Canadian Ice Service (CIS) Contribution

to the

September 2013 Sea Ice Outlook: Post-Season Summary

2013 SEA ICE OUTLOOK SUMMARY QUESTIONS:

1. The NSIDC value for average September 2013 ice extent was 5.35 million square kilometers. How would you characterize the success of Outlook predictions this year, including relative strengths or weaknesses of different methodologies?

CIS1: Although most people were expecting a slight recovery in sea ice extent this year and did not expect a repeat of the record-breaking 2012 minimum, nearly all the contributions to the Outlook in June predicted minimum extents of less than 5 million square kilometers. This would indicate that most methodologies are heavily influenced by the long-term trend and have difficulties in forecasting the year-to-year variability about this trend.

2. What were the main factors driving the minimum extent this year, in contrast to 2012 or 2011?

CIS2: Factors that possibly contributed to a closer-to-normal summer sea ice minimum extent were: 1) Air temperatures in the Canadian Arctic and southern Beaufort Sea were below normal during much of the preceding winter; and 2) During the preceding winter a negative-AO enhanced Beaufort Gyre resulted in a southward compaction of the ice pack, and also some recirculation of the Multi-Year Ice (MYI) pack, into the southern Beaufort Sea. This resulted in normal first-year ice thicknesses and greater than normal MYI concentrations in the southern Beaufort Sea at the onset of the melt season (Figure 1), which served to slow summer ice melt rates in this part of the Arctic. The reduced melt rates were also likely further reduced by processes like the ice-albedo feedback (this year working in reverse, with more ice leading to less solar absorption, and reduced surface heating and melt). This is in contrast to previous summers where large areas of open water in the Beaufort and Chukchi Seas led to enhanced ocean warming and an enhanced ice-albedo feedback. The open water also allowed for summer storms to generate large-amplitude ocean waves whose propagation into the margins of the remaining ice pack resulted in the destruction of large amounts of ice.

3. What are the implications of this year[1]s minimum (or regional patterns) for sea ice extent in the future?

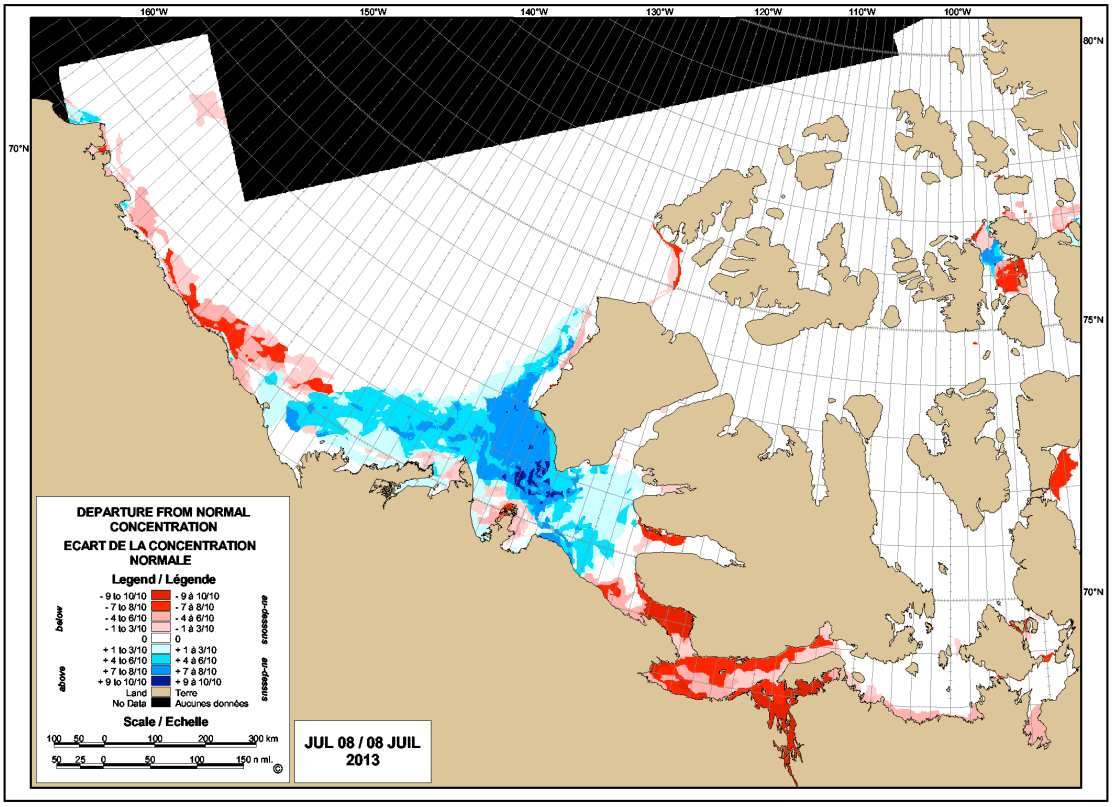
CIS3: A single partial-recovery year in terms of summer sea ice extent has no implications on its own – it might simply be the result of interannual variability or noise about the longer term trend. However, the air-sea-ice system possibly retains some "memory" of ice conditions from year-to-year; this would mean that no record-breaking minimum will be likely in 2014 either.

