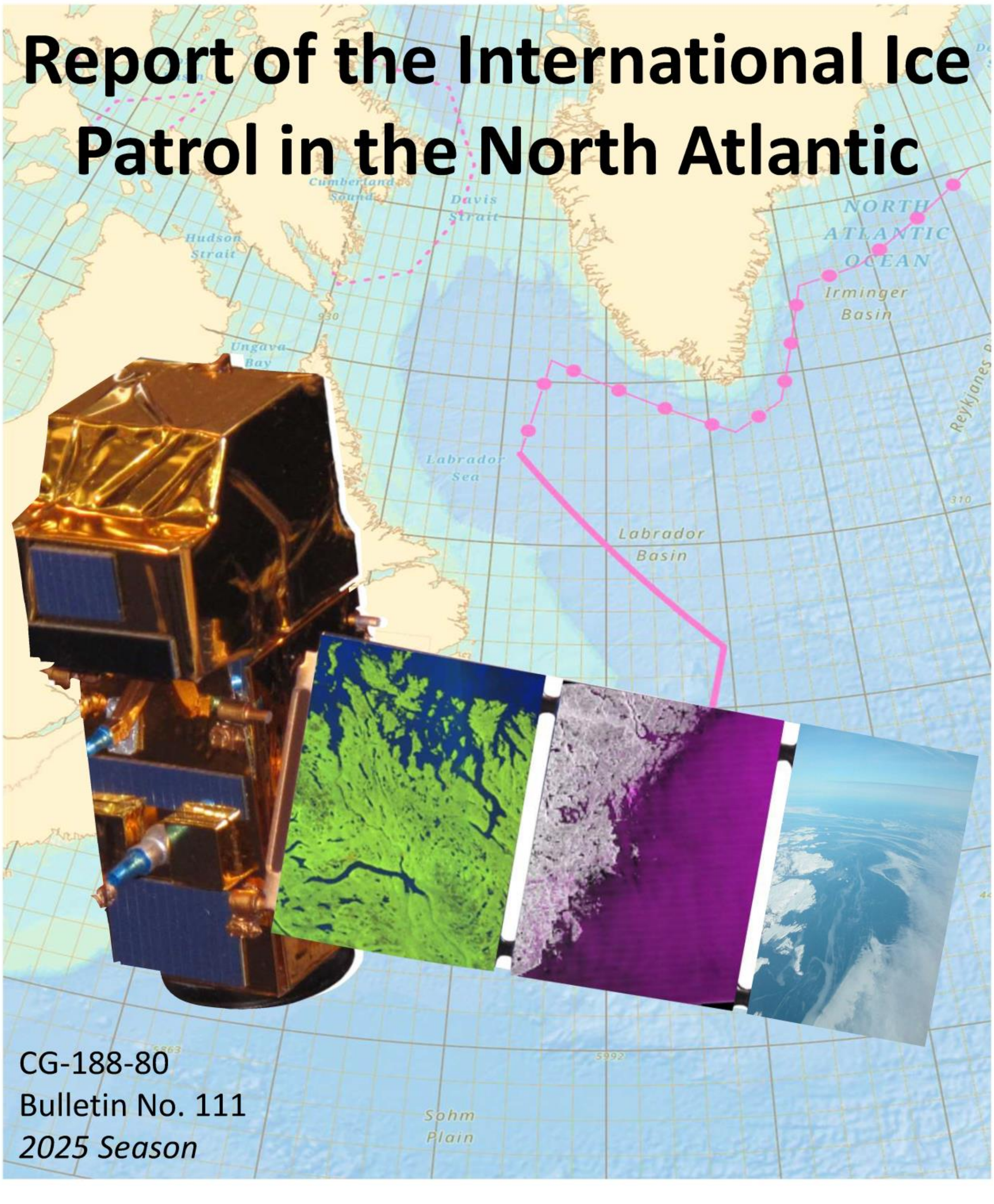
U.S. Department of Homeland Security

United States Coast Guard

Report of the International Ice Patrol in the North Atlantic



CG-188-80

Bulletin No. 111

2025 Season

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Forwarded herewith is Bulletin No. 111 of the International Ice Patrol (IIP) describing ice conditions and IIP operations during the 2025 Ice Year (1 October 2024 – 30 September 2025). In Ice Year 2025, 250 icebergs drifted into transatlantic shipping lanes, making 2025 a “moderate” Ice Year.

This year, IIP conducted its mission and successfully prevented iceberg collisions in the North Atlantic almost completely by satellite reconnaissance. The experience proved to be exceptionally educational for the team. Leveraging the innovative spirit of IIP’s crew and partner network, IIP drastically expanded its satellite imagery access to include RADARSAT-2 and other high-resolution imagery. This satellite-only strategy worked well in our northern area of operations where the icebergs were larger, and movements could be tracked southward. However, due to the inverse relationship between imagery resolution and spatial coverage, the quantity of available high-resolution imagery to confirm the melt of a single iceberg and to target small icebergs was insufficient. This increased the possibility of the maritime community encountering an untracked iceberg. To further adjust for this uncertainty, IIP extended the buffer zone on known icebergs and kept those known icebergs on the iceberg plot for longer to increase confidence that they had fully melted. While IIP took actions to maintain mariner safety, these uncertainties may have led to the expansion of our iceberg limits further south and further east than necessary. At the end of this season, IIP determined the current satellite availability cannot wholly replace aerial reconnaissance due to the discussed concerns. IIP will require aircraft for the next several years to confidently produce iceberg limits for the safe navigation of mariners off the Grand Banks of Newfoundland.

IIP strives to be better than yesterday and is coordinating with domestic and international partners to find new ways of conducting this critical mission to enhance commerce and safety of life at sea. Looking ahead to next year, IIP will work with Coast Guard, National Oceanic and Atmospheric Administration, and Canadian partners to leverage manned and unmanned airframes to supplement available satellite imagery. IIP is extremely grateful to our partners for their continued support.

Each year, IIP honors the sinking of the Royal Mail Ship (RMS) TITANIC, the event that founded our institution, by holding a memorial and wreath dedication honoring the lives lost. This year, IIP held the annual ceremony in Suitland, Maryland at the NOAA Satellite Operations Facility. We were honored to host Dr. Robert Ballard, the discoverer of the RMS TITANIC shipwreck, as our keynote speaker. IIP is proud of our contributions to safe navigation in a highly dynamic and dangerous area of the world and will continue to honor the lives of those lost 113 years ago through mission excellence.

This 2025 Ice Year report was prepared by all members of the IIP team. On behalf of all of us, I hope that you enjoy reading it.

E. M. Caldwell
Commander, U. S. Coast Guard
Commander, International Ice Patrol

Acronyms and Abbreviations

AIS	Automatic Identification System
AOR	Area of responsibility
APN-241	Tactical Transport Weather Radar
ASEC	Air Station Elizabeth City
BAPS	IceBerg Analysis and Prediction System
CCGS	Canadian Coast Guard Ship
CBC	Canadian Broadcasting Corporation
CG-5PW	United Stated Coast Guard Office of Marine Transportation Systems
CIIP	Commander, International Ice Patrol
CIS	Canadian Ice Service
CSA	Canadian Space Agency
CPC	Climate Prediction Center
CYHZ	Airport in Halifax Nova Scotia
CYYR	Royal Canadian Air Force Base in Goose Bay - Happy Valley
CYYT	St. John’s International Airport
DHS S&T	Department of Homeland Security Science and Technology
DMI	Danish Metrological Institute
DSA	Duty Satellite Analyst
DWO	Duty Watch Officer
ECMWF	European Centre for Medium-Range Weather Forecasts
ELTA	ELTA-2022 360° X-Band Surface-Search Radar
ERA5	Fifth Generation ECMWF Reanalysis
EO	Electro-Optical
EOIR	Electro-Optical Infrared
ERMA	Environmental Response Management Application
ESA	European Space Agency
ESRI	Environmental Systems Research Institute
FBO	Fixed Base Operator

GIS	Geographic Information System
HDMS	His/Her Danish Majesty's Ship
HMCS	His Majesty's Canadian Ship
IBX48°N	Icebergs that Crossed South of 48°N
ICC-GEOINT	Intelligence Coordination Center Geospatial Intelligence Branch
IDS	Iceberg Detection System
IFM	Isolated/Few/Many
IICWG	International Ice Charting Working Group
IIP	International Ice Patrol
IQR	Interquartile Range
IRD	Ice Reconnaissance Detachment
ISAR	Inverse Synthetic Aperture Radar
KADW	Joint Base Andrews Airport
KFMH	Cape Cod Airport
KML	Keyhole Markup Language
MCTS	Maritime Communication and Traffic Service
MSLP	Mean Sea Level Pressure
NAIS	North American Ice Service
NAO	North Atlantic Oscillation
NAOI	North Atlantic Oscillation Index
NAVAREA	Navigational Area
NAVCEN	United States Coast Guard Navigation Center
NAVTEX	Navigational Telex
NAVWARN	Navigational Warning
NCEP	National Centers for Environmental Prediction
NGA	National Geospatial-Intelligence Agency
NL	Newfoundland
NM	Nautical Mile
NOAA	National Oceanic and Atmospheric Administration
NRL	Naval Research Labratory

NSIDC	National Snow and Ice Data Center
NSOF	NOAA Satellite Operations Facility
NWS	National Weather Service
OPC	Ocean Prediction Center
OPCEN	Operations Center
POD	Probability of Detection
R&D	Research and Development
Radiofax	Radio Facsimile
RCM	Radarsat Constellation Mission
RMS	Royal Mail Ship
RS2	RADARSAT-2
SAR	Synthetic Aperture Radar
SAT	Surface Air Temperature
SIM	Standard Iceberg Message
SITOR	Simplex Teletype Over Radio
SN1(A/C)	Sentinel-1 (A/C)
SN2(A/B/C)	Sentinel-2 (A/B/C)
SOLAS	Safety of Life at Sea
SST	Sea Surface Temperature
SWH	Significant Wave Height
TC	Tactical Commander
UK	United Kingdom
US	United States
USCG	United States Coast Guard
USCGC	United States Coast Guard Cutter
USNIC	United States National Ice Center
WMO	World Meteorlogical Organization
WWNWS	World-Wide Navigational Warning Service

Table of Contents

1 Introduction

This is the 111th IIP annual report describing the 2025 Ice Year. It depicts IIP operations, along with environmental and iceberg conditions, in the North Atlantic from October 2024 to September 2025.

This Ice Year IIP conducted satellite-only ice reconnaissance due to aircraft availability with some supplemental iceberg reports from commercial aircraft and mariners in the North Atlantic region. Without dedicated aerial reconnaissance, IIP operated in a degraded reconnaissance posture for the entirety of the season.

IIP personnel analyzed iceberg and environmental data using iceberg drift and deterioration models within the IceBerg Analysis and Prediction System (BAPS) at the IIP Operations Center (OPCEN) located in the National Oceanic and Atmospheric Administration (NOAA) Satellite Operations Facility (NSOF) at Suitland, MD. In accordance with the North American Ice Service (NAIS) Collaborative Arrangement, IIP used BAPS to produce daily iceberg charts and text bulletins from the model output. These iceberg warning products were then distributed daily to the maritime community. In addition to these routine broadcasts, IIP also responded to individual requests for iceberg information.

IIP remains unequivocally committed to maintaining mariner safety as it explores adding new technology and tools to its iceberg reconnaissance mission. This year proved educational in assessing tools and techniques for satellite-only reconnaissance. IIP greatly expanded its access to new satellite constellations and worked closely with partners to create new and effective collection strategies. However due to coverage and resolution constraints, difficulties arose in targeting icebergs smaller than 20 meters in length at the waterline and in confidently deleting melted icebergs from the BAPS model. IIP will continue to develop a diverse and resilient system of space-based collection platforms but this year proved that air assets are still needed for the next several years. .

IIP was formed after the RMS TITANIC sank on 15 April 1912. Since 1913, except for periods of World War, IIP has monitored the iceberg danger in the North Atlantic and broadcast iceberg warnings to the maritime community. The activities and responsibilities of IIP are delineated in U.S. Code, Title 46, Section 80302, and the International Convention for the Safety of Life at Sea (SOLAS), 1974.

For the 2025 Ice Year, IIP was under the operational control of the Director of Marine Transportation (CG-5PW), Mr. Michael D. Emerson. CDR Erin M. Caldwell remained as Commander, IIP (CIIP).

For more information about IIP, including historical and current iceberg bulletins and charts, visit our website at https://www.navcen.uscg.gov/international-ice-patrol.

2 Ice and Environmental Conditions

2.1 International Ice Patrol Oceanographic Area of Responsibility

This section describes the ice and environmental conditions in the IIP oceanographic area of responsibility (AOR) during the 2025 northern hemisphere Ice Year (1 October 2024 to 30 September 2025). IIP has the statutory mission, encoded in international (International Maritime Organization 1974) and United States (US) law (Title 46, United States Code § 80301 2021), to monitor and warn of iceberg danger in the North Atlantic Ocean. Under this mission, IIP's AOR encompasses the area of ocean around the Grand Banks of Newfoundland, Canada, where icebergs pose a threat to vessels traversing North Atlantic shipping lanes (**Figure 2.1**).

As a part of its mission, IIP collects and reports daily iceberg data (numbers, distribution, and extent, or "limit") in its AOR (International Maritime Organization 1974). IIP reports these data as estimates because IIP uses a combination of direct, imperfect measurement (human visual sighting and remote sensing detection) of icebergs or their absence, and computer modeled drift and deterioration of previously detected icebergs to estimate the daily iceberg population.

IIP's iceberg dataset is unique: due to the long history and singular mission of IIP since its formation in response to the sinking of the RMS TITANIC in 1912, it is likely the largest and most continuous, comprehensive, and accurate North Atlantic iceberg record. It is the authoritative dataset, and the only of its kind, for icebergs in IIP's AOR. For more information on the methods IIP employs to monitor icebergs in its AOR, see **Sections 3** and **4**.

2.1.1 Ice Year and Iceberg Season

The northern hemisphere Ice Year begins and ends roughly when sea ice (frozen saltwater ocean surface) reaches its minimum extent in the Arctic Ocean (September, see **Figure 2.1a**). Thus, midway through the Ice Year (March, in the northern hemisphere, see **Figure 2.1b**) corresponds to maximum sea ice extent (F. Fetterer, et al. 2017).

Within an Ice Year, IIP considers the Iceberg Season in the North Atlantic to span the months (typically January/February through August/September, **Figure 2.2**) during which icebergs (freshwater ice, of land origin, in the ocean) pose the greatest threat to the transatlantic shipping lanes by drifting south of 48°N latitude, which is nearly on parallel with St. John's, Newfoundland (**Figure 2.1c** through **e**). Previously, IIP reported that the Iceberg Season typically spanned January through September based on the mean monthly number of icebergs from 1983 to present which drift south of 48°N (IBX48°N) being greater than zero. However, **Figure 2.2** has been updated to include the monthly IBX48°N median and interquartile range (IQR) for this period rather than the mean alone. Based on the statistcal analysis of the monthly median IBX48°N and IQR, icebergs typically threaten transatlantic shipping lanes from February to August (see **Figure 2.2**, months in which the median IBX48°N is greater than zero). We offer the definition of the Iceberg Season to now encompass both the mean and median analysis.

Icebergs in IIP's AOR originate from Arctic glaciers along the coast of western Greenland (see **Figure 2.1f**, *white diamonds*). At these glacial termini, ice calves (breaks off) into the ocean to become icebergs (individual pieces of floating glacial ice), which, amid sea ice and in open ocean, drift generally south in major currents in Baffin Bay and the Labrador Sea until, after several years, they reach the Grand Banks and intersect with major transatlantic shipping lanes (Larsen, et al. 2015, Newell 1993, Marko, et al. 1994, Wilton, Bigg and Hanna 2015).

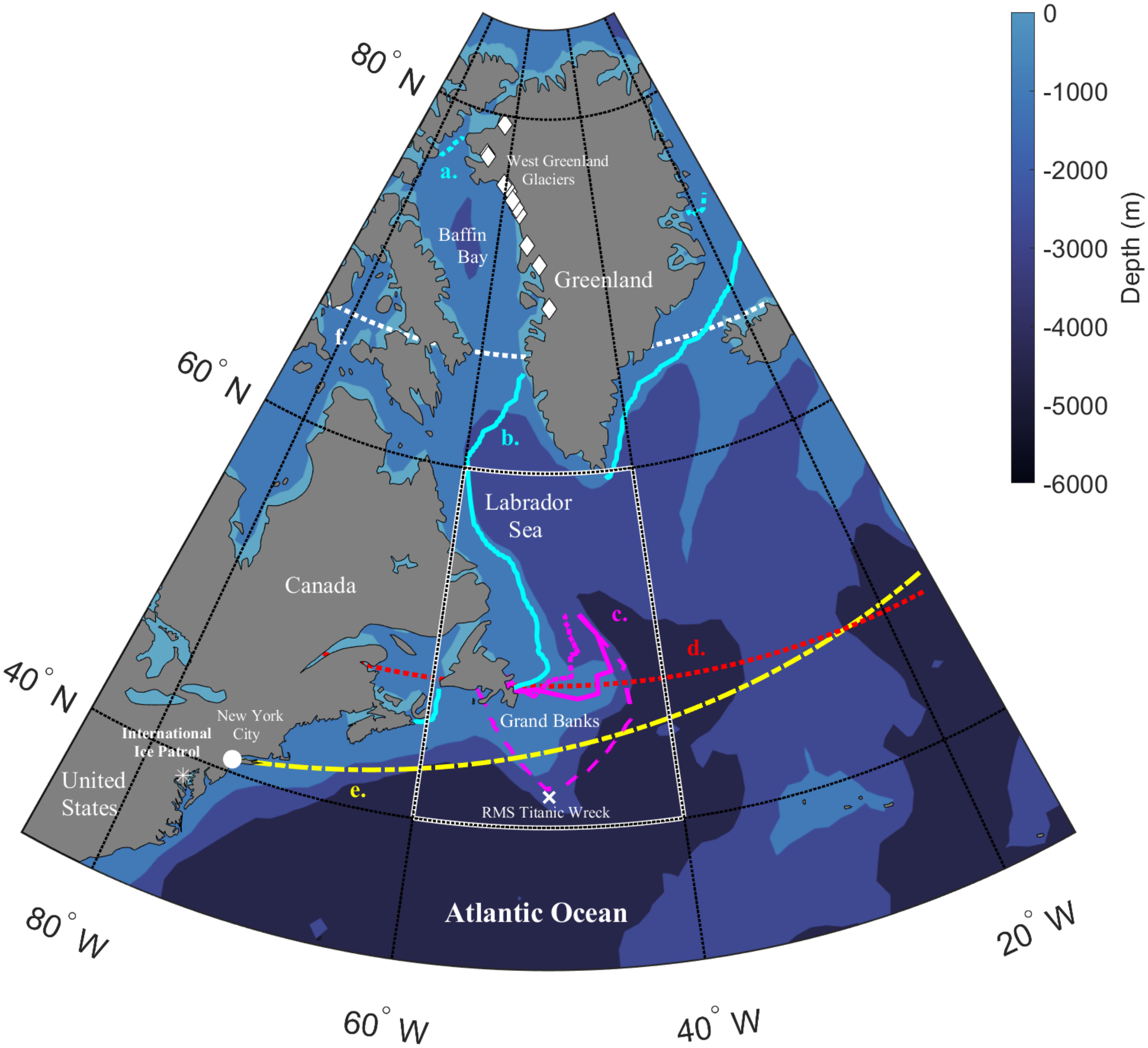

Figure 2.1. International Ice Patrol (IIP) approximate area of responsibility (AOR, *white outlined area*) around the Grand Banks of Newfoundland, Canada, in the North Atlantic Ocean, where icebergs threaten shipping lanes during the Iceberg Season. **a.** The median sea ice extent in September (at its yearly minimum, *cyan dotted line*) and **b.** March (at its yearly maximum, *cyan solid line*) for 1981 to 2010. **c.** The median mid-January (*dotted magenta line*), mid-May (*dashed magenta line*), and early-September (*solid magenta line*) iceberg limits for 1991 to 2020; prior to about 2010, IIP did not systematically monitor icebergs north of 52°N. **d.** 48°N (*red dotted line*); IIP considers this latitude as that south of which icebergs pose a significant threat to the shipping lanes, and records the daily, monthly, and yearly estimated number of icebergs which drift south of it. **e.** An example transatlantic shipping route *(yellow dashed line*) along a rhumb line between Southampton, United Kingdom (UK) and New York City, US. **f.** The Arctic Circle at roughly 66.5°N (*white dotted line*). Icebergs in IIP's AOR calve (break off) into the ocean primarily where Greenland glaciers terminate on the island's west coast (*white diamonds*) (Rignot and Kanagaratnam 2006). They drift south over years in major Arctic and North Atlantic currents and within sea ice, to IIP's AOR. The depiction of west Greenland glacial termini is not comprehensive but includes those which contribute most icebergs to IIP's AOR. Sea ice extents are from the National Snow and Ice Data Center (NSIDC) Sea Ice Index, Version 3 (F. Fetterer, et al. 2017). Iceberg limits are from IIP. See discussion in **Section 2.1**.

Outside of the Iceberg Season, typically October through December (see **Figure 2.2**), IIP transfers primary responsibility for monitoring and warning of icebergs in the North Atlantic and marginal Arctic seas to its close NAIS partner, CIS, as primarily Canadian vessels and coastline will be threatened during this time. During these months, IIP focuses on oceanographic research and scientific development of iceberg reconnaissance methods to advance the state of its

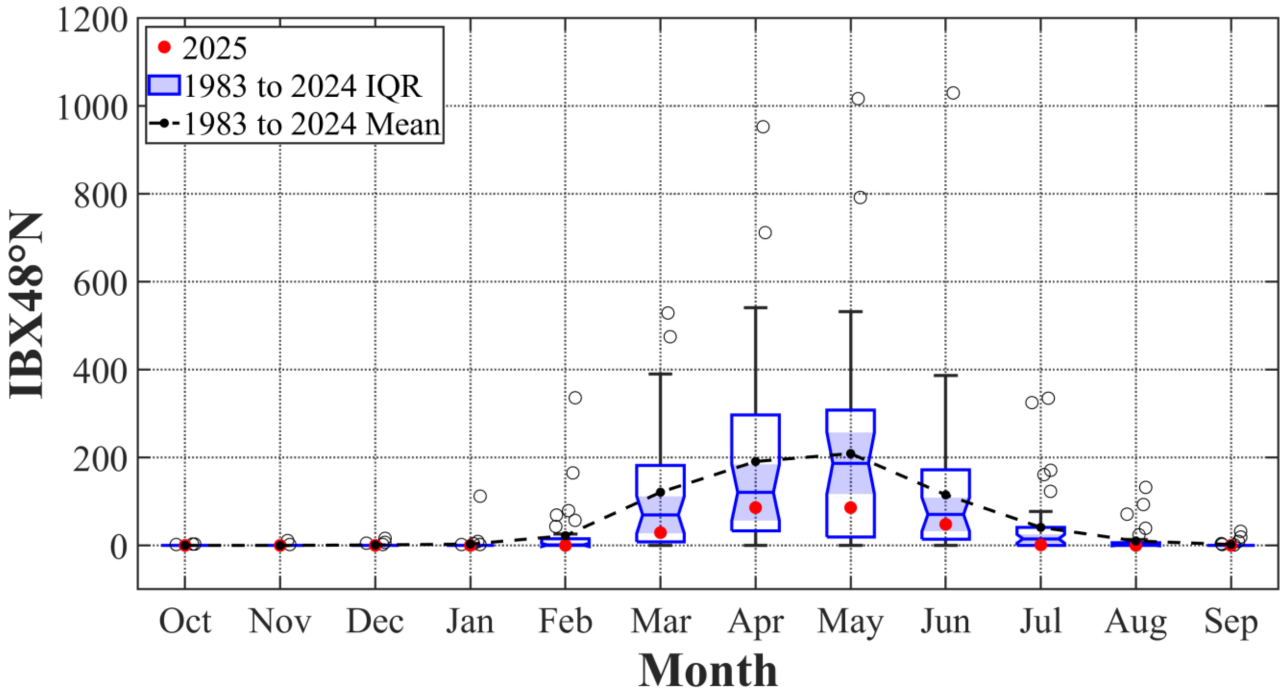

Figure 2.2. Estimated number of icebergs which crossed south of 48°N (IBX48°N) each month for Ice Years 1983 to 2024 (*blue box and black whisker plots, and black dot-dashed line*) and 2025 (*red dots*). The notched blue boxes indicate the interquarterile range (IQR) of the monthly IBX48°N for 1983 to 2024, in which the bottom border corresponds to the first quartile (25th percentile), the middle line to the median (second quartile, 50th percentile), and the top border to the third quartile (75th percentile). The shaded light blue regions ("notches") indicate the range of monthly IBX48°N occupying the median $\pm\frac{\mathbf{1.57\times IQR}}{\sqrt{n}}$ in which n is the number of Ice Years from 1983 to 2024 (42). A monthly median is not significantly different at the 5% significance level from another if their respective notches overlap (have overlapping ranges of IBX48°N). Nonoutlier minimum and maximum monthly IBX48°N for 1983 to 2024 are indicated by black error bars, and outliers (calculated as $\mathbf{1.5}\times \boldsymbol{IQR}$ less or greater than the first or third quartile respectively) are indicated by black outlined circles. The black dot-dashed line indicates the mean estimated monthly IBX48N for 1983 to 2024, which IIP previously reported along with monthly standard deviation and standard error to characterize average or normal conditions for this period. The IQR gives a more complete and accurate depiction of average conditions than the mean alone for distributions which are heavily skewed; the monthly IBX48N distributions for 1983 to 2024 are heavily right-skewed (note how the mean is markedly higher than the median and that the median is closer to the minimum than the maximum IBX48N in each month during the Iceberg Season for this period). Therefore, in this report, reference to normal monthly conditions will be in relation to monthly median IBX48N and IQR for 1983 to 2024, rather than mean. 1983 marked the beginning of what IIP defines as the modern reconnaissance era, in which IIP began using modern airborne radar to detect icebergs and computer modeled iceberg drift and deterioration to estimate the daily iceberg population. Iceberg data is from IIP.

iceberg warning and monitoring; however, IIP continues to accept reports of icebergs and actively communicates them to CIS.

2.1.2 Iceberg Season Severity and the Environment

IIP considers one of the metrics of the severity of a given Iceberg Season to be the total number of icebergs that drift south of 48°N latitude in an Ice Year (**Figure 2.3**) (Smith 1926, Trivers 1994). IIP classifies Iceberg Season severity for this metric as light for an iceberg number of 230 or less, moderate for 231 to 1036, severe for 1037 to 1398, and extreme for greater than 1398 (International Ice Patrol 2018). In 2018, IIP reestablished these classes and their thresholds to account for differing iceberg detection and monitoring methods through its history and into what IIP considers as its modern reconnaissance era (1983 to present), during which it has employed sophisticated airborne radar, computerized iceberg drift and deterioration models, and more recently, spaceborne sensors, to monitor icebergs. For a detailed discussion on this classification, see International Ice Patrol, 2018.

Another metric historically used by IIP to

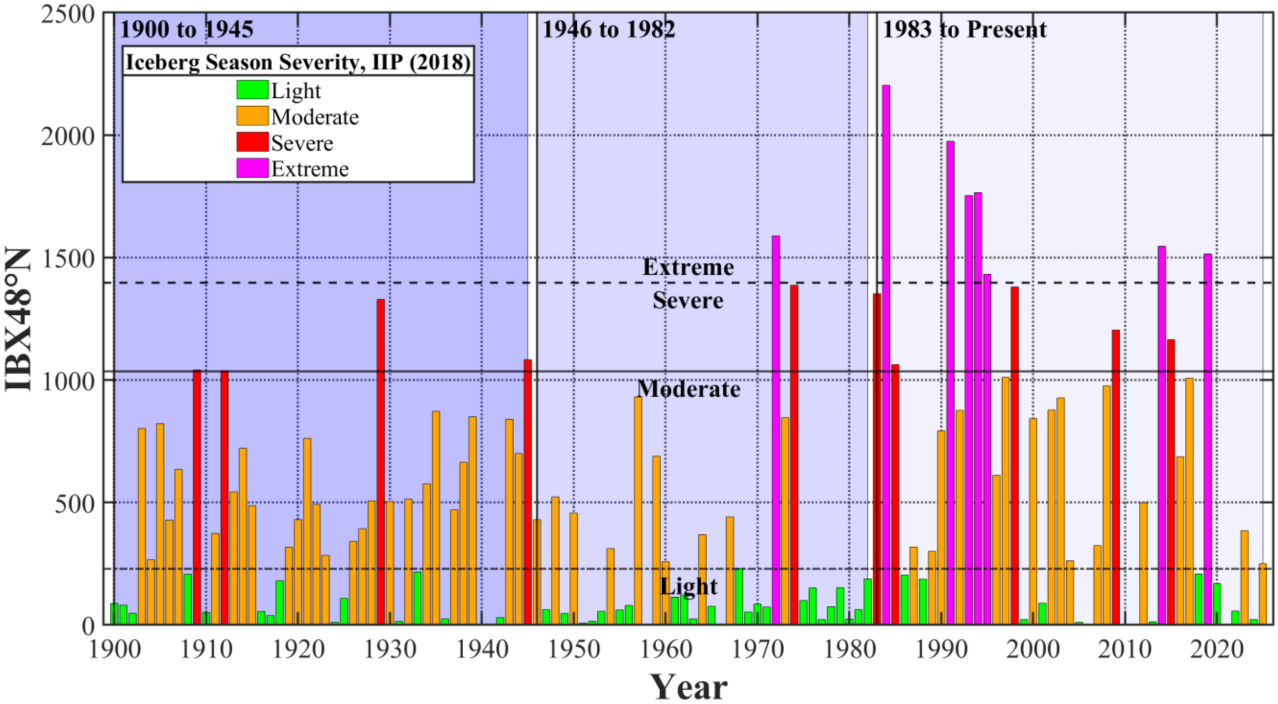

Figure 2.3. Estimated number of icebergs which crossed south of 48°N each Ice Year from 1900 to 2025. Since 2018, IIP has classified Iceberg Season severity in a given Ice Year for this metric as light (*green bars*) for an iceberg number of 230 or less (*black dot-dashed line*), moderate (*orange bars*) for 231 to 1036 (*black solid line*), severe (*red bars*) for 1037 to 1398 (*black dashed line*), and extreme (*magenta bars*) for greater than 1398 (International Ice Patrol 2018). Iceberg data is from IIP; prior to 1914, iceberg data is from the United States Hydrologic Office (Trivers 1994). IIP considers 1983 to present as its modern reconnaissance era (*rightmost lightest blue-shaded region*).

characterize Iceberg Season severity is season length, in which a longer season would correspond to greater severity, as the iceberg threat to vessels traversing shipping lanes would be prolonged (Trivers 1994). Additionally, IIP has used the total areal extent of the known iceberg population over an Ice Year as a metric of Iceberg Season severity, given that a greater extent would correspond to icebergs threatening a greater portion of the ocean near the shipping lanes (Trivers 1994, International Ice Patrol 2018).

The absolute number of icebergs that drift into IIP's AOR and south of 48°N latitude, their corresponding spatiotemporal distributions, and the duration of the Iceberg Season vary each year. However, patterns in these parameters emerge due to large-scale and long-term environmental forcings (Bigg, et al. 2014). Notably, large scale atmospheric and regional sea ice conditions have been shown to relate to North Atlantic iceberg conditions. Specifically, higher sea ice concentrations and greater sea ice extent are correlated with greater iceberg numbers and extent, because sea ice protects icebergs from destructive open ocean forces (waves and melting), and conversely from grounding in shallow coastal waters to melt quickly, as they drift south (Marko, et al. 1994, Trivers 1994).

In addition, it has been shown that the mode of the North Atlantic Oscillation (NAO), a temporal pattern of modification of the strengths of a large-scale predominately low surface pressure over Greenland and the Labrador Sea and a large-scale predominately high pressure over the mid North Atlantic, may correlate to iceberg conditions (Hanna, et al. 2011). The normal mode, indicated by a positive NAO index (NAOI) corresponds to a stronger Greenlandic low, offshore winds along the Labrador and northern Newfoundland coasts, increased storms through IIP's AOR, and increased precipitation. These conditions favor offshore transport of icebergs and a potential expansion of the iceberg limit, but also expose icebergs to open ocean where they

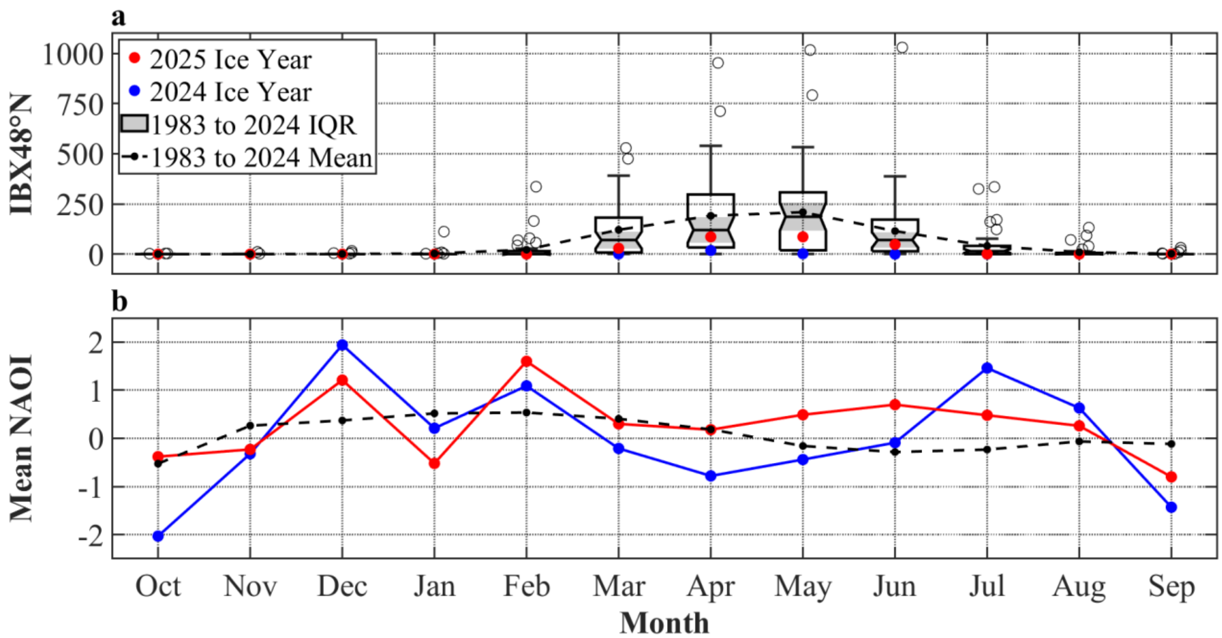

Figure 2.4. Iceberg and atmospheric conditions throughout the 2025 Ice Year as compared to 2024 and 1983 to 2024. **a.** Monthly IBX48°N for Ice Years 2025 (*red dots*), 2024 (*blue dots*), and 1983 to 2024 (*black box and whisker plots and black dotted dashed line*). The notched black boxes indicate the interquarterile range (IQR) of the monthly IBX48°N for 1983 to 2024, where the shaded region ("notch") indicates overlap between monthly medians which will not be significantly different from each other at the 5% significance level. The black error bars indicate non-outlier monthly minima and maxima IBX48°N and the black outlined circles indicate monthly outlier IBX48°N values for this period. See **Figure 2.2** for a detailed explanation. **b.** Mean monthly North Atlantic Oscillation Index (NAOI) for Ice Years 2025 (*red dotted solid line*), 2024 (*blue dotted solid line*), and 1983 to 2024 (*black dotted dashed line*). Iceberg counts are from IIP. Mean monthly NAOI values are from the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Prediction (NCEP) Climate Prediction Center (CPC) (NOAA/NWS NCEP Climate Prediction Center 2024).

deteriorate faster. Conversely, a negative NAOI corresponds to a weaker gradient between the Greenlandic low and North Atlantic high, onshore and alongshore-winds along the Labrador and northern Newfoundland coasts, decreased storms through the AOR, and decreased precipitation (Fettweis, et al. 2013, Noël, et al. 2014). These conditions instead favor onshore transport of icebergs and a contracted iceberg limit, but also harbor icebergs inshore within calmer ocean conditions and coastal sea ice.

