



Supplement of

Assessing vertical coordinate system performance in the Regional Modular Ocean Model 6 configuration for Northwest Pacific

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Supplements

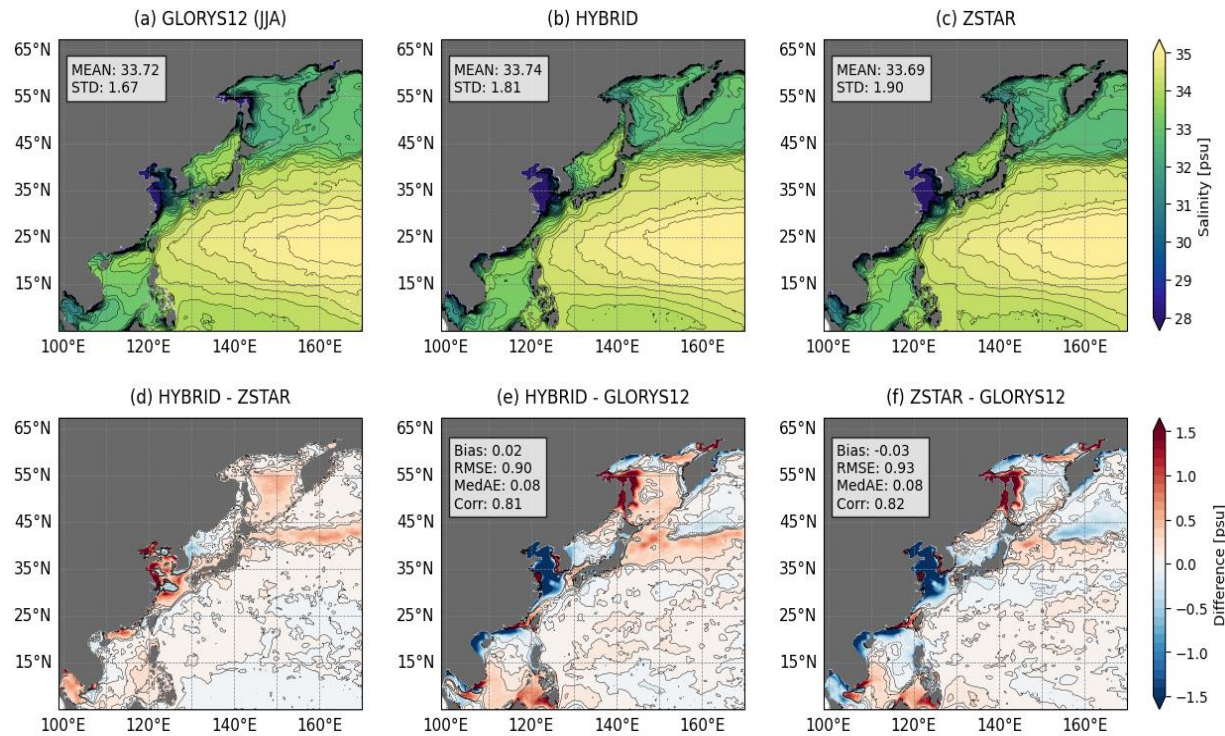
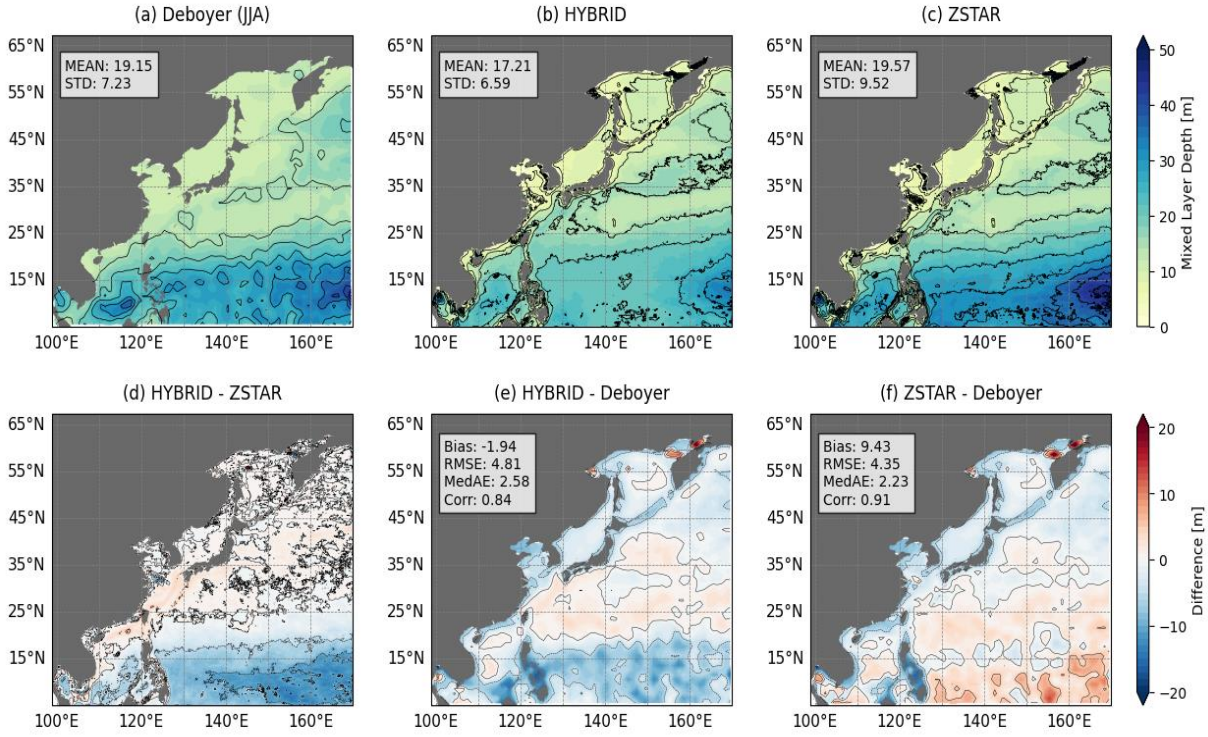
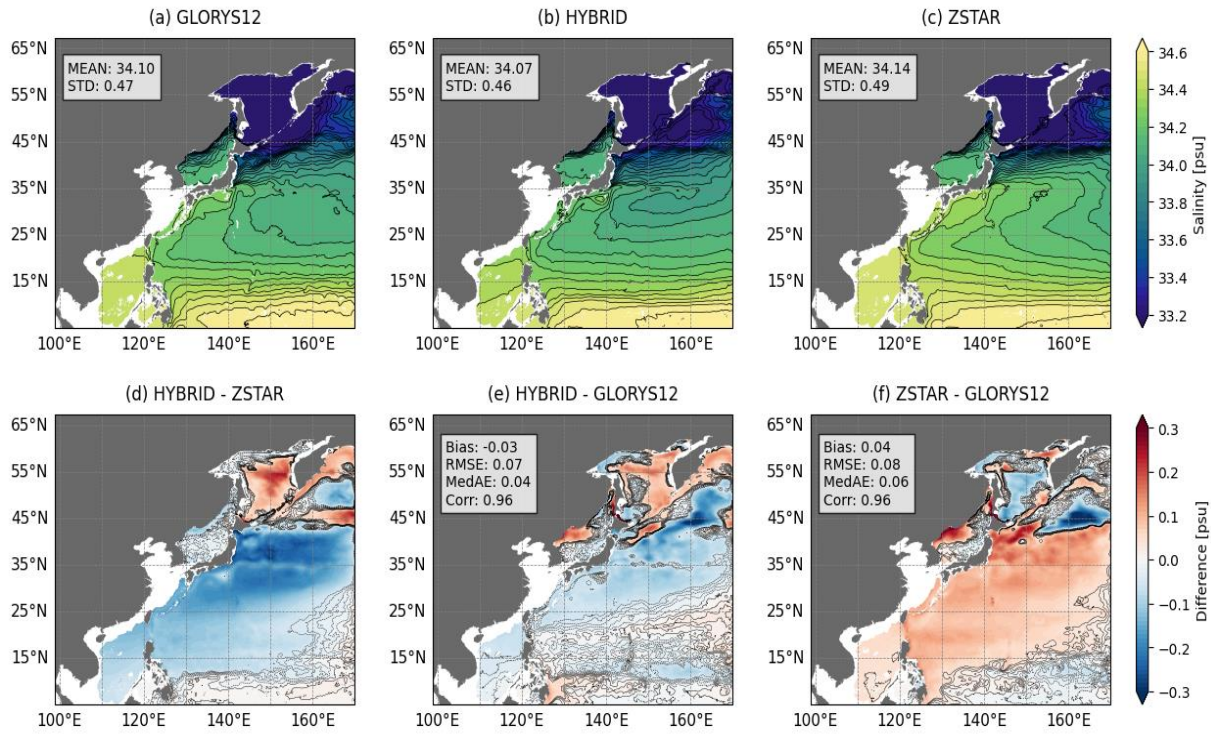


