#3 Cecilia Bitz
1. Name of contributor: Cecilia Bitz

2. Estimate of the sea ice extent for the Arctic as a whole for the month of September 2008
5.30 million square

3. Principal method
Statistical, based on observations and coupled climate model

4. Short basis for prediction

The 29-year observational record of September sea ice extent has zero autocorrelation, zero skew, and only a weak correlation with the extent in the prior June. The June extent in 2008 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 June 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.
It is worth noting that this method would have given a very poor estimate of September 2007 because the monthly mean extent in June 2007 was also very near the long term trend.

However, extent in the last week of June 2007 was much lower than earlier in the month. I suspect that the extent near the end of the month of June (rather than the average for the month) is more highly correlated with September extent and could be useful for estimating the extent in September. Yet in 2008, the extent at the end of June was not below the long-term trend, so refining the method would not alter my prediction for this year. 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.
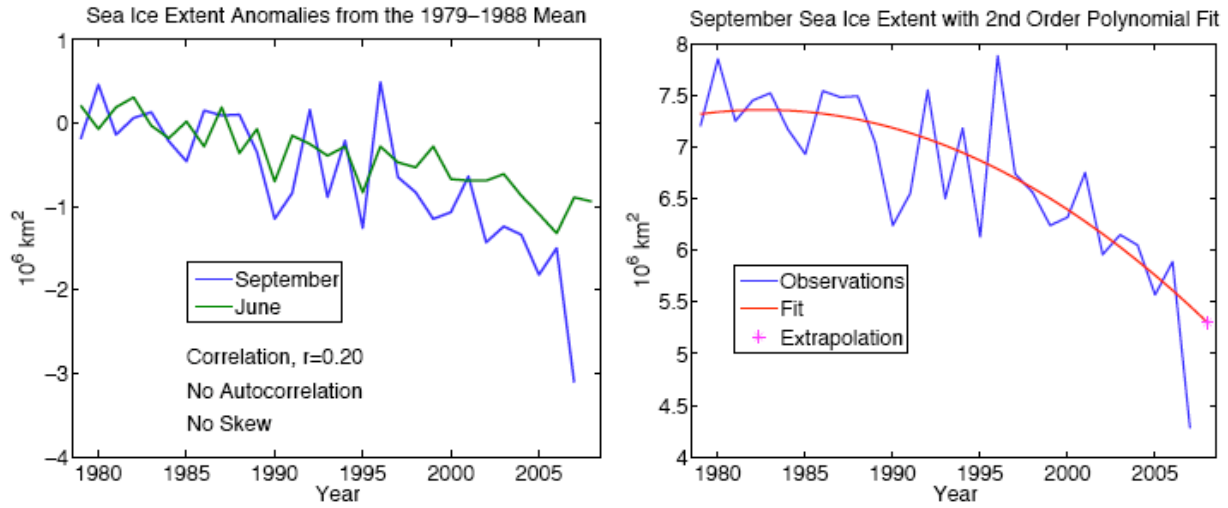
Figure 1: Left panel: The twenty-nine year observational record of September sea ice extent has zero autocorrelation, zero skew, and only a weak correlation with the June extent. All time series are detrended BEFORE correlations and skew are estimated. Right panel: Observed September sea ice extent and trend line with extrapolation to 2008. The trend line is given by a 2nd-order polynomial fit to the record in years 1979-2007.
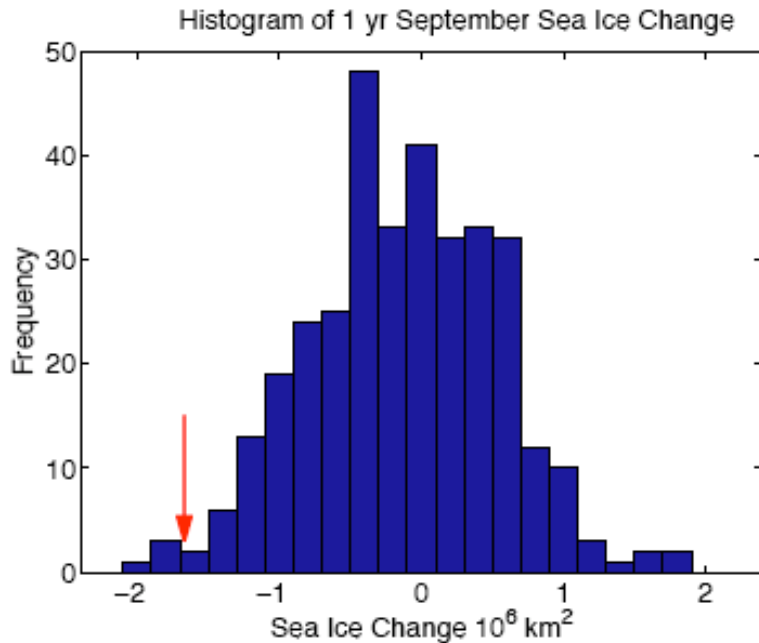

Figure 2: Histogram of September-to-September sea ice extent change in the first half of the 21st century in seven ensemble members from CCSM3 SRES A1B scenario (350 yrs total). This model has a very rapid loss of September sea ice extent, essentially loosing 30–40% of the sea ice extent in one decade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