ICEBridge LVIS/DMS Antarctic 2015 Flight Lines
7/23/15

The following document presents flight lines identified for overflights during the Fall 2015 Antarctic OIB deployment on the NCAR G-V.

2015 Resource Constraints:

Aircraft: NCAR GV, ~10 hour flight capability for Icebridge/Antarctica
~6 week deployment in September-November 2015.
180 hours of operation out of Punta Arenas, Chile
~40,000' flight altitude
Potential for temporary plane relocation if high winds in Punta Arenas

2015 Instrumentation:

LVIS – 1064nm full-waveform imaging lidar system. Nominal ~2km swath, 20m footprint
DMS: 100mm lens, field of view: ~14x20deg (80cm footprint, ~2.9kmx4.4km)

Land Ice Flight Line Concept:

The operational strategy is to generate final flight plans in response to weather and other conditions on the day of the flight. Plans will be developed using the line priorities set by the science team. Example flight plans containing the flight lines are presented here, and also provide information on line priorities for final flight plan generation: for example, if a fight plan is designated "high", then all lines within that plan are also designated "high" and will be prioritized as such when final plans are developed in the field. Note that the lines contained in the flight plans as presented require significantly more flight hours than allocated. This provides operational flexibility in the presence of persistent weather issues. Plans are also not yet fully optimized for final GV operations, and in some cases additional lines could be added if time and conditions allow. These will be added based on the line priority.

Final land ice flight plans will be built using the following priorities (1 being highest, 5 lowest):

1. Line is contained in a "baseline" plan
2. Line is contained in a "high" priority plan
3. Line repeats a 2011 or 2009 LVIS line
4. Line is from a 2014 "medium" or "low" priority plan
5. ICESat track or unflown LVIS master grid line

Sea Ice Flight plans:

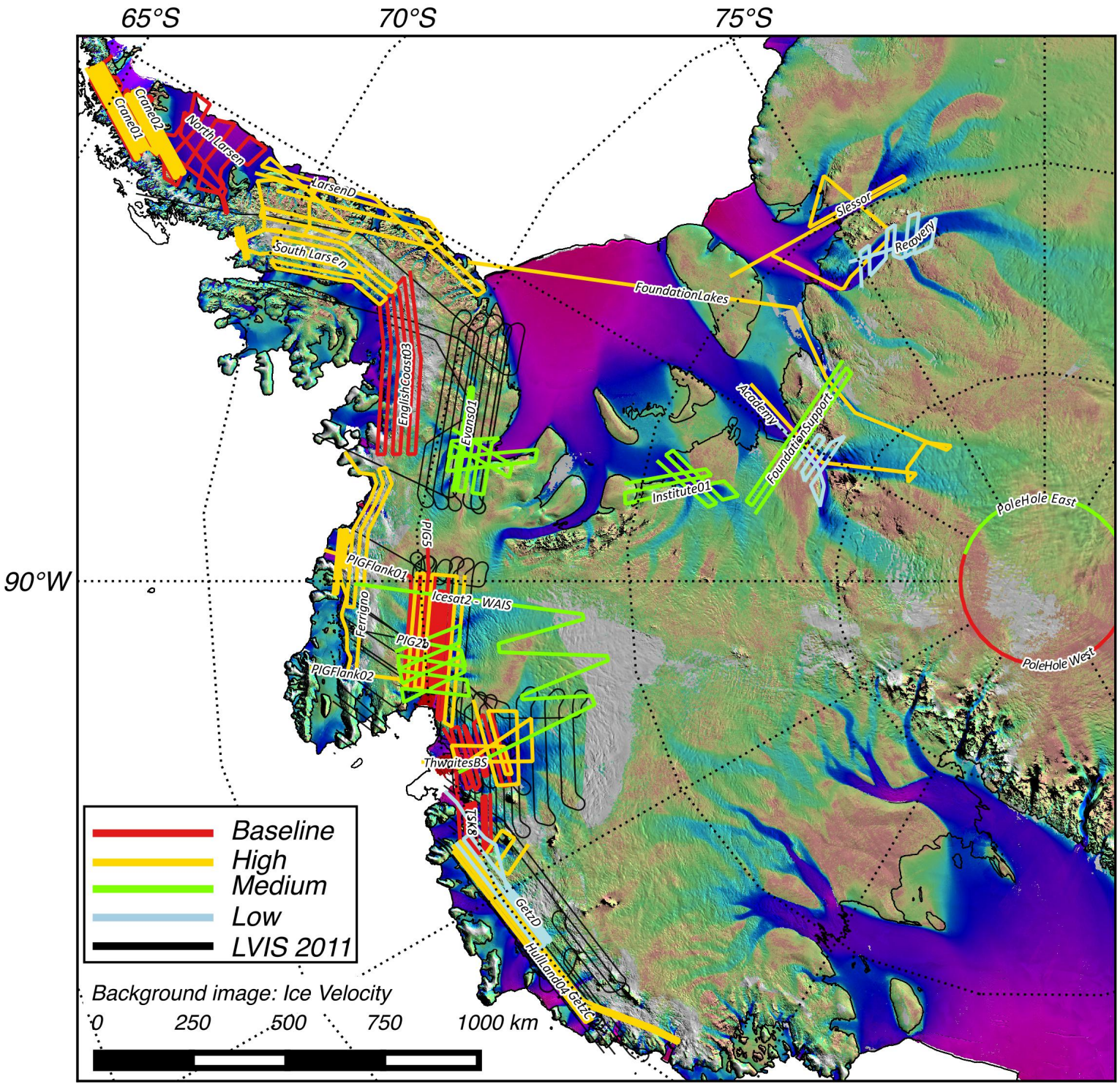
It is important to fly sea ice plans as designed.

Note: Much of the background information on each example flight came from the 2014 OIB Antarctica flight planning document, updated to G-V operations where appropriate.

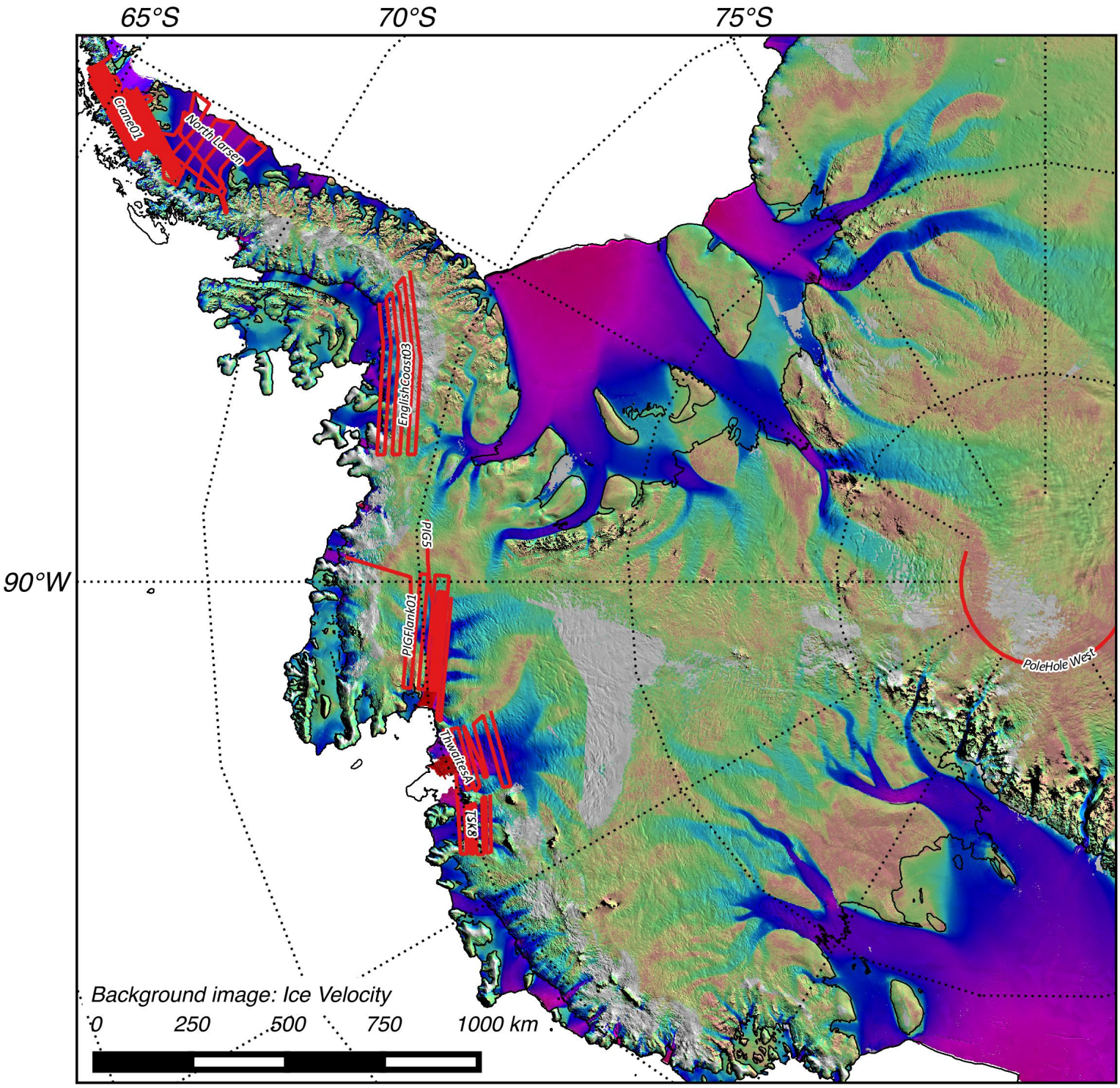
Summary by Priority

# Flights	Flight Description	Last Flown	Priority
1	Sea Ice – Bellingshausen 1	2009,2010,2011,2012,**2014**	Baseline
2	Sea Ice - Endurance	2009, 2010,2011,2012,**2014**	Baseline
3	Sea Ice – Seelye Loop	2009, 2010,2011,**2014**	Baseline
4	Sea Ice – Bellingshausen 2	2012	Medium
5	Sea Ice – Twisted	2011	Medium
6	Sea Ice – Weddell Zigzag	New flight	Low
7	Land Ice – Crane01	2009	Baseline
8	Land Ice – North Peninsula	Portions in 2002,2009,2010,2011	Baseline
9	Land Ice – English Coast 03	Portions in 2011, **2014**	Baseline
10	Land Ice – PIG Flank01	Portions in 2009,2012, 2011,2014	Baseline
11	Land Ice – Pine Island 5	Portions in 2009, 2012, **2014**	Baseline
12	Land Ice – Thwaites A	Portions in 2009, 2011,2012,**2014**	Baseline
13	Land Ice – Thwaites-Smith-Kohler 8	Portions in 2012, **2014**	Baseline
14	Land Ice – Pole Hole 88 West	**2014**	Baseline
15	Land Ice – Crane02	2009	High
16	Land Ice – Larsen D 01	Portions in **2014**	High
17	Land Ice – South Peninsula	Portions in 2004,2008,2009,2010,2011, **2014**	High
18	Land Ice – Ferrigno-Alison-Abbott 01	Portions in 2008,2009,2011,2012,**2014**	High
19	Land Ice – PIG Flank02	2011, Portion in 2012	High
	Land Ice – Thwaites BS	Portions in 2012, LVIS 2011	High
20	Land Ice – Getz C	Portions in 2011, 2012,**2014**	High
21	Land Ice – Hull-Land 04	**2014**	High
22	Land Ice – Foundation Lakes 01	2012, **2014**	High
23	Land Ice – Slessor 1a	2011, **2014**	High
24	Land Ice – Pine Island 2b	2009,2011	Medium
25	Land Ice – LVIS PIG North 2011	2011	Medium
26	Land Ice – LVIS PIG South 2011	2011	Medium
27	Land Ice – IceSat-2 WAIS	New flight	Medium
28	Land Ice – LVIS Lower Thwaites 2011	2011	Medium
29	Land Ice – LVIS Upper Thwaites 2011	2011	Medium
30	Land Ice – LVIS Pope 2011	2011	Medium
31	Land Ice – LVIS Getz1 2011	2011	Medium
32	Land Ice – LVIS Getz2 2011	2011	Medium
33	Land Ice – LVIS Getz3 2011	2011	Medium
34	Land Ice – Evans 1	2009, 2011	Medium
35	Land Ice – LVIS Evans 2011	2011	Medium
36	Land Ice – LVIS Drewry 2011	2011	Medium
37	Land Ice – Institute 1	**2014**	Medium
38	Land Ice – Foundation-Support Force 02	**2014**	Medium
39	Land Ice – Pole Hole 88 East	**2014**	Medium
40	Land Ice – Getz D	Portions in 2004,2011, 2012	Low
41	Land Ice – Academy	2012	Low
42	Land Ice – Recovery Channel	2012,**2014**	Low

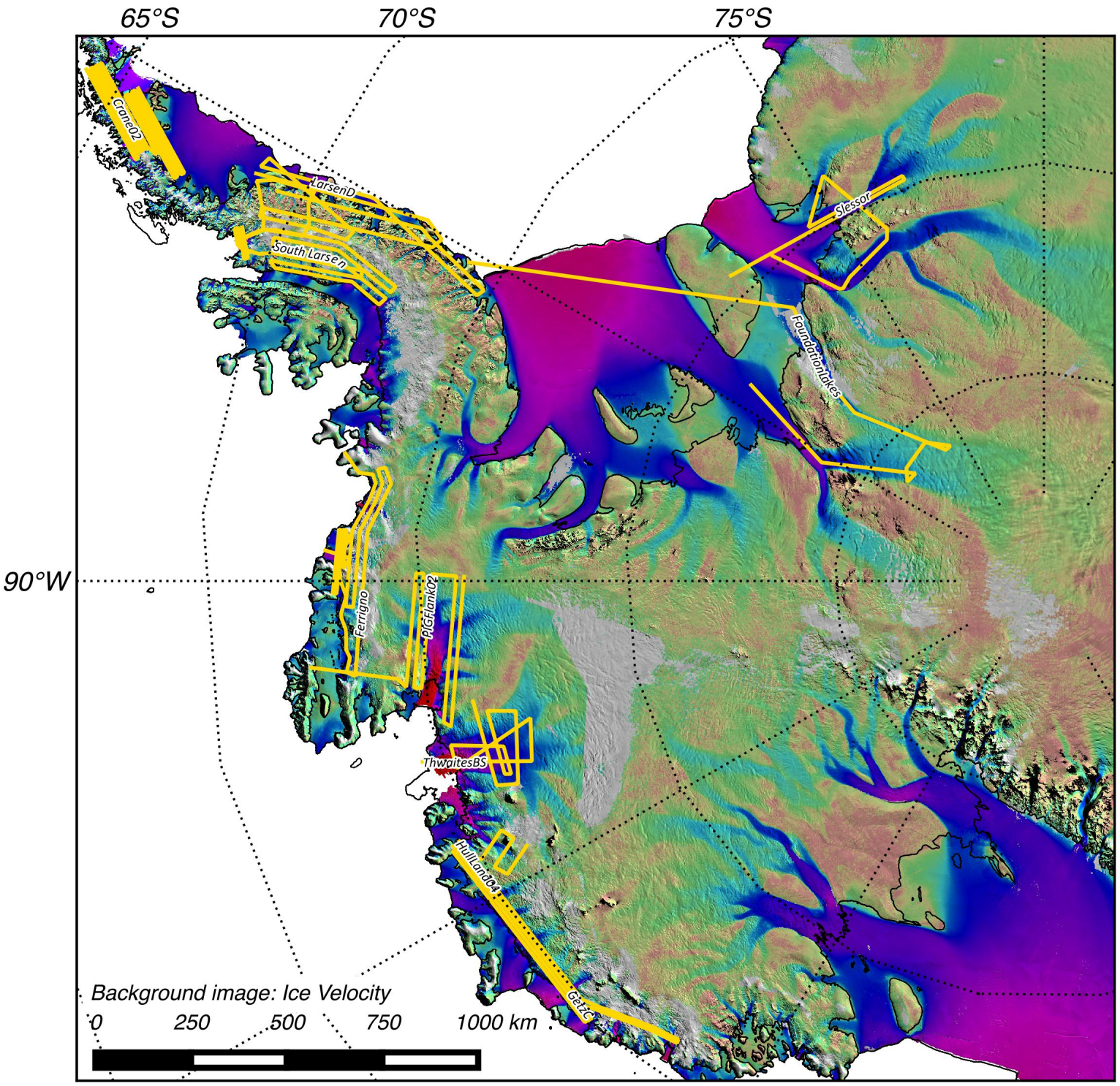
Land Ice Overview – All Priorities



Land Ice Overview – Baseline Only

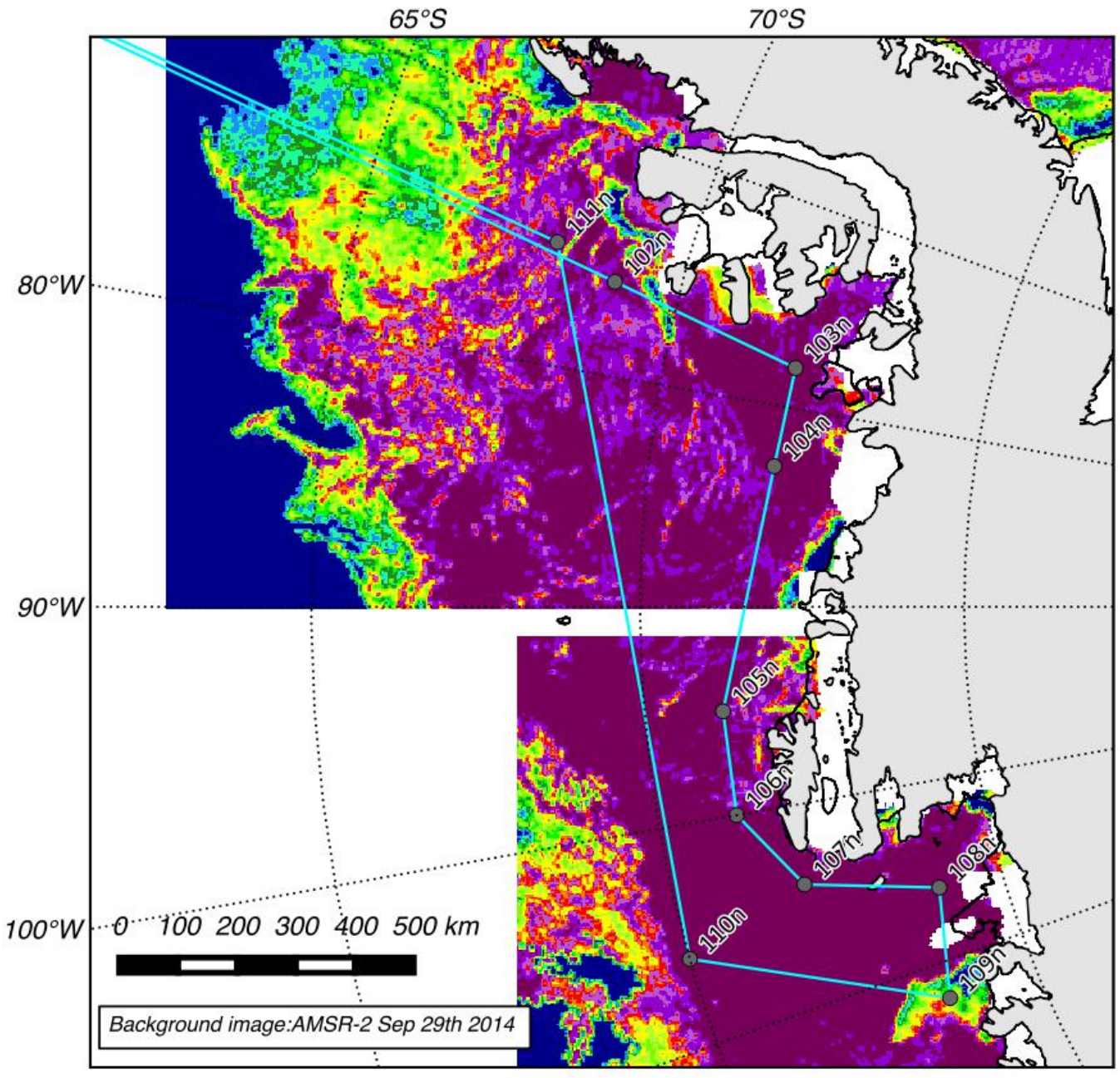


Land Ice Overview – High Priority Only



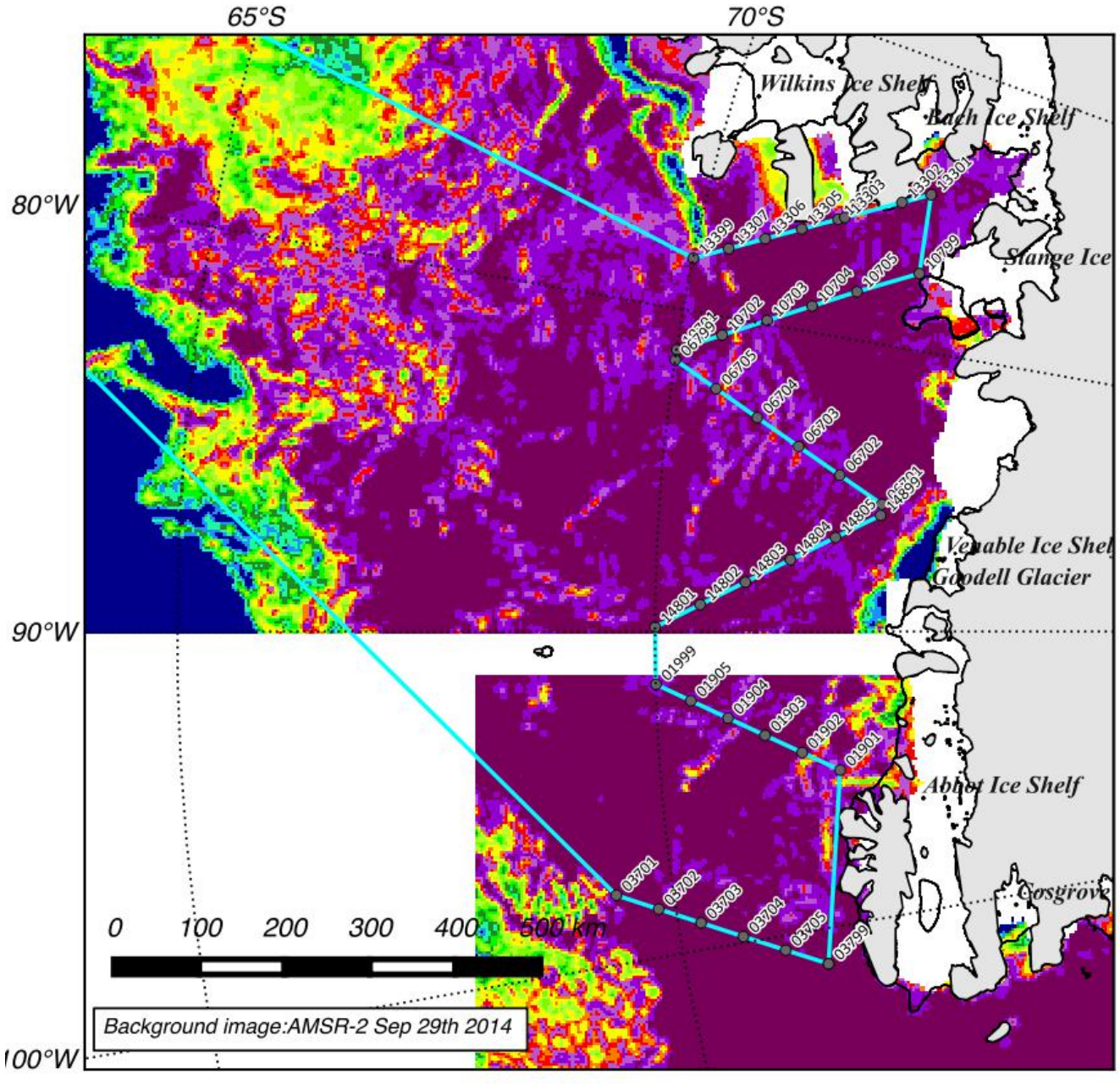
Sea Ice – Bellingshausen 1				Priority: Baseline
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
2.3 hours	420 knots	8.2 hours	none	2009,2010,2011,2012,2014

This mission represents a continuation of the IceBridge time series. The northern portion of this flight (i.e. between WP110n and 111n) may be adjusted according to sea ice coverage reports obtained just prior to (or during) the deployment, specifically the location of the ice edge. This mission should be flown as early as possible, preferably before mid-Oct, because of the relatively early onset of melt of in this region. **If all 3 baseline plans are an option: priorities are Endurance, Seelye Loop, Bellingshausen 1**.



