Sea Ice Outlook

2021 June Report

Individual Outlook

Name of contributor or name of contributing organization:

RASM@NPS (Maslowski 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.

RASM@NPS (Maslowski et al.)

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.)

Repeat this submission in all future monthly reports

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.

4.762

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.

0.667

"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.

The Arctic sea ice extent September 2021 minimum is predicted to roughly continue the September declining trend (of 0.541x10^6 km^2/decade) based on 2000-2020 output from the Regional Arctic System Model (RASM) hindcast simulation. The difference between the 31-member ensemble mean September sea ice extent prediction and the extrapolation 2000-2020 linear trend into 2021 is 0.174x10^6 km^2. Compared to the RASM September 2020 sea ice extent minimum from the hindcast, the ensemble mean forecast for 2021 minimum is higher by 0.631x10^6 km^2, suggesting a temporary rebound similarly as it occurred following the 2007 and 2012 minima. According to the RASM ensemble mean predicted September sea ice thickness distribution, the majority of surviving ice thickness ranges between 1.0 m and 1.5 m, with the thickest sea ice north of the Canadian Archipelago and Greenland within the range of 1.5 m-2.5 m, and almost no sea ice thicker than 3.0 m. The RASM September outlook has been commonly biased high in recent years (bias of 0.086x10^6 km^2 and standard deviation of 0.419x10^6 km^2) compared to the NSIDC observation (2000-2020), especially in the northern Barents/Kara and East Siberian seas.

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

We used RASM2_1_00, which is a recent version of the limited-area, fully coupled climate model consisting of the Weather Research and Forecasting (WRF), Los Alamos National Laboratory (LANL) Parallel Ocean Program (POP) and Sea Ice Model (CICE), Variable Infiltration Capacity (VIC) land hydrology and routing scheme (RVIC) model components (Maslowski et al. 2012; Roberts et al. or 2015; DuVivier et al. 2015; Hamman et al. 2016; Hamman et al. 2017; Cassano et al. 2017). The model is forced with CFSR/CFSv2 reanalysis output for RASM-WRF lateral boundary conditions and for nudging winds and temperature starting above 500 mb for September 1979-May 2021. Then, RASM is used for dynamic down-scaling of the global NOAA/NCEP CFSv2 7-month forecasts. Each of the 31 ensemble members ran forward for 7 months using outputs from CFSv2 forecasts. The CFSv2 forcing

(https://www.ncei.noaa.gov/data/climate-forecast-system/access/operational-9-month-forecast/) streams used for the ensemble members were initialized every day (at 00:00) between May 1st and May 31st and used for RASM forcing at 00:00 on June 1st, 2021 and onward until the end of November 2021.

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

The initial sea ice conditions for the June Sea Ice Outlook were derived from the RASM 1979-2021 hindcast and are physically and internally consistent across all the model components. Neither data assimilation nor bias correction was used.

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

See the above.

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:

The version of Regional Arctic System Model (RASM v2_1_00) used for this contribution consists of the following components:

Ocean: POP2.1
Atmosphere: WRF3.7.1
Sea-ice: CICE 5.1.2
Land hydrology: VIC 4.0.6
River streamflow routing: RVIC 1.0.0
Flux Coupler: CPL 7

This model initial condition for ensemble forecast was derived from a hindcast, forced with CFSR/CFSv2 reanalysis for September 1979 through May 2021. The ocean and sea ice initial conditions at the beginning of the hindcast were derived from the 32-year spin-up of the ocean-sea ice model only (RASM G-case) forced with CORE2 reanalysis for 1948-1979.

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

Median

4.748

Lower error bound

4.297

Lower error bound

5.589

Standard Deviation

0.33

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

The uncertainty of pan-Arctic September sea ice extent was estimated from the 31 ensemble members: low error bound is the lowest of 31 ensemble members and high error bound is the highest of 31 ensemble members: see also Fig.3 in the supplementary material.

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

Daily mean sea ice with concentration <=15% and thickness <= 20 cm was excluded in the estimates of September sea ice extent.