IMPACTS OF PHYTOPLANKTON BLOOMS ON SEA SPRAY AEROSOL

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1. INTRODUCTION

Sea Spray Aerosol (SSA) is produced when air bubbles are entrained into the marine atmosphere by the breaking of waves, and plays a significant role in climate processes. SSA can affect the planet's solar radiation budget, which in turn may alter cloud albedo and precipitation processes (Quinn 2014). SSA can also act as cloud condensation nuclei, providing a surface for water vapor to condense (Quinn, 2014). These marine aerosol particles contains not only sea salt but also various types of ions and organic matter.

The North Atlantic Aerosols and Marine Ecosystems Study (NAAMES) is a five-year project that collected marine and atmosphere data for each season in the North Atlantic to understand the key processes between the ocean and atmosphere and their implications on climate. During the cruises, aerosol samples were generated at the ocean surface and collected for organic and inorganic ion analysis.

The two main types of organic carbon in the ocean are dissolved and particulate organic carbon. Phytoplankton release dissolved organic matter (DOC) into the ocean and then is eventually released into the atmosphere through bubble bursting at the surface (Quinn 2014). While POC makes up only ~3% of the ocean's total organic carbon, analysis of the data collected from NAAMES may point to an interaction between DOC and POC with the atmosphere.

Determining the relationship, if any, between components of ocean surface waters and the atmosphere, is crucial in gaining a better understanding of processes changing with our changing climate. Specifically, whether there was a positive correlation between dissolved organic carbon and the organic carbon fraction making its way into the atmosphere.

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2. METHODS

Data for the seawater parameters were collected by many scientists aboard the NAAMES cruises over the four seasons measured (Spring: 2018/03/20-2018/04/13 (NAAMES 4), Summer: 2016/05/11-2016/06/05 (NAAMES 2), Fall: 2017/08/30-2017/09/24 (NAAMES 3), Winter: 2015/11/06-2015/12/01(NAAMES 1). The seawater parameters were collected using CTD-Niskin Rosette. The sea spray aerosol samples collected by NAAMES scientists using the means of sea sweep and ambient. For this particular project, only the sea sweep SSA was analyzed. Carbon aerosol analysis and ion chromatography were used to analyze the samples.

3. DATA ANALYSIS

IGOR Pro©, a data analysis software, was used to graph the seawater and sea spray aerosol parameters (Fig. 1, 2, 3).

The Enrichment Factor equation (Equation 1.) was used as a comparative means between sea spray aerosol and seawater since sodium is the common factor between these two.

$$EF_{OC} = \frac{[(\text{OC as C}) / Na^{+}]_{SSA}}{[(\text{TOC as C}) / Na^{+}]_{seawater}}$$

Equation 1. The enrichment factor of organic carbon found in sea spray aerosol relative to the organic carbon in seawater (Quinn, 2015)

The possible relationship between dissolved organic carbon (DOC) and organic carbon (OC) was plotted over the four legs (Fig. 1). There was particular interest in Leg 2, Station 4 (NAAMES 2) due to the changing weather systems over the region the ship was stationed, and the phytoplankton bloom in this region was changing as well. See Fig 2, 3.

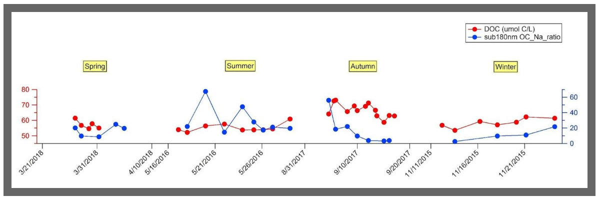

Figure 1. DOC and OC (sea spray aerosol parameter) over the four legs/seasons of the NAAMES expeditions.

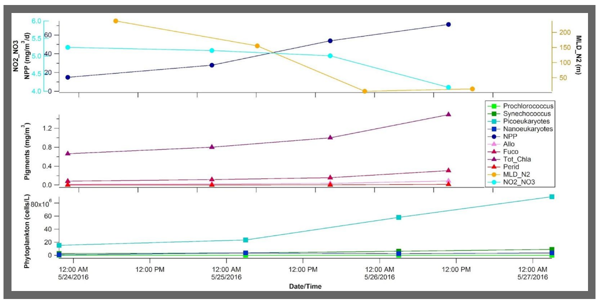

Figure 2. Leg 2, Station 4. Top graph: Nitrite/Nitrate & Net Primary Productivity (NPP) vs Mixed Layer Depth. Middle graph: Pigments vs. Date/Time. Bottom graph: Phytoplankton vs. Date/Time.

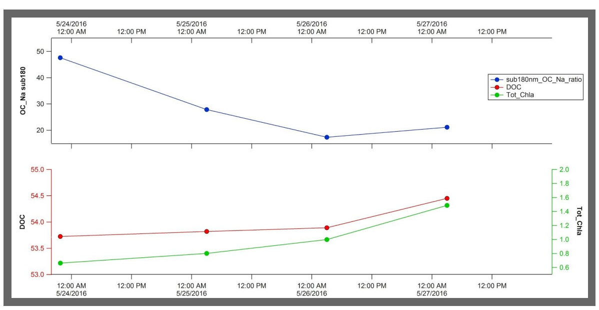

Figure 3. Leg 2, Station 4. Top graph: OC fraction vs. Date/Time. Bottom graph: DOC and Total Chlorophyll vs. Date/Time.

3. SUMMARY AND CONCLUSIONS

No clear seasonal trend was found in the small fraction of OC in SSA. The sea sweep data did not show an obvious trend between OC and DOC, and so that relationship is still undetermined at this time. However, the case study of Leg 2, Station 4 did show biological changes. It may be of use to analyze ambient aerosol samples as to whether a relationship may be found between SSA and DOC.

4. ACKNOWLEDGEMENTS

This work was supported by the NOAA Ernest F. Hollings Scholarship. Thank you to Trish Quinn, Lucia Upchurch, and Derek Coffman

5. REFERENCES

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