Name of Contributor of 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.

William J. Merryfield (primary), ECCC/CCCma
Arlan Dirkson, UVic/SEOS
Woosung Lee, ECCC/CCCma
Michael Sigmond, ECCC/CCCma
Slava Kharin, ECCC/CCCma
Adam Monahan, UVic/SEOS

ECCC* Environment and Climate Change Canada
CCCma* Canadian Centre for Climate Modelling and Analysis
UVic* University of Victoria
SEOS* School of Earth and Ocean Sciences

Do you want your June contribution to be automatically included in subsequent reports? (If yes, you may still update your contribution via a form like this one.)

Yes automatically include my contributions in July and August 2017

What is the type of you 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.

4.53

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 the 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 forecasts of total Arctic sea ice extent (SIE) and sea ice probability (SIP) were produced using the Canadian Seasonal to Interannual Prediction System (CanSIPS), but in a modified experimental mode intended to test several potential 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), as well as the methodology to produce probabilistic SIC forecasts. We are pleased to be contributing to the SIO for the first time.

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). The Arctic SIE anomaly was calculated for each individual ensemble member relative to the 1981-2010 climatology for the respective model. These anomalies were then added to the NSIDC climatological value of 6.5 million square kilometers, and then averaged over all 20 ensemble members to yield a total SIE of 4.53 million square kilometers.

For constructing the SIP map, we first fit the 10-member ensemble SIC values from each model (per grid point) to a zero- and one- inflated beta distribution (Ospina and Ferrari, 2010 doi:10.1007/s00362-008-0125-4; Dirkson et al, 2017 in preparation). After calibrating the parametric distributions per grid point and per model (as described below in question 10c), we then calculated the probability that local SIC will exceed 15% (or equivalently SIP) directly from the calibrated parametric distribution. Lastly, the average was taken between CanCM3 and CanCM4 SIP estimates to produce the final SIP map.

Historical skills for prediction of September-mean SIE from the beginning of June by Modified_CanSIPS are

Anomaly Correlation Coefficient:
0.86 (1979-2016) 0.81 (1981-2010) [trend included]
0.39 (1979-2016) 0.35 (1981-2010) [linear trend removed]

Root-Mean Square Error (in million sq km):
0.57 (1979-2016) 0.53 (1981-2010) [trend included]

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.**

SIC is initialized by nudging model SIC to the Canadian Meteorological Centre (CMC) daily SIC analysis with a 3 day time constant. The initial SIC field provided to the SIO is the ensemble average of these nudged SIC values on May 31, the day the forecasts were initialized.

Dataset of 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 PIOMAS SIC and SIT data over the period 2001-2016. The daily CMC 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:

Component Name Initialization
(assimilation: nudging)
CanCM3
Atmosphere CanAM3 6-hourly CMC GDPS analysis
Ocean CanOM4 daily CMC (SST), GIOPS (subsurface)
Ice Cavitating Fluid daily CMC (SIC), SMv3 (SIT)

CanCM4
Atmosphere CanAM4 6-hourly CMC GDPS analysis
Ocean CanOM4 daily CMC (SST), GIOPS (subsurface)
Ice Cavitating Fluid daily CMC (SIC), SMv3 (SIT)

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 in forecast total SIE is estimated to be ±0.72 million square kilometers. This value was found by calculating the standard deviation of the ensemble of 20 forecast SIE anomalies, and multiplying by 1.96 to estimate the 95% range (between the 2.5 to 97.5 percentiles) of the forecast distribution. The anomalies were calculated relative to each model's climatology over the period 1981-2010. The uncertainty in spatially-distributed (local) SIE is provided in the map of SIP.

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

The uncertainty estimate of ±0.72 million square kilometres for total SIE, and that indicated in the spatial map of SIP, reflects the inter-model uncertainty between CanCM3 and CanCM4 after having removed model mean bias, as well as the uncertainty in the climate system simulated by each ensemble member, resulting from imperfect knowledge of initial conditions.

c) same as in (b) but for the Alaskan region. Please also tell us the maximum possible extent if every ocean cell in your region were ice covered. See https://www.arcus.org/sipn/sea-ice-outlook/2017/june/call **in the section on "Instructions for Submitting an Alaskan Regional Outlook" for detailed instructions.**

For pan-Arctic SIE, a simple climatological bias correction was performed, as described above in question 6. For SIP, the parametric distributions described in question 6 were calibrated using a modified version of the ‘quantile mapping’ technique that explicitly accounts for SIC trends and is specifically designed for the parametric distribution used to fit SIC ensemble forecasts (Dirkson et al., 2017 in preparation). The calibration relies on previous CanCM3/CanCM4 forecasts of SIC and observations of SIC from HadISST2 (which is most similar to the CMC SIC data used to initialize SIC in real time) over the 1981-2016 period.

d) Raw (and/or post processed) forecasts for this year and retrospective forecasts in an excel spreadsheet with one year on each row and ensemble member number on columns (specifying whether raw or post processed).

For pan-Arctic SIE, a simple climatological bias correction was performed, as described above in question 6. For SIP, the parametric distributions described in question 6 were calibrated using a modified version of the ‘quantile mapping’ technique that explicitly accounts for SIC trends and is specifically designed for the parametric distribution used to fit SIC ensemble forecasts (Dirkson et al., 2017 in preparation). The calibration relies on previous CanCM3/CanCM4 forecasts of SIC and observations of SIC from HadISST2 (which is most similar to the CMC SIC data used to initialize SIC in real time) over the 1981-2016 period.