Community Submissions for July Sea Ice Outlook: Report Based on July Data

15 August 2008

Table of Contents

Tom Agnew
July 2008 Sea Ice Outlook: Report Based on July Data

Scientist: Tom Agnew

Forecast: 5.3 million sq. km for September 2008

Discussion: Over monthly to seasonal time scales, persistence of the anomaly is pretty hard to beat. Fig 1 shows the approach to September minimum over the last 5 years. Summer of 2008 (green) is very similar to 2005 although the two years are quite different regionally. Fig 2a and 2b are the July sea ice anomaly for 2008 and 2005 from the 20 year average over the SSMI satellite record. Summer of 2008 shows a large region of less sea ice than normal over the Beaufort Sea compared to 2005 which had less ice cover than normal in the E. Siberian Sea and Laptev Sea. Both years show more ice in the Canadian Archipelago compared to 2007.

The sea ice cover from satellite however does not indicate ice thickness which is much thinner in the western Arctic especially in the Canadian Archipelago. Within the last two weeks ice cover in this region has deteriorated much faster for this reason. Based on similar total ice extent for 2008 and 2005 and persistence of the monthly regional anomalies, total ice extent for September 2008 will be 5.3 million sq. km (the same as 2005) with much less ice than normal in the Beaufort Sea and near normal ice conditions for the E. Siberian Sea, Laptev Sea. The Canadian Archipelago will have less ice than normal but not as ice free as 2007. The southern route through the NWP will be ice free but the northern route through M'Clure Strait will not.

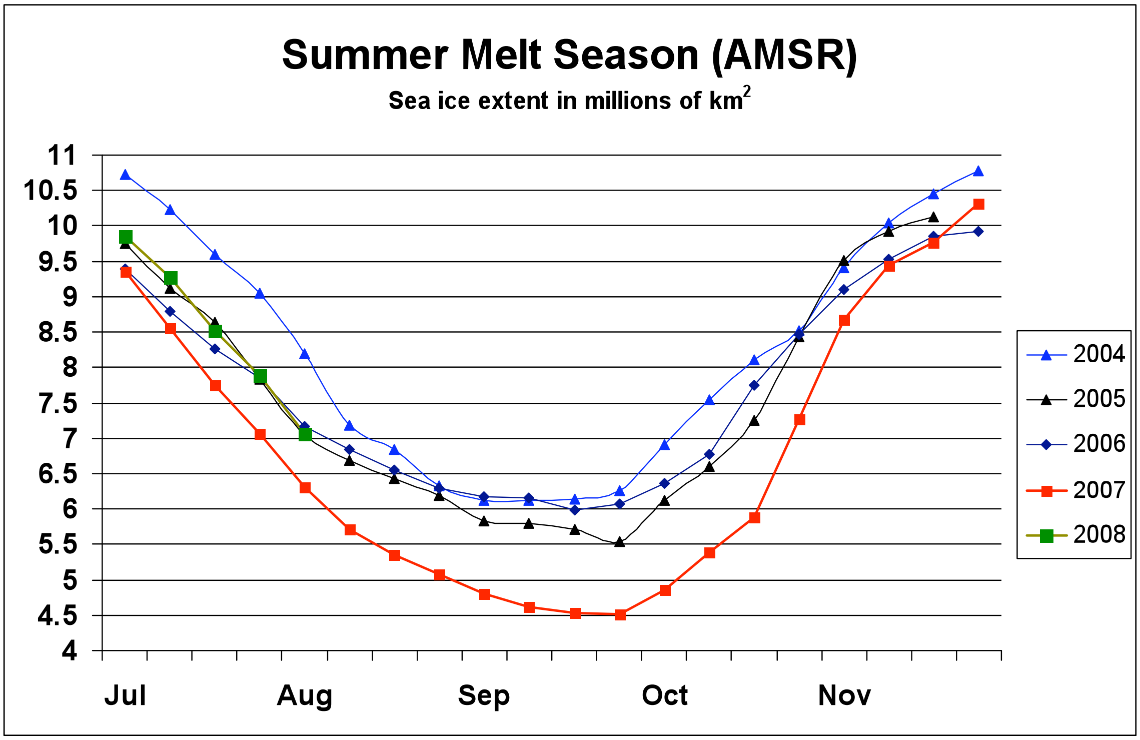

Fig 1 Approach to minimum sea ice extent for the last 5 years.

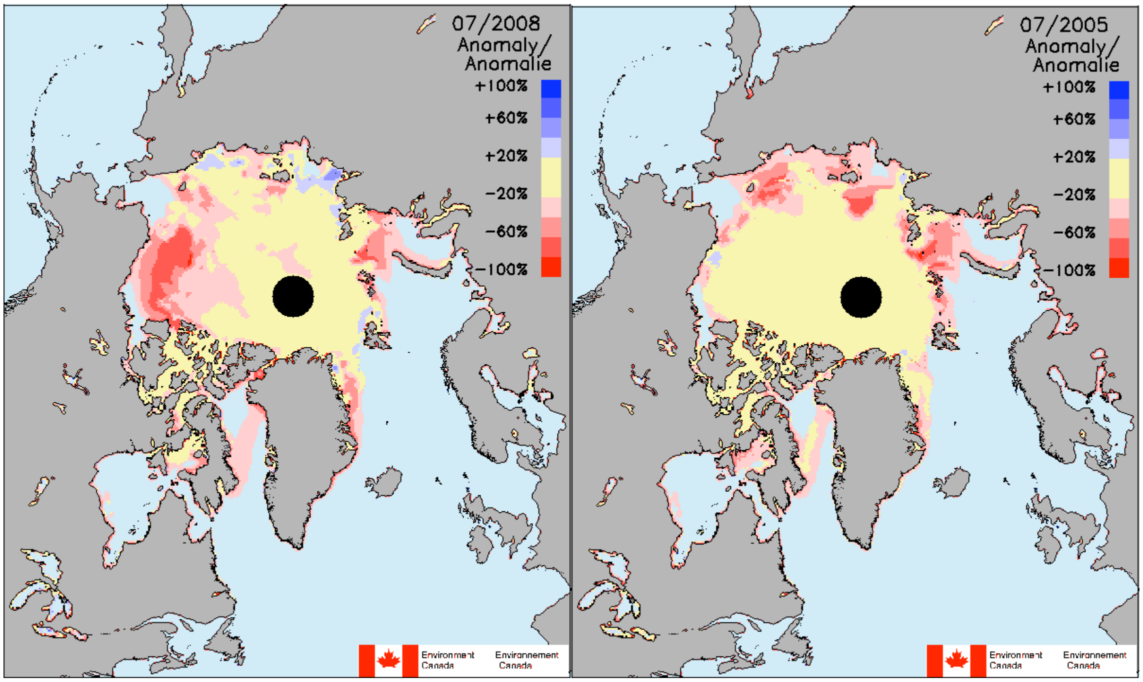

Fig 2 Sea Ice anomaly compared to the 20 year SSMI satellite record for: a) July 2008 and b) July 2005

Todd Arbetter, C. Szorc, Pablo Clemente-Colón, S. Helfrich, and Ignatius Rigor
July 2008 Sea Ice Outlook: Report Based on July Data

Provisional Outlook for 2008 September Minimum

Prepared by the National Ice Center - 6 August 2008

T. Arbetter[1], C. Szorc[2], P. Clemente-Colón[1], S. Helfrich[1], I. Rigor[3]

[1]*NIC Science and Applied Technology Department*

[2] *NIC Operations Department*

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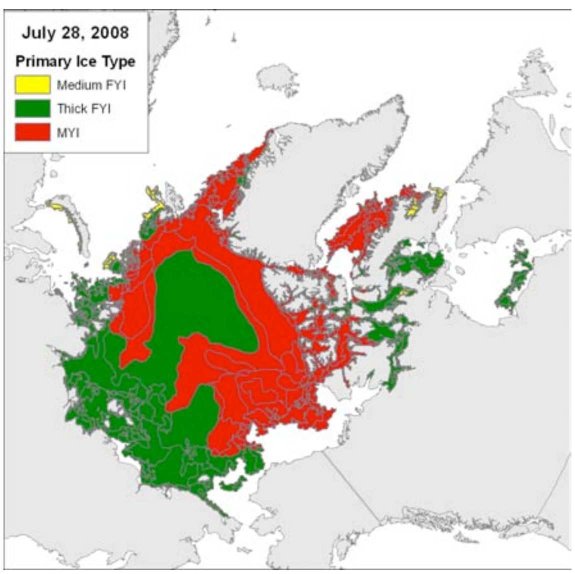
Overview:

This outlook was prepared by considering a NIC chart of Sea Ice Conditions for 28 July 2008. Any ice containing multiyear ice (MYI) was identified and classified by the partial amount (1/10, 2/10, etc.). All other ice was considered first year ice (FYI). As in the previous outlook (3 July 2008), much of the central Arctic is devoid of MYI, a situation not observed prior to 2008 in the satellite era. The summer minimum will depend on how much FYI melts out during August and September.



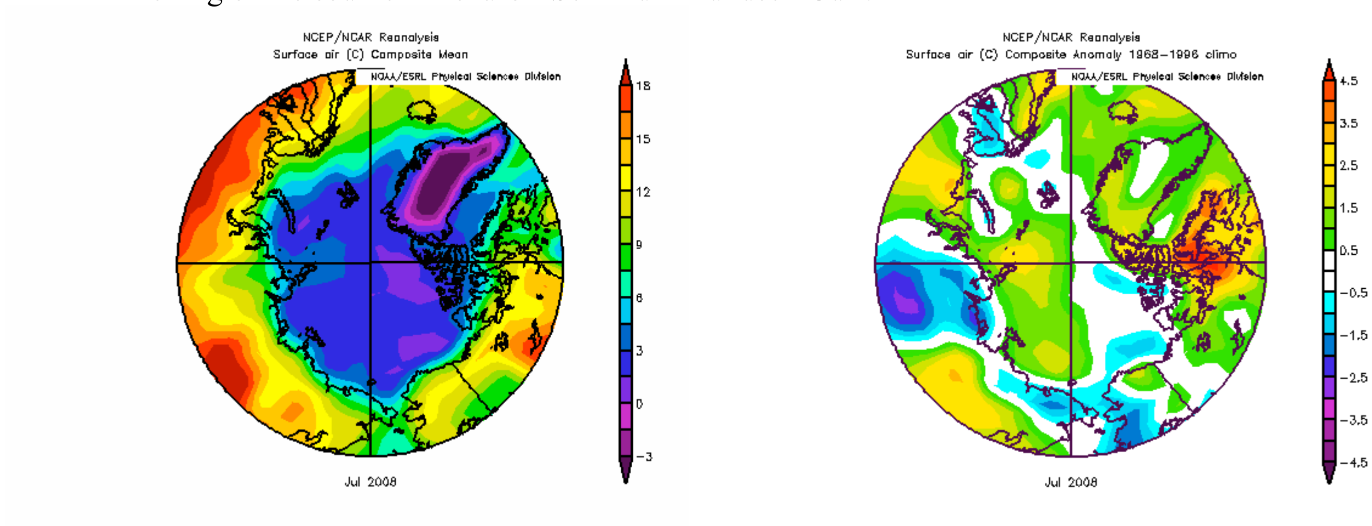
Sea ice conditions for 28 July 2008. First year ice is shaded in yellow (medium: 70-120cm thickness) and green (thick: >120cm thickness), while Multiyear ice is shaded red. Actual thicknesses may be lower than defined (see text).

The overall ice extent (>1/10 concentration is 7.71 million km^2. The extent of ice containing MYI (red) is 3.85 million km^2.

It should be noted that the primary ice types represent the final stages of development of the ice (based on a theoretical ice thickness model using cumulative freezing-degree days). For example, ice classified as thick FYI may not necessarily be thicker than 120 cm at present. Thus, the actual ice thickness may be much thinner than the primary ice type would indicate. Of course, in some cases it could also be thicker than expected due to dynamic ridging and rafting of sea ice.

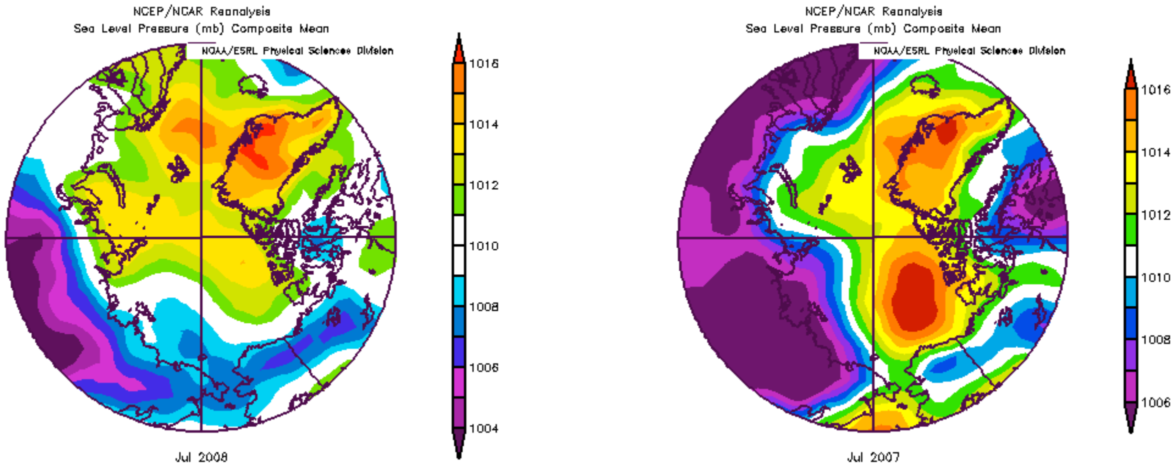
Meteorological conditions for July 2008:

The Eurasian side of the Arctic basin experienced warmer than average temperatures (locally up to 3^{o} C), while the North American side saw normal or below normal temperatures. Early July saw very warm temperatures over the Amundsen Gulf which, combined with the easterly winds, favored clearing of the southern Beaufort Sea and Amundsen Gulf. This influenced early melting of the southern Beaufort Sea and Amundsen Gulf.



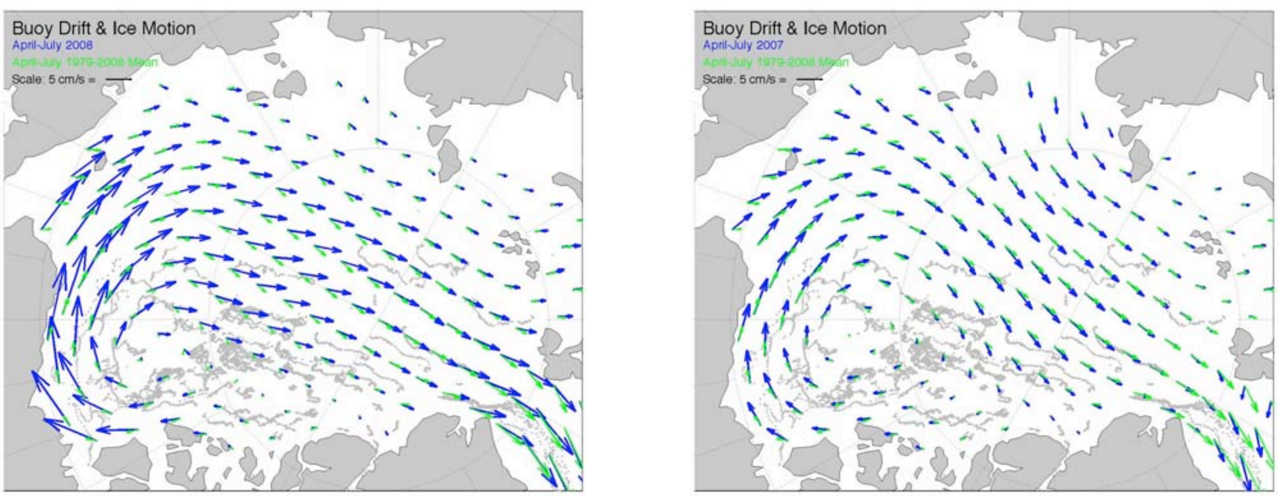
July 2008 surface air temperature mean (left) and anomaly relative to 1968-1996 climatology (right), in degrees Celsius. (Source: NOAA Climate Diagnostic Center)

The July 2007, sea level pressure (SLP) field indicated a forming “Polar Express” trans-arctic pattern was with transport of ice generally strongest from the Beaufort and Chukchi Seas toward the central Arctic and Kara Sea. In contrast, the July 2008 shows weaker overall atmospheric circulation, although ice has been transported from the Beaufort Sea west toward the East Siberian and Laptev seas.



Mean sea level pressure for July 2008 (left) and July 2007 (right), in millibars. (Source: NOAA Climate Diagnostic Center)

In fact, cumulative ice motions for April-July 2008 derived from drift buoys indicate the overall transport of ice out of the Beaufort Sea around the Beaufort Gyre to the central Arctic was actually much stronger than in 2007, but it appears to be converging (motion is slowing) over the Amundsen and Nansen Basins. In 2007 the cumulative transport was stronger from the Eurasian coast toward Fram Strait with a smaller region of convergence. On the other hand, ice that reaches Fram Strait (lower right of map) is exported faster in 2008 than in 2007.



Buoy-derived ice motion (blue) for April-July 2008 (left) and April-July 2007(right). Mean motion from 1979-2008 is shown in green.

Outlook for September 2008:

The primary question about summer 2008 continues to be the fate of the FYI in the central Arctic. The National Centers for Environmental Prediction (NCEP) 14-day atmospheric outlooks for mid-August suggest average surface air temperatures. However, these projections are based on NCEP models that assume that ice itself will continue to persist in the central Arctic. As the ice melts, absorption of solar radiation by the ocean will warm the surface layer and could contribute to an accelerated melting of the FYI. The effect of increased open water is not considered in the atmospheric projections.

Actual visual observations of sea ice recently made from aircraft during buoy deployment operations over the Arctic by the Naval Oceanographic Office and National Guard confirm that the ice cover is noticeably thinner and that it is more fractured than in previous years. Because of its relatively higher salinity, the dominant component of first year ice in the central Arctic ice pack is subject to melt at lower temperatures than the multiyear ice typically found in the region. A fundamental assumption by NIC is that this FYI will melt out in greater amounts than MYI.

