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Microplastics distribution in the water column

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Spatial distribution, dynamical behavior, and possible ecosystem threats of microplastics (MPs), small plastic particles < 5 mm, attract a significant share of attention of environmental scientists in the last years. Plastics in general have various densities from hundredths-tenths of g/cm3 to around 2 g/cm3. MPs denser than water will immediately sediment to the seabed from the surface, while particles with positive buoyancy could stay in the mixed layer for some time until they form aggregates with (in)organic particles, or are biofouled, and thus their buoyancy is changed to negative leading to sedimentation. Particles with slight excess density might be more sensitive to the water stratification and slow down while reaching the density gradients. At these depths dynamic zones of MPs accumulation may exist. However, vertical distribution of MPs in the water column is poorly investigated up to date. Distribution of MPs in the water column was studied on the basis of field data collected in the Baltic Sea during 7 cruises of Atlantic Branch of Shirshov Institute of Oceanology in 2015-2018. Temperature and salinity profiles were obtained from CTD measurements. Water was sampled with 10 l Niskin sampler on the following depths: surface, near bottom layer, depths corresponding to the cold intermediate layer, thermocline, and halocline. Water was filtered on 174 μm filters and analyzed using optical and spectrometry methods. Bulk mean concentration of particles was 199 $\pm$ 65 particles/m3. Fibers represent the main type of MPs found (were detected in more than 70% of samples). One factor ANOVA test shows that MPs concentrations at the sea surface, near-bottom and intermediate depths (with mean value of 332, 205, and 50 particles/m3, correspondingly) are significantly different, F3,05=5.8, p=0.05. Differences between MPs concentrations on five specific depth levels were not statistically significant, however the mean values demonstrate physically relevant distribution with highest concentrations in the surface and near bottom layer with supposedly highest mixing rates and turbulence, decreased concentrations upon the thermo- and halocline and associated density gradients, and lowest concentration in the cold intermediate layer. Observed pattern corresponds to the distribution of suspended particulate matter and marine snow implying that 1) MPs could be considered as another type of suspended matter in the marine environment, 2) existent knowledge on suspended matter behavior might be applied to MPs, 3) attempts should be made to incorporate MPs in the complex system of suspended particles behavior and interaction in the water column, 4) density stratification might be considered in the MPs studies of vertical distribution especially in shallow seas.