



Potential Impacts of Ocean Carbon Cycle on Future Climate Projection Spread

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The uncertainty ranges of future climate projection for emission scenarios come from the physical processes and the carbon cycle processes. As an important carbon sink of atmospheric CO₂, the carbon absorption of the ocean needs to be well simulated to project future climate. Compared with observation from Valsala and Maksyutov [Valsala and Maksyutov, 2010], the 13 earth system models of the fifth phase of the Coupled Model Intercomparison Project (CMIP5), which make their carbon cycle experiments outputs available, well capture the pattern characteristics and seasonal cycle of the air-sea CO₂ exchange flux. Especially two critical areas, Equator Pacific and North Atlantic, which releases about 40% of total CO₂ emission and absorbs about 20% of total CO₂ absorption from ocean respectively, are evaluated in this research. More than half of the models underestimate the CO₂ emission in Equator Pacific, because of the sea surface temperature is overestimated and the near surface wind speed is undervalued. In addition, most of the models overestimate the CO₂ absorption in the North Atlantic, resulting from the high sea surface temperature, low dissolved inorganic carbon and large near surface wind speed. Considering the total flux in these two areas, most of the models overestimate the absorption ability of the ocean. In future projections driven by emissions, most of the models with fast temperature increasing speed are those models which overestimate the absorption ability of ocean, and the models with relatively slow temperature rise speed are mostly the models which underestimate the ocean absorption. If the ability of these earth system models in simulating the air-sea CO₂ flux is promoted, the warming speed of those models with fast temperature increasing speed may be faster and of those models with slow temperature rising speed may be relatively slower. It implies that the upper limit of the future temperature projection range may be higher and the lower limit may be slightly lower than the current, which makes the future climate projection spread more widely.

Key words: Air-sea CO₂ flux, Ocean absorption, Future projection, Uncertainty range