

Author's General Response to Reviewer #3

We sincerely thank the reviewer for their careful reading and constructive feedback. The reviewer's comments were very helpful in improving the clarity, completeness, and presentation quality of the manuscript. We have added appropriate references and examples where needed, refined figure readability, and clarified several descriptions to better explain the physical interpretation of our results. In addition, we have added a new part discussing the computational cost differences between the HYBRID and ZSTAR configurations, as suggested (line 661-674). These revisions have enhanced both the accuracy and readability of the paper. Detailed responses to each comment are provided below.

Line 200-204: My interpretation is that the bias correction was applied only to the Yangtze River. If so, why was this only done for this river? The authors recognize in the results and conclusions the biases in salinity, I wonder why the authors did not apply the same correction to other rivers to potentially help with the SSS biases shown.

- ➔ We thank the reviewer for this question. In the initial configuration, discharge bias correction was applied only to the Yangtze River, which exerts the strongest freshwater influence in the Northwest Pacific region. However, despite this correction, the model still exhibited low-salinity biases along the Chinese coast. To address this issue, we have recently extended the bias correction to include the Yellow River as well. We agree that applying discharge adjustments to multiple river sources can further reduce coastal salinity biases, and we plan to incorporate additional river discharge datasets as they become available.

Line 270: "The K-KE regions..." as obvious as it may seem, you have not defined what this stands for.

- ➔ We thank the reviewer for pointing this out. The term "K-KE" has been defined in the revised manuscript as referring to the Kuroshio and its Extension regions. (line 299)

Lines 249-254: It would be useful to define the period over which the average of the u and v velocities is calculated.

- ➔ We thank the reviewer for this helpful comment. The averaging period for the zonal (u) and meridional (v) velocity components has been clarified in the revised manuscript as 2003–2012, consistent with the main evaluation period used throughout the analysis. (line 280)

Figures 2, 3 and others: I found it hard to distinguish land and contours on areas with high contour line density in the panels showing differences between products and model output because the color used for land and contours is the same. I would encourage changing land color to black or setting the contour line color to a color other than gray.

- We thank the reviewer for this helpful suggestion. We agree that the use of similar colors for land and contour lines reduced visual clarity in the difference plots. In the revised figures (Figs. 2, 3, and others), we have improved readability by changing the land color to dimgray and slightly adjusting the contour line contrast to ensure clearer distinction between land and contours.

Section 3.4: It would be useful to include here and/or in Section 4 a discussion on how the volume transport differences come about with the different vertical grids. It seems that, while not perfect, z-star was consistently better than the hybrid grid.

- We thank the reviewer for this valuable suggestion. This comment aligns with another reviewer's question regarding how the vertical coordinate system influences the simulated volume transport through major straits. We have clarified this connection in the revised manuscript (Section 4.2), explaining that both configurations used identical bottom drag formulations and free-slip lateral boundary conditions; thus, the transport differences mainly arise from how each vertical coordinate represents stratification and the associated baroclinic pressure gradients. In particular, HYBRID tends to preserve steeper isopycnal slopes and stronger density gradients, which may locally enhance the pressure-gradient force and result in stronger along-strait velocities, while ZSTAR's smoother vertical discretization dampens these gradients and yields weaker transports. (line 758-764)

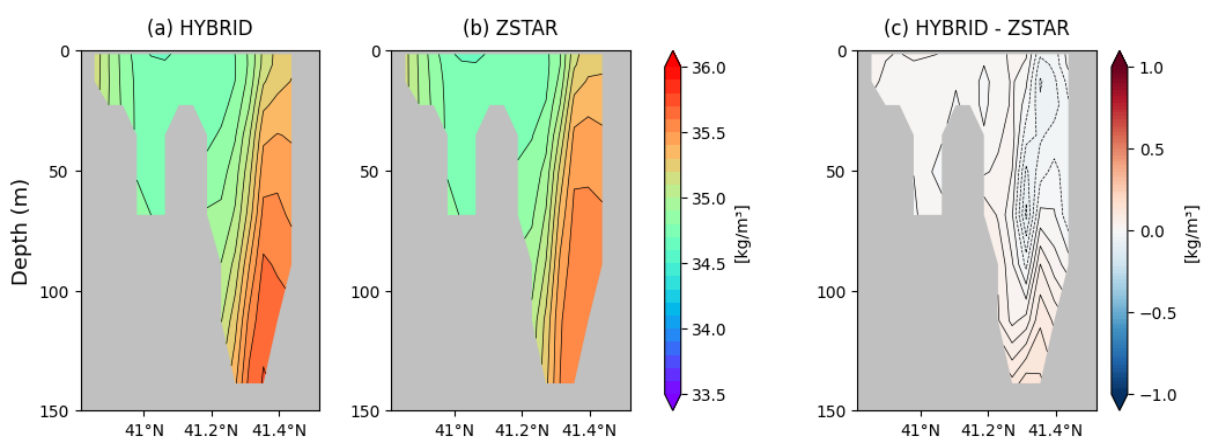


Figure 1 Meridional section of potential density (σ_2 , referenced to 2000 m) across the Tsugaru Strait, averaged over 2012. (a) ZSTAR, (b) HYBRID, and (c) HYBRID–ZSTAR difference.

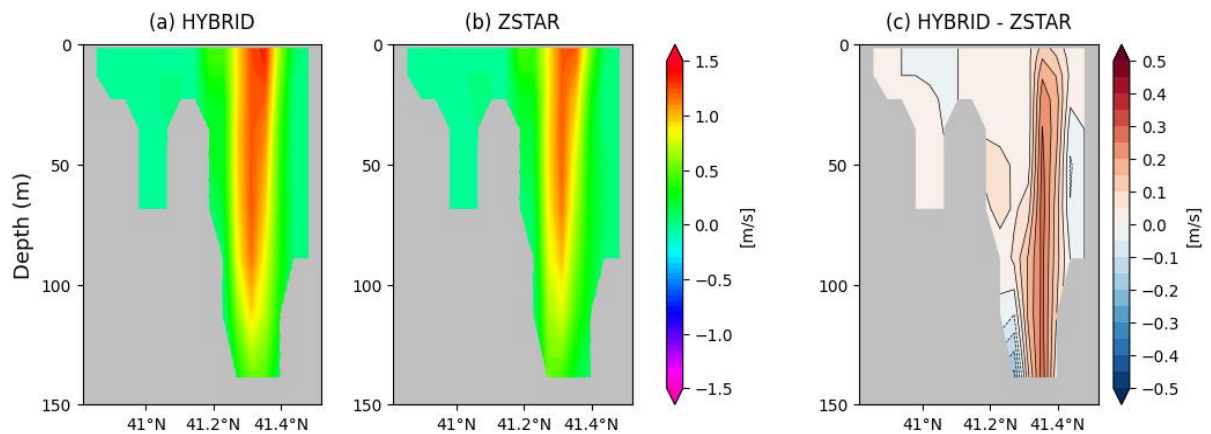


Figure 2 Meridional section of along-strait velocity (U) across the Tsugaru Strait, averaged over 2012. (a) ZSTAR, (b) HYBRID, and (c) HYBRID–ZSTAR difference.

Lines 658-660: provide reference and/or examples.

- ➔ We thank the reviewer for this helpful comment. Relevant references and supporting examples have been added in the revised manuscript to substantiate this statement. (line 679)