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Variability of Arctic sea-ice thickness using PIOMAS and the CESM Large Ensemble

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Authors
Labe, Zachary
Magnusdottir, Gudrun
Stern, Hal

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Supplemental Material

Supplemental Material for "Variability of Arctic sea-ice thickness using PIOMAS and the CESM Large Ensemble"

Zachary Labe*

Department of Earth System Science, University of California, Irvine, Irvine, California

Gudrun Magnusdottir

Department of Earth System Science, University of California, Irvine, Irvine, California

Hal Stern

Department of Statistics, University of California, Irvine, Irvine, California

**Corresponding author address:* Dept. of Earth System Science, University of California, Irvine, 3200 Croul Hall, Irvine, CA 92697-3100

E-mail: zlabe@uci.edu

ABSTRACT

This document contains supporting figures for the main document.

S.1: Future projections of sea-ice volume

Predicting the timing of the first ice-free summer is of significant interest for scientists and numerous stakeholders. The most common definition of “ice-free” is a threshold of sea-ice extent (SIE) falling below 1.0 million km^2 (e.g., Wang and Overland 2012; Overland and Wang 2013; Jahn et al. 2016). Here we define an arbitrary threshold for the timing of the first September sea-ice volume (SIV) dropping below 1000 km^3 to determine the spread in the RCP8.5 LENS simulations (strong emission scenario; 2006-2080). Between all future ensemble members we find a spread larger than one decade, which suggests the timing is subject to large uncertainties from internal variability (Fig. S.4). Averaging out all of the ensemble members (and hence the noise), the ensemble mean suggests the SIV threshold is first crossed in the mid-2040s. This timing is fairly consistent with a recent study using LENS by Jahn et al. (2016), which estimated the SIE “ice-free” predictability and found a spread of approximately two decades in a single emission scenario. However, it should also be noted that there is little to no predictability for using SIV with the timing of the first SIE “ice-free” summer ($<$1 million km^2) (Jahn et al. 2016).

References

Jahn, A., J. E. Kay, M. M. Holland, and D. M. Hall, 2016: How predictable is the timing of a summer ice-free Arctic? *Geophysical Research Letters*, doi:10.1002/2016GL070067, URL http://doi.wiley.com/10.1002/2016GL070067.

Overland, J. E., and M. Wang, 2013: When will the summer Arctic be nearly sea ice free? *Geophysical Research Letters*, **40 (10)**, 2097–2101, doi:10.1002/grl.50316, URL http://doi.wiley.com/10.1002/grl.50316.

Wang, M., and J. E. Overland, 2012: A sea ice free summer Arctic within 30years: An update from CMIP5 models. *Geophysical Research Letters*, **39 (18)**, n/a–n/a, doi:10.1029/2012GL052868, URL http://doi.wiley.com/10.1029/2012GL052868.

LIST OF FIGURES

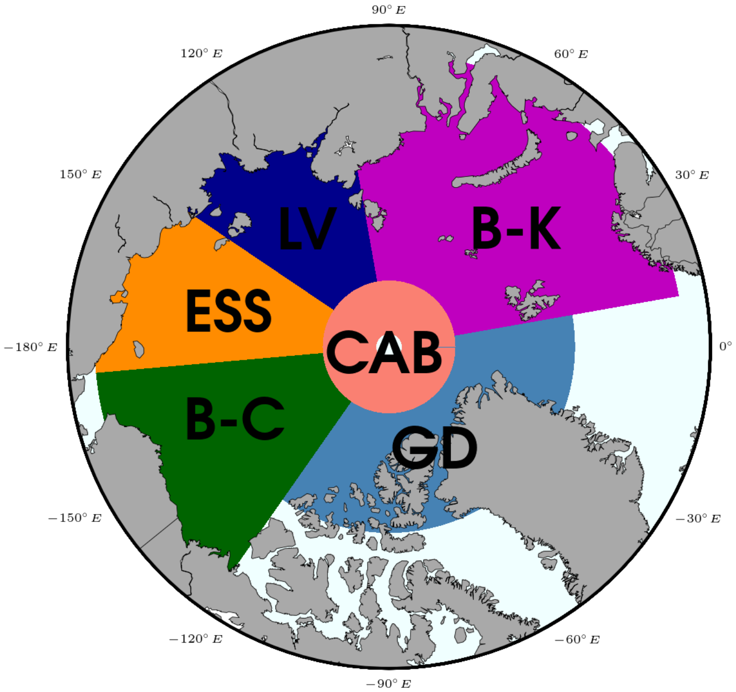


Fig. S.1. Masks for regional sea ice analysis are as follows: Central Arctic Basin (CAB), northern Canadian Arctic Archipelago and Greenland coast (GD), Beaufort and Chukchi Seas (B-C), East Siberian Sea (ESS), Laptev Sea (LV), Barents and Kara Seas (B-K)

