



Supplement of

The future of the El Niño–Southern Oscillation: using large ensembles to illuminate time-varying responses and inter-model differences

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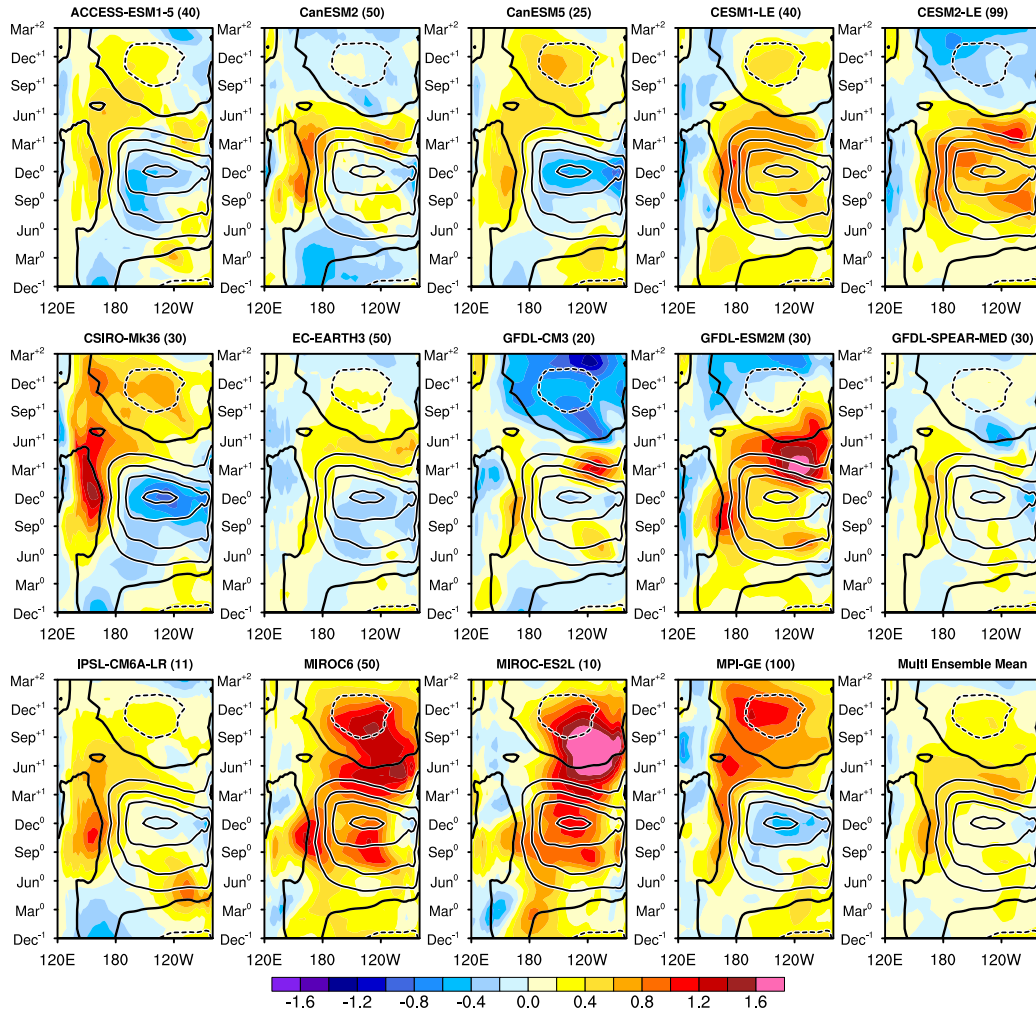


Figure S1. Longitude-time sections of the difference of equatorial Pacific (5°S - 5°N) SST anomalies ($^{\circ}\text{C}$; shading) composed for El Niño events during 1950-2014 in 14 models and the multi-ensemble mean compared to observations. The SST anomalies for observed El Niño events during 1950-2014 are overlaid ($^{\circ}\text{C}$; contours at intervals of 0.4°C ; zero contours thickened and negative contours dashed). El Niño events are defined when the Niño3.4 index exceeds exceeds 0.75 standard deviations in Dec0 but not in Dec-1. Monthly SST anomalies are calculated by removing the ensemble mean from individual ensemble members.

