Objective assessment of the evolution of microplastic contamination in sediments from a vast coastal area

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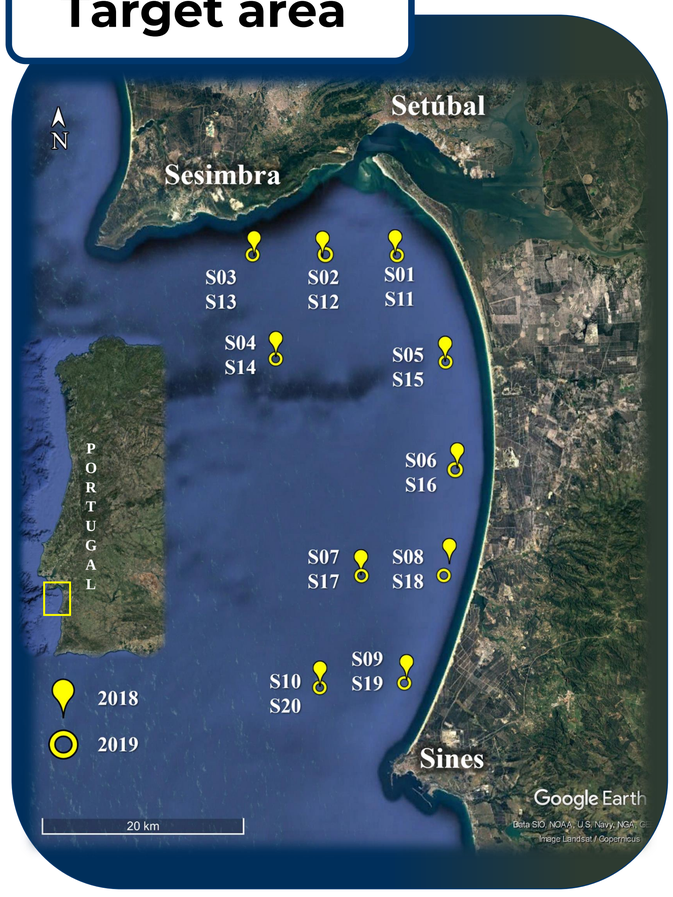
Contextualization

The environmental pollution by microplastics is well recognized. Microplastics were already detected in various matrices from distinct environmental compartments worldwide, some from remote areas. Various methodologies and techniques have been used to determine microplastic in such matrices, for instance, sediment samples from the ocean bottom. In order to determine microplastics in a sediment matrix, the sample is typically sieved through a 5 mm mesh, digested to remove the organic matter and density separated to isolate microplastics from the denser part of the sediment [1]. The physical analysis of microplastic consists of visual analysis under a stereomicroscope to determine particle size, colour, and shape. The chemical analysis is performed by an infrared spectrometer coupled to a microscope (micro-FTIR), allowing the identification of the chemical composition of microplastic, *i.e.*, the type of polymer. Creating policies and legislation to control and manage (micro)plastic pollution is essential to protect the environment, namely the coastal areas. The developed regulation must be supported by the known relevance and trends of the pollution type. This work discusses the assessment of contamination trends of a 700 km^2 oceanic area affected by contamination heterogeneity, sampling representativeness and the uncertainty of the analysis of collected samples [2]. The methodology developed consists of objectively identifying meaningful variations of microplastic contamination by the Monte Carlo simulation of all uncertainty sources. The comparison of contamination levels was performed for a 99% confidence level. The collected information on the environmental area is crucial for the objective and binding determination of microplastic contamination relevance [3].

