

Atmos. Chem. Phys. Discuss., referee comment RC2 https://doi.org/10.5194/acp-2022-265-RC2, 2022 © Author(s) 2022. This work is distributed under the Creative Commons Attribution 4.0 License.

Comment on acp-2022-265

Anonymous Referee #2

Referee comment on "Impacts of marine organic emissions on low-level stratiform clouds – a large eddy simulator study" by Marje Prank et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-265-RC2, 2022

This study uses large-eddy simulations to investigate how marine organic aerosol affects the drizzle-initiated transition of a low-level cloud deck. In this setup two pathways are considered: organic aerosol is either emitted directly from sea surface or else formed from volatile organic compounds in gas-to-particle processes. The authors perform a range of sensitivity experiments for either pathway to demonstrate the complexity of factors affecting drizzle formation and subsequent cloud transitions.

The paper is generally well-written and addresses important research questions. I have several major concerns that should be resolved before publication.

Major concerns

Many references are not included in the reference list. In particular, references from the Section 1 are missing. Please check for completeness.

All figures are of low quality. Please use more sophisticated plotting routines (e.g., from R, python, ...) to adjust line thickness, line color (especially Fig. 1), axis labels, units (many length scales are provided in meters), and appearance of legends. In addition, the chosen short names of experiments that are shown in the legend aren't self-explaining and require carefully reading the main text – please improve this also. Accordingly, Table 1 and 2 should be improved.

Given the range of questions, the paper is structured well. However, individual sections lack clarity and make it hard to follow. I recommend splitting section 3 (that combines results and discussion) into a result section and a discussion section. Having a discussion section may also make it easier to express the advance in knowledge that this study provides.

The paper could benefit from a proper definition of chemical reactions that are considered in this study. Readers less versed in atmospheric chemistry could benefit from definitions. Please also clarify: (1) Are oxidants consumed during reactions and are there any (other) sinks or sources for oxidants? (2) Is sunlight necessary for reactions?

The study importantly shows how giant CCN affect drizzle but no definition of "giant CCN" is provided. Is there a dry-diameter threshold that the authors use to discern CCN from giant CCN? Would this definition change if a different horizontal/vertical resolution was used?

Having such a strong focus on microphysical processes, I think it's important to show the dependence on horizontal/vertical resolution as well as domain size. In addition, the authors should produce a small ensemble of simulations for at least one setup (perhaps the baseline) to approximate simulated uncertainty.

While the paper investigates one pathway or the other, it is unclear what would happen if both pathways were used (presumably the most realistic setup?). Please discuss.

The term "cloud lifetime" is used throughout the paper. Do the authors refer to a single cloud cell? If so, please define so upon first use. Else (if the cloud fraction of the entire cloud deck is meant) please rephrase "lifetime" to "fraction" and perhaps also show cloud fraction.

Minor concerns

- I. 10 "in larger scale" should be rephrased.
- I. 63 "as shown by (...)" should have not parenthesis.

II. 76-83 Perhaps also provide actual kappa values in addition to qualitative adjectives (i.e., "high" and "low").

II. 118ff. It is unclear which category (of the aforementioned overview) isoprene and monoterpenes fall into. Please clarify/expand.

I. 130 "DOC" is defined for a second time and differently from the first time (I. 72).

I. 148 "wind" should be "windspeed"?

I. 175 Please provide a citation.

II. 175-176 It is unclear how aging could be relevant here. Please briefly explain.

I. 195 Please explain "dry-size based cloud bins" as this term appears contradictory.

I. 247 It is not clear where the authors see "open cells". Perhaps rephrase/clarify.

I. 290 Please elaborate on how reduced fine mode aerosol (presumably too small to serve as CCN) reduce "cloud lifetime".

I. 321 Why was DOC set to zero?

I. 365 Is this a realistic setup (no sea spray, just secondary formation)?

II. 409-410 As currently written, it is unclear which one is zero and which one isn't.

Fig. 1 Please briefly explain how dry size was obtain from size at RH~80%.