Manuscript "*Neodymium budget in the Mediterranean Sea: Evaluating the role of atmospheric dusts using a high-resolution dynamical-biogeochemical model***"**

Mohamed Ayache, Jean-Claude Dutay, Kazuyo Tachikawa, Thomas Arsouze, and Catherine Jeandel

Dear Pr. A. Mazumdar

We would like to thank you for providing us the opportunity to revise our manuscript, and we would like to thank Reviewer #2 for taking the time and effort necessary to review the manuscript. We sincerely appreciate all valuable comments and suggestions, which helped us to improve the quality of the manuscript (ms hereafter).

Color code
Editor/Reviewer
Authors response
Change in the manuscript (ms)

Anonymous Referee #2

This paper is an extension of Ayache et al. (2016) which intend to simulate epsilon Nd and its concentration in the Mediterranean Sea, using a regional dynamical-biogeochemical coupled model. In this paper, authors have considered Nd sources from benthic sediments, river discharge and atmospheric input to assess their relative contribution in the Nd Cycle for the Mediterranean Sea. Based on the modelling exercise, they have concluded that Sediments are dominant (almost 90 %) contributor of Nd to its oceanic cycle, with minor contribution from dust deposition and river input. While Nd contribution from atmospheric dust is low (~ 5%), it is very sensitive to Nd cycle and potentially important parameter to investigate in other regions which are strongly impacted by dust deposition.

I have thoroughly enjoyed reading results and discussion of this well drafted paper. This paper is of utmost importance for both atmospheric and Oceanic community and fits well within the scope of Biogeosciences. There are few typos in the draft, which I believe, will be taken care during proof reading stage. I recommend this paper for publication.

We warmly thank the reviewer for his overall encouraging comment concerning the utility of our study for the Bio-geoscience community.

Minor comments:

Line 63: can be reworded
We agree with the referee; this sentence was not very clear. Text was changed in the revised ms for clarification.

"~~*Ayache et al. (2021) used the simplified version of the εNd simulation proposed by Arsouze et al. (2007) to investigate with idealized hosing experiments in the IPSL-CM5 model the link between the intensification of the upper AMOC (Atlantic meridional overturning circulation) and the Mediterranean overflow.*~~
Ayache et al. (2021) explores the impact of drastic changes in Mediterranean thermohaline circulation on the North Atlantic Circulation, using the simplified version of the εNd modelling approach (Arsouze et al. 2007) with idealized hosing experiments implemented in the IPSL-CM5 model."

Line 98: "…too-radiogenic…" not clear

We meant that the simplified approach (including only the boundary exchange between sea water and continental margin, publish in Ayache et al., 2016) simulated a too-radiogenic isotopic composition of εNd, *i.e,* this approach overestimates the observed Nd isotopic composition.

Clarified in the revised ms

"*Nevertheless, this simplified approach yields too high (too radiogenic) eNd values compared to the modern Mediterranean Sea waters.*"

Line 138: C:N:P ratio is 122:16:1.. is it correct"?

Agreed. This was changed in the revised manuscript.

"*PISCES is a Redfieldian model where the C:N:P ratio used for plankton growth is fixed to 122:16:1*"
Line 141-143: Does smaller particle include Aeolian dust? It will be particularly important for open oceanic region as there is an enrichment of fine (clay) fraction in atmospheric deposition.

We totally agree with the referee about the role of Aeolian dust for open oceanic region. However, the small particle pool in the currents version of the biogeochemical model PISCES includes only particulate organic carbon (POCs, between 2 and 100 µm in size)
Our work highlights the need to consider more carefully the representation of the various particle fields in the biogeochemical model, and could be investigated in future studies.

Line 185: Typo "the"
Corrected

References

Arsouze, T., Dutay, J. C., Lacan, F., and Jeandel, C.: Modeling the neodymium isotopic composition with a global ocean circulation model, Chemical Geology, 239, 165–177, https://doi.org/10.1016/j.chemgeo.2006.12.006, 2007.

Arsouze, T., Dutay, J.-C., Lacan, F., and Jeandel, C.: Reconstructing the Nd oceanic cycle using a coupled dynamical – biogeochemical model, https://doi.org/10.5194/bgd-6-5549-2009, 2009

Ayache, M., Dutay, J.-C., Arsouze, T., Révillon, S., Beuvier, J., and Jeandel, C.: High-resolution neodymium characterization along the Mediterranean margins and modelling of Nd distribution in the Mediterranean basins, Biogeosciences, 13, https://doi.org/10.5194/bg-13- 5259-2016, 2016.