Fluxes of bio-active aerosol trace elements in the North Atlantic

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The supply of bio-active trace elements (TEs) to the open ocean from aerosol deposition is an important, but poorly constrained, process. To reliably quantify this process one needs a suitable time series of aerosol concentrations, an estimate of the solubility of aerosols to produce bio-active TEs in the upper ocean, and some way to quantify the aerosol deposition rate. Time series of aerosol concentrations are available from a number of island sampling locations, and more recently from ship-board collections, although the need for more data remains. Aerosol solubility has been measured using many different methods, including exposing aerosols to freshly collected seawater with its natural TE binding ligands. Quantifying aerosol deposition using Be-7 inventories in the upper water column shows promise for constraining the effective aerosol deposition velocities. In this work, we compared a variety of aerosol leaching methods. We then investigated the aerosol solubility from samples collected at the Tudor Hill site on Bermuda and from the north Atlantic (US GEOTRACES GA03 cruise) using an ultrapure water leach (UHP) and a more aggressive leach using 25% acetic acid with 0.02M hydroxylamine (the "Berger leach"), and compared it to samples leached with fresh seawater. The UHP leach is likely to represent the minimum aerosol solubility, while the Berger leach may reflect the maximum solubility. With respect to aerosol deposition, we used the inventory of Be-7 in the upper water column in the Sargasso Sea coupled with aerosol Be-7 measurements to constrain the effective bulk aerosol deposition velocity (2600 +/- 300 (95% CI) meters per day). The fluxes of soluble aerosol bio-active TEs were then compared to the estimated biological requirements based on the net primary productivity across the North Atlantic to judge whether aerosol input was sufficient to satisfy the TE requirements for primary producers.