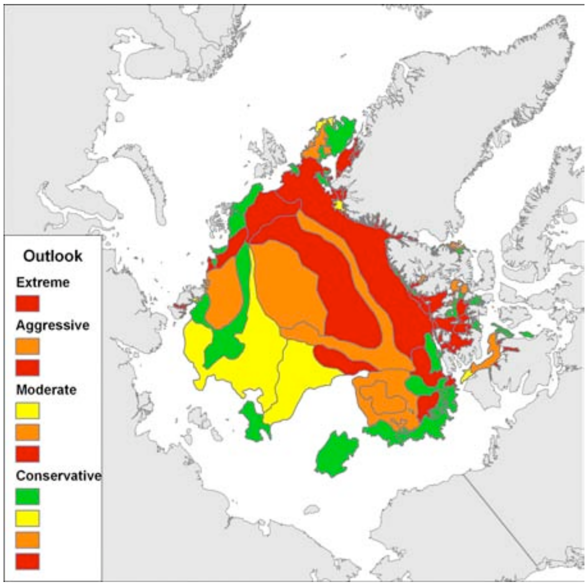
For the outlook, the following initial assumptions were made by the NIC Science Team:

1) None of the existing ice in Baffin Bay or the southern Greenland Sea would survive
2) No multiyear ice of 1/10 or 2/10 concentration would survive except for ice in assumption (3).
3) Ice with thick FYI of 8/10 or greater concentration would survive.
4) No areas with primary ice type of medium FYI would survive.

The NIC hemispheric chart for 28 July 2008, was imported into ArcGIS and these areas were removed graphically, in the same manner as was done for the 3 July Outlook. The Operations Senior Analyst removed additional ice from the chart to reflect August 4 conditions. Four cases were then considered:

1) Conservative melt: All of the thick FYI in the central pack survives
2) Moderate melt: MYI with 3/10 or 4/10 concentration was removed if total ice concentration was less than 8/10. Peripheral areas with partial concentrations of thick and/or medium FYI greater than 4/10 were removed.
3) Aggressive melt: All peripheral ice with less than 8/10 total concentration removed. FYI remaining in central pack reduced.
4) Extreme melt: Areas remaining with MYI < 4/10 inside the basin, < 5/10 in the Canadian Archipelago and south of Fram Strait were removed. Remaining FYI in central Arctic reduced.

These 4 scenarios were presented by the Science Team to the Operations Senior Analyst. The analyst's assessment was that the most likely scenario was Moderate. This would give a minimum September ice extent of **3.32 million km^2**. This value is below NIC charts last year's record value of 3.98 million km^2 but above the 3 July assessment of 2.65 million km^2. The chart below indicates the cumulative ice under each scenario. Although t assessment for the Extreme case is lower than in the 3 July outlook, the assessments for the other cases were above those made last month.

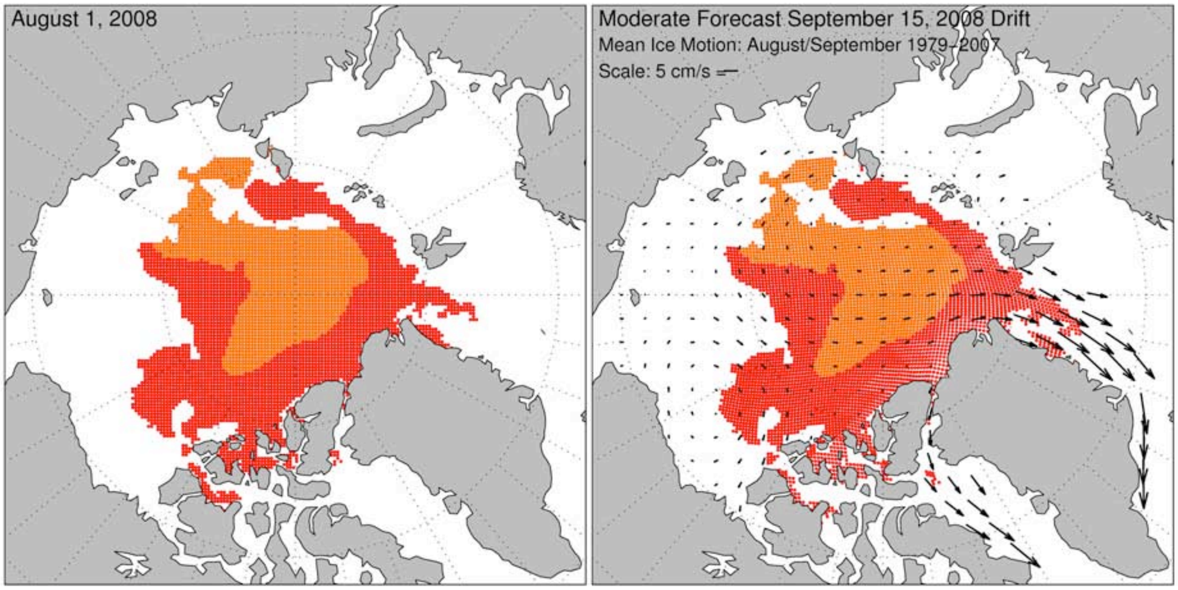


Projection of September 2008 minimums

1) Conservative: 4.02 million km2
2) Moderate: 3.32 million km2
3) Aggressive: 2.64 million km2
4) Extreme: 1.52 million km2

While these projections should not be considered as spatial outlooks, the lack of MYI in the lower Canadian Arctic Archipelago continues to suggest the possibility of the Northwest Passage becoming navigable in 2008, particularly the southern (shallow water) route.

A drift model using climatology from 28 years of buoy-derived ice motion for August and September was further applied to the Moderate scenario to create a spatial projection of ice for September 15, 2008. The model indicates some compacting of the ice pack against the Canadian Archipelago, as well as some MYI moving south through the islands. Export of ice through Fram Strait is also observed. However, because this is a 28-year average, the motions are somewhat slower than what will be observed this year (this is also apparent in the April-July 2008 cumulative ice motion, above). Particularly, the area of convergence seen in 2008 is not well represented by the climatology, nor is the strong Beaufort Gyre. Little motion is seen in the climatology along most of the Eurasian coast. Thus, we expect the actual conditions to be different, with more transport and compaction of the FYI in the central Arctic toward Fram Strait.



Spatial projection of the Moderate Scenario using climatology of August-September ice motions and a dynamic sea-ice drift model. Left: Initial conditions assumed for August 1, 2008. Right: Final conditions on September 15, 2008. Areas containing MYI are red. Areas containing only FYI are orange.

NIC will update this outlook on more time in early September based on August conditions.

Sea Ice Outlook based on Statistics of Observed Ice Extent and Global Climate Model

July 2008

1. Name of contributor: Cecilia Bitz

2. Estimate of the sea ice extent for the Arctic as a whole for the month of September 2008

   5.30 million square kilometers

3. Principal method

   Statistical, based on observations and coupled climate model output.

4. Short basis for prediction

   The 29 year observational record of September sea ice extent has zero autocorrelation at one-year lag and zero skew. The correlation with the extent in the prior July is significant, but the July 2008 extent lies very close to the long term trend. Therefore, my prediction for September 2008 is an extrapolation of the long term trend for September. These statistical relationships are in general agreement with much longer records that are available from the Community Climate System Model version 3, CCSM3.

5. Longer basis for prediction

   With little deviation from the long term trend in July 2008 and no significant autocorrelation or skew from one September to the next in the observations (Fig. 1a), the conservative estimate for the future is on the trend line in September. An extrapolation of the trend line (Fig. 1b) to year 2008 gives 5.30 million square kilometers.

   The observational results were compared with a statistical analysis of an ensemble of 20th and 21st century simulations and long control runs from CCSM3. With ensembles and multi-century control runs giving far more degrees of freedom, it is clear that CCSM3 does have a weak but significant autocorrelation in September ice extent from one year to the next. However, the autocorrelation is so weak that it did not compell me to modify my prediction based solely on the observations. In contrast, there is more considerable lagged correlation between thickness and extent, as expected owing to the much much greater memory in thickness.

   Figure 2 shows that years with September sea ice loss comparable to the 2007 observed loss are very rare.

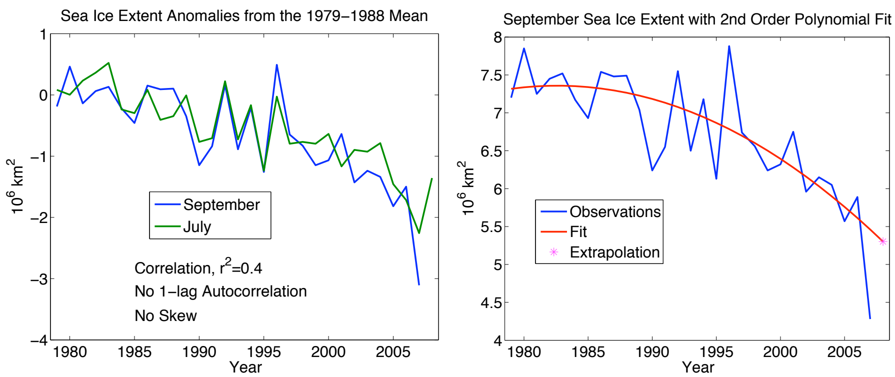


Figure 1. *Left panel:* The twenty-nine year observational record of September sea ice extent has zero one-lag autocorrelation and zero skew. September and July extents are significantly correlated. However, the extent in July 2008 followed the long-term trend, so I am predicting September will also follow the long-term trend. All timeseries are detrended BEFORE correlations and skew are estimated. *Right panel:* Observed September sea ice extent and trend line with extrapolation to 2008. The trend line is given by a 2nd-order polynomial fit to the record in years 1979-2007.

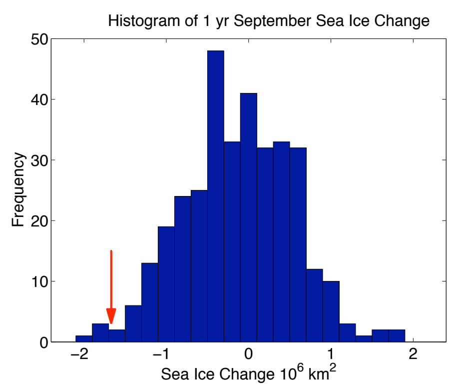


Figure 2. Histogram of September-to-September sea ice extent change in the first half of the 21st century in seven ensemble members from CCSM3 SRES A1B scenario (350 yrs total). This model has a very rapid loss of September sea ice extent, essentially loosing 30–40% of the sea ice extent in one decade (2030-2040). Yet a 1 yr drop as large as observed in 2007 (red arrow) only occurs about 1% of the time.

Sheldon Drobot, James Maslanik, Chuck Fowler
July 2008 Sea Ice Outlook: Report Based on July Data

Names of Scientist(s) making the Outlook.
Sheldon Drobot, James Maslanik, Chuck Fowler

Estimate of sea ice extent for the month of September 2008 (the value for September 2007 was 4.3 million square kilometers).
Based on data available in early June, our *most likely* solution using the probabilistic model described below is 4.86 million square kilometers. Our best guess using empirical analysis of overall conditions and short-range weather forecasts suggests a minimum of 4.4 million square kilometers.

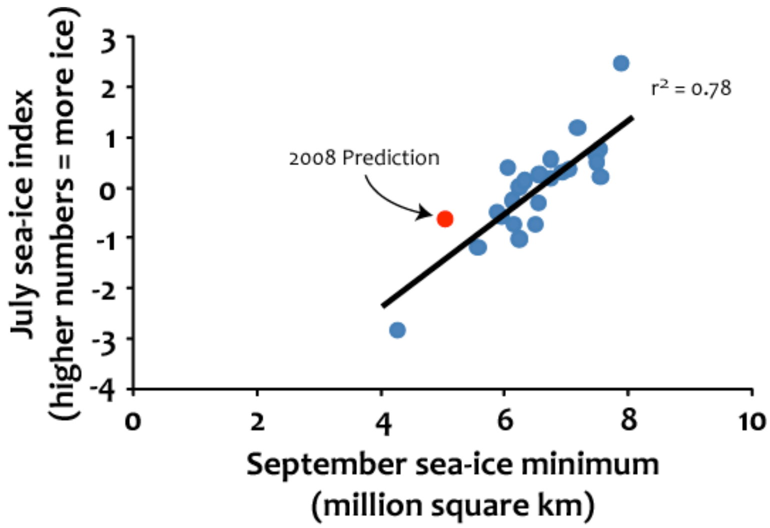
Principal Method (numerical model, statistical model, comparison to 2007 weather and satellite data, etc.) Keep this short as it will go into a table.
Probabilistic statistical model and subjective analyses of weather data

A short several sentence summary of your primary physical reasoning behind the estimate provided in #2. Last time I extracted most of this information from your essays, but it is better if you provide this up front.
Our probabilistic model follows the methods outlined in [Drobot, S.D., 2007: Using remote sensing data to develop seasonal outlooks for Arctic regional sea-ice minimum extent. Remote Sensing of Environment, 111, 136-147, doi:10.1016/j.rse.2007.03.024]. For this forecast, we are relying mainly on the spatial pattern of early June sea-ice concentration and an ice-age index [which is based on Figure 2 in Maslanik, J. A., C. Fowler, J. Stroeve, S. Drobot, J. Zwally, D. Yi, and W. Emery, 2007: A younger, thinner Arctic ice cover: Increased potential for rapid, extensive sea-ice loss. *Geophysical Research Letters*, 34, L24501, doi:10.1029/2007GL032043.] Compared to last year at this time, the sea-ice extent is now much greater, but the ice age data indicates that the ice pack is more vulnerable to loss this year. Air temperatures over the last couple of months have been cooler this year than last year, which also helps to explain why our current forecast is slightly higher than the preceding one, which was 4.40 million square kilometers. More details will be online at http://ccar.colorado.edu/arifs

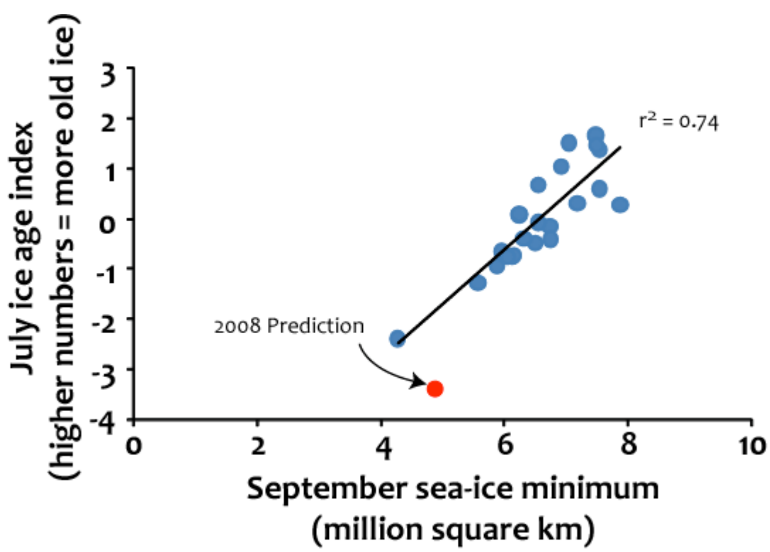
The empirical estimate given above (of 4.4 million sq. km.) subjectively factors together the observed ice concentration patterns, locations of the remaining ice, and short-range weather forecasts. Since reduced concentrations extend well into the central pack this summer and occur in areas that are predominantly first-year ice, those portions of the pack may be susceptible to melt out by September. While atmospheric conditions through July have tended to favor retention of ice in the Arctic Basin, circulation patterns over the past several days and forecasted for the next week are likely to add an additional, transport-related, component to the retreat in ice extent, particularly in the Siberian Arctic.   The rate of ice extent loss should accelerate over the next week to two weeks, given these conditions.

Any expanded information with figures which backs up #4.
We can provide these in better formats if requested:

The first image is a scatterplot of the September sea ice extent and the July sea ice index. The red dot is the July 2008 sea ice index and the predicted September sea ice extent.



Next, we have a scatterplot of the September sea ice extent and the July ice age index. The red dot is the July 2008 sea ice index and the predicted September sea ice extent.



Lastly, since our model is probabilistic, we can provide a probability of setting a new record. We are forecasting a 5% chance of setting a new record this year (down from 40% in the last forecast). Based on our subjective analysis however, we place the chance of another record minimum still at about 40%.

Any information on regional sea ice conditions or outlooks.
We still have not done any probabilistic regional forecasts this year.

Hajo Eicken
July 2008 Sea Ice Outlook: Report Based on July Data

Sea Ice Outlook 2008: A regional perspective on ice evolution in the Pacific Arctic sector (July update, released 5 August 2008)

Data

Ice extent:
• Passive microwave data (SSM/I) distributed by the National Snow and Ice Data Center (NSIDC) indicate that rapid ice retreat observed in May has slowed down in June and July. In the southern Chukchi and eastern East Siberian Sea, the ice edge is near its normal position, while it is further north than normal in the Beaufort Sea (and somewhat further north than its 2007 summer position at the same time of year; see Fig. 1).

Ice thickness and ice characteristics:
• *Eastern Chukchi/Western Beaufort Sea:* The multiyear ice studied off Barrow in April 2008 (5-7 years old, level ice 3.3 m thick; see May Sea Ice Outlook document) that was advected from the high Canadian Arctic appears to linger in the northern Chukchi Sea. Thinner ice formed locally in the Beaufort and eastern Chukchi Sea has melted back rapidly, leaving large swaths of open water.

Coastal sea ice:
• At *Wales*, in Bering Strait, the shorefast ice broke up on June 9, over a week later than last year. Local ice observers reported the last ice offshore on June 22, almost two weeks later than in 2007 and no ice has been observed in the Bering Strait region since.
• At *Barrow*, most of the landfast ice was melted out completely by the first week of July. Both newly grounded and remnant ridges remained offshore along the Barrow stretch of coast through mid-July. These ridges were driven out by surface currents and winds on July 19. Local observers and a coastal radar indicate that ice continues to linger off of town, occasionally grounding off the beach as the wind drives floes inshore. Such conditions are mostly favorable for marine mammals and subsistence hunting but present hazards for shipping.