SCAN ME

FOR THE COMPLETED WORK VERSION

Target area

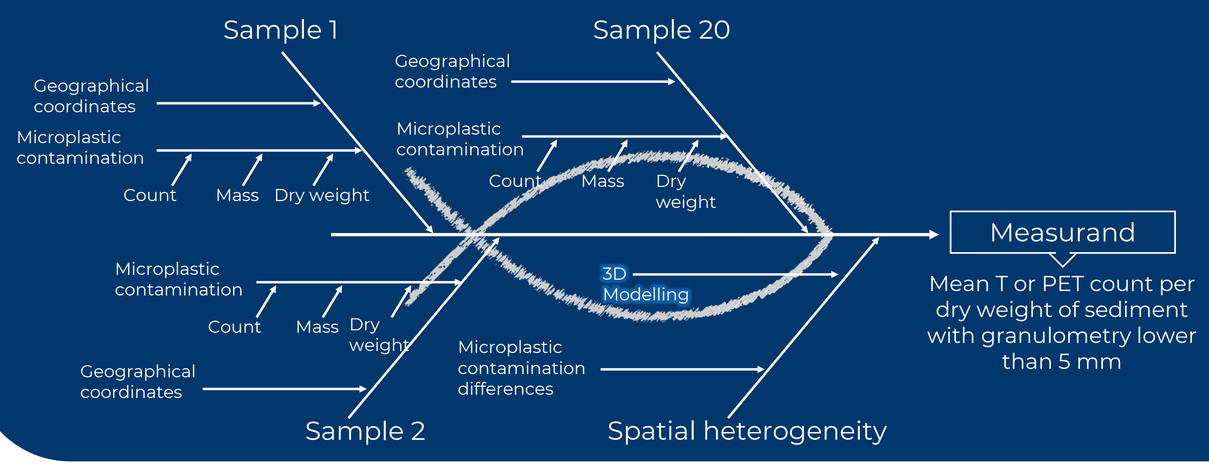


Experimental

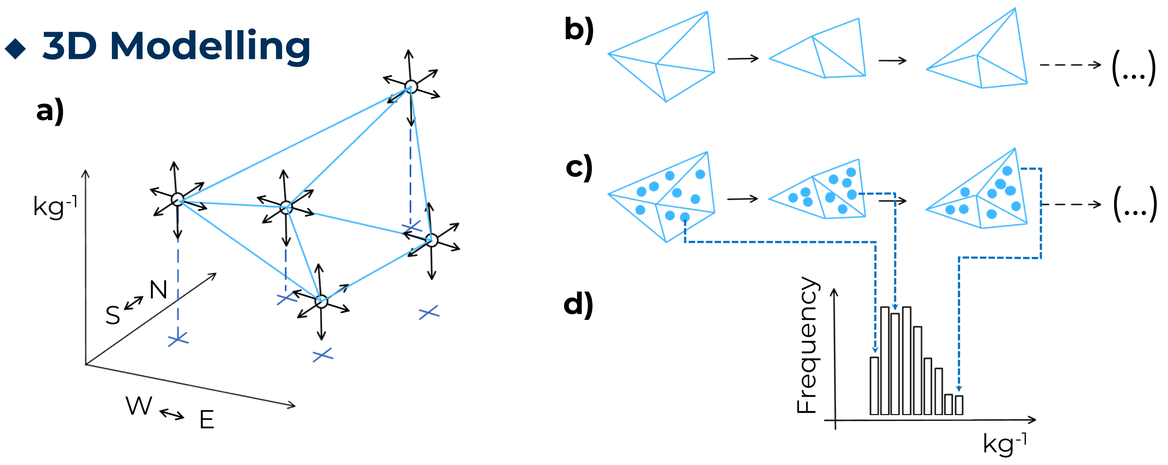
- Sampling
- 5 mm sieving
- H_2O_2 digestion
- NaCl density separation
- Visualisation
- Micro-FTIR analysis

