



Contribution ID: 30

Type: Poster

Seasonality of the tropical pipe position from ANCISTRUS mean velocities

The tropical pipe is the part of the Brewer-Dobson circulation where air is transported upwards from the troposphere into the higher atmosphere. Mixing with air from higher latitudes is widely suppressed by the so-called subtropical mixing barriers. The width and latitudinal position of the tropical pipe varies with time, driven (at least) by seasonal and QBO variations.

Metrics for the latitudinal position of the subtropical mixing barriers can be separated in chemical ones (derived from tracer distributions) and dynamical ones (derived from zonal and vertical winds). Ivaniha et al. (2025) have demonstrated that the seasonal variations between chemical and dynamical metrics are subject to a phase shift.

We analyse here the seasonal variability of the latitudinal position of the tropical pipe from MIPAS tracer observations and the meridional velocities derived from the same MIPAS tracers by the inversion tool ANCISTRUS (von Clarmann and Grabowski, 2016). We find that the same phase shift occurs between the chemical metrics and the zonal mean vertical and meridional velocities.

References:

Oksana Ivaniha, Marta Abalos, Natalia Calvo, Gabriele P. Stiller, Kasturi Shah, and Sean Davis, Stratospheric subtropical transport barriers in CESM-WACCM and observations: climatology, variability, and trends, in preparation (2025).

Thomas von Clarmann and Udo Grabowski, Direct inversion of circulation and mixing from tracer measurements –Part 1: Method, Atmos. Chem. Phys., 16, 14563–14584, <https://doi.org/10.5194/acp-16-14563-2016>, 2016.

Topic

Atmospheric composition (Earth and planets), chemistry and transport

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