

Interactive comment on “Climate driven decadal variations of biological production and plankton biomass in the equatorial Pacific Ocean: is this a regime shift?” by X. J. Wang et al.

Anonymous Referee #1

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In this paper the authors use a physical-biogeochemical model to explore the shifts in nutrient, biomass, zooplankton for two periods (1988-1996 and 1999-2007) to explore the regime shift. They use a model that has been well documented, and consider the model shifts in these two time periods extensively. The bottom line is that there does seem to be a shift induced by changes in the physic forcing, particularly an increase in primary and secondary production. Though competent illustrations are given and regional variations in these changes are explored, I felt the the results were lacking. Yes, the model shows a regime shift, but it is just a model. The authors need to go further and indicate how well this compares to observations. I am aware that there are few such observation, but there needs to be some attempt to show these results

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are not just a model artefact. Can any inferences made from the observations they do reference for fisheries and carbon cycle that suggest the regime shifts that the model captures. Importantly, the authors also need to explore further why their model behaves in this manner; it is, for instance, not immediately clear why there was such a big shift in secondary production.

Examples of further things to explore:

- Are there any observations of a shift to large phytoplankton? Could this be an artifact of the model parameterization?
- Has there been any documentation of the increased secondary production, and again could this be a artefact of the grazing parameterization.
- Could these shifts be a result of a longer term drift in the model? The model has only a 30 year spinup, which is not long enough to remove all drift in the biogeochemical fields. Has there been a control run without changes in physical forcing done to establish this drift?
- Why is there a shift to more large phytoplankton? Does increased nutrients alone explain this?
- I assume biomass remains constant even though primary production increases because secondary production increases too - but this should maybe be stated.
- Why, in the model, does this increase in secondary production occur. It is much larger than the primary production increase - why?
- Why is there larger temporal variability in the later period?
- What are the combined effect of primary and secondary shifts on, for instance, export of organic matter? The authors have a last paragraph reflecting on carbon cycle, but don't attempt to use their model to speculate on what might happen.

Details:

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2172, line 5: "these" is ambiguous, do you mean "these studies deal specifically with"?

2173, lines 15-20: Are there important signals over the 30 year period from outside the model domain that would impact the shifts that they see? Can these be assumed to be negligible?

2174, line 20-30: Though the authors give these demonstrations of their "model fidelity" they only give observations from 1990-1996, could they not give PP values from the latter period - satellite derived possibly? Such a comparison of the observations from both periods would go a long way to "validate" the long term model shifts.

2176, lines 7-9: Are there any evidence of this in the real ocean?

2176, line 17: "placed" might be better as "located"

2177, line 2-3: I'm not sure what "pooled two-sample" means - please elaborate.

2177, line 14: remove "the"

2177, line 17: What mean is used to find these anomalies? Do both periods have same mean, or is the mean specific for both periods? Please state.

2179, line 2: should "states" be singular

2179, line 15: remove "the" from "the sign"

2179, paragraph starting line 25: This information seems a little out of place here, at least mention that these physical changes are included in the model. And does your model respond in the appropriate way - you do have stronger upwelling, but how about "circulation", stronger SEC and deeper thermocline?

2180, section 4.3: Ending the paper with this much conjecture is problematic. If your model does not resolve the carbon cycle, then the least you could do is calculate shifts in export of organic matter.

Fig 3: labels are messed up in my version. Also state what the white and black lines

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represent.

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