

## ***Interactive comment on “Summer ozone variation in North China based on satellite and site observations” by Lihua Zhou et al.***

### **Anonymous Referee #1**

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This manuscript aims to analyze the variation and the influential factors in summertime ozone over North China using multi-satellite and ground-based observations. While topic is of importance to the field, I don't think the authors have presented and interpreted the data in a convincing way. There are a number of issues:

1. I don't think satellite-observed tropospheric ozone can be used as an indicator of surface ozone pollution for several reasons. First, satellite retrieval of tropospheric ozone is very uncertain, as the abundance from stratospheric ozone is so dominated that separating tropospheric ozone from stratospheric ozone is very difficult. There is no discussion on the uncertainties of OMI ozone throughout the paper. Second, tropospheric ozone is not the same as the near-surface ozone. Upper tropospheric ozone is more often considered as a greenhouse gas, while near-surface ozone is considered

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as a pollutant. Throughout the manuscript, the authors fail to distinguish tropospheric ozone with near-surface ozone. The authors mention that they use ground-observed ozone, but there are almost no discussions on this. How does the trend in ground-level ozone agree with satellite-observed tropospheric ozone?

2. The trend analysis and the attribution is not convincing to me for a number of reasons. First, the trend analysis is mostly qualitative. The authors suggest an overall increasing trend of ozone from 2005 to 2016, but there is no information on the trend and the statistical significance of the trend. Same is true for other components. Second, the authors try to attribute the trend to other factors by analyzing if the trend in ozone coincides with NO<sub>2</sub> or CO or SO<sub>2</sub> or HCHO, but I couldn't see how they are correlated just by reading the manuscript. I'd suggest the authors at least provide R<sup>2</sup> for the correlation. Even if they are statistically correlated, correlation doesn't mean causality. Third, the authors conclude that VOC, temperature and radiation are the most important factors for increasing ozone, but Figure 6 shows the inter-annual variability of ozone does not follow any of them. I'd suggest the authors provide more quantitative evidence.

3. While the idea of combining satellite and in-situ observations is interesting, I don't see any connection between them. The authors simply analyze them separately. I think ground-based observations could be useful for validating the variation seen from satellite observations.

4. The authors tend to use satellite data without considering the potential issues (e.g. missing values, detection limit) and uncertainties of satellite retrieval. I think the authors should at least discuss how the uncertainties of satellite retrieval would affect the results.

5. The Introduction should be expanded to include the large body of literature behind this topic. For example, how severe is the ozone pollution in China? How have ozone and its precursors changed over the past decades? How have satellite data been used

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for studying air pollution (especially ozone) in China?

6. Overall, I think the language of the manuscript should be further polished. There are several grammatical errors, which should be edited carefully.

Specific comments:

Page 1 Line 29: How could you not consider the transport of ozone? Since it's an observation-based study. The spatial patterns you see reflect combining effects of horizontal/vertical transport, chemistry, deposition.

Page 2 Line 5: The references do not use OMI observations to characterize ozone variability. They are focused on NO<sub>2</sub>, not ozone.

Page 2 Line 15: The description of the satellite data is not clear to me. For example, did you use Level-2 or Level-3 data? Are they daily or monthly products? Which satellite retrieval did you use? I'd suggest the authors refer the relevant papers of the product developers and include more details on the retrieval.

Page 2 Line 16: How could the resolution be 360 x 180 degree?

Table 1: What's the meaning of reporting the percentage of the concentration of Ozone?

Page 3 Line 1: What do you mean by concentrations here? Concentration of ozone? I don't see any correlation between ozone and NO<sub>2</sub> in June and August.

Page 5 Line 3: What's the basis of the conclusion?

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