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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Artificial primary marine aerosol production: a laboratory study with varying water temperature, salinity and succinic acid concentration" *by* J. Zábori et al.

Anonymous Referee #2

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This paper comprises a laboratory experimental study aiming to analyse the influence of temperature, salinity and marine organics on aerosol production. This is an interesting topic as a better understanding on the underlying mechanisms leading to primary marine particle production is needed, particularly in the Arctic region. Although I consider the experimental study in this work is of high quality and the paper is well written, to my view this paper does not provide significant novel results with respect to previous literature. Although with a different experimental set-up, a study on the effect of temperature and salinity was already addressed in Martensson et al., while the study on the effect of organics presented in this paper provides little insight with respect to previous works because of using succinic acid as organic proxy. Nevertheless, this paper

provides evidence that confirms some interesting findings, particularly regarding the temperature and salinity effects, and constitutes a first attempt to analyse the simultaneous interaction of three relevant parameters for particle production, i.e., temperature, salinity and organics. Therefore I recommend publication for ACP after addressing the comments indicated below.

Major comments

It is arguable that succinic acid can be used as a proxy to represent the average behavior of marine biogenic organics. While marine organics have been shown to present an average molar mass of the order of 2 kDa (Moore et al., Fuentes et al.), succinic acid is a low molar mass compound that might not represent the behavior of organic biopolymer mixtures. Given its molecular size, succinic acid would only be representative of the seawater DOC fraction and not of the biogenic nanogels released by marine biota. The surface activity and the conformational changes of surfactants as a result of temperature and ionic concentration variations are highly dependent on the compound chain structure and on the interaction between the large biopolymer molecules. For this reason I consider that the results from experiments with succinic acid in this study are not valid to derive conclusions on the average behavior of marine biogenic organics. Some of the succinic acid concentrations applied in this study are much higher than what would be expected to find in real seawater samples. The authors indicate that 94 uMol/L is a representative concentration of DOC in Arctic ocean seawater but 4 orders of magnitude above the average concentration of succinic acid in seawater. Nevertheless, concentrations up to 2450 umol/L are applied in their experiments. For comparison purposes it is fine to use a wide range of concentrations; however the results obtained for these high concentrations are not valid to derive conclusions for real conditions. It is misleading to state in the abstract that succinic acid produces a 43% reduction in the particle production, when this is what happens for the 2450 umol/L case. Statements in abstract and conclusions should be limited to findings that can be extrapolated to real conditions.

The authors should make clear that the fact that the Arctic seawater distributions in Fig. 10 were shifted towards larger sizes with respect to the pure NaCl measurements could also be due to the presence of inorganic compounds other than NaCl. Thus, although the succinic acid and Arctic seawater results were both shifted with respect to the pure NaCl measurements, it is not demonstrated that this is due to marine organics in the Arctic seawater nor that succinic acid can be used as a proxy for these organics.

Section 5.2- Previous studies on the influence of organics on particle production by Sellegri et al., Fuentes et al. and Tyree et al. showed a shift of size distributions toward smaller sizes or an increase in particle production with increasing organic concentration regardless of the experimental set up used. The authors claim that the different behavior observed in their measurements with succinic acid is likely due to the different experimental set-up and organic compound used. The authors should note that previous works were conducted at room temperature, while measurements in this paper are performed at very low temperature. Surfactants behavior is indeed strongly affected by temperature and this could be key to explain why a different trend was observed in this study with respect to previous literature.

As a last comment it is important that the authors acknowledge not only a need for reaching a consensus on the type of experimental set-up to be used in different studies but also on using representative proxy biogenic organic mixtures covering a wide range of molar masses rather than individual low molar mass compounds.

Minor comments

Abstract Line 7: replace “smaller” by “small”.

Line 7: this sentence needs rephrasing; I would suggest the following “from 0 C where they represent 85-90% of the total aerosol number to 10 C, where they represent 60-70% of the total number”.

Statements in lines 7-10 and 12-14 in the abstract seem contradictory. In lines 7-10

it is said that there is a reduction in the particle number from 0 to 10 C, while in lines 12-14 it is stated that there is no change in the shape of the particle size distribution in the temperature range between 0 and 16 C.

I find it difficult to follow the last sentence in the abstract. Is it meant here that the distributions with succinic acid and Arctic sea water were shifted towards larger sizes with respect to the NaCl experiments? 19043 Lines 20-29. Please modify this section taking into account the discussion presented in the major comments.

19045 line 9: replace “to minimize any influence of organic matter” by “to minimise any organic matter contamination”

19060 lines 11-14. The fact that the Arctic seawater distributions were shifted towards larger sizes with respect to the pure NaCl measurements could also be due to the presence of other inorganic compounds. It is misleading that the authors state that similar behavior was obtained for the succinic acid and Arctic waters measurements, while the effect of other inorganic substances could have affected the results obtained for the Arctic waters.

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