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

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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.

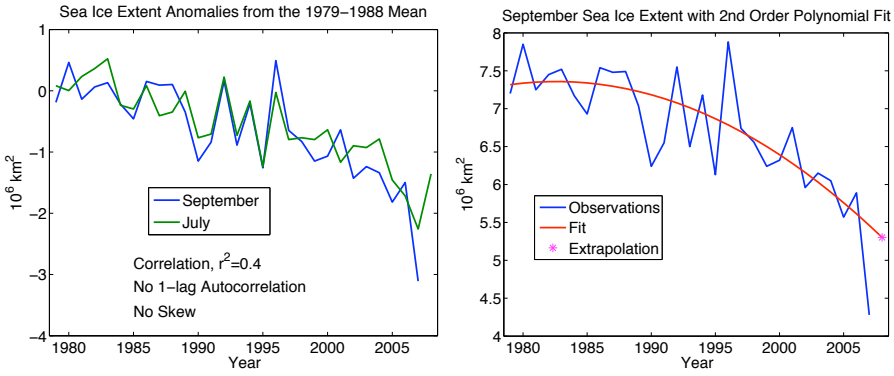

Figure 1. *Left panel:* The twenty-nine year observational record of September sea ice extent has zero one-lag autocorrelation and zero skew. September and July extents are significantly correlated. However, the extent in July 2008 followed the long-term trend, so I am predicting September will also 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.

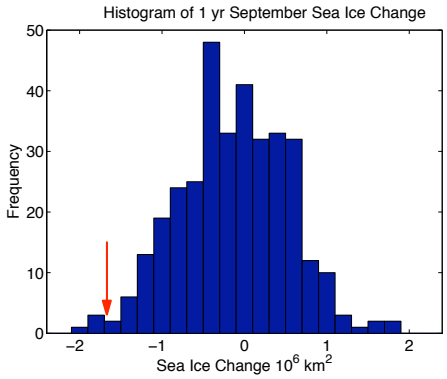

Figure 2. Histogram of September-to-September sea ice extent change in the first half of the 21st century in seven ensemble members from CCSM3 SRES A1B scenario (350 yrs total). This model has a very rapid loss of September sea ice extent, essentially loosing 30–40% of the sea ice extent in one decade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