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# Analysing the vertical structure of the atmosphere using the Dynamic-State-Index (DSI)

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A new coupled ocean-atmosphere GCM is developed at the Free University of Berlin, which is named EGMAM (ECHO-G Middle Atmosphere Model). It reaches up to the mesosphere with a height of 0.01 hPa (around 80 km). The new model is compared with Reanalysis data. Analysing the vertical structure of the troposphere and stratosphere a new Dynamic State Index (DSI) is used.

The DSI is a result of the Energy-Vorticity-Theory of fluid mechanics, which is postulated by NÉVIR (1999, 2004). The DSI has the form of a Jacobi determinant, which combines the information of energy, potential vorticity and entropy. Under stationary conditions there exists an energy-vorticity-state, which is a generalisation of the geostrophic equilibrium. The DSI is zero in this generalised state. The deviations from this basic state are a measure of the synoptic activity and the diabatic processes of the climate system. An average over an area (like the northern hemisphere) allows to estimate the instationarity or the fast changes of the synoptic variability. Positive deviations from the basic state are a signal of an anticyclonal development. A negative index indicates an intensification of the westerlies or cyclonic circulation. For climatological purposes a time average is used. A positive index describes an intensification of the circulation due to diabatic processes and a negative index displays a weakening of the circulation.

Calculating the DSI the NCEP/NCAR-Reanalyses from 1948 to 2003 are used. The data are available over 17 pressure-levels (1000 up to 10 hPa) and are evaluated on 17 isentropic levels (from 260 to 730 K, equal to 900 to 10 hPa). The isentropic analysis is provided by the REIMER model.

The vertical structure of the DSI is investigated by the standard deviation. The results indicate the PBL as well as the height of the tropopause and the different behaviour

of the stratospheric circulation in summer and winter. If the data are distinguished additionally between the phases of the solar cycle, the results agrees with LABITZKE (2003). She shows that the troposphere is warmer during solar maxima years. The DSI is also calculated for a 100 year run of EGMAM under current (but constant) conditions. EGMAM is able to reproduce the most features of the vertical structure of the DSI.