2020 August Sea Ice Outlook
Supplementary Report
ECCC-CanSIPSv2

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Outlook Summary and Methods:

Our outlook includes an estimate of pan-Arctic sea ice extent (SIE), as well as spatial forecast fields of sea ice probability (SIP), sea ice concentration (SIC), ice-free dates (IFD), and ice-advance dates (IAD). The outlook was produced using the Canadian Seasonal to Interannual Prediction System (CanSIPv2; Lin et al., 2020: https://doi.org/10.1175/WAF-D-19-0259.1), which combines ensemble forecasts from two models, CanCM4i and GEM-NEMO, with a total of 20 ensemble members (10 from each model). Our pan-Arctic SIE estimate was formulated by calculating (for each ensemble member) the SIE anomaly relative to a piecewise linear trend fitted to the respective model's ensemble-mean SIE time series over 1980-2019. These anomalies were then added to the fitted piecewise linear trend for the NSIDC sea ice index SIE time series, and then averaged over all 20 ensemble members to yield a total SIE of 4.41 million square kilometers. The piecewise linear fit, including the breakpoint year, was found using non-linear least squares. Sea ice probability maps were produced by first calibrating the ensemble SIC forecasts for each respective model using trend-adjusted quantile mapping (TAQM; Dirkson et al., 2019: https://doi.org/10.1175/JCLI-D-18-0224.1), computing the probability for SIC>15%, and then averaging those probabilities across both models. Our outlook for the 80% SIC contour was prepared by first bias correcting the full ensemble SIC fields for each model separately using a 2011-2019 baseline, and then averaging the ensemble mean SIC across both models. The resultant SIC field was then converted to 0's and 1's corresponding to which grid cells have SIC<80% and which have SIC>=80%, respectively. Similarly, our IFD and IAD forecasts have been bias-corrected based on the 2011-2019 mean IFD/IAD (Sigmond et al., 2016: https://doi.org/10.1002/2016GL071396).

Pan-Arctic SIE: 4.41 million sq. km (95% CI=3.98,4.84)

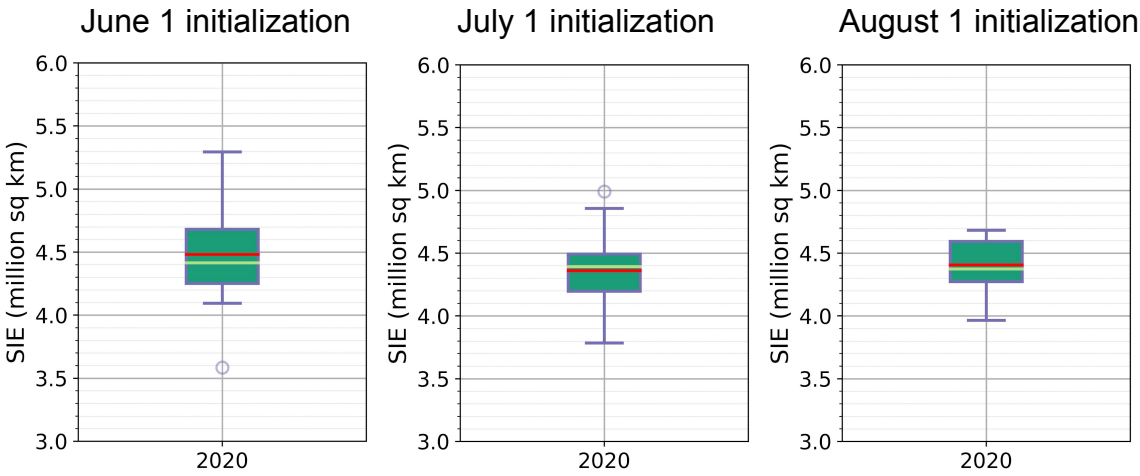

Figure 1 Box-and-whisker diagram of CanSIPSv2 forecast September mean SIE using initial conditions from June 1 (left), July 1 (middle) and August (right); box=Q1 to Q2; whiskers= Q1 - 1.5*IQR to Q3 + 1.5*IQR; dots=outliers; red line = ensemble mean; lime green line = ensemble median. Note: the 95% confidence interval in red text was obtained by approximating the forecast ensemble as a Gaussian distribution. The ensemble mean SIE from August 1 is slightly above that from July 1, and there is expectedly higher confidence in the forecast.

