Regional sea ice outlook for Greenland Sea and Barents Sea - based on data until the end of April 2011

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The monthly mean sea ice extent for April 2011 based on Norwegian ice charts produced primarily from passive microwave satellite data, supplemented with high resolution SAR imagery since 2007, is compared with the corresponding monthly mean for April for the years 2008-10 (Fig. 1), and with 30, 20, and 10 year averages for monthly means for the periods 79-08, 80-99 and 99-08 (Fig. 2).

The sea ice systems in the Greenland Sea and Barents Sea are substantially different. Sea ice in the Greenland Sea is dominated by ice drifting with the transpolar drift and the East Greenland current out of the Arctic Basin southwards (see e.g. Vinje et al. 1998), whereas sea ice in the Barents Sea consists to a high degree of seasonal ice formed in the same area during the past winter (see e.g. Vinje and Kvambekk 1991).

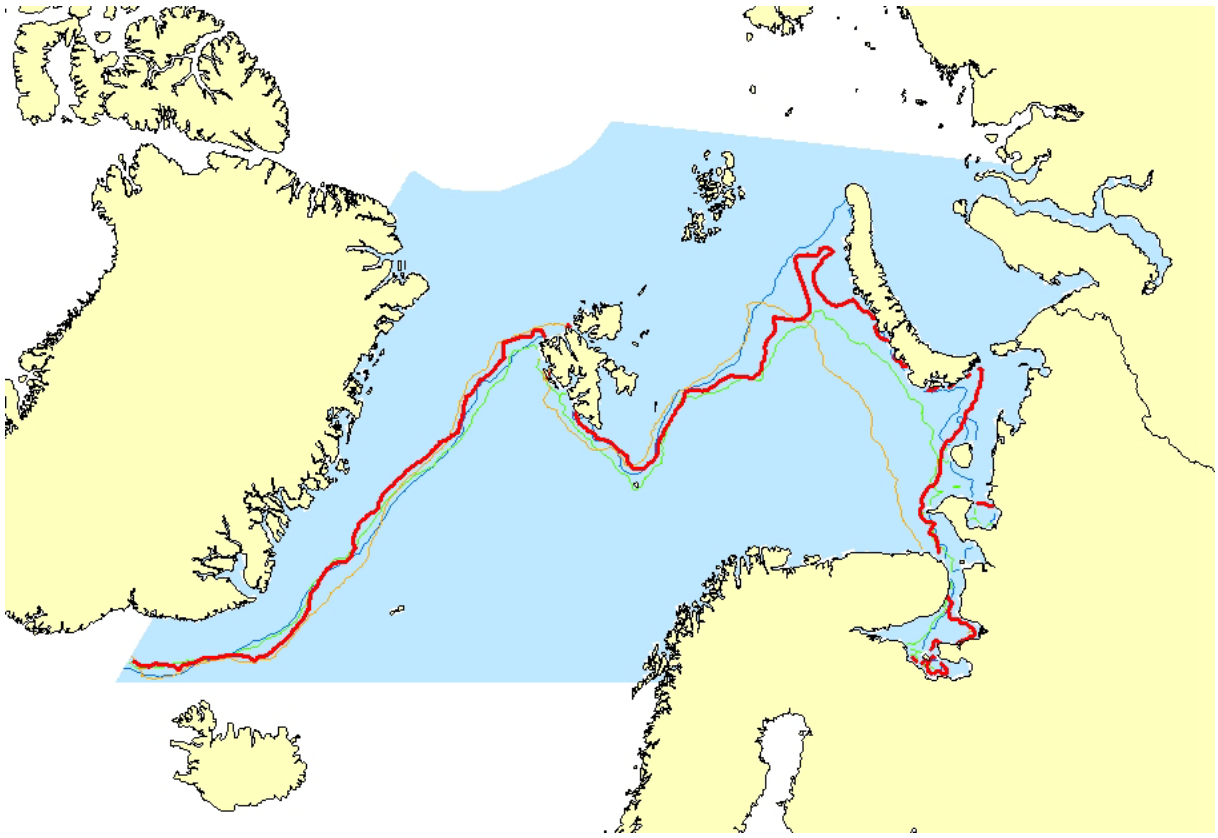

Fig. 1: Ice extent (monthly means, April) southern border of 30% ice concentration, in the Greenland Sea / Fram Strait and Barents Sea, based on passive microwave satellite data (red = April 2011, orange = April 2010, green = April 2009, blue = April 2008).

