September 2012 sea ice outlook (from July 1):
Pan-arctic and Northwest Passage region

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Pan-arctic outlook: The September 2012 ice extent predicted from July 1, 2012 is **4.2 +/- 0.3 million square kilometers** (Fig. 1). The predicted ice edge in the western Arctic in 2012 is close to that observed in 2011, while the predicted ice extent in the eastern Arctic is smaller than in 2011 (Fig. 2).

These results are obtained from a numerical ensemble seasonal forecasting system. The forecasting system is based on a synthesis of a model, the NCEP/NCAR reanalysis data, and satellite observations of ice concentration and sea surface temperature. The model is the **Pan**-Arctic **I**ce-**O**cean **M**odeling and **A**ssimilation **S**ystem (**PIOMAS**, Zhang and Rothrock, 2003). The ensemble consists of seven members each of which uses a unique set of NCEP/NCAR atmospheric forcing fields from recent years, representing recent climate, such that ensemble member 1 uses 2005 NCEP/NCAR forcing, member 2 uses 2006 forcing …, and member 7 uses 2011 forcing. These seven ensembles of the reanalysis atmospheric forcing fields, which incorporate a range of observations, may capture the climate variability expected in 2012. Each ensemble prediction starts with the same initial ice–ocean conditions on 7/1/2012. To obtain the "best possible" initial ice-ocean conditions for the forecasts, we conducted a retrospective simulation using PIOMAS that assimilates satellite ice concentration and sea surface temperature data. More details about the ensemble prediction procedure can be found in Zhang et al. (2008).

In addition, the recently available IceBridge and helicopter-based electromagnetic (HEM) ice thickness quicklook data are assimilated into the initial 12-category sea ice thickness distribution fields in order to improve the initial conditions for the predictions. The IceBridge data consisted of thickness observations from ten flights conducted between the 14th and 28th of March. The thickness estimates were computed by Nathan Kurtz at NASA Goddard Space Flight Center (http://nsidc.org/data/docs/daac/icebridge/evaluation_products/sea-ice-freeboard-snowdepth-thickness-quicklook-index.html). A team of researchers from the University of Alaska Fairbanks and Alfred Wegner Institute carried out a HEM survey based out of Barrow to measure sea ice and snow thickness in the vicinity. The ice-plus-snow thickness was computed by Stefan Hendricks and Priska Hunkeler at AWI. (http://www.arcus.org/search/seaiceoutlook/ice-thickness-data#SIZONet_Airborne_Electromagnetic-induction_EM_Ice_Thickness_Surveys_Quicklook_Data). Data from all of the flights from the two campaigns were binned into 50-km clusters and the PIOMAS ice thickness distribution for 1 April was then modified to approximate the observations using optimal interpolation. The model was run forward in time using the NCEP/NCAR data for this year through the months of April and May before beginning the ensemble projections starting 1 July using forcing data from past years.

