Arctic primary aerosol production strongly influenced by riverine organic matter

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Introduction

The sources of primary and secondary aerosols in the Arctic still are poorly known. Here, sea spray generation chamber was used to assay a number of surface seawater samples from coastal to open ocean waters, with varying degrees of riverine and sea ice influences, for their potential to produce sea spray aerosols (SSA) and cloud condensation nuclei (CCN).

Methods

Seawater sampling was conducted in the Beaufort Sea of the western Arctic Ocean onboard the Korean icebreaker R/V Araon from 30 August to 11 September 2017. Surface seawater samples were collected at 9 stations (Figure 1). 3 surface water samples from the coastal sea (CS 1 – CS 3), 4 surface water samples from the shallow ocean (SO 1 – SO 4), and 2 surface water samples from the deep ocean (DO 1 and DO 2) were collected.

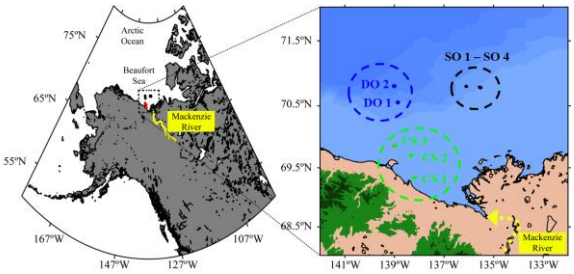

Figure 1. Locations of surface seawater samples from coastal waters, shallow ocean, and deep ocean.

SSA particles were produced onboard using a laboratory-scale sea spray tank. The tank and how it works has been described previously in more detail (Sellegri *et al*., 2006). SSA particles generated by this tank were dried using a series of diffusion dryers, and the size distribution and CCN concentration of the dried SSA particles were measured using various aerosol instruments. Simultaneously, OM indicators in seawater such as chlorophyll *a* (Chl *a*), bacteria, viruses, dissolved organic carbon (DOC), chromophoric DOM (CDOM), fluorescent DOM (FDOM), dissolved organic nitrogen (DON), transparent exopolymer particles (TEP), and coomassie stained particles (CSP) were measured.

Conclusions

Data showed that both sea salt and organic matter significantly influenced the sea spray production. The number concentration (N) of SSA in the coastal samples was negatively correlated with salinity and positively correlated with DOC, indicating that organic matter of riverine origin enhances primary aerosol production. Strong positive correlations were also found for CDOM, TEP, CSP, and Chl *a* (Figure 2) but not for viral and bacterial abundances. When all samples were considered, TEP correlated positively with the ratio N/sea salt. Since Arctic rivers account for ~61% of the Arctic total area, it is expected that riverine organic matter has a substantial impact on marine primary aerosol production. However, the impact of organics on CCN activity of SSA particles was minor or even negative.

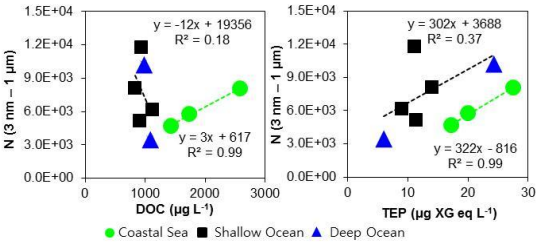

Figure 2 Relationships between N (3 nm–1 µm) of SSA and concentrations of DOC and TEP in seawater samples from CS (green circles), SO (black squares), and DO (blue triangles).

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Sellegri, K., O'Dowd, C. D., Yoon, Y. J., Jennings, S. G., & Leeuw, G. d. (2006). *J. Geophysical. Research. Atmospheres.* 111, (D22).