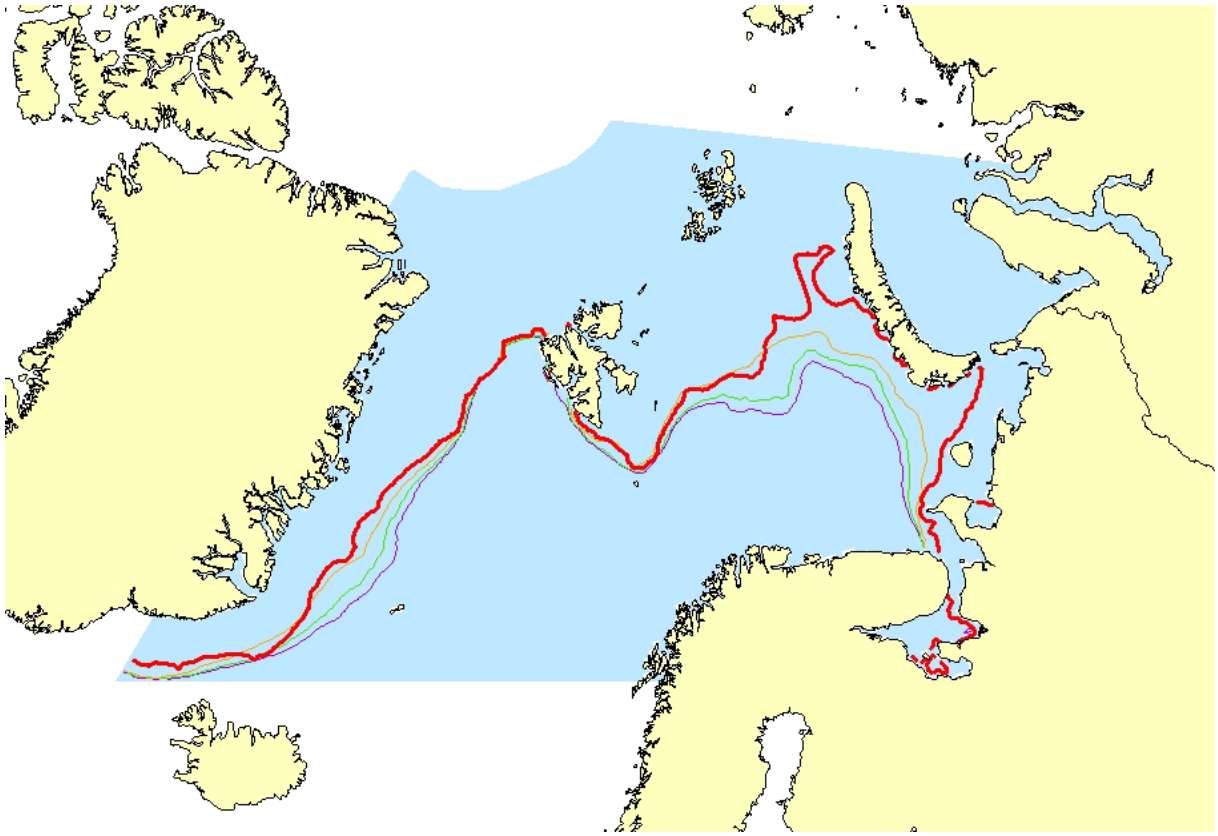

Fig. 2: Ice extent (monthly means, April) southern border of 30% ice concentration, in the Greenland Sea / Fram Strait and Barents Sea, based on passive microwave satellite data (red = April 2011, orange = mean April 1999-2008, purple = mean April 1980-1999, green = mean April 1979-2008).