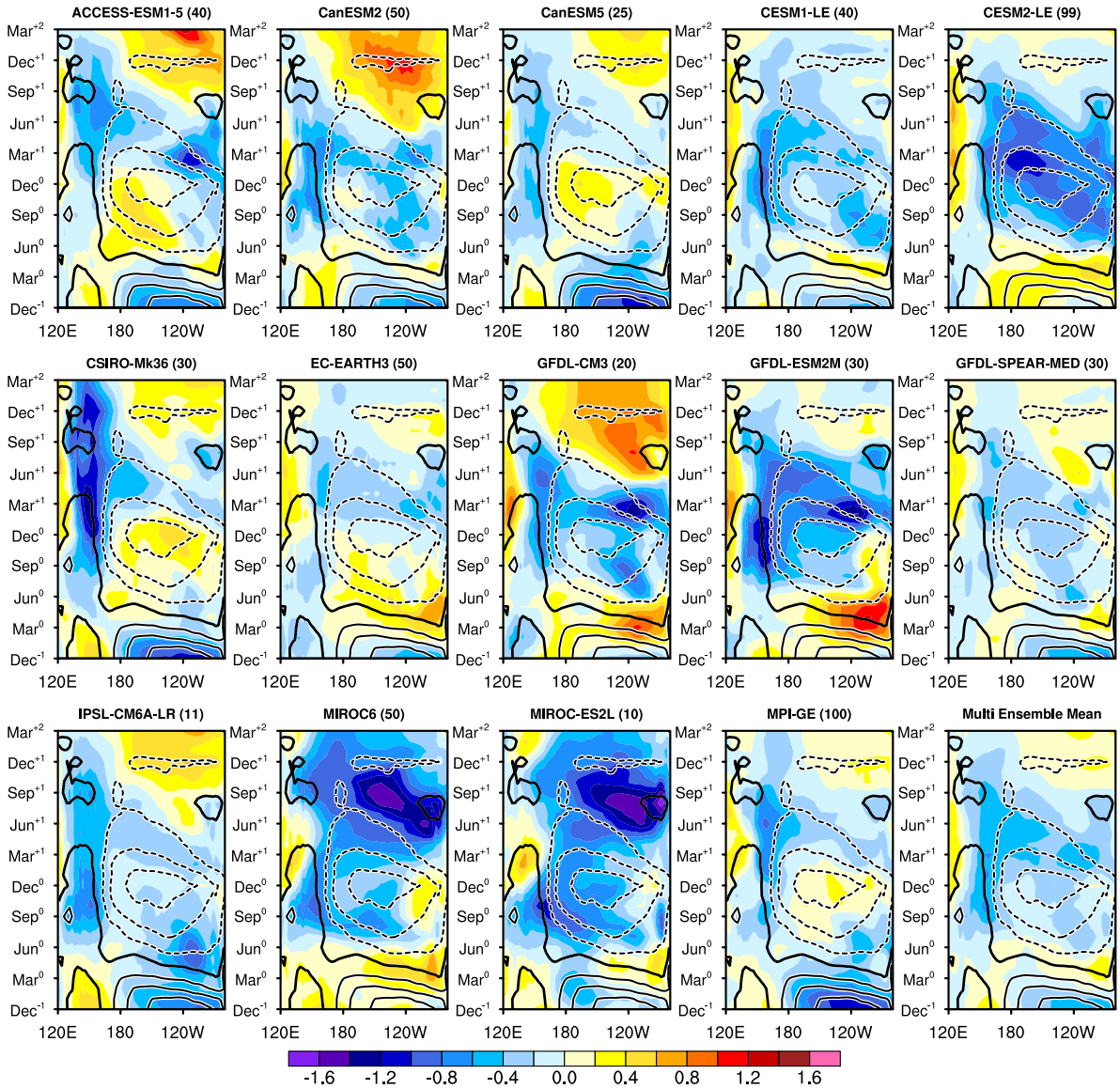


Figure S2. As in Figure S1, but for La Niña

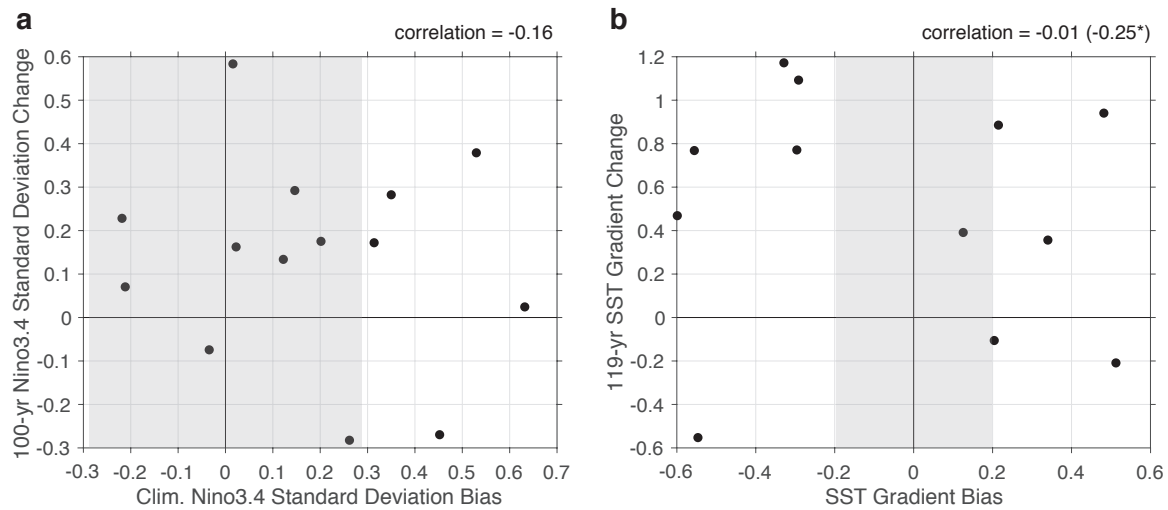


Figure S3. (a) Scatter plot of each model's ensemble-mean Niño3.4 amplitude change between 1951-1980 and 2051-2080 versus its climatological Niño3.4 amplitude in 1951-1980, referenced to the Niño3.4 amplitude in ERSST5 over the same period. (b) Scatter plot of each model's ensemble-mean Pacific SST gradient change between 1951-1980 and 2070-2099 versus its climatological Pacific SST gradient in 1951-1980, referenced to the Pacific SST gradient in ERSST5 over the same period. Pacific SST gradient is defined as in Figure 7 (x-axis). In each panel, the grey shading depicts the 95% range of internal variability in the observational quantity, estimated from the multi-model-mean of the ensemble-mean variance in the corresponding quantity. The correlations between the quantities in the scatter plots are depicted in the upper right. *Note that the correlation increases to -0.25 if the outlier in the bottom left (CSIRO-Mk36) is excluded.

