

Response to referee #2

Referee #2:

General Comments:

This paper highlights the importance of grid point scale modeling of anthropogenic pollutants, especially CO₂, and the integration of such modeling through a new module called "Population Parameterization for Earth Models" (POPEM). The module is integrated into a highly distributed climate model like Community Earth System Model (CESM). The authors present clearly and adequately the added value of their contribution (POPEM) to the model simulations and underline its impact to the climate predictions of both precipitation and temperature.

Reply: Thanks for your positive feedback.

Referee #2:

Minor comments:

Figures 6B and 8B do not illustrate clearly any differences between GPCP – CONTROL, GPCP – POPEM and CRU – CONTROL, CRU – POPEM respectively. Maybe the authors should consider an alternative way to show the differences.

Reply: Thanks for your suggestion. We added new more detailed figures (Figures 9, 11, 12, 13 and 14) to highlight the added value of our approach.

New figures look:

Figure 9

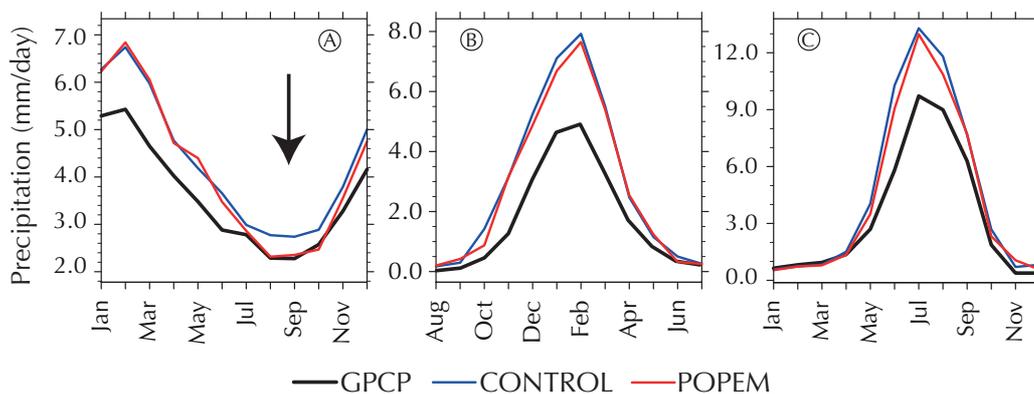


Figure 9: Monthly precipitation (1980-1999) based on GPCP, CTRL and POPEM for three of the regions with important biases in CESM. (A) shows precipitation for the area affected by the double-ITCZ bias in the Southern Hemisphere (20S-0, 80E-100W); (B) for Australia Top End (30S-10S, 128E-140E); and (C) for the Tibetan Plateau (22N-32N, 78W-92W). The black line represents observations (GPCP), the blue line is the CONTROL case, and the red line is the POPEM case. Units are in mm/day. The arrow indicates the improvement of the POPEM model.