Outlook for the Northwest Passage region: The Northwest Passage (NWP) is predicted to be open fully in September 2012 (Fig. 3a) with small uncertainty (Fig. 3b).
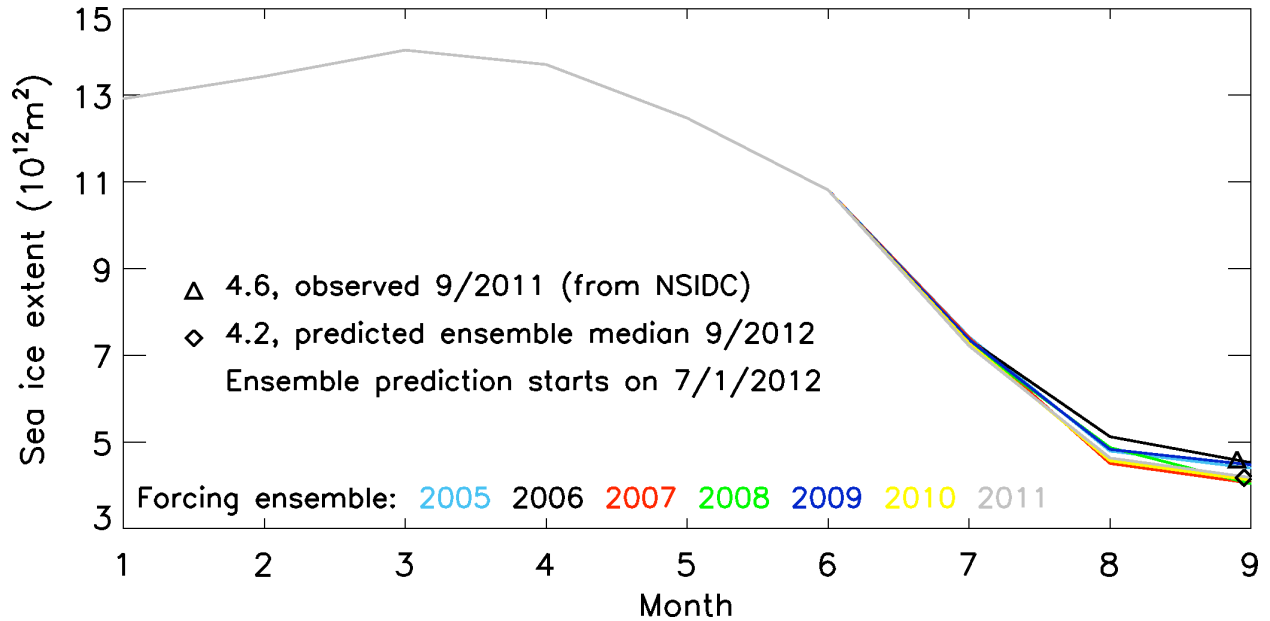
Figure 1. Monthly evolution of arctic sea ice extent from the seven ensemble members. The ensemble median of 4.2 million square km is considered to be the predicted value of arctic sea ice extent for September 2012.
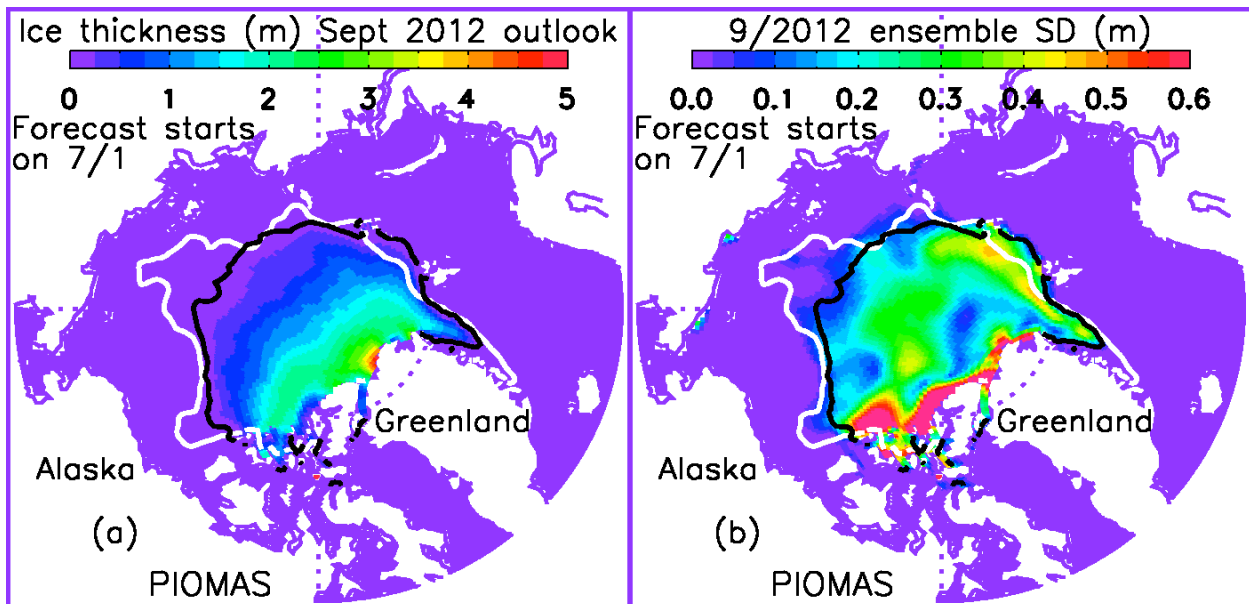
Figure 2. (a) Ensemble median prediction of September 2012 mean sea ice thickness and edge location, and (b) ensemble standard deviation (SD) of ice thickness which shows the uncertainty of the prediction. The white line represents the satellite-observed mean September 