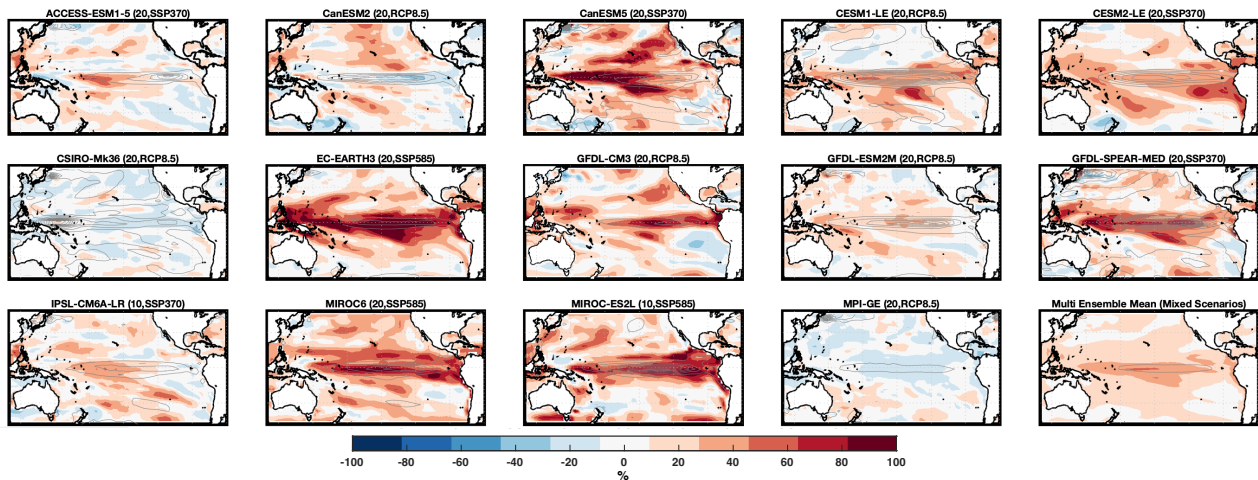


Figure S4. As in Figure 2, but for the period 2021-2050 compared to 1951-1980.