Figure 11

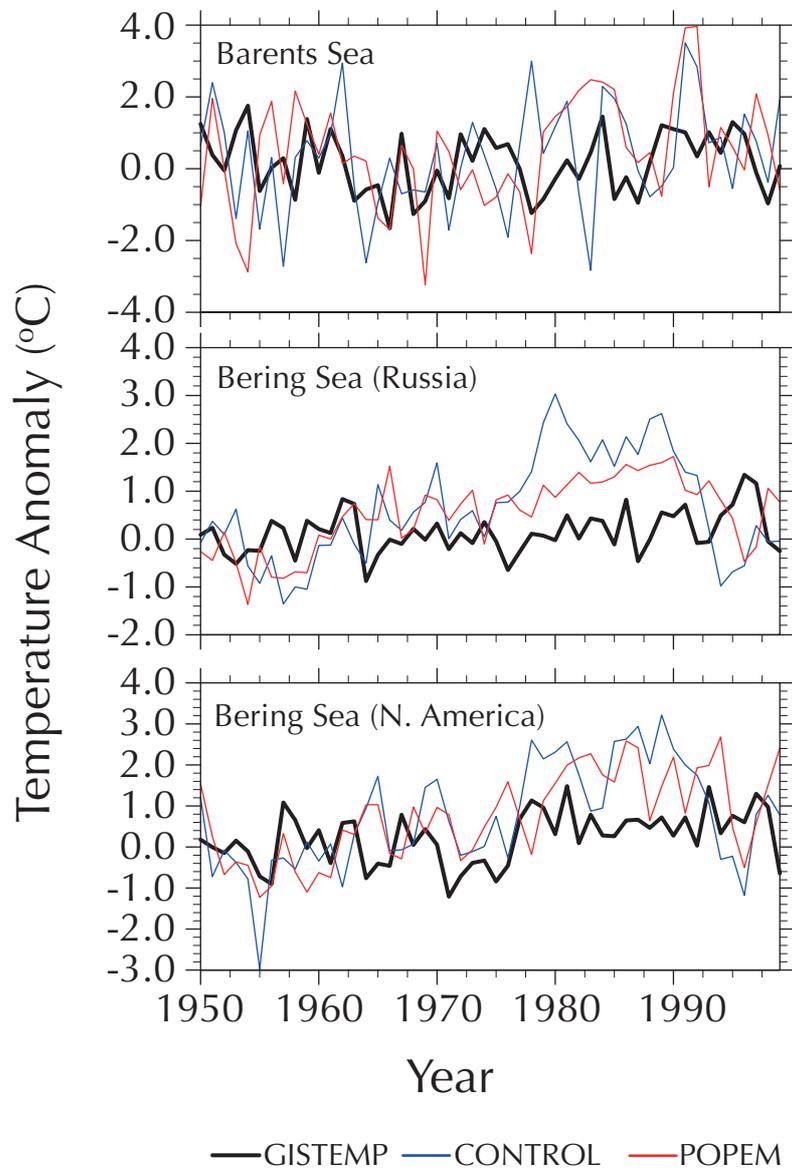


Figure 11: A comparison of the annual mean surface temperature anomaly between GISTEMP, CONTROL and POPEM from 1950 to 1999. (Top) represents the Barents Sea (68N-80N, 19E-68E); (middle) Russian part of the Bering Sea (50N-65N, 150E-180E); and (bottom) American part of the Bering Sea (50N-75N, 140W-180W). The black line represents observational data (GISTEMP), the blue line is the CONTROL case, and the red is the POPEM case. Anomaly was referenced to 1951-1980 period.

