Do we inhale aerosolized microplastics on the beach?

Lambert Silke[1,2], Vercauteren Maaike[1], Van Landuyt Josefien[3], Liu Zixia[1], Diopere Eveline[2], Boon Nico[3], Janssen Colin R.[1] and Asselman Jana[1]

[1] Ghentoxlab, Faculty of Bioscience engineering, Ghent University, Coupure Links 653, 9000 Gent, Belgium
E-mail: silke.lambert@UGent.be
[2] Blue Growth Research lab, Ghent University, Bluebridge Ostend Science Park, Wetenschapspark 1, 8400 Oostende, Belgium
[3] Center for Microbial Ecology and Technology (CMET), Faculty of Bioscience engineering, Ghent University, Coupure Links 653, 9000 Gent, Belgium

A lot of microplastics (MPs) enter aquatic ecosystems, with estimated amounts between 19 and 23 million metric tons (Mt) or 11% of the plastic waste generated globally in 2016. Under business as usual, plastic waste entering the world's aquatic ecosystems could, according to predictions, reach 90Mt per year by 2030. Thus oceans, and aquatic ecosystems in general, are known to be sinks for plastic pollution. This plastic pollution contains microplastics (MPs), plastic particles with sizes between 1µm and 5mm, and nanoplastics (NPs), plastic particles with sizes smaller than 1 µm. MPs are used in applications such as personal-care products and cosmetic products or are the result of fragmentation of bigger plastics due to photodegradation, physical abrasion, hydrolysis and biodegradation. The plastic particles may pose a risk to the aquatic environment and can be a potential threat to human health. The particles itself may pose a risk as well as potential pathogens and persistent organic pollutants that can be associated and transported with the particles.

However, what if these MPs do not stay in the ocean, but are transferred into the air? Then, the ocean is not only a sink for MPs but also a source. A possible pathway into the air could be the transfer of micro- and nanoplastics in sea spray aerosols (SSAs). When waves in the ocean break, underwater air bubbles are created. When these bubbles come to the surface, they burst and aerosols are ejected into the air. Research has already shown that these SSAs introduce particulate matter, microorganisms, fatty acids and many more organic and inorganic compounds into the atmosphere. Nonetheless, little to no information is available on the presence of plastics in SSAs. If micro- or nanoplastic particles are indeed capable to be included in these SSA, plastics from the ocean could be transferred to the air and transferred to terrestrial environments.

The aim of this study was to investigate the possible presence of micro- and nanoplastics in SSAs and study the influence of different polymer types and sizes on this process. An experimental set up that simulates the aerosolization process at sea was set up, based on Masry et al. (2021, doi: 10.1016/j.envpol.2021.116949), where air bubbles bursting at the surface of the water was created on a small scale. The water was spiked with a known concentration of MPs. Aerosols were created and the MPs present in these aerosols were collected onto a filter and particle concentrations were counted under the microscope or with the use of flowcytometry. Different size classes and different types of microplastics were tested. Afterwards an enrichment factor of MPs was calculated, relative to the sodium concentration, which is used as a proxy for the amount of sea spray aerosol.

From the performed experiments, we can observe that only the small microplastics particles seem to be incorporated in the SSAs, but the bigger particles will not be introduced in the air via sea spray aerosols. Thus, as expected, the size of the plastics has an impact on the aerosolization, but further experiments with particles in wider size ranges (100 nm-5µm) will be able to provide more information on the size-thresholds for aerosolization. The importance of the type of plastics on their aerosolization behavior, is currently being investigated.

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