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Sizing the impact of ozone feedbacks in climate sensitivity experiments - what is the best way forward?

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The representation of atmospheric ozone can have large effects on the results of abrupt 4xCO_2 simulations. In particular, estimates of the Equilibrium Climate Sensitivity (ECS), zonal jet shift changes as well as the response of the El Niño Southern Oscillation (ENSO) can be affected (Nowack et al., 2015, 2017, Dietmüller et al., 2014, Chiodo & Polvani, 2017). Nevertheless, such ozone feedbacks have not received much attention in the climate sensitivity community. Here, we give an overview of the most recent results in this context and investigate potential climate impacts of a specific ozone representation used in simulations for the Coupled Model Intercomparison Project phase 5 (CMIP5). The method considers ozone changes only in the troposphere and lower stratosphere and prescribes stratospheric ozone elsewhere. Using this method within the HadGEM3-AO climate model, we find a significantly increased global and regional climate sensitivity compared with a fully interactive atmospheric chemistry set-up, as well as an increase in ENSO amplitudes. Finally, we discuss data-driven statistical methods to represent ozone in climate sensitivity simulations as an alternative, which could lead to an adequate representation of ozone without adding the high computational expense of a fully interactive atmospheric chemistry scheme. Using such methods consistently could thus be a major leap forward in the quest to constrain climate sensitivity, as current model treatments of ozone differ and therefore add to the uncertainty.

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