Projected sea level rise, gyre circulation and water mass formation in the North Pacific: CMIP5 inter-model analysis

*寺田 美緒[1]、見延 庄士郎[1]
*Mio Terada[1], Shoshiro Minobe[1]

1. 北海道大学
1. Hokkaido University

Spatial dependency of sea level (dynamic sea level; DSL) change attracts much attention, because it directly impacts on the human society. Relatively large sea-level rise is expected to occur in the western North Pacific. It is suggested that wind stress change and heat flux change contribute to DSL change there. However, there is no comprehensive study of DSL dealing with both surface forcings and subsurface ocean using multi-models. In this study, DSL changes over the North Pacific and the associated changes of the subsurface ocean and surface forcings are investigated until 2300 under two greenhouse-gas emission scenarios (RCP4.5, RCP8.5) by analyzing the output from CMIP5 models.
The DSL changes in the North Pacific until 2100 are characterized by a DSL rise in the western North Pacific around the Kuroshio Extension (KE), as also reported by previous studies in both the scenarios. From 2100 to 2300, DSL rises most of the North Pacific with the large positive DSL change located on the KE front only in RCP8.5. DSL changes little after 2100 in RCP4.5 related to the faster stabilization of the radiative forcing than that of RCP8.5. Subsurface density analysis indicates that DSL rise around the KE is associated with decrease in density of subtropical mode water (STMW) and with northward KE migration, while the density decrease of STMW (northward KE migration) is relatively strong between 2000 and 2100 for both RCP4.5 and RCP8.5 (2100 and 2300 for RCP8.5). A large regional density decrease in the STMW is due to a large heat uptake of the STMW related to an excess downward heat flux in the south of the KE. A regional density decreases around the KE front by 2300 induced by the northward migration of the KE, which is related to the northward migration of the zonal wind stress. These features are commonly found in multi-model ensemble means and the relations among representative quantities produced by different climate models.

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