Figure S1. Boreal summer (JJA) mean sea surface salinity (SSS) distributions from GLORYS12 reanalysis and HYBRID and ZSTAR simulations. (a–c) Spatial SSS distributions with corresponding means and standard deviations (STD). (d) Differences between HYBRID and ZSTAR. (e, f) Biases relative to GLORYS12, including mean bias, RMSE, MedAE, and Corr. Contour lines in (d–f) indicate SSS biases ranging from -0.1 to 0.1 psu at 0.1 psu intervals.



10 **Figure S2. Boreal summer (JJA) mean mixed layer depth (MLD) distributions from de Boyer Montégut and HYBRID and ZSTAR simulations. (a–c) Spatial MLD distributions with corresponding means and standard deviations (STD). (d) Differences between HYBRID and ZSTAR. (e, f) Biases relative to de Boyer Montégut, including mean bias, RMSE, MedAE, and Corr. Contour lines in (d–f) indicate MLD biases ranging from -0.1 to 0.1 m at 0.1 m intervals.**



15 **Figure S3. Salinity distributions at depths corresponding to $\sigma_2 = 35.8$ from (a) GLORYS12, (b) HYBRID, and (c) ZSTAR simulations, along with their respective means and standard deviations (STD). (d) Differences between HYBRID and ZSTAR. (e, f) Biases relative to GLORYS12, including mean bias, RMSE, MedAE, and Corr. Contour lines in (d-f) indicate salinity biases ranging from -0.1 to 0.1 psu at 0.1 psu intervals.**

