

Spring 2011 IceBridge Flight Plans
4 March 2011 Draft

compiled by

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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 2011. 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 42 planned missions totaling over 300 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 B-200 King Air. 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, costal 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

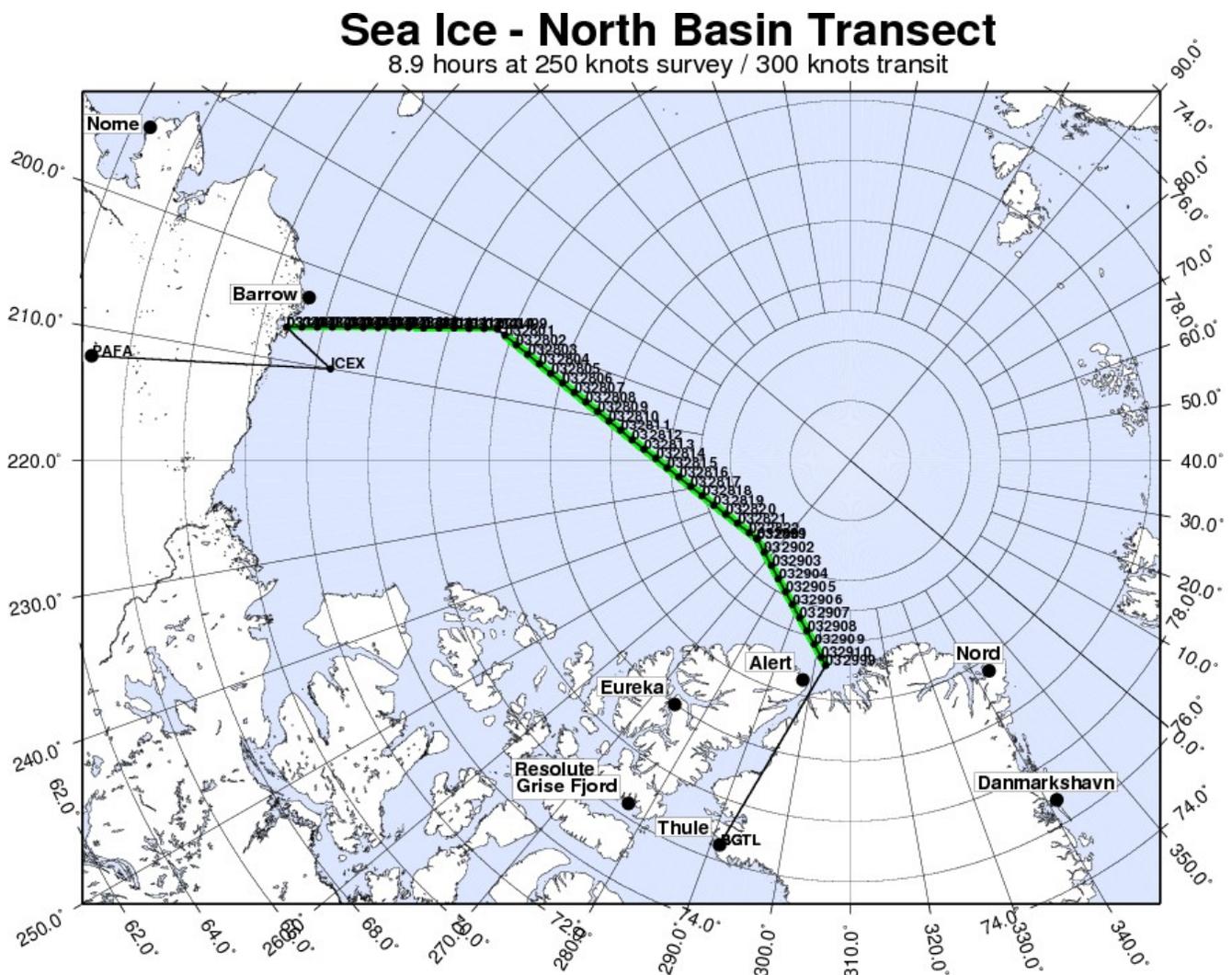
This mission is a near-exact repeat of the 090405 Arctic basin transect from Fairbanks to Thule. It also includes a single pass over the ICEX camp north of Prudhoe Bay, whose precise coordinates will be provided later. In addition to Level-1 Requirements 4.1.1.A.3a and b, the flight addresses sea ice 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: Need coordinates for ICEX camp pass



Sea Ice – South Basin Transect / Thule-Fairbanks

This mission is an exact repeat of the 090402 flight. Timing on this flight is very tight because we need at least 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

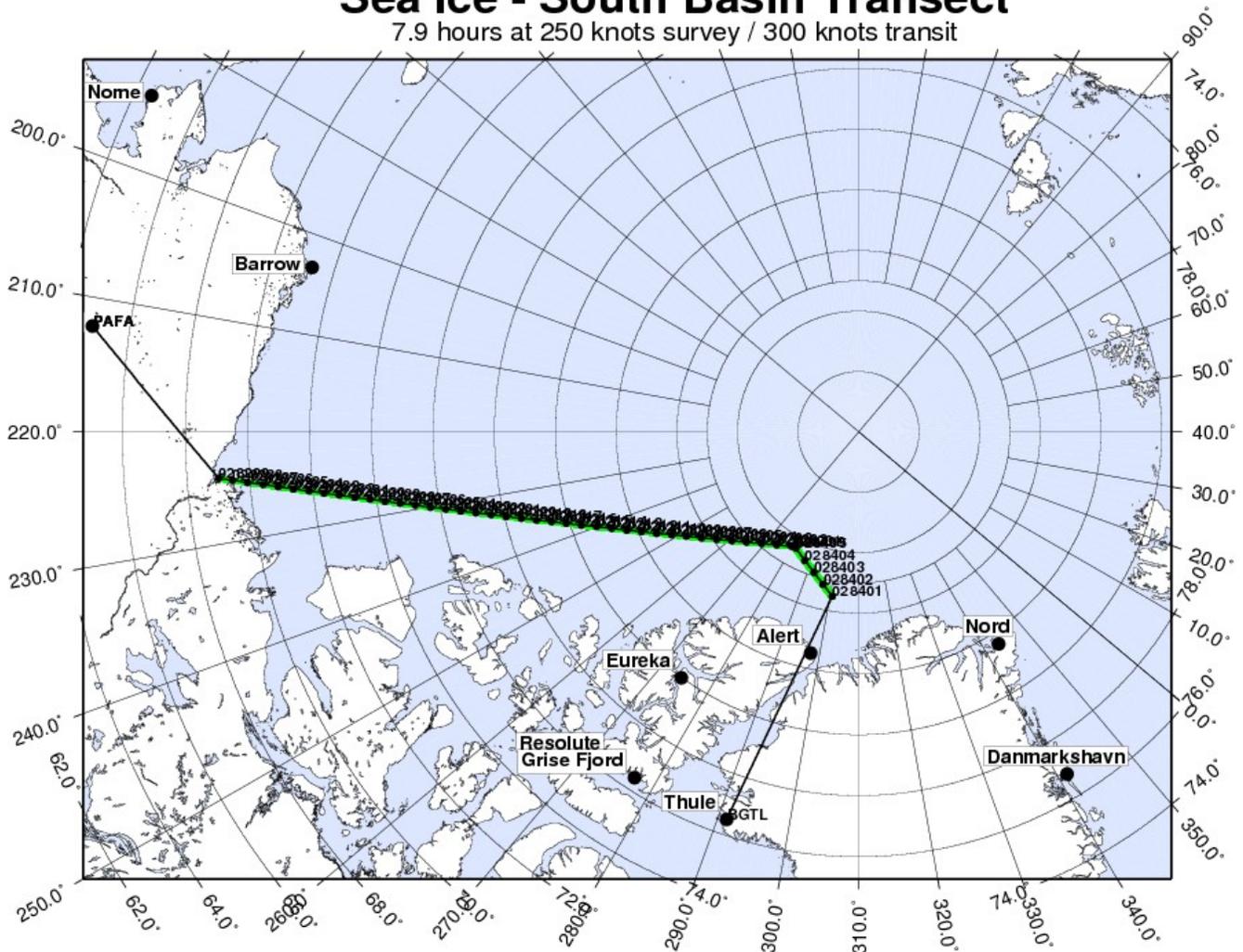
Instrument Priority: ATM/Snow/KU/DMS/Grav

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 – ICEX Camp Survey / Fairbanks

This is a new mission, designed to overfly the ICEX camp north of Prudhoe Bay. Specifically, we will overfly a line of retroreflectors which will be installed by March 21st. We will first overfly the retroreflector line twice at 500' altitude, in part to verify the coordinates of the line. Then we climb to 1500', re-fly the retroreflector line, and fly four more lines parallel to the main line but displaced 100 m and 200 m on each side. We also include a lead-in to each line of approximately 5 km to allow the aircraft navigation systems to settle in on each line. 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.3i by providing an opportunity to evaluate and improve remote sensing measurements of sea ice thickness and snow depth.

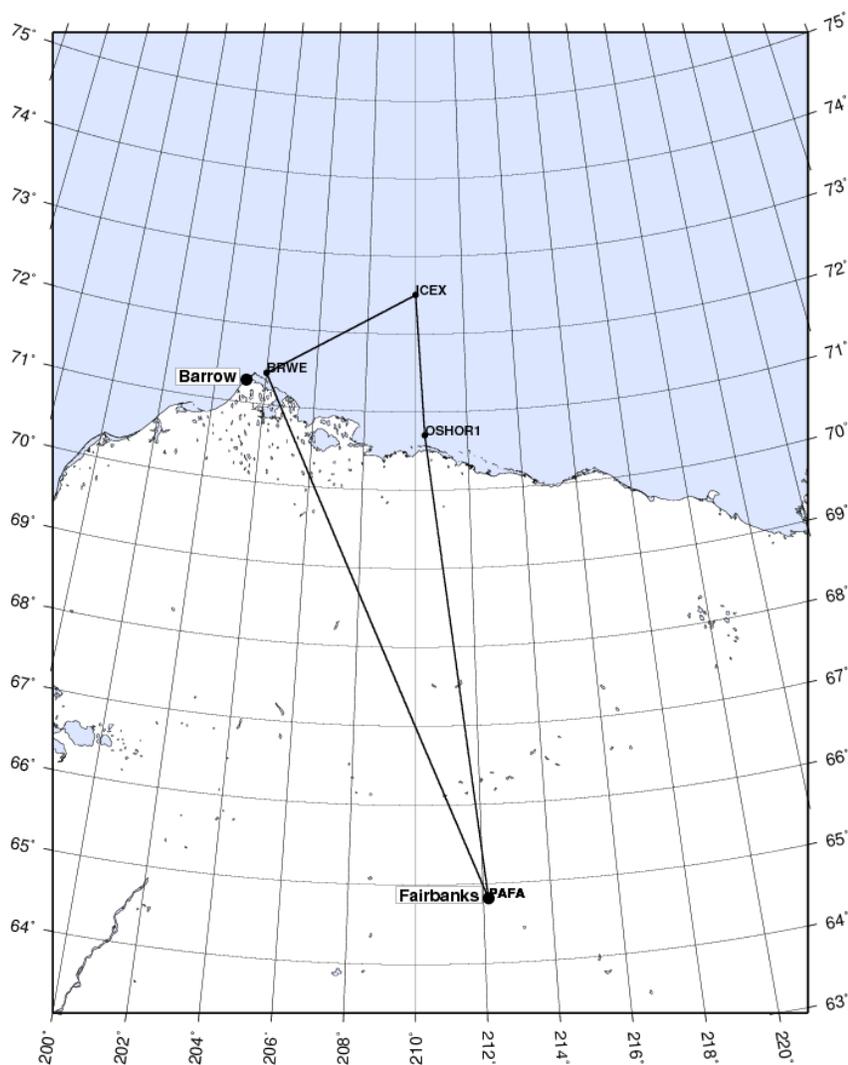
Flight Priority: High

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

ICESat Track: none

Remaining Issues: Need up-to-the-moment coordinates to plan the camp survey.

Sea Ice - ICEX Camp
5.3 hours at 250 knots survey / 300 knots transit



Sea Ice – Cryovex Site / Kangerlussuaq

This is a new mission, designed to overfly the Cryovex site north of Alert. The coordinates of the site and the exact survey pattern over the site are being determined. In addition to Level 1 Requirements 4.1.1.A.3a and b, this flight addresses sea ice level 1 baseline requirements 4.1.1.A.3i and d by providing an opportunity to evaluate and improve remote measurements of sea ice thickness and snow depth. Of particular interest is the on-ice collection of snow depth via a ground-deployed snow radar system that will be operated by Cryovex. This mission must be flown from Kangerlussuaq because of timing – the in-situ field work will be done in mid-April while the P-3 must be in Kangerlussuaq.

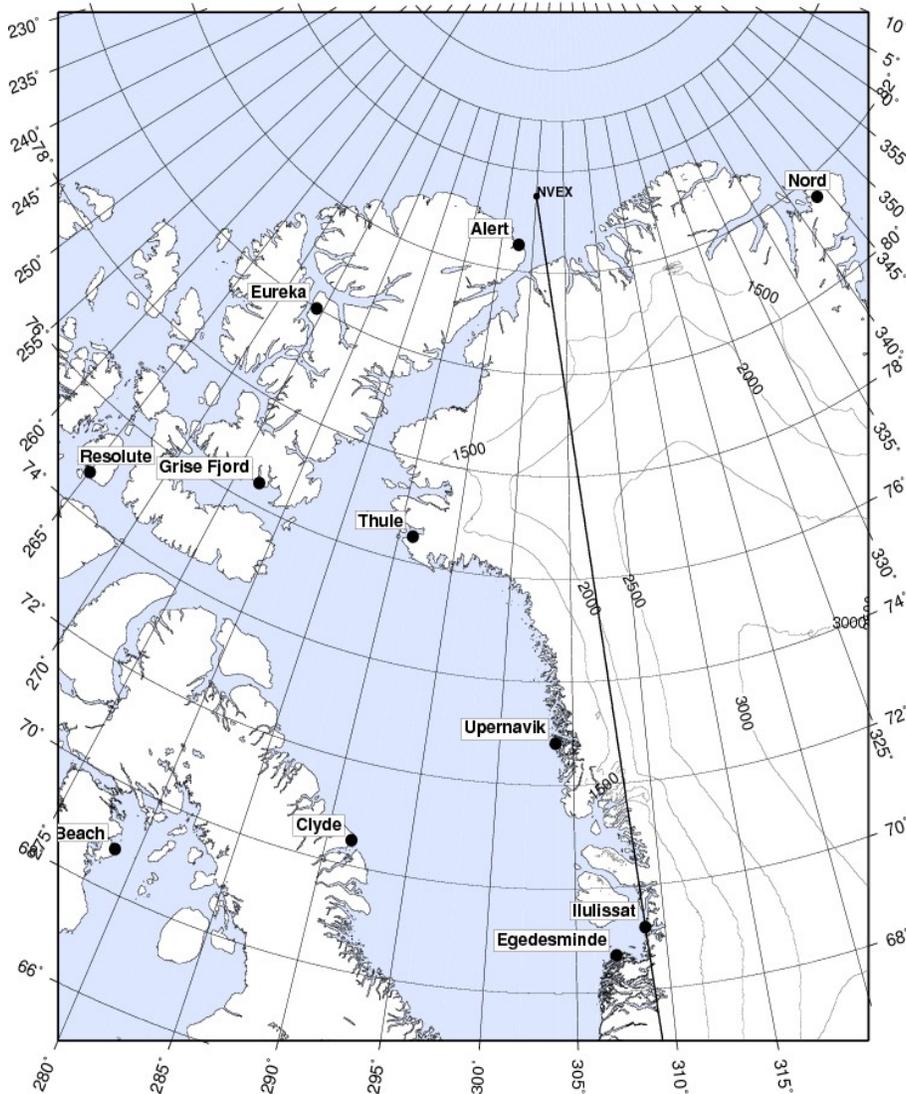
Flight Priority: High

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

ICESat Track: none

Remaining Issues: Need coordinates and pattern for site survey

Sea Ice - Cryovex 8.0 hrs at 250 knots groundspeed



Sea Ice – Zigzag West / Thule

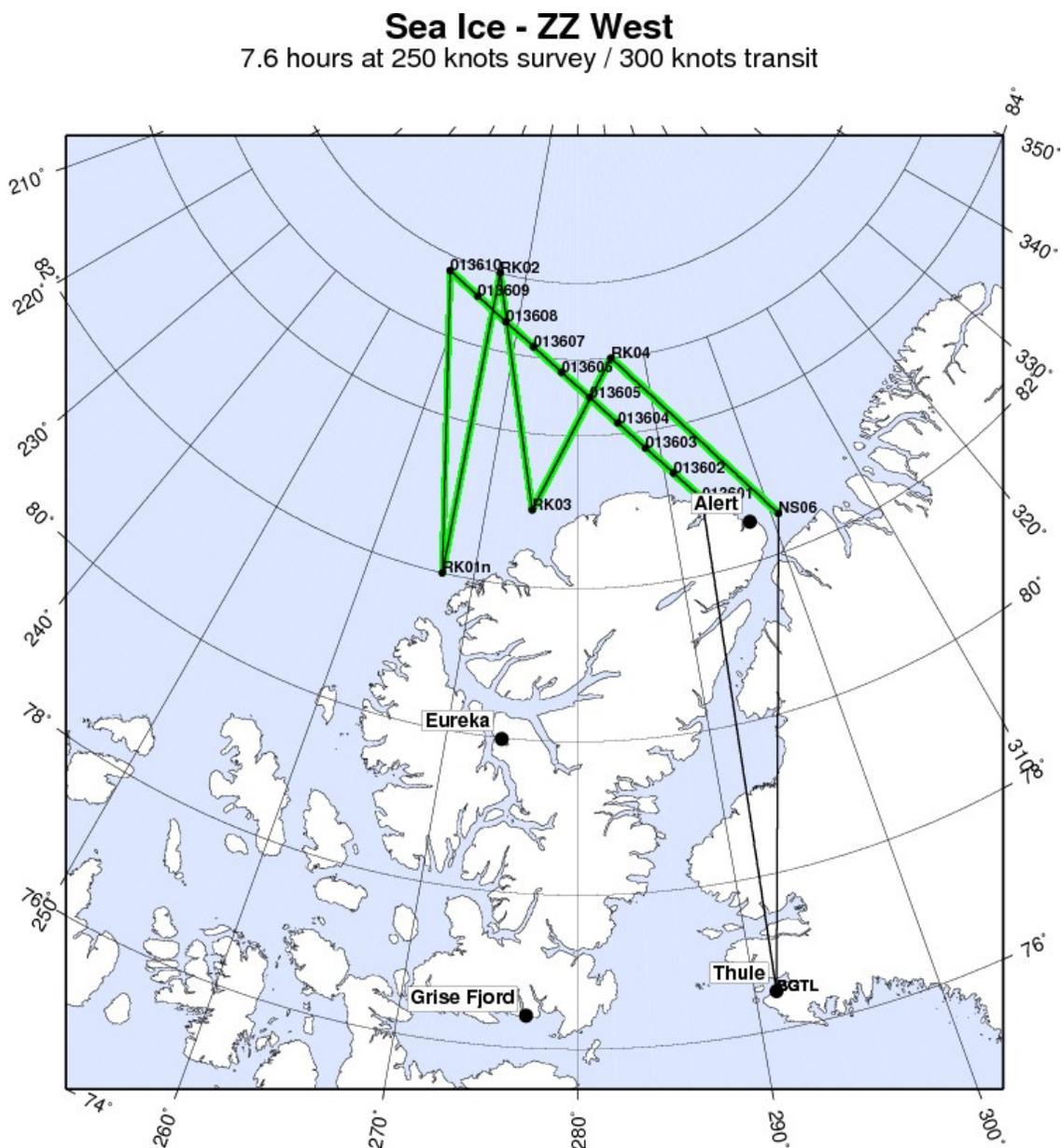
This mission is similar to the Sea Ice 05 mission from 2010 and is intended to sample thick multi-year ice immediately north of Ellesmere Island, and the gradient to thinner ice toward the pole. It was shortened from the 2010 version. In addition to Level 1 requirements 4.1.1.A.3a and b, it addresses 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: High

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

ICESat Track: 0136

Remaining Issues: none known



Sea Ice – Zigzag East / Thule

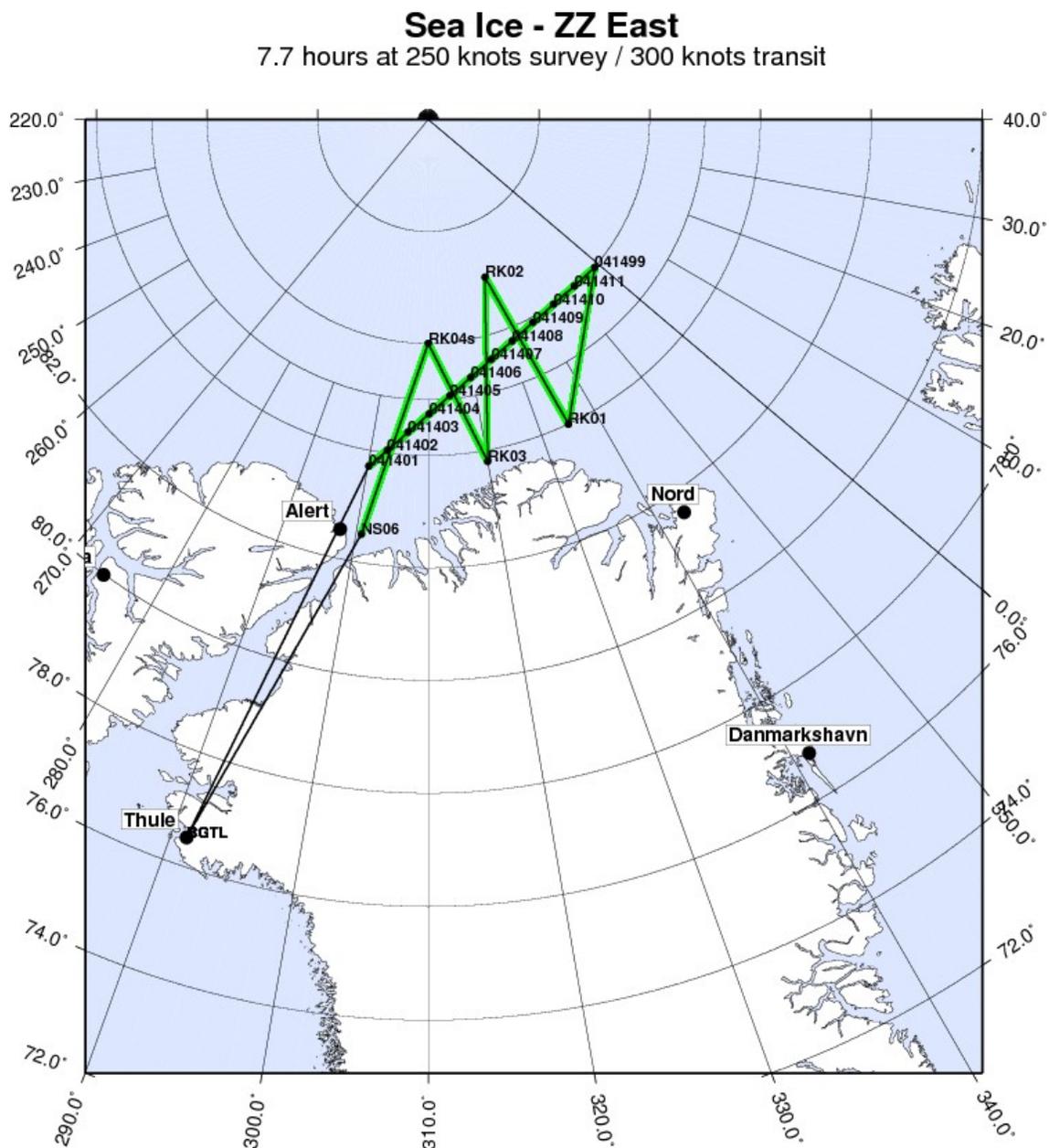
This mission is similar to the 2010 Sea Ice 04 flight, but with the zigzags shortened slightly. It is intended to sample the thick multi-year ice near the Greenland coast as well as the gradient to thinner ice closer to the pole. It also samples ICESat track 0414. In addition to Level 1 Requirements 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: none known



Sea Ice - Fram Gateway / Thule

This mission is similar to the 090331 Fram Strait mission, though we shorten the eastern end of the line to avoid open water near Svalbard. 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.

