Update of Regional Sea Ice Outlook for Greenland Sea and Barents Sea - based on data until the end of June 2013

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In this report, we give a brief update on the sea ice situation for Greenland and Barents Seas for spring 2013, including data until end of June, and an updated regional prediction. See also the previous regional report, based on data from April and May 2013 (Gerland et al. 2013).

Sea Ice Extent Maps

The monthly mean sea ice extent for June 2013 is compared with the corresponding monthly means for June for the years 2009-13 (Fig. 1), and with 30, 20, and 10 year averages of monthly June means for the periods 79-08, 80-99 and 99-08 (Fig. 2). The ice extent data is based on Norwegian ice charts (http://met.no/Hav_og_is/) produced primarily from SAR data since 2007 and supplemented with cloud-free optical data, where available. Passive microwave observations are used where no higher resolution

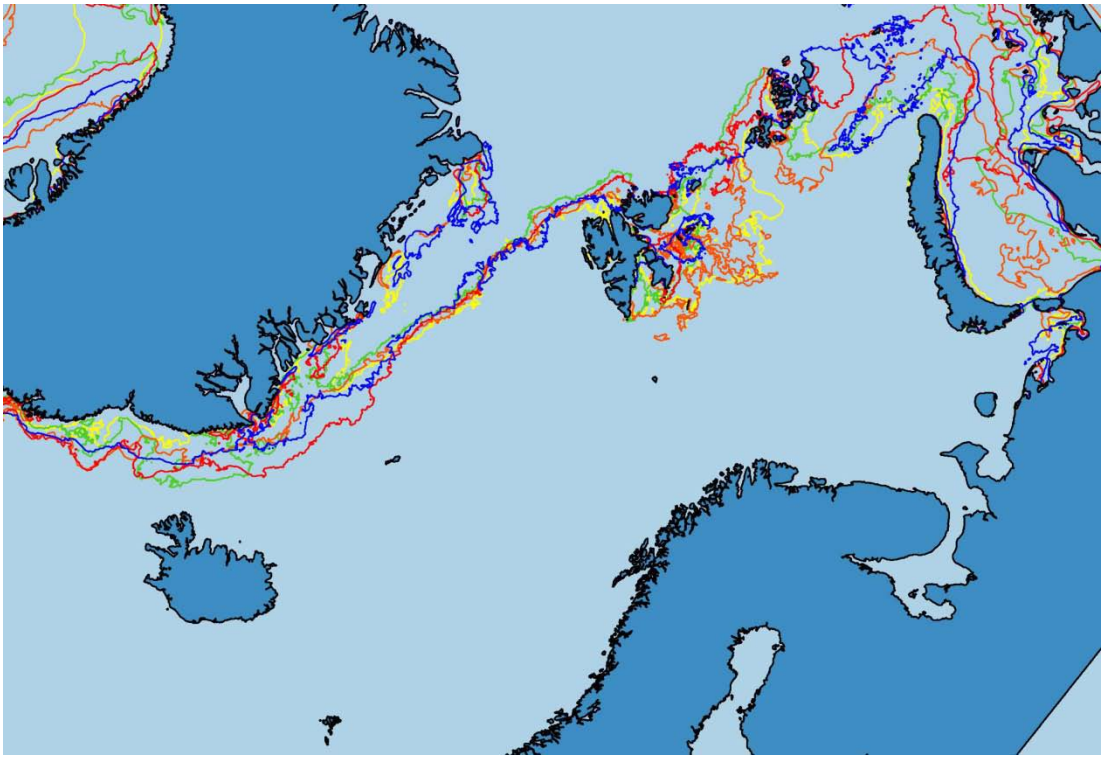

Fig. 1: Sea ice extent (monthly means, June), border of 30% ice concentration, in the Greenland Sea/Fram Strait and Barents Sea, based on met.no ice charts (June in 2013 (blue), 2012 (red), 2011 (orange), 2010 (green) and 2009 (yellow).

data is available.

The sea ice regimes in the Greenland Sea and in the 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; Spreen et al. 2009), 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). However, years with high inflow from the Arctic Basin exist (e.g. Kwok et al., 2005) and can cause positive ice area anomalies in the Barents Sea (Kern et al., 2010).

Sea Ice Extent in June 2013

Sea ice in the Greenland Sea in general exhibits little interannual variability for June 2013 (Fig. 1, blue line), as also observed and commented in earlier years of the Arctic Sea Ice Outlook. As for the previous months, only a few sub-regions have some difference in the position of the ice edge between recent years, most prominent the area NW of the island Jan Mayen (more ice in 2012 relative to earlier). While in April this year, sea ice was relatively close to Jan Mayen, compared to other recent years (see Gerland et al. 2013), in June the ice edge NW of Jan Mayen is within the range of the extents of the past years, continuing the development from May 2013 (Fig. 1). As also in most of the previous years, in June, ice-free areas close to the east coast of Greenland start to form.

