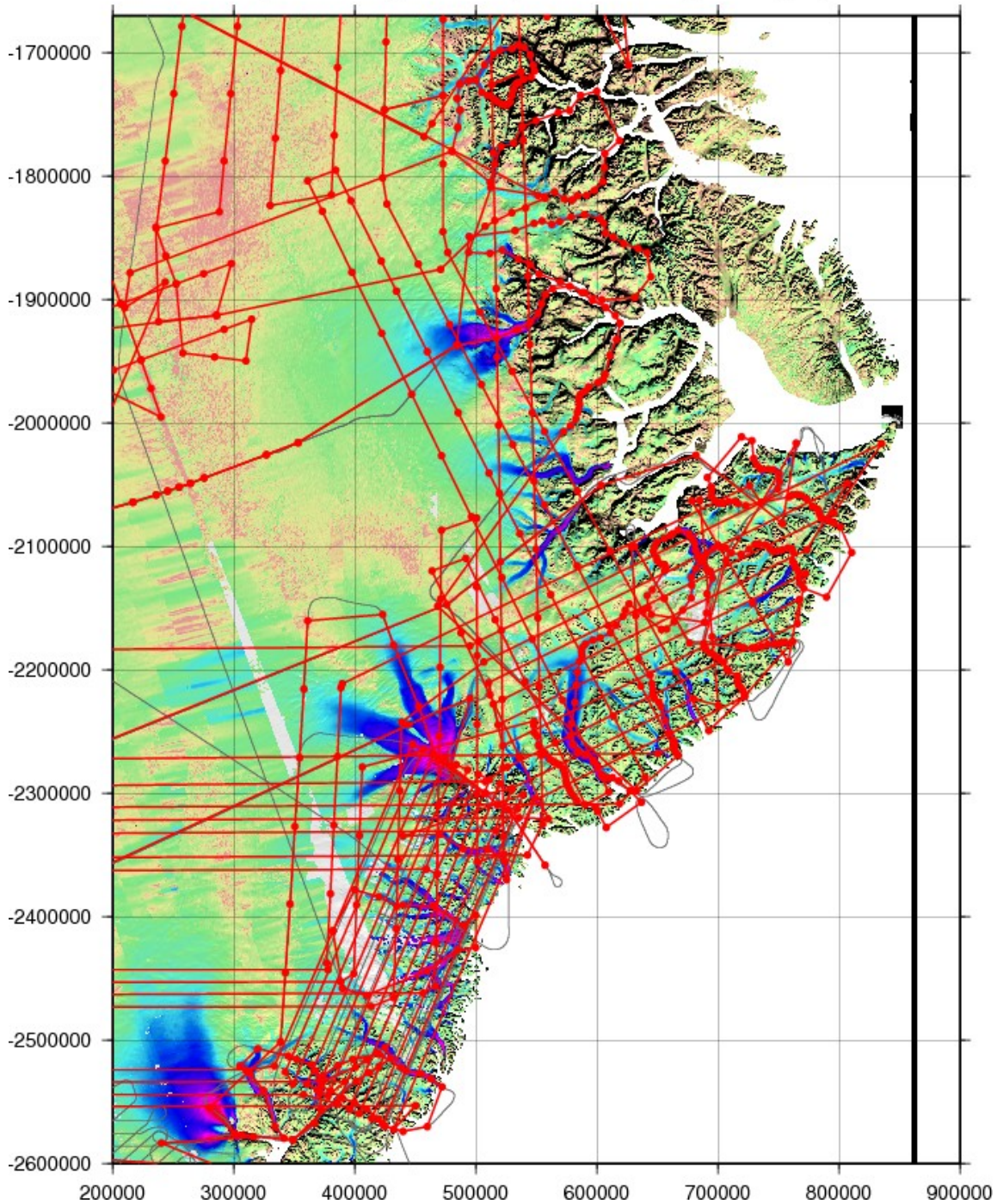


# Composite Map of East-Central Greenland Missions

This map shows the all of the planned 2012 flights in east-central Greenland. The background image is the Rignot et al InSAR velocity map.