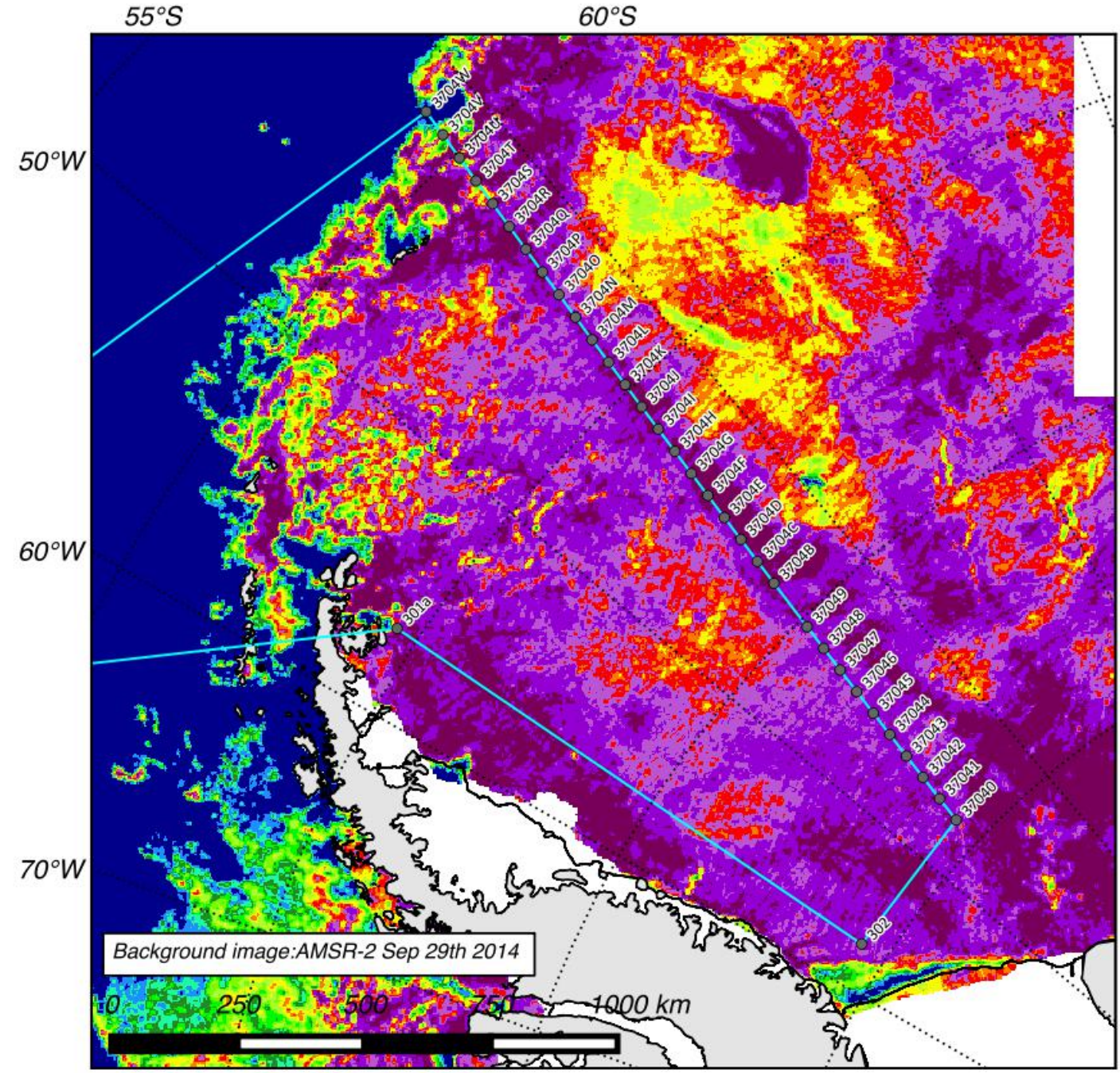
Sea Ice – Bellingshausen 2				Priority: Medium
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
2.5 hours	420 knots	8.6 hours	Cryosat-2 TBD	2012

This mission represents a modification of Bellingshausen 1, to be flown in its place in the event Bell1 does not seem likely to be flown, due to light sea ice conditions (i.e. sea ice cover does not extend very far offshore). The primary objective in the zigzag pattern is to sample sea ice gradient over a large area, extending from thicker ice closer to the coast through to the marginal ice zone (MIZ) at the ice edge. The flight plan should contain similar zigzag passes as the 2012 flight, but can be repositioned within clear patches of clouds, ideally to fly along CS2 orbits (if possible, within 2 hrs of an overpass). From 2014 doc: Of medium priority on this mission is the opportunity for a coordinated under flight of a CryoSat-2 orbit along one of the north-south legs. This opportunity should not dictate the decision to fly the mission. Instead, the coordinated under flight should only be flown if, on the day selected for the mission, there is a CryoSat-2 ground track that is well-located relative to one of the planned grid lines and well-timed (plus or minus 2 hours). This mission should be flown as early as possible, preferably before mid-October, because of the relatively early onset of melt of in this region.



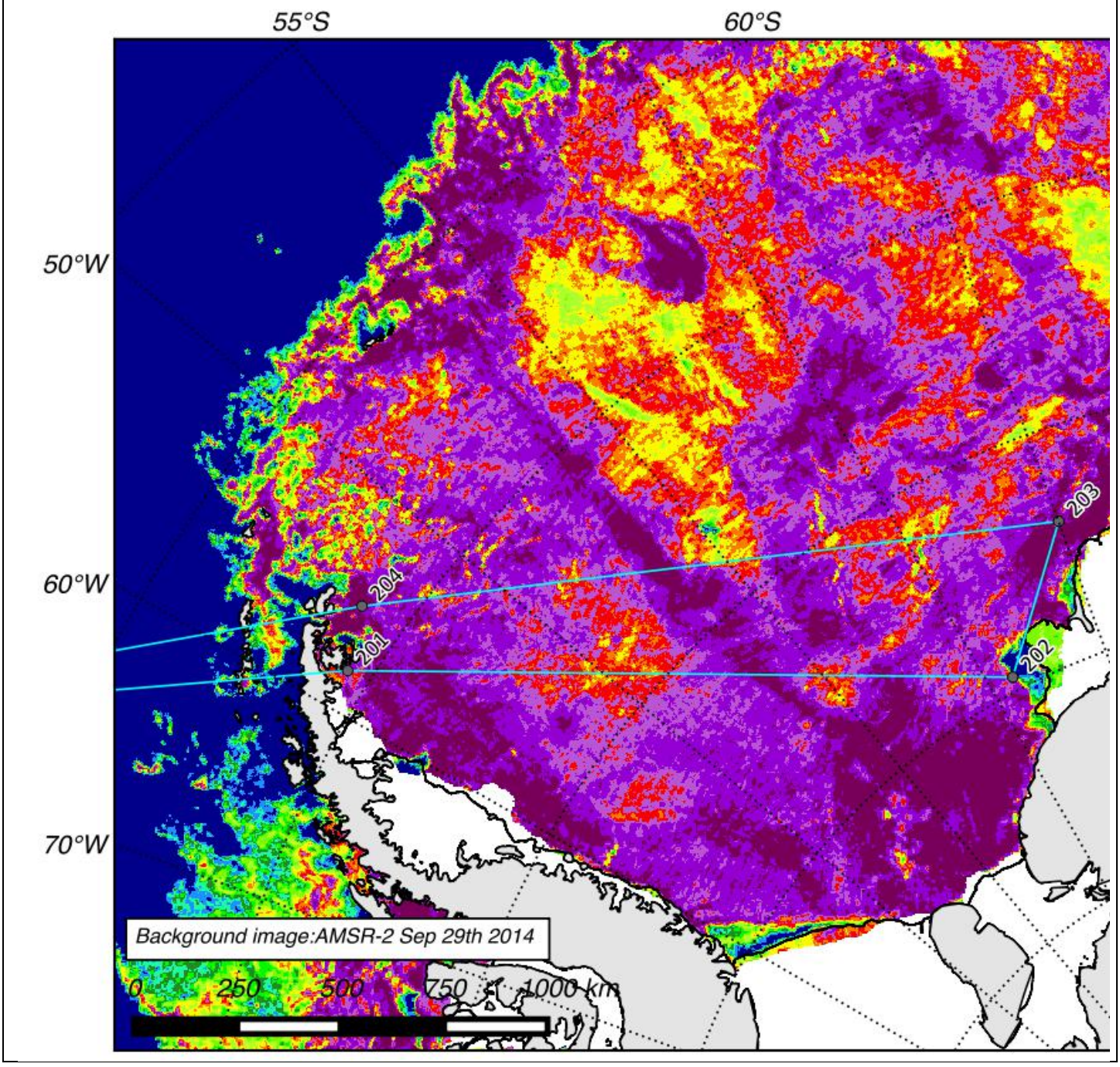
Sea Ice – Endurance			Priority: Baseline	
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
2.5 hours	420 knots	8.5 hours	Cryosat-2 TBD	2012, 2014. Portions 2009, 2010,2011

This mission represents a continuation of the IceBridge time series. It typically crosses rough sea ice. The eastern flight line (37040-3704W) shoud be adjusted to occupy a contemporaneous CryoSat-2 orbit. The CryoSat-2 over pass should be as close in time to the underflight as possible, and the recommended maximum time offset is ~+/-2 hours. The loop in this leg will be used to estimate ice drift rate, and should be positioned over sea ice at 69° S or further south, avoiding an area of persistent lower ice concentration that typically forms around 67/68° S. The loop does not need to be repeated if the CS2 leg isn't within 2 hours of the CS2 overpass. With extra time, extend the legs across the marginal ice zone (MIZ) and into the ocean - particularly the CS2 leg. The transition across the MIZ and detection of wave propagation into the sea ice pack is of scientific importance. **If all 3 baseline plans are an option: priorities are Endurance, Seelye Loop, Bell1**



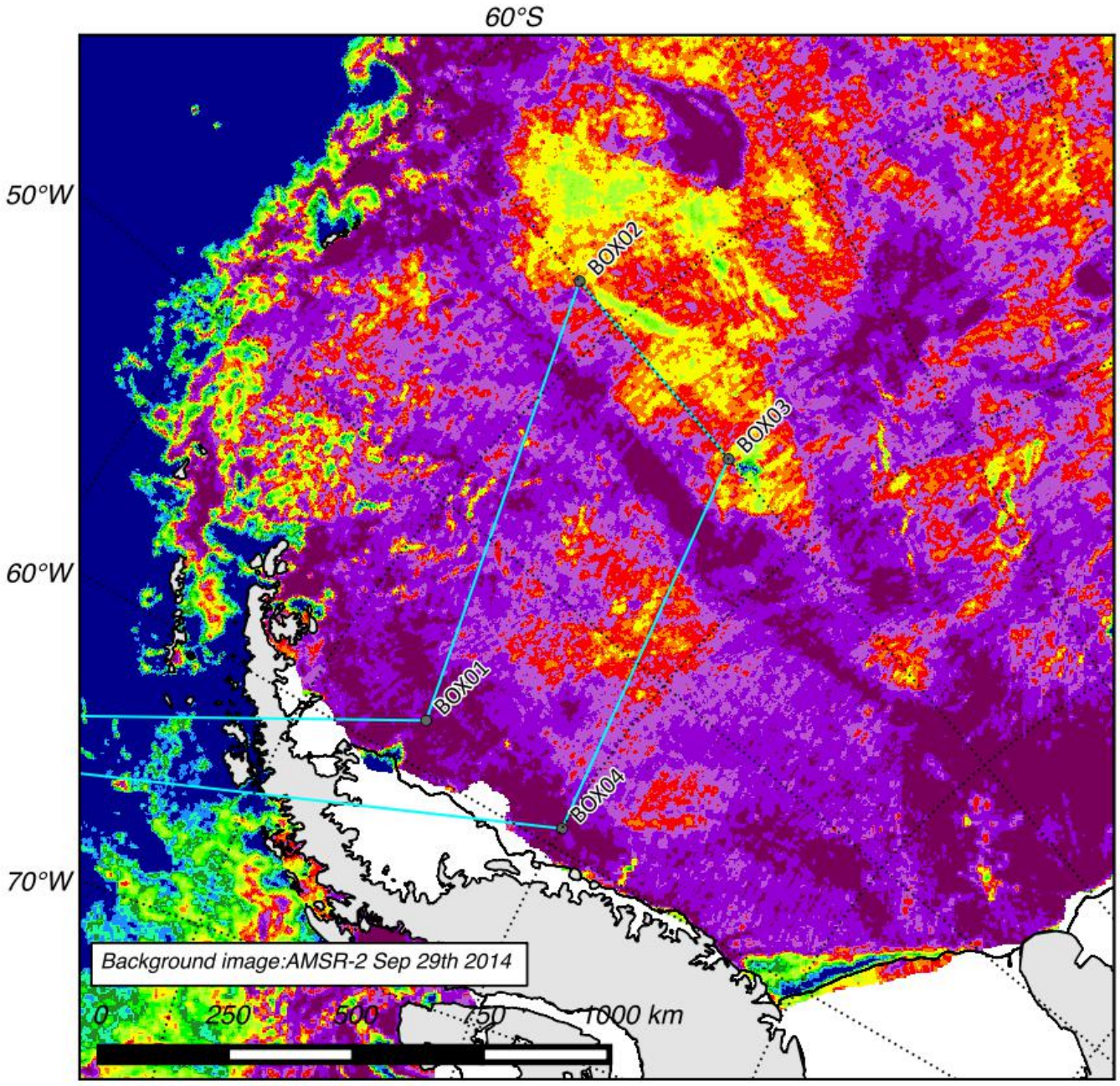
Sea Ice – Seelye Loop				Priority: Baseline
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
2 hours	420 knots	8.6 hours	none	2009,2010,2011,2014

This mission represents a continuation of the IceBridge time series, repeating the 24 October 2009, 26 October 2010, 12 October 2011 and 25 October 2011 missions. It targets gradients in sea ice freeboard and thickness along the "gate" connecting the tip of the Antarctic Peninsula with Cape Norvegia. Flying across the southern, coastal polyna (which usually develops in the region near waypoint 202) in this case is important. **If all 3 baseline plans are an option: priorities are Endurance, Seelye Loop, Bellingshausen 1**.



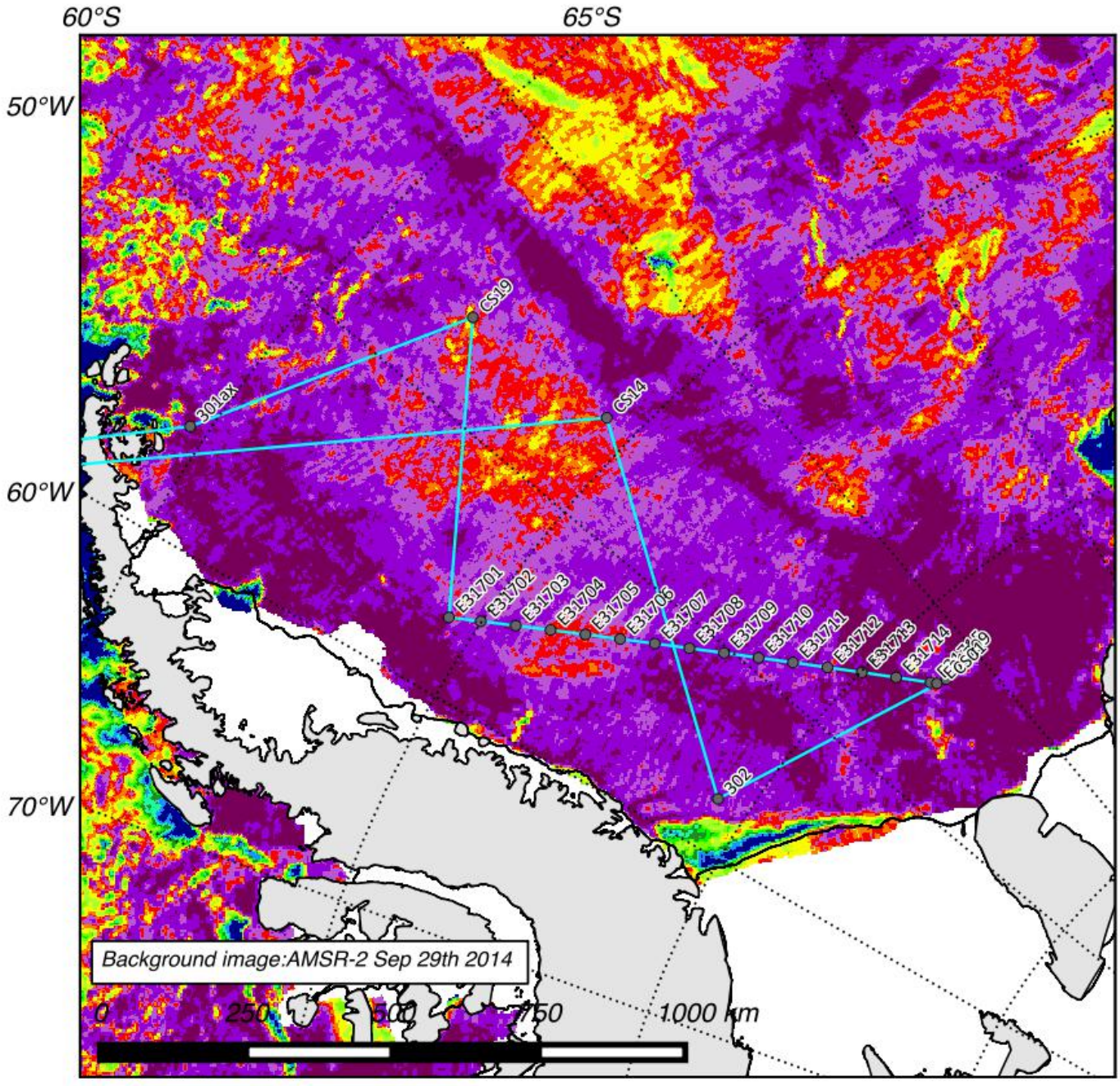
Sea Ice – Twisted				Priority: Medium
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
2.2 hours	420 knots	7.5 hours	none	2010, 2011,2012

This mission represents an alternative pattern over the Weddell, generally rotating, or twisting, the Seelye Loop pattern northward, closer to ice edge. This is a medium priority mission to be considered in the event of poor weather at other higher priority sea ice mission sites



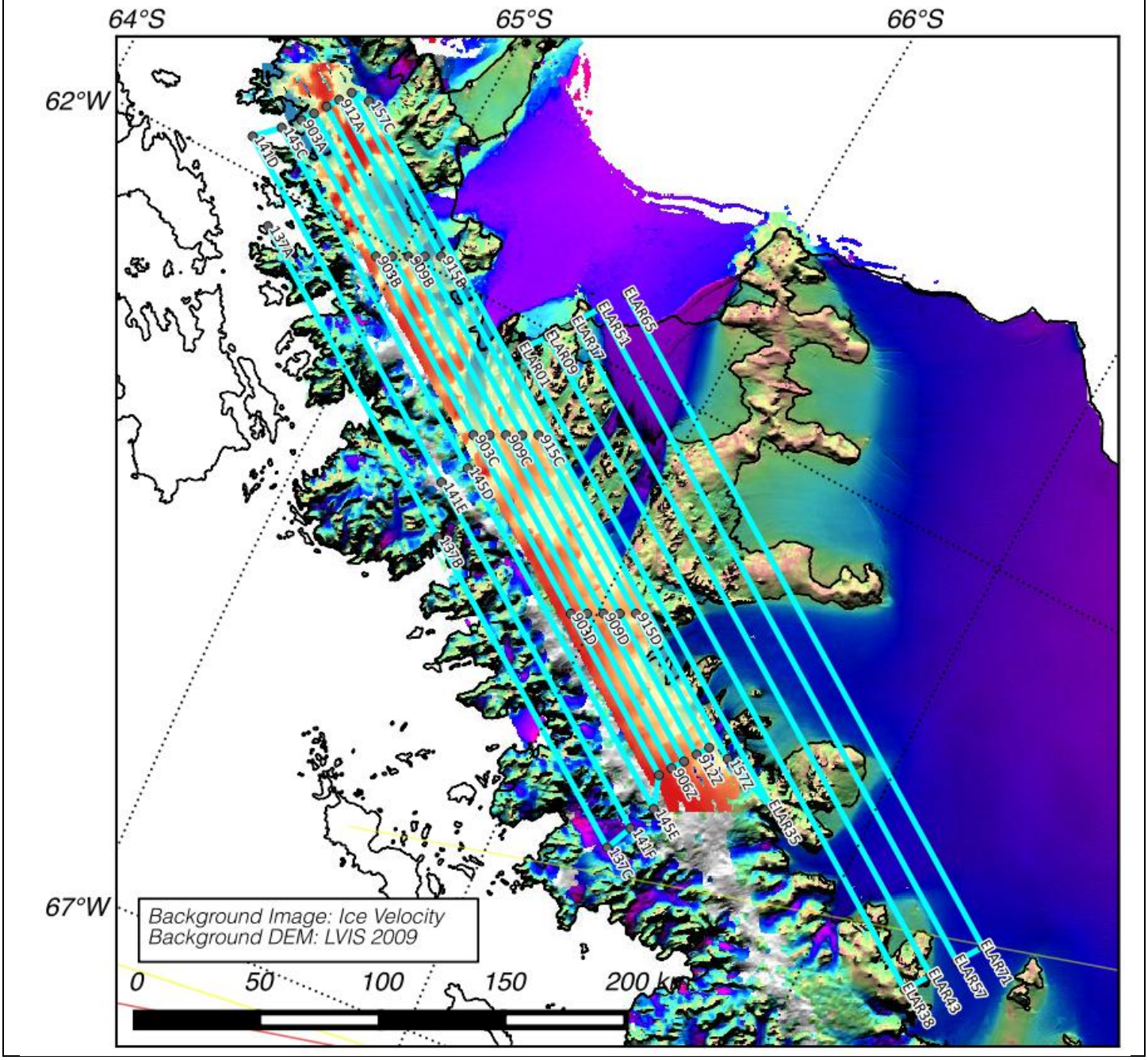
Sea Ice – Weddell Zig Zag				Priority: Low
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
2.0 hours	420 knots	8.7 hours	Envisat/AltiKa	

This is a new, planned mission (in 2014) designed with the aim of providing more detailed coverage over a region in the Weddell Sea characterized by a significant thickness gradient (the ice gets older and thicker closer to the Antarctic Peninsula). The zig-zag pattern crosses the space between the Endurance flight lines. The southernmost line is a repeat of the Endurance line, which is desired for comparisons between the two missions. The segment from E31701 to E31799 follows a historical Envisat orbit (and is consistent with the orbit pattern of the currently operating SARAL/AltiKa mission). This is a low-priority mission to be considered in the event of poor weather at other high priority sea ice mission sites.



