Geophysical Research Abstracts, Vol. 9, 07548, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-07548

Evaluation of modelled upper tropospheric carbon monoxide and ozone over the Northern Hemisphere by comparison with MOZAIC measurements

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Within the framework of the GEMS subproject on Global Reactive Gases (GRG), ozone and related species were simulated by 3 state-of-the-art Chemical Transport Models (CTMs) for the year 2003. The three models (MOZART3, TM5 and MOCAGE) were driven by ECMWF operational analysis and they used monthly emissions specific for that year.

Modelled carbon monoxide (CO) and ozone (O3) distributions in the upper troposphere are currently being evaluated against MOZAIC aircraft measurements performed at cruise altitude. At each simulation time step the modelled instantaneous fields were interpolated to all coinciding observation points. This approach allows for a very close comparison with observations and fully accounts for the specific meteorological and emission conditions during the measurements. Comparisons are performed on a monthly basis over different areas of the Northern Hemisphere, including Europe, the Atlantic Ocean, the east and west of North America, Africa, Western Russia and Northeast Asia. The results from the ongoing comparisons will allow for the evaluation of the emission inventories and schemes used for transport and chemistry of gas species.

MOZART3 and TM5 tend to significantly underestimate CO and overestimate O3 measured from MOZAIC aircraft in the upper troposphere. A preliminary analysis of the stratospheric ozone tracer from TM5 points to too strong downward transport from the stratosphere into the troposphere in this model. This possibility will be evaluated

for the different models.

A detailed analysis of MOZART3 output reveals that when the highest tropospheric model levels are ignored, a generally good agreement in the magnitude and yearly cycles of measured and modelled CO/O3 mixing ratios is obtained for most areas. The largest discrepancies between modelled and measured CO are found over North-east Asia during the spring fire season, which was particularly intense in 2003. In this particular case, the measured upper tropospheric CO concentrations are close to those given by the model for the lower mid-troposphere. This indicates that although the seasonal variations in the emission inventories - including biomass burning emissions - seem to be correct, some processes are not well captured/understood by the model. The different hypotheses for these discrepancies will be investigated: absence of plume injection heights in the model, deficiencies in model transport and convective schemes, and possibly insufficient strength of biomass burning emissions over that area in the emission inventory. The analysis of MOZART3, TM5 and MOZAIC output is ongoing.