Contribution of tidal energy dissipation to variations of transient climate response and steric sea level rise through ocean heat uptake

*Michio Watanabe[1], Hiroaki Tatebe[1], Tatsuo Suzuki[1], Kaoru Tachiiri[1]

1. Japan Agency for Marine-Earth Science and Technology

Micro-scale turbulent mixing due to tide-induced internal wave breaking is a key process to determine the strength and pattern of the global ocean overturning circulation, that redistributes the heat all over the world ocean. Heat redistribution in the ocean have a strong impact on ocean heat uptake (OHU), thus transient climate response (TCR) and steric sea level rise (SLR) under the global warming. To study the impact of the vertical diffusivity distribution on the TCR and steric SLR, we ran a climate model of which value of CO_2 concentration is increased by 1% yr^{-1} for 150 years, employing each of two vertical diffusivity distributions in the ocean, an empirical one-dimensional one (CTRL) and a three-dimensional one considering tidal energy dissipation (TED). In TED under the pre-industrial forcing, the larger sea ice in the Southern Ocean prevents the air-sea heat flux, leading to weaker bottom water formation and lower air temperature than in CTRL. The less effective heat transport to the deep layers in TED causes less OHU and larger TCR than in CTRL by about 0.16˚C. In addition, smaller ocean heat content change in TED than in CTRL leads to significant future sea-level depression of ~0.4 m in the Southern Ocean. Since OHU under the global warming is controlled by the distribution of vertical diffusivity, it is necessary to clarify its global distribution in the real ocean for reliable TCR estimation and future SLR projection.

Keywords: diapycnal diffusivity, transient climate response, sea level rise, global warming, climate model, ocean heat uptake

