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ENSO Dynamics in the E3SM-1-0, CESM2, and GFDL-CM4 Climate Models

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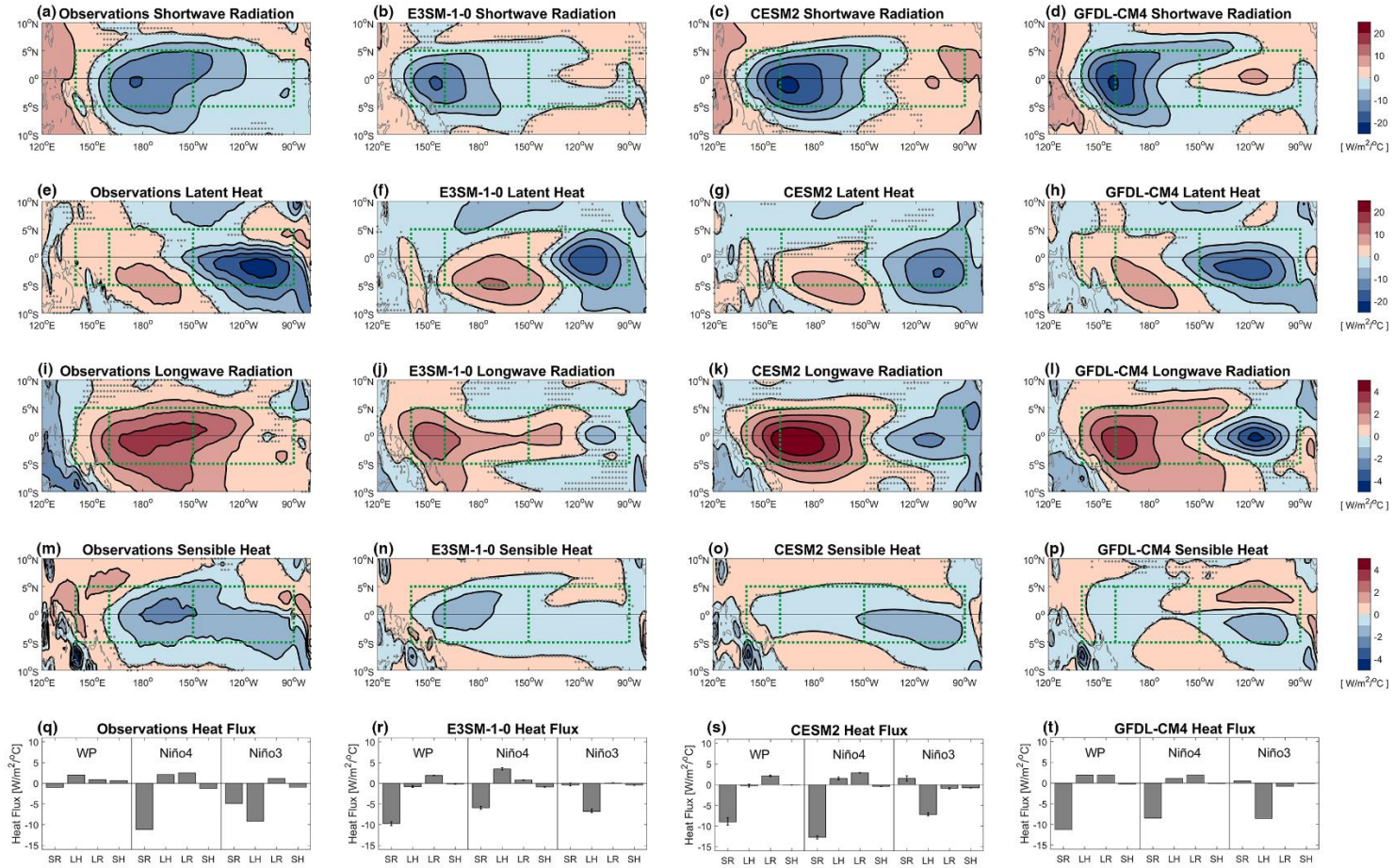


