September 2009 Regional Sea Ice Outlook: July Report*
By: Sebastian Gerland and Harvey Goodwin
Region: Greenland Sea and Barents Sea
*Based on data until the end of June 2009

Contact Information
Norwegian Polar Institute, 9296 Tromsø, Norway
(E-mail: gerland@npolar.no; goodwin@npolar.no)

a. Sea ice extent, based on satellite data (passive microwave)

Monthly mean sea ice extent (30% concentration threshold) is compared with the corresponding monthly mean for June (Fig. 1) and May (Fig. 2) for the record minimum year 2007, and with 30, 20, and 10 year averages for monthly means for the periods 79-08, 80-99 and 99-08. The sea ice systems in the Greenland Sea and Barents Sea are substantially different. Sea ice in the Greenland Sea is (see e.g. Vinje et al. 1998) dominated by ice drifting with the transpolar drift and the East Greenland current out of the Arctic Basin southwards, whereas sea ice in the Barents Sea (see e.g. Vinje and Kvambekk 1991) consists to a high degree of seasonal ice formed in the same area during the past winter.

In the northern **Greenland Sea** ice extent appears roughly similar for all calculated means (Fig. 1). However, in the south (south of Scoresby Sund (Greenland) in the Denmark Strait, between Iceland and Greenland) the ice edge for June 2009 is located further north than ice extent for 2007 and for all 10- and 20-year averages calculated. In the central Greenland Sea, the 2009 June extent shows more ice than the last decade (99-08) average. In the Fram Strait all ice edges are very similar. One may note that polynyas are appearing in June 2009 and 2007 at different locations.

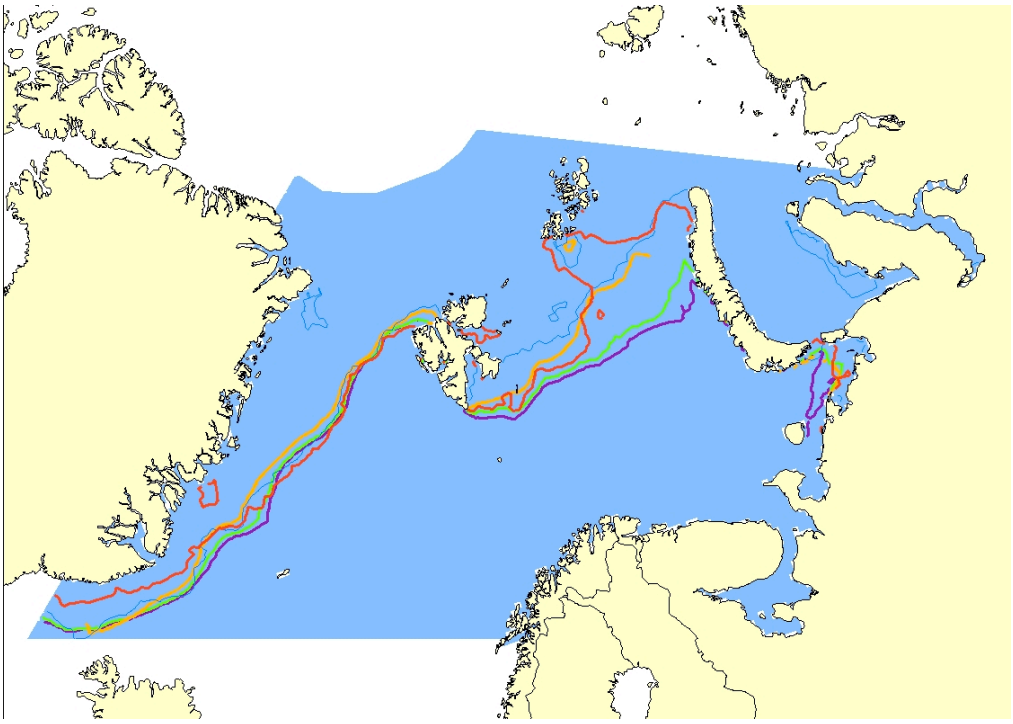

Figure 1. Ice extent (monthly means, June) southern border of 30% ice concentration, in the Greenland Sea / Fram Strait and Barents Sea, based on passive microwave satellite data (red = June 2009, orange = mean June 1999-2008, green = mean June 1979-2008, purple = mean June 1980-1999). The thin blue line indicates the ice extent for June 2007.

