Sea Ice Conditions off NW and NE Greenland from Satellite Measurements, Airborne and In-situ data

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DTU Space
National Space Institute

DMI

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Summary

This report outlines the sea-ice conditions for the spring 2008 ice in the Baffin Bay area off NW Greenland and the NE Greenland shelf region, as well as gives satellite maps of ice coverage back to 2004, and ice drift maps and statistics for ice-free days back to 1979, the start of the satellite observations.

Airborne ice observation campaigns were carried out in the days of April 19-24, 2008 on both the Northwest and Northeast shelf regions. The program consisted of airborne scanning laser (lidar) observations of sea-ice freeboard heights (thickness) and in-situ measurements from drilling. The observation program was supported by detailed satellite SAR imagery.

The sea-ice observations shows an average thickness of the first-year ice on the Greenland west coast of about 80-100 cm, with only limited amounts of thicker, multiyear ice (i.e., ice originating from the Arctic Ocean, passing through the Nares Strait). The ice conditions on the NE Greenland shelf region are more severe, with an average thickness of 180 cm, consisting in part of up to 3-4 m thick multiyear ice floes from the central Arctic Ocean drifting rapidly south along the Greenland coast. The main results are presented as histograms, tables, plots, statistics and imagery, and we have on purpose not drawn major conclusions concerning trends in the ice development, as future predictions of ice conditions were not the task of the present project.

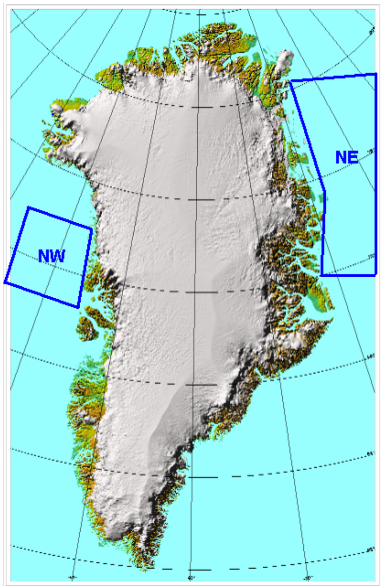


Fig. 1. Areas studied in this report.

NW ice off Upernavik with first year floes and thin ice.

1. Introduction

The sea ice conditions in NW and NE Greenland are quite different, with the NW area being a seasonally ice covered area, with ice forming in the Baffin Bay every winter. The floes are thus nearly exclusively first year ice, which typically can only grow to a maximal thickness of about 1.5-1.8 meter in one season. Phenomena such as pressure ridges and rafting of floes can occasionally produce thicker ice; also, in recent years, an increased outflow of multi-year ice through the Nares Strait means the likelihood of encountering multi-year floes of Arctic Ocean origin are higher. Such floes are often drifting around the Baffin Bay in a counterclockwise fashion, occasionally drifting from south to north in the Melville Bay.

For the NE Greenland shelf area conditions are quite different, with the ice conditions dominated by outflow of multiyear ice floes from the Central Arctic Ocean, typically of 3-4 m thickness in the north, with thinning and diminishing floe sizes as the ice drifts south. The later years have seen significant changes in the ice concentrations, with some years having little or no ice in the late summer period.

Fig. 2 shows (as background for understanding the Greenland ice conditions) the overall Arctic Ocean satellite-derived ice concentration and velocities for April 2008, same time as the airborne ice survey.

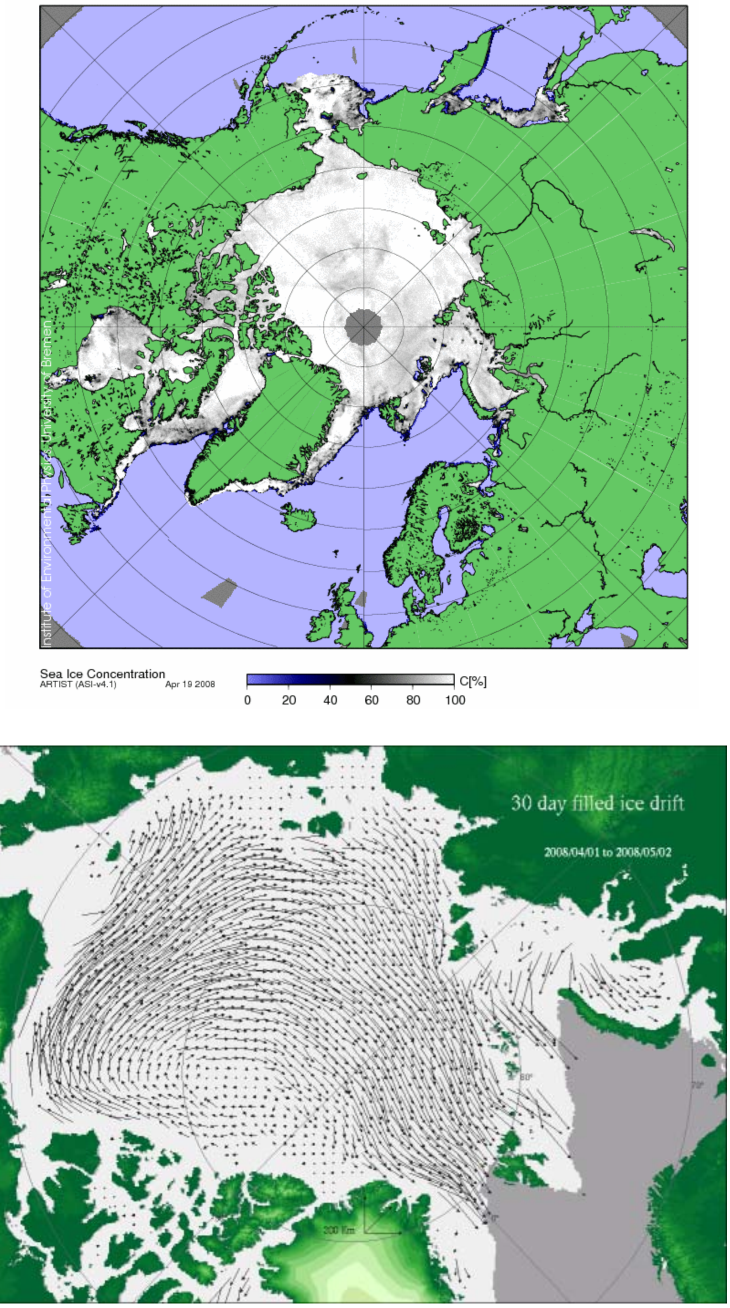


Fig. 2. Arctic Ocean sea ice in April, 2008. Upper: concentration, lower: ice drift [Univ. Bremen/Ifremer]

The primary aim of the 2008 sea ice investigations by DTU-Space and DMI was to give a detailed overview of the spring 2008 ice conditions, in terms of thickness, ridges and distribution of leads, as well as giving a summary of ice conditions in the previous years, especially as a background for judging the possibilities for future oil and gas exploration acitivities on the NW and NE shelf areas, the socalled Kanumas areas (Fig. 3).

We will in the sequel summarize the satellite based sea ice concentration and drift results for the two shelf areas, followed by the results of the airborne and in-situ determination of ice thickness parameters, collocated with detailed SAR imagery.

The investigations of the present report were sponsored by the Greenland Home Rule Government Bureau of Minerals and Petroleum (www.bmp.gl), and carried out by the National Space Institute (DTU-Space) and the Danish Meteorological Institute.

The investigations are analogous to the earlier 2006 investigations and field ice observation programme in the Disko-West area, south of the current NW region.

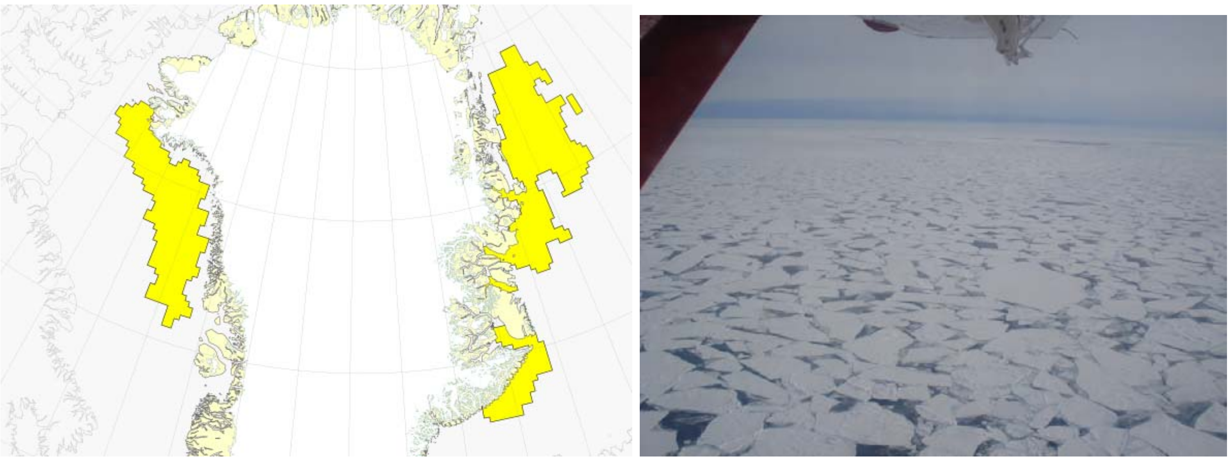


Fig. 3. Left: Kanumas areas. Right: Typical Sea ice conditions in the NE area. Apr. 21, 2008.

2. Ice concentration maps from satellite

In this section we show satellite images of ice concentration, based on the AMSR-E passive microwave sensor on the NASA Aqua satellite. The plots in the sequel show the satellite results for different times of the year, for the period 2004-8.

2.1. NW Greenland 2004-8

The ice in northern Baffin Bay is mainly first-year ice formed in the bay. However, every year a certain amount of Multi-year ice from the Arctic Ocean is exported mainly through Nares Strait. This typically amounts to 30-35.000 square kilometers in area, but in recent years where the Nares Strait has been open for ice drift almost all year this amount has increased to some 80.000 square kilometers. Most of this multi-year ice drifts down along the coast of Baffin Island on the Canadian side of the centerline, but some of it may intrude into the westernmost parts of the

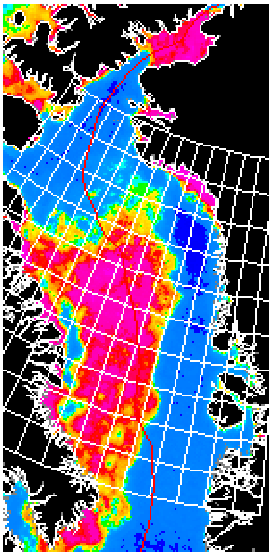
Greenland zone. When the ice in Baffin Bay finally melts in summer this old and thicker ice is typically the last to disappear in the central parts of Baffin Bay. In recent years most of the ice has disappeared by late July and does not reappear until mid- to late October leaving 3-4 months of sea-ice free conditions in substantial parts of the area.

A pronounced feature during the winter in Northern Baffin Bay is the North Water polynya. This is an area of open water or reduced ice concentration formed downstream of Smith Sound (at the exit of Nares Strait into Baffin Bay). In a typical year the sound gets blocked with ice sometime during the winter, and due to the prevailing strong winds towards the south in the Strait, the ice south of the blockage keeps moving away to the south, leaving an area of reduced ice concentration behind. During the cold winter this is an area of very intense ice formation as a consequence of the balance between the intense cooling from the atmosphere and the removal of the ice by the wind.

NW Greenland ice concentration

Ultimo June

Blue and lightblue is ice free or very low concentrations. Green-yellow-orange-red-purple are increasing concentrations to 100%.



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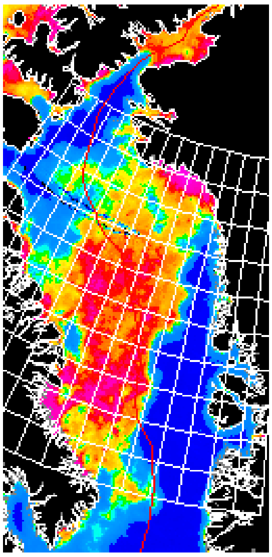

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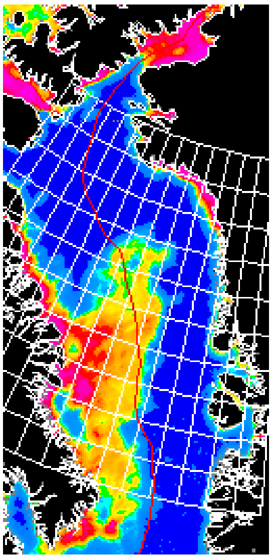

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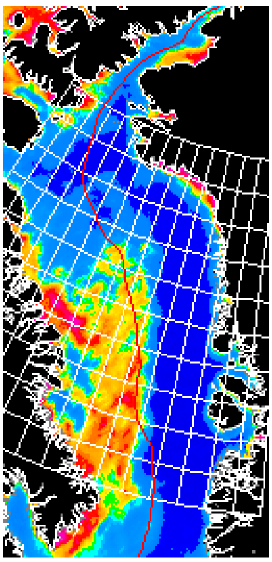

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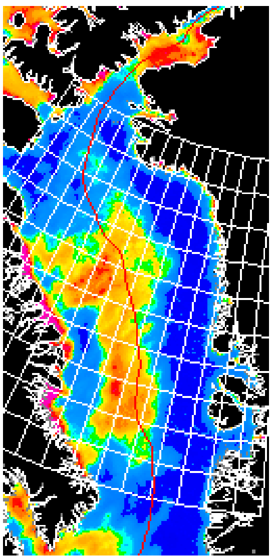
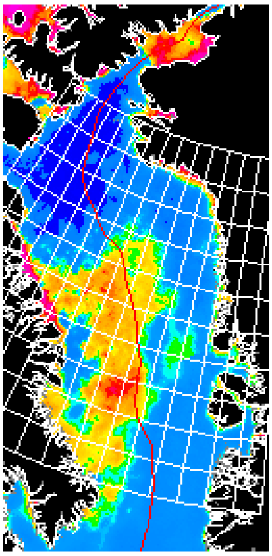


2008

NW Greenland
Mid July

Blue and lightblue is ice free or very low concentrations. Green-yellow-orange-red-purple are increasing concentrations to 100%



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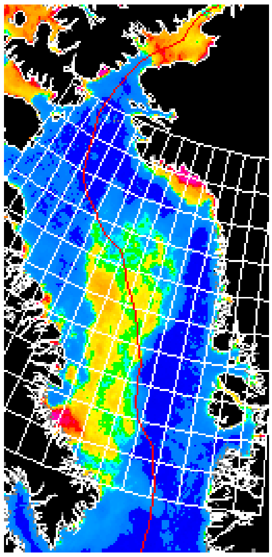

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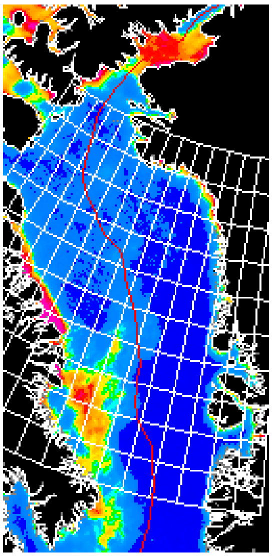

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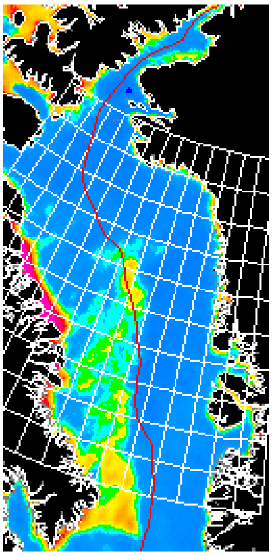

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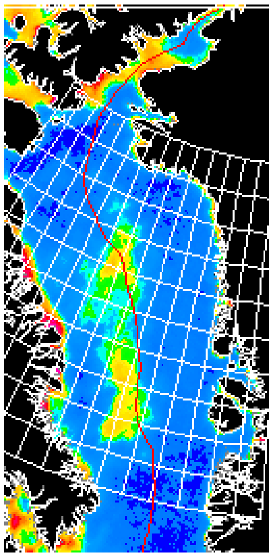

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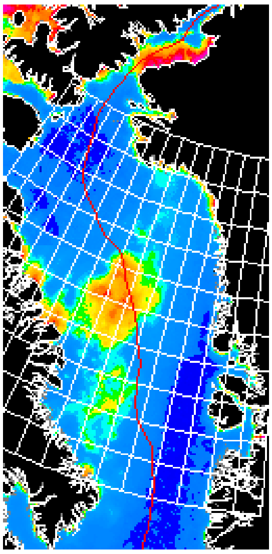
NW Greenland
Ultimo July



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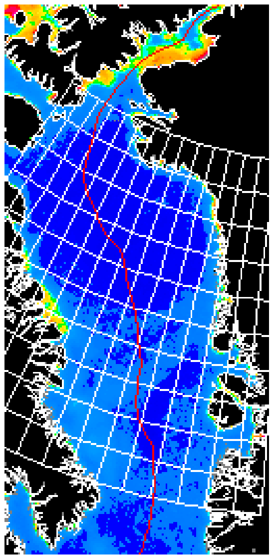

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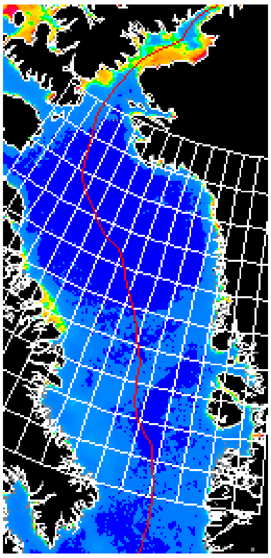

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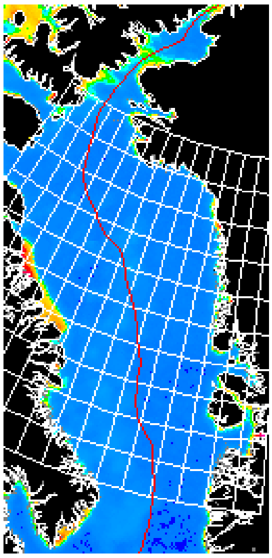

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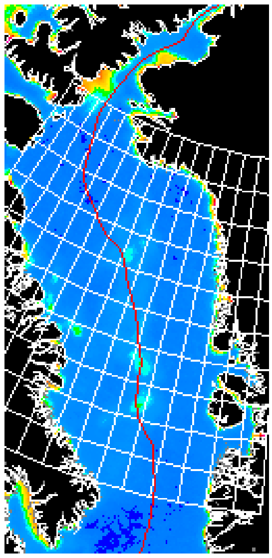

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NW Greenland
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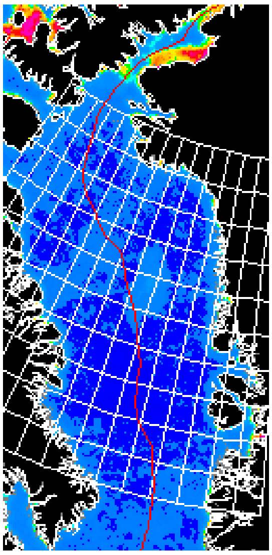

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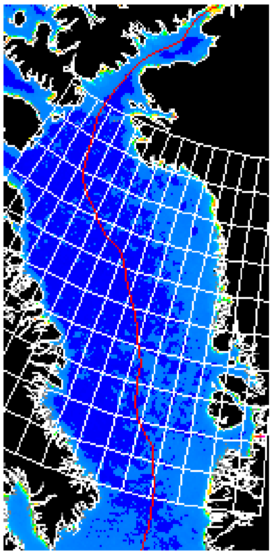

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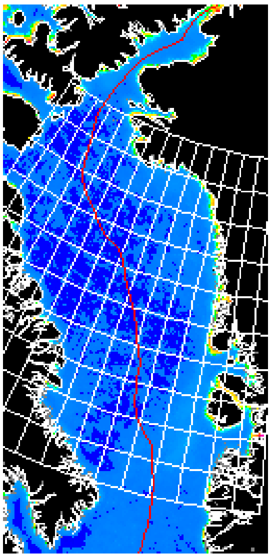

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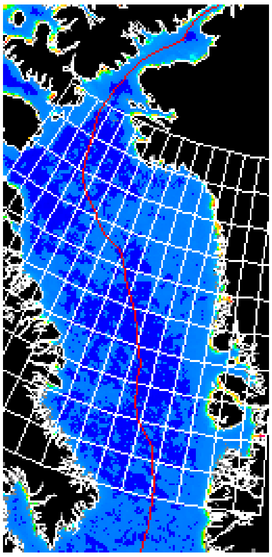

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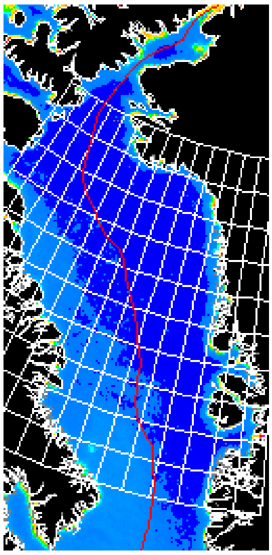

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NW Greenland
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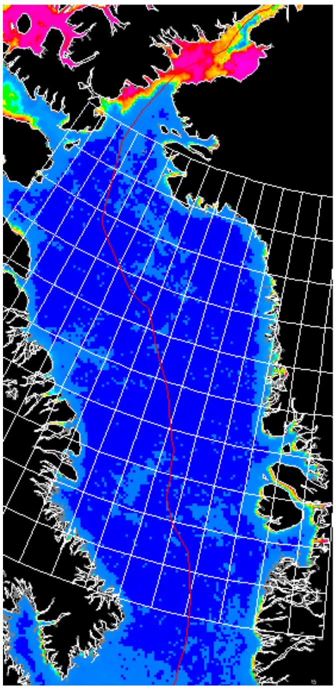

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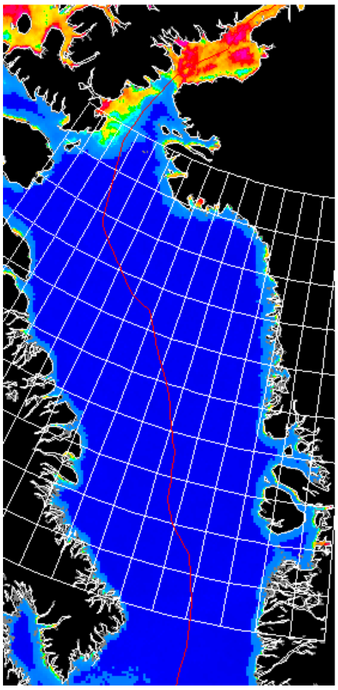

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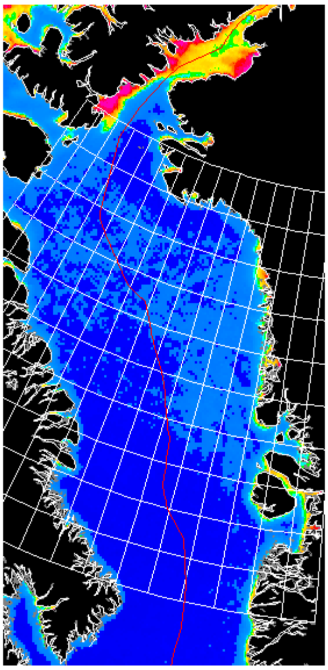

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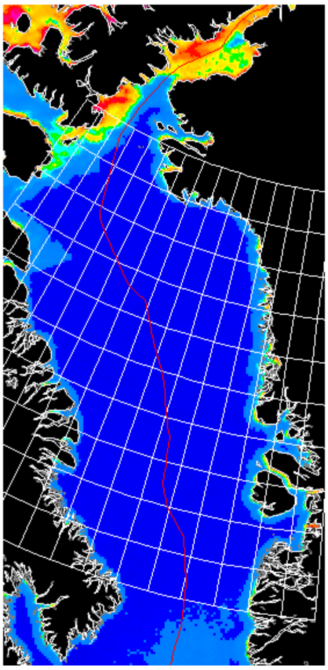

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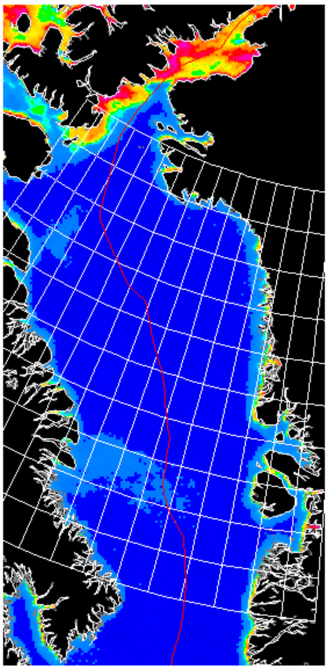

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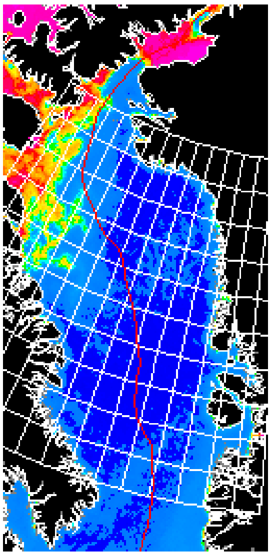

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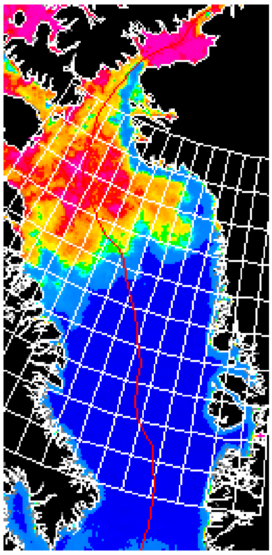

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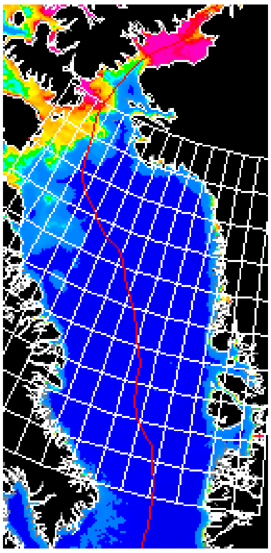

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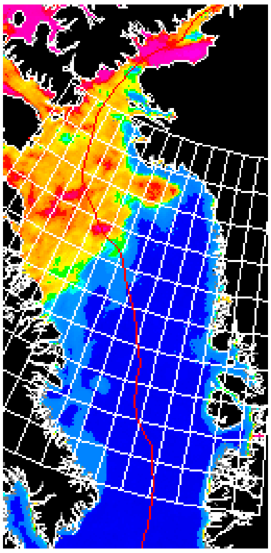

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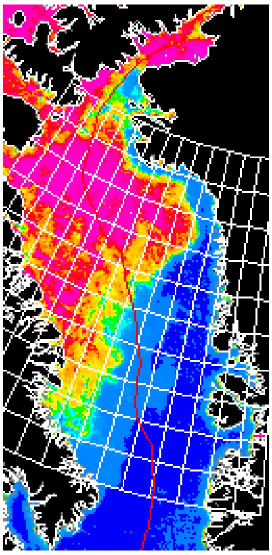

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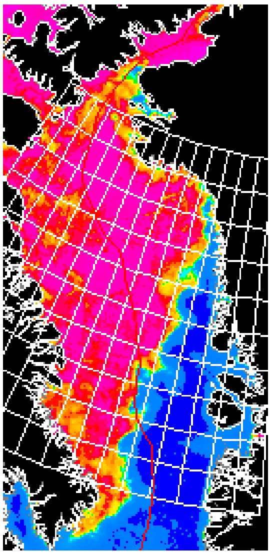

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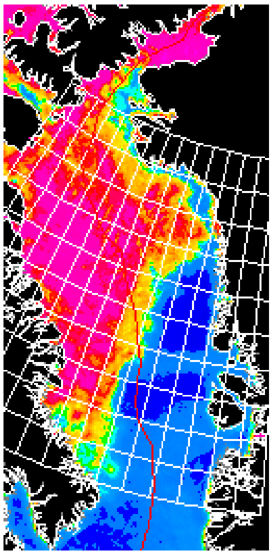

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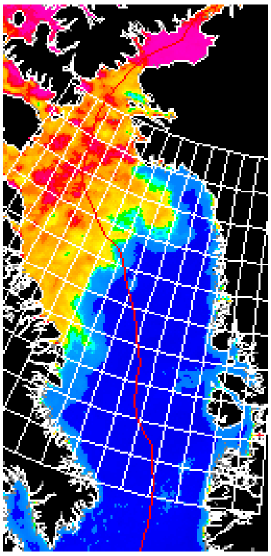

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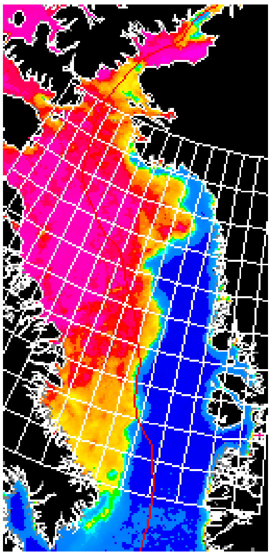
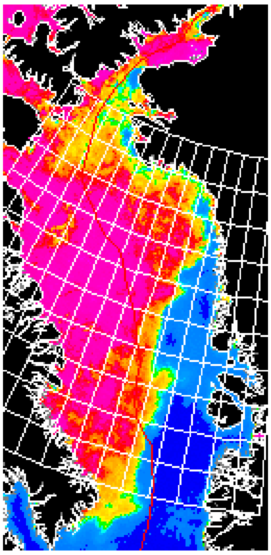


2007

NW Greenland
Mid-November

Blue and lightblue is ice free or very low concentrations. Green-yellow-orange-red-purple are increasing concentrations to 100%



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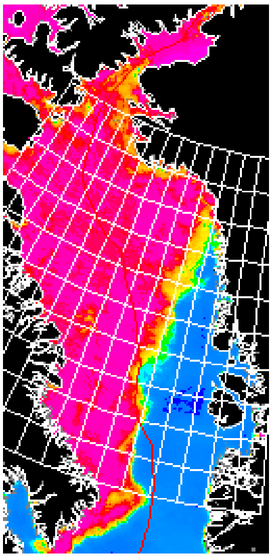

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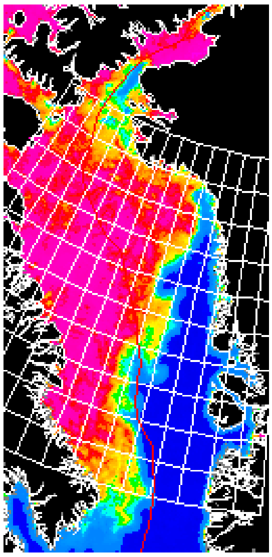

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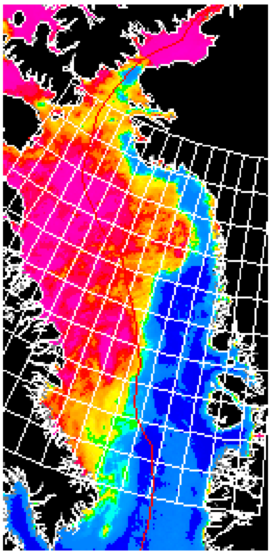

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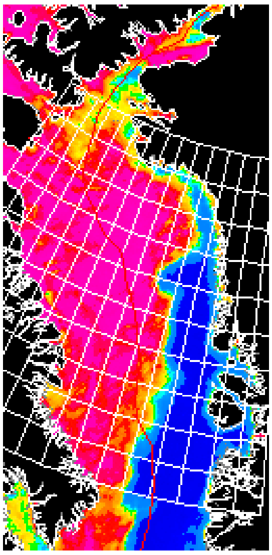


2007

NW Greenland
Ultimo November

2.2. NE Greenland 2004-8

The NE Greenland shelf AMSR images illustrates the spring over summer to fall conditions. The East Greenland Current (EGC) carries relatively fresh water and ice south from the Arctic Ocean along the east coast of Greenland. The core of the current is along the continental shelf break where the largest ice drift velocities are also found when the wind and current acts in the same direction.