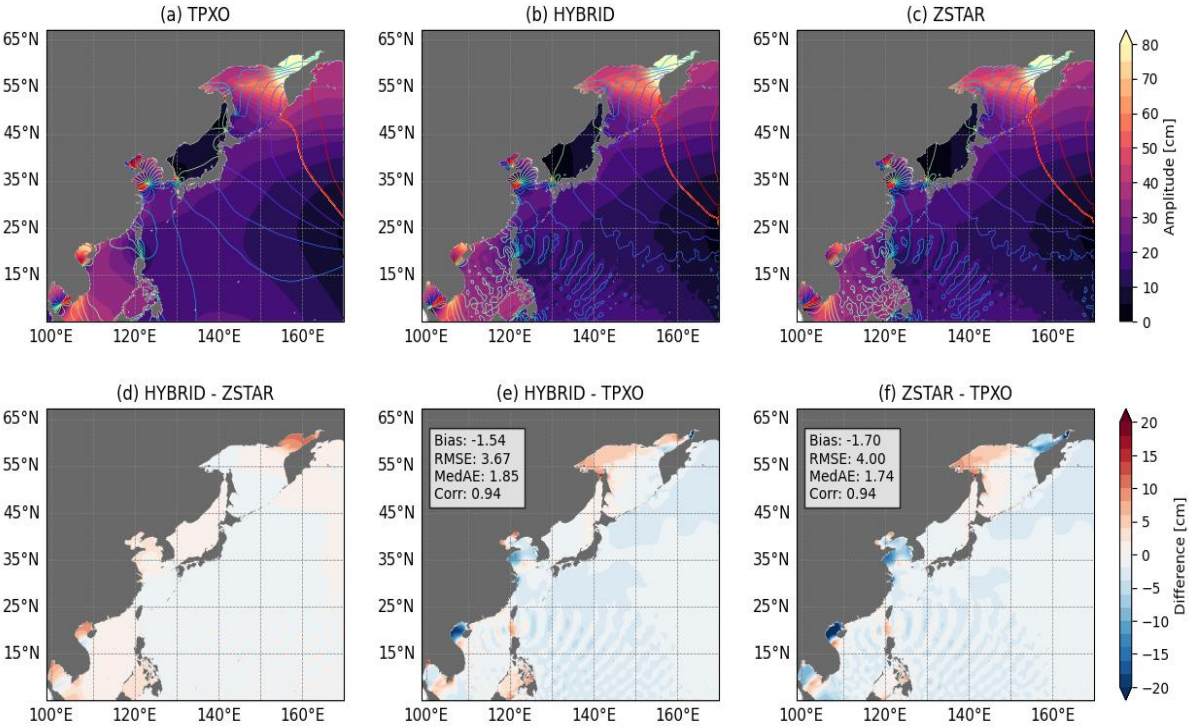


Figure S4. Diurnal K1 tidal amplitude and phase from TPXO data, HYBRID, and ZSTAR simulations. Shaded contours represent tidal amplitude, while overlaid coloured contours show tidal phase for K1 (a–c). Panels below display tidal amplitude differences: (a) HYBRID vs. ZSTAR, (b) HYBRID vs. TPXO, and (c) ZSTAR vs. TPXO. Metrics include mean bias, RMSE, MedAE, and Corr.

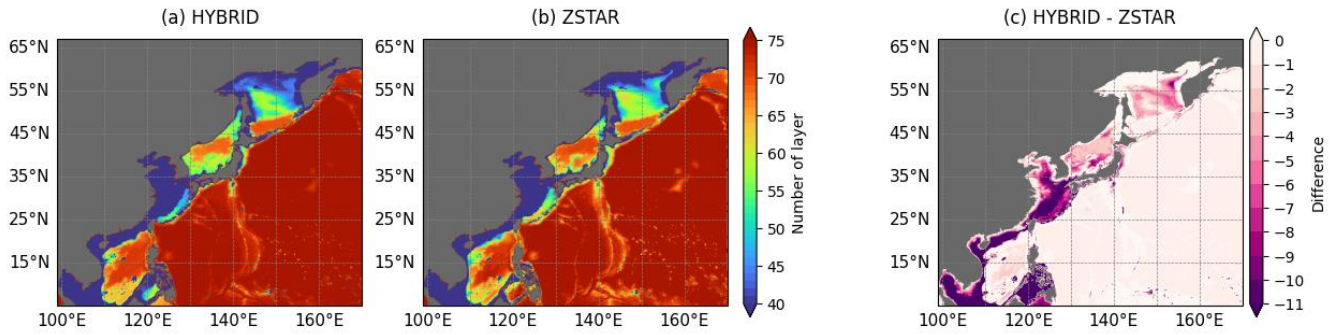


Figure S5. Spatial distribution of active layers in HYBRID and ZSTAR on December 22, 2012. (a, b) Number of active layers in HYBRID and ZSTAR, respectively, where an active layer is defined as having a thickness greater than 0.001 m. (c) Difference (HYBRID - ZSTAR).

