SEA ICE PREDICTION NETWORK (SIPN)
Template for Pan-Arctic Sea Ice Outlook Core Contributions
July 2015 Report

1. David Rennie / Amateur Individual

2. Executive summary

This estimate is primarily based on the distribution of the April PIOMAS sea ice volume estimate taking into account the extent of ice represented by various thicknesses. There appears to be a fairly consistent rate of loss measured by original thickness through until the end of July. Predicting the final figure for mid-September is much more problematic and is heavily influenced by June to Sept weather.

The methodology is similar to the starting point for my estimate last year which proved to be extremely low. This years' estimate is modified to accommodate additional factors and takes into account last years' experience and factors that may have resulted in that figure being too low.

These include:

a. the importance of a sequence of warm years to prepare the ice for a significant melt season.
b. The summer temperatures from May – Sept.
c. The April extent that was covered by ice estimated at between 1.5 and 2.5 m thick which, according to this methodology, would melt out at the end of the season.
d. The observation that over the past 15 years there appears to be a developing correlation between the duration when the extent is within 200 K km^2 of the winter maximum and the depth of the decline.

3. Type of Outlook projection
   heuristic

Components of the model: Ice__, Atmosphere

4. September monthly average projection 3.8 M km^2 (unchanged)

5. *Short explanation of Outlook method (max 300 words).

The PIOMAS April figures are represented on a graph showing the volume of ice at each 10 cm range of thickness. An estimate is made of the extent this represents. The expected extent as each 10cm thickness range melts is calculated and subtracted from the NSIDC April average sea ice extent. This provides a prediction of the expected extent. The loss measured in this way is fairly consistent with most years having lost approx. 160 cm in thickness by July 16th. After that the figures vary more significantly until the end of the melt with the final melt ranging from 194 cm (2014) to 2.37 cm (2010 and 2012).

6. Uncertainty: 3.8 M km^2 +/- 600 K km^2 (unchanged)

7. Uncertainty is based on the variation in the extent loss over the past 10 years. It encompasses 1 standard deviation from the mean.

Analysis
Update July 2015

So far this summer has been a tale of two ice packs. Melting within the Canadian islands and bays has been slow while the melting in the main Arctic basin particularly on the Russian side has been aggressive in line with 2012.

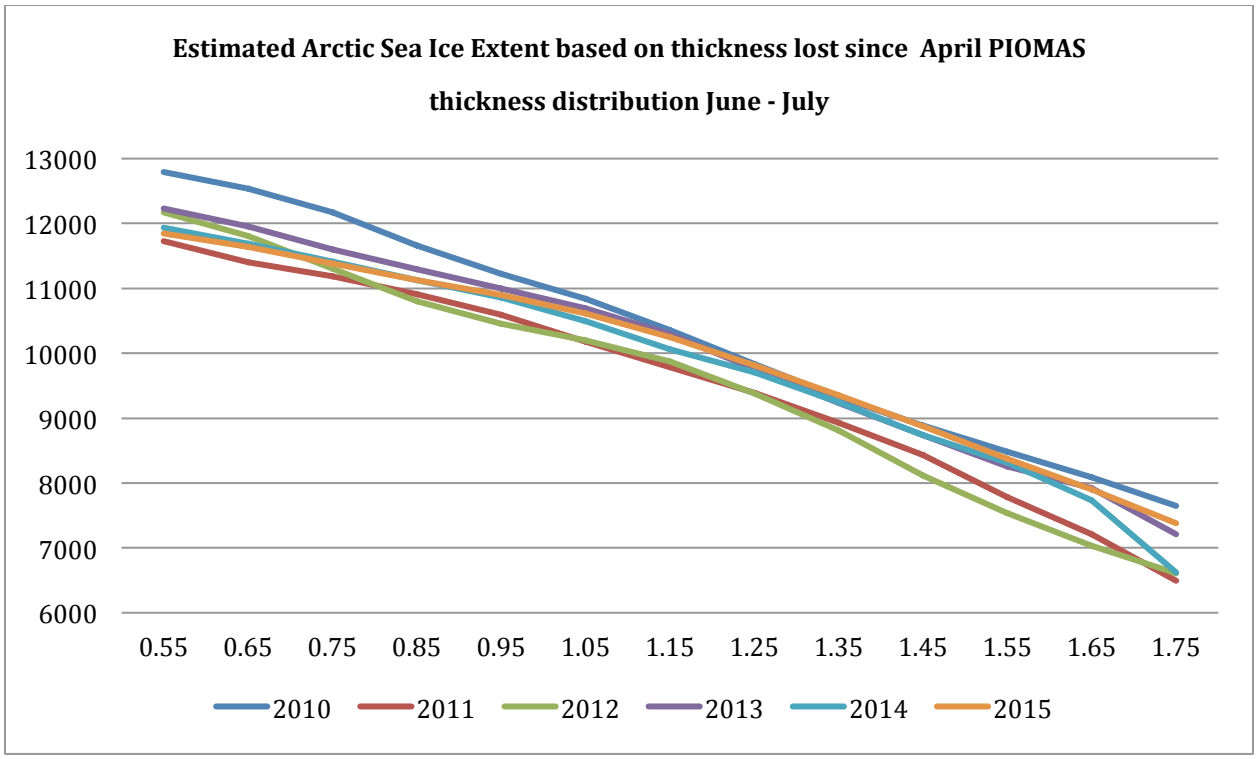
As a consequence the extent and area is currently much higher than the records. However all of this additional extent is in the Baffin Bay and Hudson Bay areas which are extremely unlikely not to melt out by the beginning of September so will have no impact on September figures.