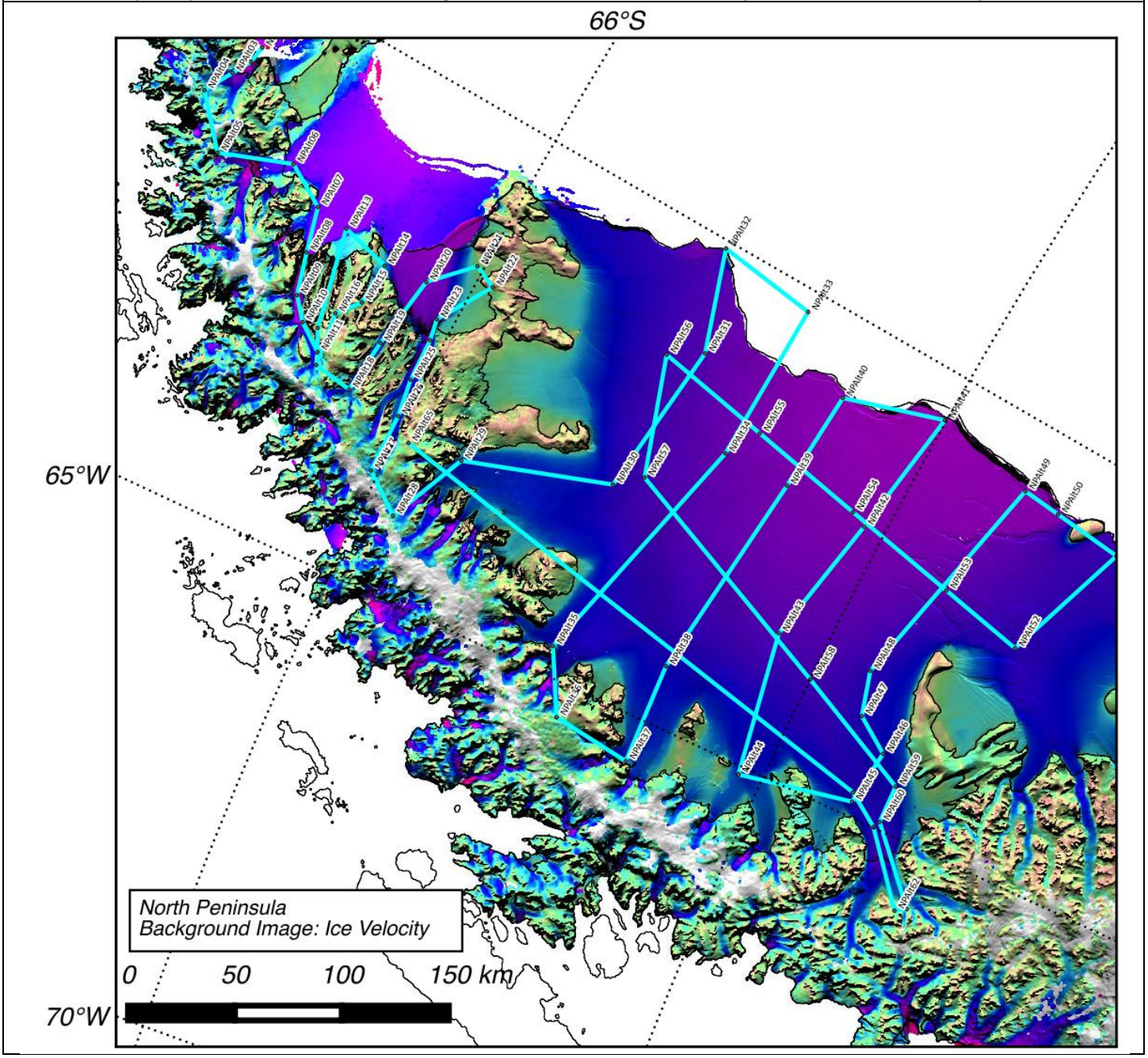
Land Ice – Crane 1				Priority: Baseline
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
1.9 hours	420 knots	9.8 hours	none	2009

This plan repeats part of the LVIS grid from 2009. To the East and West of the LVIS grid, it extends lines at 10km intervals. This plan interleaves the Crane02 plan. The intent is to get broad spatial coverage in this area with either one of these plans in case weather prevents both missions from being flown.



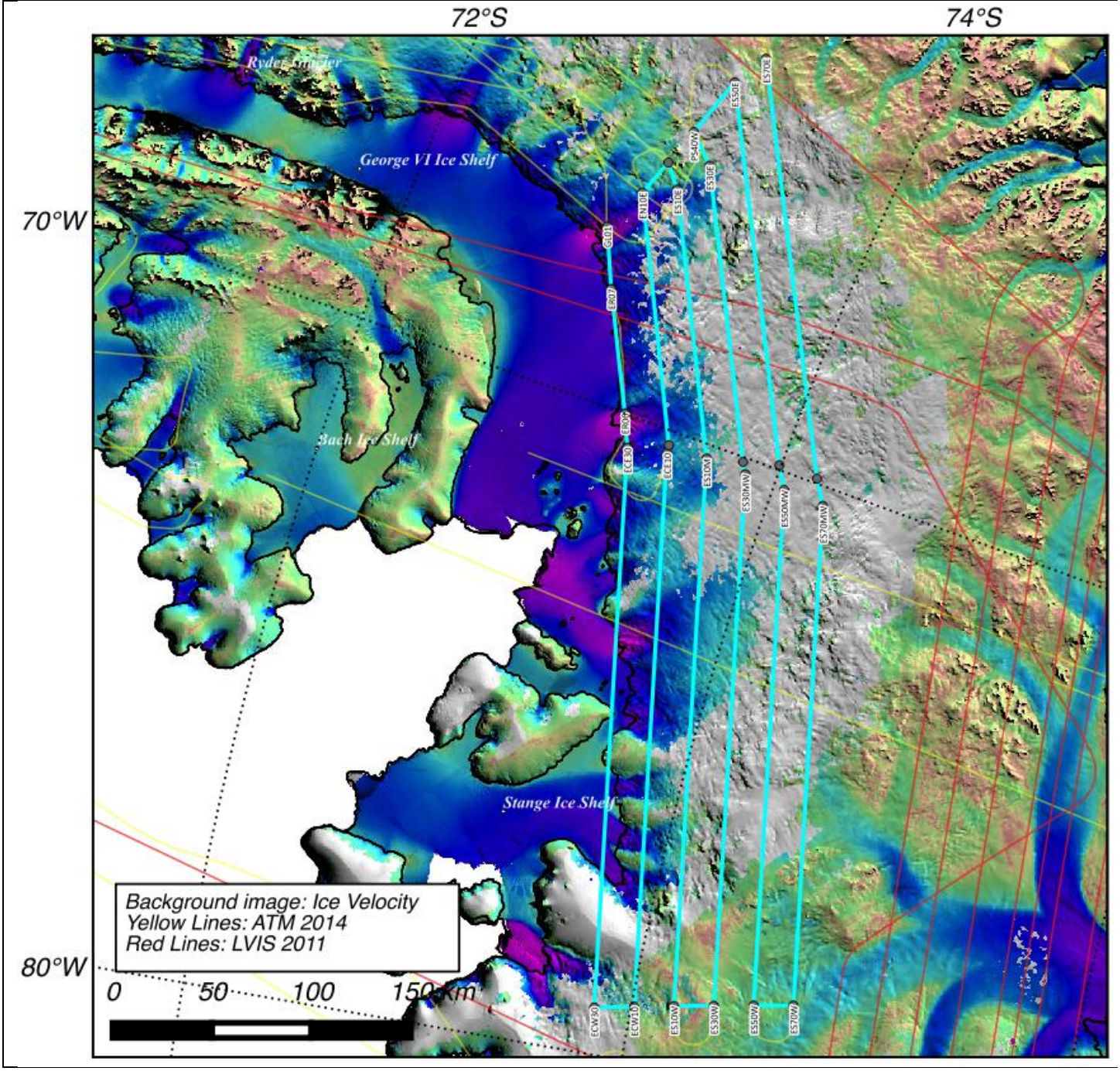
Land Ice – North Peninsula				Priority: Baseline
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
1.9 hours	420 knots	8.7 hours	none	Portions in 2002,2004,2008,2009,2010,2011

This flight has been adapted to optimize the lines for a high altitude LVIS mission. It is a repeat flight, designed to assess dh/dt of several glaciers draining into the Larsen-A, -B, and -C embayments. From north to south, these glaciers are the Drygalski, Hektoria, Crane, Melville, Rachel, Flask, Leppard, Attlee, Quartermain, Flint, and Weyerhauser. In addition to these glaciers, we repeat two lines over Scar Inlet, several flowlines on the Larsen-C Ice Shelf, and four north-south tie lines over the Larsen-C, including overflights of three AWS stations and several areas of stagnant ice so that contributions of surface processes to dh/dt can be assessed independently of dynamic processes. Finally we overfly the Gipps (in the south) and Bawden (north) Ice Rises on the eastern edge of the Larsen-C, since these may contribute to the stability of the ice shelf.



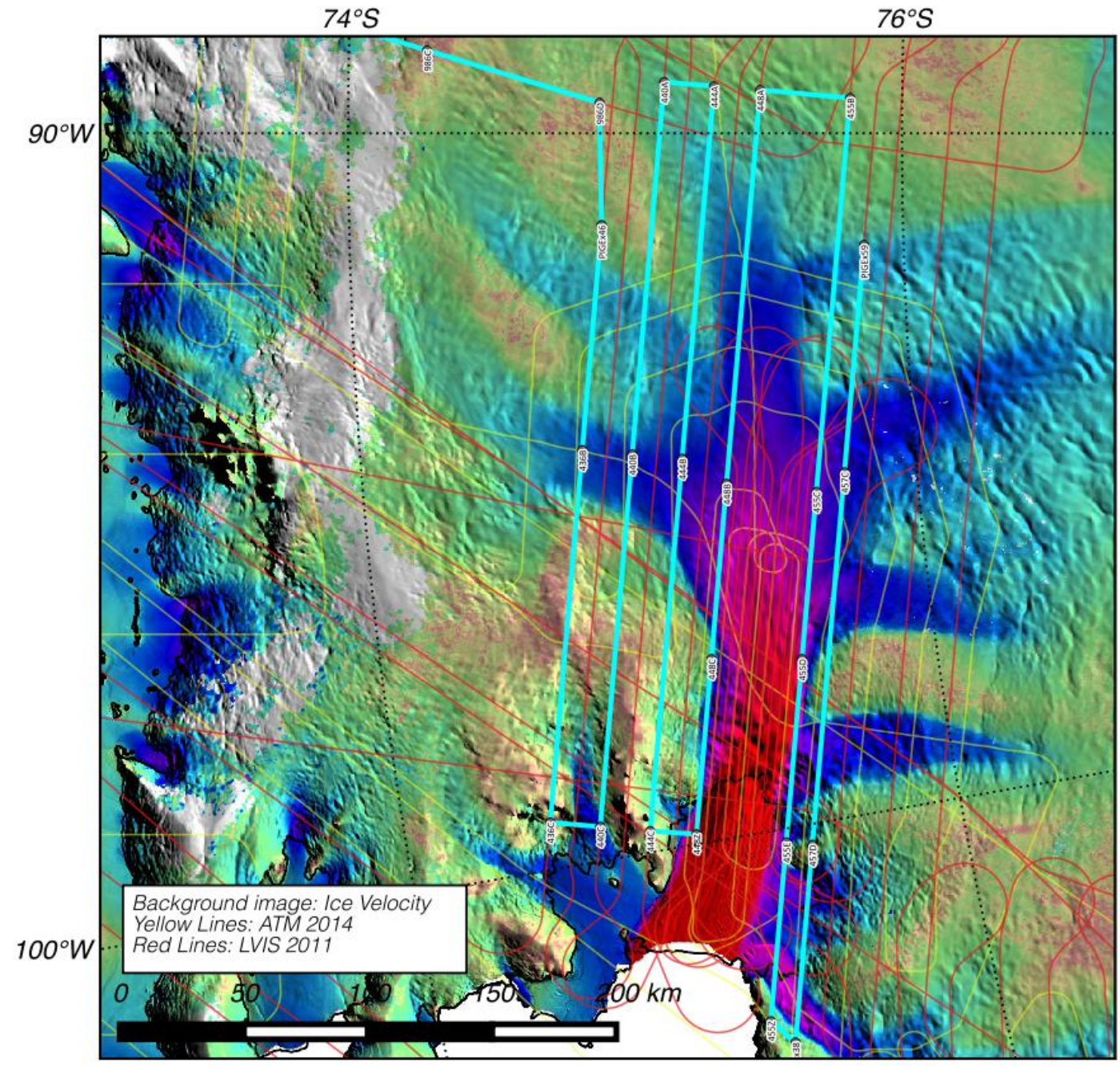
Land Ice – English Coast 03			Priority: Baseline	
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
2.9 hours	420 knots	9.8 hours	none	Portions in 2011, 2014

Flown in 2014 to collect dh/dt measurements in the area inland of the Stange Ice Shelf and western George VI Ice Shelf along a 20 km coast-parallel grid. This grid continues the English Coast 01/02 grid inland, and connects with the South Peninsula grid in the east.



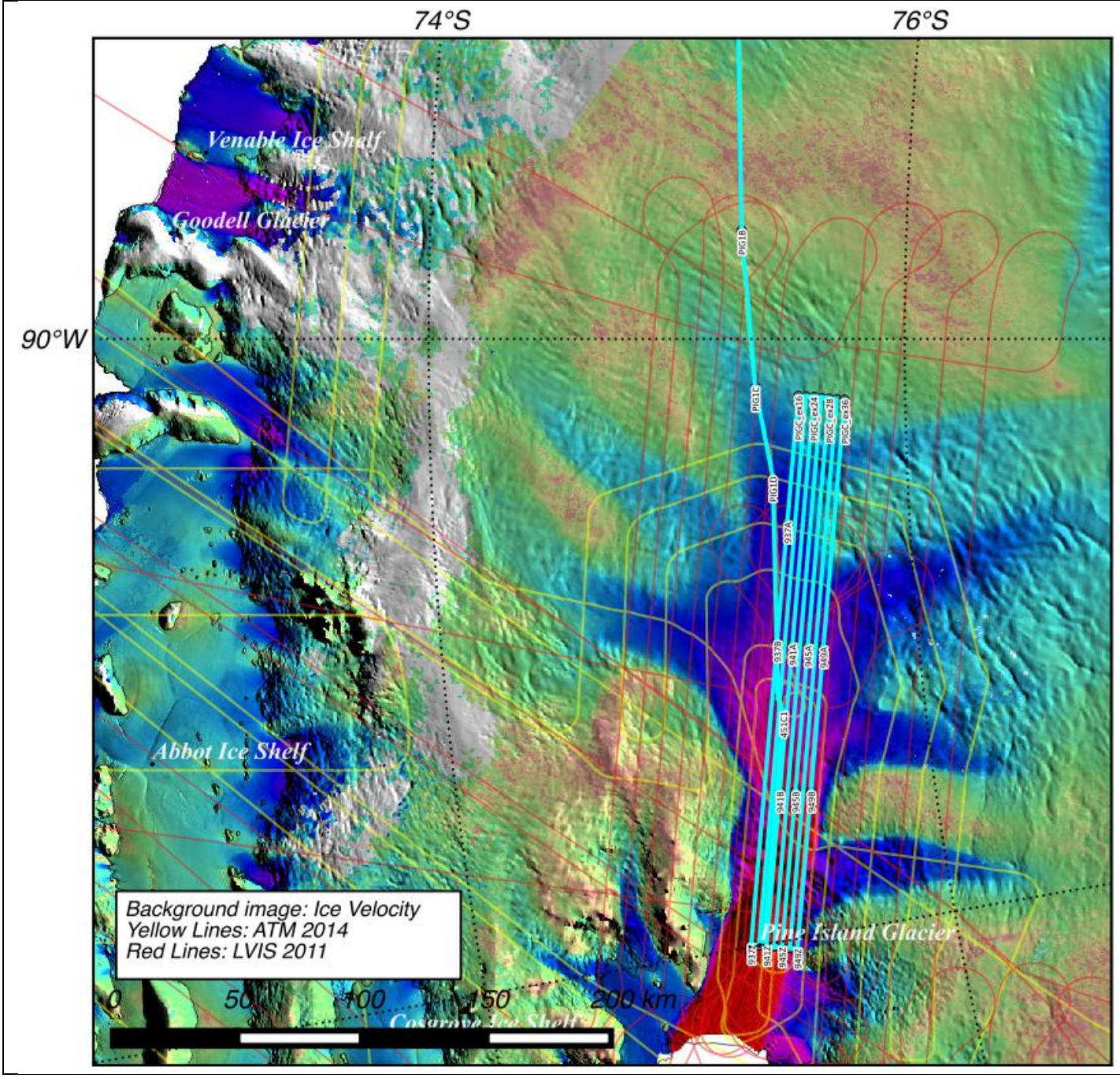
Land Ice – PIG Flank01				Priority: Baseline
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
3.1 hours	420 knots	10.0 hours	ICESat 234	Portions in 2009,2012, LVIS-2011

This flight is designed to repeat portions of LVIS flights flown on the G-V in 2011. The plan interleaves PIG Flank02, and together they form a nominal 10 km grid to the north and south of the Pine Island Glacier. Note on Flank01/02 plans: try to cover lines from both flanks in 1 flight is weather allows. Capture tributary bottom right at expense of inland section of line. Extra time: concentrate on main tributary of PIG.



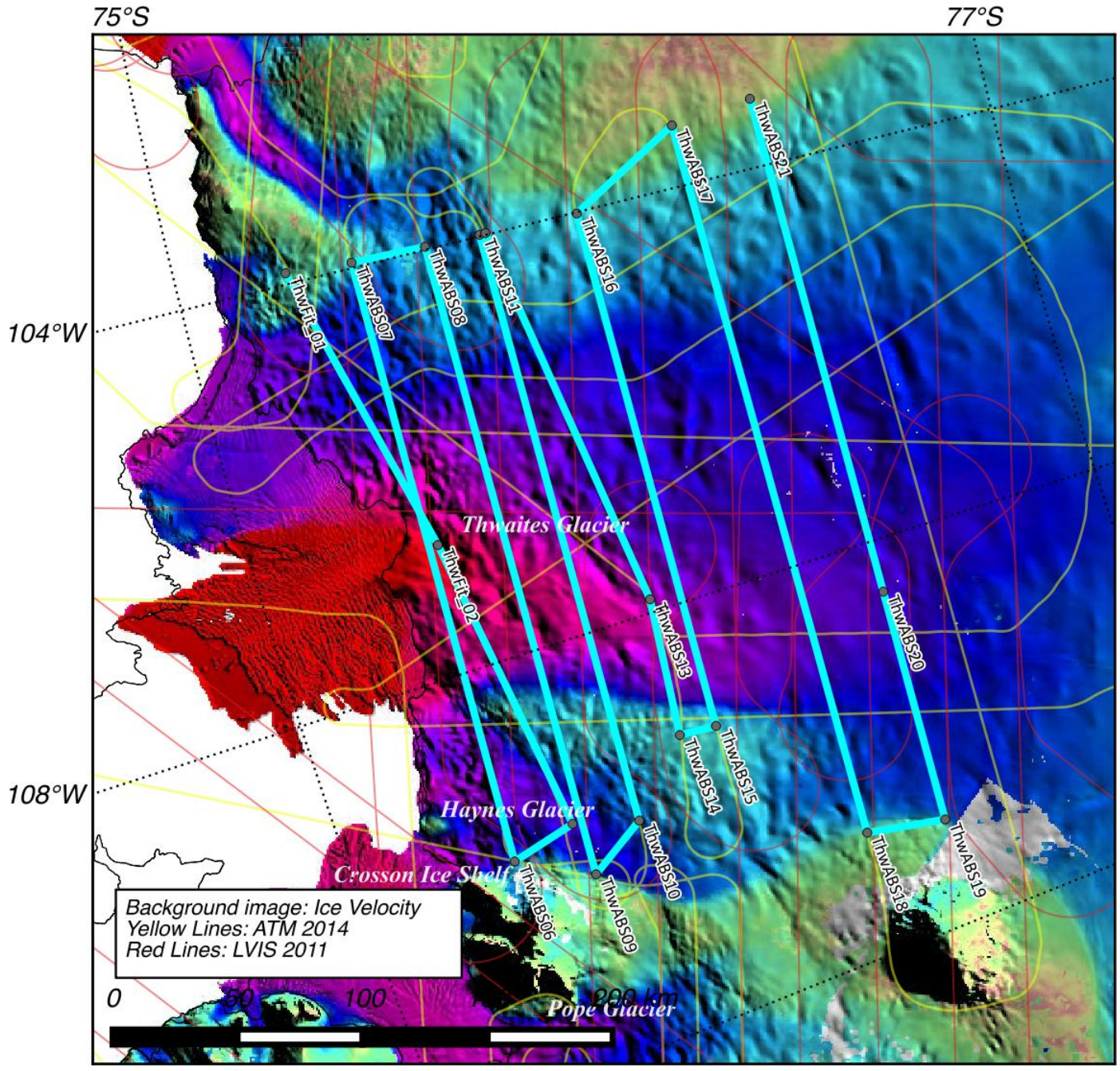
Land Ice – Pine Island 5				Priority: Baseline
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
3.3 hours	420 knots	10.6 hours	none	2009, 2011, 2012, 2014

This flight is a repeat and extension of LVIS 2009 and 2011 flights. Lines were extended to the east in order to capture more of the fast flow portions of the Pine Island Glacier.

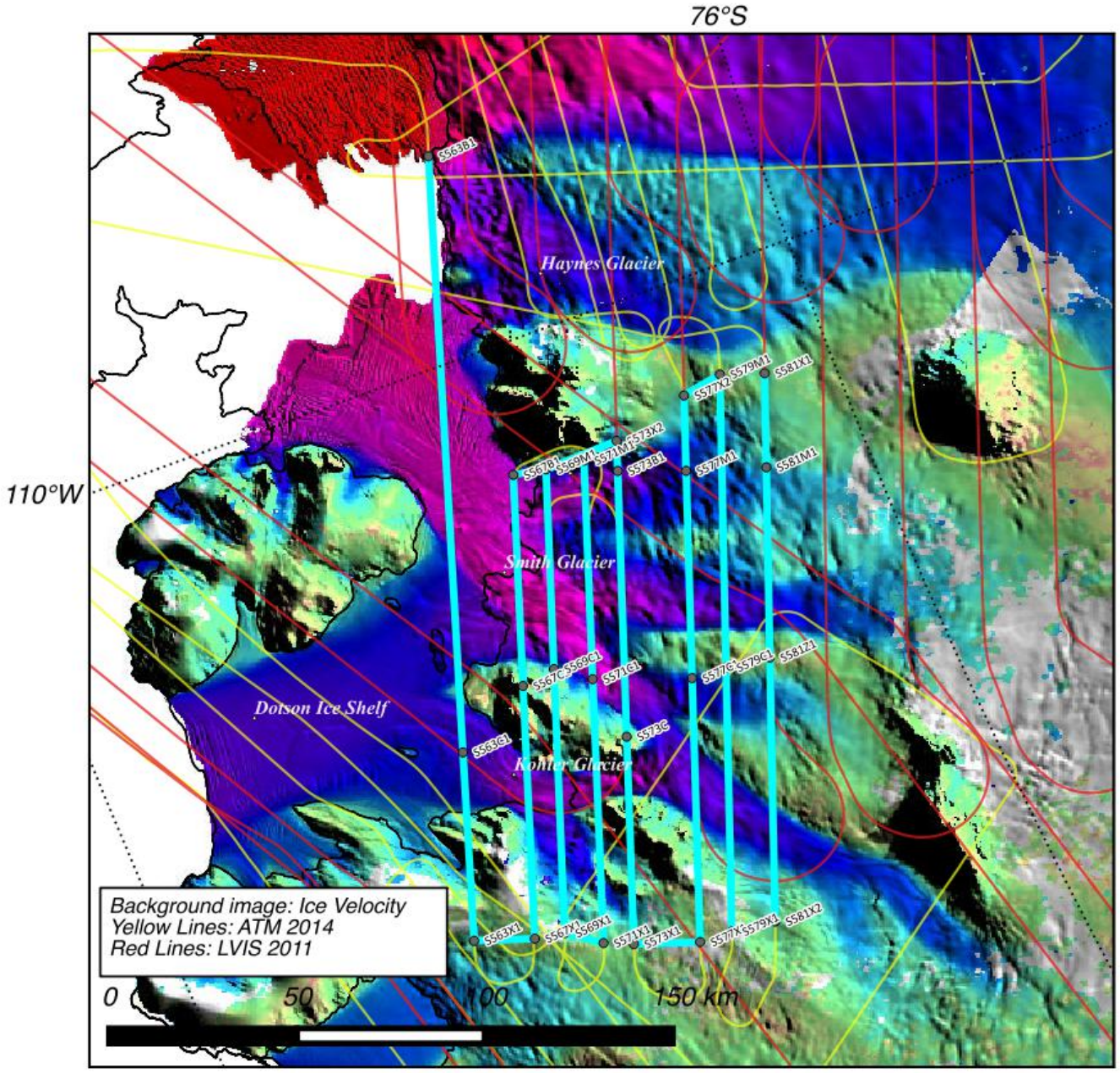


Land Ice – ThwaitesA				Priority: Baseline
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
3.7 hours	420 knots	10.2 hours	none	2009, 2011, 2012, 2014

This mission was flown in 2014, and is designed to collect dh/dt measurements over lower Thwaites Glacier. It re- occupies six flight lines first flown in 2011 and 2012 as part of an extensive grid, as well as two crossing lines last flown in 2009, and first flown in 2002 by ATM and CreSIS as part of the NASA- Chilean project. The plan has been slightly revised to incorporate an LVIS 2011 grid line on the southern end of the plan. If extra time, potential options: repeat LVIS 2011/icesat line through center of grid or attempt to catch outer edge or arch.

