Microplastics at the water column: Their distribution and dynamics at the Eastern Northatlantic ocean down to 1150 meters -337446-

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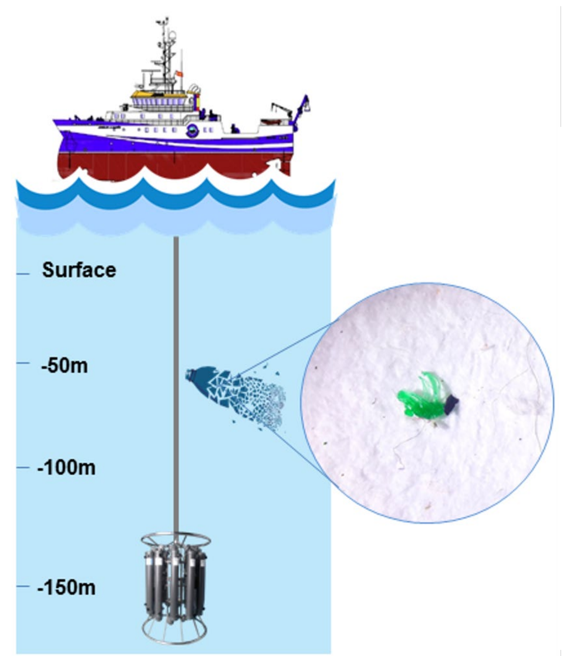
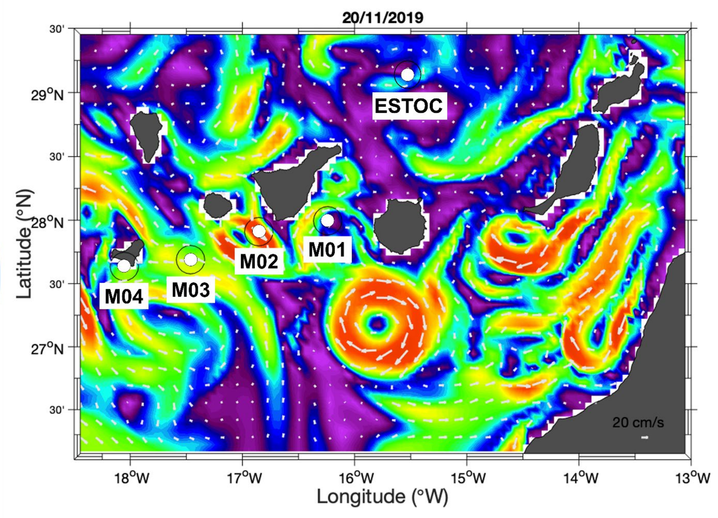
Abstract

Nowadays it is widely known that pollution by microplastics at the open ocean covers immense areas. Buoyant plastics tend to accumulate in areas of convergence at the sea surface such as subtropical gyres, while non-buoyant plastics accumulate at the seafloor. However, model studies have revealed that the total amount of plastic in the different oceans is not well correlated with the measured concentrations on the sea surface and the sea floor, showing a significant amount of missing plastic in the oceans. This deviation could be related to an underestimation of the role played by small fragments of plastic and fibers in the oceans. Furthermore, microplastic fragments with a density lower than the density of seawater have been gathered hundreds of meters below the sea surface in the Pacific Ocean due to their size and shape.





The main objective of this study is to carry out an equivalent analysis in the Atlantic Ocean. A total number of 51 samples were collected during four different oceanographic cruises between February and December 2019 and from the sea surface down to 1150 meters depth at the open ocean waters of the Canary Islands region (Spain). For each sample, 72 litres of seawater were filtered on board with a mesh size of 100 µm, where the presence of microplastics has been clearly observed. Our results reveal the presence of microplastics at least up to 1100 meters depth, at the open ocean waters of the Northeastern Atlantic Subtropical Gyre. These microplastics have being horizontally transported by the ocean dynamics as passive drifters.

Results and conclusions

Microplastic vertical distribution

Microplastics appear in all the samples analyzed between surface and 1150 meters depth, with an especially predominant presence of fibres, but small fragments can also be found down to the maximum sample depth.

