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Interdecadal variability and linear trend of sea level around Japan in the 20th and 21st centuries

Tamaki Yasuda[†]; Masakazu Sueyoshi
[†] Meteorological Research Institute, Japan
Leading author: tyasuda@mri-jma.go.jp

Japan islands are located at the latitude of boundary between the subtropical and subpolar gyres in the North Pacific and the area where the strong Kuroshio and Oyashio currents meet. Therefore, sea level around Japan could be dynamically influenced by the change in these current systems. In this study, interdecadal variability and linear trend of sea level around Japan during the 20th century and in the future climate projected by IPCC-AR4 CGCMs. Historical tide gauge data show that sea level along the Japanese coast has no significant trend during the 20th century. Rather, bidecadal variability and simultaneous variation along the Japanese coast are remarkable. The long-term variability of the sea level along the Japanese coast is mainly due to the baroclinic Rossby waves forced by changes in the large-scale wind stress fields in the North Pacific with a lag of several years. Sea level along the Japanese coast has risen significantly since the mid-1980s. Although this is partly explained by the dynamical response to the wind stress fields, it can be considered that the global mean thermal expansion contributes considerably. We also investigate the changes in the sea surface height (SSH) east of Japan due to increased atmospheric greenhouse gases using output from IPCC-AR4 CGCMs. Results from 15 atmosphere-ocean coupled models are analyzed. Multi-model ensemble means indicate dynamical sea level rise east of Japan associated with the northward shift of the Kuroshio Extension (KE). 18cm of the dynamical sea level rise east of Japan is comparable to global mean steric sea level rise. The patterns of the SSH change east of Japan differ among the models. While some models show the largest SSH change south of the KE, others show the largest SSH change near the KE. We investigate the effect of the Sverdrup stream function (SSF), which is computed using the wind stress, on the inter-model variability in the SSH change east of Japan. The northward shift of the KE is correlated with that of the zero line of the SSF. In addition, the increase in the SSH difference between 34^{o}N and 42^{o}N is correlated with the increase in the eastward volume transport calculated from the SSF. These indicate that the inter-model variability in the wind stress change is responsible for that in the SSH change east of Japan. We show that the latitudinal shift of the zero line of the SSF is correlated with the latitudinal shift of the Aleutian Low (AL), and the increase in the transport calculated from the SSF is correlated with the strengthening of the AL in the models.