Comments and suggestions on the research article OS-2022-1443 "Intraseasonal variability of the South Vietnam Upwelling, South China Sea: influence of atmospheric forcing and ocean intrinsic variability" - authors Marine Herrmann, To Duy Thai and Claude Estournel.

The main objective of this article is to understand the mechanism of a well-known phenomenon in the Southeast Asian waters during summer: the upwelling at the Southern Vietnam coast (SVU) in the South China Sea (SCS). This manuscript is the continuation of recently published work in Ocean Science :To Duy et al., 2022 that studied the interannual variability of the SVU. In this article, authors - using the same numerical configuration as the previous paper - studied the influence of summer monsoon wind and ocean intrinsic variability on the four main areas of the SVU: the northern coastal upwelling (NCU), the southern coastal upwelling (SCU), the offshore upwelling (OFU) and the shelf off the Mekong River mouth (MKU), in daily and intraseasonal time scale. Results are extracted from ten simulations on the same period (2017 - 2018) with different initial conditions in temperature, salinity, currents and sea surface height (perturbations only made on mesoscale fields). Summer 2018 (June, July, August) is chosen for the case study analyses.

I find this article very well structured and written. The scientific objectives are presented concisely followed by a clear explanation of applied methods and rigorous analyses of the result. The scientific question and computational method are original. However, I have a few questions and suggestions for the authors in order to better understand their work.

We warmly thank the reviewer for the time and attention devoted to our paper, and for those positive and constructive comments. We have carefully considered all the comments and suggestions in the revised version of our manuscript. In what follows, and in the highlighted version of the manuscript, our answers and modifications are highlighted in green. Line numbers refer to the highlighted version of the revised manuscript.

1) In the methodology part (part 2), the bathymetry database used for the model's grid is not defined. Since the resolution of bathymetry is important in the study of current fields, it should be mentioned in the methodology part. Did the authors use a fine resolution bathymetry for the coastal zone?

The numerical grid was built in autumn 2018 based on the latest release of GEBCO bathymetry dataset, i.e. the GEBCO_2014 dataset released in April 2015 at a 30 seconds interval (~0.9 km) and available from www.gebco.net. The resolution of GEBCO_2014 was suitable for this since our grid resolution varies from a minimum of 1026 m at the coast to 4435 m offshore (see fig. A below).

→ This information was added in the revised version of our paper (lines 106-107 of the highlighted manuscript).

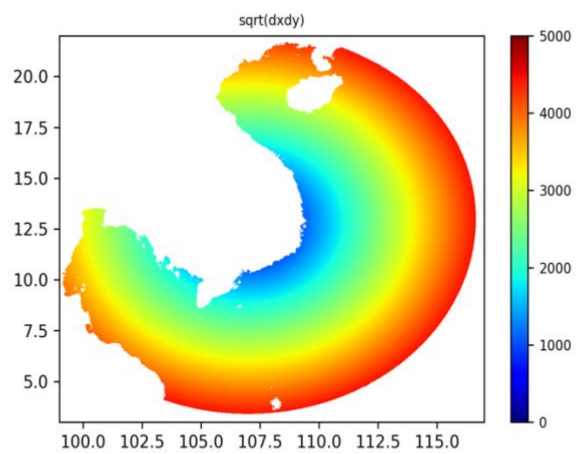

Fig. A : mesh size (meter) of the VNC grid

2) The second question concerns the ocean intrinsic variability (OIV). If I understand correctly, this OIV represents an ensemble of ocean intrinsic properties such as temperature, salinity, currents, etc. In the authors' opinion, which parameter(s) are the main factor(s) controlling this OIV?

