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***Interactive comment on* “Summertime weekly cycles of observed and modeled NO_x and O₃ concentrations as a function of land use type and ozone production sensitivity over the Continental United States” by Y. Choi et al.**

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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 NO_x or O₃ over the geographical region (e.g., urban and rural regions) or chemical regimes (e.g., NO_x-saturated and NO_x-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

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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 NO_x-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 NO_x concentrations are significantly reduced over the urban region or NO_x-saturated regime (see Figure 3 and 4). We also found that the NO_x emission changes impact on the surface NO_x particularly at the EPA stations over the urban regions or the NO_x-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

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

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

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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.

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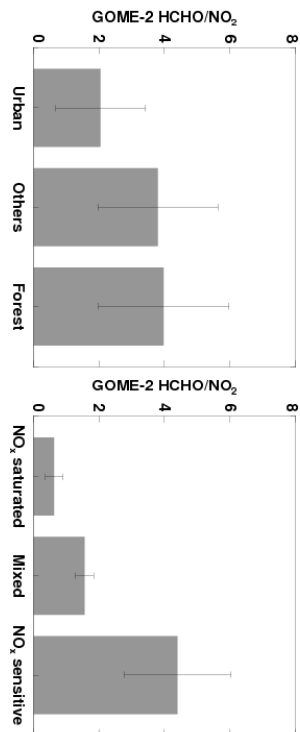
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Fig. 1. The ratio of GOME-2 HCHO columns versus NO₂ columns over AVHRR-derived geographical regions and GOME-2-derived chemical regimes

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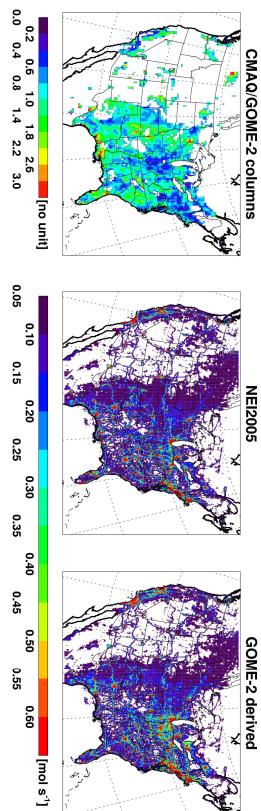
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Fig. 2. The ratio of CMAQ NO₂/GOME-2 NO₂ (left panel), the NO_x emissions from EPA NEI 2005 (middle, 462 Gg N over the US) and from GOME-2 derived emissions inventory (right, 426 Gg N) for August 2009.

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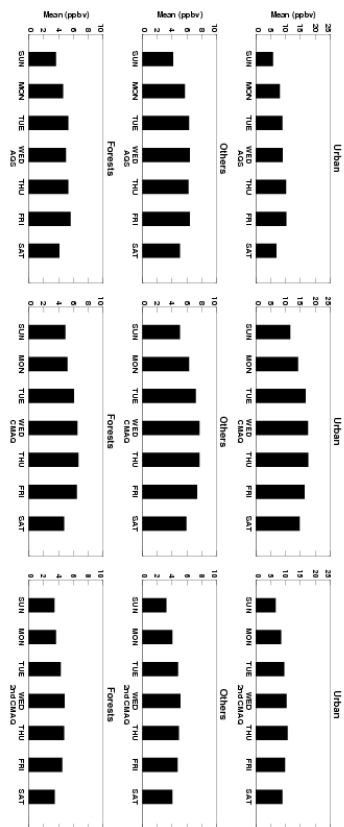


Fig. 3. Weekly anomalies of AQS-observed, CMAQ-simulated and the 2nd CMAQ simulated (with GOME-2 derived emissions) NO_x concentrations at EPA AQS stations over AVHRR geographical regions for August 2009.

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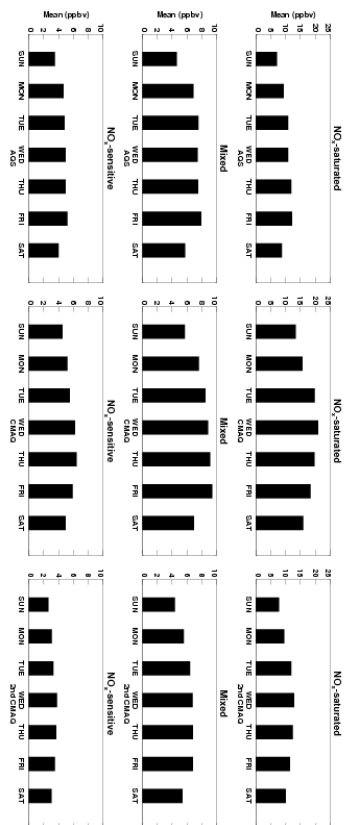
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Fig. 4. Same as Figure 3, but over GOME-2 chemical regimes for August 2009

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