
Airborne microplastics over the Baltic: the role of sea-spray emission

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Abstract

The concentrations of both atmospheric and marine MPs were measured over the Baltic along a research cruise that started in the Gdansk harbour, till the Gotland Island, and during the way back. A "Deposition box" was used to collect airborne MPs. Marine MPs concentrations were investigated during the cruise using a dedicated HydroBios microplastic 300 μm mesh net.

MPs images were recorded both using optical camera Leica ICC50W installed on a dedicated Leica DM750P microscope allowing the quantification of microparticle length and width.

Results showed airborne microplastics average concentrations higher in the Gdansk harbour ($161 \pm 75 \text{ m}^{-3}$) compared to the open Baltic Sea and to the Gotland Island (24 ± 9 and $45 \pm 20 \text{ m}^{-3}$). These latter values are closer to the ones measured in the sea ($79 \pm 18 \text{ m}^{-3}$). The MPs composition was investigated using μ -Raman (for the airborne ones) and FTIR (for marine ones after dissolution of organic matter via H_2O_2); similar results (e.g. polyethylene, polyethylene terephthalates, polyurethane, polystyrene) were found in the two environmental compartments. Airborne and marine MPs were characterised by similar colours: blue/black, transparent and red fibres.

Moreover, airborne and marine MPs appeared correlated ($R^2=0.89$) when considering the simultaneous available measurements and they were characterised by the same average width (17 ± 2 and $18 \pm 5 \mu\text{m}$, respectively) but different length (427 ± 59 and $2060 \pm 1970 \mu\text{m}$) suggesting that in case of sea emission of MPs only the shorter ones can remain suspended in the atmosphere.

The atmospheric MPs' equivalent aerodynamic diameter was calculated ($28 \pm 3 \mu\text{m}$) showing the capability of atmospheric MPs to remain suspended in the air once emitted from the sea. The estimated MPs sea emission fluxes of MPs volume ($4 \cdot 10^6$ to $18 \cdot 10^6 \mu\text{m}^3 \text{ m}^{-2} \text{ s}^{-1}$ range) showed the contemporary presence of atmospheric transport together with a continuous emission from the sea.

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