SEA ICE PREDICTION NETWORK (SIPN)
Pan-Arctic Sea Ice Outlook Core Contributions
July 2015 Report

1. Contributor Name(s)/Group

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2. Individuals submitting "public" contributions should self-identify here:

___ Yes, this is a "public" contribution.

3. "Executive summary" about your Outlook contribution (max 300 words)

The Global Ocean Forecast System (GOFS) 3.1 was run in forecast mode without data assimilation, initialized with June 1, 2015 ice/ocean analyses, for ten simulations using National Centers for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR) atmospheric forcing fields from 2005-2014. The mean ice extent in September, averaged across all ensemble members is our projected ice extent. The GOFS 3.1 outlook for the 2015 September minimum ice extent is 5.3 Mkm^2 with a range of 4.3 – 6.1 Mkm^2.

4. Type of Outlook projection

Dynamic model
Model Name: coupled HYCOM/CICE
Components of the model: Ocean/Ice
For models lacking an atmosphere or ocean, please describe the forcing: NCEP CFSR atmospheric forcing fields

5. September monthly average projection (extent in million square kilometers). To be consistent with the validating sea ice extent index from NSIDC, if possible please first compute the average concentration for the month and then compute the extent as the sum of area of all cells > 15%.)

The GOFS 3.1 outlook for the 2015 September minimum ice extent is 5.3 Mkm^2 with a range of 4.3 – 6.1 Mkm^2.

6. Short explanation of Outlook method (max 300 words)

The Global Ocean Forecast System (GOFS) 3.1 is a global coupled ice-ocean system (Metzger et al., 2015) that assimilates passive microwave ice concentration daily and is run with a horizontal resolution of approximately 3.5 km near the North Pole. It was developed by the Oceanography Division of the Naval Research Laboratory to produce 7 day forecasts of the global ocean including the Arctic and Antarctic sea ice states. This system was transitioned to the Naval Oceanographic Office in September 2014 and is currently undergoing operational testing. The system is configured and validated for its capability in producing an accurate 7 day sea ice forecast. The results presented are preliminary and additional work is required in validating the capability of this model for seasonal projections.

The GOFS 3.1 ocean component is the HYbrid Coordinate Ocean Model (HYCOM) (Metzger et al. 2010, 2014), and is two-way coupled to the Los Alamos National Laboratory Community Ice CodE (CICE) (Hunke and Lipscomb 2008) via the Earth System Modeling Framework (ESMF). The ocean and ice models are run in an assimilative cycle with the Navy Coupled Ocean Data Assimilation (NCODA) system (Cummings and Smedstad, 2013). The system is run once per day, assimilating both SSMIS and AMSR2 ice concentration into CICE to provide an initial condition for a 7 day forward model run (the forecast). Atmospheric forcing used in the real-time system is from the Fleet Numerical Meteorology and Oceanography Center Navy Global Environmental Model, but for these September forecasts, NCEP CFSR (Saha et al., 2010) forcing is used.

The GOFS 3.1 seasonal projection was made using an ensemble of forecasts. Ten model runs were made, using CFSR forcing from 2005-2014. Each model run was initialized with June 1, 2015 GOFS 3.1 ice (and ocean) conditions (Fig. 1), and run forward for 4 months using CFSR forcing for each specific year. The ensemble of ten members gives an indication of how sea ice can respond to variable atmospheric conditions during summer.

