Supporting Information

Bony et al. 10.1073/pnas.1601472113

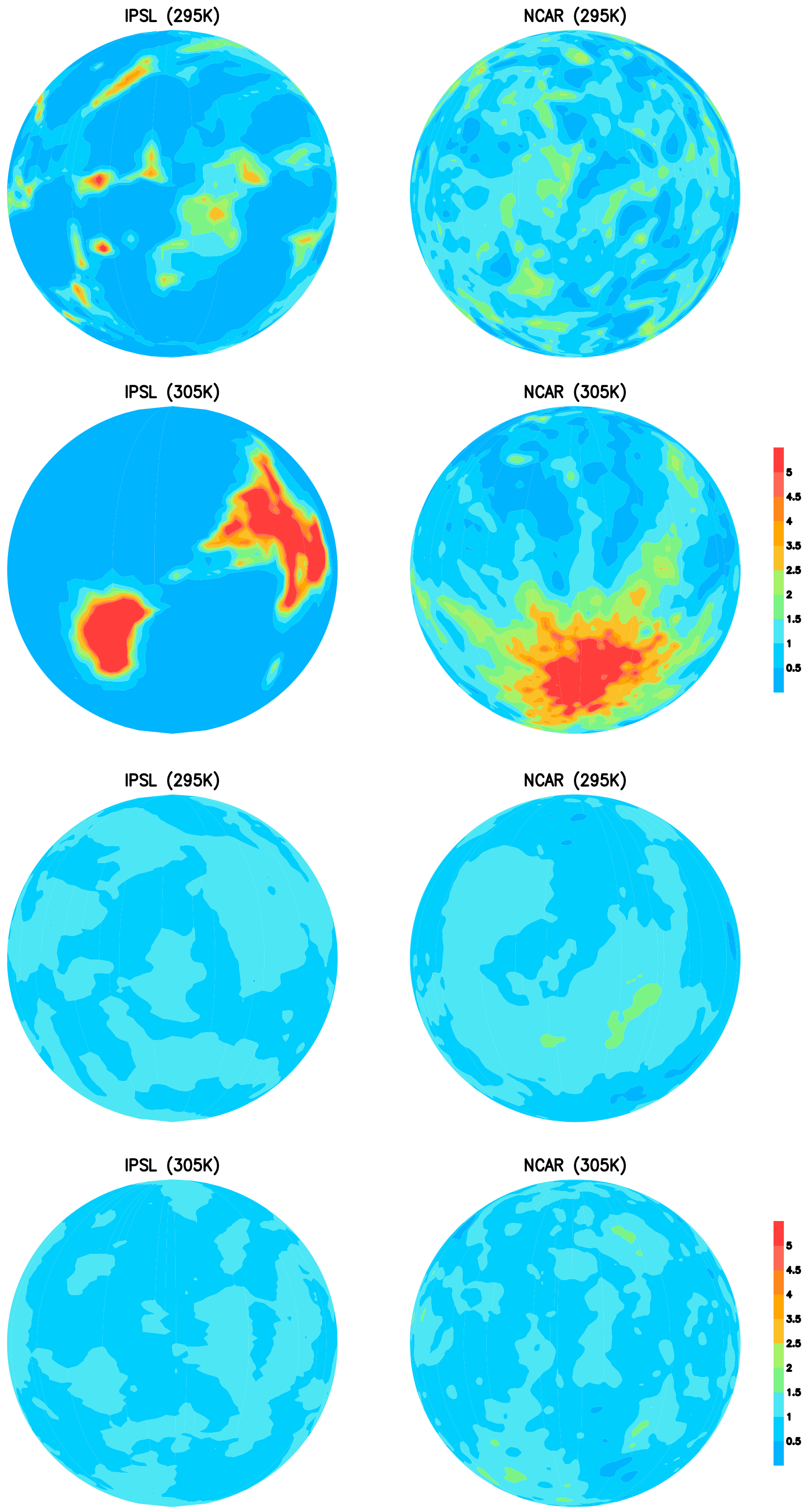

Fig. S1. Monthly precipitation (normalized by its global mean value) predicted by the IPSL and NCAR GCMs in RCE simulations forced by an SST of 295 K or 305 K. *Top* four panels: with cloud-radiative effects. *Bottom* four panels: without cloud-radiative effects. In the absence of cloud-radiative effects, these GCMs do not predict any large-scale convective aggregation.