Ocean Intrinsic variability (OIV), as opposed to the forced variability, corresponds to the unpredictable part of ocean variability: it is the variability that is not induced by the variability of external forcing factors (atmospheric forcing, lateral boundary conditions, river flow), but by the chaotic behavior of ocean dynamics. It indeed affects all variables that characterize the state of the ocean (temperature, salinity, currents, etc). Most studies have shown that mesoscale to submesoscale structures are the major source of OIV (see Penduff et al., 2011; Serazin et al., 2016; Waldman et al., 2018; Da et al. 2019; as references). The results of our study are in line with these conclusions, as we show that for the two areas most affected by the OIV, i.e., the OFU, and even more so the NCU, the chaotic part of the circulation and upwelling variability is related to the small-scale structures that develop in these regions.

→ We added a few lines in the introduction to better define the OIV at the beginning, and in the conclusion (lines 60-63 and 418-420) to highlight the contribution of our study to the understanding of OIV).

3) The third question is in regard to the application of the research findings on predicting the upwelling development. Could it be possible to predict the intensity of the upwelling zone using wind forecast?

The results of To-Duy et al. 2022 and this paper showed that MKU and SCU have very low intrinsic variability on the intraseasonal scale, and their interannual variability is mainly determined by the summer wind intensity over the SVU region. This suggests that upwelling development in these coastal regions could be largely predicted using wind forecasts, provided of course that these forecasts are reliable.

OFU has stronger intrinsic variability, but its daily to interannual variability is also primarily determined by the intensity of summer wind stress and the curvature of wind stress. Our results therefore suggest that at first order it can be partially predicted from wind forecasts, but with uncertainties in its daily to summer integrated magnitude that can vary by a factor of 1.5 to 2 (see Figure 2 and Table 1 of the paper).

The intrinsic variability of NCU is much higher. On interannual and intraseasonal scales, its development is driven by the large-scale circulation: conditions that favor upwelling in the other three areas prevent NCU. Moreover, during periods potentially favorable for NCU, the role of wind is less important than for the other areas, and the sub-mesoscale to mesoscale chaotic circulation that prevails over the coastal zone has a strong impact on NCU development. For NCU, wind forecasts could therefore be used to identify favorable and unfavorable periods for NCU development. However, favorable periods would be associated with a high uncertainty rate in terms of NCU intensity, given the strong impact of OIV that could result in very strong but also extremely weak NCUs.

→ We added a paragraph in the conclusion (420-428) to highlight this potential application of our findings for the SVU predictability.

4) The final question relates to the role of tide and river discharge on the variability of the upwelling intensity. In the authors' opinion, how important are tidal currents at coastal upwelling zones like NCU and SCU? How much influence do the enormous discharges from the Mekong river have on the properties of MKU?