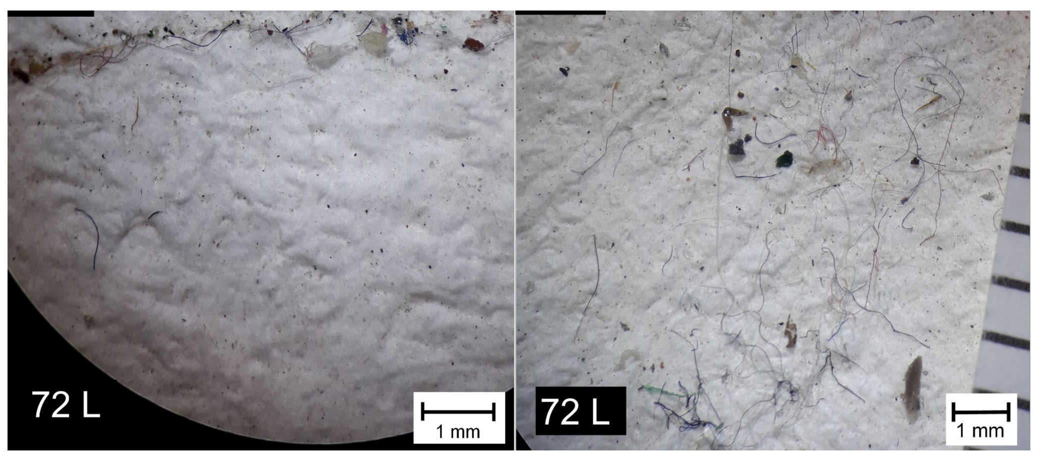


Figure 1. MP samples collected at M02 at 485 m (Nov'19) (left) and M04 at 1152 m (Nov'19) (right). *(72 liters filtered per sample)*

In these figures there are clear evidences of the presence of MP at the water column up to 1150 meters depth.

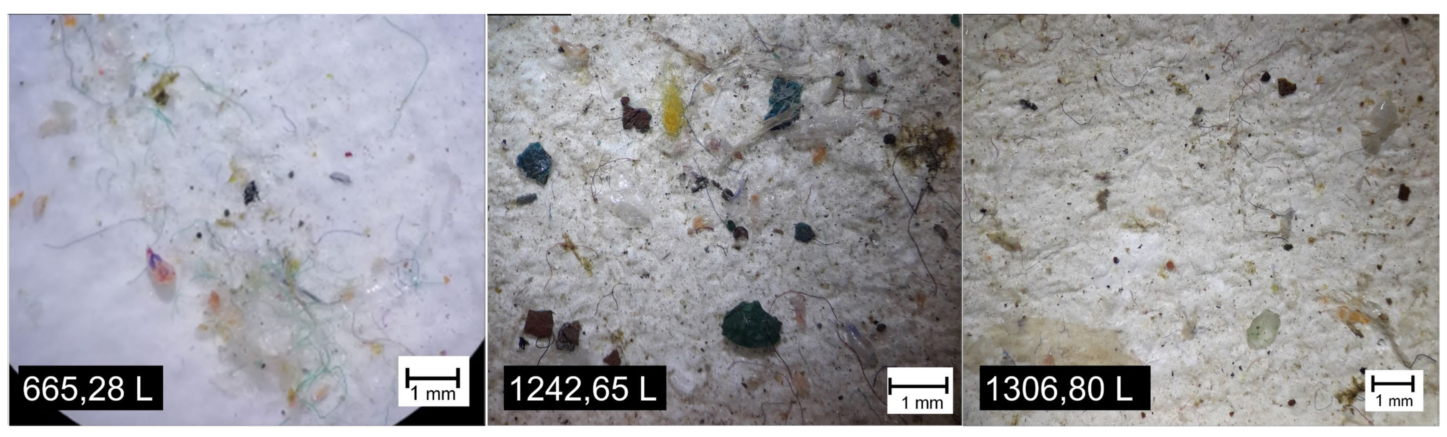


Figure 2. MP samples collected between 0 & 280 meters depth (left), 0 & 523 m (center) and 0 & 550 m (right). *(Black box- filtered volume per sample)*

