Atmos. Chem. Phys. Discuss., 12, C1895–C1902, 2012
www.atmos-chem-phys-discuss.net/12/C1895/2012/

Atmospheric Chemistry and Physics Discussions

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.

yunsooc@gmail.com

Received and published: 27 April 2012

1. Thanks for the reviewer's thoughtful insight. In the revised manuscript, to make other major points of the manuscript clear, we rewrite an abstract and perform some additional works. For example, the previous studies showed the weekly cycles of the surface NOx or O3 over the geographical region (e.g., urban and rural regions) or chemical regimes (e.g., NOx-saturated and NOx-sensitive regimes), but this study shows that in spite of the large uncertainty of remote sensing, remote-sensing-derived chemical environments (e.g., GOME-2 HCHO/NO2 column ratios) can be used for determining

chemical regimes by directly showing the weekend effects of the surface O3 from the in-situ surface measurements (at EPA AQS stations) over the GOME-2 derived chemical regimes. This is an important showcase of how the remote sensing products in space can be used to understand the air quality issue over the Earth surface.

We add a few figures and highlights in the revised manuscript. First, we analyzed how the geographical regions (e.g., urban, others and forested regions) represent the variability of GOME-2 HCHO/NO2 columns (see Figure 1). The urban regions are classified as the mixed regime, which explains why the urban region stations do not show the weekend effects (O3 high anomaly during weekends) in the text. Figure 1 also supports that the others and forest region stations are classified as NOx-sensitive regime stations. These statements are added to explain the weekly pattern of the surface O3 in the revised manuscript. Please refer to our response to the third suggestion of the second reviewer.

Second, please refer to our response of the fifth suggestion of the second reviewer. For the revised manuscript, as the second reviewer suggested, we derived GOME-2-derived emissions inventory from the EPA's National Emissions Inventory 2005 (NEI2005) (see Figure 2 below). As the second reviewer explained, two previous studies (Kim et al., 2009; Russell et al., 2010) showed the evidence for the large reduction of mobile sources from 2005 to 2009. In the original manuscript, we only considered the reduction of point sources because there were no explicit data for the reduction of anthropogenic sources over the entire CONUS domain. For the revised manuscript, we performed to run another CMAQ simulation with modified emissions inventory by using the ratio of CMAQ /GOME-2 NO2 columns over the CONUS. In the new simulation, the NOx concentrations are significantly reduced over the urban region or NOx-saturated regime (see Figure 3 and 4). We also found that the NOx emission changes impact on the surface NOx particularly at the EPA stations over the urban regions or the NOx-saturated regimes (see Figure 3 and 4). The large reductions reduce the rapid changes (increase from Monday to Wednesday and decrease from Wednesday to Friday) during

the weekdays at the stations over the urban region or NOx-saturated regime.

2. For the revised manuscript, we compared the absolute amount of the surface NOx concentrations between EPA AQS, CMAQ and CMAQ with GOME-2 derived emissions (see Figure 3 and 4). The simulated NOx concentrations from EPA NEI2005 are significantly larger than in-situ measured NOx concentrations over the urban region or NOx-saturated regimes. The weekly NOx emission trend (Figure 4 in the old manuscript) shows consistent high emissions from Monday to Friday. However, the simulated NOx concentrations rapidly increase from Monday to Wednesday and rapidly decrease from Wednesday to Friday particularly over the urban region or NOx-saturated regime, likely due to the overestimated NOx concentrations and thus in turn the overestimated concentrations introduce a fast oxidation process of NOx to form HNO3, PAN or alky nitrates in CMAQ.