Outlook and potential impacts

Landfast ice disintegrated somewhat later (about one week) in the region than last year, but was already unstable and unsafe in many areas prior to that. Ice retreat is now lagging behind last year's pace in the Chukchi Sea due to surface circulation and lack of warm weather. Most of the first-year ice formed in the Beaufort and eastern Chukchi Sea during winter has now been removed by melt. However, complete meltback of multiyear ice advected from the North in late spring (see May Sea Ice Outlook) is increasingly unlikely as the melt season enters into its final stages. As indicated in the previous outlook for the region, fields of rotten multiyear ice persist off the northern coast of Alaska, with potential impacts on marine mammals (providing a platform for foraging walrus well into the season) and and ship traffic.

Information needed to improve outlook

At the regional level, atmospheric circulation and surface winds are key drivers of seasonal evolution of the ice pack. Mid-range forecasts of prevailing wind patterns will improve assessments of potential for multiyear ice incursions and subsequent solar heating of surface waters. Remote sensing satellites cannot distinguish reliably between first- and multiyear ice during melt, but large-scale detection of the thick multiyear ice tracked since April would greatly help in assessing the likelihood of complete ice removal in the northern Chukchi Sea.

Submission information

Submitted by Hajo Eicken (hajo.eicken@gi.alaska.edu) on behalf of Seasonal Ice Zone Observing Network (SIZONet) project with support from the National Science Foundation's Arctic Observing Network Program and additional support from the Alaska Ocean Observing System.

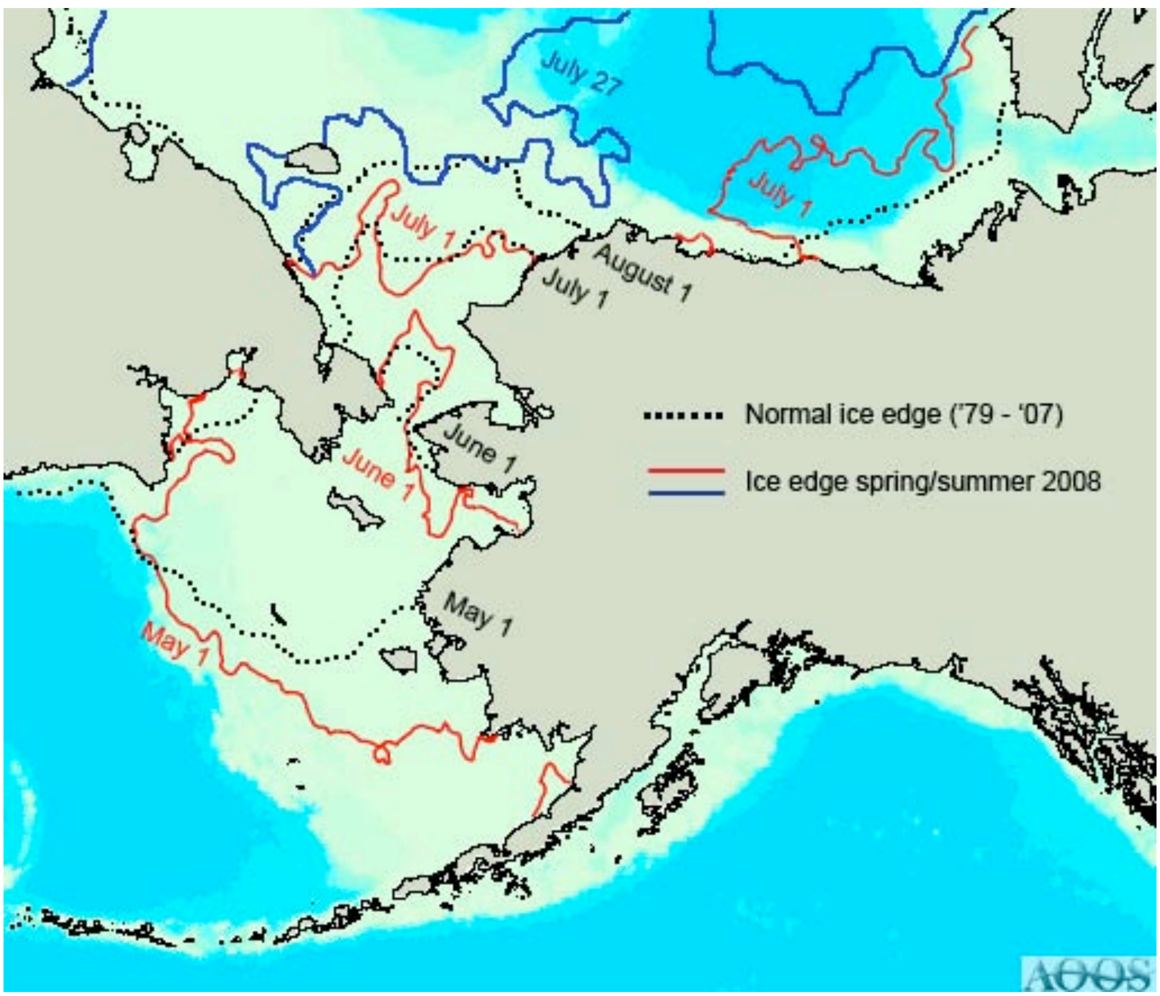


Fig. 1: Ice extent derived from passive microwave satellite data (SSM/I, data provided by NSIDC, nsidc.org) for Pacific Arctic sector. Shown are observed ice edges for May, June and July (shown as red lines for May 1, June 1 and July 1, and blue line for July 27), along with "normal" ice edges (median positions, shown as black dots) from 1979 to 2007.

Sebastian Gerland and Harvey Goodwin
July 2008 Sea Ice Outlook: Report Based on July Data

Update to the notes for the Arctic Sea Ice Outlook for the Greenland Sea and Barents Sea (Status: 5th August 2008)

As one would expect, the ice edges in the Greenland Sea and Barents Sea moved slightly northwards from June to July 2008.
In the Greenland Sea, the ice extent for July is very similar to the mean extent for 1999-2008. These two ice extents indicate a more northerly ice boundary differing somewhat from the longer term means which extended further into the southwestern part of the Greenland Sea. This is also different relative to the June situation where both longer and shorter term means showed similar patterns). In July 2007 the ice extent in this region was greater than in 2008 and for the mean ice extent 1999-08. This could indicate a reduced ice export from the Arctic Basin through the Fram Strait so far in 2008 relative to 2007.
The relationship between the present ice extent and earlier extents in the Barents Sea changed relative to June 2008. Comparing the mean extent for 1999-2008 with the July 2008 extent we see a slightly greater ice extent west of Franz Josef Land (FJL), and a slightly smaller extent east of FJL. East of FJL (but quite close to it), the ice edge in July 2008 was further north than in July 2007. When comparing the ice extent for July 2007 with that of 2008 between Svalbard and FJL, the ice edge was much further north in 2007 than in 2008. This correlates with the general speed of seasonal ice reduction for the entire Arctic during July 2008 and 2007 and earlier as published on the NSIDC website.

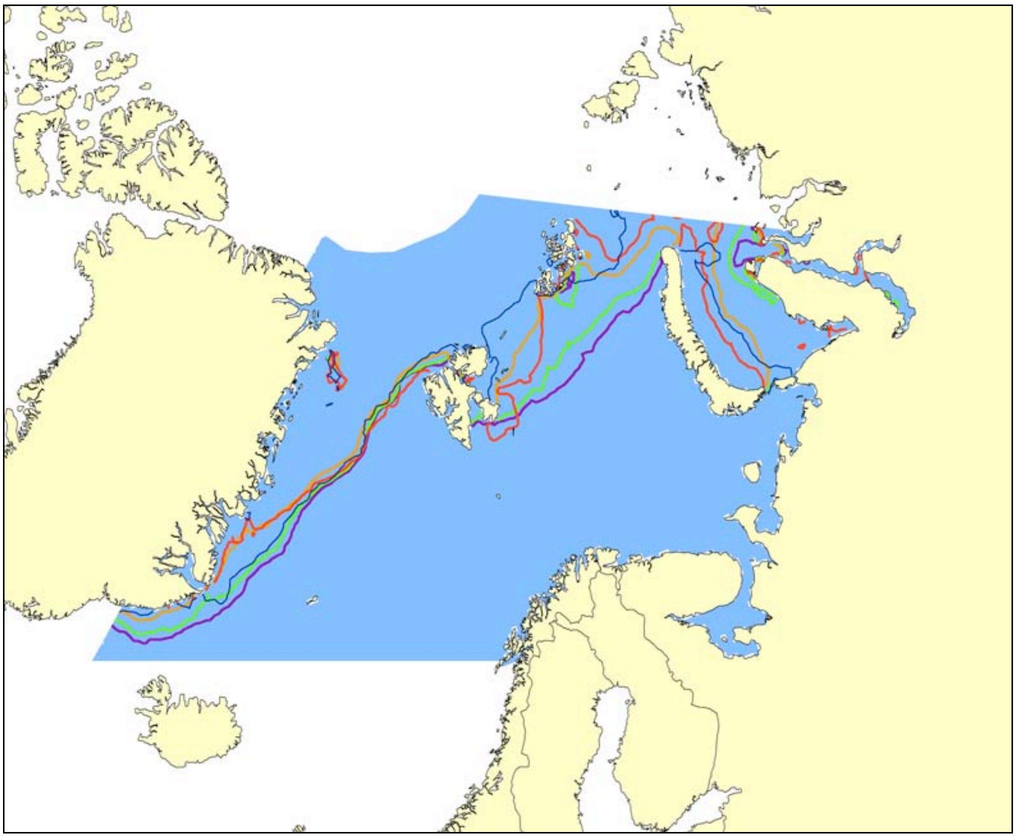


Figure 3: Ice extent (monthly means, July) southern border of 30% ice concentration) in the Greenland Sea / Fram Strait and Barents Sea, based on passive microwave satellite data (red = July 2008, orange = mean July 1999-2008, green = mean July 1979-2008, purple = mean July 1980-1999). The thin blue line indicates the ice extent for July 2007.

Notes for the Arctic Sea Ice Outlook for the areas Greenland Sea and Barents Sea (Status: 1st July 2008)

The Greenland Sea and the Barents Sea are Arctic regions with different basic sea ice regimes. The Fram Strait in the northern Greenland Sea represents the only deepwater connection between the Arctic Basin and the other world oceans. The dominant part of sea ice exiting the Arctic Basin drifts through the Fram Strait, at the end of the transpolar drift. Consequently, ice in the very dynamic Fram Strait and Greenland Sea consist to a large part of advected sea ice that was formed further north in the Arctic Basin, or in the Siberian shelf seas. Ice types in the Fram Strait include multi-year ice, and first-year ice (season depending). Contrary, the more shallow Barents Sea consists mainly of seasonal ice (first-year ice), that was formed in the Barents Sea and Kara Sea.

The difference in the ice regimes in these two regions make the Barents Sea more likely to respond faster and more directly to changes in atmospheric and oceanic conditions, and climate.

Regarding the development in 2008, we review the mean ice extent for June 2008 relative to means of time spans on decadal scale back to 1979 (Fig. 1). However, these ice edges are limited in what they can show, since i. the spatial resolution of passive microwave sensors is limited to about 10-20 km (depending of year of observation and post-processing), ii. because monthly means average over different conditions within one month. Ice conditions in early June can differ from those in late June substantially, and iii. means over 10-20 and 30 years remove interannual variability of ice extents. Saying this, we find this choice is still well illustrating changes over the last decades. In large parts of the Barents Sea one can see that the position of the marginal ice zone in June was on average further north since 1999 compared to the 20 years before that. 2008 fits in the same range. In the Fram Strait, no big changes in ice extent can be seen (on this scale), both the decadal means and the 2008 observations are in the same area. The data show also the appearance of polynyas east of northern Greenland and south of Franz Josef Land (NE Barents Sea). These areas are known for their polynyas. For the area south of Franz Josef Land, it is interesting that the polynya appears also in the 1999-2008 mean.

In September 2007 (Fig. 2), the sea ice extent means indicate changes during the last 10 years for the Barents Sea, where the MIZ was significantly further north. Also in the Greenland Sea the last decade shows less ice, but 2007 appears rather similar to extents from earlier than the last decade.

The passive microwave satellite observations do not give information on ice thickness, and here we have only considered ice concentration more than 30% and not taken account of variability of higher ice concentrations. Combining the limitations of this data with the (interannual) variability in atmospheric and oceanic conditions between now and September 2008 leaves a wide range of scenarios open for how sea ice conditions may develop throughout the summer.

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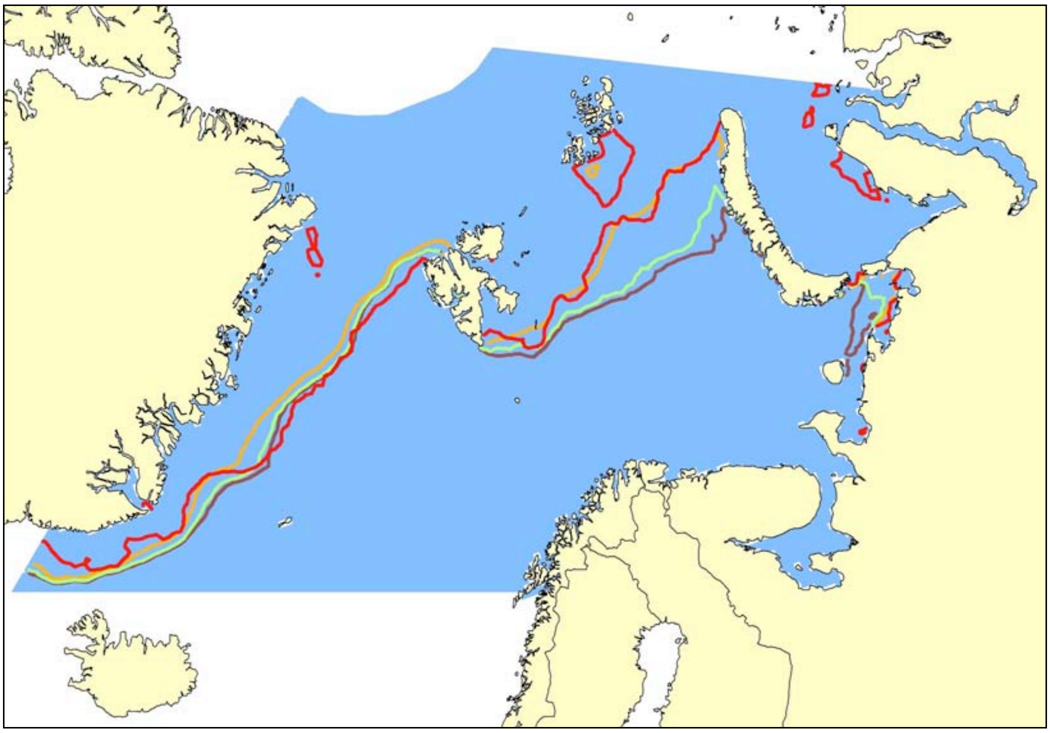

Figure 1: Ice extent (monthly means, June) southern border of 30% ice concentration) in the Greenland Sea/Fram Strait and Barents Sea, based on passive microwave satellite data (red = june 2008, orange = mean june 1999-2008, green = mean june 1979-2008, purple = mean june 1980-1999).

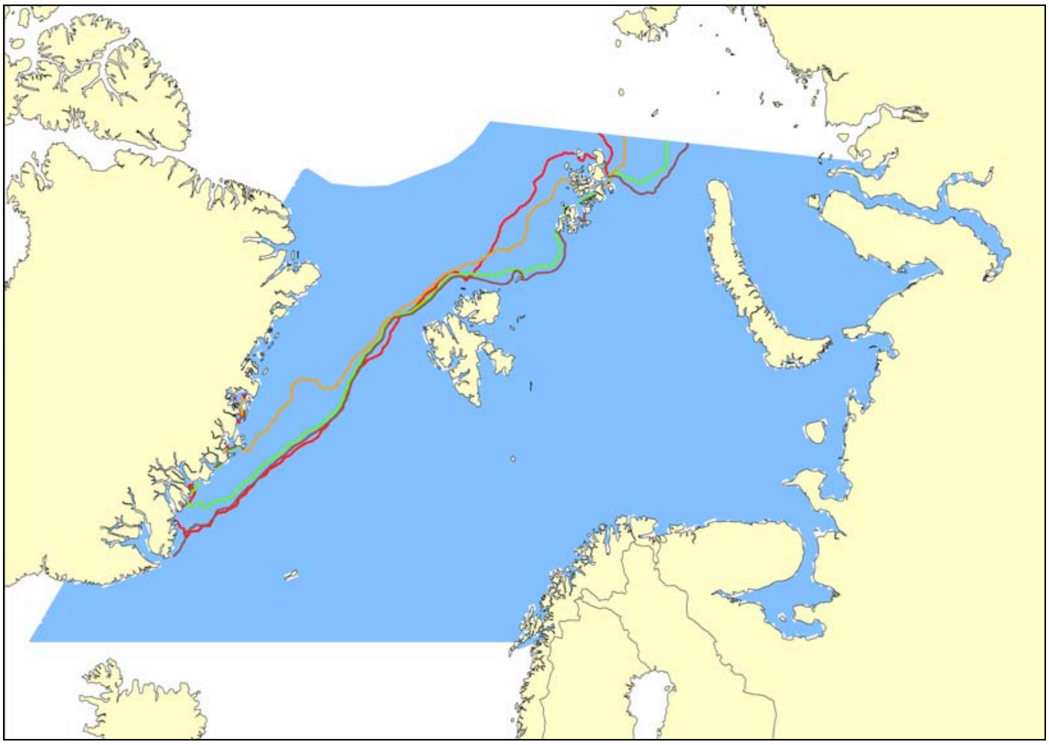

Figure 2: Ice extent (monthly means, September) southern border of 30% ice concentration) in the Greenland Sea/Fram Strait and Barents Sea, based on passive microwave satellite data (red = Sept. 2007, orange = mean Sept. 1999-2007, green = mean Sept. 1979-2007, purple = mean Sept. 1980-1999).

