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Interactive comment on "Global sea level reconstruction for 1900–2015 reveals regional variability in ocean dynamics and an unprecedented long weakening in the Gulf Stream flow since the 1990s" *by* Tal Ezer and Sonke Dangendorf

Jenny Jardine

jenjar@noc.ac.uk

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This paper was the subject of a journal club discussion at the National Oceanography Centre. This is not intended as an exhaustive review, but the following points were raised during the discussion and we hope that they will be helpful to the authors.

Write up: Jenny Jardine.

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Discussion paper

Discussion participants: Jenny Jardine, Jo Williams, Ben Barton, Peter Hogarth and 1 other.

Institution: National Oceanography Centre, Liverpool, UK.

Description:

The manuscript uses a coarse (1o x 1o) global reconstruction of sea level from 1900-2015 to investigate the long-term regional dynamics of the Western Atlantic Ocean and US East Coast. The two main objectives in this study were to evaluate the model's efficiency in capturing regional sea level variability and ocean dynamics, and to evaluate the sea level reconstruction against recent observations. Main conclusions suggested a weakened Gulf Stream during the late 1960s-70s and since the 1990s that long-term trend analysis using Ensemble Empirical Mode Decomposition (EEMD) correlated to the AMO and AMOC. The manuscript further concluded that the reconstruction was able to adequately capture the regional sea level variability in periods longer than 5 years.

Main Comments:

The paper uses EEMD to separate oscillations at different timescales, yet there was some ambiguity as to what statistical analyses can be done with the output. There is some doubt on the statistical confidence of the EEMD method, given that there are two low frequency oscillations being compared and there is no mention of how many Degrees of Freedom were used to assess the significance of results. As a group, we felt that more description is needed of the EEMD methodology and more confidence that results presented are statistically significant. This could be done by using a comparison to other time-series analysis methods (e.g. EOF analysis), another model output, or more recent datasets in the region (as supplementary material or by referring another paper).

In Figure 2, there is a distinct lack of sea level variability before 1940 that looks a lot

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like artificial smoothing. We anticipate this is due to the lack of data during this time period, but this needs to be acknowledged in the main text. Another suggestion is to run the model with random sub-sampled data after 1940 to have a more constant data input. This could show if the increased variability is dependent on the number of data points.

The manuscript also needs a clearer structure. The main conclusion, which reads as the long-term variability in the Gulf Stream, is an interesting result but is quickly lost in the middle of the paper, when the focus shifts to evaluation of regional sea level. One suggestion would be to put Section 3.2 just after the methodology, and then ending with the long-term Gulf Stream variability with AMO/AMOC. At present, it reads like two separate manuscripts pushed into one.

Other Comments:

Line 104: a brief explanation of the ocean dynamics mentioned would be useful. Throughout the manuscript, a more detailed (though still very brief) description of processes would be preferable when listing several references to explain a point

Suggest replacing “weakening trend” to “weakened”

Section 4: this is a very detailed/lengthy section that could benefit from some further summarisation. Much of the information here would be best going into the introduction or discussion sections

Fig 1: the jet colour scheme is slowly being phased out, due to the sharp colour contrasts. Suggest using another colormap

Fig 2: the red-green lines in 2b (and other figures throughout the manuscript) may be difficult for colour-blindness. Suggesting using different colours. Figure 2a would also benefit from an error bar.

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