

Sea Ice Outlook
2017 August Report
Individual Outlook

Name of contributor or name of contributing organization:

Lamont (Yuan et al.)

Is this contribution from a person or group not affiliated with a research organization?

Name and organization for all contributors. Indicate primary contact and total number of people who may have contributed to your Outlook, even if not included on the author list.

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**Do you want your June contribution to automatically be included in subsequent reports?
(If yes, you may still update your contribution via the Google form.)**

What is the type of your Outlook projection?

Statistical

Starting in 2017 we are accepting both pan-Arctic and pan-Antarctic sea ice extent (either one or both) of the September monthly mean. As in 2016, we are also collecting Alaskan regional sea ice extent. To be consistent with the validating sea ice extent index from NSIDC, if possible, please first compute the average sea ice concentration for the month and then compute the extent as the sum of cell areas > 15%.

a) Pan-Arctic September extent prediction in million square kilometers.

4.9

b) same as in (a) but for pan-Antarctic. If your method differs substantially from that for the Arctic, please enter it as a separate submission.

19.41

c) same as in (b) but for the Alaskan region. Please also tell us maximum possible extent if every ocean cell in your region were ice covered.

0.52

"Executive summary" of your Outlook contribution (using 300 words or less) describe how and why your contribution was formulated. To the extent possible, use non-technical language.

A statistical model, namely linear Markov model, is used to predict monthly Arctic sea ice concentration (SIC) at all grid points in the pan Arctic region. The model is built in a multi-EOF space and is capable to capture the co-variability in the ocean-sea ice-atmosphere system. The September pan Arctic sea ice extent (SIE) is calculated from predicted SIC. The model predicts negative SIC anomalies throughout the pan Arctic region. These anomalies are relative to the 1979-2012 climatology. The September mean pan Arctic SIE is predicted to be 4.90 million square kilometers with an RMSE of 0.33 million square kilometers. Similar statistical models were also developed to predict the SIE in the Alaskan region and the SIE in the Antarctic. The September mean pan Antarctic SIE is predicted to be 19.41 million square kilometers with an RMSE of 0.84 million square kilometers. The Alaskan regional SIE is predicted to be 0.52 million square kilometers with an RMSE of 0.20 million square kilometers.

Brief explanation of Outlook method (using 300 words or less).

The linear Markov model has been developed to predict sea ice concentrations in the pan Arctic region at the seasonal time scale. The model employs 6 variables: NASA Team sea ice concentration, sea surface temperature (ERSST), surface air temperature, GH300, vector winds at GH300 (NCEP/NCAR reanalysis) for the period of 1979 to 2012. It is built in multi-variate EOF space. The model utilizes first 11 mEOF modes and uses a Markov process to predict these principal components forward one month at a time. The pan Arctic sea ice extent forecast is calculated by summarizing all cell areas where predicted sea ice concentration exceeds 15%. Bias corrections have been applied to ice concentration predictions at grid points as well as the total sea ice extent prediction. The predictive skill of the model was evaluated by anomaly correlation between predictions and observations, and root-mean-square errors (RMSE) in a (take one-year out) cross-validated fashion. On average, the model is superior to the predictions by anomaly persistence, damped anomaly persistence, and climatology (Yuan et al, 2016). The

skill of the two-month lead prediction of the pan Arctic sea ice extent in September is 0.94 with an RMSE of 0.33 million square kilometers. The Alaskan regional SIE prediction is produced by a regional linear Markov model developed by using SIC, SST and SAT in a rotated-EOF space. Following the SIPN Alaskan regional mask, the SIE forecast is calculated from predicted SIC. The skill of the regional SIE is 0.92 (correlation using cross-validated experiments) with RMSE of 0.20 million square kilometers. A similar model is used for the Antarctic SIE forecast (Chen and Yuan 2004).

Tell us the dataset used for your initial Sea Ice Concentration (SIC). Include name and date (e.g., "NASA Team, May 2017"). We also encourage you to submit initial fields to the dropbox, see <https://www.arcus.org/sipn/sea-ice-outlook/2017/june/call> in the section on "Submitting Figures and Gridded Data of Full Spatial Fields (Optional) of Forecasts and Initial Conditions" for detailed instructions. Required if sea Ice concentration is used.

The data sets include NASA Team SIC, ERSST and, surface air temperature, GH300 and vector winds at GH300 from NCEP/NCAR reanalysis

Dataset of initial Sea Ice Thickness (SIT) used (include name and date):

N/A

If you use a dynamic model, please specify the name of the model as a whole and each component including version numbers and how the component is initialized:

N/A

If available from your method for pan-Arctic extent prediction, please provide

a) Uncertainty/probability estimate such as median, ranges, and/or standard deviations (specify what you are providing).

The uncertainty of SIC prediction was estimated based on cross-validated model experiments for 34 years of two-month lead September predictions. It was achieved by subtracting one-year of data from principal components and re-build Markov model for that year's prediction. The process was repeated for each year of 34-year time series (Yuan et al., 2016). RMSE in figure 2b is based on 34 predicted September Arctic SIC including grid point bias corrections. The skill of the two-month lead prediction of the pan Arctic sea ice extent in September is 0.94 with an

RMSE of 0.33 million square kilometers. The skill for the two-month lead Alaskan regional SIE prediction is 0.92 with an RMSE of 0.20 million square kilometers. For the Antarctic SIE prediction, the RMSE of 0.84 million square kilometers was estimated from the errors of the last fourteen years of forward predictions.

b) Brief explanation/assessment of basis for the uncertainty estimate (1-2 sentences).

The uncertainty is assessed by cross-validated model experiments for the pan Arctic SIE and Alaskan regional SIE predictions. The uncertainty of the Antarctic SIE prediction is based on forecast errors of the last fourteen years of 2-month lead forward predictions.

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

Post processing includes model bias corrections and resolution bias corrections for all SIE predictions.