The majority of the ice (~75%) exported this way from the Arctic Ocean is so-called multi-year ice which is characterized by mean thicknesses of 3-5m and may contain pressure ridges with keels of more than 30m depth. Recent investigations seem to indicate that the number of pressure ridges with deep keels have reduced drastically the last 10 years, however.

Since the core of the ocean current is situated over the shelf break, this is often the area with the longest ice season. Outside the shelf break most of the ice is locally grown and rather thin (<1m) with a season that may lasts from November to April with occasional extensions through May-June and in one case during the last 30 years (1996) the ice persisted to the middle of August.

Along the shelf break the ice may persist throughout the year and in addition a substantial area of semi-permanent fast ice exist along the east coast from approx. 78-80N blocking the outlet of several floating glaciers in the area. In recent years this area of fast ice has become more unstable and broken off on several occasions. The fast ice itself is supposedly not very thick, but it helps preventing a substantial number of large (tabular) icebergs from the 79 Fjord glaciers and the Jøkelbugt getting out into the EGC.

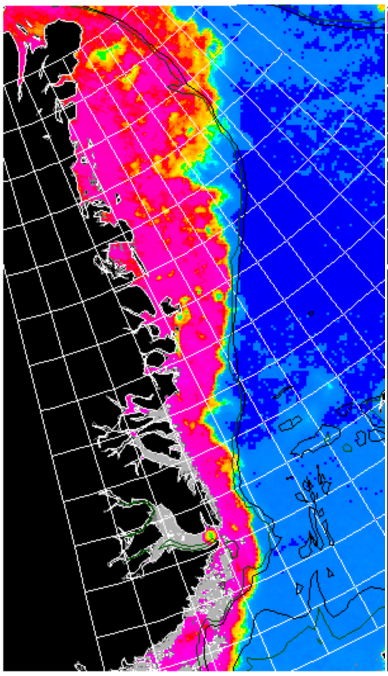
Another pronounced feature of the area is the North East Water polynya, an area of open water or new ice off the Nordostrundingen (North east corner of Greenland). This area typically start opening sometime in May (see the following AMSR images) and is the basis for the open water area that often exist during summer between the extended Arctic ice along the continental shelf break and the fast ice along the shore (see AMSR images from July-August). Refreezing of the ocean typically starts in mid to late September.

The minimum number of ice free days is 0 over most of the continental shelf. Even during the rather week ice years of the 2000s we still have seen years with ice in almost the entire continental shelf area throughout some summers.

NE Greenland ice concentrations

Ultimo April

Blue and lightblue is ice free or very low concentrations. Green-yellow-orange-red-purple are increasing concentrations.



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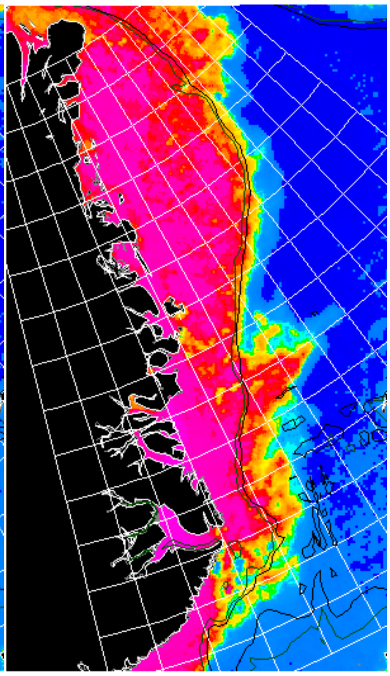

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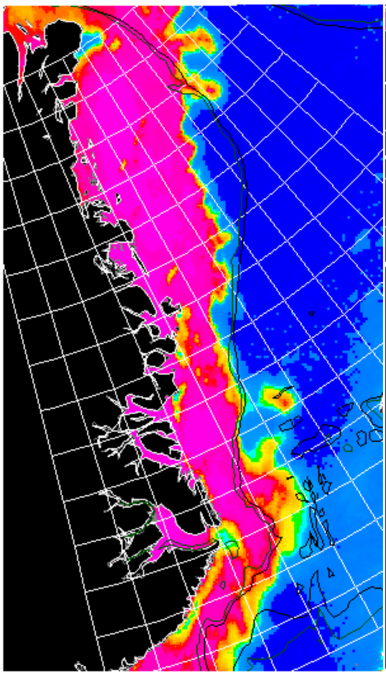

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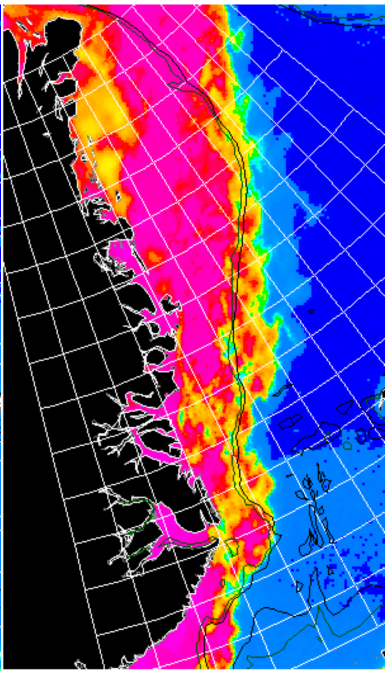

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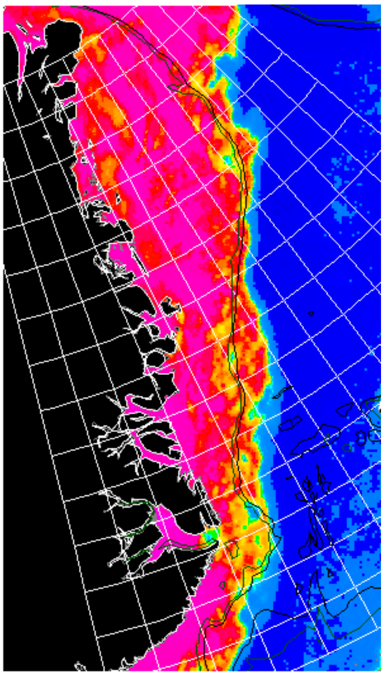

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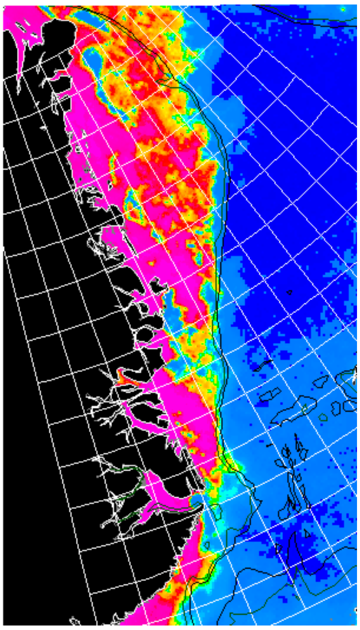
NE Greenland
Ultimo May



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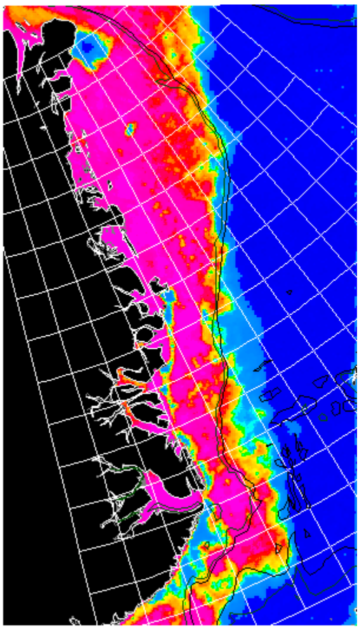

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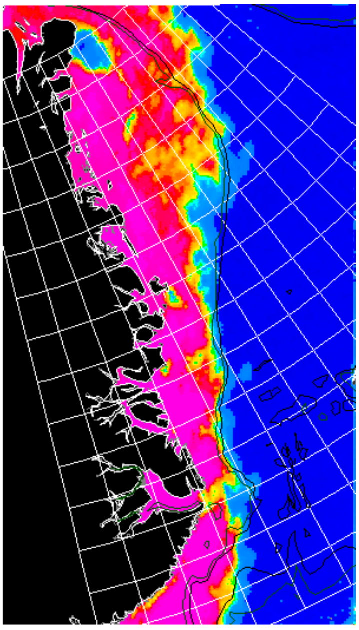

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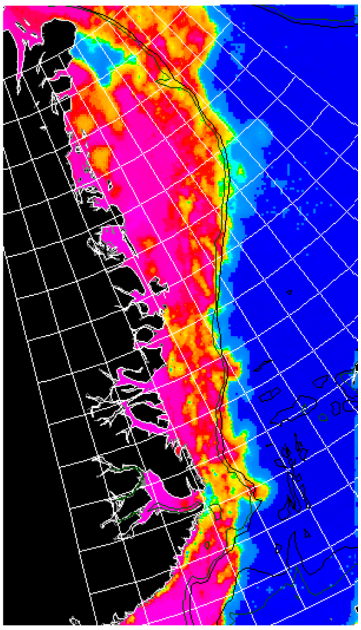

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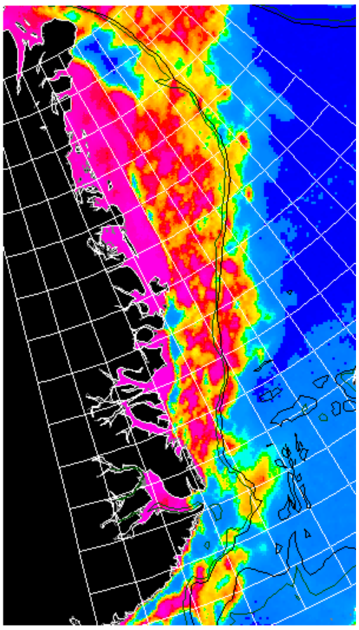

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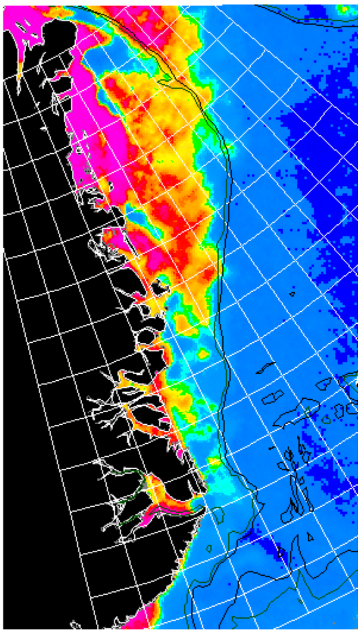
NE Greenland
Ultimo June



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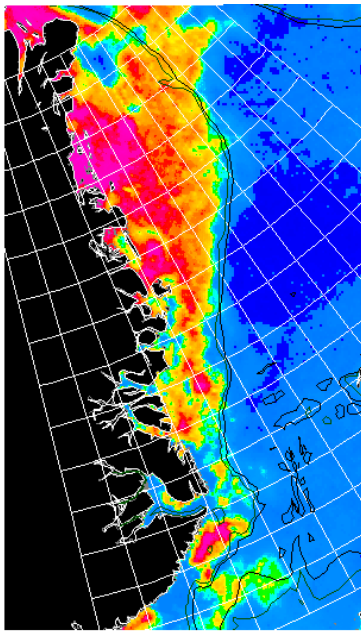

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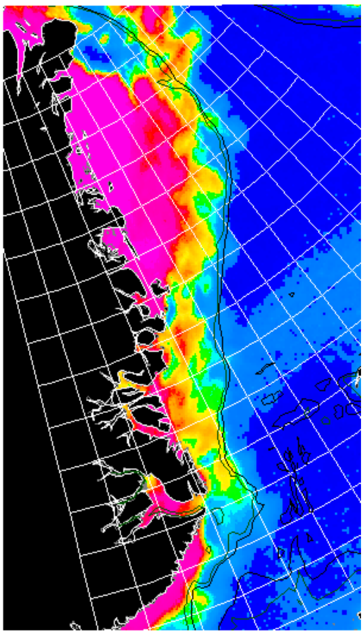
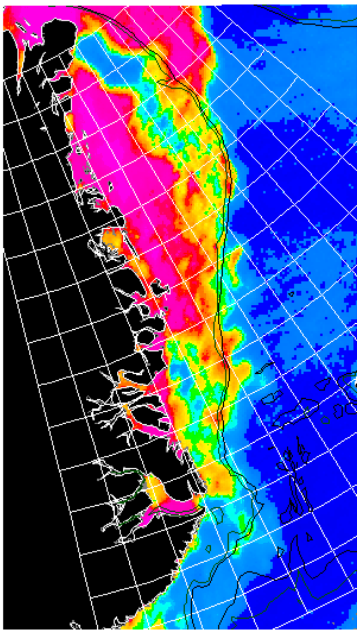


2006



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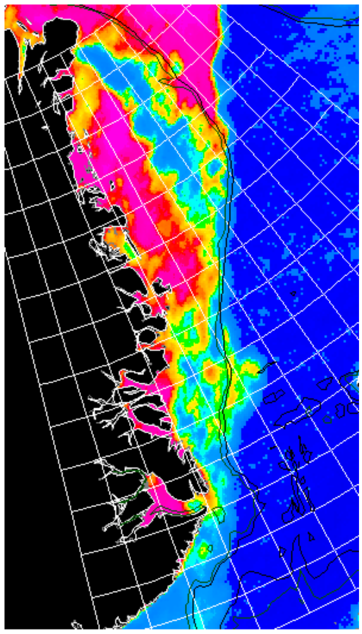
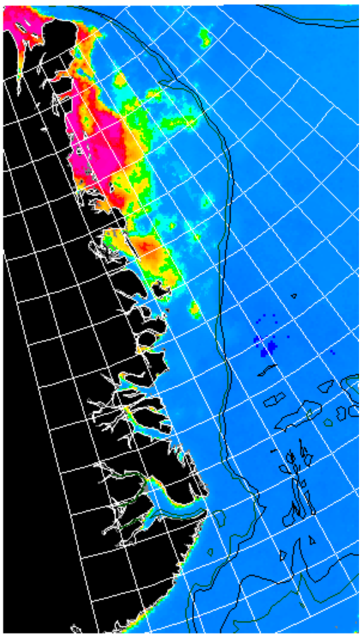


2008

NE Greenland
Ultimo July



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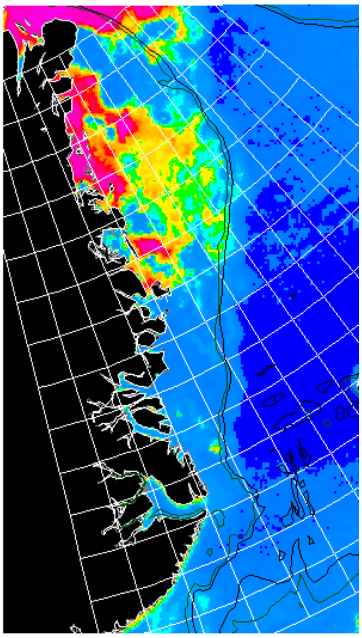

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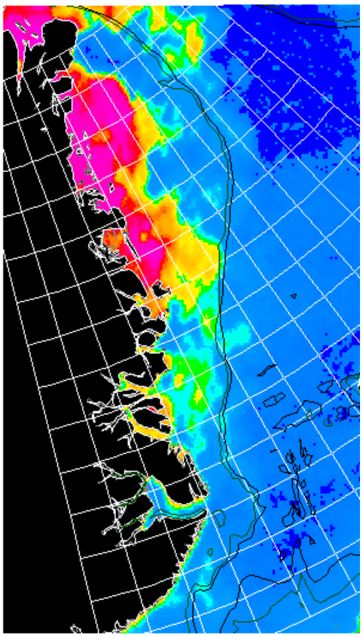

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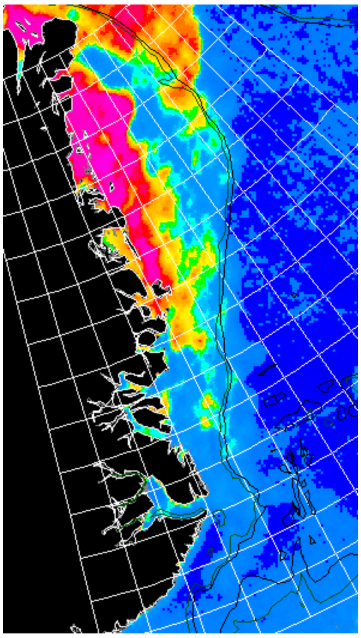

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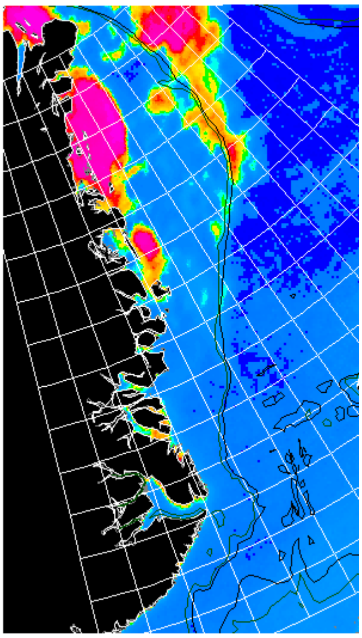

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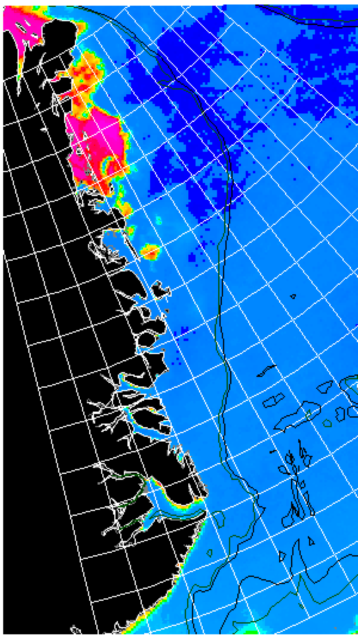

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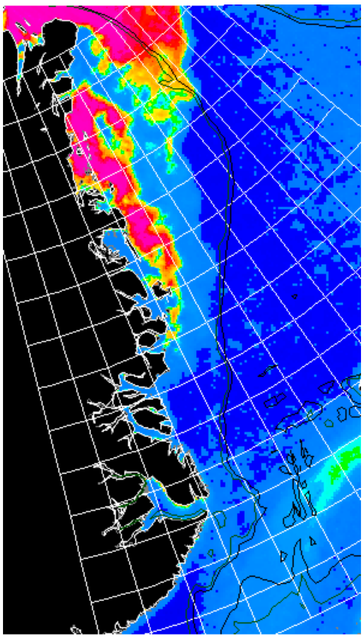

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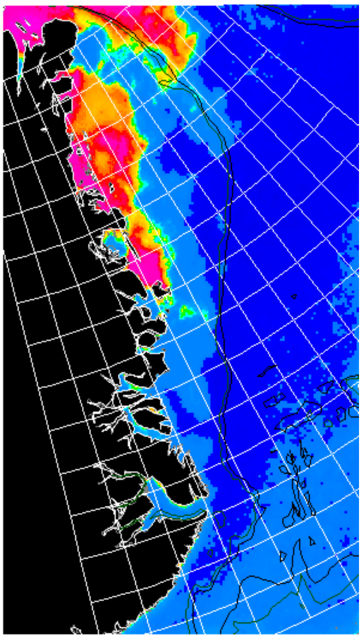

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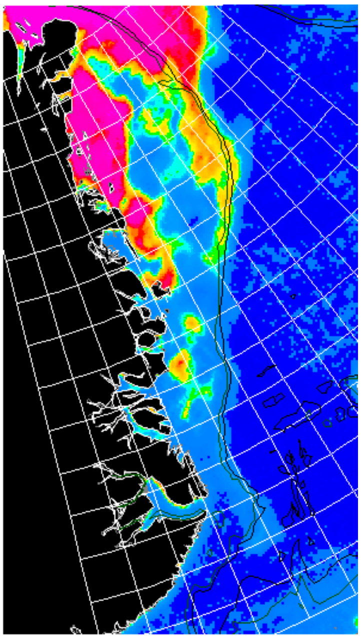

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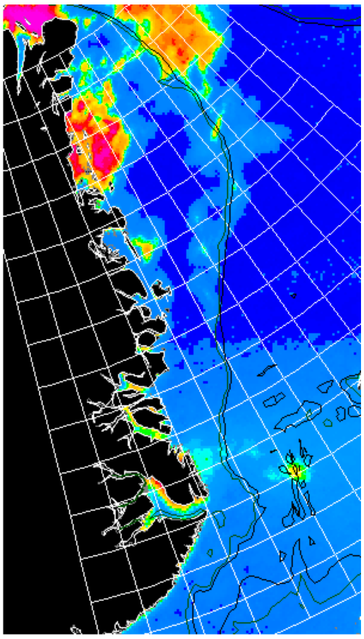

2008

NE Greenland
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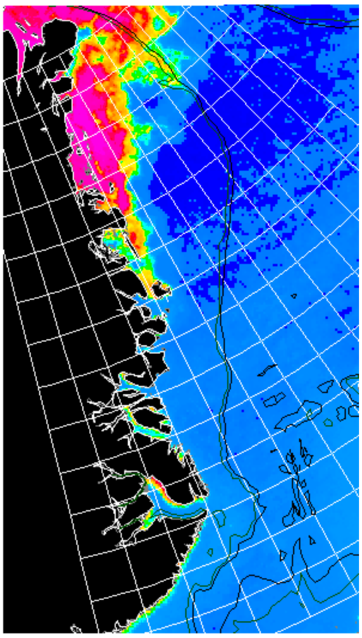

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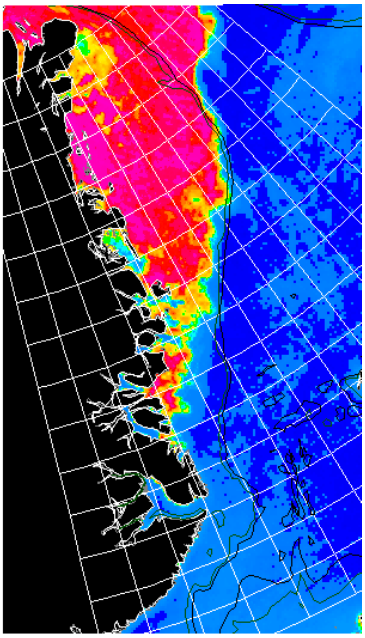

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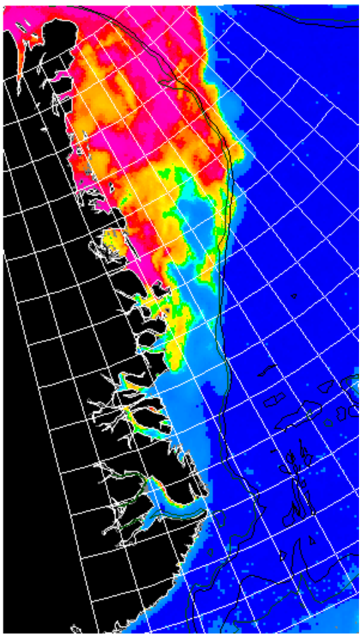

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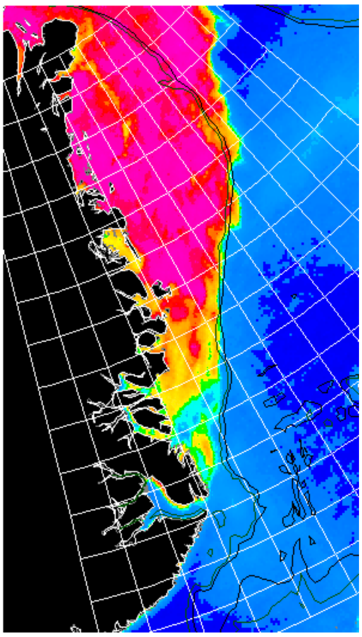

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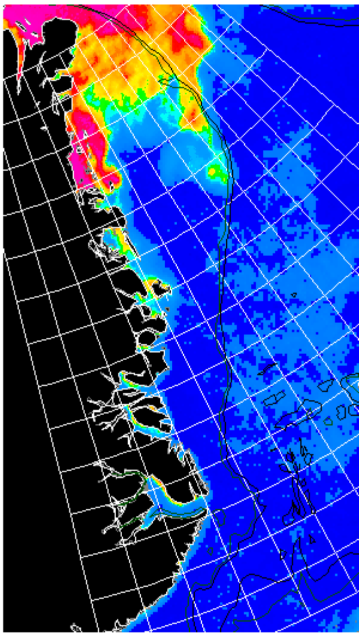


2008

3. Number of ice free days

The number of ice free days are computed from the passive microwave observations presented in Sect. 2, and shown below as overview plots, with details given in Appendix A.

3.1. West Greenland 1978-2008

From Fig. 5 below it is seen that the number of ice free days has increased when comparing the average for the period 1978-2008 with data from 2000-2008. The increase is largest in the Disko-West area, where the ice free season is +30 days longer. In the areas and further north the increase in ice free period is more modest (typically 1-3 weeks).

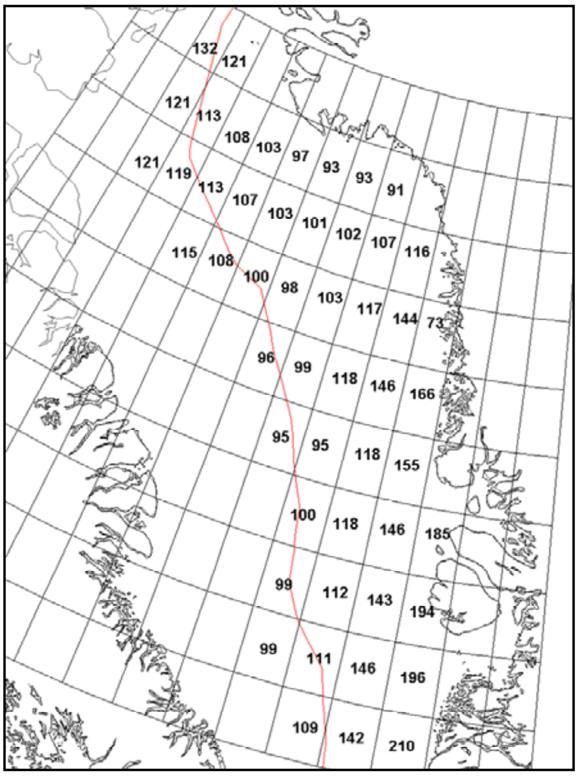


Fig. 5a. Average number of ice free days defined as number of days with SSMI ice concentration below 30% in each grid cell. 1978-2007.