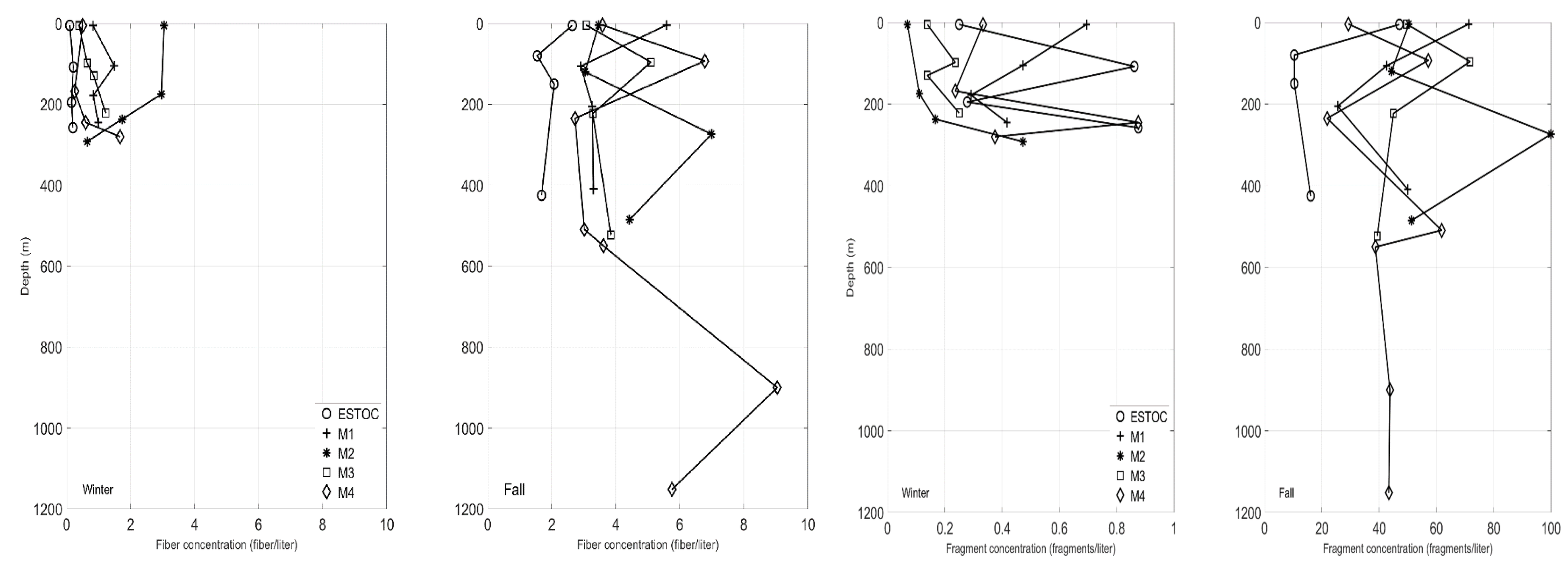


Figure 3. Microplastic vertical distribution of fibers (left) and fragments (right) sampled.

Ocean dynamic and convergence areas

As passive drifters, the MP spatial distribution is largely related to the underlying velocity field. The accumulation of MP might respond to the existence of long-lived mesoscale convergent structures, which is the case of wakes and eddies.

Velocities decrease with depth, being much higher at 1 m depth that at 250 m (Figure 4). The flow below 250 m north of the islands is largely affected during winter and fall by the presence of a meddy just north of Gran Canaria, which highly conditions the circulation and the convergent/divergent areas. On the other hand, south of the islands we may observe alternative patterns of convergent/divergent areas, likely related to the presence of mesoscale eddies.

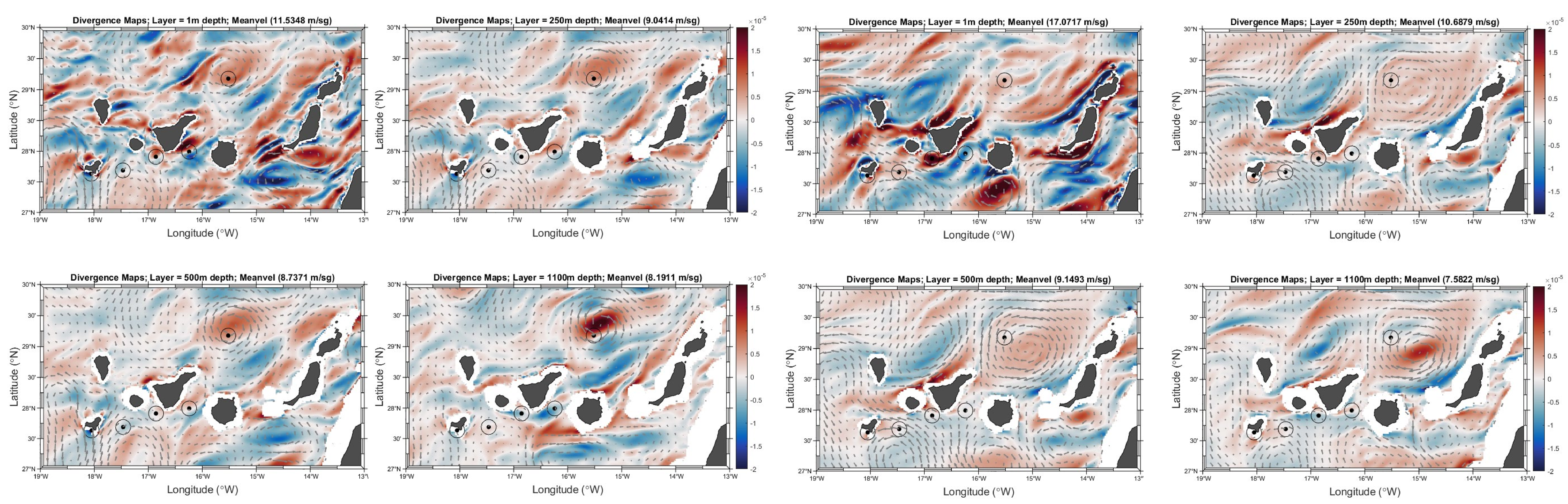


Figure 4. Divergence of the velocity field during winter 2019 (first four panels, left) and fall 2019 (right) at 4 different depths: surface, 250 m, 500 m and 1100 m. Velocity fields are averaged during the 15 days previous to the samplings (numerical model IBI).

Relation between MP vertical distribution and ocean dynamic

MP vertical distribution (Figure 3) might be indicating that the long-term velocity field north of the Canary Islands is not inducing a large variability in the MP spatial distribution. However, for stations M1 to M4, located south of the islands, the concentrations are notably higher than from ESTOC and variable with depth, likely as a consequence of the eddies that might be contributing to MP accumulation and vertical transfer along the water column.

Acknowledgment

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