Figure 1. Regression of (a)–(d) surface shortwave radiation, (e)–(h) surface latent heat flux, (i)–(l) surface longwave radiation, and (m)–(p) surface sensible heat flux onto the Niño3 index in observations, E3SM-1-0, CESM2, and GFDL-CM4. Positive values indicate downward flux. (q)–(t) The area-average of each term in Niño3, Niño4, and western Pacific region. The three rectangles from west to east in (a)–(p) represent the region for equatorial western Pacific, Niño4, and Niño3, respectively. The vertical lines in (r)–(t) indicate the minimum and maximum values of the model ensemble members. Grey dots indicate the shading values that are not statistically significant at the 95% confidence level.

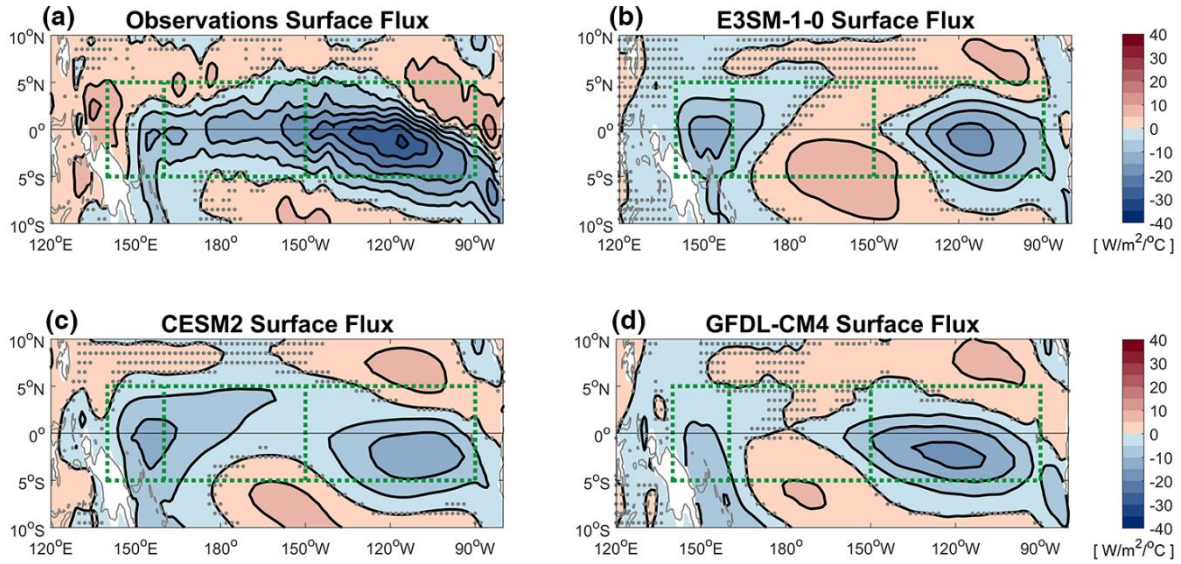


Figure 2. Regression of surface heat flux onto the Niño3 index with a lag of 3 months in (a) observations, (b) E3SM-1-0, (c) CESM2, and (d) GFDL-CM4. Positive values indicate downward flux. The three rectangles from west to east in (a)–(d) represent the region for equatorial western Pacific, Niño4, and Niño3, respectively. Grey dots indicate the shading values that are not statistically significant at the 95% confidence level.

