This study explored the fate of plastic waste generated in the Mediterranean Sea catchment and authors proposed a box-model to evaluate different OECD policy scenarios toward 2060. This is a highly forward-looking study, essential for the development of public policy. The model is well presented and results are interesting. I recommend this paper for publication after major revision.

Major comments and other comments

I recommend authors stating right from the introduction that this is a prospective, exploratory exercise, that it tries to take into account a maximum of plastic pollution (large, small, etc.), but that it cannot consider all categories for all the compartments but this model tries to take as much as he can. I appreciated the limitation of the model section, which really help to understand what the model proposes or not.

We added this sentence at the end of the introduction to clarify the nature and purpose of this study: L104. *“The aim of this exploratory study is to investigate the relevance of the OECD’s scenarios regarding plastic pollution in the Mediterranean catchment, while taking into account a wide plastic size range (from microplastics to macroplastics) in a maximum of environmental compartments. This prospective assessment is a necessary step to guide public policies and decision makers, while UN negotiations for an international legally binding treaty to end plastic pollution are under way.”*

My first and solely concern is the concept of runoff, which still unclear from my side. L70. of plastic runoff from land to sea. What do you mean by runoff form land-to-sea? Remobilization of all plastic litter undependably of the connection with river first and then Sea? Or direct runoff to the Sea? It’s also parametrized to consider the intensity of the rain? A major conclusion of this study is the important of runoff – what I would call river discharges during high flow periods or during flooded but not definitely runoff. From my point of view, this concept, or what runoff mean, should be better explained.

To clarify this concept, we decided to replace the expression “runoff from land to sea” by “input from land to sea”. The more generic term “input” is then defined on L298 as any leakage from the terrestrial plastic pool, including, to mention the more commonly quoted examples, rivers (law and high flow period), coastal urban and non-urban areas, fishing and aquaculture industries, and shipping activities. Literature on different leakage pathways were also quoted.

Implementation of the OECD Global Ambition policy scenario, that targets near-zero new plastics waste leakage, would not significantly lower this stock (25 Mt, median, IQR 12-44 Mt) by 2060. Totally agree with this conclusion. Very important as regard the OCED recommendation and the objectives. Behind this policy scenario, the main idea is to significantly reduce the plastic consumption and not necessary the plastic pollution in the environmental compartment. One other important idea is the “legacy stock” of plastic.

L15. his underlines the necessity to address upstream legacy plastic waste on land. How upstream? On land? Or for the consumption?

In this article, we refer to “*upstream legacy plastic waste*” as the terrestrial mismanaged plastic pool. Under the Remediation and OECD-GA scenarios, the mismanaged plastic production rates (fraction of the waste mismanaged in the environment) fall to near 0, which implies that the change in consumption, or not, won’t affect new mismanaged plastic waste after 2060.

L24. Plastic items are also very mobile due to their relatively low density and buoyancy, and can travel long distances by rivers and ocean currents. Some studies suggest that significant amount of plastic litter can be also trapped along the river banks and flooded pain aera.

This is very true. The current model has no implementation of such compartment. The main reason is that its stock is not constrained enough as yet. Ultimately, the implementation of the terrestrial freshwater compartment in our model would allow a more temporally detailed approach, and for instance simulate seasonal river inputs to the sea. We would need new funding to develop this.

L69. This study investigates the fate of plastic waste in the Mediterranean Sea catchment across various environmental compartments 70 (terrestrial, sea surface and water column, shelf and deep sediments, beaches and atmosphere). Until here, we cannot determine if the study will focus on plastic litter only or include microplastic. If atmosphere is included, probably microplastic is considered. If yes, why? It's clearer L90-95.

To clarify this point, we replaced the generic term plastic in the introduction and in the abstract by '*macroplastics and microplastics (hereafter 'plastics')*' when referring to our model.

L280. Results on the atmospheric SMP cycle are not presented here, as they are not yet constrained enough in the Mediterranean. I suggest to remote this section to the core manuscript. It can be mentioned in model structure.

OK. We moved this comment to the section 2.4.5 SMP extrapolation from global data (L284)

Figure 2. Which data are used to build this figure?

Figure 2 display the modelled stock and fluxes at the beginning of year 2015. The scenario chosen is irrelevant, since they are all identical before 2015. We added the comment in the caption of Fig.2. "*for the year 2015 under all scenarios*" for clarification.

L112. Plastic mass transport between boxes is approximated to be first order, where the plastic flux FA→B [Mt y-1] from box A to box B is proportional to the plastic mass MA [Mt] in box A. How can we justify this assumption? Which implication would have a different one? It's here a question of the assumption sensibility.

The assumption that fluxes between boxes (or between chemical compounds) follow first order rates (and equations) is justified by its wide application in chemical kinetics, radioactivity, and biogeochemical cycling. In all these systems, transformation or transport of matter is often linearly proportional to the amount of matter at the starting point. It is the simplest assumption one can make for upstream dependent fluxes in box models. First order fluxes have the advantage to need only one parameter (k-value) to be measured or optimized, which simplifies greatly the model calibration process against observations. The ideal observations to justify a first order assumption would be data on fluxes, for example from peat, sediment or ice core natural archives. These fields are in their infancy, though preliminary results show a gradual increase in historical MP deposition to such archives (Allen et al., 2021). A different assumption would be non-linear, higher order MP dispersion and fragmentation behaviour in the environment. Example could be that fragmentation rates accelerate as plastics age; or that climate change influences several fluxes (k values would become dependent on other factors), for example land to sea plastic inputs via changes in Mediterranean precipitation. Based on the absence of evidence of higher order behaviour we make the typical choice of the first order approach in our model.