Masahiro Hori
July 2008 Sea Ice Outlook: Report Based on July Data

1) Names of scientist(s) contributing outlook content

Masahiro Hori (Japanese Aerospace Exploration Agency (JAXA))

2) Estimate of sea ice extent for the month of September 2008 (the value for September 2007 was 4.3 million square kilometers)

5.4 million square kilometers

3) Principal method (e.g., numerical model, statistical model, comparison to 2007 weather and satellite data, etc.). Keep this short, as this information will go into a table for the final report

Comparison to 2007 weather and satellite data

4) A short (several sentences) summary of the primary physical reasoning behind the estimate of September sea ice extent (provided in #2). The organizers are primarily interested in how you may be using data from July.

We have been monitoring daily changes of the Arctic sea ice extent using AMSR-E data. The trend of sea ice extent in July 2008 is following those of 2005 and 2006 (i.e., second minimum extent). Two factors can be considered important for estimating the minimum extent to be observed in September 2008. One is the ice thickness preconditioned in winter to spring seasons. This year's sea ice thickness in spring can be estimated to be the thinnest among recent 6 years (http://www.eorc.jaxa.jp/en/imgdata/topics/2008/tp080514.html). Thus, sea ice physical condition is considered to become much more fragile in this melting season. On the other hand, as second factor, the summer weather condition so far observed this year is not necessarily favorable to sea ice melting. Our analysis of cloudiness anomalies during June and July derived from MODIS data indicates that it was mostly cloudy over north of the Eastern Siberia Sea where much sea ice remains in this July and mostly clear over north of Alaska and Canada near the Banks Island where large open water area appears. The cloudiness pattern is consistent with those of the sea level pressure derived from NCEP/NCAR reanalysis data. Thus, clear weather under high pressure pattern seems to promote melting of sea ice in the latter region. Depending on August weather conditions there is still a possibility of sudden decrease of sea ice extent as the case in 2007 taking into account the fragile physical condition of sea ice. However, weather conditions in most of the Arctic Ocean in June and July tended to be cloudy on an average as opposed to the abnormal clear weather conditions seen in 2007. As a result, this year's minimum extent is expected to become among those of 2005 and 2006.

5) Any expanded information with figures that support #4

The daily information of the Arctic sea ice extent is available at the website "Arctic Sea-Ice Monitor by AMSR-E" on the International Arctic Research Center (IARC) web (Daily browse image: http://www.ijis.iarc.uaf.edu/cgi-bin/seaice-monitor.cgi?lang=e, Daily updated plot showing seasonal variation of sea ice extent: http://www.ijis.iarc.uaf.edu/en/home/seaice_extent.htm). These web pages are maintained by Japan Aerospace Exploration Agency (JAXA) through the cooperation between IARC and JAXA. Thanks to the cooperative relationship between NASA and JAXA, JAXA is applying the sea ice concentration algorithm developed by Dr. Comiso in NASA/GSFC to the analysis of sea ice extent from AMSR-E data.

Several figures are attached below supporting the summary explained above (#4) as follows.

Fig_1. Images showing sea ice concentration at the end of July in 2007 and 2008.

Fig_2. A plot showing seasonal variations of sea ice extent during the recent 7 years.

Fig_3. Images showing RGB color composite image of AMSR-E brightness temperatures at the 36GHz-V and 18GHz-V channels captured on April 20 during 2003 to 2008 which indicate rough estimates of the spatial distribution of the arctic sea ice thickness (thick multi-year ice is shown in dark blue, and thin young ice in light blue).

Fig_4. Images showing spatial distribution of cloudiness anomalies in the Arctic in summer (June-July) of 2007 and 2008. The anomaly is calculated from the 9-year average (2000-2008) of cloudiness analyzed using MODIS data.

Figures

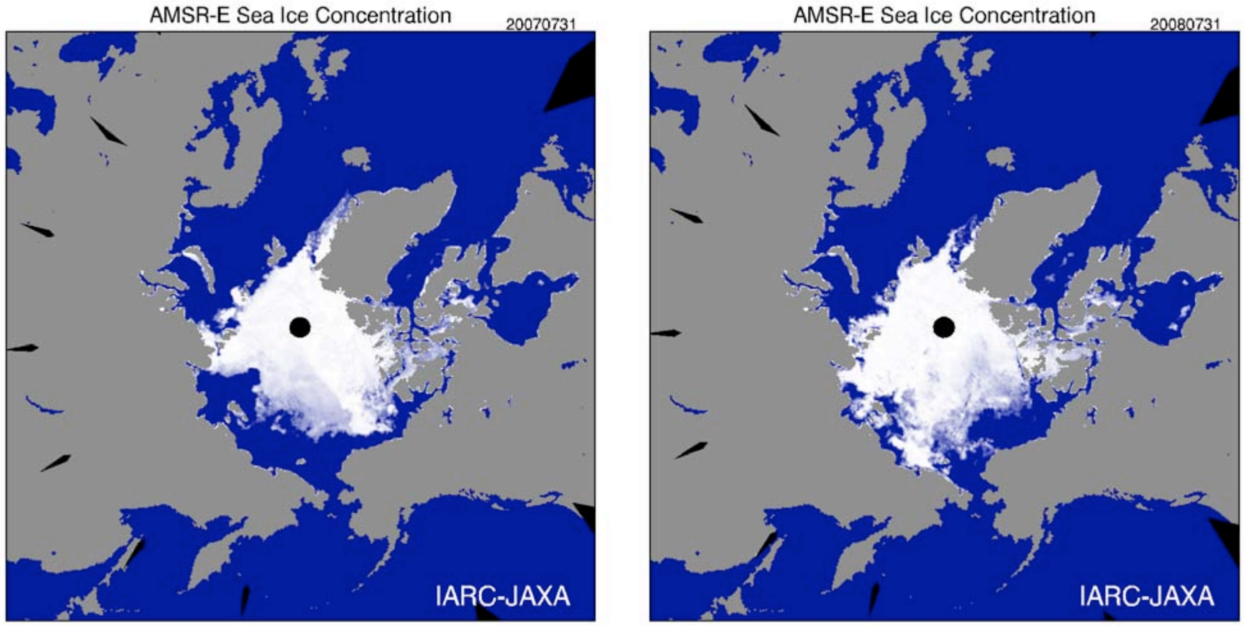

Fig.1 Images showing sea ice concentration at the end of July in 2007 (left) and 2008 (right).

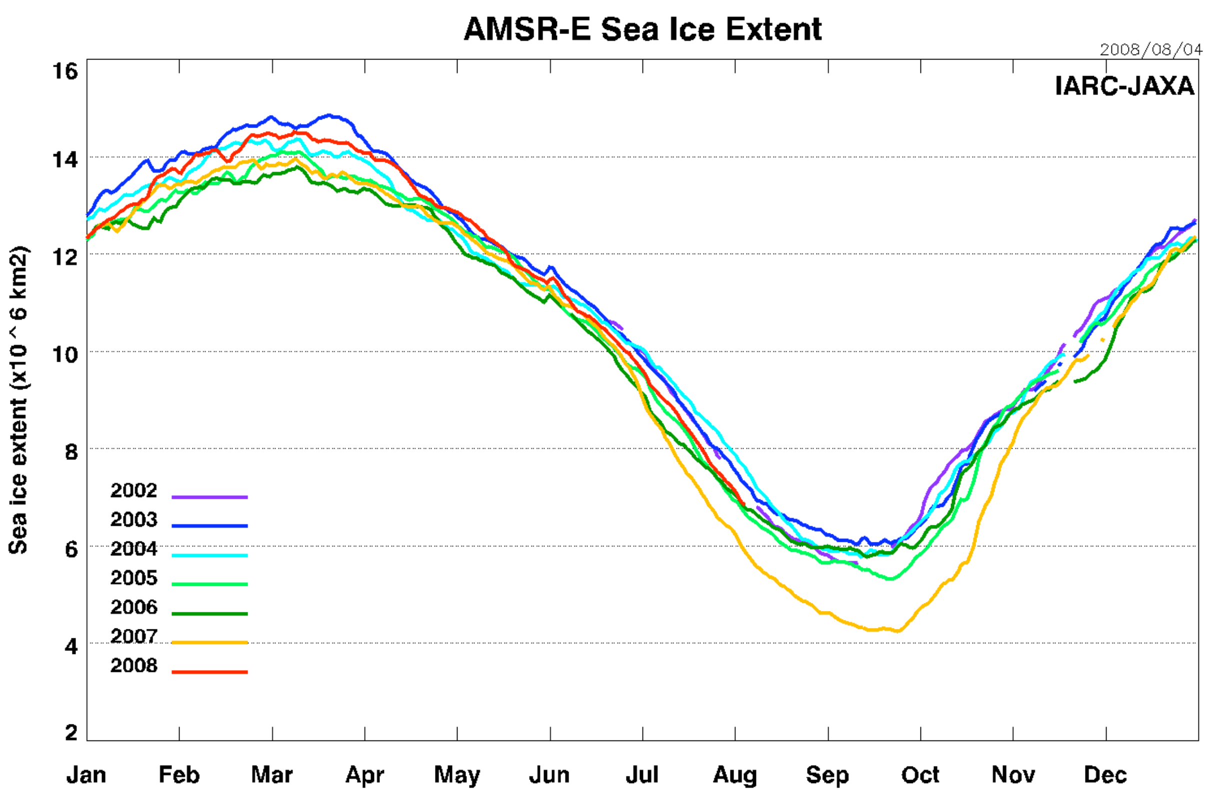

Fig_2. Seasonal variations of the Arctic sea ice extent during recent 7 years.

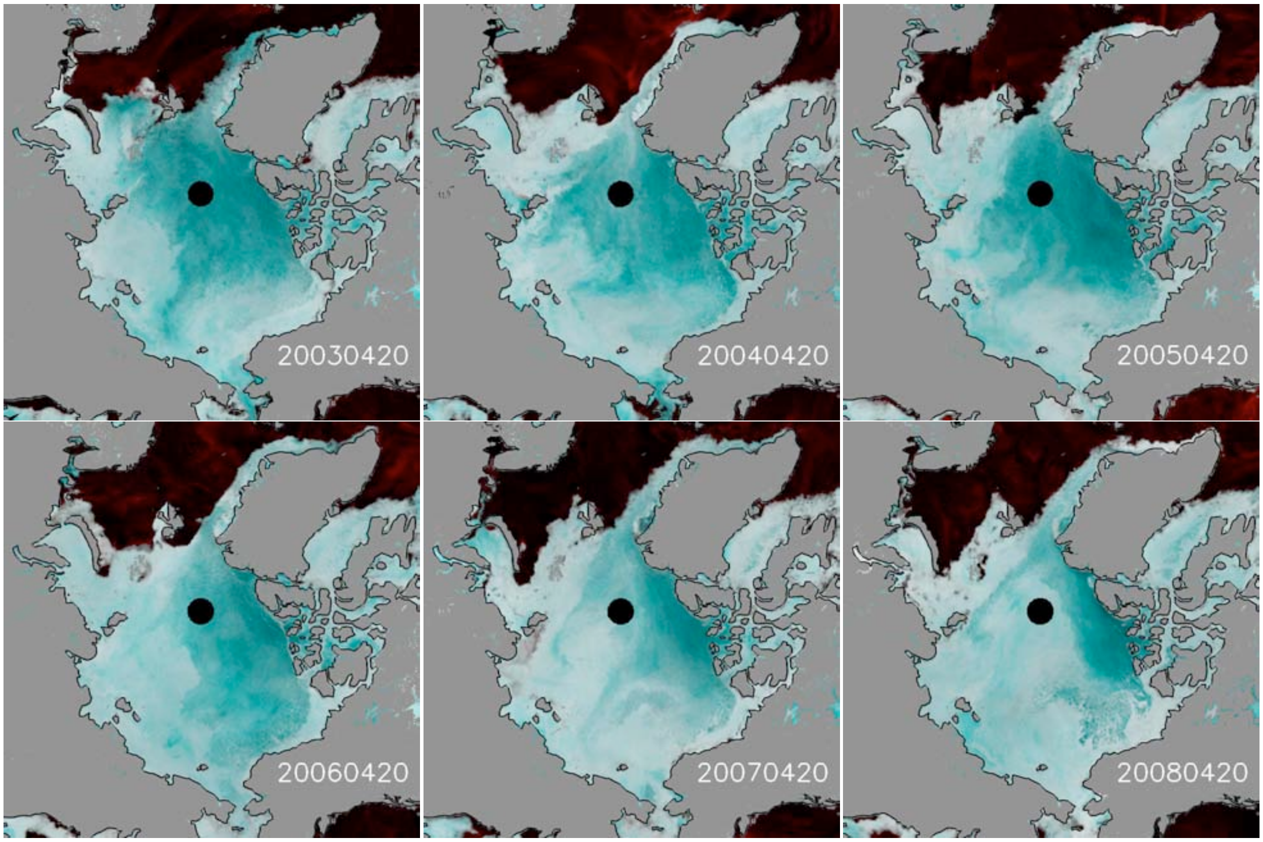

Fig.3 RGB color composite images of AMSR-E brightness temperatures at the 36GHz-V and 18GHz-V channels captured on April 20 during 2003 to 2008 which indicate rough estimates of the spatial distribution of the sea ice thickness (thick multi-year ice is shown in dark blue, and thin young ice in light blue).

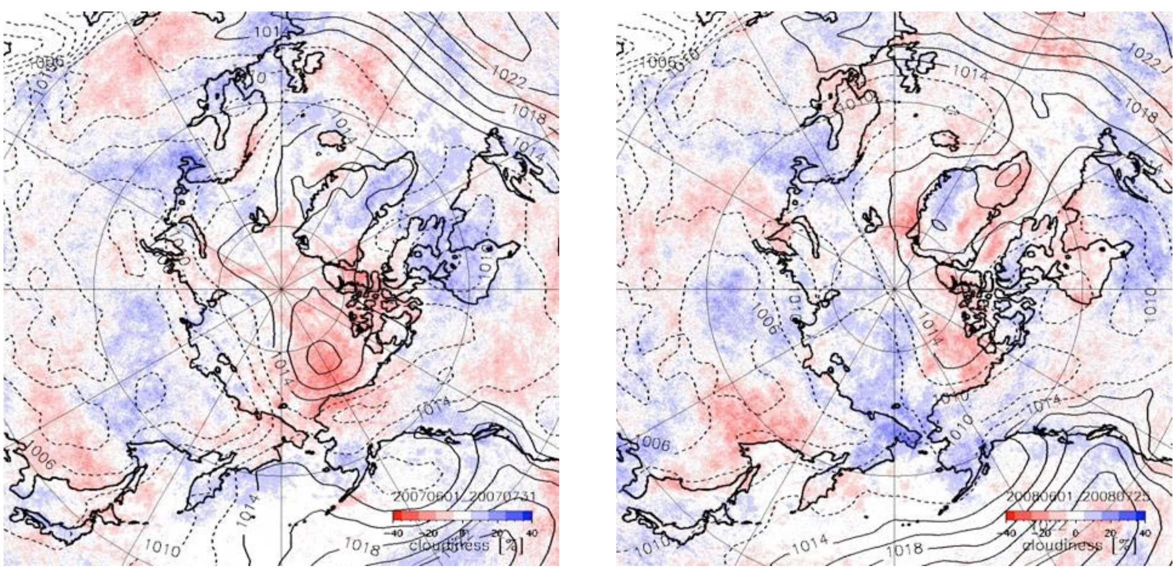

Fig.4 Spatial distribution of cloudiness anomalies in the Arctic in summer (June-July) of 2007 (left) and 2008 (right) calculated from the 9-year average (2000-2008) derived from MODIS data. Contour lines indicate sea level pressure from NCEP/NCAR reanalysis data.

Sea Ice Assessment within the Northwest Passage for 2008: July 2008 Update

Stephen Howell and Claude Duguay Cryosphere Group Interdisciplinary Centre on Climate Change (IC3) University of Waterloo 200 University Avenue West Waterloo, Ontario, Canada N2L 3G1

July 2008 Update: As of July 28th, multi-year ice (MYI) the Western Parry Channel region of the Northwest Passage has remained relatively unchanged (Figure 1) and the Canadian Arctic Archipelago itself still contains high sea ice concentrations (Figure 1; bottom right panel). The weekly time series of MYI coverage in the region for 2008 illustrates that although well below the 1968-2000 average, more MYI is present in 2008 compared to the record low of 1999 (Figure 2). The entrance to the M'Clure Strait does contain low sea ice concentrations and almost no MYI (Figure 1) but the opening of the entire Northwest Passage in 2008 will also be contingent on i) MYI from the Queen Elizabeth Islands entering the region and ii) the survival of seasonal first-year ice (FYI) in the region, both of which are known to occur (see May report).

Breakup in this region of the Northwest Passage is now just getting underway and when the FYI eventually breaks up this will cause the MYI to become mobile. Flushing of MYI from the Queen Elizabeth Islands should occur provided northerly winds prevail. We expect this MYI to then be transported into this bottleneck region of the Northwest Passage (Figure 1; bottom middle panel) and begin to accumulate just north of Victoria Island. However, there is considerable uncertainty as to how much MYI will survive in the region after it has been flushed. Flushing from the Queen Elizabeth Islands is undoubtedly going to occur but warm August temperatures could ablate this flushed MYI soon afterward.

