

## ***Interactive comment on “Natural variability in the surface ocean carbonate ion concentration” by N. S. Lovenduski et al.***

**Anonymous Referee #1**

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This is a thorough and well-written manuscript on carbonate ion concentrations in the surface oceans. There are no observations appropriate for such evaluations so the authors use a long control simulation from an Earth System Model. This allows for evaluation of variance, analysis of the length scales of internal natural variability, as well as determination of the noise-to-signal ratios. These are all valuable and important insights into a carbon system variable that is becoming more and more important in the future as a result of ocean acidification.

Minor issue: Some information is repeated a few times in the manuscript. Most notably the information about the model run and the lack of external forcing, which is given both in the introduction and the model description section.

I find no major issues with this manuscript.

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The one thing I as the reader miss is more discussion. The results are all very well presented, but lack some discussion. One of the main results, also highlighted in the abstract, is that “the anthropogenic trend in pH is detectable sooner than the anthropogenic trend in  $\Delta\text{Aragonite}$ .” (page 13134, line 20). I would like some discussion of the implication of this result. In particular since the spatial variability in the detection time is very large. There is some discussion of the model results in relation to the time series data published by Bates et al. (2014), and especially mentioned that “all located in places with relatively short detection times”. Again I miss some discussion on the implication of this. Are the time series then less representative of the “typical” ocean variability and trends? There is a lot of work going on currently aimed at optimizing the observational network (both using fixed time series stations and lines/transects covering larger areas). I think such work on the long-term natural variability of key ocean carbon chemistry is highly relevant for such work. This merits some mention and discussion also in this paper. Finally, since the detection time is so spatially variable and the variability has such different time scales in different regions: is there any point trying to calculate global trends with the observations we have available today? What additional constraints are necessary to make such estimates robust? Some discussion along these lines would be very nice.

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