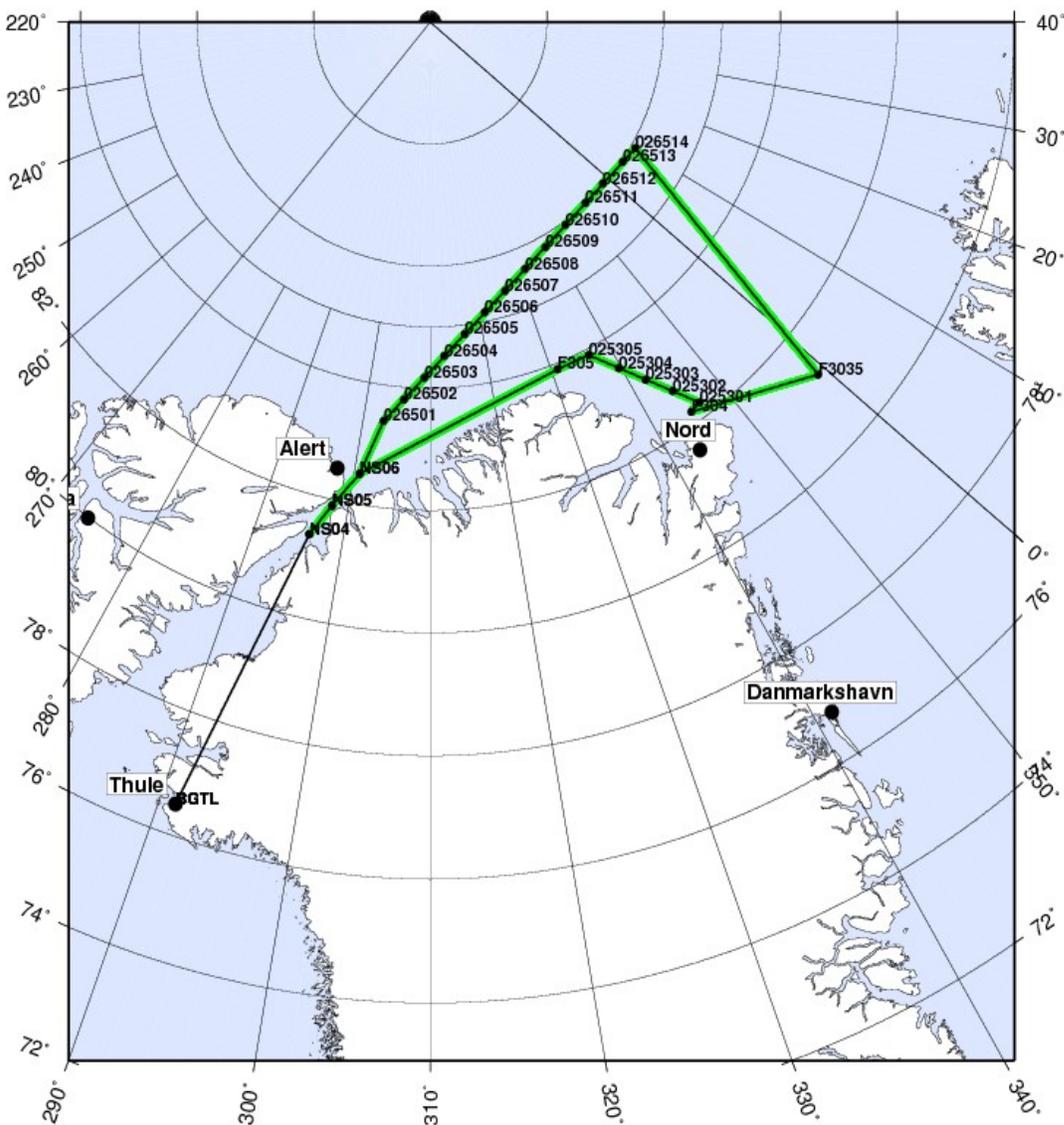
Flight Priority: Medium

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

ICESat Track: 0265, 0253

Remaining Issues: none known

Sea Ice - Fram Gateway 7.6 hours at 250 knots survey / 300 knots transit



Sea Ice – CryoSat Underflight / Thule

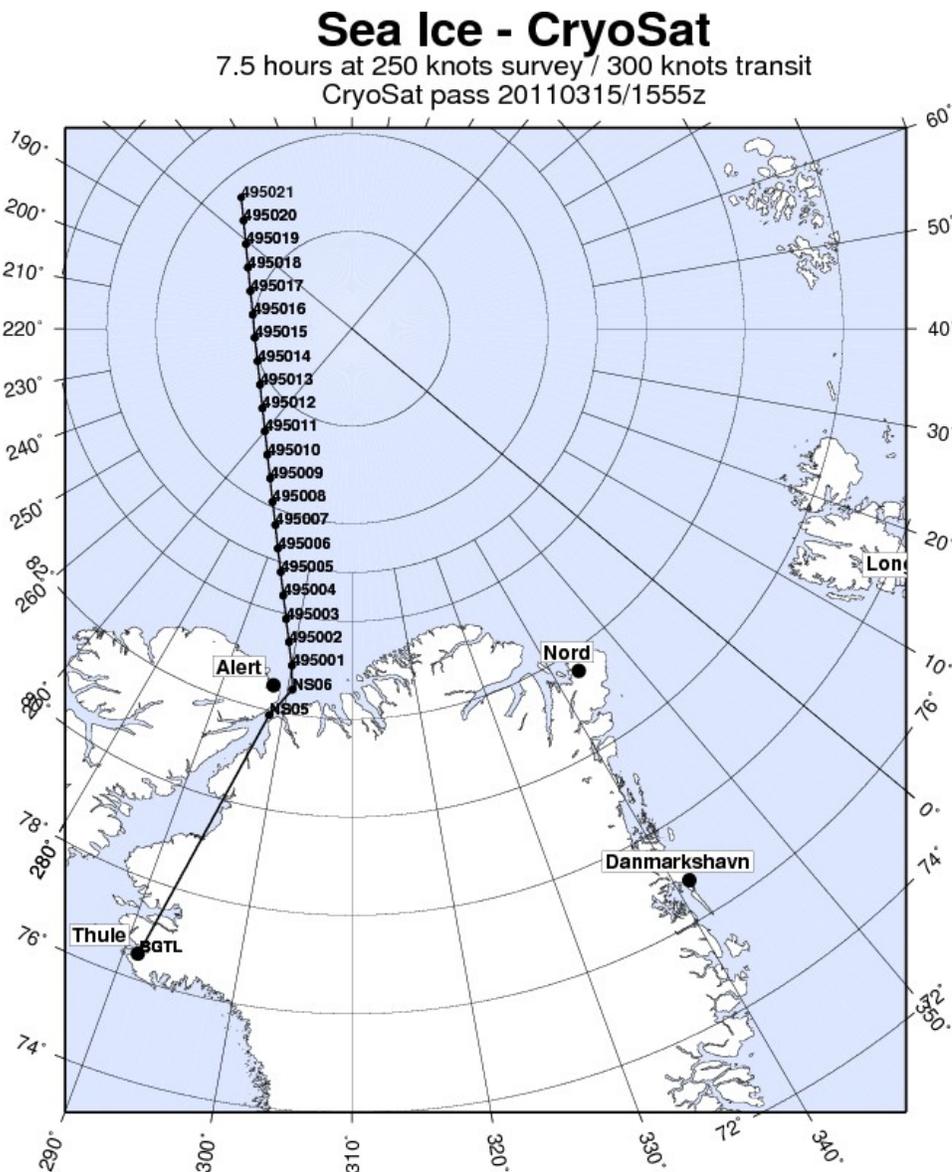
This mission is intended to underfly the Cryosat spacecraft, as nearly simultaneous with the spacecraft as possible. The field team will plot Cryosat orbits for each day we might fly the mission, and select the best combination of weather and geometry subject to all constraints and flight priorities. The Cryosat track will be flown out and back to enable estimation of ice drift. 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. The track depicted below as a placeholder is the 2010 CryoSat underflight mission.

Flight Priority: Medium

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

ICESat Track: none

Remaining Issues: must redesign mission for each potential flight day to underfly orbit; must refine waypoints with FOS predicted orbit when that becomes available



Sea Ice – Connor Corridor / Thule

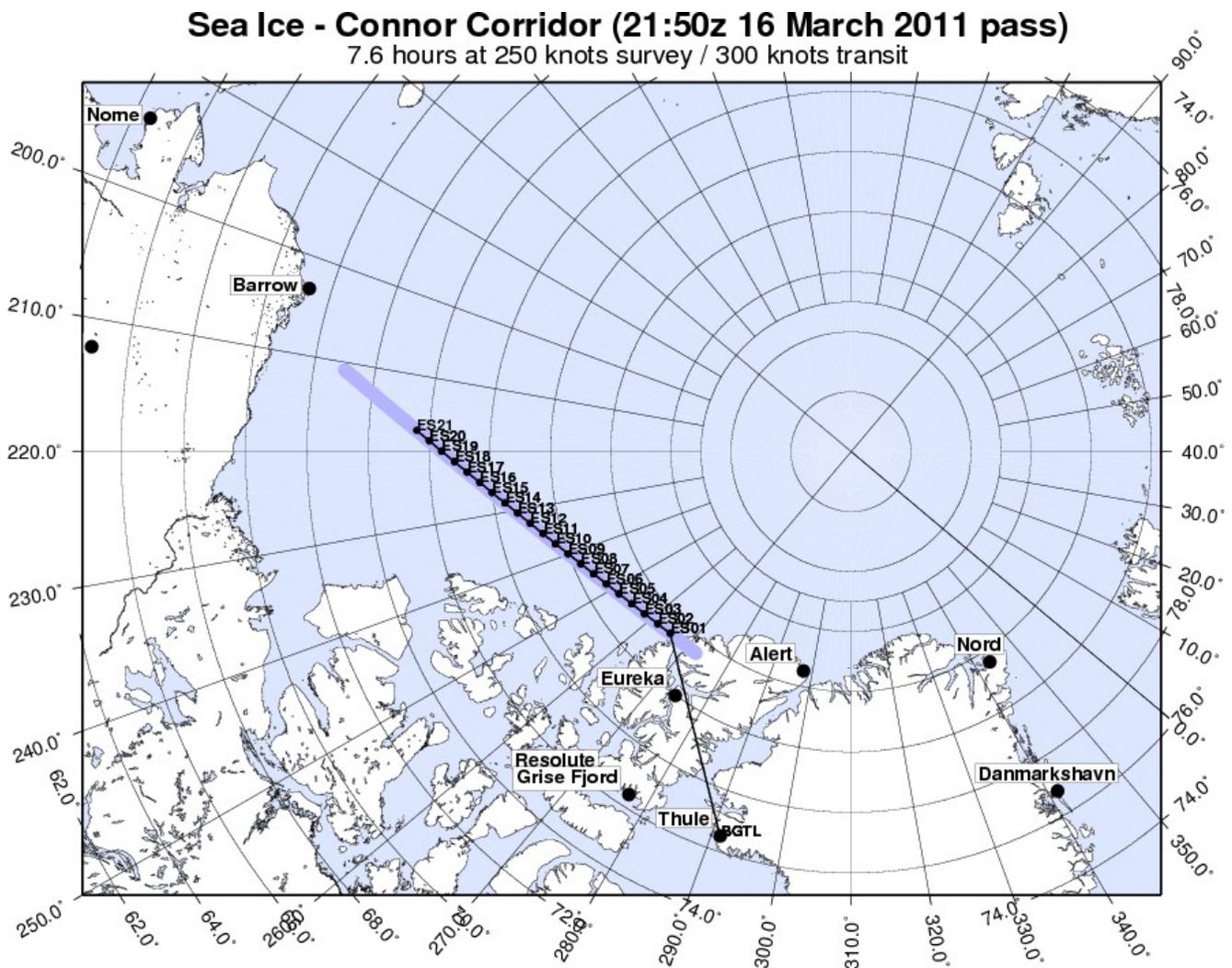
This mission is intended to sample sea ice along the Envisat ground track. As depicted here the mission is drafted for the Envisat pass occurring March 16th at 2150z, but if do not fly this mission on the 16th we will redraft it for subsequent opportunities. Additional days with favorable orbit geometry are the 17th, 19th, 21st, 22nd, 24th, 27th, 28th, and 30th of March. 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: must redesign mission for each potential flight day (orbit)



Sea Ice – Northwest Passage / Thule

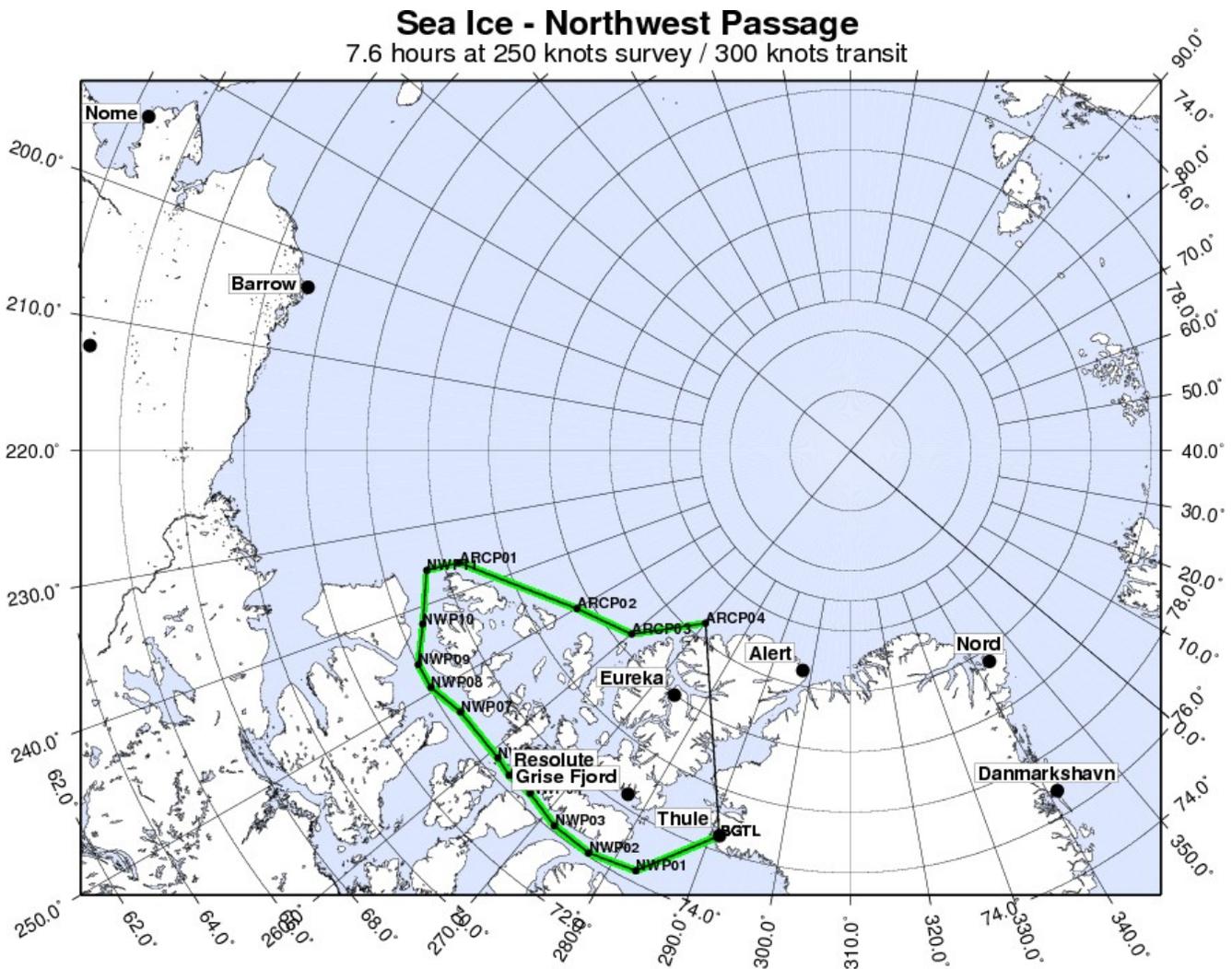
This mission is similar to the Sea Ice 08 flight from 2010, except that we now return to Thule by a path north of the Canadian Archipelago at low altitude. We return to Thule across Ellesmere Island at high altitude. In addition to Level 1 Requirements 4.1.1.A.3a and b, the flight addresses sea ice level 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



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.

Flight Priority: High

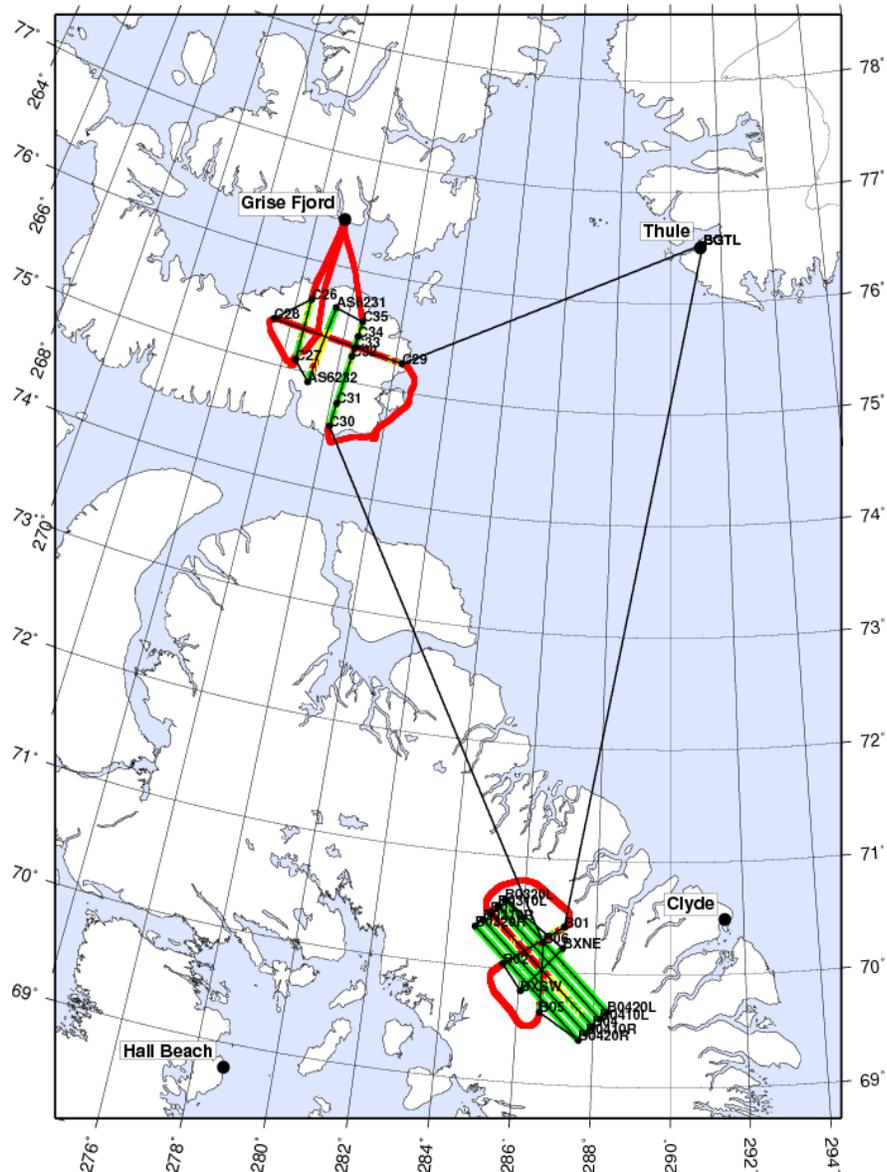
Instrument Priority: ATM/KU

ICESat Track: none

Remaining Issues: Regarding CryoVex field sites: ASIRAS623 “CryoSat” line is included, but Dave Burgess informed us they would conduct field surveys along the May 1st and possible the April 20th CryoSat passes as well. However the spacecraft orbit has apparently changed since then and Dave has not informed us of his adjusted plan. We only have marginal flight time remaining anyway.

Baffin 01

7.4 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

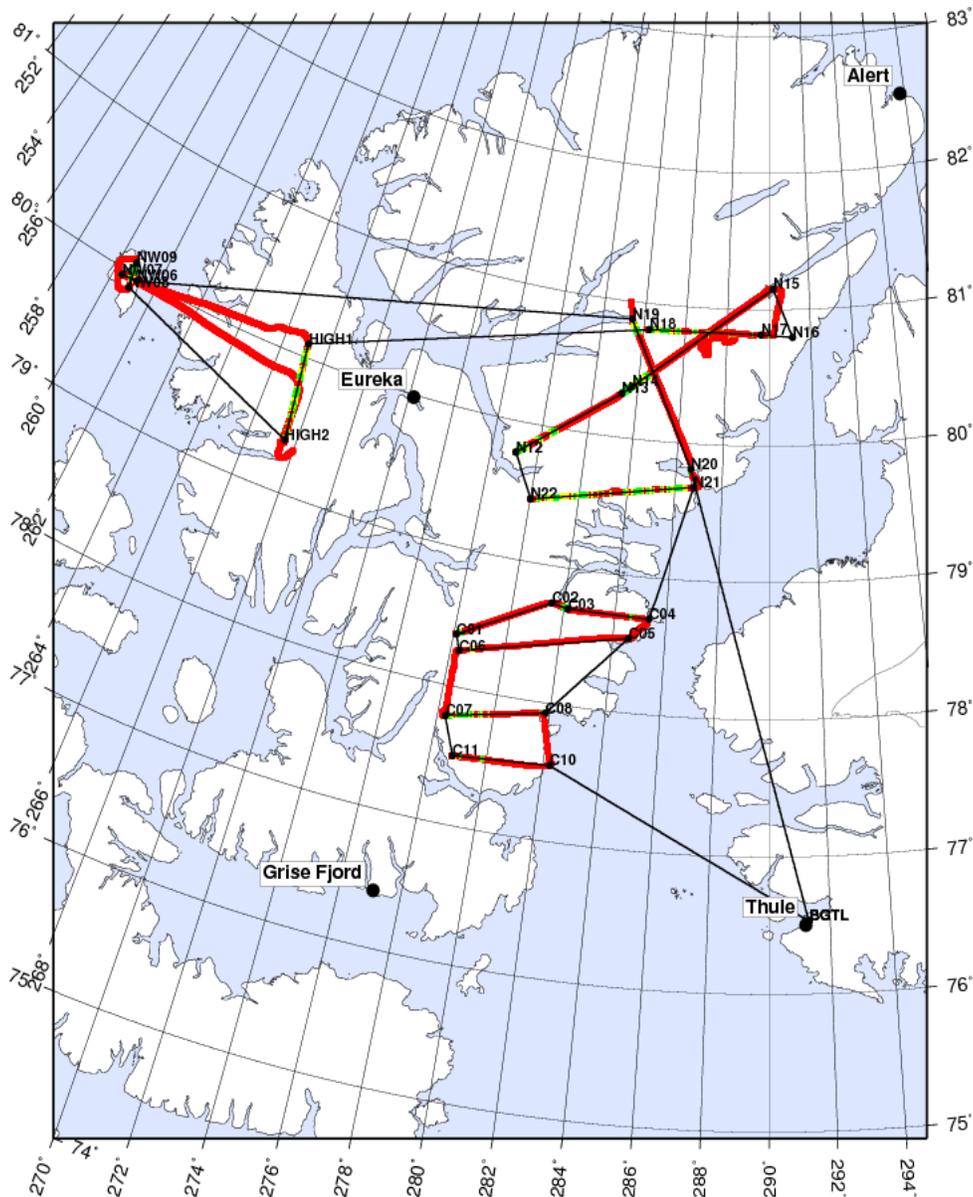
Instrument Priority: ATM

ICESat Track: none

Remaining Issues: none known

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. See the Appendix for a composite map which shows all the 2010 and 2011 NW Coastal flights in context.

