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Atmospheric Chemistry and Physics Discussions

ACPD
12, C1903–C1910, 2012

Interactive Comment

Interactive comment on "Summertime weekly cycles of observed and modeled NO_x and O_3 concentrations as a function of land use type and ozone production sensitivity over the Continental United States" *by* Y. Choi et al.

Y. Choi et al.

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1. Thanks for the thoughtful insight of the second reviewer. Please refer to our responses to the first and second responses from the first reviewer's comments. In spite of the large uncertainty of the remote sensing products, we showed that GOME-2 derived chemical regime classifications are useful to tell chemical regime stations (e.g., NOx sensitive regime or NOx saturated regime stations) by showing that the weekends effects (O3 high anomaly during weekends) are observed at the EPA AQS stations over the GOME-2-derived NOx-saturated regimes. This is a critical showcase of how the

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remote sensing products in space can be used to understand air quality issues over the Earth surface. From our responses of the first and second comments of the first reviewer, we also show how this work contributes to our knowledge about AVHRR (Figure 1 below), GOME-2 and CMAQ model. Of particular, CMAQ simulations with GOME-2 derived emissions inventory showed that a large uncertainty of bottom-up emissions inventory of NOx from EPA NEI2005 is found over the NOx-saturated regimes or the urban regions (Please see Figures 2, 3 and 4 from our responses to the first and second comments of the first reviewer).

2. Please refer to our response to the third suggestion of the first reviewer.

3. The different classifications of AVHRR geographical regions are explained in the caption of Figure 1 in the original manuscript. The Air Quality forecasting communities have used two typical classifications to divide geological regions - geographical regions (e.g., urban and forested regions) and chemical regimes (e.g., NOx-saturated and NOx-sensitive regimes) - and they sometimes think that the urban and forested/rural regions could be a proxy for NOx-saturated regime and NOx-sensitive regimes respectively. For the revised manuscript, we analyzed how GOME-2 HCHO/NO2 ratios vary for three geographical regions (i.e., urban, forested and others regions). Please refer to our response to the first suggestion of the first reviewer (particularly see Figure 1). From the figure, we figured out that as the reviewer indicated, the land types give low/high VOC/NOx values. Particularly, the urban regions from the AVHRR data show about 2 for the GOME-2 HCHO/NO2 ratios over the regions (with a large variability), which mean that the urban regions are classified as the mixed regimes. The others and forest regions from the AVHRR data show the high VOC/NOx value (about 4), which corresponds to the NOx-sensitive regimes. The O3 weekly trends at the stations over the urban, forest and other regions can be clarified and justified by these findings.

4. We agree that OMI data can be a better data set. This issue was described this in the section of remote sensing preparation. As the reviewer indicated, when we started to work on the data, the OMI anomaly problem was being issued. The one month data

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are being used for this study and the reason was addressed in our response to the third suggestion of the first reviewer. Thus, the 40% cloud fraction filtering criteria is being used.

5. Thanks for the reviewer's insightful thoughts on this. Please refer to our responses to the first general comment of the first reviewer (see Figures 2, 3, 4). As the reviewer indicated, we considered the reduction of point sources in the original study, but mobile source changes were not considered in the preparation of the emission inventory (i.e., NEI2005). As the reviewer indicated, two previous works indicated that there have been substantial reductions in the mobile NOx emission from 2005 to 2009 (e.g., Kim et al., 2009; Russell et al., 2010) and NEI2005 emissions in the original manuscript are too high for this study. Using the ratios of CMAQ/GOME-2 NO2 columns (see Figure 2 below), we prepared for another CMAQ simulation with modified emission inventory to consider the reduction of the mobile sources. Please refer to our response to the first comment of the first reviewer. From Figure 2 below, we found that there are large reductions (from 462 Gg N to 426 Gg N over the US) of NOx emissions particularly at the urban region or NOx-saturated regime (Figure 3 and 4). Thus, the emissions reductions reduce the rapid changes (increase from Monday to Wednesday and decrease from Wednesday to Friday) of NOx concentrations during the weekdays at the stations over the region or regime.

6. We agree that discarding the GOME-2 NO2 column observations with low column concentrations (<1x1015 molecules/cm2) is effectively throwing out many low-NOx observations. However, filtering out the low GOME-2 NO2 column data is to avoid the impact of the retrieval uncertainty of the analysis as Russell et al. (2010) described in the previous study. For the revised manuscript, we describe this issue in the context.

7. Specific comments: 1) The manuscripts by Kim et al. (2009) and Russell et al. (2010) are added in the revised manuscript. 2) In the revised manuscript, the table is included. 3) TEMIS releases GOME-2 NO2 column data on a daily basis and each orbit datum point of the HCHO column. The sentence is added in the section 2.2, "Daily

GOME-2 NO2 and each orbit datum point of the HCHO column retrieval products are from http://www.temis.nl/airpollution." 4) Please refer our responses to the first and second suggestions of the first reviewer. 5) In the revised manuscript, the canopy plot is removed 6) In the revised manuscript, Figure 2 was modified to show the results (Sensitivity run – Baseline) to make it clear. 7) In the revised manuscript, the figures are modified so that the data are within the chart.

