September 2018 sea ice outlook (from August 1, 2018):
Pan-arctic and all Arctic regions

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Yes, use this contribution for all of the 2018 SIO reports.

Prediction type: Dynamic model: **P**an-Arctic **I**ce-**O**cean **M**odeling and **A**ssimilation **S**ystem (**PIOMAS**, Zhang and Rothrock, 2003), with coupled sea ice and ocean model components. The ocean model is the POP (Parallel Ocean Program) model and sea ice model is the TED (Thickness and Enthalpy Distribution) model. Atmospheric forcing is from the NCEP Climate Forecast System (CFS) version 2 (Saha et al., 2014) hindcast and forecast.

Pan-arctic outlook: The September 2018 Arctic sea ice extent predicted from August 1, 2018 is **4.95 ± 0.40 million square kilometers**.

Outlook of all Arctic regions: The September 2018 Arctic sea ice thickness field and ice edge location are predicted and presented with standard deviation (uncertainty) (Figure 1).

Method: These results are obtained from a numerical seasonal forecasting system. The forecasting system is based on a synthesis of PIOMAS, the NCEP CFS hindcast and forecast atmospheric forcing, and satellite observations of ice concentration. The CFS forecast ranges from hours to months: there are a total of 16 CFS ensemble forecast runs every day, of which four ensemble runs go out to 9 months, three runs go out to 1 season, and nine runs go out to 45 days (*Saha et al*., 2014). These ensemble runs all create 6-hourly forecast atmospheric data that are widely accessible in real time, thus ideal for forcing PIOMAS forecasts on daily to seasonal time scales. Here we used four CFS forecast ensemble members to drive the PIOMAS ice–ocean ensemble forecasts. Ensemble mean values from these four members are considered to be the prediction. To obtain the "best possible" initial ice-ocean conditions for the forecasts, we conducted a retrospective simulation that assimilates satellite ice concentration and sea surface temperature data through the end of May 2018 using the CFS hindcast forcing data. After that, four ensemble PIOMAS forecast runs were conducted using atmospheric forecast forcing from four CFS ensemble runs. Additional information about PIOMAS prediction can be found in Zhang et al. (2008).

Uncertainty for pan-Arctic extent: The uncertainty of the predicted September 2018 Arctic sea ice extent is **± 0.40 million square kilometers** and the uncertainty of the predicted ice thickness field is reflected in the ensemble standard deviation (SD) of ice thickness field (Figure 1b). These uncertainties are derived from the 4 prediction ensemble members.

Executive summary: Driven by the NCEP CFS forecast atmospheric forcing, PIOMAS is used to predict the total September 2017 Arctic sea ice extent as well as ice thickness field and ice edge location, starting on August 1. The predicted September ice extent is **4.95± 0.40 million**

square kilometers. The predicted ice thickness fields and ice edge locations for September 2018 are also presented.

Data used:
NCEP CFS hindcast and forecast atmospheric data for forcing.
Satellite sea ice concentration data (NASA team) and SST for data assimilation.

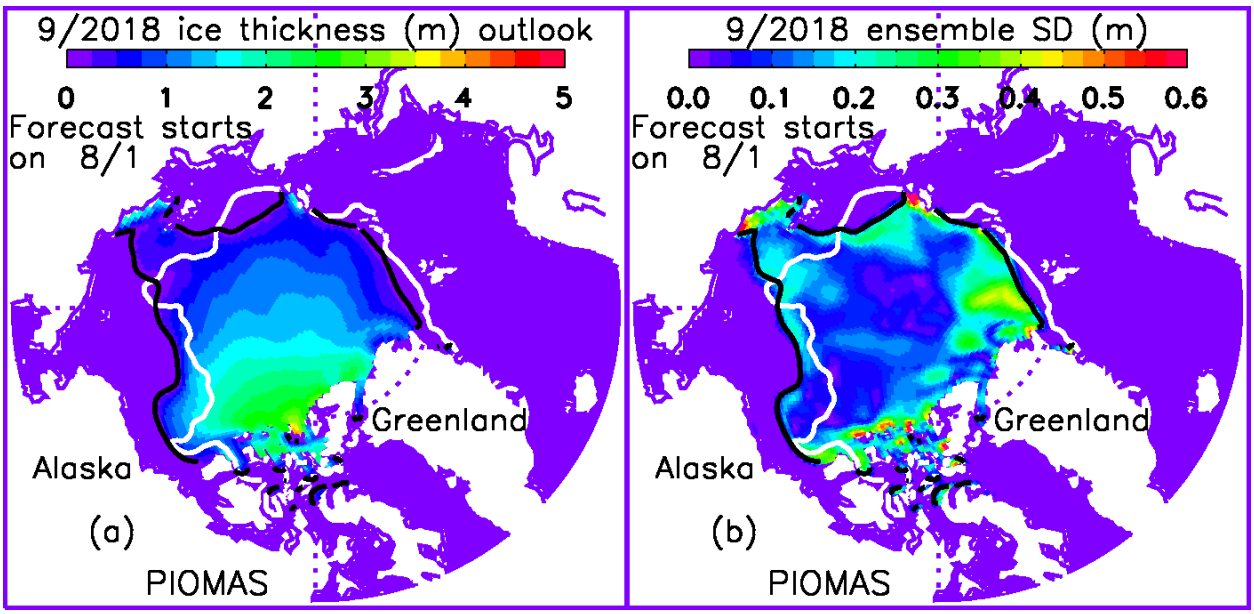

Figure 1. (a) Predicted Arctic September 2018 sea ice thickness and edge location (from ensemble mean), and (b) ensemble standard deviation (SD) of ice thickness which shows the uncertainty of the prediction. The white line represents the satellite-observed September 2017 ice edge defined as the line of 0.15 ice concentration, while the black line is the model predicted September 2018 ice edge.

References:

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