Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2018-114-RC1, 2018

Biogeosciences Discussions

Interactive comment on "Resource and physiological constraints on global crop production enhancements from atmospheric particulate matter and nitrogen deposition" *by* Luke D. Schiferl et al.

Anonymous Referee #1

Received and published: 12 April 2018

General Comments: The goals of this paper are to answer questions about the impact of PM and N deposition on crop productivity, and specifically, how water, nitrogen, and plant physiological limitations contribute to the impact that PM and N deposition have on crops. These questions are important to address within the scientific community in order to increase our understanding of how anthropogenic activities affect food production. However, the introduction needs to better describe the current state of knowledge about PM and N deposition impacts on plant productively. To make the paper's arguments compelling, and to provide the reader with enough background knowledge

about the state of research on PM and N deposition impacts on plant growth, the authors need to include a much more substantial and accurate discussion of current literature. In addition, more details about the simulations and how the model handles the N cycle could be added to help the reader interpret the impact of different variables on crop production. Similarly, it would be helpful to add a discussion section or place the manuscript's results in context to other literature, including other modeling and field studies.

Specific Comments: 1. Some of the claims in the introduction are too strong, and seem to contradict the current state of research. For example, on Page 2, lines 2-3, authors say that research has been done on the impact of climate and air quality on climate without considering physiological limitations and effects of water and nutrients. However, many disciplines examine how and why changes in crop production occur with climate change or changes in resource availability, particularly with regards to water use efficiency and nitrogen use efficiency.

2. Most of the papers explaining the impacts of diffuse light on plant production are missing from the introduction, including those that discuss specific impacts on crops. For example, papers by Dev Niyogi (doi: 10.1029/2004GL020915), Kaicun Wang (doi: 10.1029/2008GL034167, and Xiaoliang Lu (doi: 10.1016/j.agrformet.2017.02.002). Work by Gretchen Keppel-Aleks (doi: 10.1002/2016GL070052) may also be useful to discuss in this manuscript.

3. Much more literature explaining the role of N deposition on plant and crop production also needs to be included in the introduction. There is a long history of research about the different responses plants have to N deposition and why this may occur.

4. What kinds of physiological limitations/caps do the authors have in mind when they discuss this in the introduction (e.g., Rubisco/chlorophyll production, root growth, cellular physiology)?

5. Can the authors provide more details about how crop growth is calculated in

pDSSAT? Or is the crop model only a RUE model?

6. What size PM is used in the model?

7. How was the land cover and proportion of rice, wheat, and maize chosen for the crop model?

8. Page 4, Line 31: Can the authors provide more details about how the data are regridded to match the crop model resolution?

9. Page 5, Line 6: Why was PM not chosen to change evaporation, when diffuse light can also reduce air and leaf temperatures?

10. If the manuscript is discussing changes in global crop production, why do the maps in the fitures only include part of the world?

11. Page 7, Line 26: If PM includes nitrate and ammonium, how do the authors remove the confounding effect of PM on the effect of N deposition on crop productivity?

12. Figure 2: Is the mean change in daytime SW and DF a daily mean or a mean (or total reduction) in the 2010 growing season? How do the authors define growing season when different regions of the world have different growing season lengths?

13. Page 7, Line 2: By offline analysis, are the authors referring to the base simulation? If not, can they provide more details to the difference?

14. Page 7, Line 26: What was the amount of extra N added? Figure 6 shows the total amount, but it is not clear what the base case's N deposition was. How were these amounts chosen? Also, how were fertilizer amounts chosen for simulations and were these the same across the globe? Does this make it more difficult to separate out the effect of N deposition alone?

15. Page 8, Lines 15-18: Why do the authors decide to use a fertilizer application of 30 days prior to planting?

16. Page 8, Line 25: This claim that this manuscript is the first to integrate atmospheric air quality inputs into a dynamic crop model seems bold. Can the authors more specifically describe what kind of work modelers have previously done to provide context for how their own manuscript is unique? For example, there has been work done on ozone pollution on plant productivity.

17. It may also help strengthen the paper and help place the methods and results within the greater biogeochemistry discipline to include a discussion section with information about past research on the effect of N deposition and PM on modeled and/or field-based forest or crop productivity.

Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2018-114, 2018.