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Quantitative assessment of Southern Hemisphere ozone in chemistry-climate model simulations

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Abstract. Stratospheric ozone recovery in the Southern Hemisphere is expected to drive pronounced trends in atmospheric temperature and circulation from the stratosphere to the troposphere in the 21st century; therefore ozone changes need to be accounted for in future climate simulations. Many climate models do not have interactive ozone chemistry and rely on prescribed ozone fields, which may be obtained from coupled chemistry-climate model (CCM) simulations. However CCMs vary widely in their predictions of ozone evolution, complicating the selection of ozone boundary conditions for future climate simulations. In order to assess which models might be expected to better simulate future ozone evolution, and thus provide more realistic ozone boundary conditions, we assess the ability of twelve CCMs to simulate observed ozone climatology and trends and rank the models according to their errors averaged across the individual diagnostics chosen. According to our analysis no one model performs better than the others in all the diagnostics; however, combining errors in individual diagnostics into one metric of model performance allows us to objectively rank the models. The multi-model average shows better overall agreement with the observations than any individual model. Based on this analysis we conclude that the multi-model average ozone projection presents the best estimate of future ozone evolution and recommend it for use as a boundary condition in future climate simulations. Our results also demonstrate a sensitivity of the analysis to the choice of reference data set for vertical ozone distribution over the Antarctic, highlighting the constraints that large observational uncertainty imposes on such model verification.

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