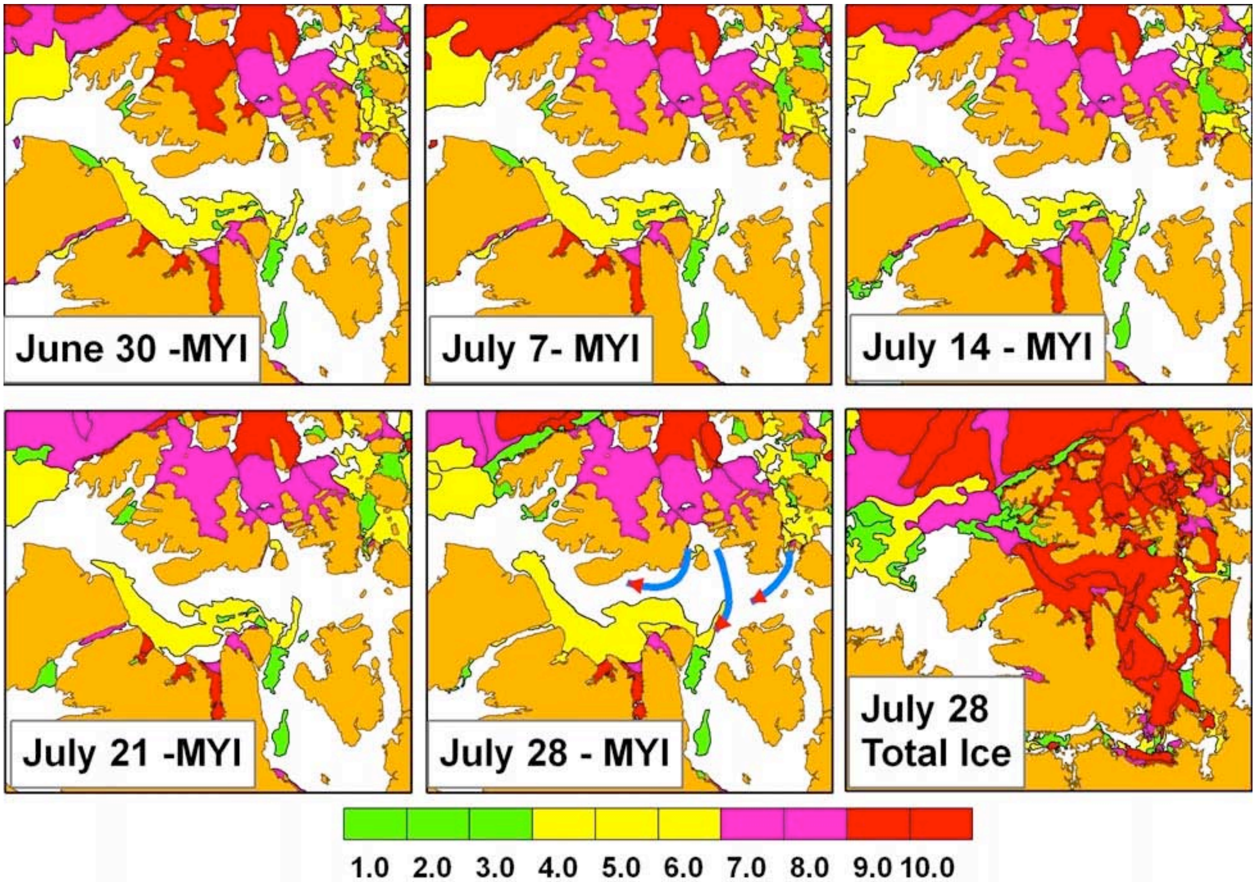

Figure 1. Spatial distribution of multi-year ice concentration in the Western Parry Channel region of the Northwest Passage for July 2008. Total sea ice concentration on July 28 shown in the bottom right panel. Legend is concentration in tenths.

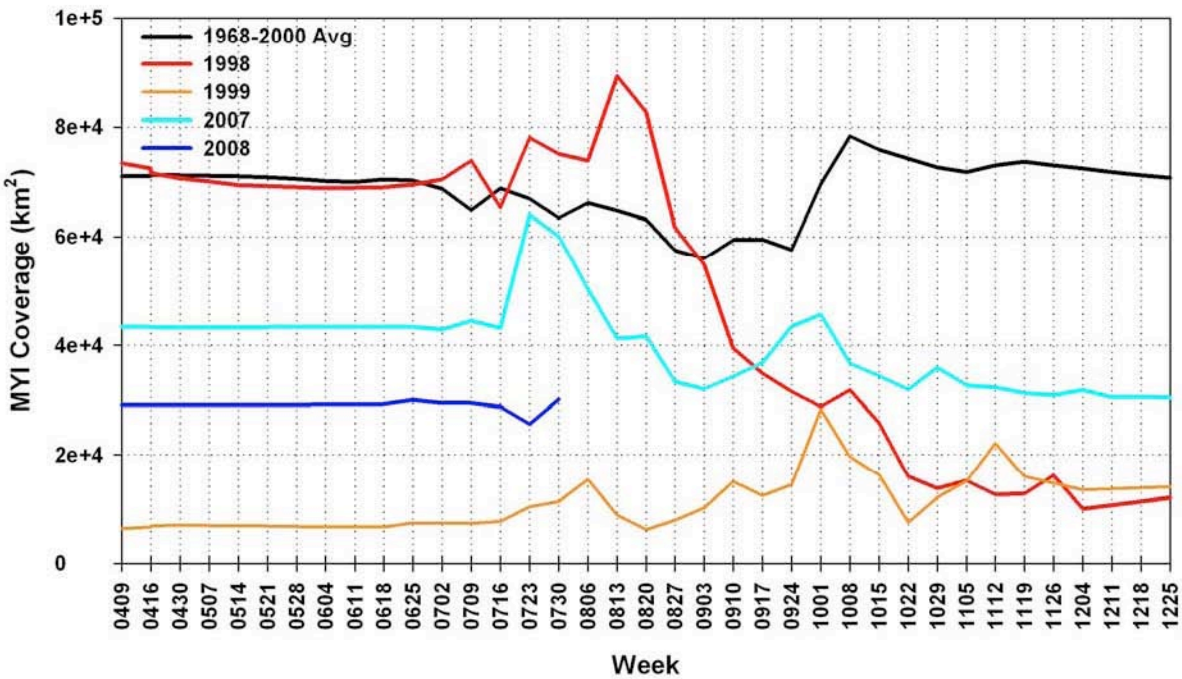

Figure 2. Weekly time series of multi-year ice coverage in the Western Parry Channel region of the Northwest Passage.

Jennifer Hutchings
July 2008 Sea Ice Outlook: Report Based on July Data

My thoughts are that the ice conditions have "exceeded my expectations" in the Beaufort Sea. A colder summer in the Siberian Arctic has led to a slower loss of sea ice than I anticipated. My outlook was focused on ice dynamics, and I really did not have enough insight on thermodynamics in this sector (where variability is known to be correlated to thermodynamic forcing). Goes to show that dynamics and thermodynamics are equally important.

Daily updated Sea Ice Outlook based on statistics of the sea ice area from 85 GHz SSM/I data 1992-2008

July 2008 by Lars Kaleschke

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Estimate of sea ice extent for the month of September 2008:

5.4 ± 0.6 Mio km²

ftp://ftp-projects.zmaw.de/seaice/prediction/regression.png
ftp://ftp-projects.zmaw.de/seaice/prediction/prediction_timeseries.png

Principal method
Daily updated statistical regression based on sea ice concentration derived from 85 GHz SSM/I data

Primary physical reasoning
The auto-correlation of the sea ice area anomaly time series is in the order of three months. Therefore, a skillful prediction of the September ice extent is possible based on the satellite derived sea ice area at the end of June.

Expanded information
As we temporally approach the summer sea ice minimum, a skillful prediction is feasible based on the presently observed sea ice area. Several algorithms exist to calculate the sea ice concentration from passive microwave data. Here the ARTIST Sea Ice (ASI) algorithm is used to derive the sea ice concentration from SSM/I data (Kaleschke et al. 2001). A validation with ship based observations in the summer season showed the good performance of the ASI algorithm in terms of standard deviation and correlation to the ground truth (Andersen et al. 2007).
Average values of the September sea ice area were calculated for the years 1992-2007. A linear scaling is used to convert the sea ice area to the extent which is justified by the high correlation of the September sea ice area with the extent. The sea ice area of the present day is used together with the same days of the 16 previous years and the September averages to estimate this year's September extent (Figure 1). The time evolution of the prediction and the correlation coefficient is shown in Figure 2. The uncertainty of the prediction is expressed by three standard deviations because the 2007 ice extent anomaly just exceeded this boundary. The drops in the correlation time series reflect the technical issue that near real time data are used and satellite data gaps have not been corrected for.

Regional sea ice conditions

The AMSR-E 89 Ghz channels have been used to calculate the sea ice concentration with a resolution of about 5 km in order to show the regional differences between the years 2007 and 2008 (Figure 3). On August 5 2008 there is considerable less ice in the East Greenland Current and the Beaufort Sea as compared to August 5 of 2007 whereas there is more ice in the Laptev and Chukchi Sea and around north of Svalbard.

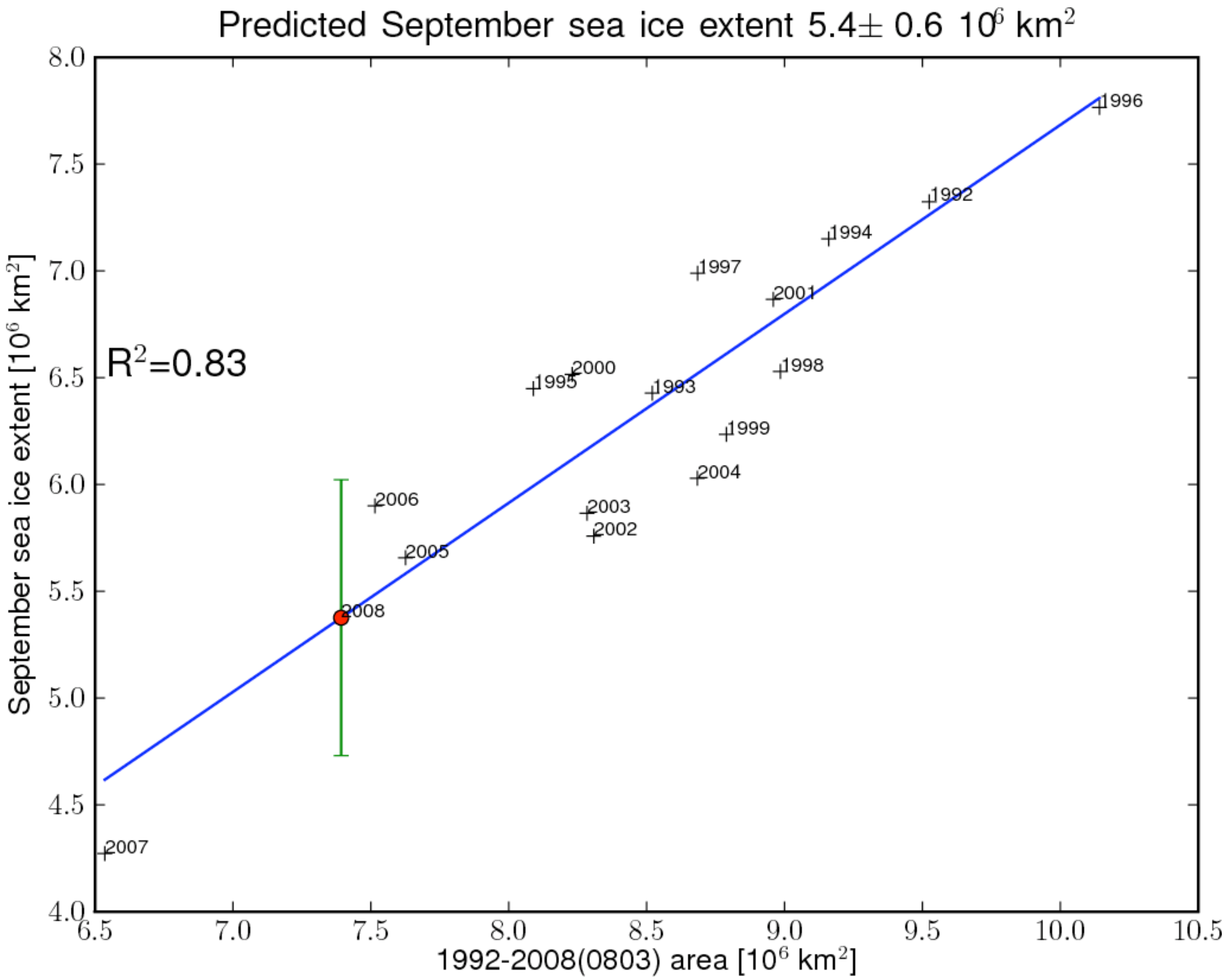


Figure 1: Predicted September sea ice extent. The linear regression line was calculated from the sea ice areas of the 3rd August and the September average for the years 1992-2007. The September sea ice extent is estimated from the observation of the 3rd August 2008. Daily updates of this figure are available at ftp://ftp-projects.zmaw.de/seaice/prediction/regression.png

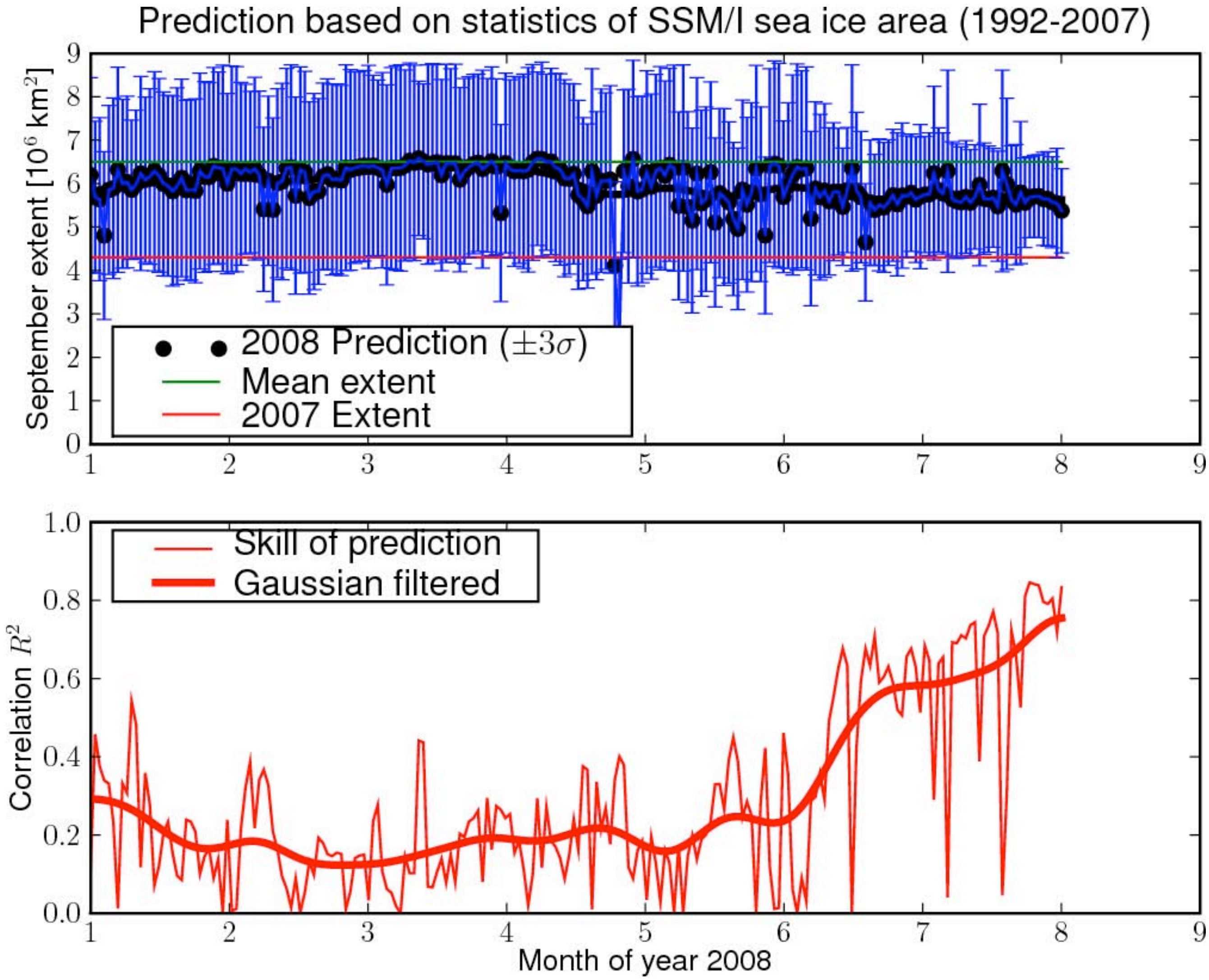


Figure 2: Estimated September sea ice extent and skill of the estimate (correlation). This graph is the result of the method shown in Figure 1 applied for every day of the year 2008. The drops of correlation indicated satellite data gaps which have not been accounted for. Daily updates of this figure are available at: ftp://ftp-projects.zmaw.de/seaice/prediction/prediction_timeseries.png

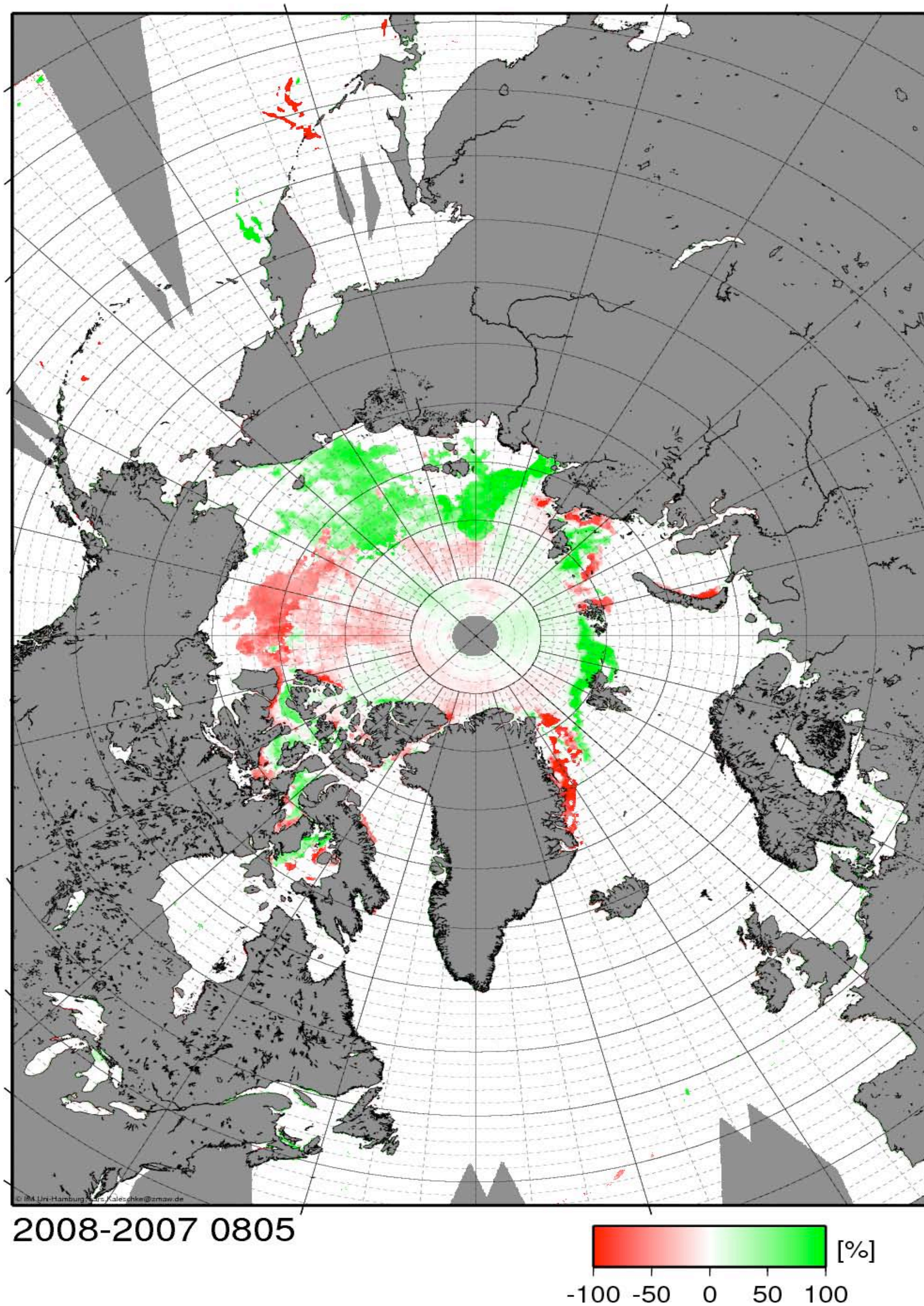


Figure 3: Difference of sea ice concentration derived from AMSR-E 89 GHz channels of 5th August 2008 minus 5th August 2007. The red areas indicate less ice in 2008 as compared to 2007.