Historical context and past skill:

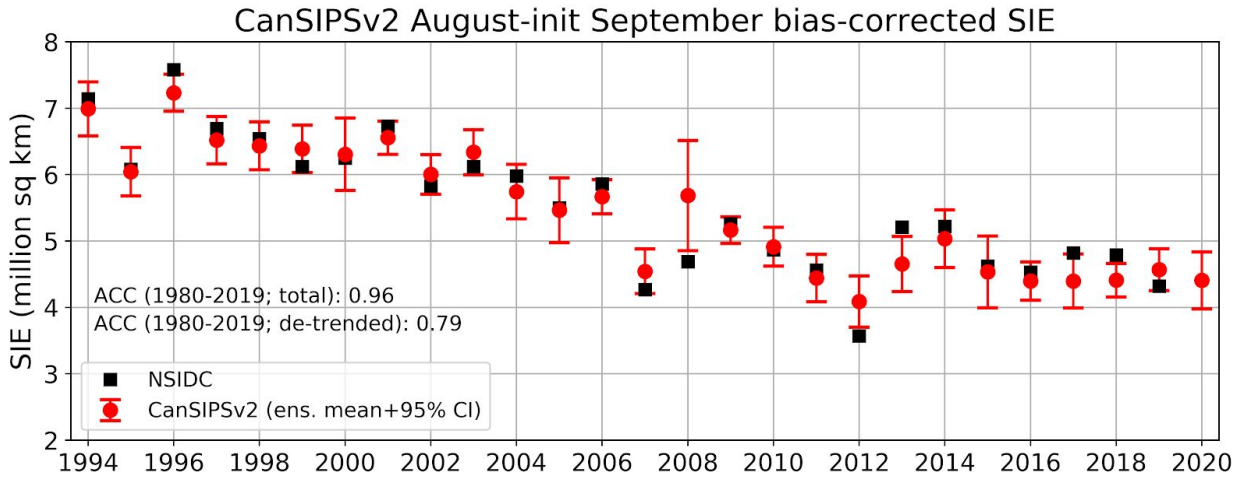

Figure 2 Bias-corrected CanSIPSv2 hindcasts of September mean SIE from 1994-2020. Skill estimates provided (ACC = anomaly correlation coefficient) were computed using the full hindcast record from 1980-2019. The linearly de-trended correlation for hindcasts initialized on August 1 is 0.18 units larger (more skillful) than hindcasts from July 1.

Sea Ice Concentration:

