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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Summertime ozone formation in Xi'an and surrounding areas, China" *by* T. Feng et al.

Anonymous Referee #3

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General comments:

Air pollution has been a serious problem in China in recent decades. While most of the previous studies have focused on the three major polluted regions with dense population – the Beijing-Tianjin-Hebei region, the Yangtze Delta region, and the Pearl River Delta region (as cited in the manuscript), there are many other cities which have also been experiencing heavy air pollution but with limited studies so far. Being the largest city in northwestern China, Xi'an is such an example. This study employed the WRF-CHEM model to investigate the ozone formation in Xi'an and surrounding areas during a heavy air pollution episode in August 2013. Simulated meteorological fields and near-surface ozone and PM2.5 concentrations showed reasonable agreement with measurements. Sensitivity studies were performed to evaluate the impact of aerosols

and changes in anthropogenic and natural emissions on the surface ozone concentrations. Based on the simulation results, the authors concluded that ozone formation in Xi'an and surrounding areas varied from NOx to VOC-sensitive regimes, constituting a dilemma for ozone control strategies. Although the conclusions are unsurprising, this study is comprehensive and presents some new data/results that are beneficial for future air quality studies in China. Therefore, I think the topic covered in this study is appropriate for ACP. However, the English needs to be improved a little bit before publication and more efforts are needed to highlight the significance and application of the results.

Specific comments:

1. This study focused on a three-day simulation episode in August 2013, which is too short to be representative of the prevalent meteorological conditions. It would be helpful if the authors could show time series of observational temperature, relative humidity, and other variables for a longer period (for example, June, July, and August) to see whether the meteorological conditions of the simulation period is adequately representative over the study area.

2. It is also recommended to show longer period of observed ozone and PM2.5 concentrations in Xi'an and surrounding areas, not only to justify the choice of the short simulation period, but also provide useful realistic observations for future studies.

3. In Section 3.1.1, the authors tried to explain the possible causes for the biases of simulated wind speeds and wind directions. It would be more convincing if any evidence could be found from previous studies with similar comparisons.

4. It would be helpful if the authors could briefly introduce the air quality standards in China as many readers might not be familiar with them.

5. It would be helpful to show a map of biogenic emissions (similar to Figure 2b) so that the readers can have a sense of the relative magnitudes of biogenic VOC emissions

versus anthropogenic emissions.

6. The paper would be more influential if the authors could stress more on the PM2.5 and ozone concentrations in north China (Page 30582, line 16 to Page 30583 line 13). For example, the authors could discuss more about the similarities and differences of the ozone formation regimes in Xi'an versus other mega-cities in north China. Does the dilemma of O3 control strategy also exist in other cities?

Technical corrections:

1. Page 30564, line 18 Please spell out VOC.

2. Page 30570 line 12 and Page 30581 line 1 The RMSE of surface temperature is 1.0 °C while in Table 1 it is 1.1 °C.

3. Page 30572 line 6 "the plume formed in the urban region of Xi'an is pushed to the north of Xi'an and surrounding areas in the afternoon...", which seems to be inconsistent with Figure 6f. As shown by Figure 6f, the convergence zone is located in the south of Xi'an and surrounding areas.

4. Page 30583, line 20 Please specify the base year.

5. There are some grammatical errors throughout the manuscript and I suggest the authors go through the manuscript carefully. Here are some examples. 1). Page 30566, line 18 "at the nine districts" -> "in the nine districts". 2). Page 30570, line 1 "results in" -> "results from" 3). Page 30574, line 10 "closed" -> "close" 4). Page 30576, line 14-16 The sentence "which is determined ... in the presence of sunlight" sounds a little weird. 5). Page 30582, line 10 "whether" is not used correctly. Line 17 "having experiencing" -> "experiencing". 6). Page 30583, line 1 Delete "within"?

6. There are some places in the manuscript that need appropriate references. For example, page 30574, line 11 after "...under humid conditions". Page 30583, line 10 "With the implementation of stringent air quality standards for PM2.5 in China since 2014 (need ref.), O3 has been frequently reported to be the major pollutant during

summertime in the Beijing-Tianjin-Hebei area with the decrease of the PM2.5 level (need ref.), which is consistent with the results in the present study."

Tables and Figures:

1. Table 2 needs appropriate citation for the data presented.

2. Figure 2. It is recommended to add "anthropogenic" before emissions in the title. Also please specify the meaning of the black lines in the plots.

3. Figure 9 "scattering plot" -> "scatter plot".

4. Figure 13. There are no explanations for how Y-axis is defined. According to Page 30577, line 2 and line 10, the changes of J[NO2] and O3 concentrations are defined as (SEN-REF), i.e. results from sensitivity simulation minus results from reference simulation. However, the changes of J[NO2] and O3 concentrations in Figure 13 are both negative, which are calculated as (REF-SEN). This inconsistency caused confusion when I first read the text and looked at the figure.

5. Figure 15 Please add the unit for plot (a) and (b) beside the legend. "a 50% reduction" is duplicated in the title.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 30563, 2015.