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Supplemental Materials

Effects of macro vs. micro initialization and ocean initial-condition memory on the evolution of ensemble spread in the CESM2 Large Ensemble

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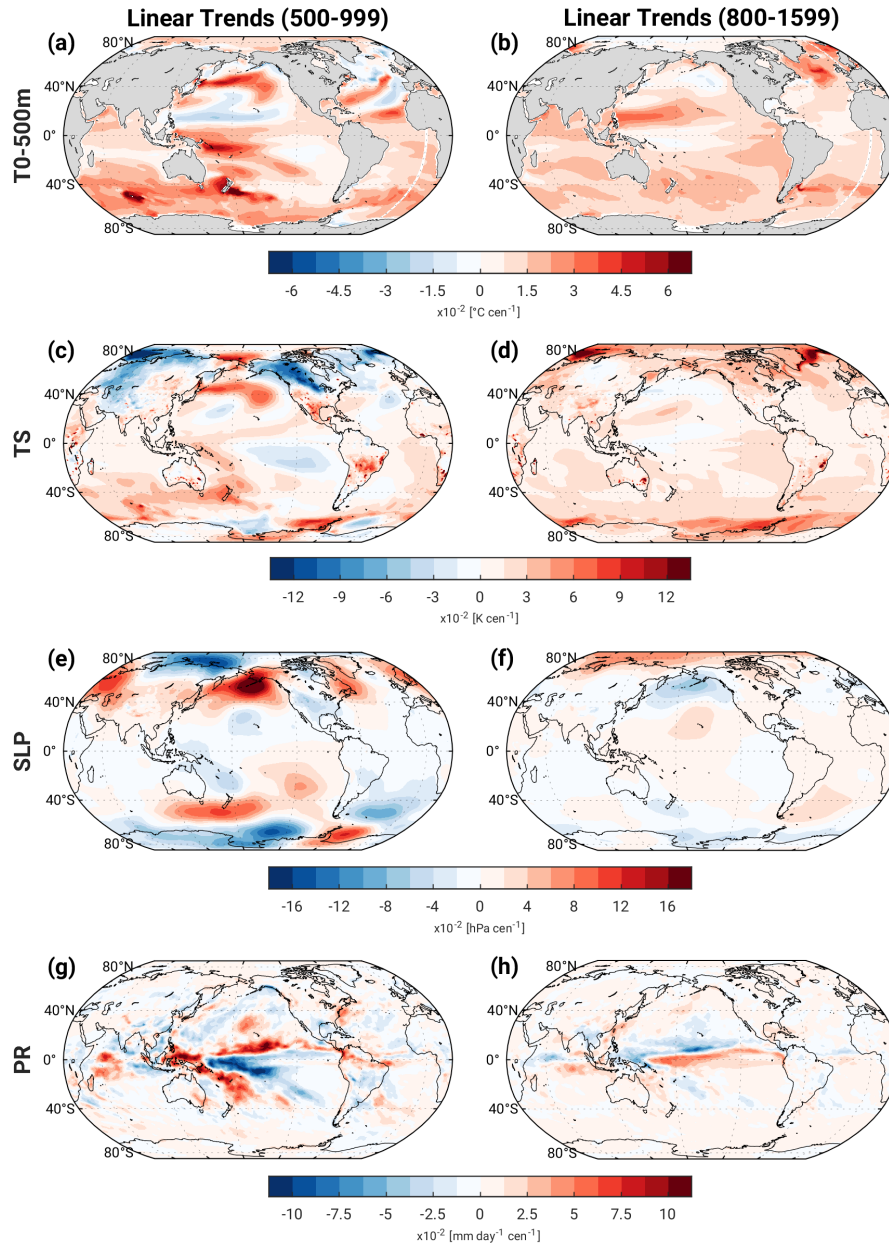
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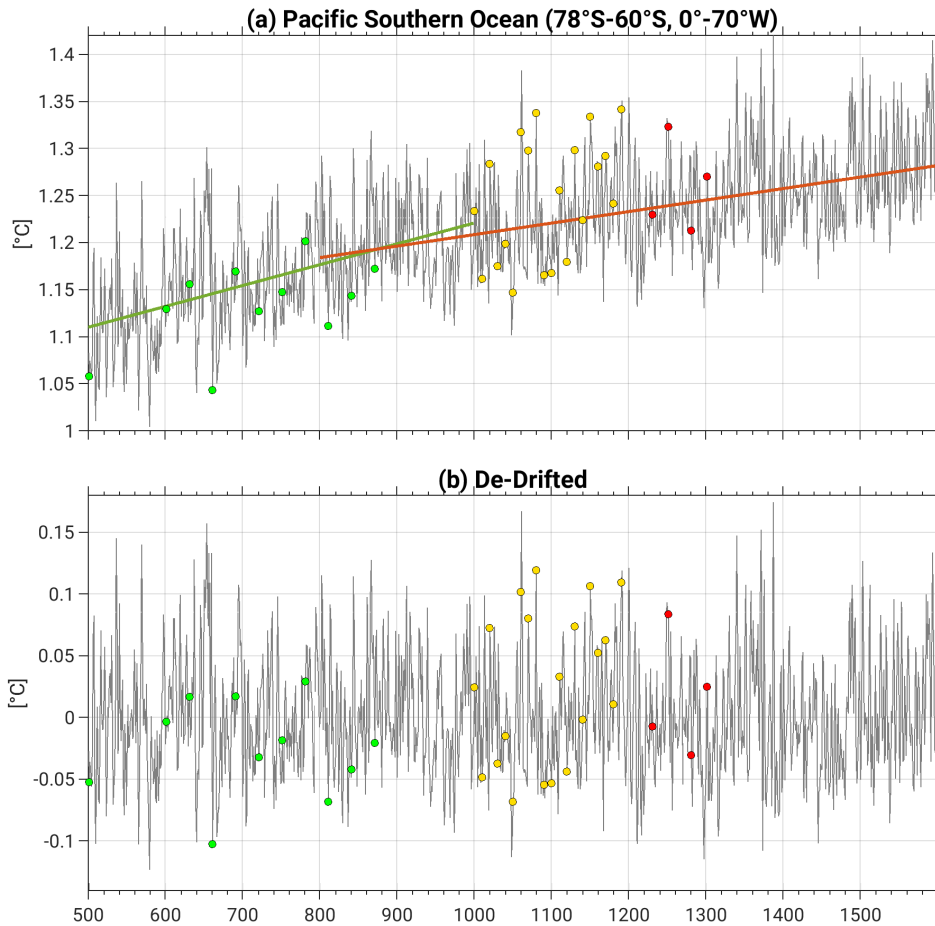
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28 This document contains 6 figures (Figs. S1-S6).