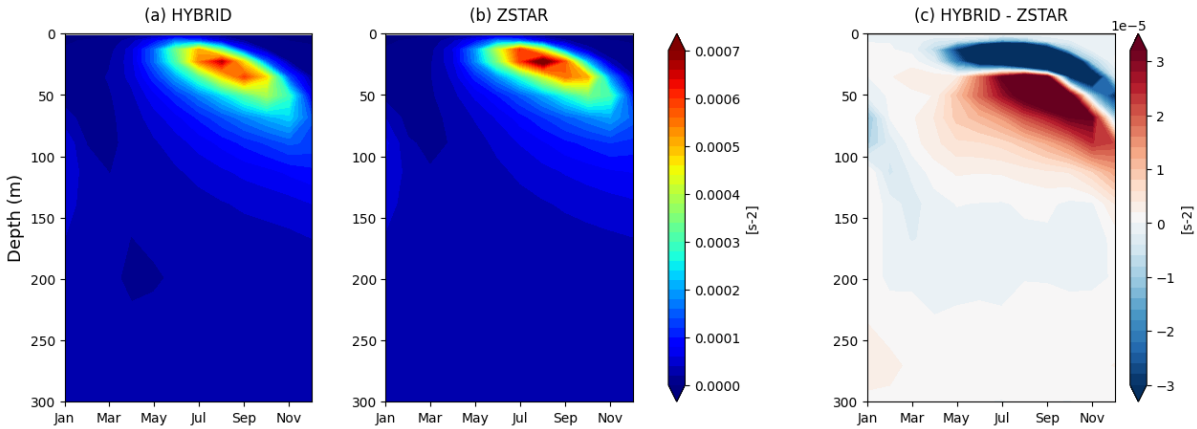


Figure S6. Seasonal evolution of buoyancy frequency squared (N^2 , s^{-2}) averaged over 25°–35°N and 140°–160°E for (a) HYBRID, (b) ZSTAR, and (c) their difference (HYBRID - ZSTAR).

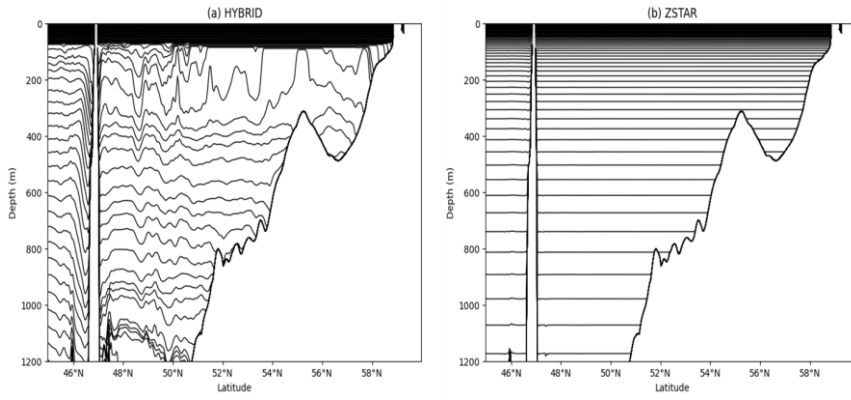


Figure S7. Model interfaces along 152°E in the Sea of Okhotsk for (a) HYBRID and (b) ZSTAR.

