ARCTIC SEA ICE OUTLOOK
2016 Report

July report (using June Data)

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2. Research organization – NASA-GSFC/UMD.

3. Yes, use this contribution for all of the 2016 SIO reports (this contribution will be superseded if you submit a later one).

4. "Executive summary"

Based on an analysis of June sea ice concentration data provided by the NSIDC (NASA Team), I forecast a 2016 September Arctic sea ice extent of 4.12 +/- 0.30 M km^2. This is lower than the observed ice extent in 2015 (4.63 M km^2) and is lower than the extent expected from persistence of the long-term linear trend (4.66 M km^2). The forecast does not suggest a new record low September extent will be reached in 2016 (lower than the 3.62 M km^2 observed in 2012).

The forecast model uses past sea ice concentration data to find regions of predictive importance for September sea ice extent. The ice concentration in these regions are given more weight in forecasting future sea ice extent. For the 2016 forecast, the strong declines in the southern Beaufort Sea, and the Barents/Kara seas appear to dominate the low forecast, countered somewhat by a small positive anomaly in the Laptev Sea.

Note that a May forecast was produced (not submitted to the SIO) which suggested a lower extent (3.81 +/- 0.40 M km^2). However, the skill of the May forecast is lower than the June forecast. The small recovery in sea ice through June appears to suggest a new record is unlikely. The variance of a forecast using linear regression is often biased low, however, so a new record low is still plausible and perhaps outside the scope of this simple model. Uncertain dynamics through summer are also a crucial missing factor, of course.

5. Type of Outlook method: Statistical

6. Dataset of initial SIC used: NA (statistical forecast)

7. Dataset of initial SIT used: NA (statistical forecast)

8. September Arctic sea ice extent forecast: 4.12 M km^2

9. NA (I do not predict the minimum sea ice week.)

10. Short explanation of Outlook method:

In this forecast we use sea ice concentration (SIC) data (1979-present day), derived from passive microwave brightness temperature (Tb) using the NASA Team algorithm [*Cavalieri et al*., 1996, updated 2015]. We use the spatial correlation weighting method utilized by *Schroder et al.,* [2014] and described in more detail by *Drobot et al.,* [2006] to include, and weight, only SIC grid cells that correlate historically with SIE. Only data preceding the given forecast year are included in the weighting calculation, and these weightings are thus updated each year. The detrended SIC data from the given forecast year are multiplied by the spatial weightings (R-values) and averaged, to generate a detrended/weighted SIC dataset. A least-squares linear regression model is fit from the mean weighted/detrended SIC/SIE data. To produce the SIE forecast, the relevant monthly mean/detrended/weighted SIC data are applied to the linear regression model.

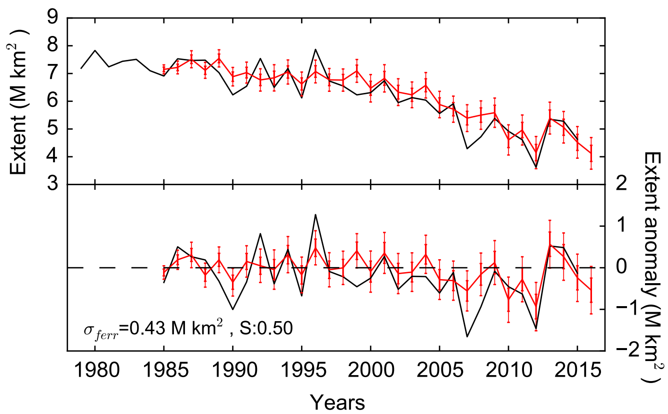

Figure 1: September sea ice extent observed (black) and forecast (red) using NASA Team sea ice concentration data. σ_{ferr} is the forecast error standard deviation and S is the forecast skill. The vertical red lines show the 1 SD (bold) and 2 SD/95% prediction intervals generated from each annual forecast.

Figure 1 shows forecasts of September sea ice extent using this new forecast model. The skill value (S=0.51) is extremely high for a spring (June) forecast of detrended SIE. The model has successfully captured the strong interannual variability in sea ice extent over the last few years.

