Geophysical Research Abstracts, Vol. 7, 04918, 2005
SRef-ID: 1607-7962/gra/EGU05-A-04918

Impact of Baroclinic Wave Development on the Sharpness of the Tropopause

T. Szabo and V. Wirth

Johannes Gutenberg-University Mainz, Germany

Observed composite profiles of buoyancy frequency in mid-latitudes show a sharp peak just above the tropopause. Earlier theoretical studies with idealized models suggested that the sharpness of the extratropical tropopause is, at least partly, due to conservative balanced dynamics in the tropopause region. It was hypothesized that the vertical convergence and divergence of the secondary circulation plays an important role in sharpening or smoothing the tropopause locally.

In order to examine the proposed dynamical mechanism in a more realistic framework, the Lokal-Modell (LM) of the German Weather Service was configured in a channel version. Numerical experiments on baroclinic wave development were carried through. The initial state was chosen to consist of a perturbed jet flow with piecewise constant Brunt-Väisälä frequency in the troposphere and the stratosphere, respectively.

The results reveal, indeed, several of the features predicted by the earlier studies. The composite buoyancy frequency profile in the model features a peak at 1 km above the tropopause, supporting the view that dynamical processes play an important role for the tropopause sharpness. The effect of vertical convergence and divergence proves to be relevant for sharpening and smoothing the tropopause. Cut-off cyclones and anticyclones contain smooth and sharp buoyancy frequency profiles, respectively, which is in qualitative agreement with the earlier results from idealized balanced models. Furthermore, the analysis reveals a significant influence of inertia-gravity waves on the static stability in the tropopause region. Implications for the occurrence of clear air turbulence are considered as well.