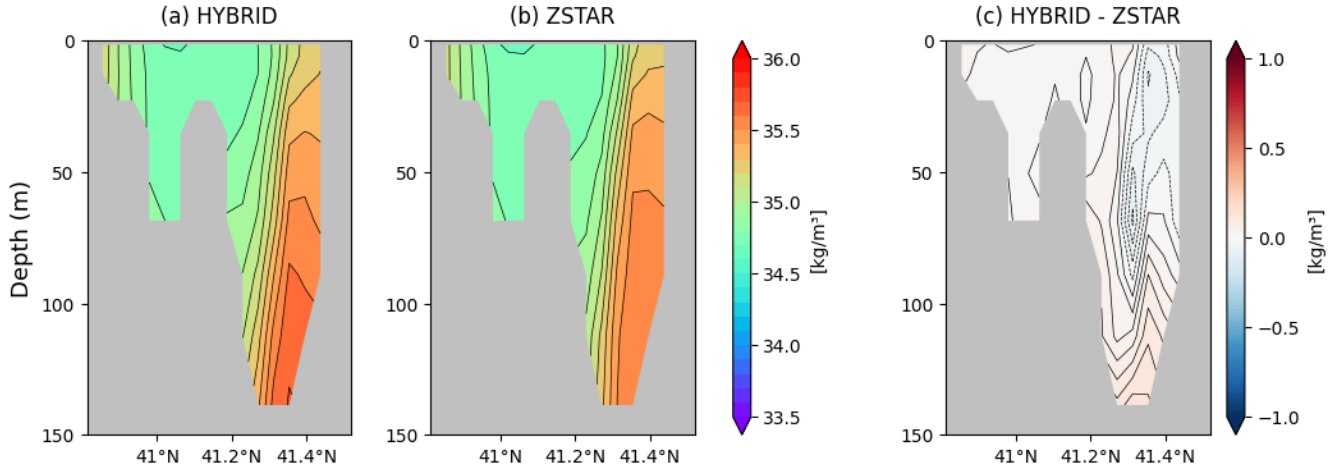
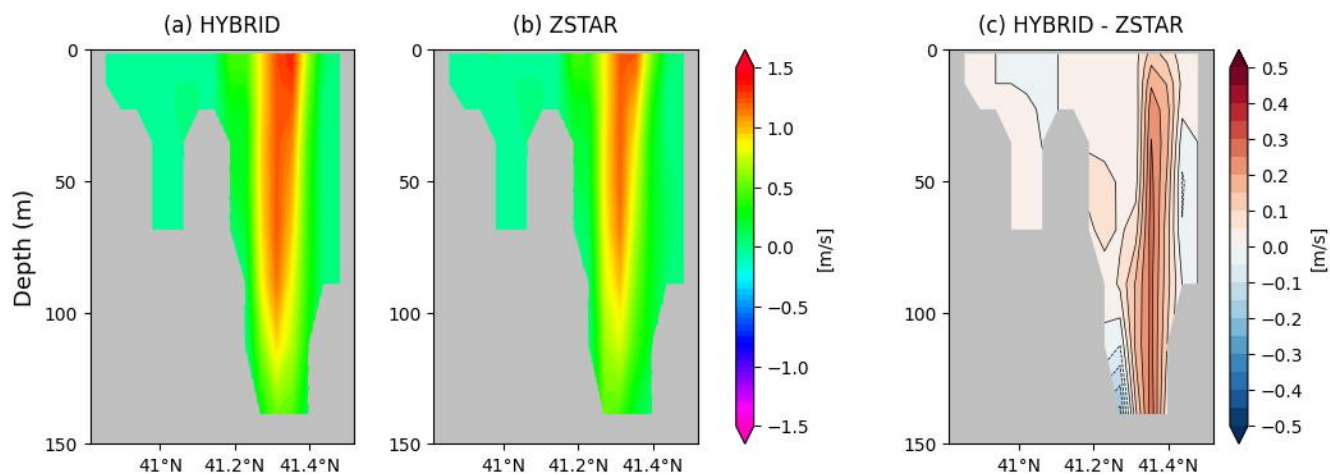


Figure S8. Meridional section of potential density (σ_2 , referenced to 2000 m) across the Tsugaru Strait, averaged over 2012. (a) ZSTAR, (b) HYBRID, and (c) HYBRID–ZSTAR difference.



65 **Figure S9. Meridional section of along-strait velocity (U) across the Tsugaru Strait, averaged over 2012. (a) ZSTAR, (b) HYBRID, and (c) HYBRID–ZSTAR difference.**