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The control of the stratosphere state on the development of sudden stratospheric warmings in WACCM

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In this study we explore to what extent the stratospheric circulation influences the development of sudden stratospheric warmings (SSW) in a comprehensive climate model. To this end, we perform targeted experiments with the Whole Atmosphere Community Climate Model version 4 (WACCM4) on selected modelled SSW events. Specifically, we restart the model run three weeks before a given SSW, relaxing the tropospheric evolution (surface fluxes, wind and temperature) to the fields from the free-running simulation. This way, the tropospheric wave activity is unaltered among the experiments, but the stratosphere itself can evolve freely. We then significantly alter the stratospheric initial conditions and analyse the consequences.
It is found that a given tropospheric evolution concomitant with the development of an SSW does not uniquely determine the occurrence of an event, and that the lower stratospheric conditions are relevant to the subsequent evolution of the stratospheric flow towards an SSW. We will also show that interpreting the meridional heat flux at 100 hPa as a proxy of the tropospheric injection of wave activity into the stratosphere should be regarded with caution, and that stratospheric dynamics strongly influences the heat flux at that altitude.