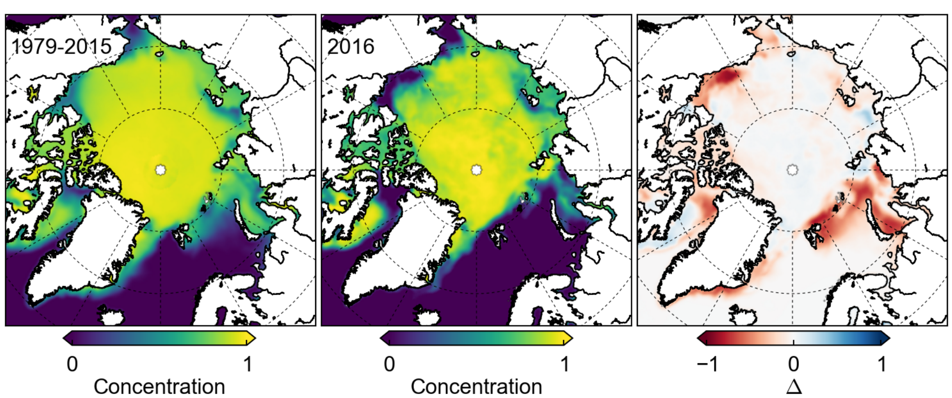

Figure 2: (top) June ice concentration using the NASA-Team algorithm for the 1979-2015 climatology (left), 2016 (middle), and the 2016 anomaly from climatology (right).

12.

a) Uncertainty/probability estimate: +/- 0.30 M km^2 (one standard deviation of the prediction interval)

b) The uncertainty represents one standard deviation of the 2016 prediction interval. This uncertainty changes every year a forecast is made (based on regression with previous years). It is expressed by the thicker red line in Figure 1 (the thinner/longer line is the 95%/2 S.D. interval)

c) Brief description of any post processing you have done (1-2 sentences): NA

d) Raw/bias corrected?: NA

Alaskan Regional Outlook:

1. September Alaskan region sea ice extent forecast: 0.25 M km^2

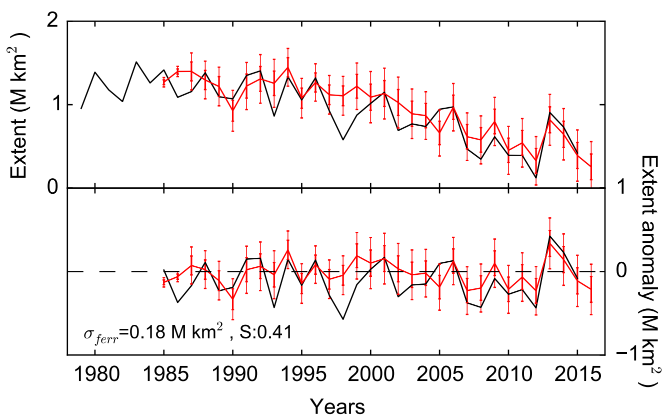

Figure 3: As in Figure 1, but for the forecast of Alaskan sea ice extent defined by the NSIDC region mask.

The forecast suggests the 2016 Alaskan sea ice extent could be close to the record low extent observed in 2012 (0.12 M km^2).

2. NA (I do not predict the minimum sea ice week.)

3. Short explanation of Outlook method:

Same as the Arctic forecast model, but the sea ice concentration is instead regressed against the Alaskan sea ice extent (defined by the Beaufort/Chukchi/Barents seas NSIDC mask).

4.
a) Uncertainty/probability estimate: +/- 0.15 M km^2 (one standard deviation of the prediction interval).

b) The uncertainty represents one standard deviation of the 2016 prediction interval. This uncertainty changes every year a forecast is made (based on regression with previous years). It is expressed by the thicker red line in Figure 1 (the thinner/longer line is the 95%/2 S.D. interval)

c) Brief description of any post processing you have done: NA

d) Raw/bias corrected?: NA

5. Tell us how you defined the region:

Use the NSIDC definition (the three areas). I calculate extent using ice concentration and the ice flag data, following the NSIDC Arctic Sea Ice Index extent calculation.

References:

Cavalieri, D., C. Parkinson, P. Gloersen, and H. J. Zwally (1996, updated 2015), Sea Ice Concentrations from Nimbus-7 SMMR and DMSP SSM/I-SSMIS Passive Microwave Data, Version 1, Boulder, Colorado USA: NASA DAAC at the National Snow and Ice Data Center, doi:10.5067/8GQ8LZQVL0VL.

Drobot, S. D., J. A. Maslanik, and C. F. Fowler (2006), A long-range forecast of Arctic summer sea-ice minimum extent*, Geophys. Res. Lett.*, 33, L10501, doi:10.1029/2006GL026216.

Schröder, D., Feltham, D.L., Flocco, D., Tsamados, M. (2014). September Arctic sea-ice minimum predicted by spring melt-pond fraction. *Nature Clim. Change*, 4 (5), 353-357, doi: 10.1038/nclimate2203