3. Thanks for the reviewer's thoughtful idea. Differently from the previous studies (e.g., Kim et al., 2009; Russell et al., 2010) to perform a direct comparison between satellite and in-situ measurements, in this study, we first determined the chemical regime stations or geophysical region stations by utilizing one-month GOME-2 HCHO/NO2 ratios or AVHRR land category data, and then we chose all the available hourly EPA station NOx or O3 data during the afternoon hours (between 1-5 PM) (for example, we think that we have enough data of 400-1500 different surface NOx concentrations and 800-15,000 different O3 concentrations for each geographical region or chemical regime). The other issue is on the different classification of the chemical regime stations for other months. The classification standard varies according to the chemical environments from month to month. Thus, for a different month, the different ratios to tell among NOx-saturated stations, mixed stations, and NOx-sensitive regime stations should be carefully examined beforehand. The two addressed issues are more clearly described in the discussion section in the revised manuscript. Furthermore, the corresponding author (person who prepared for all the simulation setups) is going through a job change from NOAA ARL to the other institute. For this reason, extending simulation

time period is challenging due to both a limited access to computational resource at the previous institute. However, the authors agree with the reviewer's point, so that we include this issue as one of the weaknesses of this study in detail in the discussion of the revised manuscript.

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

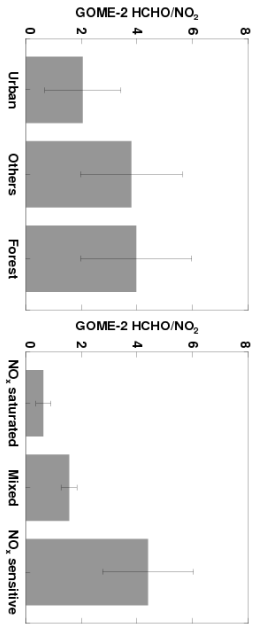

Fig. 1. The ratio of GOME-2 HCHO columns versus NO2 columns over AVHRR-derived geographical regions and GOME-2-derived chemical regimes

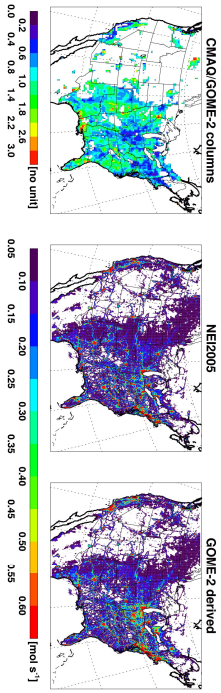

Fig. 2. The ratio of CMAQ NO2/GOME-2 NO2 (left panel), the NOx emissions from EPA NEI 2005 (middle, 462 Gg N over the US) and from GOME-2 derived emissions inventory (right, 426 Gg N) for August 2009.

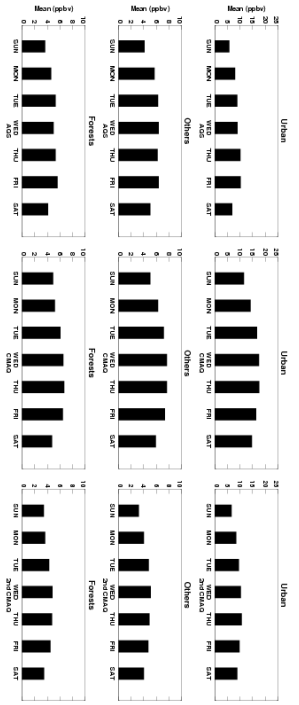

Fig. 3. Weekly anoamlies of AQS-observed, CMAQ-simulated and the 2nd CMAQ simulated (with GOME-2 derived emissions) NOx concentrations at EPA AQS stations over AVHRR geographical regions for August 2009.

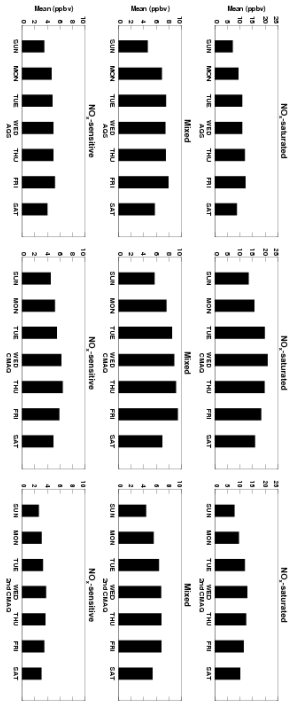

Fig. 4. Same as Figure 3, but over GOME-2 chemical regimes for August 2009