Geophysical Research Abstracts, Vol. 7, 05620, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05620

Impacts of an Improved Isoprene Chemical Scheme in a 3D Air Quality Model, GEM-AQ

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Isoprene is an important and active nonmethane hydrocarbon and is estimated to account for almost half of all biogenic nonmethane hydrocarbon emissions. As a result of its interactions with OH and NO it has a substantial impact on the production of O3 as well as some long lived chemical compounds in the atmosphere. The isoprene chemical mechanism of the current chemical module, ADOM, within 3D Global Environmental Multi-Scale Air Quality Model (GEMAQ) is no longer state-of-art. A highly condensed reaction scheme for the tropospheric oxidation of isoprene, which is mainly based on the recently published Mainz Isoprene Mechanism (MIM), was implemented into ADOM. The MIM code was modified to be consistent with a modified version of ADOM and two versions of MIM scheme, as well as the ADOM isoprene chemistry scheme, were tested against another fairly detailed isoprene chemical mechanism that was taken as a reference mechanism. All four different isoprene schemes have been tested in a one dimension column model for four different scenarios employing conditions ranging from clean to highly polluted air masses. The mechanism intercomparison revealed that the MIM scheme provided the better agreement with the reference. Furthermore, the sensitivity test of the ADOM isoprene chemical scheme was also analysed to reveal the reason for its over estimation of some key atmospheric species such as ozone for different situations. Since no significent disprepancies were observed between the two versions of MIM, the one with fewer reactions was chosen and implemented into ADOM of GEMAQ. The intercomparison of the simulation results from old isoprene chemistry scheme and new revised MIM within GEMAQ against the satellite measurement over the North America was performed. It was found that significant deviations were obtained for the concentration of some key atmospheric species between the two shemes. The new revised MIM scheme also exhibited a better performance with regard to the observation.