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Impact of climate change on stratosphere-troposphere coupling – a study with the chemistry-climate model EMAC

Joscha Pültz[1], Ulrike Langematz[1], Dr. Stefanie Meul[1], Dr. Blanca Ayarzagüena[2], Dr. Sophie Oberländer-Hayn[1]

[1] Freie Universität Berlin

[2] University of Exeter

joscha.pueltz@met.fu-berlin.de

Previous studies have shown that coupling between the tropospheric and statospheric circulations can affect northern hemisphere wintertime weather. The stratosphere-troposphere coupling (STC) is characterized by vertical propagation of anomalies in geopotential from the stratosphere into the troposphere. These anomalies in geopotential reflect the variability of the polar vortex. In a changing climate, the STC may be altered, as an increase in greenhouse gas (GHG) concentrations will affect the temperature and dynamics of the stratosphere.

This study contributes to the discussion of how future changes in stratospheric and tropospheric dynamics, especially dynamics of the polar vortex, affect the STC. Timeslice simulations of the coupled chemistry-climate model EMAC are analysed for the years 1865, 1960, 2000, 2045 and 2095. Each simulation covers 40 years and allows for the analysis of strong and weak vortex events at a high statistical level. Additional sensitivity simulations are used to assess the anthropogenic (GHG/ODS) influence. STC is analysed using the northern annular mode (NAM), which is the dominant pattern of variability in geopotential. It is investigated if the onset and duration of stratospheric anomalies change with GHG-induced climate change or with increasing ozone. Special attention is given to events propagating downward into the troposphere, which potentially influence tropospheric weather.