Reply to Editor of

"GEST: A multi-scale dynamics-based reconstruction of global ocean surface current"

Authors: Guiyu Wang et al.

September 9, 2023

Responses to Editor Comments:

(EC: Editor Comments | AC: Authors Comments)

EC: In addition to what has already been written by the two referees (with whom I fully agree), I would like to point out that the power spectrums shown by the authors leave me very perplexed. One can clearly see that very few points were used for their calculation (a spatial resolution of 0.25 deg means only 40 points over a distance of 10 degrees) and that the interpretation of the resulting effective resolution is wrong for the following reason:

The effective resolution of a spatial or temporal series is not the last point plotted in the PSD figures (the Nyquist frequency I suppose i.e., two times the grid resolution of about 50 km), but the frequency at which the spectrum slope drops down. In this case this is not clear given the few points used to calculate the psd. Perhaps a vague indication of a change of slope could be at wavelengths of about 100 km, but certainly the spectrum shown does not allow this to be stated with certainty. My suggestion is to compute the power spectrum in an area of the ocean where the longest series can be produced, compute a spectrum for each single date and finally average all the spectra. As an example, see figure 2 of Yang et al. "Sea Surface Temperature Intercomparison in the Framework of the Copernicus Climate Change Service (C3S)" available at https://journals.ametsoc.org/view/journals/clim/34/13/JCLI-D-20-0793.1.xml.

In addition, the authors should better explain the concept of "training" mentioned in the response to referee 2 not described in the paper. In this regard, I also suggest publishing the entire time series mentioning the period used for the least-squares linear regression.

Considering that, in its current form, this article is between 'major revision' and 'rejected', I suggest that the authors, if they still intend to resubmit a revised version of the article, consider all referee comments very carefully in order to produce a new paper that fully satisfies them.

AC1: Thanks for your valuable comments. Following your suggestion, we have expanded the spatial and temporal scale of the dataset used to compute the power spectrum and averaged the spectra for each single date. By referring to Yang et al. (2021), the wavenumber-power spectral density curve has been modified and the relevant description has been revised in the response to referee 1.

