Role of deep ocean mixing on climate change assessed by an Earth system model

*Michio Watanabe[1], Akitomo Yamamoto[1], Tomohiro Hajima[1], Hiroaki Tatebe[1]

1. Japan Agency for Marine-Earth Science and Technology

Incorporating biogeochemical processes into general circulation models (GCMs), Earth system models (ESMs) have been developed for future climate projection. Micro-scale turbulent mixing in the deep ocean due to the tide-induced internal wave breaking is a key process to determine the strength and pattern of the meridional overturning circulation (MOC), which redistributes the absorbed heat in the ocean. In addition, strong carbon uptake is found in the deep and bottom water formation regions in the high latitudes, and the absorbed carbon is also redistributed by the MOC, so that the deep ocean mixing has a strong impact on the global carbon cycle. However, the distribution of the intensity of deep ocean mixing is not clear and the impact of the deep ocean mixing on the global carbon cycle has not been well discussed. In this study, employing each of two implementation of deep ocean mixing, we execute an Earth system model under the preindustrial forcing, then under increasing atmospheric CO_2 concentration by 1 % per year. Our results show the strong impact of the distribution of the intensity of deep ocean mixing on the ocean carbon and heat uptakes, the carbon and heat transports down to the deeper ocean, as well as the transient climate response. Better parameterizations for deep ocean mixing processes could contribute to reducing uncertainties in future climate projections.

Keywords: Earth system model, Transient Climate Reponse, ocean carbon uptake, Meridional Overturning Circulation, ocean heat uptake

