Modeling of ecosystem changes due to ocean acidification based on the Blue Carbon Ecosystem Model

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Ocean acidification is thought to cause growth inhibition and reduction in numbers of marine organisms, including shellfish, zooplankton, algae and so on. Forecasting the impacts of ocean acidification on marine ecosystems is important for marine resources preservation.
Recently, ocean acidification is progressing on a global scale due to carbon dioxide emissions from human activities, and it is predicted that by 2100 the global average pH will be up to 0.3 below the current level (Gustafsson et al., 2023). Rapid acidification has already occurred in certain closed bays and coastal areas around rivers, and there is concern that pH changes may affect organisms there (Golbuu et al., 2016; Salisbury et al., 2011). The impact of ocean acidification on marine organisms has been observed in laboratory environments (Riebesell et al., 2010). However, due to difficulties in observations there is limited data on the effects of acidification on marine organisms in real environments. For example, compounding effects such as increasing water temperature or pollutions and predator-prey relationships make it difficult to isolate the effects of acidification (Ferrari et al., 2011; Doropoulos et al., 2012).
The objective of our study is to model and forecast the complex effects of ocean acidification on ocean organism. First, we need to add ocean acidification impacts to current ecosystem models. Then we aim to model of bay-scale area in which ocean acidification is already occurring to develop effective adaptation and mitigation measures for ocean acidification in the future. In this study, we will focus on macroalgae which have been observed to be affected in Harvey et al., 2021. We formulated and examined hypotheses regarding the pH-dependent changes of macroalgae biomass referring to Ohmachi and Sohma, 2022.
We focus on the Blue Carbon Ecosystem Model (Sohma et al., 2020) and consider adding fluxes of ocean acidification on respective ocean organisms to the model to quantify the changes of marine organisms due to carbon dioxide-derived ocean acidification. First, we examined hypotheses about which terms in the Blue Carbon Ecosystem Model might be affected by ocean acidification. In our presentation, we will explain macroalgae model structure, formulate and simulation results of the hypotheses and research outlook.
In the future, we aim to forecast the change of marine biomass due to ocean acidification. Also, we believe that we can quantitatively verify the effectiveness of ocean acidification countermeasures such as marine carbon capture by using our model.

Keywords: Ocean Acidification, Ecosystem Model, Carbon Cycle, Blue Carbon