8. Technical corrections: 1) In the revised manuscript, it is corrected 2) In the revised manuscript, it is corrected 3) In the revised manuscript, it is corrected 4) In the revised manuscript, it is corrected 5) In the revised manuscript, it is corrected

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Interactive comment on Atmos. Chem. Phys. Discuss., 12, 1585, 2012.

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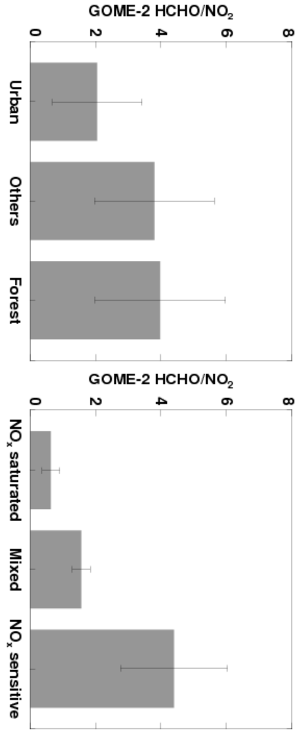

Fig. 1. The ratio of GOME-2 HCHO columns versus NO2 columns over AVHRR-derived geographical regions and GOME-2-derived chemical regimes

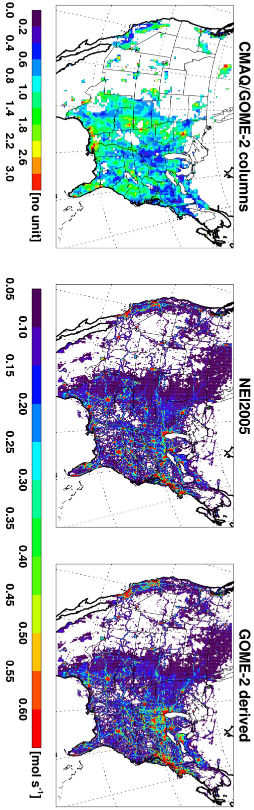

Fig. 2. The ratio of CMAQ NO2/GOME-2 NO2 (left panel), the NOx emissions from EPA NEI 2005 (middle, 462 Gg N over the US) and from GOME-2 derived emissions inventory (right, 426 Gg N) for August 2009.

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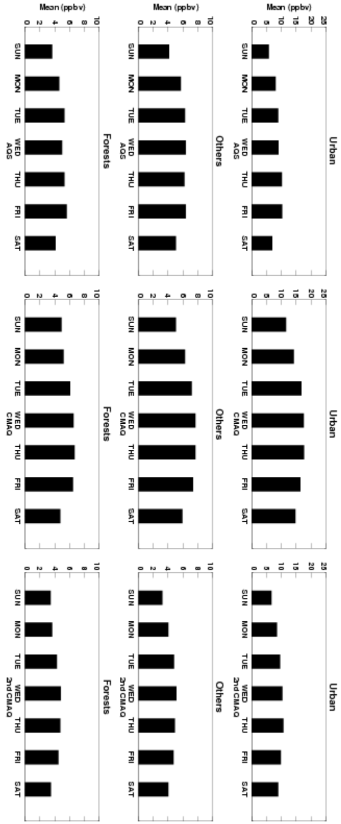

Fig. 3. Weekly anoamlies of AQS-observed, CMAQ-simulated and the 2nd CMAQ simulated (with GOME-2 derived emissions) NOx concentrations at EPA AQS stations over AVHRR geographical regions for August 2009.

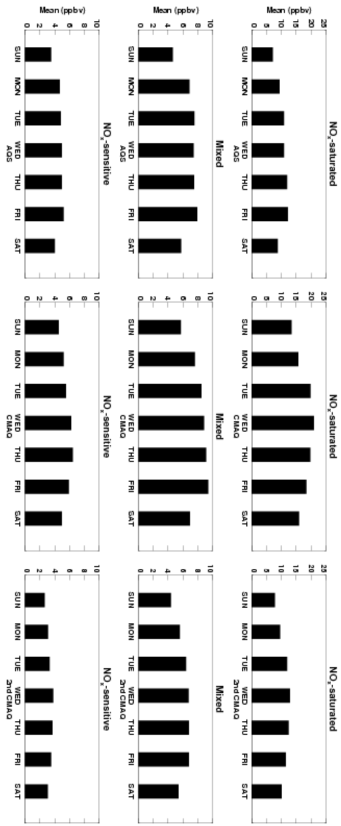

Fig. 4. Same as Figure 3, but over GOME-2 chemical regimes for August 2009

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