While these relationships are known between sea ice, the atmosphere, and icebergs, they remain a topic of ongoing study.

2.2 Ice and Environmental Conditions in Ice Year 2025

In Ice Year 2025, 250 icebergs drifted south of 48°N (see **Figure 2.3**, *rightmost orange bar*), classifying the 2025 Iceberg Season as having moderate severity for this metric using the approach adopted by IIP in 2018 (International Ice Patrol 2018). This monthly number also remained near normal (within IQR and near- to below-median, **Figure 2.4a**, and see **Figure 2.2**, *red dots* and *box plots*) throughout the entirety of Ice Year 2025. The 2025 Iceberg Season was near- to slightly below-normal length: icebergs first drifted south of 48°N in March 2025, one month later than the 1983 to 2024 median, and stopped drifting south of this latitude after July 2025, one month earlier than the 1983 to 2024 median (see **Figures 2.2** and **2.4a**, February to August), shortening the 2025 Iceberg Season from median length (seven months) by two months. Notably, the 2025 Iceberg Season spanned the peak median 1983 to 2024 Iceberg Season length (see **Figure 2.2**, March through June IQR, *blue notches*, in which the median monthly IBX48N are significantly higher than the rest of the Ice Year), adding to the evidence that 2025 was a near-normal to normal Iceberg Season. Finally, iceberg extent in each month of the peak of the 2025 Iceberg Season except March, barring the northeastern limit, overlapped or slightly exceeded the 1991 to 2020 mid-monthly median (**Figure 2.5**).

Ice Year 2025 was characterized by moderate, near-normal environmental conditions during the Iceberg Season – a shift from the lingering of extreme atmospheric and oceanic heat of Ice Year 2024 after record North Atlantic summer temperatures in 2023 (Aubourg 2023, NOAA NCEI 2023).

All sea ice extents reported here are from the National Snow and Ice Data Center (NSIDC) Sea Ice Index, Versions 3 (through December 2024) and 4 (from January 2025) (F. Fetterer, et al. 2025, F. Fetterer, et al. 2017).

All NAOI values reported here are from the NOAA National Centers for Environmental Prediction (NCEP) Climate Prediction Center (CPC) (NOAA/NWS NCEP Climate Prediction Center 2024).

Sections 2.2.1 through **2.2.4** describe in detail the ice and environmental conditions in each quarter of the 2025 Ice Year.

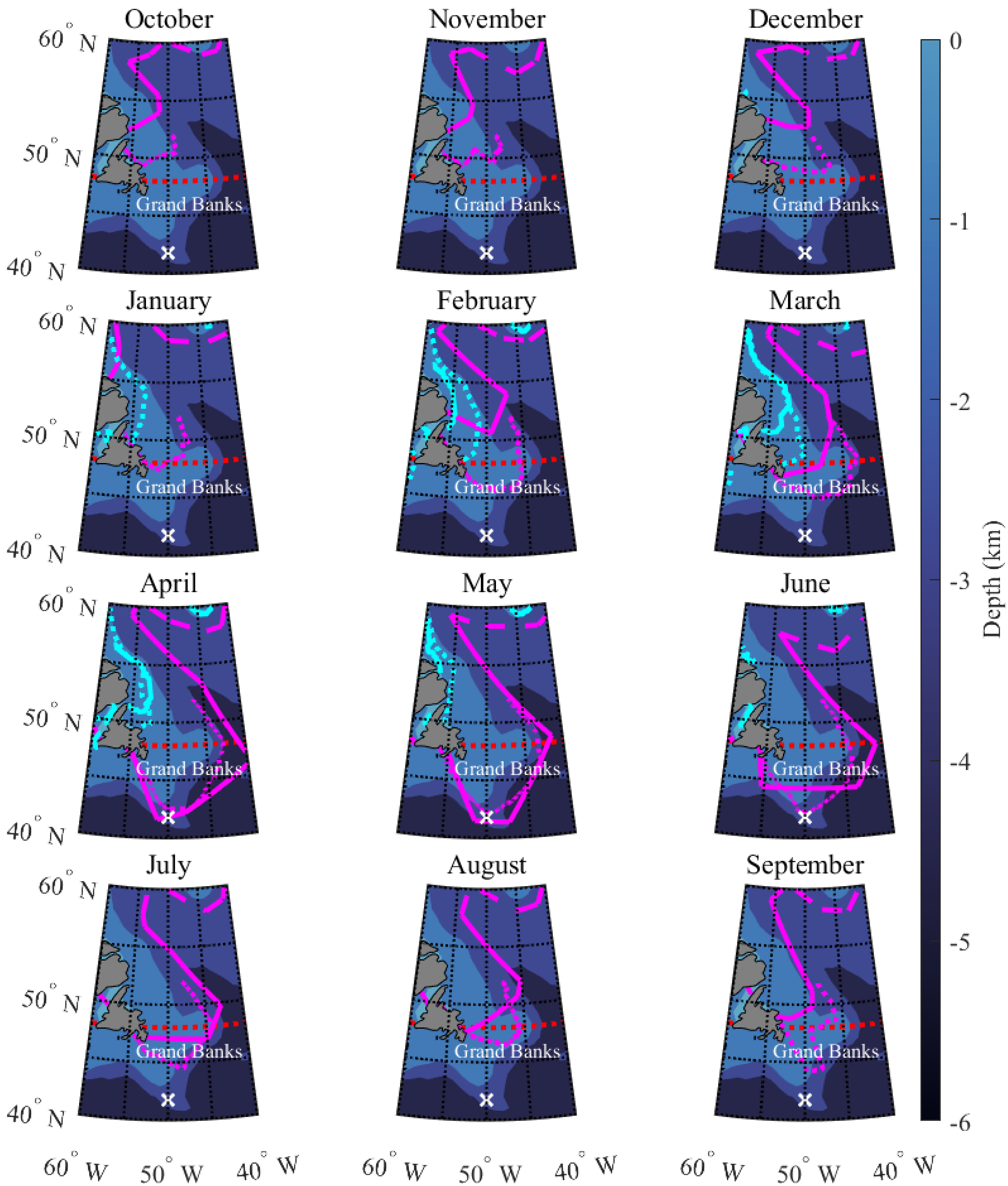

Figure 2.5. Median monthly sea ice extents *(cyan solid lines*) and mid-month iceberg extents (*magenta solid lines*) in IIP's AOR throughout the 2025 Ice Year in comparison to median monthly sea ice extents for 1981 to 2010 (*cyan dotted lines*) and mid-month iceberg limits for 1991 to 2020 (*magenta dotted lines*). Sea ice extents are from the National Snow and Ice Data Center (NSIDC) Sea Ice Index, Versions 3 and 4 (F. Fetterer, et al. 2017, F. Fetterer, et al. 2025). Iceberg limits are from IIP.

2.2.1 October to December 2024

Surface air temperatures (SATs, 2-m) cooled over the entire AOR through the first quarter of Ice Year 2025, reaching freezing levels in December along the Labrador coast and over the Grand Banks (**Figure 2.8**). SATs were several degrees above normal over the entire AOR throughout the quarter **(Figure 2.9**). Sea surface temperatures (SSTs) correspondingly cooled through the quarter, especially in the Labrador Sea and over the Grand Banks, but remained above freezing (**Figure 2.10**). SSTs were several degrees above normal over the AOR through the quarter and remained so especially within the Gulf Stream/North Atlantic Current (**Figure 2.11**). All SATs and SSTs reported here are from the Fifth Generation European Centre for Medium-Range Weather Forecasting (ECMWF) Reanalysis (ERA5) monthly averaged data on single levels from 1940 to present (Hersbach, et al. 2023, Copernicus Climate Change Service 2023).

Arctic sea ice reached minimum extent in late September 2024 (United States National Ice Center 2024). Without subfreezing SATs (sea water generally freezes at -1.9°C), sea ice did not expand into the AOR during the first quarter of the Ice Year (see **Figures 2.5** and **2.8**).

The mean monthly NAOI increased from a normal slightly negative value in October to an above-normal value near unity in December (see **Figure 2.4b**). Mean sea level pressures (MSLPs) responded through the quarter, with the gradient between the Greenlandic low and Azores high pressures shifting from shallow in October to steep in December (**Figure 2.12**). MSLPs became well below normal (~-10 hPa) over the Grand Banks through November, but turned well above normal (~10 hPa) over the entire AOR in December (**Figure 2.13**). Consistent with the return to a strong positive sign (normal mode) of the NAOI, winds strengthened in the Northern AOR and turned offshore over the entire AOR by December after turning briefly onshore in November (see **Figure 2.6**). Winds were slightly more offshore than normal in October, and more weakly offshore than normal over most of the AOR, and especially the Grand Banks, by December (see **Figure 2.7**). Total precipitation was largely near-normal throughout the quarter, increasing to a few mm above normal over the Grand Banks in November (**Figures 2.14** and **2.15**). All MSLPs, wind data, and precipitation rates are from the ECMWF ERA5 monthly averaged data on single levels from 1940 to present (Hersbach, et al. 2023, Copernicus Climate Change Service 2023).

Wave activity remained relatively static through the quarter, with slightly-above-normal significant wave heights (SWHs) over the Grand Banks in October and November, which decreased to well below normal over the Grand Banks in December (**Figures 2.16** and **2.17**). All SWHs are from the ECMWF ERA5 monthly averaged data on single levels from 1940 to present (Hersbach, et al. 2023, Copernicus Climate Change Service 2023).

Under above-normal temperatures and with near-normal, mild atmospheric conditions (below-normal offshore winds and near-normal precipitation) and near-normal, calm ocean conditions, the iceberg limit remained fairly static and well within median extent (for 1991 to 2020) through the quarter, with the southern limit near 53°N and the eastern limit near 50°W (see **Figure 2.5**). No icebergs crossed south of 48°N during this first quarter of the Ice Year (see **Figure 2.4a**).

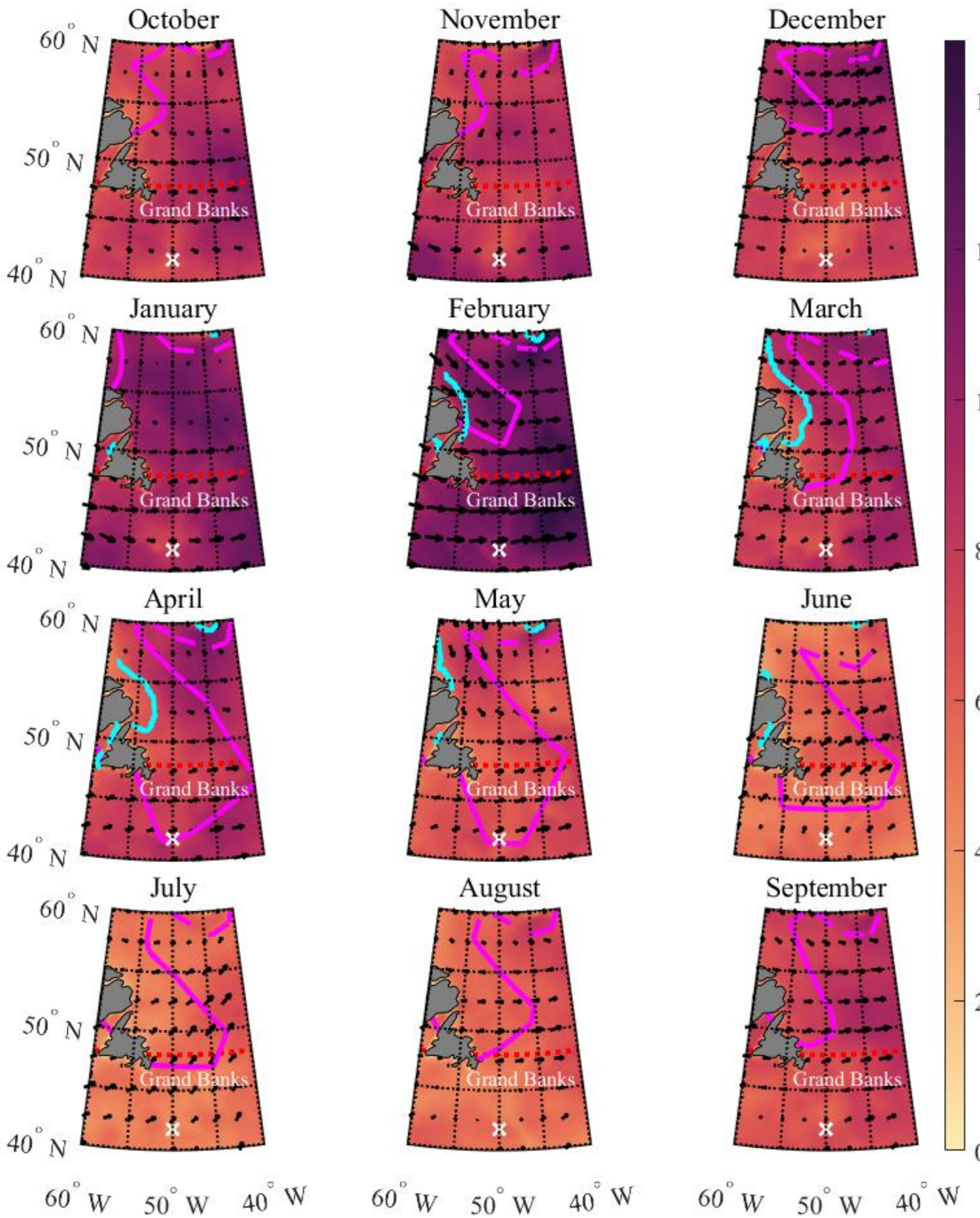

Figure 2.6. Mean monthly wind velocities (10 m) in IIP's AOR throughout the 2025 Ice Year. Median monthly sea ice extents (*cyan solid lines*) and mid-month iceberg limits (*magenta solid lines*) are shown. Wind data are from the ERA5 monthly averaged data on single levels from 1940 to present (Hersbach, et al. 2023). Sea ice extents are from the NSIDC Sea Ice Index, Versions 3 and 4 (F. Fetterer, et al. 2017, F. Fetterer, et al. 2025). Iceberg limits are from IIP.

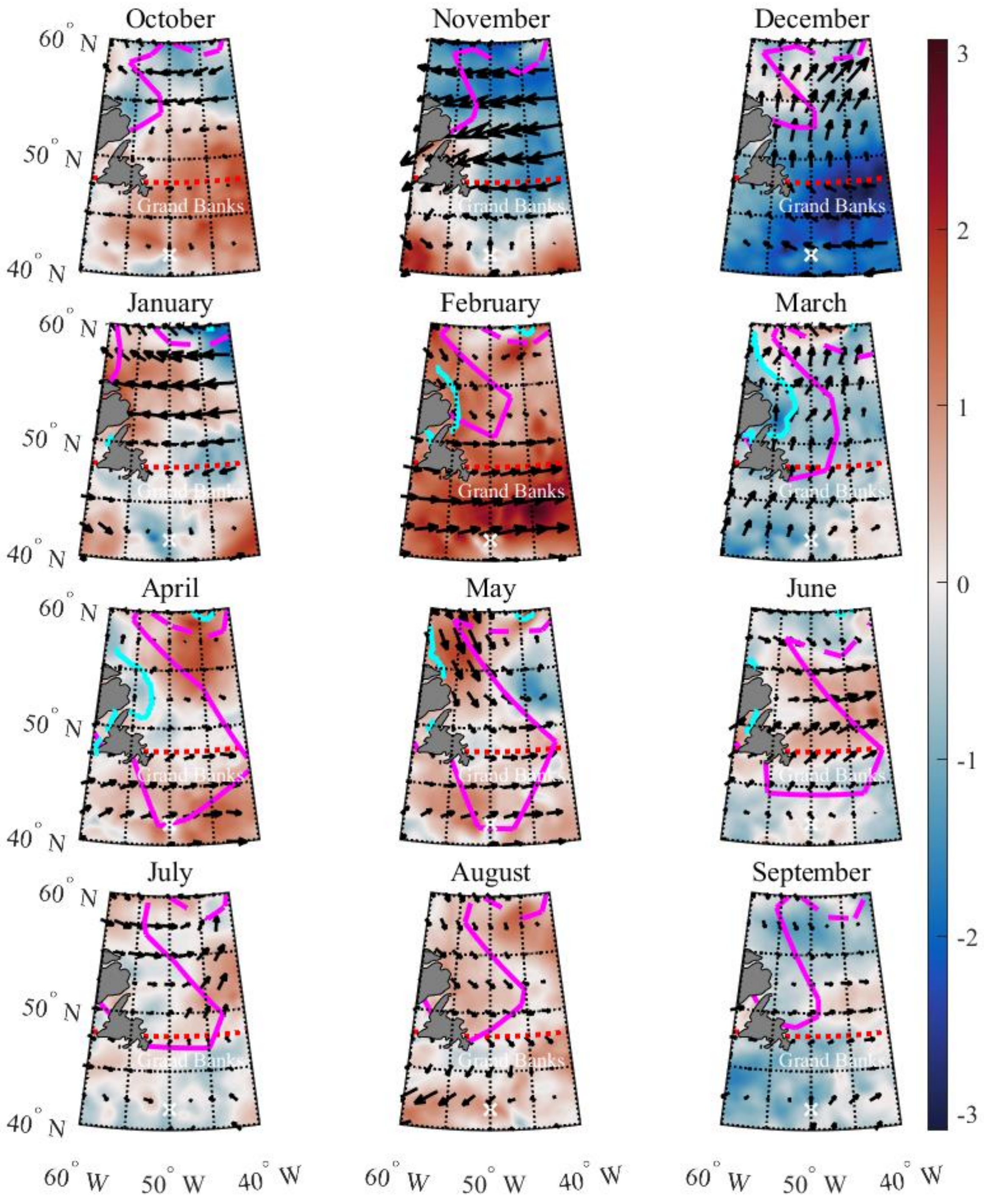

Figure 2.7. Mean monthly wind velocity (10 m) anomalies in IIP's AOR throughout the 2025 Ice Year. Wind velocity anomalies are calculated by subtracting 1983 to 2025 mean monthly wind velocities from the corresponding 2025 monthly wind velocities. Anomalies indicate how different observed values are from normal, and IIP takes environmental normals to be the mean monthly value for the relevant environmental parameter averaged over the modern reconnaissance era (1983 to present). Median monthly sea ice extents (*cyan solid lines*) and mid-month iceberg limits (*magenta solid lines*) are shown. SSTs are from the ERA5 monthly averaged data on single levels from 1940 to present (Hersbach, et al. 2023). Sea ice extents are from the NSIDC Sea Ice Index, Versions 3 and 4 (F. Fetterer, et al. 2017, F. Fetterer, et al. 2025). Iceberg limits are from IIP.

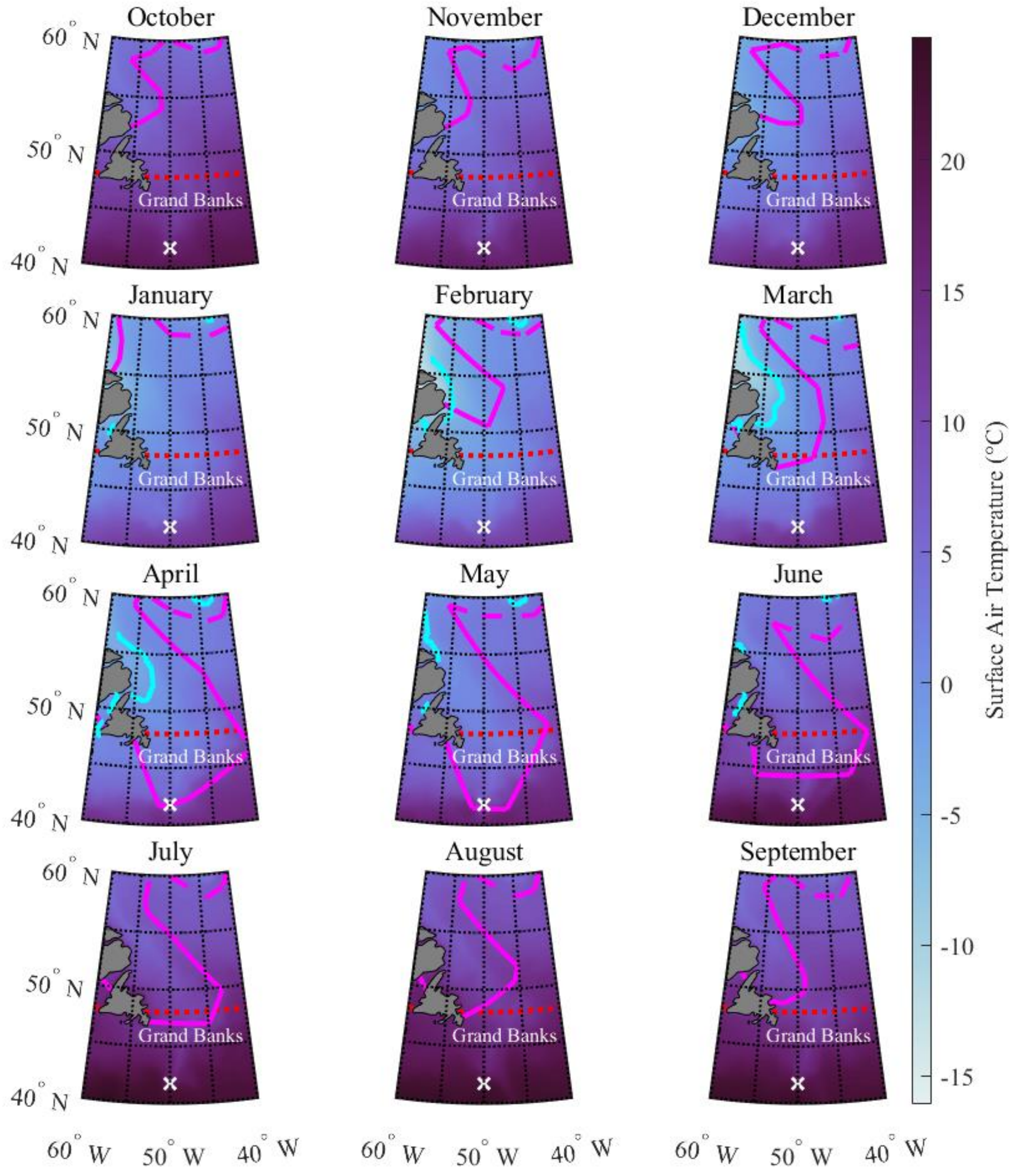

Figure 2.8. Mean monthly surface air temperatures (SATs, 2-m) in IIP's AOR throughout the 2025 Ice Year. Median monthly sea ice extents (*cyan solid lines*) and mid-month iceberg limits (*magenta solid lines*) are shown. SATs are from the ERA5 monthly averaged data on single levels from 1940 to present (Hersbach, et al. 2023). Sea ice extents are from the NSIDC Sea Ice Index, Versions 3 and 4 (F. Fetterer, et al. 2017, F. Fetterer, et al. 2025). Iceberg limits are from IIP.

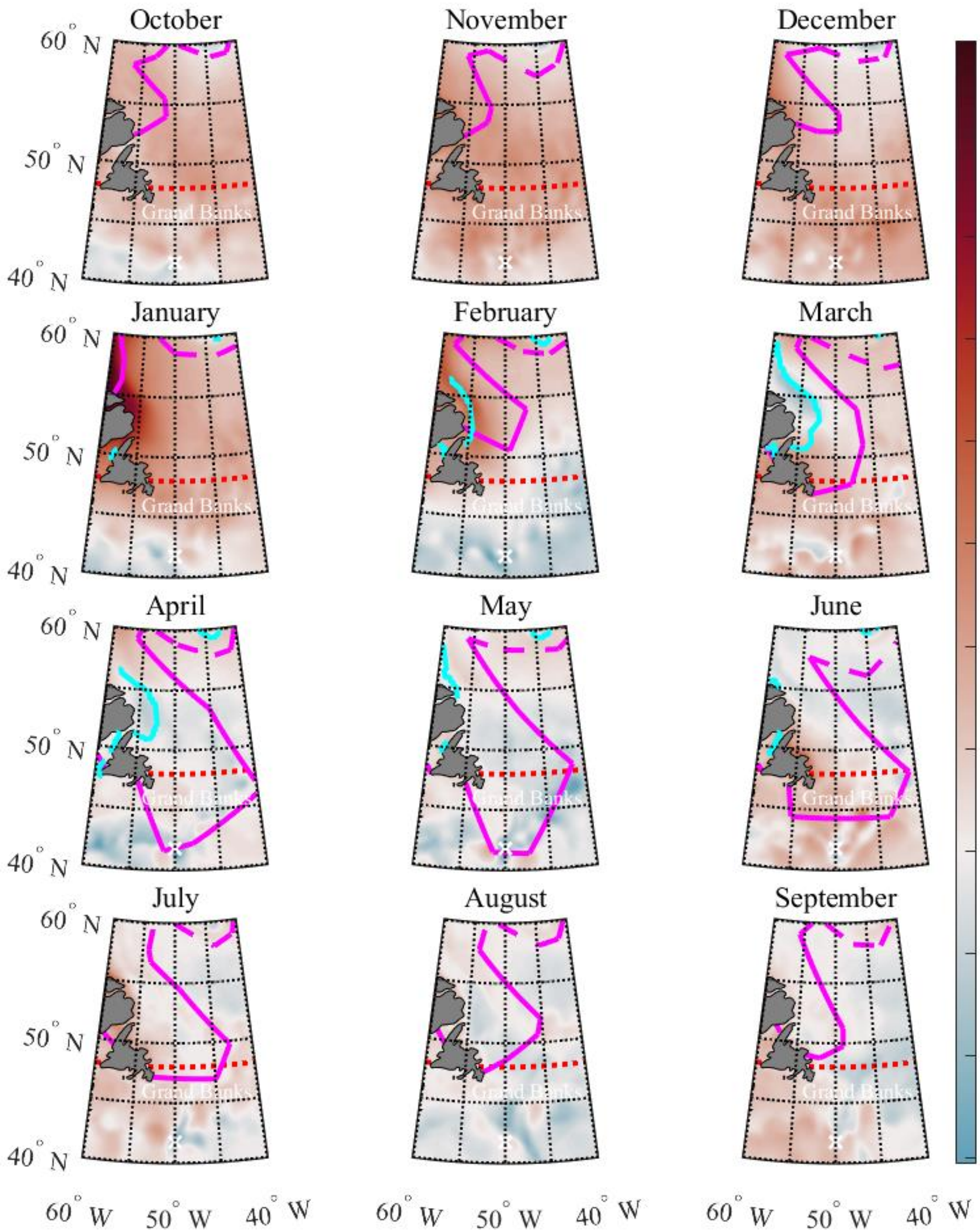

Figure 2.9. Mean monthly surface air temperature (SAT, 2-m) anomalies in IIP's AOR throughout the 2025 Ice Year. SAT anomalies are calculated by subtracting 1983 to 2025 mean monthly SATs from the corresponding 2025 monthly SATs. Median monthly sea ice extents (*cyan solid lines*) and mid-month iceberg limits (*magenta solid lines*) are shown. SATs are from the ERA5 monthly averaged data on single levels from 1940 to present (Hersbach, et al. 2023). Sea ice extents are from the NSIDC Sea Ice Index, Versions 3 and 4 (F. Fetterer, et al. 2017, F. Fetterer, et al. 2025). Iceberg limits are from IIP.

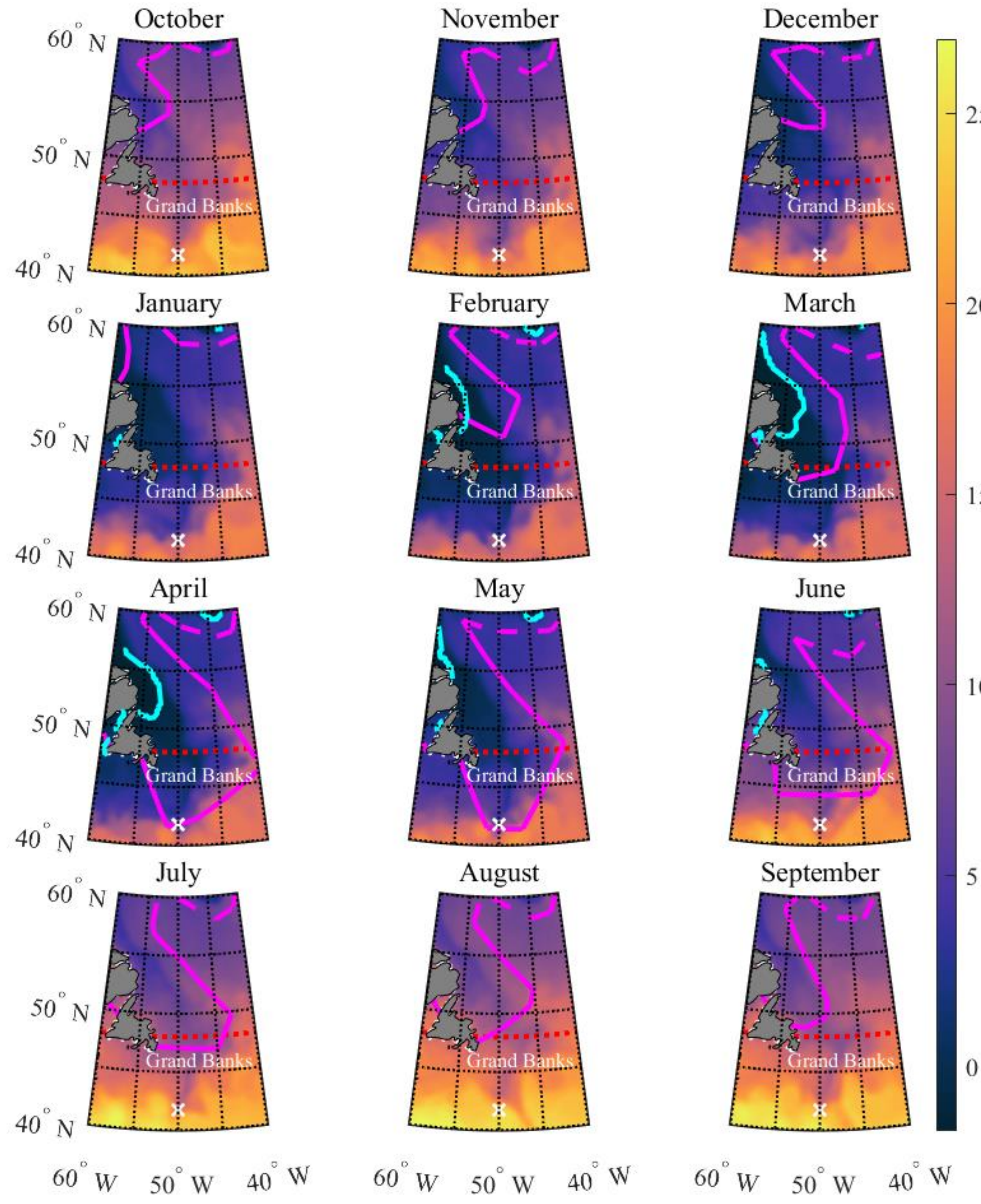

Figure 2.10. Mean monthly sea surface temperatures (SSTs) in IIP's AOR throughout the 2025 Ice Year. Median monthly sea ice extents (*cyan solid lines*) and mid-month iceberg limits (*magenta solid lines*) are shown. SSTs are from the ERA5 monthly averaged data on single levels from 1940 to present (Hersbach, et al. 2023). Sea ice extents are from the NSIDC Sea Ice Index, Versions 3 and 4 (F. Fetterer, et al. 2017, F. Fetterer, et al. 2025). Iceberg limits are from IIP.

