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comment

Interactive comment on "Measurement and model analyses of the ozone variation during 2006 to 2015 and its response to emission change in megacity Shanghai, China" *by* Jianming Xu et al.

Anonymous Referee #1

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This manuscript studied O3 trend during the past 10 years and ascribed the increasing O3 trend to emission changes (i.e., decrease of NOx emissions) because currently O3 formation in Shanghai is VOC-limited. Following these observational analysis, WRF-Chem simulations for September 2009 with different emission scenarios were conducted to investigate impact of future emission changes on O3 in Shanghai. The sensitivity WRF-Chem simulations indicate that O3 formation in Shanghai may change to NOx-limited at certain point (2020) and O3 may decrease since then if further reduction of NOx emission would happen.

The scientific story is interesting. The structure of the manuscript is logically con-

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Discussion paper

structed, and the English writing is good. I would recommend publish after addressing the following concerns/comments:

Major comments

1. This manuscript apparently focused on the daytime O3 formation mechanisms (VOC-limited or NOx-limited). But most of the analysis is conducted for daily mean O3 concentration. Daytime O3 and nighttime O3 are affected by totally different processes/mechanisms and they may have different variations/trends.

The tread of daily mean O3 discussed mostly in this manuscript may be dominated by the trend of nighttime O3, which are not governed by the daytime O3 formation mechanisms (VOC-limited or NOx-limited).

Given that this manuscript wants to focus on NOx-limited or VOC-limited, I would recommend the authors change their analysis to focus on daily maximum O3.

2. Showing change of mean diurnal variation of O3 would be helpful to identify the different trends of daytime/nighttime O3. In the few places when daytime/nighttime O3 are separately discussed in this manuscript, the time ranges for the "daytime"/"nighttime" are not specified. Thus, it is hard for this reviewer to judge whether the "daytime" O3 is only affected by O3 formation mechanisms or the "daytime" O3 is still affected by the O3 removal processes during nighttime and early morning. Thus, showing the trend of mean diurnal variation is critical.

3. The current writing sounds like nighttime O3 is only affected by NO titration. Actually nighttime O3 is affected by three main processes, i.e., NO titration, dry deposition and vertical mixing (Hu et al., 2013). Both of the latter two processes are related to nighttime turbulence, which are further related to extent of urbanization. Thus the increasing trend of nighttime O3 may reflect reduced NO titration, as well as enhanced nighttime vertical mixing, or say less stable nighttime boundary layer, which may be induced by enhanced urban effects through the years (Hu et al., 2016).

Other minor comments:

LN33 in -> for

LN48-49, I believe these should be in one sentence.

LN76, what is the definition of "non-attainment days" in terms of O3 in China?

LN81, what is the "Chinese National Ambient Air Quality Stand" in terms of O3?

LN95, anti-correlation for what time period? Nighttime anti-correlation does not indicate VOC-limited mechanism.

LN104 "However, such O3 variation responding to emission change has not been clearly investigated". You just wrote "Gao et al. (2017) reported that O3 concentration in Shanghai downtown increased 67% from 2006 to 2015, whereas NOx concentration decreased about 38%"

LN120, I thought Gao et al. analyzed 10 yr data as in this study.

LN124, high-resolution? Figure 7 looks like very coarse resolution. What is the resolution in Fig. 7?

Fig. 7 should be combined into Fig. 1

LN141-142, why these point sources do not show up on Fig. 7? Please mark these major point sources in Fig. 7

LN153, either remove this sentence or move it to the beginning of this paragraph.

LN193, what aerosol module?

LN197, what is the "anon-traditional SOA module"

LN204, Fig. 7 appears to have a resolution coarser than 6km.

LN329-342, these basical O3 reactions should be put in the introduction, rather than in the results.

LN355-356, or more intensified urbanization in XJH (thus more enhanced downward mixing of O3 (Hu et al., 2013))

References:

Hu, X.-M., Klein, P. M., & Xue, M. (2013). Evaluation of the updated YSU planetary boundary layer scheme within WRF for wind resource and air quality assessments. Journal of Geophysical Research-Atmospheres, 118(18), 10490-10505. 10.1002/jgrd.50823

Hu, X. M., Xue, M., Klein, P. M., Illston, B. G., & Chen, S. (2016). Analysis of Urban Effects in Oklahoma City using a Dense Surface Observing Network. Journal of Applied Meteorology and Climatology, 55(3), 723-741. 10.1175/jamc-d-15-0206.1

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