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Diagnosing the Stratosphere-Troposphere Stationary Wave Response to Climate Change in Chemistry-Climate Models

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The zonally asymmetric component of the climatological mean atmospheric circulation, known as the "stationary wave", is an essential aspect of the global climate and is also closely related to regional climate. Chemistry-Climate Models (CCMs) have simulated significant changes in the stationary wave field in response to climate change, in both troposphere and stratosphere. Stationary wave models are simplified atmospheric models that elucidate the stationary wave dynamics. We here apply a recently developed stationary wave model that captures both the stratospheric and tropospheric stationary wave field to the question of the stationary wave response to climate change. Past stationary wave models largely focused on tropospheric circulation, but the stationary wave field extends into the stratosphere and plays an important dynamical role there. We use this model to diagnose the stationary wave response to climate change in the CCM simulations. Our model allows us to separately diagnose the effects of the changes in the zonally asymmetric diabatic heating and the changes in the zonal mean state on the stationary wave response to climate change. We find that in these simulations the changes in the zonal mean state play a major role in explaining the changes in the stationary wave field, especially in the stratosphere, while the diabatic heating changes are only responsible for a modest portion of the total stationary wave response. Further investigation on the decomposition of zonal mean changes has revealed that the stationary wave response is controlled by specific localized features of the zonal mean change.