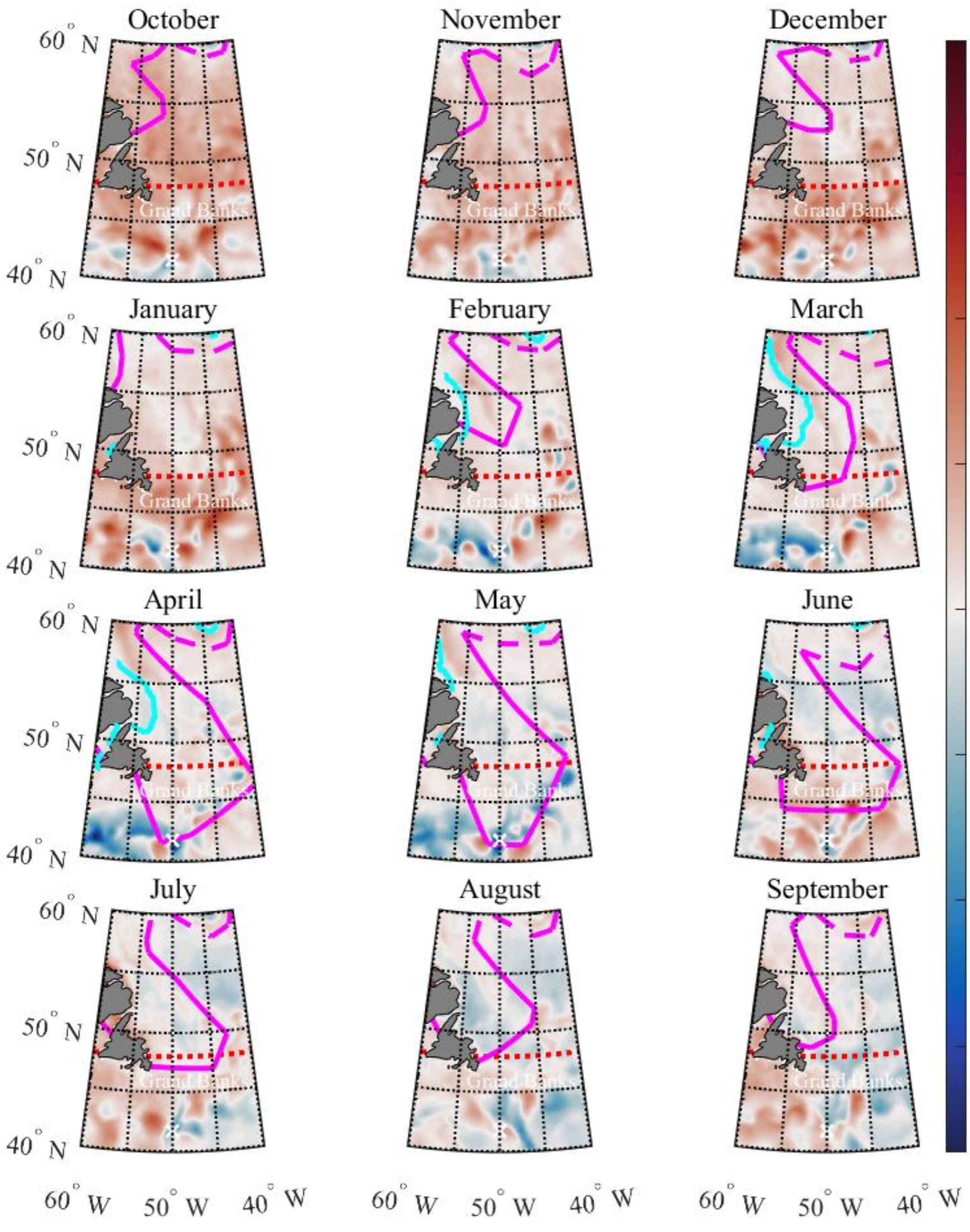

Figure 2.11. Mean monthly sea surface temperature (SST) anomalies in IIP's AOR throughout the 2025 Ice Year. SST anomalies are calculated by subtracting 1983 to 2025 mean monthly SSTs from the corresponding 2025 monthly SSTs. Median monthly sea ice extents (*cyan solid lines*) and mid-month iceberg limits (*magenta solid lines*) are shown. SSTs are from the ERA5 monthly averaged data on single levels from 1940 to present (Hersbach, et al. 2023). Sea ice extents are from the NSIDC Sea Ice Index, Versions 3 and 4 (F. Fetterer, et al. 2017, F. Fetterer, et al. 2025). Iceberg limits are from IIP.

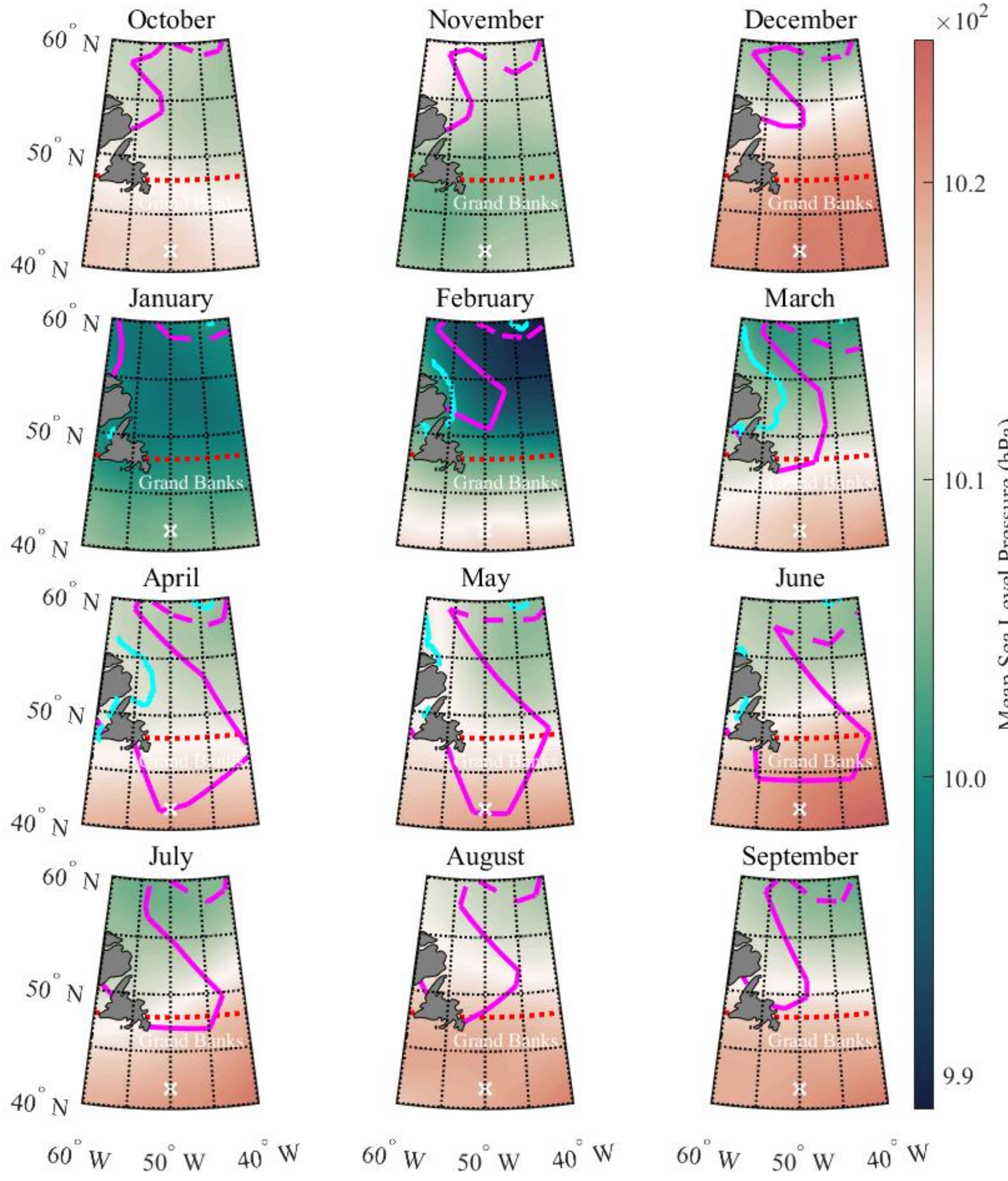

Figure 2.12. Mean monthly mean sea level pressures (MSLPs) in IIP's AOR throughout the 2025 Ice Year. Median monthly sea ice extents (*cyan solid lines*) and mid-month iceberg limits (*magenta solid lines*) are shown. MSLPs are from the ERA5 monthly averaged data on single levels from 1940 to present (Hersbach, et al. 2023). Sea ice extents are from the NSIDC Sea Ice Index, Versions 3 and 4 (F. Fetterer, et al. 2017, F. Fetterer, et al. 2025). Iceberg limits are from IIP.

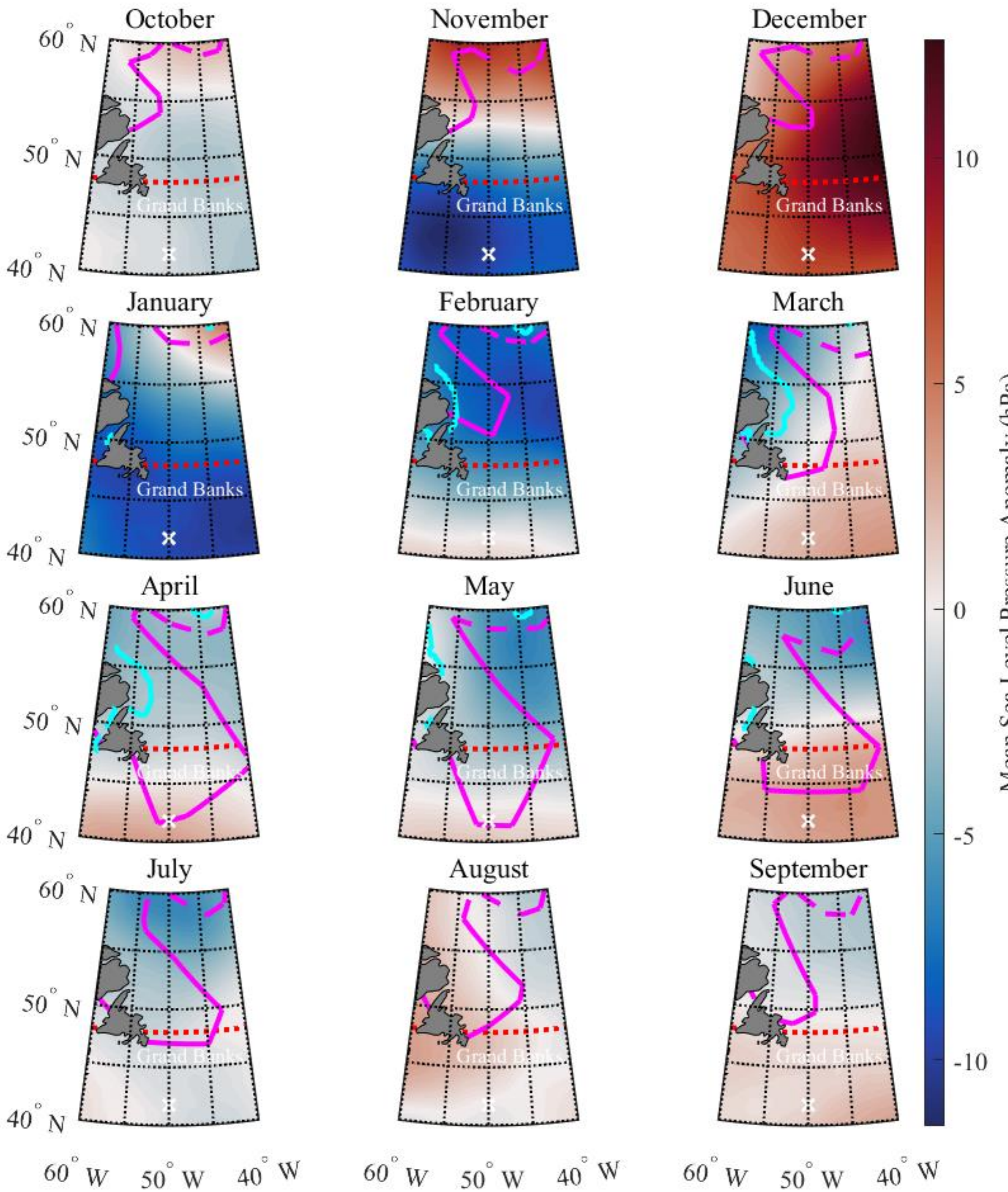

Figure 2.13. Mean monthly sea level pressure (MSLP) anomalies in IIP's AOR throughout the 2025 Ice Year. MSLP anomalies are calculated by subtracting 1983 to 2025 mean monthly MSLPs from the corresponding 2025 monthly MSLPs. Median monthly sea ice extents (*cyan solid lines*) and mid-month iceberg limits (*magenta solid lines*) are shown. MSLPs are from the ERA5 monthly averaged data on single levels from 1940 to present (Hersbach, et al. 2023). Sea ice extents are from the NSIDC Sea Ice Index, Versions 3 and 4 (F. Fetterer, et al. 2017, F. Fetterer, et al. 2025). Iceberg limits are from IIP.

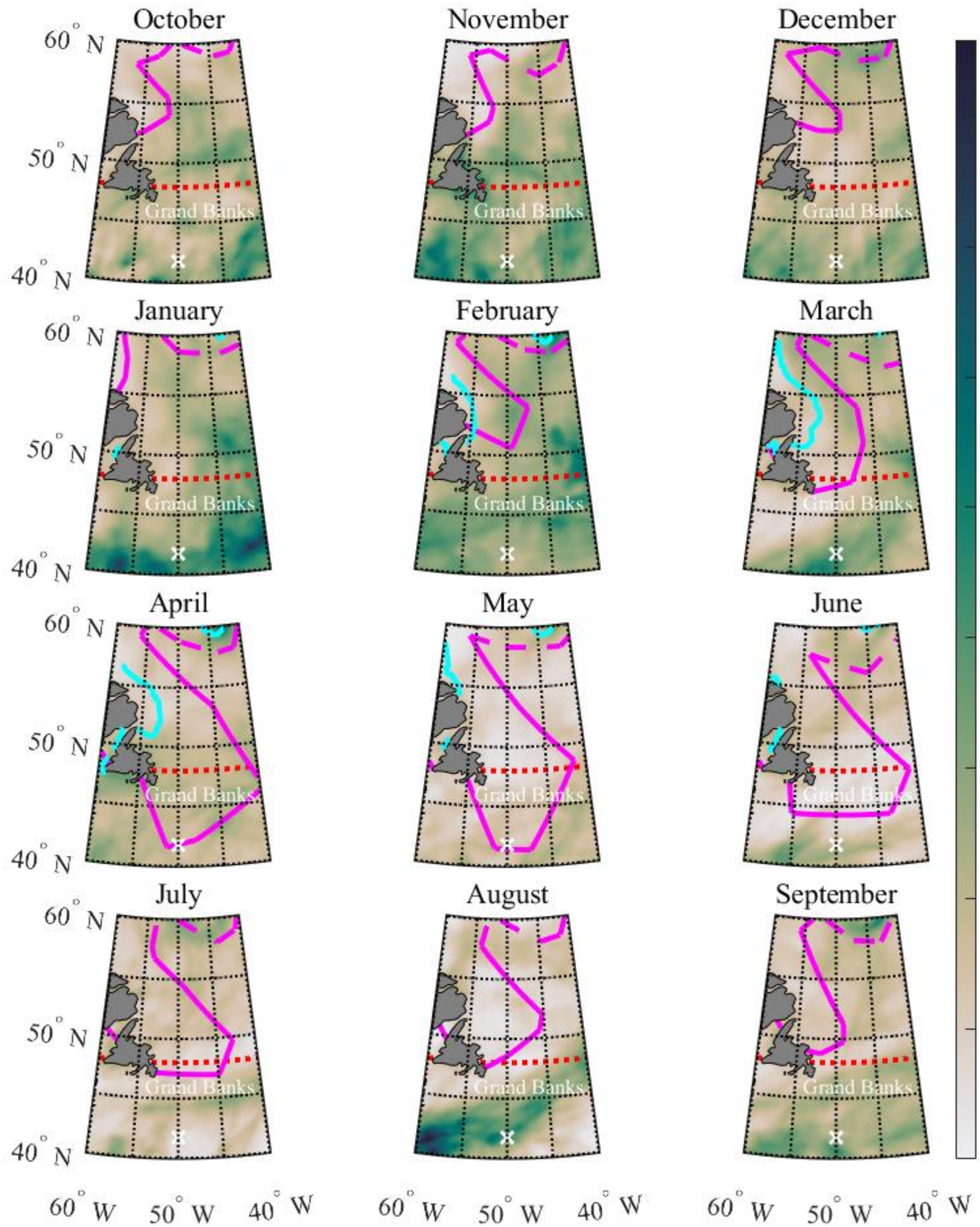

Figure 2.14. Mean monthly total precipitation in IIP's AOR throughout the 2025 Ice Year. Median monthly sea ice extents (*cyan solid lines*) and mid-month iceberg limits (*magenta solid lines*) are shown. Precipitation data are from the ERA5 monthly averaged data on single levels from 1940 to present (Hersbach, et al. 2023). Sea ice extents are from the NSIDC Sea Ice Index, Versions 3 and 4 (F. Fetterer, et al. 2017, F. Fetterer, et al. 2025). Iceberg limits are from IIP.

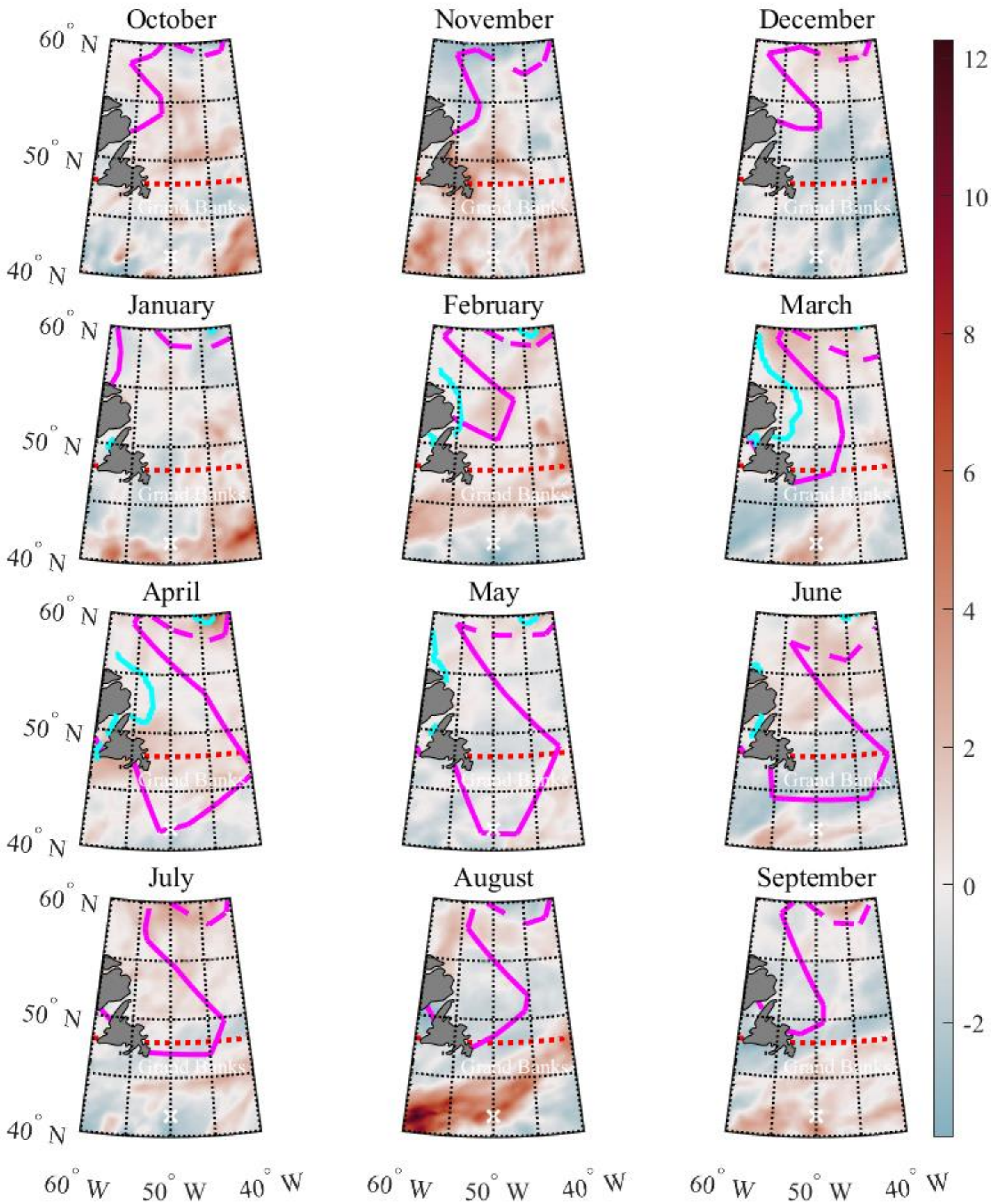

Figure 2.15. Mean monthly total precipitation anomalies in IIP's AOR throughout the 2025 Ice Year. Total precipitation anomalies are calculated by subtracting 1983 to 2025 mean monthly total precipitation from the corresponding 2025 monthly total precipitation. Median monthly sea ice extents (*cyan solid lines*) and mid-month iceberg limits (*magenta solid lines*) are shown. SSTs are from the ERA5 monthly averaged data on single levels from 1940 to present (Hersbach, et al. 2023). Sea ice extents are from the NSIDC Sea Ice Index, Versions 3 and 4 (F. Fetterer, et al. 2017, F. Fetterer, et al. 2025). Iceberg limits are from IIP.

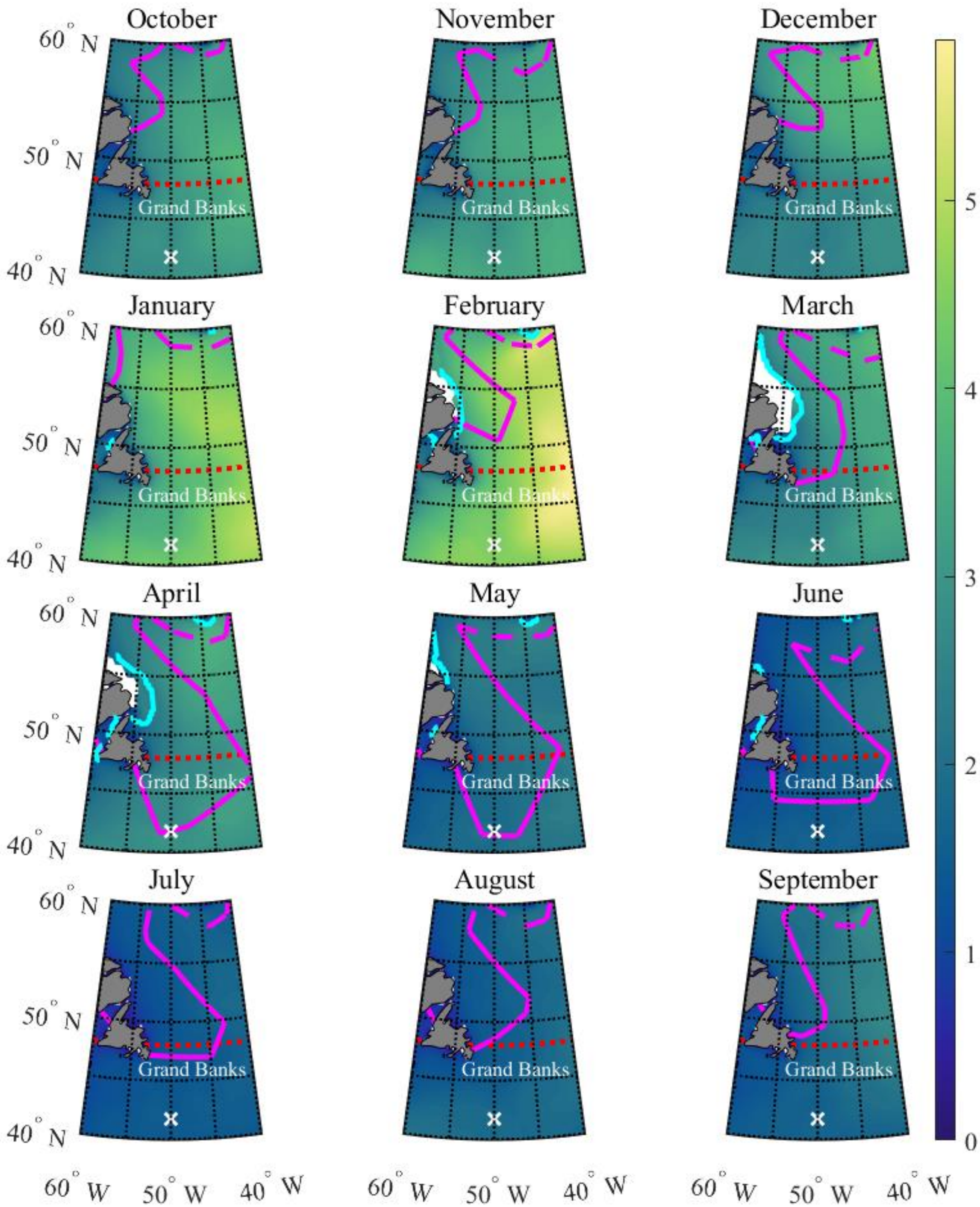

Figure 2.16. Mean monthly significant wave heights (SWH) in IIP's AOR throughout the 2025 Ice Year. Median monthly sea ice extents (*cyan solid lines*) and mid-month iceberg limits (*magenta solid lines*) are shown. SWHs are from the ERA5 monthly averaged data on single levels from 1940 to present (Hersbach, et al. 2023). Areas in white indicate no data. Sea ice extents are from the NSIDC Sea Ice Index, Versions 3 and 4 (F. Fetterer, et al. 2017, F. Fetterer, et al. 2025). Iceberg limits are from IIP.

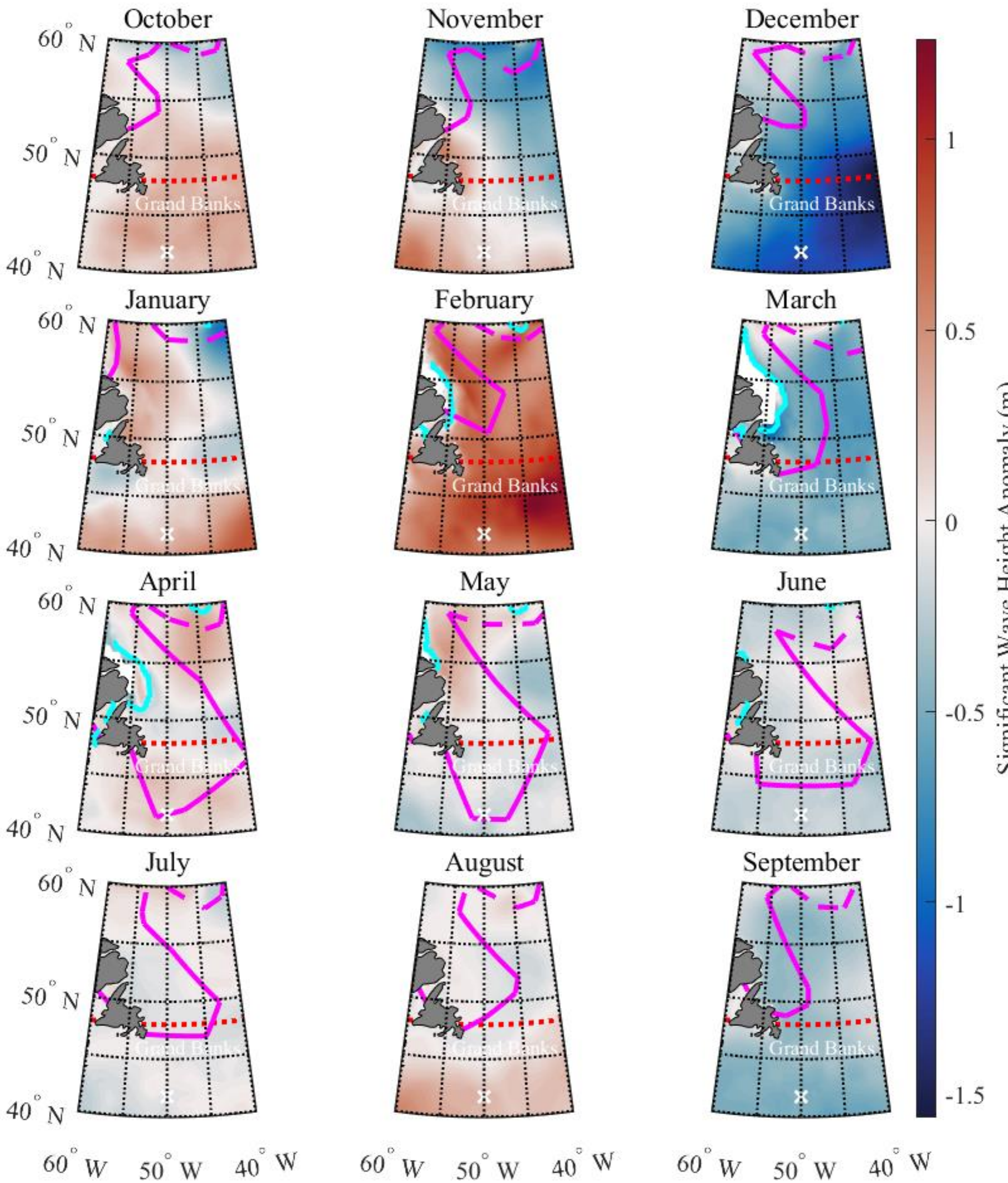

Figure 2.17. Mean monthly significant wave height (SWH) anomalies in IIP's AOR throughout the 2025 Ice Year. SWH anomalies are calculated by subtracting 1983 to 2025 mean monthly SWHs from the corresponding 2025 monthly SWHs. Median monthly sea ice extents (*cyan solid lines*) and mid-month iceberg limits (*magenta solid lines*) are shown. SSTs are from the ERA5 monthly averaged data on single levels from 1940 to present (Hersbach, et al. 2023). Areas in white indicate no data. Sea ice extents are from the NSIDC Sea Ice Index, Versions 3 and 4 (F. Fetterer, et al. 2017, F. Fetterer, et al. 2025). Iceberg limits are from IIP.

2.2.2 January to March 2025

SATs continued to cool to below freezing in the AOR through the second quarter of Ice Year 2025, reaching minimum values for the year over the Labrador Sea and Grand Banks in February (see **Figure 2.8**). Except for below-normal temperatures over the Grand Banks in February, SATs remained above normal over most of the AOR through the quarter, and were well above normal over the Labrador Coast in January and February (by ~3-7°C, see **Figure 2.9**). SATs remained well above normal there until March, when temperatures along that coast were below normal along the sea ice edge. SSTs continued to cool through the quarter, especially in the Labrador Current and over the Grand Banks, reaching freezing along the Labrador Coast in February (see **Figure 2.10**). SSTs remained slightly above normal throughout the AOR, especially in January in the Gulf Stream and North Atlantic Current, with cooler than normal ocean water traveling northeast within eddies in these major ocean currents in Febuary and March (see **Figure 2.11**).

As subfreezing SATs entered the AOR, sea ice expansion and growth into the region started along the western coast of Newfoundland in January, eventually encompassing the eastern coast of Labrador by March (see **Figures 2.5** and **2.8**); sea ice expanded south and east from the Labrador coast to its maximum extent at 50°N, 57°W in March. Sea ice extent was below normal through the quarter (with the southern sea ice edge remaining at least 5° farther north than the median for 1981 to 2010 in January and at least 2° farther north through February and March), except for the sea ice edge along western Newfoundland in January and the eastern sea ice edge in March which reached median extent. Sea ice extent in the second quarter closely resembled that of Ice Year 2024, except for the January sea ice edge along the eastern Labrador Coast in the AOR which was present in the previous Ice Year but absent during Ice Year 2025. In Ice Year 2023, the sea ice maximum (in March) extended as far south as St. John's, Newfoundland for the first time since 2017 (International Ice Patrol 2023); except for the western sea ice edge in the Strait of Belle Isle, sea ice did not extend farther than the northern Newfoundland peninsula in either 2024 or 2025 (International Ice Patrol 2024).

The mean monthly NAOI decreased to a below-normal, negative value in January, rising again to an above-normal maximum positive value in Febuary before decreasing to a normal near-zero value in March (see **Figure 2.4b**). In turn, MSLPs were low and well below normal in January, consistent with a negative NAO mode during that month, before transitioning to a near-normal pattern of Labrador lows and mid-Atlantic highs as the NAOI became positive into March (see **Figures 2.12** and **2.13**). Winds increased through the second quarter, and turned offshore for the rest of the Ice Year. They reached maximum above-normal values in February under the transition to a strong positive NAOI (see **Figure 2.4b**) before decreasing again to slightly below-normal offshore values in March (see **Figures 2.6** and **2.7**). Total precipitation remained high through the quarter, increasing to above-normal levels within the Gulf Stream and North Atlantic Current in January especially. Precipitation remained above normal over the Grand Banks through March (see **Figures 2.14** and **Figure 2.15**).

Ocean wave activity increased markedly through February, when SWHs were at well above-normal (~5-6 m) maximum values for the Ice Year. Wave activity decreased again in March to below-normal values (~2-3 m) throughout the AOR (see **Figures 2.16** and **2.17**).

In the second quarter of the Ice Year, the iceberg limit expanded south and east outside of the sea ice edge, reaching into the major transatlantic shipping lanes south of 48°N by March (see **Figure 2.5**). The iceberg limit remained within the mid-month median for 1991 to 2020 through the quarter; however, the northeastern limit approached normal, intersecting the median eastern limit by March. Twenty icebergs drifted south of 48°N in this quarter – all in March: fewer than the 1983 to 2024 mean number for these months, but on par with to slightly below median and within the IQR for those years (see **Figure 2.2**).

2.2.3 April to June 2025

SATs warmed steadily through the third quarter of Ice Year 2025, rising above freezing (see **Figure 2.8**) by June over the Grand Banks. However, SATs remained near normal (see **Figure 2.9**) through the quarter, with only slightly above-normal temperatures present over the Grand Banks and Gulf Stream in June. SSTs also warmed steadily through June, with freezing water dissappearing over the Grand Banks and in the southern Labrador Current by the end of the quarter (see **Figure 2.10**). SSTs were near normal throughout the quarter, and below normal within the Gulf Stream, but rose to slightly above normal in June over both the Gulf Stream and the Grand Banks (see **Figure 2.11**).

Sea ice responded and steadily retreated northwest through the quarter, with June being the last month of sea ice presence in the AOR for the Ice Year. Sea ice extent remained normal to near-normal, overlapping or nearing the 1981 to 2010 median in every month (see **Figure 2.5**).

The mean monthly NAOI rose through the quarter, from precisely normal at near-zero in April to slightly above normal near-unity in June (see **Figure 2.4b**). MSLPs correspondingly held a normal-mode NAO pattern through the quarter, with near-normal to slightly-below normal lower pressures over the Labrador Sea and normal to slightly above-normal higher pressures over the Grand Banks and the North Atlantic of the south AOR through the quarter (see **Figures 2.12** and **2.13**). Winds also correspondingly held offshore, decreasing slightly from April through June, but holding steady around 6 m/s throughout the AOR in the quarter (see **Figures 2.6** and **2.7**). Predominate offshore winds forcing the eastern limit remained slightly above-normal through the quarter. Total precipitation dropped to near-normal values through the third quarter (see **Figures 2.14** and **2.15**).

