Review of paper titled "Water transport among the world ocean basins within the water cycle" submitted to Earth System Dynamics,

Manuscript Number: esd-2020-54

Dear Editor

Thank you for sending the manuscript to me for a review. Below you will see a short summary of the manuscript, followed by my specific (major) comments, and then technical corrections (minor comments) at the end.

Summary

The wind-driven, heat-driven and salinity driven circulations of the oceanic waters balance the water transport among different ocean basins, atmosphere, and the continents. These transports are important in deriving climate of the earth system. In this manuscript, the authors use the GRACE observations of monthly net mass of the basins to derive the mass balance of land-atmosphere-ocean systems. The authors note that data on lateral water transport through the boundaries of oceans are sparse, and GRACE estimates can prove to be useful in estimating the mass balances. The mass balances of four oceanic basins are considered and the output variable of interest, the water mass transport/transfer among different oceanic basins, is discussed further. Among some important results, it is shown that the Pacific oceans transfers a large quantify of water to Atlantic and Indian oceans throughout the year.

The mass balance of oceanic basins supplemented by GRACE data is a very simple yet powerful idea that I think it can be of interest to many readers of ESD and other similar journals. There, however, are many concepts and ideas in the manuscript where authors need to provide

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more justifications and clarifications; I added these and many important suggestions in the "specific comments" section below. I will be looking forward to reading a revised draft.

Specific comments

1. I feel a strong motivation for estimating the lateral water transports from oceanic boundaries is lacking. It is not clear why we require measurements of lateral transports, given that the overall transport among different oceanic basin is known to a reasonable degree of certainty, such as by the studies noted by the authors in the introduction and discussion sections. The authors should write a concise and clear paragraph of why it is important to estimate the water fluxes through boundaries with this novel approach.

2. In addition, the authors note in their introduction that their method improves upon the previous estimates. The literature on previous estimates and how (and how much) the new method improves upon them is not discussed in detail. In addition, a critical comparison of previous estimates of water transports and the estimates provided in this study is lacking.

3. The authors observe that loss through E-P is much more in AIA as compared to the Pacific, even though the surface area is same. However, the reasons for such disparity is not discussed. Similarly, the potential reasons for other important results are not discussed. I hope to see some discussion on the results from this study.

4. Results section (L160-170). As of now, when I read the number and where the losses and gains take place, it is difficult for me to visualize the transfers among different basins. I strongly suggest the authors to present this information in terms of a multi-panel graph/map, where each map shows specific water transfer-related variable (such as N, R, etc.) with thick arrows giving the direction of transport, their color showing the magnitude of transport or we can just add text (number) inside the arrows to show magnitude.

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5. L218: This is related to my comment#3. If none of the major indices shows strong correlation with the Pacific outflow, we do not have a confidence in what causes the interannual variability of Pacific Ocean outflow. Perhaps, more detailed insights from P and E series might help and/or some literature review on this might guide the authors in understanding the likely causes of the interannual variability of the Pacific Ocean outflow. Likewise, it would be useful to perform the same analysis on other basins for understanding their interannual variability of outflows.

Technical corrections

L44: Correct 'de' here

Many details are missing: Such as how were E and R computed? Are these also taken from ERA5?

Figure 1: What is the source of Figure 1? Or how was this figure obtained?

Figure 1: Please add color labels to the figure. I also think the figure would look better is you add the basin names in the figure itself.; perhaps major continental basins as well.

In addition, major known pathways of water transport can be added to the figure.

L93: Elaborate more.

L94-L95: Please provide more details as to why this is required.

L98: Have you defined "GAD" earlier? Please provide details. Also, provide detailed justification of effects ignored here.

L97-100: This sentence is not very clear, rephrase for better clarity.

L99: What is MPIOM?

L105 to 115: I am not able to quite follow these sentences, perhaps because of my lack of expertise in GRACE. I'd suggest writing them in more details for readers who are not well-versed with GRACE estimates. In fact, I feel the entire paragraph can be re-written for more clearity.

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L126: Bootstrap replications of what variables? Are these timeseries data?

L128-130: Please write these in more details. "subtracted" what from what? Please clarify.

L135: All these can be written concisely in a table.

Figure 2: Should be made clearer. Shouldn't "R" be same in both left and right columns. Perhaps, you can remove the space between columns and extended the x-axis of the plots.

L145: The P-E estimate of 142 Gt/month should be corrected for final presentation, since it was earlier noted that ERA5 may have some internal inconsistency when comparing previously estimated values from the literature.

Figure 2: It might be useful to show N in right panels. Perhaps, you can only keep P- E, rather than showing both P and E.

L145: How does the results on fluxes in this manuscript compare with the values in the literature.

Figure 3: I'm not sure if Figure 3 is required. I think it can be removed without loss of any critical details.

L145 to 155: I would suggest the values to be put in a graphical format, which might look more appealing that writing the numbers.

L164: What is basis of deciding the salinity of water in this study?

L181: I though the data is monthly; if so, how can we say day of month also?

L198: Again, it seems important that authors add N time series also in Figures 2 and 4.

Figure 6: In addition to showing the timeseries, you can show the correlation values of each index with Pacific outflow.

L225: The importance of these changes has not been discussed before in the manuscript.

Appendix:

Have we referend to Appendix anywhere in the main text?

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