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Planetary waves and their role in stratosphere-troposphere coupling under a changing climate - simulations with ECHAM6

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Stratosphere and troposphere are coupled via radiative, dynamical and chemical processes. In the Northern hemispheric winter, planetary waves originating from the troposphere propagate up into the stratosphere. Their dissipation decelerates the polar night jet, which, in extreme cases, can lead to the occurrence of a major sudden stratospheric warming (SSW) event.
Climate change could affect both planetary wave sources and their propagation. Several studies pointed out that changes in stratospheric conditions may have implications for the troposphere. This has been in particular shown for the Northern Annular Mode (NAM) index, which at the surface is highly correlated to the North Atlantic Oscillation.
So far, it is not well understood, how this network of processes building up the vertical coupling between the stratosphere and the troposphere behaves in a changing climate.
To investigate the impact of increasing greenhouse gas (GHG) concentrations on the coupling of the stratosphere-troposphere system, model simulations with the ECHAM6 general circulation model were performed for time slices reflecting preindustrial, present-day and future climate conditions. Age-of-air tracer data obtained from these simulations imply that the Brewer-Dobson Circulation, which is the stratospheric part of the residual mean meridional circulation, accelerates under increasing GHG concentrations. Derivation of the tropical upwelling velocity at the tropopause supports this.
In this work we address the role of planetary waves in the coupling of the stratosphere-troposphere system for different atmospheric states, represented by three sets of boundary conditions. A statistical analysis is applied to investigate correlations between Eliassen-Palm flux divergences, planetary wave amplitudes, frequency of major SSW events and the NAM index. The results of this analysis are presented.