C22

Downscaling of Coastal Current System on Ibaraki Coast

〇Josko TROSELJ, Yuki IMAI, Junichi NINOMIYA, Nobuhito MORI

Introduction and Objective

Global mean sea level, sea surface temperatures and extreme precipitation amounts are expected to increase in 21st century under the climate change impact. It will especially affect coastal zones which are sensitive to all of these factors because extreme freshwater inflow, inundation levels, erosion as well as fishery industry nearshore are expected to be largely impacted. Coastal processes, such as variabilities of shallow water temperatures nearshore, cannot be precisely reproduced by coarse scale global climate models and therefore downscaling the coastal current system to fine resolution scales is needed.

Objective of the study is assessment of natural variability of physical processes of the coastal ocean with providing fine scale coastal ocean circulation reanalysis by downscaling of coastal current system for Ibaraki prefecture in Japan from 10 km scale parent dataset to related projections of 222 m scale, so that it can be used for adaptation of countermeasures for climate change impact assessment.

Methods

A coupled model COAWST was used for dynamical downscaling, consisting of hydrostatic ocean model (ROMS) and spectral wave model (SWAN) (Fig.1).

Bathymetry was used from Japan Hydrographic Association Submarine topography digital data.

Surface boundary conditions of wind speed, sea level pressure, air temperature, precipitation, shortwave radiation flux and cloud fraction are used from JRA-55, while river forcing conditions are used as observed river temperature and discharge (from MLIT) with constant salinity of 0.5 PSU for Tone, Naka and Kuji rivers.

Lateral boundary conditions of velocity, sea surface height, temperature and salinity were used from FORA-WNP30 ocean reanalysis dataset (FORA) with types Chapman-implicit (free surface), Flather (2D momentum) and Gradient (3D momentum, mixing turbulent kinetic energy, temperature and salinity).

The COAWST model used 3 domain nesting with 2 km, 667 m and 222 m scales and 10s, 5s and 2.5s baroclinic time steps respectively, for targeted reanalysis period of whole 2000. The downscaled results were validated by in-situ observed data (Hasaki, PARI) and coastal domain averaged fine scale satellite observation dataset (MGDSST).