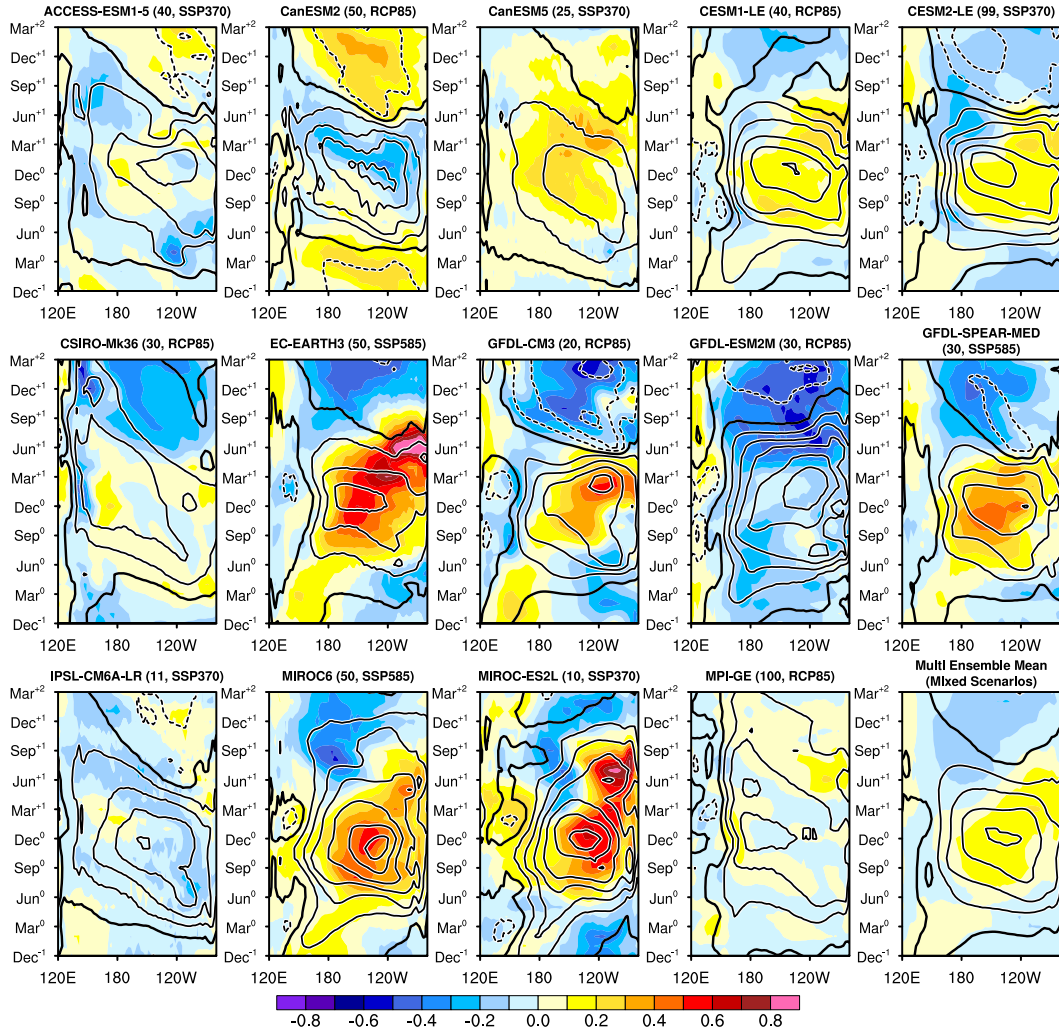


Figure S5. As in Figure 3, but for the difference between 2021-2050 and 1951-1980.

