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Interactive comment on "Main drivers of transparent exopolymer particle distribution across the surface Atlantic Ocean" *by* Marina Zamanillo et al.

Anonymous Referee #2

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General comments This is a good manuscript, well written and very informative about TEP distribution in surface waters of the Atlantic Ocean, taking into account many other studies. The main limitations, in my opinion, rely on the number of data collected and the depth, only at 4 m, which probably underestimates other processes related to TEP presence especially close to the depth of the chlorophyll maximum. As pointed out by the other referee, conversions factors may be approximative and a proper critical consideration on any limitation should be included in the manuscript. Another general recommendation: TEP importance in processes such as air-sea gas exchange, aerosol formation, marine snow and carbon export and cycling should be better addressed in the whole study, as focal points of TEP influence on carbon dynamics, please see my

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comments in the introduction and discussion. I recommend that the following points are addressed before publication.

Abstract: Lines 37-38: The authors should be aware that air-sea gas exchange and aerosol emissions are complex processes, which are not properly explained in the manuscript. I would thus remove this sentence that in the abstract appears a bit vague and would concentrate on the role of TEP in channeling the carbon produced by primary productivity (see Mari et al. 2017). Lines 50-51: it could also be an inhibited TEP-aggregation by UV, not just breaking. I would rephrase the sentence.

Introduction: Lines 63-75: The introduction is a bit vague, I would introduce the concept of a marine gel, the composition and cross-links in the molecule that make TEP water insoluble but still subject to fragmentation and further aggregation processes, and the size distribution in the ocean, mentioning the size range we are talking about. 0.4 μm falls into the truly dissolved phase, and a discussion on the continuum of sizes linking DOM and POM should be added. Several species can directly release TEP or macrogels, but such macromolecules can also form from dissolved abiotic material in the absence of phytoplankton (Chin, W.-C., Orellana, M.V., Verdugo, P., 1998. Spontaneous assembly of marine dissolved organic matter into polymer gels. Nature 391, 568–572.) Moreover, the importance of TEP and marine snow should be mentioned. The role of TEP in the sea-surface microlayer should be either expanded or left out. The description presented here about air-sea gas exchange and aerosol is a bit vague and not precise. I would suggest spending more words on it, especially because 4 m depths is close to the surface so surface ocean processes and air-sea interaction should be properly mentioned. The role of TEP in the sea-surface microlayer depends on many factors: wind speed, primary productivity, and they are not the only class of gel particles present (e.g., highly productive region, see Engel and Galgani 2016, Biogeosciences, Wurl, O., Miller, L., Röttgers, R., and Vagle, S.: The distribution and fate of surface-active substances in the sea-surface microlayer and water column, Mar. Chem., 115, 1–9, 2009. Wurl, O., Miller, L., and Vagle, S.: Production and fate

of trans- parent exopolymer particles in the ocean, J. Geophys. Res., 116, C00H13, doi:10.1029/2011JC007342, 2011.). Line 69: specify what do you mean by "affect air-sea gas exchange". Lines 70-71: caution is needed here. Orellana et al. discuss about micro and nanogels, determined with a different method with respect to the one reported here. When gels are present in the sea-surface microlayer, it will depend on their size distribution whether they will be part of the organic aerosol fraction or not. Aerosol particles smaller than 1 μm will be part of the accumulation mode of sea-spray aerosols, but when further aggregating and reaching sizes above 2.5 μm they won't actually stay in the atmosphere longer than a few hours – as their size distribution is described as coarse mode aerosols. TEP as macromolecules are between accumulation and coarse mode but not ice-nucleating particles or cloud condensation nuclei. Another consideration is that if high wind speed are present (above 5 m/s), there might be increased aggregation rates of TEP with solid particles which will favour the formation of negatively buoyant aggregates that will sink out of the surface microlayer and surface waters in general. Line 80: not just photolysis but also UV inhibited aggregation of precursor polymers limits TEP formation. Line 102: What does this sentence mean? Please explain how HP affect TEP production and assembly of precursors. Line 106: I suggest introducing the concept of biological carbon pump and the importance of TEP in ocean carbon cycle, as this is a central idea of the study. How much estimated primary production carbon is channeled into the TEP pool? (See Mari et al., 2017). This could also help making confrontations with phytoplankton-derived carbon, still estimates but could be interesting. Lines 107-108: As mentioned already, TEP span over a wide range - DOC or POC is just an operational definition. From colloids (dissolved) to macrogels (particulate) (see Verdugo 2012 Annual Rev. of marine sciences).

Methods: If you have DOC data, I think it would be worth showing them and looking for the missing fraction that drives POC underestimation with respect to TEP, as TEP are connecting both pools of organic matter. Can you provide a standard deviation or error estimation for POC filters? Do you have wind speed information? This would be useful in estimating whether TEP could accumulate in the surface layer.

Discussion: Lines 317-319: Can you provide any reason why you think your values are higher than those observed in the Mediterranean Sea and Pacific Ocean? Is it related to nutrient concentration/time of year, different analysis method (e.g. spectroscopy vs microscopy for gel particles identification), depth?

Lines 355-356: The authors should mention here any limitation of the conversion factors. Line 331: is the organic matter that influences HPA concentration and their TEP production or ..? How does the organic matter pool influences TEP formation? If you mean, by abiotic assembly of a pool of dissolved precursors, this concept should be mentioned early in the introduction.

Lines 370-374: Again, the fate of TEP depends on further aggregation processes. Generally less dense than water could accumulate in the surface microlayer but wind speeds, high heterotrophic activity, coagulation with other organic and mineral particles thanks to their stickiness should be mentioned to describe their fate in the area. Which one do you think would predominate?

Lines 409-410: Again on aerosol formation, it's a complex process and without any information on the size distribution of TEP in this study I would recommend caution in making such affirmations. Here, it's a bit a "stand alone" sentence without any further explanation, which does not make much sense. It should be expanded and explained better. Also, please see the paper by Quinn et al. 2014 "Contribution of sea surface carbon pool to organic matter enrichment in sea spray aerosol" Nature Geoscience, which actually breaks up the concept of organic aerosols related to phytoplankton blooms (and in this case, TEP). Line 444: as mentioned, TEP can also be produced by aggregation of colloids in the absence of phytoplankton, that is, in the presence of polymeric precursors in the dissolved phase. Thus, it would be interesting to see the relationship of TEP to DOC or acidic sugars.

Line 454: UV also inhibits gel aggregation (Orellana and Verdugo 2003, Ultraviolet radiation blocks the organic carbon exchange between the dissolved phase and the

gel phase in the ocean, Limnology and Oceanography). It should be mentioned here.

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