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Robustness of the simulated tropospheric response to ozone depletion

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Recent modeling studies have differed as to the magnitude of the response of the Southern Hemisphere tropospheric circulation to ozone depletion. This inconsistency may be a result of different model dynamics, different ozone forcing, or differences in the analysis. Here, we analyze this response across a hierarchy of climate model simulations; ranging from atmospheric models with prescribed ozone concentrations to coupled atmosphere-ocean models with interactive chemistry. Aside from models with interactive chemistry, the same change in ozone is prescribed in each simulation. A broadly consistent poleward shift and intensification of the extratropical jet is found among simulations. All models also simulate a widening of the southern edge of the Hadley cell, although its magnitude is less consistent. Despite a wide range of climatologies among the models analyzed, we find no relation between a model's mean state and the magnitude of the tropospheric response to ozone depletion. However, differences in the stratospheric temperature response to ozone depletion are shown to explain a significant fraction of the inter-model variance in the tropospheric response. Given this consistency among models, we propose that the majority of differences between model responses in previous studies has arisen from either statistical uncertainty due to natural variability, or differences in the prescribed ozone forcing.