Supporting Information for "H_2O windows and CO_2 radiator fins: a clear-sky explanation for the peak in ECS"

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Contents of this file

1. Figures S1 to S4

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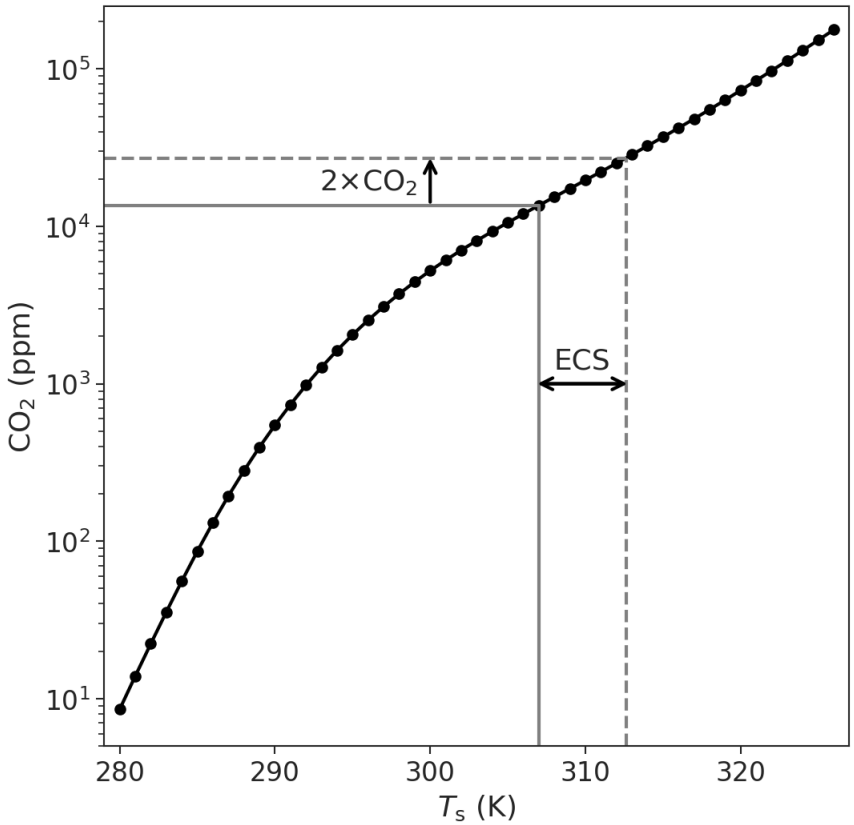

Figure S1. Equilibrated CO_2 concentration as a function of T_s from our simple climate model in its default configuration. The procedure for calculating ECS from this curve is illustrated for an example T_s of 307 K.

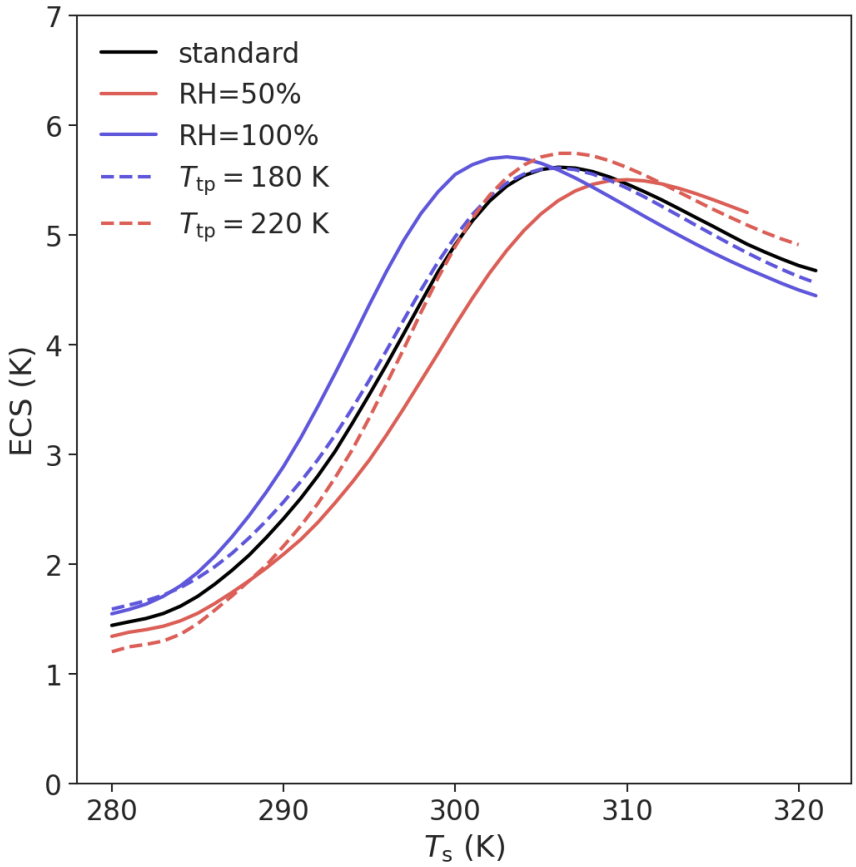

Figure S2. ECS as a function of T_s from our simple climate model for varied tropospheric RH and tropopause temperature T_{tp}.

