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Interactive comment on "A model study of warming-induced phosphorus-oxygen feedbacks in open-ocean oxygen minimum zones on millennial timescales" *by* Daniela Niemeyer et al.

Anonymous Referee #2

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Using the UVic Earth System Model the authors describe a feedback loop between expanding oxygen minimum zones (OMZ's) and the availability of dissolved inorganic phosphorus (DIP). A warming climate stimulates weathering processes on land leading to an eutrophication of the oceans. The excess nutrients are taken up by marine phytoplankton which decays due to bacterial decomposition while it sinks out of the euphotic zone, thereby consuming extra oxygen. Increasing benthic oxygen depletion stimulates the redox dependent phosphorus fluxes from sediments, further elevating the concentration levels of DIP, leading to an even larger spread of OMZ's.

General comments: The paper provides an interesting contribution to the actual discussion of the trends of oxygen concentrations under the impact of anthropogenic green-

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Discussion paper

house gas emissions. It discusses at the first time the very relevant issue of the threat of an accelerated expansion of OMZ's due to a warming- induced phosphorus-oxygen feedback. The paper is nicely written and I recommend it - subject to minor revisions - for publication in the journal "Earth System Dynamics".

Specific comments: The authors report an increase of ocean net primary production (ONPP) between preindustrial times and year 3005 from 43.8 Tmol P a−1 to 65 Tmol P a−1 even for their reference model run (REF). Usually, global warming is thought to cause a decline in chlorophyll_a concentrations and NPP owing to a strengthening of ocean stratification (see references below).

Gregg W W, Casey N W and McClain C R 2005 Recent trends in global ocean chlorophyll Geophys. Res. Lett. 32 L03606

Boyce D G, Lewis M R and Worm B 2010 Global phytoplankton decline over the past century Nature 466 591–6

The authors should provide a short discussion of how this increase in ONPP, notably in the tropical ocean of their model, can be explained. The volume of OMZ's in UVic under present day conditions is drastically underestimated in comparison with observational data (15.8x106 km3 vs. 102x106 km3). The authors should discuss this flaw more in detail, notably if and how it could influence their conclusions. I would like to see the oxygen concentration map not only in 300 m depth (as shown in Figure 5) but also at depth of 900m.

Technical corrections: In the abstract the sentence ending with: " ... due to increased alkalinity, which, in turn, got there through weathering." sounds awkward. Please rephrase. Page 6 line 19 please replace Tol P a−1 by Tmol P a−1

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