Reply on RC2

Michael Whitney

I appreciate the reviewer’s comments. The concerns and questions raised can be addressed with some additional analysis and a greatly expanded discussion. There is a clear need for updated 21st century forecasts for conditions in coastal hypoxic areas around the world. The paper presents and describes such forecasts and places them in context with global observations. The revised paper will more effectively motivate the objectives and much more fully discuss results, limitations, implications, and ways to improve forecasts. This paper should inform many scientists and managers about the intensity and spatial distribution of warming pressures confronting coastal hypoxic areas.

I have endeavored to provide an appropriate level of detail in conveying the main points raised by the reviewer and in describing the ways the paper will be revised.

The reviewer suggests considering other future scenarios (e.g. with lower emissions than RCP8.5) that may track better with the observed trend. I just looked into data availability for the RCP4.5 ensemble companion to the RCP8.5 ensemble analyzed. Unfortunately, the Earth System Grid reports the data files as now inaccessible for RCP4.5. There are other CMIP5 models that can be accessed and analyzed for multiple scenarios. I seriously considered delving into the new analysis, but I have determined it would be a prohibitively large new analysis effort for revising this single-author paper. That said the overall point is worth making to the extent possible by citing published research. Such a discussion will be added to the section where the forecasts and observations are compared for overlapping years.

The reviewer asks if the model biogeochemistry actually adds value to the oxygen forecasts. Analysis indicates the model biogeochemistry adds oxygen variability. This question will be explored with further analysis. This point also will be added to the discussion particularly in regard to how forecasting methods can be improved.

The reviewer commented on the limits of using coastal model cells (from a coarse global grid) to represent estuary conditions. The other reviewer raised a similar point and a discussion of estuary conditions and forecasting limitations will be discussed. The discussion is a good way to motivate the need for new forecasting approaches.

The reviewer would like more discussion about the larger uncertainty in the Arctic and how
it affects confidence in the surface oxygen capacity trends here. The trends remain statistically significant in these regions. Text will be added to discuss this issue.

The reviewer points out that there are some open-ocean and coastal areas where the forecast trend indicates increasing (vertical-minimum) oxygen concentration and states this raises a question that is not discussed. Additional analysis on these data will be completed to answer this question, at least for the coastal areas. Part of the answer involves the model biogeochemistry since warming pressures favor decreasing oxygen.

The reviewer suggests removing the passing references to ocean circulation since they are not a focus of the paper. The sentences about ocean circulation will be removed from the discussion of results.

The reviewer indicates the discussion should be more in-depth and should specifically describe why regional differences emerge and what bearing the analysis has on estuaries or how adjacent deoxygenation might matter for them. These topics will be treated in a considerably expanded discussion. The reviewer also feels it is unclear how the analysis contributes to new thinking about hypoxia and future change. The aim of the paper is not seeking a paradigm shift on how we think of hypoxia. Rather, the objective is providing a much needed update on hypoxia forecasts in global coastal areas. The results emphasize where and how rapidly warming pressures on hypoxia will lead to further water quality deterioration. The paper should contribute to raised awareness of this dire threat to coastal environmental water quality. The new discussion points and other revisions will help the paper make these points most effectively.

The reviewer lists some minor edits that can be made quickly.