Flight Priority: Low

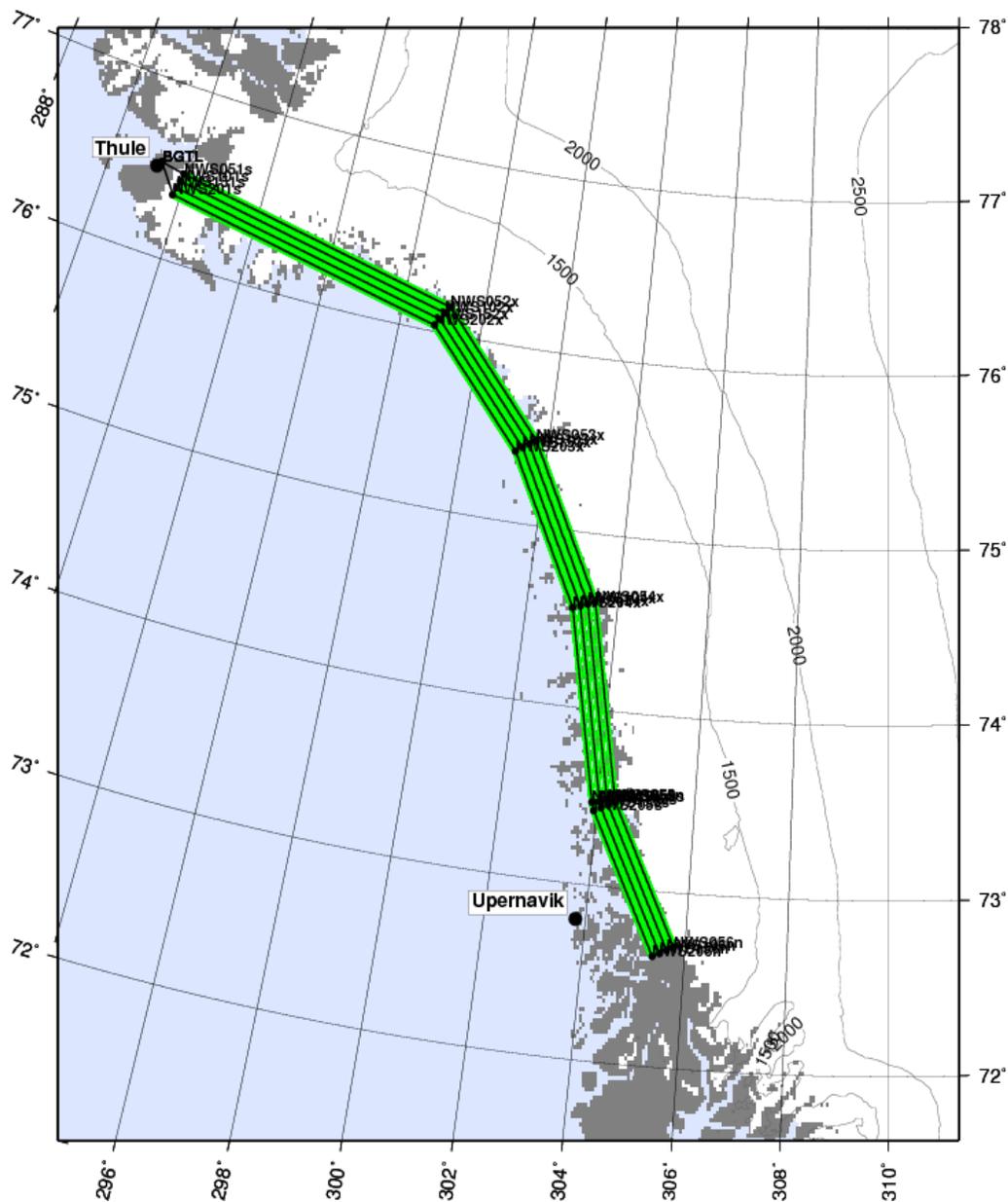
Instrument Priority: Grav

ICESat Track: none

Remaining Issues: none known

NW Fjords 01

5.9 hrs at 250 knots groundspeed



Land Ice – Northwest Coastal 05 / Thule

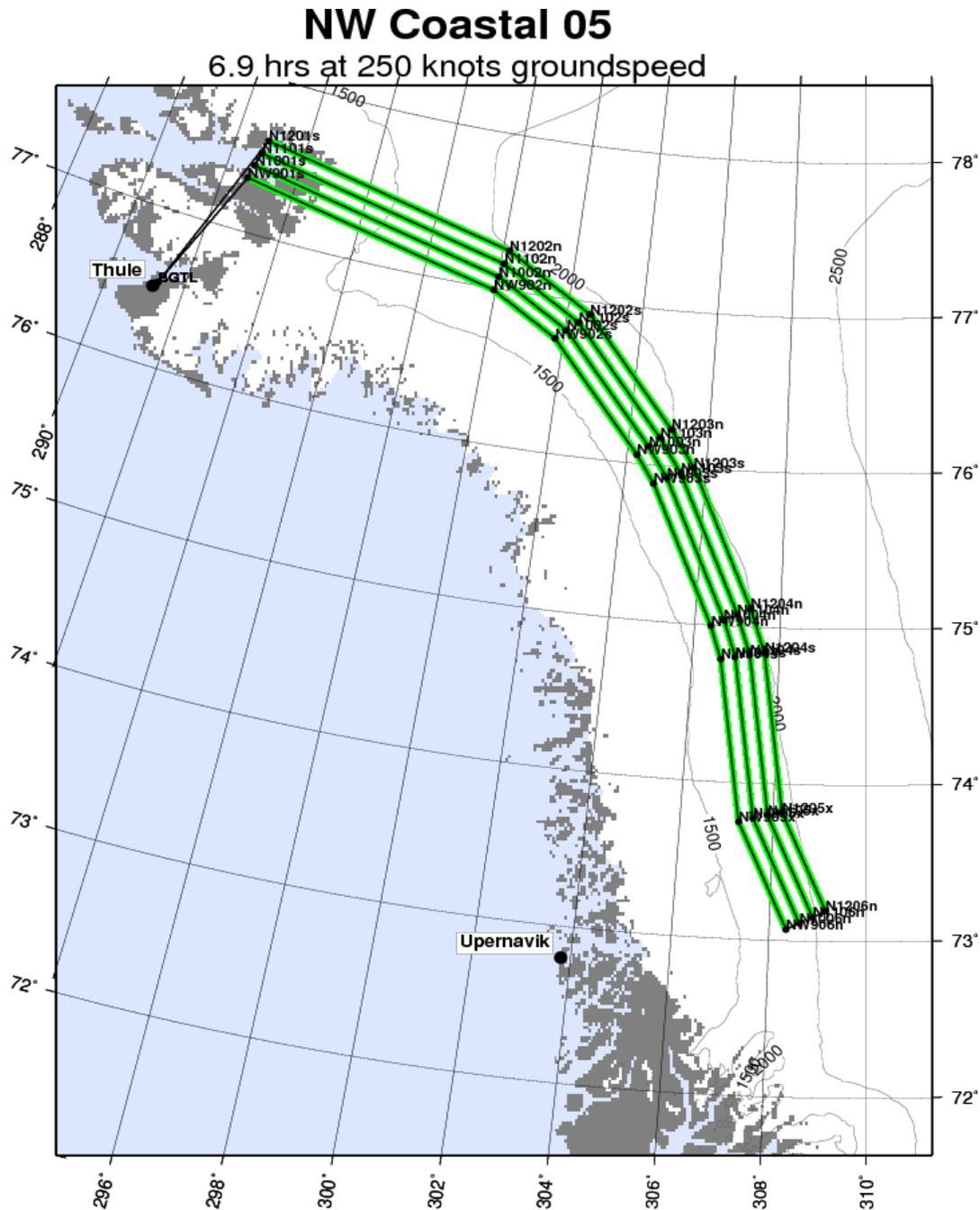
This is a new mission which extends the suite of Northwest Coastal grid lines uphill from the 2010 LVIS NW grid at 10 km spacing. See the Appendix for a composite map which shows all the 2010 and 2011 NW Coastal flights in context.

Flight Priority: Medium

Instrument Priority: ATM/MCORDS

ICESat Track: none

Remaining Issues: none known



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.

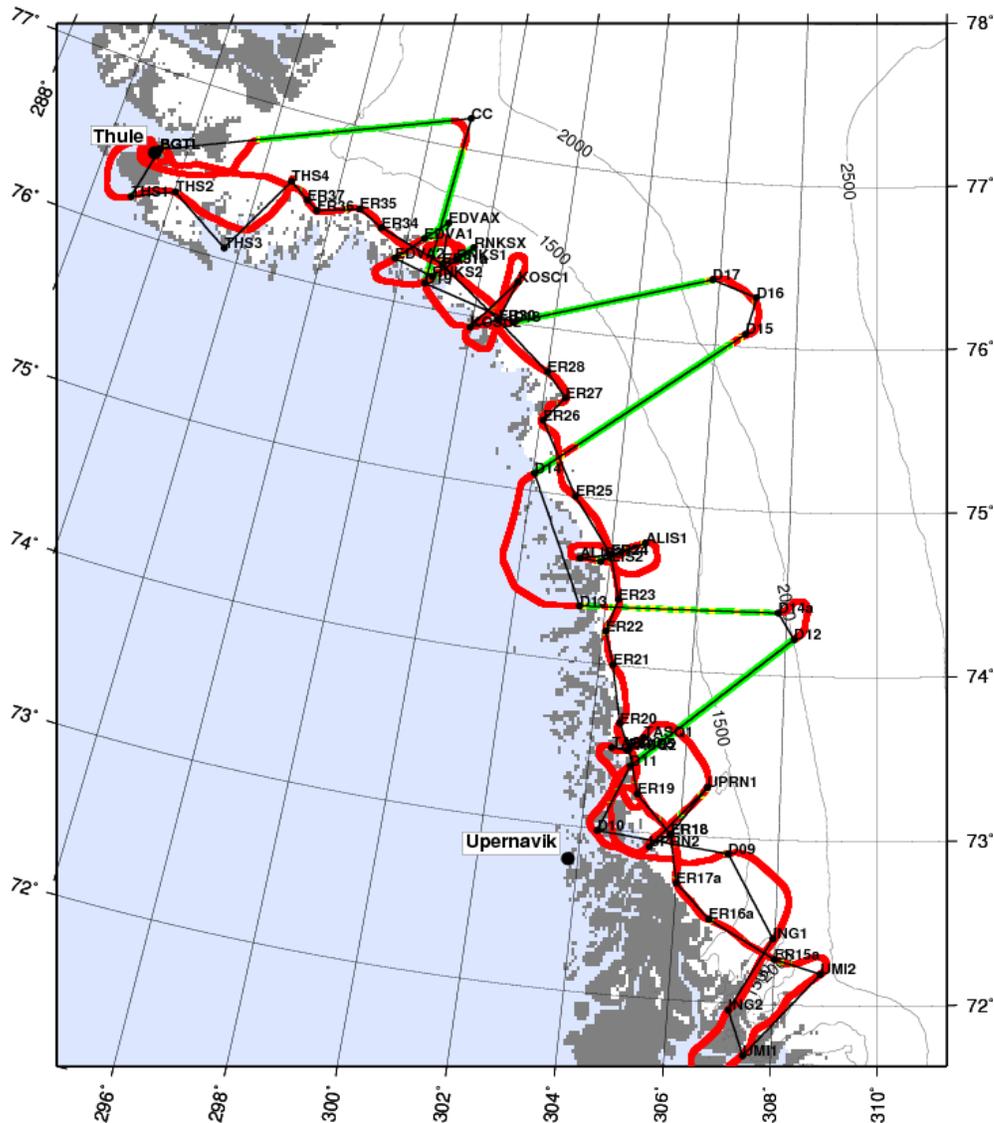
Flight Priority: High

Instrument Priority: ATM/MCORDS

ICESat Track: none

Remaining Issues: none known

NW Glaciers
7.9 hrs at 250 knots groundspeed



Land Ice – Petermann 02 / Thule

This is a new mission, designed to extend the 2010 Petermann 01 grid upstream. It also occupies one of the two central flowlines flown in 2009 and 2010, and another flowline flown in 2002 selected to optimize gravity data. Both lines also extend offshore to capture data over a possible sill and connect with shipborne bathymetry data. Finally, it resurveys the Tracy and Heilprin Glaciers north of Thule. See the Appendix for a composite map which shows both Petermann missions in context with the 2010 IceBridge flights.

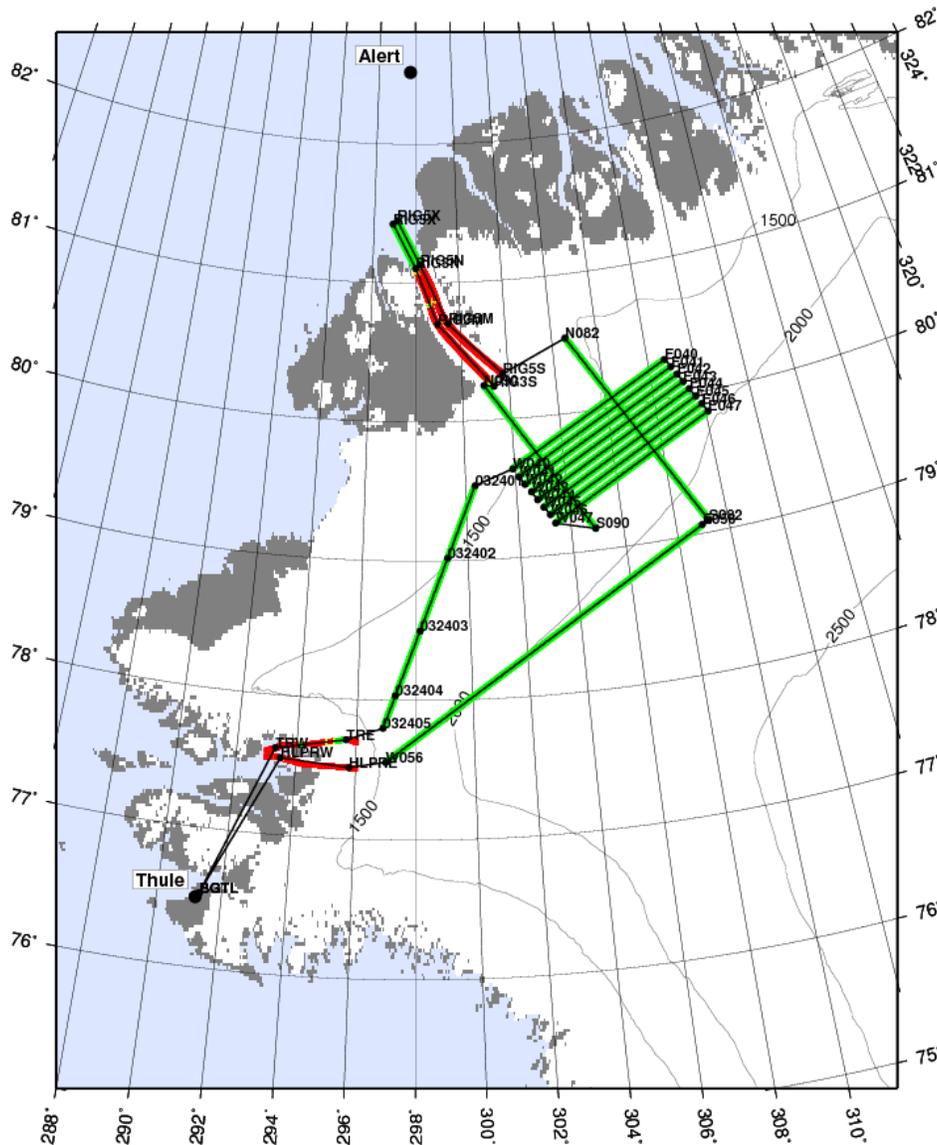
Flight Priority: High

Instrument Priority: ATM/MCORDS/Grav

ICESat Track: 0324

Remaining Issues: none known

Petermann 02 7.4 hrs at 250 knots groundspeed



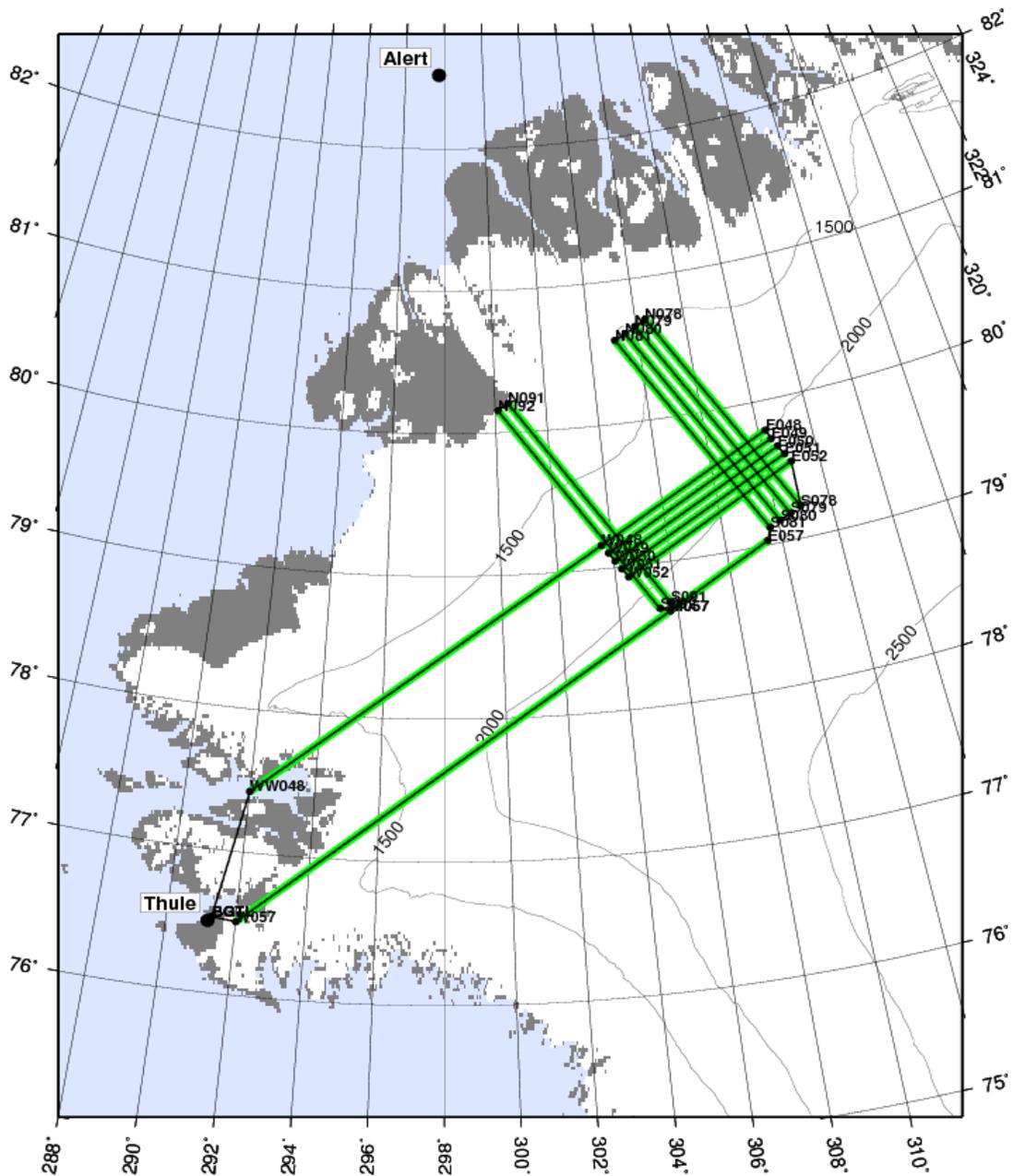
Land Ice – Petermann 03 / Thule

This is a new mission, designed to extend the 2010 Petermann 01 grid upstream in conjunction with Petermann 02. See the Appendix for a composite map which shows both Petermann missions in context with the 2010 IceBridge flights.