2011 ice edge defined as the line of 0.15 ice concentration, while the black line is the model predicted September 2012 ice edge.
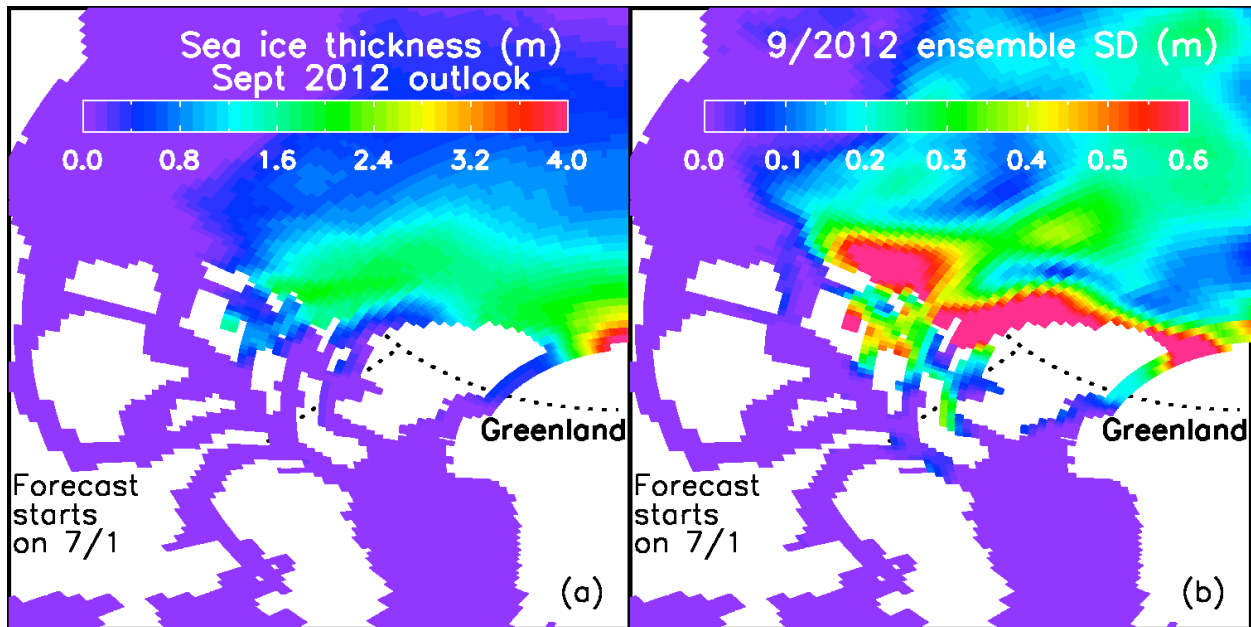

Figure 3. (a) Ensemble prediction of September 2012 sea ice thickness in the Northwest Passage region and (b) ensemble standard deviation (SD).

References:

Zhang, J., and D.A. Rothrock: Modeling global sea ice with a thickness and enthalpy distribution model in generalized curvilinear coordinates, *Mon. Wea. Rev.*, *131(5)*, 681–697, 2003.

Zhang, J., M. Steele, R.W. Lindsay, A. Schweiger, and J. Morison, Ensemble one-year predictions of arctic sea ice for the spring and summer of 2008. *Geophys. Res. Lett.*, *35*, L08502, doi:10.1029/2008GL033244, 2008.