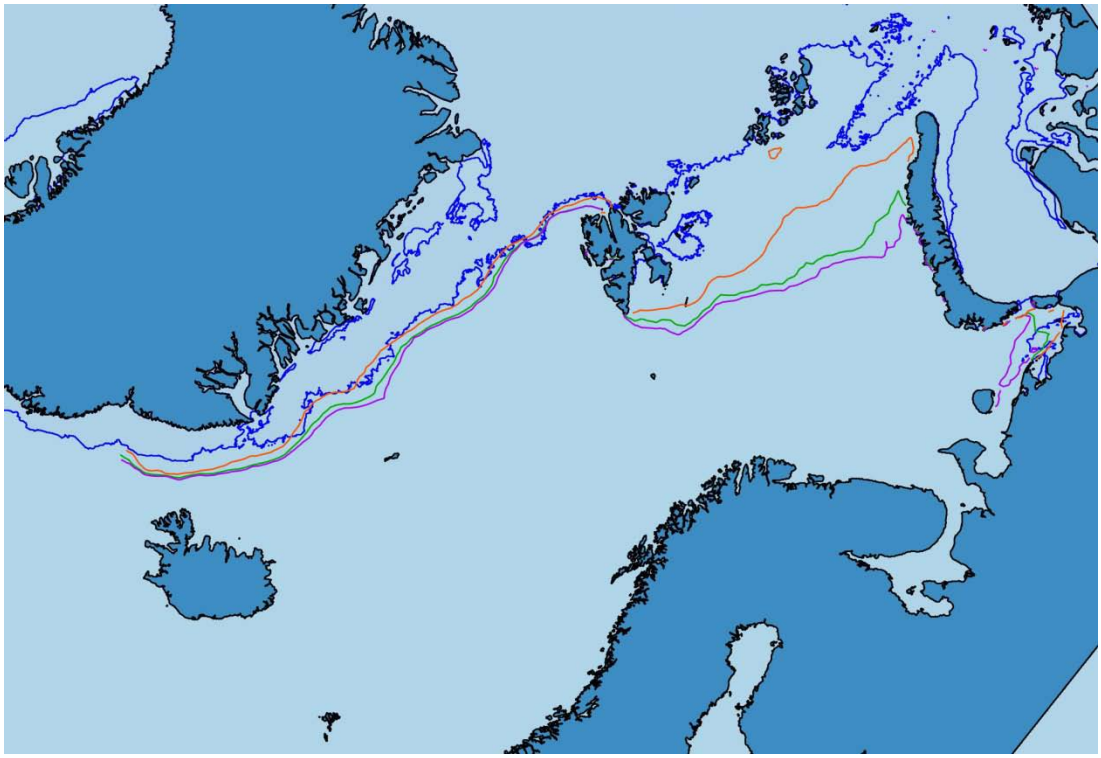

Fig. 2: Ice extent (monthly means, June) border of 30% ice concentration, in the Greenland Sea / Fram Strait and Barents Sea, based on met.no ice charts (blue = monthly mean June 2013, orange = mean June 1999-2008, purple = mean June 1980-1999, green = mean June 1979-2008).

In the Barents Sea, interannual variability for June is in general substantial higher than for Greenland Sea and Fram Strait. In the western Barents Sea, the main sea ice edge in June 2013 was relatively far north, on the latitude of Nordaustlandet/Svalbard (about 80° N), just north of Kvitøya. But the map shows also some drifting ice further south, east of Edgeøya, Svalbard. Further east, the ice edge continues on the level of Franz Josef Land, exhibiting an ice "tongue" between Franz Josef Land and Novaya Zemlya (Fig. 1). Most of the coast of Novaya Zemlya appears now ice-free (except the southern part of the eastern coast).

Looking at decadal means (Fig. 2), June 2013 (blue line) appears, as the two previous months, again as a month with pretty much representative sea ice extent for Fram Strait and Greenland Sea, in general with the ice edge near the mean with least extent (orange line, mean June 1999-2008 in Fig. 2). In the southern part of the Greenland Sea, close to Denmark Strait, June 2013 sea ice extent is substantially smaller than during the previous three decades.

In contrast, in the Barents Sea, decadal means and June 2013 differ for all subregions, most in the east (Fig. 2). Following the development from April to June (see also Gerland et al. 2013), one can see that these differences are strongest for June.

Brief Comments on Sea ice in situ observations spring 2013

Observations from an ice mass balance buoy (IMB) in Storfjorden (see Gerland et al. 2013) show that melting was going on in June, ending up in that most of the fast ice broke off by now. The last Storfjorden IMB observation from 22nd June shows surface water temperatures of 0.5°C. Data from an IMB installed on iceberg fast ice in Fram Strait, off Greenland, tell us that also here melting has started.