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

Instrument Priority: MCORDS/ATM

Petermann 03 7.3 hrs at 250 knots groundspeed



Land Ice – North Glaciers / Thule

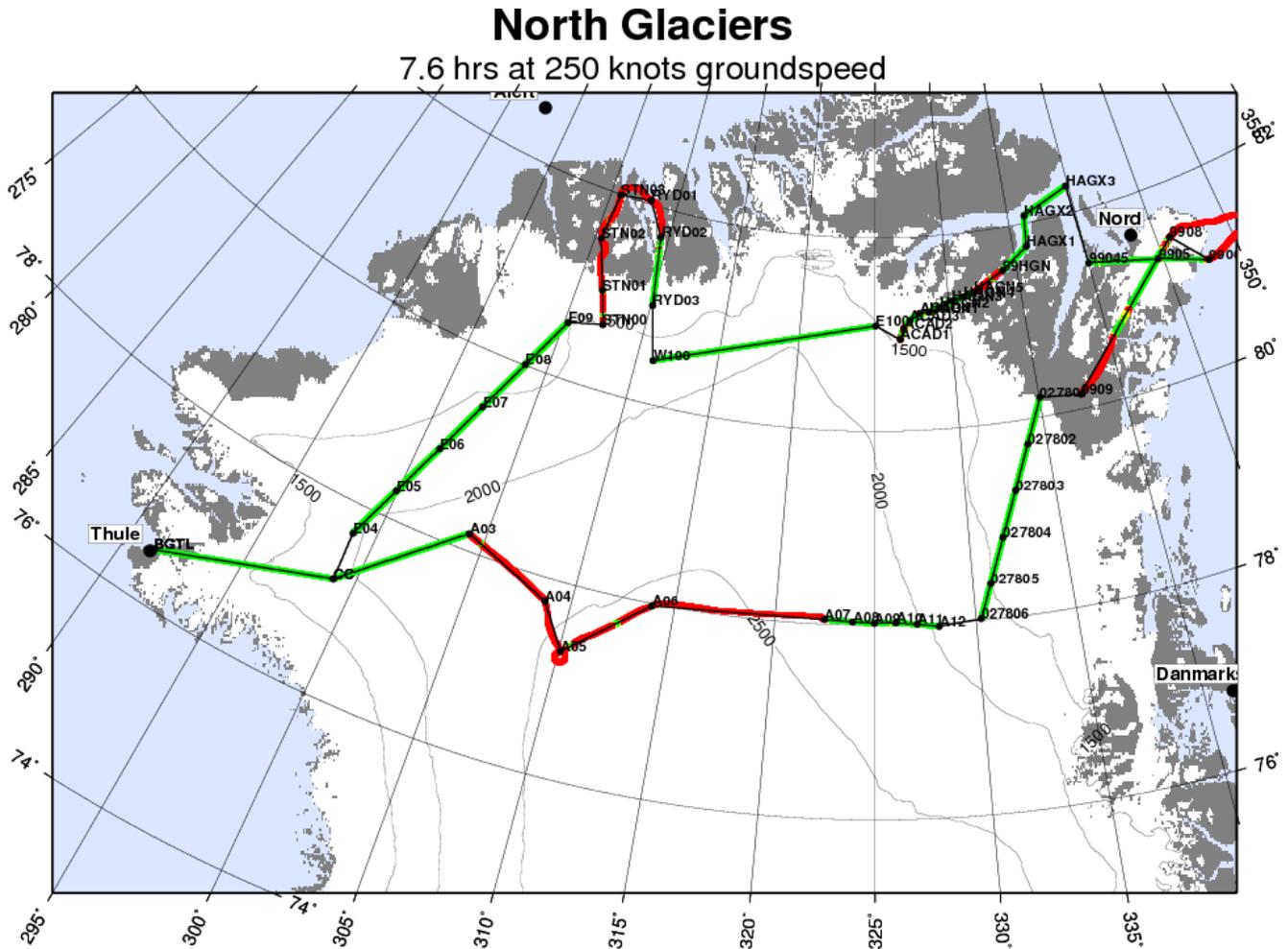
This is a new mission, designed to resurvey historical ATM longitudinal surveys of several glaciers in northern Greenland, including Steensby, Ryder, and Hagen Glaciers. A previous draft of the mission also occupied Academy Glacier – this has been eliminated to keep the flight time within acceptable limits. 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: Medium

Instrument Priority: ATM/MCORDS

ICESat Track: 0278

Remaining Issues: none known



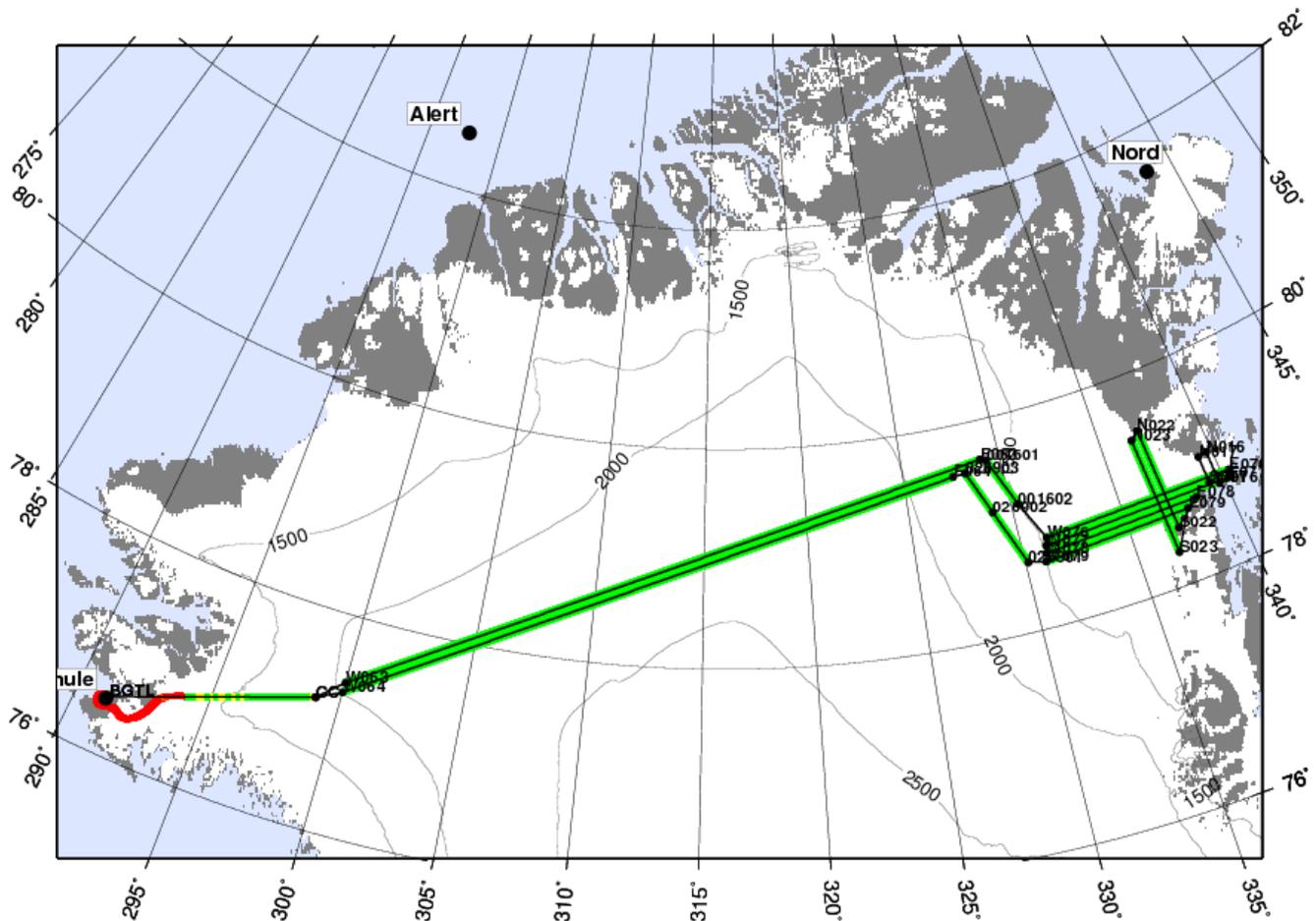
Land Ice – NEIS 04 / Thule

This is a reflight of a 2010 IceBridge mission which was aborted due to aircraft problems. It fills a gap in the other three NEIS grid missions flown in 2010, yielding a complete 10-km grid of the lower Northeast Greenland Ice Stream. Planned missions NEIS 05 and NEIS 06 extend the coverage of this 10 km grid upstream. 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: 0016,0269
Remaining Issues: none known

Instrument Priority: MCORDS/ATM

NEIS 04 7.6 hrs at 250 knots groundspeed



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. 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

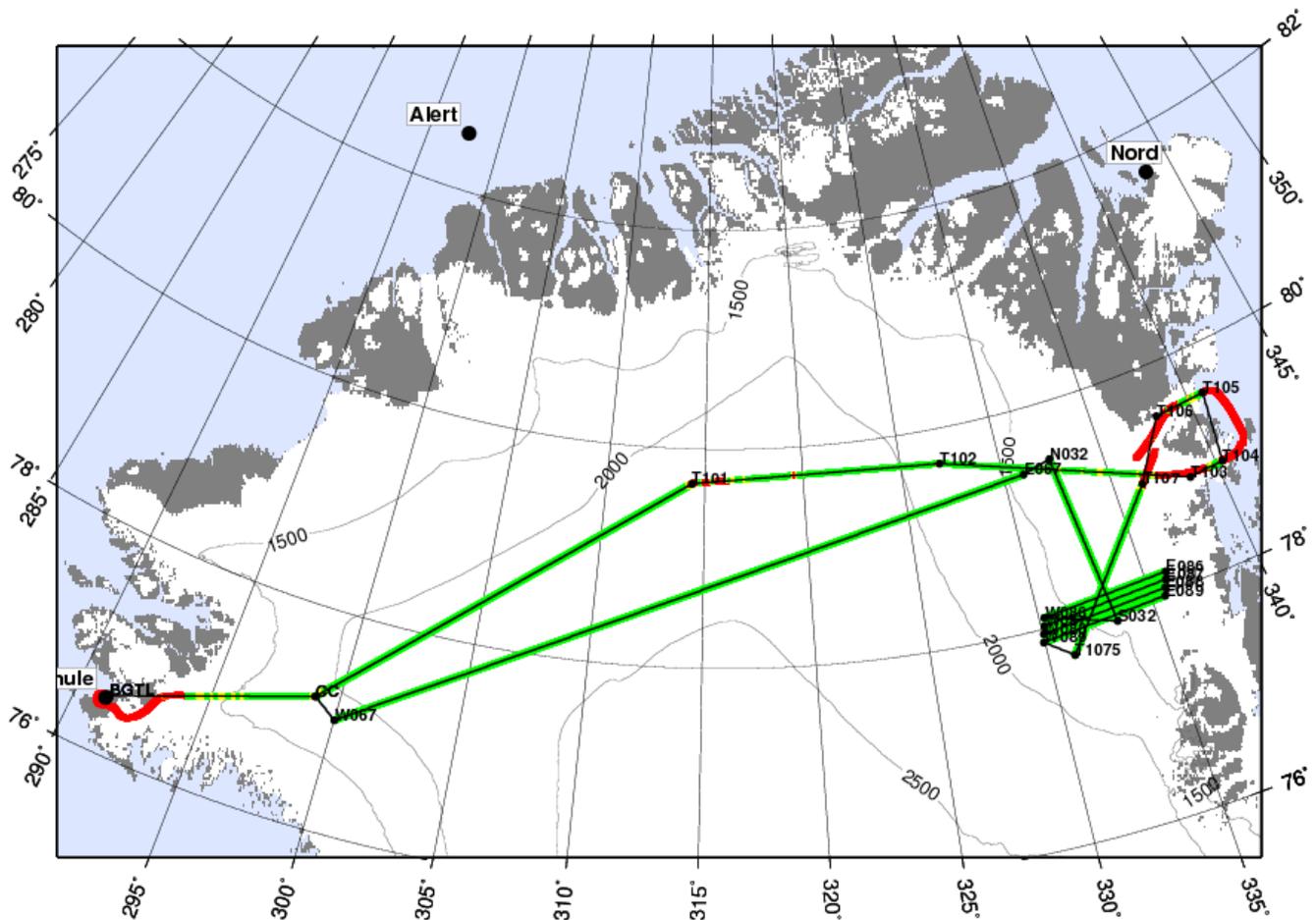
Instrument Priority: MCORDS/ATM

ICESat Track: none

Remaining Issues: none known

NEIS 05

7.9 hrs at 250 knots groundspeed



Land Ice – NEIS 06 / Thule

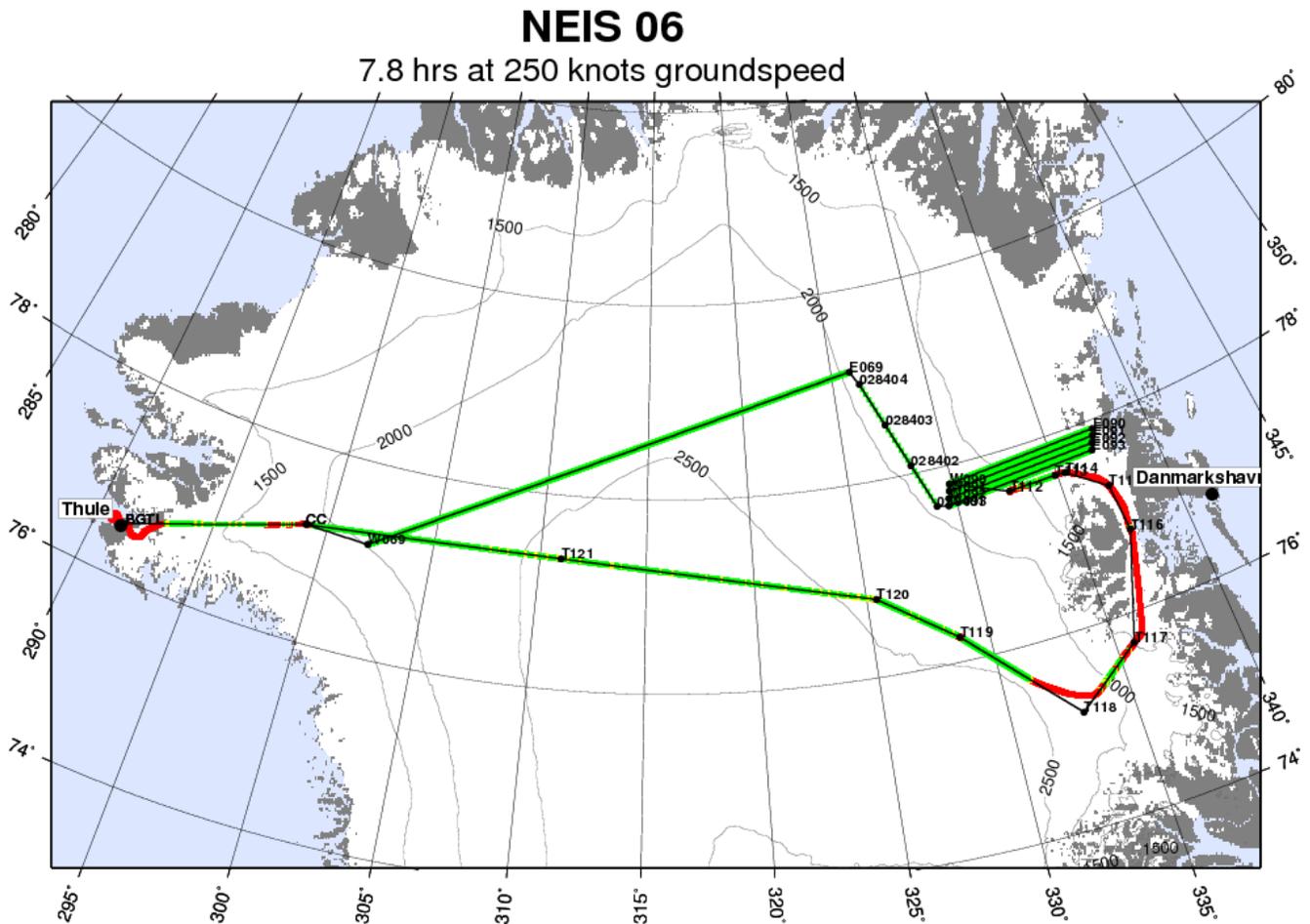
This is a new mission which extends the coverage of the Northeast Ice Stream 10 km grid upstream. It also resurveys the ATM centerlines of Bistrup and Storstrommen Glaciers. One of the east-west transit lines from Thule also resurveys an old ATM line, which crosses through an area of the central ice cap which may be thickening slightly. 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: Low

Instrument Priority: MCORDS/ATM

ICESat Track: 0284

Remaining Issues: none known



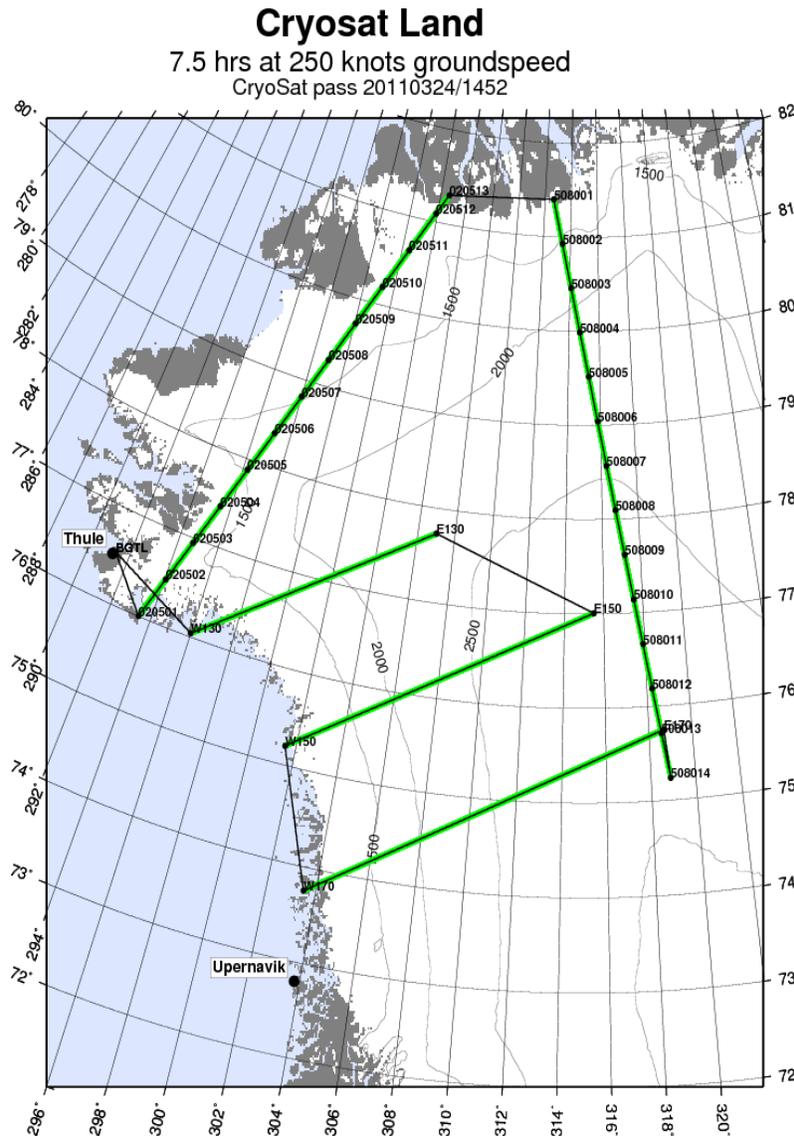
Land Ice – CryoSat Land / Thule

This is a new mission which occupies a CryoSat ground track over northern Greenland, an ICESat track, and three north Greenland master grid lines connecting the ice sheet ridgeline (and the Bob Hawley traverse route) with the northwest coast. 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. Prior to the March 24th CryoSat pass, the groundtracks are displaced to the east and are not as orthogonal to the contour lines as they are after March 24th.

Flight Priority: High
ICESat Track: 0205

Instrument Priority: ATM/KU

Remaining Issues: must select CryoSat track to be overflown within a few days of IceBridge AND remain approximately orthogonal to contour lines; replace CryoSat waypoints with new ones derived from FOS predicted orbit when that becomes available



Land Ice – Layers / Thule-Kangerlussuaq

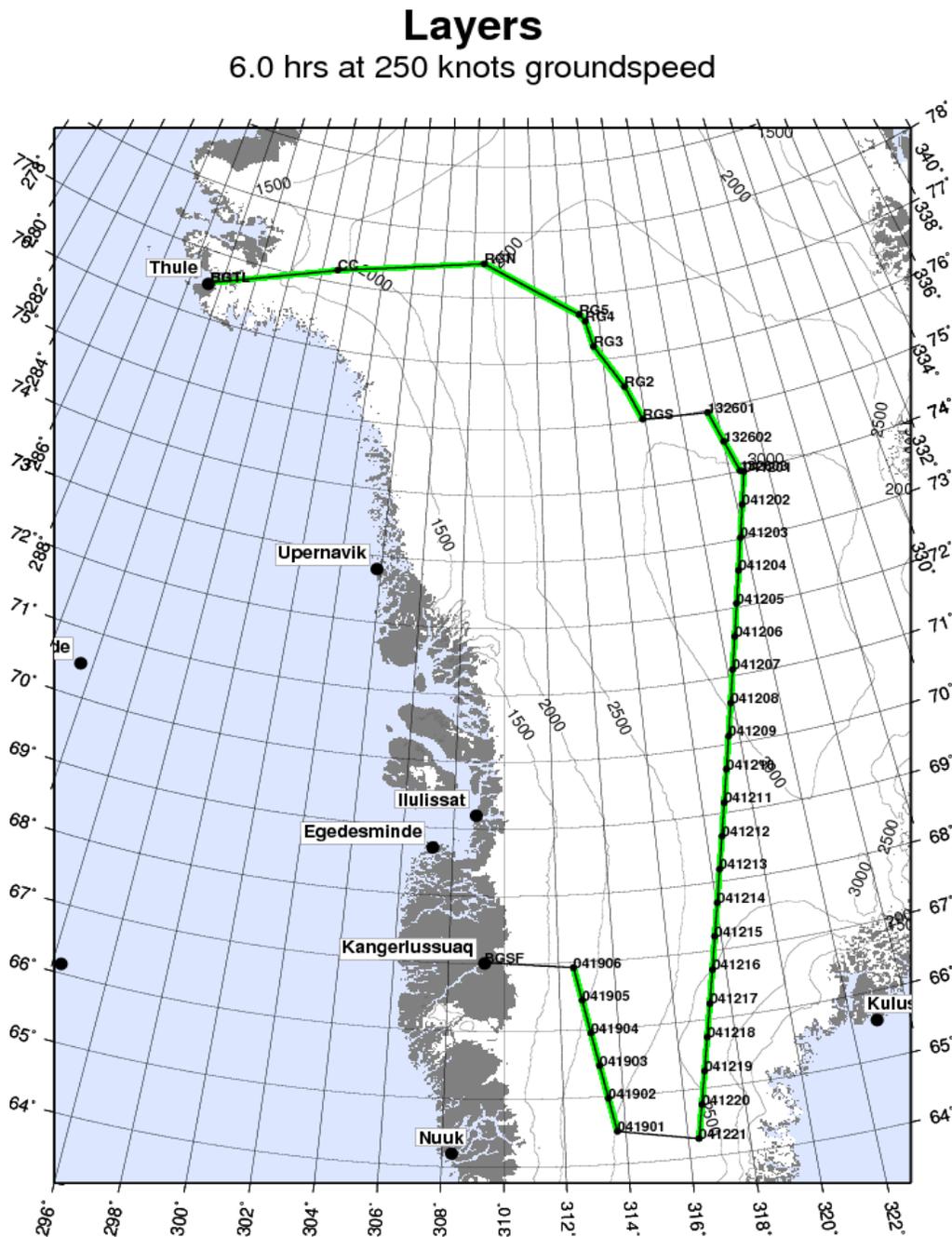
This is a new mission which serves to reposition the P-3 between Thule and Kangerlussuaq. It also connects Thule, Camp Century, NEEM, NGRIP, Summit, and south-central Greenland for the purpose of tracking accumulation layers through core sites and across a large swath of Greenland. In addition it surveys a lengthy portion of ICESat track 0412, the part of which passes over Summit Camp is also a cal-val site for ICESat.

Flight Priority: ???