Using the current extent figures, the estimate of lost thickness as July 10th is 146 cm slightly behind the previous 5 years. However if we account for the slow melt in Canada and add that into the estimate the loss is 162 cm. This is well ahead of all the previous years, indicating that the situation in the main basin is deteriorating as fast as in previous years.

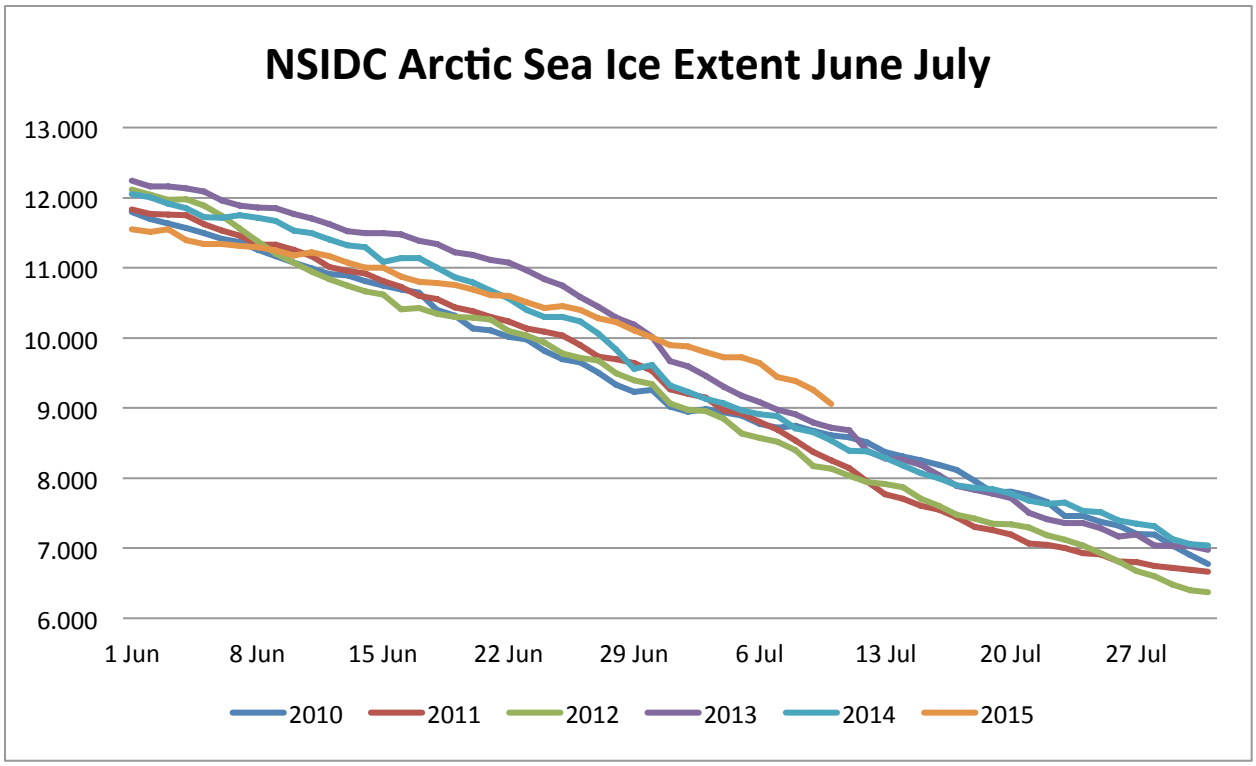
Estimated Sea Ice loss in cm from PIOMAS April distribution						Date
2010	2011	2012	2013	2014	2015	
17	13	21	16	13	17	May 01
87	57	62	60	55	73	Jun 01
113	96	102	84	90	101	Jun 16
147	133	135	132	138	129	Jul 01
157	153	150	150	155	146	current
167	165	159	163	165		Jul 16
206	179	187	184	176		Aug 01
217	191	222	197	185		Aug 16
237	203	237	200	194		Minimum

