

## Response to reviewer 2

We thank the reviewer for their time in reviewing this paper. The reviewer comments are in *blue italics* and our responses are in plain black text.

*I can only make few editorial comments on this manuscript:*

*135-136: confusion in the numbering of figures 1b, 1c, 1d.*

Fixed.

*144-145: in figure 3 the units of measurement are in kgN, and in the text - in kg.*

Clarified to kgN.

*152-153: the marker "b" is missing in Figure 3.*

Done.

*187-200: figures 4c, 4d, 4e are missing in the manuscript.*

In the conversion from draft to Biogeosciences formatting this part of the figure was missed off. Our apologies: it is now reattached.

*470-...: we see BNF for the periods 1980-2014 (Figure 1), 1980-2015 (Figure 2), 2005-2014 (Figure SI 2). May be it would be better to average BNF estimates for the period of 1980-2014.*

Apologies, this is a typo and has been corrected.

*I think this is a very good student-level technical study. I do not see new scientific results in this manuscript. For these reasons, I consider this article to be inappropriate for Biogeosciences status.*

We disagree with the notion that this study does not contain new scientific results and would therefore be inappropriate for Biogeosciences. The inclusion of the nitrogen cycle is one of the key innovations of CMIP6 compared to CMIP5. BNF is one of the most important factors determining the long-term trajectory of N availability and therefore the N limitation of the simulated carbon cycle. While individual assessments of individual model components have been published elsewhere, This paper is, to our knowledge, the first evaluation of the performance of these new CMIP6 models using a new synthesis of field observations and upscaled observational data.

Evaluation of climate and Earth System Models is a well-known line of scientific enquiry and has been for decades. However, routine benchmarking tools do not account for any N cycle specific database, and our manuscript thereby addresses a key gap in the literature. We hope that the demonstration of the current state of N cycle modelling in Earth System Models contributes to improved consideration of the ecological complexity of BNF in these models.