Pan-Arctic September 2016 Sea Ice Outlook

July report (based on June data)

Antoine Barthélemy[1,*], François Massonnet[1,2], Hugues Goosse[1], Thierry Fichefet[1]

[1] Georges Lemaître Centre for Earth and Climate Research (TECLIM), Earth and Life Institute (ELI), Université catholique de Louvain (UCL), Louvain-la-Neuve, Belgium
[2] Barcelona Supercomputing Center (BSC), Barcelona, Spain

[*] Primary contact (antoine.barthelemy@uclouvain.be)

Contributor label

Barthélemy et al.

Type of contribution

This contribution is not from citizen scientists.

Subsequent reports

We plan to submit separate contributions for subsequent reports.

Executive summary

Our estimate is based on results from ensemble runs with the global ocean-sea ice coupled model NEMO-LIM3. Each member is initialized from a reference run on June 30, 2016, then forced with the NCEP/NCAR atmospheric reanalysis from one year between 2006 to 2015. Our final estimate is the ensemble median, and the given range corresponds to the lowest and highest extents in the ensemble.

Type of projection

Based on the dynamical ocean-sea ice model NEMO-LIM3:

- ocean component: NEMO (Madec, 2012);
- sea ice component: LIM3 (Vancoppenolle et al., 2009);
- atmospheric forcing: NCEP/NCAR (Kalnay et al., 1996).

Initialization

The initial state of the model on June 30, 2016 (for both the ocean and the sea ice, including concentration and thickness) is provided by an atmospherically-forced run of NEMO-LIM3 without data assimilation.

September monthly average Arctic sea ice extent projection

3.8 million square kilometers.

Method

Our estimate is based on results from ensemble runs with the global ocean-sea ice coupled model NEMO-LIM3. The ensemble members are expected to sample the atmospheric variability that may prevail this summer. In practice, the model is forced with NCEP/NCAR atmospheric reanalysis data from 1948 to June 30, 2016. No data are assimilated during this simulation. Ten ensemble members are then started from the obtained model state, each using atmospheric forcing from one year between 2006 and 2015. This choice is a compromise between a sufficiently large ensemble and the rapidly changing Arctic atmospheric conditions in recent decades. The estimate given above corresponds to the ensemble median monthly September extent, corrected by the mean bias between simulated and observed values reported in the NSIDC sea ice index, which equals 0.8 million square kilometers. The model configuration is exactly the same as in our last three years contributions. Additional details can be found in the 2013 reports.

Projection uncertainty range

From 2.6 to 4.6 million square kilometers.

Basis for the uncertainty estimate

The projection uncertainty is given as the range between minimum and maximum extents in the ensemble. Although relatively wide, this neglects potential erroneous initial state and model errors not accounted for through the mean bias correction. It is based solely on the uncertainties arising from atmospheric variability, and on the hypothesis that the 2016 atmospheric summer conditions will be similar to the ones observed during the last decade.

Post processing

The September sea ice extents from the ensemble members have been corrected by the mean bias between the observed (from the NSIDC sea ice index) and simulated (by the reference NEMO-LIM3 run) extents over 2006-2015, which equals 0.8 million square kilometers.

Hindcast validation

Our contribution is based on the known model skill in reproducing the monthly Arctic sea ice extent anomalies over the last 30 years, as well as the observed long-term downward trend. However, apart from our relatively successful last three years contributions, the projection method has not yet been evaluated in hindcast mode.