Ocean wave activity decreased steadily in the AOR and remained near-normal through the third quarter, with maximum open ocean SWHs of only a few meters by June (see **Figures 2.16** and **2.17**).

The iceberg limit expanded rapidly from the second quarter into the third, hitting maximum eastern extent in April, maximum southern extent in May, and maximum western extent in May and June. The southeastern limits exceeded the 1991 to 2020 median in each month of the third quarter, except for the tip of the southern limit in June (see **Figure 2.5**). Two hundred and twenty icebergs drifted south of 48°N in the third quarter of Ice Year 2025 (86 in April and May each, and 48 in June; see **Figures 2.2** and **2.4a**). While IBX48N was below mean throughout the quarter, in April and June it approached median and was within the 1983 to 2024 IQR in all three months (see **Figure 2.2**).

2.2.4 July to September 2025

In the final quarter of Ice Year 2025, SATs generally warmed into August (see **Figure 2.8**) over the AOR, remaining near normal; while at their maximum for the Ice Year in August, SATs were near to slightly below normal over most of the AOR, especially the Grand Banks (see **Figure 2.9**). SSTs warmed through the final quarter (see **Figure 2.10**) but remained near normal, with slightly above-normal temperatures (~1-2°C) in the Gulf Stream; SSTs did not reach the record high values in the AOR seen in the same quarter of Ice Years 2023 and 2024 (above 25°C over the southern Grand Banks) (Thiem 2024, International Ice Patrol 2024).

The mean monthly NAOI decreased from an above-normal positive value in July to a below-normal value near negative one in September, crossing a normal near-zero value in August (see **Figure 2.4b**). MSLPs continued to hold near-normal values (see **Figure 2.12**) in a normal-mode NAO pattern, with a shoaling of gradiants between the northern and southern AOR. Winds remained offshore through the rest of the Ice Year (see **Figure 2.6**) at mostly near-normal minimum speeds for the year (see **Figure 2.7**). Precipitation largely remained low at near-normal values (see **Figure 2.14**), but maximum anomalous precipitation for the Ice Year (~10 mm above normal) occurred over the Gulf Stream in August (see **Figure 2.15**).

The ocean remained at its calmest for the Ice Year through the quarter (see **Figure 2.16**), with SWHs near normal throughout most of the AOR through August, turning below-normal over the entire AOR in September (see **Figure 2.17**). SWHs increased slightly above normal in August outside of the iceberg limit.

The iceberg limit retreated north and west through the final Ice Year quarter (see **Figure 2.5**), finally barely leaving the shipping lanes in September and settling near 49°N. Even so, the iceberg limit continued to exceed the eastern median limit for 1991 to 2020 through August before receding within-median in September. One final iceberg drifted south of 48°N in fourth quarter in July, on par with normal for all three months (see **Figure 2.3**, July to September IQR).

2.3 Summary of Ice and Environmental Conditions in Ice Year 2025

The 2025 Iceberg Season severity was moderate based on the near-normal total IBX48N (250), the near-normal season length (five months), and the near to slightly above-normal monthly iceberg extents during the peak of the season. Iceberg extent threatened shipping lanes into August—a reminder that regardless of Iceberg Season severity, the presence of icebergs at all poses a danger to the mariner navigating nearby.

3 Operations Center Summary

The Operations Center (OPCEN) is the hub of IIP's iceberg information processing and dissemination. OPCEN personnel stand watch to receive and process iceberg reports, analyze ice and environmental conditions, and create and distribute daily iceberg warning products. Iceberg reports are generated and received primarily through IIP, CIS, and commercial aerial and satellite reconnaissance. Iceberg reports can also be generated and received from vessels and shoreline reports. IIP processes iceberg reports to update sighted iceberg locations and characteristics within IIP's iceberg database. Positions of icebergs within the database are then predicted for the same times (0000Z and 1200Z) daily via iceberg drift and deterioration (predicted melt) computer models using BAPS. Finally, iceberg limits are generated to contain the modeled iceberg positions for 0000Z the next day and are distributed to mariners and the public within the NAIS daily warning products.

3.1 Iceberg Warning Products

IIP and CIS partner to create and distribute the NAIS daily iceberg warning products. IIP takes responsibility for product generation and dissemination, including deploying personnel to Newfoundland and Labrador for aerial iceberg reconnaissance, generally during the active Iceberg Season. In Ice Year 2025, IIP took this responsibility from 30 January to 03 September 2025. The operational statistics contained in this section are taken exclusively from this period. CIS publishes the iceberg warning products generally outside of the Iceberg Season (usually September to January) when the iceberg population threatens primarily the Canadian coastline.

NAIS iceberg warning products are generated in text (NAIS-10 bulletin) and graphic (NAIS-65 chart) form. The NAIS-10 bulletin lists the latitude and longitude points along the predicted iceberg limit and reported sea ice limit and the NAIS-65 chart shows the predicted iceberg limit and estimated iceberg quantity per square degree (iceberg frequency). Semi-monthly NAIS-65 iceberg charts are shown in **Section 5**. Both products include information on the most recent relevant iceberg reconnaissance, including date, type, and coverage. The products are released daily between 1830Z and 2130Z and are valid for 0000Z the following day. During the 2025 Ice Year, all iceberg warning products were released on time.

IIP publicly disseminates the NAIS iceberg warning products through various means. The NAIS-10 bulletin is broadcast over SafetyNET, Navigational Telex (NAVTEX), and Simplex Teletype Over Radio (SITOR); the NAIS-65 chart is broadcast over radio facsimile (Radiofax) and posted to the National Weather Service (NWS) Marine Forecast (https://www.weather.gov/marine/marsh) and NOAA Ocean Prediction Center (OPC) (https://ocean.weather.gov/Atl_tab.php) websites. Both products are posted daily on IIP's product webpage (https://www.navcen.uscg.gov/north-american-ice-service-products).

The daily iceberg and sea ice limits are also posted to the IIP product website as Geographic Information System (GIS) compatible files (Keyhole Markup Language (KML), and Environmental Systems Research Institute (ESRI) shapefiles). Additionally, the daily iceberg limit is available as a displayable layer within several online mapping applications: NOAA's Environmental Response Management Application (ERMA) mapping tool for the Arctic (https://erma.noaa.gov/arctic) and Atlantic (https://erma.noaa.gov/atlantic), and the USCG Navigation Center (NAVCEN) website (https://www.navcen.uscg.gov/international-ice-patrol-map).

3.1.1 Iceberg Warning Product Changes for 2025

Each year, IIP and its NAIS partners, CIS and the Danish Meteorological Institute (DMI), review NAIS iceberg products, procedures, and distribution processes to improve product content, delivery, and value for the mariner. For 2025, no minor or major changes were made to the NAIS-65 chart or NAIS-10 bulletin.

3.2 Iceberg Reports

During the 2025 Iceberg Season, the OPCEN received reports of icebergs from IIP satellite reconnaissance, CIS, commercial flights, and ship reports. The wide variety of reporting sources helped IIP to better estimate the state of the iceberg population by diversifying available iceberg reconnaissance data for comparison. This comparison was particularly important for analysts verifying targets in satellite imagery against those sighted by aircraft and increases confidence in semi-automated satellite analysis routines. Mariners transiting the AOR remain a vital source of iceberg reporting for IIP to maintain its positive safety record. **Table 3.1** lists ships that made voluntary iceberg reports while IIP was responsible for the iceberg products.

Once received, iceberg reports (**Figure 3.1**) are converted into standard iceberg messages (SIMs) which include specific iceberg characteristics such as time of sighting, position, size, shape, and other relevant information. Iceberg messages are still transmitted even if the message does not include any reported icebergs. A message with no reported icebergs can be useful for confirmation of their absence, especially when generated with a high-confidence source (e.g., aerial reconnaissance, cloud-free optical imagery, or ship). Due to model limitations, it can be prudent to keep icebergs longer than 30 dyas of drift, these SIMs are called “CIIP SIMs”.

In the 2025 Ice Year, IIP received, analyzed, and processed 1,756 SIMs: 1,182 from satellite reconnaissance, 492 from aerial reconnaissance, and 82 from other sources. Of the satellite SIMs, the majority originated from IIP satellite imagery analysis (91%), followed by commercial satellite reconnaissance (9%). **Table 3.2** provides further detail on the number and source of SIMs received while IIP held product responsibility.

Icebergs which enforce the shape of the drawn iceberg limit due to their proximity to the maximum iceberg extent are termed “limit-setting” icebergs. The number of limit-setting icebergs is limited by product generation procedure to seven or less. Icebergs further inside the maximum extent (interior to the iceberg population or near land) do not affect the shape of the iceberg limit. The number of limit-setting icebergs per reporting source can be seen in **Figure 3.1** and **Table 3.2**.

In this document, "incorporated" means the iceberg, growler, or radar target was added or re-sighted to the database. A total of 7,563 icebergs, growlers, and radar targets were incorporated in the model from iceberg reports, a decrease from the year 2024 by 7% (8,139 icebergs, growler, and radar targets). This decrease corresponded to both a smaller population of icebergs in the area and a reduced number of targets reported by commercial partners.

Reported icebergs that could be correlated with existing icebergs in IIP’s database are “re-sighted” to the database with their more recently reported position. If an iceberg cannot be correlated to an existing database iceberg, it is added to the database. In an Ice Year, the number of icebergs added corresponds to the number of unique iceberg sightings. In Ice Year 2025, there were 2,413 icebergs added to the database, which was 25% of all database actions taken (add, delete, re-sight, no action) through the year.

Reported icebergs that are added to or resighted (no action) in the iceberg database often originate from coincident reports from multiple sources. In these circumstances, the OPCEN will only include the most recent position and size of the most complete iceberg report received.

CANADA	
CCGS Pierre Raddison	5
IT Integrity	4
CCGS Louis S. ST-Laurent	1
CCGS Amundsen	1
CCGS Jacques Cartier	1
Tug Atlantic Elm	1
Maersk Clipper	1
Coastal Server	1
HMCS William Hall	1
Nunalik	1
Avalon Sea	1
NETHERLANDS	
Statengracht	2
Ijborg	1
Qamutik	1
MARSHALL ISLANDS	
Federal Bering	3
Federal William Paul	2
Federal Shimanto	2
Federal Yukon	2
Federal Caribou	1
Federal Satsuki	1
Federal Spruce	1
Riviera	1
AUSTRIA	
Stravanza	1
MALTA	
Boka Sweeper	1
PANAMA	
Lowlands Century	1
BAHAMAS	
Podlasie	1
GERMANY	
Seefalke	4
USA	
Friendship 4	1
PORTUGAL	
Eco Monegasque	1

Table 3.1. 2025 Ship reports by Nation of Origin. IIP awards the vessel that submits the most iceberg reports each year. The award is named after the CARPATHIA, the vessel credited with rescuing 705 survivors from the TITANIC disaster.

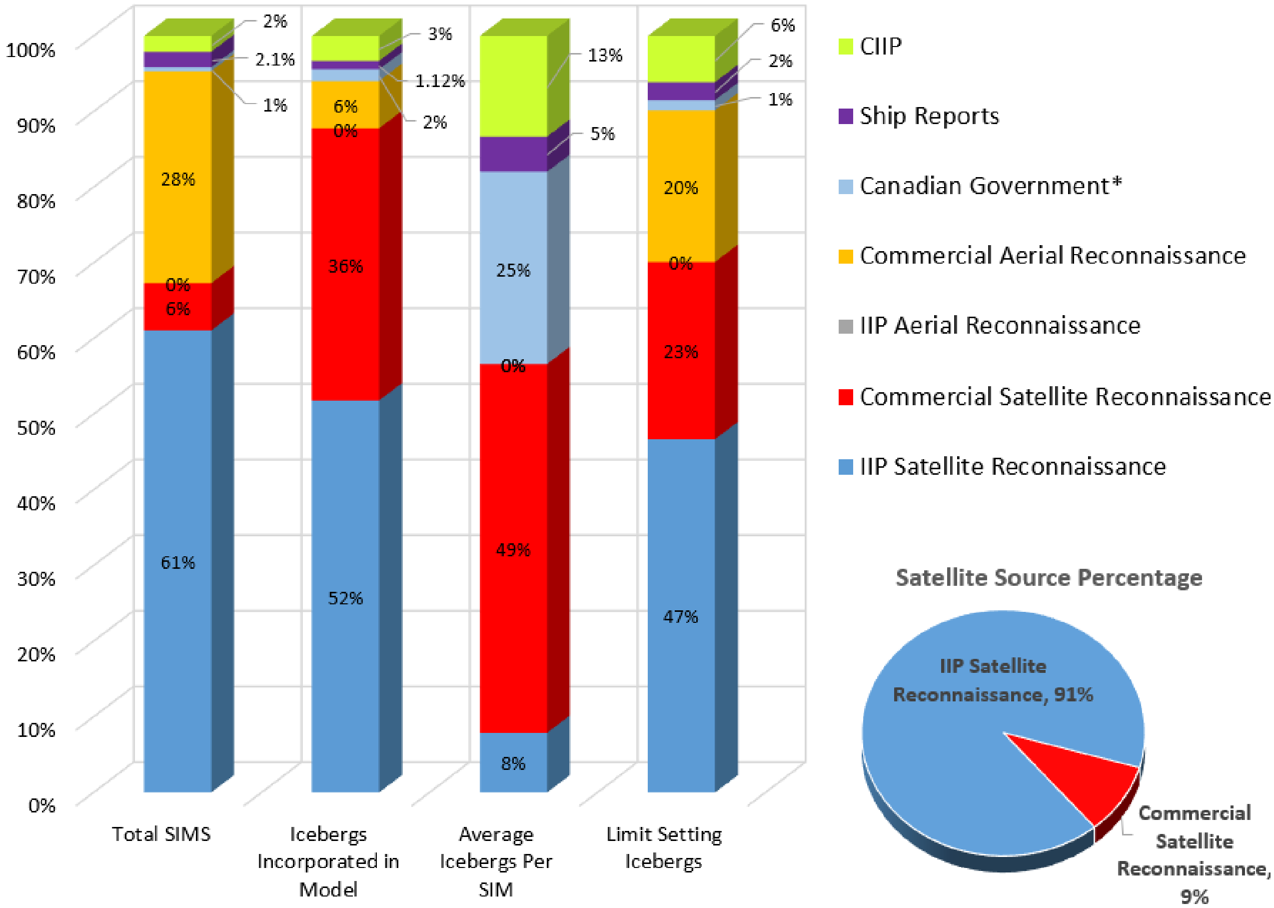

Figure 3.1. Proportion of total SIMs, icebergs incorporated into the model, average icebergs per SIM, and limit-setting icebergs by reporting source. CIIP SIMs represent iceberg messages for icebergs which are prudent to keep longer than 30 days of drift. This is required due to model limitations.*The Canadian Government row does not include Government-funded Commercial Aerial Reconnaissance (which are included in the Commercial Aerial Reconnaissance source) and is mostly made up of Canadian Coast Guard reports.

Source	Total SIMS	Detailed Source	Total SIMS	Icebergs Incorporated in Model	Average Icebergs Per SIM	Limit Setting Icebergs
Satellite Reconnaissance	1,182	IIP Satellite Reconnaissance	1,072	3,918	4	275
		Commercial Satellite Reconnaissance	110	2,721	25	138
Aerial Reconnaissance	492	IIP Aerial Reconnaissance	0	0	0	0
		Commercial Aerial Reconnaissance	492	473	0	118
Other Reconnaissance	82	Canadian Government*	9	116	13	8
		Ship Reports	36	85	2	14
		CIIP	37	250	7	36
Total	**1,756**	**Total**	**1,756**	**7,563**	**51**	**589**

Table 3.2. Detailed information of this year's icebergs received from each SIM source. *The Canadian Government row does not include Government-funded Commercial Aerial Reconnaissance (which are included in the Commercial Aerial Reconnaissance source) and is mostly made up of Canadian Coast Guard reports.

3.3 Iceberg Reconnaissance

3.3.1 Satellite Iceberg Reconnaissance

IIP generates iceberg reports from both internal satellite analysis and external satellite analysis (typically commercial). In the 2025 Ice Year, IIP satellite reconnaissance added 1,541 icebergs, 0 growlers, and 3 radar targets to the database from the 1,072 IIP satellite reconnaissance iceberg reports. Commercial satellite reconaissance added 695 icebergs, 0 growlers, and 0 radar targets from the 110 commercial satellite reconnaissance reports. In Ice Year 2025, commercial satellite reconnaissance was provided by C-CORE, a Canadian company headquartered in St. John's that monitors icebergs for oil and gas industry clients.

Overall, 2,239 icebergs, growlers, and radar targets from all satellite reconnaissance iceberg reports were added to the iceberg database, accounting for 93% of database additions. See **Section 4** for detailed information on IIP satellite iceberg reconnaissance.

3.3.2 Aerial Iceberg Reconnaissance

This season IIP did not conduct internal aerial reconnaissance due to aerial asset availability (see **Bulletin 111** and **Introduction** for more detail). This resulted in a significant shift and focus on satellite operations. **Section 4** contains detailed information on IIP aerial iceberg reconnaissance processes and equipment.

Commercial aerial reconnaissance from PAL Aerospace (a private contracted company) incorporated an additional 87 icebergs, 17 growlers, and 0 radar targets into the iceberg database. Unlike IRDs conducted by IIP, many commercial flights by PAL Aerospace are not flown primarily for iceberg reconnaissance. As a privatized company, they conduct other primary missions for different clientele alongside their iceberg specific reconnaissance missions for CIS and the oil/gas industry. **Figure 3.2** differentiates the PAL Aerospace flights that were dedicated to ice reconnaissance (funded by CIS or the oil/gas industry) and other flight operations that resulted in iceberg reports as a byproduct. This commercial aerial reconnaissance data is described further in **Table 3.2.**

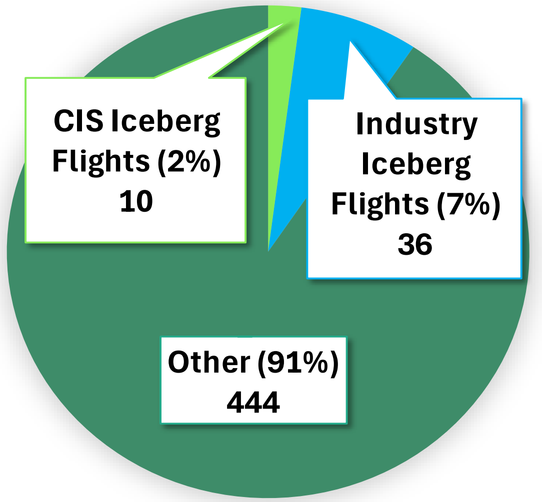

Figure 3.2. PAL Aerospace flights by primary mission type that reported icebergs. The "Other" category includes flights that reported icebergs but with a primary mission other than iceberg reconnaissance.

A majority, 91%, of the PAL Aerospace flights that reported icebergs were flown for primary missions other than iceberg reconnaissance. PAL flights funded by the oil and gas companies concerned with icebergs in the vicinity of offshore oil rigs accounted for 7%. Only 2% of PAL flights were funded by CIS specifically for iceberg reconnaissance in areas designated by either IIP or CIS. **Figure 3.2** reflects these percentages. The willingness of PAL Aerospace to identify and share iceberg reconnaissance information regardless of their source of funding demonstrates a notable and significant commitment to maritime safety across the region.

3.4 Iceberg Deletions

Internal parameters developed by IIP allow an iceberg to be deleted from the database based on one of three factors: 1) its modeled positional circle of uncertainty ("error circle") must be declared iceberg-free based on recent reconnaissance, 2) its "time on drift" must exceed 30 days, or 3) its predicted degree of melt must be between 125-150%, based on its proximity to the iceberg limit. Due to degraded reconnaissance in the 2025 ice year, the predicted degree of melt was required to be greater than 200% melt for the third deletion criteria.

Iceberg drift and deterioration (predicted melt) in the IIP database was estimated via numerical models executed in BAPS. Icebergs were deleted from the active iceberg database based on modeled deterioration, time since last sighting, or recent reconnaissance results. For predicted melt, IIP employs a conservative approach for estimating when an iceberg melted entirely. The model provides a melt factor based on the original sighted position between 0-500%. An iceberg that has melted 100% by deterioration calculations has theoretically melted to nothing, while an iceberg that has melted to 500% has endured enough environmental factors (wave action, sea surface temperature, etc.), that it could have melted five times over.

An iceberg error circle may be declared free of icebergs from either a high-confidence reconnaissance flight or from cloud-free, high-resolution optical imagery. While satellite imagery usually covers an error circle, it may not allow for high-confidence iceberg deletion due to cloud-cover, imagery resolution, ocean wave radar backscatter, target ambiguity, or other factors. For this reason, IIP rarely deletes database icebergs using satellite imagery. However, on a case-by-case basis for high-resolution optical (e.g., Sentinel-2, or SN2) imagery, deletions are allowed if there is little cloud cover and reduced ocean noise. These conditions allow the analyst to have high confidence of the absence of icebergs.

Similarly, a commercial flight might fly over a modeled position, but may not cover the error circle entirely, leaving a possibility that the iceberg was missed. For this reason, deletes are also not typically based on the results of commercial flights. In 2025, PAL Aerospace flew 10 CIS-funded iceberg reconnaissance flights using IIP-drawn flight plans. This provided a testing ground for IIP to plan commercial flights based on internal criteria for deleting modeled icebergs. This season, seven modeled icebergs were deleted from CIS-funded PAL flights.

3.5 Limit-Setting Icebergs

The single most important icebergs monitored by IIP are limit-setting icebergs. Typically, an average of four icebergs (minimum of one and maximum of seven) set the iceberg limit at any time.

In Ice Year 2025, the maximum extent of the iceberg limit was during a period of reduced reconnaissance, in which the entire iceberg limit was estimated. It stretched 864 NM East of St. John's to 47°10'1" N, 32°44'59" W, at its maximum Easternmost extent on 02 May 2025 (**Figure 3.3**). The limit reached its Southernmost extent at 40°40'3" N 52°10'9" W, 414 NM South of St. John's also on 02 May 2025 (**Figure 3.3**).

Reconnaissance from satellite imagery was the leading source for spotting limit-setting icebergs (85%) in 2025. This was an increase from 2024 (60%).

Many of the limit setting icebergs incorporated into the model were observed by satellite, typically synthetic aperture radar (SAR). However, it is often challenging to reliably determine ice-free conditions from SAR imagery due to low confidence in analysis from difficulty in eliminating false positives and false negatives. More information on the difficulties faced with Satellite imagery can be found in **Section 3.6** and **Section 4.6**.

A false positive result is one in which a target is determined to be an iceberg where, in fact, there is not one. This can result in the needless expansion of the iceberg limit, negatively impacting shipping without a corresponding increase in safety.

Of greater concern are false negatives, in which it is determined there are no icebergs where icebergs do, in fact, exist. This situation is especially dangerous and can result in the iceberg limit not encapsulating the iceberg hazard, placing ships in harm's way.

Continued development of satellite imagery analysis is aimed at reducing these errors through increased understanding of the impact of satellite parameters, image quality, and environmental conditions on detection and classification of targets.

For now, IIP considers the most reliable and highest confidence method for monitoring the iceberg limit to be aerial reconnaissance due to the platform's ability to cover large swaths of ocean while targeting growlers at the same time. IIP anticipates a continued slow but steady shift towards satellite reconnaissance as more high resolution imagery become available.

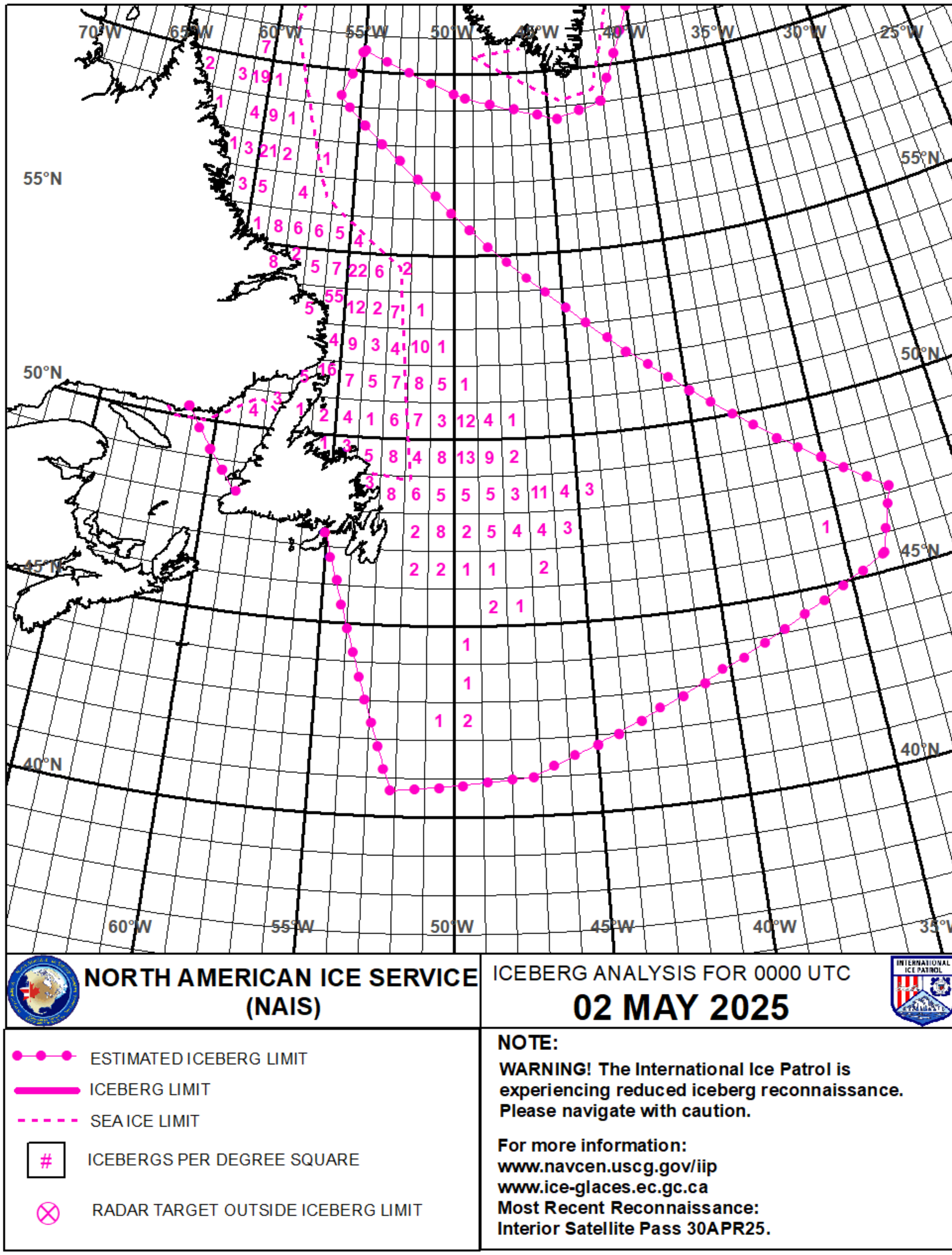

Figure 3.3. Easternmost and southernmost extent of the iceberg limit on 02 May 2025.

3.6 Icebergs Reported Outside of the Iceberg Limit

If an iceberg or radar target is reported outside of the published iceberg limit, the OPCEN Duty Watch Officer (DWO) takes prompt action to warn the maritime community.

Typically, the first step is for the DWO to notify the Canadian Coast Guard (CCG) Maritime Communication and Traffic Service (MCTS) Port aux Basques. In turn, MCTS issues a Navigational Warning (NAVWARN), which is the primary means of relaying immediate iceberg information to the transatlantic shipping community, while IIP watch standers generate and transmit revised products. The NAVWARN is sent via NAVTEX and forwarded to the U.S. National Geospatial-Intelligence Agency (NGA). NGA broadcasts the message as a Navigational Area (NAVAREA) IV warning message over satellite (SafetyNET) and posts it to their website. NAVAREA IV is one of 21 navigational areas, designated by the World-Wide Navigational Warning Service (WWNWS); the United States is the coordinator for NAVAREA IV.

If the report of an iceberg or radar target outside the limit is received by IIP during watch hours (1200Z to 0000Z), products will be immediately revised by the OPCEN valid for 1200Z or 0000Z, depending on the time received. If the report reaches IIP outside of these hours, products will be revised by 1400Z the following morning valid for 1200Z.

Categorizing targets in SAR imagery as icebergs, vessels, or "other" (such as marine life, fishing gear, or weather artifact) remains a challenge. SAR backscatter can generate noise that looks similar to potential iceberg or vessel targets and can be unintuitive for analysts to interpret. In cases where SAR analysis yields ambiguous target results outside of the iceberg limit, IIP takes a conservative approach and categorizes this target as an iceberg, ensuring the maritime community receives a timely warning and keeps the target in the database until subsequent reconnaissance verifies otherwise. IIP relies on coordination with other data sources such as those vessels providing an Automatic Identification System (AIS) to help reduce target ambiguities.

In years past, several cases of icebergs outside of the iceberg limit were closely linked with the sea ice limit, in which they were undetected within sea ice (from deteriorated aerial or satellite reconnaissance), but subsequently broke free and drifted outside of the published iceberg limit. IIP policy requires the sea ice limit generated by CIS be contained within the iceberg limit.

3.6.1 Icebergs Detected Outside of the Iceberg Limit in 2025

18 February 2025

An iceberg was reported outside the limit on 18 February 2025. This was a visual report made by the Canadian Coast Guard off the coast of Newfoundland around the time that normal product generation occurs, so no revised product was created. Instead, the iceberg was incorporated into the routine afternoon product generation process. Limits were extended to include the iceberg reported. **Figure 3.4** demonstrates limits and actions taken for the iceberg outside of the limits.

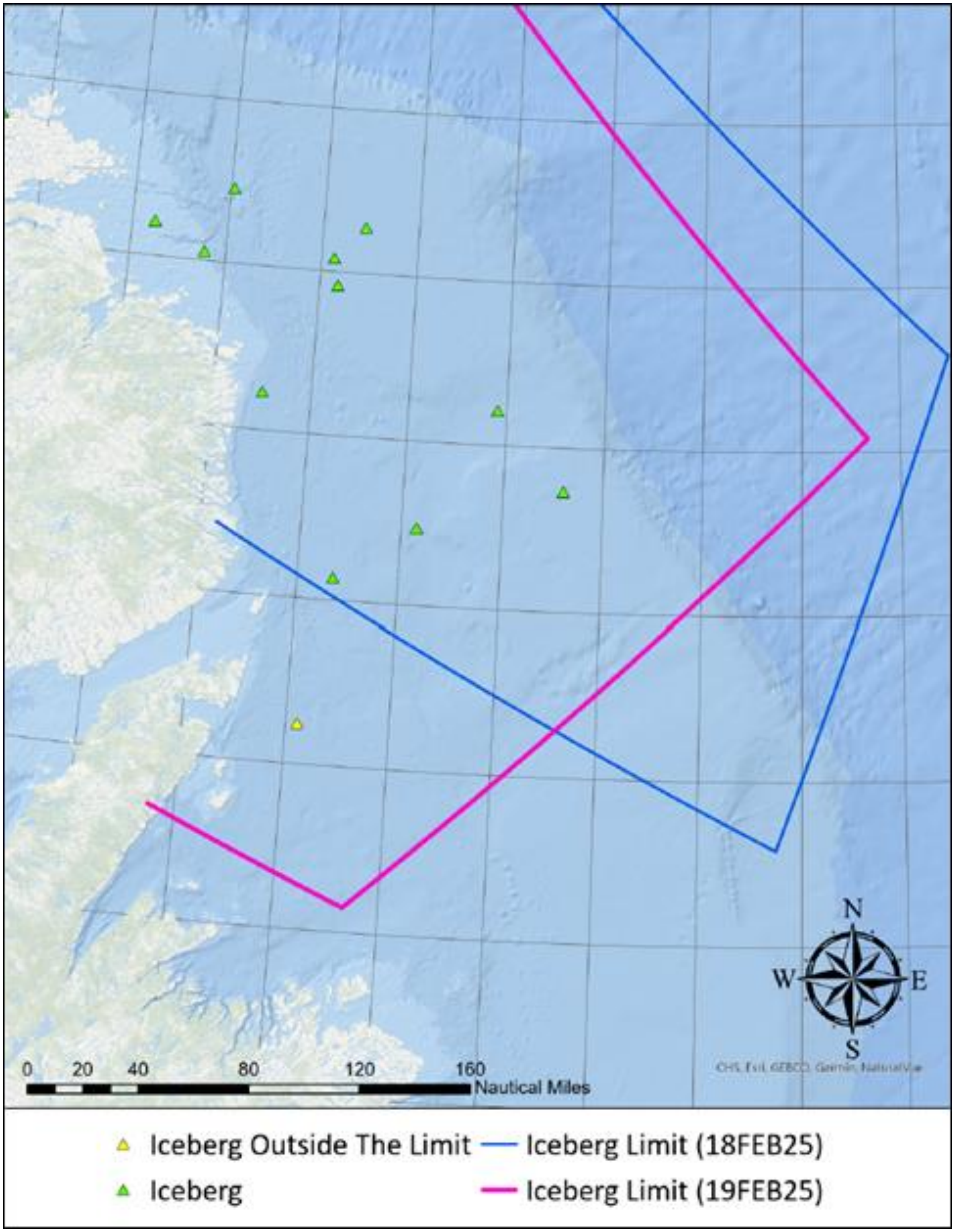

Figure 3.4. Iceberg outside of the limit case, 18 February 2025.

3.7 Risk-Based Iceberg Products and Tailored Support

When IIP is tasked with supporting vessels inside the iceberg limits, IIP develops an additional daily experimental iceberg hazard chart known as the "Isolated/Few/Many" (IFM) product. The IFM product can be used to inform vessel risk assessments for intended movements. In 2025, IIP received zero requests for any tailored iceberg risk assessments.

IIP's capability to generate IFM products is the result of much effort and collaboration between IIP, DMI, and CIS, as well as with other government and commercial agencies through the International Ice Charting Working Group (IICWG) and NAIS. DMI employs an automated iceberg detection and classification algorithm that quickly and accurately sorts through satellite images to find the thousands of icebergs in its waters surrounding Greenland. IIP typically relies on that output to create IFM products near Greenland, drifting the icebergs using the NAIS drift and deterioration model to predict the location of relevant icebergs based on when vessels are transiting nearby. Those modeled positions can be used to depict iceberg concentration which are sent out daily to supported vessels.

