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Stratospheric methane and water vapour scheme for global models

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For a better assimilation of stratospheric radiances, and therefore more realistic transport, the descriptions of radiatively active gases in numerical weather prediction (NWP) models and data assimilation systems (DAS) need to be improved. Ozone has been included with reasonable success in NWP/DAS systems, however, significant difficulties still exist in modelling humidity in the stratosphere, while other important gases (CH4, CFCs) are only included as a global value. Full-chemistry CTMs can be used to create sufficiently realistic schemes for NWP/DAS models.

A new linear parameterisation for stratospheric methane (CoMeCAT) is obtained with the TOMCAT/SLIMCAT chemical transport model (CTM). The derived parameterisation scheme is suitable for any global model and it has been tested within our CTM and within the ECMWF model. We compare CH4 distributions obtained with a nudged version of the ECMWF general circulation model (GCM), with the free-running ECMWF model and with the CTM using the same methane parameterisation. The impact of the coupled scheme on the GCM radiation and temperature fields is also shown.

As an application of CoMeCAT, the scheme has been used in multiannual CTM runs for the HALOE period (1991-2002), using both ERA-40 and ERA-Interim. The CoMeCAT methane tracer is then used to evaluate transport barriers in the simulations. The effect of different resolutions is also investigated.

The CH4 scheme is also used to parameterise a source of stratospheric water vapour. The H2O scheme has been implemented and tested in the CTM and the GCM. Results have been compared against full-chemistry CTM results and HALOE CH4 and H2O observations. The schemes perform well and results obtained are in good agreement with observations, in particular modelled CH4 vertical profiles and zonal distributions agree very well with HALOE measurements.