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Annular Modes in an AOGCM with interactive stratospheric chemistry

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Annular Modes as Arctic Oscillation (AO) and Antarctic Oscillation (AAO) characterize the interannual to decadal scale atmospheric variability due to internal processes within the climate system and nonlinear feedbacks between them. Amongst others, stratospheric chemistry is an important factor for such feedback chains, since the amount and distribution of trace gases control the radiative forcing and thus the structure and circulation of the middle atmosphere. The downward control mechanism driven by planetary waves establishes a link to the tropospheric circulation. For this study, we performed 150 year equilibrium simulations with the Atmosphere-Ocean-sea ice General Circulation Model (AOGCM) ECHO-GiSP, which covers the troposphere and strato-mesosphere up to 80 km height, and includes an interactive stratospheric chemistry. In both winter hemispheres, the simulation with enabled stratospheric chemistry shows a weaker polar vortex in the middle atmosphere and tends to the negative phase of the Annular Mode (AO, AAO) in the troposphere compared to the reference simulation. At the same time, the tropospheric planetary wave activity behaves opposite between northern hemisphere and southern hemisphere, which appears to be a consequence of a differing vertical structure of AO an AAO. This result is also supported by reanalysis data.