IIP expects the demand signal for IFM tailored support products to continue to grow as domestic and international assets unaccustomed to ice navigation begin to venture further and farther north for operations and transits.

4 Iceberg Reconnaissance Operations

4.1 Iceberg Reconnaissance Detachments (IRDs)

The Iceberg Reconnaissance Detachment (IRD) is a partnership between IIP and Air Station Elizabeth City (ASEC) to conduct aerial iceberg reconnaissance. No aerial asset availabiltiy resulted in zero IRD deployments during the 2025 Ice Year to observe and report icebergs, sea ice, or oceanographic conditions in the North Atlantic Ocean. Without dedicated aerial reconnaissance, IIP operated in degraded reconnaissance for the entirety of the season. Prior to commencing the 2025 Ice Year, there were 11 planned deployments spanning the months of February to August. In previous years, IRDs have provided critical observations that are reported to the IIP OPCEN in Suitland, MD for processing and incorporation into BAPS, which are then used to create and distribute the daily NAIS iceberg warning products and iceberg limits. See **Section 5** for semi-monthly NAIS iceberg warning products for Ice Year 2025.

4.2 Aerial Iceberg Reconnaissance Equipment

When flying, IRDs are conducted using HC-130J aircraft equipped with two radars and an integrated AIS in the mission system suite. One radar is the ELTA-2022 360° X-Band surface-search radar, which can detect and differentiate surface targets automatically (as iceberg, ship, or "other") by utilizing AIS input. The other is the HC-130J Tactical Transport Weather Radar (APN-241), which can detect surface targets, but cannot differentiate them automatically.

The 360° coverage provided by the ELTA radar allows IIP to plan for patrols with up to 30 NM flight ground track spacing. IRDs use 30 NM ground track spacing while maintaining the probability of detection (POD) of small icebergs (15 to 60 m) at 95%.

If the ELTA radar is inoperable, the IRD would draw flight plans under "visual-only" specifications using 10 NM ground track spacing which covers 40% less area compared to flights with radar coverage. Good reconnaissance conditions (at least 50% visibility and few to no white caps) are preferred for visual-only patrols, but they are relatively rare in IIP's meteorologically active AOR.

IRDs are typically flown with Minotaur Mission System-equipped aircraft. Minotaur is a software and hardware suite that allows for onboard networking of cameras, radars, navigational instruments, and communications. This also allows OPCEN watch standers to communicate directly with aircraft personnel in flight.

IRD crews also frequently utilize the inverse synthetic aperture radar (ISAR), a function of the ELTA radar. ISAR uses target motion to generate high-resolution images of such targets. ISAR imagery is analogous to the satellite SAR imagery IIP analyzes, in that it is created using radar energy pulses in the microwave band of the electromagnetic spectrum. However, SAR relies on the motion of the platform carrying the radar (e.g., satellite motion in orbit), while ISAR relies on the motion of the target, to generate an image. This technology has proven extremely useful for identifying and distinguishing icebergs from ships, especially in poor visibility and for those ships which do not transmit AIS (**Figure 4.1**).

Figure 4.1. ISAR imagery of a ship (*top*) and an iceberg (*bottom*).

4.3 Deployment Season Summary

Deployment data for the 2025 Ice Year is unavailable due to IRD cancellations. In past seasons, IRDs based out of St. John's, Newfoundland, Canada, encountered significant logistical challenges transporting spare parts to deployed aircraft. Notably, IRDs based out of Happy Valley-Goose Bay, Newfoundland and Labrador, Canada encountered significantly less weather delays and received exceptional support from the 5th Wing Operations Support Squadron. IIP relied heavily on international and commercial partners such as CIS and PAL to provide aerial reconnaissance for incorporation to the iceberg database. IIP looks forward to the 2026 ice season for resumption of dedicated flights based on domestic assets allocation.

4.4 2025 IRD Iceberg Detections

With no IRDs during the 2025 Iceberg Season, no IRD detected icebergs were incorporated into the iceberg database, accounting for 0% of icebergs incorporated in 2025.

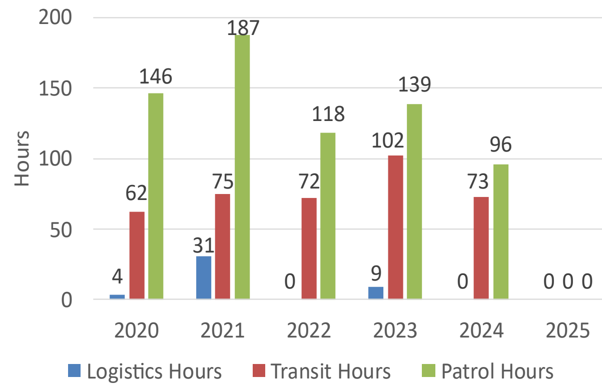

Figure 4.2. Flight hours broken down by patrol, transit, and logistics hours over the past five years.

4.5 2025 Flight Hours

As in previous seasons, IIP was allotted 500 Maritime Patrol Aircraft flight hours for the 2025 Ice Year operations. All flight hours were cancelled due to reasons specified in **Section 4.1**.

The following is a description of the typical breakdown of hours tracked in an IRD. **Figure 4.2** provides a visual representation of the past six years of flight hours.

Transit hours are the hours the aircraft is traveling between specific locations in support of the IIP mission, without conducting reconnaissance. Those locations include Elizabeth City, NC and the forward operating area with a brief stop at Joint Base Andrews in Prince George's County, MD to onload IIP personnel and equipment. There were zero hours used for transit this season.

Patrol hours are those which the IRD uses to conduct iceberg reconnaissance, including flight time to and from the reconnaissance area. When a patrol is conducted during a regularly planned transit flight, such as a patrol while transiting back to Joint Base Andrews, the hours are accounted for accordingly. There were zero hours used for patrol this season.

Logistics hours are the hours used to support the IIP mission, but do not fall into the previous two categories. Logistic hours accrue when a Coast Guard aircraft is used to transport

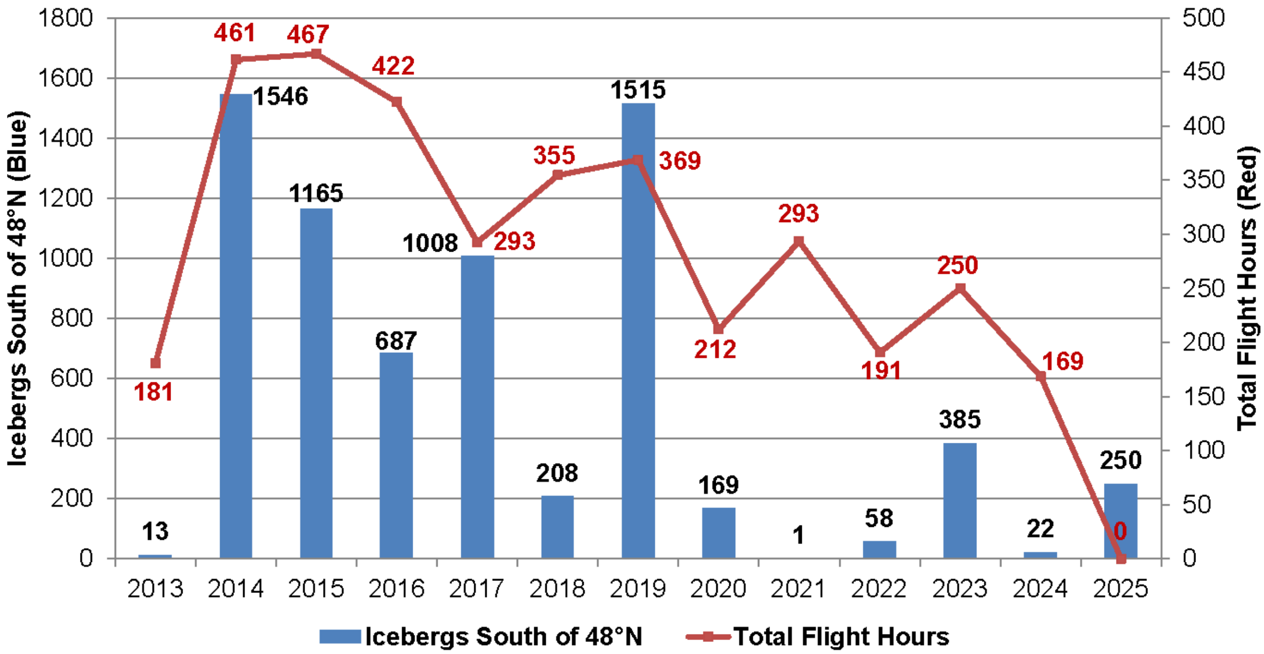

Figure 4.3. Comparison between total IRD flight hours per season and season severity, measured by number of icebergs sighted or drifted below 48ºN for the past 12 years. More icebergs south of 48ºN may require increased reconnaissance efforts.

parts for an aircraft deployed on an IIP mission. There were zero hours used for logistics this season.

The spatial and temporal distribution of icebergs, as well as the number drifting south of 48ºN, all contribute to the amount of reconnaissance needed to effectively monitor the iceberg danger and provide relevant warning products. **Figure 4.3** shows a comparison of flight hours to the number of icebergs that drifted south of 48ºN from 2013 to 2025.

In Ice Year 2025, IIP estimated a total count of 250 icebergs that drifted south of 48oN, making this an Iceberg Season of moderate severity. See **Section 2.1.2** for further details on how Iceberg Season severity is determined.

4.6 Satellite Reconnaissance

4.6.1 Satellite Collections

IIP iceberg satellite reconnaissance is conducted daily by a qualified Duty Satellite Analyst (DSA) when IIP has responsibility for the NAIS iceberg warning products. Every morning, the DSA is responsible for determining daily or emergent reconnaissance requirements and deconflicting (avoiding redundancy) with commercially provided iceberg reconnaissance. The DSA takes all relevant information and determines image priority based on sensor characteristics and strategic region (**Table 4.1, Figure 4.4**).

Satellite reconnaissance strategic regions help analysts prioritize which satellite imagery to download each morning. Strategic Region A is the portion of the IIP AOR south of 52°N, where icebergs pose the greatest threat of collision with transatlantic vessels in the vicinity of the Grand Banks and the Strait of Belle Isle. Higher resolution satellite imagery is required for monitoring this area, as icebergs here are smaller due to advanced deterioration, and are usually in the open ocean. Generally, there are also more ships and fishing gear in this region, making discrimination between ship and iceberg targets more challenging for analysts.

Strategic Region B is the portion of the IIP AOR north of 52°N, where DSAs analyze satellite imagery of greater coverage, but reduced resolution. Such imagery allows the DSA to

Satellite	Preferred Acquisition Mode	Revisit Time	Scene Size	Resolution	Polarization Mode
Sentinel-1 (SN1A/C)	Interferometric Wide Swath (IW)	12 days	250x250 km	20 m	HH/HV
Sentinel-2 (SN2A/B/C)	Multispectral: Level 1-C	5 days	100x100 km	10 m	EO
Radarsat Constellation Mission (RCM)	Medium-Maritime	4 days	350x350 km	50 m	HH/HV
Radarsat-2 (RS2)	Wide Fine	24 days	150x170 km	8 m	Single-Pol or Dual-Pol
ICEYE	Scan	Tasked	100x100 km	15 m	V V

Table 4.1. Satellite systems and capabilities available to IIP satellite analysts.

identify larger, slower moving icebergs, often trapped in sea ice, in a greater area. This region contains the population of icebergs which may eventually drift into high-traffic shipping lanes ("feeder" icebergs). The presence of sea ice in this region early in the season can make target detection more difficult.

IIP continues to rely on the European Space Agency's (ESA) Sentinel-1 (SN1A/C) and Sentinel-2 (SN2A/B/C) sensors, which both follow a consistent collection schedule and remain publicly available online in near real-time. SN1 provides SAR imagery and the launch of SN1C in December 2024 filled the gap that SN1B left since its failure in December 2021. The ESA anticipates launching SN1D in late 2025 which will increase the frequency of coverage over our AOR.

Multispectral electro-optical (EO) imagery, in particular from SN2, can be an incredibly useful resource for IIP satellite reconnaissance as it results in very high confidence iceberg classifications. The scenes, imaged in the optical band, are more intuitive for analysts to determine what is and what is not an iceberg compared to SN1 due to the similarity in visual appearance to objects in life and photography. However, frequent cloud cover in the AOR renders many SN2 images unusable for analysis.

This year, IIP also continued operational use of imagery from the Canadian Space Agency's (CSA) RADARSAT Constellation Mission (RCM), a direct result of the important partnership between IIP and CIS. While previously RCM has been used for monitoring the northern AOR, and usually a lower priority sensor for DSAs, several medium to large icebergs that drifted south of 52°N were detected and tracked using RCM imagery (generated in lower resolution modes) in these higher priority southern regions.

Through partnership with the NGA, RADARSAT-2 (RS2) SAR imagery was also available to IIP for satellite reconnaissance. RS2 imagery requires tasking up to 30 days prior to image collection. Access to this resource is phenomenal since it has a finer resolution than SN1 and RCM images, however, the lag between tasking and collection makes it difficult to use RS2 in dynamic regions, such as at the iceberg limits.

Additionally, IIP requested and tested imagery from the ICEYE constellation through NGA. Testing by IIP analysts concluded it was difficult to distinguish icebergs from sea ice within ICEYE imagery. See **Table 4.1** for platform specific parameters

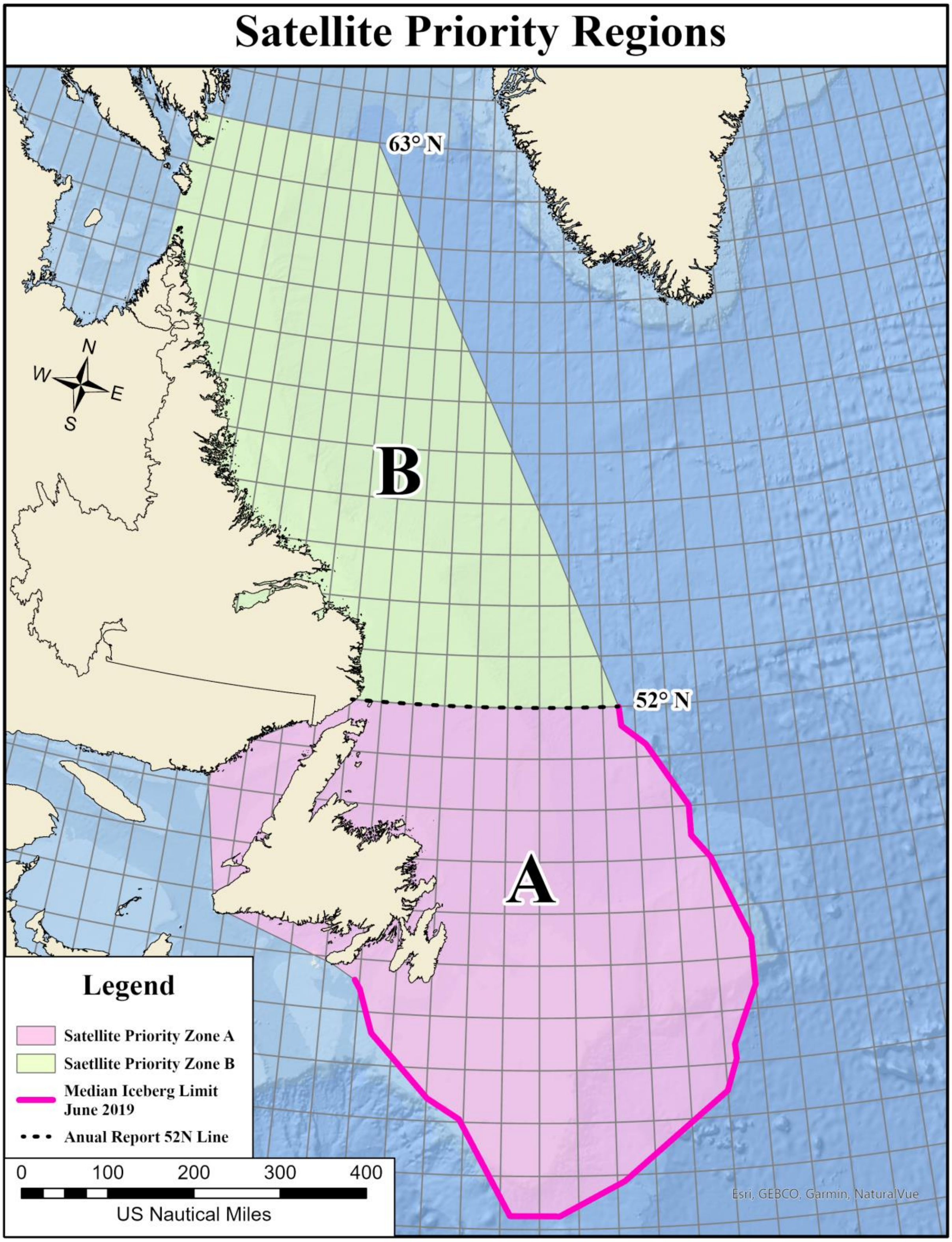

Figure 4.4. Graphic depicting satellite reconnaissance priority regions within the IIP AOR. South of 52°N is generally the area analysts should consider high priority for satellite imagery, where icebergs pose the greatest threat to shipping lanes.

4.6.2 Satellite Analysis

After satellite sensors and region priority are considered, the DSA downloads relevant imagery from the previous 24 hours, or as directed by the DWO. The DSA then processes the selected satellite frames through an Iceberg Detection System (IDS). IIP utilizes a commercial IDS provided by C-CORE to analyze both SAR and EO imagery.

At this point, the DSA begins the crucial target verification process. The IDS generates a shapefile of potential iceberg targets, which is currently reviewed with the GIS tool in AcrGIS Pro. Analysis involves careful examination of each target's size, shape, location relevant to sea ice, and pixel-level properties.

To minimize false positives, AIS data is used to deconflict potential iceberg targets with known ship locations. This is particularly important in high-traffic areas to help distinguish icebergs from vessels. This comprehensive assessment allows the DSA to make a classification determination and decide if a target is an iceberg, ship, or noise/clutter. A SIM is then generated by the DSA, which is passed to the OPCEN DWO for incorporation into BAPS, where the satellite detected icebergs are added or re-sighted to the IIP iceberg model.

4.6.3 Satellite Iceberg Detections

IIP satellite reconnaissance during the 2025 Iceberg Season relied primarily on SN1 and RCM. Watch standers at IIP analyzed 1104 individual satellite images, also referred to as frames, to generate a total of 1072 SIMs during the 2025 Ice Year. The breakdown of total frames analyzed at IIP by satellite source can be seen in **Figure 4.5**. RCM became the primary workhorse of IIP satellite reconnaissance in the 2025 Ice Year, the result of a significant focus on satellite reconnaissance by IIP analysts.

IIP's analysts identified a total of 4,052 icebergs in satellite imagery in Ice Year 2025, of which 3,913 were incorporated into the database. The total number of images analyzed in-house by IIP significantly increased by 79%, from 616 frames in 2024 to 1104 frames in 2025, as seen in **Figure 4.6**. As IIP continues to improve its satellite program, streamline analysis methods, and develop DSA expertise and training, future satellite reconnaissance is expected to increase.

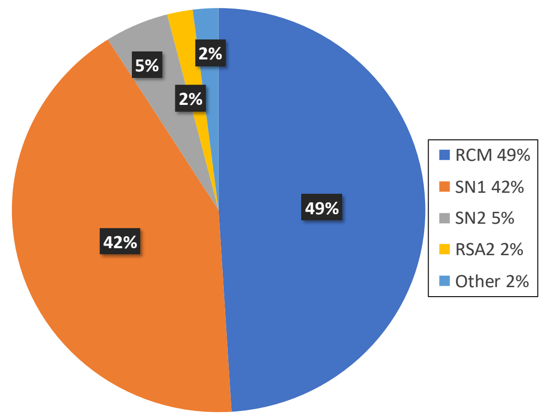

Figure 4.5. Percentage of total frames analyzed by satellite at IIP.

The percentage of satellite detected icebergs incorporated into the iceberg model slightly increased from 87% in 2024 to 88% in 2025 (**Figure 4.7**). This may be attributed to an increase in commercial satellite imagery from C-CORE, satellite reconnaissance from IIP, commercial aerial reconnaissance from the Canadian Government, and ship reports, as a consequence from IIP not having dedicated aerial reconnaissance. There was a steep increase in the percentage of icebergs detected by satellite between 2014 and 2020, after which this number approaches a plateau between 80-90% of total icebergs detected. IIP expects the percentage will remain around that plateau while IIP fully utilizes satellite and leverages other sources in the interim until the IIP aerial reconnaissance mission begins again. Even with the future continuance of IIP aerial reconnaissance, IIP expects the percent to stay between 80-90% as it has in previous years.

At first glance, this metric might indicate that satellite reconnaissance is the primary method for iceberg detection and has been since 2019 due to the prevalence of satellite reports. However, it

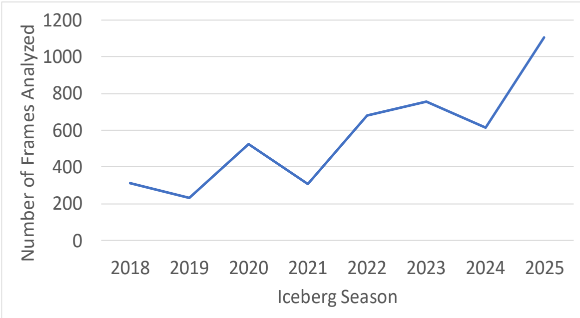

Figure 4.6. Frames analyzed each year by IIP satellite analysts.

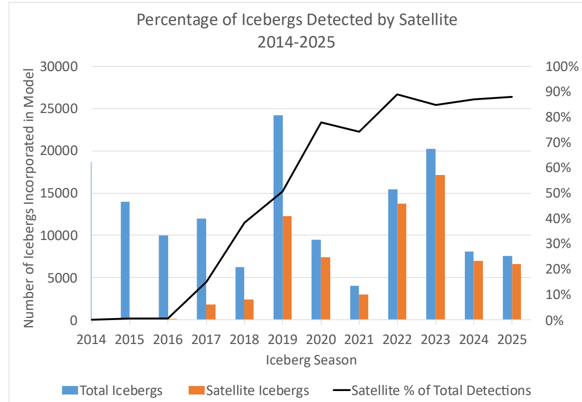

Figure 4.7. Number and percentage of icebergs identified by satellite and incorporated into the model compared to total incorporated icebergs between 2014 and 2025.

is important to note the current difficulties in achieving criteria for iceberg detection and database deletion using satellite imagery alone. These difficulties reduce confidence in iceberg detection and database deletion, resulting in false positives, false negatives, and a longer target timeframe of icebergs on model, potentially inflating the iceberg limits beyond what is actually needed.

Also important is the critical role IRDs play during the height of the ice season in validating icebergs near the limit, outside the limit, and from satellite imagery. Until satellite imagery is proven to provide the same level of confidence in detecting icebergs less than 20 meters or better, IIP continues to recommend aerial reconnaissance as IRDs currently provide the highest confidence in detecting icebergs.

4.6.4 Northern Survey

The Northern Survey is a satellite survey that estimates the "upstream" iceberg population that could drive aerial reconnaissance decision-making in the early part of IIP's iceberg reconnaissance season.

In December 2024, IIP conducted the Northern Survey between 55°N and 70°N along the coast of Labrador, Eastern coast of Baffin Island, and Southwestern Baffin Bay for the 2025 Iceberg Season. The survey investigated 32 RCM images from 02 to 06 December 2024, detecting a total of 295 icebergs as seen in **Figure 4.8**.

Within the survey area, 77% of the icebergs were detected in gray-white to first-year sea ice. Sea ice helps to insulate icebergs from ocean waves which quickly deteriorate them (see **Section 2.1.2**). For that reason, these icebergs were deemed the most likely to drift south through the winter, and potentially into shipping lanes, with the movement of the sea ice.

IIP's satellite analysts continue to refine the methodology for repeatable Northern Survey results year by year, building a data set that may be useful in correlating season severity (number of icebergs detected south of 48°N) with icebergs detected in a Northern Survey. This year, the scope of the survey area was confined to the Canadian East Coast.

Based on data collected since IIP started implementing satellite analysis in 2017, **Figure 4.9**, there is a weak linear correlation between icebergs identified in the Northern Survey and the number of icebergs detected south of 48°N. This is statistically significant and is an effective method of prediction for 2025's Iceberg Season severity. Continuing to build a comprehensive data set may be useful in the future for predicting season severity several months before the peak of the iceberg season.

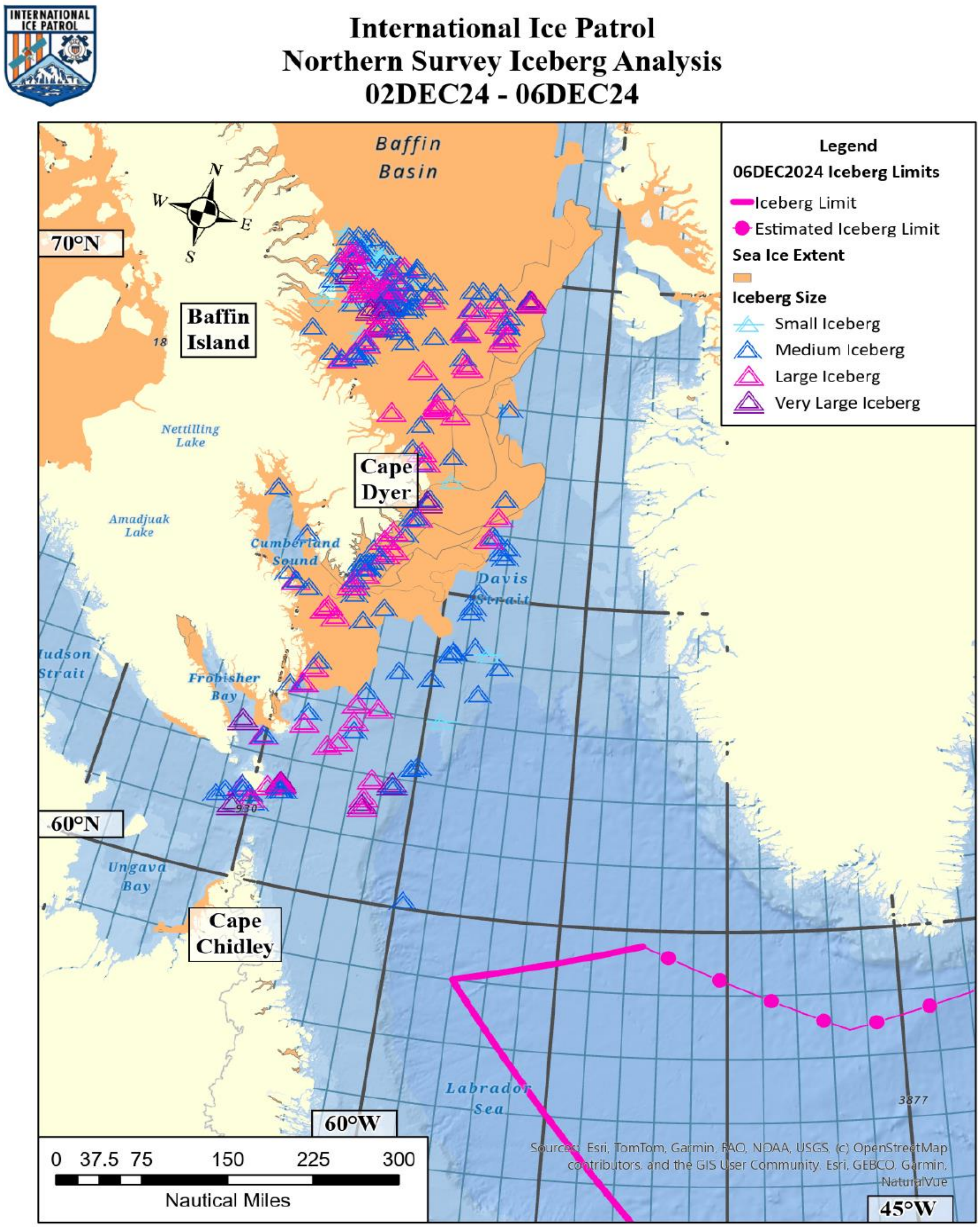

Figure 4.8. Results of the December 2024 Northern Survey. Iceberg data collected using the Canadian Space Agency's (CSA) Radarsat Constellation Mission (RCM) satellite.

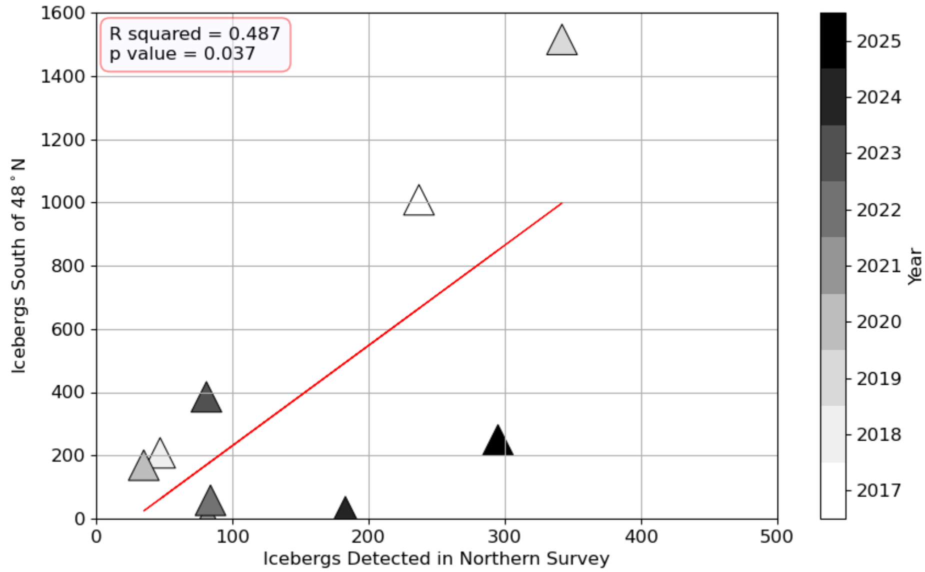

Figure 4.9. Comparison between iceberg detections in Northern Surveys and iceberg crossings South of 48°N between 2017 and 2025.

4.7 Other Reconnaissance Activities

4.7.1 NAIS Collaboration

IIP continued to leverage its NAIS partnership with CIS in 2025. IIP coordinated flight plans with CIS throughout the whole season for our commercial partner PAL Aerospace due to the cancellation of IIP's internal aerial reconnaissance. CIS contracts flights year-round and during the 2025 Ice Year, CIS contracted 28 flights to PAL Aerospace. **Figure 4.10** depicts the hours flown by IIP and CIS contracts from the past 10 years.

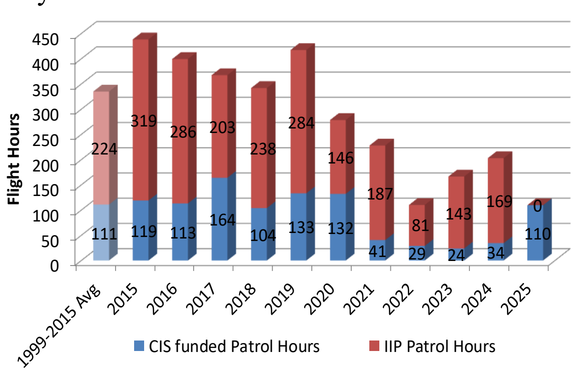

Figure 4.10. NAIS flight hours, a combination of IIP patrol hours and CIS funded PAL Aerospace patrol hours compared to the previous 10-year average. More icebergs south of 48ºN may require increased reconnaissance efforts.

4.7.2 Ship Interactions

When flying, IRD on-scene patrol time in the HC-130J aircraft is mainly focused on locating and classifying icebergs using visual and radar reconnaissance methods. However, during patrols, the IRD will also communicate directly with the maritime community to request recent iceberg sighting information. This communication takes two forms: a sécurité broadcast to all vessels in the vicinity of the aircraft, and direct call outs to vessels identified by AIS. The information from the individual vessels is especially useful during periods of reduced visibility, or when numerous small vessels not equipped with AIS are present in the reconnaissance area. Vessel observations are valuable for confirmation of data provided by the aircraft's radar. During the 2025 season, there were zero general sécurité broadcasts and zero direct vessel callouts due to the cancellation of all IRDs.

5 Semi-Monthly Iceberg Charts

5.1 Chart Description

The NAIS-65 Iceberg Chart is released daily by IIP (in the active Iceberg Season) and CIS (outside the active Iceberg Season). It depicts the iceberg limit which delineates the iceberg population from open water, the estimated distribution and frequency of icebergs within this limit, and the sea ice limit.

The iceberg limit is comprised of the following: the iceberg limit over the Grand Banks and east of Newfoundland and Labrador (**Figures 5.1** through **5.24**, *solid/dotted magenta line to the south and east of Newfoundland and Labrador*), the iceberg limit to the west of Newfoundland (western limit, *solid/dotted magenta line within the Strait of Belle Isle and the Gulf of St. Lawrence*), and the Greenland iceberg limit (*dotted magenta line south of Greenland*, from DMI). The Grand Banks iceberg limit is the primary component of the chart, as it affects transatlantic navigation, and IIP allots the most detection and monitoring efforts to ensure its accuracy and reliability.

The western iceberg limit is drawn when icebergs drift south into the Strait of Belle Isle and the Gulf of St. Lawrence, which is a heavily trafficked area. If icebergs begin to approach Anticosti Island, IIP may elect to split the western limit into two segments to account for icebergs to the north and south of the island. Rarely, when icebergs drift south of the line between Port aux Basques, Newfoundland and the southeastern tip of Anticosti Island, IIP may draw the iceberg limit across Cabot Strait between Newfoundland and Cape Brenton Island. This would likely adversely affect shipping traffic, as vessels headed to the St. Lawrence Seaway would have to cross the iceberg limit.

The Greenland iceberg limit (termed the "estimated iceberg limit") is provided by DMI to IIP and CIS semi-weekly. DMI uses an automated approach to detect icebergs around Greenland and does not model an individual iceberg's drift and deterioration as IIP does. For this reason, the Greenland iceberg limit is assigned a lower level of confidence and reported in the NAIS iceberg warning products as estimated. The Greenland iceberg limit affects primarily specialized ice navigators who take on their own risk by crossing it.