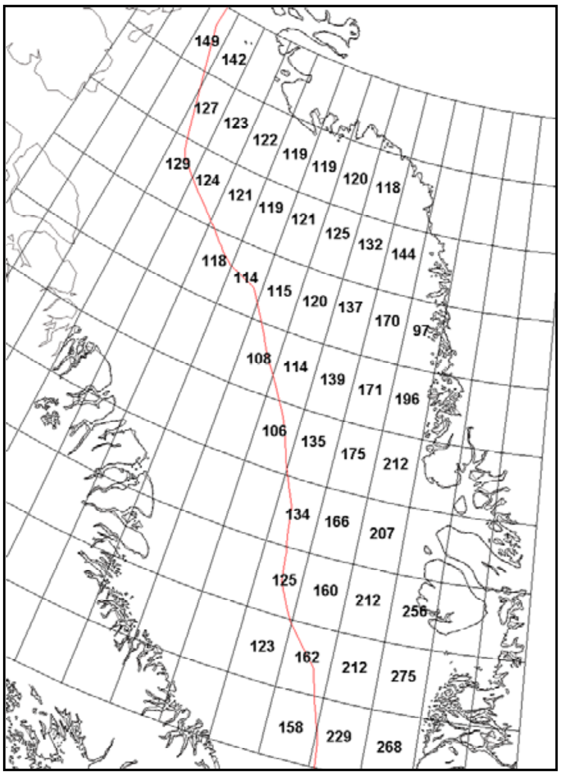


Fig 5b. Average number of ice free days defined as number of days with SSMI ice concentration below 30% in each grid cell. 2000-2007.

3.2. East Greenland 1978-2008

The NE Greenland number of ice free days is shown in Fig 6, and data given in Appendix A3-A4. It is seen that the number of ice free days have not decreased as much as on the NW coast.

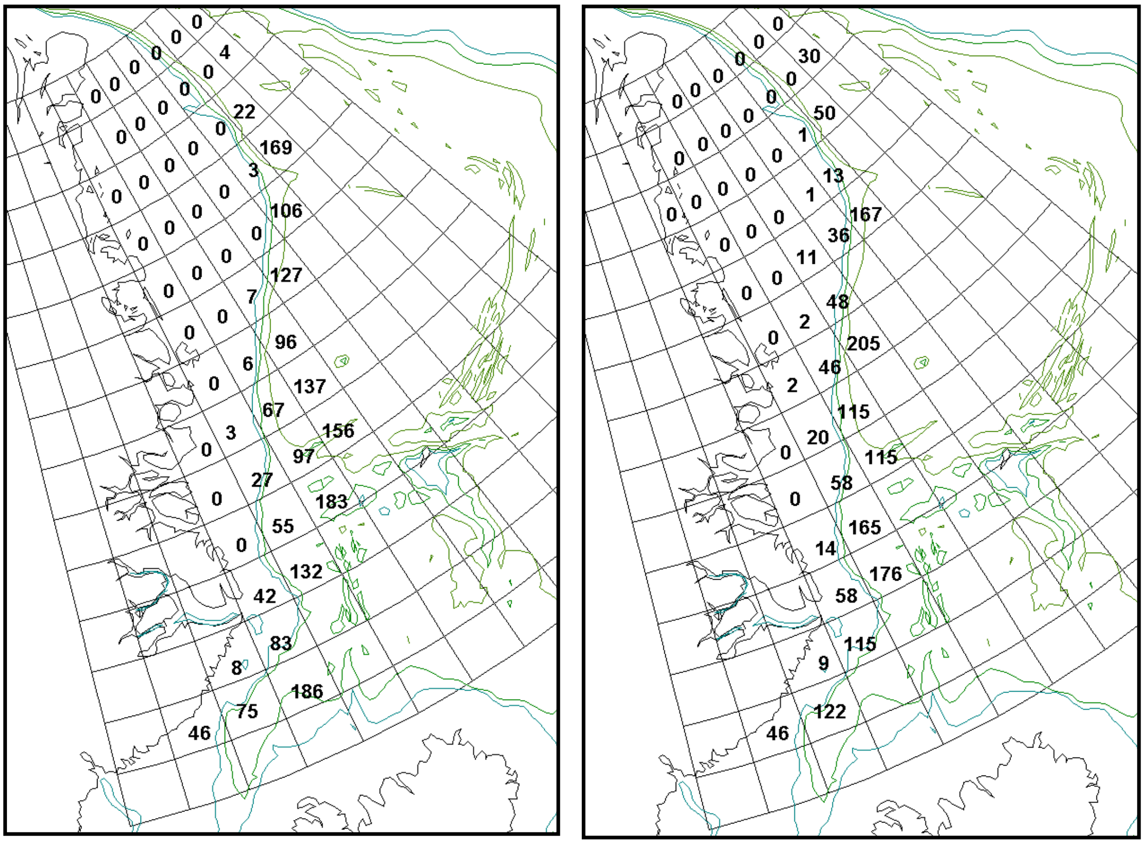


Fig . 6. Minimum number of ice free days during the period 1978-2008 (left) and 2000-2008 (right). Ice free defined as total ice concentration less than 30%.

4. Ice drift

The Tables and Figures below show monthly mean and maximum ice drift, given as average velocities over 24 hours. Fig. 7 shows the mean expected ice drift over a 28 year long period

4.1. West Greenland ice drift

The general ice circulation in Baffin Bay during winter is dominated by the south going Labrador Current along the coast of Baffin Island. In addition the prevailing winds seem to also favor ice drift towards the south in most of Baffin Bay. This means that ice grown in the northern part of the Bay will end up further south several months later much thicker than could be expected from local ice growth in that area.

Along the west coast of Greenland the West Greenland Current is known to carry icebergs northwards and also periods of substantial sea ice drift towards the north has been observed.

Fig. 8 and Appendix B show the monthly average and maximum sea ice velocities and number of observations.

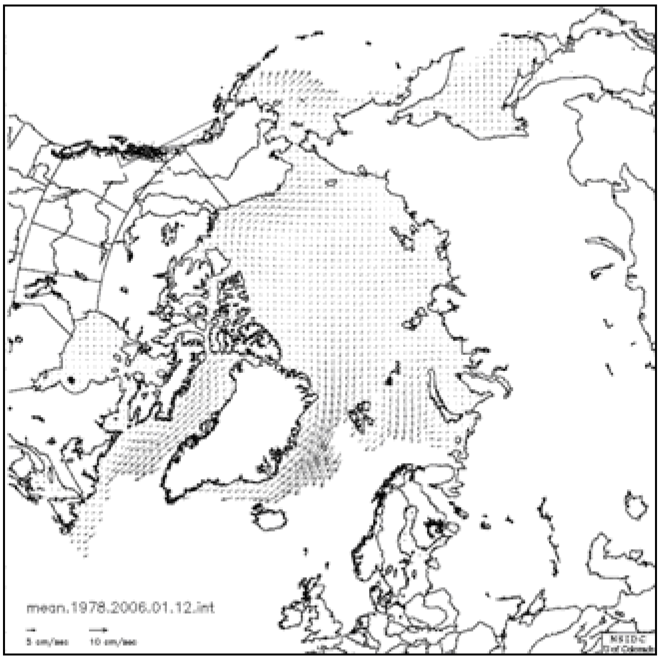


Fig. 7. 28 year average ice drift pattern for the Arctic. The ice drift dataset used for this analysis originates from NSIDC 2006 (Polar Pathfinder Daily 25 km EASE-Grid Motion). Only AVHRR data used, considered to have the better quality.

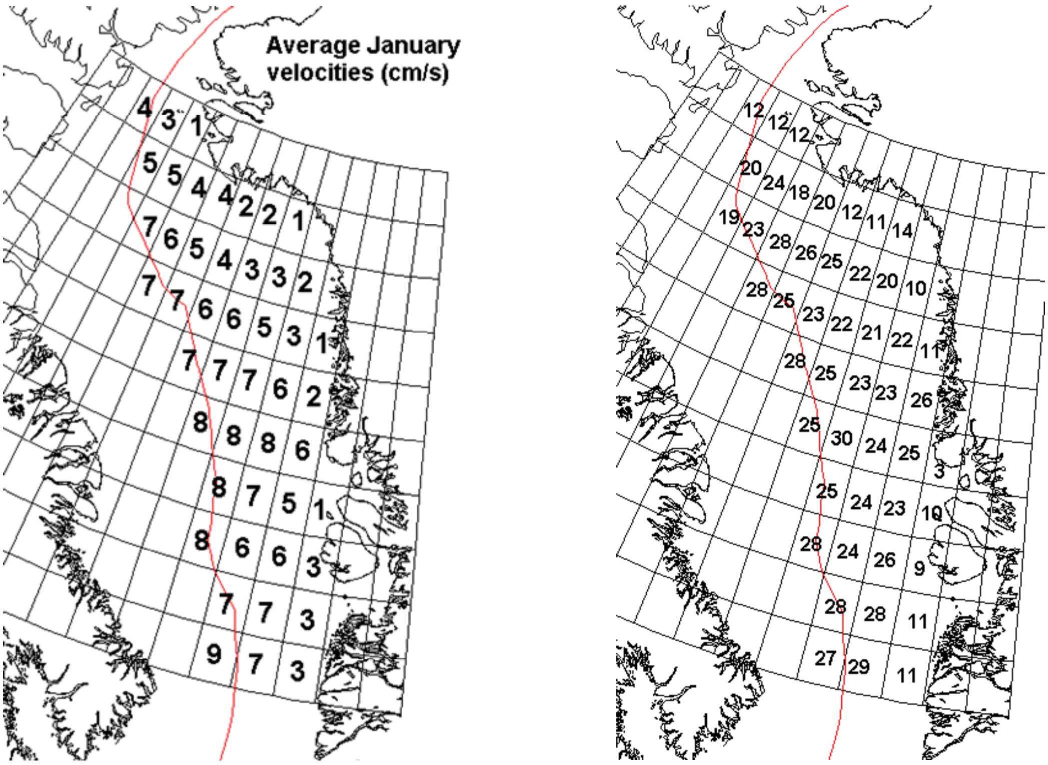


Fig. 8. Map of average (left) and maximum (right) January ice drift (specified as average velocity over 24 hours in cm/s). For other months, see Appendix B. 30 cm/s corresponds to approximately 35 km in 24 hours.

Baffin Bay ice ice drift is generally moderate. Drifts slow down during the calmer summer months since the ice drift is predominantly wind driven. Ice drift increases towards the south and is in general largest near the borderline to Canada. Occasionally a counterclockwise rotation is seen in the Baffin Bay, meaning ice drift north, in part driven by ocean circulation.

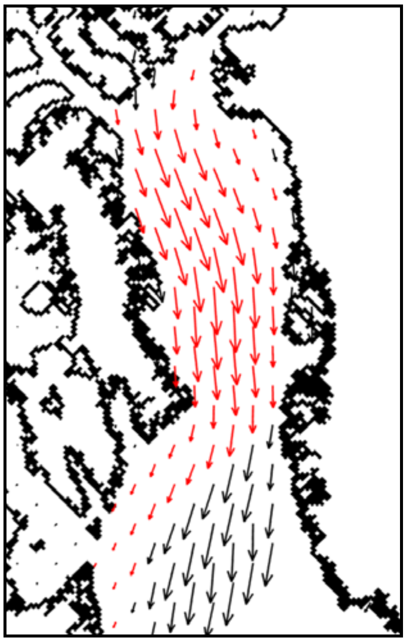


Fig. 9. Average January ice drift directions in the Baffin Bay 1979-2006. Black arrows indicate few data points.

4.2. East Greenland ice drift

The most pronounced feature of the ice drift off north east Greenland is the East Greenland Current. As stated earlier the current is strongest near the shelf break, but in general the current carries ice and relatively fresh water southwards over most of the continental shelf as well as just outside. During winter, the maximum ice drift is near the upper detection limit of ~35 cm/s in most areas. During summer, ice drift slows down. In addition, the prevailing winds in the area are from north and north-easterly directions during winter, so the southward flow of the ice is supported by the wind as well. There are some indications of a return coastal current going north near the coast (north of ~76N). Fig. 10 and 11 below show the satellite determined ice drifts from feature tracking, with data detailed in Appendix B3-B4.

Drifting multiyear ice floes on the NE Greenland outer shelf (77N 5W, from Oden, Sept. 2007)

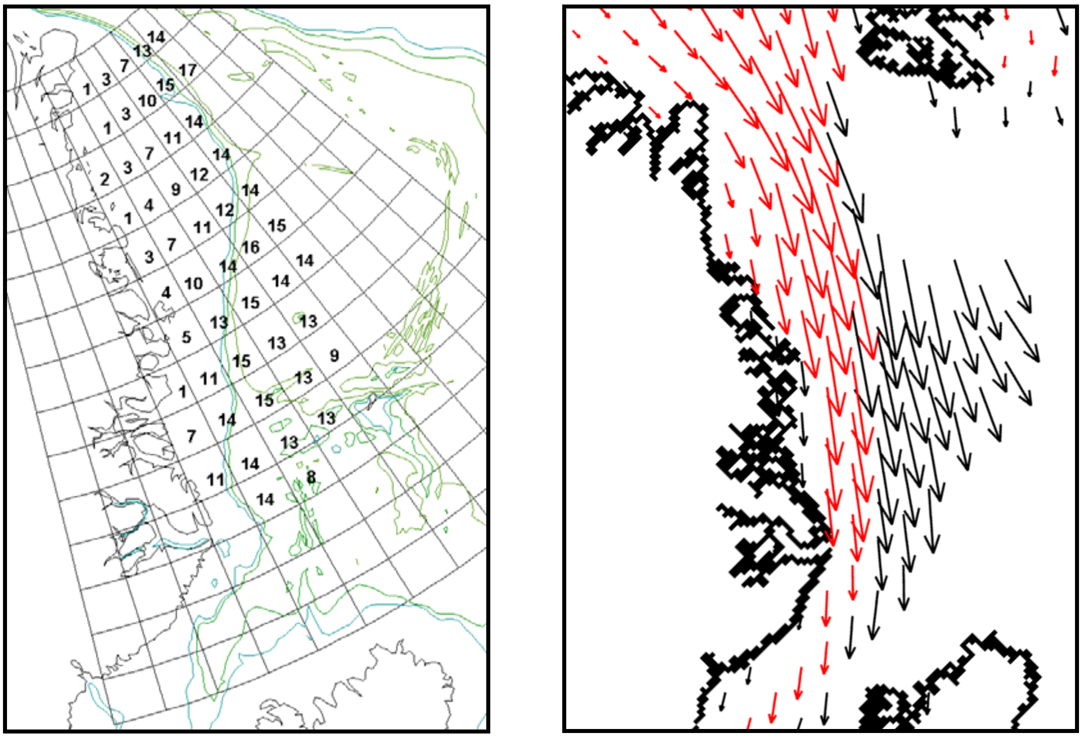


Fig. 10. Average ice drift in January from all data. Drift in left figure given as cm/s for 24 hours. 15 cm/s corresponds to ~17 km in 24 hours. Black arrows indicate few datapoints. Data plotted in 1x3 degree grid boxes.

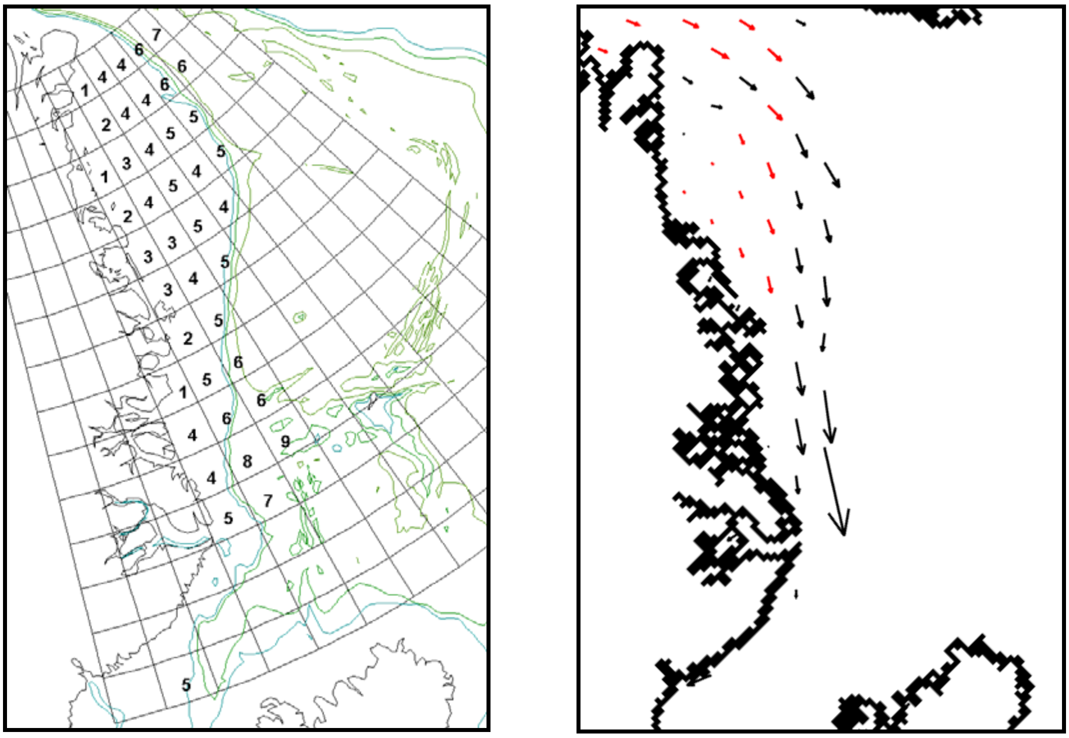


Fig. 11. Average July ice drift (24 hour average velocity in cm/s) and drift directions.

5. Airborne laser measurements of sea ice freeboard, April 2008

A field campaign to collect airborne and in-situ observations of sea ice thickness by airborne laser scanning was conducted on April 17-24, 2008. The campaign used (as in 2006) the Air Greenland Twin Otter OY-POF, carrying an airborne laser scanning system, inertial navigation units, GPS receivers, and a nadir-looking imaging camera. The experiment was carried out prior to a major European Space Agency experiment in the Arctic Ocean north of Greenland (CryoVex-2008), and the airplane was therefore also equipped with an advanced 13 GHz interferometric radar altimeter ASIRAS, an airborne equivalent of the radar on the future ESA CryoSat satellite radar. CryoSat is due for launch late 2009, and is especially designed to measure changes in the sea-ice thickness.

Air Greenland Twin-Otter at Station Nord, April 2008. ASIRAS radar antenna seen just behind door.

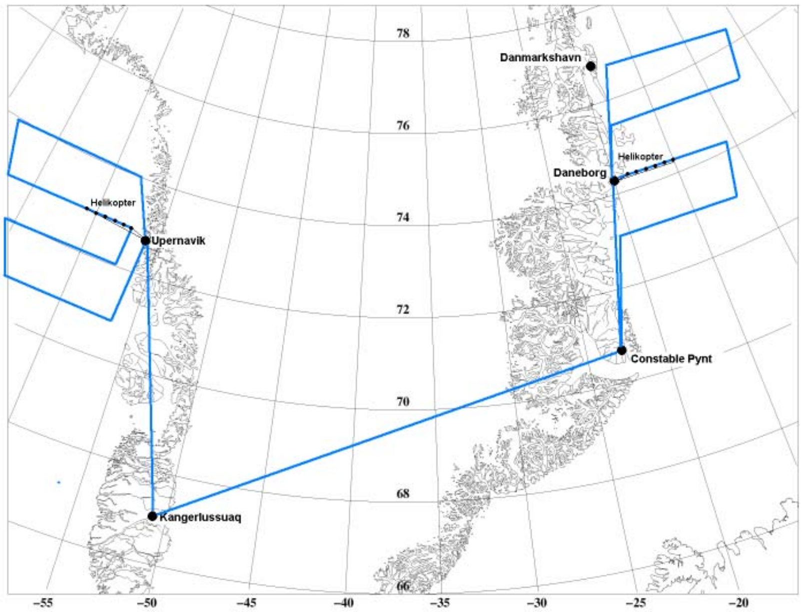


Fig. 12. Originally planned flight lines.

A number of East-West flight lines were planned, both on the NW coast (based on Upernavik) and on the NE coast (based on Constaple Pynt airport and Daneborg), cf. Fig. 12. Unfortunately

the East coast operations were hampered by bad weather, with persistent low fog. Therefore lidar operations were shifted to Station Nord, and the lidar lines flown in the northern part of the continental shelf region (including the region of the "Danmarkshavn Basin"). The originally planned southern lines were also flown, but due to the cloud cover essentially no laser measurements were obtained, but instead ASIRAS radar data were collected. The processing of the ASIRAS data is presently ongoing, and sea-ice thickness data from these lines will be made available at a later stage.
In-situ data on ice thickness, freeboard heights and snow depths were collected by helicopter on the West Coast, flying out of Upernavik. The helicopter profile was overflown coincident in time with the Twin Otter lidar system, allowing a direct comparison of measurements.

The main time of events were:

APR 17	Installation of equipment in OY-POF and test flight from Kangerlussuaq
APR 18	Survey of icebergs in Disko Bay (separate project)
APR 19	Flights on 4 lines in NW Greenland, with refueling at Upernavik
APR 20	Transit flight across ice sheet from Ilulissat to Constaple Pynt.
APR 21	Flight of southern lines from Constaple Pynt to Daneborg and Station Nord
APR 24	Flight of northern lines from Station Nord, with refueling in Danmarkshavn

The DTU-Space personnel involved in the field operations were Sine M. Hvidegaard, Henriette Skourup and Lars Stenseng (lidar and ASIRAS installation and operation), Susanne Hanson, Janna Mulcova and Simone Bircher (helicopter field operations). The relatively large number of persons was needed due to the complicated logistics of near-simultanous operations on both the West and the East coast of Greenland (and the Twin-Otter not being able to carry extra passengers with all the instruments installed).

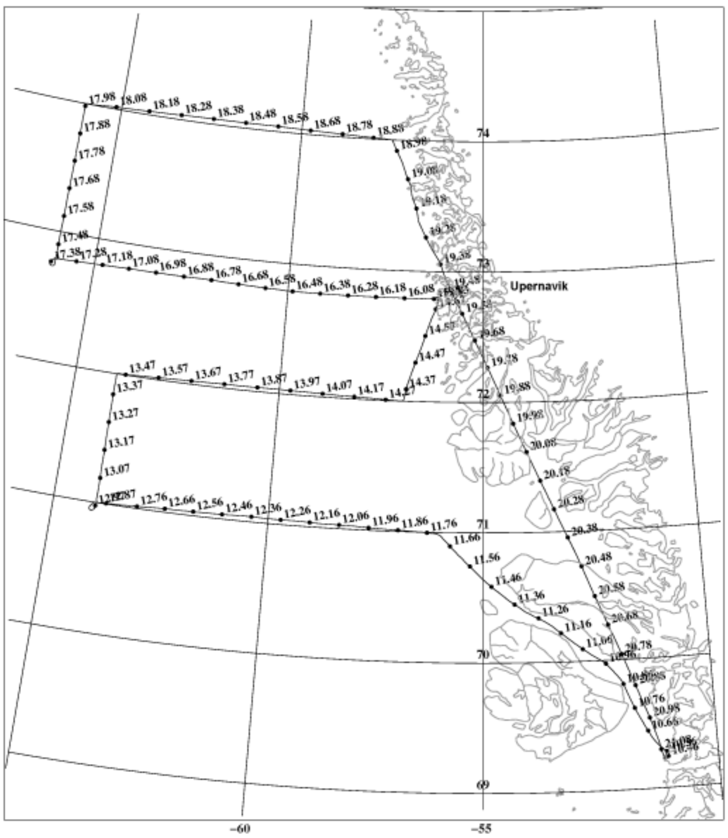


Fig. 13. Actual flight lines on the NW Coast. Numbers are the UTC times in dec.hr.

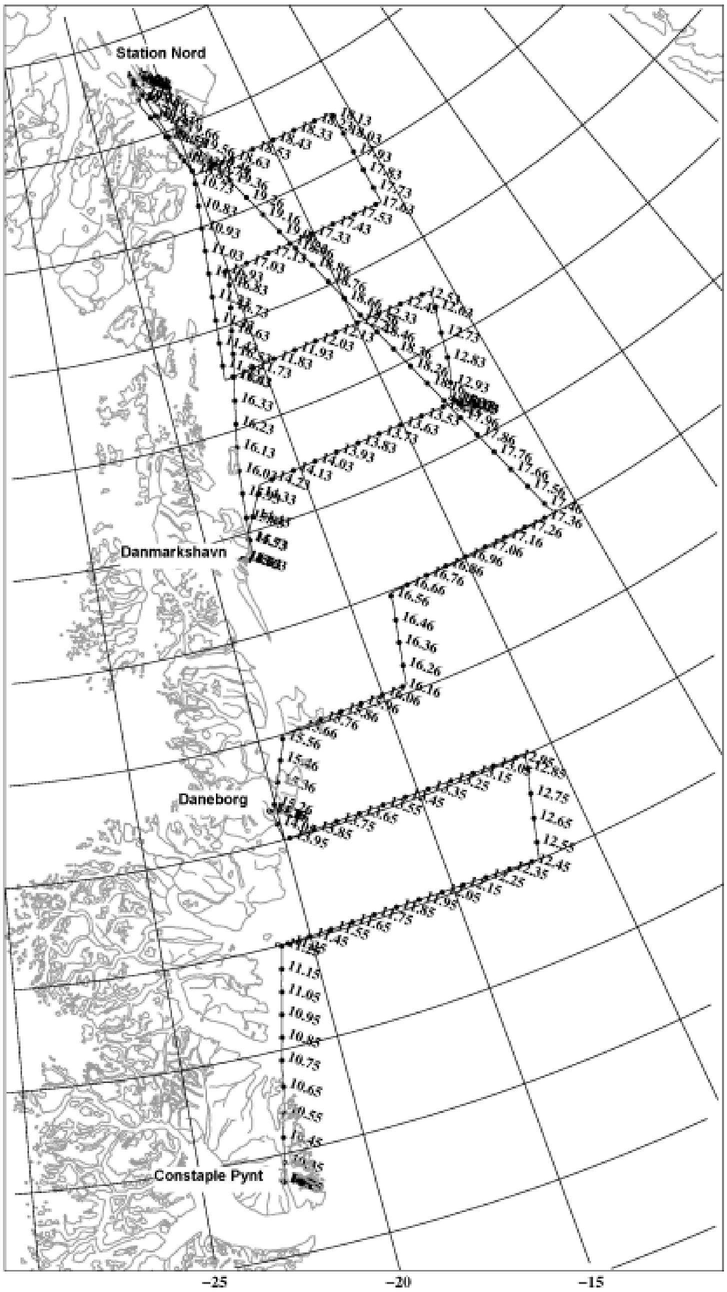


Fig. 14. Actual flight lines on the NE Coast. No lidar measurements were possible on the southern lines due to fog, but measurements were done instead with the 13 GHz ASIRAS interferometric radar, yet to be finally processed.

The thickness of sea ice is a quantity that is difficult to measure by remote sensing, either from satellite or aircraft. The DTU-Space (formerly Danish National Space Center) has since 1998 developed and flown an airborne laser altimeter system, capable of resolving the fine details of the sea ice *freeboard* height. The basic principle of the airborne sea ice thickness determination is thus to measure the freeboard, from which the thickness is inferred in practice by an empirical constant "k-factor", estimated from climatological models of snow depth and ice/snow densities (Warren, 1999), or fitted to empirical in-situ data. A large "climatology" of k-values have in recent years been assembled in the Arctic Ocean as well as Greenland shelf regions by DTU-Space in connection with EU and ESA projects, as well as the 2006 BMP investigations in the Baffin Bay. The k-factor is usually varying between 5.5 and 6.5, strongly dependent on snow load and to a lesser degree on ice thickness and age.

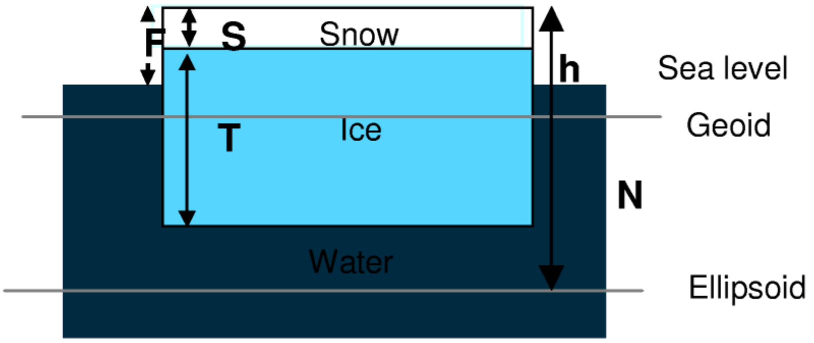


Figure 15. Principle of lidar measurement of sea ice thickness: Freeboard height, F, is derived from airborne laser scanning, which gives snow height h above a reference ellipsoid. Using a model of the geoid, derived from a combination of local gravity and satellite measurements combined with a lowest-level filtering algorithm, the freeboard F can be found at few cm accuracy, and can then be converted to thickness by local buoyancy assumptions. This is the same principle to be used by the CryoSat satellite, with the difference that radar maps the snow/ice interface rather than the top of the snow.

The hardware used for the 2008 survey consisted of numerous geodetic GPS receivers on the aircraft and at airports, allowing precise (10 cm) positioning of the aircraft; a military-grade inertial navigation system (Honeywell 764), providing pitch, roll and heading information; and a scanning laser system (Riegl Q240i), providing detailed laser ranges to the surface at a resolution of about 1 m, and an accuracy in height of a few cm. A new Riegl unit was purchased for the 2008 survey. The total processing scheme is quite complex, and several hardware and data synchronization problems were encountered, delaying the final processing. It has therefore not been possible to finally process the ASIRAS data, which is even more complicated as the methods for retracking the data are still very much research. An example of the laser scanning data is shown in Fig. 16. The data volumes are very large (about 2 GB/day), but all processed data are available on ftp on request.

