

This article presents a model of plastic pollution in the Mediterranean area. A mass budget for the year 2015 was proposed, and a box-model was calibrated to evaluate different OECD policy scenarios up to 2060. All steps and assumptions of the method are well-justified, and the results and conclusions are thoroughly developed. The authors critically examine the limitations of the current model and provide suggestions for improvement, although some of these potential improvements strongly depend on further studies for determining microplastics in the various environmental compartments considered. In particular, the lack of information on the concentration of nanoplastics in these compartments leads to a portion of the plastic pollution being 'missed,' an issue that must be addressed in future research. This type of study is crucial for understanding the potential impact of plastic waste reduction policies and for emphasizing the lack of ambition in current proposals. It is key to fostering the development of more robust and effective policies. This article is recommended for publication after minor revisions. The comments are provided below.

Abstract

Line 4: « based on recent observations. » be more specific, From what year is the literature used in this study?

The sampling period of all studies reviewed here range from 2013 to 2020 with an average sampling year of 2015. This year is therefore used as the reference for calibration. The publication date of all studies considered here range from 2015 to 2024. We added the comment “*The year 2015 is chosen as reference for calibration as it is the average sampling date of all studies reviewed here*” at L213.

Introduction :

Line 30 : Introduce the idea that plastic waste fragments in the environment, which in turn influences its mobility.

This is indeed a very important part of the dynamic of plastics in the environment, which was lacking in the introduction. We added this sentence to the introduction L35-38: “*Plastic objects in the environment fragment from macroplastics (>5mm) to microplastics (1µm – 5mm) to nanoplastics (<1µm) under the combined effects of (photo-)oxidation, structural fragilization and mechanical abrasion at a rate of approximately 3% per year (Chamas et al., 2020; Lebreton et al., 2019; Sonke et al., 2022, 2024).*”

Line 51 : Please specify what is referred to as plastic litter in this context. Later in the text, it appears to include macroplastics, but does it also encompass microplastics?

In this study, marine litter was used to be coherent with the sources quoted. Marine litter is defined by UNPE and IMO as human-created solid material released to the ocean, and includes indeed macroplastics and microplastics. We added this clarification to L69.

Lines 50-55 : What can explain the variability between studies, and how does your study address these uncertainties?

Generally, variability between observation studies can be related to several factors. Natural variability between sites can be very substantial and difficult to assess due to the lack of homogeneity in sampling and analytical methods. In this particular example, Pedrotti et al. (2022) used a Manta net (mesh size 333µm) and Cózar et al. (2015) used a Neuston net (mesh size 200µm), and their observed plastic size range is therefore similar. Both studies used a visual sorting method. These two studies differ by their extrapolation method to the whole Mediterranean Sea surface. Cózar et al. (2015) simply aggregated observation (after correcting for wind speed) from different datasets, while Pedrotti et al. (2022) used

a more elaborated Lagrangian model. This difference in extrapolation method, and the fact that the two studies used two different datasets, is likely explaining the difference between the two studies. Nevertheless, both studies provide estimates within the same order of magnitude.

In this study we address this uncertainty by reviewing more data. Across all the sea surface studies reviewed here, the uncertainty of sea surface plastic stock is also relatively low (“only” 2 orders of magnitudes between the lower and highest estimates according to Fig. 4), which is among the smallest uncertainties given the higher number of observations for the sea surface compartment.

During calibration, we address the uncertainties of the observed plastic stocks by transposing the k value uncertainty to the downstream box uncertainty. We added to clarify LXX. *“The uncertainties of the k -values were optimized to match the uncertainty of the literature observations in the corresponding downstream boxes”*.

Methods

Lines 90-91 : « small microplastics (SMP) defined as $1\ \mu\text{m} \leq L < 0.3\ \text{mm}$ ». "Why this category? It is not a standardized size classification in the literature."

SMP ($1 - 300\ \mu\text{m}$) were considered in this study following box model development in Sonke et al. (2022, 2025). The limit at $300\ \mu\text{m}$ correspond both to the lower bound of plankton/neuston nets and to the approximate upper size of airborne microplastic able to travel between compartments (Shaw et al., 2023). We added this sentence at L132 to clarify *“The upper size limit of SMP correspond to the usual plankton net mesh size used to sample LMP in surface ocean. It is also a good estimate of the upper bound of airborne microplastics”*

Lines 96-97 : « Fragmentation is caused by (photo-)oxidation, structural fragilization and mechanical abrasion at a rate of approximately 3% per year (Chamas et al., 2020; Lebreton et al., 2019; Sonke et al., 2022, 2024) ». This information should already be presented in the introduction, see comment below

We moved this line to the introduction, L35. We then adjusted this sentence to avoid repetition with the introduction. L139 “Fragmentation rate was set to 3% per year following Chamas et al., 2020; Lebreton et al., 2019; and Sonke et al., 2024, 2022.”

Tables S1 and S2 : How do you explain that some of your sd are 0.0?

Sorry, thanks for raising this issue. Most of the $\text{sd} = 0$ arise from the fact that they were kept constant in the model because no reasonable estimations of the uncertainty were available for these parameters, such as regional runoff, remote soil fraction or shelf fraction (Table S1). We added a comment to the Table caption explaining this: “Whenever uncertainties were unavailable, they are set to zero, and parameters treated as constants.” We also corrected the uncertainty of 3 k -values ($k_{\text{LMP_surf_to_wcol}}$, $k_{\text{P_surf_to_sand}}$ and $k_{\text{P_surf_to_ssed}}$). The manuscript values and SI were updated without change in any conclusion, this update only affecting slightly some values.

Lines 191-195 : SMP extrapolation from global data. Could you please explain in more detail how you performed this extrapolation? Why is this the best option? Could an extrapolation from P and LMP in the Mediterranean be considered as an alternative?

Facing the lack on documentation about SMP in the Mediterranean Sea, we decided to use the same parameters (k -values) for SMP as Sonke et al. (2025). To keep consistency, we also choose to extrapolate SMP concentrations for the global ocean reviewed in Sonke et al. (2025).

We are currently working on a new improved method to extrapolate SMP from LMP that we will include in future modelling work. This approach uses plastic particle size distribution and should be more accurate than the method used here.

To clarify the extrapolation calculation, we added Table S3 and SI text VI the supporting information.

Lines 209-210 : It is more detailed, rather than being contradictory.

Indeed, the studies of Lebreton et al. (2017), Meijer et al. (2021) and Nyberg et al. (2023) are considering the plastic input to the ocean globally. Cózar et al. (2024) focussed specifically on the Mediterranean Sea. We changed “contradictory” by “differ” in L.314

Results and Discussion

-line 321 : It is important to note here that « The Ocean Cleanup » is a non-profit organization

We totally acknowledge that. We gave this comparison to put in perspective the work needed to achieve the goals set by the Remediation scenario, indicating that more than just non-profit organisation and NGO efforts are needed. We clarified in the text that The Ocean Cleanup is an NGO.

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