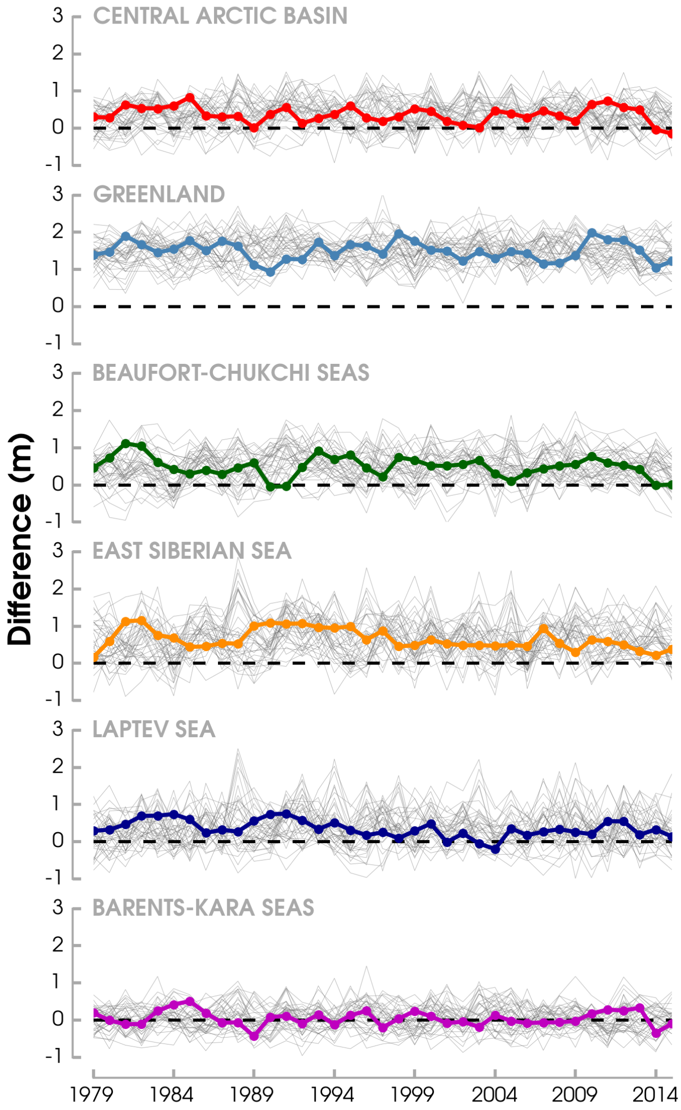


Fig. S.2. September sea-ice thickness differences between the LENS mean and PIOMAS over the 1979 to 2015 period. Individual ensembles are shown by each gray line. Regions are an area weighted average for mean grid cell thicknesses of at least 0.15 m.

