

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

Differences between SSM and RRTMG

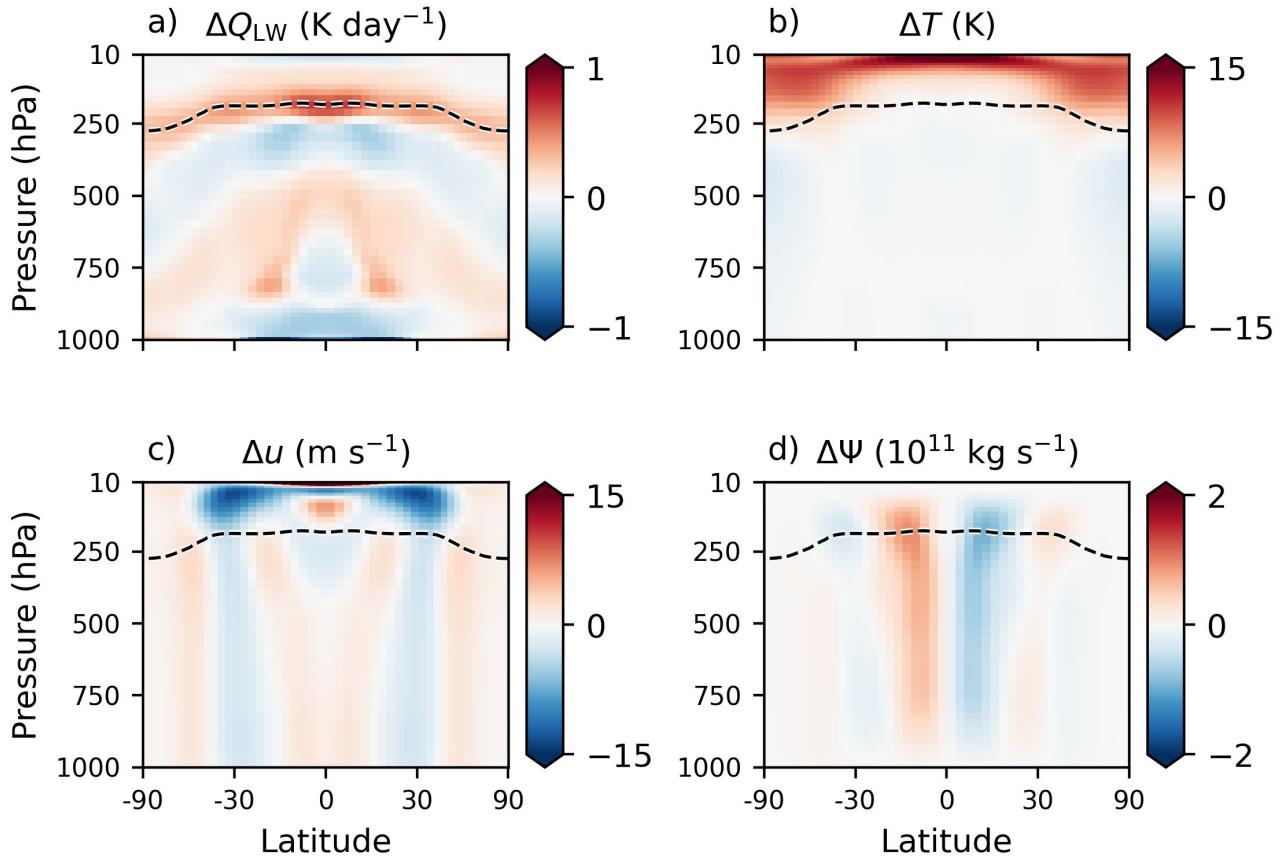


Figure S1. The SSM exhibits some biases with respect to RRTMG. Difference in the zonally- and temporally-averaged (a) longwave cooling, (b) temperature, (c) zonal wind, and (d) mean meridional streamfunction between the control simulations of the SSM- and RRTMG-enabled models. Even though the SSM does 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.