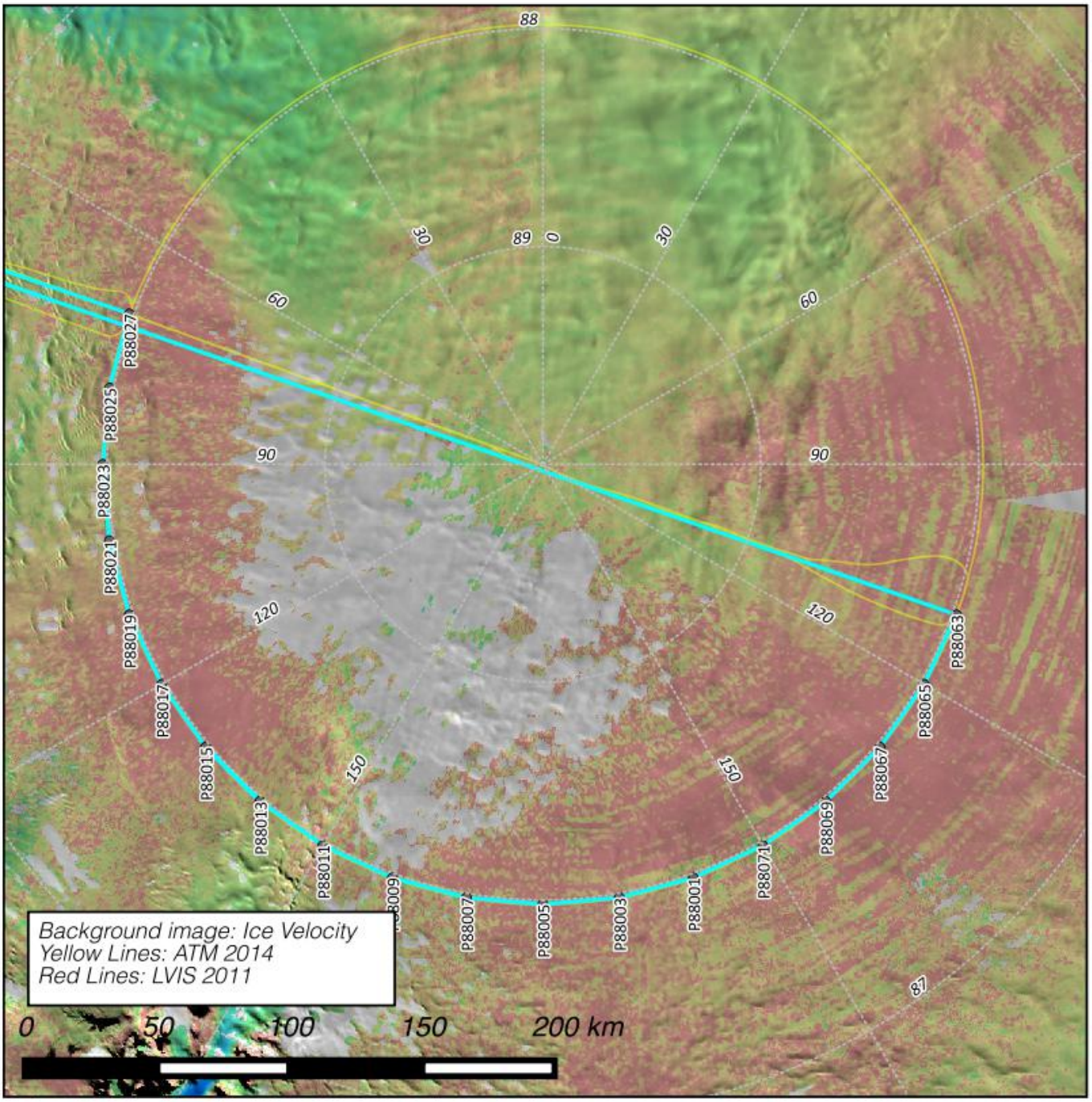


Land Ice - Thwaites-Smith-Kohler 08				Priority: Baseline
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
3.8 hours	420 knots	10.2 hours	none	Portions in 2012, LVIS 2011
This mission was flown in 2014 and is based on the western portion of the 2012 PTSK High-Altitude mission. It is designed to collect dh/dt measurements over the Smith, Kohler and Pope Glacier catchments.				



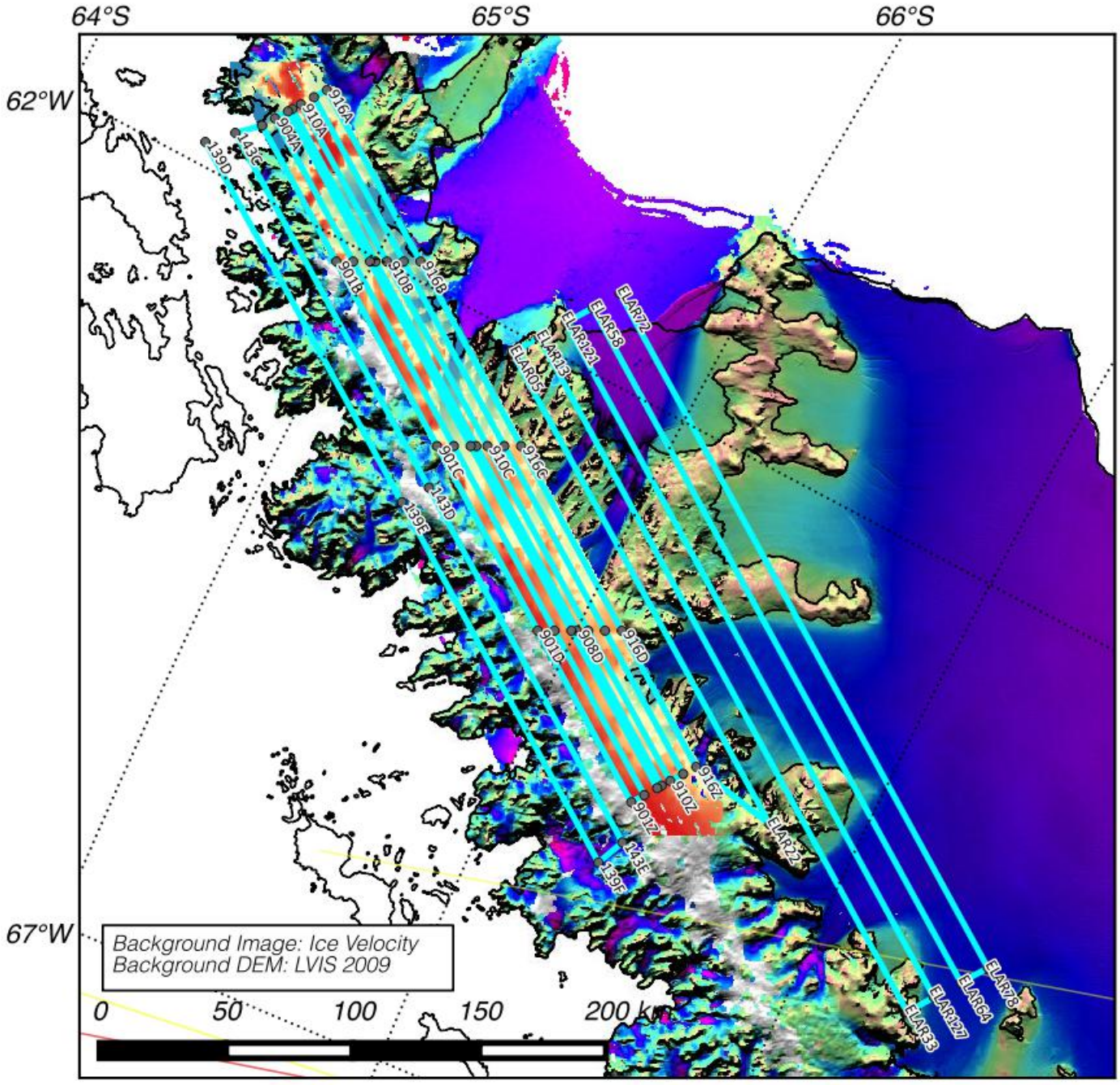
Land Ice – Pole Hole West				Priority: Baseline
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
4.8 hours	440 knots	11.0 hours	ICESat-2	2014

This flight was flown in 2014, and its purpose is to sample the surface topography at the southern apex of half of all planned IceSat-II orbits. Specifically this flight samples the ground tracks on the west Antarctica and Trans-Antarctic Mountains side of the Pole. Repeat of 2014 flight potential provides information on the changes of the surface. Note: "Dark zone" within 20km of the pole – switch off instrumentation.



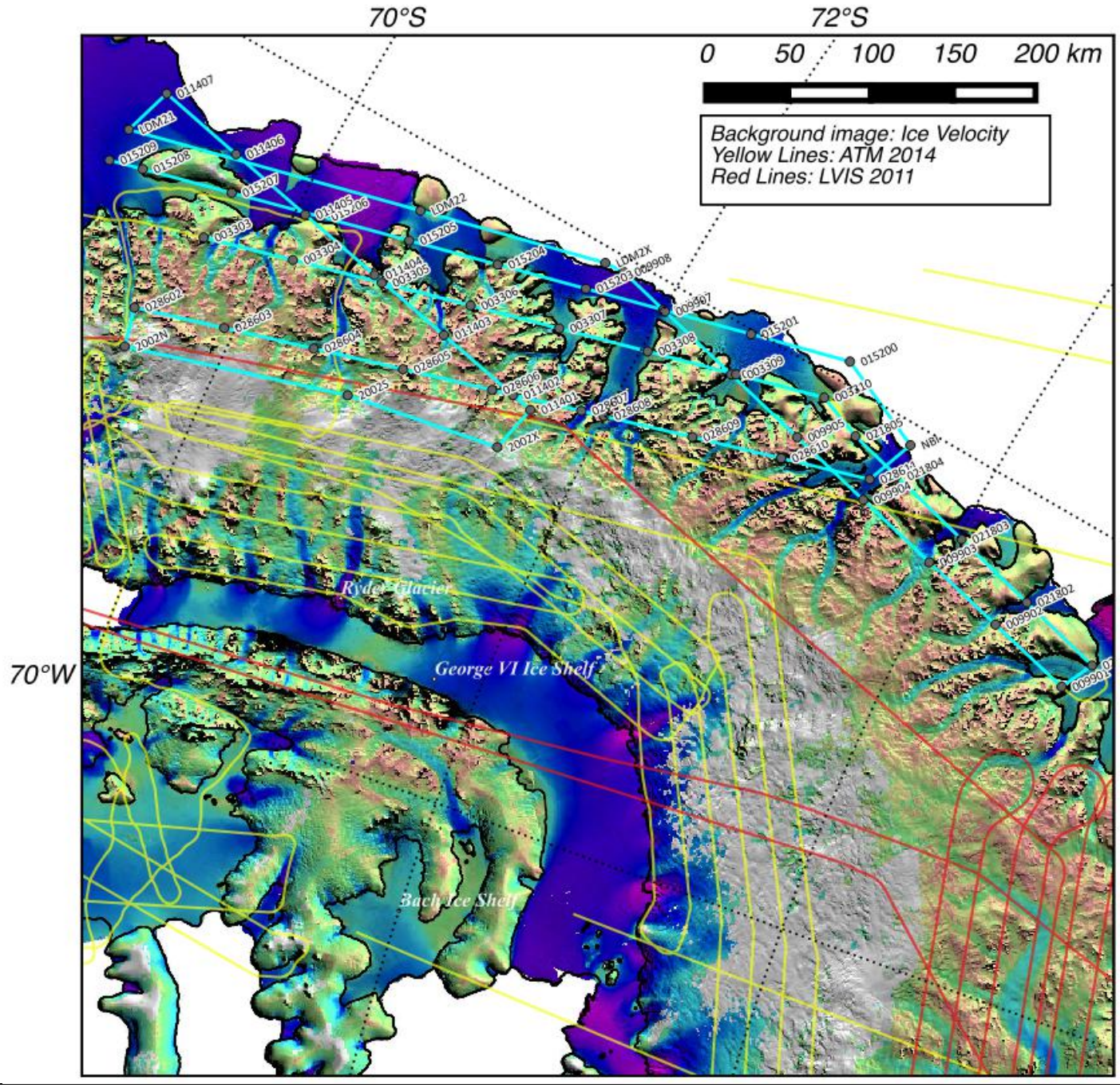
Land Ice – Crane 2				Priority: High
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
1.9 hours	420 knots	9.8 hours	none	2009

This plan repeats part of the LVIS grid from 2009. To the East and West of the LVIS grid, it extends lines at 10km intervals. This plan interleaves the Crane01 plan. The intent is to get broad spatial coverage in this area with either one of these plans in case weather prevents both missions from being flown.



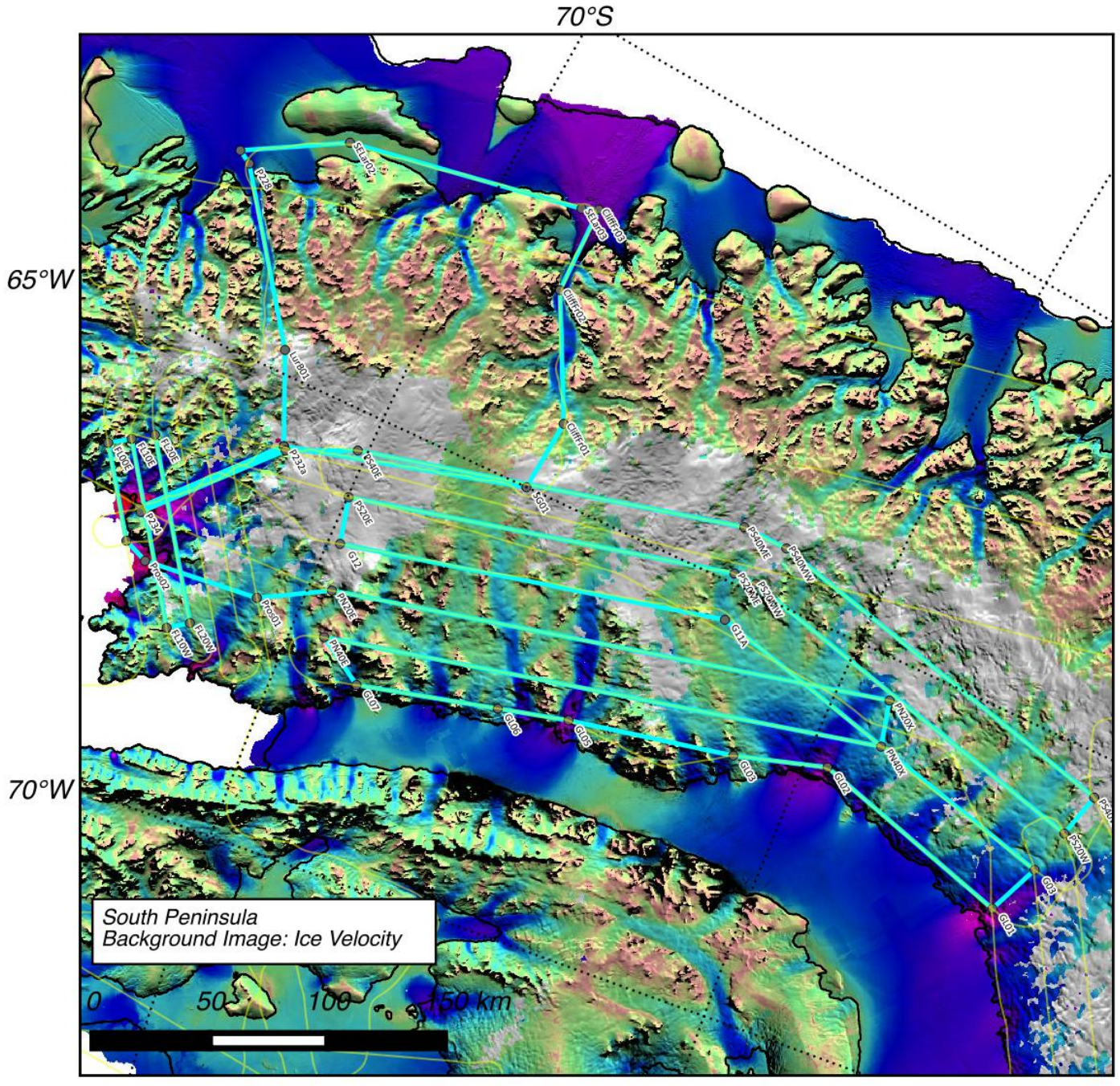
Land Ice – LarsenD01				Priority: High
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
2.4 hours	420 knots	9 hours	ICESat 33,218,99,114,286,152	Partial in 2014

This is a new flight, designed to map dh/dt in the area of the Larsen-D Ice Shelf, between the southern end of the Larsen-C and the northwestern Ronne ice shelves. It is designed primarily along IceSat-1 tracks, supplemented by a 2002 NASA-Chilean line along the Peninsula's ridgeline and a new extension to the south. Any extra time allows other priority lines to be added, depending on clouds.



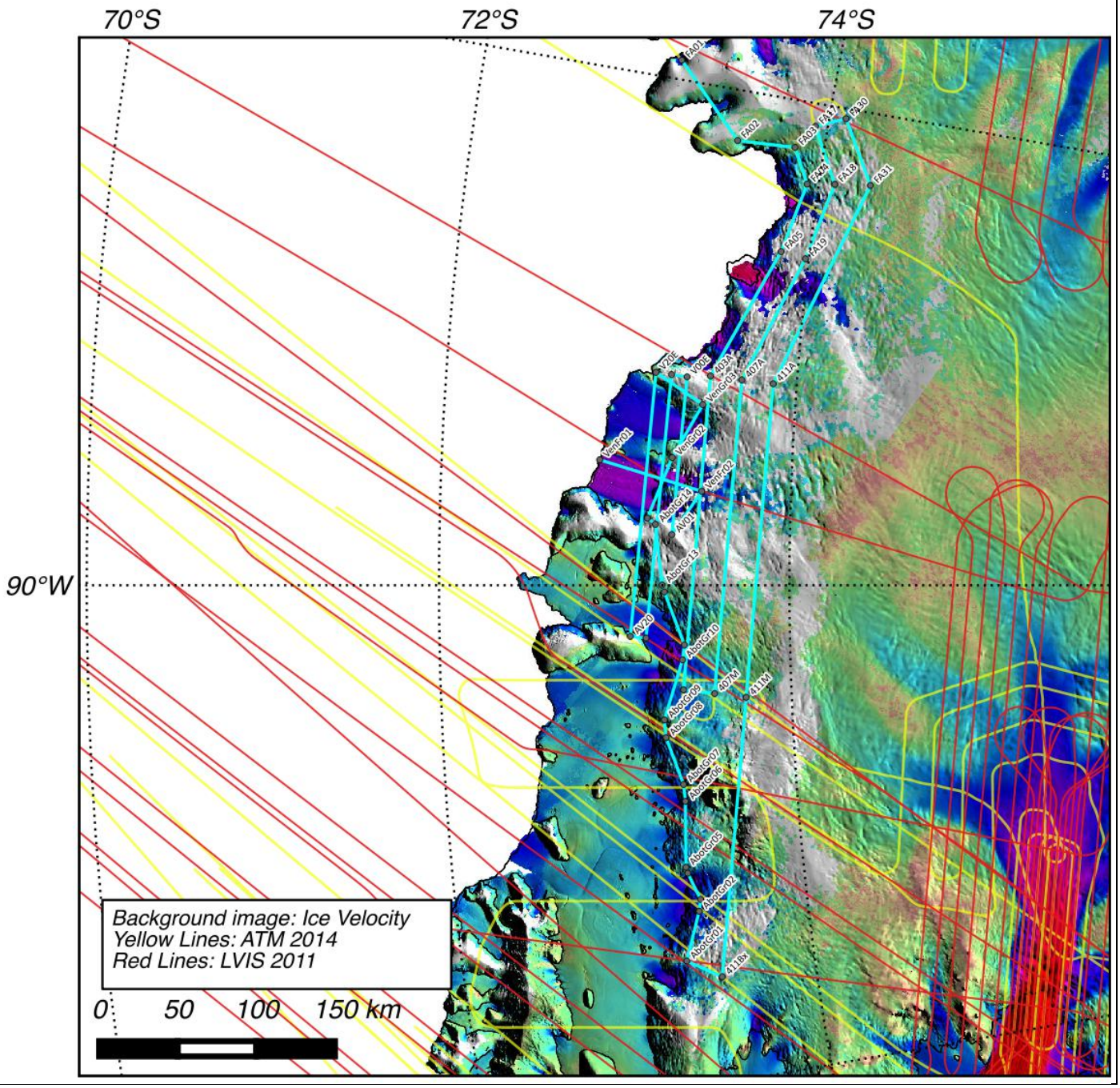
Land Ice – South Peninsula				Priority: High
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
2.4 hours	420 knots	9.8 hours	none	Portions in 2004,2008,2009,2010,2011, **2014**

Repeat flight to assess dh/dt of four glaciers draining the Dyer Plateau. These are the Fleming, Lurabee, and Clifford. A portion of the grounding line along the George VI Ice Shelf has been straightened for GV flying. 2 lines are placed along X glacier to enable repeat coverage of 2014 lines. Any extra time allows other priority lines to be added (e.g., icesat), depending on clouds. Cliffr01 to Cliffr02 priority (be on line) over Cliffr02 to Cliffr03 (close to line). Larsen ice shelf lines SE03 to P228: Don't have to exactly repeat.



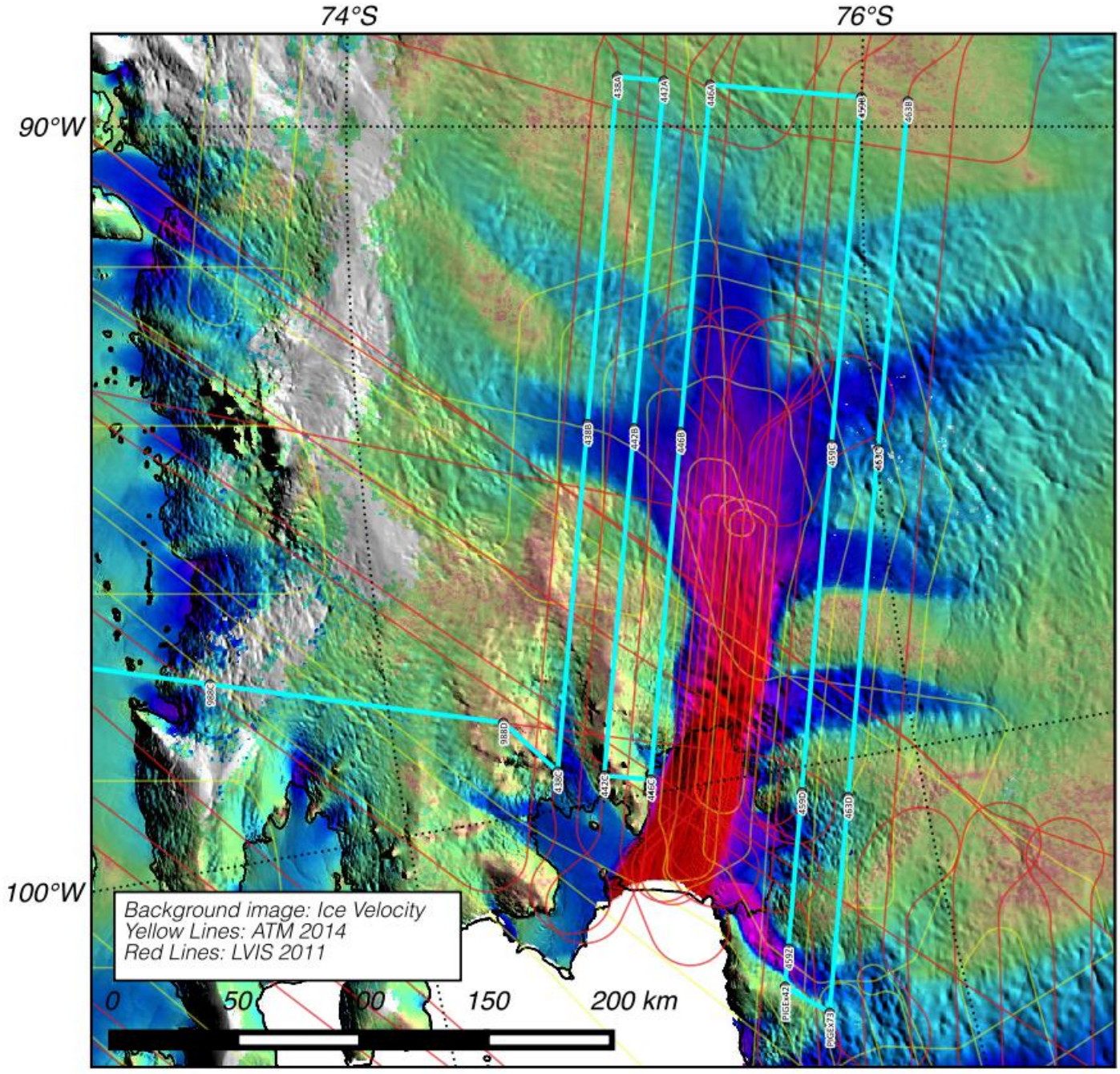
Land Ice – Ferrigno-Alison-Abbott 01				Priority: High
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
2.9 hours	420 knots	9.8 hours	ICESat 234	Portions in 2008,2009,2011,2012,2014

This flight was flown in 2014 and was designed to collect dh/dt measurements on established OIB flight lines along the coast near the Ferrigno and Alison ice streams, and adjacent grounded ice along the Eights Coast. It has been re-designed slightly to take advantage of extra time. The inland grid line is extended along a previously un-flown LVIS grid line. This serves as a transit west in order to pick up another 2009 line that covers the grounding line of Abbott. This continues east to cover the grounding line of the Venable Ice Shelf and ICESat track 234 over the ice shelf front - both of which were flown in 2008,2009, & 2011. If time permits, lines over the grounding line from the Abbott-Venable plan can be added.