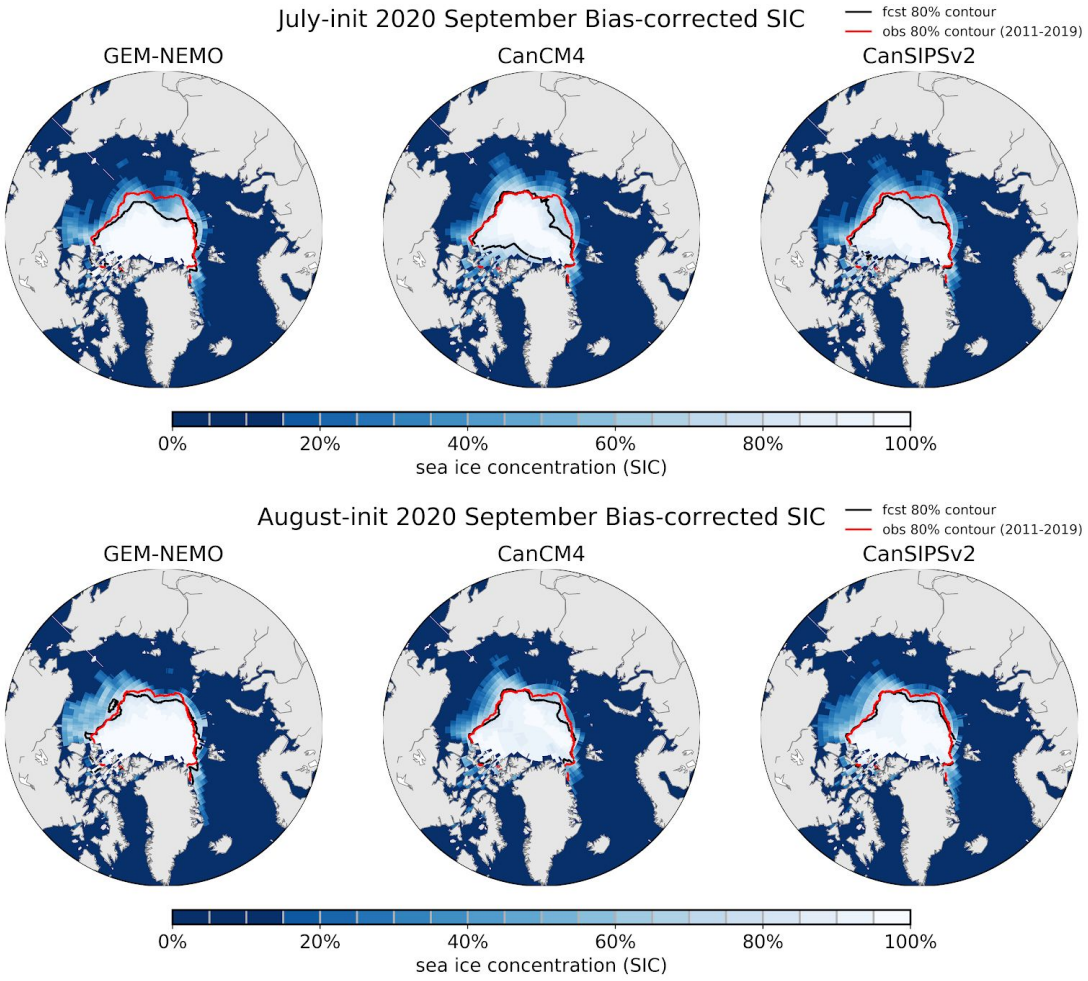

Figure 3. Bias-corrected ensemble-mean sea ice concentration forecast for September, 2020, for GEM-NEMO, CanCM4i, and (their combination) CanSIPSv2. The top row shows the July 1 initialized forecast, whereas the bottom row shows the forecast initialized on August 1. The forecast 80% contour in the Fram Strait is very consistent between the two forecasts. Interestingly GEM-NEMO predicts that most of the ice currently in the northern Beaufort Sea will remain in place through the summer, whereas the CanCM4i forecast indicates ice will still melt out in that region (although slightly more ice is predicted relative to what was forecast from July 1).