Compared with the Greenland Sea, the sea ice extent in the **Barents Sea** shows more variability between individual years and also between 10, 20 and 30 year averages for June, especially for the eastern part. As known from Barents Sea monitoring studies (Gerland et al. 2009), the inter-annual variability of the position of the ice edge in spring and autumn is high, but shows a clear negative trend since 1979. In June 2009, ice extent was substantially less than the 10, 20 and 30 year averages in the north eastern Barents Sea (area between Franz Josef Land and Novaya Zemlya), whereas it was relatively similar to the mean extents in the north western Barents Sea, east of Svalbard. Interestingly, the 2007 June sea ice extent shows an opposing pattern west and east in the Barents Sea compared with June 2009. In the west, ice extent was less in 2007, and in the east the ice extended further south than in 2009. The fact that open water extended in June 2009 all the way to Franz Josef Land is interesting, and this could ease the warming of surface water masses, which as a part of a feedback process can increase the speed of ice melt.

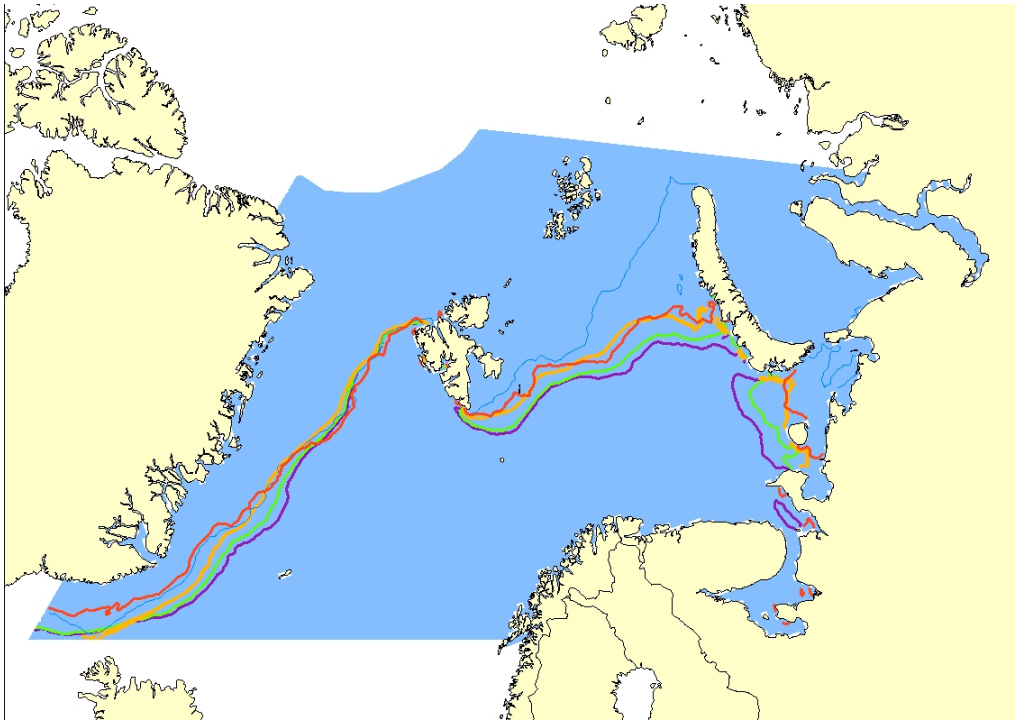

Figure 2. Ice extent (monthly means, May) southern border of 30% ice concentration, in the Greenland Sea / Fram Strait and Barents Sea, based on passive microwave satellite data (red = May 2009, orange = mean May 1999-2008, green = mean May 1979-2008, purple = mean May 1980-1999). The thin blue line indicates the ice extent for May 2007.