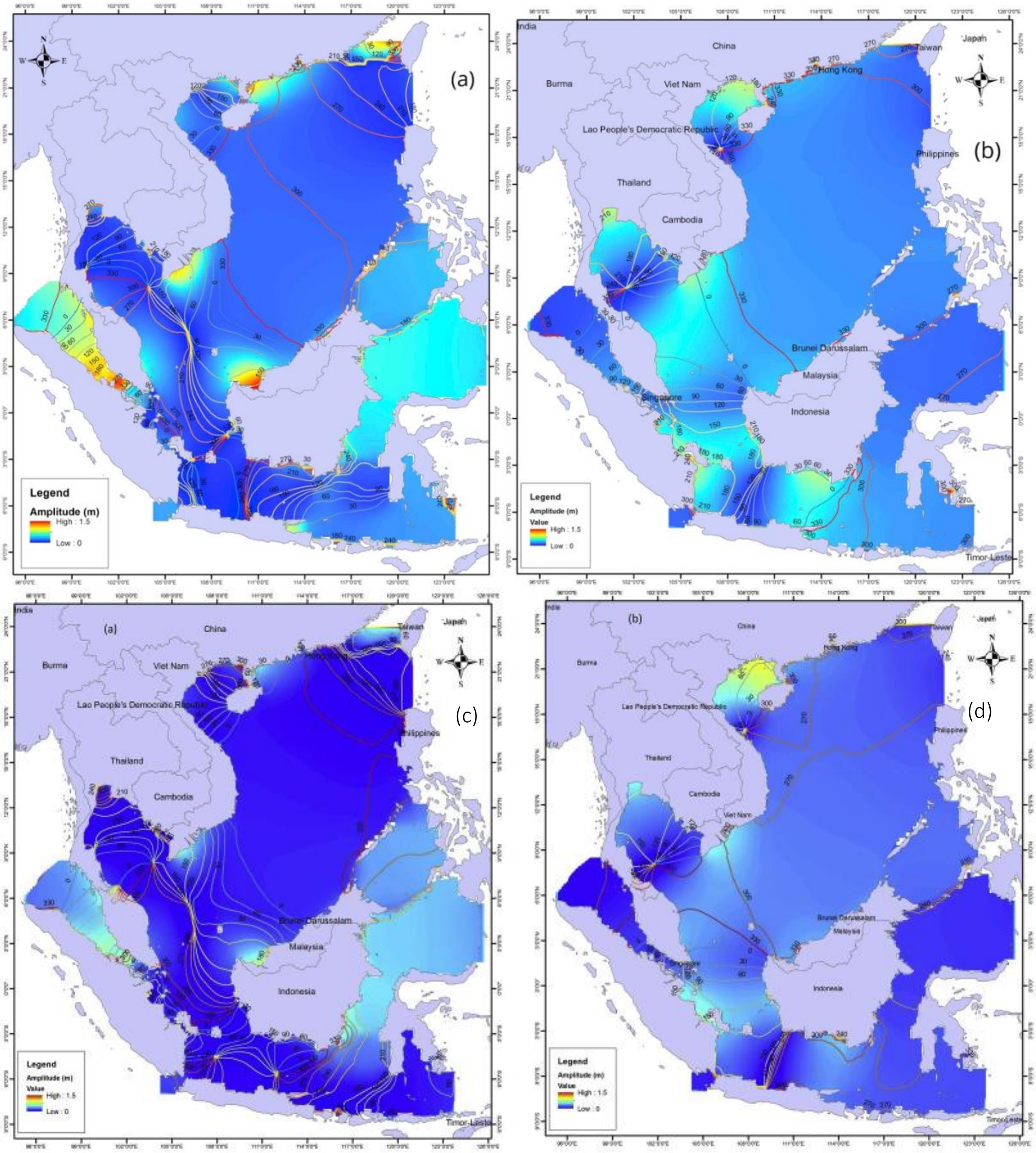

Fig. B : Co-Tidal charts of M2, K1, S2, O1 (colors show the tidal amplitude in m) from Phan et al. (2019).

Previous modeling studies suggested that tides could influence the SVU development (Chen et al. 2012). Figure B shows the amplitude and phase charts for the four principal tidal components over the South China Sea: M2, K1, S2, and O1 (Phan et al. 2019). Tides are overall very weak in the relatively deep northern coastal and offshore regions. Their amplitude is larger over the shallow Mekong shelf region, with amplitudes of each component reaching ~1 m, suggesting that tidal currents could be strong in this area. Indeed, residual currents over this area can reach 5 cm/s, as shown by the map of tidal residual currents produced by the FES2022 tidal atlas (see Fig. C below).