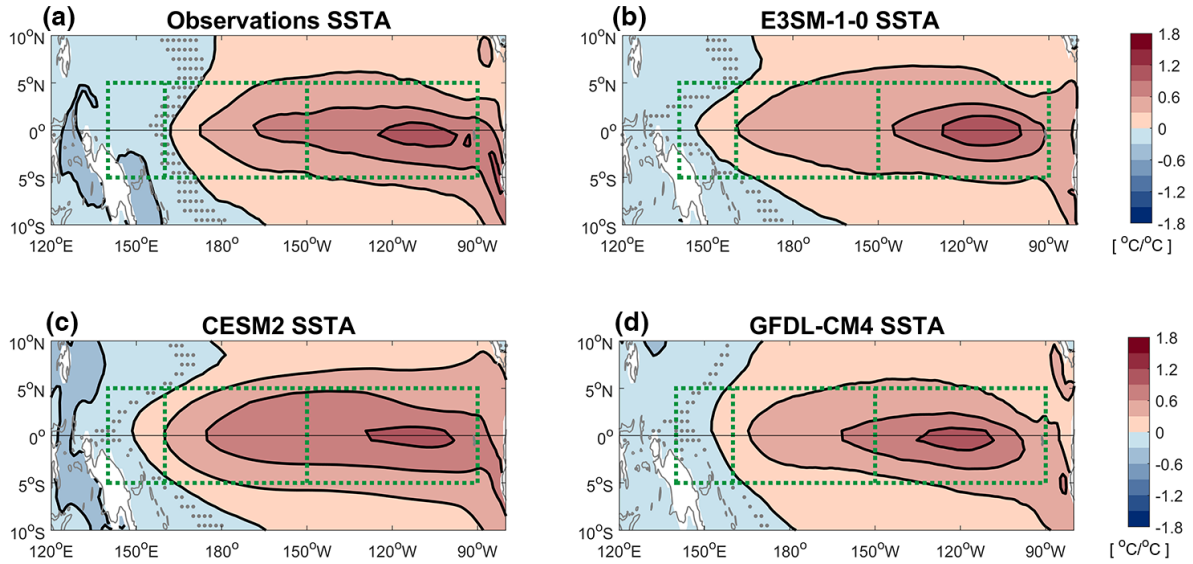


Figure 3. Regression of SSTA onto the Niño3 index with a lag of 3 months in (a) observations, (b) E3SM-1-0, (c) CESM2, and (d) GFDL-CM4. The three rectangles from west to east in (a)–(l) represent the region for equatorial western Pacific, Niño4, and Niño3, respectively. Grey dots indicate the shading values that are not statistically significant at the 95% confidence level.