The laser flights were generally flown at a nominal altitude of 1000 ft. A nadir-looking imaging camera was used for mapping local sea ice conditions, and a number of representative ice images can be found in Appendix C.

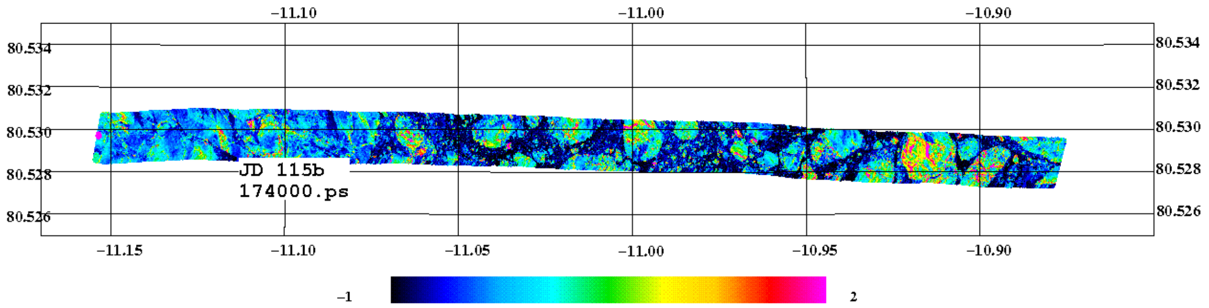


Fig. 16. Example of laser scanning data in NE Greenland (northern area), before lowest level filtering. Range of colour scale is in m. The width of the swath is approx. 300 m, showing clearly the individual floes, separated by thin ice. Length of scan about 5.5 km. A total of more than 30 hr of such laser scanning data have been collected.

6. In-situ ice drilling program

Measurements on the sea ice of the true sea ice thickness are done to validate the airborne measurements, especially in order to check the assumptions on the "k-factor". As mentioned earlier, the sea ice thickness is calculated from remote sensing of the freeboard, which is the height of the sea ice (including snow) above the sea surface. The snow thickness can not be separated from the ice in the laser scanner data, and therefore might result in errors in the calculated sea ice thickness. For example, a region with thick snow cover over thin ice might show a similar freeboard as a region with thin snow cover over thicker ice. This is an inherent problem with both laser and radar methods for measuring ice thickness; the combination of laser and radar measurement at the same time would – in principle – allow the direct measurement of snow thickness, thus increasing the accuracy of the method. This was the main reason for flying both the lidar and the ASIRAS during the BMP/CryoVex-2008 operations.

The in-situ program of 2008 was done using the Air Greenland Bell 212 helicopter stationed in Upernavik. At each stop a number of holes were drilled with a Kovacs power drill, and ice thickness, free-board height and snow depth was determined.

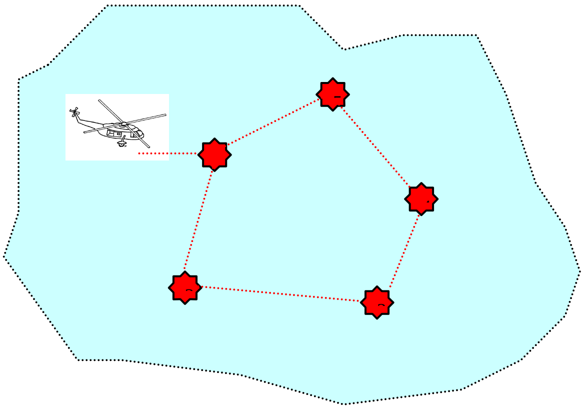


Fig. 17. Left: Air Greenland helicopter on the ice off Upernavik, April 19; right: ice floe drilling scheme.

In practice this is a complicated helicopter operation. On the chosen ice floes the helicopter will land near the center and the first measurement is often taking out of the door while the helicopter is still hanging a few centimeters above the ice. If the ice is more than 17 cm thick the helicopter will land, but still maintain lift (pitch on rotor blades). Only when ice is close to 60 cm or more in thickness will the helicopter be able to idle. The application of rotor pitch ensures a fast take off if the ice is breaking up, but also means more fuel is burned, shortening the distance the helicopter can reach from land. Typically 4-5 measurements were done on each ice floe, avoiding the edges. Since it is not possible to sample the leads, the helicopter measurements are not representative of a true mean thickness, as thinner ice is not sampled.

In the NW Greenland experiment, a near-coincident overflight with the Twin-Otter laser system was done, ensuring the measurement of the same ice as far as possible by the two methods. A total of 6 floes were sampled, giving an average thickness of 77 cm, within a range of 30 to 100 cm. The ice in 2008 was therefore relatively thin, possibly in part due to the advanced season, with open water already off Upernavik (two planned helicopter stops closer to the coast turned out to be open water). The details of the in-situ measurements are given in Appendix D.

Examples of thin ice, first year ice floes, icebergs, pressure ridges, and a visitor; ice off Upernavik, April 24

The coincident helicopter/Twin-Otter flights were successful. Fig 18 shows the alignment of the 6 helicopter stations with the airborne lidar; Fig. 19 shows an example of the detailed laser scanning around the westernmost helicopter station HE8 and the easternmost HE4. It is apparent that the ice – as expected - is thicker towards the west, but also that there is a number of pressure ridges in the area, as well as some open water leads (where laser is reflected away from the aircraft, and thus not recorded). The local features complicate the comparison to the airborne data, since at very local scales the assumption of buoyancy equilibrium might not hold.

Table 1 shows a comparison between the averaged laser thickness data, and the in-situ drilling results. A k-factor of 5.7 was used, based on the in-situ data, and also consistent with earlier (2006 and climatology) results. Table 1 shows a mean error in the lidar determination of 18 cm, with a standard deviation of 30 cm. This is consistent with results of the 2006 report. Since some of the errors are coming from ice drift, averaging and ridges, it is probably realistic to estimate an accuracy of the laser system at around 20 cm r.m.s.

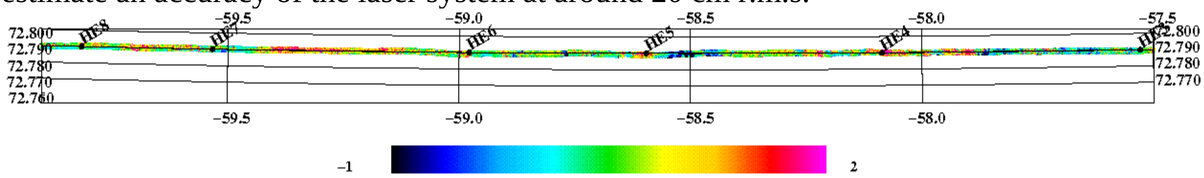


Fig. 18. Helicopter ice drilling and laser scanning overflight off Upernavik. Colours are unfiltered freeboards.

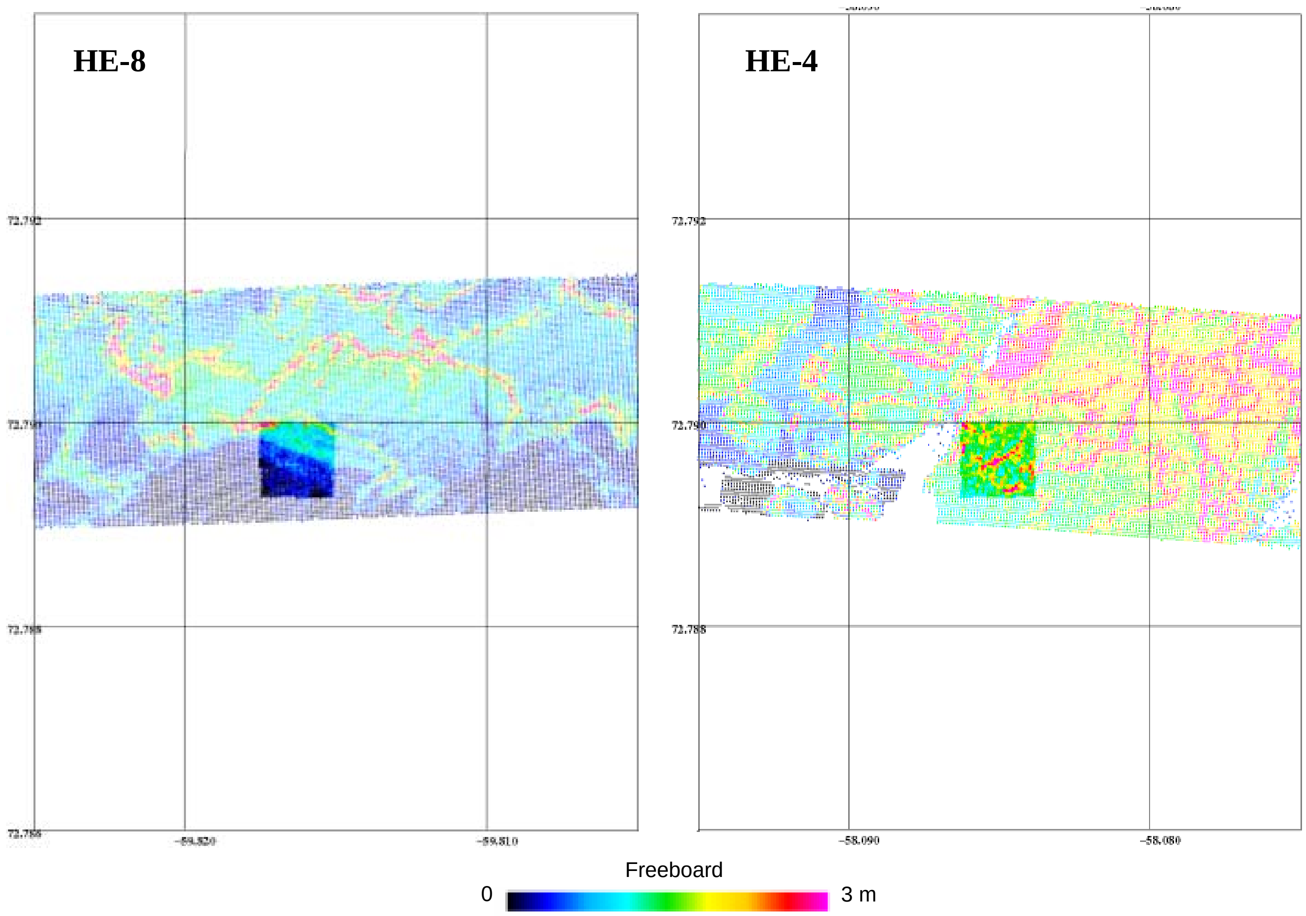


Fig. 19. Example of laser scans around helicopter ice stations. Laser scan is subsampled to 2 x 2 m, and plotted with larger dots in a 40 x 40 m zone around the helicopter landing site. The eastern site (HE4) is close to a lead.

Table 1. Comparisons of in-situ drilling data and lidar ice thickness determination.

Site	Position	In Situ observation	Area mean from scanner, 40x40 m
HE3	72.790N 57.52818W	0.80 m	0.80 m
HE4	72.790N 58.08628W	1.07 m	1.65 m
HE5	72.790N 58.59538W	1.03 m	1.38 m
HE6	72.790N 58.97913W	0.88 m	1.08 m
HE7	72.790N 59.53297W	1.07 m	0.70 m
HE8	72.790N 59.81628W	0.38 m	0.69 m

The planned NE Greenland helicopter flights from Constaple Pynt could not be carried out due to the clouds. Instead we have based the estimates of k-factors on ice drilling data provided by Norsk Polarinstitut (S. Gerland). NPI had the icebreaking vessel "K/V Svalbard" moored at a large ice floe during the BMP ice flights, and a successful Twin-Otter overflight was done on April 24. The East Greenland drilling results, together with some measurements from the Oden icebreaker cruise and 2003 Polarstern data, were used to estimate a k-factor, and a value of 5.5 was adopted for the East Greenland flights. The East Greenland thickness measurements are also listed in Appendix D. It should be noted that NPI has observed ice thickness data by helicopter and electromagnetic methods in a larger region (up to 100 km away from the ship) but these data are not yet available.

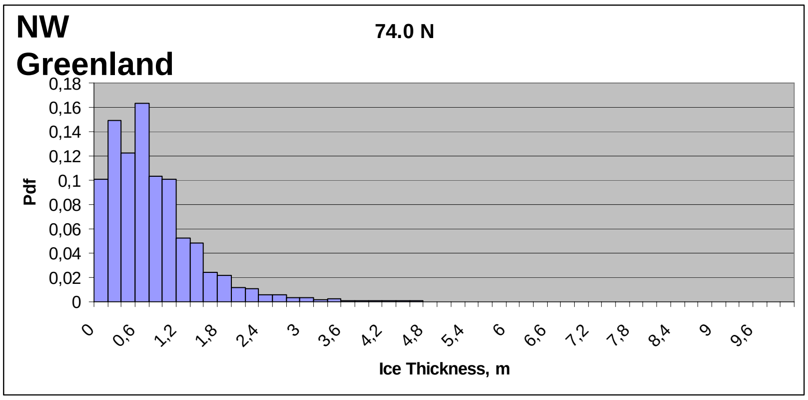
Due to the relatively short in-situ line presently available from K/V Svalbard, and the non-time coincident data from the "Oden", these data were only used to estimate and confirm the k-factor, and detailed overflight comparisons have not been made (yet). Because the K/V Svalbard also deployed a radar reflector for ASIRAS, these comparisons will be important to properly use the ASIRAS for mapping the sea-ice thickness on the fog-limited southern flights.

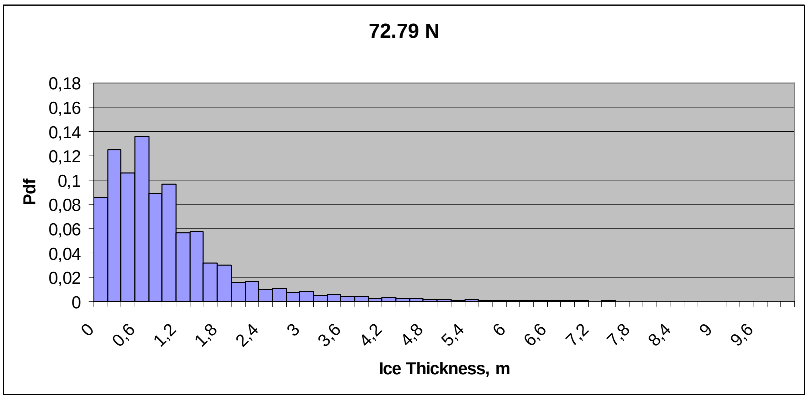
K/V Svalbard seen from the Twin Otter overflight

Ice drilling at K/V Svalbard [courtesy S. Hudson, NPI]

7. Airborne data statistics and comparisons of to satellite data

The results of the overall airborne determinations of the sea ice thickness in the NW area are shown below as histograms on a line-by-line basis in Fig. 21, and as colour plots in Fig. 22. Similar plots for the NE area (northern part) are shown in Fig. 23 and 24.





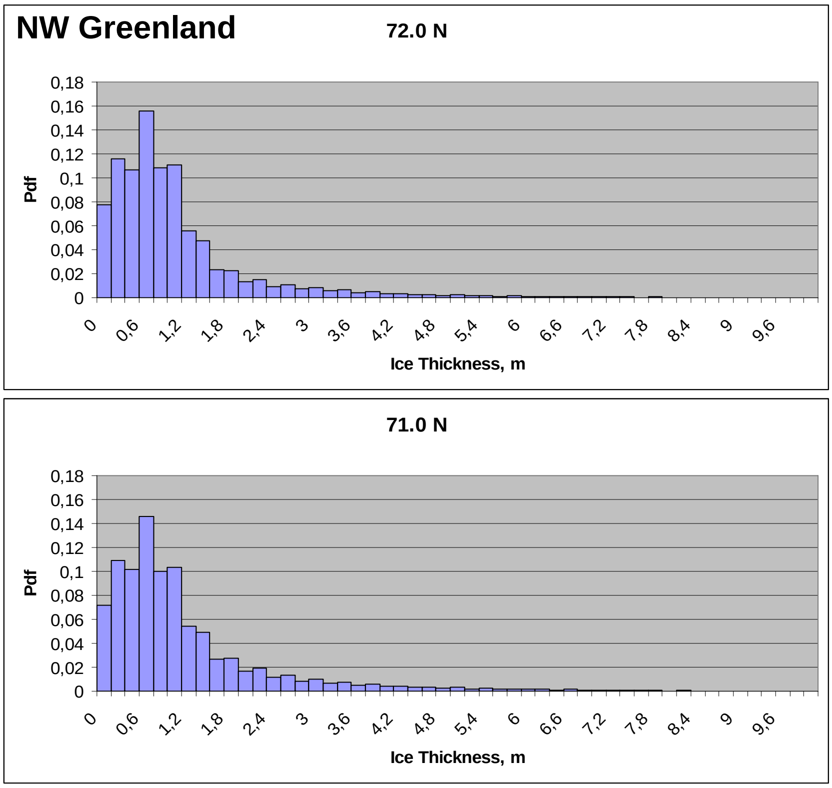


Fig. 21. Histograms of distributions of ice thickness in the NW Greenland area, along E-W flight lines.

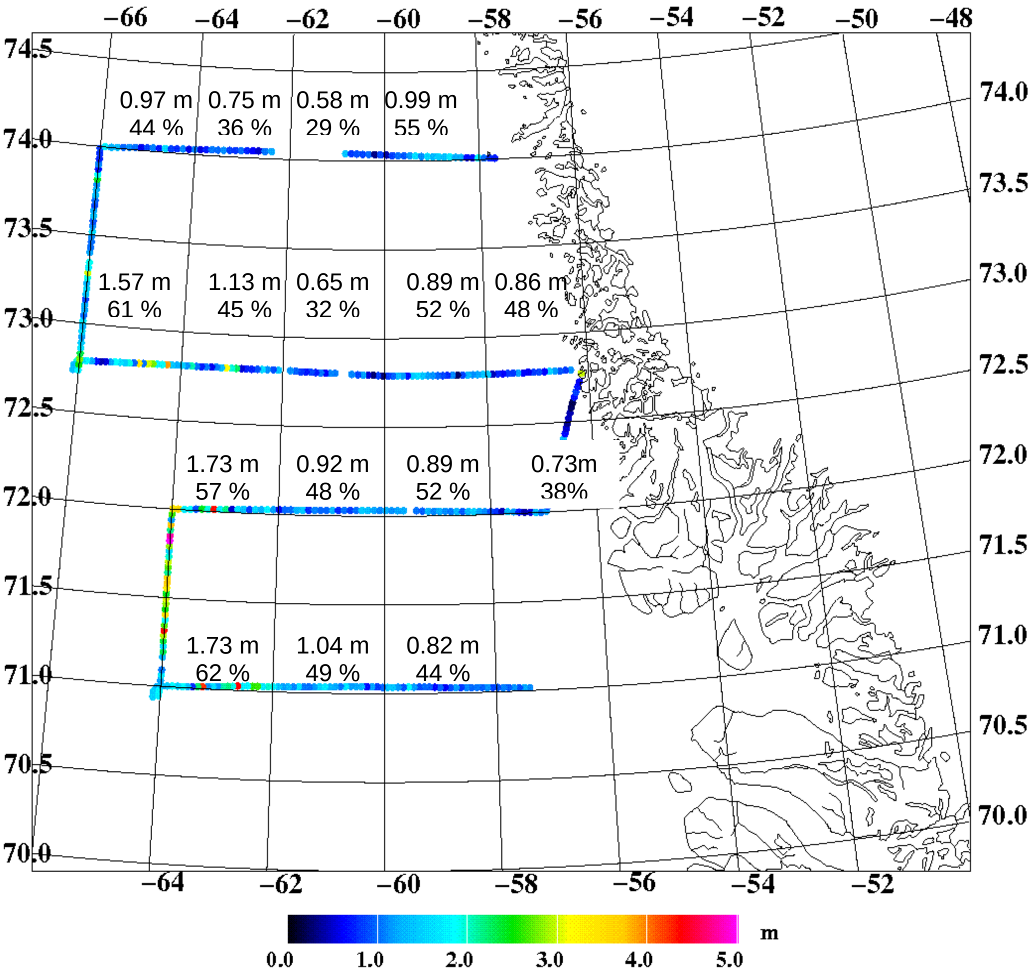


Fig. 22. Ice thickness in the NW area from lidar. Numbers show averaged thickness in 2 degree blocks, along with the probability of ice thickness greater than 80 cm in the block.

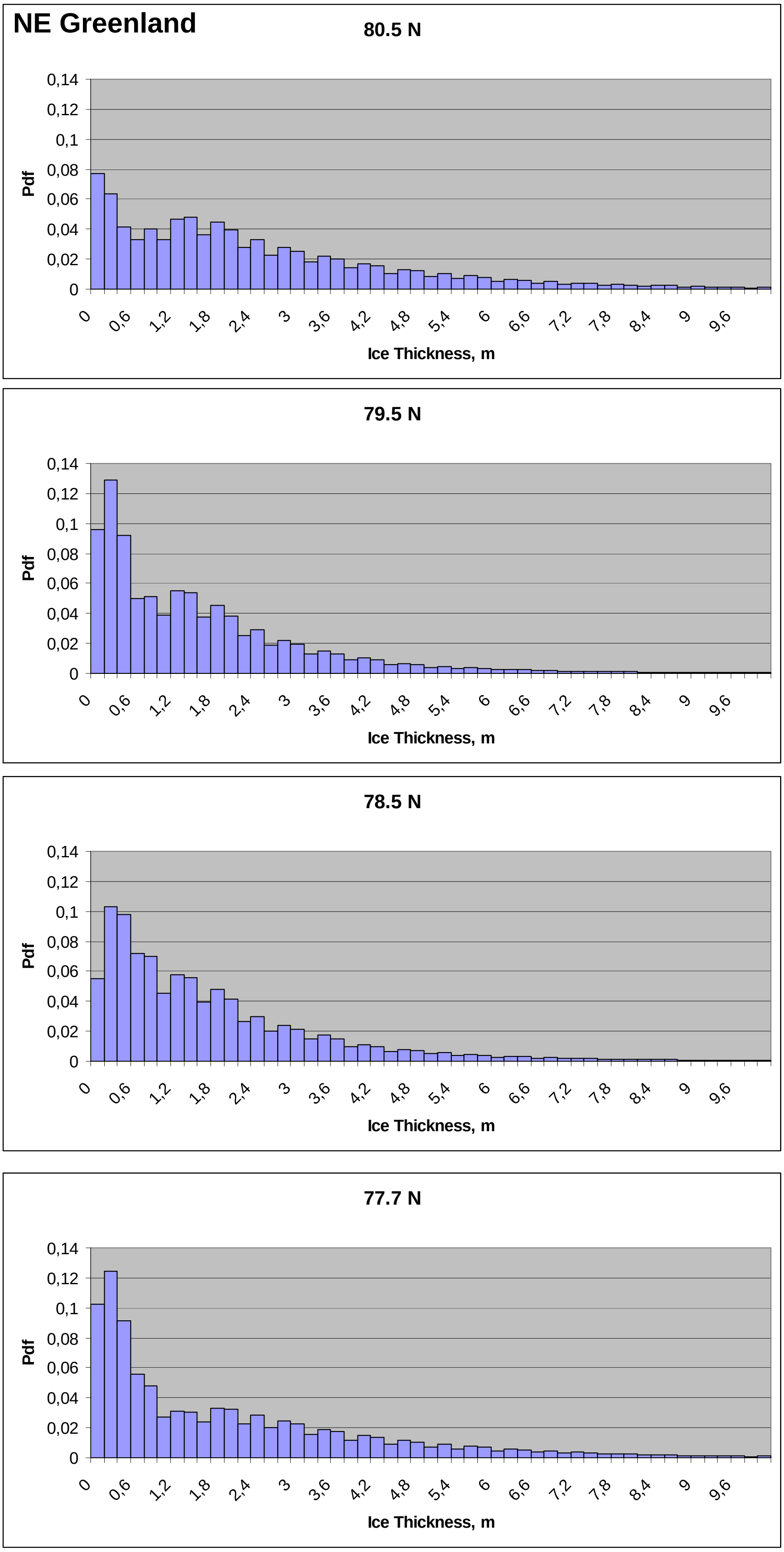


Fig. 23. Histograms of distributions of ice thickness in the NE Greenland area.

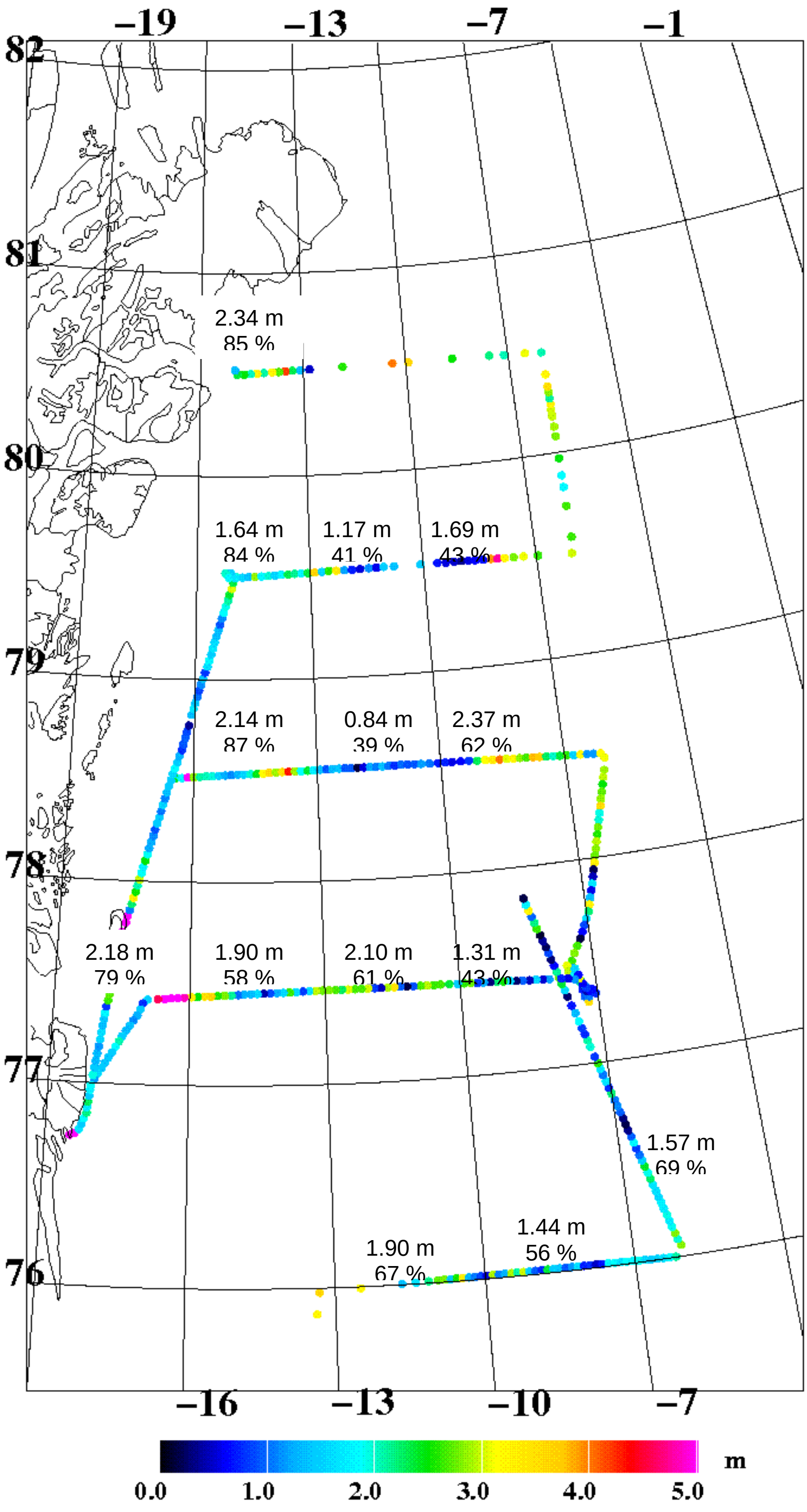


Fig. 23. Ice thickness in the NE Greenland shelf area from lidar. Numbers show averages in 3 degree longitude blocks, along with probability of ice thickness greater than 80 cm.

The data of Figures 20-23 are the main results of the airborne lidar campaign. Comparing NW and NE, it is clear that the ice thickness is larger in NE, with a broader tail in the pdf due to very thick ice floes. In the NW area, it is clear that the ice thickness increase towards Canada.

A number of Synthetic Aperture Radar images from ESA’s ENVISAT satellite were ordered and processed in order to guide the aircraft and helicopter operations, and comparisons to these data further enhance the understanding of the ice data.

7.1. SAR comparisons – West Greenland

Fig 24 shows the passive microwave ice concentrations, and the QuikSCAT backscatter signal for April 19. The latter is sensitive to a.o. the presence of multiyear ice floes. The airborne flight track is shown as reference.

