Response to Reviewer 1:

Dear Reviewer:

We would like to thank you for dedicating time to carefully read our manuscript and provide feedback. We sincerely think their detailed comments have helped us to improve the manuscript. Below is our point-by-point response to your comments (text in blue denotes our response).

Comments 1: I just wonder if the RMSEs in Figure 2c and Figure 4d are smaller than that of climatology.

Response 1: We appreciate your comment on the comparison between the RMSEs in Figures 2c and 4d and the climatological values. However, we are unsure if you are suggesting using climatology as the estimate for SWH overall time. If so, it is evident that the errors of climatology would be significantly larger than those of the AI model. We implemented a climatology-based model as per your comment. The results are shown in the figures below.

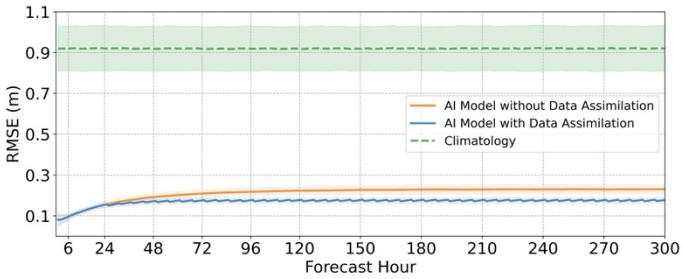

Figure R1. Error curves with climatology added on Figure 2c

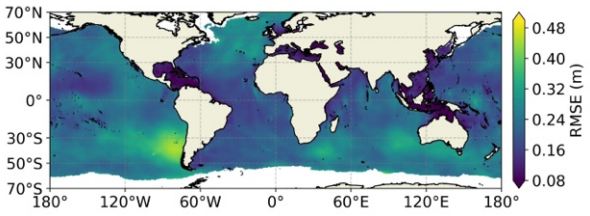

Figure R2. RMSE distribution of the AI model (Figure 4d)

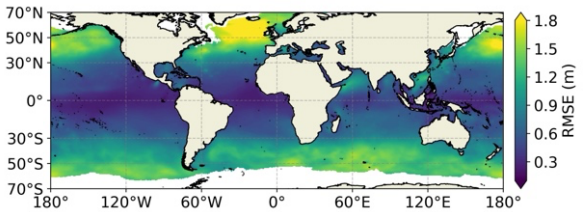

Figure R3. RMSE distribution when using the climatology as the estimates

As expected, the RMSEs are significantly higher than those from our model when using climatology as the estimate. The RMSE of the climatology remains consistently above 0.9 m throughout the error curve. In the spatial distribution of RMSE errors for the climatology model,

the errors in high-latitude regions exceed 1.5 m, showing that the climatology is not a good estimate.

Comments 2: For the sake of comparison, the color bar scales in Figures 6-7 should be the same as those used in Figures 4-5.

Response 2: We thank your suggestion to unify the color bar scales for better comparison. we have adjusted the color bar scales in Figures 6 and 7 to match those used in Figures 4 and 5. These changes enhance the clarity of how the results improve after data assimilation. The assimilation process reduces errors and increases the accuracy of the model. Notably, it is now clear that the correlation coefficient of the swell pools in the equatorial regions increases significantly with data assimilation. The updated figures will be included in the revised manuscript.