Regional Prediction

Ice concentration data from the Norwegian Ice Service ice charts were analysed to produce monthly ice area values for the Svalbard region, 0 to 40° E longitude, 72 to 82° N latitude. These were compared against climatic variables, including sea surface temperature (SST) for the West Spitsbergen Current, atmospheric pressure in the Barents Sea and Fram Strait, and Arctic Oscillation (AO) index values, to develop a support vector regression (Smola and Scholkopf 1998) to predict sea ice area in the coming months.

Monthly SST data was acquired from the NOAA Extended Reconstructed SST V3b (http://www.esrl.noaa.gov/psd/data/gridded/data.noaa.ersst.html) dataset, sea level pressure values from the NCEP/NCAR Reanalysis (http://www.esrl.noaa.gov/psd/data/gridded/data.ncep.reanalysis.html), and AO index values from the NOAA National Weather Service (NWS) Climate Prediction Center (CPC) (http://www.cpc.ncep.noaa.gov/products/precip/CWlink/daily_ao_index/ao.shtml).

Data was input into the Weka data mining software (http://www.cs.waikato.ac.nz/ml/weka/) to experiment with different methods for predicting future ice area values. The time series extension to this software provides a support vector regression with a sequential minimal optimization algorithm (SMOreg) to train the regression using polynomial or RBF kernels (Shevade et al 1999). Using this model to determine the best fit to the data by the predictor variables at large number of time lags, the prediction for the sea ice area around Svalbard in September 2013 is 177,436 km^2 (Fig. 3). The data file

regarding the data input into Weka and the LOG file output of the model run can be provided. If interested in the files, contact Nick Hughes at met.no (nick.hughes@met.no).

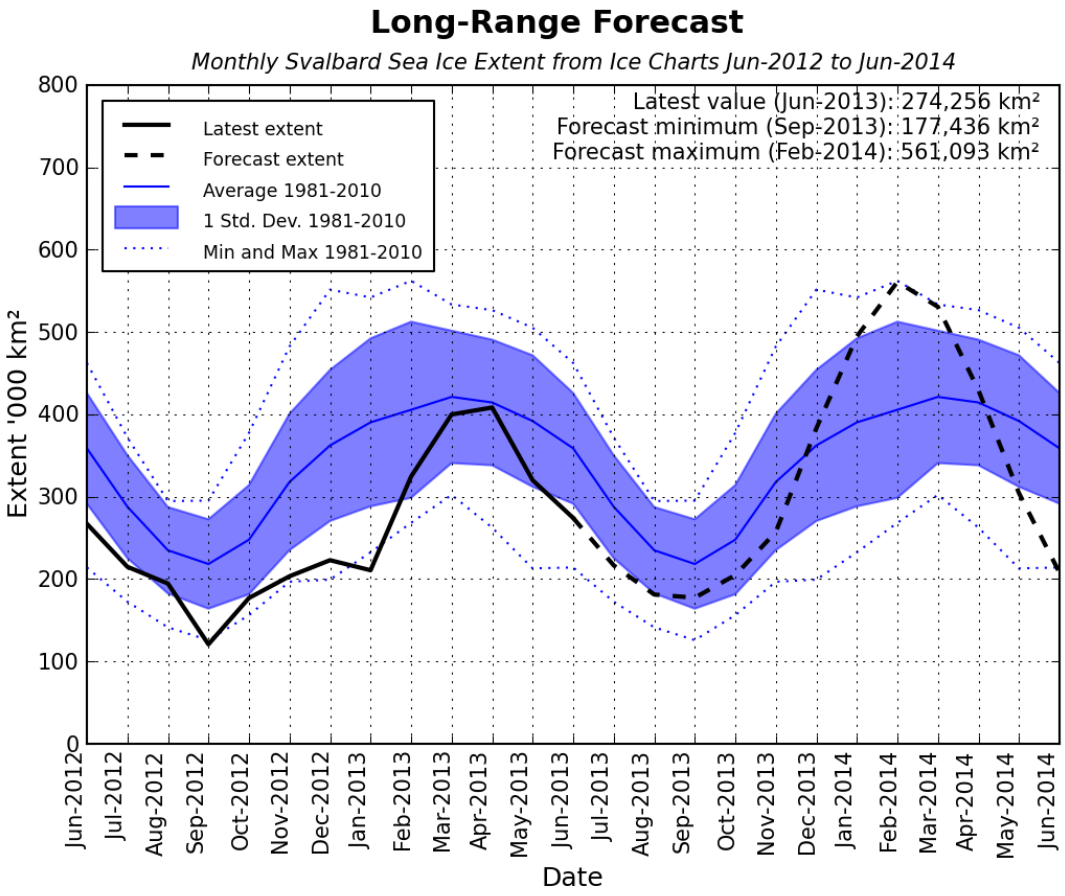

Fig. 3: Sea ice area for the past 12 months and forecast from July 2013 for the next 12 months, shown against 1981-2010 climatology.

Acknowledgements

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