We added a phrase in this sense to the cited section, on L164: "*Without broad evidence for higher order, non-linear plastic dispersion dynamics, we consider Eq.1 to be a reasonable assumption that is based on similar behaviour during chemical kinetics, radioactivity, and biogeochemical cycling.*"

Table 1. For each study, in addition to the stock considered, which compartments are considered? This is important since in your model you consider all compartments.

The compartment considered is Mediterranean Sea surface, as mentioned in the table title and column names.

2.4.6 Runoff to sea surface. Here what is the concept of runoff? It's the discharges by river during high flows/flooded?

As detailed above, we clarified the concept of what we considered runoff by changing our nomenclature and using input instead. Indeed, as you pointed at rightly, the term runoff has a specific meaning in hydrology that does not correspond exactly to our situation. In our case, inputs of plastic from land to sea include runoff, alongside a number of other processes such as direct littering in the sea, flood events, wind etc…

The geographical distribution of plastic runoff was found to be dominated by S. Europe (87.9%), followed by N. Africa & M. East (12.0%) and the Nile basin (0.1%). Do this observation is linked to the crossed explanation, population density and high flows of river? In contradiction with other studies (as underlined by authors). This has a very strong implications for policy. I would suggest to explain more why you found these contradictory results and how our approach is relevant in regards to others studies.

In this paper, we implement a bottom-up approach to estimate the total plastic input to sea: the observed quantity of plastic in the marine environment constrains the inputs from land. To be able to regionalize this flux between S. Europe, N; Africa & M. East and Nile basin, we use the % given by Cózar et al. (2024) are quoted in the sentence you mention. Cózar et al. derived this geographical distribution from satellite observations of marine litter. We only use population density to estimate the plastic waste generated in each region, and then calculate the mismanaged plastic waste using the % of MMPW provided by the OECD. We choose to select Cózar et al. (2024) results among all the other studies that investigate the geographical distribution of plastic input to sea because it was applied to the Mediterranean Sea specifically, and also adopted a bottom-up estimation. A recent study by Weiss et al., 2025 found similar fractions between our 3 regions (79.5% for S. Europe, 14.0% for N. Africa & M. East and 6.5% for the Nile basin). Their results are based on population density and river flow for each basin (top-down approach). We rewrote the paragraph at L.312 for clarity, and mentioned the study of Weiss et al. (2025) throw-out the text and figures.

L395. This means that most of MMPW is still in terrestrial areas, which are not detailed yet in the model. Totally agree.

Results section. Do the results/conclusions will be different by considering only the large fraction of plastic litter (> 5 mm)?

Most conclusions would be different because microplastic makes most of plastic inputs from land to sea, and because a non-negligible fraction of plastic waste are primary microplastics. Ignoring fragmentation of large plastic litter would also bias its mass budget, especially if microplastic that have deposited in sediment are ignored.

Minor comments

L4. for the Mediterranean region. Please clarify the aera.

We specified « Mediterranean catchment and Sea" for more clarity. Please also note that the next phrase specifies that "*Mediterranean watersheds in Southern Europe, Northern Africa and Middle-East, and Nile basin*" are considered.

L54. Simon-Sánchez et al. (2022) reviewed and reported concentrations in sediments (300 items kg-1) and beaches (60 item kg-1), insisting on the high uncertainties and 55 variability between studies. You discussed here about microplastics. What is the link with plastic litter mentioned?

This paragraph is a broad introduction to plastic pollution. The number quoted from Simon-Sánchez et al. (2022) are referring to all plastic items, macro and microplastics included.

L60. Sea litter by Cózar et al. (2024) highlighted the close relationship between marine litter occurrence and heavy rainfall events, pointing at Southern Europe as the largest macroplastic source to the Mediterranean Sea. What is their hypothesis?

Cózar et al. (2024) hypothesised that the cluster of marine litter observed at the sea surface by satellite imaging (referred to as *litter windrows*) are a good proxy for 'marine plastic litter'.

Based on the fact that plastic items represent as significant fraction of the total floating marine litter, Cózar et al. (2024) proposed to monitor litter windrows as a proxy for surface floating plastics. The reflectance spectra of plastic litter, alongside spectra of other confounding floating debris (algae, driftwood and seafoam) were compiled into a tool able to detect pixels containing litter windrows.

Importantly, this method is only a proof of concept, using already existing EU Copernicus Santinel-2 multispectral instrument that is suboptimal. The method is not yet able to detect litter windrows shorter then 70m, and is not able to estimate the percentage of plastic in these structures. The model only asses the presence or absence of dense litter cover in a 10*10m pixel.

Cózar et al. (2024) found a correlation between plastic input from land and litter windrow density, and particularly a correlation between rainstorm or flood events on land and the formation of litter windrows near the coast. They hypothesise that this phenomenon is the result of the flushing of the watersheds after high precipitation events. They indeed observe that southern Europe, despite presumed low mismanagement rate of plastics, is a major contributor to plastic input to the sea, as shown by the high concentration of windrows near its shore.

L142. The year 2015 is chosen as reference for calibration. Why?

The year 2015 was chosen as reference for calibration as it is the average sampling year of the reviewed literature. Also, this date was used in similar work on the same basis (Sonke et al., 2022, 2025), making direct comparison easier. We added this comment on L212. to clarify: "*The year 2015 is chosen as reference for calibration as it is the average sampling date of all studies reviewed here*"

Table 2. What is the unit of the first reported concentration? 5.6 10-3

We forgot to include the unit. The correct unit was "kg km^{-2}", fixed.

L289. we calculare. Calculate

Typo fixed

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