Glacial ocean carbon cycle changes caused by enhanced stratification in the Southern Ocean and iron fertilization from glaciogenic dust

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The glacial-interglacial variation of atmospheric carbon dioxide concentration (pCO_2) is recognized to mainly arise from changes in the ocean carbon cycle, but the detailed mechanism behind this change is not clarified. This study conducts an ocean carbon cycle simulation using a global-scale three-dimensional ocean general circulation model considering the enhanced stratification in the Southern Ocean and the iron fertilization from glaciogenic dust during the glacial periods and shows the glacial change of atmospheric pCO_2 by about 80 ppm. Considering these processes also improves simulating the ocean inventory and distribution of dissolved oxygen, carbonate ion, $\delta^{13}C$, and radiocarbon ages. We show that the effective biological pump under the enhanced stratification and increased ocean alkalinity inventory due to carbonate compensation, which are not appropriately considered in previous OGCM studies, are important to sequester carbon to the deep ocean under the constraints of proxy data during glacial periods.

Keywords: ocean carbon cycle, glacial-interglacial cycle, Southern Ocean, iron fertilization, carbonate compensation