References:

Andersen, S., R. Tonboe, L. Kaleschke, G. Heygster, and L. T. Pedersen (2007), Intercomparison of passive microwave sea ice concentration retrievals over the high-concentration Arctic sea ice, J. Geophys. Res., 112, C08004, doi:10.1029/2006JC003543.

Kaleschke, L., C. Lüpkes, T. Vihma, J. Haarpaintner, A. Bochert,, J. Hartmann, and G. Heygster (2001), SSM/I sea ice remote sensing for mesoscale ocean-atmosphere interaction analysis, Can. J. Remote Sens., 27(5), 526– 537.

Spreen, G., L. Kaleschke, and G. Heygster (2008), Sea ice remote sensing using AMSR-E 89-GHz channels, J. Geophys. Res., 113, C02S03, doi:10.1029/2005JC003384.

Daily gridded sea ice concentrations from http://cersat.ifremer.fr/data/discovery/by_parameter/sea_ice

Arctic Sea Ice in summer 2008 – July outlook

Frank Kauker, Rüdiger Gerdes, and Michael Karcher

August 12th, 2008

For the July outlook we run the coupled ocean-ice model NAOSIM with NCEP forcing until the 7th August 2008. The ensemble experiment starts from these initial conditions. For details of the ensemble technique see the June outlook.

Results

Minimum Ice Extent 2008

The summer minimum sea ice extent for all 20 realizations is shown in Figure 1, ordered by the magnitude of ice extent. Note, the extraordinary value of the 2007 forcing. The ensemble mean value for the 20 summers is 4.53 million km^2 which is somewhat higher than the mean value of the June outlook (4.43 million km^2). The standard deviation of the ensemble is 0.15 million km^2 – considerably smaller than the standard deviation of the June outlook (0.21 million km^2). Assuming a Gaussian distribution we can draw the following probabilistic statements:

The probability that in 2008 the minmum ice extent will fall below the minimum from September 2007 is less than 1%, the probability to fall below the minimum of 2005 (second lowest value in the last 20 years) is practically 100%.
With a probability of 80% the minimum ice extent in 2008 will be in the range between 4,34 and 4.72 million km^2.

The ensemble runs have been started from initial conditions which are not constrained by observations (no data assimilation) but calculated from a forward run. Due to model or forcing deficits the initial state on August 7th underestimates considerably the ice concentration in the Eurasian basin (not shown) as compared to observation. Though we account for a systematic underestimation of the model by a constant correction, we cannot exclude that the July outlook still tends to underestimate the ice extent for September.

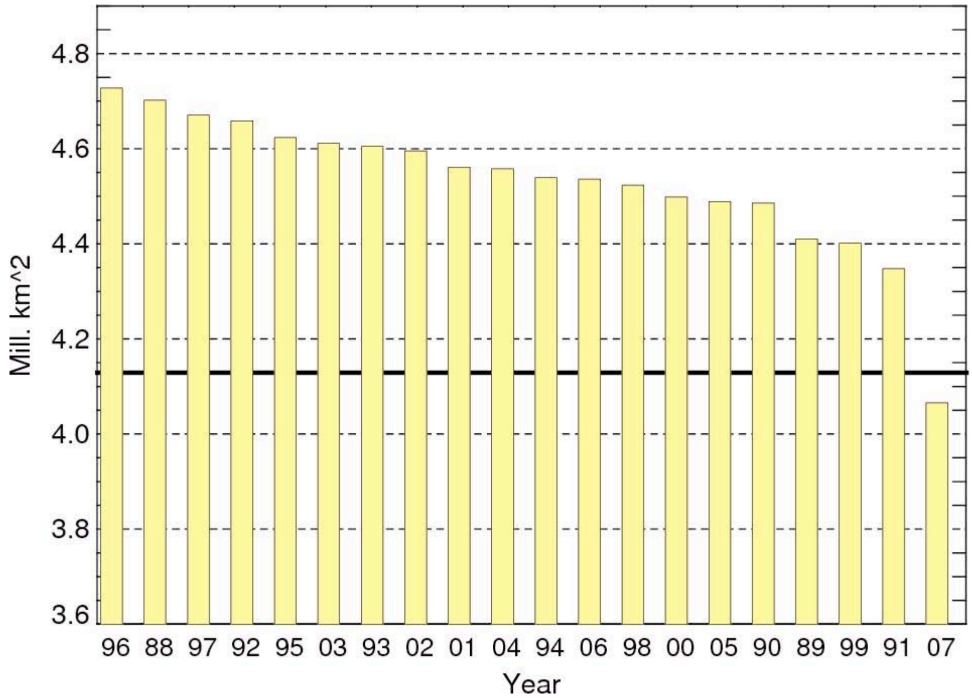


Figure 1: Simulated minimum sea-ice extent in 2008 [Mill. km^2] when forced with atmospheric data from each year between 1988 and 2007 from the initial state of August 7, 2008. Model derived ice extents have been adjusted with a constant offset to account for discrepancies with satellite-derived ice extents. The thick black horizontal line displays the minimum ice extent observed in 2007.

2008 September sea ice outlook - R. Kwok

1. Estimate of sea ice extent of the Arctic at summer minimum: 5×10^6 km^2 (no change from May estimate) – see May Outlook for discussion. This value includes ice coverage outside the Arctic Basin.

2. Figures (addendum to May outlook). The following two figures show: 1) the Arctic ice extent at end of June, July, August and at its minimum during 2006, 2007, and 2008 (Fig. 1); and 2) our estimates for this summer compared to that observed in June and July. (Fig. 2).

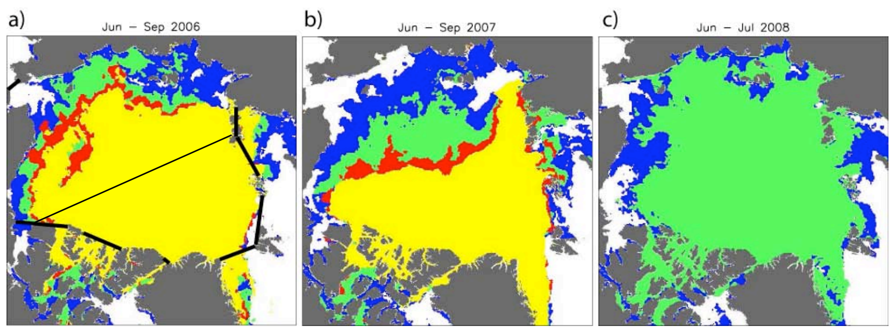


Fig. 1 (a,b) The Arctic ice extent at the end of June (blue), July (green), August (red), and at its minimum in September (yellow) during 2006 and 2007. (c) The two months of 2008 from passive microwave estimates.

See page 2…

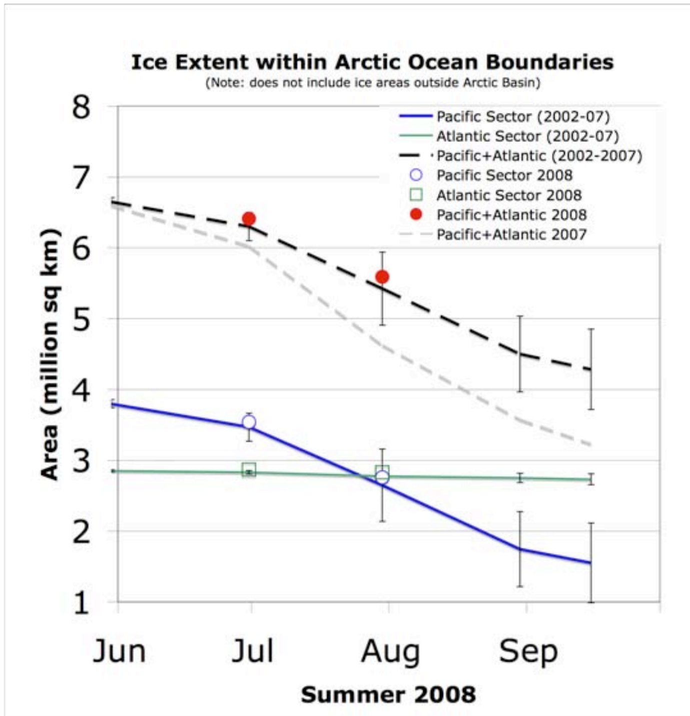


Fig. 2 Comparison of our Arctic Ocean ice extent estimates (black dashed line) with that in 2007 (dashed light gray) within the boundaries shown in Fig. 1a. Red dots show the observed extent at the end of June and July from passive microwave analyses. The blue line and blue circles are the estimated and observed ice extents in the Pacific Sector. The green line and green squares are the estimated and observed ice extents in the Atlantic Sector. The line that separates the Pacific and Atlantic Sectors are shown in Fig. 1a.

2

Martin Miles
July 2008 Sea Ice Outlook: Report Based on July Data

Names of Scientist(s) making the Outlook.
This outlook was produced by Martin Miles
Environmental Systems Analysis Research Center (ESARC) and Bjerknes Centre for Climate Research (BCCR)

Estimate of sea ice extent for the month of September 2008
4.4 million square kilometers

Principal method (numerical model, statistical model, comparison to 2007 weather and satellite data, etc.) Keep this short as it will go into a table.
Semi-empirical / semi-theoretical (i.e., "seat-of-the-pants")

A short several sentence summary of your primary physical reasoning behind the estimate provided in #2. We are primarily interested in how you may be using data from July.
Our latest estimate of 4.4 million square kilometers, is an upward adjustment of 0.6 million square from our original estimate of 3.8 in the May outlook. (Did not participate in June.) As we stated in the May outlook, the single most important additional information that would improve the prediction is the expected predominant mode(s) of atmospheric-circulation variability in the Arctic in June–September 2008. It happened that the atmospheric-circulation patterns in June–July were generally favorable for preservation of sea ice, at least compared to the same period in summer 2007. Assuming the patterns in August–September are neutral, then our expectation is that sea-ice decreases may yet approach the record minimum in 2007, the reason being the susceptibility of the predominantly first-year ice cover – as reasoned in our May outlook contribution – and the large areas of reduced sea-ice concentration evident in the late July AMSR-E image data.

Thomas Newbury
July 2008 Sea Ice Outlook: Report Based on July Data

31 July Update from Pt. Barrow, Alaska
A huge storm took out a house in Wainwright and pushed a great deal of ice to shore at Pt. Barrow, closing off the route around the point for several oil and gas vessels. The ice might be blown back out this weekend.

Leif Toudal Pedersen
July 2008 Sea Ice Outlook: Report Based on July Data

1. Names of Scientist(s) making the Outlook.
   This outlook was produced by Leif Toudal Pedersen, Rasmus Tonboe and Gorm Dybkjær, Danish Meteorological Institute (DMI)

2. Estimate of sea ice extent for the month of September 2008
   4.46 million square kilometers

3. Principal method (numerical model, statistical model, comparison to 2007 weather and satellite data, etc.) Keep this short as it will go into a table.

   Statistical model, multiple linear regression

4. A short several sentence summary of your primary physical reasoning behind the estimate provided in #2. We are primarily interested in how you may be using data from July.

   The multiple linear regression estimates September ice extent from

   a) **Number of freezing degree days the previous winter (proxy for thickness of FY ice)**
   b) **End of April multi-year ice extent (the last reliable measure of MY-ice extent from scatterometer data)**
   c) **July total ice extent.**

   Item c) is updated every month to provide information about the recent developments.

5. Any expanded information with figures which backs up #4.

   Description of input parameters.
   From ECMWF reanalysis (ERA40) (1999-2002) and operational (T511) (after 2002) model grids we estimated

   - Freezing degree days between Oct. 1. and May 31

   The temperature compared to ERA40 climatology is shown in figure 1.

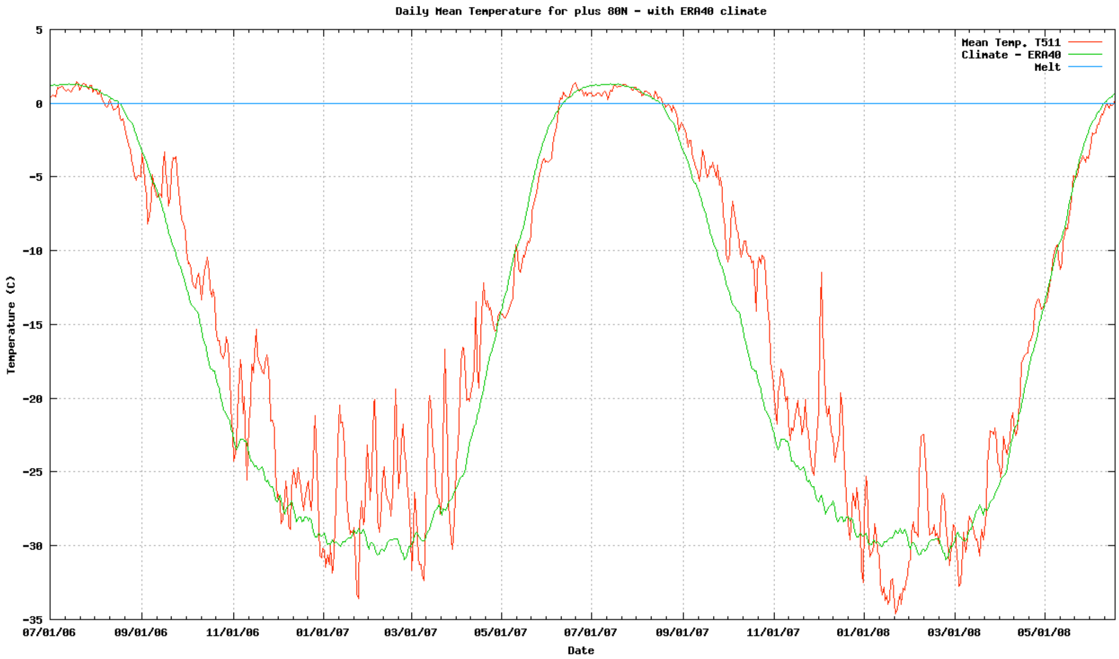


Figure 1 The average 2m air temperature (T2m) north of 80N for the last two years in red and ERA40 climatology in green. Note that during the 2006-07 winter T2m was above the climatological mean almost all the time. The fall of 2007 also had T2m above the climatological mean whereas the spring of 2008 has been close to 'normal'.

Multiyear ice extent is mapped for the area inside the Arctic Ocean using QuikScat SeaWinds scatterometer data (CERSAT/IFREMER) in a Bayesian classification. The classification is done on the daily grids between Oct. 1. and Apr. 30 and the multiyear ice area is observed to decrease during winter approximately at the same rate as the Fram Strait export. We use the April average multiyear ice area for each year in the prediction. Data are available since 2000. The thick multiyear ice melts at a much slower rate than the thinner first-year ice. The multiyear ice is the 'memory' from last year.

The total ice extent in July is from NSIDC.

Method:

Our estimate of the September ice extent is calculated using a multiple linear regression with the source data mentioned above as independent variables. Various parameter combinations were tried out, and the presented estimate is based on the following parameters:

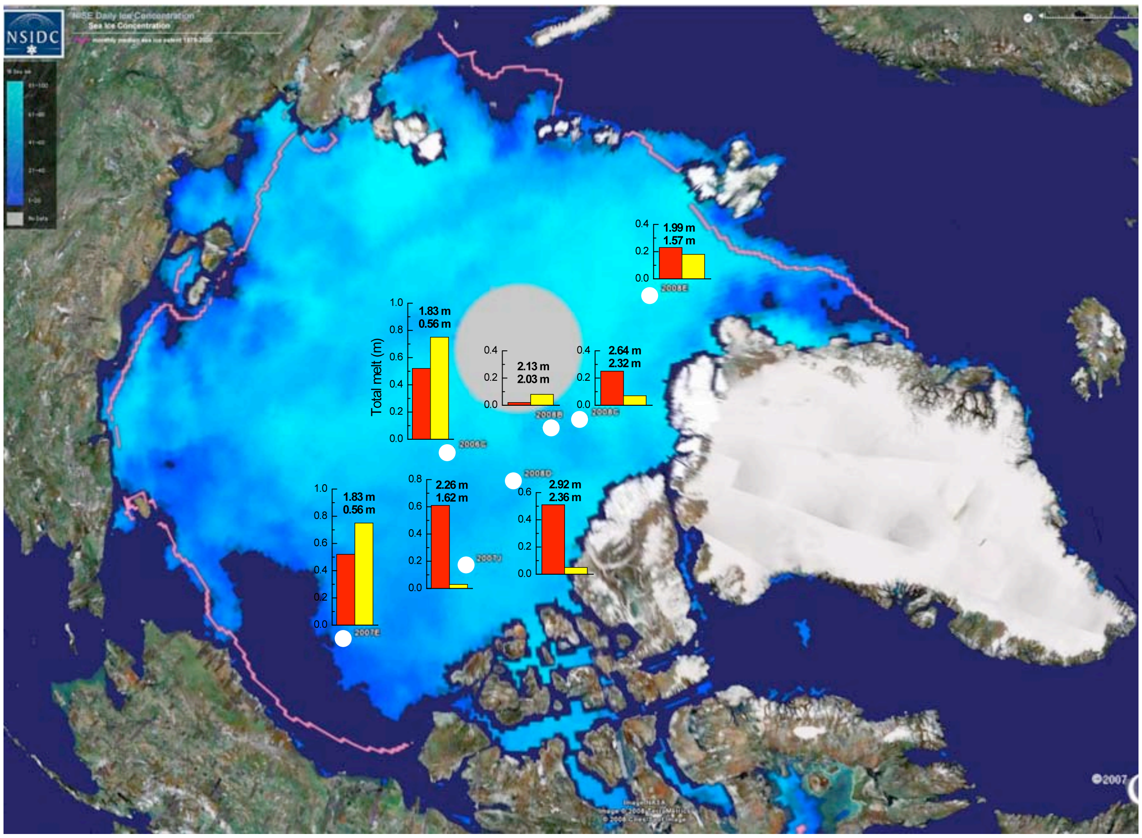
- Freezing degree days during winter,
- April MY area,
- Total Northern Hemisphere ice extent in July.

