Sea Ice Outlook
2019 June Report
Individual Outlook

Name of contributor or name of contributing organization:

Lamont (Yuan and Li)

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 submission form.)

This is a new submission.

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.

4.51

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.

18.64

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.

0.24

"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 linear Markov model is used to predict monthly Arctic sea ice concentration (SIC) at all grid points in the pan-Arctic region (Yuan et al., 2016). The model is capable of capturing 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 4.51 million square kilometers (mskm) with an RMSE of 0.48 mskm, at the four-month lead. It is 0.2 mskm below September SIE in 2018. Similar statistical models were also developed to predict the SIE in the Alaskan region (Li et al., in revision) and the Antarctic (Chen and Yuan, 2004). The Alaskan regional SIE is predicted to be 0.24 mskm with an RMSE of 0.22 mskm, which is only about 50% of the last year Alaska SIE. The September mean pan Antarctic SIE is predicted to be 18.64, at the same level of September 2018, with an RMSE of 0.57 mskm.

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). For the four-month lead prediction of September sea ice concentrations, the model has the higher skill (anomaly correlation) and lower RMSE in the Chukchi Sea and Beaufort Sea than in other regions (figure 4). The skill of the four-month lead prediction of the pan Arctic sea ice extent in September is 0.87 with an RMSE of 0.48 million square kilometers. The Alaskan regional SIE prediction is produced by a regional linear Markov model developed by using SIC, SST, SAT, and in a rotated-EOF space (Li et al., in revision). Following the NSIDC regional mask, the Alaska SIE forecast is calculated from predicted SIC. The skill of the regional SIE is 0.90 (correlation using cross-validated experiments) with RMSE of 0.22 million square kilometers. A similar model is used for Antarctic SIE forecast (Chen and Yuan 2004).

Tell us the dataset used for your initial Sea Ice Concentration (SIC).

NSIDC NASA Team, https://nsidc.org/data/nsidc-0081,
https://doi.org/10.5067/U8C09DWVX9LM.

NOAA NCEP/NCAR Reanalysis-1 atmospheric variables,
http://iridl.ldeo.columbia.edu/SOURCES/.NOAA/.NCEP-NCAR/.CDAS-1/

NOAA NCDC ERSST version3b sst: Extended reconstructed sea surface temperature data,
http://iridl.ldeo.columbia.edu/expert/SOURCES/.NOAA/.NCDC/.ERSST/.version3b/.sst/Include source (e.g., which data center), name (algorithm), DOI and/or data set website, and date (e.g., "NSIDC NASA Team, https://nsidc.org/data/nsidc-0081,
https://doi.org/10.5067/U8C09DWVX9LM.")

Tell us the dataset used for your initial Sea Ice Thickness (SIT) used. Include name and date.

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:

Not Specified

If available from your method.
a) Uncertainty/probability estimates:

Median

Ranges

Standard Deviations

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

The uncertainty is accessed by RMSE derived from cross-validation exeriments. See details in the report.

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

Model biases, datasets biases, and resolution biases were corrected during the porst processing. See the details in the report.