In the **Greenland Sea** ice edge positions for April 2011 does not differ much from the Aprils of the previous three years (Fig. 1). Only differences can be seen east of Scoresby Sund (Greenland), and close to Svalbard. Compared with 10, 20 and 30 year means, the 2011 sea ice extent for April is significantly less than for the 1-, 2-, and 3-decadal means in the region between Scoresby Sund and Jan Mayen. The areas north and south of this region do not show any significant variability of the April 2011 ice edge versus the means over longer times.

In the **Barents Sea**, the picture is different. Whereas the western Barents Sea shows quite constant conditions for April since 2008, Fig. 1 shows that the central and eastern Barents Sea has a strong variability between individual years, as it is also known from longterm monitoring (Gerland et al. 2010a and b). Parts of the region west of Novaja Semlja appear to be ice free in April 2011, while in 2010 and 2009 Novaja Semlja was completely surrounded by ice. In 2008 the entire west coast of Novaja Semlja was ice free. Fig. 2 shows a tendency to less ice in the recent decade (orange), also confirmed by the 2011 picture (red), compared to the curves that include the 1980s (purple, 1980-99; green 1979-2008).

The Norwegian Polar Institute led two expeditions to the region north of Svalbard in April (KV Svalbard) and May 2011 (RV Lance) which focused heavily on in situ and helicopter-borne sea ice measurements. We encountered predominantly first year ice with a level ice thickness of around 70 cm. The ice cover was very uniform over the entire study area with level first year ice with some ridges. Away from the ice edge, the ice cover was continuous and floe sizes reached several tens of kilometers. Leads were mostly covered by grey ice and nilas during the first cruise. Following some

bad weather in the week between the two expeditions, this thin ice had disappeared at the start of the second cruise, but reformed over the duration of the fieldwork so that in mid-May, most lead were again covered by nilas. The snow cover increased between the two cruises so that in May, the amount of snow was substantial: while the modal thickness was only approximately 17 cm, the tail of the thickness distribution is very wide and some floes were covered by more than 50 cm of snow. On many of the stations, we therefore found flooding leading to negative freeboard and a slush layer at the ice/snow interface.

The Norwegian Ice Service ice charts provide a record for the Svalbard area that extends back to 1967 (45 years). The ice charts use six categories for ice concentration: open water (0-10%), very open drift ice (10-40%), open drift ice (40-70%), close drift ice (70-90%), very close drift ice (90-100%), and fast ice (100%). Monthly average area values for each of these classes were calculated within a box extending from 72 to 85°N and 0 to 40°E, using average ice concentrations for each class. The sum of these values was then used as the average monthly ice area for our analysis.

The forecast uses a simple statistical regression, using:

- ice extent from the ice charts,
- NOAA Extended Reconstructed Sea Surface Temperature (SST) V3b (http://www.esrl.noaa.gov/psd/data/gridded/data.noaa.ersst.html), and
- NWS Climate Prediction Centre (CPC) Arctic Oscillation Index (http://www.cpc.ncep.noaa.gov/products/precip/CWlink/daily_ao_index/ao.shtml).

At the time of producing this analysis, only complete monthly data to the end of April was available. For September ice extent, we find:

$$Ice_{September} = 224642 + (-22995.0 * AO_{March}) + (0.11207 * Ice_{February}) + (11992.54 * SST_{April})$$

Taking the values of 1.424, 528,468, and 1.87 for AO_{March}, $Ice_{February}$, and SST_{April} respectively, we obtain predicted ice extent of 257,947 km^2. This would be a slightly higher than average ice extent for September and this may be due atmospheric circulation patterns that have produced a higher Arctic Oscillation Index (1.424 compared to -0.432 in 2010) and hence lower SST (1.87°C compared to 2.14°C in 2010) due to less Atlantic Water influence. At the time of writing there is still much ice in the western Barents (e.g. see the ice chart in Fig. 3 and updated maps at http://polarview.met.no/regs/c_map6.jpg) with ice still being reported by the weather station at Bear Island (74°30'N 19°00'E).
The general conclusion from the forecast of the Norwegian Ice Service is that there will be slightly more ice in the Svalbard area this year than there was in 2010.