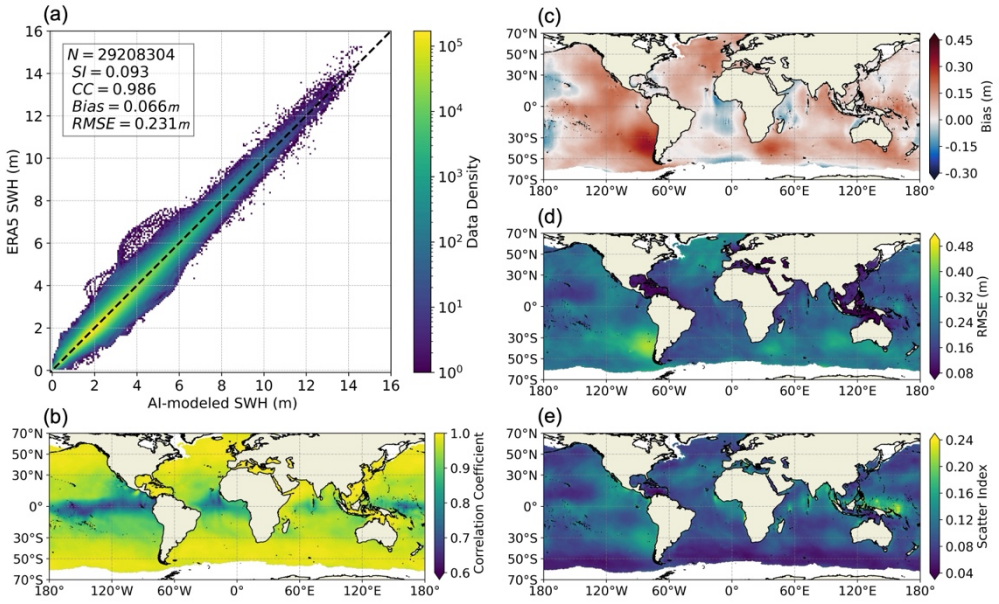

Figure 4: Comparison of SWHs from the AI model at 240-h hindcast time (when the errors are stable) with ERA5 for the year 2020. (a) Scatter plot between the SWHs from the two datasets. (b-e) Global spatial distributions of CC, bias, RMSE, and SI, respectively.

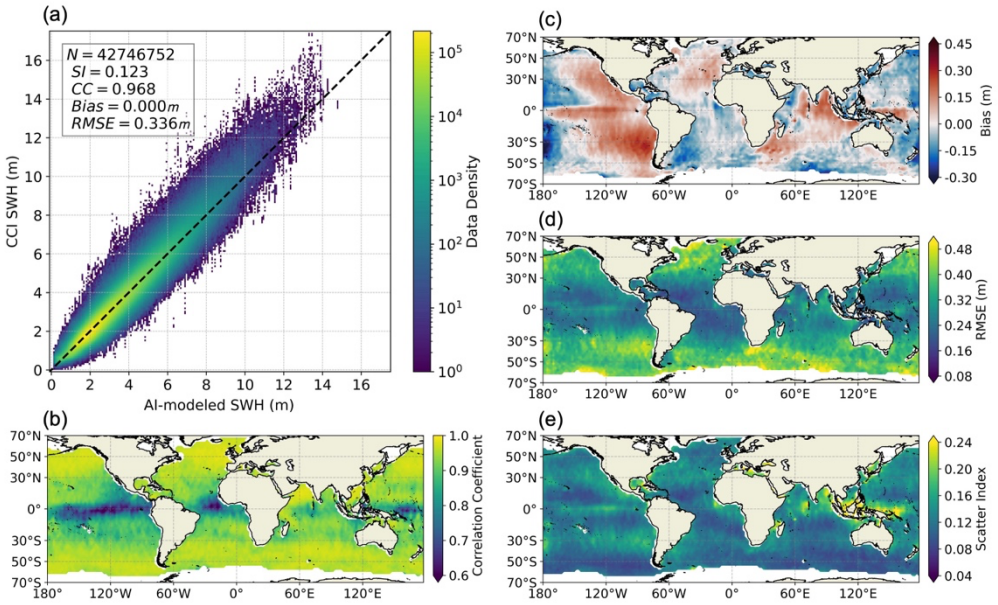

Figure 5: The same as Fig. 4, but the comparison is between the 240-h SWH hindcasts of the AI model and the CCI-Sea State dataset.