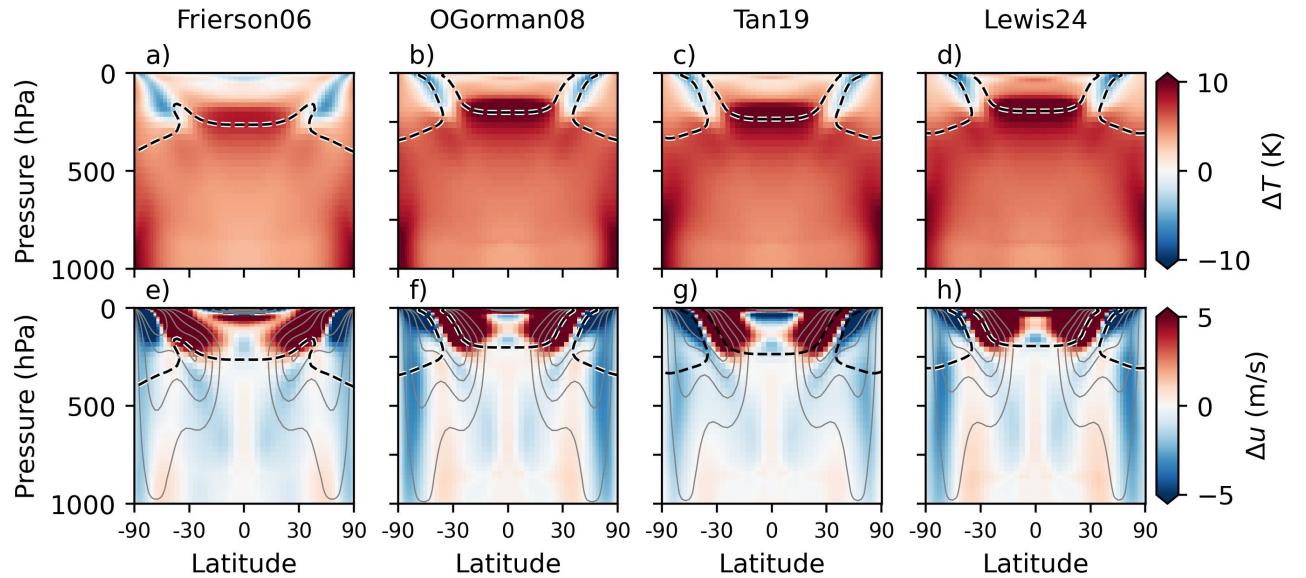


Figure S2. Gray radiation simulations exhibit an equatorward jet shift in slab-ocean simulations, when forced by a multiplicative optical depth perturbation. This figure shows the response of temperature (a-d) and zonal-mean zonal wind (e-h) in response to a 40 % increase in τ_{lw} (Eq. 10 of main text) 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.

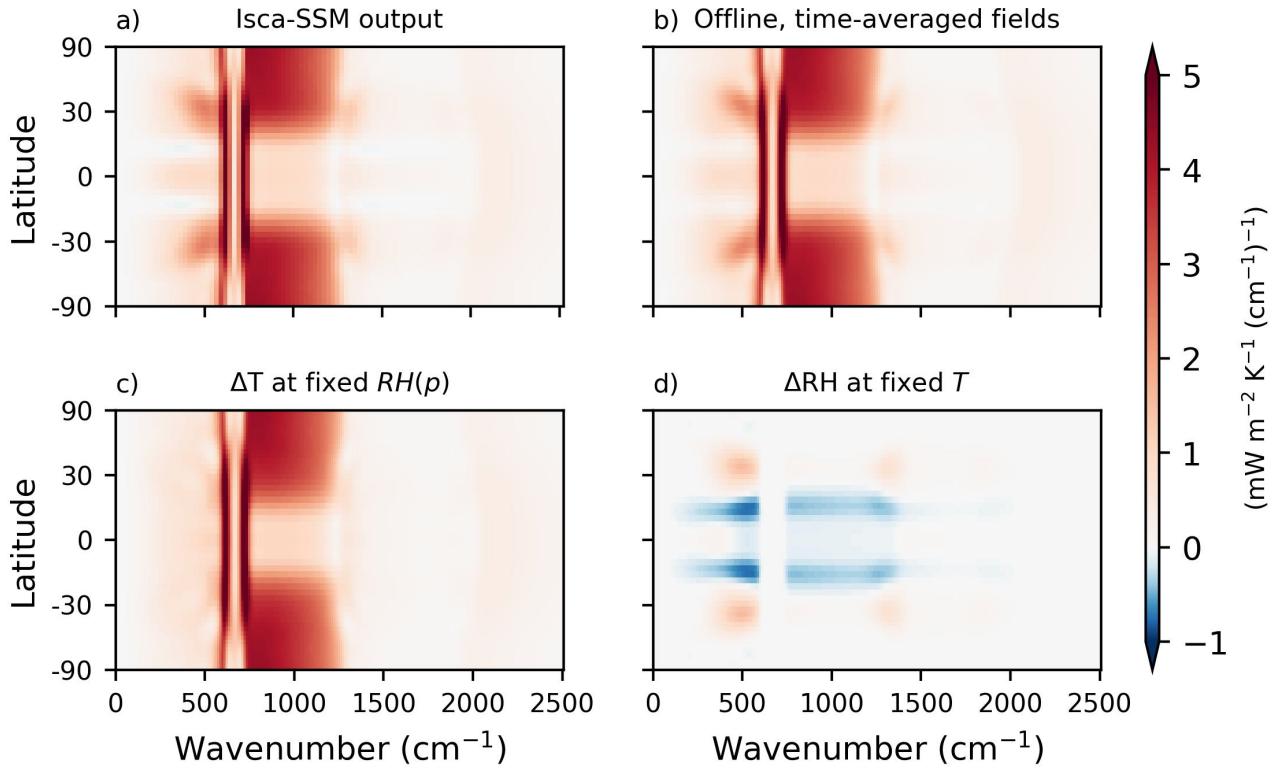


Figure S3. Offline calculations confirm the arguments in the main text. Panel (a) is the same as Figure 6a of the main text. Panel (b) is the reconstruction of (a) using temporally- and zonally-averaged fields from the Isca simulations run through an offline implementation of the SSM scheme. Panel (c) shows the contribution to $\lambda_{\tilde{\nu}}$ 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.