PAN-ARCTIC OUTLOOK
Update 9 July 9 2015

1. James Morison

2. Summary
My estimate as of July 9, 2015 is 5.5 million square km. This is higher than my June estimate based on prior year's ice and Arctic Oscillation index plus in situ observations of ice in April and June.

3. Methods/Techniques
Heuristic

4. Extent Projection
5.5 million square km

5. Method

Short explanation: Judging by the NSIDC ice extent and microwave and visible imagery, the ice extent seems to be going in the - 1 sigma of recent climatology, and melt pond coverage in the central Arctic anyway seems about average for recent years. Therefore I am significantly increasing my estimate from June (4.8 million square km) discussed in detail below to be consistent with a Sept 1, 2015 value of 5.7 and a Sept 2015 Average of 5.5 million square km.

Detailed Outlook
My June projection of average September, 2015 Arctic sea ice extent WAS 4.8 million square kilometers. My estimate this year, as in past years working with Norbert Untersteiner, is an impression based on comparison of a few variables over the last few years.

A) Our observations during the 2015 North Pole Environmental Observatory (NPEO) deployment were suggest that the snow cover is a little thicker in the central Arctic Ocean. This is a factor that tends to decrease September ice extent by inhibiting sea ice growth in winter and reducing melt pond formation and associated melt in summer. The NPEO web cameras suggest that as of early June there was no early formation of melt ponds and much of the snow remains. In act it has gotten a little thicker in the last couple of weeks. This is suggests we may have extensive melt ponding and associated ice melt later in the summer, a negative factor.

B) A new wrinkle is the accumulation of ice off the Canadian Archipelago and associate average thickening of the ice cover (Kwok, personal communication). This was associated with a clockwise shift in the axis of the Transpolar Drift measured in Spring 2013, probably related to a strongly negative AO, reducing ice export. The ice drift in the winter-spring 2014-2015 showed drift orientation in spite of a positive AO the previous winter. The

number of observations is limited, but ice in the North Pole region in April 2015 was slightly thicker than seen in the previous few springs. These are positive factors.

C) The high AO last winter (NDJFMA) was virtually the same as for 2013-2014, about one standard deviation above the 1950-1989 average. 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 that 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 2014, the Sept average was 5.28 million. One million off of that is 4.28 million.

A) and B) suggest positive and negative factors should average out and produce a September similar to last year 5.28 million. Splitting the difference between 4.28 and 5.28 yields 4.78 million. Supporting this, so far the extent seems to be tracking the 2 Sigma extent and looks similar to 2006 in other ways, suggesting and Sept average of 4.6 million. I like the feel of the increasing ice thickness and think that will retard really big losses in the late summer.

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Revision for July: Judging by the NSIDC ice extent and microwave and visible imagery, the ice extent seems to be going in the - 1 sigma of recent climatology, and melt pond coverage in the central Arctic anyway seems about average for recent years. Therefore I am significantly increasing my estimate from June (4.8 million square km) discussed in detail below to be consistent with a Sept 1, 2015 value of 5.7 and a Sept 2015 Average of 5.5 million square km.

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6) Uncertainty
1 million square kilometers

7) Uncertainty Method
Experience

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.