The sea ice limit (see **Figures 5.1** through **5.24,** *dashed magenta line*) is provided daily by CIS and delineates ice-covered from ice-free waters. The sea ice limit provides no additional information on sea ice concentration or stage of development and is meant only as a rough indicator of the presence or absence of sea ice.

Finally, the estimated distribution of icebergs is depicted as the estimated number of icebergs per square degree. IIP does not report the individual estimated locations of the icebergs in the database due to uncertainties associated with iceberg detection and modeling. The reported iceberg distribution should not be used for navigation.

It should be noted that IIP may report radar targets within the NAIS iceberg warning products. Radar targets are targets detected by spaceborne, aircraft, or vessel radars that were observed with low confidence and were indistinguishable as icebergs, vessels, or other targets. In the NAIS-65 chart, radar targets are depicted as small circles encompassing an "x". IIP attempts to minimize the number of radar targets reported and prioritizes reconnaissance to investigate and accurately classify them.

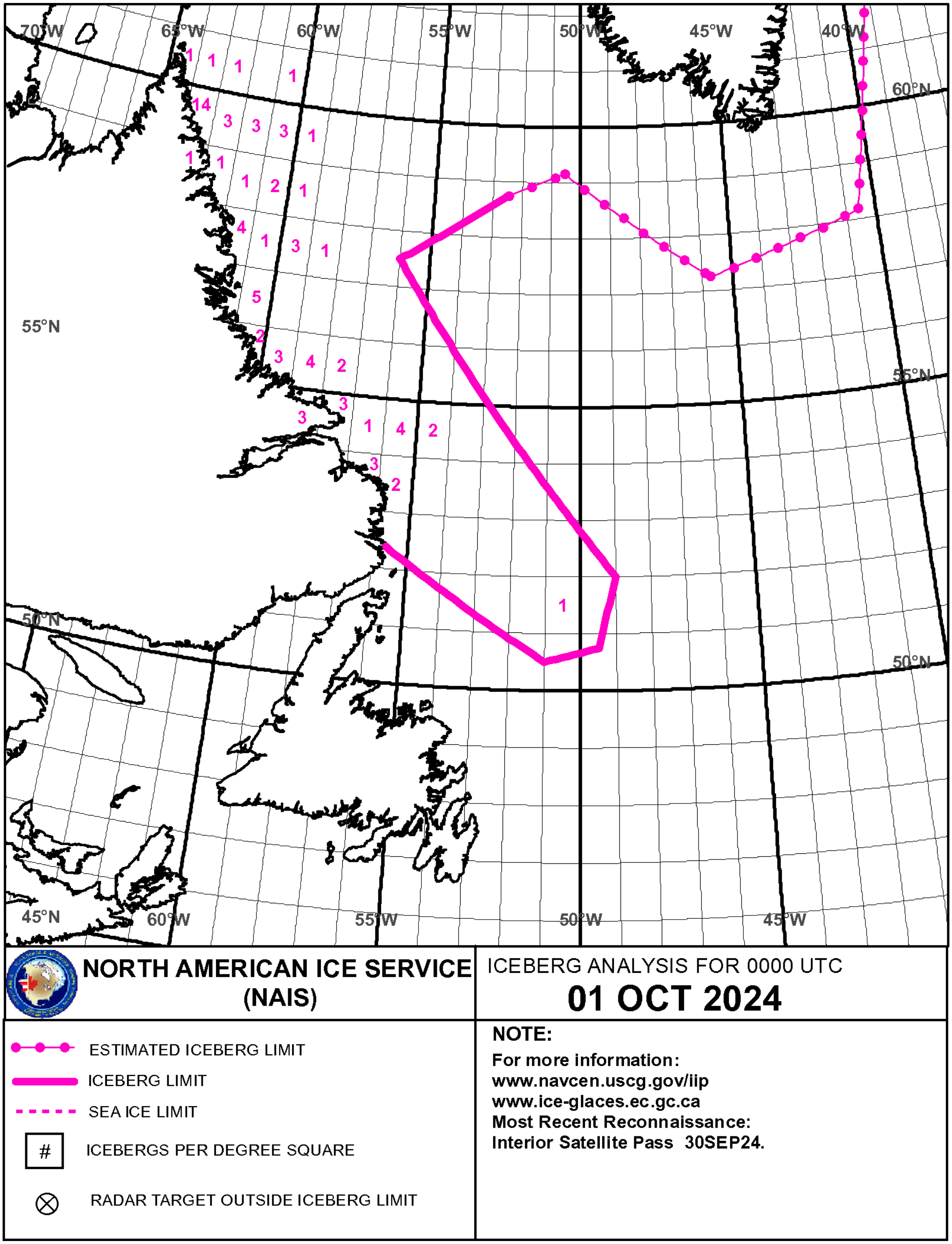

Figure 5.1. NAIS-65 Iceberg Chart for 01 October 2024.

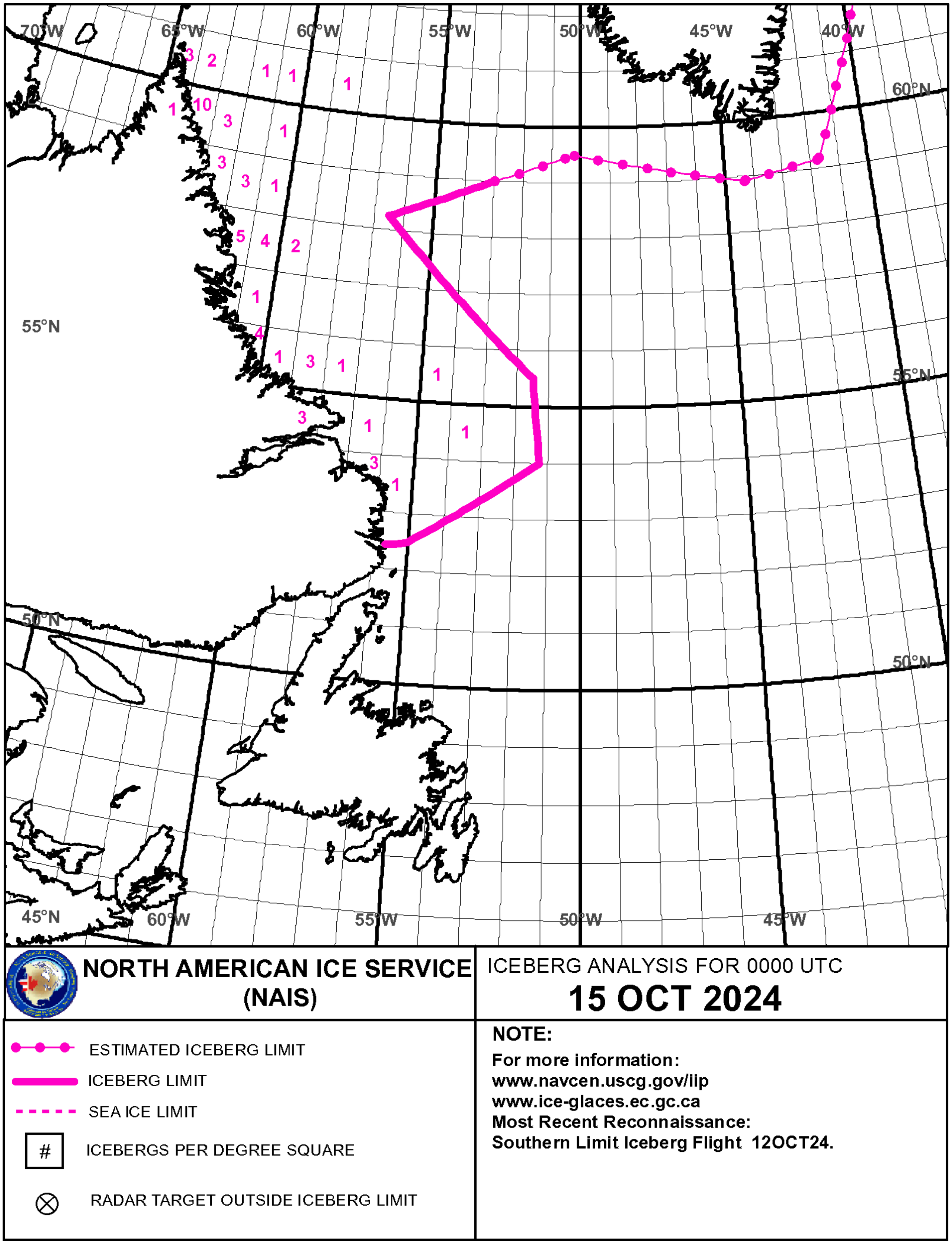

Figure 5.2. NAIS-65 Iceberg Chart for 15 October 2024.

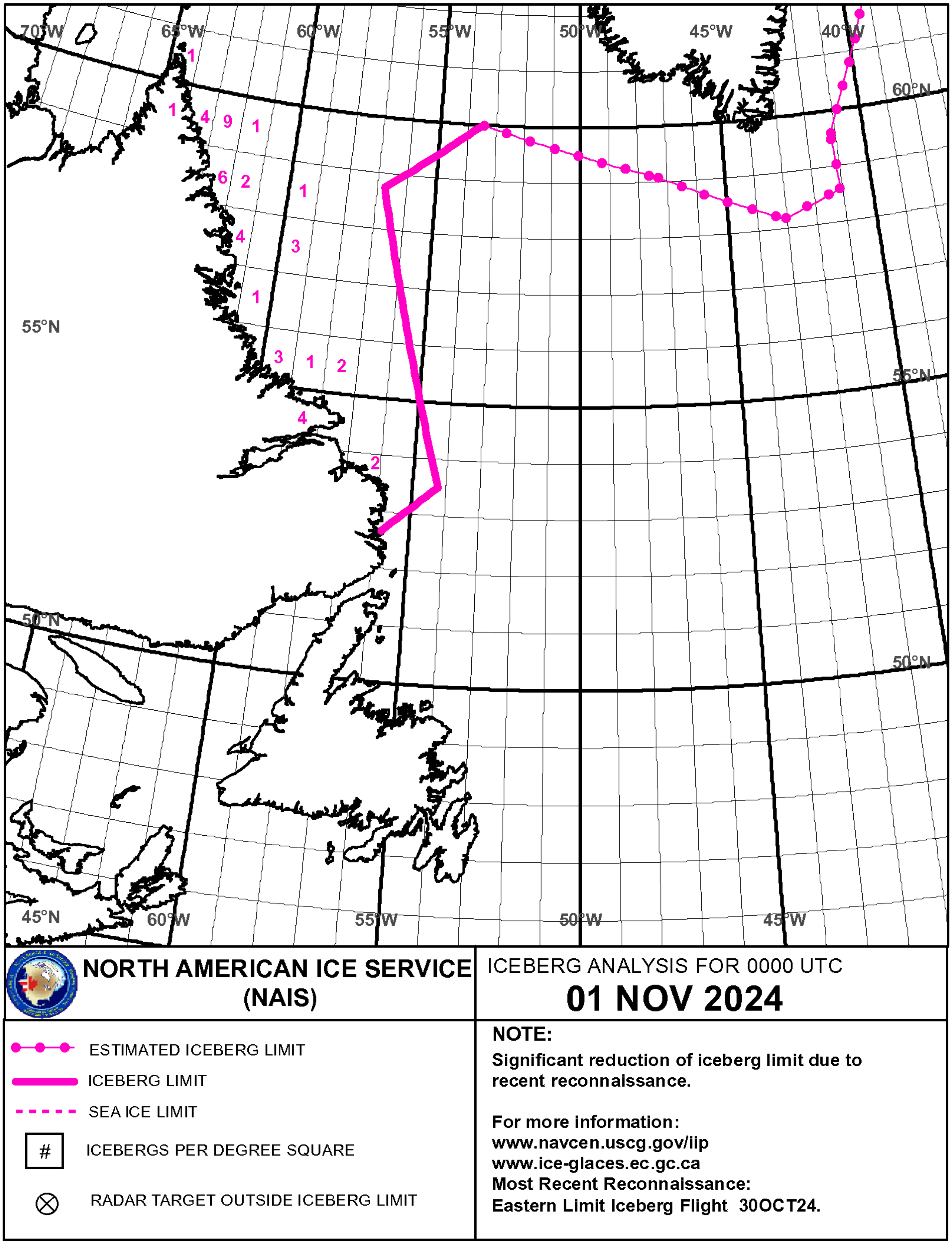

Figure 5.3. NAIS-65 Iceberg Chart for 01 November 2024.

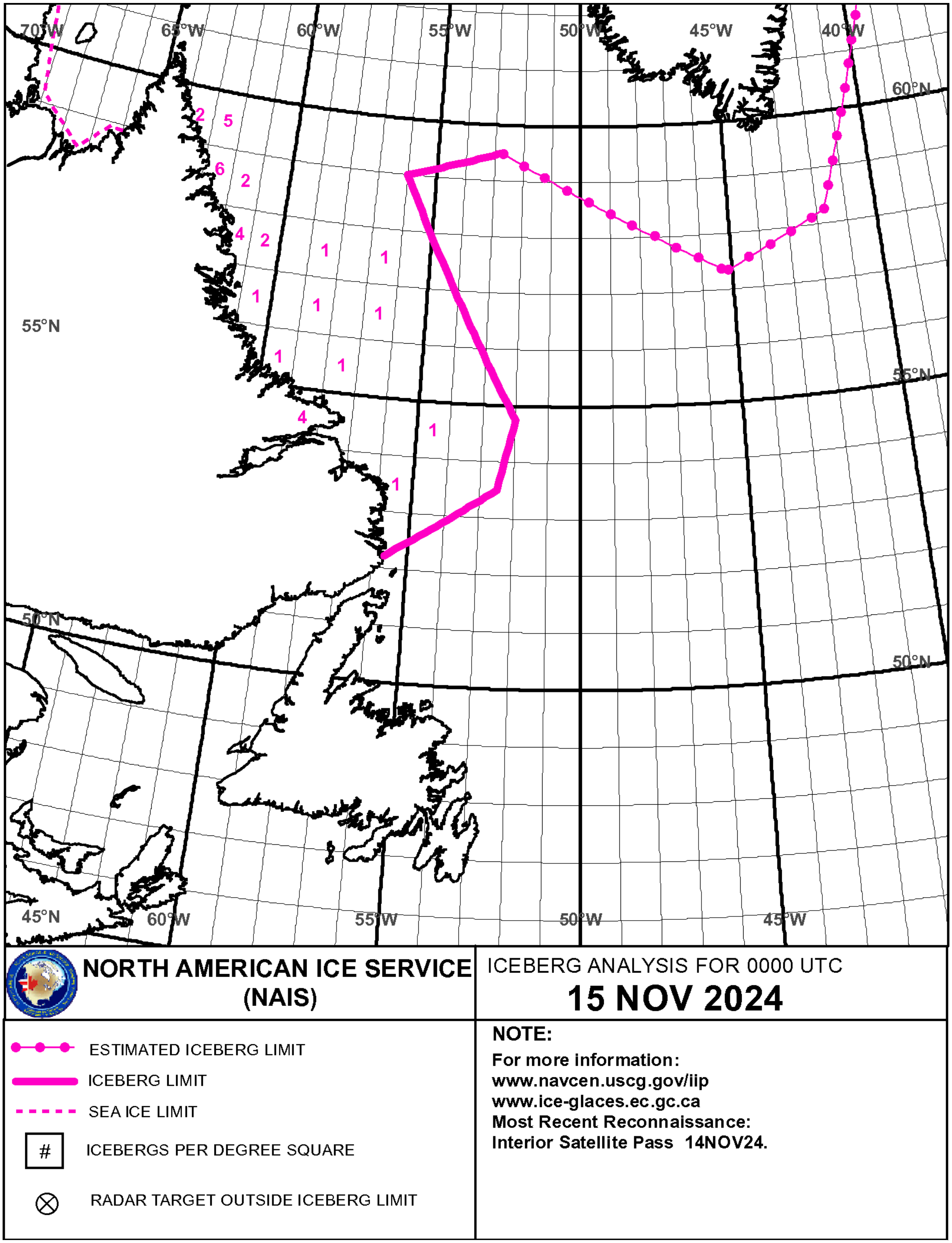

Figure 5.4. NAIS-65 Iceberg Chart for 15 November 2024.

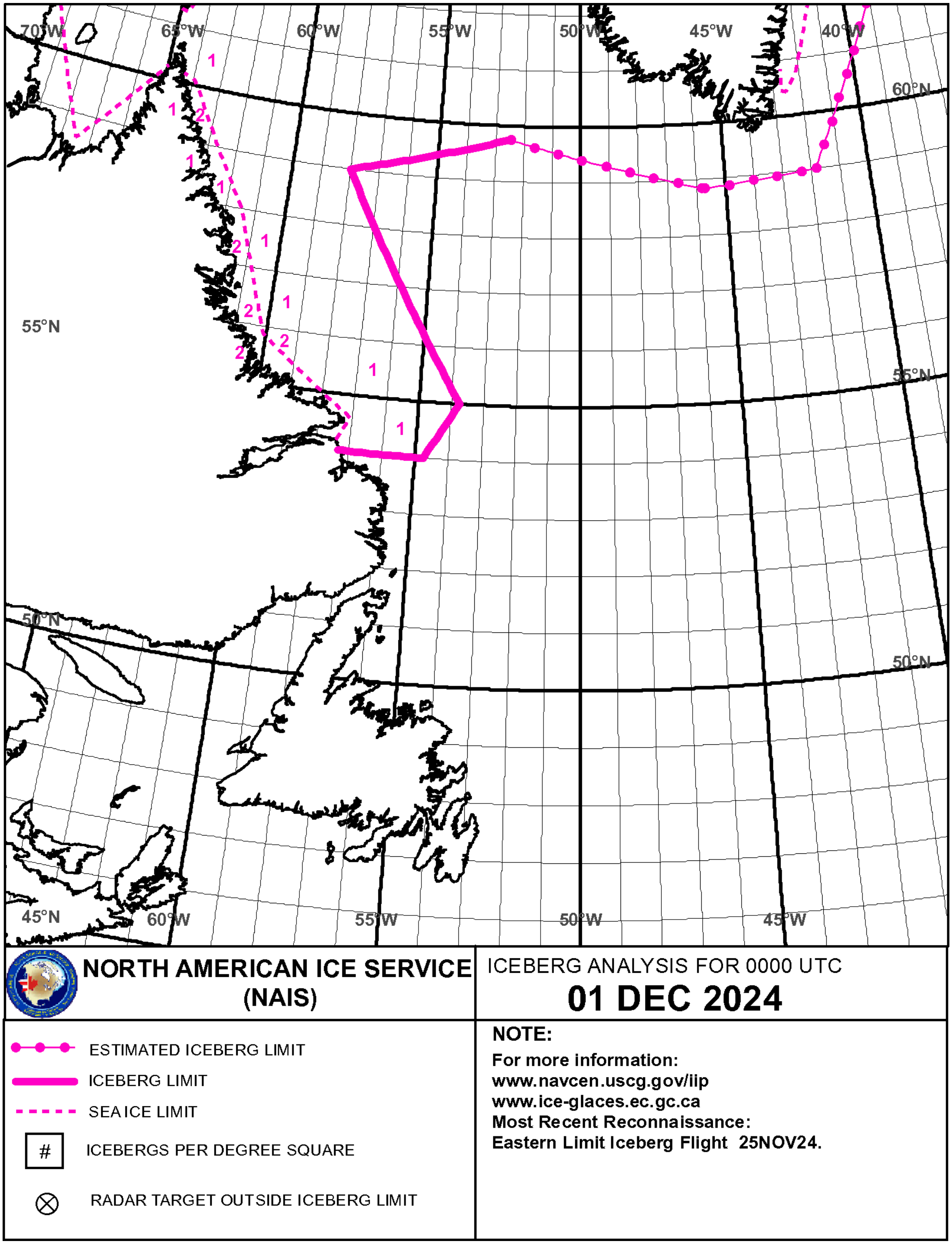

Figure 5.5. NAIS-65 Iceberg Chart for 01 December 2024.

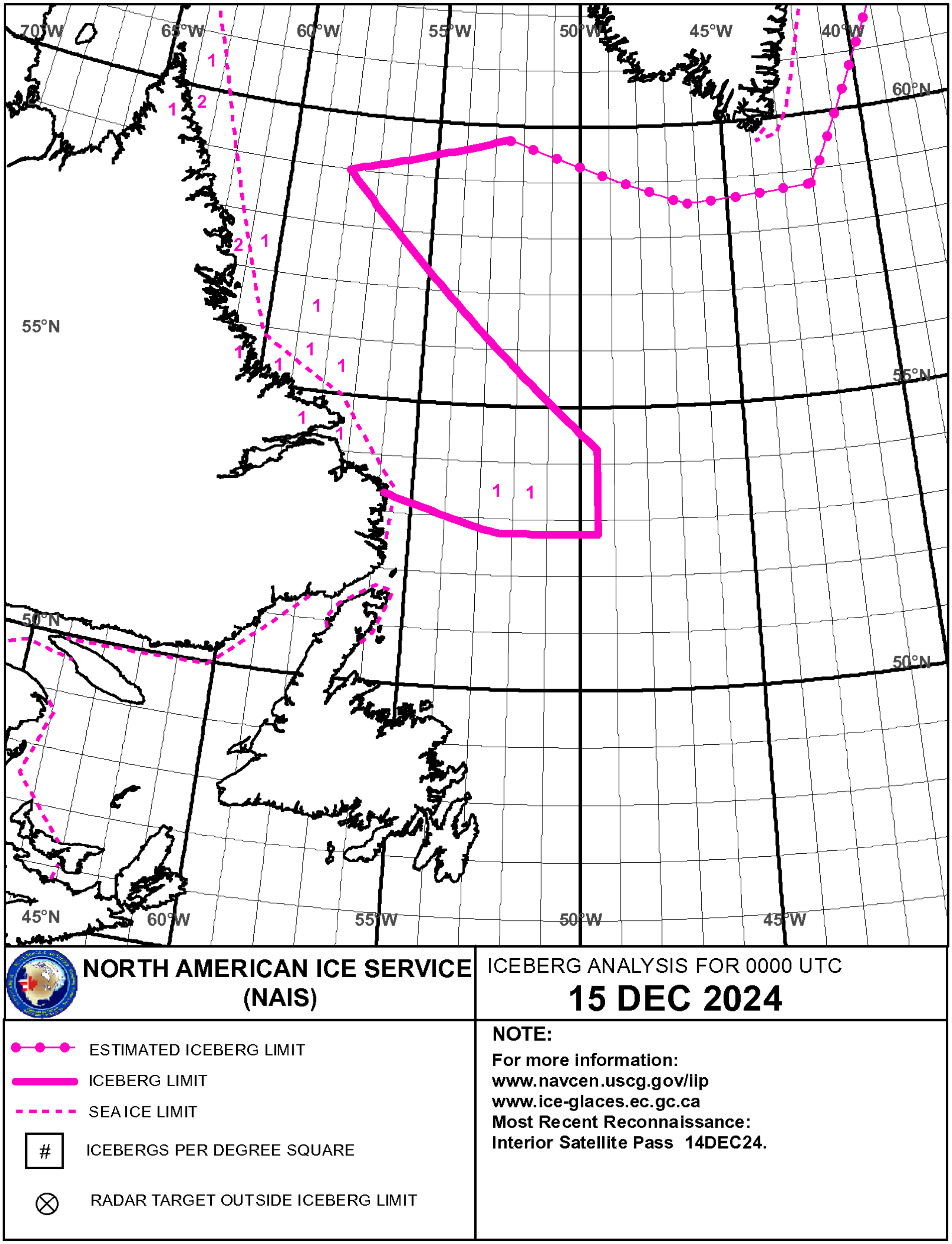

Figure 5.6. NAIS-65 Iceberg Chart for 15 December 2024.

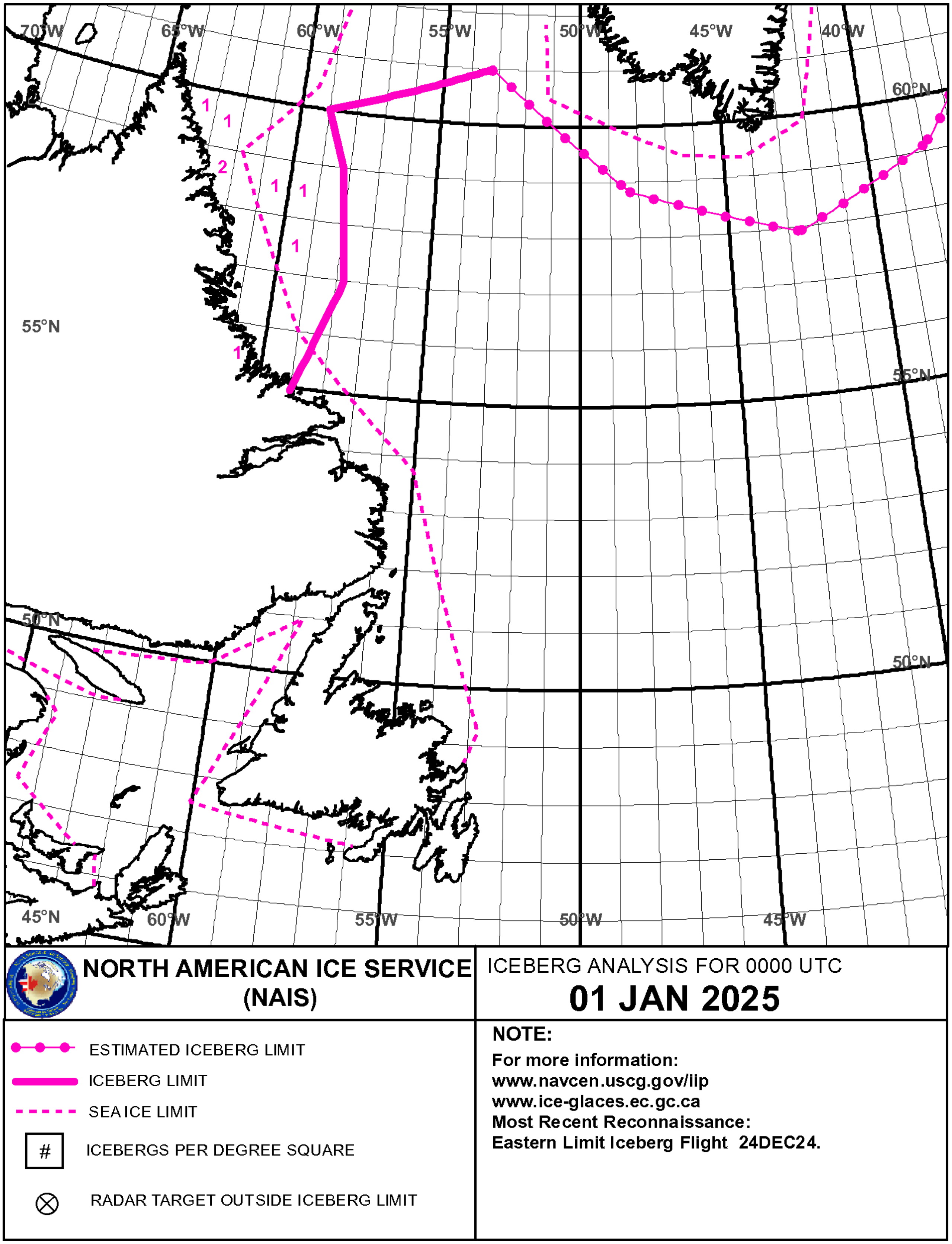

Figure 5.7. NAIS-65 Iceberg Chart for 01 January 2025.

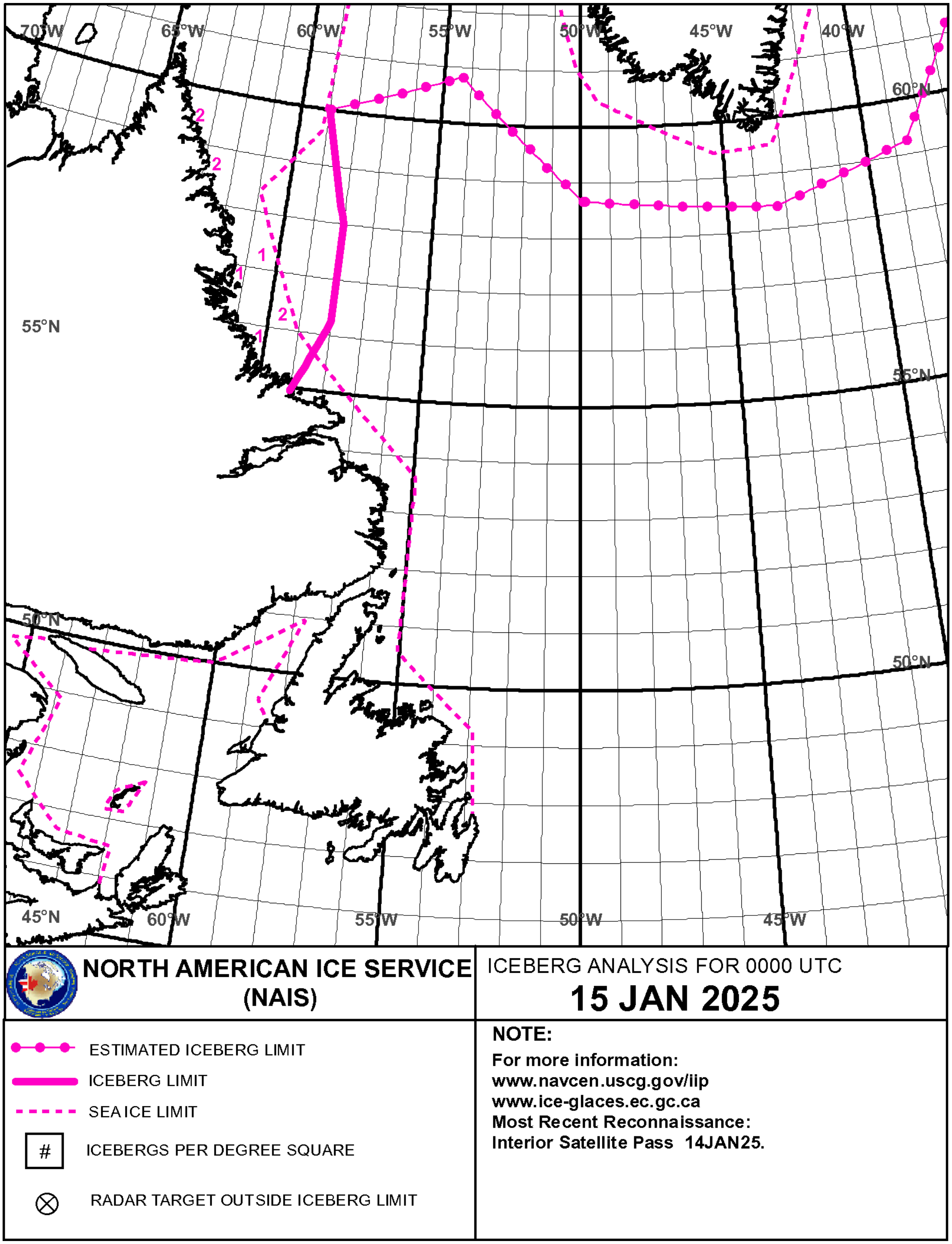

Figure 5.8. NAIS-65 Iceberg Chart for 15 January 2025.

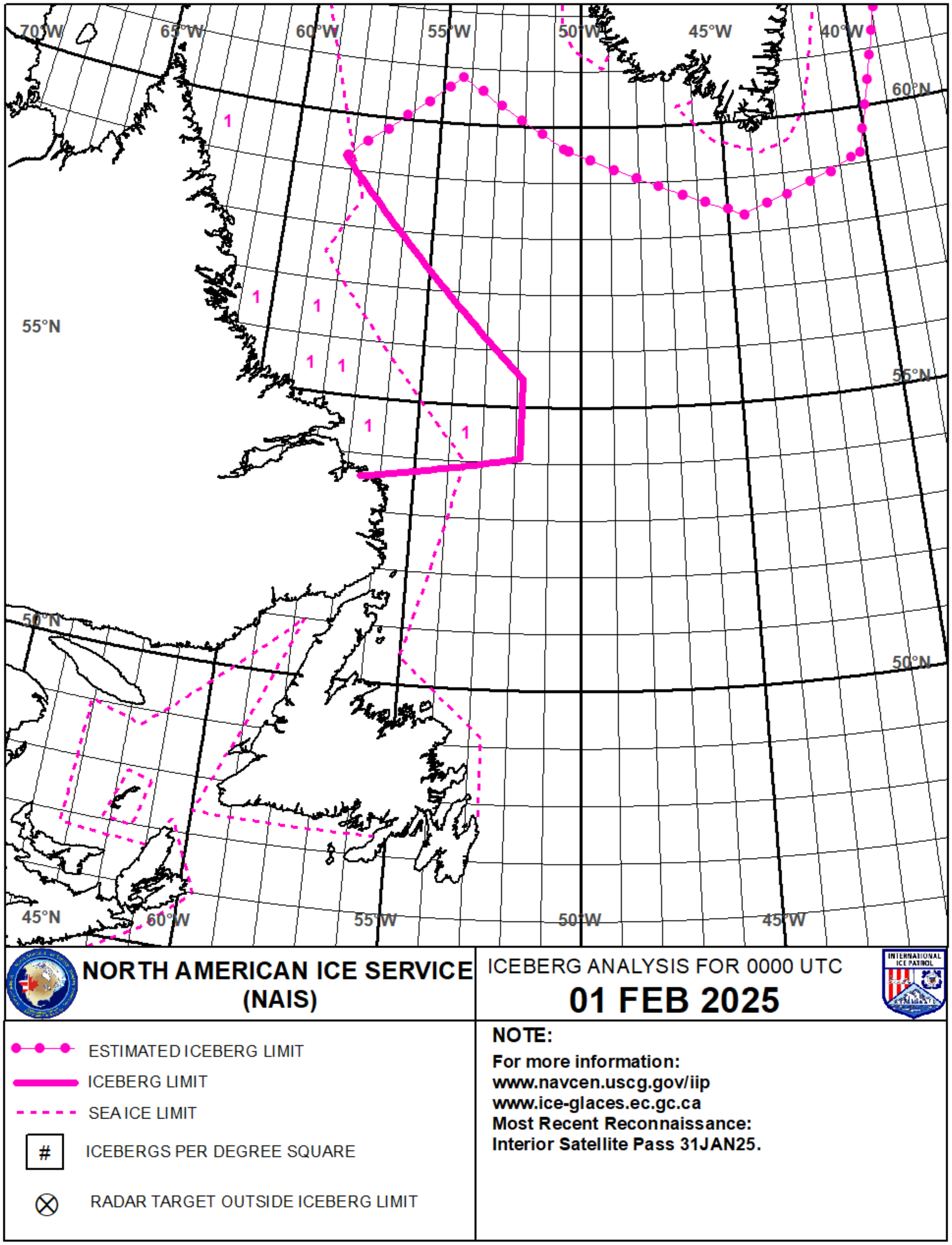

Figure 5.9. NAIS-65 Iceberg Chart for 01 February 2025.

