Author's response

Both reviewers indicated that the novelty of our study is not very clear in the manuscript. Changes were made to the manuscript in order to improve it. The introduction, discussion and conclusion were changed to contextualize further the study with the references suggested by the reviewers, particularly with Ezer (2019) and Dangendorf et al. (2021) since these are the most relevant. The discussion and conclusion were particularly reworked, with greater emphasize now given to our main result. The abstract was slightly changed to state that this study extend previous results limited to the altimetry era.

Anonymous reviewer #1 suggested to discuss in more details the upstream patterns of sea surface velocity in both oceans, whereas Tal Ezer suggested to consider in the discussion the role of water temperature and transport. A paragraph was added to the discussion which states that off-shoreward motion during positive phase of the leading principal component is also seen in the Pacific (southeast of Kyushu) so that the situations in the two basins are not necessarily contradictory. We also develop on the role of oNLM and nNLM path alternance and of temperature changes in the discussion. A paragraph that used to be in the discussion and which briefly mentioned the upstream patterns was greatly enhanced and moved to the conclusion. Therefore the upstream situation is now much more discussed in the manuscript than before. The role of temperature is also further discussed. Reference was made to Domingues et al. (2018), Ezer (2019) and to Kuroda et al. (2010) as they link the upstream sea-level variability with the WBC temperature. Consideration of both the upstream situation and of the role of transport and temperature led us to be less conclusive on the Sasaki et al. (2014) framework than before.

All minor comments from the referees were accepted and subsequent changes were made to the manuscript.

Finally, additional changes were made when we thought they were needed. The sea surface velocity product used was changed, and the figures were printed again. This was made to avoid any confusion regarding the Ekman component of the dataset that was previously used. The dataset we now used has no Ekman component, which makes the manuscript easier to understand. Additionally, a small error in our script, which was leading to slightly incorrect isolines in Supplementary Figure S4, was corrected. The difference is hardly discernible to the naked eye. The Northern Recirculation Gyre line in Figure 1 was previously missing and was added. Ordinate and abscissa labels were added in Figures 3 and 4. The captions of Figures 5 and 6 were reworked to be more clear. A few typos were corrected. Finally, the last two paragraph were inverted to end the manuscript on a more positive note.

Samuel Diabaté, On behalf of all co-authors.

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