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The importance of interactive stratospheric chemistry on the tropospheric jet variability under climate change

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The importance of including the stratosphere in coupled global climate models to improve also tropospheric variability has been discussed extensively and is still a topic of major interest. The number of models representing stratospheric dynamics increased significantly from CMIP3 to CMIP5. But only few of these high-top models also include an interactive chemistry scheme in the middle atmosphere. Past studies have shown competing effects of increasing greenhouse gas concentrations and ozone recovery on the shift of the southern hemisphere tropospheric jet. But how important is the representation of interactive chemistry for the representation of changes in the tropospheric jets?

We investigate this question using NCAR's Community Earth System Model (CESM1) with the high-top Whole Atmosphere Community Climate Model (WACCM) as its atmospheric component. WACCM includes a fully interactive stratospheric chemistry module in the standard configuration. An alternative configuration, the specified chemistry version of WACCM (SC-WACCM) enables us to evaluate the relative importance of the interactive chemistry scheme by systematically inhibiting the feedback between chemistry and dynamics. We conducted a number of experiments under no climate change as well as under extreme climate change conditions.

The analysis will concentrate on the differences between the interactive and the specified chemistry model simulations in the subtropical jets, on the Northern as well as on the Southern hemisphere. While the Northern hemisphere is more dynamically disturbed, the Southern hemisphere shows a strong chemical-dynamical feedback during the ozone hole period. Significant differences occur between the interactive and specified chemistry simulations especially for those seasons, in which the feedback between chemistry and dynamics is most important. We will also show differences between the two model setups with regards to changes in the tropospheric jet under the RCP 8.5 scenario.