



EGUsphere, referee comment RC5
<https://doi.org/10.5194/egusphere-2022-606-RC5>, 2022
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Comment on egusphere-2022-606

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Referee comment on "Simulating marine neodymium isotope distributions using Nd v1.0 coupled to the ocean component of the FAMOUS–MOSES1 climate model: sensitivities to reversible scavenging efficiency and benthic source distributions" by Suzanne Robinson et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-606-RC5>, 2022

This discussion paper by Robinson et al. discusses the incorporation of Nd (isotopes and elemental concentration) into FAMOUS GCM's ocean component to better understand the GLOBAL marine Nd cycle. I really like the paper and it addresses the current debate on the direction of control in Nd (and REE) distribution. Acknowledging the paper has set its focus on the sensitivity of the scavenging efficiency and benthic fluxes, it leans towards comparing itself with previous modelling studies (Rempfer et al., Siddall et al., Pöppelmeier et al). The overall reality test is done by comparing their results with a global data base. They conclude that reversible scavenging is important for the Atlantic-Pacific gradient in eNd, but again the modelled Pacific Ocean does not match the observed data there. They admit that a global constant sediment flux in the model runs could be the issue here as the Pacific Ocean supposedly provides more reactive material (young, mafic rocks) than the Atlantic, which would support different sediment fluxes within these basins.

As a non-modeller, I would like to avoid evaluating the technical parts of this paper, but I would like to highlight some important aspects on the biogeochemical cycles of Nd. Overall, I found the paper very well written, a bit wordy though. I do admit, I am bit surprised that recent particle studies (e.g. Lagarde et al. 2020, Paffrath et al., Stichel et al. 2020) were very marginally used in this paper. From those studies, we now have information on eNd in particles, different mineral fractions, different kDs etc. from the same locations as the dissolved fraction. We also know that pNd/dNd unfortunately is not uniform in the ocean. Also, in the last paragraph of the discussion (lines 927 ff.), where the authors compared their model outcome with observations in the North Atlantic – the area where the aforementioned papers have their study area – the composition of particles would help to assess the NADW composition (e.g. fig.6 in Stichel et al. 2020). In the search for end member composition, the authors might want to consider the very dynamic particle composition in that area (pointing towards different sources) and not necessarily from bulk sediments. If I am not mistaken, in those papers the observational pNd/dNd are often one order of magnitude higher in the North Atlantic, compared to the global average assumed in the modelling studies (0.001 to 0.006). Or do I miss something here? Of course, it is reasonable to assume that Pacific pNd are very much lower than in

the North Atlantic and therefore the pNd/dNd is very much skewed towards lower values. This discrepancy should at least be mentioned and justified.

I would like to point out another rather minor issue, which is the database used. I acknowledge that with the now very impressive global Nd data sets available, it is very convenient to cite the GEOTRACES IDP. However, the authors want to double-check whether data actually IS in the data product. For instance, large parts of the eNd from GA03 (or US-GEOTRACES North Atlantic Zonal Section) are not included in the IDP 2021 but was used a citation here. For those data sets you can find the correct citations here:

http://data.bco-dmo.org/jg/info/BCO/GEOTRACES/NorthAtlanticTransect/Nd_GT10%7Bdir=data.bco-dmo.org/jg/dir/BCO/GEOTRACES/NorthAtlanticTransect/,data=data.bco-dmo.org:80/jg/serv/BCO/GEOTRACES/NorthAtlanticTransect/Nd_GT10_v8_joined.html0%7D? I apologise for this rather shameless self-advertisement...

I fully support the publication of this paper eventually. It is an important work and will be key for a better understanding of the Nd cycle as it is one of (if not) the most complete modelling papers for marine Nd isotopes and concentrations. The supplement's profound eNd/YREE data set is also great! Thanks for providing this with your publication.