Figure 12

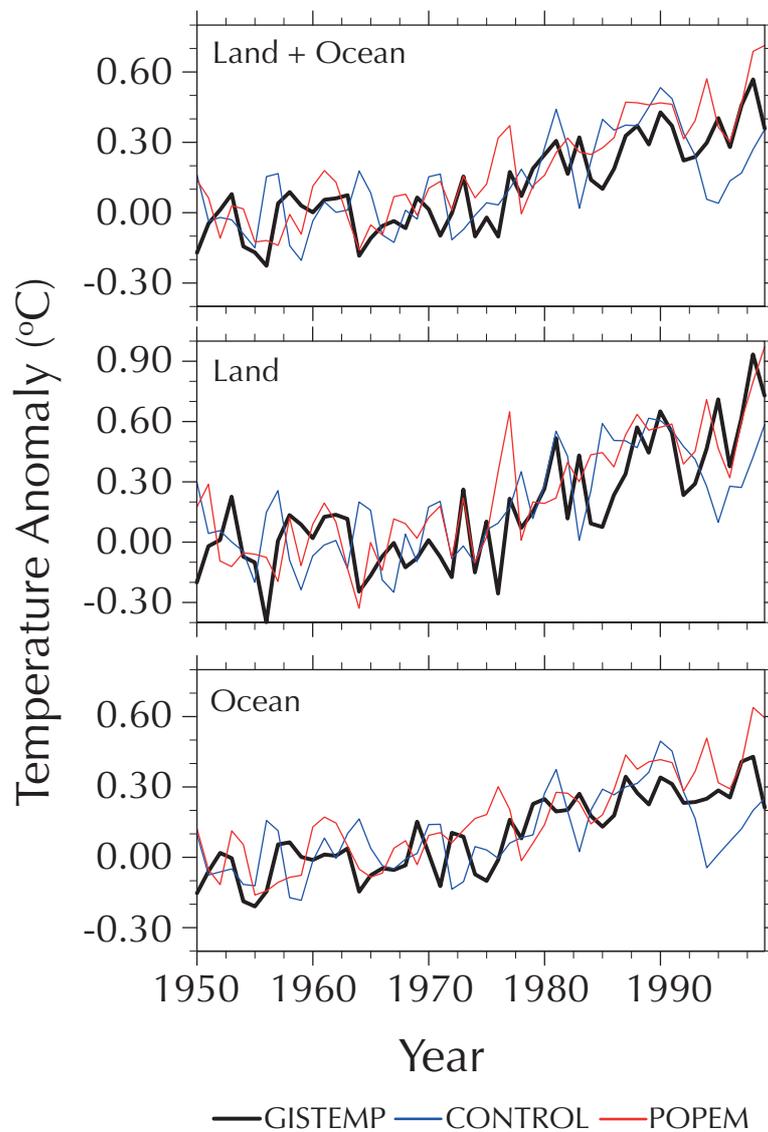


Figure 12: A comparison of the global annual mean surface temperature anomaly between GISTEMP, CONTROL, and POPEM from 1950 to 1999. (Top) global; (middle) land; and (bottom) ocean. The black line represents observational data (GISTEMP), the blue line is the CONTROL case, and the red is the POPEM case. Anomaly was referenced to 1951-1980 period.

