

PAN-ARCTIC OUTLOOK  
August Report (Based on July Data)

1. James Morison
2. Methods/Techniques  
Heuristic
3. Extent Projection  
5.0 million km<sup>2</sup>
4. Method

Short explanation: June estimate was based on prior year's snow, AO index, observations of ice in April and June. This month's estimate is revised upward based on ice edge conditions observed in July SIZRS flights.

My June projection of average September, 2014 Arctic sea ice extent was 4.4 million square kilometers. This estimate, as in past years working with Norbert Untersteiner, was an impression based on comparison of a few variables over the last few years. However, on our Seasonal Ice Zone Reconnaissance Survey flights in mid-July, I was impressed with how little the ice edge had retreated in the Beaufort Sea and have revised my July estimate upward.

A) Our observations during the 2014 North Pole Environmental Observatory (NPEO) deployment were similar to 2013 and suggest that the snow cover was low in the central Arctic Ocean. This is a factor that helps increase September ice extent by allowing for more sea ice growth in winter and reducing melt pond formation and associated melt in summer. The NPEO web cameras, as long as they lasted before being consumed by ice deformation, suggest that as of the end of June there was no early formation of melt ponds and much of the snow seemed gone. This is on the positive side.

B) Also, although most of the snow was gone over the Beaufort Sea ice observed during our June Seasonal Ice Zone Reconnaissance Survey Flight, there didn't appear to be a lot of surface melting of the ice itself. Ice concentration on 150°W out to about 74°N was reasonably high (95%) with reduced concentration at 75°N and 76°N. This is similar to 2012 (record minimum) at this time of year, a negative indication depending on this summer's atmospheric circulation.

C) A slightly different wrinkle in my thinking this year is the high AO last winter (NDJFMA). High winter AO should negatively correlate with AO [*Rigor et al.*, 2002]. I notice that for recent peak AO winters, the ice extent the following September is between 0.8 and 1.7 million square km less than the previous winter, making me think the atmospheric forcing associated with a peak AO will knock on the order of one million square kilometers off the previous years accumulation.

In 2013 the Sept average was 5.4 million. One million off of that is 4.4 million, similar to my intuitive guess from (A) and (B) and slightly below the long-term trend, which looks like it would give ~ 4.8 million.

However, during the July SIZRS flights, the ice edge still remained down around 70° to 72°N and the NSIDC charts indicate extent is low but remaining within a standard deviation of previous years. Given the July SIZRS observations, I am upping my estimate to slightly more than the long-term trend and estimate a September 2014 average extent of 5.0 million km<sup>3</sup>.

#### 5) Uncertainty

1 million square kilometers

#### 6) Uncertainty Method

Experience

#### 7) Summary

My estimate is based on prior year's snow and ice and the Arctic Oscillation index plus in situ observations of ice in April, June, and now July.

#### Reference

Rigor, I. G., J. M. Wallace, and R. L. Colony (2002), Response of sea ice to the Arctic oscillation, *Journal of Climate*, 15(18), 2648-2663.