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Intercomparison of the impact of stratospheric ozone handling on tropospheric composition using the global NMMB/BSC-CTM model

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Stratospheric chemistry is dominated by ozone-related reactions. Atmospheric ozone distribution heavily depends on the dynamical, chemical and radiative coupling between the stratosphere and the troposphere. A detailed description of stratospheric ozone photochemistry would involve hundreds of chemical species and reactions, requiring higher computational time. However, in applications focused on the troposphere, such as numerical weather prediction (NWP) or chemical weather forecast (CWF), it is necessary to apply simple stratospheric ozone handlings, in which no complex stratospheric chemistry is involved.

The main objective of this contribution is to implement and evaluate different approaches in handling stratospheric ozone as an upper boundary condition within the model NMMB/BSC Chemical Transport Model (NMMB/BSC-CTM) (Jorba et al., 2011; Pérez et al., 2011). NMMB/BSC-CTM is a chemical weather prediction system under further development at the Earth Sciences Department of the Barcelona Supercomputing Center. It is a fully on-line system for meso- to global scale applications. The meteorological driver is the NCEP/NMMB numerical weather prediction model developed at the National Centers for Environmental Prediction (NCEP).

Here, we present an evaluation of the tropospheric gas-phase chemistry for summer 2004 on a global scale using three different stratospheric approaches. Two linear ozone stratospheric schemes are tested: the linear ozone model Cariolle v2.9 (Cariolle and Teyssedre, 2007), and the new linear ozone scheme COPCAT (Monge-Sanz et al., 2011). Another simulation, incorporating an ozone climatology, GISS clim, in three stratospheric layers (10mb, 50mb and 100mb) is also evaluated. GISS clim is produced by a 1997-2009 simulation with the nudged version of the GISS composition-climate model (Shindell et al., 2006). Background surface O_3, NO_2 and CO observations from EMEP, WDCGG and CASTNET, as well as ozonosondes and HALOE measurements (Brühl et al., 1996) available for the period of study are used to evaluate the impact of the different stratospheric handlings on tropospheric chemistry.

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