Geophysical Research Abstracts, Vol. 8, 09025, 2006
SRef-ID: 1607-7962/gra/EGU06-A-09025

Troposphere-stratosphere coupling during strong stratospheric Northern Annular Mode

N. Omrani (1)

M. Latif (1)

M. A. Giorgetta (2)

1. Leibniz Institute of Marine Sciences & IFM-Geomar, Kiel, Germany
2. Max-Planck-Institute for Meteorology, Hamburg, Germany

nomrani@ifm-geomar.de

The coupling between troposphere and stratosphere during the evolution of extreme high (low) stratospheric Northern Annular Mode (NAM) is investigated using the Middle Atmospheric version of the ECHAM5 general circulation model (MAECHAM5) coupled with a mixed layer model. The model is able to simulate the observational vertical structure of NAM patterns in the troposphere and stratosphere realistically.

A lag composite analysis (+/-60 days) based on the annular mode index at 10hPa level clearly shows a downward propagation of positive (negative) wind anomalies from the stratosphere into the troposphere during a strongly positive (negative) NAM phase. This is associated with a downward propagation of negative (positive) temperature anomalies from the troposphere into the stratosphere at the pole.

Analyses of the heat and momentum budget in the Transformed Eulerian Mean formulation (TEM) show that the positive wind anomalies in the middle and the low stratosphere during the highly positive stratospheric NAM phase are maintained by the anomalous divergence of the EP-flux against the anomalous equatorward motion (negative Coriolis forcing). This is caused by anomalous equatorward propagation of the tropospheric stationary waves. The resulting anomalous stratospheric equatorward motion during the positive NAM phase leads, by continuity, to anomalous upward motion in the polar stratosphere, and thus to anomalous adiabatic cooling, which explains

the temperature anomalies there. The positive wind anomalies during a highly positive NAM phase near the tropospheric polar jet are maintained mainly by the anomalous positive residual forcing (mainly friction) against the equatorward motion (negative Coriolis forcing). The positive wind anomaly near the ground is maintained by the anomalous poleward motion (positive Coriolis forcing) against the anomalous convergence of the EP-flux and the negative residual forcing. The resulting anomalous equatorward motion near the ground and the poleward motion near the tropospheric polar jet during positive NAM phase leads, by continuity to anomalous upward motion in the troposphere north of the polar Jet and thus to anomalous adiabatic cooling, which explains the temperature anomalies there. South of the tropospheric jet we get, by continuity, an anomalous downward motion during the positive NAM phase and thus an anomalous adiabatic warming, which explains the temperature anomalies there.