Sea Ice Outlook
2019 June Report
Individual Outlook

Name of contributor or name of contributing organization:

Modified CanSIPS

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.

Primary contact: William J. Merryfield, ECCC/CCCma

Arlan Dirkson, UQAM

Woosung Lee, ECCC/CCCma

Michael Sigmond, ECCC/CCCma

Slava Kharin, ECCC/CCCma

ECCC* Environment and Climate Change Canada

CCCma* Canadian Centre for Climate Modelling and Analysis

UQAM* Université du Québec à Montréal

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?

Dynamic Model

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.

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.

"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.

Our Outlook of forecast total bias-corrected Arctic sea ice extent (SIE), bias-corrected Ice-Free-Date (IFD) and Freeze-up-Date (FUD), and calibrated sea ice probability (SIP) was produced using the Canadian Seasonal to Interannual Prediction System (CanSIPS), but (as in 2017 and 2018) in a modified experimental configuration intended to test updates to the sea ice forecast methodology. These updates include changes to the data used to initialize both sea ice concentration (SIC) and sea ice thickness (SIT).

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

CanSIPS combines forecasts from two models, CanCM3 and CanCM4, with a total of 20 ensemble members (10 from CanCM3, 10 from CanCM4). First, the Arctic SIE anomaly was

calculated for each individual ensemble member relative to a piecewise linear trend fitted to the respective model's ensemble-mean SIE time series over 1979-2018. These anomalies were then added to the NSIDC SIE time series also fit to a piecewise linear trend, and then averaged over all 20 ensemble members to yield a total SIE of 4.51 million square kilometers. The piecewise fit, including the breakpoint year, was found using non-linear least squares. This bias correction method differs from that used in 2017 and 2018 in an effort to account for trend dependence on forecast SIE bias.

The IFD/FUD is defined as the first date in the retreat season (April 1 to September 30) or advance season (October 1 to March 31) at which the grid box sea-ice concentration drops below/exceeds 50% and stays below/above that threshold for at least 10 days (more details in Sigmond et al GRL, 2016). The dates are bias corrected based on 1981-2010 hindcasts.

For the SIP field, we first interpolated the raw SIC fields from the model grid onto a 1deg by 1deg regular grid, fit each grid point and each model SIC ensemble to the zero and one inflated beta distribution the parametric distribution. We then calibrated each distribution using `trend-adjusted quantile mapping' (see Dirkson et al. 2019; https://doi.org/10.1175/JCLI-D-18-0224.1), and calculated the probability that local SIC will exceed 15% (or equivalently SIP) directly from the calibrated predictive probability distribution. Lastly, the average SIP value was taken across CanCM3 and CanCM4 to produce the final SIP field.

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

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.")

SIC is initialized by nudging model SIC to the Meteorological Service of Canada analysis (MSC) with a 3 day time constant. Initial conditions for the June submission are from May 31 nudged SIC.

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

SIT was estimated using the statistical model 'SMv3' described in Dirkson et al., 2017 (doi:10.1175/JCLI-D-16-0437.1). The parameters in SMv3 were fit using a blended SIC product (Had2CIS=HadISST2&Ice Charts) and PIOMAS SIT data over the period 2003-2018. The daily MSC SIC described above for May 31st was then used as the real-time predictor field in SMv3 to estimate real-time SIT.

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:

Coupled

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

Median

4.57

Ranges

min=3.86, max=5.50

Standard Deviations

1 standard deviation = 0.39, uncertainty = ±0.77 (95% CI)

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

The uncertainty values were calculated from the ensemble of 20 fcst bias-corrected SIE anomalies (see section 5).

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

Please refer to section 5 describing our outlook method.