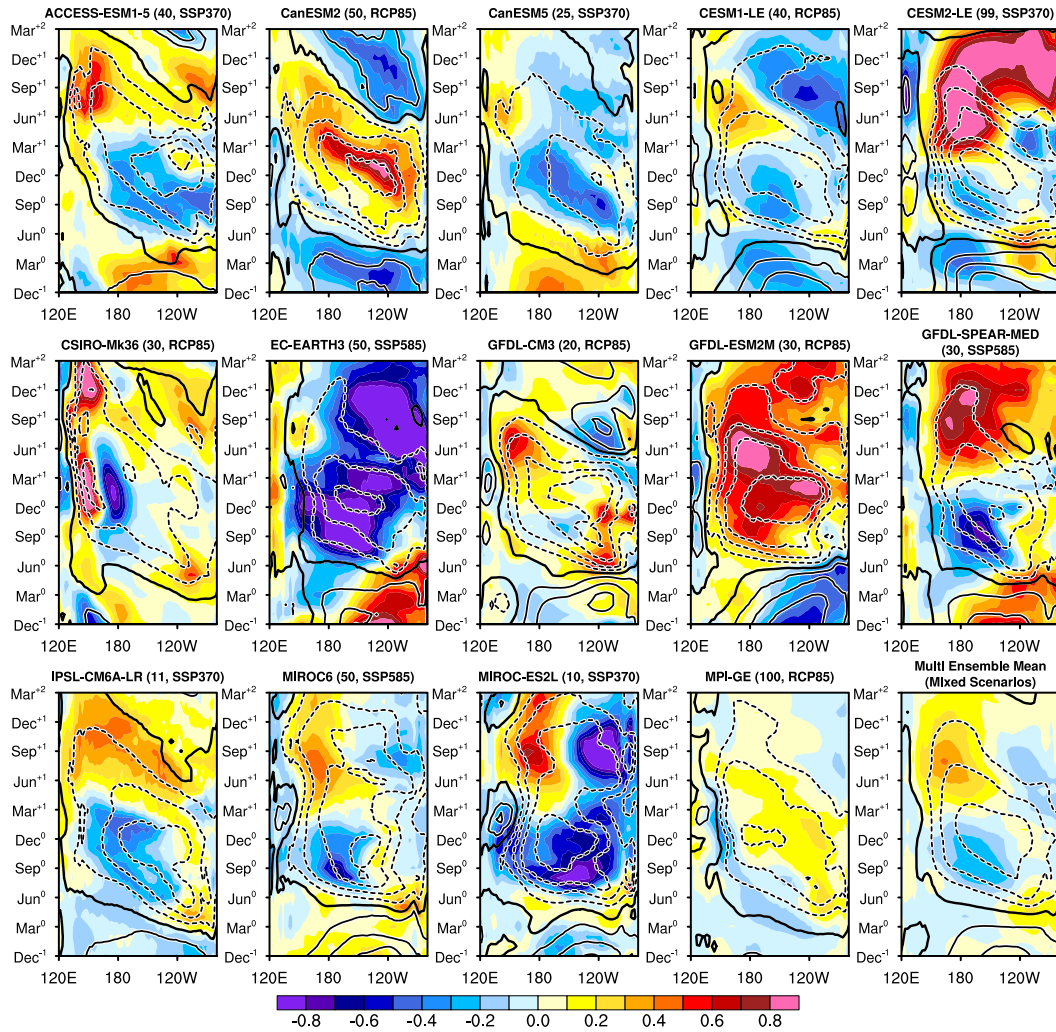


Figure S6. As in Figure 3, but for La Niña

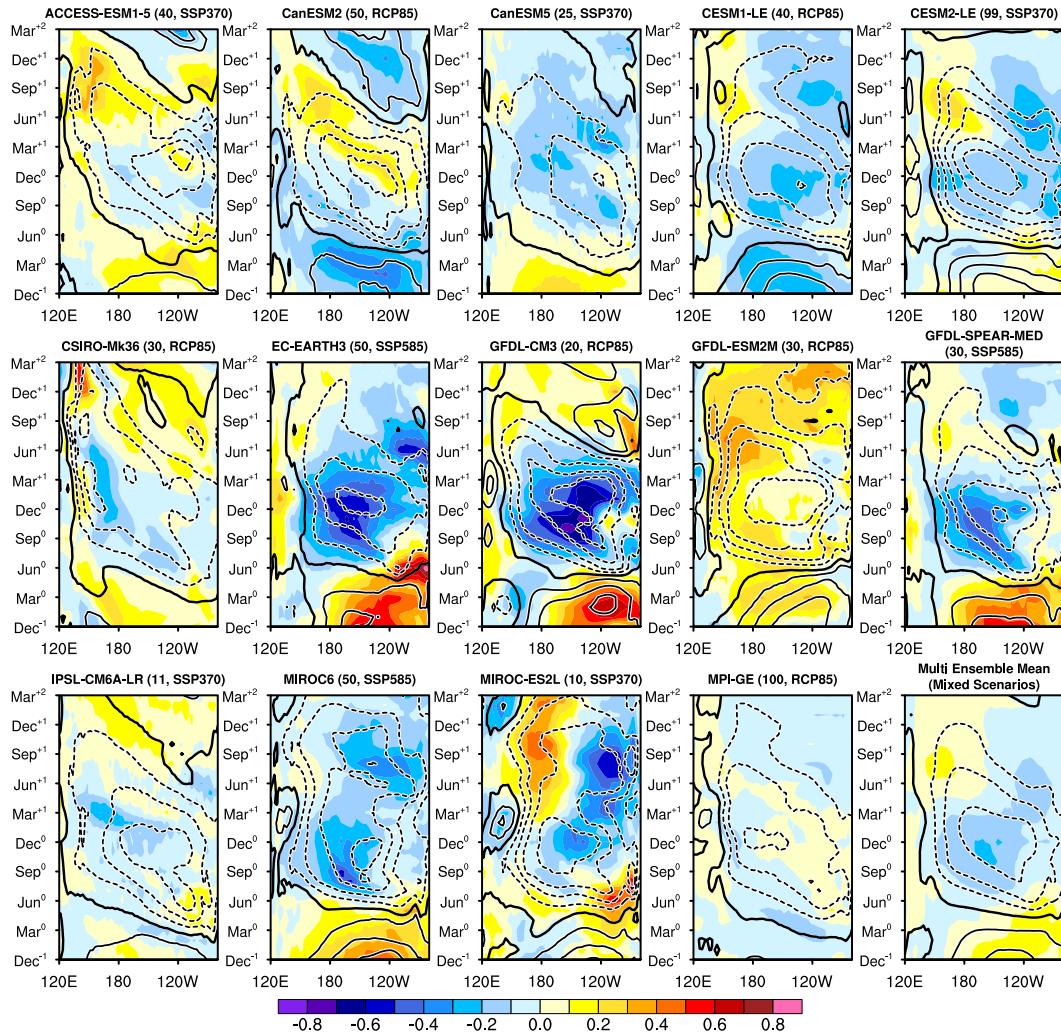


Figure S7. As in Figure 3, but for the difference between 2021-2050 and 1951-1980 and for La Niña

