MMEM future experiments, that is not the case in the present-day climate (either in the observation data or the MMEM present experiments). Decadal variability accounts for the calculated linear trend in the present-day climate to a certain degree, mainly because of the short time period of the data. In this work, therefore, we used observation data alone for estimating future interannual variability, and MMEM future results alone for estimating the future linear trend. Correction of the bias in the linear trend between the MMEM present and the observation data might be desirable if the effect of decadal variability could be removed from the calculated linear trend.

If we take the median sea ice concentration of the present-day CGCM experiments, a distribution very similar to the observation data is obtained. Thus, it would be possible to estimate the long-term mean of the locations of future decreases by calculating $fice_{mf} - fice_{\mathrm{mp}}$. However, interannual variability in the location of the decrease is not represented in such a calculation because interannual variability in MMEM is very small as a result of cancellations.

The estimated SST, sea ice concentration, and sea ice thickness have been used as boundary conditions in simulations of an AGCM with a horizontal grid size of 20 km performed by the Earth Simulator. Although the method described in this work would have difficulty estimating values for the very near future, when the phases of the interannual variation would be continuous with the present-day observation data, it is nevertheless one of the most objective methods available by which to estimate sea surface conditions 10 to 100 years from now by using the MMEM results.

Supplementary Information

Monthly SST, sea ice concentration, and sea ice thickness, their changes averaged over the 25 years, and monthly $SST_{\mathrm{mf\_T}}$ and $SST_{\mathrm{obs\_V}}$, are shown in Supplemental Figs. S1–S16.

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