Analyze TIMCOM Model Datasets for the CMIP6 Ocean Model Intercomparioson Project

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Abstract

In order to contribute to the latest Ocean Model Intercomparison Project phase 2 (OMIP2), we analyze the TIMCOM ocean model output forced by the OMIP1 (IAF) and OMIP2 (JRA) forcing fields. OMIP2 is an endorsed project in the Coupled Model Intercomparison Project Phase 6 (CMIP6). The purpose of OMIP is to understand the origin of systematic model biases, and it primarily contributes to the regional sea-level change and near-term (climate/decadal) projection.

Background

- Taiwan Multi-scale Community Ocean Model (TIMCOM, Tseng and Chien, 2011; Young et al., 2012).
- CICE4: Hunke and Lipscomb (2008)

Model and Experiment

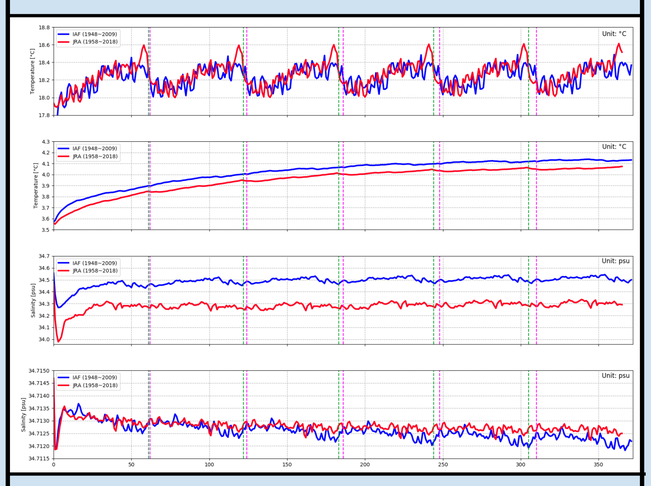
The OMIP experiment follows the protocol of CORE-II, which is an ocean-sea-ice coupled simulation forced by about 60 years (JRA&IAF). The experiment is conducted for six cycles to reach a steady-state (quasi-steady). The period of the forcing data is 62 years (1948~2009) for CORE-II and is 61 years (1958~2018) for JRA55. The turbulence momentum and heat fluxes are computed through the method of Large and Yeager (2004).

The following list is some attributes of this model:

Grid	320x288x45 levels
Data	Levitus / PHC2
Computing technics	NCAR Flux Coupler 7

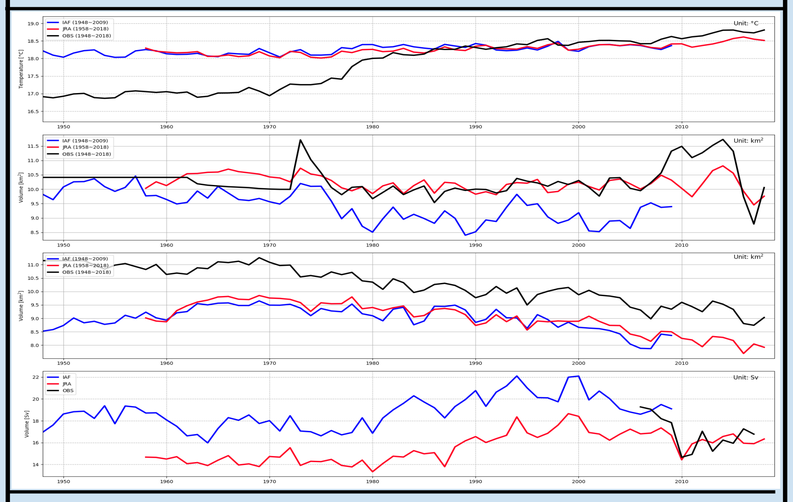
Results

All 6 cycles:
SSTGA / VOTGA / SSSGA / VOSGA



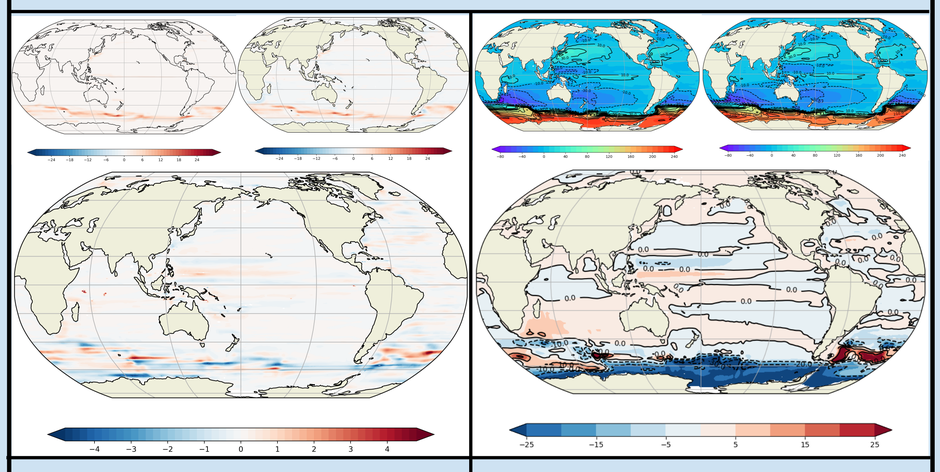
Model reach quasi-equilibrium state after 6 cycles. From the plot, we can find that the model achieves quasi-steady status.

6th cycle:
SSTGA / SIC_arctic / SIC_antarctic / AMOC (26.5° N)



SIC_arctic/SIC_Antarctic A rising trend can be found in the SSTGA. We also can observe ENSO variation in 1982~83, 1997~98, and 2015~16. shows the decreasing trend.
AMOC simulation is reasonable.