The situation was different one month earlier, in May 2009 (Fig. 2): Then, the ice edge position was fairly similar to the means from the past decade (99-08). In the Barents Sea, especially in the eastern part, May 2007 and 2009 differ strongly. The difference in the picture for May and June (ice edges relative to each other) could relate to specific weather patterns, but it could also be related to different ice thicknesses in May ice relative to earlier years, corresponding to faster melting of Barents Sea ice in the eastern part compared to other years.

b. Sea ice extent and thickness at selected sites (Svalbard)

As a part of fast ice monitoring activities of the Norwegian Polar Institute, the ice near three Svalbard sites was observed in situ during the 2008/09 winter.
Since punctual ice thickness information can be strongly biased by local conditions, we do not discuss how these thickness observations might indicate the sea ice development in summer 2009 on a larger spatial scale. However, since ice thickness information is generally sparse, we give a brief summary of our 2009 *in situ* data. Kongsfjorden is located on the north western coast of Spitsbergen, Storfjorden on the eastern coast of Spitsbergen, and Hopen is an island in the north western Barents Sea. The monitoring setups and earlier data are described in Gerland and Renner (2007) and Gerland et al. (2008).

Early in 2009, **Kongsfjorden** had a larger fast-ice extent than the previous three winters (2006-08), when fast ice extent reached exceptional minimums in this fjord. The ice extent was more similar to years between 1997 and 2005, but its seasonal maximum thickness was with 0.52 m less than observed before 2006 (Gerland and Hall 2006).

Storfjorden fast ice is usually thicker than Kongsfjorden ice, since it is not directly influenced by Atlantic water from the West Spitsbergen Current. The seasonal maximum fast ice thickness at a monitoring site in Inglefieldbukta the past winter was 1.37 m.

Hopen fast ice varies greatly inter-annually, overlaying a clear negative trend since observations started in 1966 (Gerland et al. 2008). In the past winter 2008/09, an ice thickness maximum of more than 1 m was measured twice. However, the coast at Hopen is less protected and the fast ice was removed twice during the winter by wind and currents. Hopen sea ice can also be dynamically influenced (ice advection and rafting/ridging).

Acknowledgements
We are grateful to Eric Brossier (Vagabond, Storfjorden), Ragnar Sønstebø (Hopen, met.no), and staff from the Sverdrup Station (NPI) in Ny-Ålesund for conducting ice and snow thickness measurements. Passive microwave satellite data are from SSM/I satellites and accessed from the National Snow and Ice Data Center (NSIDC) in Boulder, Colorado, USA.

References
Gerland, S., Tronstad, S., Pavlova, O. and Ingvaldsen, R. (2009) : Isutbredelse i Barentshavet (kap. 4.1.1). pp. 25-26. In: Sunnanå, K. et al. (ed.) : Forvaltningsplan Barentshavet – rapport fra overvåkingsgruppen. *Fisken og havet*, særnummer 1b – 2009, Institute of Marine Research, Bergen, Norway (in Norwegian). http://www.imr.no/__data/page/9036/Srnr_1b_liten_fil.pdf.

Gerland, S., Renner, A.H.H., Godtliebsen, F., Divine, D., & Løyning, T.B. (2008): Decrease of sea ice thickness at Hopen, Barents Sea, during 1966-2007. *Geophysical Research Letters*. Vol. 35, L06501, doi: 10.1029/2007GL032716.

Gerland, S., & Renner, A.H.H. (2007): Sea ice mass balance in an Arctic fjord. *Annals of Glaciology*, Vol. 46, pp. 435-442.

Gerland, S. and R. Hall (2006): Variability of fast ice thickness in Spitsbergen fjords, *Annals of Glaciology*, 44, pp. 231-239.

Vinje, T. and Å. S. Kvambekk (1991): Barents Sea drift ice characteristics, *Polar Research*, 10, pp. 59-68.

Vinje, T., N. Nordlund, and Å. Kvambekk (1998): Monitoring ice thickness in Fram Strait, *Journal of Geophysical Research - Oceans*, 103, pp. 10437-10449.