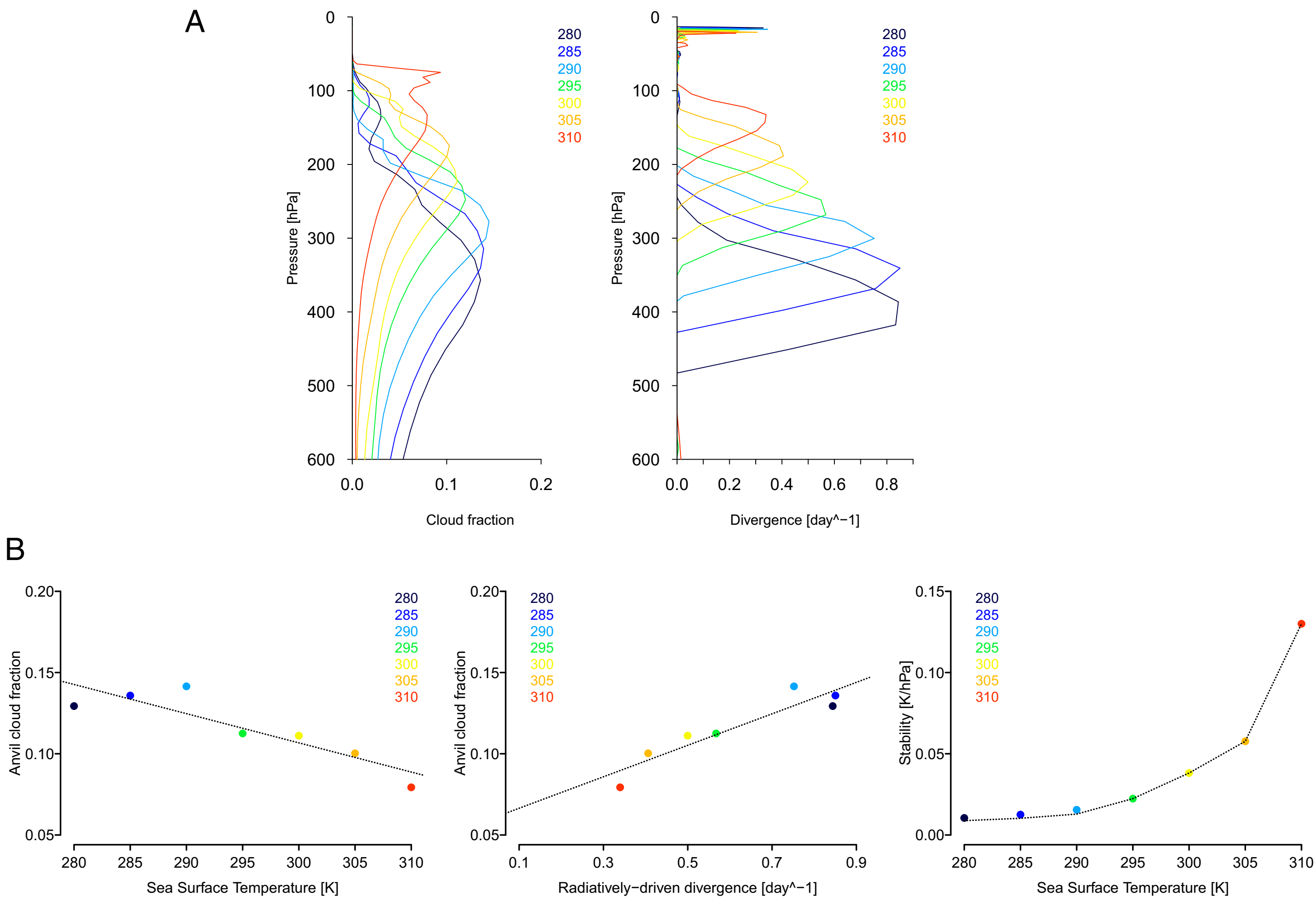

Fig. S2. CRM simulations: vertical profiles of (*Upper Left*) cloud fraction and (*Upper Right*) radiatively driven divergence associated with different SSTs (ranging from 280 K to 310 K), and relationship (*Bottom Left*) between the anvil cloud amount and SST, (*Bottom Center*) between the anvil cloud amount and the radiatively driven divergence, and (*Bottom Right*) between the static stability at the level of maximum divergence (and along the 220 K isotherm, dashed line) and SST derived from nonrotating RCE CRM simulations from Wing and Cronin (21). All quantities are domain averages computed over days 50–75 of each simulation.