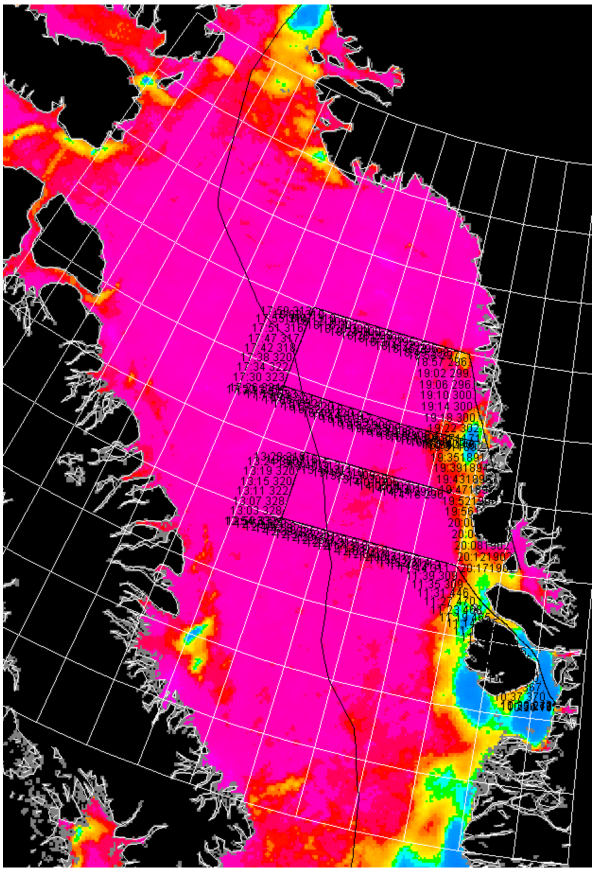


Fig 24a. AMSR-E passive microwave overview of total ice concentration on April 19, 2008.

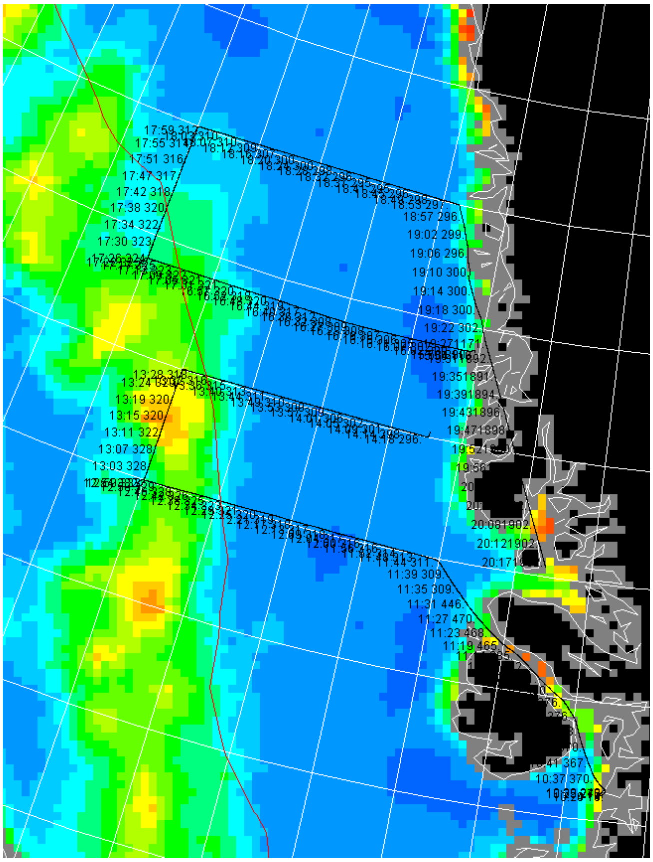


Fig. 24b. QuikSCAT scatterometer imege of April 19. Blue areas are first-year ice and green-yellow-orange areas contains a mixture of first-year ice and increasing fractions of multi-year ice from the Arctic Ocean that came south through Nares Strait during the winter.

In Fig. 25 and 26 comparisons are made to detailed Envisat SAR data, highlighting the leads and uniformity of ice closer to Greenland, and the fraction of multiyear ice in the center of the

Baffin Bay. The latter region could not be reached by helicopter, but the MY floes are detectable in the laser.

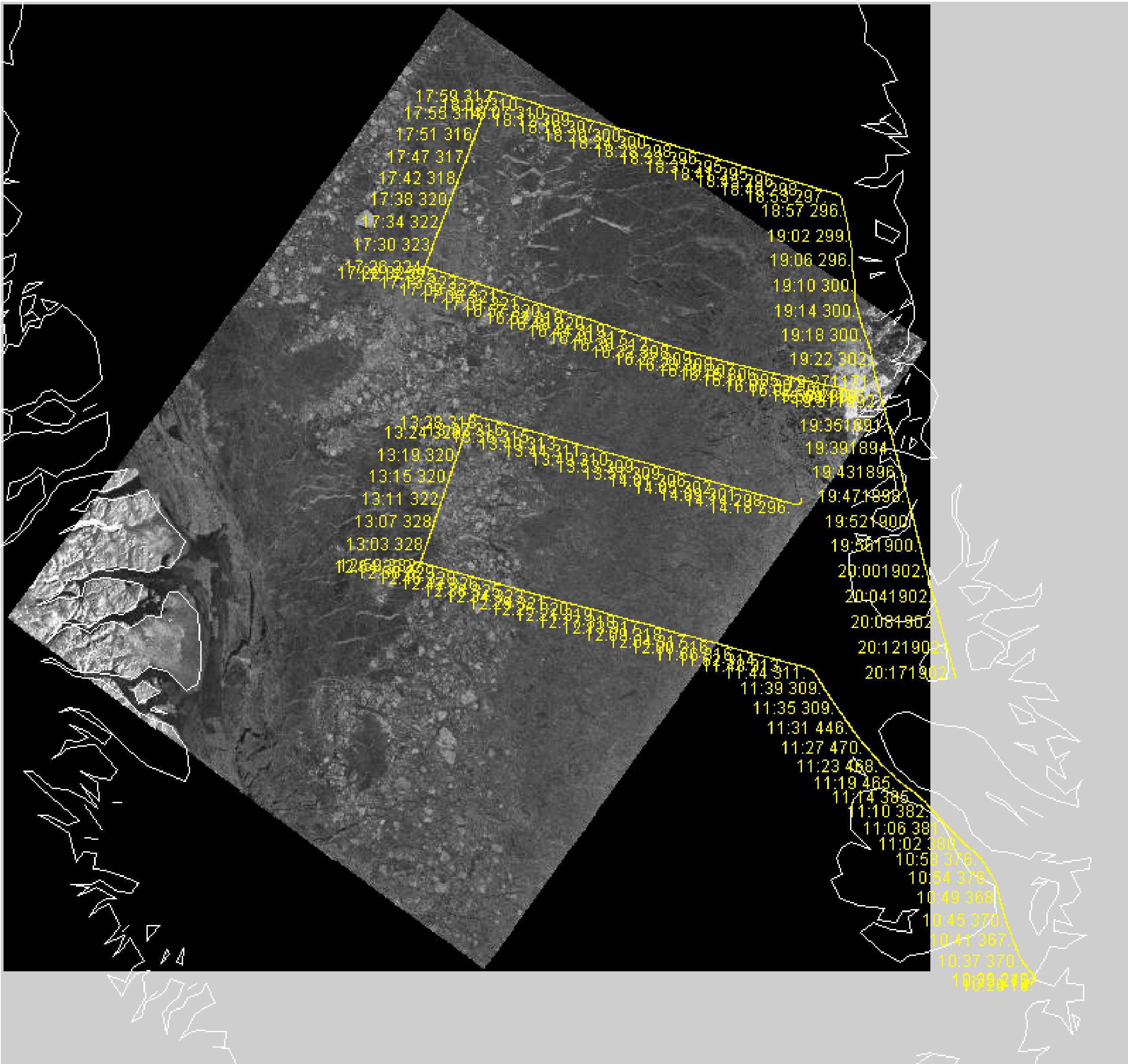


Fig. 25. ENVISAT SAR image at 15:09 with overlay of flight tracks. Numbers are time and flight altitude (m). The brighter ice floes near the western edge of the airborne tracks are the multi-year floes.

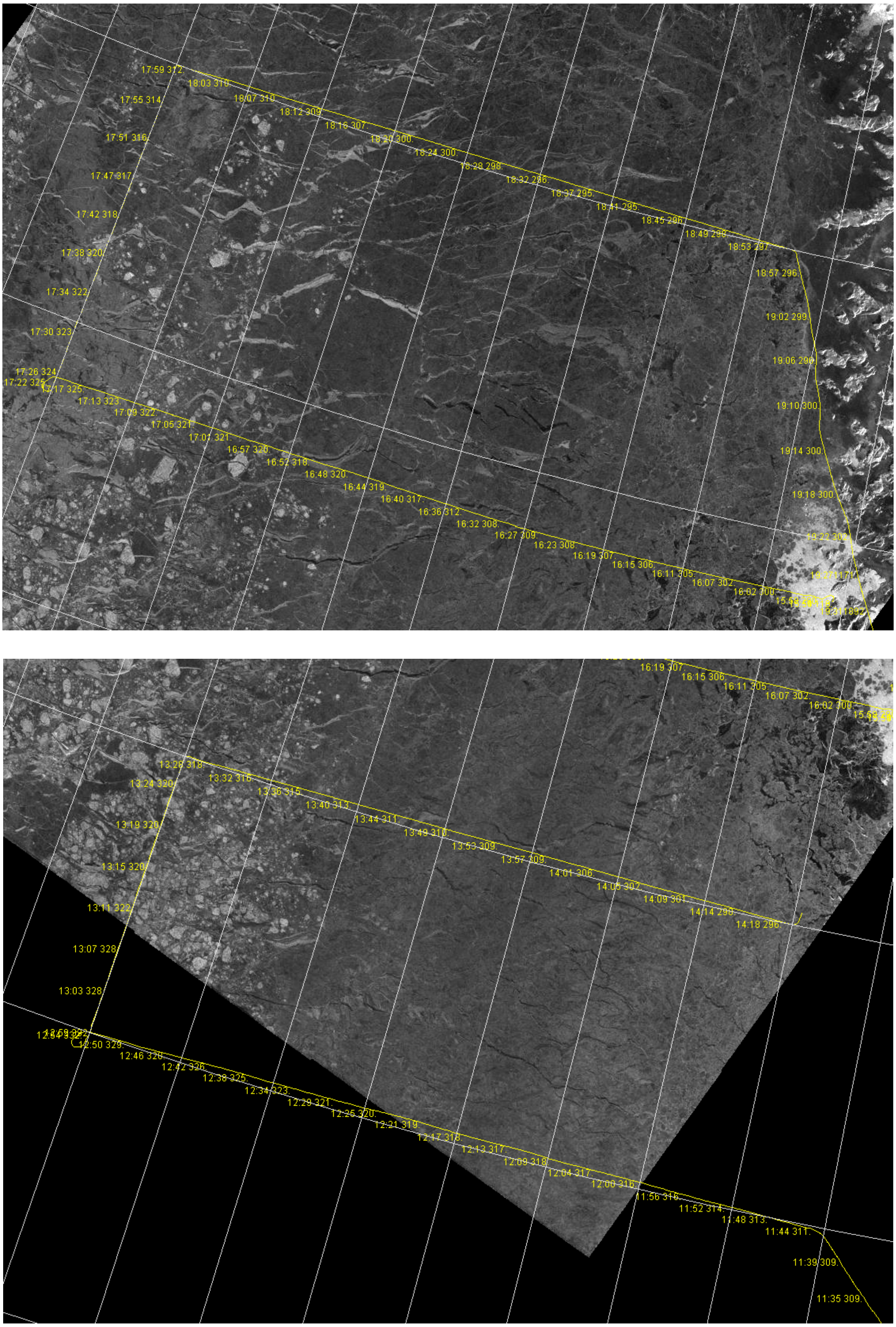


Fig. 26. Zoom of the northern and southern part of Twin-Otter track on April 19, with ENVISAT ASAR images. Brighter elongated features are refrozen leads, brighter 'floe-shaped' features are multi-year ice.

7.2 SAR comparisons - North East Greenland

The NE flights were carried out on April 21 and 24. We only consider the northern near cloud-free flights (April 24). Fig. 27 shows the AMSR and QuikSCAT images, and Fig. 28-30 SAR.

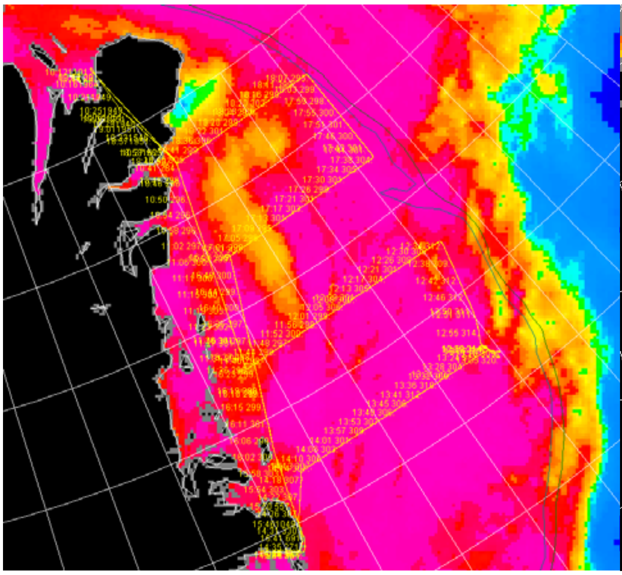


Fig 27a. AMSR-E passive microwave image overview of ice concentrations on April 24, 2008

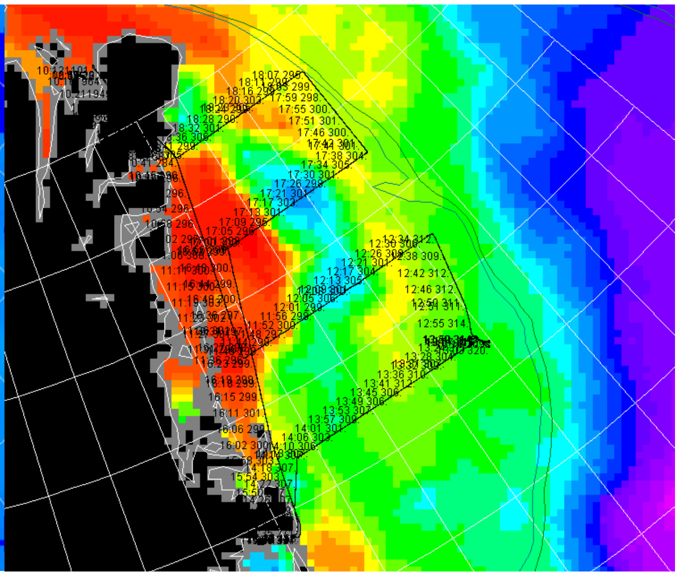


Fig 27b. QuikSCAT scatterometer image on April 24, 2008 showing the fast ice zone and multi-year ice in red and mix of first-year and multi-year ice in green-yellow

.

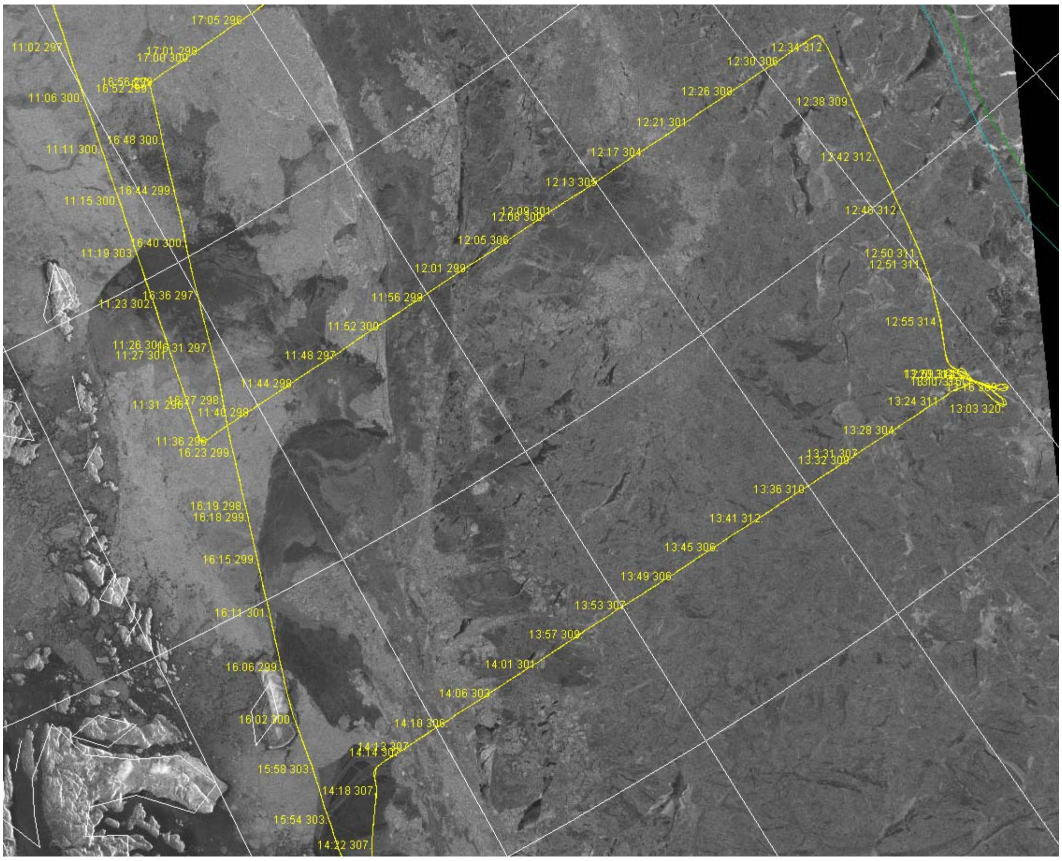


Fig. 28. Detailed ENVISAT SAR image of the central flights.

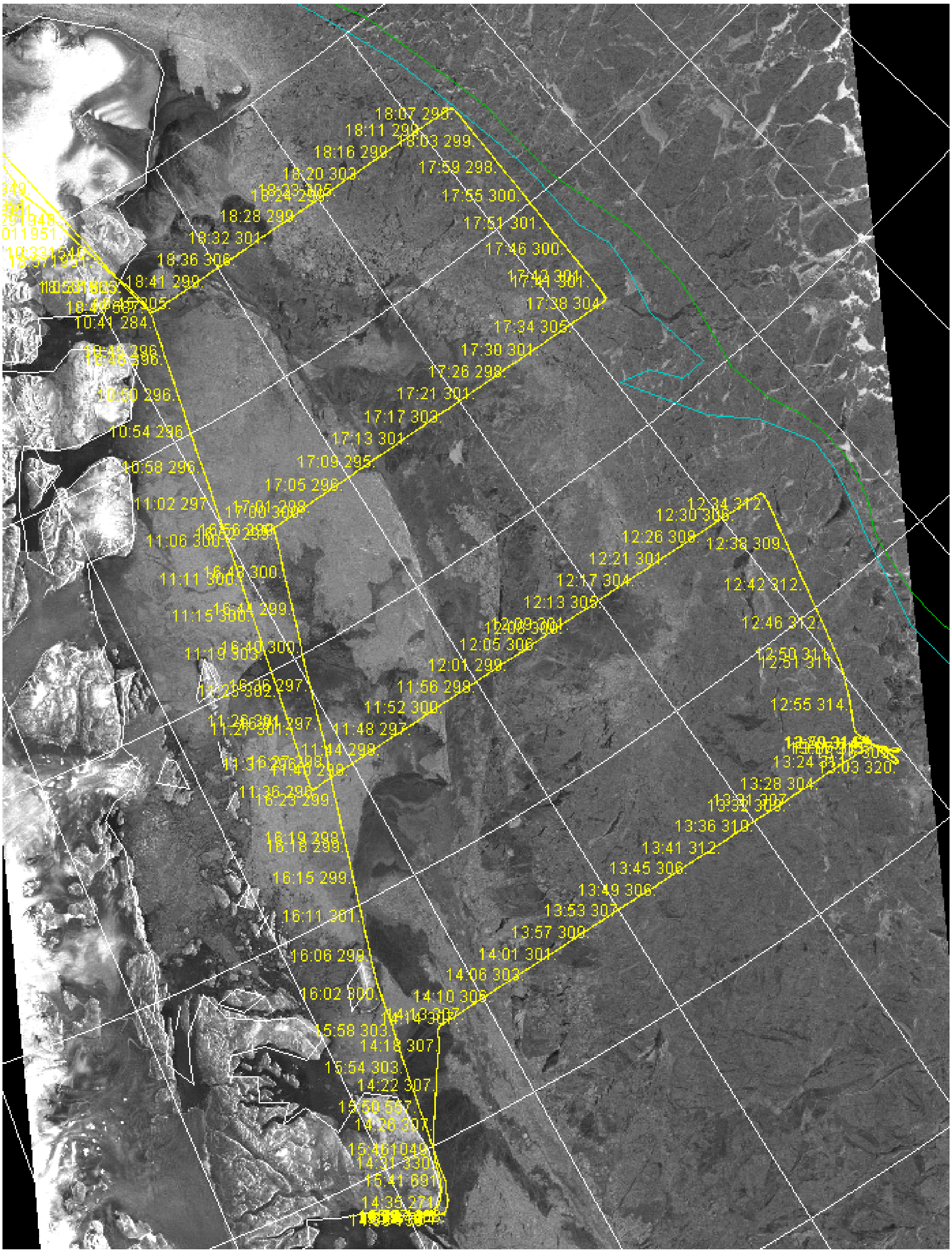


Fig. 29. ENVISAT ASAR overview image of April 24, 12:26 UTC. Flight tracks with overlay of time in UTC.

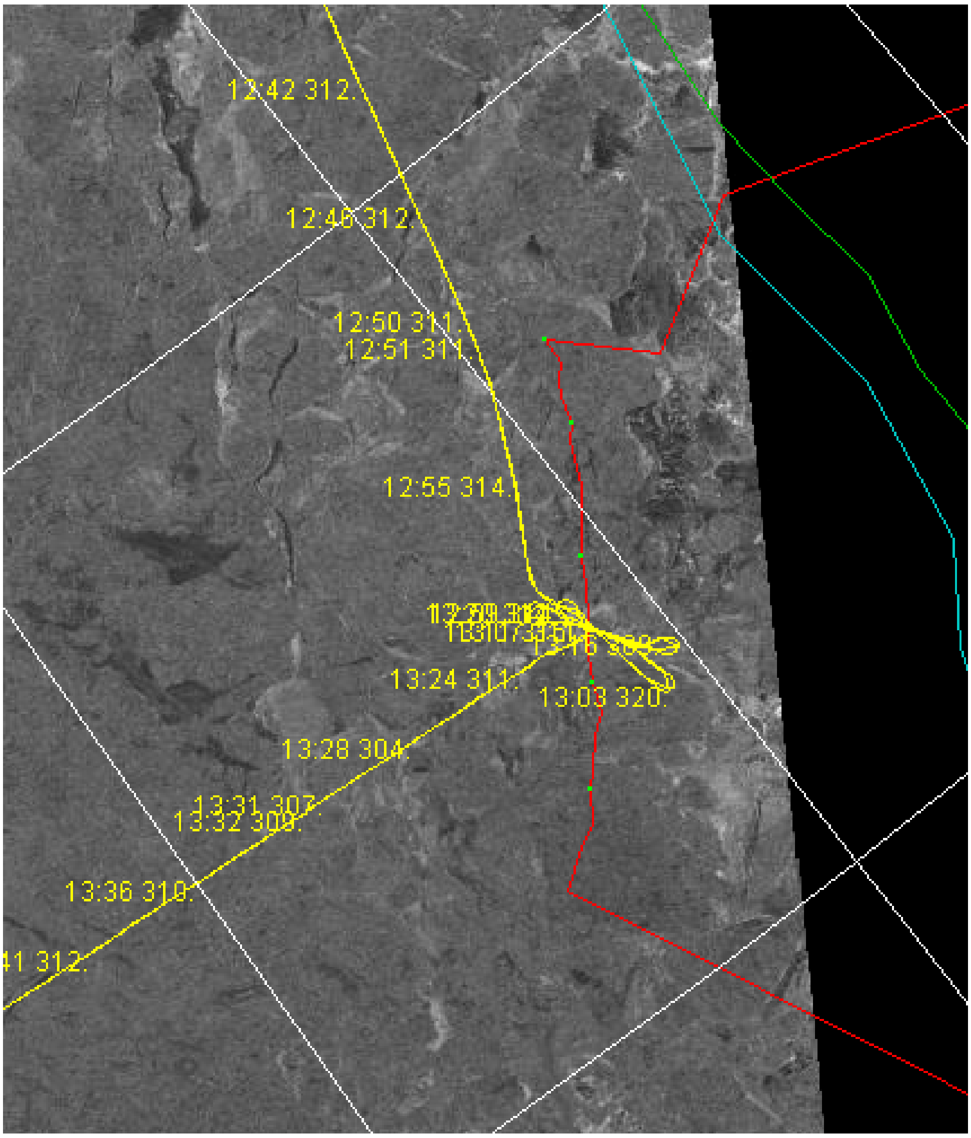


Fig .30. ENVISAT ASAR image with eastern part of flight track (in yellow) and drift track of KV Svalbard of the Norwegian Coast Guard that aided in the validation program.

The NE Greenland SAR imagery shows a good correlation with the ice thickness results of the lidar (Fig. 23). A central, thinner region is seen to exist in the central shelf region, with several areas of thicker, partly landfast ice seen along the coast.

Conclusions

The present report has outlined the ice conditions both historically and currently (April 2008) based on satellite, airborne and in-situ data.

It has been demonstrated that the satellite methods, both SAR, passive microwave and radar scatterometry data are useful for getting a better understanding of past and current ice conditions, and also that airborne and in-situ data are supporting the satellite results, and gives a qualitative estimate of the more difficult parameter to estimate – the ice thickness. The estimated accuracy of the freeboard method for ice thickness estimation is judged at 20-30 cm.

Upon the launch of the European Space Agency CryoSat mission, ultimo 2009, is is anticipated that the accuracy of this estimation will improve, especially for high-resolution combinations of airborne and satellite data.

The investigations of the present report are currently ongoing, as several of the basic data are still missing and awaiting preparation / publishing (e.g., Norwegian ice data and ASIRAS data).

The lidar data sets are very rich and detailed, and can be utilized for additional studies, such a ice ridge properties, ice dynamics and leads. The detailed data sets (lidar and SAR imagery) can be made available upon request on ftp.

Acknowledgements

The 2008 NW and NE Greenland ice studies were sponsored by the Bureau of Minerals and Petroleum, Greenland Home Rule Government. We thank for the patience in awaiting resuls.

We thank the Twin Otter and helicopter aircrews of Air Greenland for an excellent and professional flight job. We thank the Greenland command for providing access to Daneborg and Station Nord, and Tele Greenland for providing fuel at Danmarkshavn.

We thank Sebastian Gerland, Norsk Polarinstitut, for providing ice drilling data from KV Svalbard.

Thin ice and open water in the NE Greenland ice. April 21, 2008.

Appendix A. Tables of number of ice free days.

A1. West Greenland 1979-2008

The table below shows the minimum, average and maximum number of days with icecover less than 30, 40 and 60% respectively. Areas are lat/lon boxes, (lat->lat+1, lon-2->lon), period 1979-2008 and 2000-2008.