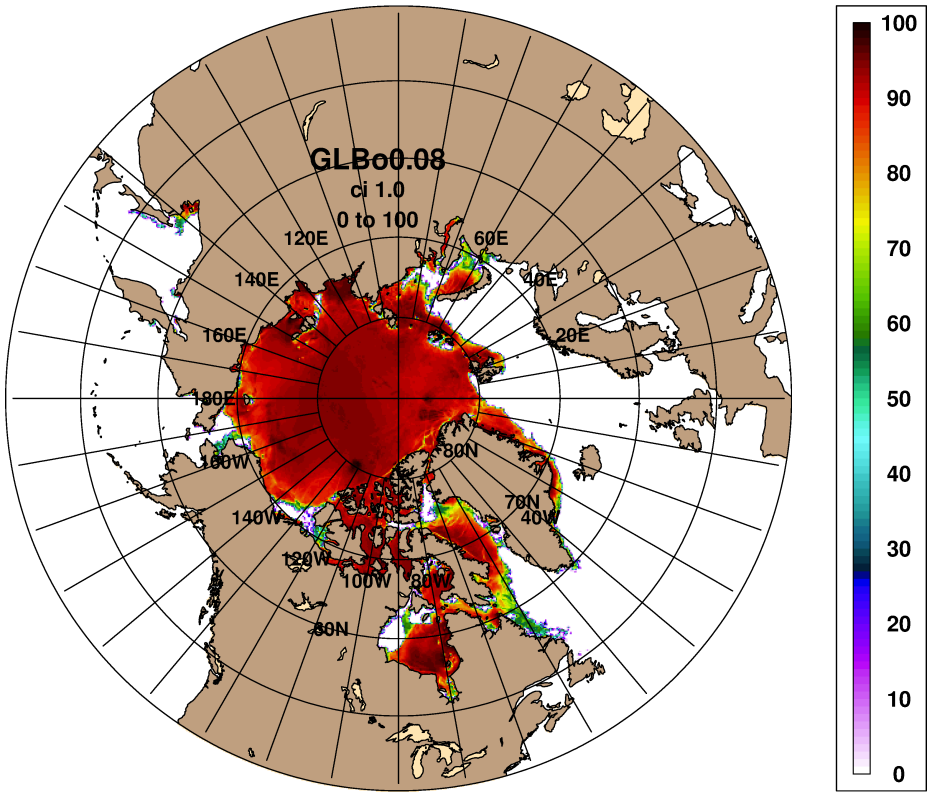

Figure 1: Ice concentration field (%) from GOFS 3.1 valid June 1, 2015. This is the initial condition for each ensemble member.

The sea ice extent of each ensemble member was calculated using all grid cells with 15% or greater ice concentration in computing the monthly mean. The GOFS 3.1 predicted 2015 September mean sea ice extent is the average of the ten member extents, 5.3 Mkm^2 with a range of 4.3 – 6.1 Mkm^2.

Included also are the sea ice probability (SIP) map (Fig. 2) and the first ice-free ordinal date map (Fig. 3) and standard deviation across all ten ensemble members (Fig. 4) for the GOFS 3.1 2015 September sea ice extent forecast.

