

## The physical and chemical characteristics of marine primary organic aerosol

MESKHIDZE, N. AND B. GANTT

North Carolina State University, Raleigh, NC, USA,  
nmeskhidze@ncsu.edu, bdgantt@gmail.com

Knowledge of the physical characteristics and chemical composition of marine organic aerosols is needed for the quantification of their effects on solar radiation transfer and cloud processes. This presentation examines research pertinent to the chemical composition, size distribution, mixing state, emission mechanism, photochemical oxidation, and climatic impact of marine primary organic aerosol (POA) associated with sea spray. Numerous measurements have shown that both the ambient mass concentration of marine POA and size-resolved organic mass fraction of sea spray aerosol are related to surface ocean biological activity. Recent studies have also indicated that fine mode (smaller than 200 nm in diameter) marine POA can have a size distribution independent from sea-salt, while coarse mode aerosols (larger than 1000 nm in diameter) are more likely to be internally-mixed with sea-salt. Modeling studies have estimated global submicron marine POA emission rates of  $\sim 10 \pm 5 \text{ Tg yr}^{-1}$ , with a considerable fraction of these emissions occurring over regions most susceptible to aerosol perturbations. Climate studies have found that marine POA can cause large local increases in the cloud condensation nuclei concentration and have a non-negligible influence on model assessments of the anthropogenic aerosol forcing of climate. Despite these signs of climate-relevance, the source strength, chemical composition, mixing state, hygroscopicity, cloud droplet activation potential, atmospheric aging, and removal of marine POA remain poorly quantified.

The current presentation will also summarize results from the recent marine aerosol workshop held in Raleigh, NC [1], where workshop participants identified the most critical open questions regarding sea spray aerosol and developed a list of priorities for conducting and facilitating novel research. The rankings of the most pressing science questions based on their feasibility impact on reducing the current uncertainty ranges for different processes will also be discussed. The workshop presentations are available online at: [http://www4.ncsu.edu/~nmeskhi/Marine\\_Aerosol\\_Workshop/WEBSITE.html](http://www4.ncsu.edu/~nmeskhi/Marine_Aerosol_Workshop/WEBSITE.html).

[1] Meskhidze *et al.* (2013) *Atmos. Sci. Lett.*, in review.

## Effect of atmospheric organics on iron bioavailability

MESKHIDZE, N.<sup>1</sup>, M. S. JOHNSON<sup>2</sup>, D. HURLEY<sup>1</sup>,  
AND M. D. PETERS<sup>1</sup>

<sup>1</sup>North Carolina State University, Raleigh, NC, USA  
nmeskhidze@ncsu.edu, dlhurley@ncsu.edu,  
mdpeter@ncsu.edu

<sup>2</sup>NASA Ames Research Center, matthew.s.johnson@nasa.gov

Iron (Fe) delivered to the surface ocean through atmospheric pathways is of specific interest for the marine environment and plays a vital role in the earth's biogeochemical cycle. The deposition of atmospheric Fe to the ocean's surface may be an important control on primary productivity in vast areas of the global oceans. Mineral Fe at the source regions is primarily in the form of Fe-oxyhydroxides and aluminosilicate minerals. Once airborne, Fe can be mobilized from the minerals through the effect of acids, organics, and sunlight initiating a complex cycling between ferric (Fe(III)) and ferrous (Fe(II)) forms of Fe.

Here mineral dust and dissolved Fe ( $\text{Fe}_d$ ) deposition rates are predicted using GEOS-Chem with a comprehensive dust-Fe dissolution scheme. The model simulates  $\text{Fe}_d$  production during the atmospheric transport of mineral dust taking into account inorganic and organic (oxalate)-promoted Fe dissolution processes, Fe(II)/Fe(III) photochemical redox cycling, dissolution of Fe-containing minerals (hematite, goethite, and aluminosilicates), and detailed mineralogy of wind-blown dust. Calculations suggest that during the yearlong simulation  $\sim 0.26 \text{ Tg}$  of  $\text{Fe}_d$  was deposited to global oceanic regions [1]. Compared to simulations only taking into account proton-promoted Fe dissolution, the addition of oxalate to the dust-Fe mobilization scheme increased total annual model-predicted  $\text{Fe}_d$  deposition to global oceanic regions by  $\sim 75\%$ . During the daytime, a large fraction of model-predicted fluxes of  $\text{Fe}_d$  are in the Fe(II) form, while nocturnal fluxes of  $\text{Fe}_d$  are largely in the Fe(III) form [1].

In addition to model simulations, laboratory experiments were also conducted to quantify the effects of atmospheric organics on Fe bioavailability after deposition to the surface ocean. Fe(II) was detected by absorbance spectrophotometry using the Ferrozine technique and total soluble iron was determined by addition of hydroxylamine to reduce Fe(III) to Fe(II). This presentation will refine the concept of what constitutes soluble Fe in atmospheric waters and bioavailable Fe in the oceans. The important role of atmospheric organics for marine biogeochemistry and carbon cycling will also be discussed.

[1] Johnson, M.S. and N. Meskhidze (2013), *Geosci. Model Dev. Discuss.*, 6, 1901-1947.