

Interactive comment on “Potential predictability of marine ecosystem drivers” by Thomas L. Frölicher et al.

Anonymous Referee #1

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This paper evaluates the potential predictability of marine ecosystem drivers (T, pH, O₂, and NPP) and discusses which physical and biological processes fundamentally determines the upper limit of the predictability at global and regional scales using a series of perfect model simulation in an earth system model (GFDL ESM2M). Whereas previous studies focus on a physical process that describes the potential predictability of marine biogeochemical variables, this study shows that the biogeochemical interactions, as well as physical processes, are key drivers to contribute to the upper limit of the predictability, which leads to the understanding of differences in the potential predictability between temperature (physical) and biogeochemical variations. The global and regional characteristics of the biogeochemical predictability that this paper shows are important information to produce skillful multi-year predictions of marine ecosys-

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tems. I recommend a minor revision according to the comments given below.

(1) To what extent does AMOC variability affect the potential predictability of marine ecosystem drivers in the North Atlantic?

The decadal potential predictability of marine ecosystem drivers is prominent in the North Atlantic, which would be strongly related to the variability in AMOC. To understand the mean states and variations in AMOC in perfect and ensemble simulations in GFDL ESM2M, I request to show the time series of AMOC variability, like Figure 1a.

(2) What limiting nutrient contributes to higher potential predictability in NPP?

In this paper, the regions of higher potential predictability in NPP (Fig. 3d) correspond to those of higher predictability in nutrient limitation, which suggests that higher potential predictability in NPP is fundamentally constrained by the availability of limiting nutrients. Since the model uses the formulations of limitation by multiple nutrients, I wonder what nutrient is key to contribute to higher potential predictability in NPP at the regional scale. The figure and description of a spatial pattern of limiting nutrients are helpful to understand the characteristics of long-term biological variability.

Other comments:

L137. Remove “The prognostic “

L159. reflect, not reflects

L. 281. largely, instead of large

L 363. Why do you refer to Fig.10?

L. 527. Figure B1 should be Figure A1 on page 37.

Page 800. The unit of the iron half-saturation coefficient would be wrong.

Figure 3d, Contour lines, and contour number information are too dark to be identified.

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