Lat,lon	<30%			<40%			<60%		
76 -74	67	132	179	80	139	185	93	153	202
76 -72	27	121	173	43	132	179	82	150	210
75 -74	71	121	168	79	127	173	90	140	180
75 -72	59	113	156	70	118	161	82	130	173
75 -70	46	108	153	57	113	159	72	123	169
75 -68	11	103	153	33	108	157	52	119	170
75 -66	0	97	155	0	101	159	2	112	172
75 -64	0	93	156	0	100	164	0	111	170
75 -62	0	93	149	0	99	157	0	110	166
75 -60	0	91	139	0	98	154	3	114	167
74 -74	83	121	158	87	125	159	94	132	165
74 -72	82	119	152	84	121	154	93	128	161
74 -70	80	113	152	83	117	154	92	124	161
74 -68	68	107	156	74	111	158	82	119	162
74 -66	51	103	154	66	107	156	80	116	160
74 -64	20	101	149	37	106	153	59	116	159
74 -62	8	102	151	15	106	155	33	115	163
74 -60	10	107	162	19	112	163	41	125	178
74 -58	28	116	178	44	125	186	66	141	201
73 -70	89	115	148	92	118	148	99	124	154
73 -68	80	108	139	84	112	142	90	119	154
73 -66	48	100	142	69	106	148	84	115	150
73 -64	41	98	141	60	104	141	72	114	146
73 -62	29	103	143	40	109	146	64	120	157
73 -60	32	117	167	40	123	177	70	136	196
73 -58	78	144	210	82	153	219	102	170	224
73 -56	5	73	164	76	141	213	107	178	233
72 -64	53	96	133	58	101	135	73	110	142
72 -62	50	99	136	52	105	141	63	117	155
72 -60	35	118	172	42	124	176	62	136	196
72 -58	67	146	214	81	157	219	94	177	232
72 -56	94	166	229	115	186	238	128	206	263
71 -64	49	95	131	62	101	134	69	111	140
71 -62	47	95	132	60	101	137	80	113	157
71 -60	51	118	168	54	125	178	65	136	197
71 -58	76	155	219	86	163	223	103	181	230
70 -64	62	96	132	65	102	135	79	114	142
70 -62	63	100	135	67	105	137	86	117	154
70 -60	64	118	164	69	124	165	92	135	190
70 -58	101	146	206	108	154	211	126	171	230
70 -56	141	185	240	149	193	243	170	209	254
69 -64	60	96	122	65	103	134	73	116	153
69 -62	67	99	130	71	105	135	84	118	152
69 -60	71	112	152	79	119	174	100	131	199
69 -58	91	143	219	106	151	227	123	165	235
69 -56	150	194	248	157	204	248	177	225	266
69 -54	155	227	291	173	245	311	200	274	345
68 -64	57	95	119	61	102	128	80	117	157
68 -62	67	99	129	74	105	134	89	118	164
68 -60	78	111	149	80	117	154	100	133	200
68 -58	106	146	213	115	154	223	127	169	238

68 -56	149	196	248	156	205	258	171	223	275
67 -62	41	90	122	67	102	134	83	118	154
67 -60	75	109	143	89	117	148	103	136	194
67 -58	103	142	201	108	154	217	127	179	235
67 -56	155	210	277	164	220	286	187	240	328

A2. West Greenland 2000-2008

Lat,lon		<30%			<40%			<60%	
76 -74	99	149	179	116	156	185	146	170	202
76 -72	110	142	173	130	153	179	148	170	210
75 -72	101	127	156	107	131	161	116	142	173
75 -70	94	123	153	101	127	159	107	135	169
75 -68	91	122	153	95	125	157	109	134	170
75 -66	83	119	155	91	123	159	106	132	172
75 -64	85	119	156	94	123	164	105	132	170
75 -62	95	120	149	99	126	157	109	135	166
75 -60	91	118	139	98	125	154	110	142	167
74 -72	112	129	152	116	131	154	120	138	161
74 -70	101	124	152	108	127	154	118	133	161
74 -68	95	121	156	102	124	158	108	130	162
74 -66	95	119	154	101	123	156	107	129	160
74 -64	97	121	149	103	124	153	114	132	159
74 -62	98	125	151	103	128	155	115	135	163
74 -60	106	132	162	112	136	163	125	149	178
74 -58	116	144	178	122	153	186	130	166	201
73 -68	95	118	139	100	121	142	109	127	154
73 -66	79	114	142	90	119	148	109	126	150
73 -64	94	115	141	99	119	141	110	126	146
73 -62	101	120	143	107	124	146	115	134	154
73 -60	103	137	167	115	145	177	123	156	196
73 -58	138	170	210	142	177	219	150	190	224
73 -56	45	97	164	118	169	213	151	201	233
72 -64	76	108	133	81	112	135	92	120	142
72 -62	77	114	136	81	119	141	93	130	155
72 -60	99	139	172	100	143	176	108	154	196
72 -58	123	171	214	134	179	219	151	194	227
72 -56	151	196	229	171	209	238	186	223	263
71 -64	76	106	130	79	110	132	93	120	140
71 -62	68	106	132	76	112	137	80	121	147
71 -60	97	135	168	100	141	178	108	151	197
71 -58	123	175	219	132	182	223	150	198	226
71 -56	170	212	241	175	215	248	179	225	259
70 -64	68	105	126	76	111	129	85	121	137
70 -62	76	111	135	79	115	137	88	127	145
70 -60	84	134	164	95	139	165	103	150	185
70 -58	119	166	206	122	172	211	136	185	218
70 -56	158	207	225	167	214	240	177	225	254
69 -60	77	125	149	81	132	157	100	144	166
69 -58	111	160	194	118	167	197	131	179	204
69 -56	170	212	239	177	218	244	193	236	259
69 -54	215	256	291	247	278	311	277	308	345
68 -60	79	123	149	80	131	154	100	145	165
68 -58	118	162	194	120	170	205	127	180	211
68 -56	157	212	240	167	221	252	181	236	275
68 -54	237	275	322	254	290	337	276	314	357
67 -58	116	158	188	118	170	196	127	191	217
67 -56	166	229	277	173	238	286	190	256	328
67 -54	219	268	311	246	286	329	288	319	356

A3. East Greenland – 1979-2008

Minimum, average and maximum number of days with icecover less than 30, 40 and 60% respectively. Areas are lat/lon boxes, (lat->lat+1, lon-3->lon). Period: 2000-2008(7).

Lat,lon	<30%			<40%			<60%		
68 -25	46	94	145	63	106	149	96	134	175
68 -22	75	142	242	107	174	286	167	243	354
68 -19	186	296	365	205	315	365	253	340	365
69 -22	8	83	150	29	100	154	76	133	181
69 -19	83	158	237	119	194	271	152	249	347
70 -22	0	0	2	0	12	43	0	74	130
70 -19	42	98	152	73	117	180	98	164	233
70 -16	132	241	359	137	264	365	183	299	365
71 -19	0	62	131	13	80	145	55	116	165
71 -16	55	201	315	89	221	332	153	254	362
71 -13	183	288	365	193	301	365	206	322	365
72 -19	0	53	121	0	66	127	15	92	149
72 -16	27	108	211	57	138	242	109	201	325
72 -13	97	238	360	143	256	365	184	289	365
72 -10	156	289	365	186	304	365	227	325	365
73 -19	0	39	116	0	52	123	6	78	139
73 -16	3	63	144	12	81	169	59	120	208
73 -13	67	173	275	104	204	305	135	253	360
73 -10	137	274	365	164	290	365	207	318	365
74 -16	0	37	118	1	53	122	33	85	132
74 -13	6	73	176	22	100	187	93	162	247
74 -10	96	237	343	134	265	362	209	302	365
75 -16	0	16	98	0	25	105	0	51	122
75 -13	0	33	104	0	49	108	40	78	129
75 -10	7	92	195	31	127	226	123	208	317
75 -7	127	275	358	149	298	365	243	330	365
76 -16	0	20	92	0	28	98	0	48	116
76 -13	0	20	97	0	34	105	6	60	120
76 -10	0	32	105	0	48	114	30	84	148
76 -7	0	63	187	12	95	208	88	171	252
76 -4	106	235	348	166	281	365	244	333	365
77 -16	0	15	88	0	21	99	0	40	115
77 -13	0	17	96	0	26	100	6	50	116
77 -10	0	19	98	0	30	107	22	64	116
77 -7	0	27	104	0	41	117	26	77	164
77 -4	3	61	182	11	94	233	85	183	314
77 -1	169	281	365	229	319	365	294	350	365
78 -19	0	0	0	0	0	0	0	1	31
78 -16	0	3	63	0	5	71	0	15	94
78 -13	0	11	86	0	15	92	0	36	103
78 -10	0	14	84	0	23	94	2	51	110
78 -7	0	18	85	0	28	88	4	60	103
78 -4	0	26	81	0	41	102	14	96	211
78 -1	22	154	343	96	214	358	209	311	365
79 -16	0	1	40	0	2	45	0	5	56
79 -13	0	7	49	0	13	60	0	40	92
79 -10	0	17	68	0	26	81	2	56	107
79 -7	0	22	77	0	35	100	6	59	109
79 -4	0	17	82	0	28	101	8	52	107
79 -1	0	18	70	0	33	104	3	78	156
79 2	4	109	286	23	161	347	97	258	365
80 -13	0	24	78	0	47	113	0	77	126
80 -10	0	34	103	0	52	108	34	83	118
80 -7	0	27	76	0	37	97	1	58	110

80 -4	0	18	64	0	26	72	0	44	102
80 -1	0	10	58	0	16	64	0	32	84
80 2	0	14	68	0	28	106	2	93	233

A4. East Greenland – 2000-2008

Minimum, average and maximum number of days with icecover less than 30, 40 and 60% respectively. Areas are lat/lon boxes, (lat->lat+1, lon-3->lon). Period: 1978-2008(7).

Lat,lon		<30%			<40%			<60%	
68 -25	46	101	145	63	113	149	118	139	175
68 -22	122	157	242	139	185	286	188	246	354
69 -22	9	94	150	29	106	154	104	137	181
69 -19	115	172	237	143	204	267	189	264	347
70 -22	0	0	0	0	15	31	24	87	130
70 -19	58	111	152	82	127	180	105	167	214
70 -16	176	266	359	220	295	365	250	329	365
71 -19	14	86	131	26	99	145	79	125	165
71 -16	165	226	315	183	244	330	205	279	362
72 -19	0	73	121	3	85	127	28	109	149
72 -16	58	134	211	88	165	242	133	214	284
72 -13	195	271	353	199	290	363	228	317	365
73 -19	0	58	116	0	70	123	17	92	139
73 -16	20	83	144	46	100	169	81	137	208
73 -13	115	204	275	164	232	297	207	276	346
74 -16	2	56	118	14	73	122	50	96	132
74 -13	46	103	176	52	132	187	93	177	240
74 -10	205	272	343	220	298	355	229	327	365
75 -16	0	27	98	0	36	105	20	68	122
75 -13	2	49	104	19	65	108	62	92	129
75 -10	48	125	195	59	152	226	132	222	282
76 -16	0	26	92	0	33	98	0	49	116
76 -13	0	32	97	0	41	105	35	71	120
76 -10	11	55	105	21	67	114	58	101	148
76 -7	36	101	187	47	126	208	96	187	252
76 -4	167	267	348	230	302	365	288	343	365
77 -16	0	22	88	0	27	99	0	43	115
77 -13	0	30	96	0	37	100	21	60	116
77 -10	0	36	98	11	48	107	38	79	116
77 -7	1	51	104	28	68	117	55	101	164
77 -4	13	96	182	37	127	233	85	202	314
78 -19	0	0	0	0	0	0	0	3	31
78 -16	0	11	63	0	13	71	0	22	94
78 -13	0	18	86	0	24	92	0	43	103
78 -10	0	26	84	0	33	94	27	64	110
78 -7	0	32	85	0	42	88	41	73	103
78 -4	1	43	81	10	62	102	48	111	211
78 -1	50	190	343	105	240	358	249	317	365
79 -16	0	4	40	0	5	45	0	12	56
79 -13	0	14	49	0	19	60	0	45	92
79 -10	0	23	68	0	30	81	16	63	99
79 -7	0	36	77	0	46	100	12	67	109
79 -4	0	32	82	0	44	101	17	63	107
79 -1	0	26	70	1	47	98	15	93	154
79 2	30	136	286	66	188	347	181	275	365
80 -13	0	20	69	0	36	113	0	61	122
80 -10	0	39	96	2	58	104	44	87	118
80 -7	0	40	75	0	52	97	1	67	110

80 -4	0	28	62	0	40	71	0	55	102
80 -1	0	18	58	0	26	64	0	42	84
80 2	0	21	68	0	38	84	2	105	177

Appendix B. Ice drift tables.

The table of numbers below shows the monthly average and maximum sea ice velocities and number of observations. Section 1 is number of observations, section 2 is average velocities in 1x2 degree grids and section 3 is maximum observed velocity (over ~24 hours). Column 1 corresponds to 74-76W longitude, column 11 to 54-56W, southern latitude given in column 0. The method has an upper limit around 30-35 cm/s, so higher velocities may have occurred. First 6 months of the year. Data from 1981-2001.

B1. West Greenland ice drift

------- month 1 ----- Number of datapoints----------------------Mean drift-------------------------max drift-------------

77.0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
76.0	115	77	39	0	0	0	0	0	0	0	0	4	3	1	0	0	0	0	0	0	0	0	12	12	12	0	0	0	0	0	0	0	0
75.0	296	325	220	185	113	367	253	303	0	0	0	6	5	5	4	4	2	2	1	0	0	0	21	20	24	18	20	12	11	14	0	0	0
74.0	442	325	487	276	417	412	279	442	293	0	0	7	7	7	6	5	4	3	3	2	0	0	24	19	23	28	26	25	22	20	10	0	0
73.0	547	487	354	530	510	447	419	149	390	168	0	5	8	8	7	7	6	6	5	3	1	0	21	23	25	28	25	23	22	21	22	11	0
72.0	135	660	509	467	456	300	429	426	239	313	0	2	4	7	7	7	7	7	7	6	2	0	10	21	23	23	28	28	25	23	23	26	0
71.0	0	124	209	443	428	660	465	415	351	221	39	0	1	2	3	7	7	8	8	8	6	0	0	11	15	18	23	24	25	30	24	25	3
70.0	0	0	0	119	509	622	477	394	340	156	40	0	0	0	0	2	6	8	8	7	5	1	0	0	0	2	15	23	23	25	24	23	10
69.0	0	0	0	0	129	404	520	386	174	119	49	0	0	0	0	0	4	8	8	6	6	3	0	0	0	0	5	21	23	28	24	26	9
68.0	0	0	0	0	0	184	436	358	188	121	76	0	0	0	0	0	3	6	8	7	7	3	0	0	0	0	0	19	23	26	28	28	11
67.0	0	0	0	0	0	0	94	248	235	120	36	0	0	0	0	0	0	1	7	9	7	3	0	0	0	0	0	0	10	29	27	29	11

------- month 2 ---------------

77.0	0	35	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0
76.0	187	125	58	0	0	0	0	0	0	0	0	4	2	1	0	0	0	0	0	0	0	0	13	10	7	0	0	0	0	0	0	0	0
75.0	317	346	227	206	140	425	274	343	0	0	0	5	5	4	4	3	2	2	1	0	0	0	16	19	16	18	20	13	12	11	0	0	0
74.0	390	274	486	288	479	473	315	441	311	0	0	6	6	5	5	4	4	3	3	1	0	0	18	23	24	19	20	19	16	16	10	0	0
73.0	510	457	339	535	554	516	465	150	413	181	0	4	6	6	5	5	5	4	4	3	1	0	22	24	18	22	24	28	25	19	16	7	0
72.0	114	522	396	410	463	351	541	494	284	368	0	1	3	5	6	6	6	6	6	6	2	0	10	19	21	20	23	28	30	31	36	16	0
71.0	0	98	129	304	378	669	537	480	401	268	57	0	1	1	2	5	6	7	6	6	5	0	0	11	11	16	20	27	32	32	30	27	10
70.0	0	0	0	85	464	667	526	456	483	233	71	0	0	0	0	2	5	7	7	7	5	1	0	0	0	3	20	24	32	32	28	25	7
69.0	0	0	0	0	129	445	572	498	304	234	101	0	0	0	0	1	3	7	7	8	6	3	0	0	0	0	10	16	25	23	28	30	14
68.0	0	0	0	0	0	231	528	462	264	205	160	0	0	0	0	0	3	5	8	7	6	3	0	0	0	0	0	15	21	25	32	31	14
67.0	0	0	0	0	0	0	125	360	342	192	53	0	0	0	0	0	0	2	7	9	7	2	0	0	0	0	0	0	12	28	26	24	10

------- month 3 ---------------

77.0	0	64	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0
76.0	361	249	122	0	0	0	0	0	0	0	0	4	2	0	0	0	0	0	0	0	0	0	15	15	4	0	0	0	0	0	0	0	0
75.0	443	478	343	302	189	566	355	442	0	0	0	5	5	4	3	3	2	1	1	0	0	0	25	25	25	22	15	15	10	14	0	0	0
74.0	480	349	629	402	643	624	414	612	423	0	0	5	5	5	4	4	4	3	2	2	0	0	26	26	23	23	22	23	24	19	14	0	0
73.0	734	596	419	663	700	696	705	242	668	319	0	4	6	5	5	5	5	4	3	2	1	0	28	32	19	26	25	22	23	20	22	11	0
72.0	171	749	561	560	609	452	739	726	469	706	0	1	3	5	5	6	6	6	5	5	2	0	10	18	24	22	22	22	25	28	30	25	0
71.0	0	148	216	463	543	940	788	767	703	503	118	0	1	1	3	5	6	7	7	7	4	0	0	10	11	16	22	29	29	29	32	31	10
70.0	0	0	0	113	625	939	767	745	813	456	153	0	0	0	0	2	5	7	7	7	5	1	0	0	0	7	18	31	27	30	28	29	11
69.0	0	0	0	0	177	646	872	851	542	432	197	0	0	0	0	1	3	6	7	7	7	4	0	0	0	0	10	25	27	29	32	30	28
68.0	0	0	0	0	0	324	730	795	523	401	287	0	0	0	0	0	3	5	8	9	8	3	0	0	0	0	0	18	23	31	35	35	26
67.0	0	0	0	0	0	0	161	588	674	418	106	0	0	0	0	0	0	1	7	11	10	3	0	0	0	0	0	0	10	29	37	35	28

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77.0	0	44	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0
76.0	297	191	81	0	0	0	0	0	0	0	0	4	3	1	0	0	0	0	0	0	0	0	20	22	14	0	0	0	0	0	0	0	0
75.0	361	376	250	216	146	435	217	253	0	0	0	6	5	5	4	3	2	2	1	0	0	0	25	23	23	21	24	17	16	11	0	0	0
74.0	358	239	397	294	466	518	327	448	260	0	0	6	6	6	5	5	4	3	3	2	0	0	23	20	23	23	23	23	18	16	12	0	0
73.0	572	417	278	438	470	456	484	168	456	172	0	4	6	6	5	6	5	5	5	3	1	0	21	25	20	21	20	21	29	20	19	11	0
72.0	135	582	385	326	317	256	442	486	344	469	0	1	3	5	5	6	6	6	6	6	2	0	12	17	20	25	18	19	23	28	23	25	0
71.0	0	93	131	300	320	518	477	486	444	336	77	0	1	2	3	5	6	6	7	7	5	1	0	7	10	17	19	20	23	21	25	25	10
70.0	0	0	0	60	378	573	425	466	562	314	106	0	0	0	0	2	5	7	7	7	5	2	0	0	0	7	17	21	27	28	29	29	10
69.0	0	0	0	0	102	415	615	578	398	333	151	0	0	0	0	2	3	6	7	8	8	4	0	0	0	0	15	16	24	28	29	27	18
68.0	0	0	0	0	0	210	479	602	459	345	241	0	0	0	0	0	2	5	9	9	8	3	0	0	0	0	0	15	21	28	32	28	22
67.0	0	0	0	0	0	0	71	438	637	375	83	0	0	0	0	0	0	1	8	12	10	4	0	0	0	0	0	0	7	30	32	35	20

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77.0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
76.0	109	69	29	0	0	0	0	0	0	0	0	5	4	2	0	0	0	0	0	0	0	0	15	18	10	0	0	0	0	0	0	0	0
75.0	151	197	144	111	93	341	191	233	0	0	0	7	7	6	5	4	4	3	3	0	0	0	32	32	24	26	15	16	14	13	0	0	0
74.0	189	133	269	205	371	432	298	435	263	0	0	8	8	7	6	6	5	4	4	3	0	0	25	29	31	26	31	31	18	21	18	0	0
73.0	333	257	164	280	332	374	443	149	396	135	0	5	7	7	6	6	6	5	6	4	2	0	29	26	21	22	20	28	22	23	26	16	0
72.0	80	397	267	232	205	178	395	465	278	286	0	2	4	6	6	6	6	6	6	6	4	0	10	32	35	33	23	18	20	22	26	22	0
71.0	0	57	80	200	240	335	354	430	346	221	30	0	2	1	3	6	6	6	7	8	7	3	0	10	11	29	28	19	28	29	30	29	24
70.0	0	0	0	30	220	393	328	325	327	172	41	0	0	0	0	2	5	8	8	8	7	2	0	0	0	3	18	21	22	25	32	30	9
69.0	0	0	0	0	52	278	439	367	258	167	36	0	0	0	0	1	3	7	8	8	7	5	0	0	0	0	11	18	28	29	25	23	14
68.0	0	0	0	0	0	128	270	338	243	157	62	0	0	0	0	0	3	5	8	8	8	5	0	0	0	0	0	10	29	31	22	23	23
67.0	0	0	0	0	0	0	31	216	312	150	14	0	0	0	0	0	0	2	7	10	9	0	0	0	0	0	0	0	11	24	28	27	0

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 ------- month  6 ---------------
  77.0      0   8   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  76.0     62  42  25   0   0   0   0   0   0   0   0     5  3  2  0  0  0  0  0  0  0  0    15 14 15  0  0  0  0  0  0  0  0
  75.0     99 161 109 105  73 243 162 205   0   0   0     6  6  5  4  4  4  2  2  0  0  0    25 25 18 21 11 16 14 14  0  0  0
  74.0    111 102 195 159 269 287 198 286 220   0   0     6  5  5  5  4  5  4  4  2  0  0    25 20 19 18 23 20 14 15 10  0  0
  73.0    197 135  97 185 239 244 268  83 261  96   0     4  6  6  6  5  5  5  5  4  3  0    17 21 19 23 20 24 18 20 15 12  0
  72.0     56 266 157 158 176 143 236 249 163 145   0     1  3  6  6  5  5  5  5  6  4  0     7 15 29 23 21 20 20 21 23 16  0
  71.0      0  59  88 178 171 276 237 236 172  89  13     0  2  2  3  6  5  5  5  6  7  0     0 12 22 22 20 20 16 18 20 23  0
  70.0      0   0   0  35 219 346 229 214 173  69  14     0  0  0  0  3  5  6  6  6  4  0     0  0  0  5 14 20 23 22 20 17  0
  69.0      0   0   0   0  68 238 271 254 118  33   7     0  0  0  0  1  4  6  6  5  5  0     0  0  0  0 10 18 18 23 23 20  0
  68.0      0   0   0   0   0 121 221 204  80  18   4     0  0  0  0  0  3  5  6  5  0  0     0  0  0  0  0 15 20 20 21  0  0
  67.0      0   0   0   0   0   0  32  94  58   8   0     0  0  0  0  0  0  1  6  6  0  0     0  0  0  0  0  0 12 15 12  0  0

------- month  7 --------- Number of datapoints---------------------Mean drift------------------------max drift------------
  77.0      0   0   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  76.0      9  13  10   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  75.0     23  44  36  36  44 151  90 120   0   0   0     6  4  4  4  4  4  3  2  0  0  0    11 15 12 10 18 15 17 11  0  0  0
  74.0     22  22  52  58 132 177 108 160  83   0   0     5  4  4  5  4  5  4  4  3  0  0    11  9 12 18 24 23 17 16 15  0  0
  73.0     14  11  23  67 113 177 160  42  88  21   0     0  0  7  6  5  4  5  4  4  3  0     0  0 15 21 21 19 18 15 12  9  0
  72.0      7  53  48  84 138 122 190 114  38  32   0     0  5  7  6  6  5  4  4  3  3  0     0 14 18 28 22 25 25 13 12 10  0
  71.0      0  16  31 106 143 252 200 116  37  12   0     0  0  3  3  6  6  5  4  3  0  0     0  0 10 15 25 21 21 13 10  0  0
  70.0      0   0   0  32 188 259 172 106  30   3   0     0  0  0  0  3  5  5  5  5  0  0     0  0  0  2 14 18 19 20 20  0  0
  69.0      0   0   0   0  62 193 237 147  33   8   0     0  0  0  0  1  3  5  5  6  0  0     0  0  0  0  7 15 16 21 19  0  0
  68.0      0   0   0   0   0 107 186 126  38   4   0     0  0  0  0  0  3  3  5  4  0  0     0  0  0  0  0 14 16 15 12  0  0
  67.0      0   0   0   0   0   0  31  73  24   2   0     0  0  0  0  0  0  1  5  6  0  0     0  0  0  0  0  0  7 14 14  0  0

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  77.0      0   0   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  76.0      0   0   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  75.0      0   0   0   0   1   4   2   2   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  74.0      0   0   0   0   2   4   3   4   2   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  73.0      0   0   0   1   4   5   4   1   4   1   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  72.0      0   0   0   0   0   1   4   5   4   3   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  71.0      0   0   0   0   0   4   4   5   3   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  70.0      0   0   0   0   6   7   6   4   2   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  69.0      0   0   0   0   3   7   4   5   4   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  68.0      0   0   0   0   0   3   1   3   2   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  67.0      0   0   0   0   0   0   0   1   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0

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  77.0      0   0   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  76.0      0   0   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  75.0      0   0   0   0   1   5   4   3   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  74.0      0   0   0   0   0   2   1   1   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  73.0      0   0   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  72.0      0   0   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  71.0      0   0   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  70.0      0   0   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  69.0      0   0   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  68.0      0   0   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  67.0      0   0   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0

 ------- month  10 ---------------
  77.0      0   0   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  76.0      5   5   2   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  75.0      5  11  10   9   7  18  15  22   0   0   0     0  0  0  0  0  0  0  1  0  0  0     0  0  0  0  0  0  0  7  0  0  0
  74.0      7   7  11  11  16  11   8  19  13   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  73.0      0   2   0   3   6   4   5   1   7   4   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  72.0      0   0   0   3   6   3   3   2   2   3   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  71.0      0   0   0   0   2   3   2   3   1   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  70.0      0   0   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  69.0      0   0   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  68.0      0   0   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  67.0      0   0   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0

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  77.0      0   4   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  76.0     38  25  12   0   0   0   0   0   0   0   0     5  2  0  0  0  0  0  0  0  0  0    12 11  0  0  0  0  0  0  0  0  0
  75.0     88 107  73  49  24  97  73  93   0   0   0     7  6  6  5  4  3  2  2  0  0  0    23 21 18 17 17 15 10 10  0  0  0
  74.0    122 100 147  78 105 110  75  92  56   0   0     8  8  8  8  8  7  5  4  2  0  0    23 28 23 30 29 26 21 17 11  0  0
  73.0    151 131  93 140  97  94 100  24  52  13   0     6  9  9  9  9  8  8  6  5  0  0    20 25 25 25 21 26 27 23 18  0  0
  72.0     39 176 143 100  83  48  74  53  22  11   0     1  5 10  9  9  8  9  9 10  0  0     7 23 34 31 19 22 25 32 33  0  0
  71.0      0  28  35  79  76  99  81  54  27   3   0     0  1  2  5  8  8  7 10  7  0  0     0  7  8 14 21 21 25 33 36  0  0
  70.0      0   0   0  20  89 106  65  63  24   1   0     0  0  0  0  3  6  8  9  7  0  0     0  0  0  0 18 26 25 33 15  0  0
  69.0      0   0   0   0  19  50  73  45   5   0   0     0  0  0  0  0  6  7  7  0  0  0     0  0  0  0  0 16 20 19  0  0  0
  68.0      0   0   0   0   0  16  45  42   9   0   0     0  0  0  0  0  0  6  7  0  0  0     0  0  0  0  0  0 17 18  0  0  0
  67.0      0   0   0   0   0   0   6  11   4   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0