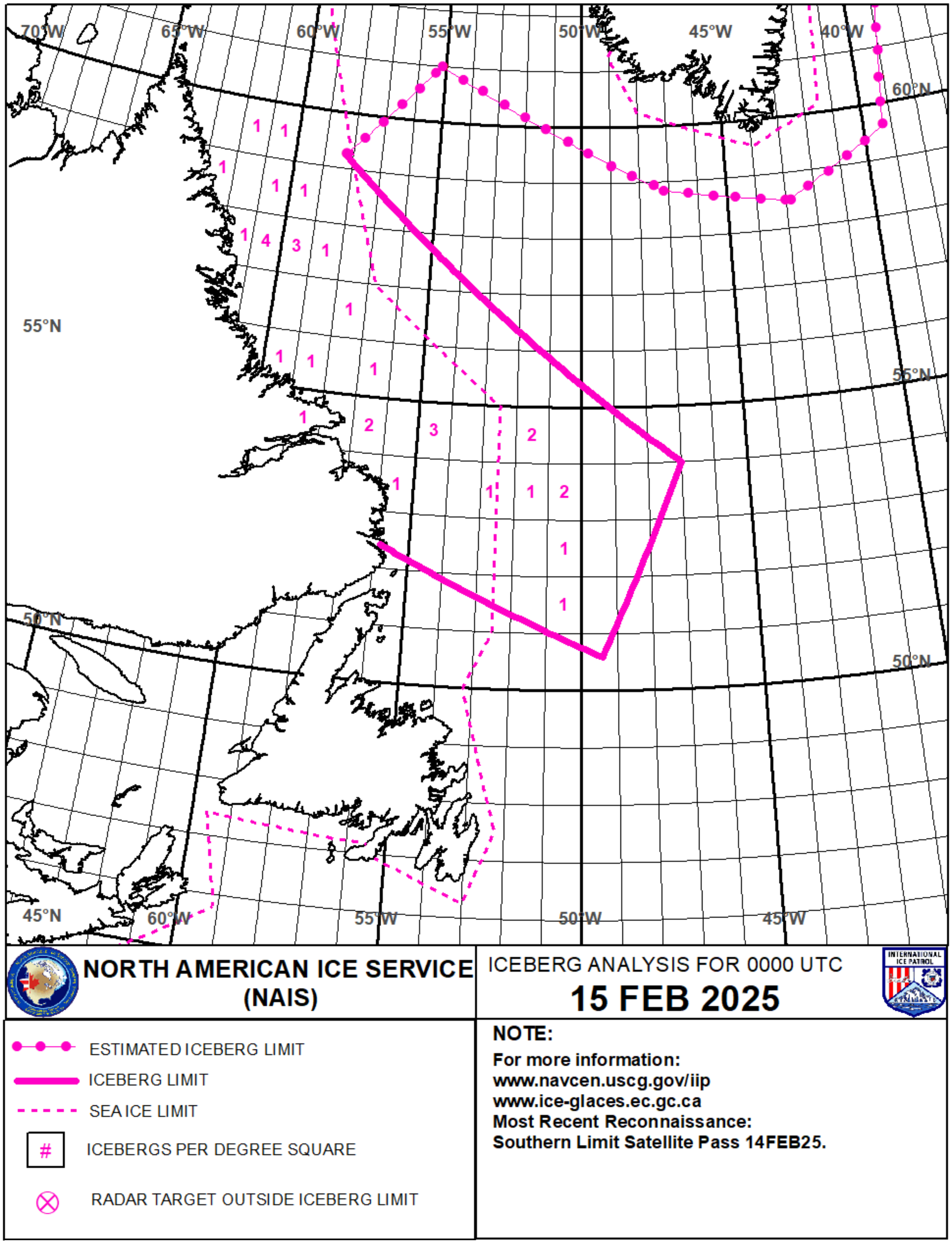

Figure 5.10. NAIS-65 Iceberg Chart for 15 February 2025.

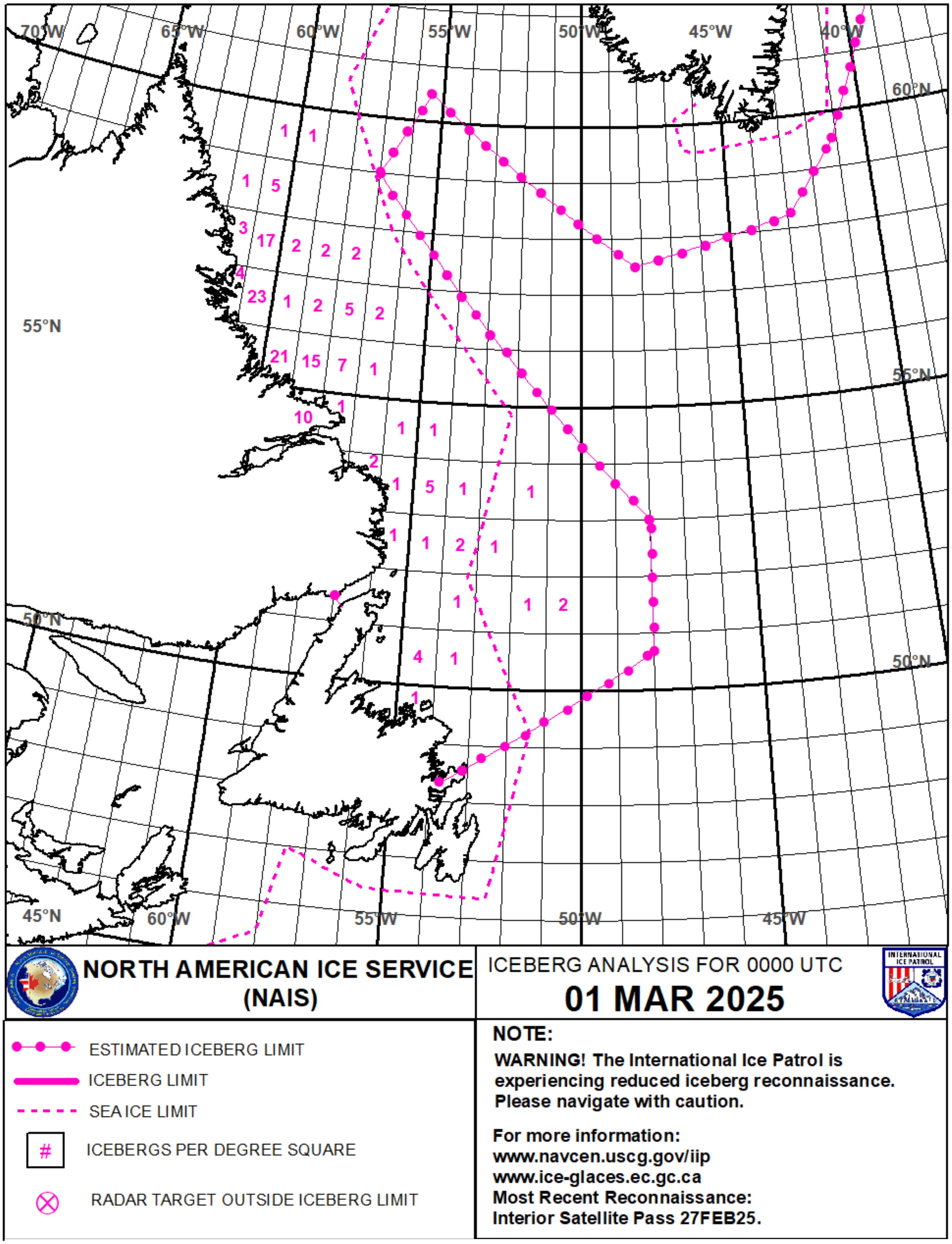

Figure 5.11. NAIS-65 Iceberg Chart for 01 March 2025.

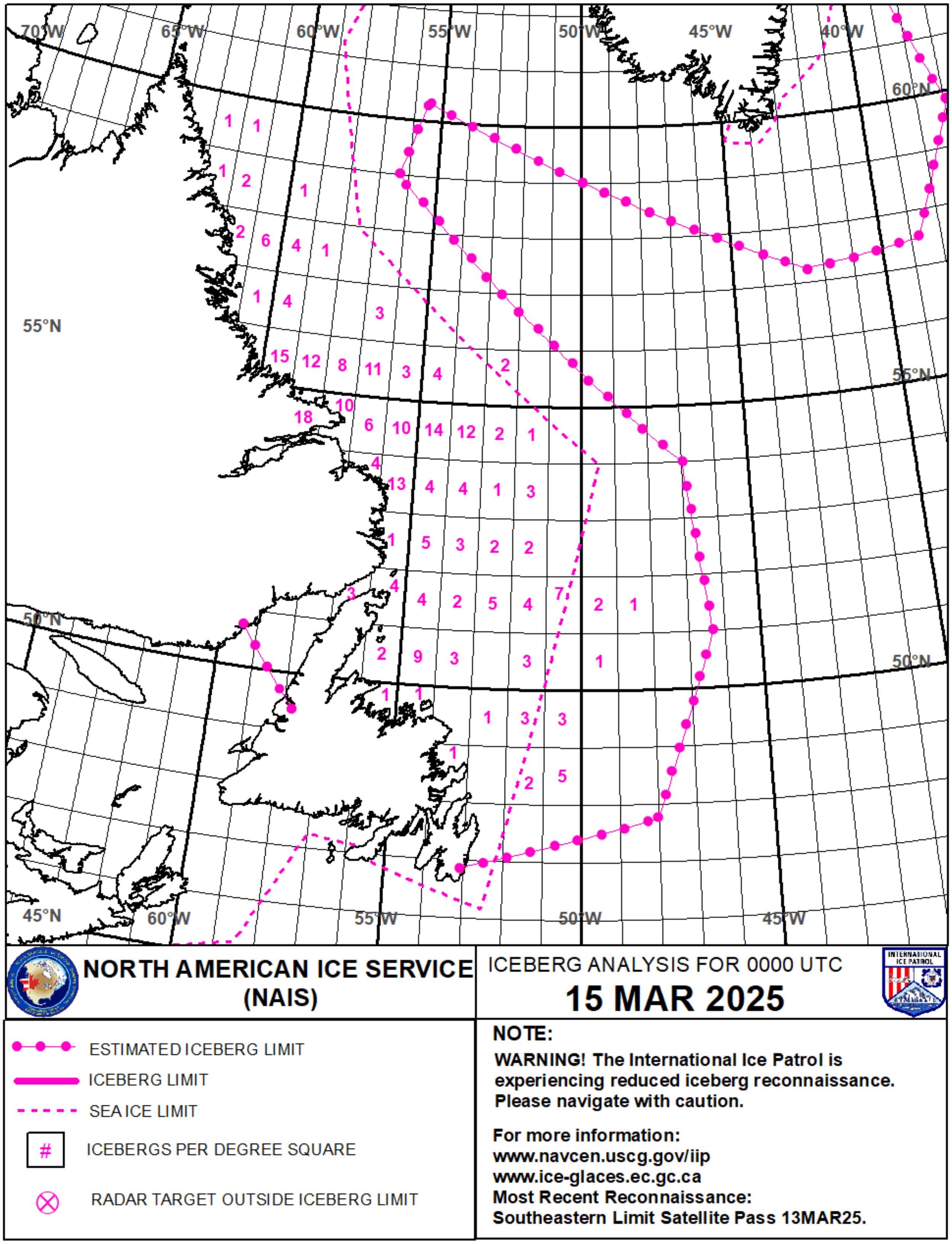

Figure 5.12. NAIS-65 Iceberg Chart for 15 March 2025.

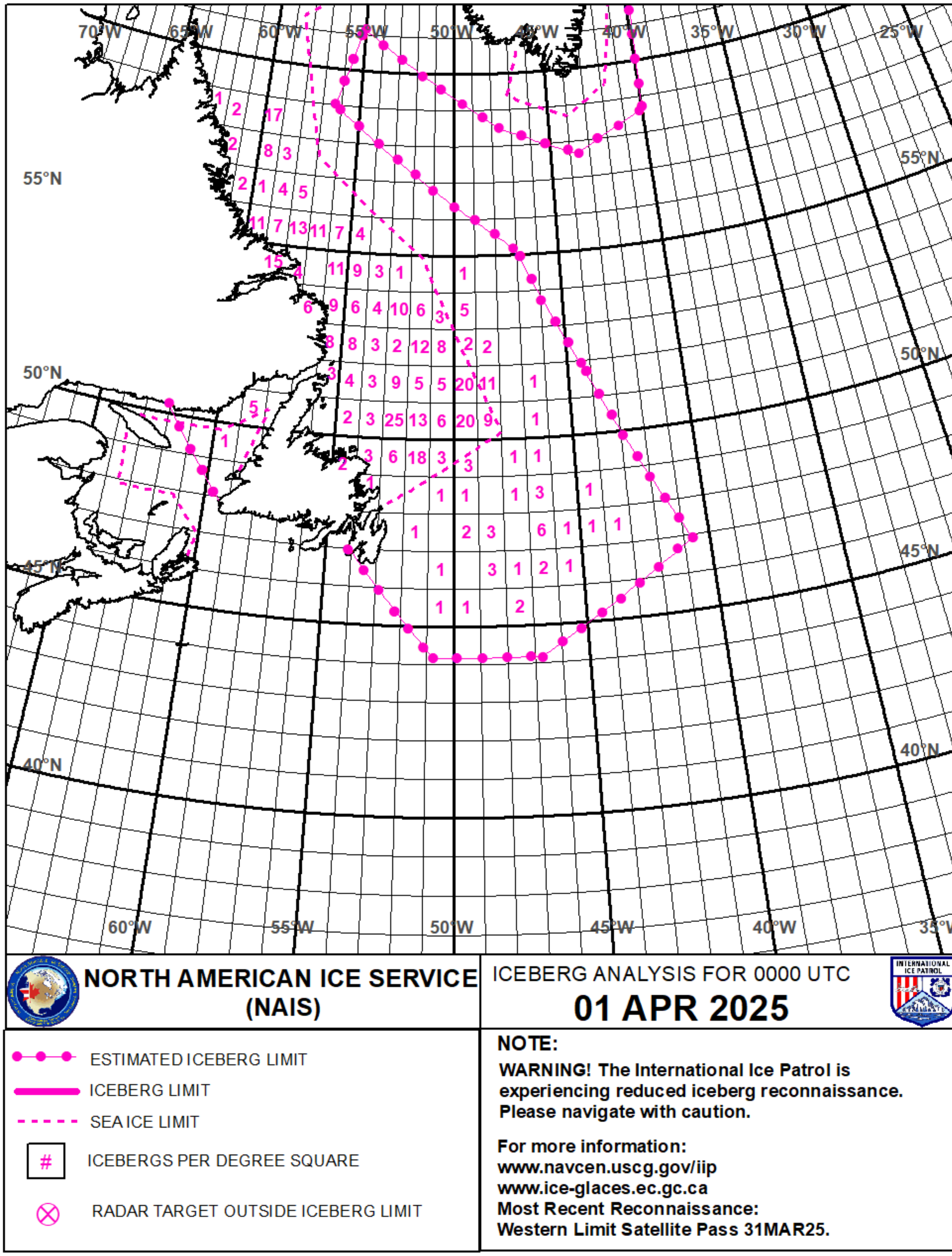

Figure 5.13. NAIS-65 Iceberg Chart for 01 April 2025.

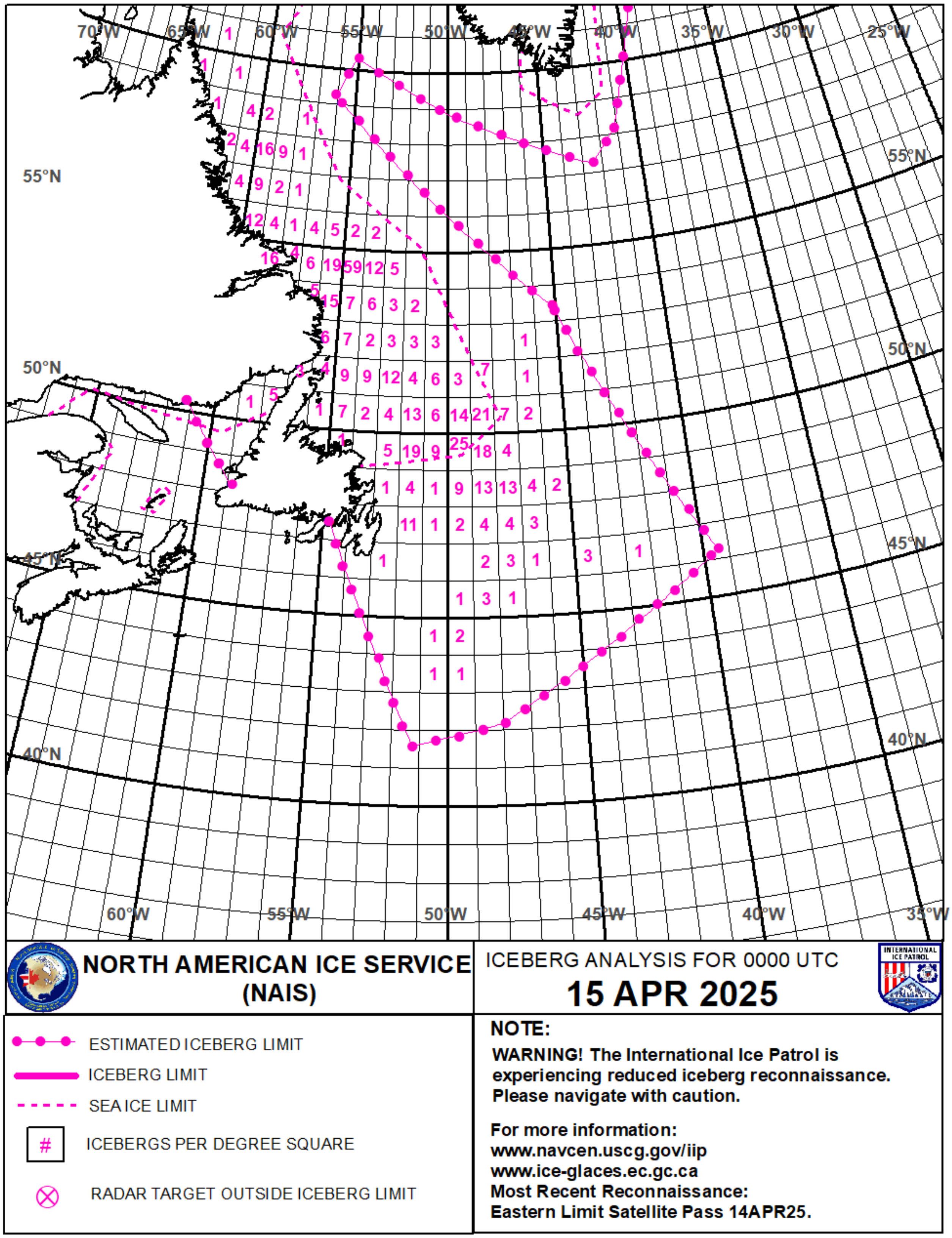

Figure 5.14. NAIS-65 Iceberg Chart for 15 April 2025.

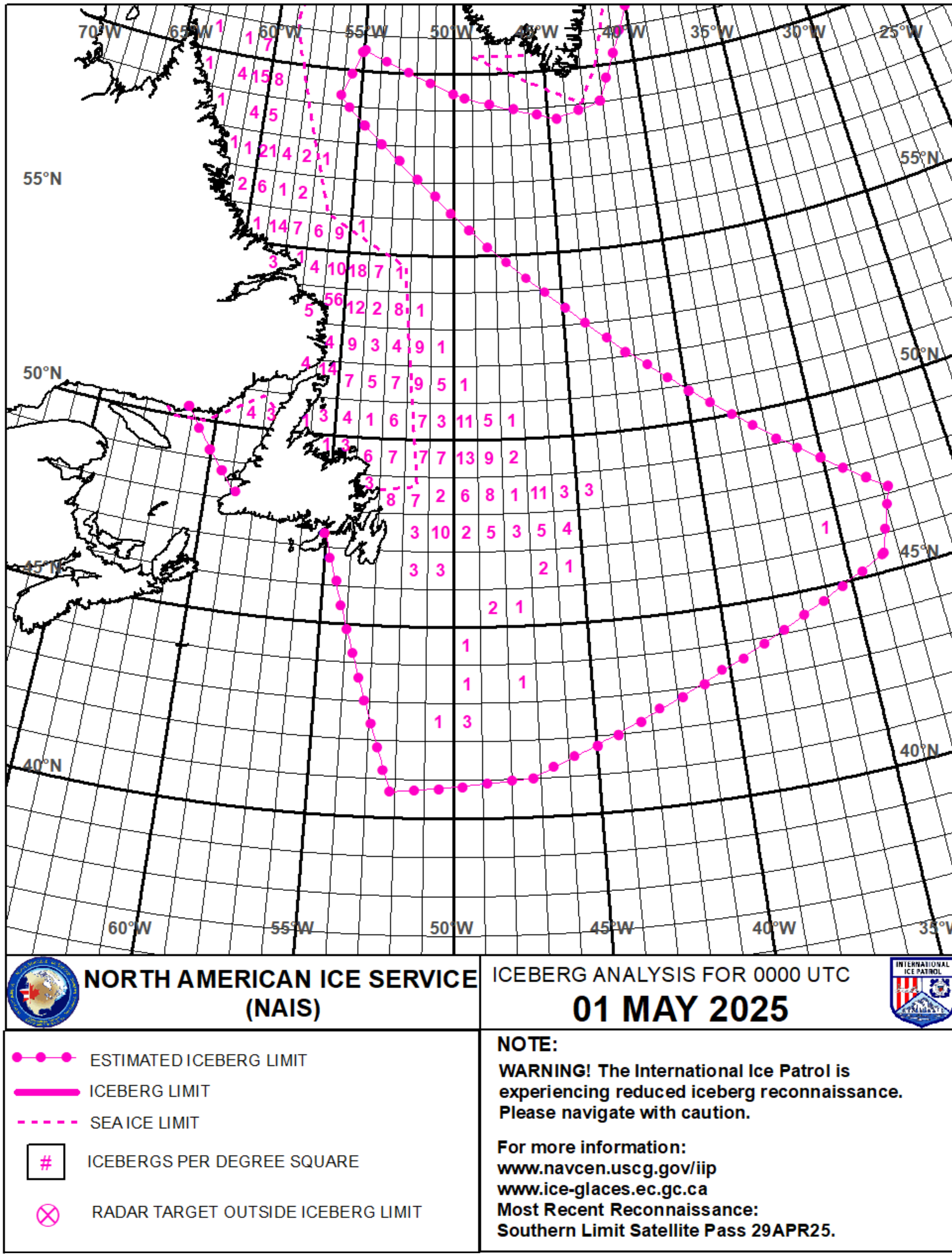

Figure 5.15. NAIS-65 Iceberg Chart for 01 May 2025.

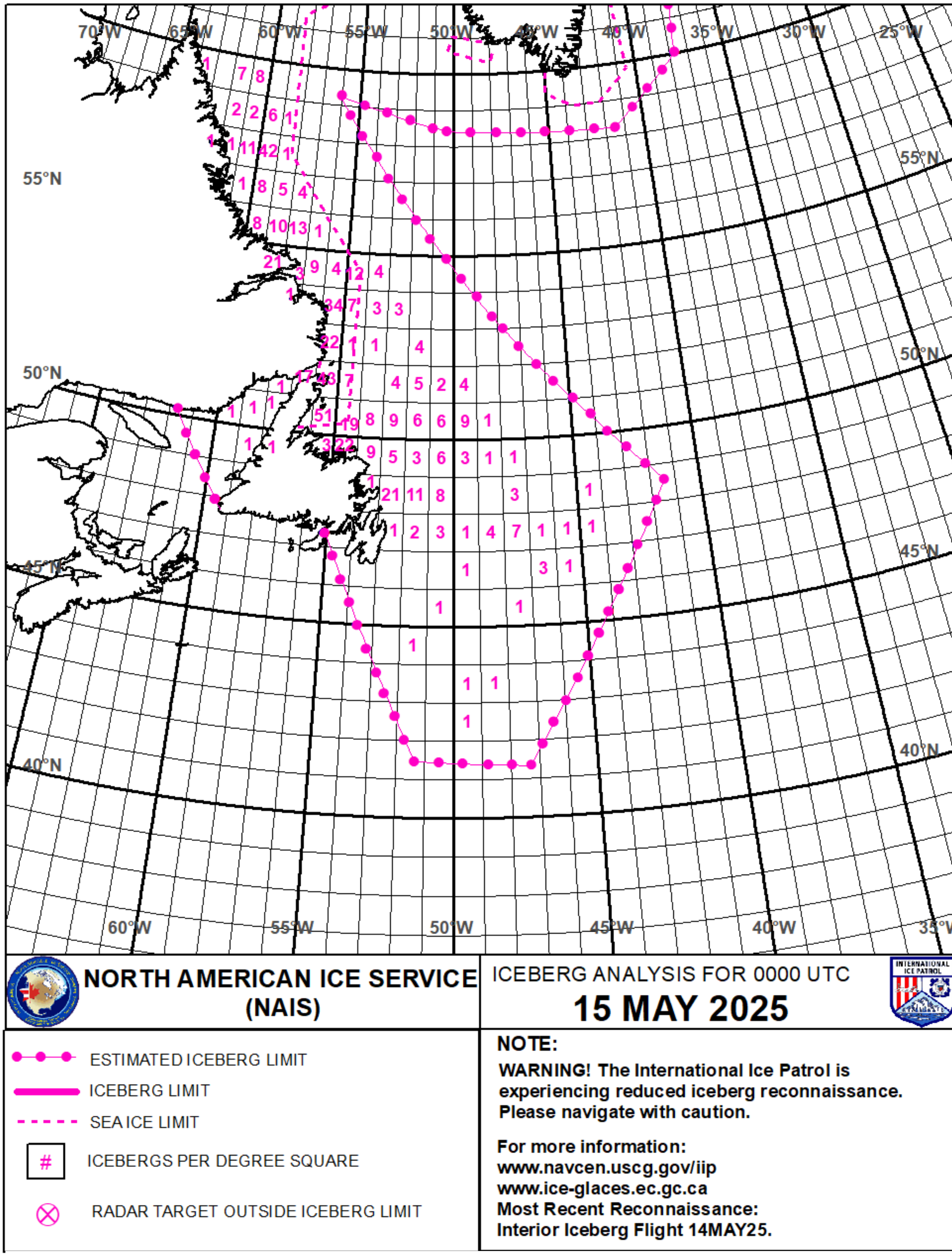

Figure 5.16. NAIS-65 Iceberg Chart for 15 May 2025.

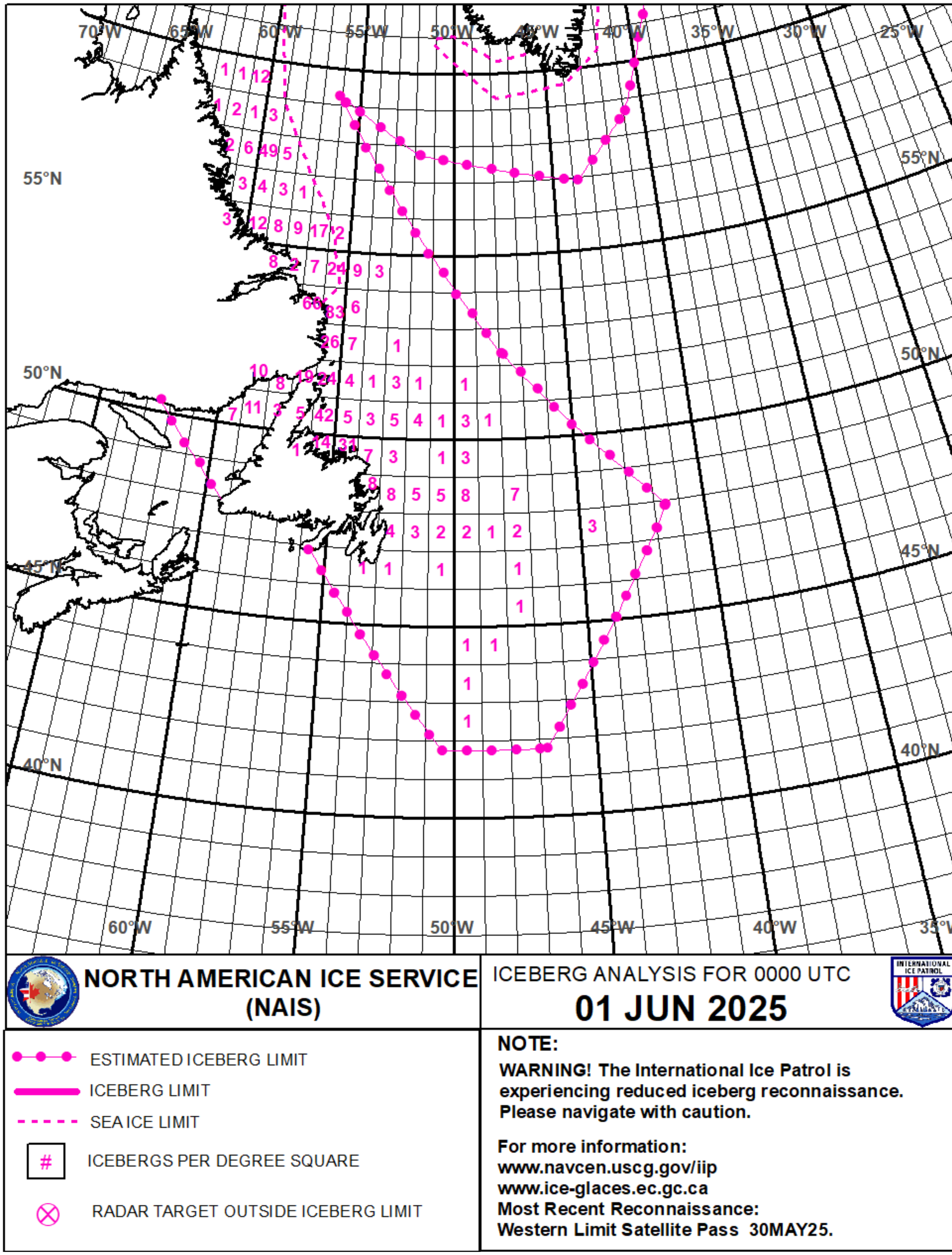

Figure 5.17. NAIS-65 Iceberg Chart for 01 June 2025.

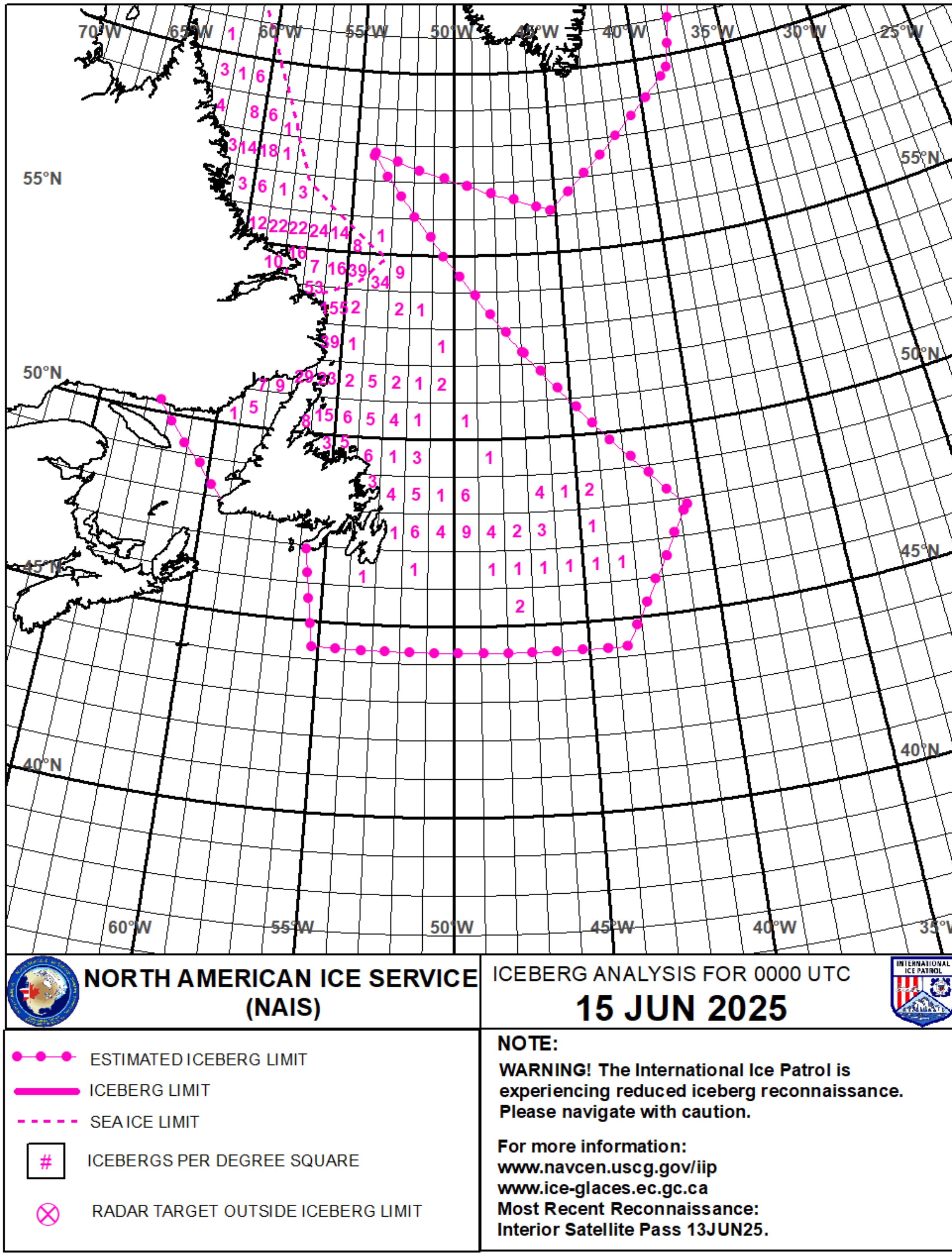

Figure 5.18. NAIS-65 Iceberg Chart for 15 June 2025.

