

## ***Interactive comment on “The trend of the oxidants in boreal forest over 2007–2018: comprehensive modelling study with long-term measurements at SMEAR II, Finland” by Dean Chen et al.***

### **Anonymous Referee #1**

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The authors use a 1-D model to study the trend of OH, NO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub> in boreal forest over 2007–2018 at SMEAR II, Finland. They compared their model results to observations at SMEAR II station. They show that their model agrees with some observations during 2007–2018, but inconsistent with others. They then use their model to calculate the long-term trend of OH, NO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub>. Finally, they also compared the modeled values of OH, NO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub> to some proxies. The paper is trying to address a very interesting question, about the long-term trend of oxidants in boreal forest in southern Finland. I have several comments about this paper:

1. I am a bit of concerned about the long-term trend in this study. As the authors

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showed in Figure 4, their BVOC does not really agree with observations. If I look at Figure 4, I see a decrease of observed monoterpene concentrations from 2007 to 2018. In contrast, their model calculations in Table 1 show an increase of 50% of monoterpene emissions for the same period. As monoterpene is presumably the most important species to determine OH, NO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub> in this work, I am not sure how robust these long-term trends are. Can the authors plot the observational trend of monoterpene concentrations from Figure 4? If the observational trend is opposite to the model calculation on monoterpenes, there seems to be little value to discuss the model trends of oxidants in this paper.

I understand that there is some agreement on OH and H<sub>2</sub>SO<sub>4</sub> between model and measurements (Figure 5 and Figure 8), but those snapshot agreements do not really help to constrain the long-term trend of those oxidants. Some observational constraints on the long-term trend of biogenic emissions would be critical for this paper.

2. Model values of oxidants used in this paper. After reading the paper a few times, I am still unclear which model level was used to provide the data for the long-term trend in Table 1 and elsewhere. Is this the average between 0 and 150 m, 20 and 40 m, or other levels? How do the authors make sure that the levels they chose are representative of the whole vertical domain? I would strongly suggest that the authors make it clear that what model level was used for the data and why.

3. OH trend explained by CO. I do not quite follow the explanations about OH trend. If OH increase by 2.8%/yr, how can this be explained by the trend of CO, which decreases at 0.5%/yr? Note that CO only accounts for 40% of OH reactivity.

4. What is the possible reason for the declining trend of NO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub> in their model?

5. I am not sure how the proxy comparison in Section 3.6 is related to the trend in this work.

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Technical edits:

1. Table 1, please explain what is the brackets for Yearly trend? What is the first number and the second number for?
2. Line 234-238, what is the criteria for Mann-Kendall test? Can the author provide some context here?
3. Line 241, incomplete sentence.

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