

A new ocean regional projection dataset with 10 km resolution for the North Pacific d4PDFv2-Ocean and its application to coastal downscale modeling around Japan

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Introduction

- Japan Agency for Marine-Earth Science and Technology (JAMSTEC) and Meteorological Research Institute/Japan Meteorological Agency (MRI/JMA) have been creating multiple ocean projection datasets for the North Pacific (NP) for the past decade.
- These datasets supported publication of reports on climate change around Japan by Ministry of Education, Culture, Sports, Science and Technology and JMA.

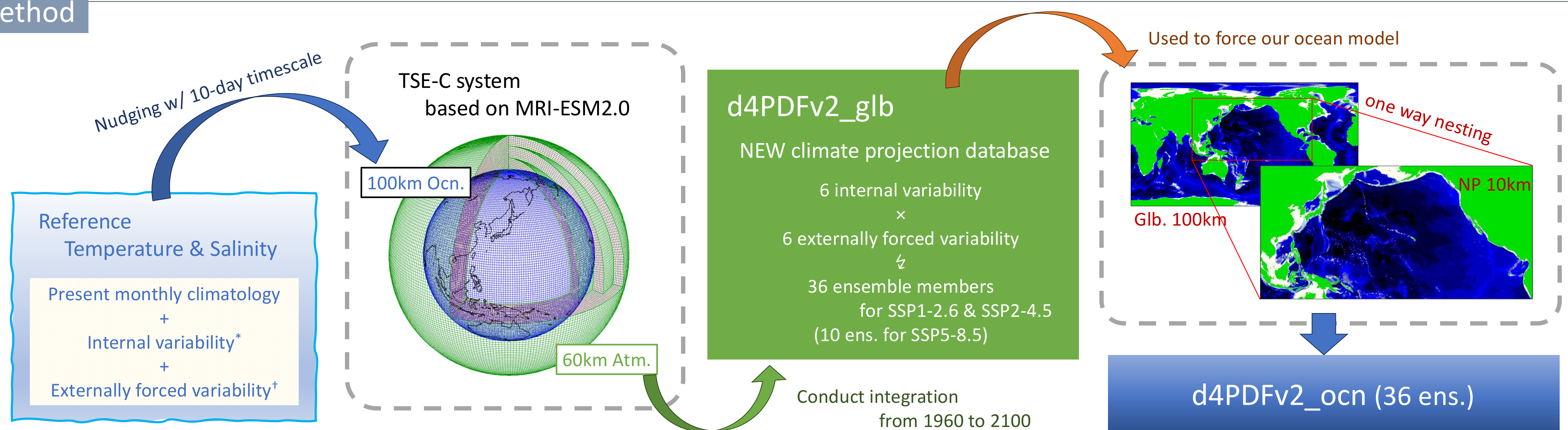
The latest versions: FORP-NP10 ver.4 and ver.4.5

- cover NP with the horizontal resolution of 10 km and the period from 1960 to 2100 under the scenarios of RCP2.6 and RCP8.5 for CMIP5.
- have 4 ensemble members driven by atmospheric forcing based on each CMIP5 experiment w/ GFDL-ESM2M, IPSL-CM5A-MR, MIROC5 and MRI-CGCM3.
- show southward shifts of Kuroshio Extension (KE) possibly related to the equatorward bias of westerly winds (Nishikawa+ 2024)

Objectives & Challenges

- Create a new version of the regional ocean climate projection dataset around Japan
- Drive our ocean model w/ bias-corrected atmospheric forcings (CMIP6 models still suffer from westerly jet position biases (e.g., Keel+ 2024))
- Offer more ensemble experiments to facilitate studies on uncertainty in regional ocean climate projections

Method



* Diagnosed from COBE-SST2 & objective analysis data of Ishii+ (2017). We consider 6 patterns of internal variability.

† T/S Variabilities coinciding with the 1st & 2nd EOF modes of ensemble mean of 10 year low pass filtered SST in each CMIP6 model (6 CMIP6 models are used here).