Measurement uncertainty determination

Identification of the measurement uncertainty sources



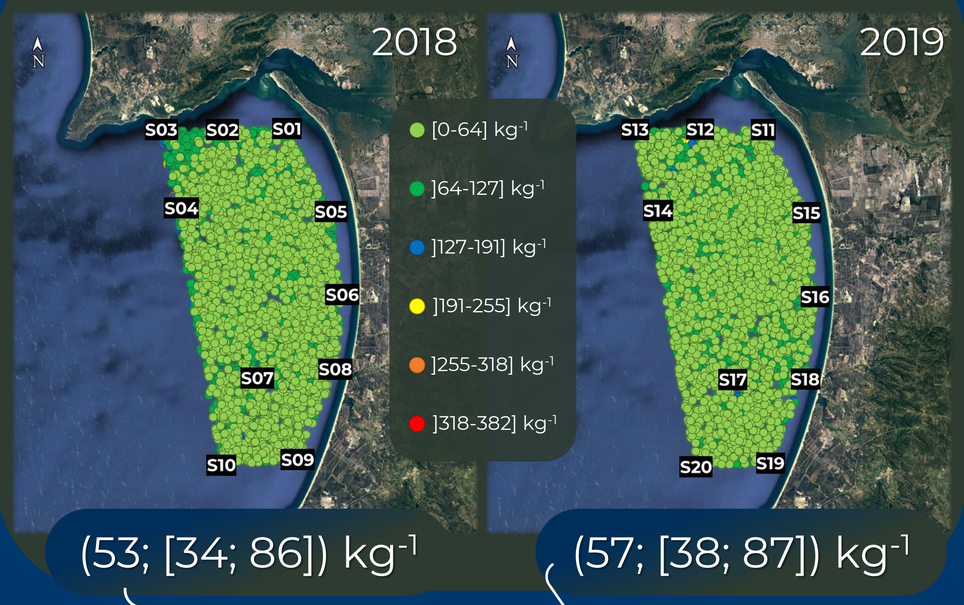
3D Modelling



Content: a) simulation of information on microplastic contamination at each sampling point; **b)** simulation of various 3D surfaces expressing spatial contamination variability; **c)** numerical scan of microplastic values in the 3D surfaces to collected contamination estimates in the sampling area (blue dots); **d)** simulation of microplastic levels distribution from contamination estimates.

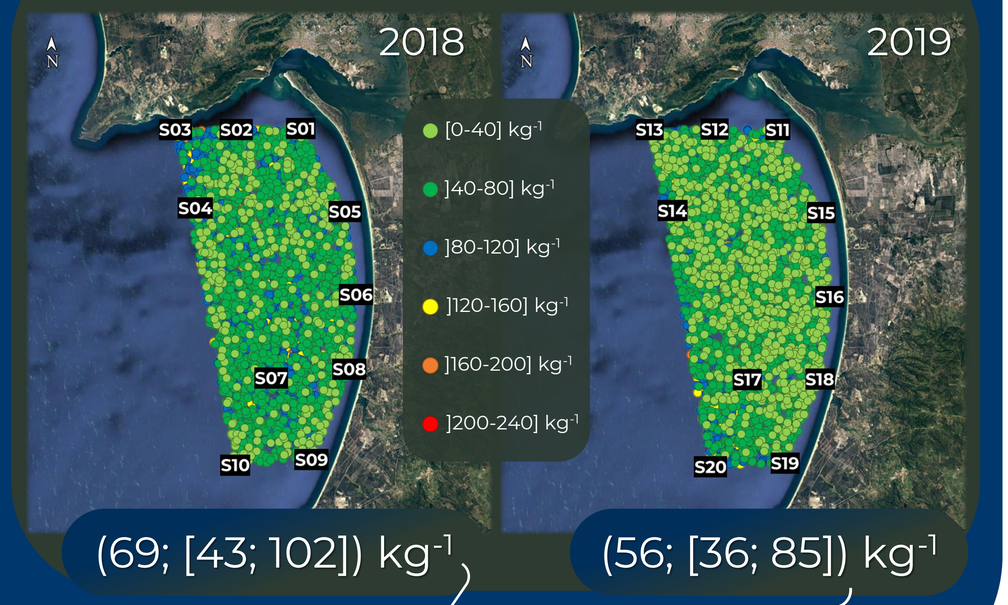
Geographic distribution of the simulated contamination

Microplastics (T)



(53; [34; 86]) kg^{-1} (57; [38; 87]) kg^{-1}

Polyethylene terephthalate (PET)



(69; [43; 102]) kg^{-1} (56; [36; 85]) kg^{-1}

Mean result expressed with uncertainty for a 99% confidence level

Note: The mean result and uncertainty interval were extracted from the respective simulated density distribution according to the following parameters: mode; [0.5th percentile; 99.5th percentile].

Conclusions

- PET microplastics are the most abundant polymer type.
- No relevant variation of microplastic contamination from 2018 to 2019 in 700 km^2 area.

References

[1] V. Morgado, L. Gomes, R.J.N.B. Silva, C. Palma, *Sci. Total Environ.*, **2022**, *832*, 155053.
[2] V. Morgado, C. Palma, R.J.N.B. Silva, *Environ. Sci. Technol.*, **2022**, *56*, 11080-11090.
[3] V. Morgado, C. Palma, R.J.N.B. Silva, *Sci. Total Environ.*, **2023**, *884*, 163612.

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