**Supporting Materials**

**Interannual variability of the atmospheric CO2 growth rate: Relative contribution from precipitation and temperature**

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Figure S1. Interannual variabilities (IAVs) in the Niño 3.4 index (color-shaded) and tropical photosynthetically active radiation (PAR, purple line) over land. The PAR datasets are from the Surface Radiation Budget (SRB) project during 1984–2007.

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Figure S2. The IAVs in the atmospheric CO2 growth rate (CGR) at Mauna Loa and regional land–atmosphere carbon fluxes. The black line denotes Mauna Loa CGR, and the red, blue, and purple lines represent the ensemble-mean fluxes from the tropics (23°S–23°N), Northern Hemisphere (23°N–90°N), and Southern Hemisphere (60°S–23°S), respectively. The color-shaded areas show the standard deviations among models.



Figure S3 Scatter plots across the TRENDY and C4MIP models, showing the relationship of the interannual sensitivity of the tropical net ecosystem productivity (NEP) to the interannual sensitivity of (a, c) the tropical heterotrophic respiration (Rh), and (b, d) the tropical net primary productivity (NPP).

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Figure S4. Color-coded correlation matrices for the interannual anomalies in the tropical heterotrophic respiration (Rh) and disturbances (D) estimated by the 7 terrestrial carbon cycle models. Panel (a) shows correlation coefficients in pairs among the estimated Rh, and (b) correlation coefficients in pairs among the D in the period 1960–2010. The Mauna Loa CGR and modeled ensemble mean (ENS) were included in these correlations as well. The values in each cell demonstrate the significance levels (p 0.05 refers to above 95% significance).

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Figure S5 Cross-correlations of the simulated tropical Rh anomalies with Mauna Loa CGR, tropical near-surface temperature, and precipitation over land. The negative months on the horizontal axis indicate that the anomalies in Rh lag behind. Bold lines indicate correlation above 95% significance (p 0.05).

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Figure S6. Cross-correlations of the simulated D with Mauna Loa CGR, tropical near-surface temperature, and precipitation over land. The negative months on the horizontal axis indicate that the anomalies in Rh lag behind. Bold lines indicate correlation above 95% significance (p ≤ 0.05).