

Supporting Information for “Bridging Clarity and Accuracy: A Simple Spectral Longwave Radiation Scheme for Idealized Climate Modeling”

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1. Figures S1-S3

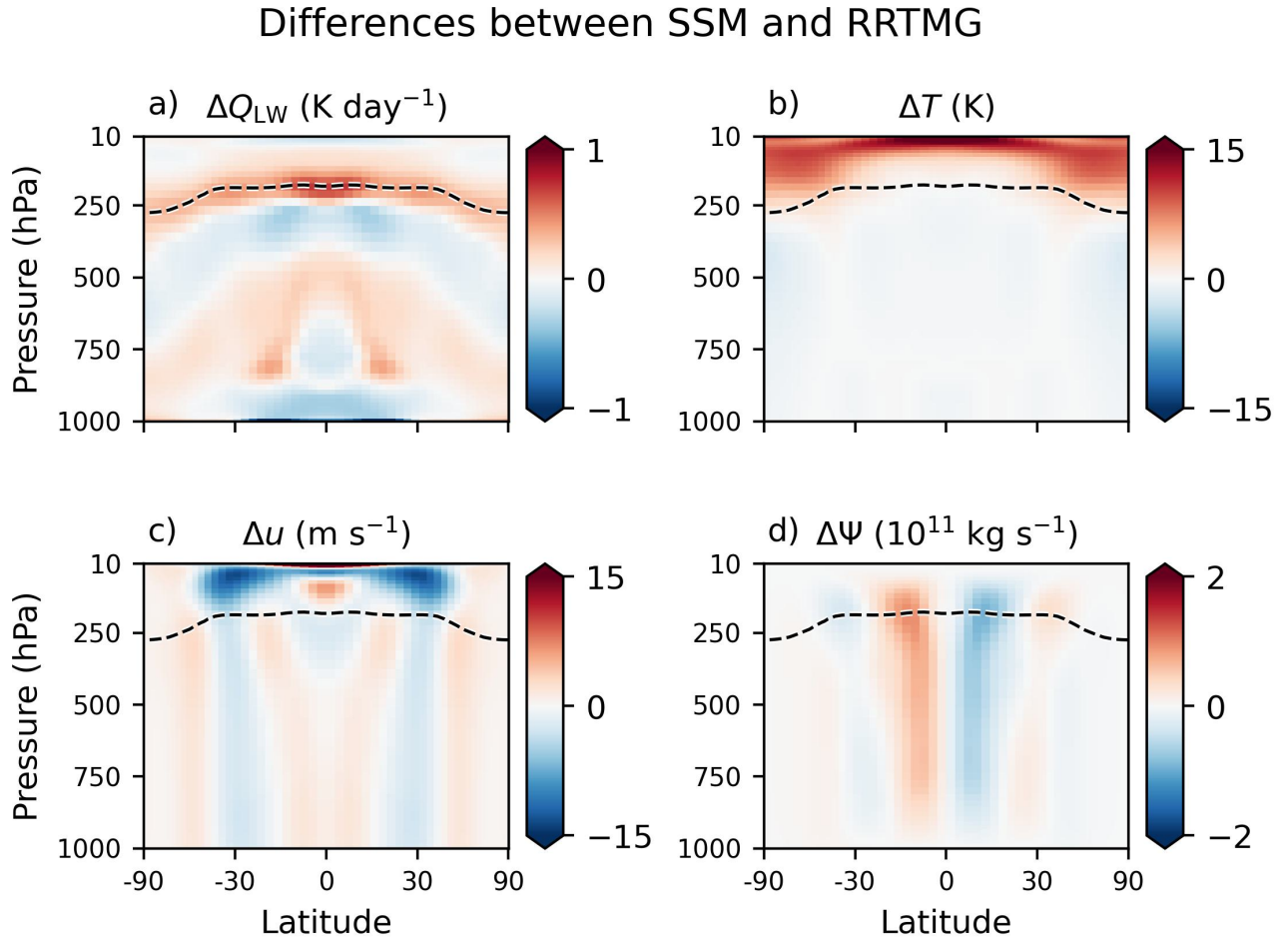


Figure S1. *The SSM exhibits some biases with respect to RRTMG.* Difference in the zonally- and temporally-averaged (a) longwave cooling, (b) temperature, (c) zonal wind, and (d) mean meridional streamfunction between the control simulations of the SSM- and RRTMG-enabled models. Even though the SSM does significantly better than gray radiation (main text) it still exhibits biases with respect to the correlated-k benchmark, as expected given its simplicity. The differences are largest in the stratosphere. The radiative tropopause from the SSM's control run is shown in all the panels.

