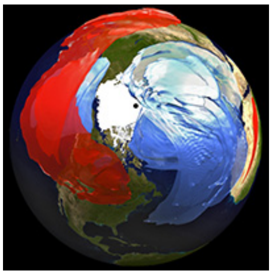

Contribution ID: **72** Type: **Poster presentation**

# Uncertainties in stratospheric circulation climatologies and trends in global models

The large-scale circulation of the stratosphere is affected by increasing greenhouse gas concentrations in various ways. The meridional transport circulation of the stratosphere is projected to speed-up in a future climate, and the strength of the winter polar vortex is projected to decrease in the northern hemisphere, but increase in strength in the southern hemisphere. In the current study, the uncertainties in those circulation changes in global model simulations are investigated in relation to the climatological mean states of the models. Simulating stratospheric transport (as measured by "Age of Air", AoA) is still a major challenge in global models: the differences in climatological mean AoA between state-of-the-art models (the CCMI models) are as high as half the mean AoA value. Long-term trends in stratospheric transport are very consistent in sign, with models simulating a decrease in mean AoA (i.e. a speed-up of the transport circulation), but the trends vary in absolute value by up to a factor of 2. We find that the differences in the strength of the trend are not related to the spread in the climatological mean AoA value. Rather, changes in the mixing strength over time causes differences in simulated long-term AoA trends, and those mixing trends likely reflect uncertainty in structural circulation changes. Sensitivity tests with regard to the role of parametrized gravity wave (GW) drag indicate that the inclusion of GW drag in the models strongly modifies climatological mean winds and trends in the polar vortices, while the trends in circulation and AoA are rather insensitive to the inclusion of GW drag. Overall, we conclude that AoA trends simulated by global models are very robust across different models and model set-ups. However, the trends in the polar vortex strength in both the southern and northern hemisphere is sensitive to the inclusion of gravity wave drag, which might simply be a result of the different basic state climatology. In the suit of CCMI models, we find a relation between the strength of the SH polar vortex trend (which varies from -2 to +7 m/s over 140 years, as measured by maximal zonal winds at 10 hPa) to the basic state SH polar vortex strength. To understand the role of the basic state climatology for the trends of the SH vortex in the full CCMI models, simulations with a dynamical core model with idealized tropical heating are utilized. Those simulations reveal the non-linear nature of the response of the polar vortex to enhanced tropical heating.

**Primary authors:** GARNY, Hella (DLR); DIETMÜLLER, Simone (DLR); EICHINGER, Roland (DLR); WALZ, Roland (DLR)

**Presenter:** GARNY, Hella (DLR)

**Session Classification:** Poster session

**Track Classification:** Workshop: Stratospheric predictability and impact on the troposphere