 ------- month  12 ---------------
  77.0      0  12   0   0   0   0   0   0   0   0   0     0  0  0  0  0  0  0  0  0  0  0     0  0  0  0  0  0  0  0  0  0  0
  76.0    132  80  43   0   0   0   0   0   0   0   0     5  3  0  0  0  0  0  0  0  0  0    25 20  7  0  0  0  0  0  0  0  0
  75.0    214 221 126  95  57 222 155 207   0   0   0     6  5  4  4  3  3  2  1  0  0  0    18 29 16 18 11 15 10 14  0  0  0
  74.0    280 184 235 137 213 214 159 248 168   0   0     8  7  7  5  5  5  4  3  2  0  0    25 23 25 27 26 17 15 15 11  0  0
  73.0    340 305 212 243 222 214 202  61 184  81   0     5  9  9  8  7  6  5  4  3  0  0    23 32 28 29 28 22 16 16 16 11  0
  72.0     55 308 251 202 195 127 180 187  81  85   0     1  5  9  9  8  8  7  7  6  3  0     7 23 30 28 26 29 23 27 22 14  0
  71.0      0  47  69 149 165 205 161 147 109  40   4     0  1  3  4  9  8  9  9  9  7  0     0  5 12 26 25 28 34 23 25 25  0
  70.0      0   0   0  49 196 225 150 124 107  24   1     0  0  0  0  2  7  9  9  9  6  0     0  0  0  7 13 28 26 31 24 21  0
  69.0      0   0   0   0  38 115 142 107  31  17   2     0  0  0  0  1  5  8  8  7  0  0     0  0  0  0  5 16 23 21 19  0  0
  68.0      0   0   0   0   0  38 115  85  31  15   8     0  0  0  0  0  3  7  9  8  0  0     0  0  0  0  0 14 20 22 18  0  0
  67.0      0   0   0   0   0   0  19  53  26  13   3     0  0  0  0  0  0  0  8  8  0  0     0  0  0  0  0  0  0 22 15  0  0
```

B2. East Greenland ice drift

Monthly average and maximum ice drift (in equivalent velocity cm/s). Ice drift calculated in 0.5 by 3 degree grid boxes.

------- month 1 Number of datapoints---------------------Mean drift------------------------max drift------------

	-28	-25	-22	-19	-16	-13	-10	-7	-4																		
79.5	0	0	0	0	110	229	189	84	65	0	0	0	0	1	3	10	15	17	0	0	0	0	14	15	29	27	29
79.0	0	0	0	0	120	120	277	67	34	0	0	0	0	1	3	9	16	16	0	0	0	0	10	25	29	27	30
78.5	0	0	0	113	121	114	93	112	10	0	0	0	2	2	4	10	14	0	0	0	0	12	20	23	26	30	0
78.0	0	0	0	101	240	191	84	87	5	0	0	0	1	3	8	11	13	0	0	0	0	10	14	27	26	27	0
77.5	0	0	0	89	116	294	77	64	0	0	0	0	1	3	8	12	13	0	0	0	0	7	12	26	28	28	0
77.0	0	0	0	73	107	190	69	50	0	0	0	0	2	4	10	11	14	0	0	0	0	12	22	29	30	29	0
76.5	0	0	0	0	280	101	146	25	7	0	0	0	0	6	11	12	13	0	0	0	0	0	25	30	30	30	0
76.0	0	0	0	36	179	80	103	11	3	0	0	0	3	8	11	13	0	0	0	0	0	10	30	30	28	0	0
75.5	0	0	0	42	157	137	51	7	4	0	0	0	2	9	13	15	0	0	0	0	0	10	28	30	28	0	0
75.0	0	0	0	52	65	75	39	16	1	0	0	0	5	13	15	17	0	0	0	0	0	17	26	33	32	0	0
74.5	0	0	0	29	169	57	20	31	2	0	0	0	0	13	16	0	13	0	0	0	0	0	29	30	0	27	0
74.0	0	0	0	89	94	55	41	9	1	0	0	0	7	14	14	13	0	0	0	0	0	23	30	29	29	0	0
73.5	0	0	38	138	116	61	35	9	2	0	0	0	12	15	13	13	0	0	0	0	2	28	35	27	29	0	0
73.0	0	0	47	136	74	48	36	10	2	0	0	1	11	15	11	13	0	0	0	0	14	26	34	31	30	0	0
72.5	0	0	89	156	55	44	15	8	4	0	0	4	14	14	12	0	0	0	0	0	19	31	25	27	0	0	0
72.0	0	0	79	65	46	18	15	6	3	0	0	9	15	15	0	0	0	0	0	0	24	31	26	0	0	0	0
71.5	0	0	17	90	38	33	13	3	2	0	0	0	14	14	14	0	0	0	0	0	0	33	30	30	0	0	0
71.0	0	0	16	40	29	11	4	3	1	0	0	0	13	11	0	0	0	0	0	0	0	28	26	0	0	0	0
70.5	0	0	11	34	15	6	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	31	0	0	0	0	0
70.0	0	0	5	11	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69.5	0	0	5	7	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69.0	0	4	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.5	0	2	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

------- month 2 ---------------

	-28	-25	-22	-19	-16	-13	-10	-7	-4																		
79.5	0	0	0	0	145	273	230	116	100	0	0	0	0	1	3	9	14	16	0	0	0	0	10	15	30	29	30
79.0	0	0	0	0	140	148	366	100	59	0	0	0	0	1	2	9	14	15	0	0	0	0	9	19	27	26	28
78.5	0	0	0	127	145	144	122	176	25	0	0	0	2	2	4	10	13	13	0	0	0	12	22	22	25	27	21
78.0	0	0	0	106	299	259	119	143	9	0	0	0	1	3	8	11	13	0	0	0	0	8	18	23	28	30	0
77.5	0	0	0	108	135	379	112	104	2	0	0	0	1	3	8	12	12	0	0	0	0	7	14	26	32	28	0
77.0	0	0	0	97	122	217	93	66	0	0	0	0	2	4	10	11	11	0	0	0	0	11	21	29	26	25	0
76.5	0	0	0	0	292	90	157	30	6	0	0	0	0	5	11	12	10	0	0	0	0	0	28	29	32	21	0
76.0	0	0	0	46	183	78	98	18	1	0	0	0	1	8	12	12	0	0	0	0	0	5	35	30	29	0	0
75.5	0	0	0	59	158	112	48	5	8	0	0	0	2	8	12	13	0	0	0	0	0	10	26	31	30	0	0
75.0	0	0	0	49	55	68	25	9	4	0	0	0	5	12	16	16	0	0	0	0	0	18	22	35	32	0	0
74.5	0	0	0	32	142	46	12	27	3	0	0	0	0	11	15	0	13	0	0	0	0	3	27	31	0	29	0
74.0	0	0	0	67	51	28	26	23	5	0	0	0	7	11	13	12	10	0	0	0	0	19	22	25	28	26	0
73.5	0	0	22	78	59	21	21	20	6	0	0	0	11	11	11	10	0	0	0	0	0	22	28	20	26	0	0
73.0	0	0	31	86	43	20	28	13	5	0	0	3	11	12	0	9	0	0	0	0	11	24	29	0	25	0	0
72.5	0	0	60	98	28	23	15	8	6	0	0	5	12	8	10	0	0	0	0	0	21	28	21	20	0	0	0
72.0	0	0	58	47	18	12	11	5	3	0	0	10	12	0	0	0	0	0	0	0	23	27	0	0	0	0	0
71.5	0	0	13	57	16	16	11	4	1	0	0	0	14	0	0	0	0	0	0	0	0	28	0	0	0	0	0
71.0	0	0	10	21	9	6	2	1	0	0	0	0	13	0	0	0	0	0	0	0	0	25	0	0	0	0	0
70.5	0	0	6	17	7	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70.0	0	0	2	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69.5	0	0	4	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69.0	0	2	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.5	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67.5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

------- month 3 ---------------

	-28	-25	-22	-19	-16	-13	-10	-7	-4																		
79.5	0	0	0	0	147	273	248	111	88	0	0	0	0	1	3	11	14	15	0	0	0	0	11	20	26	29	26
79.0	0	0	0	0	137	137	360	94	53	0	0	0	0	2	3	9	14	14	0	0	0	0	11	14	29	29	28
78.5	0	0	0	133	142	140	126	166	18	0	0	0	2	2	5	11	13	0	0	0	0	10	13	23	30	28	0
78.0	0	0	0	122	289	265	124	137	9	0	0	0	1	3	9	12	14	0	0	0	0	9	17	26	30	35	0
77.5	0	0	0	108	142	393	114	104	6	0	0	0	1	4	9	12	13	0	0	0	0	10	19	30	31	29	0
77.0	0	0	0	98	137	254	99	69	1	0	0	0	1	5	10	11	12	0	0	0	0	12	17	32	28	23	0
76.5	0	0	0	0	366	123	184	31	7	0	0	0	0	6	11	12	12	0	0	0	0	0	23	23	30	25	0
76.0	0	0	0	50	236	106	109	15	4	0	0	0	1	8	12	14	0	0	0	0	0	7	26	27	30	0	0
75.5	0	0	0	72	214	151	48	14	11	0	0	0	3	10	14	16	0	0	0	0	0	12	28	30	37	0	0
75.0	0	0	0	69	76	84	38	27	4	0	0	0	6	13	17	17	17	0	0	0	0	18	26	30	35	33	0
74.5	0	0	0	39	217	57	18	33	2	0	0	0	0	14	19	0	16	0	0	0	0	10	30	35	0	31	0
74.0	0	0	0	100	104	43	27	10	2	0	0	0	8	15	16	16	0	0	0	0	0	23	32	34	24	0	0
73.5	0	0	21	155	117	41	22	8	3	0	0	0	13	15	16	15	0	0	0	0	2	33	33	33	24	0	0
73.0	0	0	21	125	91	33	23	4	4	0	0	2	13	15	16	14	0	0	0	0	9	30	34	32	23	0	0
72.5	0	0	57	144	47	24	7	6	5	0	0	6	14	15	13	0	0	0	0	0	18	34	32	22	0	0	0
72.0	0	0	75	79	38	9	3	8	5	0	0	11	15	13	0	0	0	0	0	0	25	31	32	0	0	0	0
71.5	0	0	23	109	41	13	5	9	4	0	0	16	16	13	0	0	0	0	0	0	23	31	31	0	0	0	0
71.0	0	0	26	59	30	7	1	6	1	0	0	16	14	13	0	0	0	0	0	0	29	30	30	0	0	0	0
70.5	0	0	23	56	15	7	0	0	0	0	0	15	14	0	0	0	0	0	0	0	27	30	0	0	0	0	0
70.0	0	0	9	25	16	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	29	0	0	0	0	0
69.5	0	0	12	26	7	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	22	0	0	0	0	0
69.0	0	5	18	9	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.5	0	6	11	12	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.0	9	19	11	14	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67.5	14	11	7	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

------- month 4 ---- Number of datapoints-------------------Mean drift------------------------max drift----------------

-28 -25 -22 -19 -16 -13 -10 -7 -4

79.5	0	0	0	0	196	370	333	192	177	0	0	0	0	1	4	11	15	16	0	0	0	0	12	29	30	34	32
79.0	0	0	0	0	178	177	537	173	130	0	0	0	0	2	2	9	15	16	0	0	0	0	11	12	31	35	33
78.5	0	0	0	151	194	189	205	325	45	0	0	0	2	2	4	10	14	16	0	0	0	14	14	23	29	34	33
78.0	0	0	0	124	373	394	193	256	23	0	0	0	1	3	8	11	14	15	0	0	0	8	16	25	28	35	28
77.5	0	0	0	138	177	557	187	211	15	0	0	0	1	3	8	11	14	0	0	0	0	9	16	29	30	33	0
77.0	0	0	0	130	171	373	170	153	9	0	0	0	2	4	9	11	13	0	0	0	0	13	16	25	25	32	0
76.5	0	0	0	0	488	184	311	66	20	0	0	0	0	6	10	11	14	0	0	0	0	0	20	27	29	31	0
76.0	0	0	0	82	319	157	219	22	6	0	0	0	2	8	12	12	18	0	0	0	0	11	28	29	32	33	0
75.5	0	0	0	101	309	243	85	6	11	0	0	0	3	9	13	14	0	0	0	0	0	15	23	32	33	0	0
75.0	0	0	0	120	138	163	31	11	5	0	0	0	5	12	16	17	0	0	0	0	0	20	26	36	28	0	0
74.5	0	0	0	71	382	89	13	21	2	0	0	0	0	13	19	0	15	0	0	0	0	10	31	32	0	27	0
74.0	0	0	0	191	210	63	20	8	2	0	0	0	7	14	15	0	0	0	0	0	0	25	31	29	0	0	0
73.5	0	0	56	253	221	97	24	7	0	0	0	0	11	13	13	13	0	0	0	0	7	27	31	33	26	0	0
73.0	0	0	58	228	170	77	38	6	1	0	0	3	10	13	10	11	0	0	0	0	12	24	32	34	24	0	0
72.5	0	0	113	313	137	68	19	10	2	0	0	6	12	12	11	0	0	0	0	0	20	28	30	30	0	0	0
72.0	0	0	123	184	103	43	17	6	2	0	0	10	12	12	9	0	0	0	0	0	22	26	31	21	0	0	0
71.5	0	0	44	229	113	64	14	3	0	0	0	13	13	10	10	0	0	0	0	0	23	35	29	29	0	0	0
71.0	0	0	48	132	87	27	3	0	0	0	0	14	12	10	10	0	0	0	0	0	25	24	33	31	0	0	0
70.5	0	0	45	139	49	23	0	0	0	0	0	13	12	12	10	0	0	0	0	0	28	34	35	26	0	0	0
70.0	0	0	18	64	65	5	0	0	0	0	0	0	11	11	0	0	0	0	0	0	0	33	35	0	0	0	0
69.5	0	0	23	70	46	5	0	0	0	0	0	10	9	9	0	0	0	0	0	0	23	23	37	0	0	0	0
69.0	0	7	36	42	24	0	0	0	0	0	0	10	8	5	0	0	0	0	0	0	20	25	16	0	0	0	0
68.5	0	13	25	36	9	0	0	0	0	0	0	7	7	0	0	0	0	0	0	0	16	29	0	0	0	0	0
68.0	14	32	26	20	4	0	0	0	0	0	9	6	0	0	0	0	0	0	0	21	14	0	0	0	0	0	0
67.5	21	11	16	2	0	0	0	0	0	8	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0

------- month 5 ---------------

	-28	-25	-22	-19	-16	-13	-10	-7	-4																		
79.5	0	0	0	0	228	401	259	148	135	0	0	0	0	2	4	8	12	13	0	0	0	0	14	26	25	28	30
79.0	0	0	0	0	204	204	461	126	90	0	0	0	0	2	3	7	12	14	0	0	0	0	11	14	28	28	31
78.5	0	0	0	119	188	185	180	276	42	0	0	0	2	2	3	8	11	14	0	0	0	10	12	14	21	30	35
78.0	0	0	0	83	365	382	211	250	21	0	0	0	2	3	6	9	12	14	0	0	0	10	16	25	27	31	30
77.5	0	0	0	119	180	607	213	216	8	0	0	0	1	3	6	9	11	0	0	0	0	11	15	27	30	33	0
77.0	0	0	0	124	182	402	207	168	0	0	0	0	2	4	8	9	10	0	0	0	0	13	22	27	30	30	0
76.5	0	0	0	0	541	214	390	74	17	0	0	0	0	5	9	8	10	0	0	0	0	0	23	26	25	27	0
76.0	0	0	0	82	379	195	281	27	2	0	0	0	2	6	9	9	12	0	0	0	0	17	25	28	28	29	0
75.5	0	0	0	106	352	323	112	7	2	0	0	0	3	7	10	12	0	0	0	0	0	14	25	28	33	0	0
75.0	0	0	0	123	149	187	47	11	1	0	0	0	4	10	13	11	0	0	0	0	0	18	28	30	28	0	0
74.5	0	0	0	96	383	102	19	28	3	0	0	0	1	9	14	0	8	0	0	0	0	17	28	30	0	25	0
74.0	0	0	0	260	224	71	32	12	1	0	0	0	5	12	11	10	0	0	0	0	0	21	34	25	23	0	0
73.5	0	0	116	327	260	112	37	9	1	0	0	0	9	11	9	9	0	0	0	0	17	32	30	23	21	0	0
73.0	0	0	115	327	202	86	35	5	0	0	0	2	8	10	8	9	0	0	0	0	16	30	27	23	16	0	0
72.5	0	0	194	370	151	66	6	3	0	0	0	4	9	9	9	0	0	0	0	0	16	37	28	25	0	0	0
72.0	0	0	189	173	92	25	5	2	0	0	0	6	8	7	8	0	0	0	0	0	18	33	20	20	0	0	0
71.5	0	0	42	184	58	23	8	0	0	0	0	8	10	7	8	0	0	0	0	0	21	29	23	20	0	0	0
71.0	0	0	43	83	32	7	0	0	0	0	0	9	10	6	0	0	0	0	0	0	24	27	19	0	0	0	0
70.5	0	0	44	83	20	3	0	0	0	0	0	9	8	0	0	0	0	0	0	0	22	23	0	0	0	0	0
70.0	0	0	19	36	12	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	20	0	0	0	0	0
69.5	0	0	21	30	1	0	0	0	0	0	0	9	7	0	0	0	0	0	0	0	14	15	0	0	0	0	0
69.0	0	5	23	3	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0
68.5	0	10	7	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.0	8	21	6	1	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0
67.5	9	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

------- month 6 ---------------

	-28	-25	-22	-19	-16	-13	-10	-7	-4																		
79.5	0	0	0	0	201	357	191	70	51	0	0	0	0	2	4	7	9	8	0	0	0	0	10	15	19	20	18
79.0	0	0	0	0	217	210	340	41	22	0	0	0	0	1	3	5	9	9	0	0	0	0	11	12	19	20	15
78.5	0	0	0	143	206	176	120	104	6	0	0	0	3	2	3	5	7	0	0	0	0	14	11	15	23	21	0
78.0	0	0	0	98	335	282	133	104	4	0	0	0	1	2	4	6	7	0	0	0	0	11	14	26	22	17	0
77.5	0	0	0	113	162	425	141	109	1	0	0	0	1	3	5	5	6	0	0	0	0	14	14	20	17	15	0
77.0	0	0	0	105	149	289	149	91	0	0	0	0	2	3	6	5	6	0	0	0	0	12	14	23	16	22	0
76.5	0	0	0	0	414	147	269	27	0	0	0	0	0	4	6	5	5	0	0	0	0	0	18	20	21	16	0
76.0	0	0	0	90	310	150	154	3	0	0	0	0	2	4	6	5	0	0	0	0	0	10	14	16	21	0	0
75.5	0	0	0	125	315	213	41	0	0	0	0	0	2	5	7	7	0	0	0	0	0	12	14	16	21	0	0
75.0	0	0	0	111	115	88	7	0	0	0	0	0	3	6	9	0	0	0	0	0	0	11	18	19	0	0	0
74.5	0	0	0	103	273	17	1	0	0	0	0	0	0	6	0	0	0	0	0	0	0	9	19	0	0	0	0
74.0	0	0	0	193	105	10	0	0	0	0	0	0	4	8	0	0	0	0	0	0	0	16	19	0	0	0	0
73.5	0	0	99	237	160	33	6	0	0	0	0	1	6	8	6	0	0	0	0	0	14	17	19	18	0	0	0
73.0	0	0	102	244	138	36	9	0	0	0	0	2	6	8	7	0	0	0	0	0	9	19	25	16	0	0	0
72.5	0	0	196	284	107	58	4	0	0	0	0	3	7	7	7	0	0	0	0	0	14	23	25	21	0	0	0
72.0	0	0	196	120	60	21	0	0	0	0	0	5	6	5	8	0	0	0	0	0	15	18	18	21	0	0	0
71.5	0	0	40	150	28	6	0	0	0	0	0	5	6	4	0	0	0	0	0	0	11	26	12	0	0	0	0
71.0	0	0	43	50	10	1	0	0	0	0	0	6	7	0	0	0	0	0	0	0	25	24	0	0	0	0	0
70.5	0	0	40	44	2	0	0	0	0	0	0	6	7	0	0	0	0	0	0	0	23	29	0	0	0	0	0
70.0	0	0	11	21	3	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	23	0	0	0	0	0
69.5	0	0	11	17	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69.0	0	2	12	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.5	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.0	6	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67.5	12	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

