Geophysical Research Abstracts
Vol. 12, EGU2010-12610, 2010
EGU General Assembly 2010

Residual circulation trajectories and transit times into the extratropical lowermost stratosphere

Thomas Birner
Colorado State University, Department of Atmospheric Science, Fort Collins, United States (thomas@atmos.colostate.edu)

Transport into the extratropical lowermost stratosphere (LMS) can be divided into a slow part (time-scale of years) associated with the global-scale residual (Brewer-Dobson) circulation and a fast part (time-scale of days to months) associated with (mostly quasi-horizontal) mixing (i.e. two-way irreversible transport, including stratosphere-troposphere exchange). The Brewer-Dobson circulation can be considered to consist of two branches: a deep branch more strongly associated with planetary waves breaking in the middle to upper stratosphere, and a shallow branch more strongly associated with synoptic-scale waves breaking in the subtropical lower stratosphere. In this study the contribution due to the Brewer-Dobson circulation alone to transport into the LMS is quantified using residual circulation trajectories, i.e. trajectories driven by the residual mean meridional and vertical velocities. This contribution represents the reversible (advective) part of the overall transport into the LMS and can be viewed as providing a background onto which the effect of mixing has to be added. Residual mean velocities are obtained from a comprehensive chemistry-climate model as well as from ECMWF reanalysis data. Residual transit times of air traveling from the tropical tropopause to the LMS along the residual circulation streamfunction are evaluated and compared to mean age of air estimates. A clear time-scale separation with much smaller residual transit times into the mid-latitudinal LMS than into polar LMS is found that is indicative of a clear separation of the shallow from the deep branch of the Brewer-Dobson circulation. In contrast mean age of air exhibits a much more homogeneous latitudinal structure. Nevertheless, the residual transit time distribution reproduces qualitatively the observed seasonal cycle of youngest air in the fall and oldest air in the spring.