Results of SSP2-4.5 experiments

- ✓ The position bias of westerly jets over NP is reduced in d4PDFv2_glb compared to the original CMIP6 data.
- ✓ Kuroshio realistically separates from the coast of Japan and KE shifts northward to the more realistic position.
- ✓ These differences possibly improve the projections of the SST rise around Japan in the end of the 21st century (Fig. 1).

Large ensemble members might reduce uncertainty in these regions

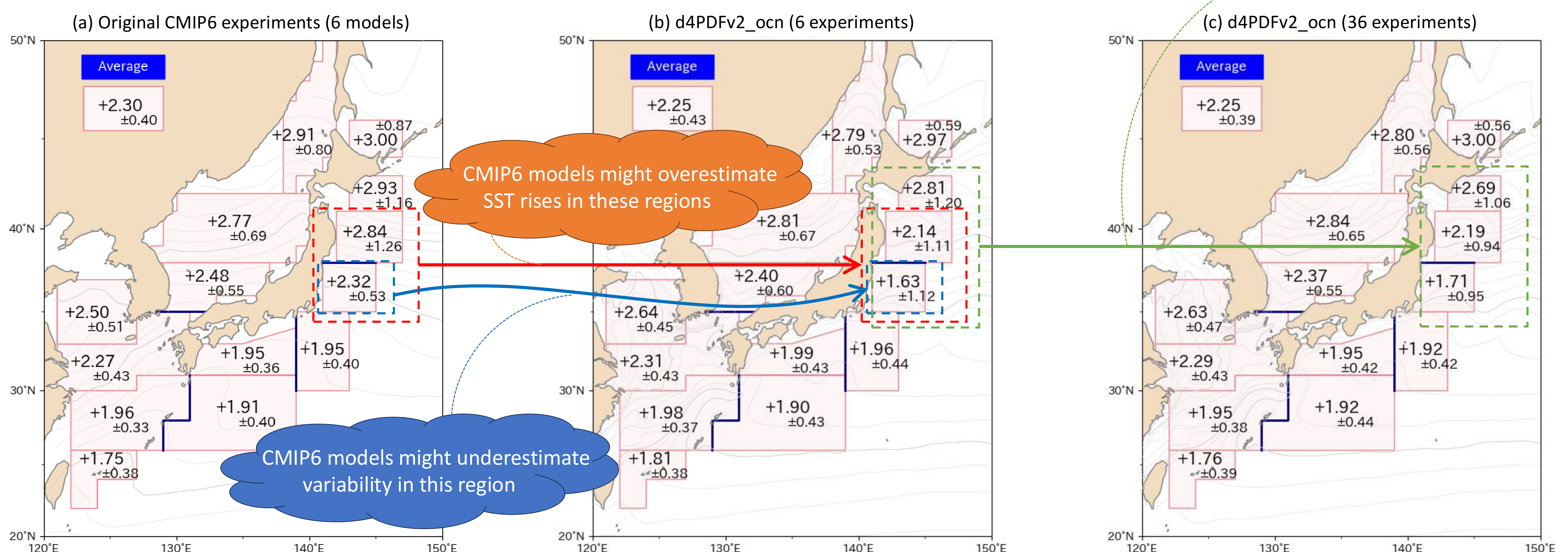


Figure 1: Projected SST rise in the end of the 21st century (2081-2100) compared to the present climate (1986-2005) around Japan in the SSP2-4.5 scenario based on (a) the 1st regridded data of 6 CMIP6 models, (b) 6 experiments in d4PDFv2_ocean with different combinations of internal variability and externally forced variability, and (c) all 36 experiments in d4PDFv2_ocean. Each value in the red boxes denotes (annual mean SST rise) ± (standard deviation). The standard deviation is calculated with the method of Wakamatsu+ (2017). Light-gray lines show SST in the present climate with a contour interval of 1°C (3 thick lines denote 15°C, 20°C and 25°C, respectively).

Future works

- ❑ Planning further downscaling w/ a 2km-resolution model around Japan (it would be timeslice experiments).
- ❑ The dataset includes BGC variables. Further downscale modeling may be useful to assess impacts of global warming on fisheries around Japan.

Acknowledgements

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