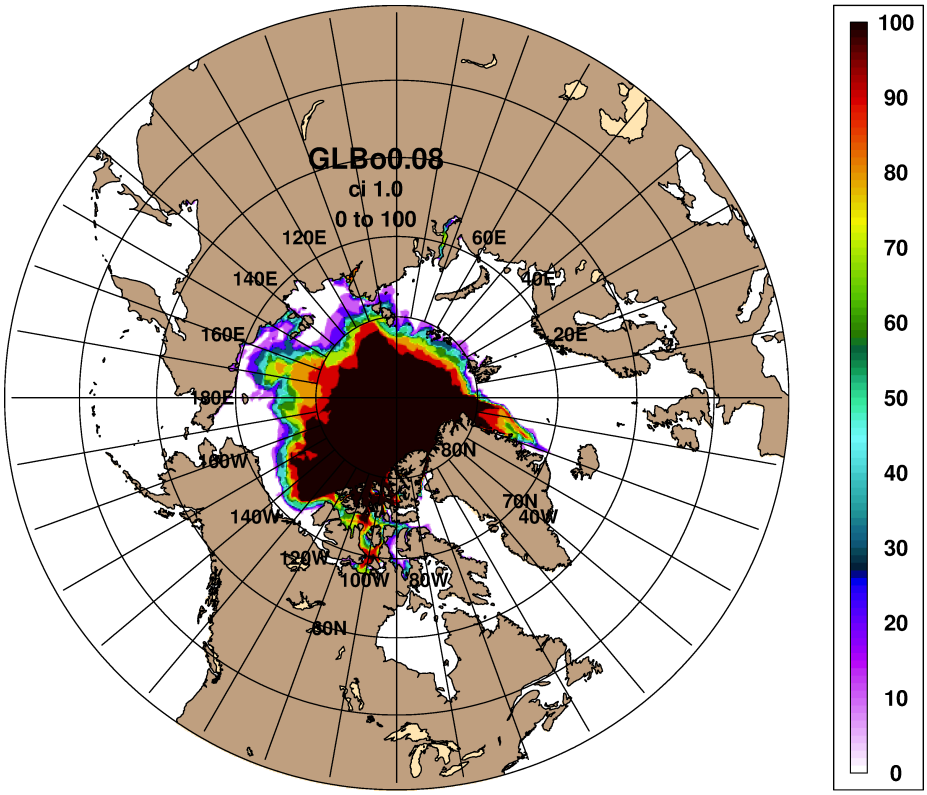

Figure 2: Sea Ice Probability (%) map of the projected GOFS 3.1 September mean ice extent for 2015.

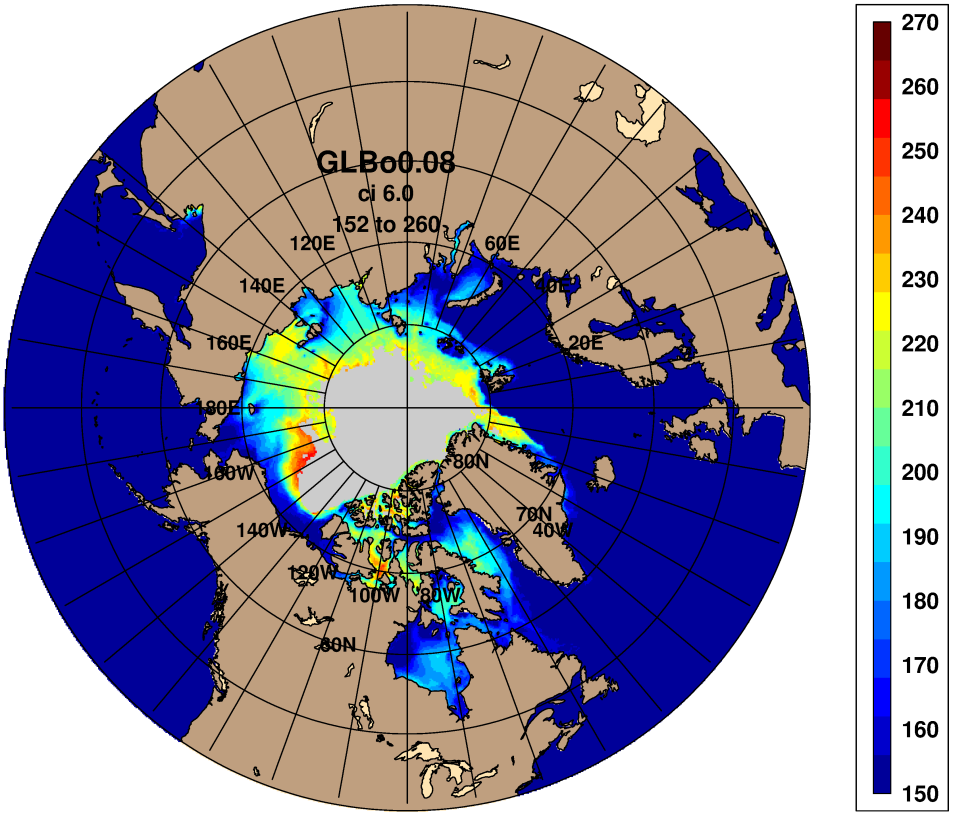

Figure 3: First ice-free ordinal date, with grey indicating a data void (i.e., no ice free days as the most likely outcome) of the projected GOFS 3.1 ensemble September mean for 2015.

