



Diabatic processes associated with the crossing of the extra-tropical tropopause: An air parcel's perspective

M. Sprenger (1), H. Wernli (2), E. Jaeger (1)

(1) Institute for Atmospheric and Climate Science, ETH Zurich, Switzerland, (2) Institute for Atmospheric Physics, University of Mainz, Germany (michael.sprenger@env.ethz.ch)

Air mass and the enclosed pollutants are transported across the tropopause in so-called STE (stratosphere-troposphere exchange) events. Several studies focused on the dynamical features associated with these STE events, among them breaking Rossby waves and extra-tropical cyclones. In this contribution, case studies and climatological composites for the year 1990 (based upon ERA-40 reanalyses) are presented to shed light on the physical processes related to STE.

We adopt an air parcel's perspective, and follow its 3d trajectory from the stratosphere to the troposphere (for STT) and vice versa for the opposite direction (TST). Thereby, the state of the atmosphere is sampled along the trajectory with respect to diabatic processes, for instance turbulence, condensational heating and radiative heating. This will finally allow to determine which diabatic processes are associated with the crossing of the tropopause (the 2 pvu isosurface), which constitutes a barrier for any adiabatic flow.

Special focus will given to the possibility of STE on isentropic surfaces, so-called isentropic transport. Detailed case studies illustrate that nearly isentropic transport is possible and indeed fairly common. Additionally, it is investigated how turbulence near the tropopause influences the crossing of the 2 pvu barrier. For STT, a low Richardson number, and therefore turbulence, is often encountered at the time when the air parcel cross the tropopause. On the other hand, no such tendency for enhanced turbulence is discernible for TST. In addition to the Richardson number, other indicators for turbulence are deduced from the ERA40 reanalyses.