Table 1 Estimated thickness loss as at July 10th

Graph 1 shows the predicted extent loss from 2010 – 2015 based on the April PIOMAS thickness distribution for the thicknesses typically lost through June and July. Graph 1 shows that the extent loss this year was predicted to be less than in previous years For comparison Graph 2 to shows the actual figures as measured by NSIDC. While 2015 is well behind the predicted value, removing the anomalous ice in the Canadian basins places it well ahead of the prediction.

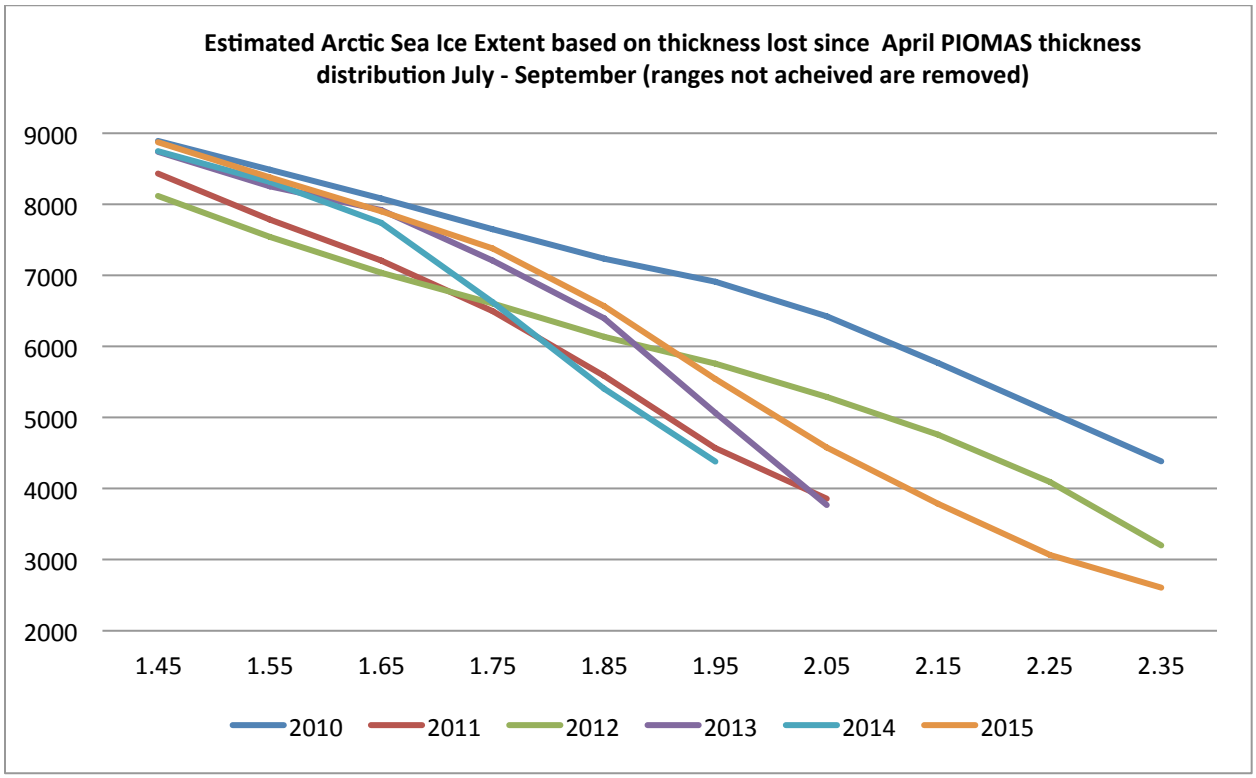


Graph 1: Predicted extent based on thickness loss June July period



Graph 2: NSIDC extent June - July period

Graph 3 shows the predictions for the end of the season from the current position. Each year has been terminated in the range where the minimum occurred. We can see from Table 1 that the total loss has ranged from 194 cm to 237 cm in the past 5 years. The question to be answered is where will it finish this year.



Graph 3 End of season extent measured by thickness loss

My current estimate assumes a melt of around 220 cm. My reasons for choosing this figure include:

