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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impact of dust on tropospheric photochemistry over polluted regions: a case study of the Beijing megacity" *by* S. Zhu et al.

Anonymous Referee #2

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General comments

This paper employed a box model MECCA to study the impact of dust on tropospheric chemistry in Beijing, a highly polluted region in northern China. Twelve heterogeneous removal reactions describing dust surface uptake processes were incorporated into MECCA and a series of simulations were conducted to investigate the influence of dust on mixing ratios of ozone and other reactive gases through the processes of transport, heterogeneous uptake and photolysis rate reduction. The authors also examined the uncertainties of the simulation results and suggested that uncertainties of the uptake

coefficients made the most contribution.

This modeling study provides us with a better understanding of the dust effect on the air quality of Beijing, a city which is frequently affected by dust storms in spring. The topic is within the scope of ACP. Methodologies are described clearly and the conclusions are based on the model results interpreted in detail. However, there are a few issues that need to be addressed and listed below.

Specific comments

1. The chemistry box model includes chemistry of organic species of up to 4 carbon atoms and isoprene. Since anthropogenic emissions in Beijing and a few its neighboring industrial zones are not trivial, the concentrations and emission fluxes of aromatic VOCs (e.g. toluene, benzene, xylene, etc.) are expected to be significant. These VOCs play an important role in influencing the mixing ratios of HOx, NOx and consequently that of ozone. The authors should include the aromatic chemistry in order to obtain simulation results that are more representative of the atmosphere in Beijing. At a minimum, a few lumped reactions representing the oxidation of aromatic compounds should be included as part of the chemical reaction scheme in the box model.

2. Photolysis reactions are important in affecting the mixing ratios of NOx, O3 and HOx. In the paper, the authors arbitrarily assigned a 50% decrease to all photolysis rates based on the work of Jeong et al (2007). Considering the arbitrary nature of the value of "50%", I think that sensitivity tests on assuming different values in the decrease of photolysis rates should be carried out and results should be included in this paper.

3. The relative significance of the two processes resulting from the introduction of dust (i.e., heterogeneous uptake and photolysis reduction), should be studied. A set of independent runs can be carried out in order to evaluate the relative importance of different processes (i.e. dust transport, heterogeneous uptakes on dust and restrained photolysis) in affecting the mixing ratios of air pollutants. It would be more informative if authors could elaborate more in the discussion part that for the changes of mixing

ratios of different gases, how much is brought in by the transport of dust and how much is due to the heterogeneous uptakes. This will help to improve the understanding of pollutant evolution due to different mechanisms.

Minor comments

Page 20149, line 14: “Table 1” should be inserted after “12 heterogeneous removal reactions”.

Page 20151, line 3: How are “best guess” values for uptake coefficients derived? Please describe the criteria for a number to be regarded as a best guessed value.

Page 20155, line 23: “(i.e. “Je/Zpbl” in Eq. 4)” should be inserted after “Be is the source term due to direct emission into the box”.

Page 20155, line 24: insert a space between “and” and “Kcl”.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 20145, 2009.