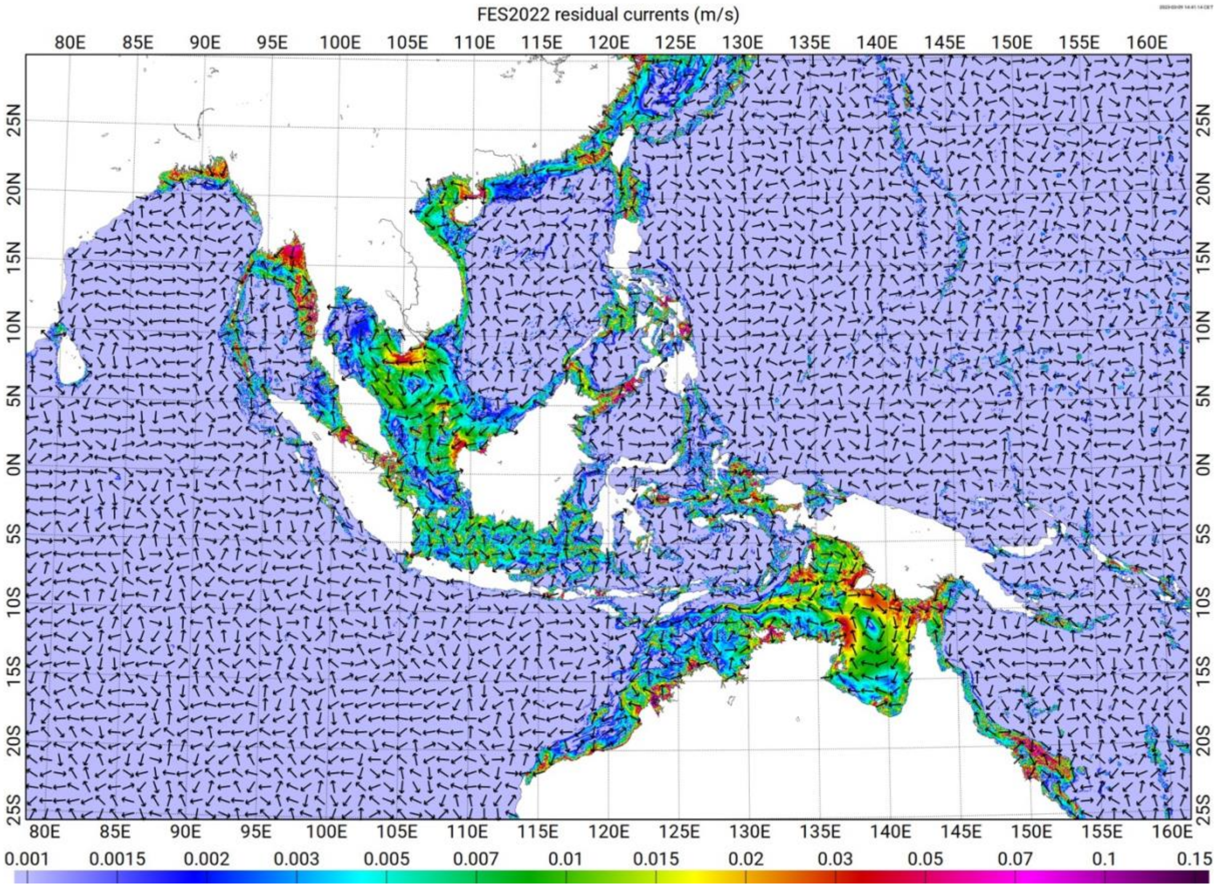

Fig. C : residual tidal currents simulated by FES_2022 tidal atlas, courtesy of Damien Allain, LEGOS.

The main rivers on the Vietnamese coast are the Mekong and Red Rivers. The Red River is quite far from the SVU region, but the Mekong plume could affect the region through its effect on vertical stratification as well as horizontal density gradient, especially the MKU region that directly receives water from the Mekong. This rapid analysis suggests that tides and rivers should have a minor impact on OFU, but may potentially affect MKU, and possibly SCU and NCU. A detailed analysis of these effects on these four upwelling areas is underway and will be presented in a paper to be submitted soon.

→ Results concerning the effects of tides and rivers on the SVU over its different areas of development will be presented in this coming paper, but we added a sentence in the manuscript regarding this potential effect (lines 429-432).

5) Technical corrections: some parts need to be re-numbered

Line 198: it should be 4.1

Line 218: It should be 4.2

Line 234: It should be 4.3

Line 287: It should be 4.4

→ There was indeed an overall numbering problem in the paper that was fixed in the revised version.

To conclude, the work provided in this paper meets the quality requirements of Ocean Science and is worth publishing. I greatly appreciate the effort of the authors helping us better understand the mechanism of the SVU

Once again warmly thank the reviewer for this very nice comment that is much appreciated.

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