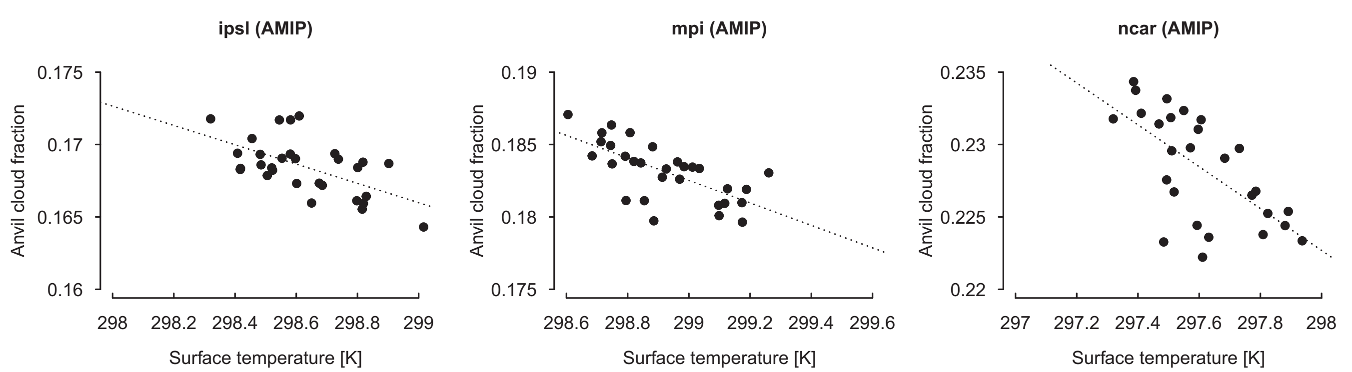

Fig. S3. Interannual variations in full-blown GCMs: relationship between the tropical mean anvil cloud amount and the tropical surface temperature (land + ocean) derived from (*Left*) IPSL, (*Center*) MPI, and (*Right*) NCAR GCMs in AMIP simulations run in a realistic configuration (with rotation, continents, etc.) and forced by observed sea surface temperatures and time-varying radiative forcings (greenhouse gases and aerosols). Each point represents an annual average of tropical mean quantities (30°S–30°N) during 1979–2005.

