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Sensitivity of 21st century stratospheric ozone to greenhouse gas scenarios

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To understand how greenhouse gas (GHG) emissions may affect future stratospheric ozone, 21st century projections from four chemistry-climate models are examined for their dependence on six different GHG scenarios. Compared to higher GHG emissions, lower emissions result in smaller increases in tropical upwelling with resultant smaller reductions in ozone in the tropical lower stratosphere and less severe stratospheric cooling with resultant smaller increases in upper stratospheric ozone globally. Increases in reactive nitrogen and hydrogen that lead to additional chemical ozone destruction mainly play a role in scenarios with higher GHG emissions. Differences among the six GHG scenarios are found to be largest over northern midlatitudes (~20 DU by 2100) and in the Arctic (~40 DU by 2100) with divergence mainly in the second half of the 21st century. The uncertainty in the return of stratospheric column ozone to 1980 values arising from different GHG scenarios is comparable to or less than the uncertainty that arises from model differences in the larger set of 17 CCMVal-2 SRES A1B simulations. The results suggest that effects of GHG emissions on future stratospheric ozone should be considered in climate change mitigation policy and ozone projections should be assessed under more than a single GHG scenario. If time allows, the study will be extended to include CMIP5 model simulations with interactive stratospheric chemistry.