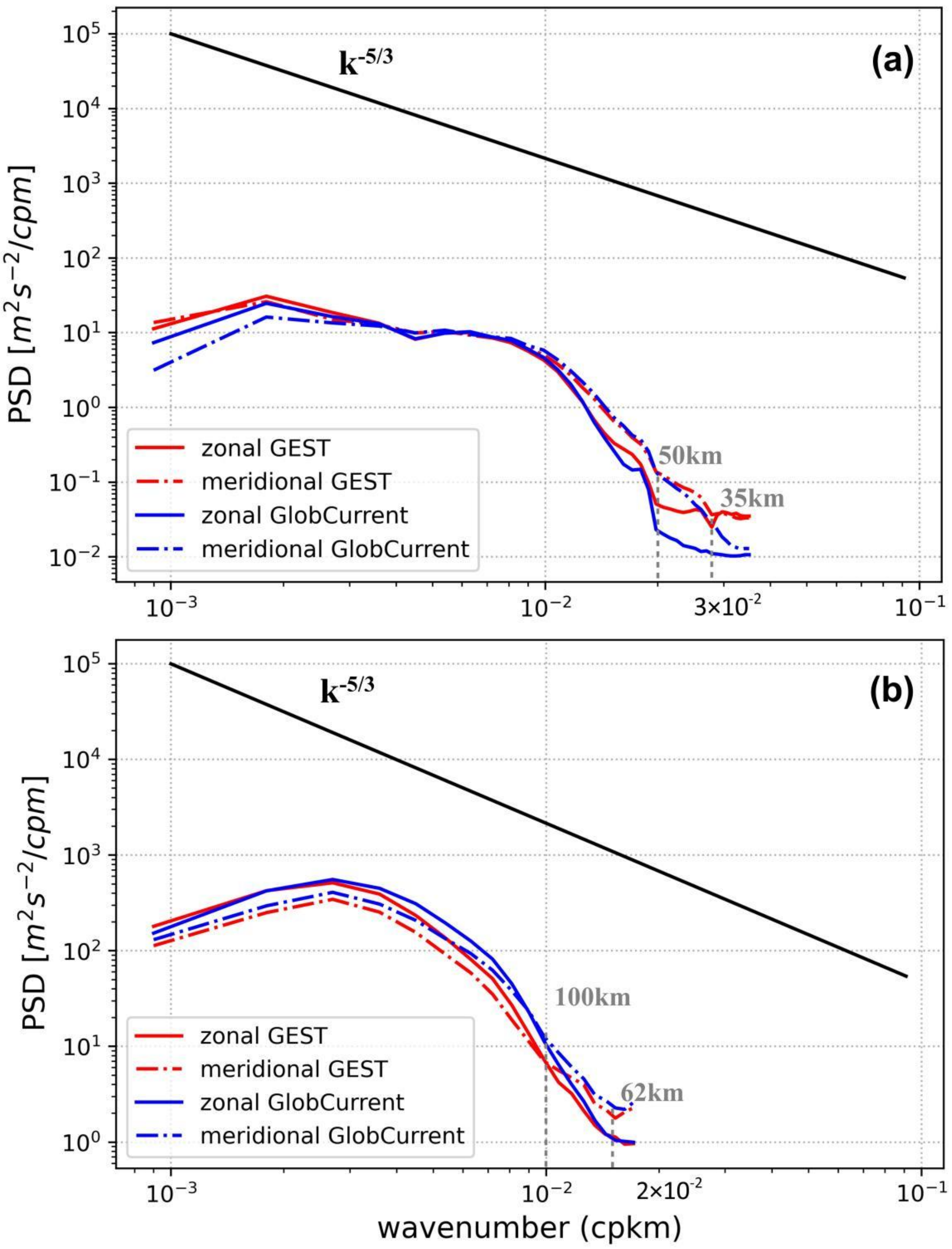

Figure A3: The GEST wavenumber-power spectral density (PSD) within the (a) the North Atlantic region (60° N-70° N, 90° W-0° W), and (b) the North Indian Ocean and Pacific Ocean (10° N-20° N, 30° E-80° W). The black solid line represents the theoretical Surface Quasi Geostrophic (SQG) approximation spectra (the $k^{-5/3}$ power law).

Figure A3 (a) shows the averaged wavenumber-spectral density for the North Atlantic region (60° N-70° N, 90° W-0° W, about 40×360 points per day) for the year 2013. The zonal component of the GEST (red solid line) and GlobCurrent data (blue solid line) in this region starts separating from the theoretical Surface Quasi Geostrophic (SQG) approximation spectra (the $k^{-5/3}$ black solid line) at a wavelength scale of ~50 km. Whereas the meridional component of the GEST product (red dashed line) separates from the SQG approximation spectrum at a much smaller wavelength scale and starts to flat (~35 km), indicating that the signal contains only noise and has no physical significance at the wavelength shorter than 35km. Similarly, Figure A3 (b) provides the power spectrum located in the North Indian Ocean and Pacific Ocean (10° N-20° N, 30° E-80° W, about 40 × 1000 points per day). The power spectral density stays closer to the -5/3 slope at wavelengths around 100 km until the gradient becomes flat around 62 km. Note that the GEST and GlobCurrent products present mostly similar energy spectra because of the same spatial resolution.

In addition, the concept of "training" mentioned in the response to referee 2 refers to the process based on least-squares linear regression. We have published the corresponding dataset used during the least squares fitting process (https://doi.org/10.5281/zenodo.8329991) and updated the relevant expressions in the final response to referee 2.

Moreover, we attempted to expand the time series for the regression and updated the reconstruction algorithm (an example of the new model distribution is shown in Figure 10). The new latitudinal RMSE and correlation are shown in Figure 14 (a) and Figure 14 (c)-(d). It can be seen that the accuracy has a better improvement in the southern hemisphere and at high latitudes in the northern hemisphere.

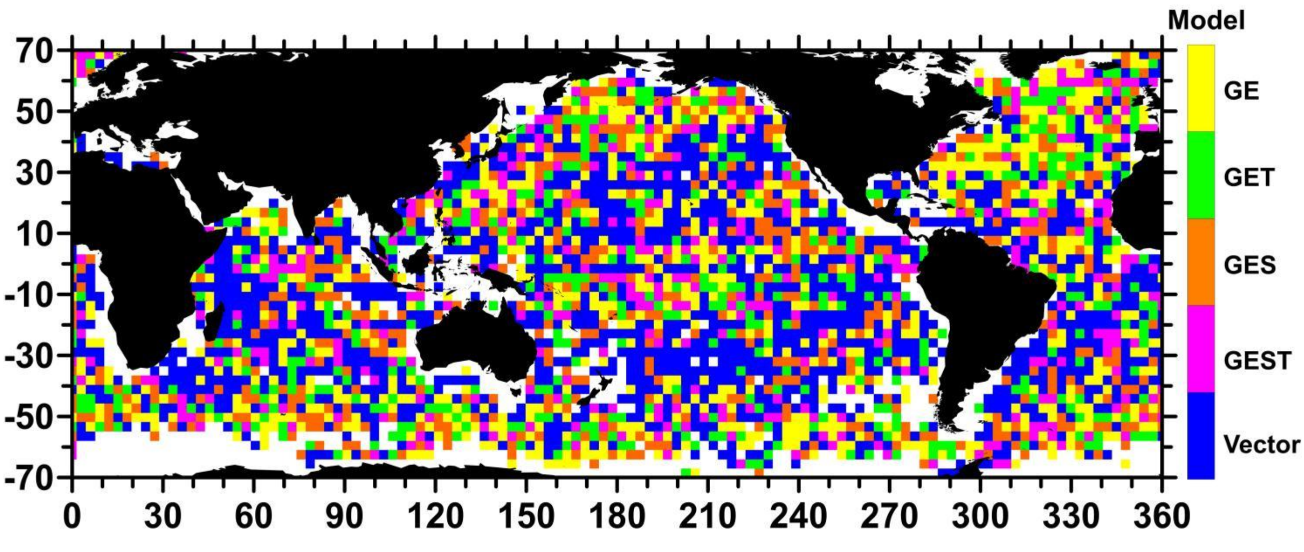

Figure 10: The global distribution of the zonal optimal sub-models combinations in spring.

