Modeling the ocean carbon cycle during the last deglaciation part II

*Hidetaka Kobayashi[1], Akira Oka[1], Takashi Obase[1], Ayako Abe-Ouchi[1]

1. Atmosphere and Ocean Research Institute, The University of Tokyo

Analyses of air trapped in ice cores have shown that atmospheric carbon dioxide concentrations (pCO2) during glacial periods are about 90 ppm lower than that during interglacial periods over the past 800,000 years. Although not yet fully understood, it is recognized that the variation of atmospheric pCO2 is mainly due to changes in the ocean carbon cycle (e.g., sea surface temperature, biological carbon pump, ocean circulation, and carbonate inorganic chemistry). Recent studies, including those of the authors, have pointed out the importance of changes in physical and biogeochemical processes in the Southern Ocean for the changes in the ocean carbon cycle. On the other hand, these consequences are mainly derived from comparisons of the state of the carbon cycle under equilibrium climates. Therefore, the mechanisms of realistic transient changes in the carbon cycle need to be finally clarified. Here, we investigated the transient response of the ocean carbon cycle during the last deglaciation between 21,000 and 11,000 years ago. Our atmosphere-ocean general circulation model simulation reproduced changes in deep ocean circulation and sea surface temperature during the Bolling-Allerod transition. In this talk, the preliminary results of the transient simulation will be presented. We will focus on the response of the ocean carbon cycle to abrupt changes in the Atlantic meridional overturning circulation during the Bolling-Allerod and Younger-Dryas transition. Sensitivity experiments suggest that the timing of enhanced vertical mixing in the surface Southern Ocean is important in determining the timing of the increase in atmospheric pCO2 during deglaciation, but existing model simulation do not seem to capture this temporal change well. Future issues for realistic simulations will be discussed.

Keywords: ocean carbon cycle, last deglaciation, Southern Ocean, Atlantic meridional overturning circulation