Sea Ice Probability

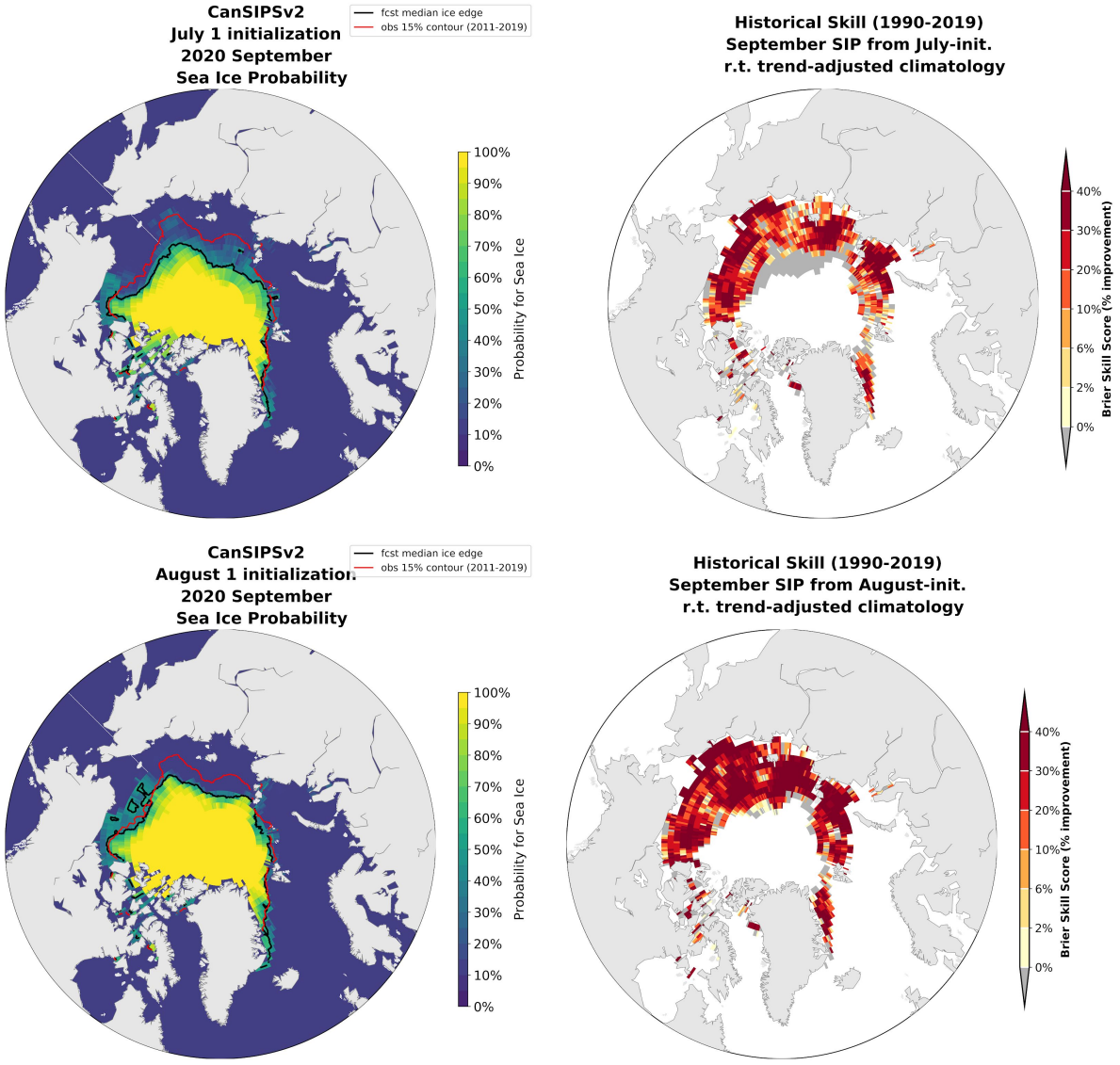

Figure 4. Top row: July 1-init; Bottom row: August 1-init; Left: Probability for ice concentration greater than 15%; Right: Historical skill based on the Brier skill score over the period 1990-2019, where skill is quantified relative to a trend-adjusted climatology. Consistent with the bias-corrected SIC forecast, higher probabilities for ice further to the north in the Beaufort Sea are predicted in the most recent forecast.

Ice-Free Date Forecast

Ensemble-mean (deterministic) forecast:

