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Study on the increasing atmospheric CO_2 impact on the ocean in the East Asia using a coupled climate-carbon cycle model

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This study investigates the impacts of increasing atmospheric CO_2 concentration on the ocean biogeochemical states in East Asia. We use the Hadley Centre Global Environmental Model version coupled with the terrestrial and ocean carbon cycle models. For evaluation, we analyze historical run for the past three decades. The observation datasets of Takahashi et al.[2009] and GLODAP and an analysis by Carbon Tracker are used. Comparison results show that HadGEM2-CC can reproduce a reasonable structure of the ocean circulation and biogeochemical processes, affecting the sea surface pH, the air-sea CO_2 flux, total CO_2, and alkalinity globally and in the western North Pacific. The trends of the simulated pCO_2, ocean CO_2 uptake, and surface pH during the past three decades are also suitably consistent with those in previous studies. During the historical run period, as atmospheric CO_2 concentration rises, the western North Pacific and the coastal seas exhibit an increase in the partial pressure of CO_2 in seawater. The ocean CO_2 uptake contributes to the surface pH decrease and potential changes in the calcification process. According to RCP, atmospheric CO_2 concentration is expected to increase in the future. The subsequent ocean uptake accompanies ocean process changes in air-sea CO_2 flux, ocean acidification. In this study, future changes in the ocean biogeochemical state are investigated, focusing on the western North Pacific region. Also ocean ecosystem changes such as ocean primary production will be studied to understand ocean uptake process.

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