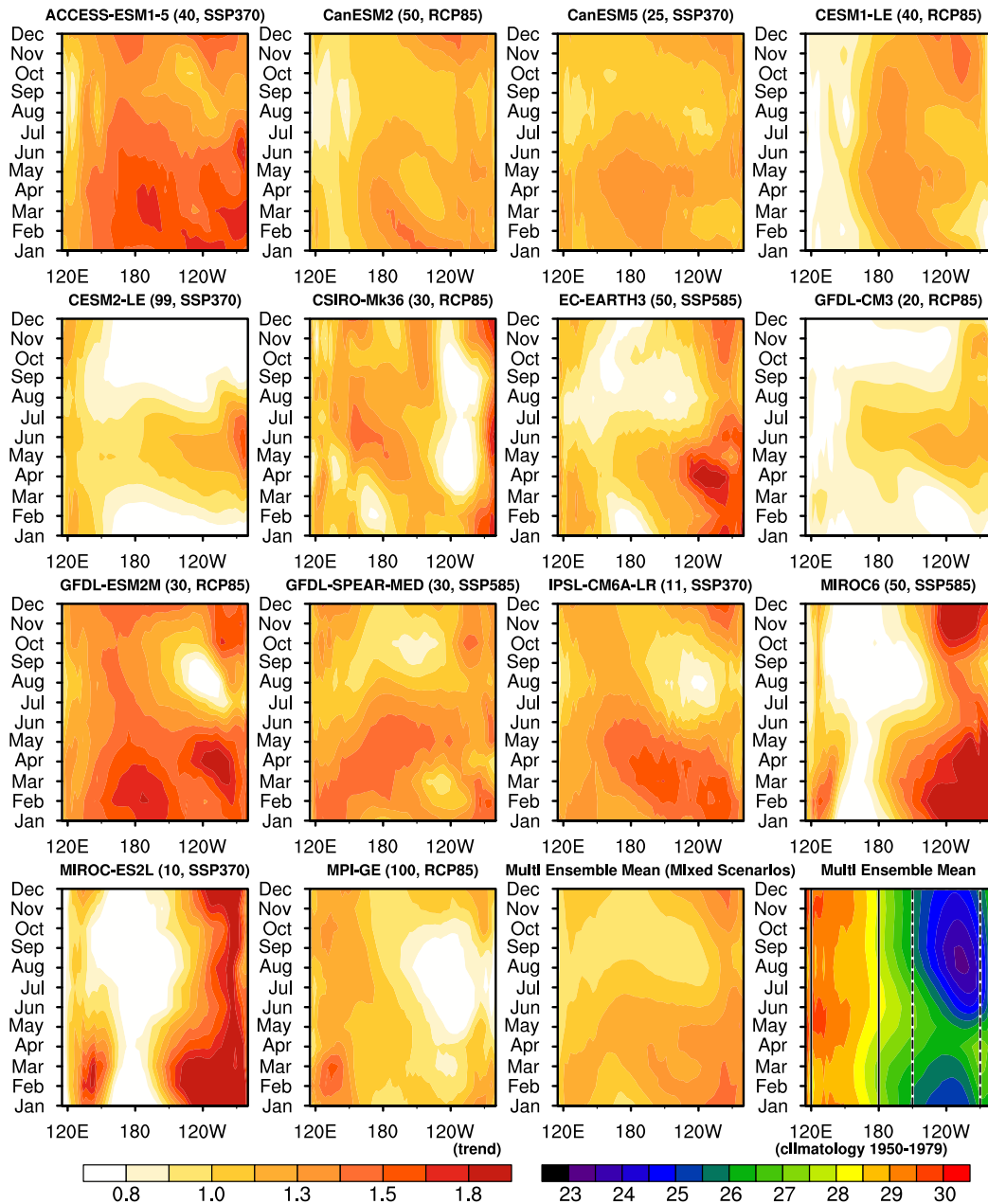


Figure S8. As in Figure 6, but for the period 1950-2014.