Instrument Priority: MCORDS/Accum/Snow

ICESat Track: 1326,0412,0419

Remaining Issues: none known



Land Ice – Jakobshavn 02 / Thule-Kangerlussuaq

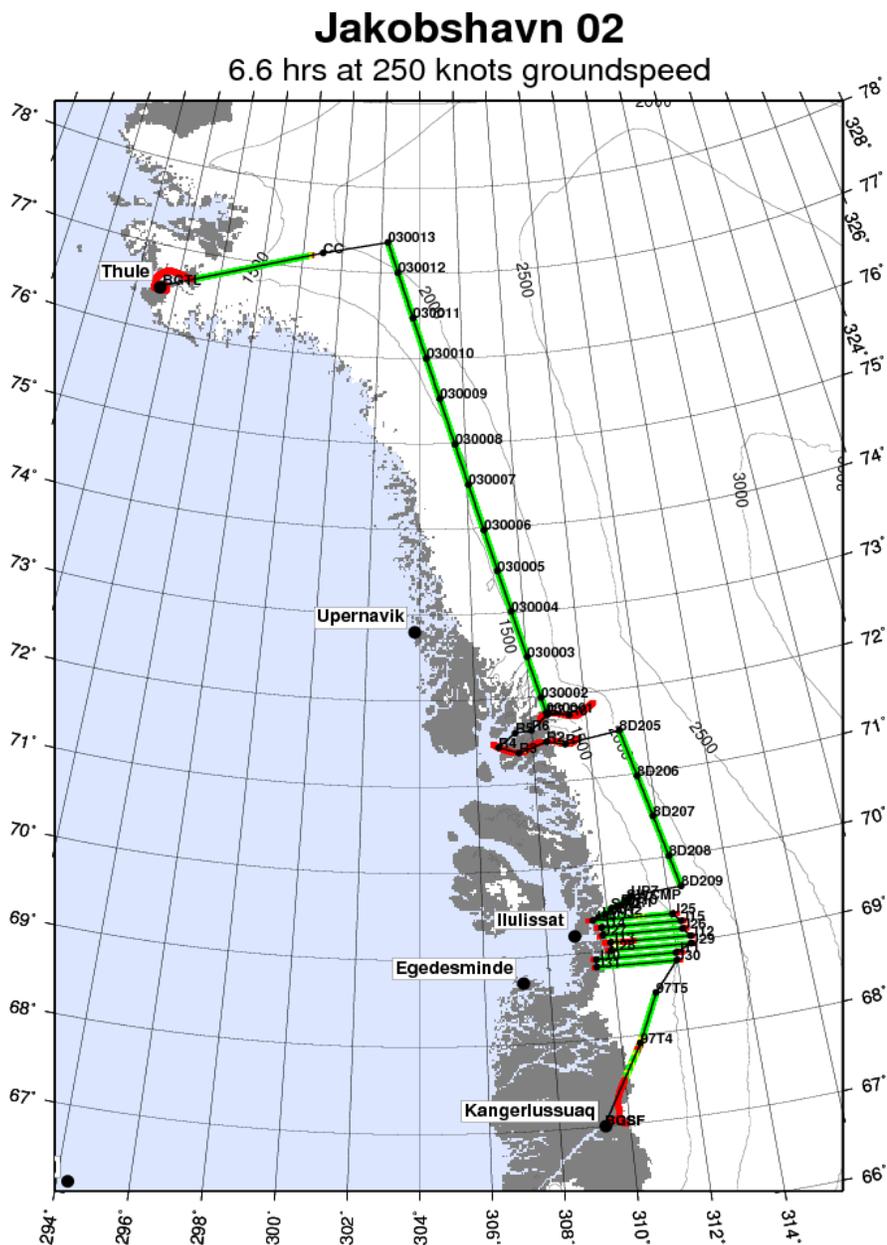
This is a new mission which serves to reposition the P-3 between Thule and Kangerlussuaq. It is similar to a 2009 and a 2010 ICEBridge flight. The primary science objectives are to (a) complete the basic Jakobshavn grid, specifically the east-west lines, (b) repeat longitudinal surveys of the Rink and Kangerdlugssup Glaciers, and (c) occupy ICESat ground track 0300. 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

Instrument Priority: ATM

ICESat Track: 0300

Remaining Issues: none known



Land Ice – Jakobshavn 01 / Kangerlussuaq

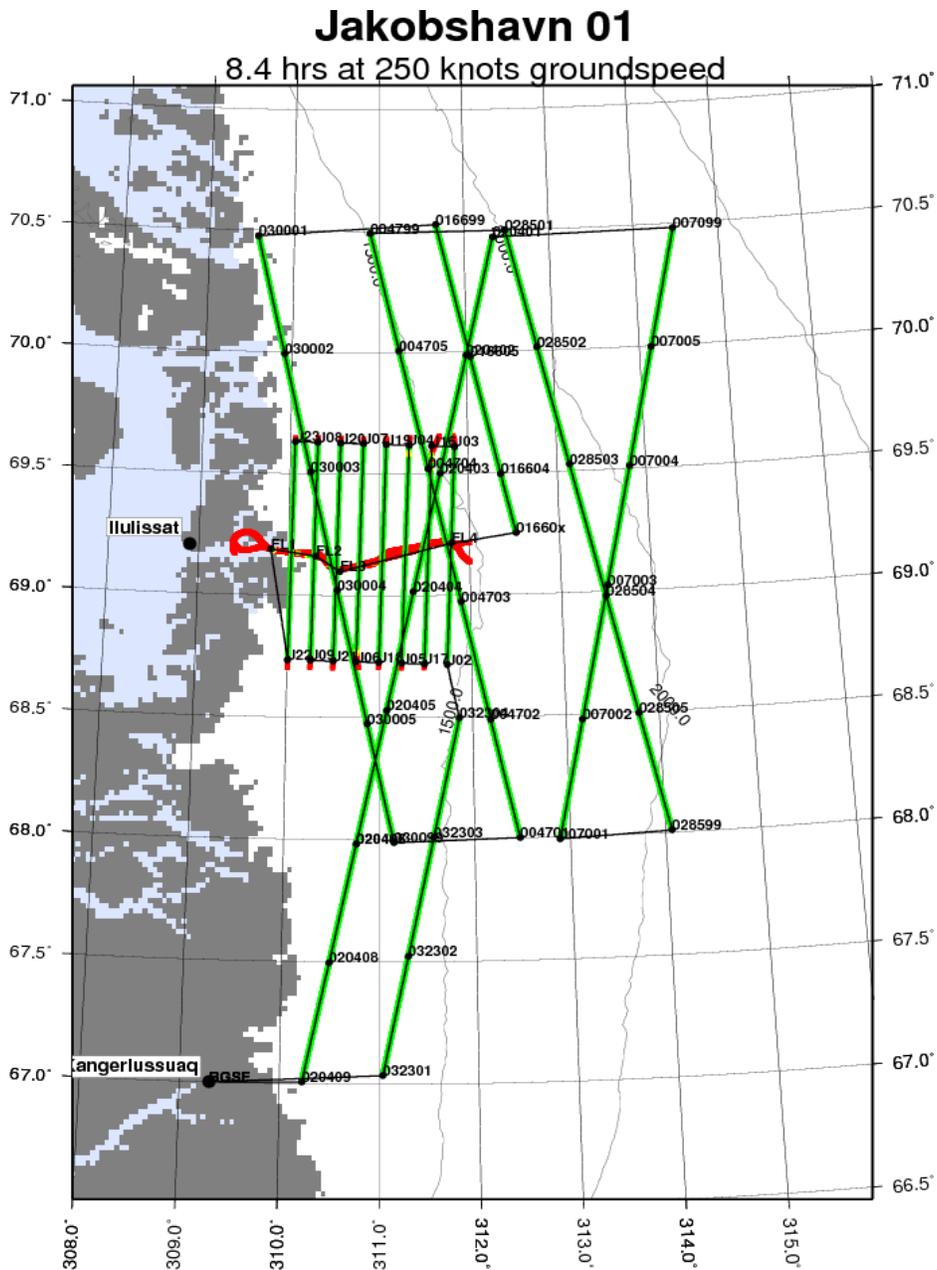
This is a repeat of 2009 and 2010 IceBridge missions. Its purpose is to re-survey the highest-priority lines of the historical ATM 10-km Jakobshavn grid, the main flowline of Jakobshavn. It also extends that grid with a broader array of ICESat ground tracks over the larger Jakobshavn basin. See the Appendix for a composite map which shows all the planned flights over the Jakobshavn basin in context with each other.

Flight Priority: High

Instrument Priority: ATM

ICESat Track: 0323,0166,0300,0047,0285,0070,0204

Remaining Issues: none known



Land Ice – Jakobshavn - Lake / Kangerlussuaq

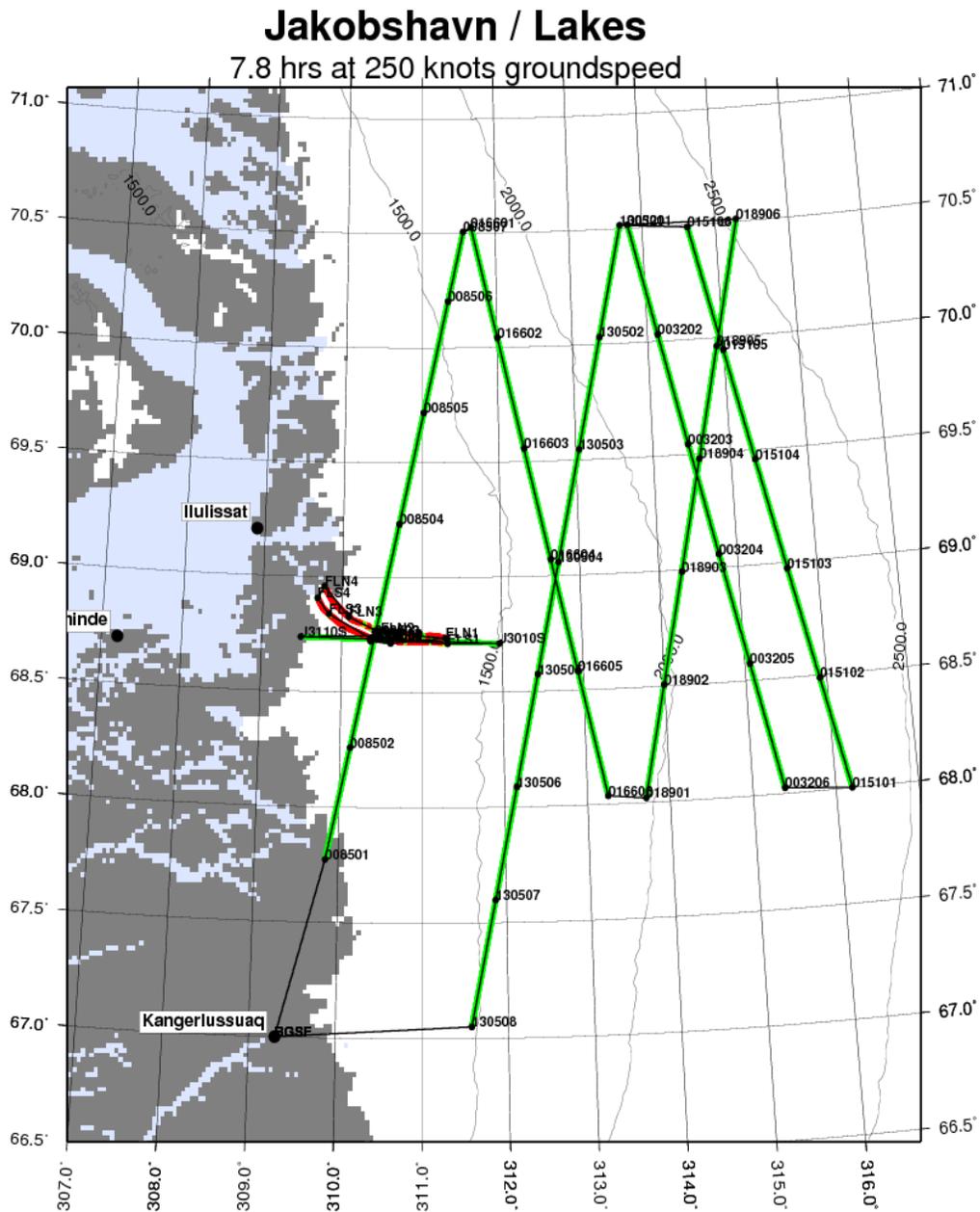
This is a new mission whose main purpose is to extend the ICESat grid begun with Jakobshavn 01 farther upstream. We also survey two flowlines of a small tidewater glacier south of Jakobshavn, map a lakebed in the same region, and extend the 10-km ATM grid south with one additional east-west in addition to the lines included in mission Jakobshavn 02 above. 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

Instrument Priority: ATM/MCORDS

ICESat Track: 0085,0166,0189,0032,0151,1305

Remaining Issues: none known



Land Ice – Umanaq 01 / Kangerlussuaq

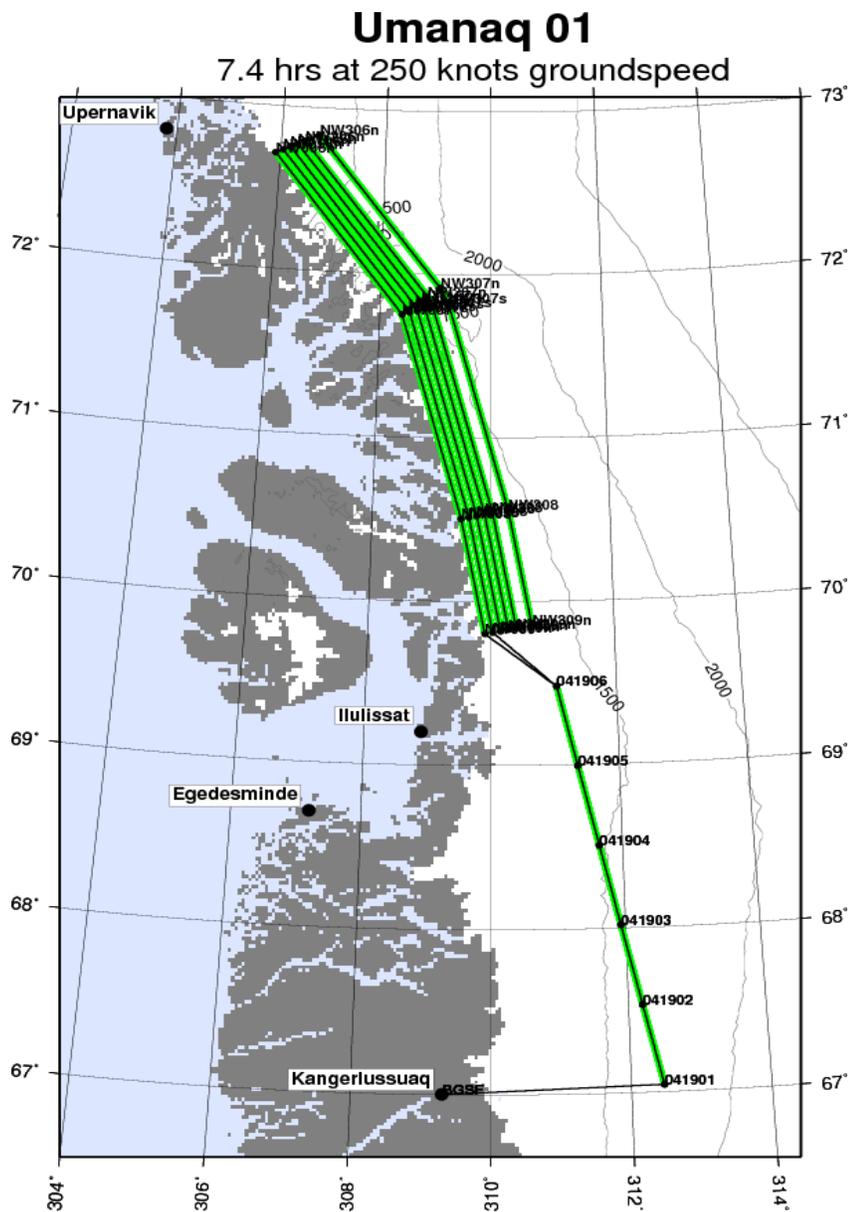
This is a new mission whose main purpose, along with Umanaq 02, is to extend the grid formed by the suite of Northwest Coastal missions from 2010 and this year to the south, and to connect to the Jakobshavn grid flights flown by CreSIS since 2008. We transit to and from the grid along the same ICESat track to facilitate instrument self-consistency checking. See the Appendix for a composite map which shows both of the planned flights over the Umanaq region in context with each other.

Flight Priority: Low

Instrument Priority: ATM

ICESat Track: 0419

Remaining Issues: none known



Land Ice – Umanaq 02 / Kangerlussuaq

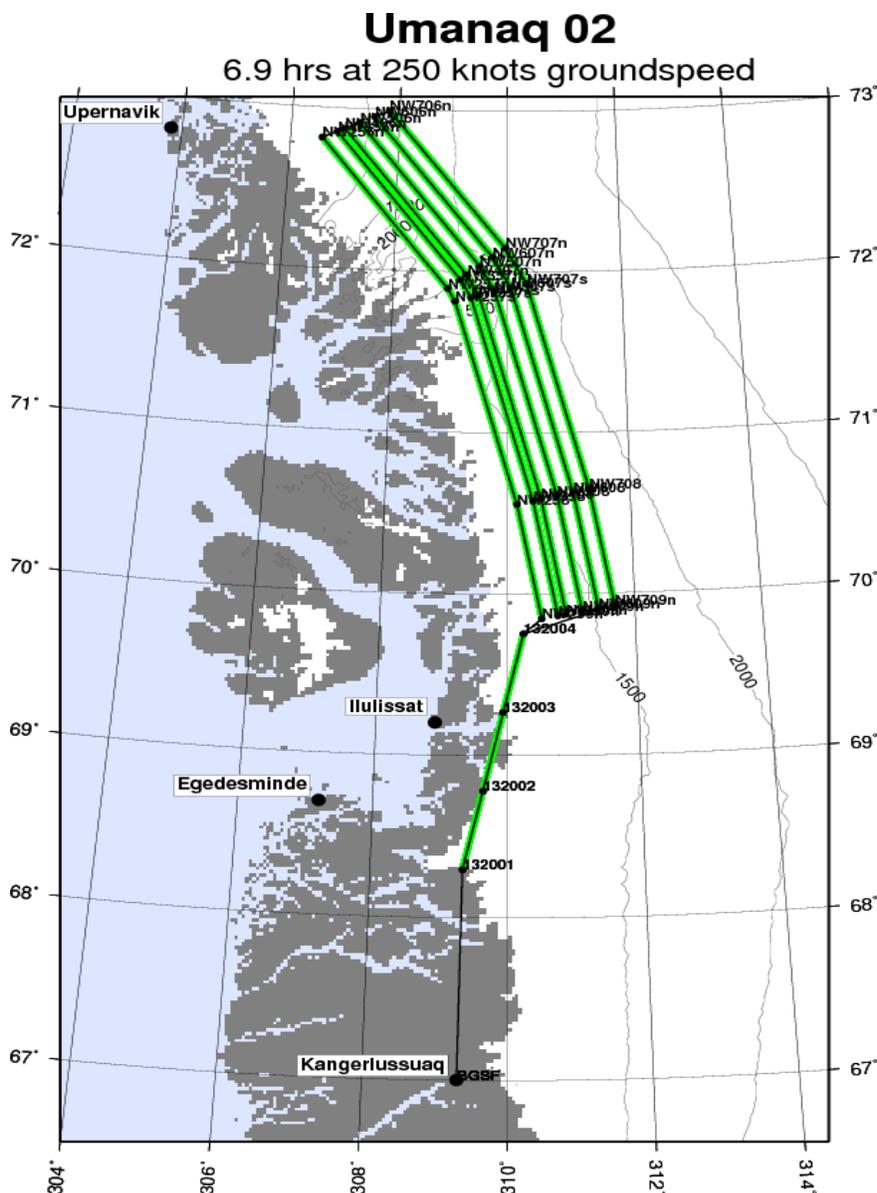
This is a new mission whose main purpose, along with Umanaq 01, is to extend the grid formed by the suite of Northwest Coastal missions from 2010 and this year to the south, and to connect to the Jakobshavn grid flights flown by CreSIS since 2008. We transit to and from the grid along the same ICESat track to facilitate instrument self-consistency checking. See the Appendix for a composite map which shows both of the planned flights over the Umanaq region in context with each other.

Flight Priority: Medium

Instrument Priority: ATM

ICESat Track: 1320

Remaining Issues: none known



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 four 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 the three planned flights over the Geikie region in context with each other.

Flight Priority: Medium

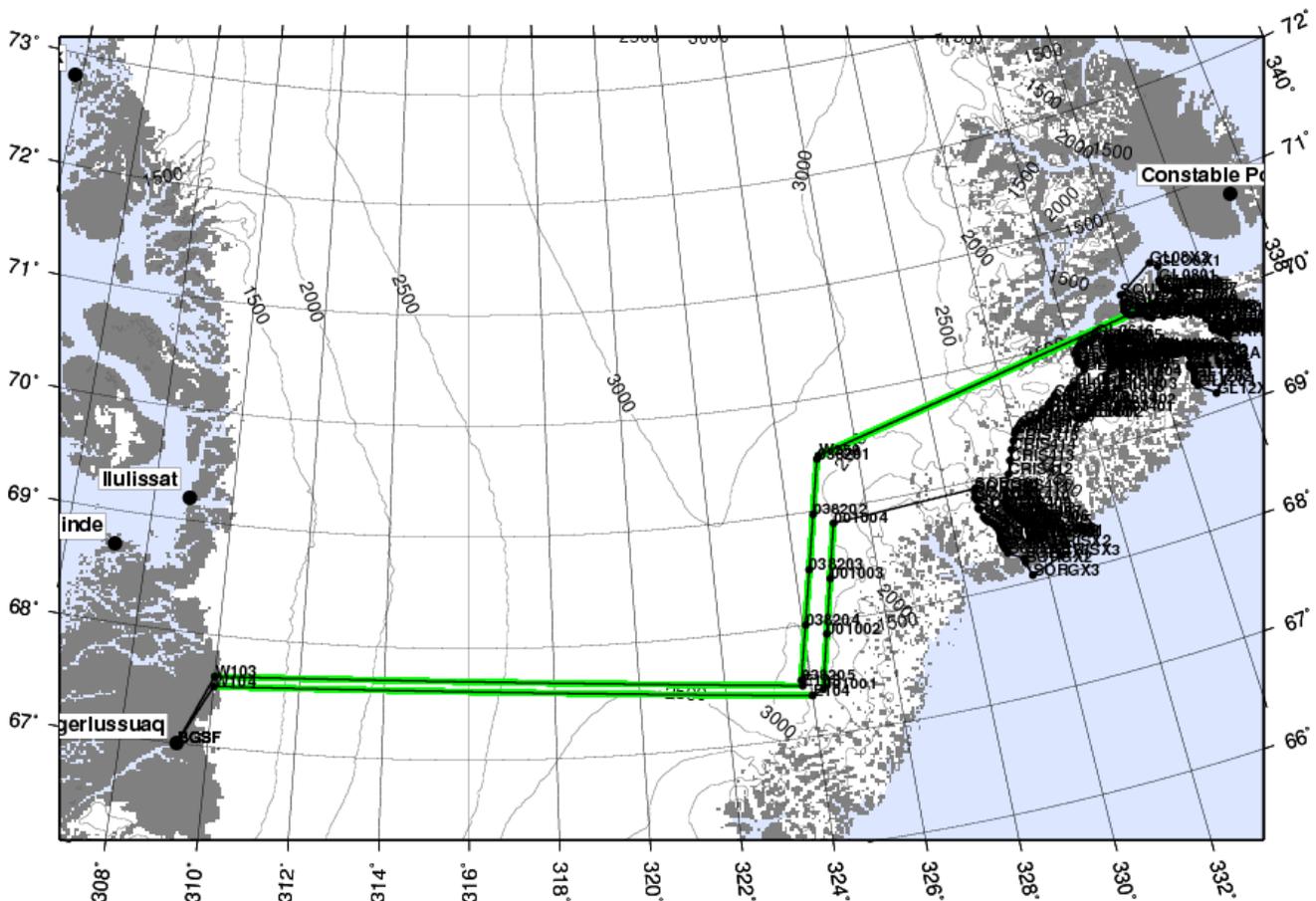
Instrument Priority: MCORDS/Grav/ATM

ICESat Track: 0010,0382

Remaining Issues: Centerline coordinates of the glacier flightlines were refined with latest Rignot et al velocity map; however georegistration of Rignot map is suspect at 5 km level when waypoints are compared with Google Earth – this needs to be resolved.

