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Chemical properties and morphology of Marine Aerosol in the Mediterranean atmosphere: a mesocosm study

Barbara D'Anna (1), Karine Sellegri (2), Bruno Charrière (3), Richard Sempéré (3), Sébastien Mas (4), Nicolas Marchand (5), Christian George (1), Aurèlie Même (1), Badr R'mili (1), Anne Delmont (3), Allison Schwier (2), Clémence Rose (2), Aurèlie Colomb (2), Jorge Pey (5), and Helen Langley Dewitt (5)

(1) Université de Lyon, Lyon, F-69626, France; Université Lyon 1, Lyon, F-69626, France; CNRS, UMR5256, IRCELYON, Institut de Recherches sur la Catalyse et l'Environnement de Lyon, Villeurbanne, F-69626, France. (barbara.danna@ircelyon.univ-lyon1.fr), (2) Laboratoire de Météorologie Physique, UMR 6016 CNRS/UBP, Observatoire de Physique du Globe de Clermont-Ferrand (OPGC), (3) 3Aix Marseille Université, CNRS/INSU,IRD, Mediterranean Institute of Oceanography (MIO), UM 110, 13288 Marseille, Université de Toulon La Garde, France, (4) Centre d'écologie marine expérimentale MEDIMEER (Mediterranean Center for Marine Ecosystem Experimental Research) UMS 3301 (Université Montpellier 2, CNRS), Sète, France, (5) Aix-Marseille Universite, CNRS, LCE FRE 3416, 13331, Marseille, France

The Mediterranean Sea is a special marine environment characterized by low biological activity and high anthropogenic pressure. It is often difficult to discriminate the contribution of Primary Sea Salt Aerosol formed at the sea surface from background level of the aerosol. An alternative tool to study the sea-air exchanges in a controlled environment is provided by the mesocosms, which represent an important link between field studies and laboratory experiments.

The sea-air transfer of particles and gases was investigated in relation to water chemical composition and biological activity during a mesocosm experiment within the SAM project (Sources of marine Aerosol in the Mediterranean) at the Oceanographic and Marine Station STARESO in Western Corsica (May 2013).

Three 2 m mesocosms were filled with screened (<1000 μm) 2260 L of subsurface (1 m) seawater and covered with a transparent Teflon film dome to minimize atmospheric contamination. The mesocosms were equipped with a pack of optical and physicochemical sensors and received different treatments: one was left unchanged as control and two were enriched by addition of nitrates and phosphates respecting Redfield ratio (N:P = 16).

The evolution of the three systems was followed for 20 days. The set of sensors in each mesocosm was allowed to monitor, at high frequency (every 10 min), the water temperature, conductivity, pH, incident light, fluorescence of chlorophyll a and dissolved oxygen concentration. The mesocosm seawaters were daily sampled for chemical (colored dissolved organic matter, particulate matter and related polar compounds, transparent polysaccharides and nutrients concentration) and biological (chlorophyll a, virus, phytoplankton and zooplankton) analyses. Both dissolved and gaseous VOCs were also analyzed.

In addition, few liters of seawater from each mesocosm were daily and immediately collected and transferred to a bubble-bursting apparatus to simulate nascent sea spray aerosol. On-line chemical analysis of the sub-micrometer fraction was performed by a TOF-AMS (Aerodyne). Off-line analysis included TEM-EDX for morphology and size distribution studies and a hybrid quadrupole-orbitrap mass spectrometer (Thermo Fischer) for molecular identification of the organic fraction.