OS13C-1309 Fingerprinting the Effects of Ocean Alkalinity Enhancement in the California Current System Regional Ocean Model with Carbon Isotopes

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Abstract

Measuring, reporting, and verification (MRV) of ocean-based carbon dioxide removal (CDR) presents challenges due to the dynamic nature of the ocean and the complex processes influencing marine carbonate chemistry. Given these challenges, finding the optimal sampling strategies and suite of parameters to be measured is a timely research question. While traditional carbonate parameters such as total alkalinity (TA), dissolved inorganic carbon (DIC), pH, and seawater pCO_2 are commonly considered, exploring the potential of carbon isotopes for quantifying additional CO_2 uptake remains a relatively unexplored research avenue. In this study, we use a coupled physical-biogeochemical model of the California Current System (CCS) to run a suite of Ocean Alkalinity Enhancement (OAE) simulations. The physical circulation for the CCS is generated using a nested implementation of the Regional Ocean Modeling System (ROMS) with an outer domain of 1/10˚ (~10 km) and an inner domain of 1/30˚ (~3 km) resolution. The biogeochemical model, NEMUCSC, is a customized version of the North Pacific Ecosystem Model for Understanding Regional Oceanography (NEMURO) that includes carbon cycling and carbon isotopes.

The CCS is one of four global eastern boundary upwelling systems characterized by high biological activity and CO_2 concentrations. Consequently, the CCS represents an essential test case for investigating the efficacy and potential side effects of OAE deployments. The study aims to address two key questions: (1) the relative merit of OAE to counter ocean acidification versus the additional sequestration of CO_2 from the atmosphere, and (2) the footprint of potentially harmful seawater chemistry adjacent to OAE deployments. We plan to leverage these high-resolution model results to competitively evaluate different MRV strategies, with a specific focus on analyzing the spatiotemporal distribution of carbon isotopic signatures following OAE. In this talk, we will showcase our initial results and discuss challenges in integrating high-resolution regional modeling into models of the global carbon cycle. More broadly, this work aims to provide insights into the plausibility of OAE as a climate solution that maintains ocean health and to inform accurate quantification of carbon uptake for MRV purposes.

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