The estimate based on June total ice extent was 3.41 and the estimate from May was 3.66 million square kilometers. The 2008 September had the potential to become a new absolute minimum, but the recent estimate is more conservative based on the fact that the July total extent was larger than feared.

Gorm Dybkjær, Rasmus Tonboe and Leif Toudal Pedersen, DMI

Don Perovich, Jackie Richter-Menge, Bruce Elder, Chris Polashenski, and Dan LaRoche
July 2008 Sea Ice Outlook: Report Based on July Data

This figure shows the total amount of surface (red) and bottom (yellow) melt through August 1, 2008 measured at seven sea ice mass balance buoys. The current buoy positions are denoted by a circle and ID number. The two numbers with each plot are the ice thickness before melt began this spring and on 1 August. Also displayed is the ice concentration from the National Snow and Ice Data Center. The buoys were deployed in conjunction with the North Pole Environmental Observatory, the Beaufort Gyre Environmental Observatory, and DAMOCLES.



Oleg M. Pokrovsky
July 2008 Sea Ice Outlook: Report Based on July Data

Sea ice Outlook based on July information

1. Names of Scientist(s) making the Outlook.
Oleg M. Pokrovsky

2. *Estimate of sea ice extent for the month of September 2008*

4.6 million square kilometers

3. *Principal method (numerical model, statistical model, comparison to 2007 weather and satellite data, etc.) Keep this short as it will go into a table.*

Analysis of current weather conditions, its comparison against these for 2007.

4. *A short several sentence summary of your primary physical reasoning behind the estimate provided in #2. We are primarily interested in how you may be using data from July.*

Persisted air circulation system in Northern Pacific provided permanent inflow of warm air to Alaska/Canada sector of Arctic and outflow cooled air through East Siberian sector of Arctic . Thus, in former domain one can find less ice sheet cover than in last year, but latter is fully covered with ice. There is a general negative trend of SST in North Pacific represented by time series of PDO (Pacific Decadal Oscillation), which is turning in negative phase (see figures). July satellite data of the NSIDC (see table) demonstrates that this factor is enforced during last month. In general, Pacific sector of Artic will be more ice covered than in 2007.
Northward wind in European sector of Arctic provided usual condition for ice melting in Barents Sea and lesser in Kara Sea.

Table. Comparison of the Arctic ice extent values between winter and spring months of 2007 and 2008.

Year/month	Arctic Ice extent (million sq. km)
2007/Feb	14.5
2008/Feb	15.0
2007/March	14.7
2008/March	15.2
2007/April	13.9
2008/April	14.5
2007/May	13.0
2008/May	13.2
2007/June	11.5
2008/June	11.4
2007/July	8.1
2008/July	9.0

5. *Any expanded information with figures which backs up #4.*

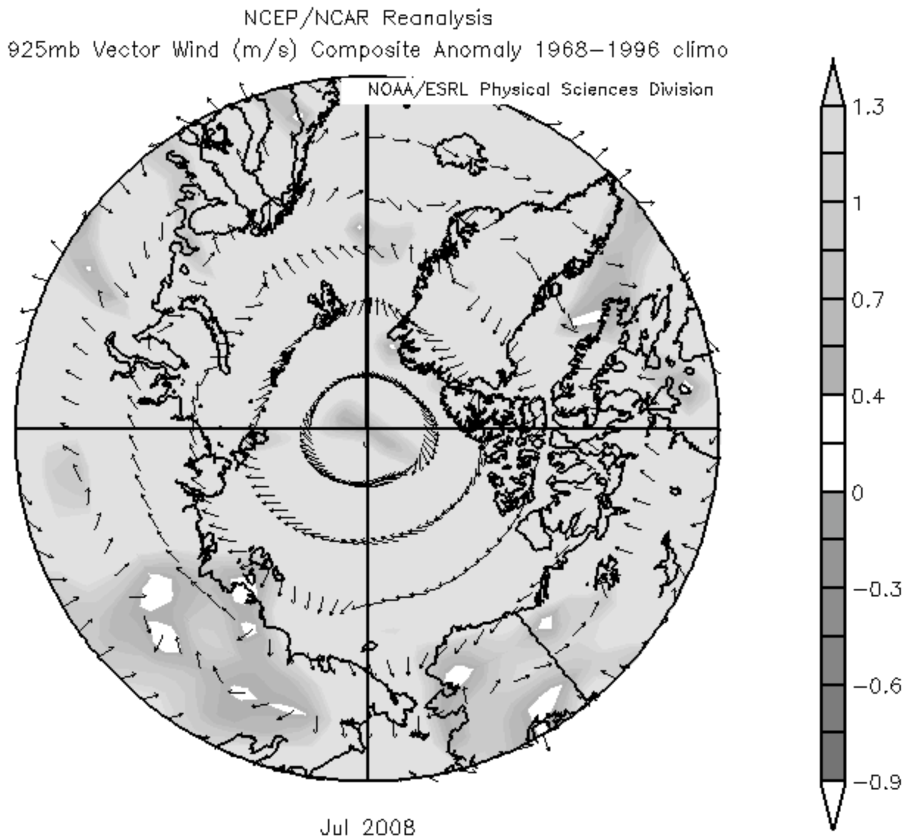


Fig.1 Vector wind field for July 2008.

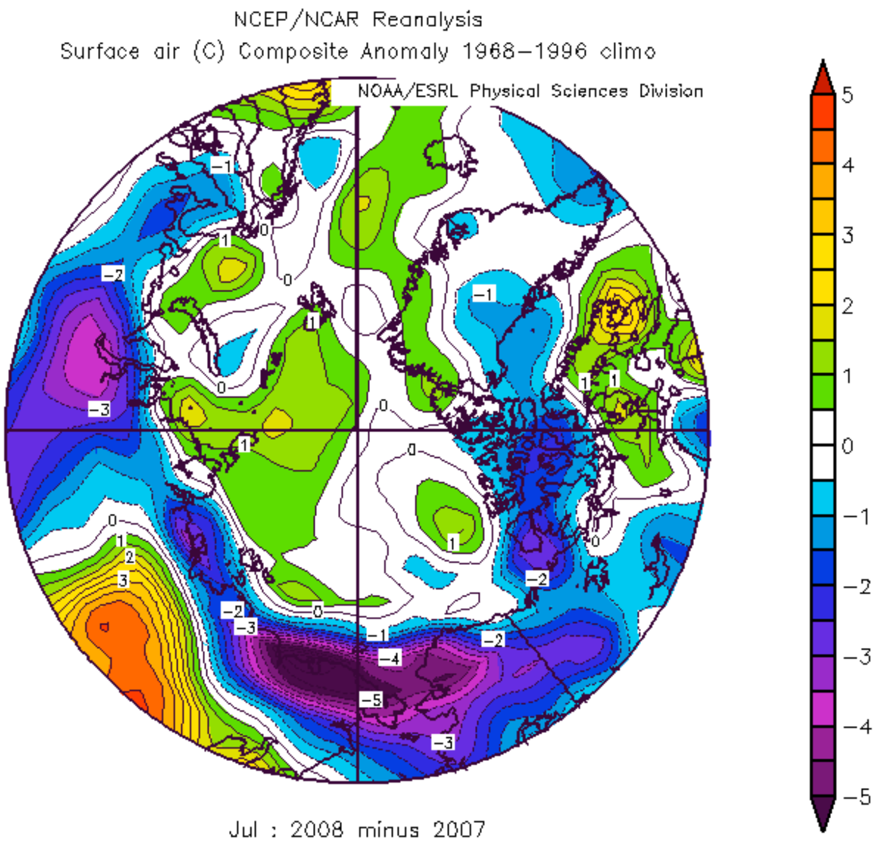


Fig. 2. Difference of the SAT between July 2008 and July 2007.

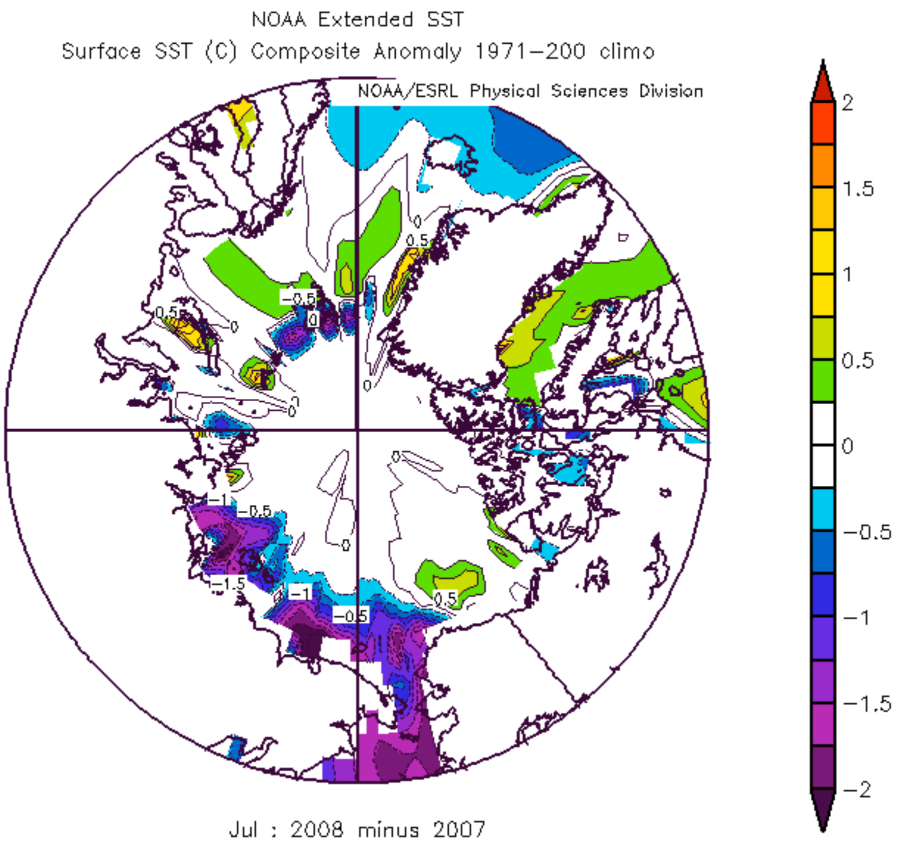


Fig. 3. Difference of the SST between July 2008 and July 2007.

6 *Any information on regional sea ice conditions or outlooks.*

It is probable that east-west passage in East Siberia (Laptev and East-Siberian Seas) will be mainly ice covered in September. In contrast, major part of Alaska/Canadian coastline - will be free of ice.

Simon Prinsenberg
July 2008 Sea Ice Outlook: Report Based on July Data

The 2008 ice extent will probably be the same as last year, as a rebound before dropping off sharply the following year. It all depends on the radiation and clouds presently in the Beaufort Sea.

1. Names of Scientist(s) making the Outlook.

Ignatius G. Rigor[1,2], Pablo Clemente-Colón[3], Son V. Nghiem[4], James Brinkley[3], and Todd Arbetter[3]
[1]Polar Science Center, Applied Physics Laboratory, University of Washington
[2]NOAA/UW Joint Institute for the Study of the Atmosphere and Ocean (JISAO)
[3]Naval/National Ice Center
[4]Jet Propulsion Laboratory, California Institute of Technology

2. Estimate of sea ice extent for the month of September 2008 (the value for September 2007 was 4.3 million square kilometers).

3.2 million sq. km

3. Principal method (numerical model, statistical model, comparison to 2007 weather and satellite data, etc.) Keep this short as it will go into a table.

Based on a survival statistics of sea ice ages/types derived from a simple Drift Age Model, and QuikSCAT retrievals.

4. A short several sentence summary of your primary physical reasoning behind the estimate provided in #2. We are primarily interested in how you may be using data from July.

This outlook emphasizes the importance of the initial ice conditions in developing a seasonal outlook. Our initial forecast was based on the estimated fractions of first-year and multi-year sea ice in March 2008, and the expected survival of these fractions through September based on data for each year from 1956 – 2007. We now show how these areas of FY/MY ice have drifted from April through July, and discuss how this may affect our initial outlook.

5. Any expanded information with figures which backs up #4.

Preconditioning of sea ice by prior winter AO and decadal changes in the age of sea ice.

As noted by Rigor et al. 2002, high Arctic Oscillation (AO, Figure 1) conditions during winter precondition summer sea ice for extensive retreats especially on the Eurasian sector of the Arctic Ocean. High AO conditions were observed during the winter of 2006/2007 preceding the current record minimum, and again this past winter of 2007/2008. The winds associated with these *conditions pushed the remaining multi-year (MY, or perennial) sea ice against the Canadian Archipelago and out through Fram Strait (Figure 2).*

The area of MY sea ice over the Arctic Ocean has dropped another 1 million sq. km. from March 2007 to March 2008 (Nghiem et al. 2008). As argued by [Rigor & Wallace (2004),](#) the age of sea ice explains over 50% of the variance in summer sea ice extent along the Alaskan and Eurasian coasts. This leaves a vast area of first-year (FY) sea ice that simply does not have enough mass to survive even a cold summer melt season. The expected minimum of 3.1 million sq. km. also agrees with typical survival rates of FY and MY ice from 1956 – 2007.

The variability in winds during the prior winter and summer are also important (Rigor 2005). During some years, the winds may pile FY ice up against a coast increasing its areal average thickness, and thus making these areas more resistant to sea ice retreat, or it may blow the ice away as it did during the summer of 2007. From late December 2007 to early January 2008, low AO conditions prevailed favoring strong easterly winds from the Canadian Archipelago. These winds fractured and blew the remnants of MY ice in the Eastern Beaufort across the Beaufort and Chukchi seas (Figure 3, more discussion and animations of this event may be viewed at http://www.ice.ec.gc.ca/app/WsvPageDsp.cfm?id=11892&Lang=eng). The extensive areas of FY ice that grew between the areas of MY ice are likely to melt earlier, quickly decreasing the concentration of sea ice, and as noted by Perovich et al. (2008), the extra sun light absorbed by the darker ocean may favor the rapid thinning of sea ice, and enhance the retreat of sea ice in the Beaufort and Chukchi seas.

Impact of Spring and Summer winds and ice drift

From April through July 2008, the AO exhibited primarily low to moderate conditions (mean = -0.5), which tended to blow the sea ice away from the Alaskan coast, which explains the dramatic decrease in ice extent in these areas (e.g. Rigor and Wallace, 2004), however, this ice was blown towards the East Siberian and Laptev Sea where ice extents remain high.

Given the distribution of FY and MY ice in July 2008 (Figure 4), and the survival rates of these ice types from July through August, we estimate that the summer minimum may be a little higher than our original projection of 3.1 million sq. km based on March 2008 data, and update our outlook to 3.2 million sq. km.

Figures

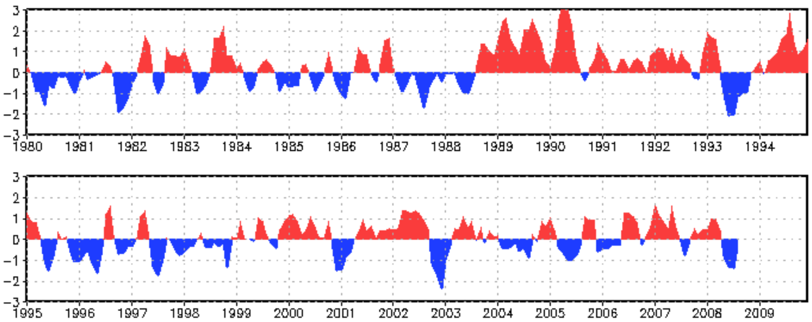


Figure 1. Standardized 3-month running mean Arctic Oscillation Index from 1980 through June 2009. Source www.cpc.ncep.noaa.gov.

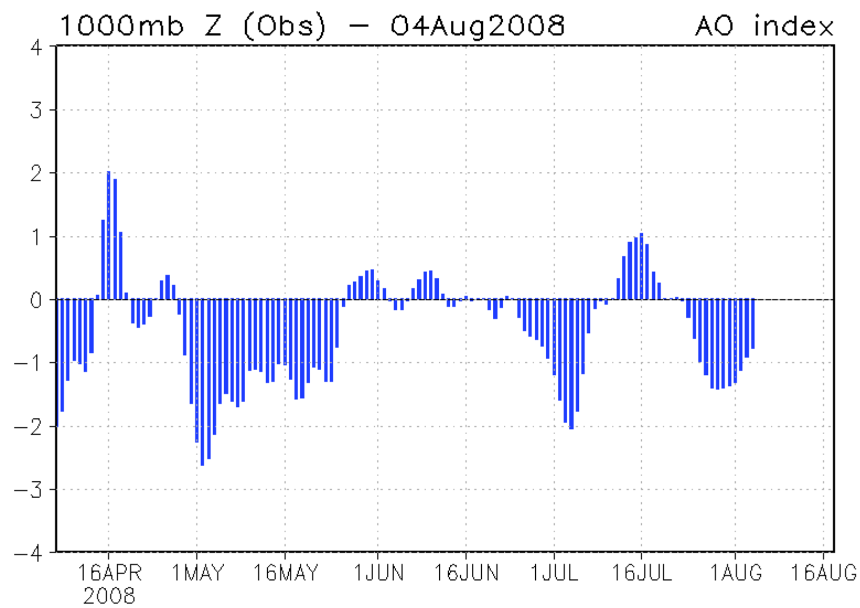


Figure 2. Standardized Daily AO index from April to August 2008. Source www.cpc.ncep.noaa.gov.

