



## **The response of the mesopause region to natural and anthropogenic forcing: Simulations with HAMMONIA**

Hauke Schmidt

Max Planck Institute for Meteorology, Hamburg, Germany (hauke.schmidt@zmaw.de)

The mesopause region links the lower and middle atmosphere that is, to a large extent, dynamically controlled with the upper atmosphere that is influenced strongly by external forcings of, in particular, solar and magnetospheric origin. Long observational time series for the mesopause region are rare. In general, not more than two solar cycles are covered. Hence, observed variability and trends in such time series are difficult to attribute unambiguously to a particular forcing type. Signals may be related to either local forcings (e.g. of varying absorption of solar radiation or changing concentrations of radiatively active gases) or related to dynamical changes in the lower atmosphere that are influencing the mesopause region due to changes in propagation conditions of waves.

Numerical simulations can provide a useful tool to better understand the possible role of these different phenomena. Here, we analyze different simulations with the general circulation and chemistry model HAMMONIA for the period 1960 to 2006. The simulations are performed according to the REF1b simulation protocol of the CCMVAL model intercomparison activity, and include the major external forcings observed for this period. It is analyzed, which part of the simulated variability in the mesopause region can be attributed to solar forcing, GHG concentration changes, ENSO, volcanic eruptions, or internal atmospheric variability related to the QBO. Results are compared to available observations, and it is studied how the attribution of simulated signals is affected if only subsets of the full time series are used for the analysis.