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A realtime, online automated system for measurement of Phosphate ions in atmospheric particles

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Primary productivity of continental and marine ecosystems is often limited or co-limited by phosphorus. Of particular interest is the role of phosphorus in marine primary productivity, owing to its potential for affecting the concentration of atmospheric carbon dioxide. The atmosphere is considered a principal source of externally-supplied nutrients for large areas of the surface ocean, and oligotrophic open oceans in particular. Atmospheric inorganic P species (e.g. mono- or diprotonated orthophosphate) comprise the most bioavailable P form, and have been studied for many decades. Nevertheless, there are very large uncertainties in the phosphate biogeochemical budget due to the lack of observations and the poor match of the model to observations.

This study presents a novel automated on-line, real-time analytical method for the analysis of water-soluble PO4-3 ions in atmospheric particles. The instrumentation consists of a particle-into-liquid sampler (PILS) coupled with a reaction coil to allow reagents to interact with the PILS liquid flow; the composite flow is then introduced into a mini spectrophotometer, which is equipped with a long path length of 250cm Liquid Wavequide Capillary Cell (LWCC), achieving low detection limit. This new system overcomes the limitations on detection and time resolution, as the configuration presented allows for measurement with 8 minute resolution. The data, when combined with routine PILS-IC or aerosol mass spectrometry, allows for an unprecedented insight towards the drivers of phosphate solubility and its relation to acidification from atmospheric acids. We present results for concentration of PM2.5 PO4-3 in Atlanta Georgia for a 2 month period (February-March, 2015) and the Eastern Mediterranean and its relation to aerosol acidity and other meteorological parameters. The results are discussed together with future directions towards optimized performance during long periods of operation.