

Interactive comment on “Pacific Decadal Oscillation and recent oxygen decline in the eastern tropical Pacific Ocean” by Olaf Duteil et al.

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We reproduced below the comments of the reviewer 2 in bold and add our replies in black

Reviewer 2 - This paper presents an analysis of idealized experiments conducted with an ocean general circulation model coupled to a simple ocean biogeochemical model. The authors construct idealized forcing representative of positive and negative phases of the PDO, as well as a mean forcing, which is a climatological year from which high-frequency variability has been removed. The difference between the circulation and oxygen fields in the model forced by the warm and cold forcings are suggestive of differences generated by transitions

C1

in the PDO. In particular, the warm phase of the PDO is characterized by lower oxygen and larger suboxic volumes than the cold phase. These results suggest that recent declines in may be attributable to transitions in the PDO from cold to warm. Overall, I find this to be a nice straightforward story and an interesting set of experiments. I think the interpretation of the results is appropriate and well presented. The forcing is highly idealized, but I think the interpretation does not over-reach. I recommend publication pending some very minor revisions.

We thank the reviewer for her/his positive evaluation

Minor comments: In 14-15: "constrained" is a poor word choice. Perhaps "controlled?"

yes, “controlled” reads much better : “The oxygen levels are mostly controlled by advective processes between 10°N and 10°S”

In 33: I agree that ocean models capture aspects of this mean picture reasonably well: the overall contrast between high latitude and tropical shadow zones is generally well simulated (in the good models), but the models tend to have OMZs that are much too extensive. In this sense, the model are terrible. This statement needs a bit more nuance.

Our original sentence L33 is “Ocean models capture this mean picture reasonably well (Bopp et al., 2013; Cocco et al., 2013, Cabré et al., 2015, Shigemitsu et al., 2017)”

We agree with the reviewer that most models tend to have too large OMZs, in particular erroneously including too low oxygen concentrations along the equator close to the eastern boundary. The ‘typical biases’ of the models are briefly discussed further in the text L177-179: “ ‘Typical’ biases (Bopp et al., 2013; Cabre et al., 2015) are present in our model. In particular: 1- the OMZ region does not extend far enough westward, in particular north of the equator, 2- oxygen concentrations at the equator close to the eastern boundary are too low”.

C2

We replaced the sentence L33 using the more precise phrasing of the reviewer: “The overall contrast between high latitude and tropical shadow zones is generally well reproduced by ocean models (Bopp et al., 2013; Cocco et al., 2013, Cabré et al., 2015, Shigemitsu et al., 2017)”.

In 120-121: I am having trouble parsing this sentence: "The corresponding time steps of the individual annual forcings of the year 1948 – 2007 have been averaged, leading to the reconstruction of a 1 year, 6h temporal resolution, climatological forcing." Please rephrase. I think you are simply saying that you construct an annual climatology of the bandpass-filtered forcing at 6h resolution.

The sentence has been replaced by : “The corresponding time steps of the individual annual forcings of the years 1948 to 2007 have been averaged to reconstruct a climatological forcing set”

In 130 and below: the units ms⁻¹ should be m s⁻¹

yes

In 141-142: what's going on here: looks like random text.

The paragraph “We spin up the model during 1000 years using the forcing dataset MEAN. We subsequently performed 2 experiments that we integrate for a period of 50 years, which corresponds to the typical oscillation period of the PDO during the past 200 years (Mc Donald and Case, 2005).

L141 -WARM: WARM forcing set (zonal and meridional wind speed, 10m air temperature, 10m humidity)

L142 -COLD : COLD forcing set (zonal and meridional wind speed, 10m air temperature, 10m humidity)”

has been modified :

“We spin up the model over 1000 years using the forcing dataset MEAN. We sub-

C3

sequently performed 2 experiments using the forcing datasets WARM and COLD, respectively, that we both integrate for a period of 50 years, which corresponds to the typical PDO oscillation period during the observational record of the past 200 years (Mc Donald and Case, 2005)”

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