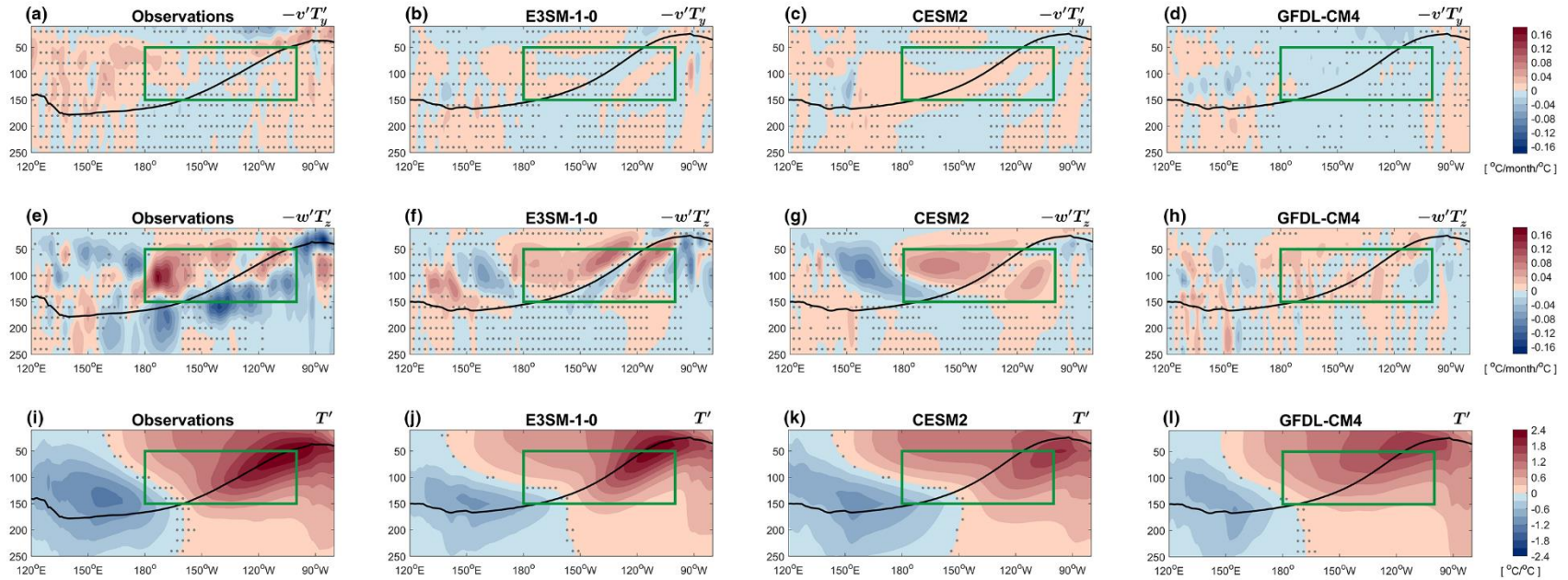


Figure 4. Nonlinearity of the equatorial Pacific Ocean (2°S – 2°N) in observations, E3SM-1-0, CESM2, and GFDL-CM4 for the regression of (a)–(d) nonlinear meridional advective anomalies, (e)–(h) nonlinear vertical advective anomalies, and (i)–(l) temperature gradient anomalies onto Niño3 index. The green rectangles represent the region where the subsurface NDH effectively influence the asymmetry of SSTA. Grey dots indicate the shading values that are not statistically significant at the 95% confidence level.

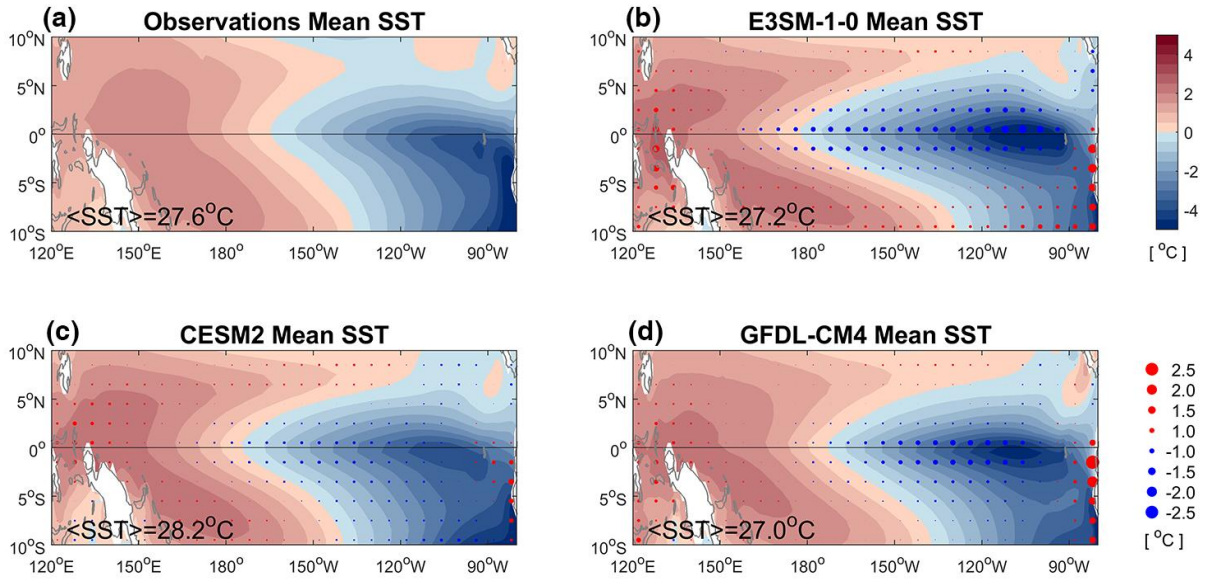


Figure 5. (a) Observations, (b) E3SM-1-0, (c) CESM2, and (d) GFDL-CM4 mean relative SST (RSST, defined as SST minus its tropical mean; shading) and bias of mean RSST (dots). The mean RSST bias is calculated by subtracting the observed RSST climatology from simulated RSST climatology. The value of tropical mean SST (10°S–10°N, 120°E–80°W) is displayed in the panels.