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Consistent circulation differences in the Southern Hemisphere caused by ozone changes: A chemistry-climate model and observational study

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We report results from two pairs of chemistry-climate model simulations using the same climate model but different chemical perturbations. In each pair of experiments an ozone change was triggered by a simple change in the chemistry. One pair of model experiments looked at the impact of PSCs and the other pair at the impact of short lived halogenated species on composition and circulation. The model response is complex with both positive and negative changes in ozone concentration, depending on location. These changes result from coupling between composition, temperature and circulation. Even though the causes of the modelled ozone changes are different, the high latitude southern hemisphere response in the lower stratosphere is remarkably similar. In both pairs of experiments the high latitude circulation changes, as evidenced by N2O differences, suggesting a slightly longer-lasting/stronger descent in runs with higher ozone destruction. We contrast the idealised model behaviour with interannual variability in ozone and N2O as observed by the MIPAS instrument on ENVISAT, highlighting the similarity of the modelled changes to the year 2006/7 in observations. We conclude that the climate system can respond quite sensitively to small chemical perturbation, that circulation adjustments seen in the model can occur in reality, and that coupled chemistry-climate models are needed for an assessment of future ozone and climate changes.