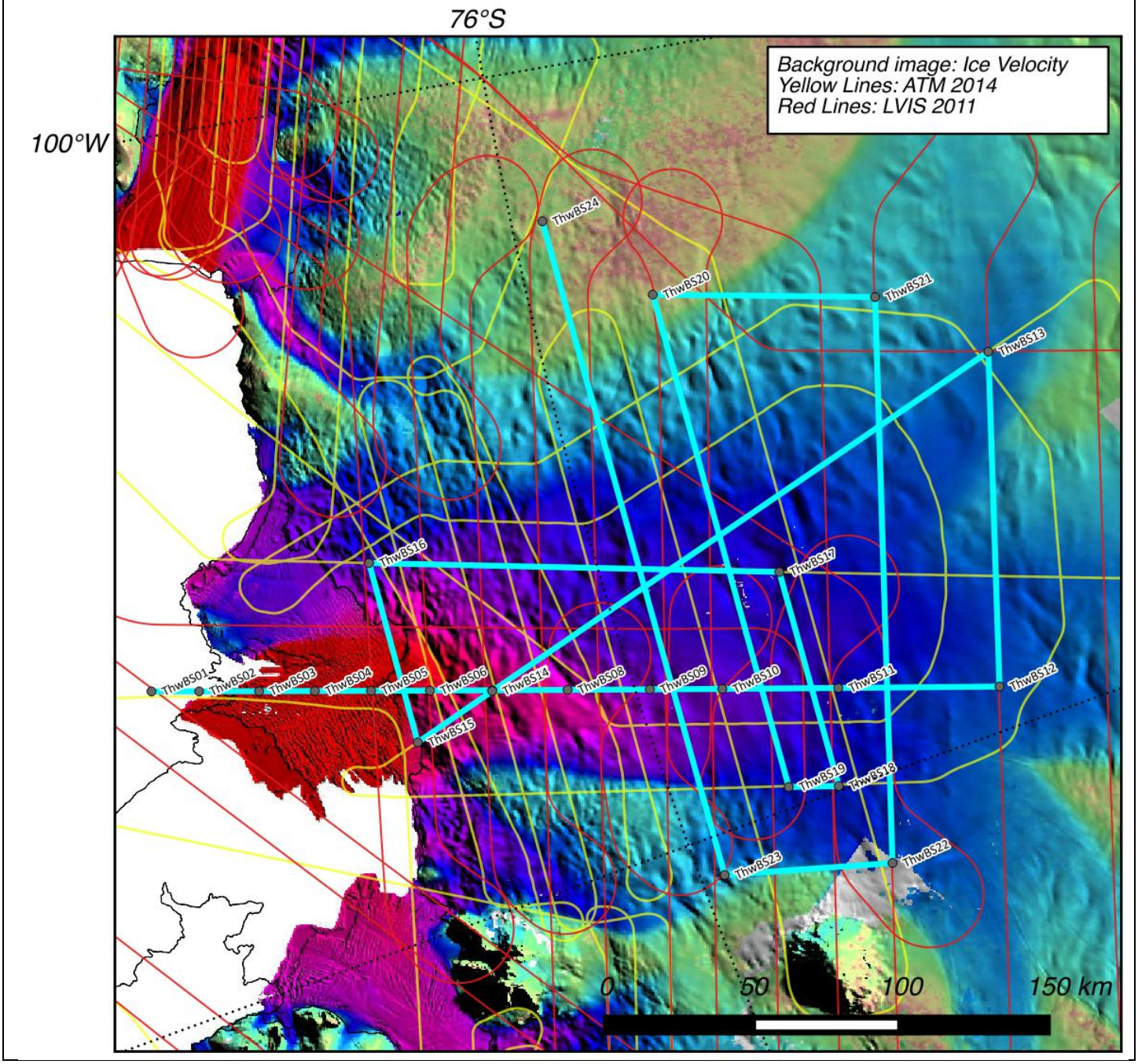
Land Ice – PIG Flank02				Priority: High
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
3.2 hours	420 knots	9.8 hours	ICESat 160	2011, Portion in 2012

This flight is designed to repeat portions of LVIS flights flown on the G-V in 2011. The plan interleaves PIG Flank02, and together they form a nominal 10 km grid to the north and south of the Pine Island Glacier. Capture lower tributary over inland portion of grid. Extra time: look for lines over main tributary of PIG.



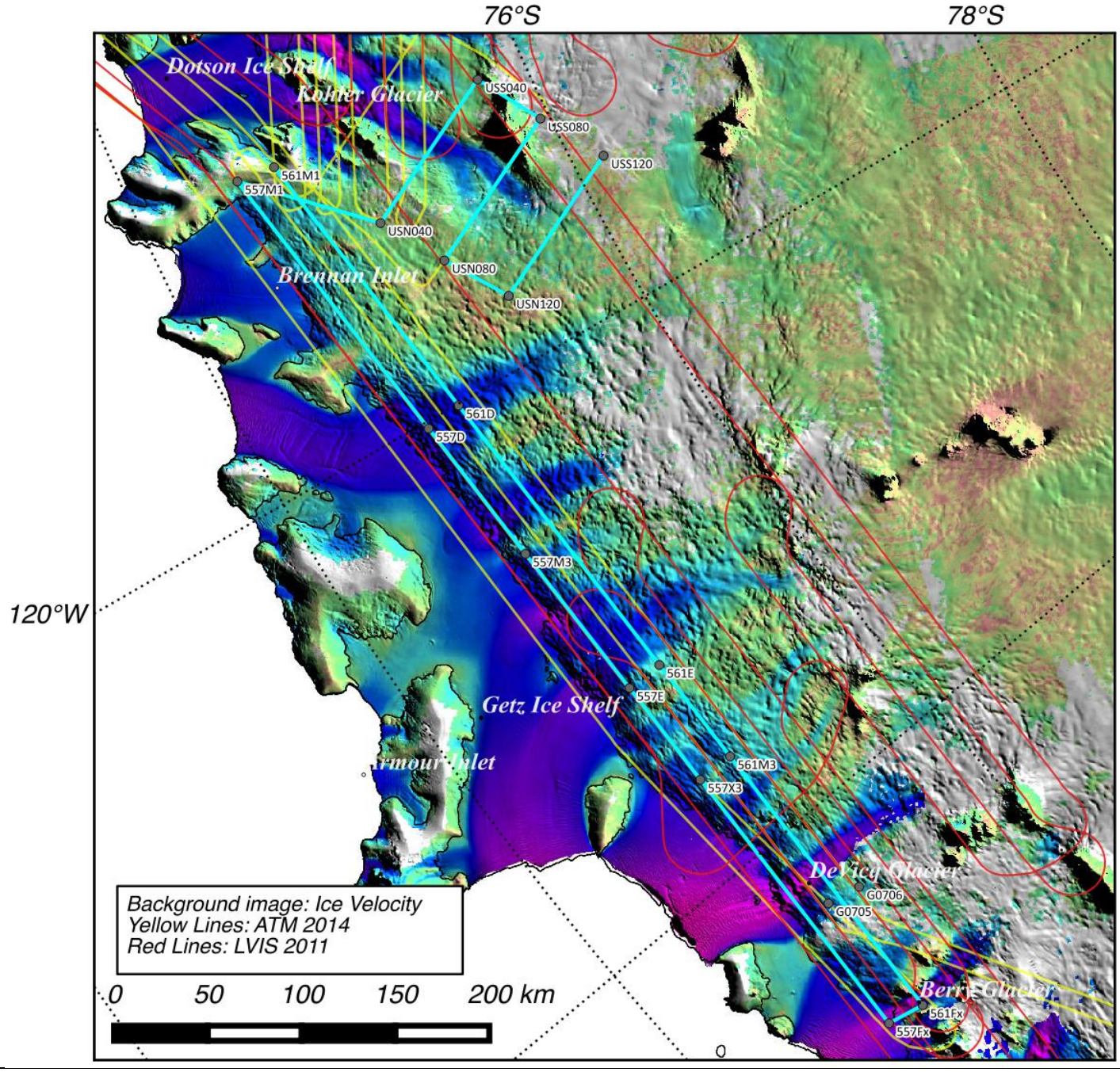
Land Ice – ThwaitesBS				Priority: High
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
3.7 hours	420 knots	10.4 hours	ICESat 1306,288,190	LVIS-2011, ATM-2011, 2012

This flight replaces the Thwaites Arch plan. It incorporates icesat tracks, LVIS 2011 lines in the upper regions of Thwaites, and ATM 2011 and 2012 lines in the lower portion of the glacier.



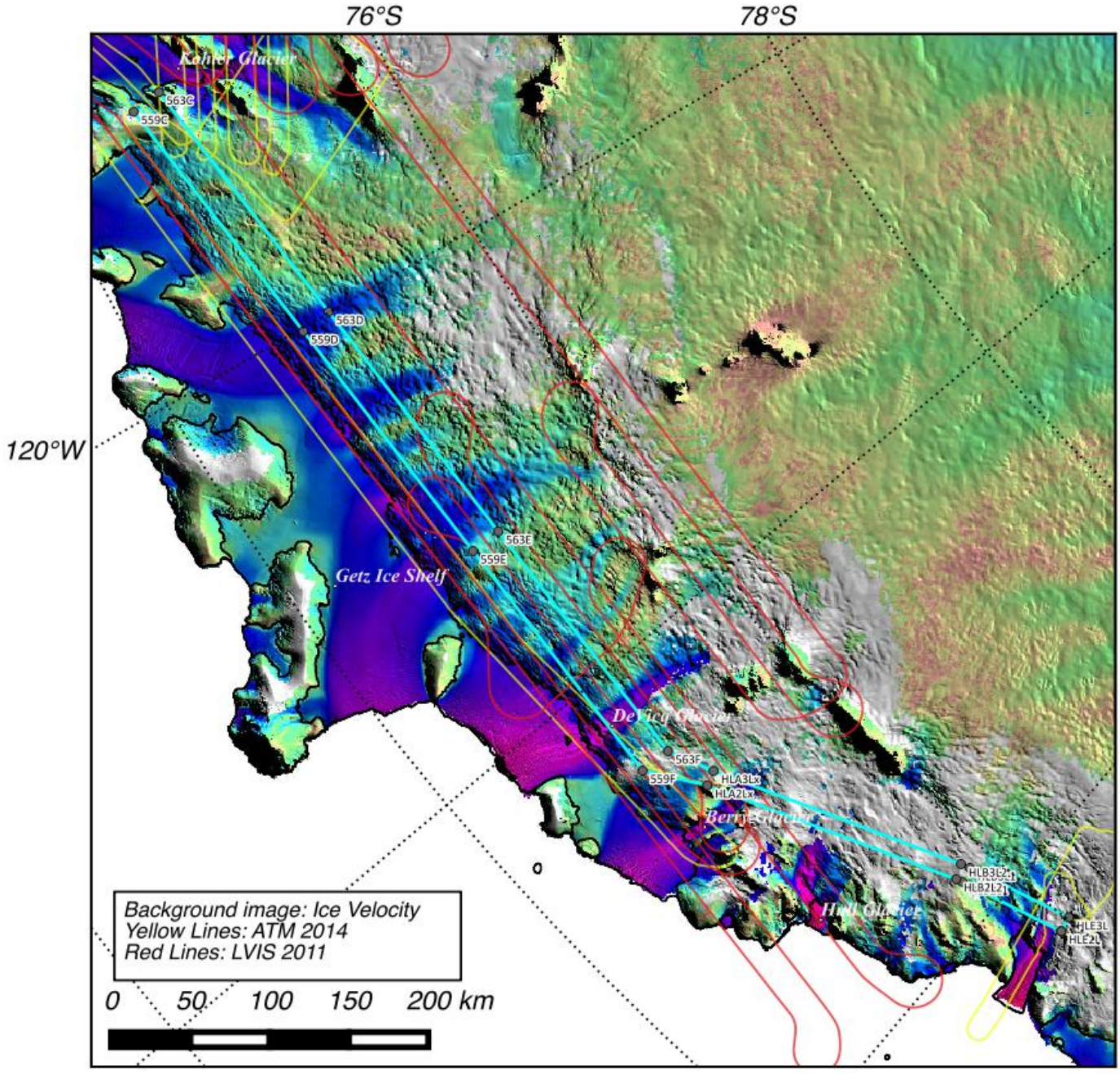
Land Ice – GetzC				Priority: High
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
4 hours	420 knots	10.5 hours	none	LVIS 2011, 2012,2014

This flight is a combination of GetzA, which was flown in 2014, and GetzB plans. It uses the grounding line portion of GetzA, and the inland leg of GetzB. It also combines the three southern-most legs that cover the upper portions of the Smith Glacier. LVIS flew three missions in the Getz area in 2011, so there will be ample opportunities for repeats if alternative options are required due to weather.



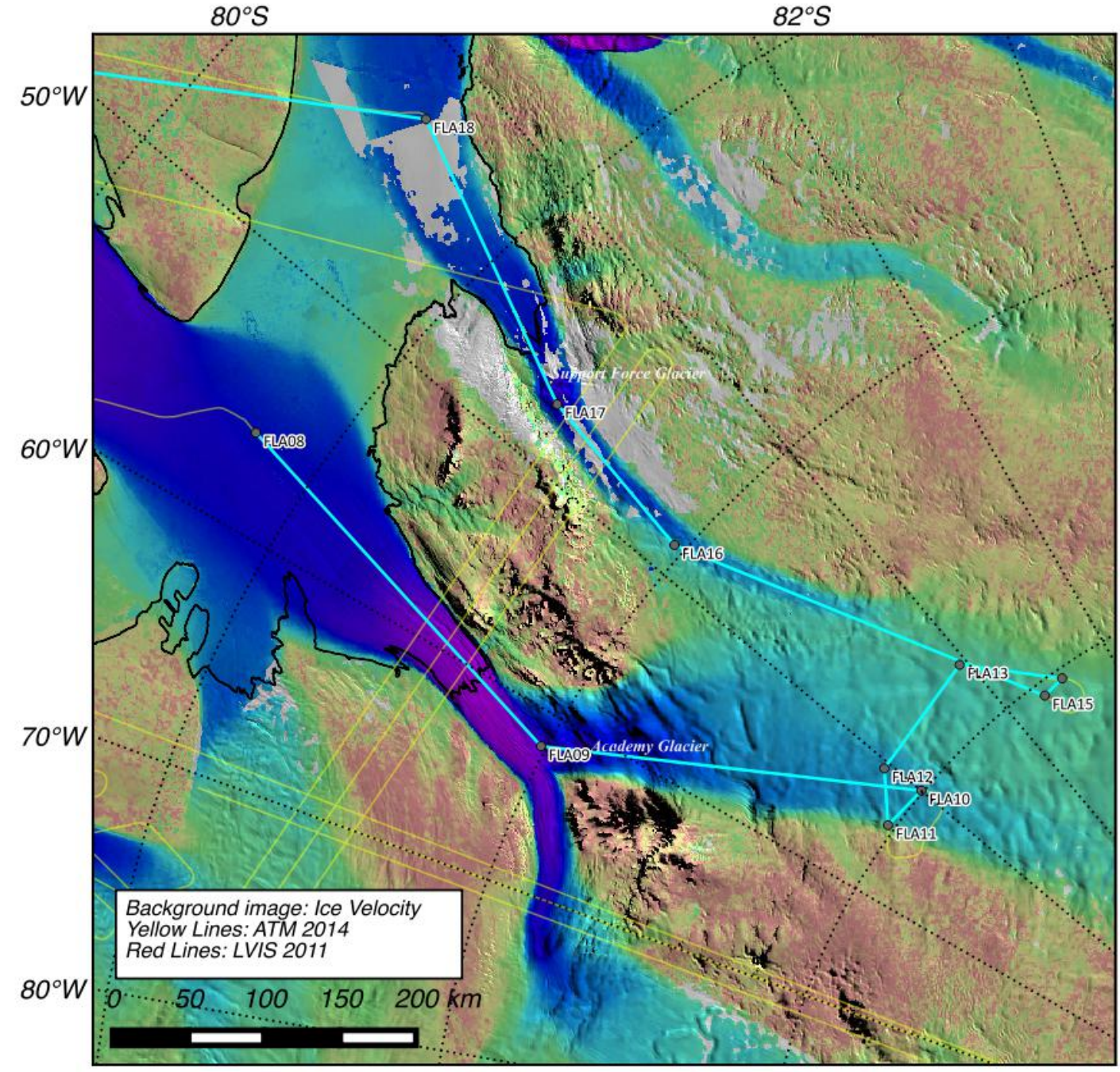
Land Ice – Hull-Land 04				Priority: High
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
4 hours	420 knots	10.1 hours	none	2011, 2014

This mission was flown in 2014, and was designed to map the coastal region encompassing the Hull and Land glaciers and surrounding areas to the west of the Getz Ice Shelf. The purpose is to establish surface topography measurements for dh/dt. LVIS grid lines in the Getz area from 2011 are repeated.



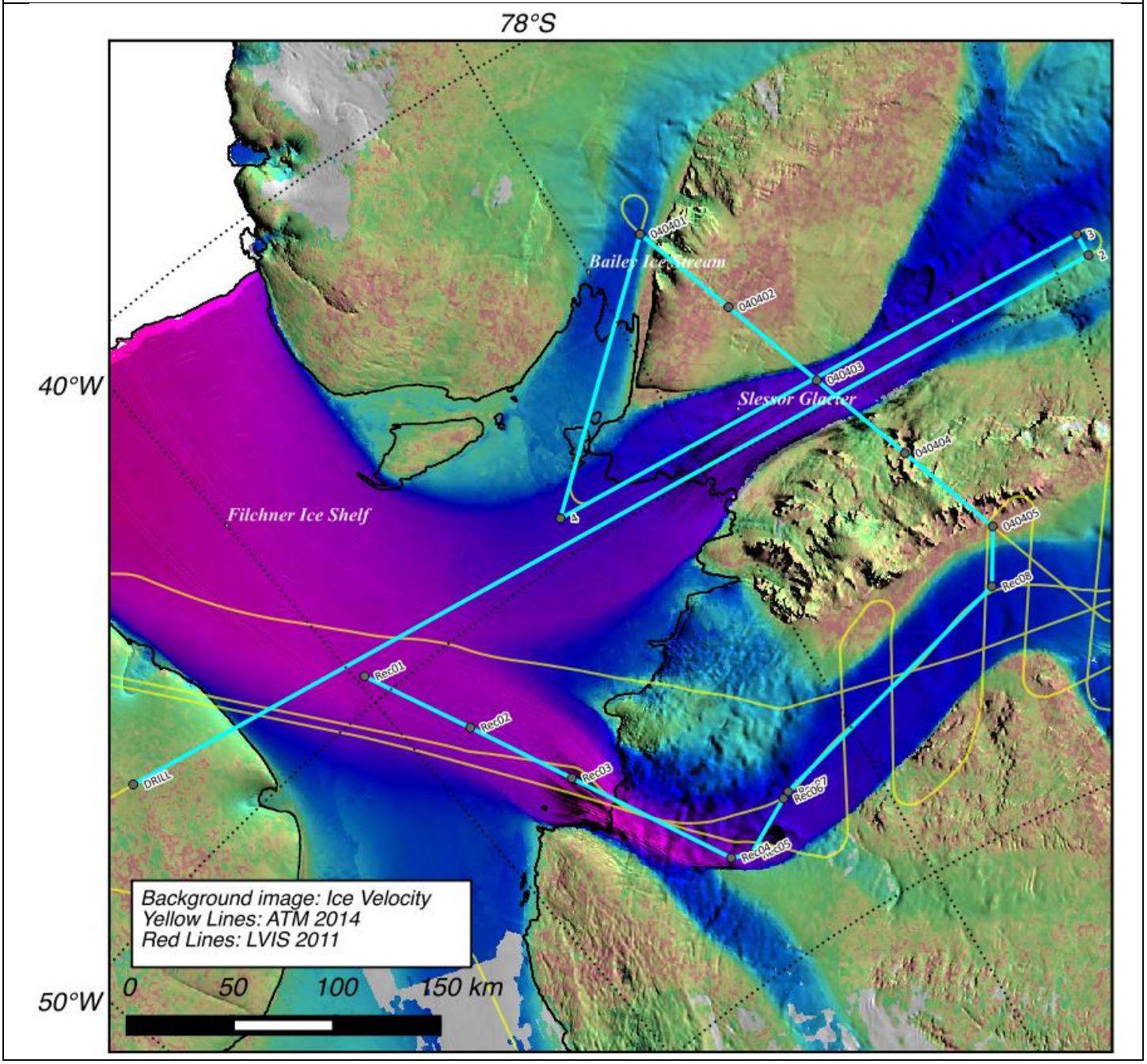
Land Ice – Foundation Lakes 01				Priority: High
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
3.1 hours	420 knots	10.3 hours	none	2012, 2014

This flight was flown in 2014, and is a dh/dt repeat of the identical 15 October 2012 flight. For 2015, it occupies straightened approximations of the Foundation and Support Force ice streams, and crosses several subglacial lakes in their upper portions.