Figure 13

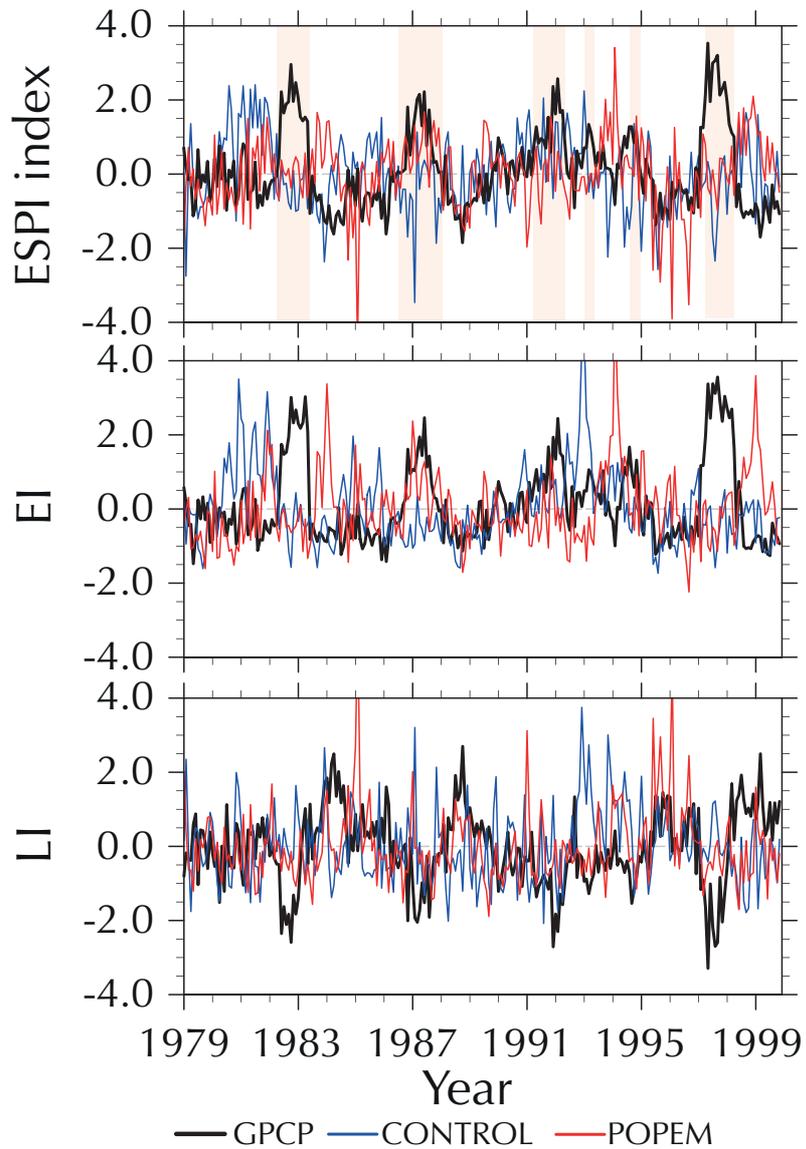


Figure 13: Time-series of precipitation anomalies for the ENSO region after Curtis and Adler (2000). (Top) ENSO Precipitation Index (ESPI); (Middle) El Niño Index (EI); and (Bottom) La Niña Index (LI). The Black line shows GPCP data, the blue line is the CONTROL case, and the red line is the POPEM case. Orange shading denotes El Niño years defined as consecutive months (minimum 3) with NIÑO3.4 sea surface temperature anomalies (5N–5S, 170–120W) greater than $+0.5^{\circ}\text{C}$.

Figure 14

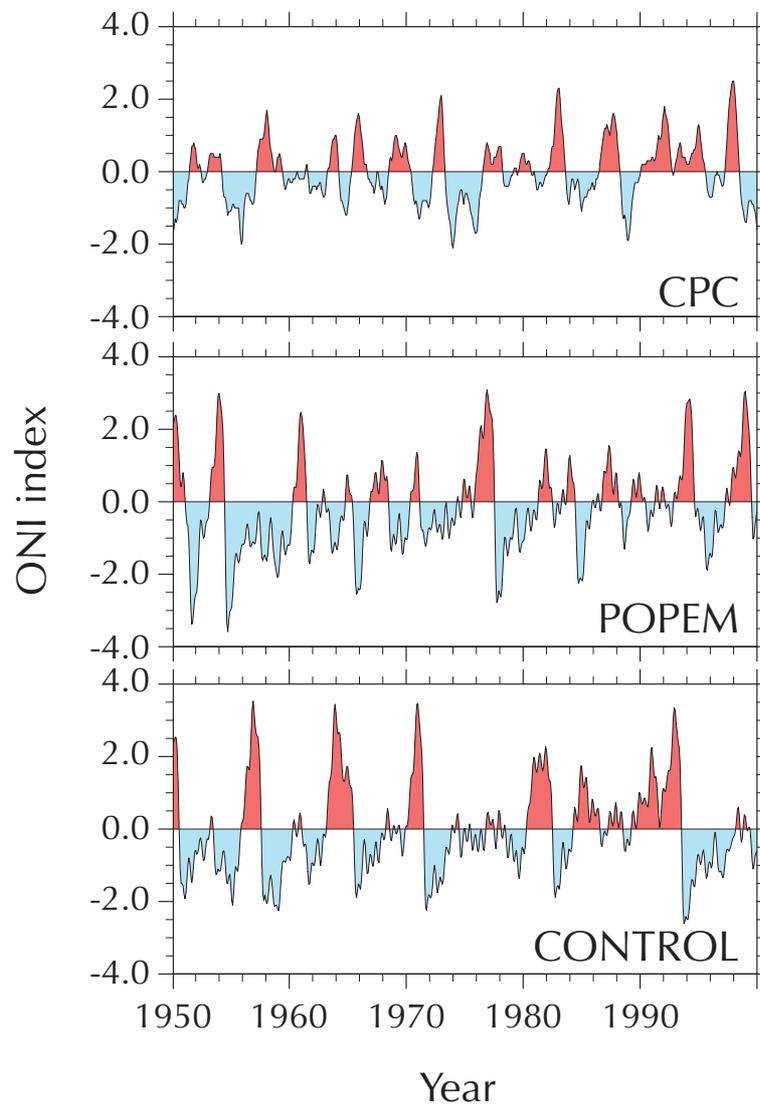


Figure 14: Comparison of the Oceanic el Niño Index (ONI) for CPC (top), POPEM (middle), and CONTROL (bottom) cases. El Niño and La Niña are defined according to Kousky and Higgins (2007): 3-month running mean with anomalies greater than $+0.5^{\circ}\text{C}$ (or -0.5°C) for at least five consecutive months in NIÑO3.4 region. The base period for computing SST departures is 1971–1999.