Geophysical Research Abstracts,
Vol. 11, EGU2009-4854, 2009
EGU General Assembly 2009

Comparison of tropospheric chemistry schemes for use within global models

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The changing concentraton of methane and ozone is one of the drivers for the changing climate. Their concentration is largely controlled by the chemistry of the atmosphere. Within chemistry-climate and transport models this chemistry is simplified for computational expediency. In this work we compare the Master Chemical Mechanism (MCM) with six tropospheric chemistry schemes (CRI-reduced, GEOSCHEM and a GEOS-CHEM adduct, MOZART, TOMCAT and CBM-IV) that are used within composition transport models. These tests occur within a box model framework under conditions derived from a composition transport model and from field observations from a regional scale pollution event. We find some significant variations between the chemical schemes. We conclude that 1) The inclusion of a gas phase N_2O_5+H_2O reaction in some schemes and not others is a large source of uncertainty in the inorganic chemistry. 2) There are significant variations in the calculated concentration of PAN between the schemes, which will affect the long range transport of reactive nitrogen in global models. 3) The representation of isoprene chemistry differs hugely between the schemes, leading to significant uncertainties on the impact of isoprene on composition. 4) Night-time chemistry is badly represented with significant disagreements in the ratio of NO_3 to NO_x. Resolving these four issues through further investigative laboratory studies will reduce the uncertainties within the chemical schemes of global tropospheric models.