

Biogeosciences Discuss., referee comment RC3
<https://doi.org/10.5194/bg-2021-86-RC3>, 2021
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Reply on AC2

Richard Bindler (Referee)

Referee comment on "Towards a history of Holocene P dynamics for the Northern Hemisphere using lake sediment geochemical records" by Madeleine Moyle et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-86-RC3>, 2021

Thank you for your thoughtful replies to my comments. Possibly there was some misinterpretation of my comments concerning comparison of the sediment-inferred lake-water TP and diatom-inferred values. I would certainly agree that the diatom TP models are not the gold standard, only that these are the data that are available. So in my mind this is not a question of a justification of SI-TP in relation to DI-TP; rather, that an observational comparison ought to be made, which I think is warranted. This does not mean a detailed comparison or motivation of which is less wrong, simply to acknowledge these data may not necessarily match in the details.

While I would agree that an evaluation and detailed discussion of one versus the other is beyond the scope of this paper, but given that diatom-based reconstructions exist for some of the records (you show two comparisons in your reply), I think an observational comparison should at least be made at this stage. Ultimately this one of the key means of validating the model in order to move on to Holocene geochemical records without paleoecological data. What you show in your reply and your brief comments/thoughts about these two comparisons are essentially what I think should be added. The fact they may reveal different patterns and brief speculation why you think they differ are relevant, and that answering that would be something to explore in a next step.

In reference to the diatoms reflecting nutrient status are robust, this is not in reference to any specific numeric value of nutrient levels derived from, e.g., diatom-inferred TP models; rather that community changes can reflect nutrient status – i.e., simply that such changes are at least qualitative regarding more or less nutrient availability, not necessarily quantitative [this assumes a more-dominant change in water chemistry, such as pH, does not control the assemblage, such as in the early Holocene in Sweden/Norway]. Ultimately, similarities in the sediment-inferred TP model and apparent changes in diatom community reflecting more-nutrient rich conditions would lend credence to the modeling concept on this Holocene timescale, whereas an increase in SI-TP, for example, without any changes in the community to indicate more nutrient availability opens some questions. These observations are important to make at this point, I believe, even without making a detailed assessment at this stage, which would be the logical next step to support the geochemical modeling approach.