- Extent and areas in the main Arctic basin are lower than 2012 and have been lower for most of the season allowing insolation to raise sea temperatures.
- Compaction is low across the Arctic so insolation is having a greater impact within the pack leading to faster melt rates.
- Sea and Air temperatures across the Arctic and above 80N have been high since the beginning of June, following an abnormally low May, which suggests there will be significant amount of additional thermal energy in the sea through July and August.
- The current El Nino, which has been building since the middle of last year, is likely to keep temperatures up in the Arctic for the remainder of the melt season.
- Hudson and Baffin Bays will melt out but will do little to reduce sea or air temperatures across the rest of the arctic so will not slow loss in those areas.
- Temperatures for the Canadian Arctic Area west of Baffin Bay are predicted to be higher than normal over the next two months.

June 2015

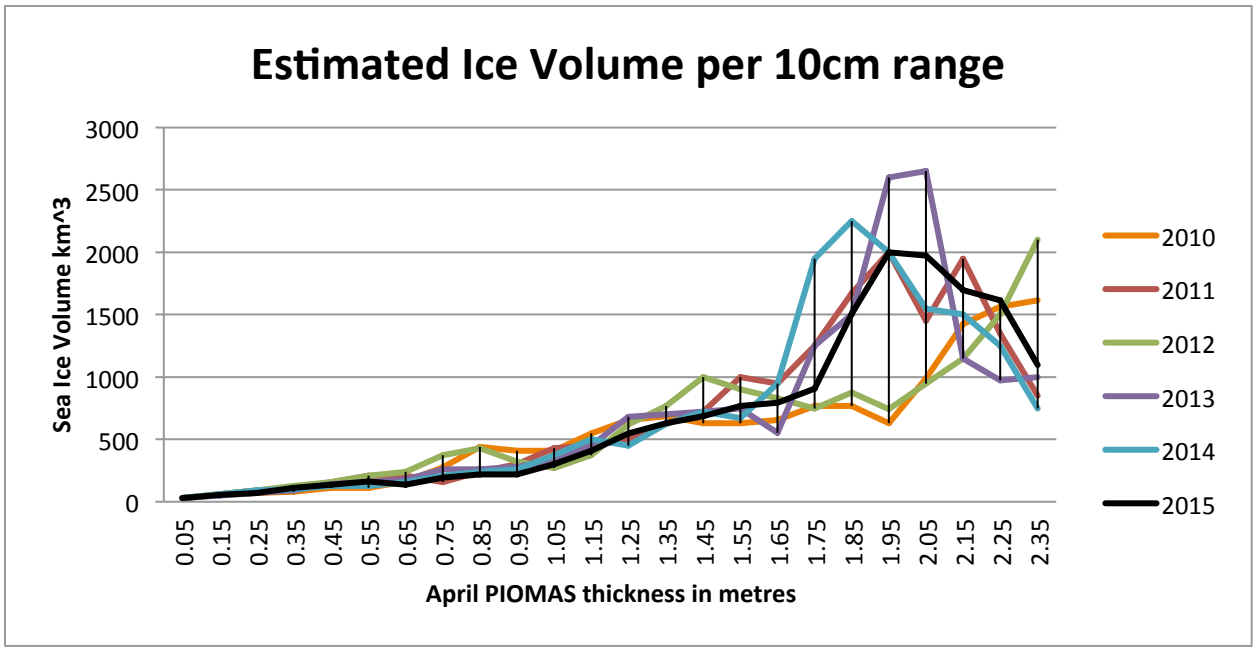


Figure 1: PIOMAS estimated volume per 10 cm thickness range.