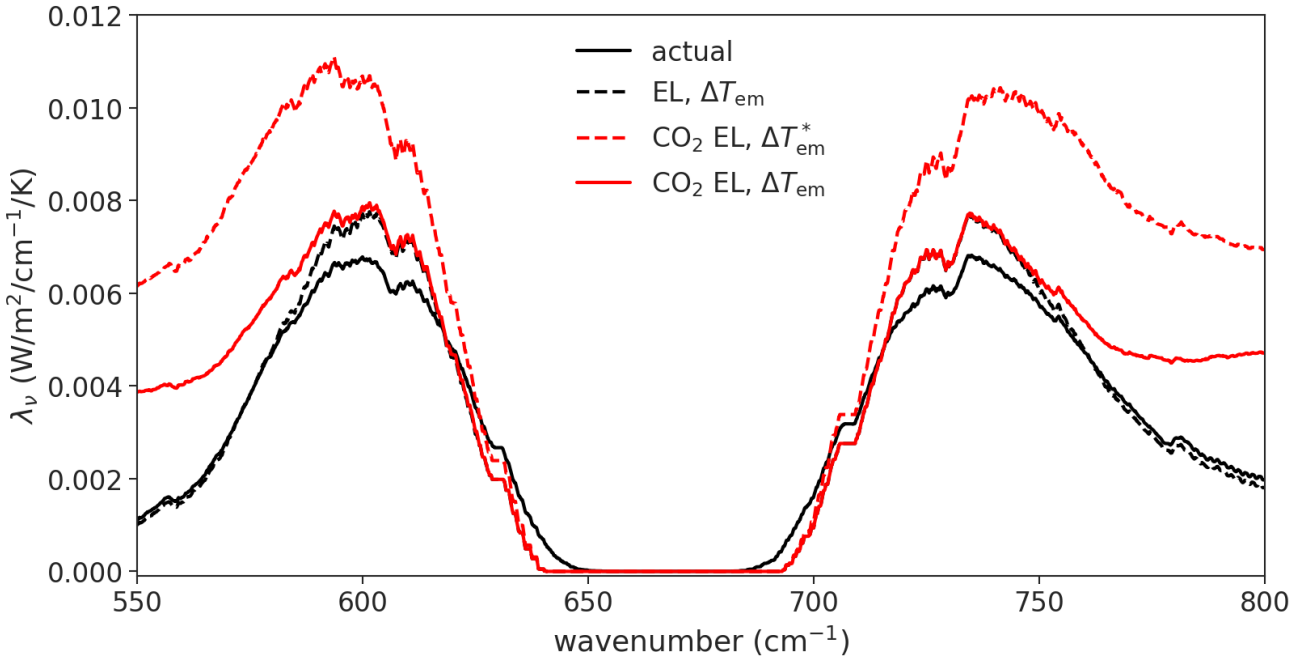

Figure S3. For $T_{\rm s} = 325$ K, a comparison of the smoothed λ_ν in the vicinity of 15 μm (solid black line) to that predicted by the emission-level approximation (eqn. 7 of main text; dashed black line). The solid red line is the estimate of λ_ν provided by calculating emission levels using CO_2 optical depths only; this leads to a significant overestimate of λ_ν at the edge of the CO_2 radiator fins, where overlap with H_2O opacity damps the warming (i.e., the spectral feedback is transitioning to Simpsonian behavior). The dashed red line shows the estimate of λ_ν provided by calculating emission levels from CO_2 optical depths only and also assuming that emission levels are fixed in pressure (i.e., assuming that $\Delta T_{\rm em}$ is governed by moist-adiabatic warming at fixed p, which we denote in the figure as $\Delta T^*_{\rm em}$); this shows that the explicit temperature-scaling of CO_2 absorption coefficients damps the warming of emission levels even in the CO_2-dominated portions of the radiator fins.

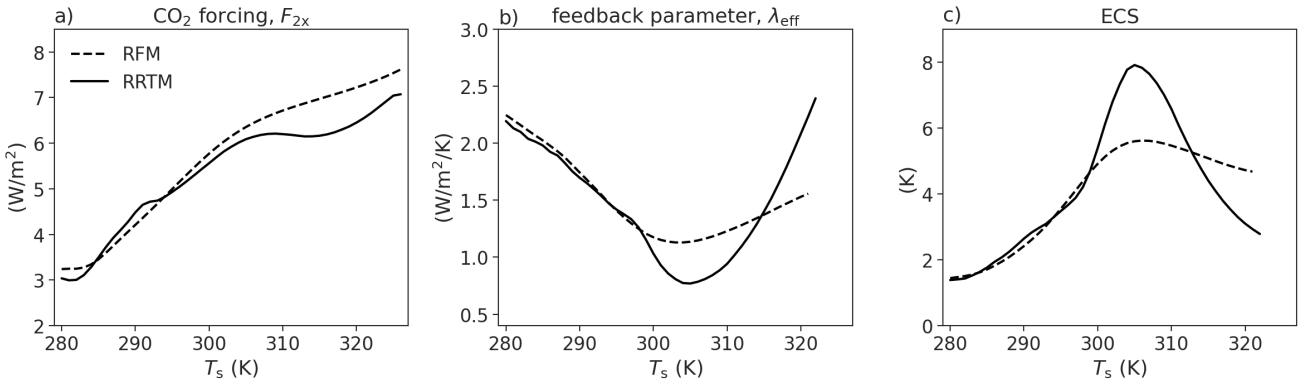

Figure S4. The lines labeled "RFM" are as in Figure 1 from the main text. Lines labeled "RRTM" are derived from our simple 1D climate model but with the radiative transfer scheme replaced by RRTM; everything else about those simulations (i.e., the input soundings) is exactly the same as for the model with RFM. Therefore, the difference between the RFM and RRTM curves shows that simply switching the radiation scheme can significantly increase the magnitude of the ECS peak.