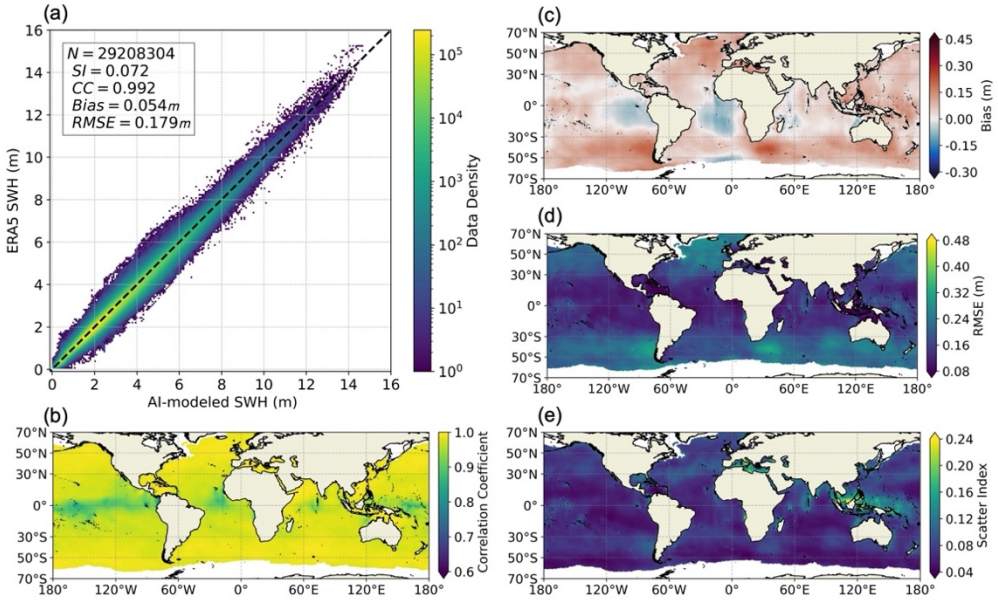

Figure 6: The same as Fig. 4, but the AI model has assimilated the data from CCI-Sea State every six hours.

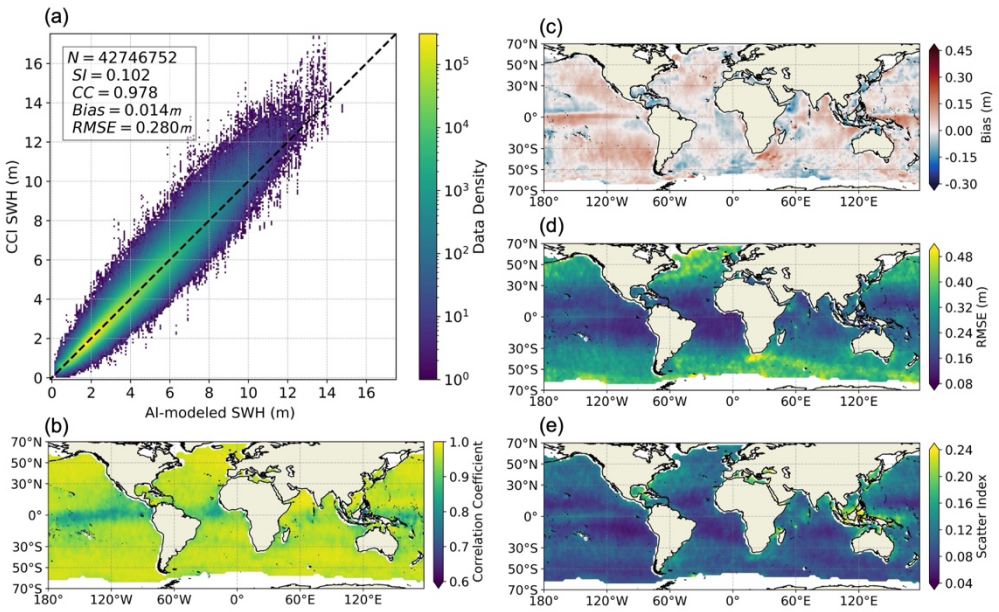

Figure 7: The same as Fig. 6, but the comparison is with the CCI-Sea State dataset.

Comments 3: The units of variables on the vertical axis are missing in (b) and (c) in Figures 2-3.

Response 3: We thank you for pointing out the missing units on the vertical axis in panels (b) and (c) of Figures 2 and 3. We have added the appropriate units to the vertical axes of these panels to ensure clarity and completeness. Thank you for highlighting this oversight, as it has helped improve the accuracy and presentation of the figures. Updated figures will be incorporated in the revised manuscript.

