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The atmospheric delivery and controls of soluble P in the E.Mediterranean

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Phosphorus is an important nutrient for terrestrial and ocean ecosystems. The availability of this element can impact primary production rates in the ocean (Schlesinger 1997, Paytan & McLaughlin 2007). Aerosols are a significant source of P to the oceans, especially dust particles and biomass burning particles increase the atmospheric influx importance over P-limited regions like Eastern Mediterranean. Recent work in the E. Mediterranean (Nenes et al., 2011) has suggested that acidification of dust by acidic species (sulfate, nitrate and organic acids) may promote the fraction of P that is water-soluble, hence bioavailable upon deposition to the surface ocean.

A novel online method combining PILS – LWCC- SRP 1 was used for automated, continuous, high-resolution and sensitive measurements of ambient PM2.5 phosphate over a period of 10 months (January−October 2016) at the premises of the University of Crete in Heraklion, Greece. This new method offers better detection of phosphate ions (detection limit was 0.4 nM P, equivalent to 0.03 nmol P m−3 in atmospheric particles) with a high temporal resolution. Alongside these measurements, in order to compare the performance of the new method and also to identify phosphate sources and the factors controlling their variability concurrent filter aerosol sampling was performed. Ion chromatography was used to identify the ionic composition of the filter samples and phosphate, sulfate, oxalate and potassium ions were detected. These data helps us to understand the drivers of phosphate solubility and its relation to acidification from atmospheric acids. Additionally, the correlation of the water soluble fraction of Ca and P with bulk pH estimated from thermodynamic modeling (isorropia) will help us estimate the impact of acid dissolution on the delivery of soluble P to the E. Mediterranean.
The concentration of the phosphate anions measured with the pils-lwcc-srp method was subsequently compared to the respective one defined from the filters. Furthermore, comparisons between the detected ions and the back trajectories were used for the identification of their potential sources.
The mean value of water-soluble phosphate concentration was estimated to be 0.32 nmol / m3. Periods with dust input from the Sahara Desert and biomass burning phenomena influenced the water-soluble phosphorus concentration. The mean phosphate value during these events was estimated to be 50% higher at 0.49 nmol / m3.

References

[1] Violaki, Kalliopi et al. 2016. “Real-Time, Online Automated System for Measurement of Water-Soluble Reactive Phosphate Ions in Atmospheric Particles.” Analytical Chemistry 88(14): 7163–70.