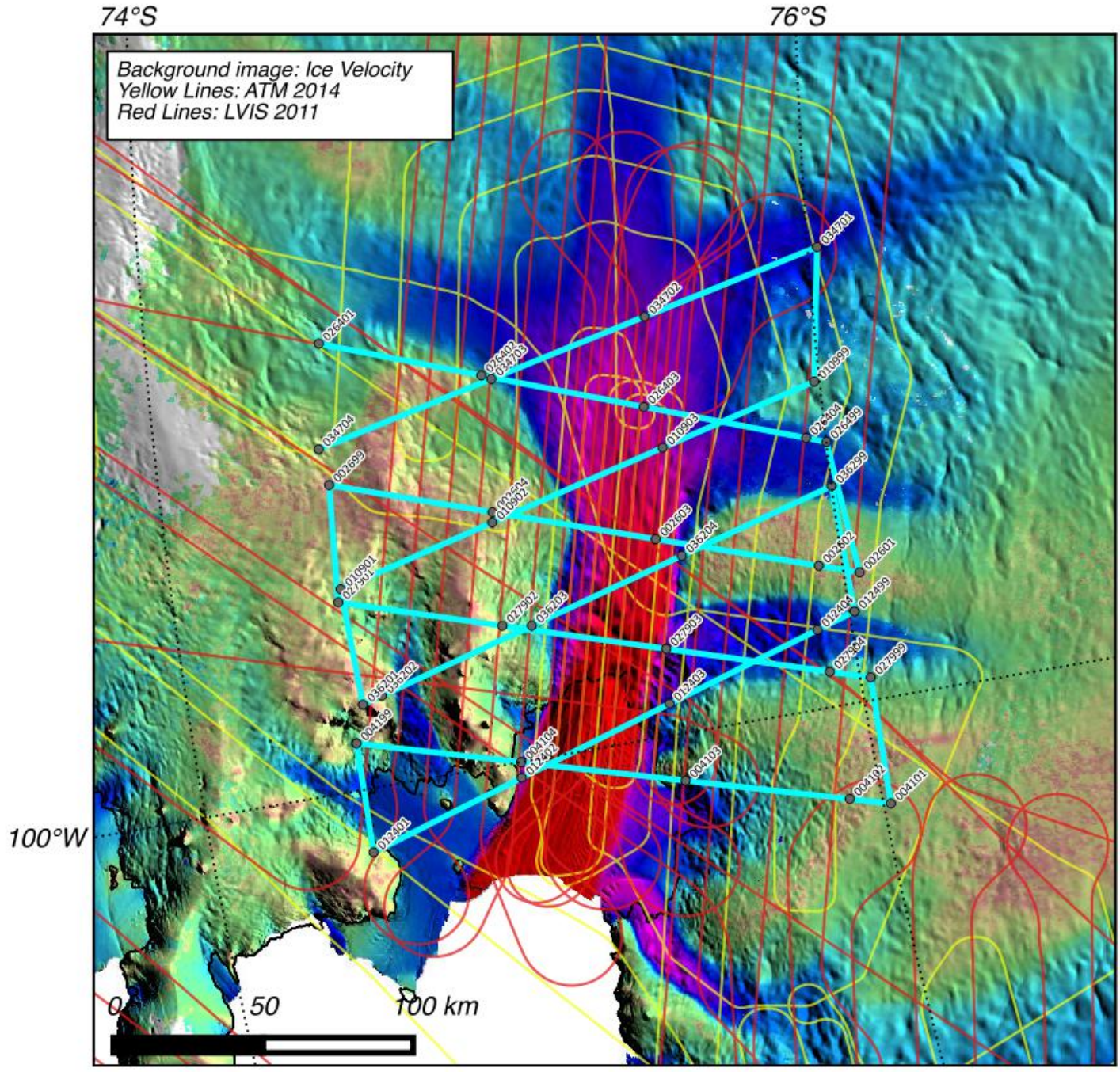


Land Ice – Slessor1a				Priority: High
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
4 hours	420 knots	10.6 hours	ICESat 404, 226	2011

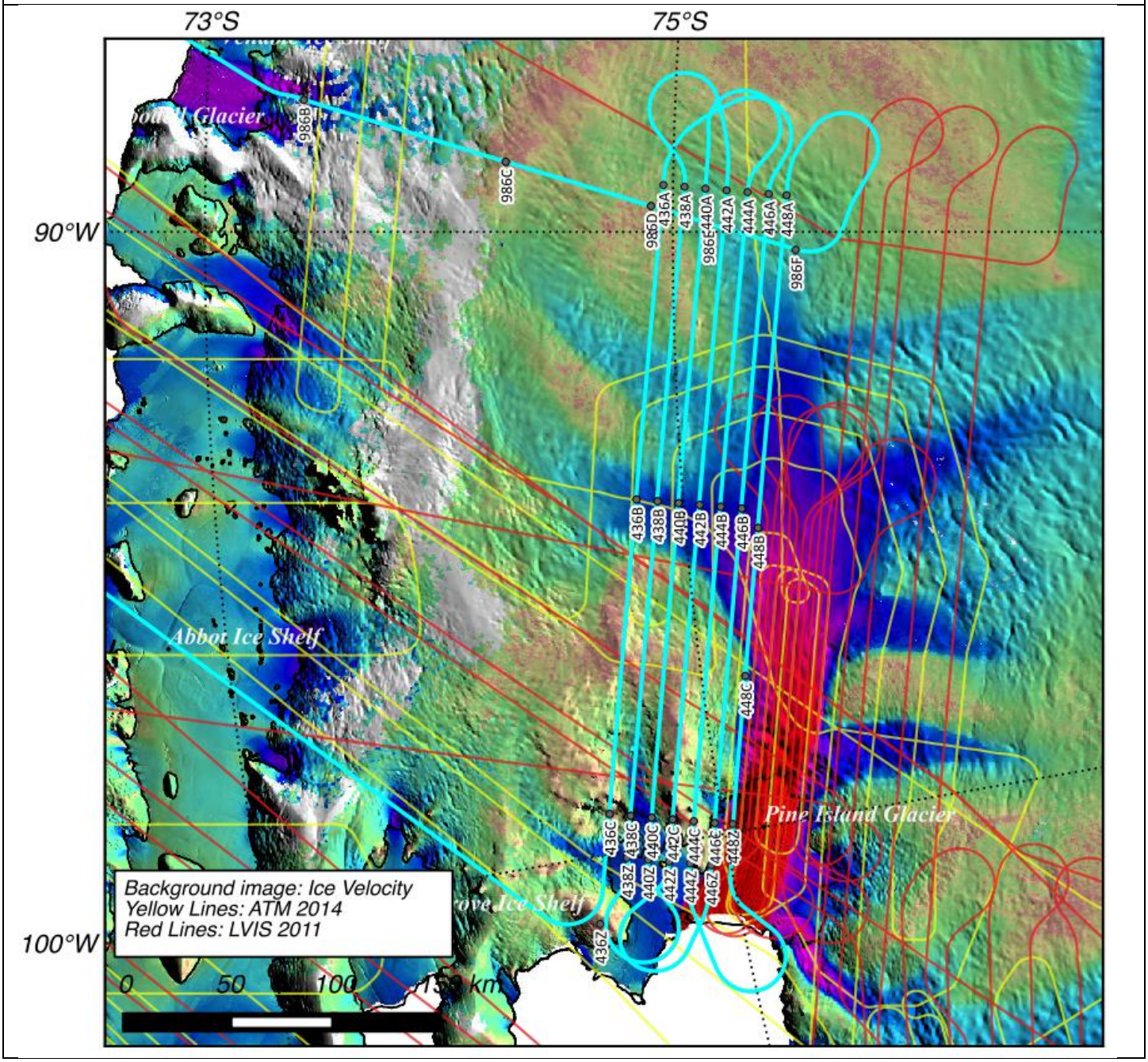
This flight is a near-repeat of the 21 October 2011 flight, and is intended to obtain dh/dt measurements of the lower Slessor, Bailey, and Recovery Glaciers. The line going over the Recovery Glacier grounding line was modified to use a straightened version of the November 7th 2011 flight line. An ICESat track connects the three glacier basins. Finally, the plan overflies a Berkner Island drill site where ice cores have been recovered.



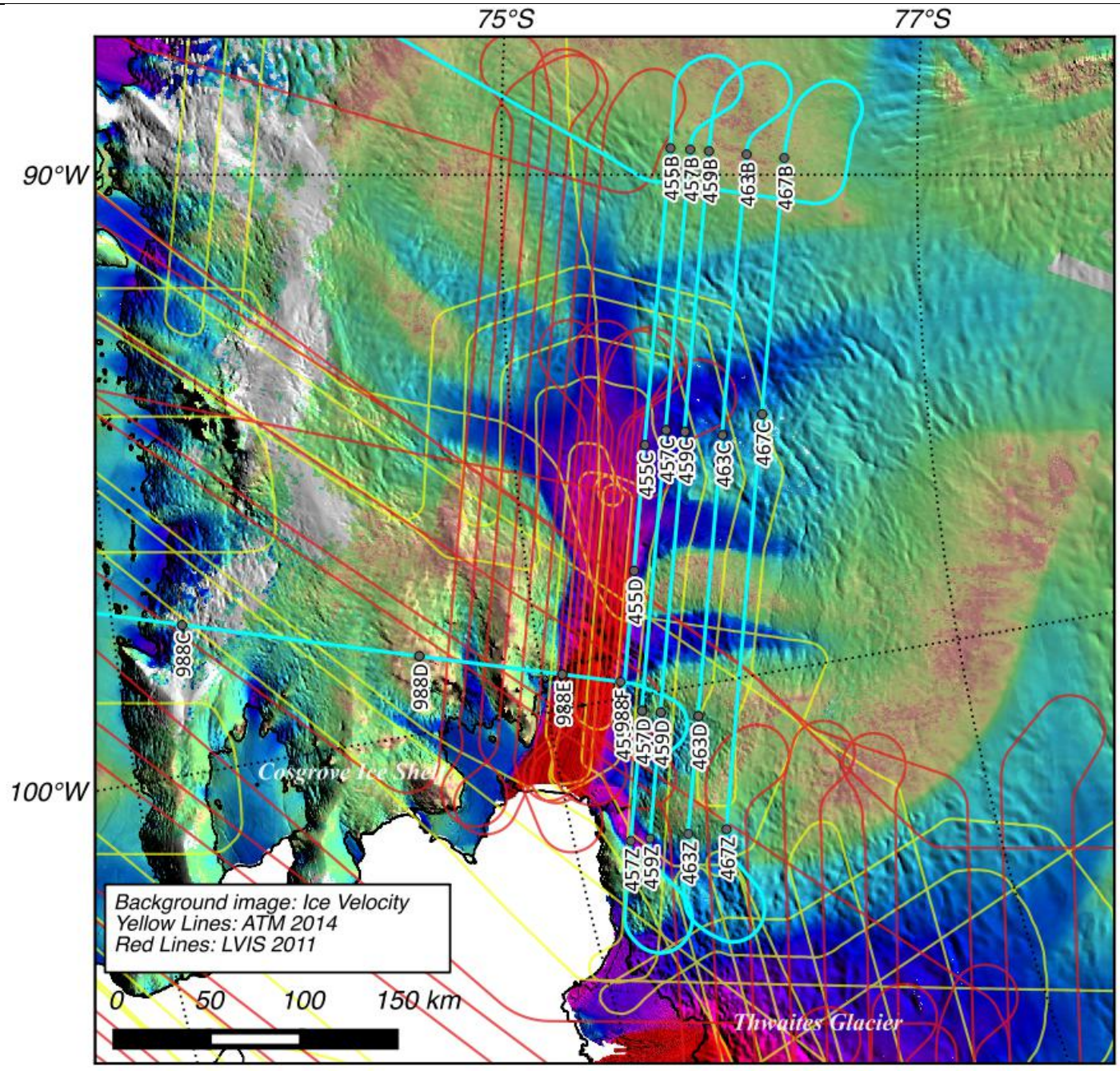
Land Ice - Pine Island 2b			Priority: Medium	
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
3.6 hours	420 knots	9.9 hours	ICESat 264,26,279,41,124,362,109,347	2009,2011
This flight is a near repeat of the 27 October 2009 IceBridge flight. It is intended to track ongoing changes in the Pine Island Glacier trunk, by comparison along ICESat ground tracks.				



Land Ice – LVIS PIG North				Priority: Medium
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
3.1 hours	420 knots	10.7 hours	ICESat 234	2011
This flight repeats the LVIS PIG North flight that was flown on the G-V in 2011. Consider lines already flown in PIG Flank 01 and 02 flights as needed.				

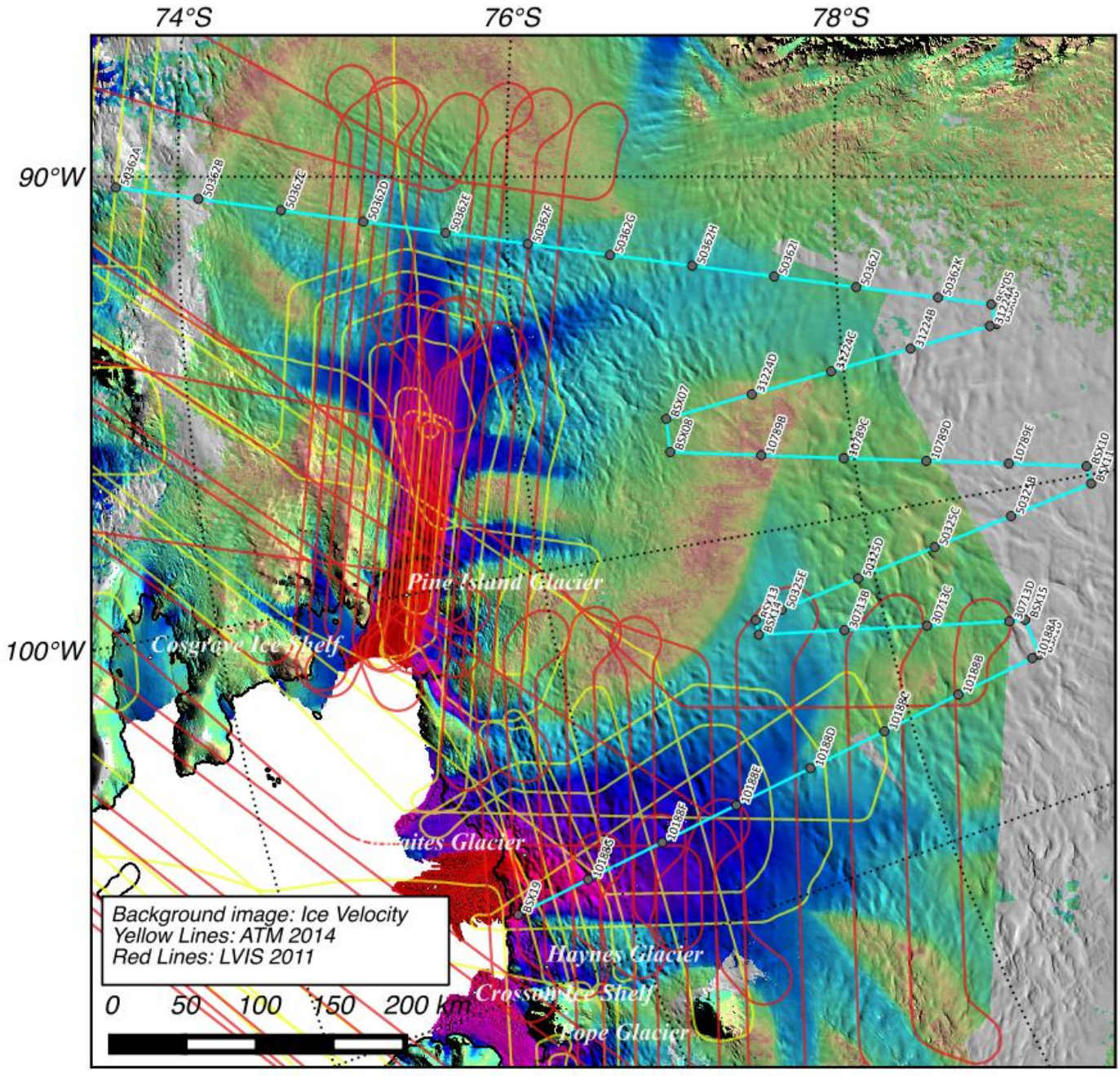


Land Ice – LVIS PIG South				Priority: Medium
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
3.1 hours	420 knots	10.1 hours	ICESat 160	2011
This flight repeats the LVIS PIG South flight that was flown on the G-V in 2011. Consider lines already flown in PIG Flank 01 and 02 flights as needed.				

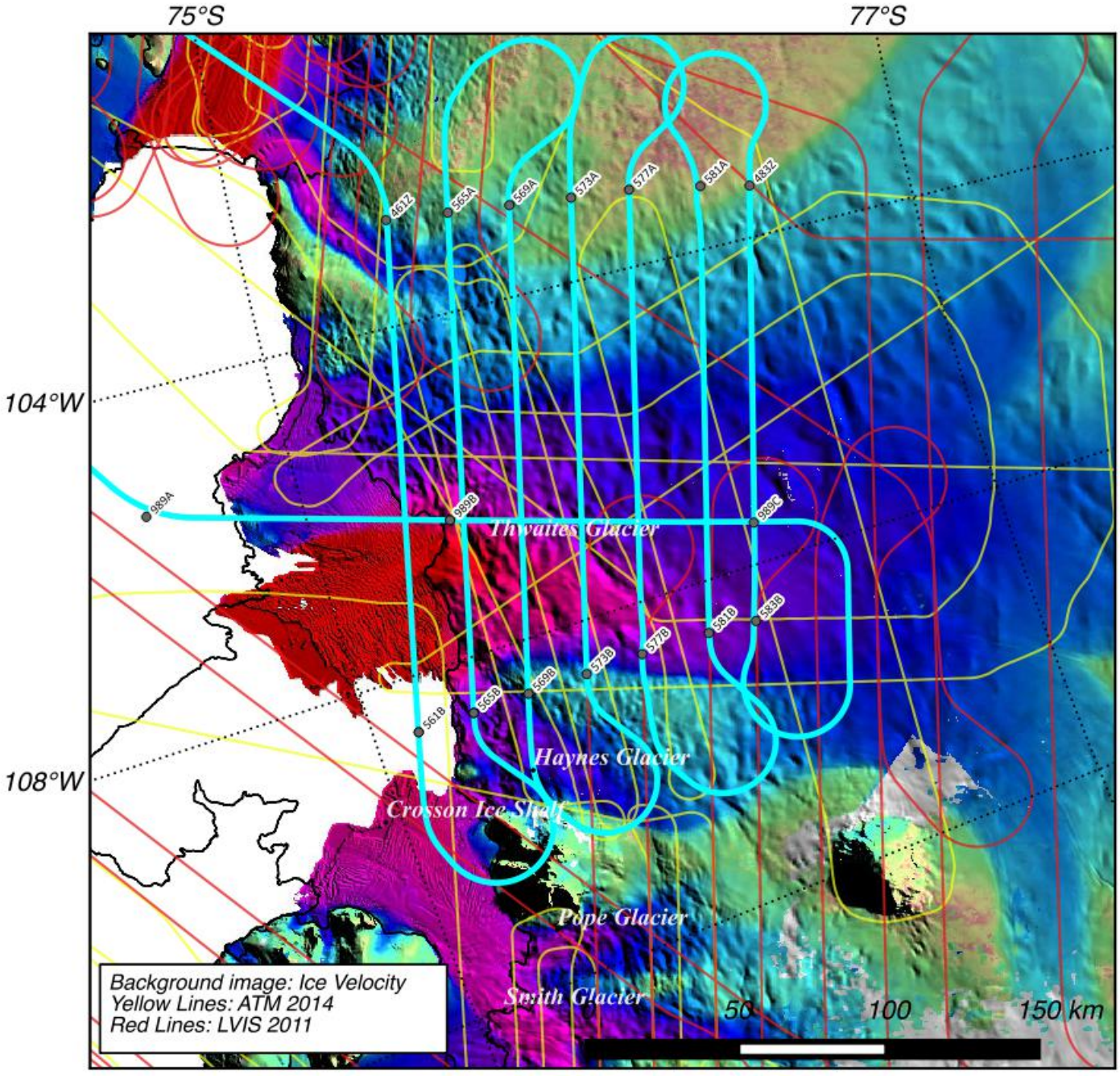


Land Ice - Icesat-2 WAIS			Priority: Medium	
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
3.2 hours	420 knots	10.2 hours	ICESat-2 0362,1224,0789,0325,0713,0188	none

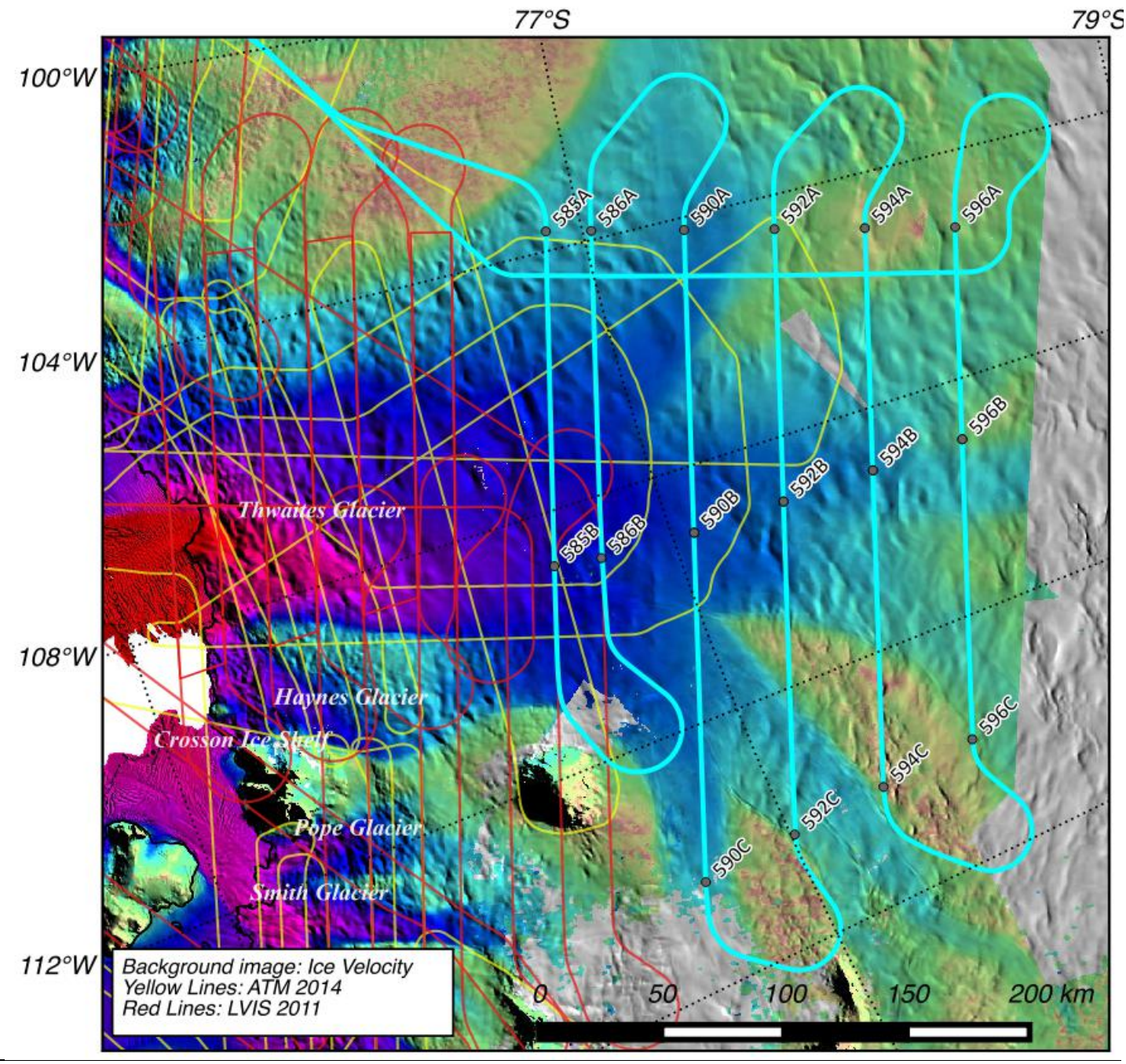
This is a new mission designed to collect baseline measurements along planned IceSat-2 ground tracks in 2014. Not flown in 2014. Most of the lines are located between the Pine Island and Thwaites channels, where the ice is expected to change relatively slowly, making this a suitable area for comparisons with future IceSat-2 measurements. This is also an area with relatively few dh/dt measurements collected to date, making it desirable to collect measurements of background change rates outside the fast-changing outlets. We also broaden the ice types measured with overflights of IceSat-2 ground tracks over lower Thwaites and upper Pine Island channels. We target left, center and right IS-2 beam pairs each with two ground tracks.



Land Ice – LVIS Lower Thwaites				Priority: Medium
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
3.7 hours	420 knots	10 hours	ICESat 71	LVIS 2011
This flight is a repeat the LVIS Lower Thwaites flight that was flown on the G-V in 2011. If ThwaitesA already flown, this concept is not a priority.				

