Comment on egusphere-2022-606
Ed Hathorne (Referee)

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., EGUsphere, https://doi.org/10.5194/egusphere-2022-606-RC4, 2022

This paper describes the results of a model of the marine Nd cycle implemented in the ocean part of the fast climate model derived from the Hadley centre GCM. The use of such a model for simulating the Nd isotopes of seawater is a useful development as the fast run times allow more experiments to be conducted, although care must be taken that the ocean circulation is resolved correctly as this is what we hope to trace with Nd isotopes. From the standpoint of a geochemical oceanographer this paper is very interesting because it directly tests the hypothesis that the distribution of Nd isotopes in seawater is mostly controlled by a flux from marine sediments, sometimes known as the "bottom flux hypothesis". Along with other models of the marine Nd isotope cycle published very recently, this work affords many insights into the processes that are likely, and unlikely, to control the distribution of Nd isotopes in seawater. The discussions paper is rather long but with some editing, clarification in places and discussion of the other very recently published works, I would gladly recommend this for publication.

This could be an important contribution as the authors have the most up to date data compilation available, but this should be utilised throughout. For example, in Figure 9 the global marine Nd inventory of 4.2 x10^12 g from Tachikawa et al. (2003) is used to assess which reversible scavenging scenarios are realistic. Although this ground breaking study is clearly still relevant, many samples have been taken and measured in the intervening decades as shown in Figure 8. Would it not make sense to estimate the marine Nd inventory with all the available data? Perhaps it will make little difference but in 2003 there were very few data available for the entire Southern Ocean and North Pacific (Table 1 in Tachikawa et al., 2003). Using these realistic reversible scavenging values (can it please be clarified if this is also 100% released like in Tachikawa et al., 2003?) a very simple universal sediment flux is tested. Although it is very interesting that this fails to simulate the tails of the observed data, both radiogenic in the Pacific and unradiogenic in the N Atlantic, this is not proof that the bottom flux hypothesis is wrong. Assuming a
constant flux over the entire ocean bottom is clearly unrealistic and this point should be clearly stated. With rare earth element concentrations >2 times that of shale, the red clay sediments covering large parts of the abyssal Pacific (e.g. Kato et al., 2011, Nature Geoscience 4) are most likely a sink for Nd. Here and also in areas influenced by hydrothermal particles (German et al., 1990, Nature 345, 516-518) the bottom flux is likely to be negative. The fact that Pasquier et al. (2022) use a parameterisation which increases the sediment flux at both radiogenic and unradiogenic extremes of sediment composition should be mentioned in the context of a constant bottom flux not simulating the highest and lowest seawater values.

Detailed comments and suggestions are provided in an annotated PDF. I still hope publishers will provide a tool for extracting comments from PDFs.

Please also note the supplement to this comment: https://egusphere.copernicus.org/preprints/2022/egusphere-2022-606/egusphere-2022-606-RC4-supplement.pdf