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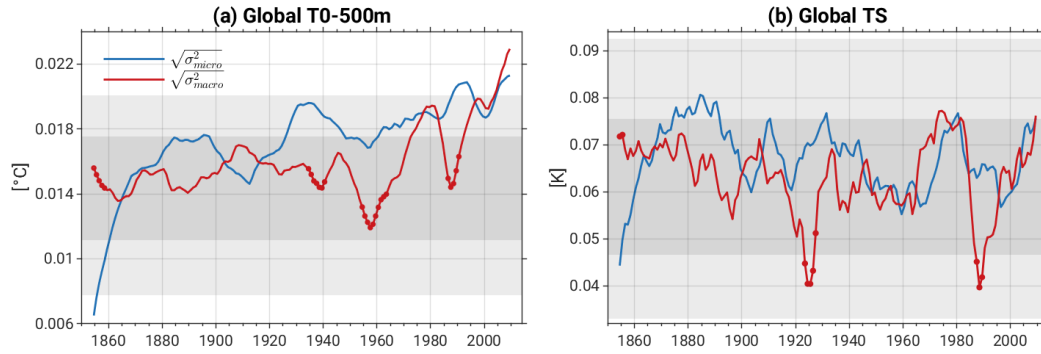
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 32 **Fig. S1.** Drift in the CESM2 pre-industrial control simulation during (left panels) years 500-999 and (right panels)
 33 years 800-1599 for (a,b) $T_{0-500\text{m}}$ (K century^{-1}) (c,d) TS (K century^{-1}), (e,f) SLP (hPa century^{-1}) and (g,h) precipitation
 34 ($\text{mm day}^{-1} \text{century}^{-1}$).