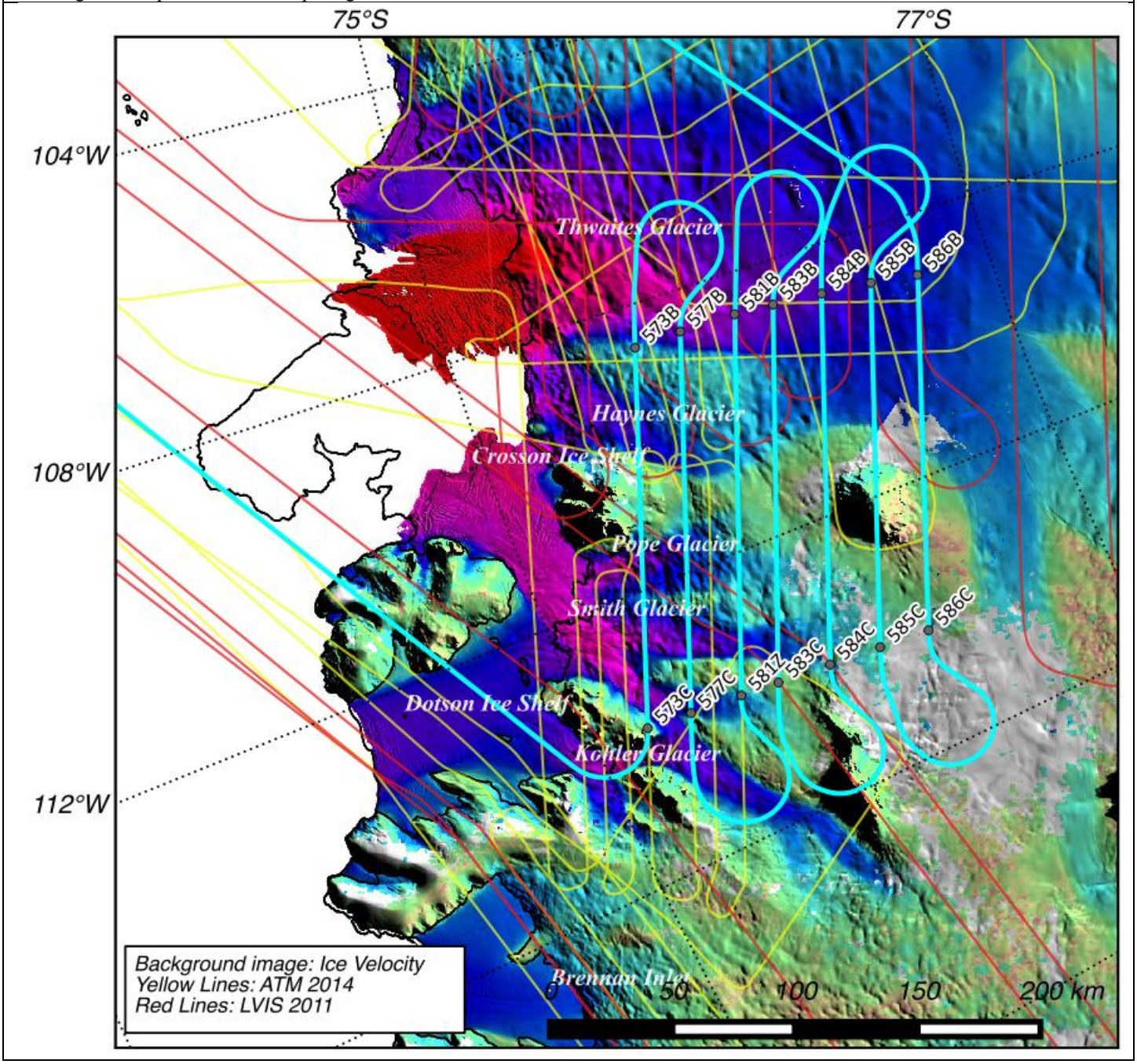


Land Ice – LVIS Upper Thwaites			Priority: Medium	
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
3.8 hours	420 knots	10.1 hours	none	LVIS 2011
This flight is a repeat of the LVIS Upper Thwaites flight that was flown on the G-V in 2011.				



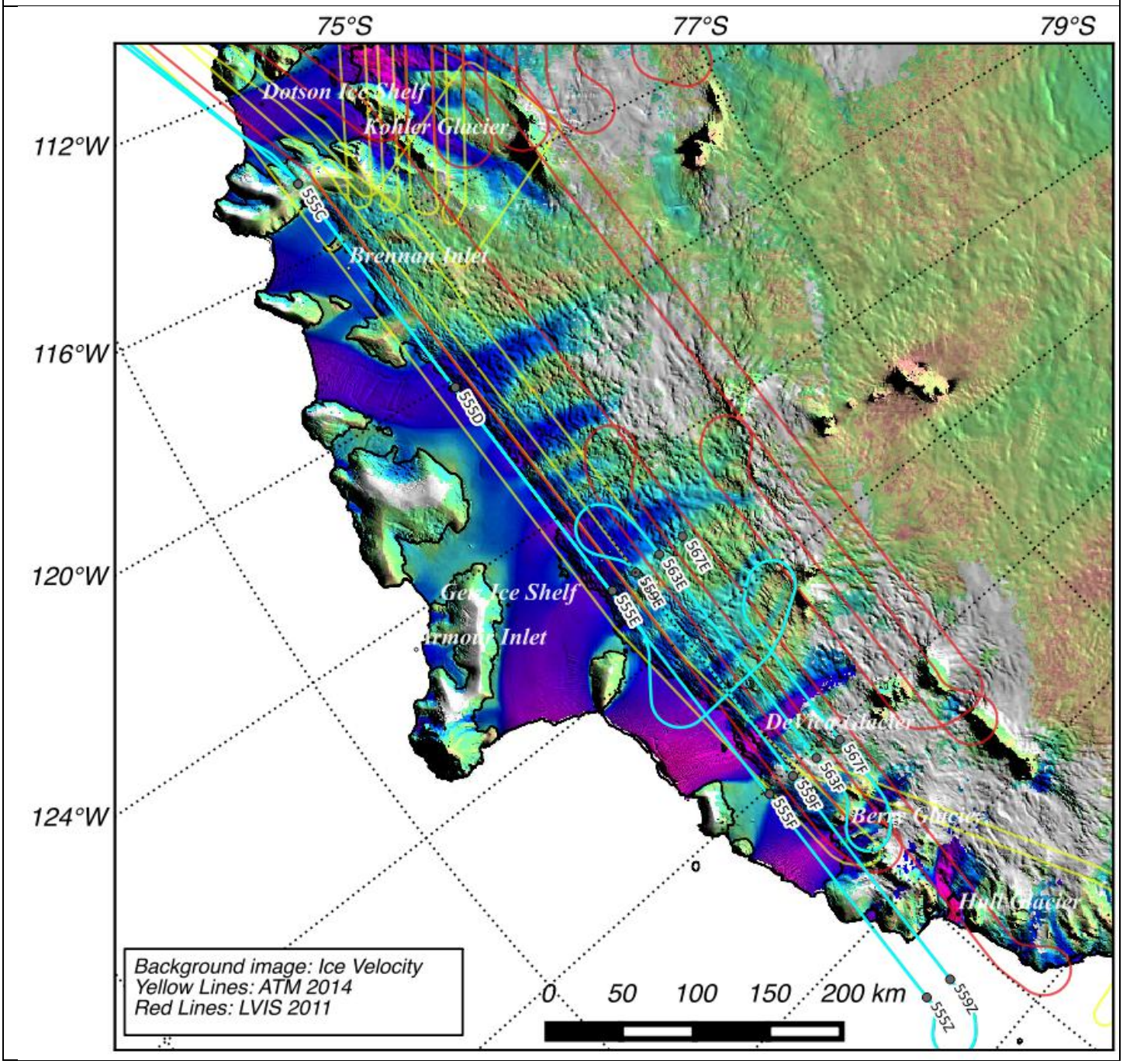
Land Ice – LVIS Pope				Priority: Medium
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
4 hours	420 knots	10.1 hours	none	LVIS 2011

This flight is a repeat the LVIS Pope flight that was flown on the G-V in 2011.



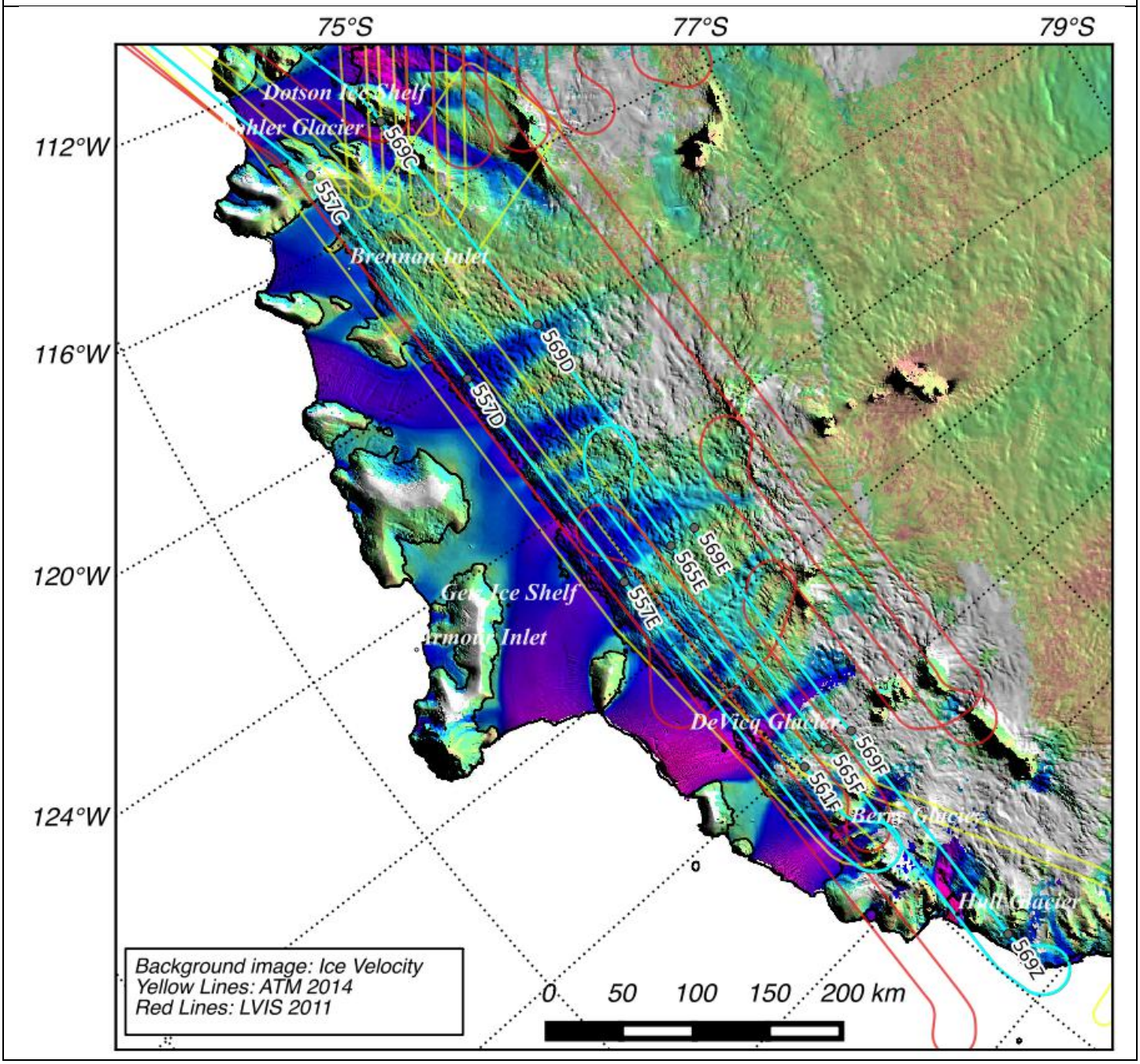
Land Ice – LVIS Getz1				Priority: Medium
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
4 hours	420 knots	10.6 hours	none	LVIS-2011, ATM-2014

LVIS flew three missions in the Getz region in 2011, so there will be ample opportunities for repeats if alternative options are required due to weather.

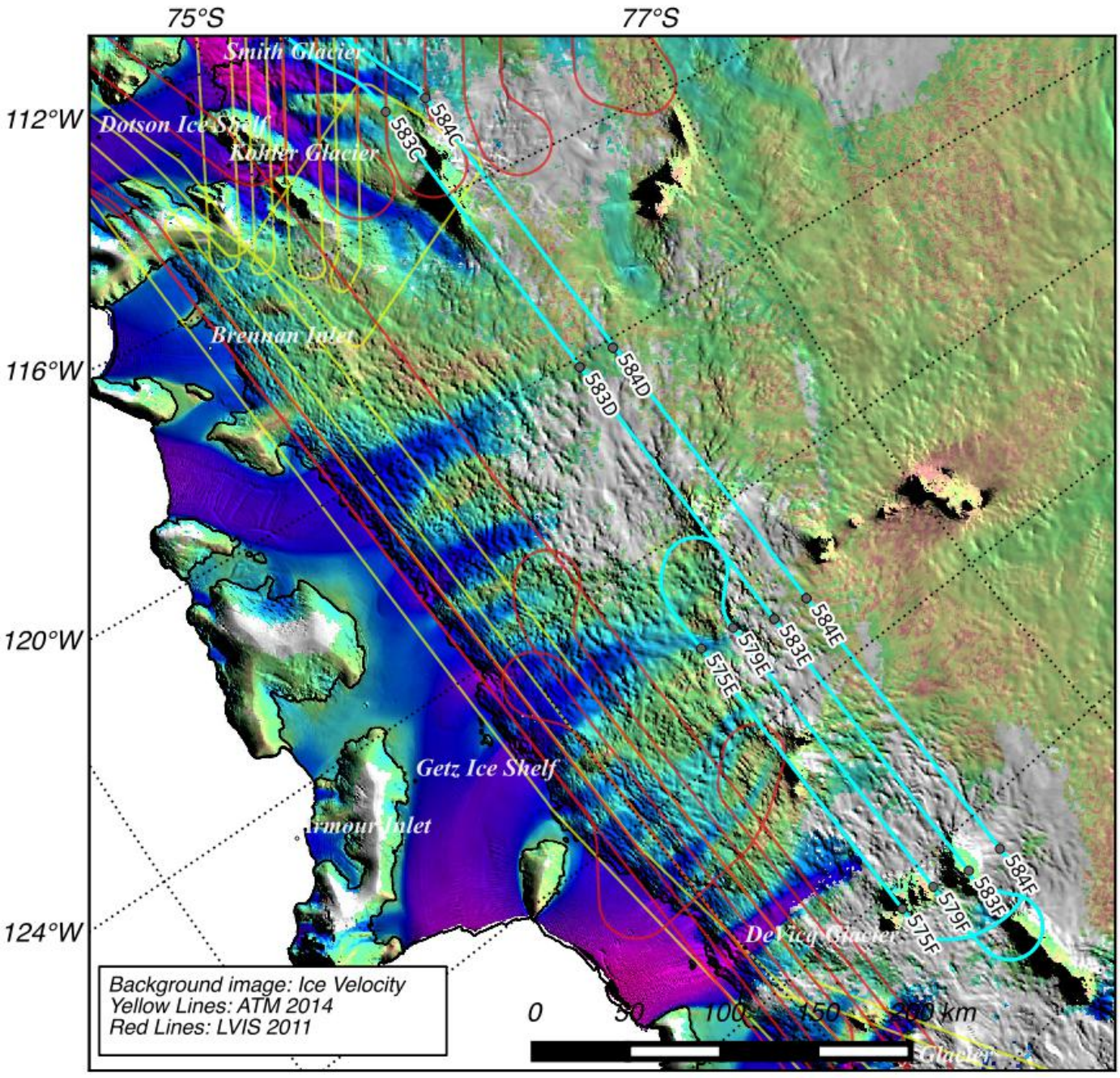


Land Ice – LVIS Getz2				Priority: Medium
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
4 hours	420 knots	10.6 hours	none	LVIS-2011, ATM-2014

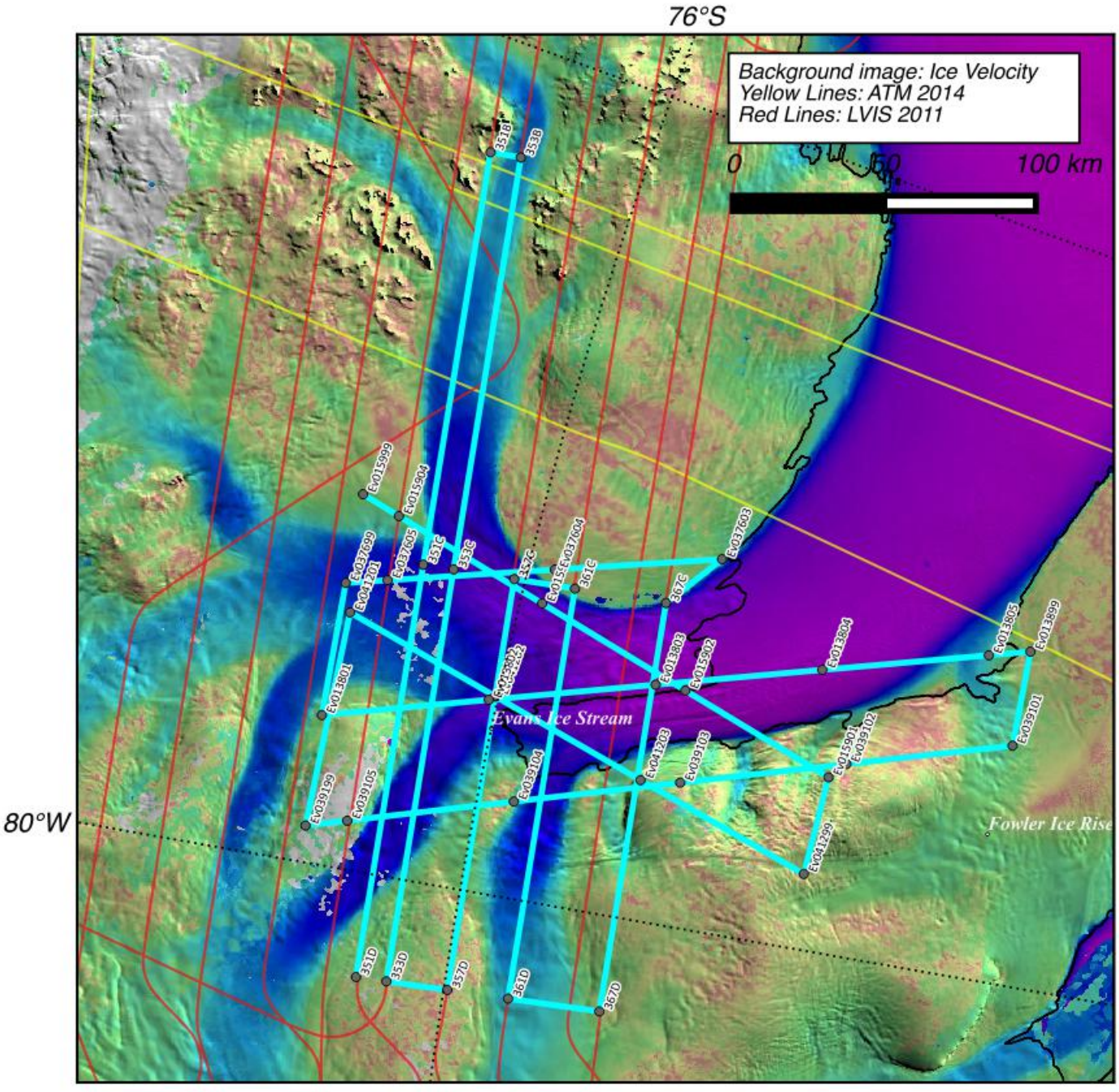
LVIS flew three missions in the Getz region in 2011, so there will be ample opportunities for repeats if alternative options are required due to weather.



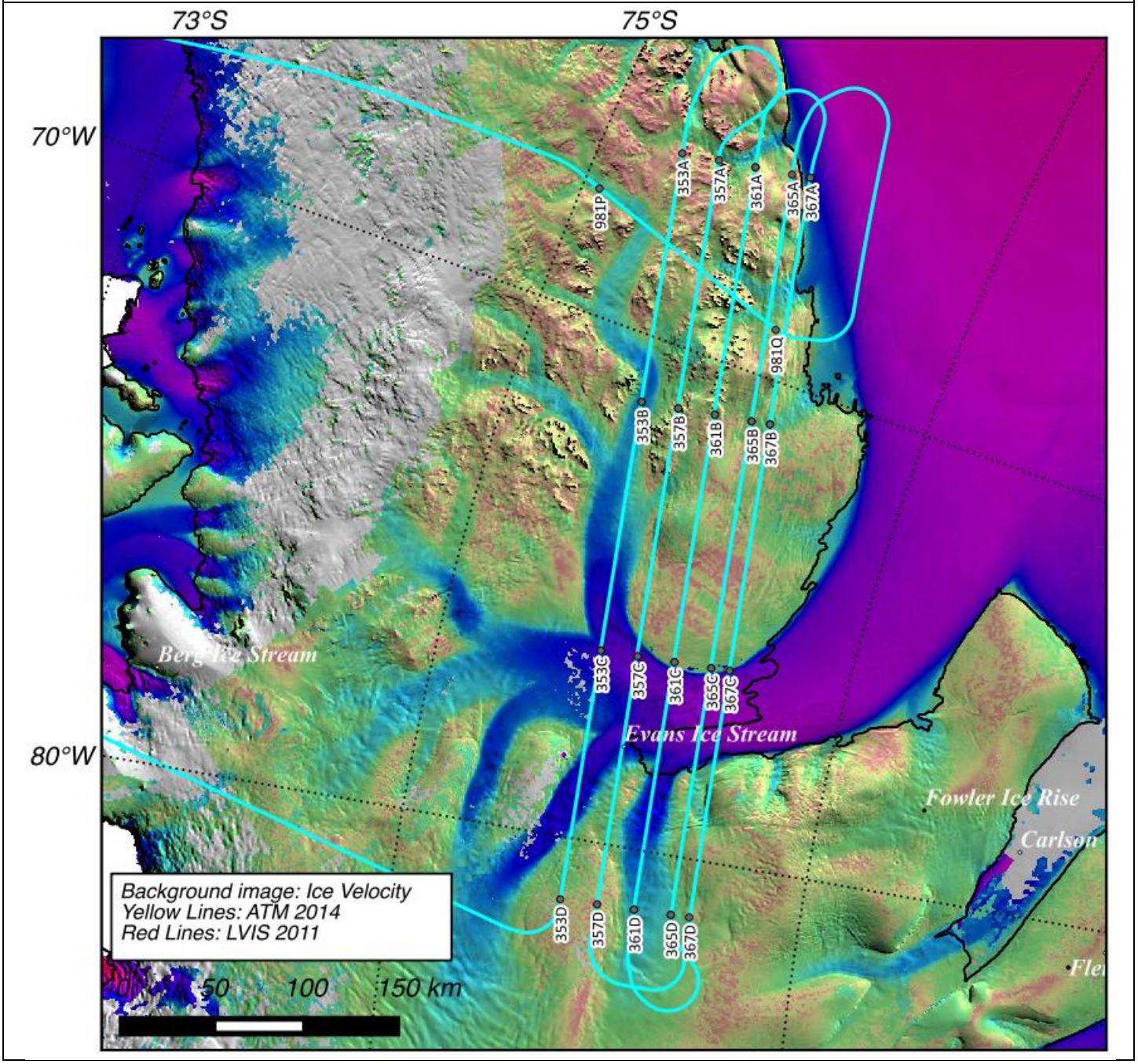
Land Ice – LVIS Getz3				Priority: Medium
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
4 hours	420 knots	10.2 hours	none	LVIS-2011
LVIS flew three missions in the Getz region in 2011, so there will be ample opportunities for repeats if alternative options are required due to weather.				