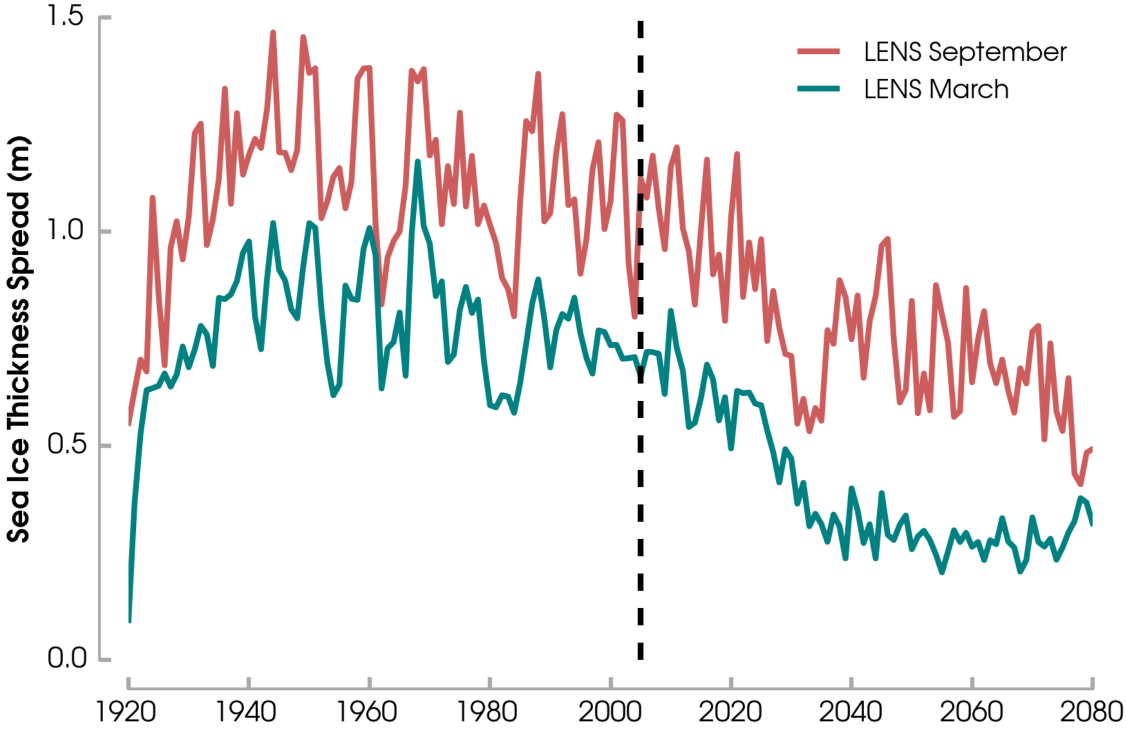
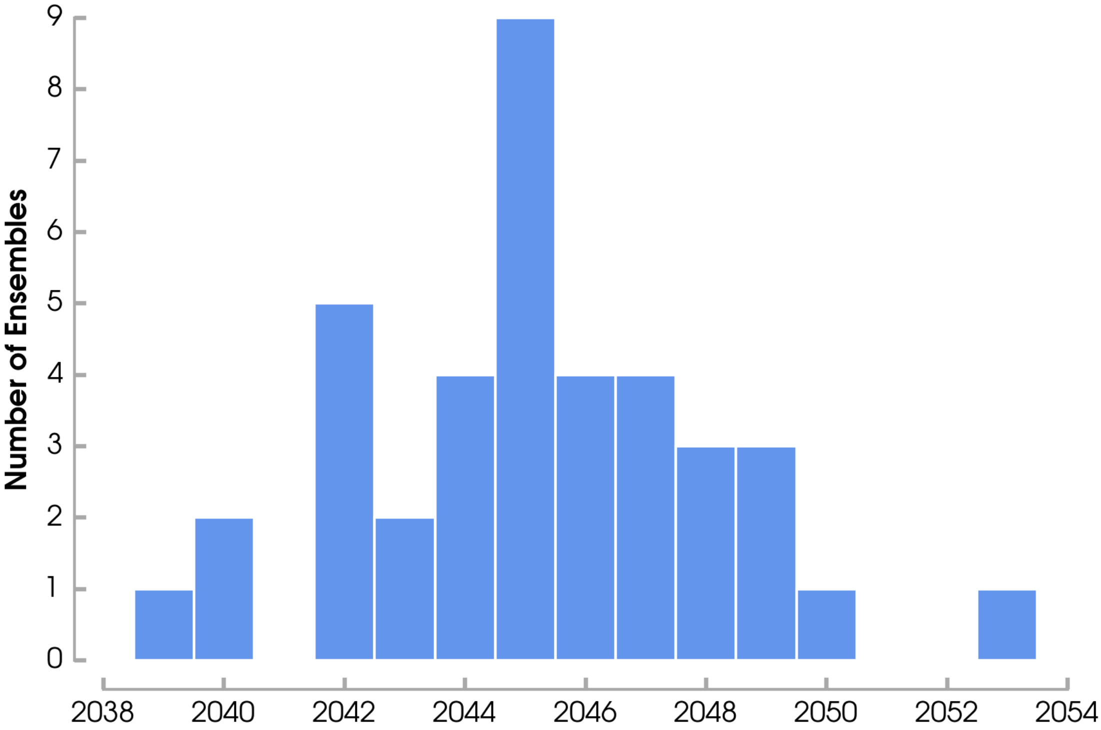


Fig. S.3. Difference between the maximum and minimum mean sea-ice thickness from LENS during September (red line) and March (blue line). Sea-ice thickness is an area weighted average north of 65°N. The dashed vertical line separates the historical simulation from the future LENS projection.



59 Fig. S.4. Frequency (histogram) of the timing for the first September with sea-ice volume less than 1000 km^3
60 as evaluated per each LENS ensemble member.