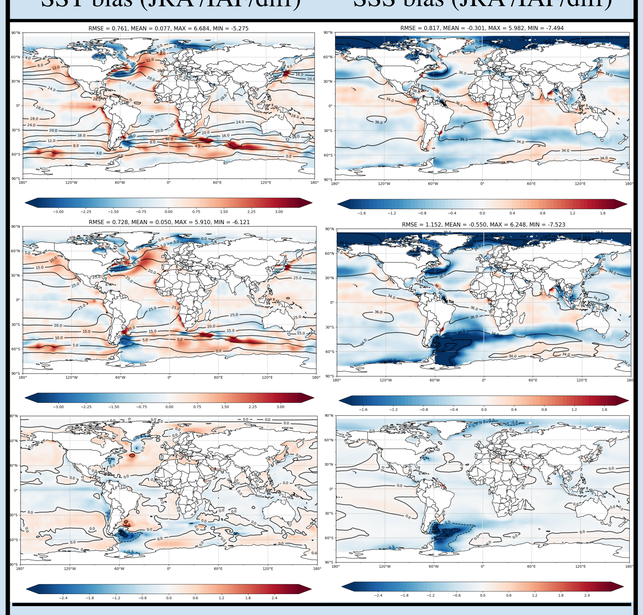
Integrated u (IAF/JRA/diff) | BSFs (IAF/JRA/diff)



Integrated zonal velocity from the surface to the bottom. Antarctic Circumpolar Current (ACC) is the strongest.

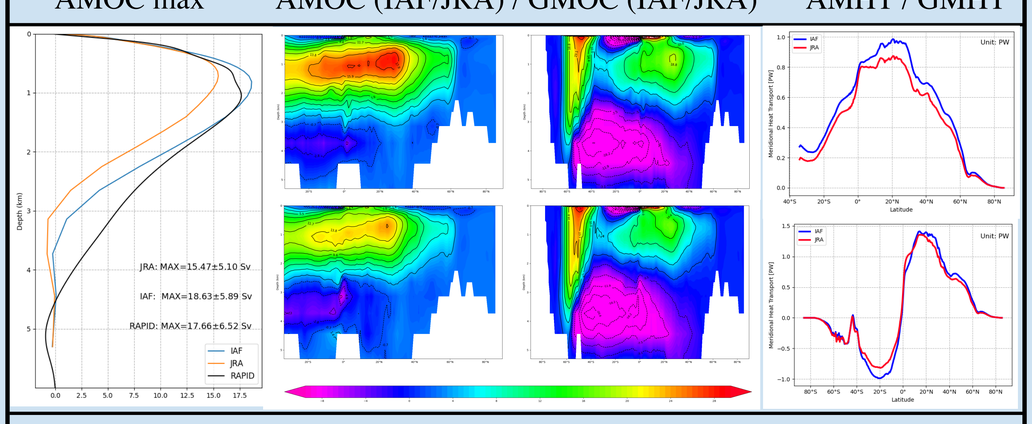
Barotropic mass stream functions shows the the overall currents flow. Largest difference can be found in the ACC

SST bias (JRA /IAF/diff) | SSS bias (JRA /IAF/diff)



SST/SSS mean bias distribution shows the systematic model biases in the Arctic/Antarctic.

AMOC max | AMOC (IAF/JRA) / GMOC (IAF/JRA) | AMHT / GMHT

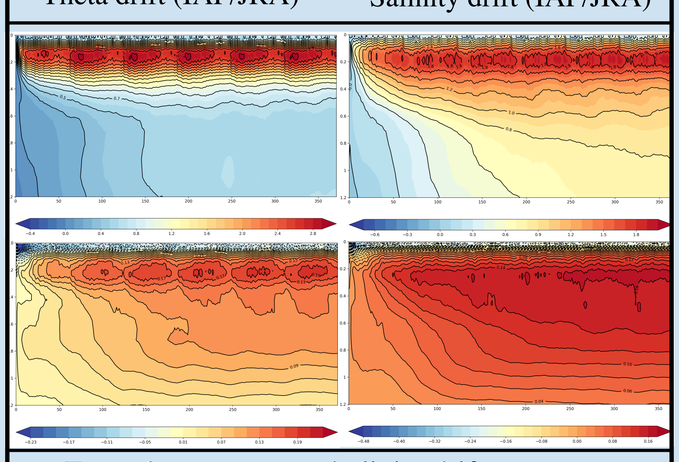


From figure AMOC (2&3), we can find the IAF profile is stronger than JRA, and we can also know this from AMOC max (1).

From figure GMOC (4&5), we can know the vertical distribution according to latitude. By this graph, we can know the global seawater flow approximately (according to latitude).

Ocean transports heat from low latitude to high latitude (AMOC is a significant circulation which will torpor much heat). After observing the AMHT&GMHT, we can know how will the heat transport.

Theta drift (IAF/JRA) | Salinity drift (IAF/JRA)



From the temperature/salinity drift, we can check whether it achieves balance in all water. We can find that it still doesn't achieve balance in the deep ocean.

We know that the period of the AMOC (deep layer water) is about one thousand years, and we only run the model for about 400 years. So, it's reasonable why seawater didn't achieve balance.

We also can find that the water has already achieved balance near the surface.

Reference

Author, Pengfei LIN et al. (2020), LICOM Model Datasets for the CMIP6 Ocean Model Intercomparison Project, Advances in atmospheric sciences, VOL. 37, March 2020, 239-249

National Oceanography Centre: https://www.metoffice.gov.uk/hadobs/hadisst/ (FEB, 3, 2008)