Ocean Sci. Discuss.,
https://doi.org/10.5194/os-2020-85-RC2, 2020

Ocean Science
Discussions

Interactive comment on "Effects of strongly eddying oceans on multidecadal climate variability in the Community Earth System Model" *by* André Jüling et al.

Anonymous Referee #2

Received and published: 19 October 2020

This study analyses the impact of model resolution on the simulation of multidecadal climate variability. 250-year simulations are run with the Community Earth System Model at high (0.1° ocean) and low (1° ocean) resolution, which are then compared to 149 years of observational data. It is found that the higher resolution run simulates larger multidecadal variability in the Atlantic and Southern Ocean (and more like observations), with little difference between the two runs in the Northern Pacific. The improvements are linked to better resolution of mesoscale ocean dynamics, and therefore larger heat content variability in the higher resolution run. Some assessment is made with regards to the impact on global mean surface temperature (GMST), but little difference is seen in multidecadal GMST variability across the two resolutions.

Major Points

The paper is well-written, well-presented, and certainly worthy of publication in Ocean Science. The question around the impact of model resolution on the representation of multidecadal variability is likely to be of interest to the community. Clearly a lot of time has been spent on polishing the manuscript, and it is in an excellent state. There are a small number of minor points below that may require some attention.

Minor Points

+ L9: "The effect on global mean surface temperature is relatively minor". It might be better to clarify here that the effect on multidecadal GMST variability is relatively minor, since you show that there are changes to interannual variability.

+ L34: please indicate here that Pacific Decadal Oscillation is abbreviated to PDO later (PDO is used at L58 for the first time).

+ L151: appears to be the first use of 'SOM', and yet to be defined.

+ L173-178: it might be useful to move the index definitions into Section 2.

+ L181: "The AMV and SOM indices (in units of Kelvin) exhibit a smaller amplitude in the simulations than in the historical data". This is also true for the PDO index?

+ L181: How much of the difference between observations and model runs can be attributed to the different data lengths? In panel d, it might be helpful to show uncertainty bars indicating the range of standard deviations for the model data, if you were to compute it in 149-year moving windows (i.e. same length as observed data).

+ L183: "Larger PDO amplitudes. . .". I don't follow this sentence. Larger PDO amplitudes with respect to what?

+ Fig. 2 caption: The sentence beginning with "The monthly time series of. . ." requires some editing.

+ L198: “This suggests possible correlations between the Indian and Pacific basins and the Atlantic basin at multidecadal time scales. . . but such correlations are not significant in observations.” Apart from sparse observations in the earlier record, this may also be a result of non-stationary teleconnections (see for example Cai et al. (2019). Pantropical climate interactions. Science, 363, eaav4236)

+ L218: “To allow a comparison between the results, also the period of variability of the historical data has been extended to 50 years. . .”. The word ‘also’ is not required.

+ L223: “. . .but they overwhelmingly remove a linear trend. . .”. I assume you mean here simply that a majority of the studies remove a linear trend? ‘Overwhelmingly’ seems to be too overwhelming a word to use. Simply stating that ‘a majority remove a linear trend’ is sufficient. Or ‘almost all’.

+ L235: For the Fig. 5 analysis, is the Indian Ocean the only additional component for the ‘Global Ocean’? In other words, if a timeseries for the Indian Ocean were added to panels 5a and 5b, would Indian+Atlantic+Pacific+Southern = Global? I’m not suggesting you add the Indian Ocean timeseries to the figure, but it might be useful to clarify this point in the text.

+ L262: “On the other hand, in the Pacific remarkable differences exist: only in the HIGH simulation OHC anomaly signals propagate equatorward around 30°N, imprinting on the global pattern.” Could you please explain this further? In particular, how to see this ‘imprinting’?

Interactive comment on Ocean Sci. Discuss., https://doi.org/10.5194/os-2020-85, 2020.