Development of a new 4DVAR Global Ocean Data Assimilation System (MOVE/MRI.COM-G4) and a new bias correction scheme in the Japan Meteorological Agency

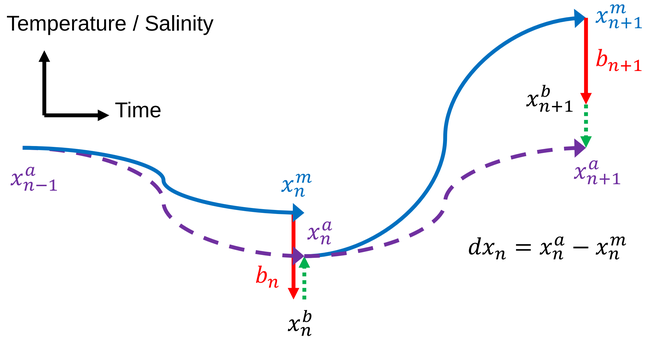
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1. Introduction

- The Japan Meteorological Agency (JMA) operates a global ocean data assimilation system, MOVE/MRI.COM-G3 (G3; Fujii et al. 2023) to monitor the El Niño Southern Oscillation and provide ocean initial conditions to the JMA coupled prediction system.
- To analyze ocean conditions more accurately, we are developing a new ocean data assimilation system, MOVE/MRI.COM-G4, including a modified model-bias correction scheme.

2. Overview of a model-bias correction scheme



Model prediction (not bias-corrected) : x^m_n

Analysis value : x^a_n

Model bias : b_n

Analysis increment except for model bias

Background value (bias-corrected) : $x^b_n = x^m_n + b_n$

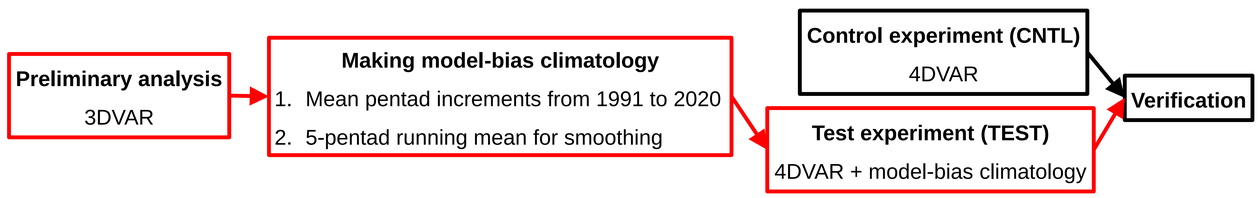
$$dx_n = x^a_n - x^m_n \quad \rightarrow \quad b_{n+1} = (1-r)\cdot b_n + r \cdot dx_n + \overline{b}_{m+1} - \overline{b}_m$$

Added terms in the new scheme

- Model biases are updated online using the previous analysis increments.
- The time constant r is set so that the amplitude of model-biases is $1/e$ over 2 years to remove random noises from analysis increments.
- Therefore, variations of model-biases shorter than the time constant, such as seasonal variation, are not corrected in the current scheme.
- **In the new scheme, the seasonally dependent model-bias climatology terms estimated a priori are added.**

3. Configuration of reanalysis experiments

- Data assimilation system is based on G3.
- Verification period is from 1991 to 2020.
- 80% of all Argo floats are assimilated and 20% are withheld for verification.



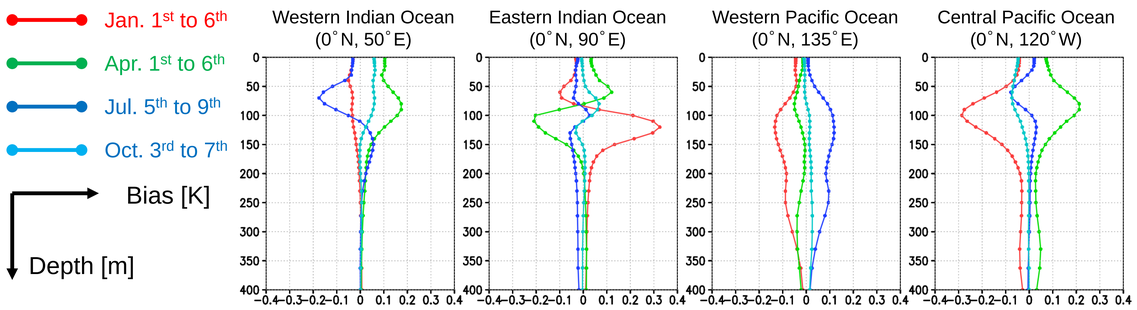
Summary

- We have modified a model-bias correction scheme to correct seasonal variations of biases.
- The test experiment using the new scheme shows that temperature and salinity fields are improved globally.
- We plan to apply the new scheme to the developing analysis system, MOVE/MRI.COM-G4.

4. Results

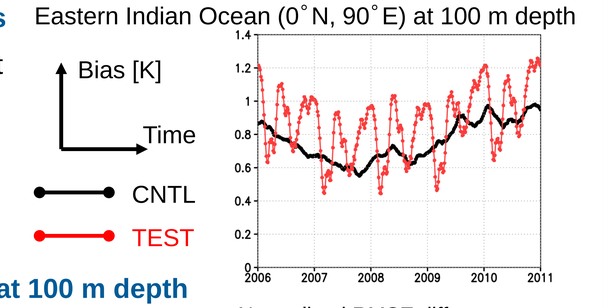
■ Vertical profiles of equatorial temperature model-bias climatology

The seasonal variations are prominent around thermocline.

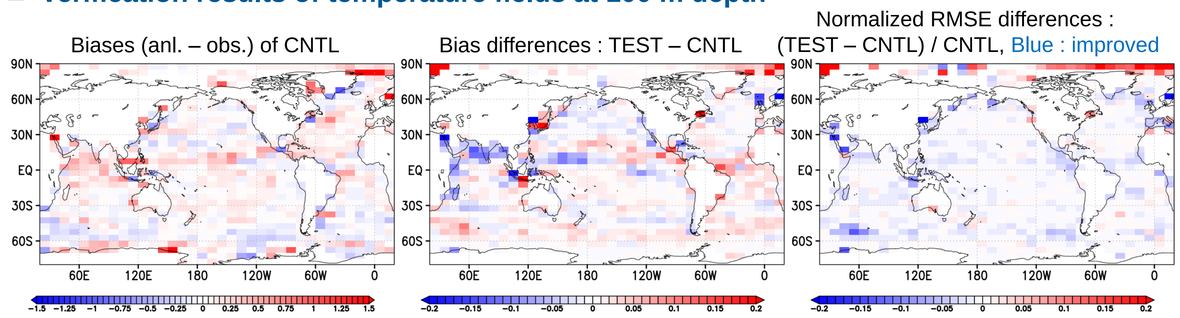


■ Comparison of temperature model-biases

The model-biases estimated in TEST represent not only inter-annual variations represented in CNTL, but also seasonal variations.



■ Verification results of temperature fields at 100 m depth



- The biases are reduced especially in the Indian Ocean and western tropical Pacific Ocean.
- The RMSEs are reduced globally except for the arctic ocean.

Reference

Fujii, Y., T. Yoshida, H. Sugimoto, I. Ishikawa, and S. Urakawa, 2023: Evaluation of a global ocean reanalysis generated by a global ocean data assimilation system based on a Four-Dimensional Variational (4DVAR) method. Front. Clim., 4, 1–20, doi:10.3389/fclim.2022.1019673