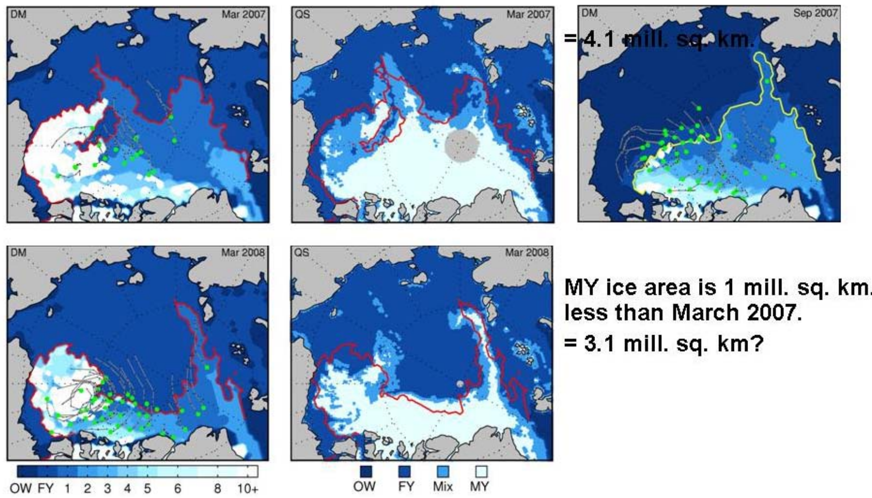


Figure 3. Age of sea ice from buoy drift model and QuikSCAT on March 2007 (top) & March 2008 (bottom), and the observed record minimum in September 2007. Adapted from Nghiem et al. 2008 and Nghiem et al. 2007. For animations of the age of sea ice visit http://seaice.apl.washington.edu/IceAge&Extent/.

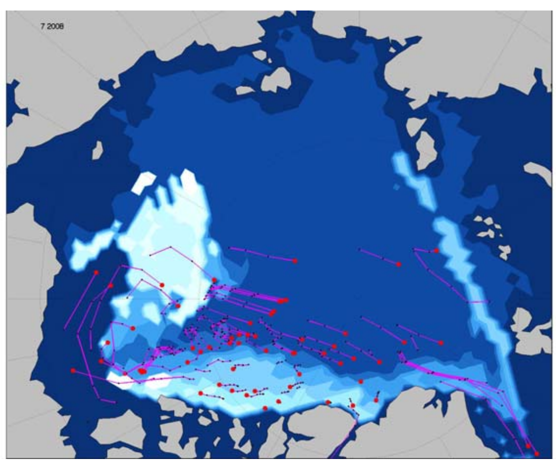


Figure 4. Age of sea ice from buoy drift model on July 2008. Same color bar as in Figure 3, right column.

Harry Stern
July 2008 Sea Ice Outlook: Report Based on July Data

No changes to report from previous months.

Julienne Stroeve, Mark Serreze, Walt Meier, and Ted Scambos
July 2008 Sea Ice Outlook: Report Based on July Data

1. Julienne Stroeve, Mark Serreze, Walt Meier and Ted Scambos
2. Estimate of sea ice extent for the month of September 2008: Our estimate has been revised. Our previous estimate was based on survival rates of first year ice. The revised estimate is based on the assumption of climatological daily rates of decline throughout the remainder of the melt season. Assuming average rates of decline, the September 2008 ice extent would be 5.56 million sq-km, falling between the second lowest ice extent, which occurred in September 2005 (5.32) and the third lowest, which occurred in September 2002 (5.64). Assuming a rate of decline one standard deviation faster than normal, the September 2008 ice extent would be 4.56 million sq-km.
3. Principal Method used for Outlook: The estimate is based on using sea ice extent on July 31, 2008 as an initial value, then projecting extent forward using the average daily rate of decline throughout the rest of the melt season. The average daily rate of decline was calculated using data from 1979 through 2006.
4. To estimate the range of possibilities, use was also made of the +/- 1 standard deviation of decline rates through the remainder of the melt season (Figure 1). The lower dashed line shows extent based on decline rate one standard deviation faster than normal, the middle dashed line shows extent based on average decline rates, while the upper dashed line shows extent assuming decline rate one standard deviation slower than normal.

   Although the June 2008 ice extent was similar to that seen in 2007, the observed rate of decline slowed in July, resulting in a monthly averaged sea ice extent for July 2008 that was 0.90 million sq-km above 2007. If the sea ice continues to decline at the average daily rates of decline throughout the rest of the summer, the minimum extent will be between the second-lowest in the satellite record, which occurred in 2005, and the third-lowest, which occurred in 2002. Even at a rate one standard deviation faster than normal, the extent will not fall below last year's minimum value. Based on these estimates, it now appears unlikely that we will set a new record low.

   However, as of this writing, there has been a sudden drop in ice extent. A strong low pressure system in the Beaufort, first noted on 29 July 2008, has persisted through at least August 3. It appears that initially, the low pressure system slowed the drop in ice extent by promoting ice divergence. However, in the first few days of August, it now appears the cyclone is fostering ice loss through mechanical ice breakup and enhanced melt. A large area of reduced ice concentrations north of Alaska apparent in AMSR-E images composites is consistent with strong winds fostering wave action and large horizontal heat transports. NSIDC will be monitoring the situation closely. See http://nsidc.org/arcticseaicenews for updates.

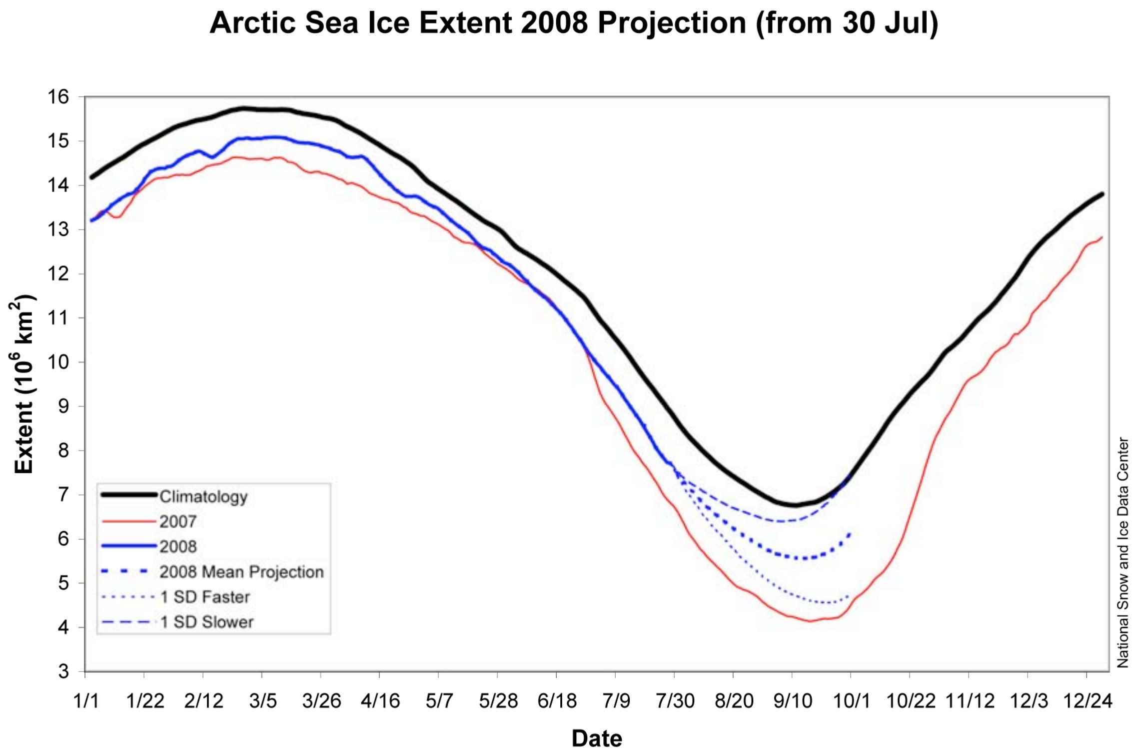


Figure 1. Range of Arctic sea ice extent through 30 September based on average decline rate and decline rates that are 1 standard deviation faster and slower.

Jinlun Zhang
July 2008 Sea Ice Outlook: Report Based on July Data

8/1/2008 outlook of 9/2008 Arctic sea ice by Jinlun Zhang <zhang@apl.washington.edu>

The predicted ensemble median of September 2008 ice extent is 5.1 million square kilometers. This is based on ensemble predictions starting on 8/1/2008. The ensemble predictions are based on a synthesis of a model, NCEP/NCAR reanalysis data, and satellite ice concentration data. The model is the Pan-arctic Ice-Ocean Modeling and Assimilation System (PIOMAS), which is forced by NCEP/NCAR reanalysis data. It is able to assimilate satellite ice concentration data. The ensemble consists of seven members each of which uses a unique set of NCEP/NCAR atmospheric forcing fields from recent years, representing recent climate, such that ensemble member 1 uses 2001 NCEP/NCAR forcing, member 2 uses 2002 forcing, …, and member 7 uses 2007 forcing. Each ensemble prediction starts with the same initial ice–ocean conditions at a given starting date of prediction before September 2008. The initial ice-ocean conditions are obtained by a retrospective simulation that assimilates satellite ice concentration data. Of course, no data assimilation is performed during the predictions. More details about the prediction procedure can be found in Zhang et al. (2008)
http://psc.apl.washington.edu/zhang/Pubs/Zhang_etal2008GL033244.pdf

Figure 1 shows the monthly variations of ice extent over January–September 2008 from these seven ensemble members and their ensemble median. Results for January–July are from the retrospective simulation and results for August–September are from the ensemble predictions (prediction range is 8/1 – 9/30/2008). The ensemble median is considered to have a 50% probability of occurrence and the ensemble median ice extent for September 2008 is 5.1 million square kilometers, slightly greater than that in September 2007 at 4.3 million square kilometers. **Figure 2** shows the predicted September 2008 ice thickness from these seven ensemble members and ensemble median and standard deviation (SD). The white line represents the satellite observed September 2007 ice extent and the black line the predicted September 2008 ice extent. The spatial ensemble median ice thickness distribution (Figure 2h) is most likely to occur in September 2008, which suggests that the Pacific sector is likely to have significantly more ice in summer 2008 than in summer 2007. Figure 2g suggests that if the wind and thermal forcing in August–September 2008 is close to that in 2007, the ice extent in summer 2008 would be close to that in summer 2007. Additional prediction results and analysis may be found at our web page: http://psc.apl.washington.edu/zhang/IDAO/seasonal_outlook.html.

Two figures are below.

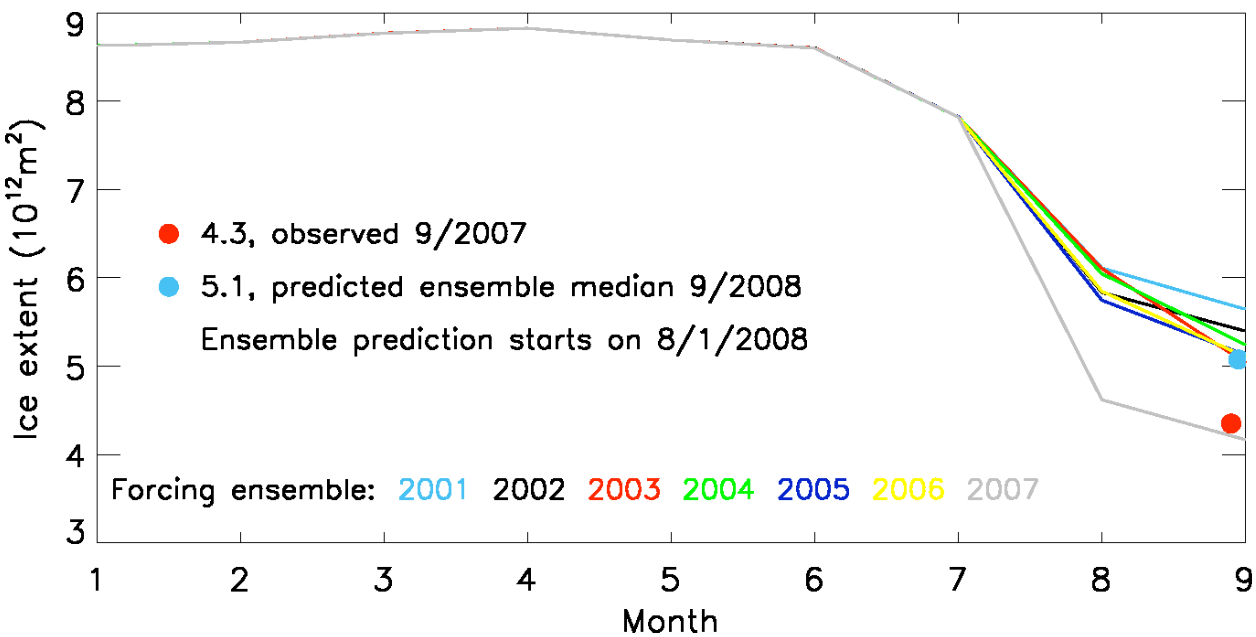


Figure 1. Monthly ice extent over January–September 2008 from seven ensemble members and their September ensemble median. Results for January–July are from a retrospective simulation and results for August–September are from ensemble predictions (prediction range is 8/1 – 9/30/2008). The ensemble median is considered to have a 50% probability of occurrence and the ensemble median ice extent for September 2008 is 5.1 million square kilometers, greater than that in September 2007 at 4.3 million square kilometers.

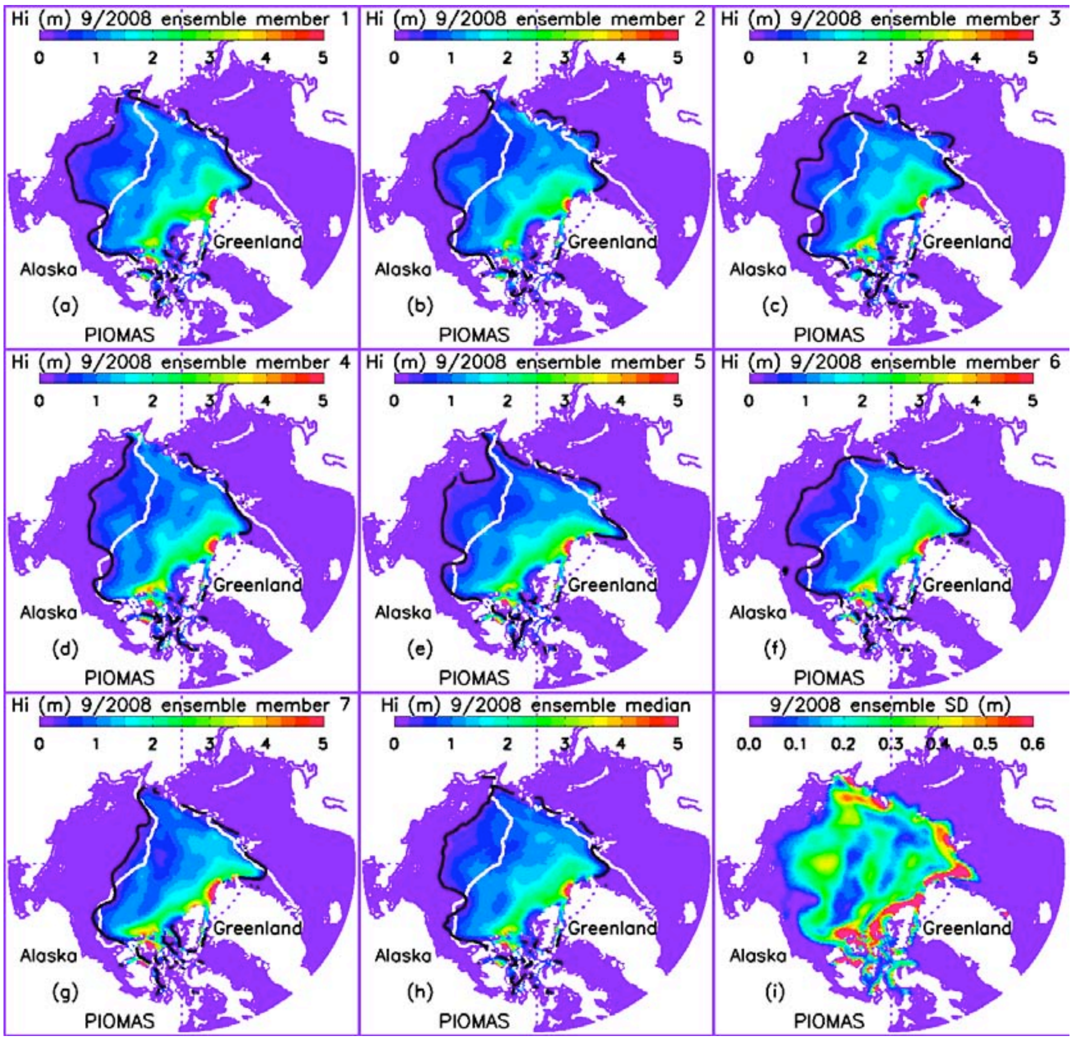


Figure 2. September 2008 mean sea ice thickness predicted by seven individual ensemble members, ensemble median ice thickness, and ensemble standard deviation (SD) of ice thickness. The spatial ensemble median ice thickness distribution (Figure 2h) is most likely to occur in September 2008, which suggests that the Pacific sector is likely to have significantly more ice in summer 2008 than in summer 2007. Figure 2g suggests that if the wind and thermal forcing in August–September 2008 is close to that in 2007, the ice extent in summer 2008 would be close to that in summer 2007.