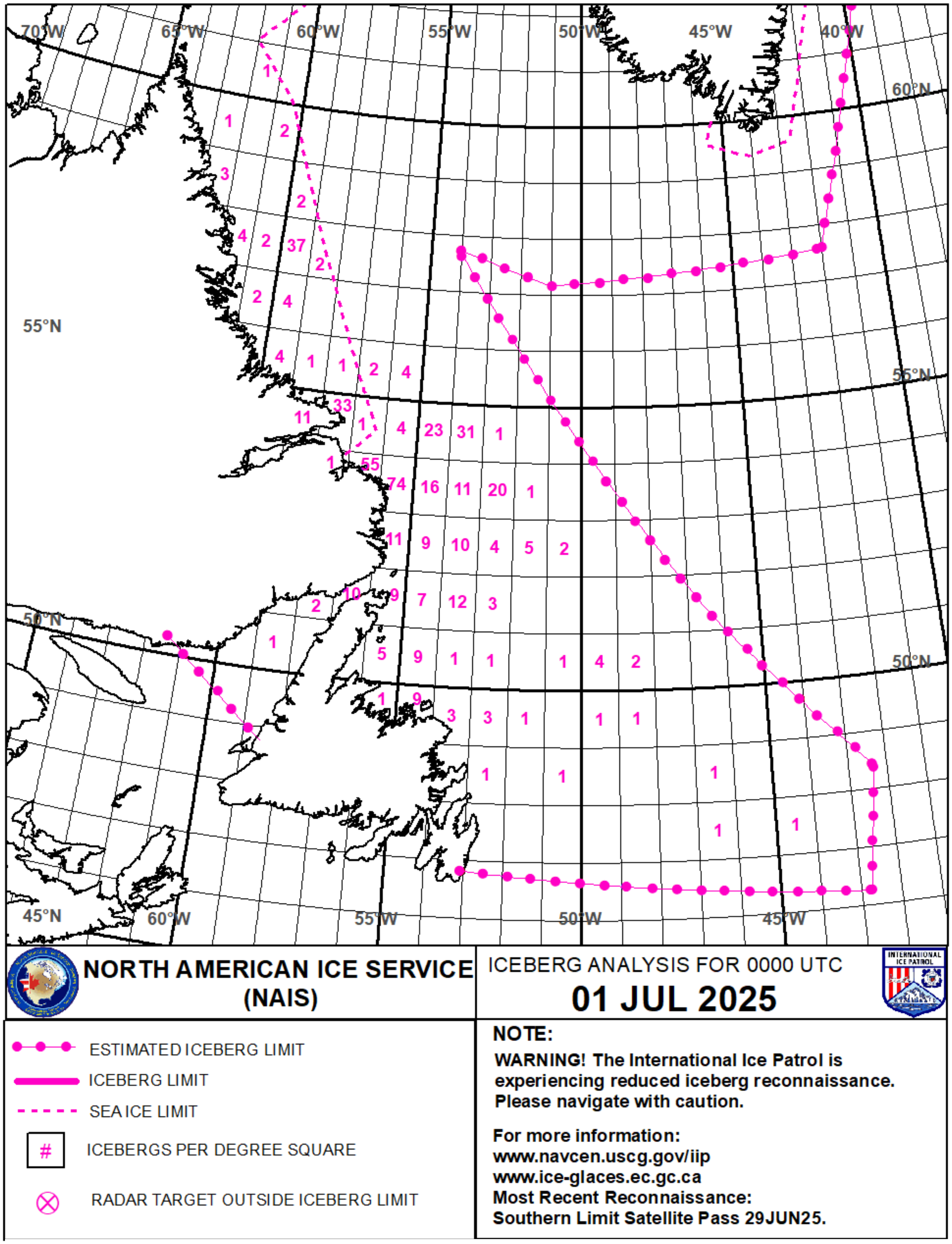

Figure 5.19. NAIS-65 Iceberg Chart for 01 July 2025.

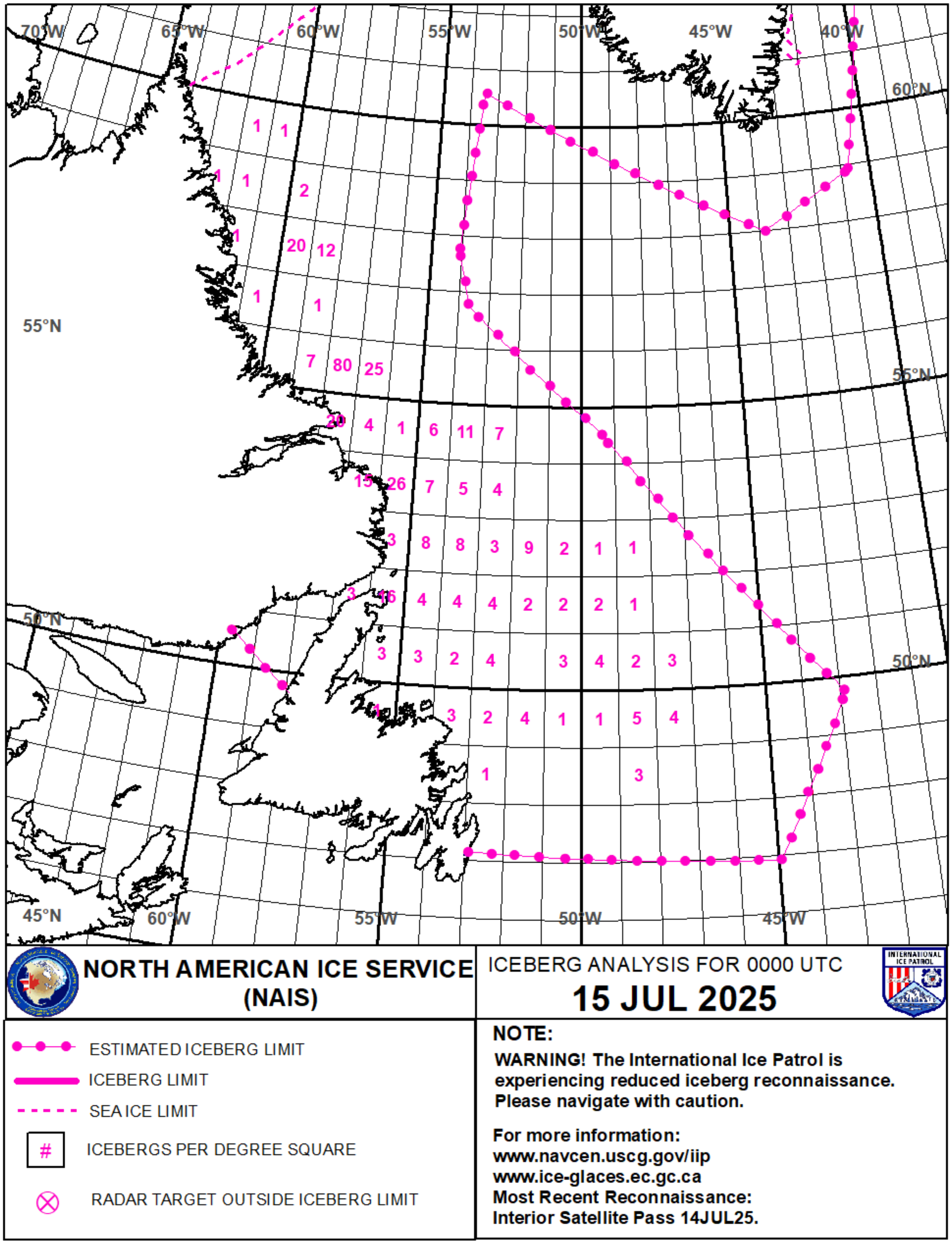

Figure 5.20. NAIS-65 Iceberg Chart for 15 July 2025.

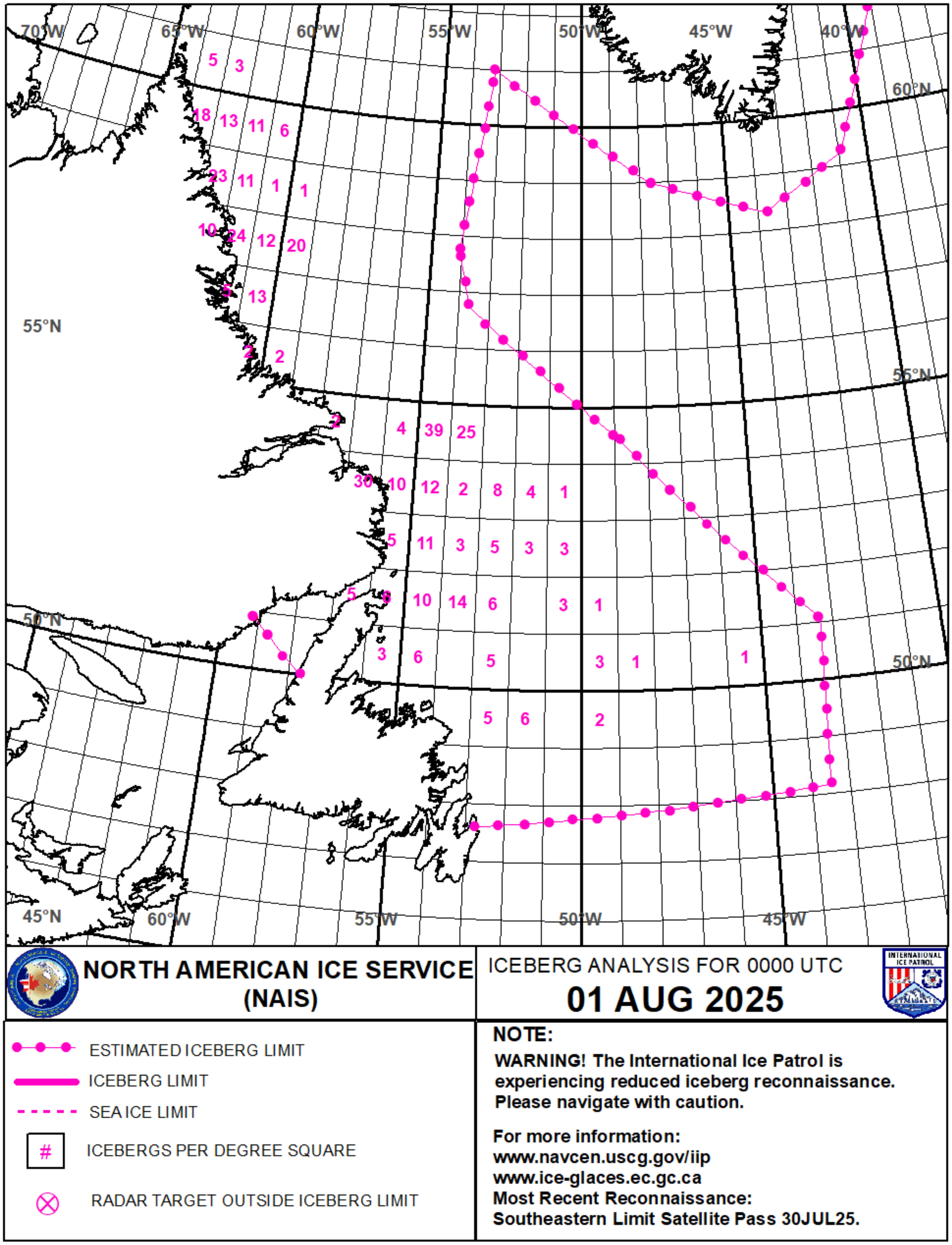

Figure 5.21. NAIS-65 Iceberg Chart for 01 August 2025.

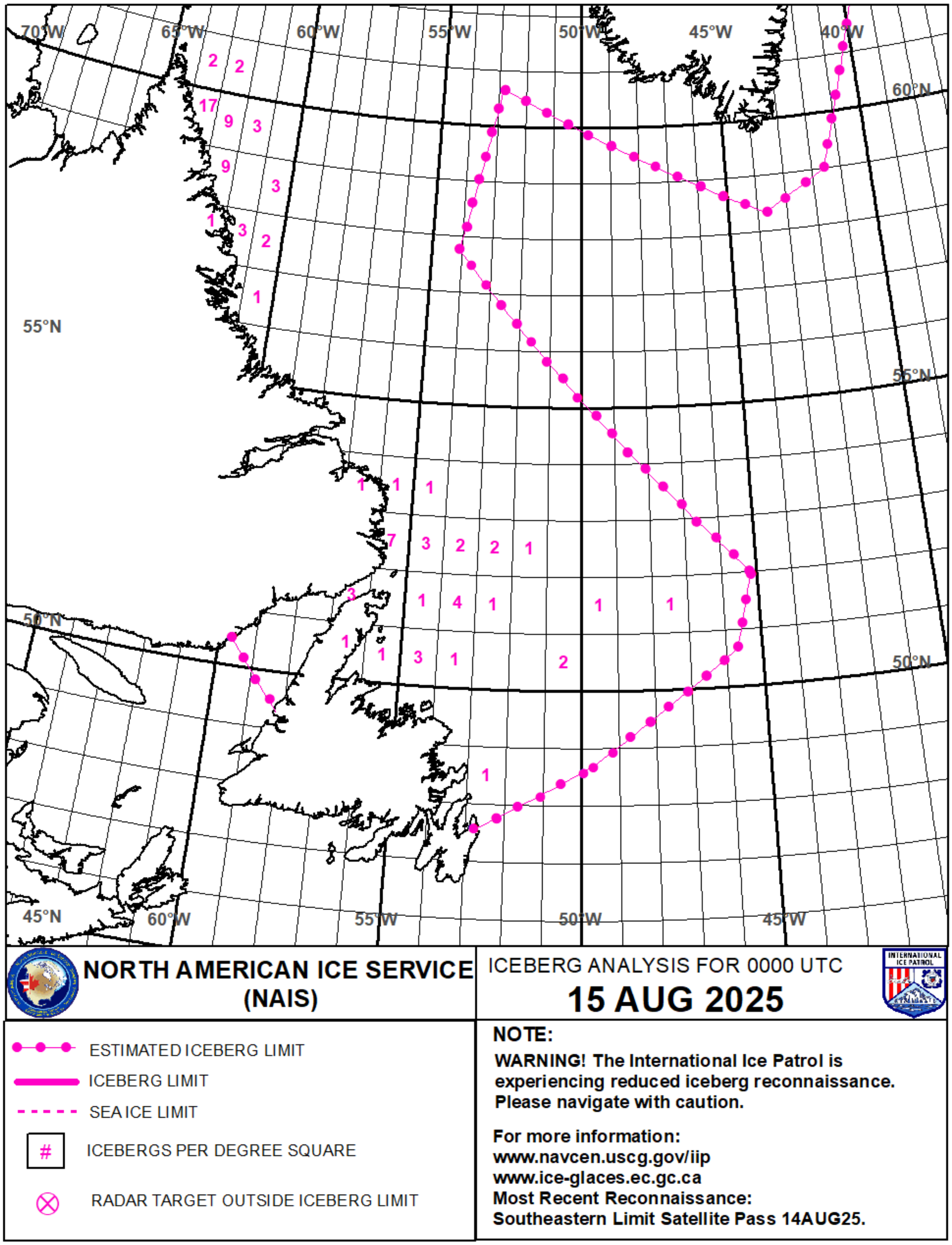

Figure 5.22. NAIS-65 Iceberg Chart for 15 August 2025.

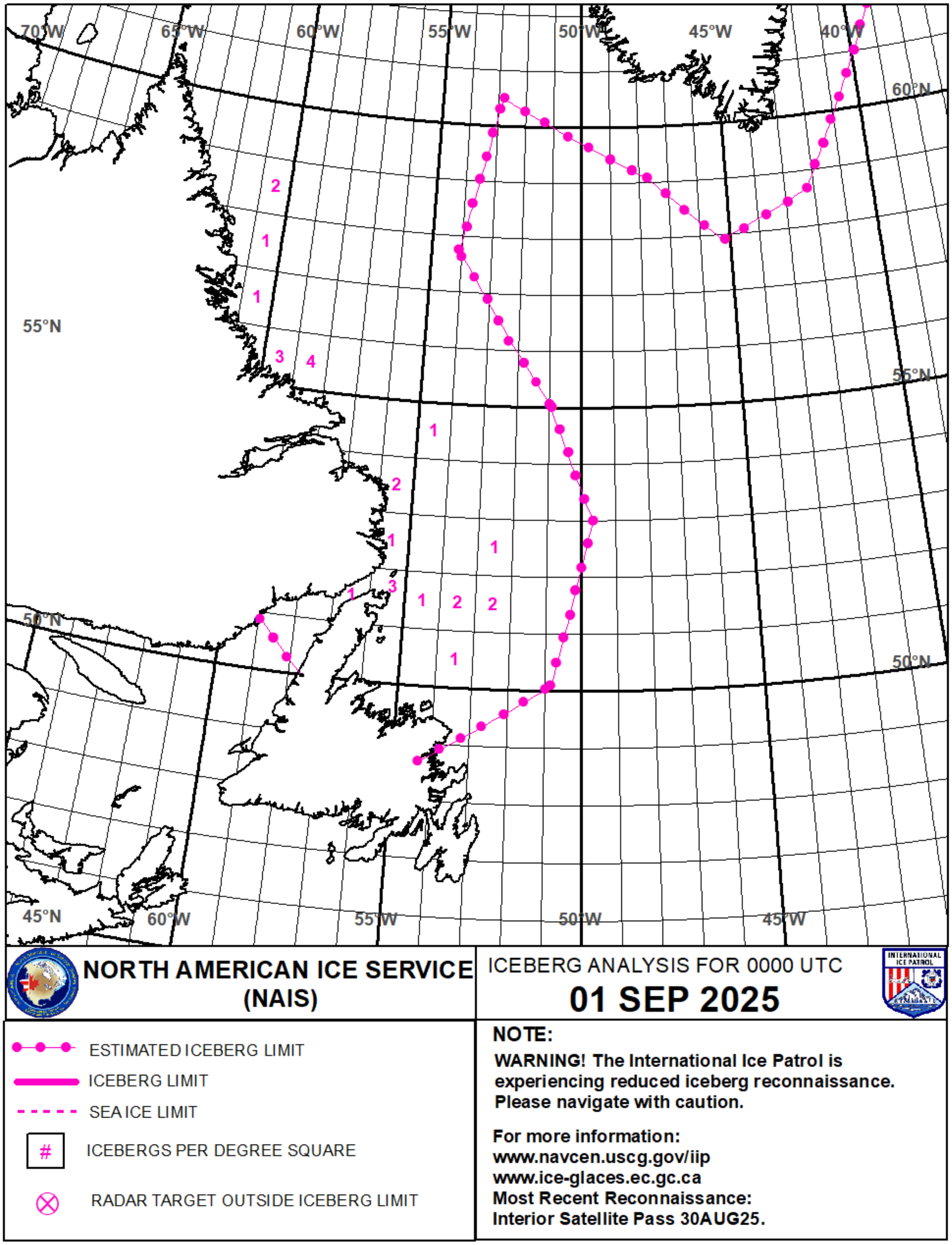

Figure 5.23. NAIS-65 Iceberg Chart for 01 September 2025.

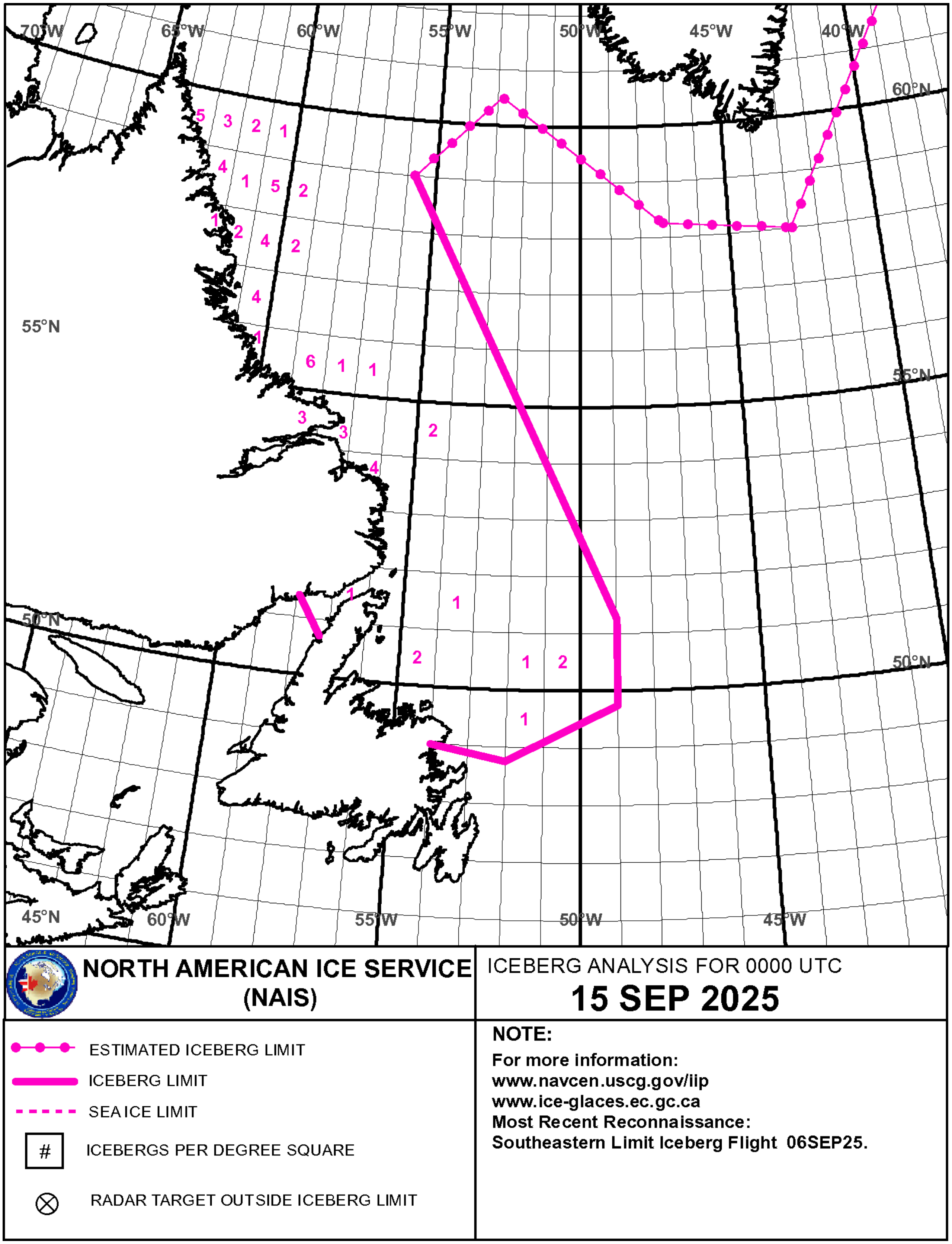

Figure 5.24. NAIS-65 Iceberg Chart for 15 September 2025.

Data and Acknowledgments

Iceberg data is from IIP. Sea ice extents are from the NSIDC, Sea Ice Index, Versions 3 and 4 (F. Fetterer, et al. 2017, F. Fetterer, et al. 2025). NAOI values are from the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Prediction (NCEP) Climate Prediction Center (CPC) (NOAA/NWS NCEP Climate Prediction Center 2024). Temperature, pressure, wind, precipitation, wave, and sea ice concentration data are from the ECMWF ERA5 Reanalysis monthly averaged data on single levels from 1940 to present (Hersbach, et al. 2023). Generated using or contains modified Copernicus Climate Change Service information <2025_2>. Neither the European Commission nor ECMWF is responsible for any use that may be made of the Copernicus information or data it contains.

IIP Commander, CDR Erin Caldwell, wrote the **Bulletin,** and **Section 1**. IIP Chief Scientist and Oceanographer, Dr. Alexis Denton, wrote **Section 2**. IIP Satellite Reconnaissance Branch Chief, LT Lauren Kowalski and IIP Iceberg Operations Branch Chief, LT Megan Toomey, coordinated, compiled, and edited **Sections 3** and **4.** The following 10 Branch members contributed to the following sections: IS1 Cole Grant created the **Cover** and wrote **Section 4.7.2**; YN1 Pablo Diaz-Hidalgo wrote **Sections 4.3** and **4.3.1**; IS2 Erik Balboa wrote **Section 4.7.1** and cowrote **Section 3.7**; IS3 Josiah Hansen wrote **Sections 4.6.2, 4.6.4** and cowrote **Section 3.7**; IS3 Olivia McKenzie wrote **Sections 3.3.2**, **3.6**, **3.6.1**, **4.1**, and **4.5**; IS3 Christian Nieves wrote **Sections 3.2**, **3.4**, and **4.6.1**; IS3 Jeffrey Rojas wrote **Sections 3.5, 4.2,** and **4.4**; IS3 Tyler Romaine wrote **Sections 3.3.1,** and **4.6.3**. IIP Command Chief, ISC Alden Eubanks, compiled **Section 5.** CDR Erin Caldwell, LCDR Rebecca Prendergast, Dr. Alexis Denton, Ms. Jennifer Sabal, LT Megan Toomey, LT Lauren Kowalski, and ISC Alden Eubanks contributed to the editing of all sections.

IIP Members During the 2025 Ice Year

The following people were IIP members ("Ice Picks") and contributed to the 2025 Ice Year (in alphabetical order by surname): IS2 Erik Balboa, CDR Erin Caldwell, Dr. Alexis Denton, YN1 Pablo Diaz-Hidalgo, ISC Trevor Doubek, ISC Alden Eubanks, IS1 Cole Grant, LT Shelby Griswold, IS3 Josiah Hansen, LT Lauren Kowalski, YN1 Amelia Lawrence, IS3 Olivia McKenzie, IS3 Chistian Nieves, LCDR Rebecca Prendergast, IS3 Jeffrey Rojas, IS3 Tyler Romaine, Ms. Jennifer Sabal, ISC Dallas Shaw, and LT Megan Toomey.

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References

Aubourg, Lucie. 2023. *N. Atlantic ocean temperature sets record high: US agency.* Phys.org, July 29. Accessed November 7, 2023. https://phys.org/news/2023-07-atlantic-ocean-temperature-high-agency.html.

Bigg, G. R., H. L. Wei, D. J. Wilton, Y. Zhao, S. A. Billings, E. Hanna, and V. Kadirkamanathan. 2014. "A century of variation in the dependence on ice sheet surface mass balance and regional climate change." *Proceedings of the Royal Society* 470 (20130662): 14. Accessed November 6, 2023. doi:http://dx.doi.org/10.1098/rspa.2013.0662.

Canadian Ice Service. 2024. *Seasonal Summary North American Arctic Waters: Spring 2024.* Environment and Climate Change Canada, Environment and Climate Change Canada. Accessed October 24, 2024. https://www.canada.ca/en/environment-climate-change/services/ice-forecasts-observations/latest-conditions/seasonal-summary-north-american-arctic-waters-summer-2024.html#toc0.

Copernicus Climate Change Service. 2023. "ERA5 monthly averaged data on single levels from 1940 to present." Copernicus Climate Change Service (C3S) Climate Data Store (CDS). Accessed August 25, 2025. doi:10.24381/cds.f17050d7 .

Fetterer, F., K. Knowles, W. Meier, M. Savoie, A. Windnagel, and T. Stafford. 2025. "Sea Ice Index. (G02135, Version 4)." Boulder, Colorado: National Snow and Ice Data Center. Accessed August 25, 2025. doi:https://doi.org/10.7265/a98x-0f50.

Fetterer, Florence, K Knowles, Walt Meier, Matt Savoie, and Ann Windnagel. 2017. "Sea Ice Index, (G02135, Version 3)." Boulder, Colorado: National Snow and Ice Data Center. Accessed October 20, 2025. doi:https://doi.org/10.7265/N5K072F8.

Fettweis, X., E. Hanna, C. Lang, A. Belleflamme, M. Erpicum, and H. Gallée. 2013. "Brief communication "Important role of the mid-tropospheric atmospheric circulation in the recent surface melt increase over the Greenland ice sheet"." *The Cryosphere* 7: 241-248. Accessed November 7, 2023. doi:https://doi.org/10.5194/tc-7-241-2013.

Hanna, Edward, Philippe Huybrechts, John Cappelen, Konrad Steffen, Roger C. Bales, Evan Burgess, Joseph R. McConnell, et al. 2011. "Greenland Ice Sheet surface mass balance 1870 to 2010 based on Twentieth Century Reanalysis, and links with global climate forcing." *Journal of Geophysical Research* 116 (D24121): 20. Accessed November 7, 2023. doi:https://doi.org/10.1029/2011JD016387.

Hersbach, H., B. Bell, P. Berrisford, G. Biavati, A. Horányi, J. Muñoz Sabater, J. Nicolas, et al. 2023. "ERA5 monthly averaged data on single levels from 1940 to present." Copernicus Climate Change Service (C3S) Climate Data Store (CDS). Accessed August 25, 2025. doi:10.24381/cds.f17050d7.

International Ice Patrol. 2024. "Report of the International Ice Patrol in the North Atlantic." Annual Report, Department of Homeland Security, United States Coast Guard, Suitland, MD, USA. Accessed August 26, 2025. https://www.navcen.uscg.gov/sites/default/files/pdf/iip/Report%20of%20the%20International%20Ice%20Patrol%20in%20the%20North%20Atlantic%202024.pdf.

International Ice Patrol. 2018. "Report of the International Ice Patrol in the North Atlantic." Annual Report, Department of Homeland Security, United States Coast Guard, New London, CT, USA. Accessed September 14, 2023. https://www.navcen.uscg.gov/sites/default/files/pdf/Annual_Report_2022_Season.pdf.

International Ice Patrol. 2023. "Report of the International Ice Patrol in the North Atlantic." Annual Report, Department of Homeland Security, United States Coast Guard, Suitland, MD, USA. Accessed June 27, 2024. https://www.navcen.uscg.gov/sites/default/files/pdf/iip/Report%20of%20the%20International%20Ice%20Patrol%20in%20the%20North%20Atlantic%202023.pdf.

International Maritime Organization. 1974. "International Convention for the Safety of Life at Sea, 1974." International Maritime Organization. https://treaties.un.org/doc/Publication/UNTS/Volume%201184/volume-1184-I-18961-English.pdf.

Larsen, Poul-Henrik, Marc Overgaard Hansen, Jørgen Buus-Hinkler, Klaus Harnvig Krane, and Carsten Sønderskov. 2015. "Field tracking (GPS) of ten icebergs in eastern Baffin Bay, offshore Upernavik, northwest Greenland." *Journal of Glaciology* (Cambridge University Press) 61 (227): 421-437. Accessed September 11, 2023. doi:https://doi.org/10.3189/2015JoG14J216.

Marko, J. R., D. B. Fissel, P. Wadhams, P. M. Kelly, and R. D. Brown. 1994. "Iceberg Severity off Eastern North America: Its Relationship to Sea Ice Variability and Climate Change." *Journal of Climate* 7: 1335-1351. Accessed September 11, 2023. doi:https://doi.org/10.1175/1520-0442(1994)007%3C1335:ISOENA%3E2.0.CO;2.

Newell, John P. 1993. "Exceptionally Large Icebergs and Ice Islands in Eastern Canadian Waters: A Review of Sightings from 1900 to Present." *Arctic* 46 (3): 205-211. Accessed September 11, 2023. doi:https://journalhosting.ucalgary.ca/index.php/arctic/article/view/64400.

NOAA NCEI. 2023. "Annual 2023 Global Climate Report." Accessed October 18, 2024. https://www.ncei.noaa.gov/access/monitoring/monthly-report/global/202313#rtempsNa.

NOAA/NWS NCEP Climate Prediction Center. 2024. "Daily NAO index since January 1950." October. Accessed October 7, 2024. https://www.cpc.ncep.noaa.gov/products/precip/CWlink/pna/norm.nao.monthly.b5001.current.ascii.table.

Noël, B., X. Fettweis, W. J. van de Berg, M. R. van den Broeke, and M. Erpicum. 2014. "Sensitivity of Greenland Ice Sheet surface mass balance to perturbations in sea surface temperature and sea ice cover: a study with the regional climate model MAR." *The Cryosphere* 8: 1871-1883. Accessed November 7, 2023. doi:https://doi.org/10.5194/tc-8-1871-2014.

Rignot, Eric, and Pannir Kanagaratnam. 2006. "Changes in the Velocity Structure of the Greenland Ice Sheet." *Science* 311 (5763): 986-990. Accessed September 6, 2023. doi:10.1126/science.1121381.

Smith, Edward H. 1926. "Summary of Iceberg Records in the Northwestern North Atlantic, 1880-1926." In *International Ice Observation and Ice Patrol Service in the North Atlantic: Season of 1926*, by International Ice Observation and Ice Patrol Service, 75-77. Accessed October 13, 2023. https://www.navcen.uscg.gov/international-ice-patrol-annual-reports.

Thiem, Haley. 2024. "For more than a year, the North Atlantic has been running a fever." *Climate.gov.* National Oceanic and Atmospheric Administration, June 25. Accessed September 24, 2024.

https://www.climate.gov/news-features/featured-images/more-year-north-atlantic-has-been-running-fever.

2021. "Title 46, United States Code § 80301." Accessed August 30, 2023. https://www.govinfo.gov/content/pkg/USCODE-2021-title46/pdf/USCODE-2021-title46.pdf.

Trivers, Geoffrey. 1994. "International Ice Patrol's Iceberg Season Severity." In *Bulletin No. 80: Report of the International Ice Patrol in the North Atlantic, Season of 1994*, by International Ice Patrol, 49-59. Groton, Connecticut. Accessed October 13, 2023. https://www.navcen.uscg.gov/international-ice-patrol-annual-reports.

United States National Ice Center. 2024. *Arctic Sea Ice at Minimum Extent - 2024.* September 27. Accessed August 25, 2025. https://usicecenter.gov/PressRelease/ArcticMinimum2024.

Wilton, David J., Grant R. Bigg, and Edward Hanna. 2015. "Modelling twentieth century global ocean circulation and iceberg flux at 48°N: implications for west Greenland iceberg discharge." *Progress in Oceanography* 138: 194-210. Accessed September 12, 2023. doi:https://doi.org/10.1016/j.pocean.2015.07.003.