In 2015 the volume of ice that is 'thin' is predominantly lower than in any of the past 5 years. There was significantly more ice in 2010 and 2012 in the 0.75 to 1.05 range representing an additional 700K km^2. This is part the range of ice that typically melts out in June and we should expect a lower melt in June as a consequence of this.

Typically by July 16th thickness lost is close to 165 cm. By the time we get to 170 cm of melt the low volumes translate, in 2015, to an extent loss of between 200 and 1500 K km^2 less than in any of previous five years.

Estimate of thickness loss based on extent for various dates (cm)						Date
2010	2011	2012	2013	2014	2015	
17	13	21	16	13	17	May 01
87	57	62	60	55	73	Jun 01
113	96	102	84	90		Jun 16
147	133	135	132	138		Jul 01
167	165	159	163	165		Jul 16
206	179	187	184	176		Aug 01
217	191	222	197	185		Aug 16
237	203	237	200	194		Minimum

Table 1 : Estimate of thickness loss during melt period.

Note that the thickness referred to is the original PIOMAS thickness and does not imply that the same loss has occurred in ice that has not melted. It is clear from the monthly volume figures that the thicker ice thins more slowly.

Table 2 shows the extent remaining as each 10 cm of ice is lost. From the tables 1 & 2 we can see that in terms of thickness lost 2015 is well ahead of the last four years. This is despite it being a relatively cool year in the Arctic so far.

	Remaining Extent (1000 km ^2)						
Thickness (M)	14,658	14,107	14,626	14,299	14,088	13,954	Max
	2010	2011	2012	2013	2014	2015	
0.05	14110	13507	14026	13699	13488	13406	
0.15	13745	13107	13626	13366	13088	13041	1-May
0.25	13471	12747	13266	13086	12728	12767	
0.35	13236	12461	12909	12829	12442	12454	
0.45	12992	12106	12553	12517	12165	12149	
0.55	12793	11724	12171	12227	11937	11850	1-Jun
0.65	12540	11401	11802	11950	11691	11640	
0.75	12175	11188	11302	11603	11411	11384	
0.85	11659	10905	10796	11297	11129	11126	
0.95	11227	10589	10460	11002	10855	10895	16-Jun
1.05	10835	10180	10202	10688	10498	10608	
1.15	10359	9789	9876	10297	10063	10251	
1.25	9833	9389	9380	9753	9703	9813	
1.35	9325	8926	8810	9234	9240	9346	1-Jul
1.45	8891	8429	8120	8738	8744	8873	
1.55	8484	7784	7540	8254	8311	8379	
1.65	8086	7208	7037	7920	7736	7897	16-Jul
1.75	7647	6494	6608	7206	6621	7380	
1.85	7233	5591	6135	6395	5405	6566	31-Jul
1.95	6910	4565	5756	5062	4379	5540	
2.05	6429	3858	5292	3769	3623	4578	15-Aug
2.15	5766	2951	4757	3234	2926	3788	
2.25	5072	2351	4091	2801	2370	3070	
2.35	4384	1989	3197	2376	2051	2603	Minimum

Table 2: Sea Ice extent remaining for each 10cm of ice loss.

