

Interactive comment on “Emergence of multiple ocean ecosystem drivers in a large ensemble suite with an earth system model” by K. B. Rodgers et al.

Anonymous Referee #1

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The authors conducted 30 Ensemble simulations with the GFDL ESM2M following the historical /DRCP8.5 pathway. These simulations were used to detect the timing when secular trends of different ecosystem drivers, such as deoxygenation, ocean acidification, warming and changes to biological productivity, emerge from their natural background variability. Their major findings are that the trend of ocean acidification emerges already in the 20th century, much earlier than any other driver and that OA is easier to detect and distinguish from background noise than for example secular trends in NPP. I also particularly like their regional analysis, which shows that if 4 ecosystem drivers are chosen, the SO emerges strongest at the end of the century, and if only OA and temperature are considered, the tropics emerge strongest. This is nicely shown in

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figure 4.

The manuscript reads really well. The topic is carefully introduced and the authors did a great job in explaining why it is complicated to distinguish secular trends from natural variability. The results are nicely illustrated with figures. I recommend this manuscript for publication after considering my suggestions and minor corrections below.

The methods are generally well explained and thought through. However, I was confused when I read the introduction and methods as to why the authors decided to use a 30-year timescale for their trend emergence analysis. Do the cited observational studies on page 18192 show that the time series needs to be at least 30 years long? Likely not. . . Based on satellite Chla data, Henson et al., 2010 (Biogeosciences) suggest that a time-series needs to be at least 40 years long in order to be able to detect secular trends in biological production. In the results presented in the this manuscript, the authors test whether 30 years are enough to detect a secular trend in each driver individually. They also show that 10-year windows are not enough to detect a secular trend, especially in certain regions that are strongly driven by large inter annual/multidecadal atmospheric patterns. To avoid confusion, it would be good to make this clearer on page 18195 – the last sentence does mention the 10-year window test, but I only realized that after rereading the methods several times. I also think that the results of these tests are important findings for oceanographers and should be mentioned in the abstract.

Minor corrections:

Page 18194, Line7: snapshots

Line 11: perturbations

Page 18199, Line3: delete “a” and change “drive” to “drivers”?

Page 18216: . . . has been used to calculate trends. . . (Erase calculated)

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