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Black carbon enrichment structures marine microbial activities and interactions

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Black carbon (BC) is a general term that describes partially combusted organic matter (aerosol and particles) deriving from biomass and fossil fuels burning. According to the IPCC's reports BC emissions are the second-largest contributor to global warming after CO_2 emissions. It follows that BC is a very pervasive force shaping the atmosphere and the oceans that we can not ignore in our studies. BC particles enter the marine system via dry deposition or river run-off. Once in the sea, BC particles structure the organic matter continuum and bacteria-mediated carbon biogeochemical cycle. In a series of five incubation experiments (one in the light and four in the dark), we have challenged the microbial community with a heavy load of BC particles (24 mg/L) in order to study the BC effect on microbial activities and interactions over time (48 h).
At the microscale, using Atomic Force Microscope we showed that BC particles can have a wide range of shape and size from few nm to tens of μm and can "scavenge" natural organic matter. The nm-size BC were attached to the microbes. Furthermore, using Laser Scanning Confocal Microscopy we showed that two most dominant bacterial isolates (Pseudoalteromonas sp. and Alteromonas sp.) could attach and take off from the BC particles and displayed opposite behaviour to a gradient of BC concentration (by dark-field microscopy). Furthermore, the larger BC particles were adsorbing viruses thus weakening the viral control onto the bacterial population.
At the macroscale, heterotrophic bacteria exploited the newly particles and become BC-attached within 30 min (equal to 2-8 % of the free-living fraction). Over time, bacteria, in the presence of BC, showed 2x faster secondary carbon production and lower alkaline phosphatase (BC releases P) and comparable protease to the non-BC exposed bacterial community.
We will present and discuss the results of the manipulation in the light of BC structuring effect on the marine carbon biogeochemical cycle and bacterial community (16S amplicons) with a microscale to macroscale prospective.