FINAL REPORT PROGRAM LEFE

Program LEFE/ CYBER	Project Title **Étude de la Vitesse vErticale de micRoplasTIques déGradés et impacts sur leur distribution dans l'Océan (VERTIGO)**	Years **2022**
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Context - Global models of microplastic (MP) distribution in the ocean currently ignore the impact of *in situ* degradation (by UV, biofouling, fragmentation…). New measurements of the vertical dynamics of MP before and after degradation are therefore needed to inform future developments of such models..

Objectives / scientific questions - The main objective of the project VERTIGO was to evaluate the impact of natural degradation of MP (UV, beach conditions, seawater immersion) on their vertical dynamics. The originality of the project was to study neutral and floating MP.

Main results

For this project, a custom-designed measuring device (Fig. 1) was developed to measure the vertical velocity of MP (we used industrial pellets with ~3mm diameter) of the six most commonly used polymers, including negatively buoyant polymers (i.e. floating MP). These MP have been artificially aged in a variety of conditions to reflect the natural conditions. The first group of pellets was exposed to artificial UV light and heating in a UV chamber for a period of 2 months. The second group was exposed to natural weathering for 18 months on an artificial beach at the Cedre laboratory in Brest. A third group of pellets was immersed in seawater for 2 months in the Tinduff artificial basin, located in the Brest Bay. The immersion period was from April to June 2022, corresponding to the spring bloom period. The pellets were therefore exposed to high concentrations of phytoplankton and organic matter. Finally, a control group received no treatment (referred to as "virgin" in Fig.2). Our measurements of the vertical velocity of the pellets indicated very rapid displacement in the water column (several km/day). Moreover, the velocities are not significantly affected by environmental degradation (Fig. 2). Thus, our results demonstrate that most pellets should be found either in sediments or on the surface of the ocean. These results have profound implications for modellers, as they demonstrate that pellets can indeed be considered as 2D particles. They also have implications for policy makers and observers, as they demonstrate that the fate of pellets in the environment depends on the location of their release.

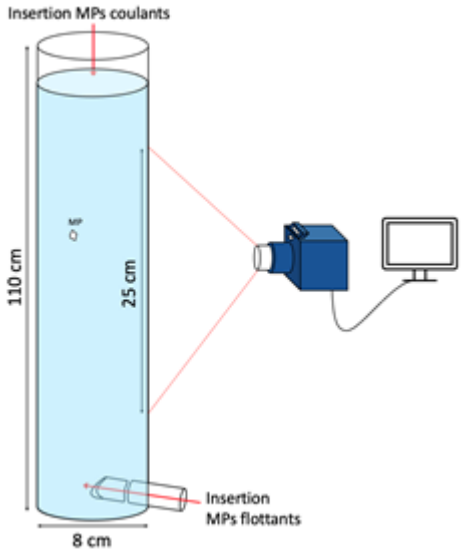

Fig.1 : Schematic representation of the experimental device used to measure MP vertical velocity

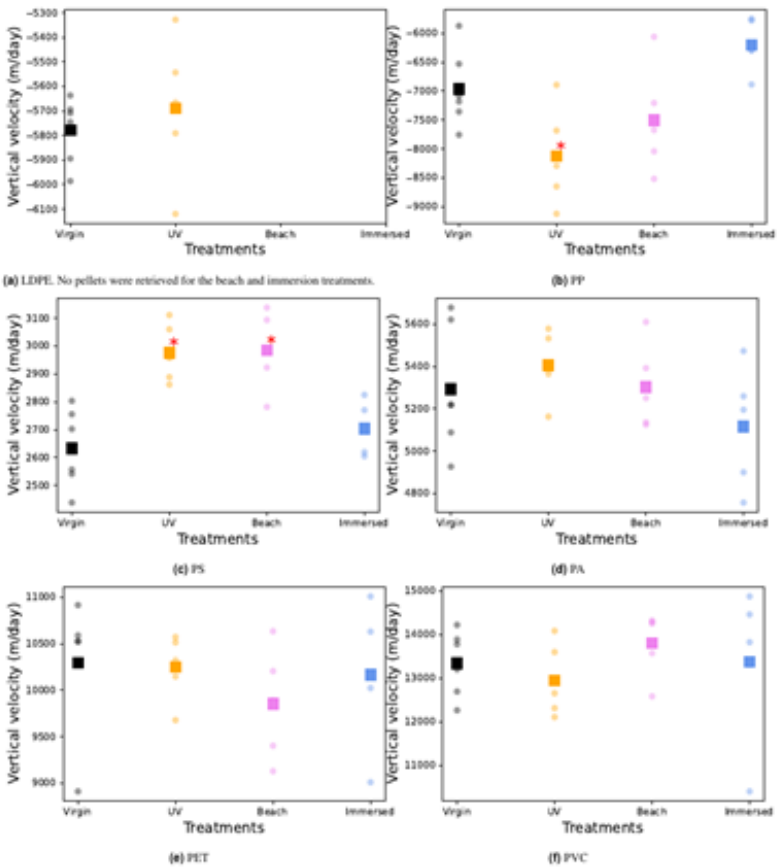

Fig.2 Impacts of environmental degradation on the vertical velocity of pellets. Each point represents the measured velocity of a pellet. Squares indicate the average velocity for each treatment. Red stars indicate average velocities that are significantly different from that of virgin pellets (Student's t-test, p-value<0.05).

Future of the project :

This project yielded first results on the vertical velocities of MP pellets. These results will be extended with different morphologies of MP (first tests have been carried out with performed with 0.9mm pellets and with fragments and fibres). The device we developed for this project will be used in other projects.

Number of publications, communications and theses

Publications :

- Richon et al., *Microplastic pellets are too fast to be found in the oceanic water column,* in preparation for Scientific Reports.

Communications :

- Delalande et al., 2022, *Impact de la dégradation des microplastiques sur leur dynamique verticale.* Poster presented at the Journées du GDR Polymères et Océans 2022, Brest, France.
- Richon et al., 2024, *Microplastic pellets are too fast to be found in the oceanic water column.* Poster presented at Ocean Sciences Meeting 2024, New Orleans, USA.

Theses :

- Delalande A., *Étude de l'impact du vieillissement des microplastiques sur leur dynamique verticale*, Master's thesis.

Data availablility

All data (measurements of vertical velocities) are available upon request to C. Richon and will be made public on a Zenodo archive upon publication of the results.