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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The impact of bark beetle infestation on monoterpene emissions and secondary organic aerosol formation in Western North America" *by* A. R. Berg et al.

Anonymous Referee #1

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The authors use the CESM to investigate the impact of infestations of Western North American forests with two bark beetle types on monoterpene emissions and associated secondary organic aerosol (SOA) formation. As biotic stress in ecosystems is likely to increase with warming climate and the emission of BVOCs affects air quality and climate, the topic is an interesting one and fits the scope of the journal. The paper is overall well written and the study performed thoroughly. The paper can be published after the following aspects have been addressed.

General:

The authors use SOA yields in their model that are likely too high under the conditions prevailing in the ambient atmosphere. The authors state so in section 4 (page 29779, line 25) but do not provide a scenario calculation with results based on more realistic SOA yields, although they announce such a comparison for section 3.4 (see text in section 2, page 29773 "…we calculate total SOA formed from all monoterpenes with a yield of 10%...."). Such a calculation could be based on laboratory studies using whole plant emissions as SOA precursors and typically observing SOA yields on the order 5-10% (Mentel et al., 2009; Hao et al., 2011) at atmospherically relevant concentration levels.

It seems that the model – based on available detailed observational data – takes into account monoterpene emission changes only, when considering the impact of bark beetle infestations. The statement that "scale-up factors could not be calculated for compounds not detected in healthy trees" (page 29771, line 19), implies that such stress induced emissions are not taken into account. While this reviewer understands that the observational data set is sparse, it seems unlikely that under bark beetle infestation typical stress induced emissions such as sesquiterpenes and methyl salicylate do not occur. As the SOA yields of these BVOCs are typically larger (e.g. on the order 20%, Kiendler-Scharr et al., 2012) than those of monoterpenes, an estimate of the effect of such stress induced emissions should be given.

The discussion of the impact of beetle infestation on aerosol direct effects and visibility on page 29778 only mentions the SOA mass concentrations under bark beetle attack and an estimated natural aerosol level. Visibility in itself is not discussed and no numbers comparing visibility with/without the bark beetle induced SOA are provided. Such numbers would be interesting and should be provided.

Specific comments:

The abstract and numerous places in the manuscript refer to "beetle mortality" when "beetle induced tree mortality" is meant. This is misleading and should be changed throughout the manuscript.

The text discussing figure 4 (p 29774) is incorrect in order of 4a, b, etc.

Inconsistency in numbers reported for increase of SOA in the pine scenario (up to 30% - p29776, line 5 – versus 43% same page line 10).

Figure 10: would be easier to compare the model with observations when OA is given for the three model runs. As far as this reviewer understands, changes in OA would be due to SOA from bark beetle attack only.

Figures 3 would be easier to read when a common concentration scale is applied in the individual panels; same holds for figure 7.

Figure 9 caption: should read . . .compare to Figs. 5c, f and 8c, f . . ..

Figure 10 caption: (a) and (b) rather than (b) and (c).

Literature: Amin et al., 2012a and 2012b are sometimes mixed up in text.

References:

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