

Interactive comment on “BVOC-aerosol-climate feedbacks investigated using NorESM” by Moa K. Sporre et al.

Anonymous Referee #1

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GENERAL COMMENTS:

The authors use the Norwegian Earth System Model (NorESM) to explore the impact of higher temperatures, and carbon dioxide concentrations, on BVOC emissions and subsequent SOA formation. The ESM is used to explore two branches of the feedback between climate and BVOC, via both temperature and gross primary productivity (GPP).

The authors find that, in NorESM, the impact of the temperature feedback on climate (via changing BVOC emissions) is greater than the impact of the GPP-driven feedback on climate (via changing BVOC emissions).

The paper is interesting, within the scope of ACP and suitable for publication following

C1

minor revisions and clarifications:

- It would be useful to understand these results in the context of the other studies you cite in the Introduction (see Specific Comment about that below). The NorESM BVOC feedback seems like it is stronger than that produced by other models but it is difficult to tell. It would be useful if you could include a map (in the Supplementary Material) to demonstrate the temperature increase that is applied in the Δ SST experiment, this would help with interpretation of the changes to BVOC emissions and subsequent feedback strength.

- How is the aerosol hygroscopicity calculated? The impact of a change in the hygroscopicity is mentioned a few times but it's not clear how this is done, and therefore what the impact of changes to the amount of SOA should be

- It would be useful to clarify what you are referring to as cloud forcing (beyond citing Ghan 2013) – what does this include? (i.e. what does and doesn't change in your ESM) Page 9, line 28-29 is confusing – what does this -0.43 W/m² represent? I think it's the difference between FB-ON and FB-OFF but that is not clear.

SPECIFIC COMMENTS:

- P3, line 17-22: this is a bit confusing because the first two values are feedback terms in W/m² per K, whereas the second two are radiative effects / radiative forcing values – do they both relate to a doubling of monoterpene emissions? Should we be able to compare all four values, or not?

- P5, line 23: can you be more specific than 'PI levels', sometimes this means 1750, sometimes 1850. What anthropogenic emissions do you use in the other 3 experiments?

- P7, line 12-14: it's not clear why a reduction in LAI would lower the albedo? Increased tree mortality and reduction of LAI would surely increase the albedo of the surface?

- P8, line 9-11: this sentence is confusing, could you rephrase?

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- P11, line 8: is there a Fig 11 c?
- P11, line 17: why aren't the emissions exactly the same? Because of the impact of the anthropogenic aerosol (or lack of) on climate (and therefore BVOC emissions) – does this confuse the response?
- P13, line 24-26: can you use any previous literature to comment on the relative strengths of these impacts and the implications for the feedbacks you calculate here? Some studies have found the gas-phase and particle-phase impacts of changes to BVOC emissions to be quite finely balanced (e.g., Unger 2014; Scott et al., 2018)
- P14, line 9: is the right value, should it be 0.49 W/m²?

TECHNICAL CORRECTIONS (there are quite a few typos, these are some I spotted):

- P1, line 20: missing "a" ?
- P3, line 12: change 'boosts' to 'boost'
- P9, line 18: change 'patters' to 'patterns'
- P11, line 22: 'were' = 'where'
- P12, line 18: 'is' = 'in'?
- P13, line 22-23: change 'oxidization' to 'oxidation'
- P21, Figure 1 caption: 'if' should be 'is' or 'of' ?

REFERENCES:

Scott et al., 2018, Nature Communications, 9.

Unger, 2014, Nature Climate Change, 4.

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