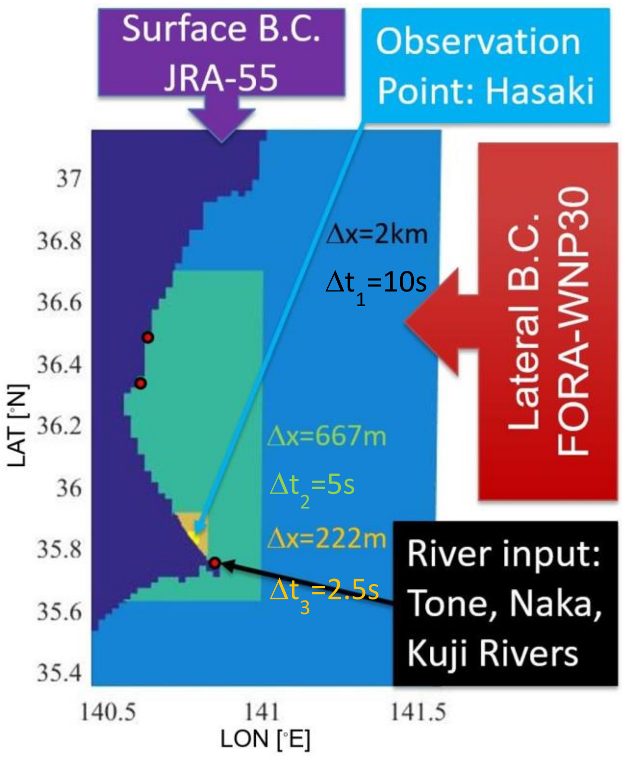

Figure 1: COAWST model setup

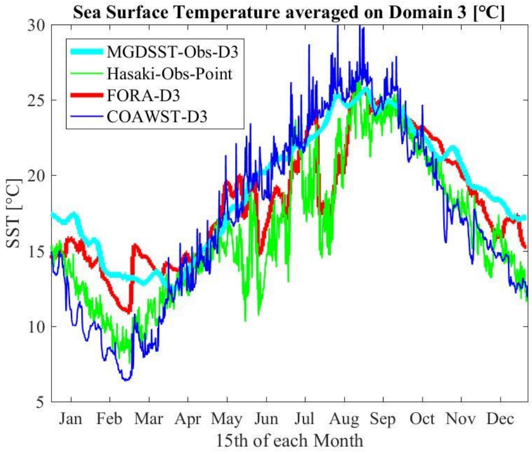

Figure 2: Sea Surface Temperature averaged on Domain 3

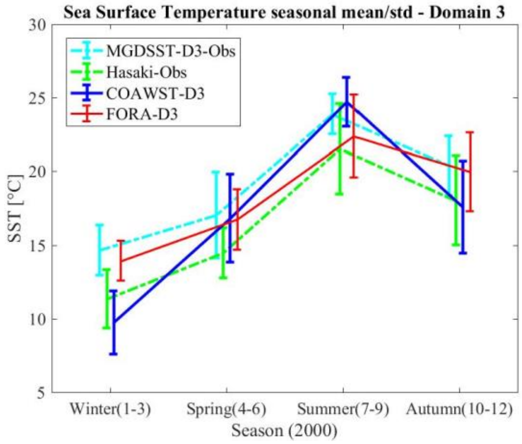

Figure 3: Sea Surface Temperature seasonal mean and standard deviation averaged on Domain 3

Results and discussions

We compared the modeled results with observed sea surface temperature data from Hasaki point and MGDSST satellite dataset averaged on modelled Domain 3.

Fig. 2 shows sea surface temperature averaged on Domain 3 from two observation datasets as well as parent modelled dataset (FORA) and our modelled results (COAWST). COAWST shows great fit with Hasaki from November to March, and with MDGSST from May to September. In April and October, both of them show great fit. Fig. 3 shows seasonal and Fig. 4 shows monthly mean and standard deviation of modelled and observed datasets. These results further confirms that COAWST show better fit and reproduction of variabilities in respect to Hasaki data in autumn and winter and in respect to MGDSST data in spring and summer than FORA parent dataset. Particularly in summer season, FORA shows cold surface temperatures (sometimes even below 15 degrees Celsius) and higher variabilities but COAWST improves these results. Furthermore, COAWST results are showing more precise variabilities of shallow water nearshore surface temperatures than FORA, which is achieved because of downscaling to very fine resolution of 222 m grid scale.

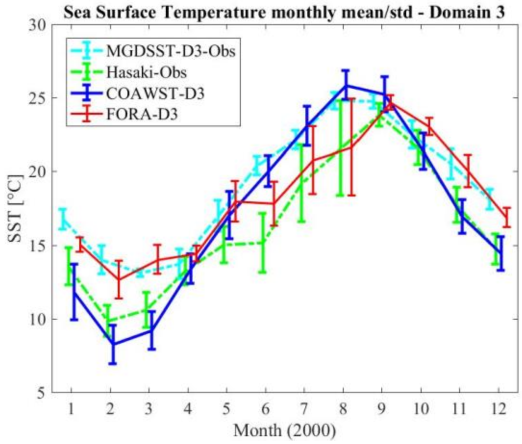

Figure 4: Sea Surface Temperature monthly mean and standard deviation averaged on Domain 3

These results suggest that there might be occurring a cold coastal current in autumn and winter, which cannot be easily captured by 0.25 degrees scale MDGSST, so then observed data from Hasaki are corresponding well with COAWST. However, during spring and summer Hasaki shows unrealistically low surface temperatures for that season and validation with MGDSST is more reliable and very precise. These conclusions should be further tested and validated by extending the calculation period to more analyzed years, which is currently under calculation.

Keywords: downscaling, coastal current, natural variability, COAWST