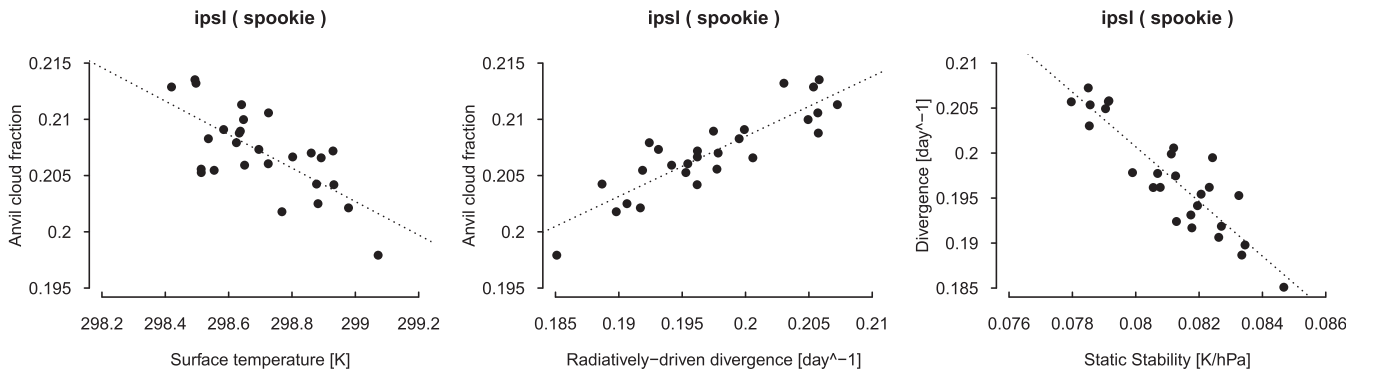

Fig. S4. Relationships among anvil cloud fraction, T_{sfc}, D_r, and S. Relationships are plotted at the height of anvil clouds, derived from an AMIP simulation run with the IPSL-CM5A-LR GCM in the absence of convective parameterization [so-called SPOOKIE simulation (43)]. Each point represents an annual average of tropical mean quantities (30°S–30°N) during 1979–2005.