Geikie 02

7.6 hrs at 250 knots groundspeed



Land Ice – Helheim-Kangerdlugssuaq / Kangerlussuaq

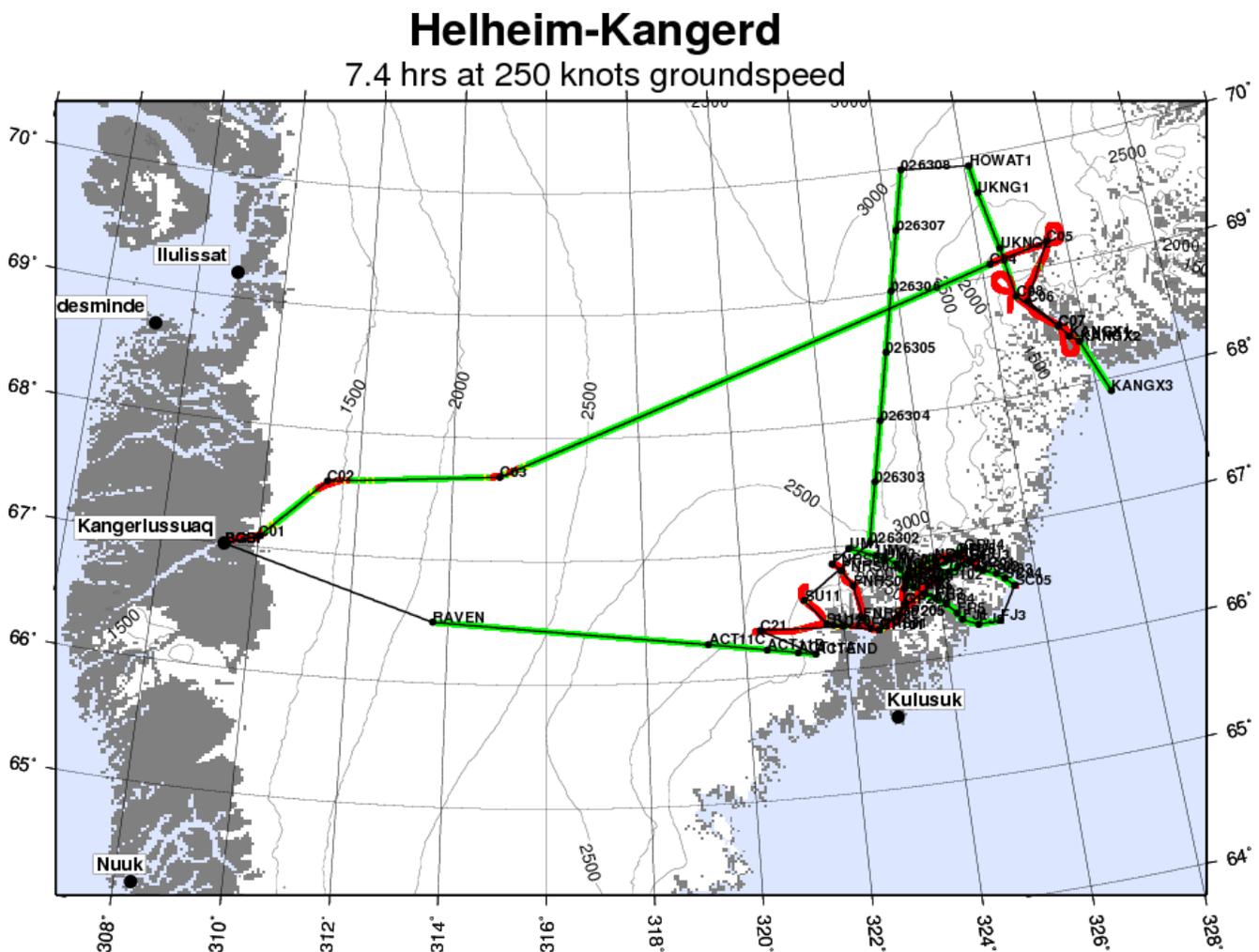
This is a new mission, based on the 2010 “Hel-Kang” mission but with considerable changes. It captures centerline surveys of the two main branches of Helheim, of Kangerdlugssuaq, Fenris and of several branches of Midgard glaciers. It also overflies the 2011 Forster traverse from Raven to the southeastern 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

Instrument Priority: ATM/KU

ICESat Track: 0263

Remaining Issues: none known

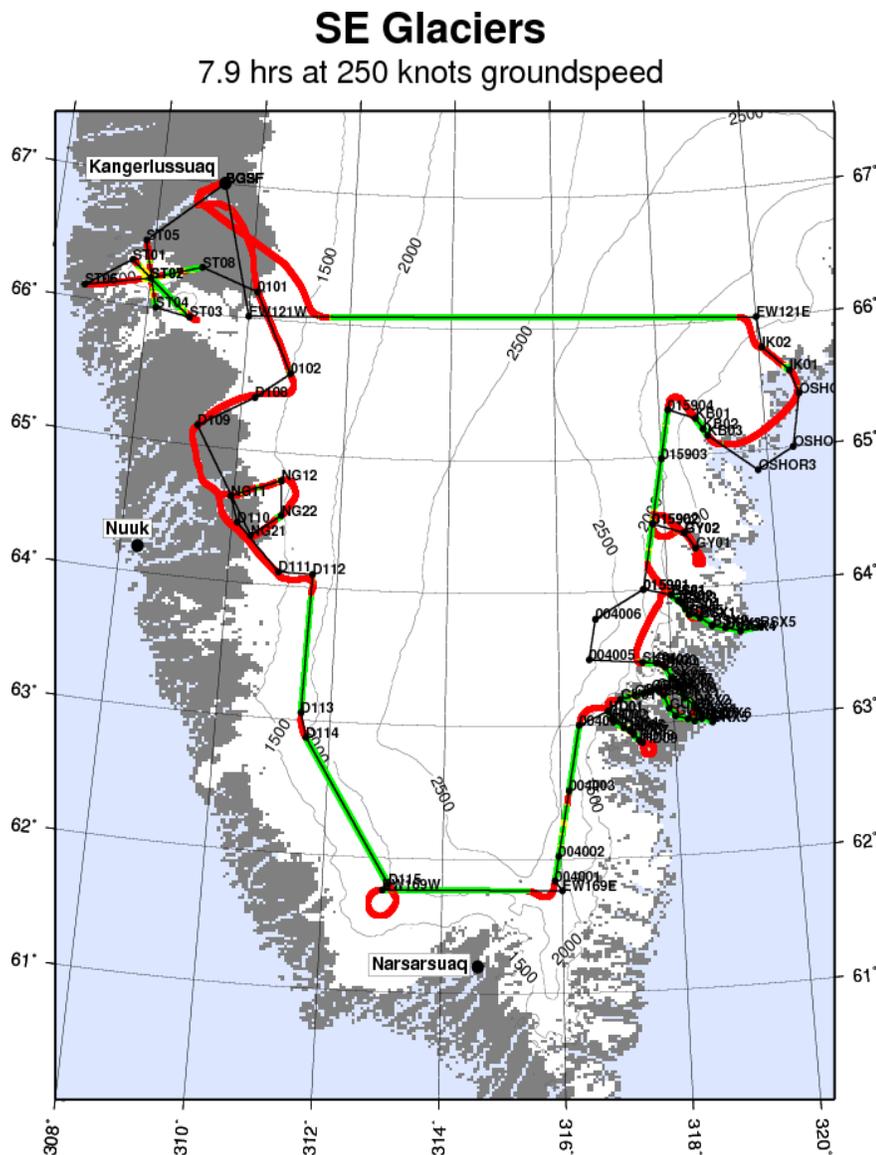


Land Ice – Southeast Glaciers / Kangerlussuaq

This mission is a repeat of the 2010 Southeast Glacier mission. Its primary purpose is to continue dh/dt monitoring of 8 glaciers in the southeast. In addition, it also re-occupies previous IceBridge lines over four glaciers in southwest Greenland, and over the Sukkertoppen Ice Cap southwest of Kangerlussuaq. We fly all of the glacier centerlines in the reverse direction that they were flown in 2010, and several are flown in both directions during the flight anyway. Finally, 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. See the Appendix for a composite map which shows all five southeast Greenland missions in context with each other.

Flight Priority: Medium
ICESat Track: 0040,0159,0278
Remaining Issues: none known

Instrument Priority: ATM



Land Ice – Southeast Flank 01 / Kangerlussuaq

This is a new mission, which extends the “SE Coastal” coast-parallel grid uphill to the central ridgeline of the icecap. The lines are spaced at 20 km. See the Appendix for a composite map which shows all five southeast Greenland missions in context with each other.

Flight Priority: High

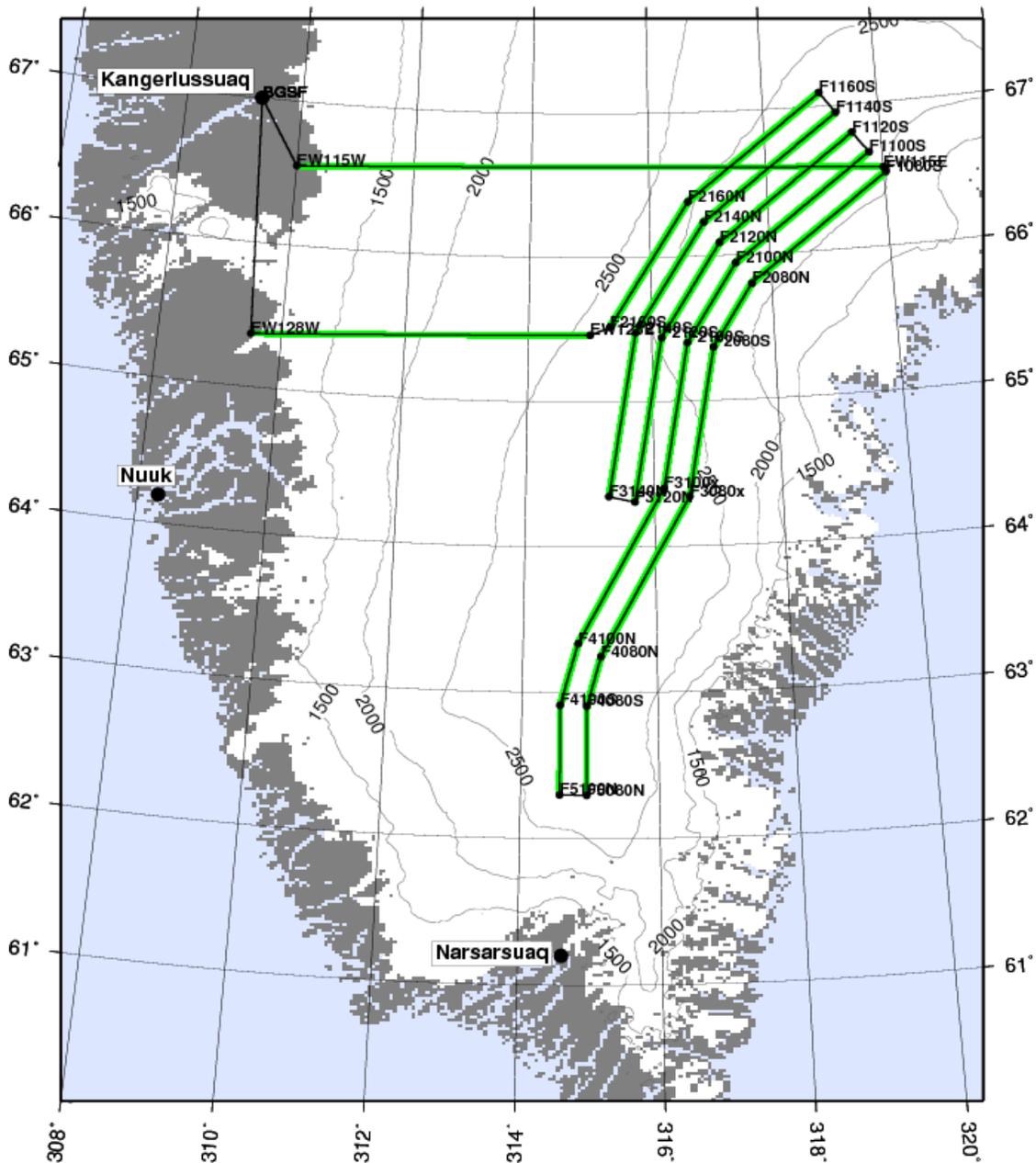
ICESat Track: none

Remaining Issues: none known

Instrument Priority: ATM/MCORDS/Snow

SE Flank 01

7.3 hrs at 250 knots groundspeed



Land Ice – Southeast Coastal 02 / Kangerlussuaq

This is a new mission, which interlaces the 2010 “SE Coastal” coast-parallel grid to a spacing of 10 km. 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: Medium

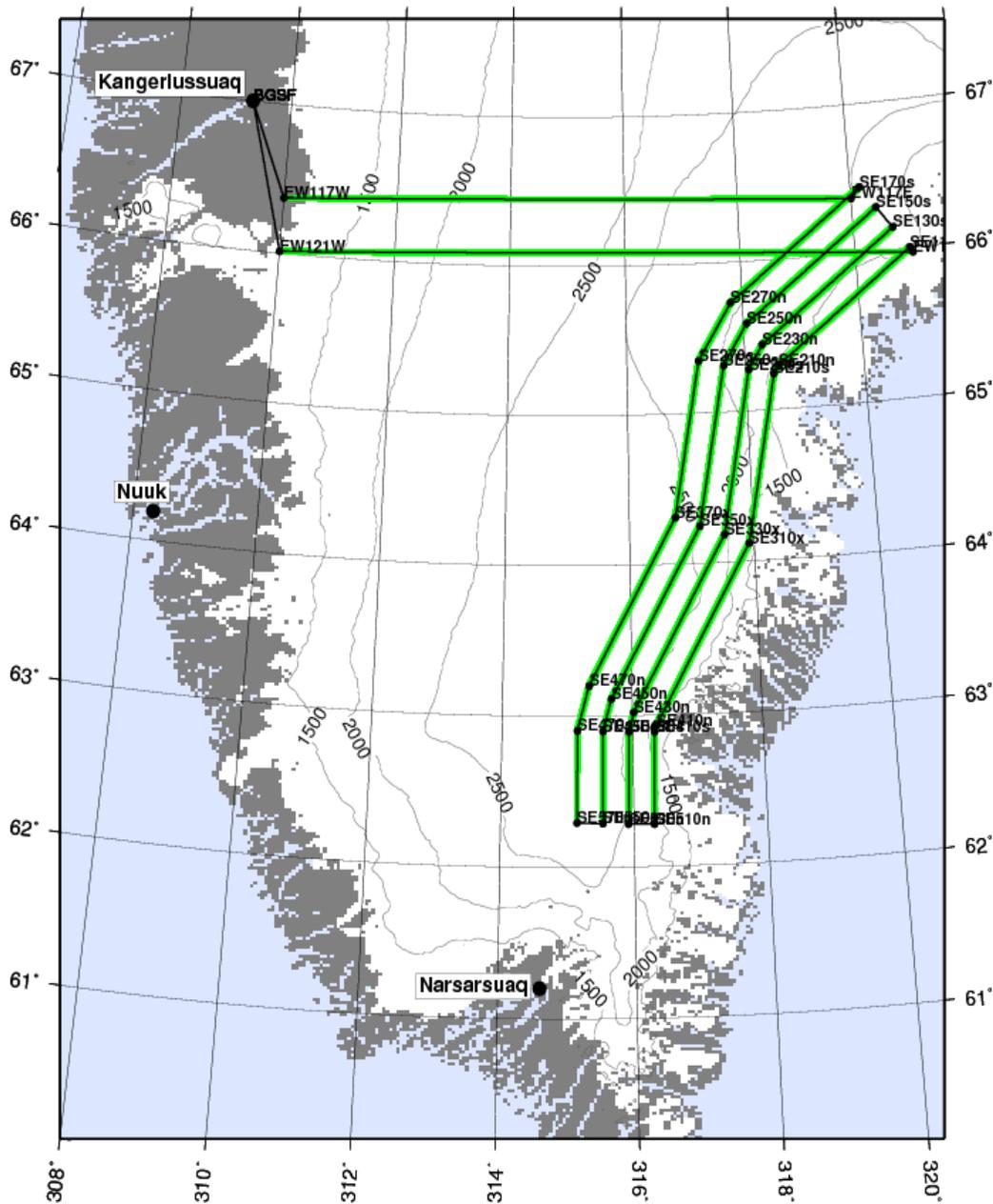
Instrument Priority: ATM/MCORDS/Snow

ICESat Track: none

Remaining Issues: none known

SE Coastal 02

7.6 hrs at 250 knots groundspeed

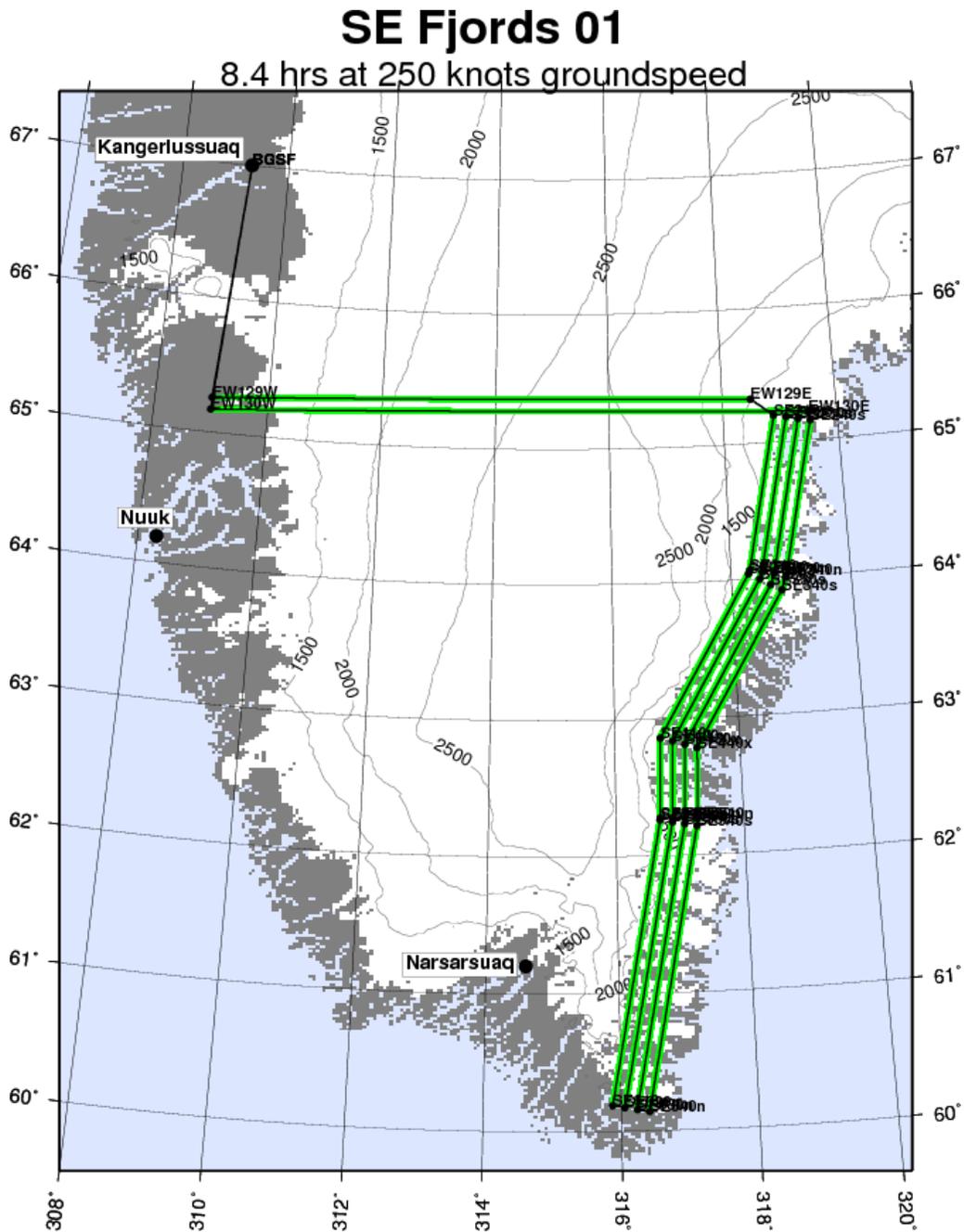


Land Ice – Southeast Fjords 01 / Kangerlussuaq

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. 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: Medium
ICESat Track: none
Remaining Issues: none known