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 38 **Fig. S2.** Illustration of drift in the CESM2 pre-industrial control simulation. a) Annual mean upper ocean potential
 39 temperature (T_{0-500m}) timeseries averaged over the Pacific sector of the Southern Ocean (78° - 60° S, 180° - 70° W)
 40 (top) before and (bottom) after de-drifting. In a), the solid green (red) line shows the best-fit linear trend over years
 41 500-999 (800-1599). Years 800-899 (900-999) are de-drifted using the trend from years 500-999 (800-1599). The red
 42 circles mark the annual mean value in the first year of each member of AMOC1231, AMOC1251, AMOC1281 and
 43 AMOC1301. The yellow and green circles mark the annual mean value in the first year of each Macro20 and Macro11
 44 simulation, respectively. See main text for details.

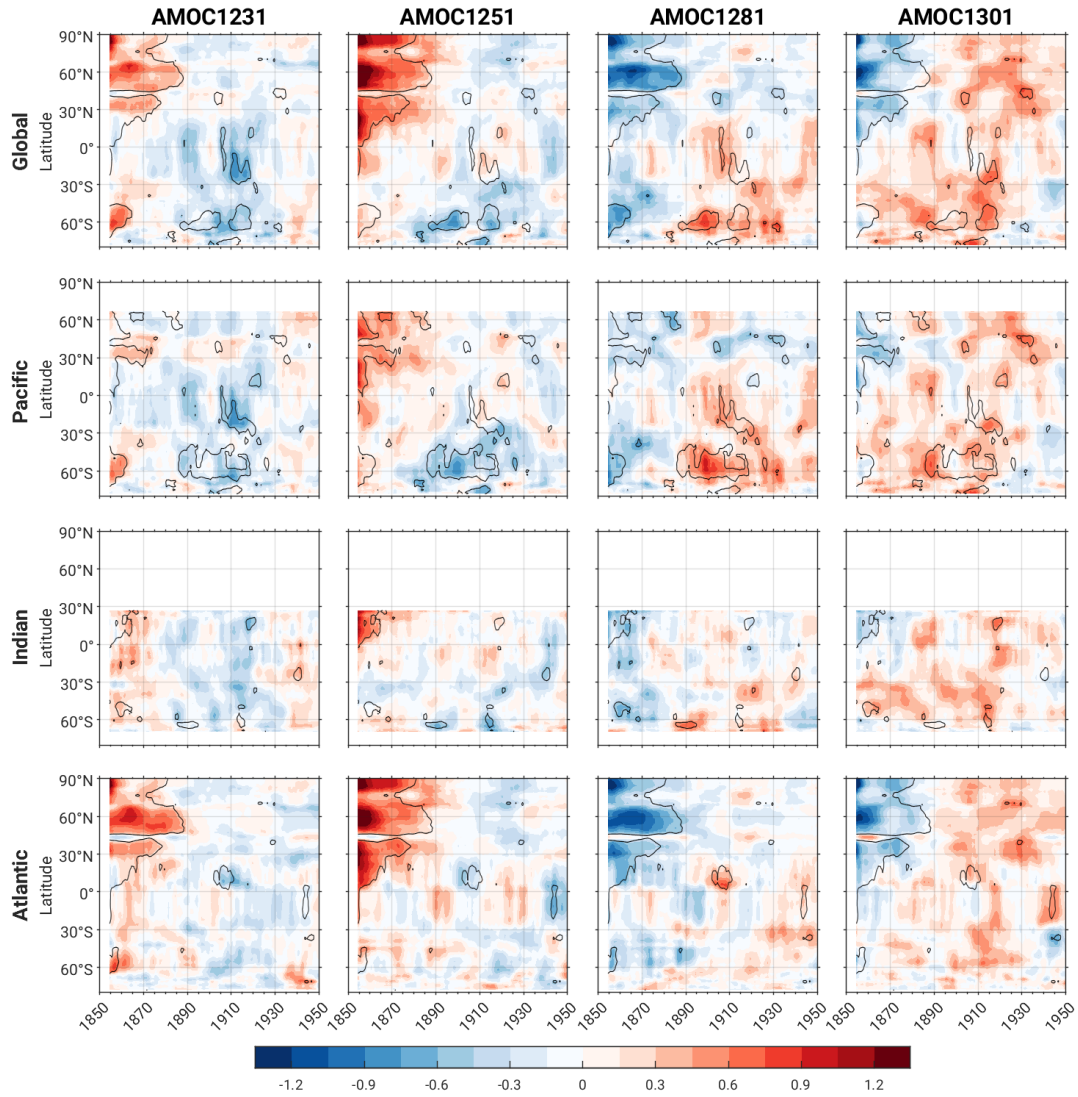
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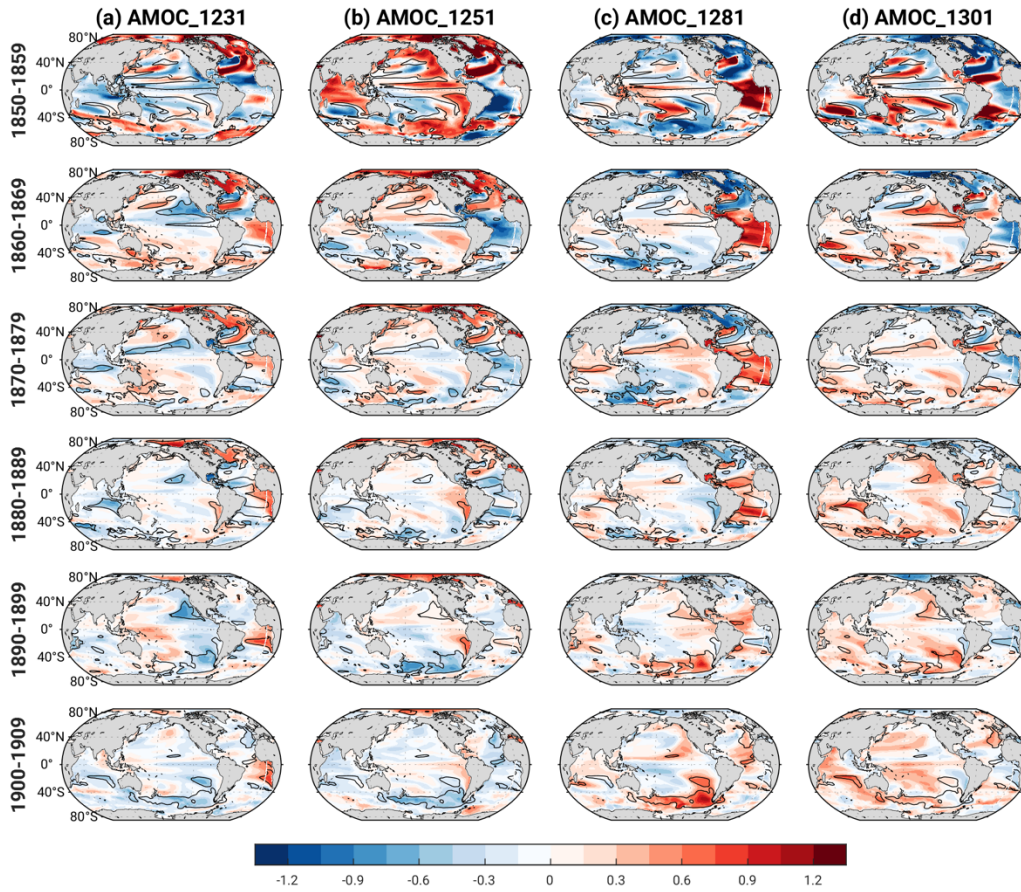
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49 **Fig. S3.** Ensemble spread due to macro (red curves) and micro (blue curves) initialization for 10-year running means
50 of global (a) T_{0-500m} and (b) TS. Black circles on the red curves indicate that the spread due to macro-initialization is
51 significantly different from that due to micro-initialization. Darker (lighter) gray shading denotes the 2.5th – 97.5th
52 percentile (full) range based on the Pictl simulation.