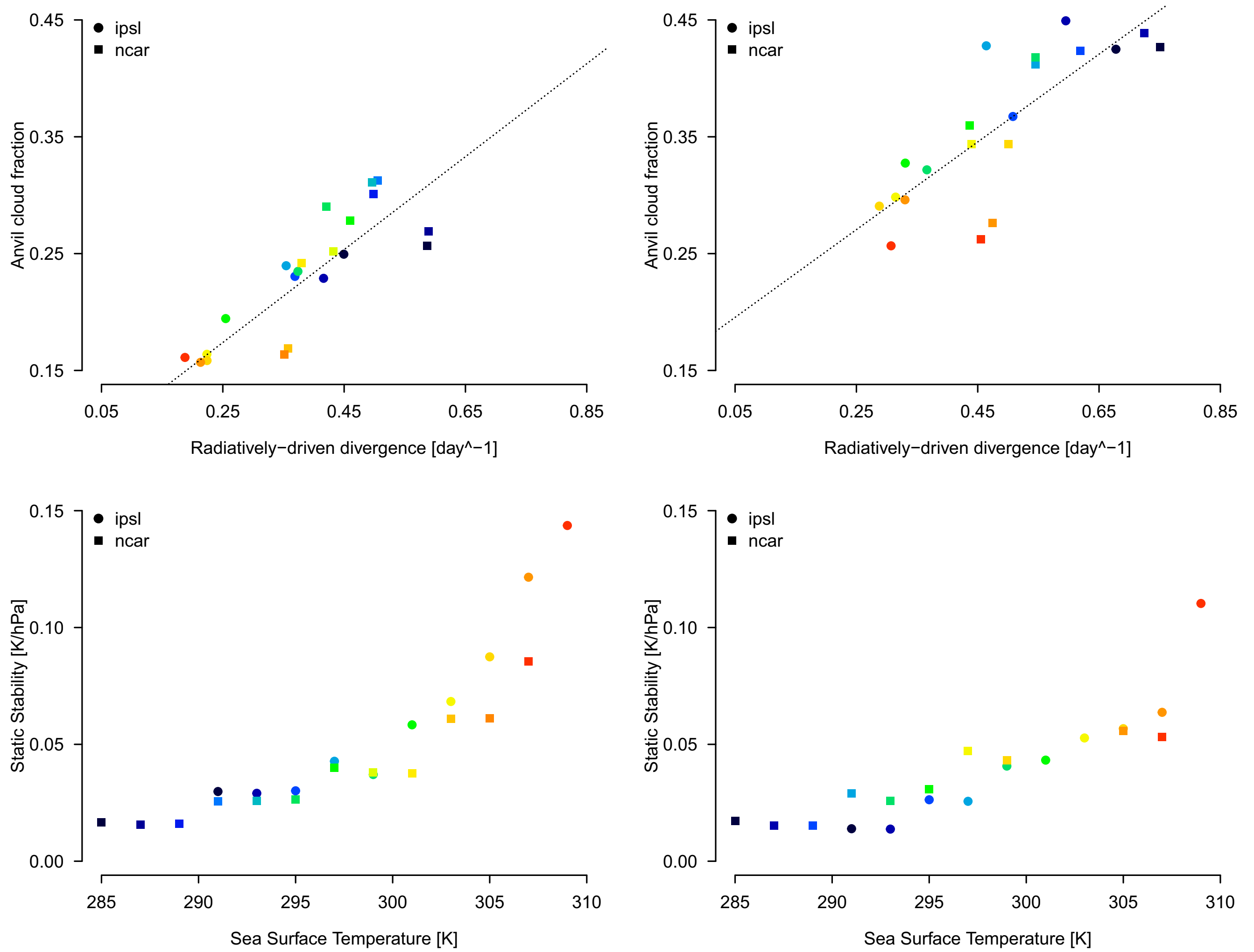

Fig. S5. Clouds-on vs. clouds-off: comparison of the relationship (*Top*) between the anvil cloud amount and the radiatively driven divergence and (*Bottom*) between the static stability at the level of maximum divergence and SST in IPSL and NCAR GCM simulations run (*Left*) with and (*Right*) without cloud-radiative effects. (*Top Left*) $R^2 = 0.68$, $\partial f / \partial D_r = 0.40 \pm 0.13$ d; (*Top Right*) $R^2 = 0.65$, $\partial f / \partial D_r = 0.37 \pm 0.14$ d.

