

Sea Ice Outlook based on Statistics of Observed Ice Extent

May 2008 by Cecilia Bitz

1. What will the sea ice extent for the Arctic as a whole be at the 2008 minimum?

5.30 million square kilometers

2. Short basis for prediction

The 29 year observational record of September sea ice extent has zero autocorrelation, zero skew, and zero correlation with the May extent. These statics are in general agreement with much longer records that are available from the Community Climate System Model version 3, CCSM3. Therefore, I have extrapolated the trend line for September sea ice extent to 2008.

3. Longer basis for prediction

With no statistically significant correlations or skew in the observations (Fig. 1a) the conservative estimate for the future is on the trend line. An extrapolation of the trend line (Fig. 1b) to year 2008 gives 5.30 million square kilometers. Furthermore this May, the sea ice extent is very near the trend line for May. There is a significant correlation between June and September sea ice extent, so next month a skillful prediction will be possible based on statistics alone.

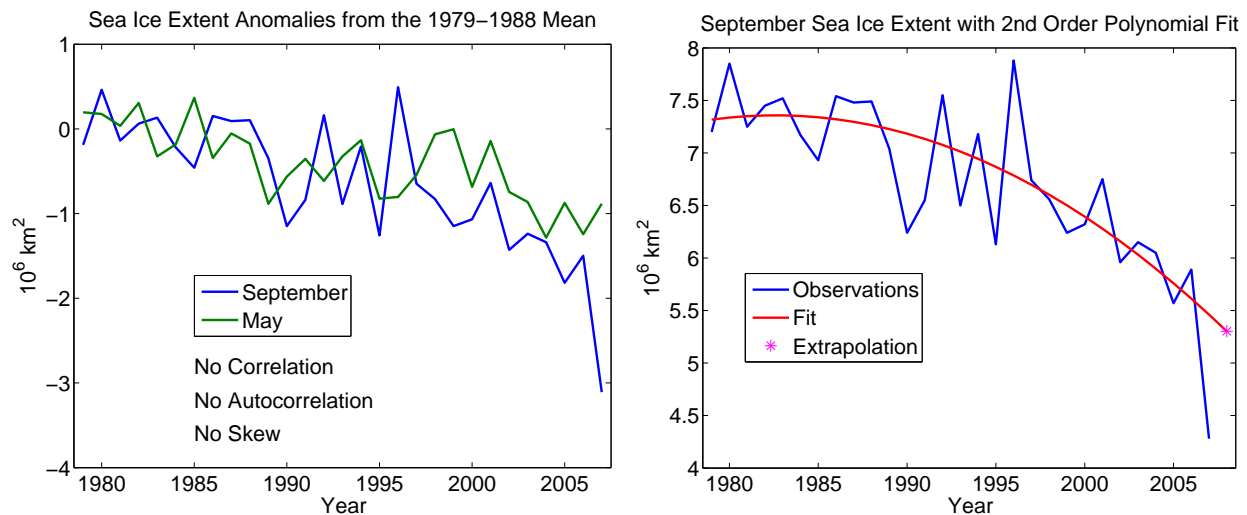


Figure 1. *Left panel:* The twenty-nine year observational record of September sea ice extent has zero autocorrelation, zero skew, and zero correlation with the May extent. All timeseries are detrended BEFORE correlation and skew are estimated. *Right panel:* Observed September sea ice extent and trend line with extrapolation to 2008. The trend line is given by a 2nd-order polynomial fit to the record in years 1979-2007.

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. However, the autocorrelation is so weak that it did not compel 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.

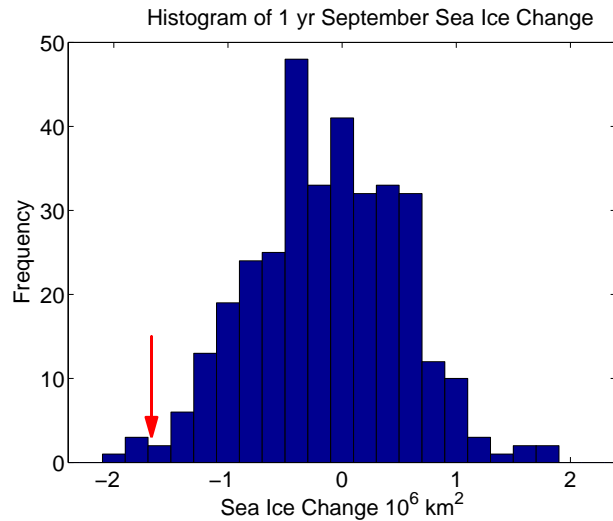


Figure 2. Histogram of September-to-September sea ice extent change in the first half of the 21st century in seven ensemble members from CCSM3 SRES A1B scenario (350 yrs total). This model has a very rapid loss of September sea ice extent, essentially losing 30–40% of the sea ice extent in one decade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

4. Additional information needed

Sea ice thickness can be used to predict sea ice extent with some skill according to CCSM, so real-time basin-wide measurements of sea ice thickness are quite likely to be of value for prediction.