Instrument Priority: Grav/MCORDS



Land Ice – Southeast Fjords 02 / Kangerlussuaq

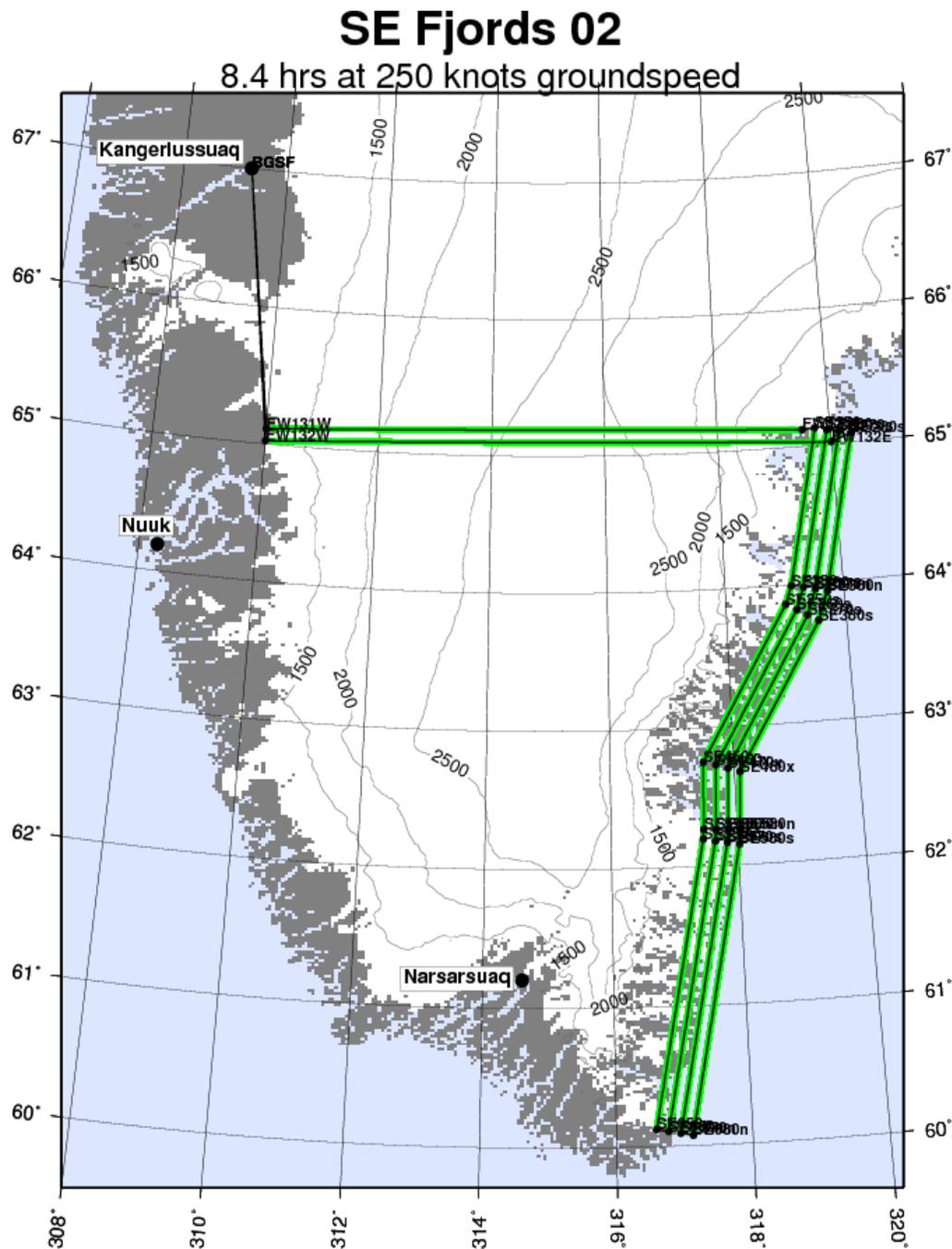
This is a new mission, which extends the Southeast Coastal grid to the seaward and to the south. The grid lines are spaced at 10 km, and the lines are placed to seaward of the Southeast Fjords 01 mission. See the Appendix for a composite map which shows all five southeast Greenland missions in context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

Flight Priority: Low

Instrument Priority: Grav

ICESat Track: none

Remaining Issues: none known



Land Ice – Duck-Clusters / Kangerlussuaq

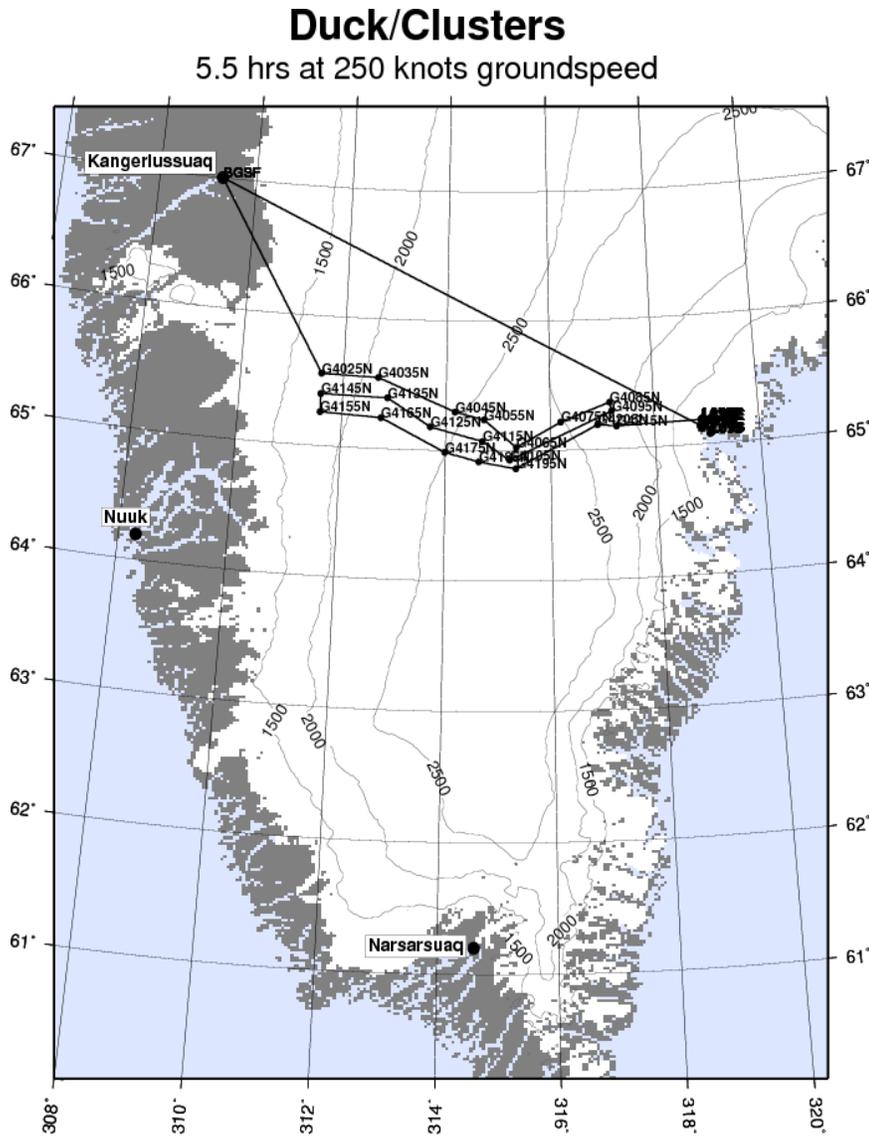
This is a new mission, whose main purpose is to re-fly the Geociever “cluster” sites which straddle the ridgeline of the ice sheet southeast of Kangerlussuaq. The sites were first surveyed more than 30 years ago and have been re-surveyed by ATM several times in the intervening years, and thus yield an unusually long dh/dt history for the sites. We also add a NASA headquarters-directed grid survey over an old aircraft crash site (the aircraft was a Grumman Duck amphibian) near Pikiutdleq Glacier on the southeast coast.

Flight Priority: Medium

Instrument Priority: ATM/MCORDS/KU

ICESat Track: none

Remaining Issues: Find more productive ways to transit between Kangerlussuaq and the survey sites; recheck Clusters coordinates with KJ; redesign Koge Bay search grid



Land Ice – Russell 02 / Kangerlussuaq

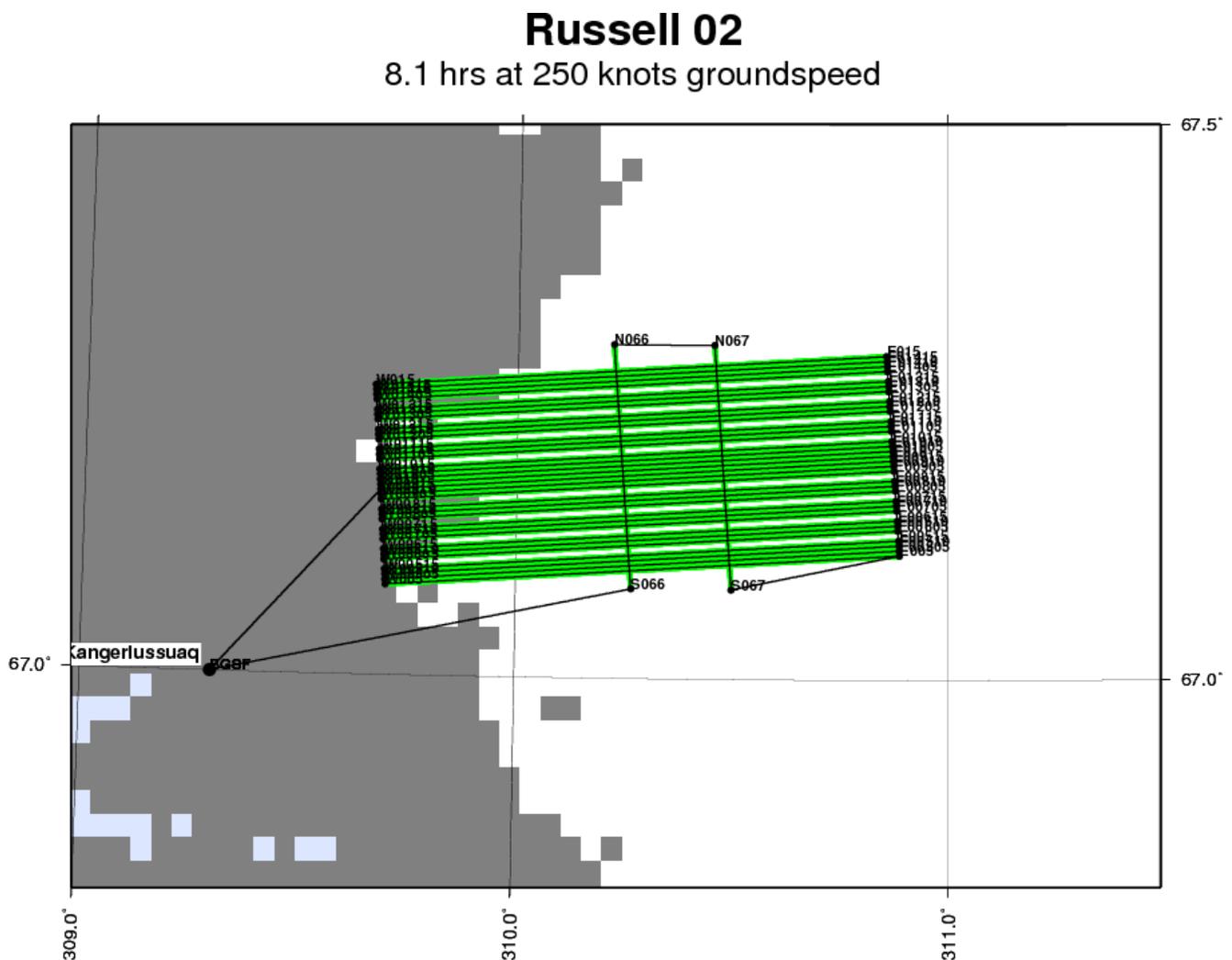
This is a new mission, whose purpose is to greatly densify the 2 km grid flown over the Russell Glacier area in 2010 to 500 m spacing in the cross-flow direction. See the Appendix for a more detailed map of this flight.

Flight Priority: High

ICESat Track: none

Remaining Issues: none known

Instrument Priority: MCORDS/ATM



Supplementary Information

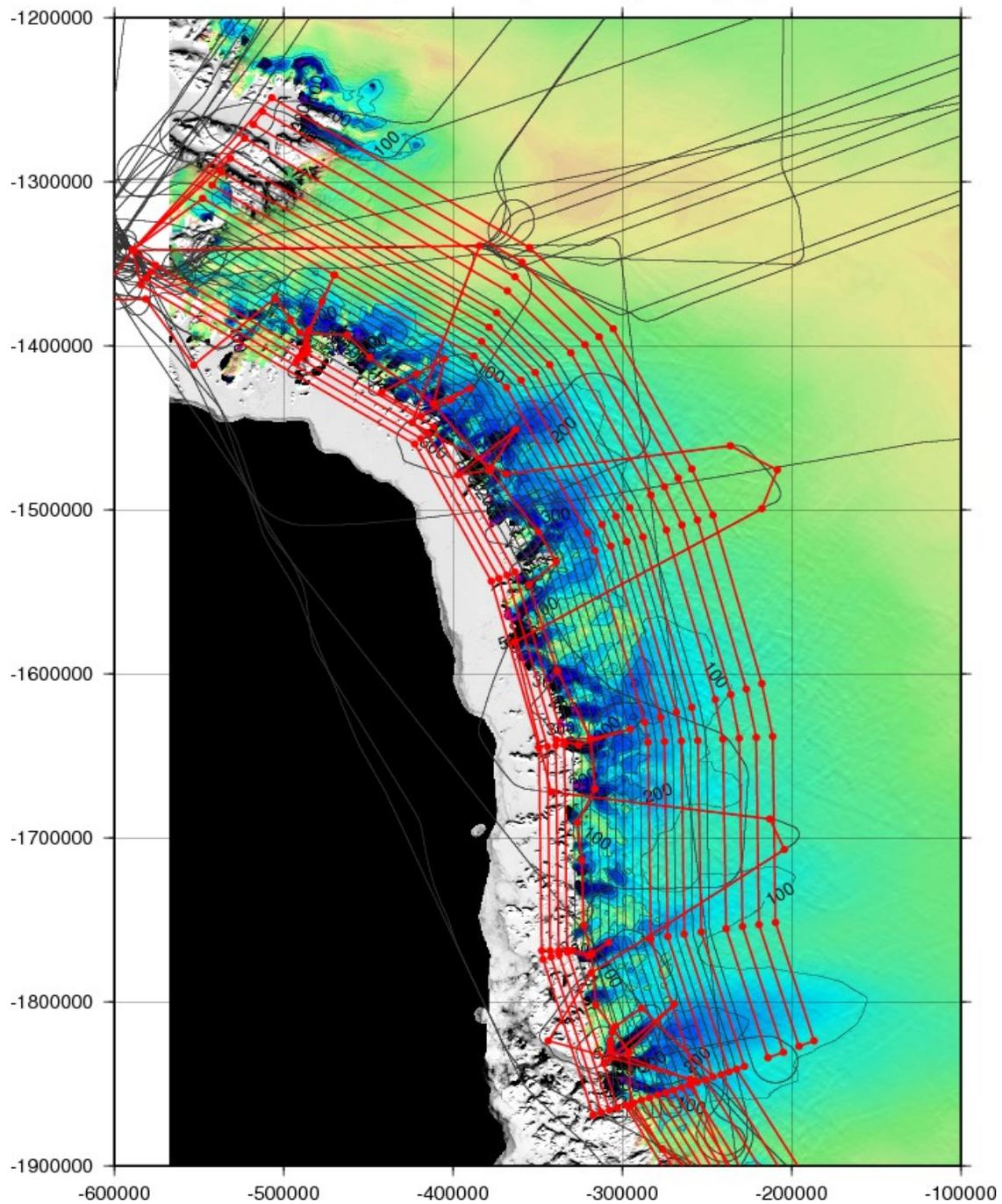
Supplementary maps and other information follow.

Composite Map of Northwest Missions

This map shows the NW Glaciers, NW Fjords 01, NW Coastal 04, NW Coastal 05, Umanaq 01 and Umanaq 02 flight plans, in relation to the 2010 IceBridge flight lines and the Rignot et al ice velocity map as the background.

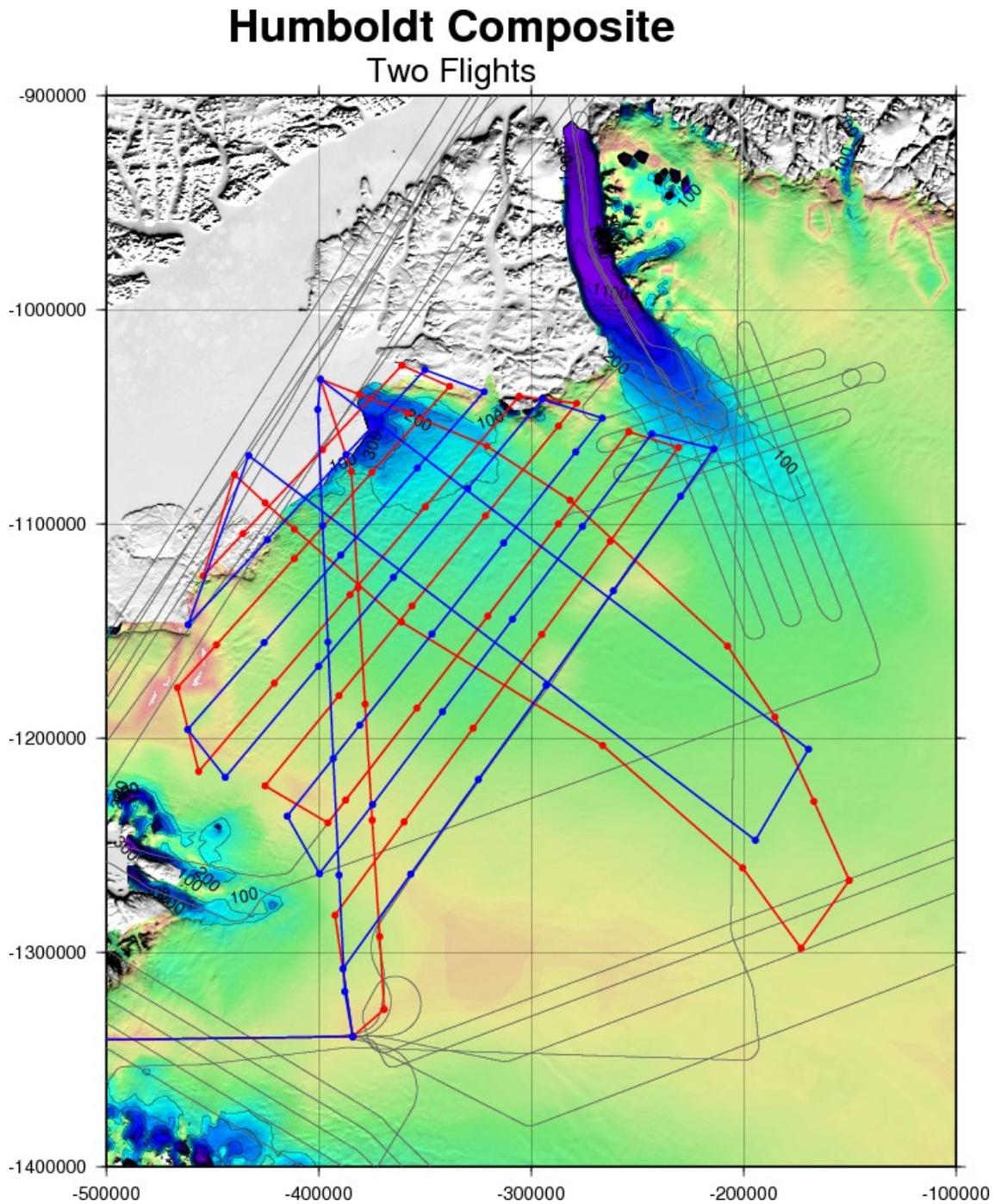
Northwest Composite

2011 Planned flights in red, 2010 flights in gray



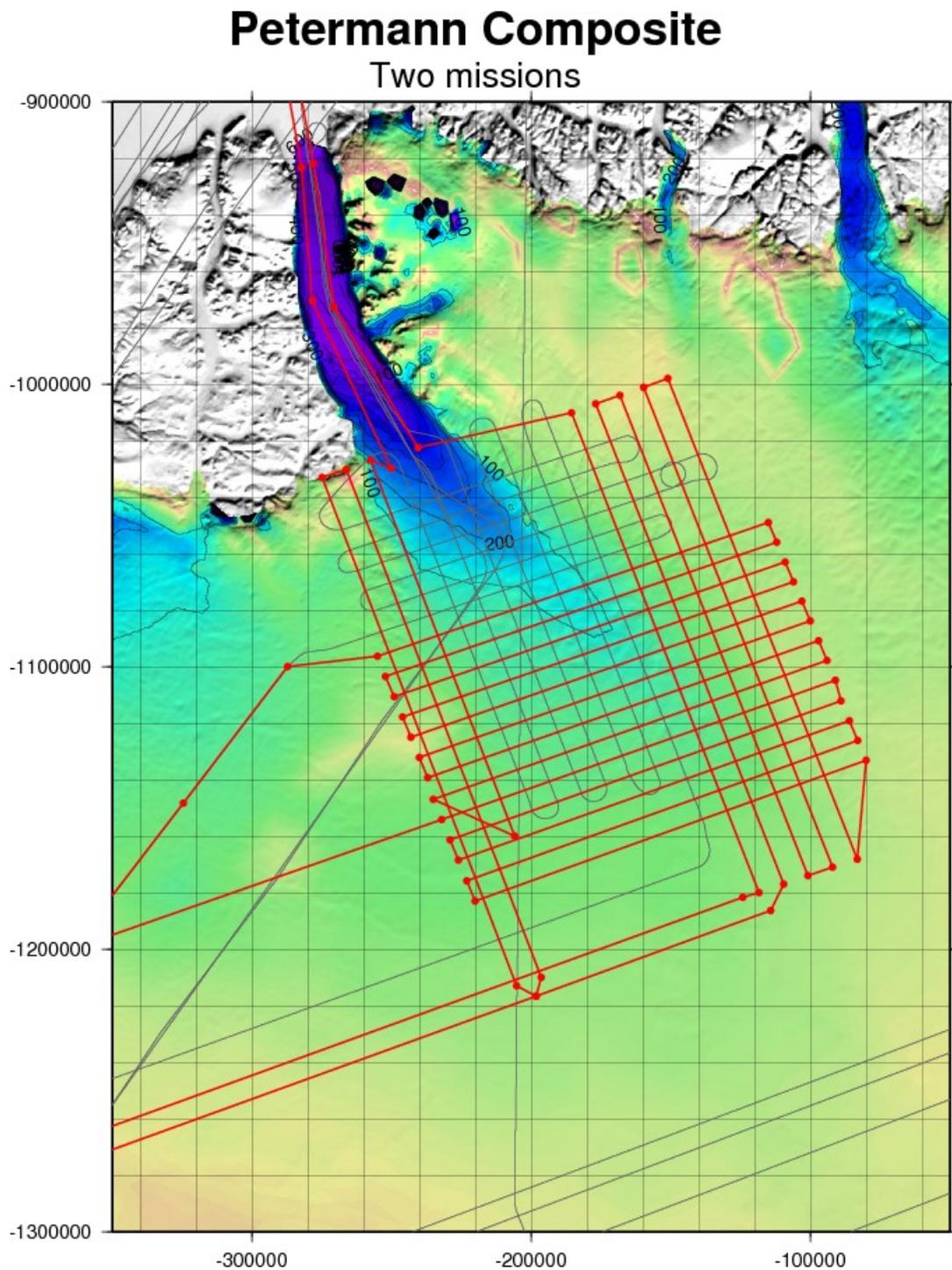
Composite Map of Humboldt Missions

This map shows the Humboldt 01 and Humboldt 02 flight plans, with the Rignot et al ice velocity map as the background. 2010 IceBridge flights are shown in gray.