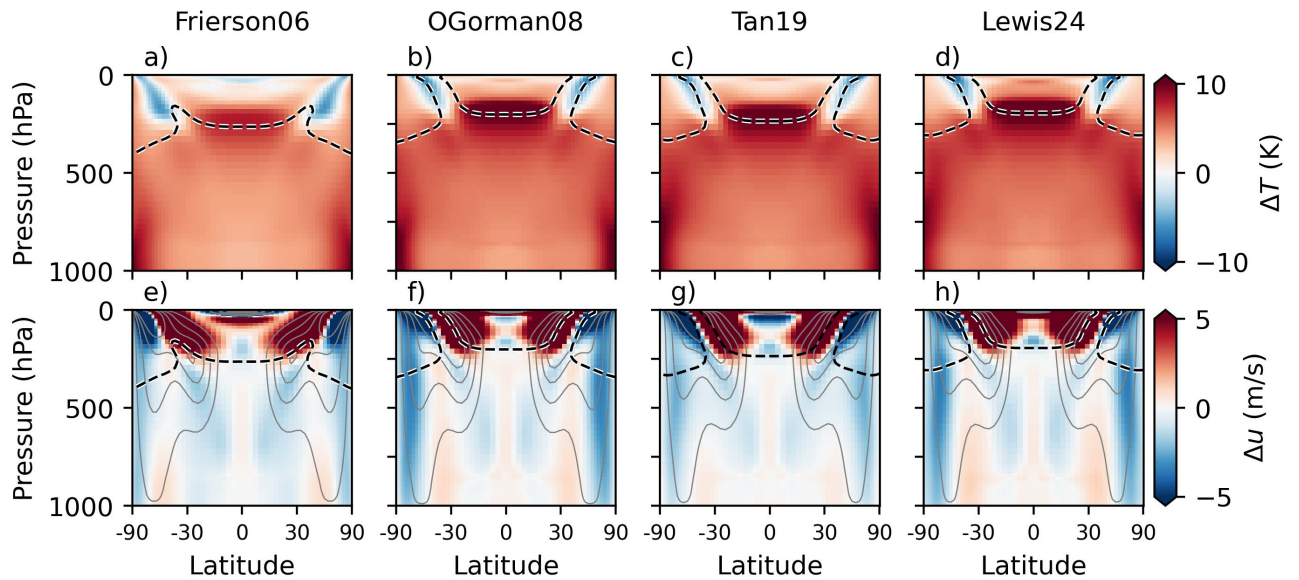


Figure S2. *Gray radiation simulations exhibit an equatorward jet shift in slab-ocean simulations, when forced by a multiplicative optical depth perturbation.* This figure shows the response of temperature (a-d) and zonal-mean zonal wind (e-h) in response to a 40 % increase in τ_{lw} (Eq. 10 of main text) in slab ocean simulations, relative to a control simulation. The slab ocean follows previous work by having no ‘Q-flux’, hence the control SST profiles are unconstrained. The radiative tropopause is shown for all the panels. Contours in (e-h) represent the 10, 20, 30, 40 m s^{-1} zonal-mean zonal winds in the control simulations.

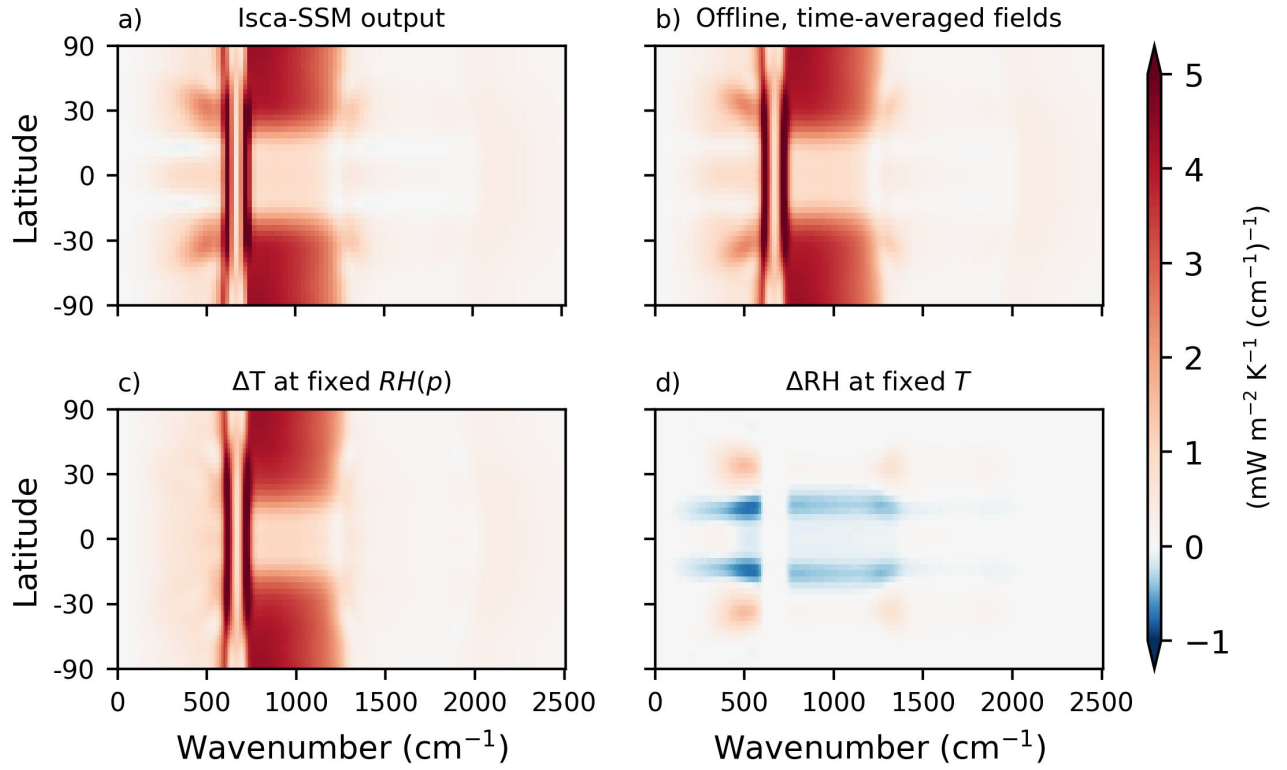


Figure S3. *Offline calculations confirm the arguments in the main text.* Panel (a) is the same as Figure 6a of the main text. Panel (b) is the reconstruction of (a) using temporally- and zonally-averaged fields from the Isca simulations run through an offline implementation of the SSM scheme. Panel (c) shows the contribution to $\lambda_{\bar{\nu}}$ which comes from the simulated changes in temperature while keeping the relative humidity fixed at its values from the control simulation. Panel (d) shows the signal from simulated warming-induced changes in relative humidity, keeping the temperature fields fixed at their values from the control simulation.