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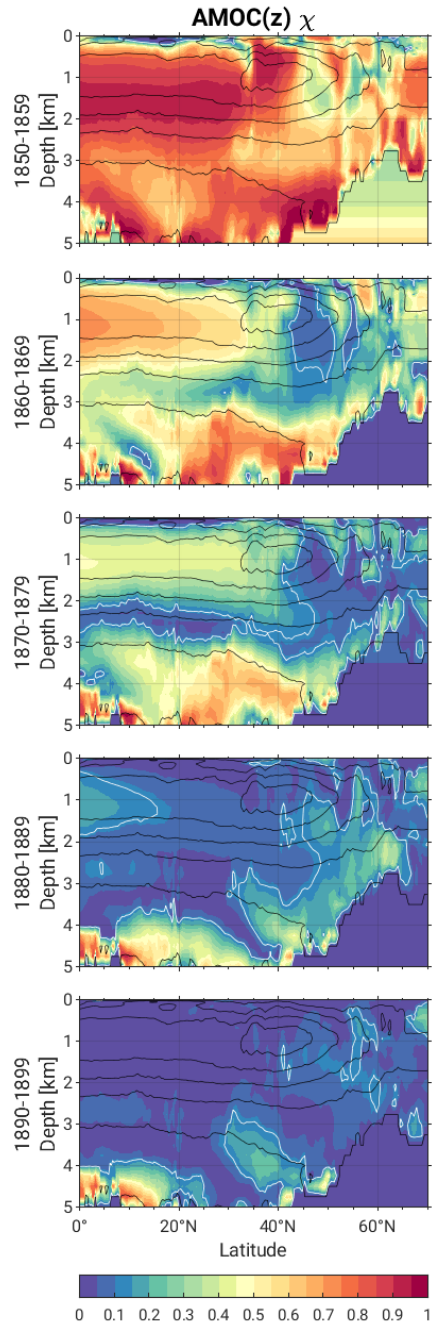


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Fig. S4. Hovmöller diagrams of zonally averaged ensemble-mean normalized SST anomalies for each AMOC ensemble based on 10-year running means for the following domains: (top row) global; (2nd row) Pacific; (3rd row) Indian; and (bottom row) Atlantic. Anomalies are defined relative to the average of the 4 AMOC ensemble-means and normalized by the Pictl standard deviation. Contours of statistically significant χ_{ocean} are superimposed for context.



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 65 **Fig. S5.** Ensemble-mean normalized T_{0-500m} anomalies over the first 6 decades of the historical simulations for each
 66 AMOC ensemble: (a) AMOC1231; (b) AMOC1251; (c) AMOC1281; and (d) AMOC1301. Anomalies are defined
 67 relative to the average of the 4 AMOC ensemble-means and normalized by the Pictl standard deviation. Contours of
 68 statistically significant χ_{ocean} are superimposed for context.
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 71 **Fig. S6.** Fraction of ensemble spread attributable to ocean initial-condition memory in the 4 AMOC ensembles (χ_{ocean})
 72 based on decadal-means of AMOC in depth coordinates [AMOC(z)] over the first 5 decades of the historical
 73 simulations. White contours outline regions that are statistically significant at the 95% confidence level based on
 74 bootstrapping the Pictl simulation (see text for details).
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