Future Projection and Assessment of Natural Variabilities of the Ibaraki Coastal Current System

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Introduction and objective

Global mean sea level, Sea Surface Temperatures (SST) and extreme precipitation amounts are expected to increase in 21st century under the climate change impact. It will especially affect coastal zones which are more sensitive to changes and disturbances of every of these factors than deeper oceanic waters. Coastal processes, such as variabilities of shallow water temperatures, cannot be precisely reproduced by coarse scale global climate models and therefore downscaling the coastal current system to fine resolution scales is needed. Therefore, dynamical downscaling of ocean currents is often used approach to reproduce fine scale ocean circulation with bigger precision than in coarse scale global or regional climate models.

Objective of the study is providing future projection of fine scale ocean circulation and assessment of natural variabilities of physical processes of the Ibaraki coastal current system, which can be ultimately used for proposing adaptation strategies for developing countermeasures against climate change impact assessment.

Methodology

We continued the study from Troselj et al. (2019) where reanalysis of past coastal current system was discussed. We applied the same methodology as in the previous study using 3 domain nested COAWST modeling system but we applied different surface boundary conditions from MIROC5 and MRI-CGCM3 forcings with rcp 2.6 and rcp 8.5 scenarios for targeted years 2046 and 2090, whereas for years 2049, 2050, 2091 and 2092 was used only MIROC5 forcing with rcp 8.5 scenario. We also simulated MIROC5 and MRI-CGCM3 forced historical runs for years 1996 and 1997. Also, River forcing conditions for Tone, Naka and Kuji rivers were not included due to lack of future projection data.

Discussions

We discussed seasonal mean and variabilities of Domain 3 Hasaki point in 3 simulations with the most realistic results (MIROC5-rcp85-2049, MIROC5-rcp85-2091 and MRI-CGCM3-rcp85-2090) and compared them with reanalysis run (forced with FORA-WNP30) from 2005. These simulations were the only ones which did not blow up during the entire simulated year, other simulations which blew up and have been restarted once or multiple times sometimes have abrupt change in SST due to the restart. SST results from some forcings and scenarios were not modelled realistically because of big bias in surface forcing input data.

We discussed changes from present to future climate for various coastal parameters and analyzed combinations of forcings and scenarios which had shown meaningful results. We also discussed interaction between surface air temperature and SST and compared coastal variabilities of various physical parameters across the 3 nested domains and with both considered historical runs.

Summary

We conducted dynamical downscaling for future projection of coastal current system on the Ibaraki coast, using downscaling methodology developed from the previous study. We showed that variability of SST in coastal shallow waters showed slight increase in MRI-CGCM-rcp85 scenario for 2090 throughout all seasons whereas autumn season SST mean in MIROC5-rcp85 for both 2049 and 2091 showed an increase of about 5 Degrees Celsius which did not occur in other seasons. We showed that reproducibility of coastal natural variabilities of physical processes showed significant increase in summer season of the analyzed 2090 and 2091 scenarios. The results are still under discussion and analysis and will be further compared with other modelled scenarios in order to determine functional relationship of physical processes between SST and surface forcing conditions.

Reference

Troselj, J., Imai, Y., Ninomiya, J., Mori, N., 2019. Seasonal Variabilities of Sea Surface Temperature and Salinity on Ibaraki Coast, Journal of Japan Society of Civil Engineers, Ser. B2 (Coastal Engineering), Vol. 75, No. 2, pp. 1213-1218.

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