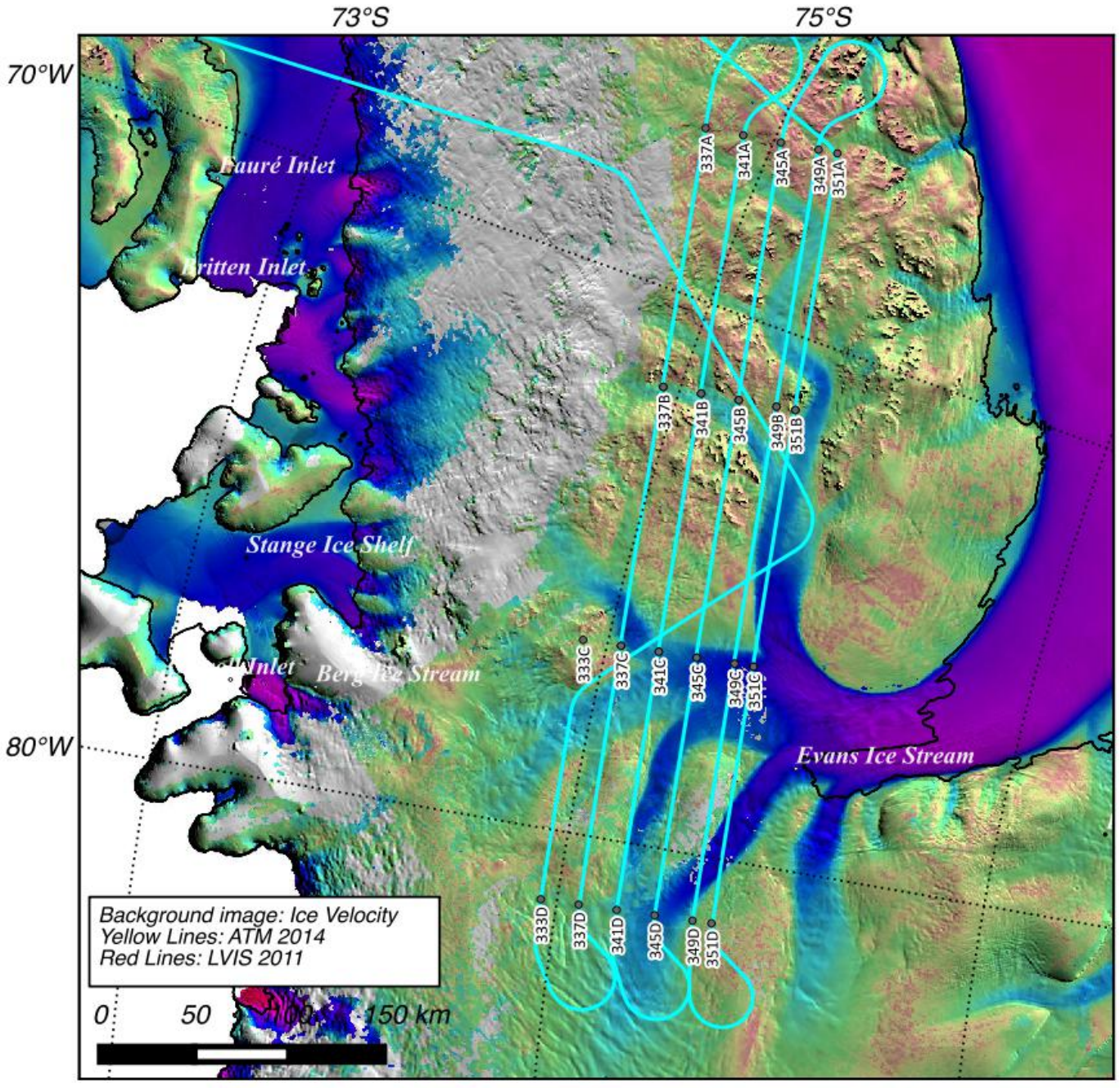
Land Ice - Evans01			Priority: Medium	
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
3.2 hours	420 knots	10.2 hours	ICESat 138,159,376,391,412	2009,2011
This mission repeats portions of ATM 2009, as well as LVIS 2011 flights. The mission covers 5 ICESat tracks that cover the Evans Ice Stream above the grounding line.				



Land Ice - LVIS Evans				Priority: Medium
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
3.3 hours	420 knots	10 hours	ICESat 367	2011
This flight is designed to repeat the LVIS Evans flight that was flown on the G-V in 2011. Portions of some lines also contained in Evans01.				

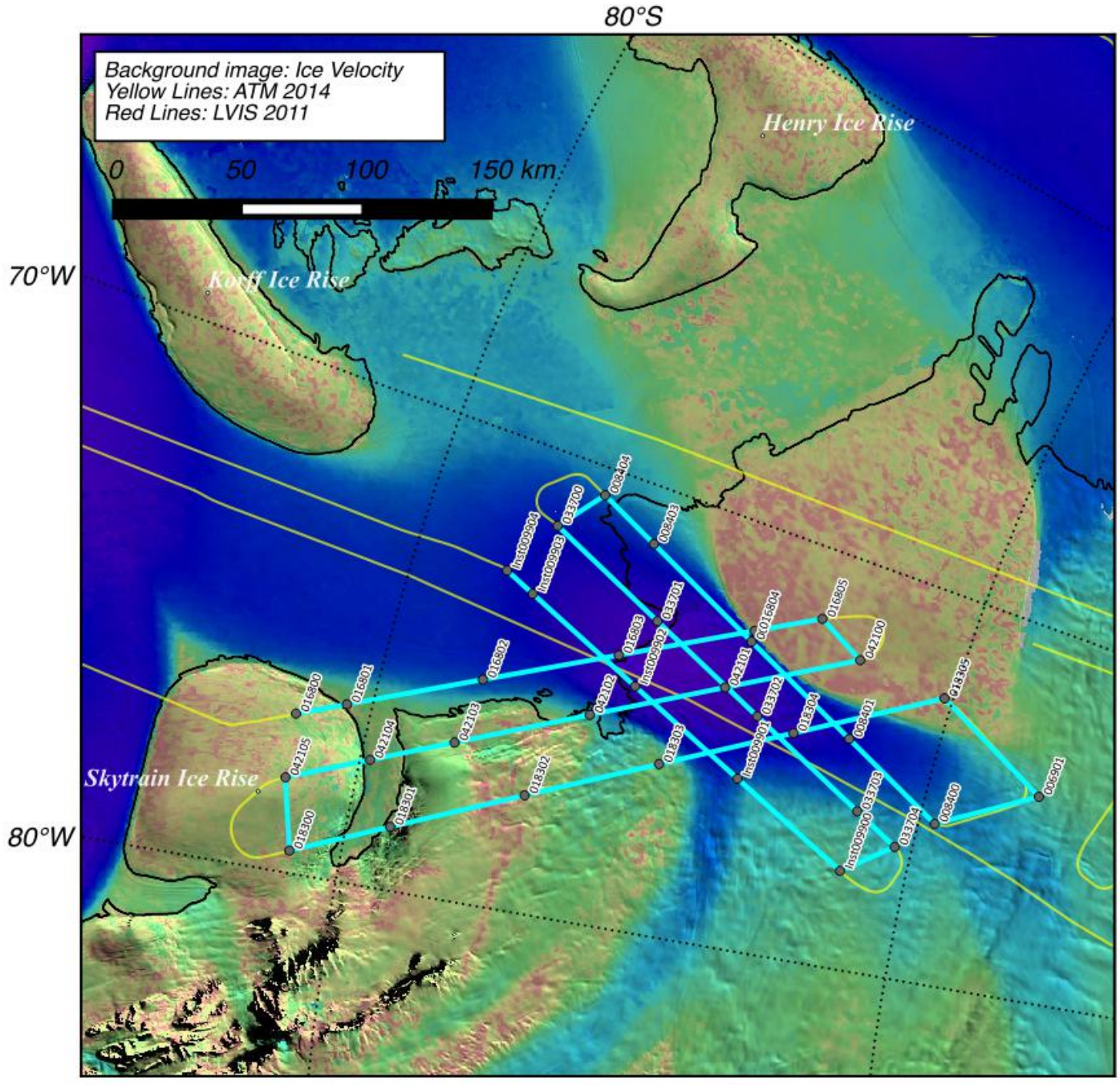


Land Ice - LVIS Drewry				Priority: Medium
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
3.2 hours	420 knots	9.9 hours	None	2011
This flight is a repeat of the LVIS Drewry flight that was flown on the G-V in 2011. Portions of these lines contained in Evans01.				



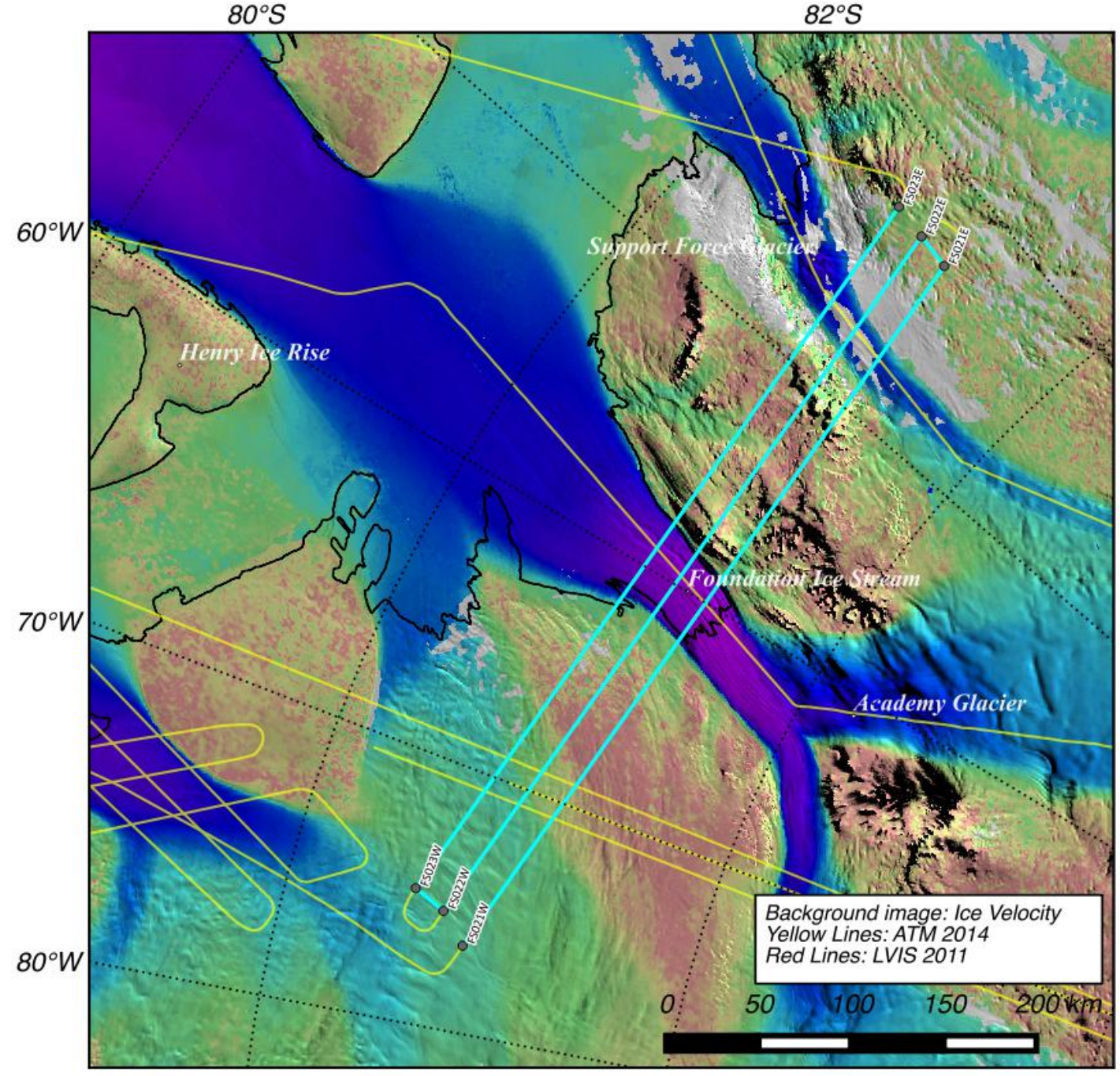
Land Ice - Institute01			Priority: Medium	
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
3.9 hours	420 knots	10.0 hours	ICESat 168,421,183,69,79,84,337,99	2014

This mission was flown in 2014. It is intended to supply altimetry data over the lower Institute Ice Stream, entirely along IceSat-1 ground tracks straddling, and upstream of, the grounding line. Request we continue lines 0168 to ice shelf. With extra time, do the same for 0421 and 0183.



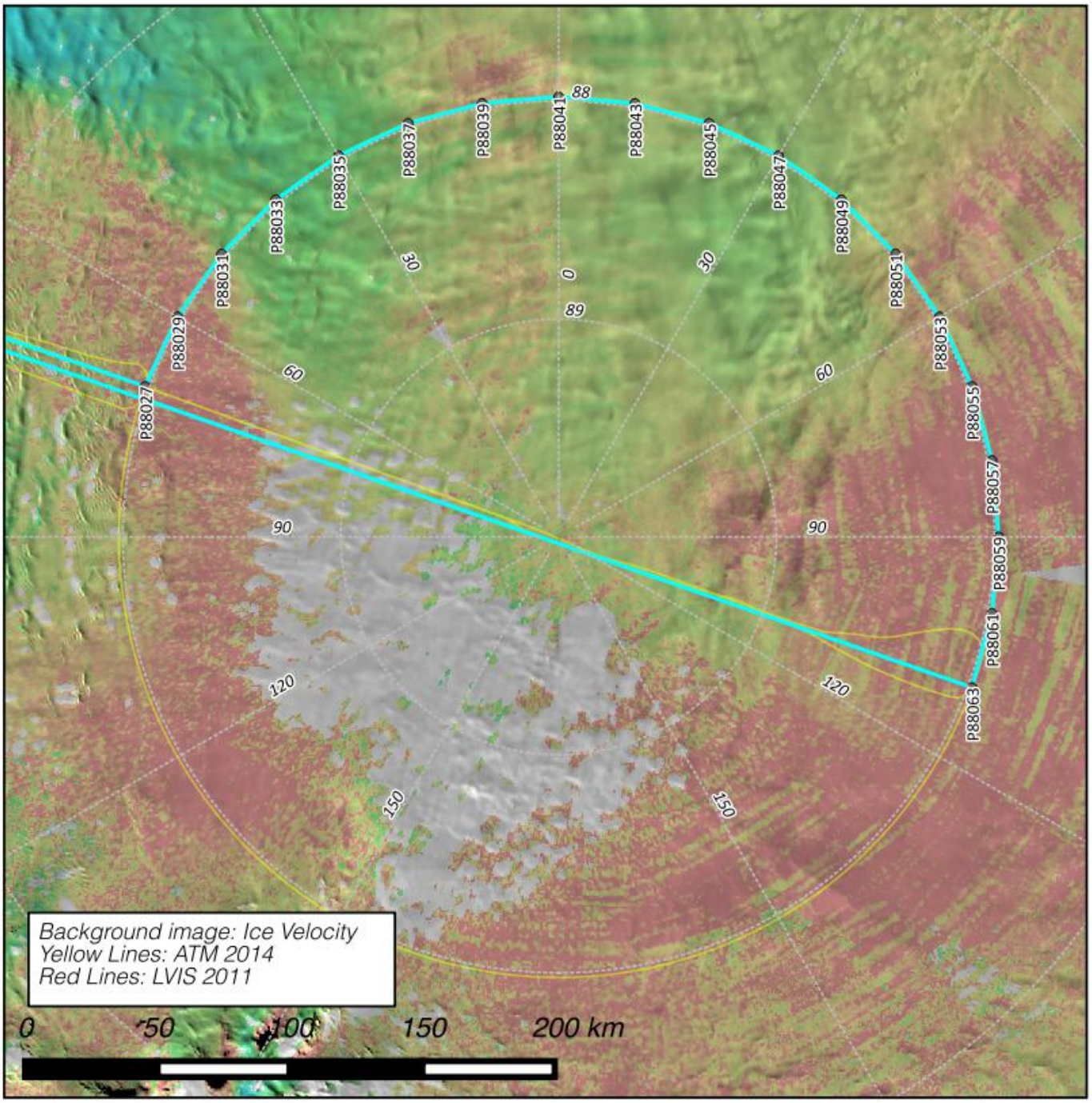
Land Ice - FoundationSupport02			Priority: Medium	
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
4.1 hours	440 knots	10.2 hours	none	2014

This mission was flown in 2014, designed to sample surface topography of the Foundation and Support Force ice streams on a 20 km grid. This particular flight targets the area at and just below the grounding lines of these ice streams.

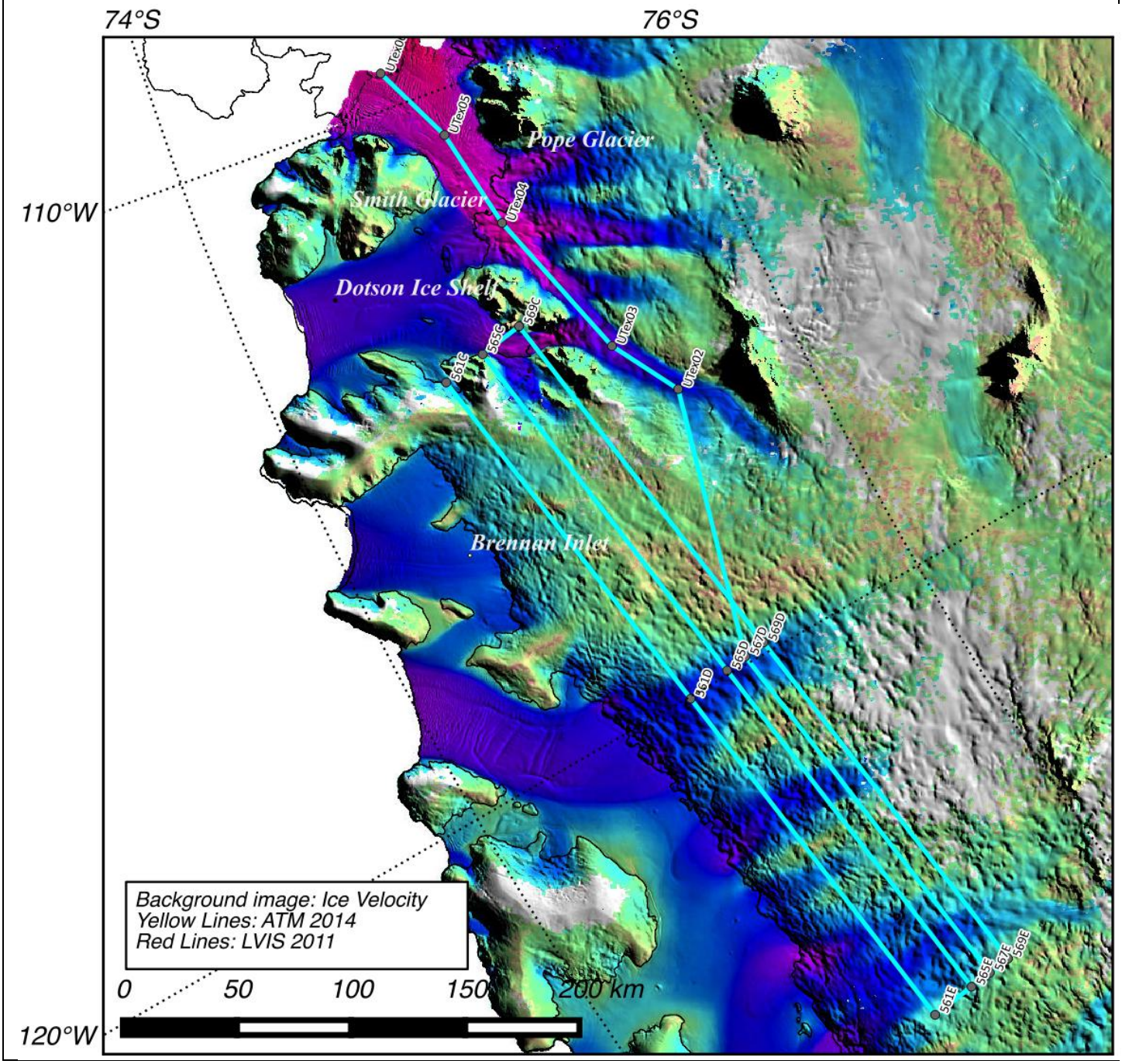


Land Ice – Pole Hole East				Priority: Medium
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
4.8 hours	440 knots	11.0 hours	ICESat-2	2014

This flight was flown in 2014, and its purpose is to sample the surface topography at the southern apex of half of all planned IceSat-II orbits. Specifically this flight samples the ground tracks on the east Antarctic plateau side of the Pole. In this way, we can provide "ground truth" for every IceSat-II orbit with just two flights, including Pole Hole 88 West as well as this one. Note: "Dark zone" within 20km of the pole – switch off instrumentation.

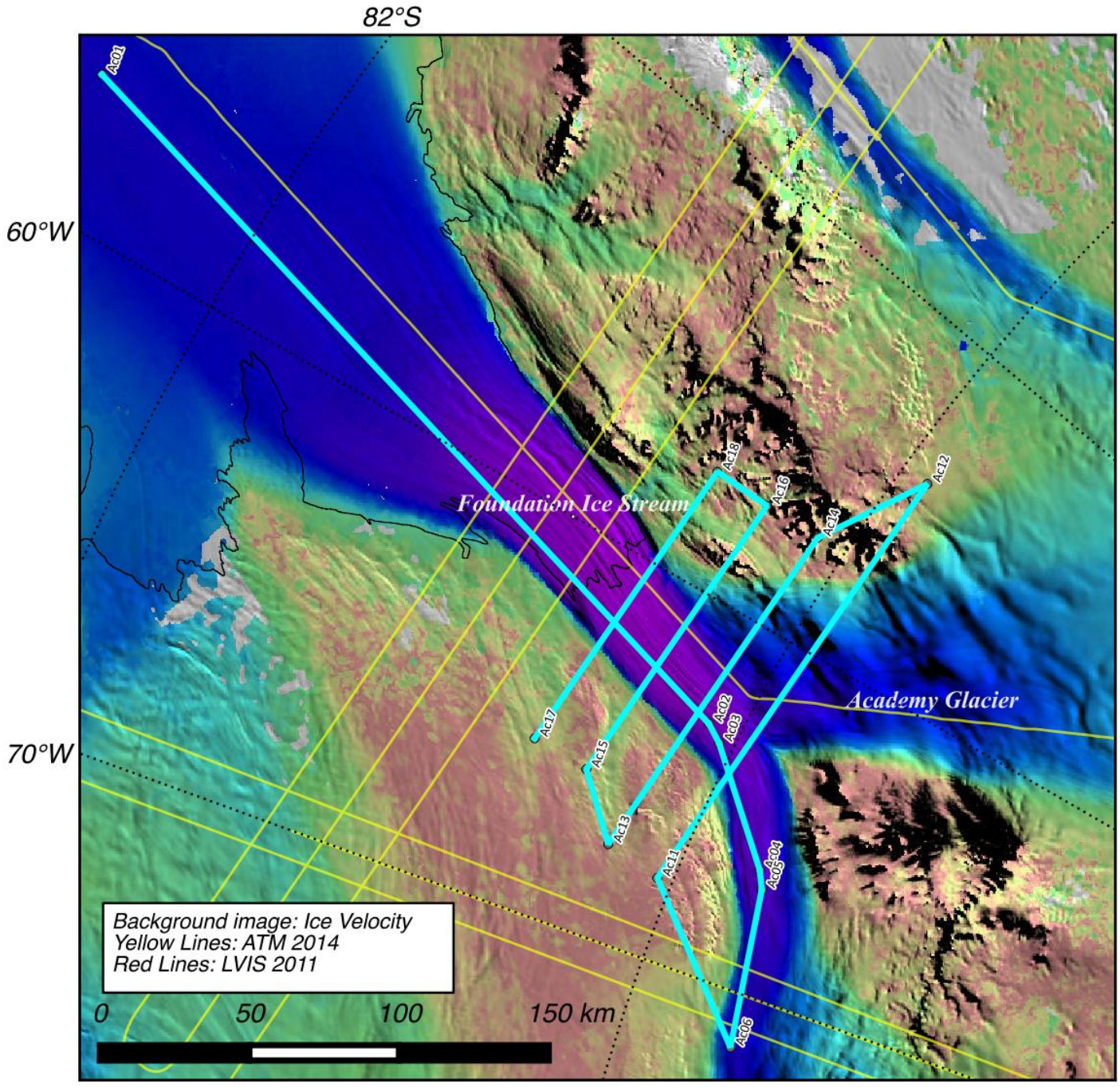


Land Ice – GetzD				Priority: Low
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
4 hours	420 knots	10.2 hours	none	UTexas 2004, LVIS 2011, 2012
This flight is fills in area over the eastern portion of Getz. A line flown by the University of Texas from 2004 can potentially be repeated over the center of the Smith Glacier.				



Land Ice - Academy				Priority: Low
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
4.1 hours	420 knots	10.2 hours	none	2012

This mission is a repeat of lines flown in 2012, and covers the region north of the Foundation Ice Stream grounding line as well as portions of the Academy Glacier.



Land Ice – Recovery				Priority: Low
Time to 1st Pt	**Plane speed**	**Total Flight Time**	**Satellite Tracks**	**Repeats**
4.2 hours	440 knots	10.6 hours	ICESat 112,350,335,82,1302,186,171	Portions in 2011, 2012,2014

This flight is a repeat of the identical 18 October 2012 flight, and its purpose is to obtain dh/dt measurements of Recovery Glacier. The mission is primarily designed along IceSat-1 ground tracks. We also fly a crossing of the tributary channel entering the main Recovery channel from the west.