4. What is needed to improve future predictions of seasonal sea ice extent (e.g., observational data, model simulations, coordination)? If more observations are needed, where and what type of data would be most helpful?

CIS4: Given the complexity of the Arctic air-sea-ice system, future predictions of seasonal sea ice extent are unlikely to improve significantly – even with additional observational data and improved model parameterizations and ensemble techniques. There are many regions and lead-times for which none of the present models show any forecast skill what-so-ever. Persistence and the long-term trend are still outperforming most models in many areas. It may be that what is needed is not more data or computing power, but simply a re-think of how seasonal forecasting is approached and the development of entirely new techniques.

5. What are the key lessons learned from this year?

CIS5: The key lesson is that the importance of interannual variability cannot be ignored in seasonal forecasts.



STATISTICS BASED UPON 1981-2010
LES STATISTIQUES BASÉES SUR 1981-2010

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Figure 1. Departure from 1981-2010 normal ice concentrations in the southern Beaufort Sea at the beginning of July, 2013 (based on the Canadian Ice Service Ice Chart database). Note: blue indicates greater than normal concentrations.

September 2013 – Arctic Sea Ice Minimum – Final Numbers

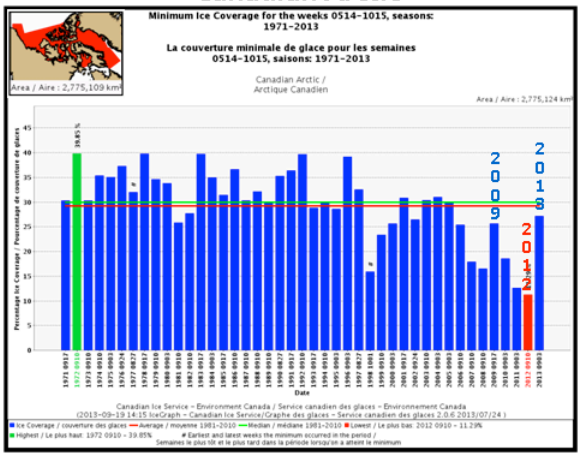
Pan-Arctic

year	date	Sept. *min.* extent (million sq. km)
2013	Sep 13	5.099 (5.1)
2012	Sep 16	3.413 (3.4) Biggest Record Min. [<4.0]
2011	Sep 11	4.351 (4.3)
2010	Sep 21	4.626 (4.6)
2009	Sep 13	5.129 (5.1)
2008	Sep 20	4.590 (4.6)
2007	Sep 18	4.170 (4.2) First BIG Record Min. [<5.0]
2006	Sep 17	5.777 (5.8)
2005	Sep 22	5.324 (5.3) Record Min. for 1979-2006
1981-2010 average September *Minimum* Extent	Sep 12	6.278 (6.3)

(data source: NSIDC Sea Ice Index)

- The pan-Arctic sea ice cover reached its minimum extent on 13 September, 2013 (using NSIDC's SSMR/I-based sea ice index for >15% concentration).
- Both the minimum extent (5.1 million sq. km) and the date of the minimum (September 13) are similar to those observed in 2009.
- Although greater than the minimum extents in 2010-2012, the 2013 minimum extent is still the 6th lowest in the NSIDC Sea Ice Index record. It is still 1.2 million sq. km less than the 1981-2010 normal end-of-summer sea ice extent.

Canadian Arctic



(data source: CIS Ice Chart Database)

- The Canadian Arctic sea ice cover reached its minimum extent during the week of 03 September 2013 (based on the CIS Ice Chart Database).
- The 2013 minimum coverage of 27.2% (0.75 million sq. km) is only slightly less than the 1981-2010 normal minimum coverage of 30% (0.83 million sq. km).
- It is slightly greater than the minimum coverage observed in 2009 (25.7% or 0.71 million sq. km), making it the greatest extent observed in the Canadian Arctic since 2005.

Prepared by: Canadian Ice Service, 02 September 2013

Figure 2. A summary of the 2013 pan-Arctic and Canadian Arctic minimum sea ice extents, in context with previous years.