

The solar cycle effect in the MLT region – Simulations with HAMMONIA

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The region of the mesosphere and lower thermosphere (MLT) links the more dynamically controlled lower and middle atmosphere with the upper atmosphere that is influenced strongly by external forcing of in particular solar origin. Consequently, in the MLT, it is often difficult to assess if signals are related to either local processes (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 MLT region due to changes in propagation conditions of waves. Additionally, long observational time series for the mesopause region are rare, covering, in general, not more than two or three solar cycles. Hence, observed variability and trends in such time series are difficult to attribute unambiguously to a particular forcing type.

Numerical simulations can provide a useful tool to better understand the observed response. 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. The simulated responses to 11-year solar cycle forcing are analyzed and compared to the MLT response to other forcing types. Furthermore it is tried to assess, which part of the simulated solar signal in the mesopause region is rather locally produced and which part is propagated upwards through wave-mean flow interaction. 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. Finally, the response to 11-year solar forcing is compared to variability resulting from solar forcing on shorter time scales, i.e. the solar rotation and solar storms.