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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Marine organic matter in the remote environment of the Cape Verde Islands – An introduction and overview to the MarParCloud campaign" *by* Manuela van Pinxteren et al.

**Anonymous Referee #1**

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The manuscript entitled "Marine organic matter in the remote environment of the Cape Verde Islands – An introduction and overview to the MarParCloud campaign" by van Pinxteren et al. describes the conditions and early results for a campaign designed to study the chemical interactions between the ocean and the marine boundary layer, including the formation of boundary layer clouds. It represents an interdisciplinary study of the sort that are increasingly seen in the field as the tight connections between ocean ecology, marine chemistry, atmospheric chemistry, and cloud formation are accepted by the community. The manuscript is generally well-written, but could benefit



from more specific language in some places, as described in the comments below. In general, I am excited to see the results that come from this study in greater detail in the future, as some of the results provide new perspectives. The manuscript is recommended for publication in Atmospheric Chemistry and Physics upon consideration of the comments provided.

Introduction and Motivation: Overall this section could be more specific about the gaps in knowledge that exist, rather than vaguely saying that broad swaths of information are 'elusive', for example. We do know quite a lot about ocean surface chemistry as a result of the prior work of many investigators, including many who are a part of this project. Some additional specific comments on this particular subject are listed below

Lines 96-101 – the word 'changing' is used often, but it is not clear what is inducing the change, and from what state a 'change' is referenced. Hence the sentence is rather vague. Consider using more active or specific verbs to be more precise about how marine OM will influence each of the important areas listed.

Lines 101-103 – the impact of primary aerosol production at the ocean surface has been explored more deeply in recent years (within the last 10 yrs or so) and, while we don't know everything, I'd say that the ability for particles to act as CCN or INP is not 'elusive' – indicating that we don't know much of anything. I would suggest that we are missing certain important pieces of information about CCN activity and also about what makes marine particles good INP (or not).

Line 122-123 – "or through a more direct transfer of OM from ocean compartments to the marine particles". This is vague – other than bubble bursting aerosol generation, what mechanisms are being discussed here?

Line 133 – "occurs as particulate and chromophoric dissolved organic matter" Imposing such a view limits one's conception of a vast array of chemicals existing in the SML, as is the case. There are fractions that are non-chromophoric and also not defined as particulate.

It is great to see the bullet list of questions in this section. I have a few small comments/questions about them, hopefully in the search for greater clarity.

Line 174 – Perhaps this is vague on purpose, but "To what extent" by which measure? By absolute mass? By absolute number of particles containing organic matter? What about the particle mixing state? As a fraction of total ambient aerosol mass? The way this question is asked has a profound effect on the environmental effects that it will speak to.

Line 176 – What are "OM groups"? Can a more specific wording be used here? Are you referring particular chemical functionality (fatty acids, carbohydrates, etc), operationally defined classes of material (DOM, POM, etc), or some other definition?

Line 189 – Are the authors asking whether the presence of marine OM in the surface ocean drives the concentration of CCN in the MBL? As written, the question does not presume the 'direction' of the relationship... presumably the implied direction is (in general terms): 'Does the ocean influence the atmosphere?' Being specific about this directionality allows this question to commute better with the final question about emission parameterizations.

Experimental Line 304 – Were cloud droplets actively removed from aerosol particle measurements? If so, which measurements? The reader may be able to deduce this from the size cuts (e.g., PM2.5, lower stages of cascade impactors) but it's less clear for some of the more indiscriminate samplers.

Conditions Section 4.2: In addition to primary producers, the state and dynamics of other portions of the microbial ecosystem have been shown to be key aspects that control how marine OM is incorporated into aerosol. Were any other biological metrics (heterotrophic bacteria, zooplankton, etc) assessed? If not, for clarity, please make a statement so that other readers and interested parties will understand the extent of data availability. [***Note: the reviewer later saw the section on marine bacteria in the 'Measurements' section. Perhaps this means that section 4.2 should be presented as



'Measurements' as well. The comment above is clearly addressed by the authors in the manuscript, but I'll leave it here as a signal that a reader may be similarly confused about the order of presentation.]

Measurements and Selected Results Section 5.1.1: Does the small fraction of sea spray aerosol determined by size distribution measurements comport with the chemical measurements in Section 5.1.2? While this may be the subject of a future paper, a evidence that different aerosol measurements agree in a general sense is an important point to make in a paper of this type.

Section 5.1.2: It is stated, somewhat simply, that the mass fraction of sodium and chloride in cloud water illustrates that supermicron particles were a dominant factor in cloud formation. However, mass-based chemical analysis, especially when not size resolved, is very easy to misinterpret. The key metric in cloud formation is the number concentration of droplets. The mass of supermicron particles increases as roughly the cube of the diameter, so particles that are 1 micron vs 100 nm contribute 1000x more mass to the cloud water! At the same time, particles larger than d = 200 nm activate at just about any relevant supersaturation relevant to this environment. The 'control' on the cloud drop number concentration, therefore, comes from the size range under 200 nm (down to, say 50 nm or so). Mass measurements will, therefore not tell us much about which particles actually control differences in cloud optical thickness, CDNC or droplet size – the climate relevant microphysical properties. Perhaps a clearer message concerning what we would like to learn from these measurements would help the description of the results, otherwise the results may be mis-interpreted by the less well-initiated reader.

Line 618-619: The dominance of C16:0 and C18:0 fatty acids aligns well with the findings of Cochran et al. (Environ Sci Technol, 2016) from sea spray tank studies. Making this type of connection for the reader may help their interpretation of the rather quick overview of this topic in this paper.

Figure 20: There is an error in the axis label for panel (a). The exponent is missing.

Section 5.7.3: Based on using just a few measurements of total bacterial abundance without process-level context, it is challenging to see that the question about the involvement of bacteria in this ocean surface/marine boundary layer system will be adequately addressed. While general reporting of the numbers is provided and is another data point to compare with across the globe, the identity of the bacteria involved is going to be of utmost importance. Some bacteria that are in high abundance are not very productive (reduced carbon utilization), so bulk number concentrations may mask the active processes that control the overall behavior driven by bacteria as a whole.

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