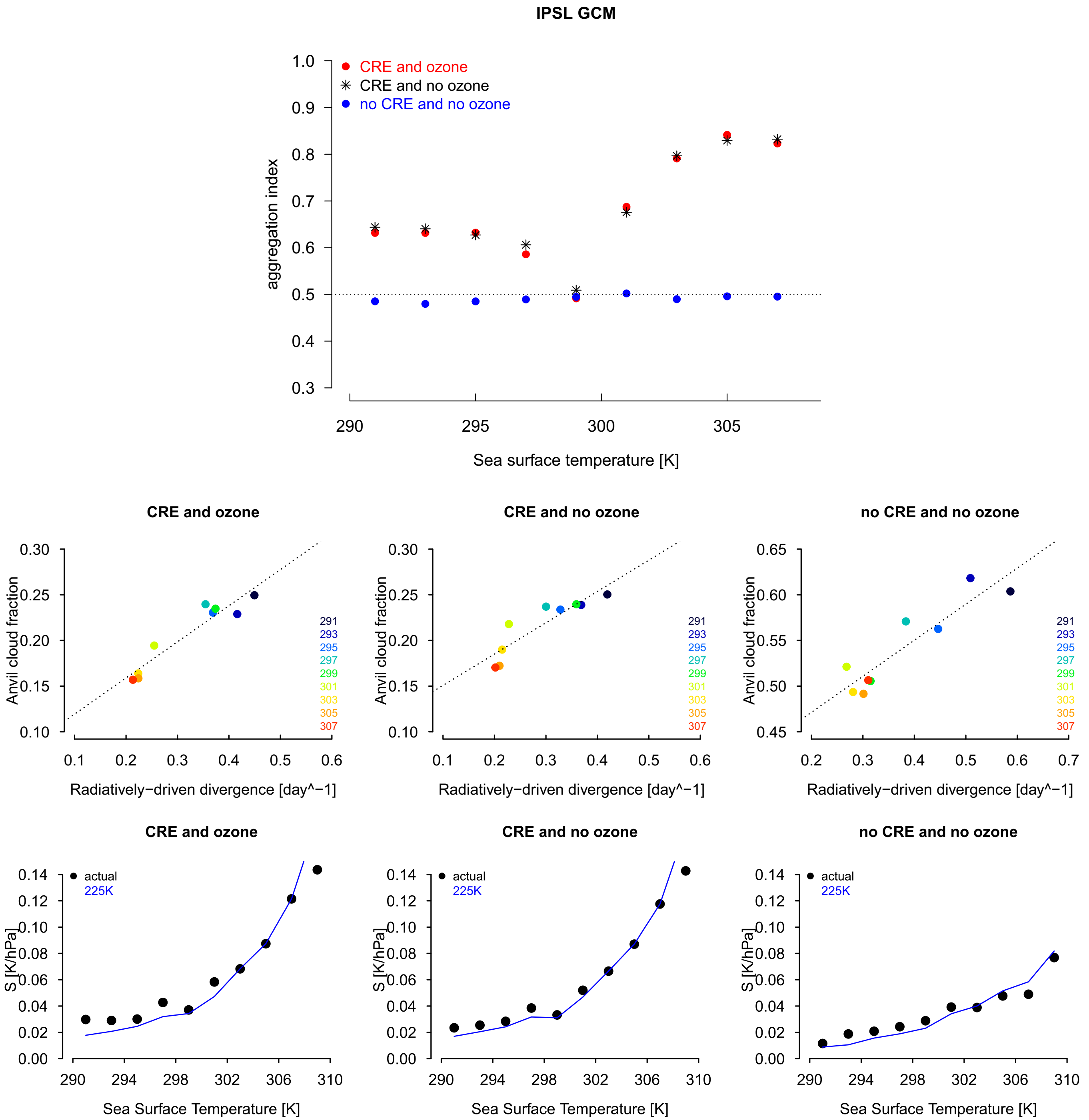

Fig. S6. Sensitivity to ozone and cloud-radiative effects in the IPSL GCM: comparison of (*Top*) aggregation vs. SST and of (*Middle*) the relationship between the anvil cloud amount and the radiatively driven divergence and (*Bottom*) between static stability at the level of maximum divergence and SST in RCE simulations (*Left*) with cloud-radiative effects (CRE) and ozone, (*Center*) with cloud-radiative effects but without ozone, and (*Right*) without cloud-radiative effects and without ozone. Also reported in *Bottom* panels are the evolutions of static stability along the 225 K isotherm. The aggregation index is defined as the fractional area of the globe covered by large-scale subsidence (31). A value close to 0.5 corresponds to the absence of aggregation.

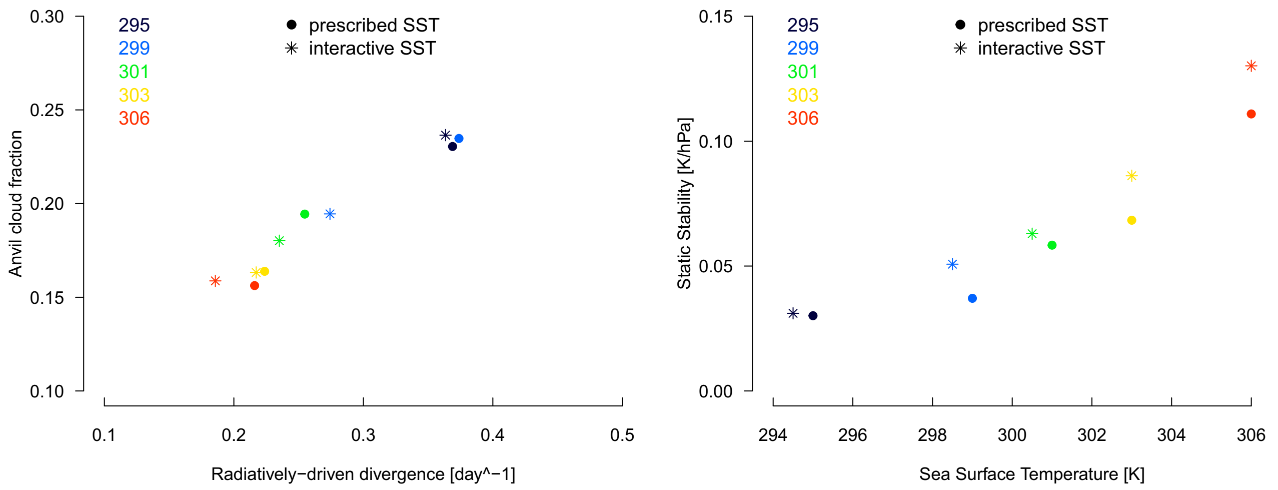

Fig. S7. Prescribed vs. interactive SST: relationship between (*Left*) the anvil cloud fraction and the radiatively driven divergence and (*Right*) the static stability at the level of maximum divergence and SST in IPSL GCM simulations forced by prescribed SSTs or by computing the SST interactively, using an ocean mixed layer of 10 m depth and a CO_2 atmospheric concentration set to 0.5, 0.75, 1, 2, or 3 times its present-day value.