

## ***Interactive comment on “Substantial ozone enhancement over the North China Plain from increased biogenic emissions due to heat waves and land cover in summer 2017” by Mingchen Ma et al.***

**Anonymous Referee #2**

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The manuscript presents a modeling analysis to quantify the contribution of isoprene emissions under heat wave conditions in North China Plain on high ozone periods in summer 2017. It reaches two important conclusions that have not been considered in previous modeling analysis of ozone pollution during heatwaves in China: first isoprene emissions not only respond to high temperatures but also to water stress often associated with heat waves; second the recent increase in broadleaf trees and urban green spaces in China has led to increases in baseline isoprene emissions making the first point more important under heat waves. The analysis is solid and writing is clear

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in most parts. I recommend publication after my following comments are addressed.

Main comments: My main concern is the modeling sensitivity analysis was conducted only for summer 2017 but the first part of the manuscript focuses on the difference of summer 2017 from the preceding years (2014-2016). While the sensitivity tests on isoprene emissions lead to better ozone simulation during high-ozone episodes in summer 2017, it is not clear how the same model settings affect ozone under more 'normal' conditions. This is important to know as it can show readers whether the changes in isoprene emissions in the model should be applied more broadly or only applied for certain conditions such as heatwaves. I suggest the authors pick a low ozone year and show how the same VPD and land type change schemes would affect ozone simulation in the model.

Second, the VPD effect on isoprene emissions from Zhang and Wang (2016) was derived from one case study in the southeast US based on a modeling sensitivity analysis. It is not a process-level algorithm as MEGAN and whether the VPD scheme would work for the time period and spatial domain outside the study of Zhang and Wang (2016) has not been investigated. This should be stated in the manuscript. The authors may not be aware that a new water stress effect on isoprene emissions is now included in the newest MEGAN3; see Jiang et al. (2018). This literature should be referenced in the manuscript and discussed.

Technical issues: Line 41: add ozone after MDA8

Figure 1: explain what H, B, and T in the figure stands for.

Line 195: How was the interpolation done? Simply averaging over a 0.5x0.5 degree grid? As this is a comparison of observations between different years, I do not understand why spatial interpolation is necessary. Is it because the site numbers differ by year?

Figure 3: how is the regression relationship calculated for each summer? For each

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day, do you average over all the sites over NCP, average over the 0.5x0.5 degree grid, or treat individual sites as separate data points? Will the slope and correlation slope change with those different representations of data?

Line 228: Figure 4 shows all four years, not just 2017.

Line 230-231: Did you verify these two periods were hit by heat waves? What definition of heat waves were used? Did the heat wave affect the whole NCP or some portion of it? It will make your argument stronger if there is also a spatial association that the sites affected by the heat waves had higher ozone concentrations than those sites not affected. I also suggest the authors describe the temperature in degrees for the two high-ozone periods in the text. July 6-14 2017 had higher temperature than the two periods you noted and ozone was also high. Why did you not highlight that period in the analysis?

Figure 4: What is the gray dashed line in each panel?

Line 268-278: the land cover change is shown for a longer period (between 2003 and 2016), not over the study period (2014-2017). I think the authors meant to say that the use of an older land cover map can lead to underestimate of isoprene emissions and such an underestimate may be exaggerated in years with high temperatures and high VPD. I suggest the authors make this point explicitly in the text.

Reference: Jiang, X., Guenther, A., Potosnak, M., Geron, C., Seco, R., Karl, T., Kim, S., Gu, L. and Pallardy, S.: Isoprene emission response to drought and the impact on global atmospheric chemistry. *Atmospheric Environment*, 183, pp.69-83, 2018

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