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Primary and secondary particles chemical composition of marine emissions from Mediterranean seawaters

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Marine emissions are among the largest source of both primary particles and do highly contribute secondary organic aerosols (SOA) at a global scale. Whereas physical processes control the primary production of marine aerosols, biological activity is responsible for most of the organic fraction released from marine sources, potentially transformed into SOA when exposed to atmospheric oxidants. The Mediterranean atmosphere displays important concentrations of SOA, especially in summer, when atmospheric oxidants and photochemical activity are at their maximum. The origin of these elevated concentrations of SOA remain unclear.

Here we present the results from a mesocosms study in a remote location in Corsica and a chamber study (using fresh sea water from Western Mediterranean) as part of the Source of marine Aerosol particles in the Mediterranean atmosphere (SAM) project. The mesocosm study was conducted at the Oceanographic and Marine Station STARESO (Corsica) in May 2013. One mesocosm was used as a control (with no enrichment) and the other two were enriched with nitrate and phosphate respecting Redfield ratio (N:P = 16) in order to produce a bloom of biological activity. Physical and chemical properties of the enclosed water samples together with their surrounding atmosphere were monitored during 20 days by a multi-instrumental high-time resolution set-up. In parallel, numerous additional measurements were conducted including water temperature, incident light, pH, conductivity, chemical and biological analyses, fluorescence of chlorophyll, dissolved oxygen concentration. The chamber studies were performed in a Teflon chamber of 1. 5m3 that accommodates a pyrex-container for the fresh sea-water samples. After injection of sea-water in the pyrex-container, the system is allowed to stabilize to 20-30 minutes, then it was exposed to 60-100ppbv of ozone and/or UV-A irradiation.

Aerosol concentrations and their physical characteristics were followed by means of Scanning Mobility Particle Sizers; clusters concentration was monitored using a Particle Size Magnifyer (PSM); the gas-phase composition of volatile organic compounds was determined by using Proton Transfer Reaction Time-of-Flight Mass Spectrometer and cartridges. Aerosol chemical composition was investigated using High Resolution Time-of-Flight Aerosol Mass Spectrometer, filters analysis and TEM-EDX microscopy.

Results evidence a complex nature of the primary emitted aerosol which is not clearly associated to the biological bloom (ex. cholrophyll), VOCs emission was observed during high biological activity periods. Formation of new particles was observed in the chamber and seemed to be related to iodine species (in the absence of any macroalgea population).