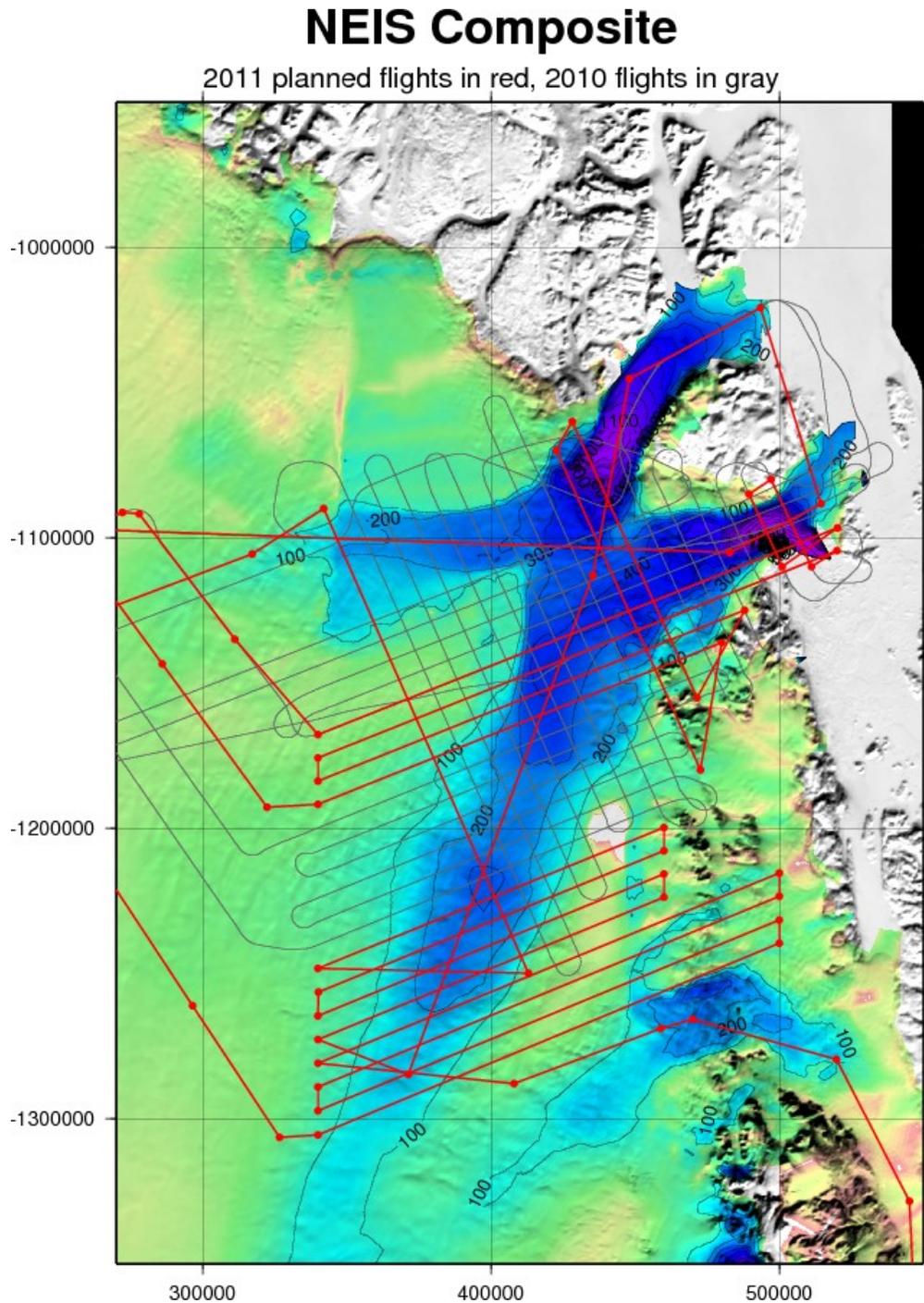
Composite Map of Petermann Missions

This map shows the Petermann 02 and Petermann 03 flight plans, with the Rignot et al ice velocity map as the background. 2010 IceBridge flights are shown in gray.



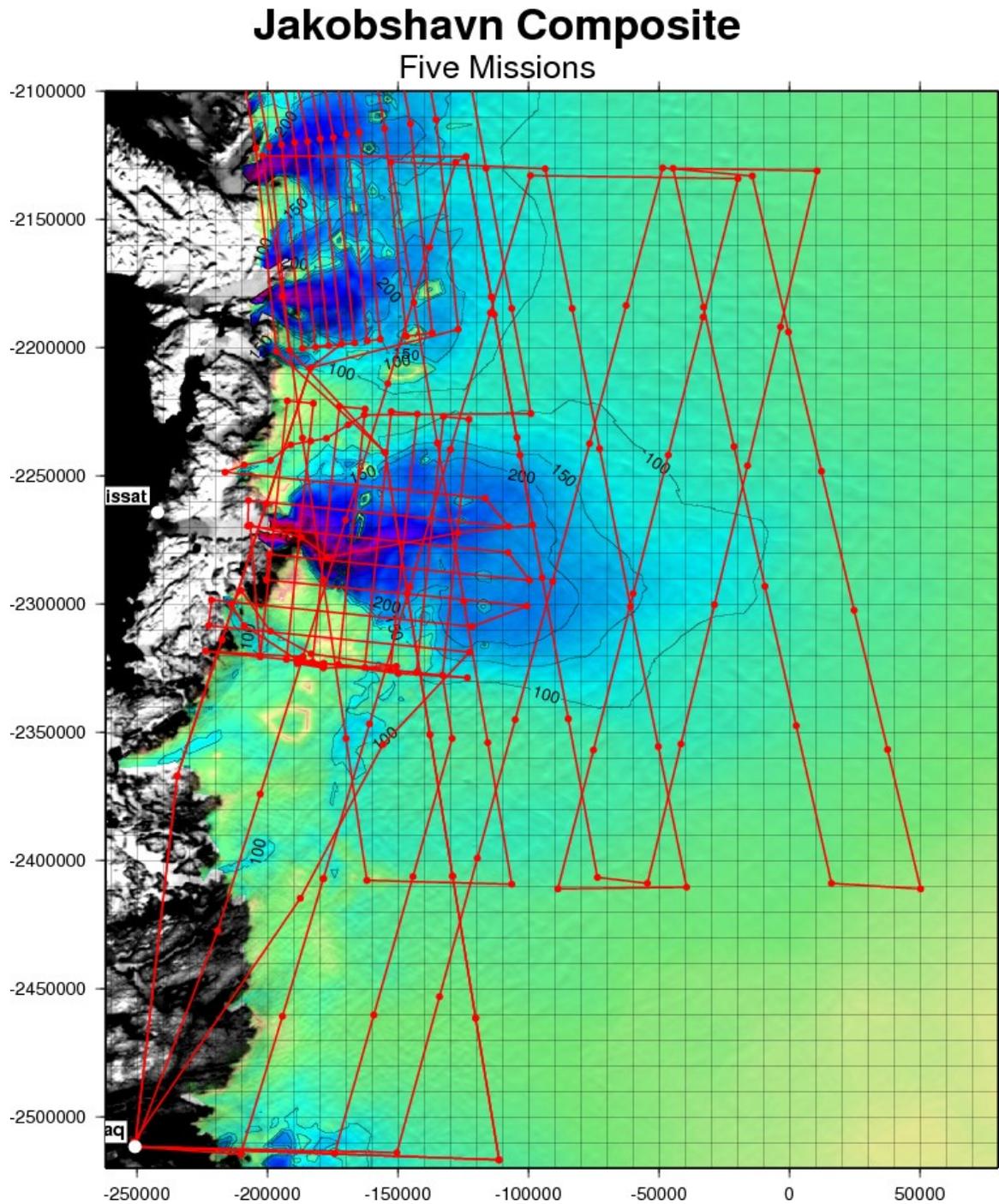
Composite Map of Northeast Ice Stream Missions

This map shows the NEIS04/05/06 flight plans, with the Rignot et al ice velocity map as the background. 2010 IceBridge flights are shown in gray.



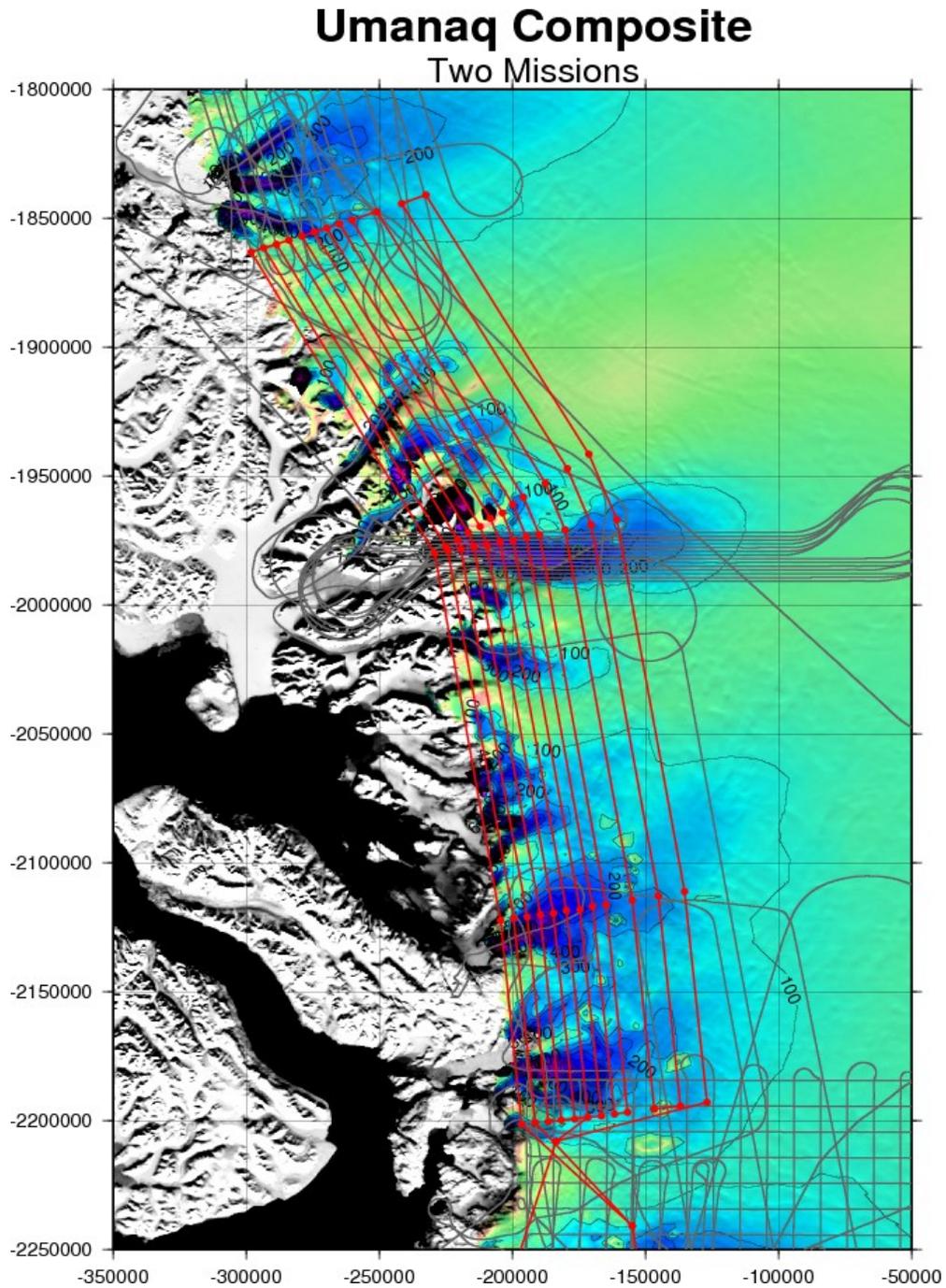
Composite Map of Jakobshavn Missions

This map shows the Jakobshavn 01 and 02 missions and the Jakobshavn/Lake mission, plus the Umanaq 01 and 02 flights, with the Rignot et al ice velocity map as the background.



Composite Map of Umanaq Missions

This map shows the Umanaq 01 and 02 missions, with the Rignot et al ice velocity map as the background and with 2008-2010 IceBridge and pre-IceBridge ATM/CRISIS flights shown in gray.

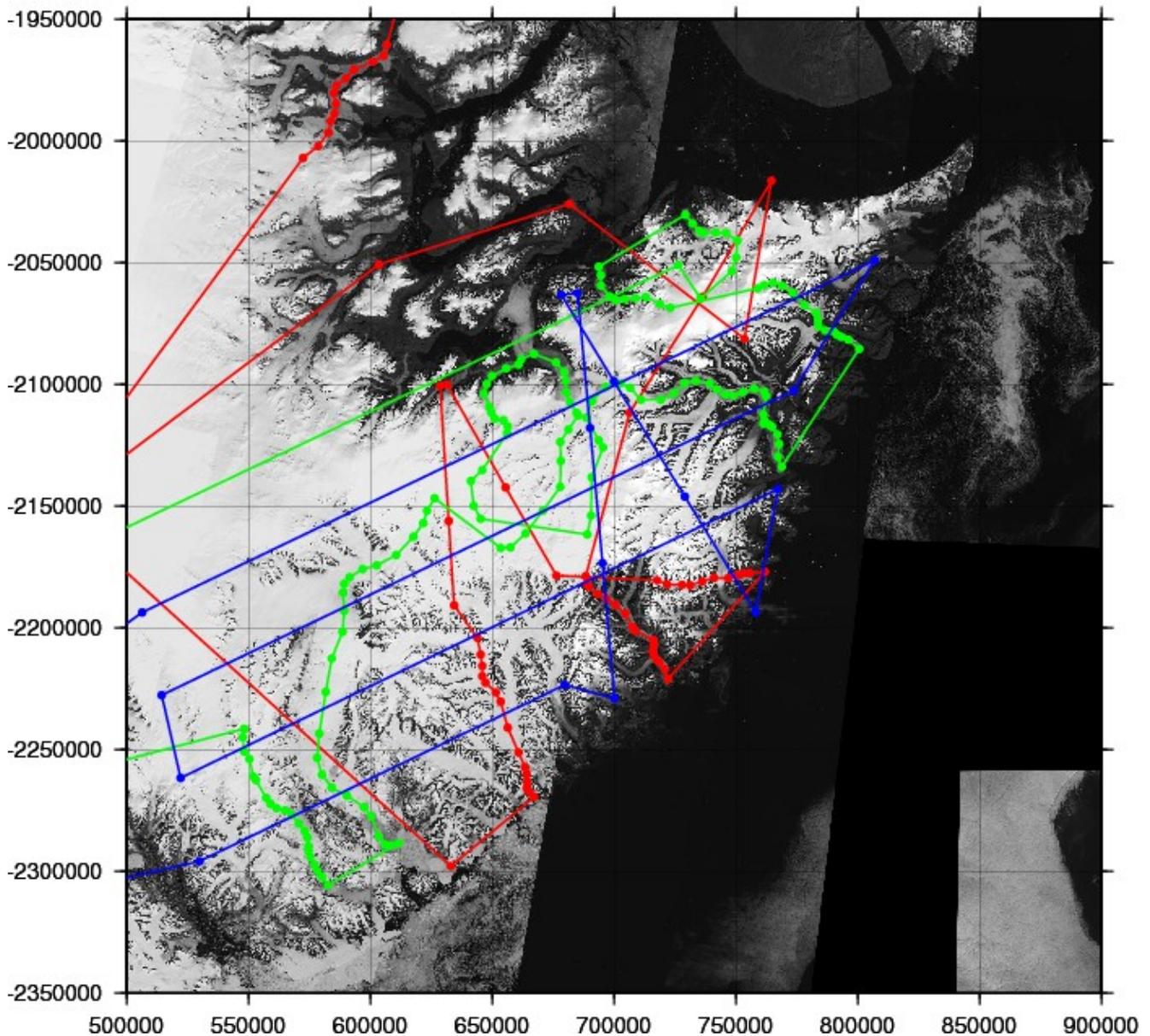


Composite Map of Geikie Missions

This map shows the Geikie 01/02/03 missions, with the Rignot et al ice velocity map as the background.

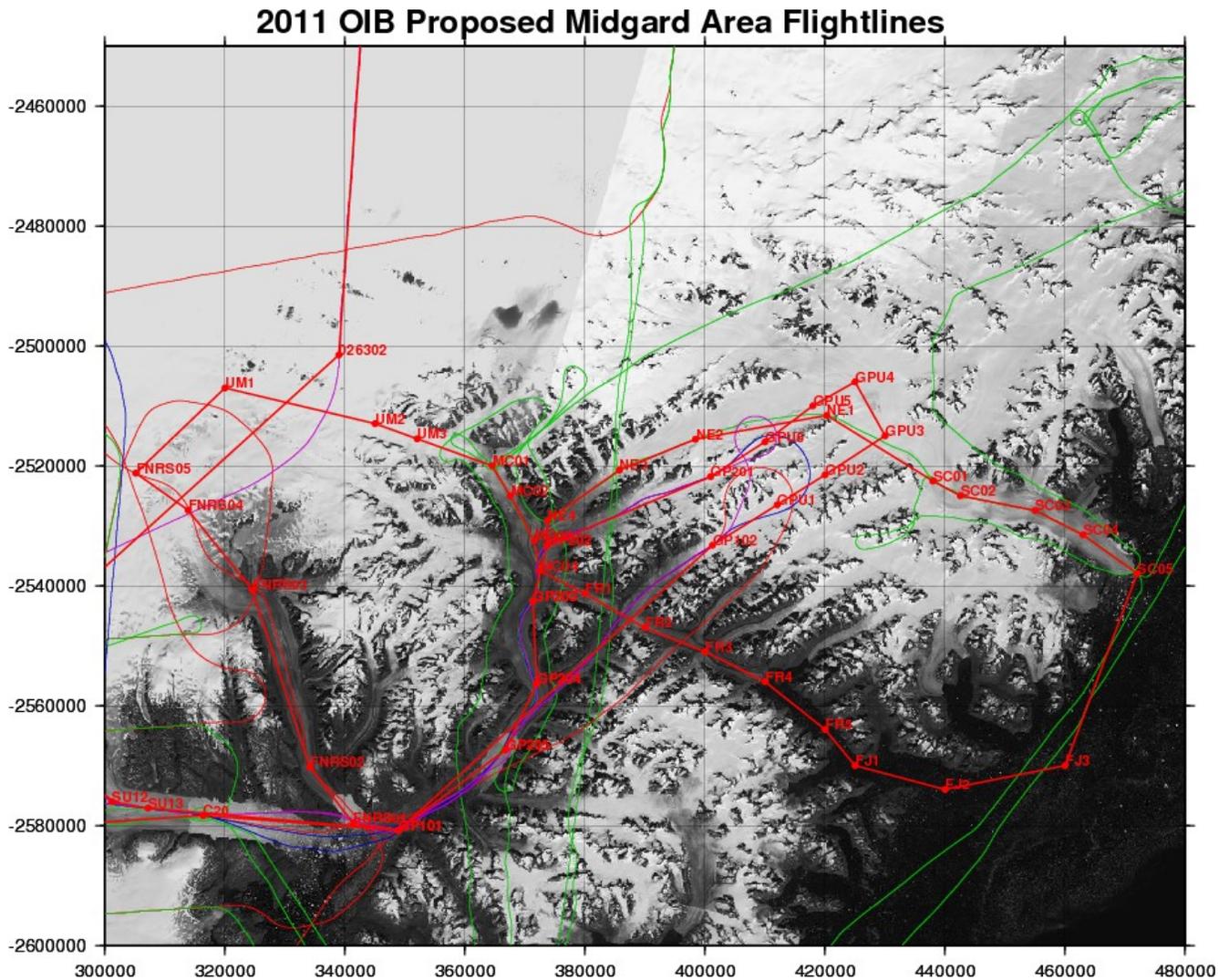
Geikie Composite

Three Planned Missions (red is repeat of a 2010 flight)



Detail Map of Midgard Glacier Surveys

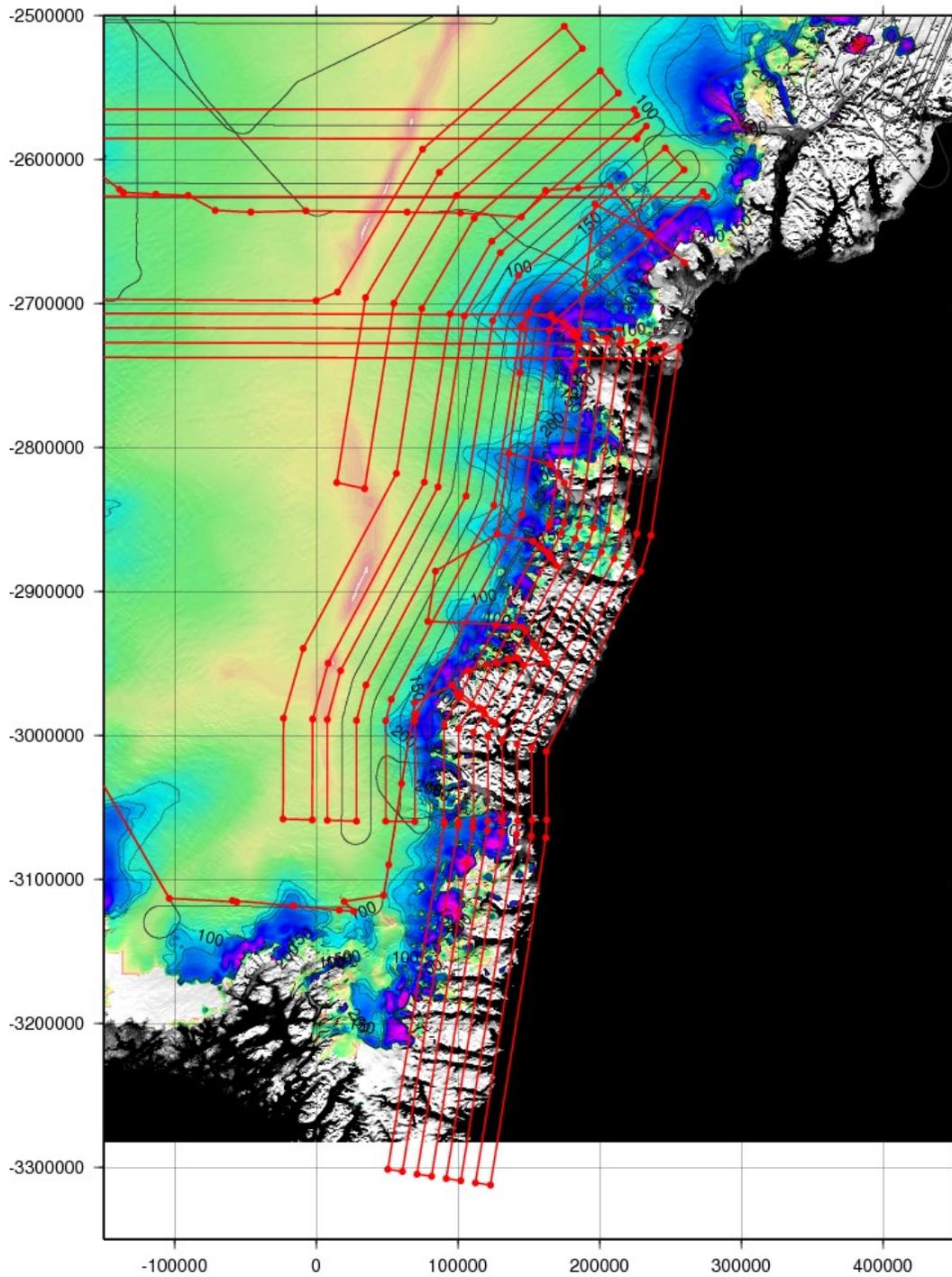
This map shows the details of the part of the Helheim-Kangerdlugssuaq mission which surveys most of the branches of Midgard Glacier and its close neighbors.



Composite Map of Southeast Missions

This map shows the SE Glaciers, SE Flank 01, SE Coastal 02, and SE Fjords 01 and 02 missions, with the Rignot et al ice velocity map as the background and the 2010 IceBridge surveys shown in gray.

Southeast Composite Five Flights



Detail Map of Russell Glacier Surveys

This map shows the Russell 02 mission superimposed on the Rignot et al surface velocity map and with the 2010 survey shown in gray.

Russell 02 8.1 hours at 250 knots groundspeed

