



A potential relation between stratosphere-troposphere exchange and the tropopause inversion layer in idealized baroclinic life cycle experiments

Daniel Kunkel, Thorsten Kaluza, Volkmar Wirth, and Peter Hoor

Johannes Gutenberg-University Mainz, Institute for Atmospheric Physics, Mainz, Germany (dkunkel@uni-mainz.de)

The tropopause inversion layer (TIL) as a well known feature of the lower stratosphere in the extratropics has often been suspected of impeding the exchange between stratospheric and tropospheric air masses (STE). However, it is still an open question whether a physical relation between STE and the TIL exists. We use a non-hydrostatic limited area model to simulate idealized baroclinic life cycles along with different diagnostics for STE such as Eulerian passive tracers and Lagrangian trajectories. Recent findings suggest a strengthening of the TIL during such life cycles due to diabatic tropospheric processes as well as wave breaking. Moreover, STE also occurs frequently during such baroclinic life cycles, e.g., in the vicinity of tropopause folds, cut-off lows, or stratospheric streamers. Contradicting to current knowledge the analysis of static stability above the thermal tropopause and the identification of regions of STE show that a temporal and spatial co-location of a strong TIL and regions of transport from the troposphere into the stratosphere is possible. Evidence is further presented that such a co-location is related to tropospheric updrafts and small scale waves in the lower stratosphere. These findings are also supported by an analysis of baroclinic life cycles in high resolution operational analysis data from the European Center for Medium-Range Weather Forecasts (ECMWF).