## East Central Greenland Composite

2012 planned flights in red, 2010/2011 flights in gray



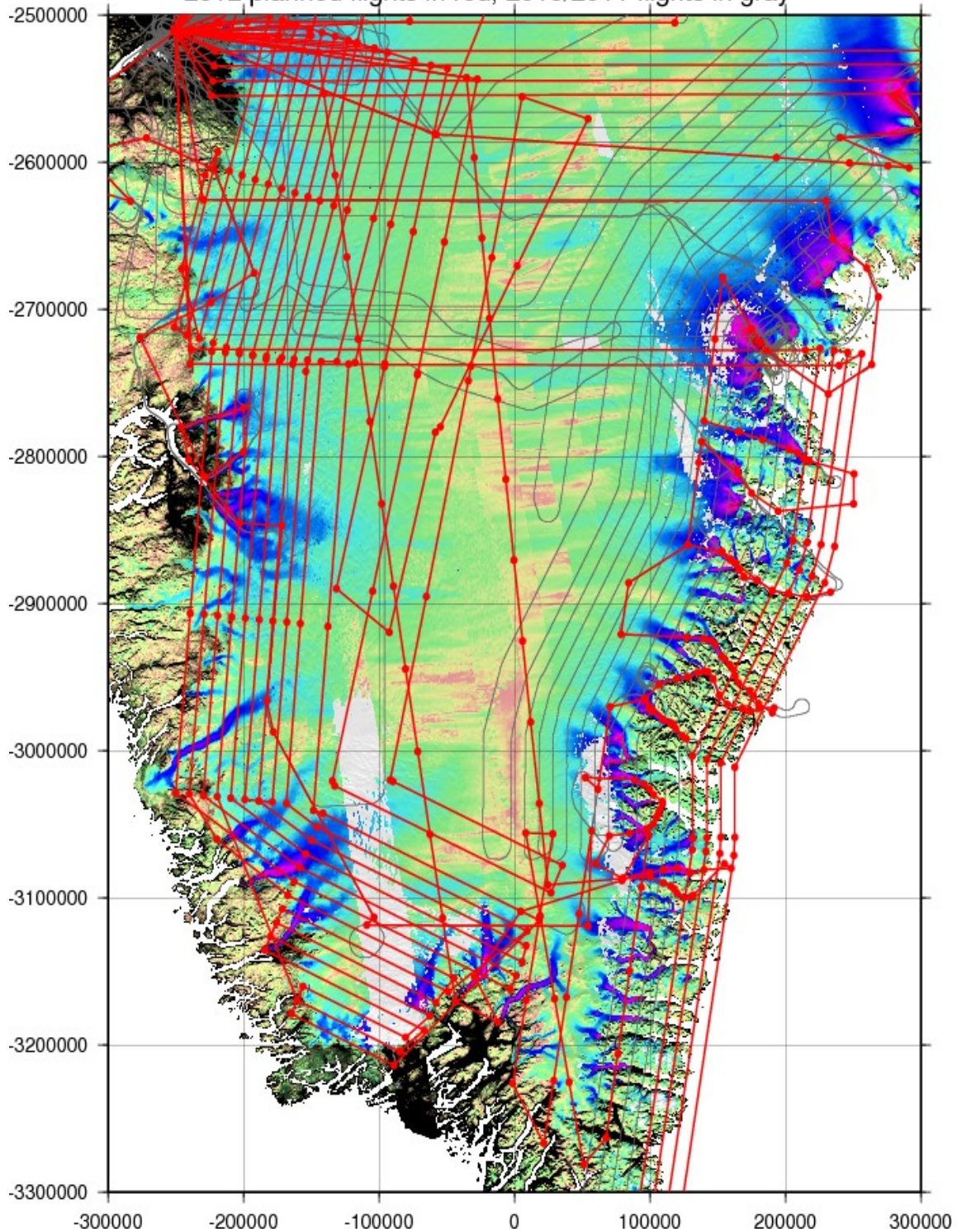


# Composite Map of South Greenland Missions

This map shows the full set of south Greenland flights. The background image is the Rignot et al InSAR velocity map.