------- month 7 ---- Number of datapoints-------------------Mean drift------------------------max drift----------------

	-28	-25	-22	-19	-16	-13	-10	-7	-4																		
79.5	0	0	0	0	134	197	96	34	20	0	0	0	0	2	4	6	6	0	0	0	0	0	12	13	15	14	0
79.0	0	0	0	0	168	122	190	28	14	0	0	0	0	1	4	4	6	0	0	0	0	0	10	14	15	12	0
78.5	0	0	0	167	168	133	62	53	5	0	0	0	2	2	3	5	5	0	0	0	0	11	10	14	14	13	0
78.0	0	0	0	142	336	211	55	43	4	0	0	0	1	3	4	4	4	0	0	0	0	11	12	14	12	14	0
77.5	0	0	0	118	161	277	43	36	2	0	0	0	1	3	5	4	5	0	0	0	0	5	12	15	11	11	0
77.0	0	0	0	106	137	104	31	22	4	0	0	0	3	4	5	4	5	0	0	0	0	14	13	15	12	10	0
76.5	0	0	0	0	294	44	64	12	3	0	0	0	0	3	5	5	0	0	0	0	0	0	14	11	14	0	0
76.0	0	0	0	68	169	38	48	6	0	0	0	0	3	4	5	4	0	0	0	0	0	10	12	14	10	0	0
75.5	0	0	0	96	180	71	12	0	0	0	0	0	2	4	4	0	0	0	0	0	0	12	15	21	0	0	0
75.0	0	0	0	67	41	28	1	0	0	0	0	0	4	4	6	0	0	0	0	0	0	13	11	19	0	0	0
74.5	0	0	0	46	111	1	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	5	15	0	0	0	0
74.0	0	0	0	86	21	3	0	0	0	0	0	0	3	5	0	0	0	0	0	0	0	14	11	0	0	0	0
73.5	0	0	36	87	32	7	3	0	0	0	0	1	5	6	0	0	0	0	0	0	7	13	12	0	0	0	0
73.0	0	0	38	80	23	15	6	0	0	0	0	1	5	6	0	0	0	0	0	0	8	12	14	0	0	0	0
72.5	0	0	69	60	20	21	4	0	0	0	0	3	6	0	6	0	0	0	0	0	12	16	0	13	0	0	0
72.0	0	0	53	19	20	9	0	0	0	0	0	4	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0

71.5	0	0	9	41	15	9	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	25	0	0	0	0	0
71.0	0	0	14	21	9	1	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	15	0	0	0	0	0
70.5	0	0	13	14	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70.0	0	0	8	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69.5	0	0	7	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69.0	0	1	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.5	0	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.0	6	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67.5	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

------- month 8 ---------------

	-28	-25	-22	-19	-16	-13	-10	-7	-4																		
79.5	0	0	0	0	95	146	69	16	13	0	0	0	0	3	4	6	0	0	0	0	0	0	10	14	16	0	0
79.0	0	0	0	0	129	101	107	9	9	0	0	0	0	1	4	4	0	0	0	0	0	0	12	12	12	0	0
78.5	0	0	0	111	131	105	25	17	3	0	0	0	2	2	3	6	0	0	0	0	0	11	12	11	17	0	0
78.0	0	0	0	85	263	126	26	17	0	0	0	0	1	3	4	6	0	0	0	0	0	10	14	15	10	0	0
77.5	0	0	0	63	102	165	17	12	0	0	0	0	1	4	4	0	0	0	0	0	0	5	14	14	0	0	0
77.0	0	0	0	36	59	29	13	4	0	0	0	0	4	4	5	0	0	0	0	0	0	11	12	11	0	0	0
76.5	0	0	0	0	105	10	4	1	1	0	0	0	0	4	0	0	0	0	0	0	0	0	16	0	0	0	0
76.0	0	0	0	22	66	8	4	0	0	0	0	0	2	3	0	0	0	0	0	0	0	6	12	0	0	0	0
75.5	0	0	0	40	84	15	2	0	0	0	0	0	2	4	0	0	0	0	0	0	0	10	12	0	0	0	0
75.0	0	0	0	36	6	3	3	1	0	0	0	0	3	0	0	0	0	0	0	0	0	14	0	0	0	0	0
74.5	0	0	0	16	29	3	2	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	7	0	0	0	0
74.0	0	0	0	34	4	3	5	0	0	0	0	0	2	0	0	0	0	0	0	0	0	7	0	0	0	0	0
73.5	0	0	16	32	4	3	2	0	0	0	0	0	5	0	0	0	0	0	0	0	0	10	0	0	0	0	0
73.0	0	0	14	25	1	2	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	11	0	0	0	0	0
72.5	0	0	22	7	0	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0
72.0	0	0	19	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71.5	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71.0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70.0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69.5	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69.0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

------- month 9 ---------------

	-28	-25	-22	-19	-16	-13	-10	-7	-4																		
79.5	0	0	0	0	68	87	29	13	8	0	0	0	0	3	5	7	0	0	0	0	0	0	11	16	27	0	0
79.0	0	0	0	0	77	60	74	9	5	0	0	0	0	1	4	5	0	0	0	0	0	0	7	14	15	0	0
78.5	0	0	0	85	74	55	26	17	2	0	0	0	2	2	3	6	0	0	0	0	0	12	14	11	15	0	0
78.0	0	0	0	74	177	92	20	10	1	0	0	0	2	3	3	0	0	0	0	0	0	14	15	15	0	0	0
77.5	0	0	0	64	87	142	15	5	0	0	0	0	1	3	4	0	0	0	0	0	0	5	18	18	0	0	0
77.0	0	0	0	54	69	48	12	4	0	0	0	0	2	4	5	0	0	0	0	0	0	10	18	12	0	0	0
76.5	0	0	0	0	142	17	21	2	0	0	0	0	0	4	0	5	0	0	0	0	0	0	14	0	10	0	0
76.0	0	0	0	28	75	7	9	1	0	0	0	0	2	5	0	0	0	0	0	0	0	10	12	0	0	0	0
75.5	0	0	0	32	66	14	2	0	0	0	0	0	1	5	0	0	0	0	0	0	0	8	11	0	0	0	0
75.0	0	0	0	21	10	6	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	10	0	0	0	0	0
74.5	0	0	0	12	30	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	15	0	0	0	0
74.0	0	0	0	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73.5	0	0	14	24	4	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	12	0	0	0	0	0
73.0	0	0	15	27	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	12	0	0	0	0	0
72.5	0	0	31	15	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0
72.0	0	0	24	4	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0
71.5	0	0	5	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71.0	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70.5	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

------- month 10 ---- Number of datapoints-------------------Mean drift-------------------------max drift----------------

	-28	-25	-22	-19	-16	-13	-10	-7	-4																		
79.5	0	0	0	0	103	201	166	63	52	0	0	0	0	1	3	7	10	11	0	0	0	0	11	12	18	18	18
79.0	0	0	0	0	111	103	249	58	33	0	0	0	0	1	2	6	11	12	0	0	0	0	8	12	21	20	20
78.5	0	0	0	121	123	105	77	104	13	0	0	0	2	2	3	6	9	0	0	0	0	10	10	10	21	22	0
78.0	0	0	0	107	275	195	82	87	5	0	0	0	2	2	5	7	10	0	0	0	0	10	12	19	19	26	0
77.5	0	0	0	119	138	324	79	66	1	0	0	0	1	3	5	7	10	0	0	0	0	7	21	17	18	22	0
77.0	0	0	0	113	132	191	68	42	0	0	0	0	2	4	7	7	9	0	0	0	0	10	15	25	18	23	0
76.5	0	0	0	0	360	93	121	14	0	0	0	0	0	4	8	8	0	0	0	0	0	0	19	28	16	0	0
76.0	0	0	0	66	217	76	64	1	0	0	0	0	1	5	8	9	0	0	0	0	0	12	19	21	19	0	0
75.5	0	0	0	87	214	114	11	0	0	0	0	0	2	5	9	0	0	0	0	0	0	10	17	23	0	0	0
75.0	0	0	0	70	46	26	3	0	0	0	0	0	3	8	8	0	0	0	0	0	0	12	14	21	0	0	0
74.5	0	0	0	47	102	4	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	18	0	0	0	0
74.0	0	0	0	87	9	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	15	0	0	0	0	0
73.5	0	0	30	73	7	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	7	14	0	0	0	0	0
73.0	0	0	27	65	1	0	0	0	0	0	0	2	7	0	0	0	0	0	0	0	9	18	0	0	0	0	0
72.5	0	0	50	42	1	0	0	0	0	0	0	4	8	0	0	0	0	0	0	0	11	18	0	0	0	0	0
72.0	0	0	44	9	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0
71.5	0	0	3	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71.0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70.5	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

------- month 11 ---------------

	-28	-25	-22	-19	-16	-13	-10	-7	-4																		
79.5	0	0	0	0	75	165	155	78	68	0	0	0	0	1	3	8	12	14	0	0	0	0	7	14	20	24	27
79.0	0	0	0	0	91	84	241	76	55	0	0	0	0	2	2	7	13	14	0	0	0	0	12	10	20	23	26
78.5	0	0	0	101	111	99	91	133	30	0	0	0	2	1	3	8	12	15	0	0	0	11	11	14	21	29	25

78.0	0	0	0	87	229	198	104	124	9	0	0	0	2	2	6	10	13	0	0	0	0	14	14	24	23	29	0
77.5	0	0	0	93	118	316	100	105	6	0	0	0	1	2	6	11	13	0	0	0	0	7	9	24	25	29	0
77.0	0	0	0	89	113	203	94	77	0	0	0	0	1	3	8	12	13	0	0	0	0	7	11	24	26	30	0
76.5	0	0	0	0	319	104	163	36	8	0	0	0	0	4	9	11	13	0	0	0	0	0	20	20	27	31	0
76.0	0	0	0	56	215	97	113	17	3	0	0	0	2	6	10	12	0	0	0	0	0	7	21	23	30	0	0
75.5	0	0	0	70	201	148	46	6	1	0	0	0	2	7	11	14	0	0	0	0	0	9	19	31	32	0	0
75.0	0	0	0	75	60	65	20	5	0	0	0	0	4	11	14	0	0	0	0	0	0	18	23	35	0	0	0
74.5	0	0	0	46	163	40	7	6	0	0	0	0	0	10	17	0	0	0	0	0	0	0	26	32	0	0	0
74.0	0	0	0	97	65	28	8	0	0	0	0	0	5	15	13	0	0	0	0	0	0	17	28	25	0	0	0
73.5	0	0	33	96	58	27	6	0	0	0	0	0	9	15	15	0	0	0	0	0	0	20	30	23	0	0	0
73.0	0	0	39	87	31	14	6	0	0	0	0	1	8	15	0	0	0	0	0	0	12	20	31	0	0	0	0
72.5	0	0	60	58	14	9	0	0	0	0	0	3	10	0	0	0	0	0	0	0	15	25	0	0	0	0	0
72.0	0	0	56	13	7	3	0	0	0	0	0	7	0	0	0	0	0	0	0	0	19	0	0	0	0	0	0
71.5	0	0	16	26	7	3	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	20	0	0	0	0	0
71.0	0	0	11	12	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70.5	0	0	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70.0	0	0	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69.5	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69.0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.5	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

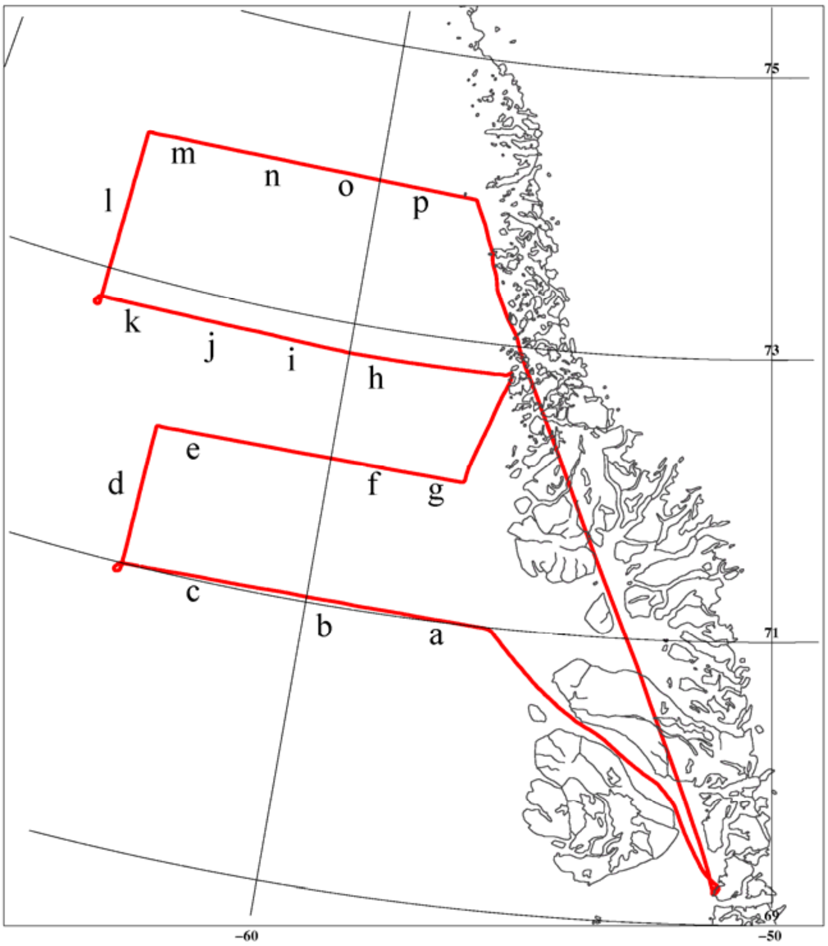
------- month 12 ---------------

	-28	-25	-22	-19	-16	-13	-10	-7	-4																		
79.5	0	0	0	0	137	279	213	114	100	0	0	0	0	1	3	10	14	17	0	0	0	0	10	15	27	28	31
79.0	0	0	0	0	144	142	371	105	71	0	0	0	0	1	3	9	15	15	0	0	0	0	8	16	30	29	26
78.5	0	0	0	135	150	136	122	209	32	0	0	0	2	2	3	10	14	15	0	0	0	10	12	20	27	30	28
78.0	0	0	0	115	309	257	118	158	27	0	0	0	2	3	7	11	14	16	0	0	0	9	20	25	27	32	28
77.5	0	0	0	115	147	395	111	125	14	0	0	0	1	3	7	12	14	0	0	0	0	9	12	23	26	26	0
77.0	0	0	0	103	132	252	107	111	9	0	0	0	1	4	9	12	15	0	0	0	0	9	25	26	25	28	0
76.5	0	0	0	0	381	125	217	50	29	0	0	0	0	5	10	12	15	15	0	0	0	0	25	26	30	34	24
76.0	0	0	0	63	260	117	162	34	21	0	0	0	2	7	12	14	16	17	0	0	0	12	29	25	32	32	30
75.5	0	0	0	73	251	204	100	23	23	0	0	0	3	8	13	16	17	13	0	0	0	11	22	30	30	35	25
75.0	0	0	0	83	104	134	74	34	12	0	0	0	5	14	17	17	13	0	0	0	0	18	26	35	30	29	0
74.5	0	0	0	50	284	99	34	70	11	0	0	0	0	13	18	14	12	0	0	0	0	7	32	35	31	26	0
74.0	0	0	0	129	154	80	57	36	15	0	0	0	8	16	15	13	14	0	0	0	0	20	33	31	27	23	0
73.5	0	0	40	193	155	87	58	28	13	0	0	0	13	16	14	14	13	0	0	0	7	25	32	33	28	26	0
73.0	0	0	49	175	128	76	66	10	9	0	0	1	12	16	12	13	0	0	0	0	5	26	32	34	29	0	0
72.5	0	0	105	231	96	59	23	7	7	0	0	5	15	15	12	14	0	0	0	0	17	31	32	32	29	0	0
72.0	0	0	112	116	58	31	16	7	4	0	0	10	16	13	13	0	0	0	0	0	23	34	30	30	0	0	0
71.5	0	0	33	162	52	31	11	3	3	0	0	12	16	13	13	0	0	0	0	0	25	32	33	25	0	0	0
71.0	0	0	34	64	19	7	1	2	1	0	0	14	16	0	0	0	0	0	0	0	26	32	0	0	0	0	0
70.5	0	0	26	57	9	2	0	0	0	0	0	14	15	0	0	0	0	0	0	0	23	34	0	0	0	0	0
70.0	0	0	11	16	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69.5	0	0	14	18	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69.0	0	4	12	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.5	0	2	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.0	1	3	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67.5	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

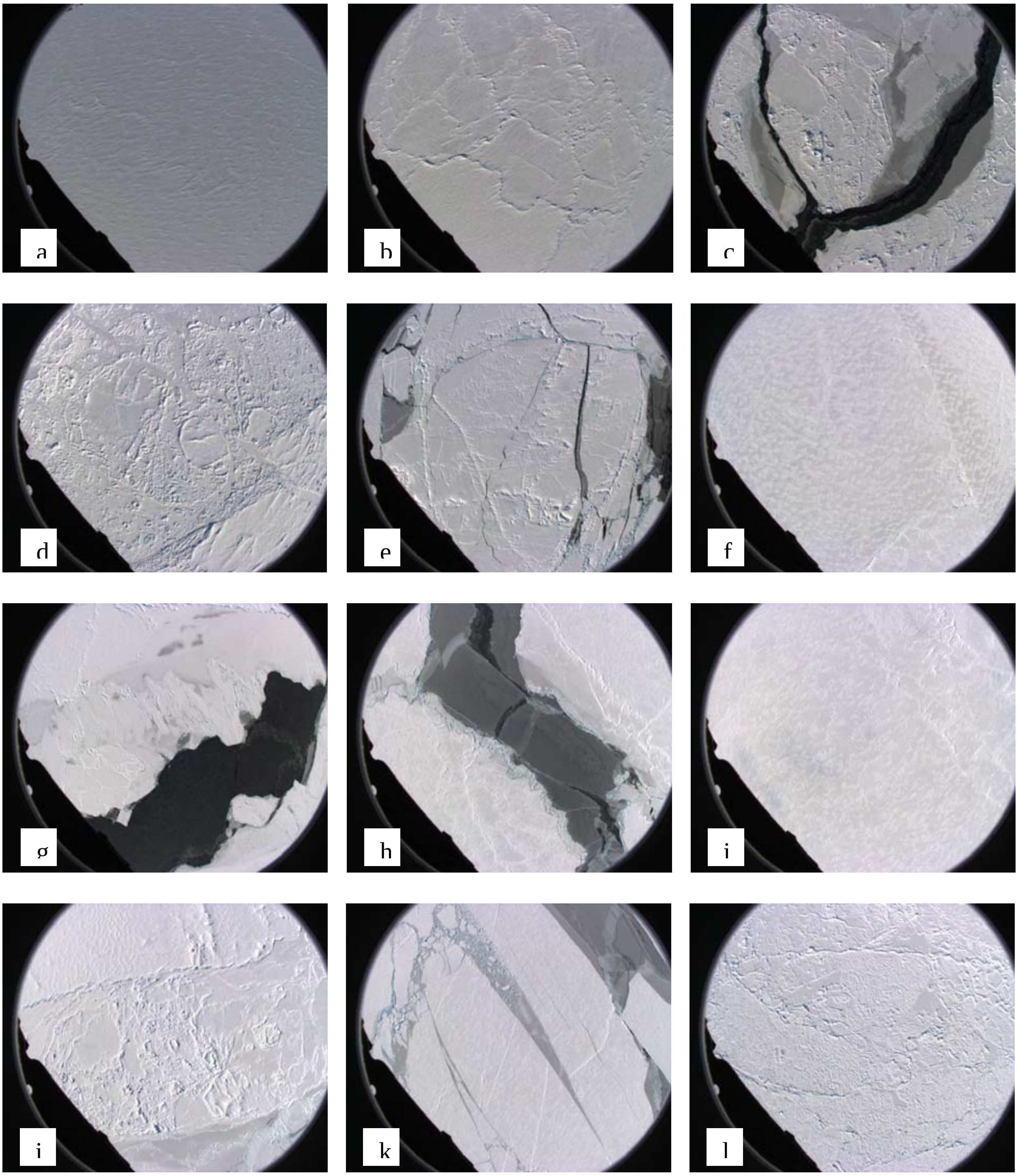
Appendix C. Nadir-looking imagery from the Twin-Otter.

The images shown in this appendix all are from a downward looking digital camera, taking overlapping images at 2 sec intervals. The images are taken from a height of about 1000 ft, and the view angle slightly larger than the laser scanner swath, implying a diameter of the images of around 350-400 m with some degree of "fish-eye" representation (the round outline is mainly due to the limited amount of space in the aircraft hole used also for the scanner, though).

C1. West Greenland Flights – April 19



JD 110, April 19, 2008. Letters show where the pictures were taken.


a
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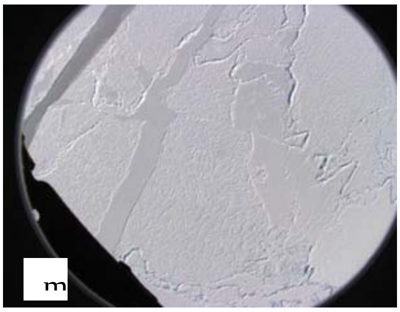
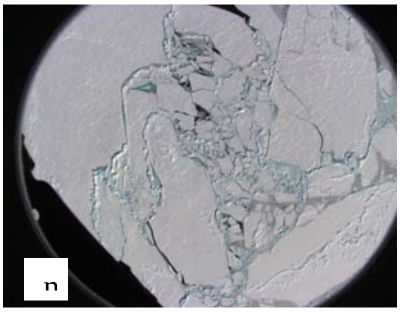
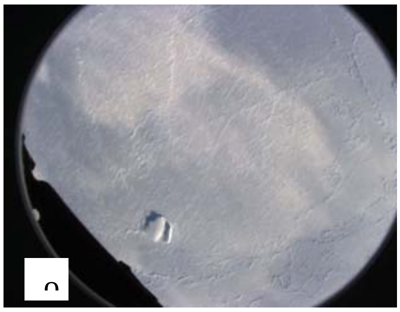
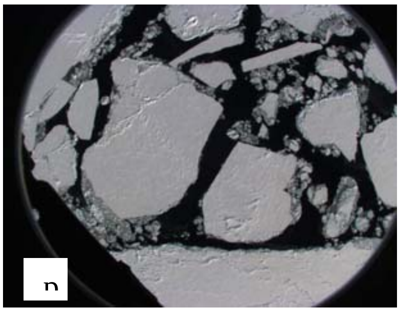
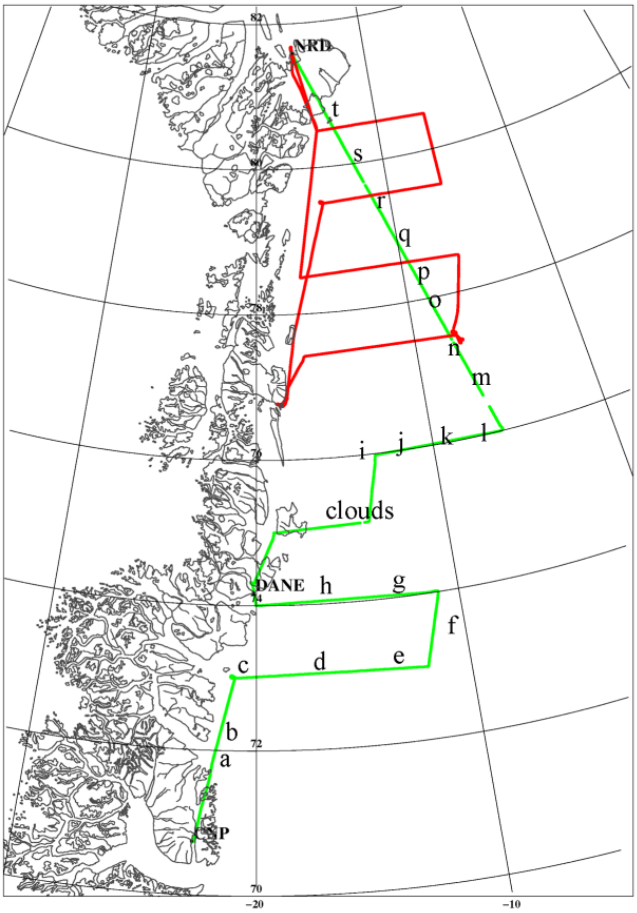





C2. East Greenland flights – April 21

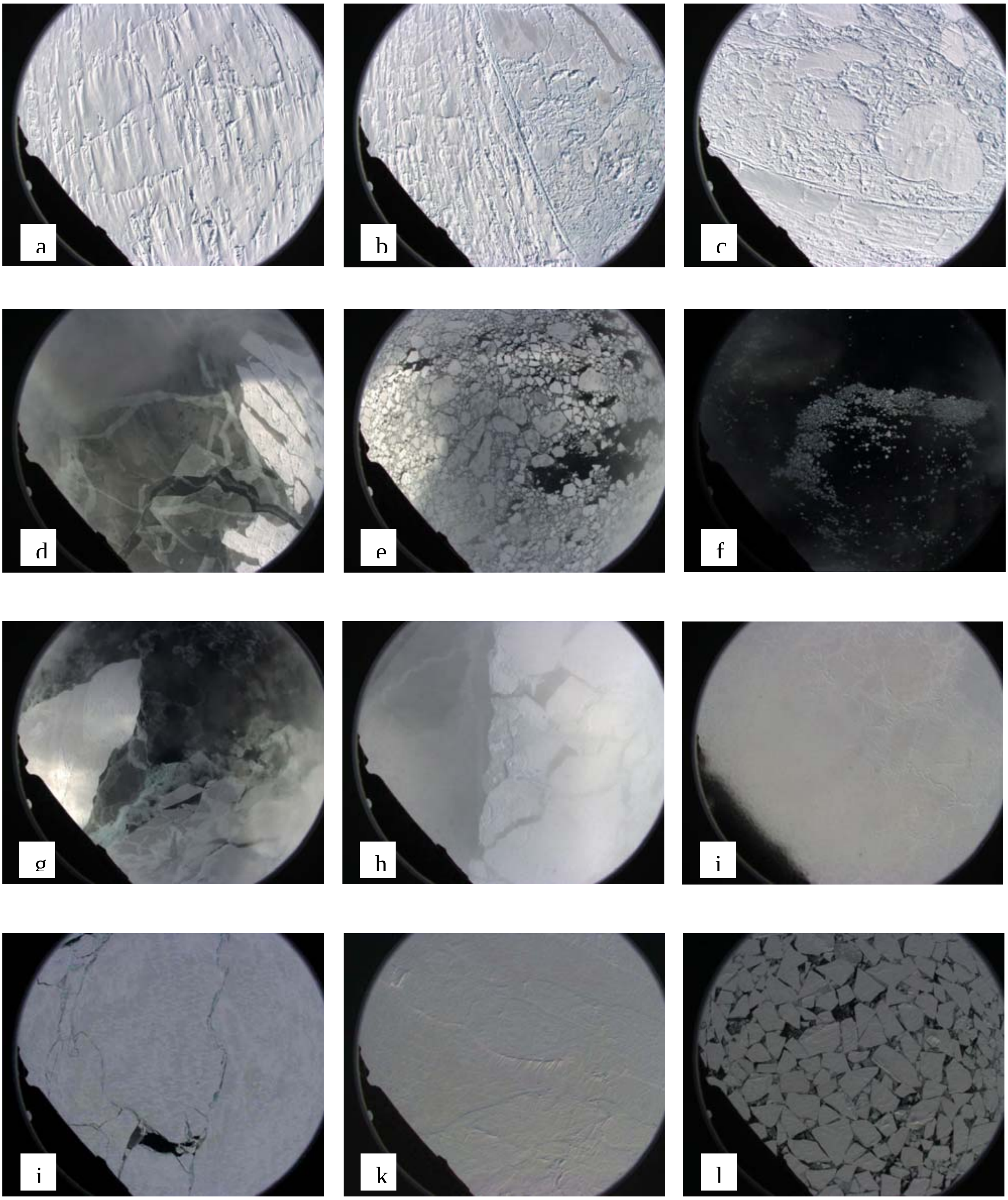


The East Greenland flights are shown over two days.

In the sequel is shown the flight of

JD 112, April 21, 2008

Scatterede holes in the clouds allowed images also to be takern on the southern lines.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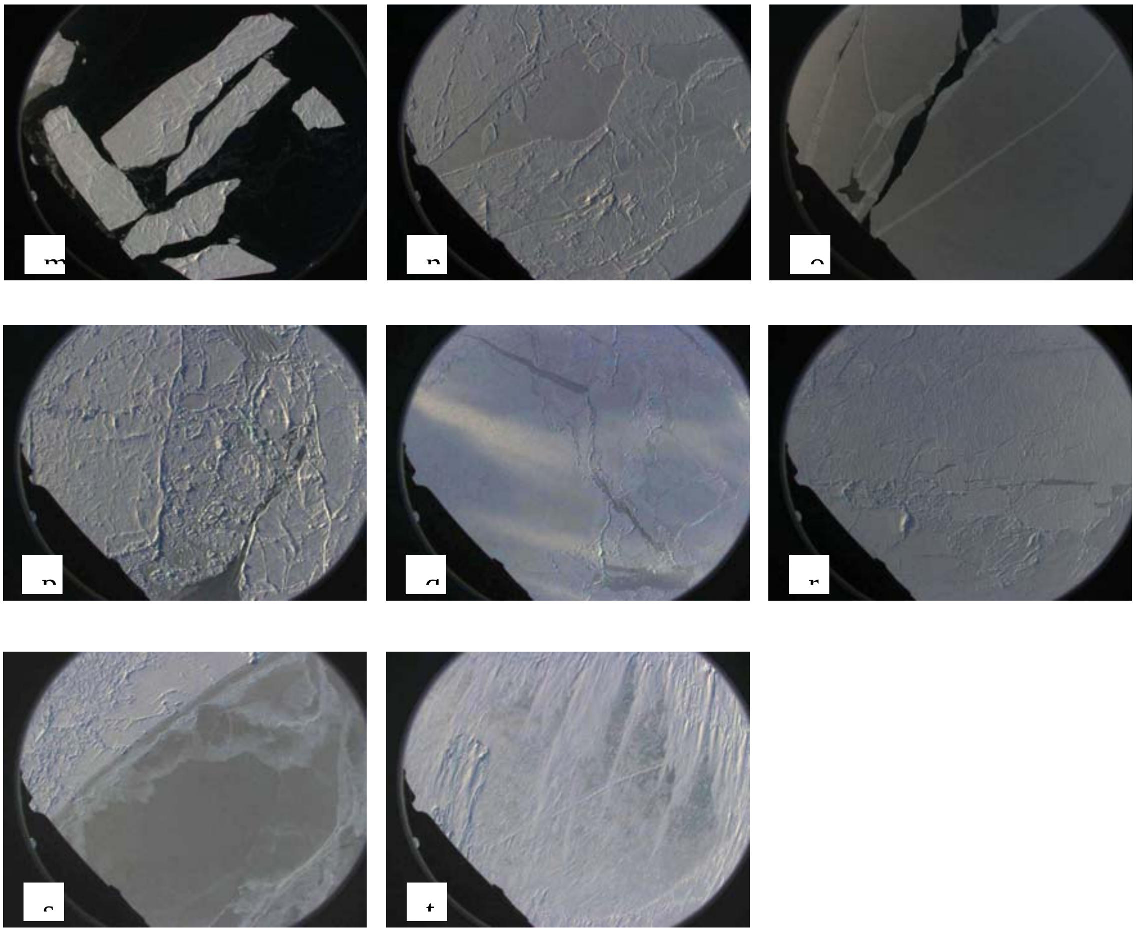
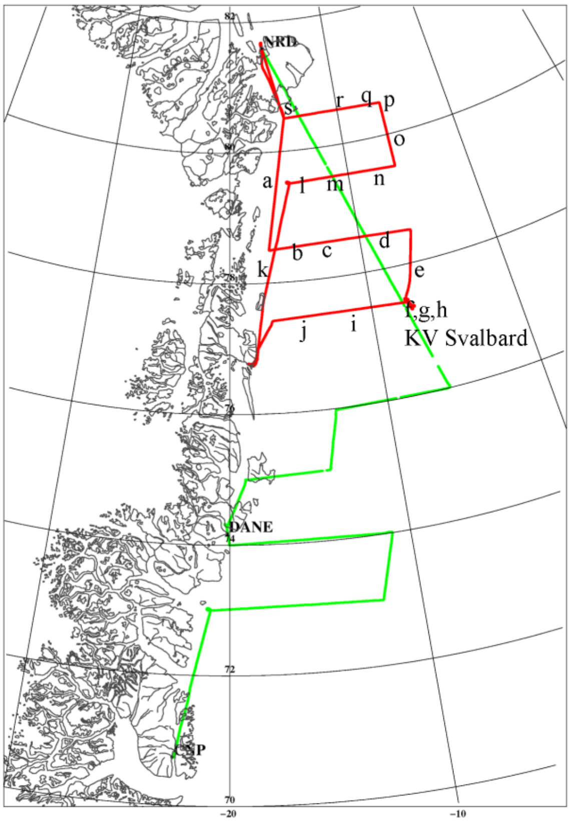
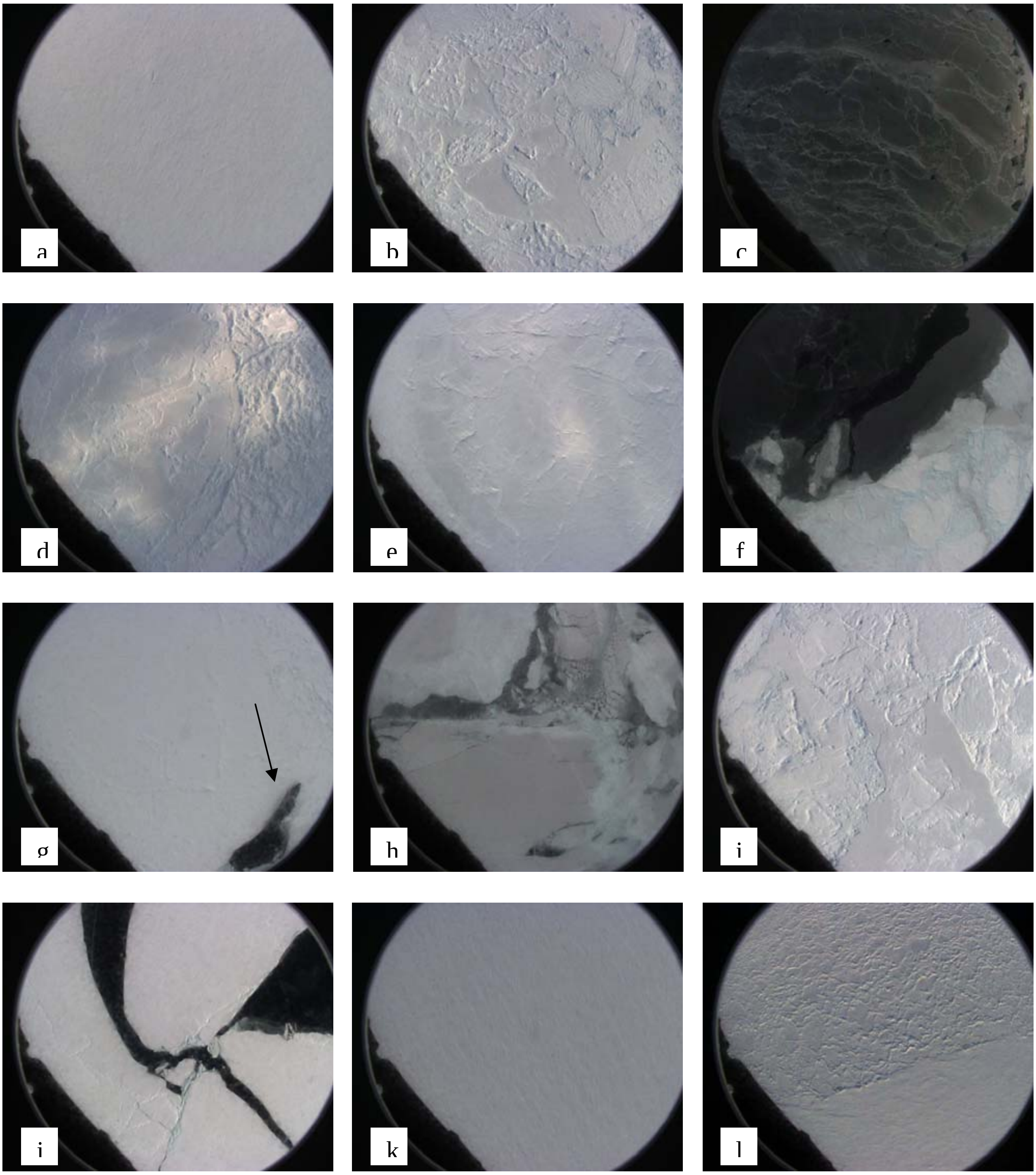
l





<u>Flight JD 115, April 24, 2008</u>

Notice on image (g) KV Svalbard in lower right corner (marked with arrow), and two buoys marking the validation line.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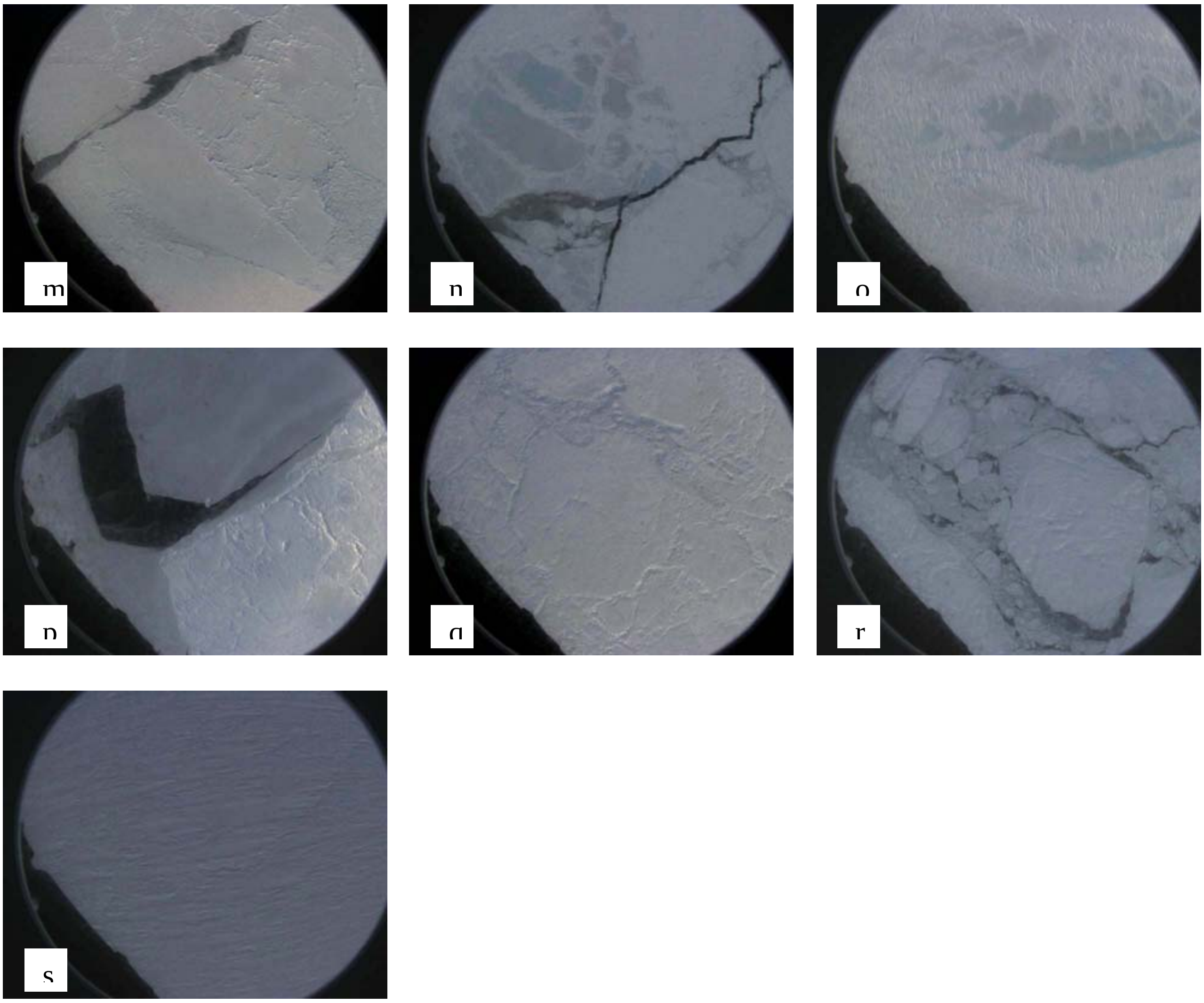
m
n
r
s

Appendix D. In-situ ice drilling data

West Greenland helicopter flight – April 19, 2008

Helicopter station		Latitude N	Longitude W	Ice thickness Cm	Freeboard height cm	Snow depth cm
HE3	ice floe	72 47.40	57 31.691	72	6	12
				80	7,5	4
				66	7	6,5
				64	5	14
HE4	ice floe	72 47.40	58 05.177	95	8	14
				94	9	8
				98	9	13
				97	9	9
HE5	ice floe	72 47.40	58 35.723	77	1	24
				82	3	22
				88	2,5	14
				94	7	11
HE6	ice floe	72 47.40	58 58.748	93	7	12
				70	0	10
				75	6	8
				72	5	11
HE7	ice floe	72 47.40	59 31.978	100	8	6
				100	8	5
				100	8	11
				99	7	7
HE8	ice floe	72 47.40	59 48.977	30	2	2
				34	3	2,5
				29	2	3
				47	3	4
Average				77	6	10

East Greenland ice thickness data – KV Svalbard (April 2008) and Oden (Sep 2007)

Line distance from K/V Svalbard [m]	Latitude	Longitude	Ice thickness [cm]	Freeboard [cm]	Snow thickness [cm]
5	77 25 N	7 20 W	338	21	36
25	-	-	214	11	45
45	-	-	233	13	40
65	-	-	131	6	36
80	-	-	137	-3	48
100	-	-	135	3	46
125	-	-	159	7	26
130	-	-	142	7	54
185	-	-	62	-5	52
190	-	-	56	-2	55
Oden Sep 9*	82 51.76 N	2 40.72 E	208	19	11
Oden Sep 10*	81 52.41 N	9 41.49 E	202	21	10
Oden Sep 14*	77 06.34 N	5 20.45 W	287	85	8

*mean of 3-4 measurements