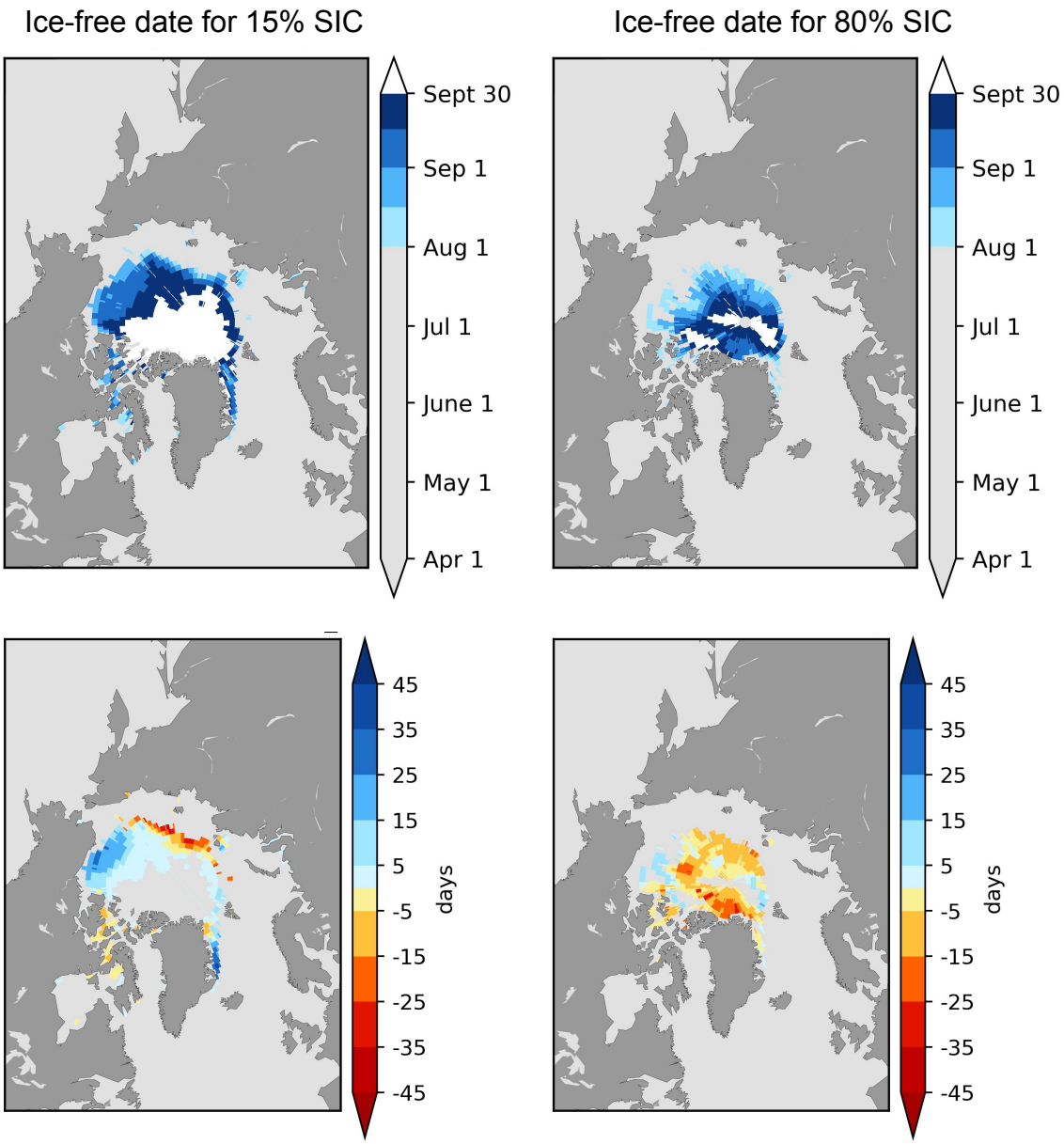

Figure 5. Bias-corrected ice-free date forecasts (top) and anomalies relative to the 2011-2019 average observed date (bottom).