## South Greenland Composite

2012 planned flights in red, 2010/2011 flights in gray



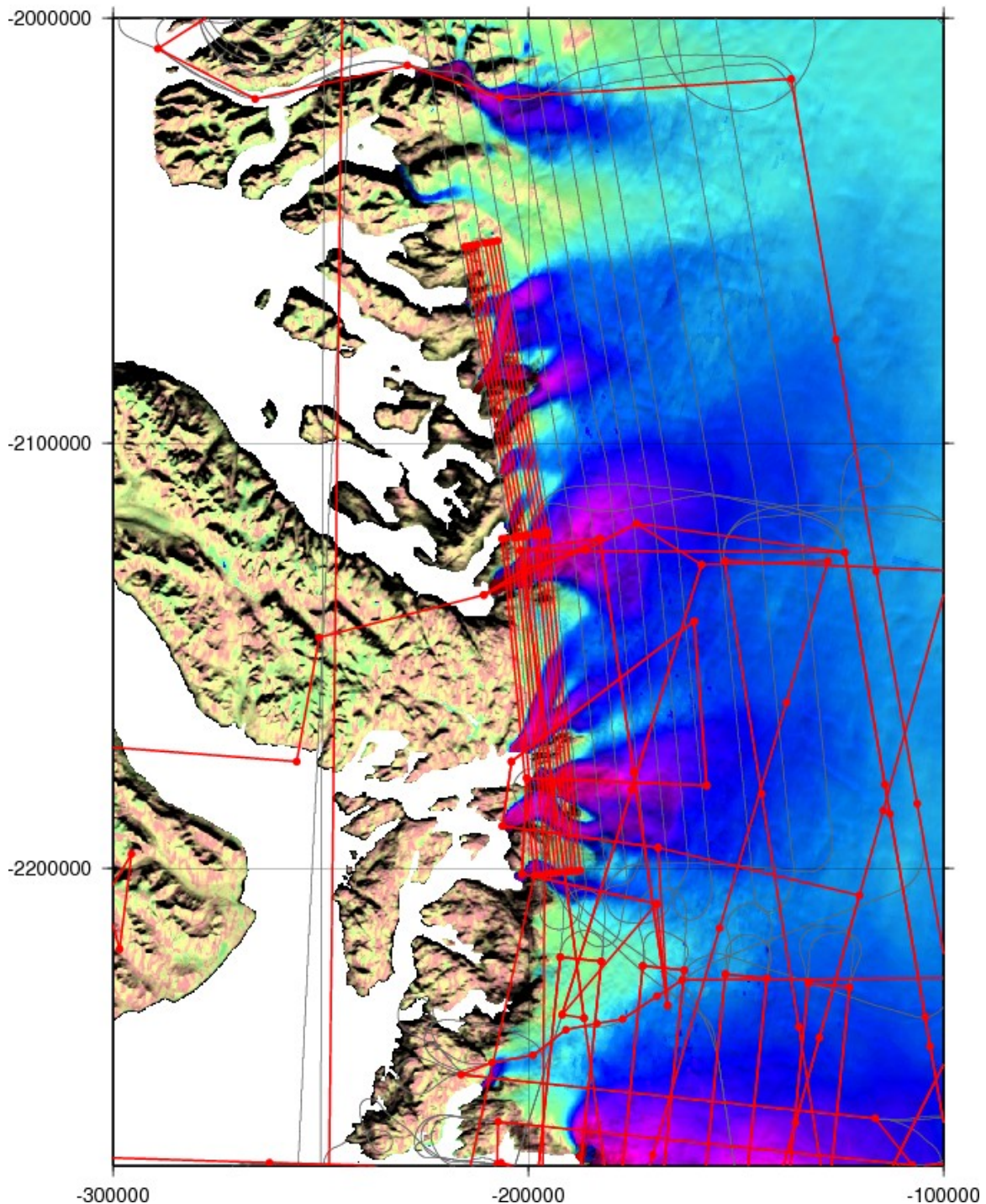


# Composite Map of Umanaq Missions

This map shows the Umanaq-Sarqardliup flight in context with the other planned flights in the area and with the 2011 Umanaq 01/02 flights. The background image is the Rignot et al InSAR velocity map.

## Umanaq Composite

2012 planned flights in red, 2010/2011 flights in gray



# Detail Map of Midgard Glacier Surveys

This map shows the details of the part of the Helheim-Kangerdlugssuaq mission which surveys most of the branches of Midgard Glacier and its close neighbors.