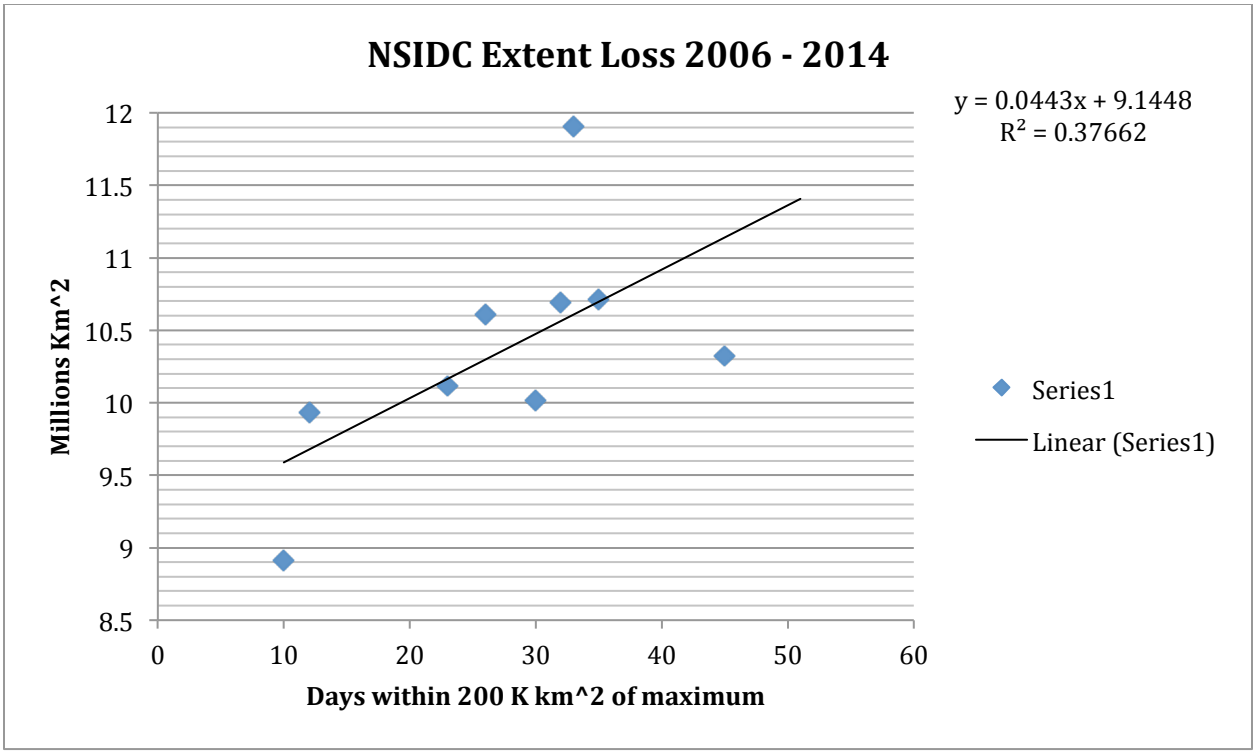
The figures on the left indicate the average of a 10 cm range, ie. 0.95 represents ice between 0.90 and 1.00 m thick at the April peak.

The figures above show the remaining extent as each 10 cm melts out. In the past few years the melt thickness loss figures for 1st July and 16th July are particularly close, however by the end of the melt season the thickness lost varies from 194 to 237. Using the table above we can estimate a final extent of between 6200 and 2740 K km ^2 depending on the total thickness lost. The question is where in the range to choose.

I am suggesting that we will see a melt equivalent to 220 cm this year which gives a final extent of 3.8 M km^2.

Factors influencing the choice

1. ENSO and the PDO both indicate that this year will be warm. Melt should continue strongly over summer.
2. Typically it takes three successive warm years to get a record. This would only be the second warm year and we still have a considerable amount of thicker ice remaining from previous years.
3. The peak volume of ice this year occurs between 190 and 210 cm and is smaller than in previous years. The last few years suggest that an early high peak is a factor in halting the loss of thickness.
4. Melt this year has been strong and increasing open waters should lead to warmer seas.
5. Reports on the condition of the ice suggest more fragmentation and easier movement into warmer waters leading to greater melt.
6. There has been a pattern emerging over recent years that a longer plateau where the winter ice extent stays close to the maximum correlates to a larger melt. (see Graph 2).



Graph 2 : NSIDC extent loss versus duration of 200K km^2 plateau of winter extent.

The extent to which this correlation has changed recently can be seen on the following graph which plots the correlation coefficient for the duration of the plateau for 15 year periods starting with 1979- 1993 and ending with 2000 – 2014.