Ice-Advance Date Forecast

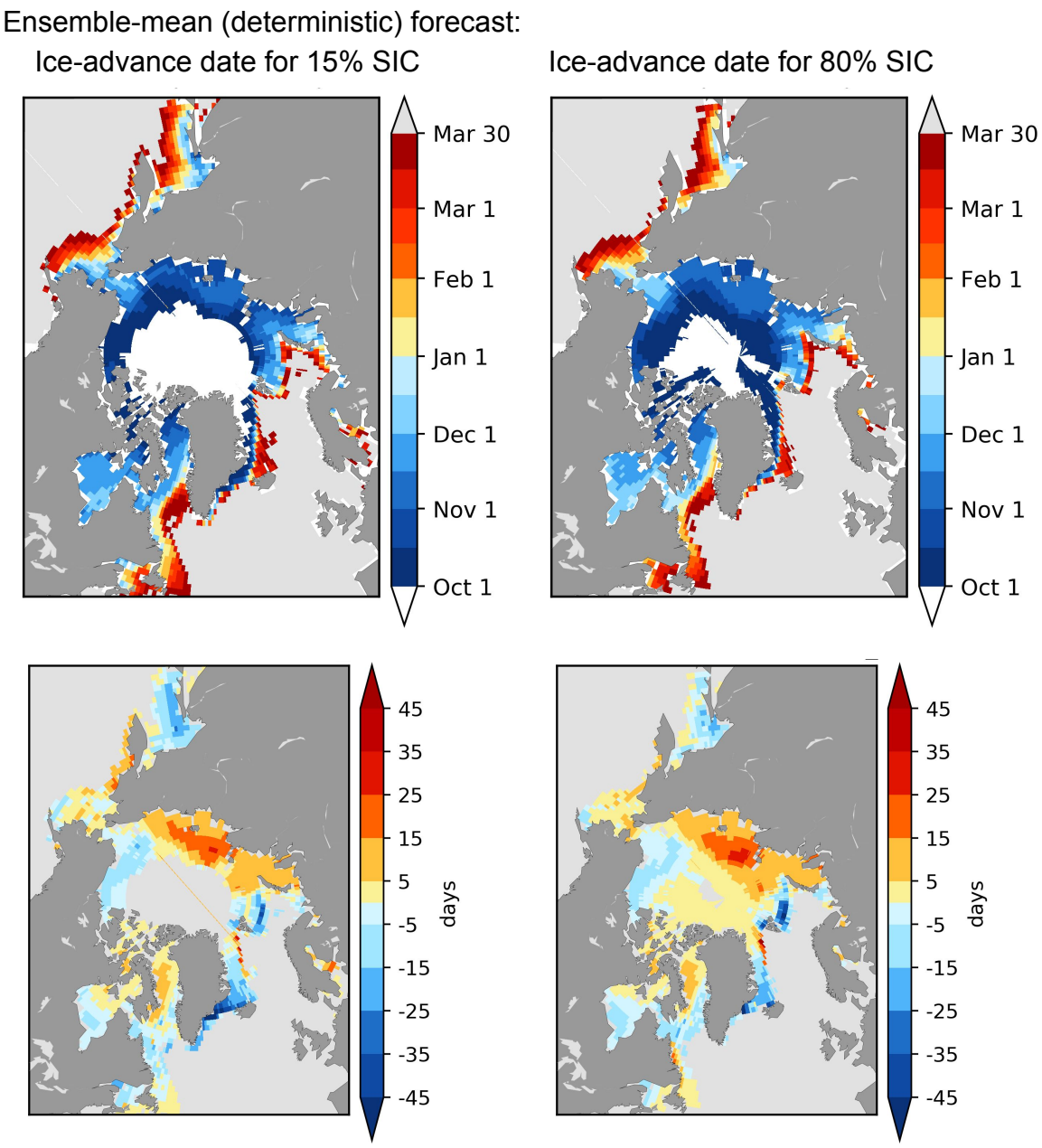

Figure 6. Bias-corrected ice-advance date forecasts (top) and anomalies relative to the 2011-2019 average observed date (bottom).

Probabilistic Ice-Free Date & Ice-Advance Date Forecast

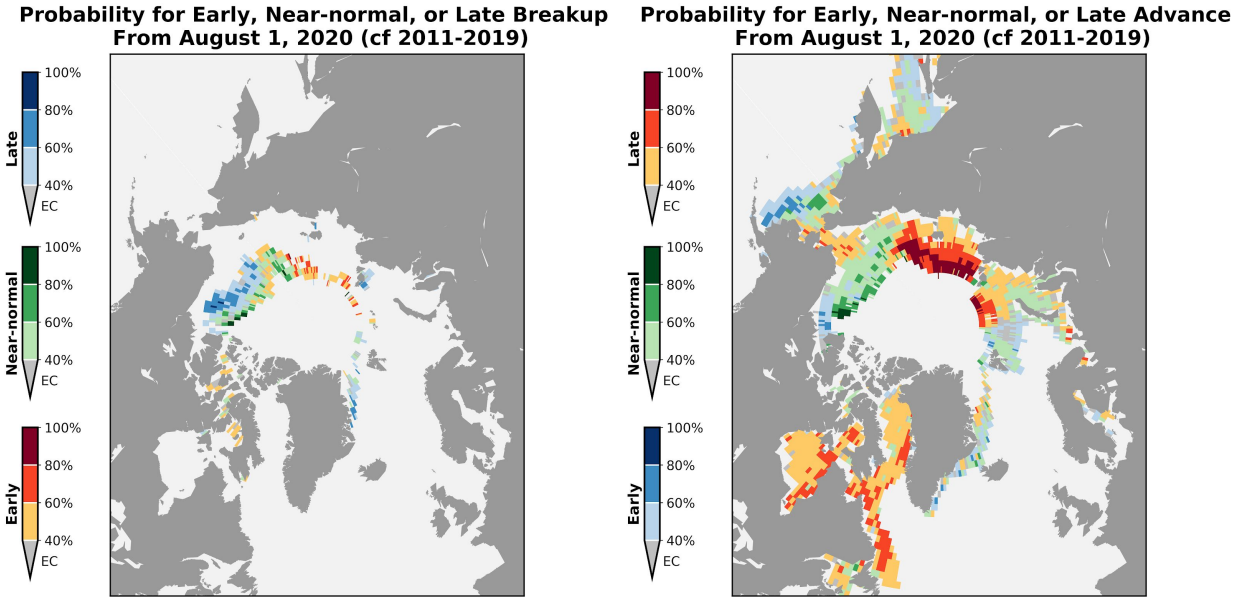

Figure 7. Probabilistic forecast for early, near-normal, or late (the most likely category is plotted at each grid point) sea-ice retreat (left) and sea-ice advance (right) from forecasts made on August 1, according to when ice concentration falls below, and exceeds, 15%, respectively. The forecast probabilities for each category are computed relative to the observed dates over the last 9 years (~earliest 3, middle 3, latest 3); EC=equal chances. The ensemble IFD at each grid point was calibrated using “non-homogenous censored Gaussian regression” (NCGR; Dirkson et al., under review @ WaF), a newly-developed calibration method designed specifically for IFD and freeze-up date forecasts.