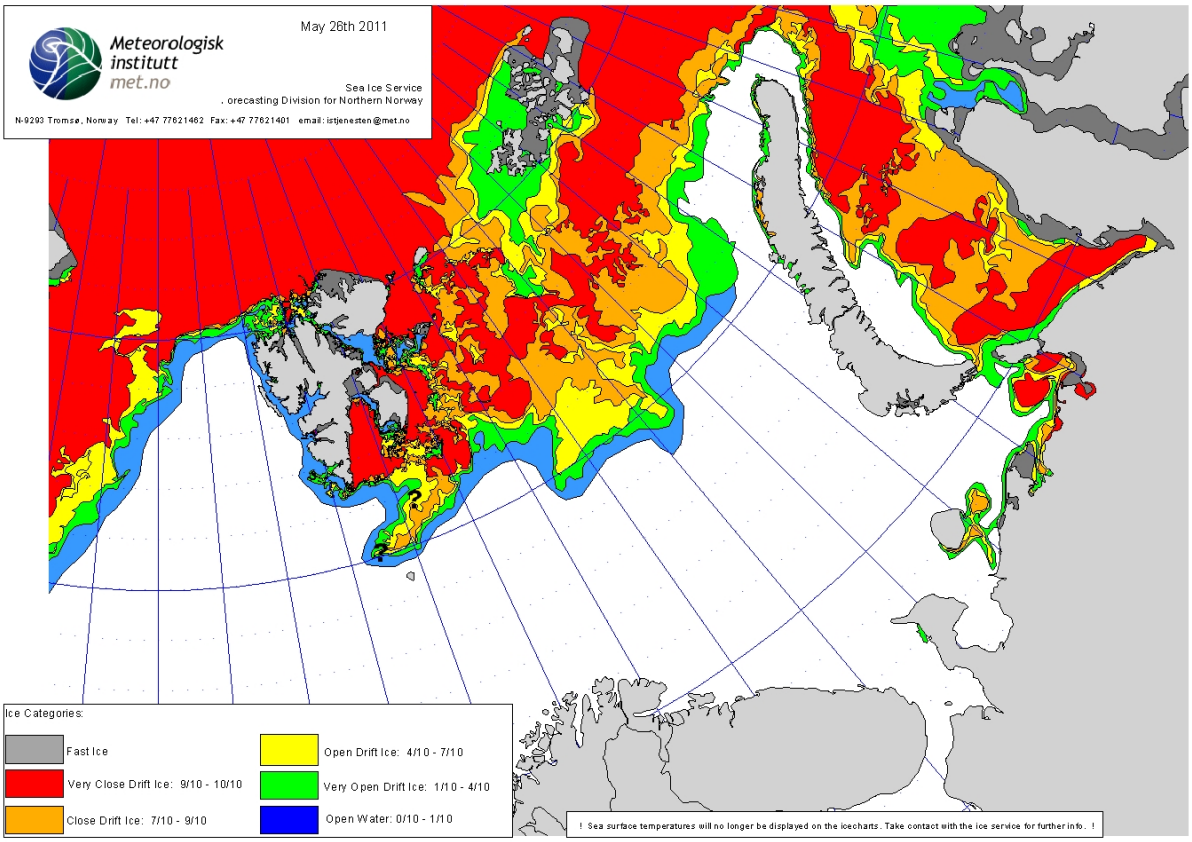

Fig. 3: Ice chart of the Norwegian Ice Service from 26 May 2011. See also http://polarview.met.no/regs/c_map6.jpg for updated maps.

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