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Comparison of tropospheric gas-phase chemistry schemes for use within global models

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Abstract. Methane and ozone are two important climate gases with significant tropospheric chemistry. Within chemistry-climate and transport models this chemistry is simplified for computational expediency. We compare the state of the art Master Chemical Mechanism (MCM) with six tropospheric chemistry schemes (CRI-reduced, GEOS-CHEM and a GEOS-CHEM adduct, MOZART-2, TOMCAT and CBM-IV) that could be used within composition transport models. We test the schemes 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 that CRI-reduced provides much skill in simulating the full chemistry, yet with greatly reduced complexity. We find significant variations between the other chemical schemes, and reach the following conclusions. 1) The inclusion of a gas phase N_2O_5+H_2O reaction in one scheme 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) Differences are found in NO_3 concentrations in the nighttime chemistry. Resolving these four issues through further investigative laboratory studies will reduce the uncertainties within the chemical schemes of global tropospheric models.

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