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Development of interdisciplinary model of microplastics transport and transformation in the Baltic sea

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Nowadays, anthropogenic pressure from the coastal areas comes up in many aspects of marine environment changes, decreasing the aesthetics of the underwater world, threatening the sustainability of marine ecosystems and influencing the quality of human life.

Microplastics are pervasive throughout the marine environment, are ingested by many marine organisms, and enter a food chain that includes humans. A certain fraction of microplastics in marine environment results from breakdown of larger items in numerous tiny fragments due to mechanical forces and photochemical processes, as well as from other degradation sources. Microplastics can absorb high levels of Persistent Organic Pollutants (POPs) and other toxins. Deep-sea sediments are a likely, but yet unquantified, sink for microplastics (Cole et al., 2011).

Since the MARBLE ('MicroplAstics Research in the BaLtic Environment') project started, three expeditions and multiple on-shore field experiments have been conducted in the South-Eastern Baltic. The samples were collected from the surface, deep water layers and bottom sediments. The samples were processed and physical parameters of the microparticles were established. In parallel, laboratory experiments under controllable conditions over the particles of regular shapes were conducted in order to test the empirical formulas for the sinking velocity. PLEX ('PLastics EXplorer') – a device for efficiently collecting microparticles in marine environment – was developed, built and tested. An attempt was made to quantify some geometrical properties of particles, to compare their surface areas, fouling rates, sinking velocities, and finally provide some estimates for the main spatial and temporal scales, describing the behaviour of the particles of different densities and shapes in the Baltic Sea (Chubarenko et al., 2016).

An original 3D model of Microplastics dynamics is under development now. Its aim is to provide a robust numerical predictive tool to study pathways and lifecycle of plastic pollution in the enclosed basins such as the Baltic Sea. The model consists of the TRACMASS lagrangian numerical module written in FORTRAN programming language, while the TRACPY shell (written in Python) provides input-output interface (Döös et al., 2013). The data on the Baltic Sea circulation was provided by Copernicus project (marine.copernicus.eu) based on HIROMB model for 1998-2015.

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