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The chemical sensitivity of stratospheric ozone to nitrous oxide and methane

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The sensitivity of the evolution of stratospheric ozone through the 21st century to different emissions scenarios for nitrous oxide and methane has been assessed. Nitrous oxide and methane, the two primary anthropogenic greenhouse gases after carbon dioxide, cause ozone depletion when they are converted to active nitrogen oxides (NOx) and active hydrogen oxides (HOx), respectively. Projected increases in nitrous oxide and methane emissions through the 21st century are expected to lead to changes in ozone. Eight simulations for the period 2015 to 2100 were performed with the Niwa-SOCOL chemistry-climate model (CCM). The greenhouse gas emissions boundary conditions generally follow the IPCC SRES A1B scenario. For four simulations, the prescribed nitrous oxide emissions were replaced with each of the four representative concentration pathway (RCP) emission scenarios for nitrous oxide. For the other four simulations, the methane emissions were replaced with each of the four RCP scenarios for methane. For each simulation, the contributions of 15 catalytic chemical cycles to ozone destruction (including three nitrogen cycles and five hydrogen cycles) were accumulated into daily means within each model grid cell. The effects of cycles on ozone loss are typically examined as functions of latitude and altitude. The results from this study are likely to be relevant for assessing the effects on ozone of different greenhouse gas emissions mitigation strategies.