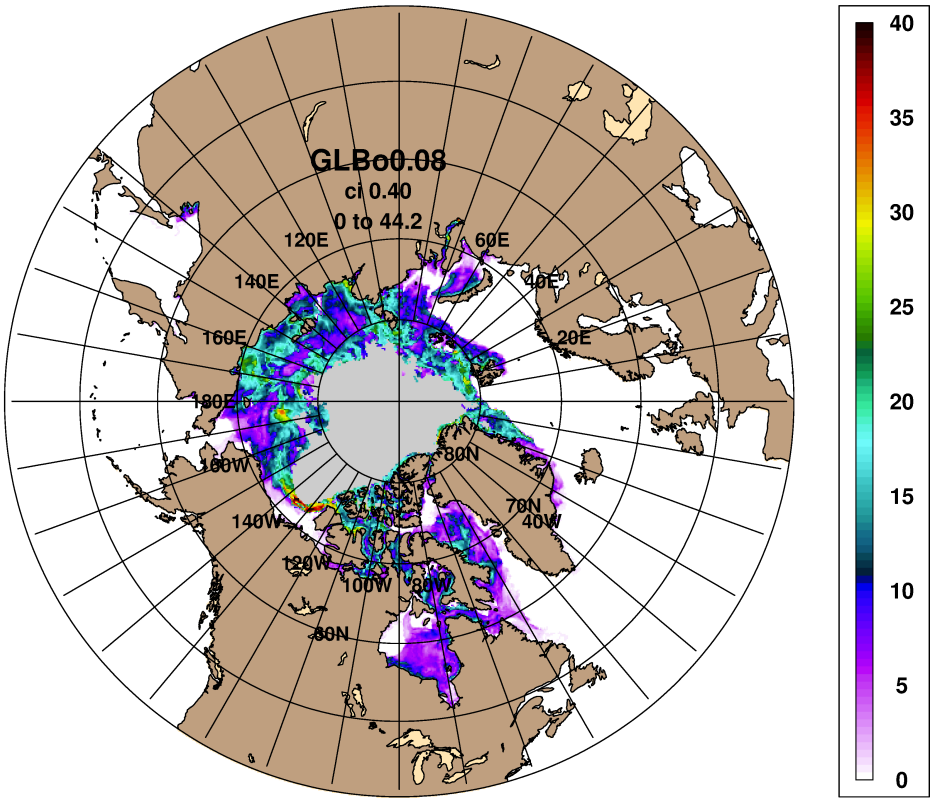

Figure 4: Standard deviation of first ice-free ordinal date, with grey indicating a data void (i.e., no ice free days as the most likely outcome) of the projected GOFS 3.1 ensemble September mean for 2015.

7. Projection uncertainty/probability estimate for September extent (only required if available with the method you are using).

   The projection uncertainty ranges from 4.3 – 6.1 Mkm^2.

8. Short explanation/assessment of basis for the uncertainty estimate in #6 (1-2 sentences).

   Uncertainty range was determined based on the minimum and maximum ice extent from the ensemble members.

9. Please indicate if this contribution should be used for both the July 2014 and the August 2015 SIO reports:

   ___ Yes use this contribution for both July and August
   _X_ No a separate contribution will be submitted for the August report.

References

Cummings, J.A. and O.M. Smedstad (2013). Variational data assimilation for the global ocean. In Data Assimilation for Atmospheric, Oceanic and Hydrologic Applications (Vol. II). S.K. Park and L. Xu, eds., Springer-Verlag, Berlin, Heidelberg, doi: http://dx.doi.org/10.1007/978-3-642-35088-7_13.

Hunke, E.C. and W. Lipscomb (2008). CICE: The Los Alamos Sea Ice Model, Documentation and Software User's Manual, Version 4.0. Los Alamos Technical Report, LA-CC-06-012, Los Alamos National Laboratory, Los Alamos, NM.

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