Review of “River discharge impacts coastal Southeastern tropical Atlantic sea surface temperature and circulation: a model-based analysis” by Aroucha et al. 2024

The study uses high-resolution model sensitivity experiments to understand the impact of freshwater input on sea surface temperature (SST) variability in the southeastern tropical Atlantic Ocean. Results from model sensitivity runs with climatological freshwater forcing and no freshwater forcing suggest that freshwater-induced SST warming occurs to the south and cooling to the north of the Congo River mouth. The authors propose that freshwater discharge from the Congo River causes halosteric changes in sea surface height, which results in alongshore downwelling circulation and leads to advective SST warming along the coast south of the river mouth. Similarly, the low salinity-induced alongshore circulation to the north of the river mouth is associated with upwelling and cooling of SST. Furthermore, the implications of the southward advection of river water on coastal upwelling are discussed.

This is an important study that highlights the impact of Congo River discharge and low salinity on coastal ocean circulation dynamics, SST variability, and coastal upwelling. The paper is well-organized, with good-quality figures. The manuscript may be considered for publication after the authors have addressed the major and minor comments listed below.

Major comments:

1. Figures 1 and 2: While I appreciate the thorough validation of the model data with in situ observations and the reanalysis dataset, the timeseries plots in both figures appear very cluttered, and the different colored curves are difficult to distinguish. My suggestion would be to remove the NO RIV' and 'CLIM' curves from these figures and make a new figure with SST and SSS from CTL, NO RIV and CLIM runs, if possible.

2. Figure 3: The velocity vectors are not clearly visible in panels i-l. Is it possible to increase the arrow length? According to the proposed mechanism (Fig. 6), one would expect to see negative SSH differences to the north of the Congo River mouth which depicts upwelling associated with advective low SST values. But Fig. 3(i) shows positive SSH values all along the coast. Can this be explained?

3. It is surprising to see that there is no difference in SSS between the CTL and CLIM runs. Interannual variability in SSS is known to be tightly linked to the interannual variability in Congo River discharge. However, the model discharge does not seem to align well with the observed discharge values at the Kinshasa station (Fig. S1). Do you think the discrepancies in model runoff forcing could be a possible reason for this?

4. Are these linear regression plots and reported correlation values calculated at zero lag? I would expect there to be a lag of 1-2 months between the SSS at the Congo River mouth and the SSH/SST in the coastal Angola-Benguela area, as it takes time for the river water to be advected south along the coast. Can you check this by plotting lagged correlation between the variables?

5. Fig. 4: It might be useful to add a panel showing the linear regression plot between SSS in CRMA and SST in CABA.

6. Would it be possible to show the horizontal advection in °C/day instead of W/m² for easier comparison with the SST plots?

7. Fig. 5 shows that the Ekman upwelling index contributes significantly more to coastal upwelling than the Geostrophic upwelling index. Additionally, there is little difference between the CLIM and NO RIV runs for the ECUI. This figure does not seem to add much to the discussion and could be moved to the supplementary material. Instead, I recommend moving Fig. S7 to the main article, as it illustrates the contribution of geostrophic currents to horizontal temperature advection. This is just a suggestion; ultimately, it is up to the authors to decide.

Minor comments:

1. There are too many acronyms (e.g., SETA, CTW, CRMA, CABA, CUI, ECUI, GCUI, etc.), which can make it difficult for the reader to follow. Please consider reducing the number of acronyms to improve clarity and simplicity.

2. Line 10: Suggest adding “significant” freshwater input from land.

3. Lines 31-32: Please mention the longitude of the mouth of the rivers as well.

4. Line 174: Why were the horizontal advection values within 20 km distance neglected? Is it because of large errors? Add a sentence explaining that.

5. Line 249-250: It is not clear what weak SSS variability in CTL run means here. I see significant variability in CTL run SSS in Fig. 2d.

6. Fig. 6: You might want to say what the blue dotted arrow represents in the right-side graphic legend.

7. Line 439: The negative values of GCUI seem to extend from 17S to 6S.