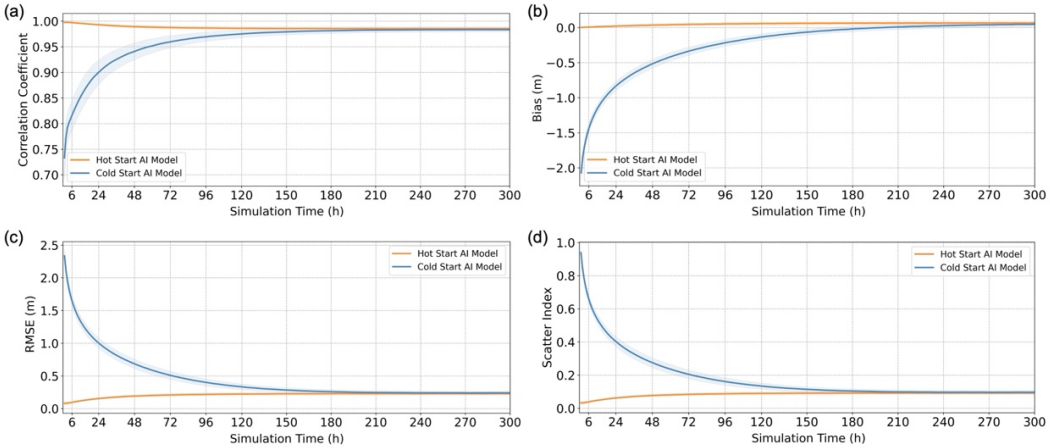

Figure 2: The variation of global overall error metrics between the AI SWH model outputs and ERA5 with simulation time: (a) CC, (b) bias, (c) RMSE, and (d) SI. The orange and blue lines represent the mean values of the error metrics for the 236 experiments starting from different initial SWH fields, before and after assimilation, respectively. The shaded areas around the lines

indicate the range of error metrics across different experiments with varying initial SWH fields.

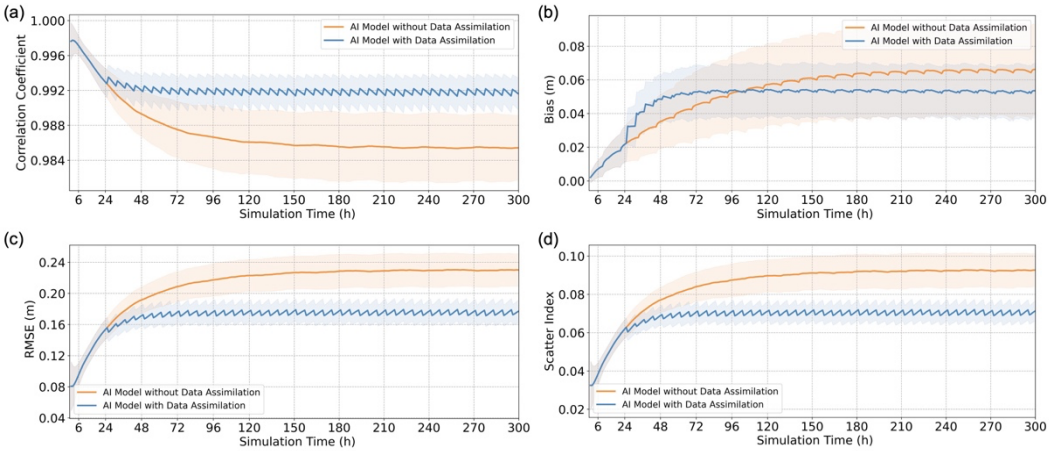

Figure 3: The variation of global overall error metrics between the AI SWH model outputs and ERA5 with simulation time: (a) CC, (b) bias, (c) RMSE, and (d) SI. The orange lines and shaded areas are the same as those in Fig. 2, but no epoch ensemble is used. The blue lines and shaded area are the corresponding results for the cold start with an initial field of zero SWH.