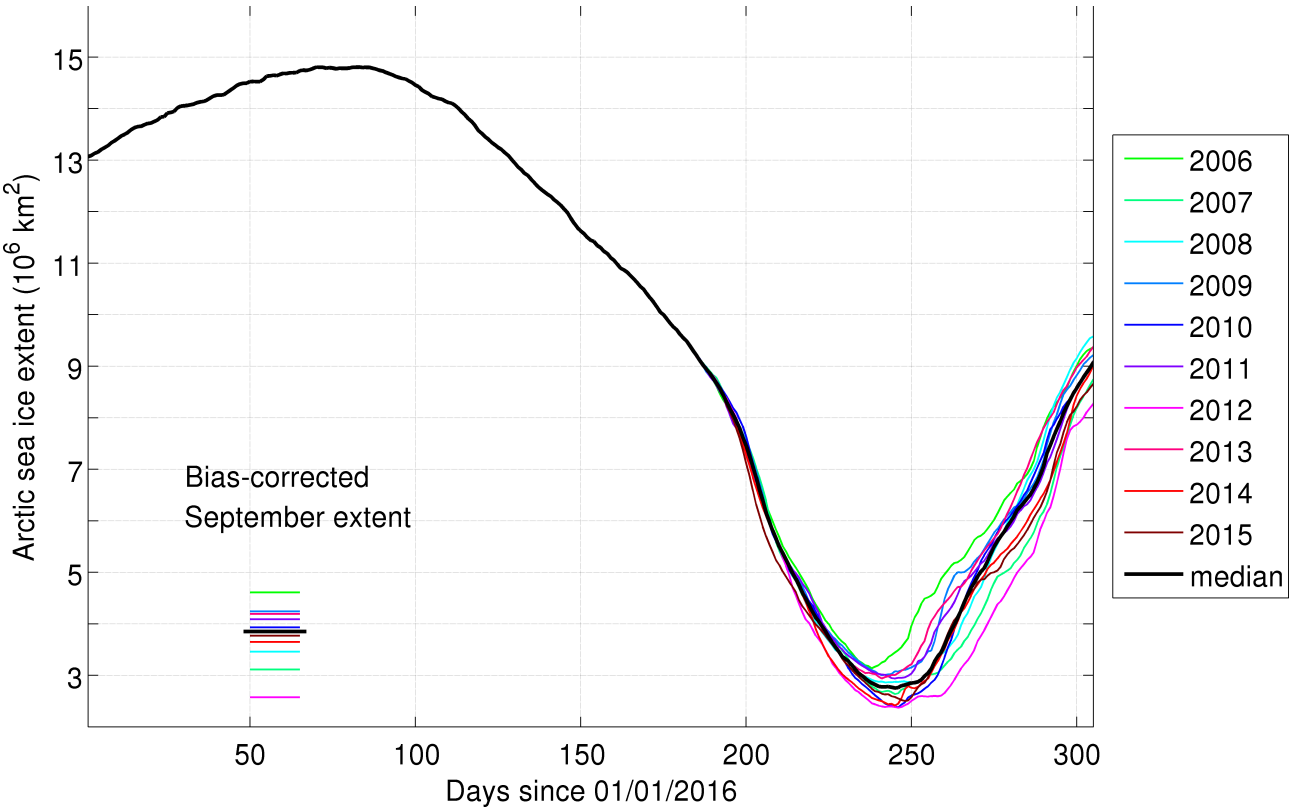

Figure: ensemble members and median 2016 daily Arctic sea ice extents. The bias-corrected September monthly mean extent for each member and their median (which is our final estimate) are also plotted as an inset.

References

Madec, G. (2012), NEMO ocean engine, Note du Pôle de modélisation, Institut Pierre-Simon Laplace (IPSL), France, No 27.

Vancoppenolle, M., T. Fichefet, H. Goosse, S. Bouillon, G. Madec and M. A. Morales Maqueda (2009), Simulating the mass balance and salinity of Arctic and Antarctic sea ice. 1. Model description and validation, Ocean Model., 27, 1–2, 33–53, doi: 10.1016/j.ocemod.2008.10.005.

Kalnay, E. and coauthors (1996), The NCEP/NCAR 40-Year Reanalysis Project, Bull. Amer. Meteor. Soc., 77, 3, 437–471, doi: 10.1175/1520-0477(1996)077<0437:TNYRP>2.0.CO;2.