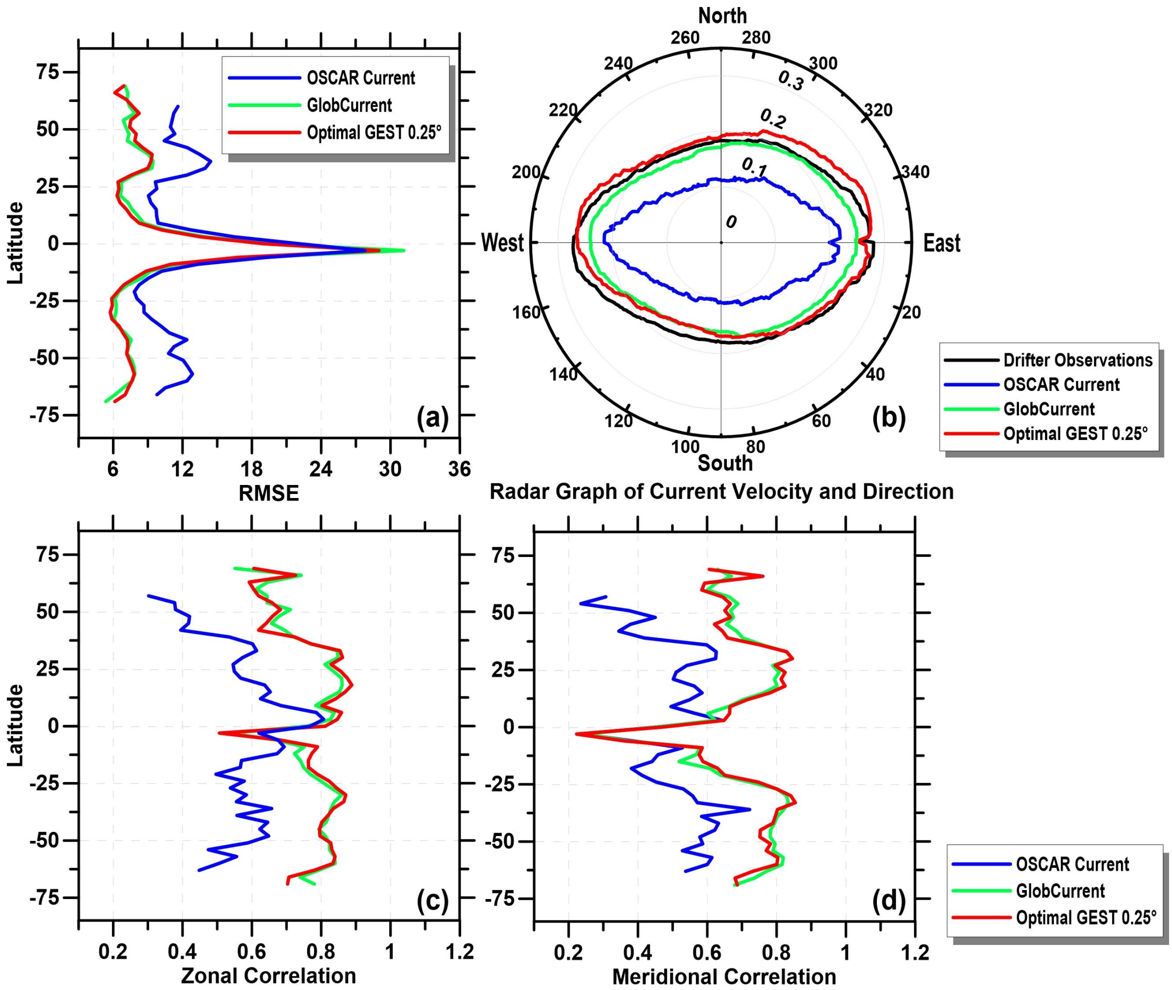

Figure 14: (a) RMSE based on latitudinal bands between each current product (the global OSCAR current (blue line), the GlobCurrent (green line), the modified 0.25° GEST current (red line)) and the surface drifters verified by a friction depth of 15 m. (b) A radar diagram of flow velocity and direction versus the drifter observations (black line), the global OSCAR current (blue line), the GlobCurrent (green line), and the modified GEST current (red line). (c) The zonal correlations and (d) the meridional correlations for the global OSCAR current (blue line), the GlobCurrent (green line), and the modified 0.25° GEST current (red line).

Furthermore, we have made a new revision of the final manuscript and comment responses based on the suggestions of the editor and referees, which can be found in the new submission.

Refrence:

Yang, C., and Coauthors, 2021: Sea Surface Temperature Intercomparison in the Framework of the Copernicus Climate Change Service (C3S). J. Climate, 34, 5257–5283, https://doi.org/10.1175/JCLI-D-20-0793.1.