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Transport of NO_x from the lower Thermosphere into the middle Atmosphere

Thomas Reddmann, Stefan Versick, and Alexey Vlasov

Karlsruhe Institute of Technology, Institute for Meteorology und Climate Research, Karlsruhe, Germany
(thomas.reddmann@kit.edu, 0049 721 6082 4742)

Transport of NO_x from the lower thermosphere to the mesosphere and subsequently to the stratosphere during polar winters can be an important supply of additional NO_y in the middle atmosphere, besides N2O oxidation. This mechanism couples solar and geomagnetic activity to the chemical budget of the middle atmosphere, and can in principle affect climate via chemical-dynamical interaction and stratosphere-troposphere coupling. As part of the upper branch of the meridional circulation of the middle atmosphere, the downward transport of NOX in the mesosphere is mainly determined by the exerted gravity wave drag. Satellite observations of the last decade clearly showed that in the Arctic especially after strong sudden stratospheric warmings the downward transport can be very effective. Model simulations therefore depend on the chosen gravity wave drag configuration in combination with realistic wind fields. We show that adjusting the source spectrum of gravity waves in a Lindzen type gravity wave drag parameterization stronger downward transport after strong stratospheric warmings and a prevailing elevated stratopause is simulated with our 3d mechanistic model KASIMA. We examine the transport properties of the model in the adjusted configuration for the Arctic winters in the period 2001 to 2011. The additional NO_y transported into the middle atmosphere and the subsequent ozone loss is estimated assuming an additional NO_x source in the lower thermosphere. The consequences of the adjusted gravity wave drag parameterization on the general transport properties of the model is studied using the full ERA-Interim period 1979 - 2011 in terms of mean-age of air and other long-lived tracers.