

**Review on the manuscript No: OS-2016-70 entitled “Synoptic fluctuation of the Taiwan Warm Current in winter on the East China Sea shelf” by Xuan et al.**

**General comments**

The authors aim to study the spatial distributions and dynamics of synoptic fluctuations of the Taiwan Warm Current (TWC) so as to better understand the TWC’s role in winter on the cross-shelf water exchange due to the influence of its fluctuations on the regional material transport. This could be an interesting and significant scientific study. Regrettably, their analysis, interpretation and discussion are found to be incoherent and devoid of strong/convincing physical reasonings probably due to lack of comprehensive understanding of winter monsoonal flows. Some key findings of the following articles may be helpful to enhance this study:-

- (i) Hong, Huasheng, et al. "An overview of physical and biogeochemical processes and ecosystem dynamics in the Taiwan Strait." *Continental Shelf Research* 31.6 (2011): S3-S12.
- (ii) Hu, Jianyu, et al. "Review on current and seawater volume transport through the Taiwan Strait." *Journal of Oceanography* 66.5 (2010): 591-610.

In addition, definitions and terms such as north of Taiwan, inshore area, inshore branch, offshore branch, alongshore, cross shore and cross shelf are noted to cause confusion when some of these terms are used interchangeably at times. Quoting literature review without further elaboration to strengthen a point is insufficient. Some figures are hard to see, not properly captioned and without the unit specified for the parameter. There exists a number of structural and grammatical errors in the language used. Finally, this is merely a case study (for January and February 2009) and the conclusions drawn are only applicable for this specific late-winter case. As such, a major revision of this manuscript, inclusive of its title, is needed before it can be considered for publication.

**Major comments**

1: Are November to March the winter months? How could you explain the weak mean velocity of the winter TWC on the ECS shelf (lines 51-52)? What are the dominant physical factors that cause the fluctuations of the TWC to have periods between 3 and 15 days (lines 55-58)? What do you mean by “the intermittency of the TWC in winter” (line 60)? Under what synoptic condition can the TSC be considered as an upstream flow of the TWC (line 96)? What is the physical significance of inserting “Takahashi ..... the annual (?) variation of the TWC ..... the propagation of vorticity anomalies .....” (lines 98-100)?

2: It is obvious that your case study is for January and February 2009. Hence, your climatological (Years of climatological period are not mentioned in your manuscript) and observational deductions must refer only to these late-winter months. Apart from defining near-coast, inshore and offshore areas based on isobaths, can you offer an explanation why the TWC inshore and offshore branches only dominate in those specific isobaths (lines 75-78)?

- 3: Lines 103-113 under Introduction should be moved to Data and Methods (suggest to change from Methods and validation) section.
- 4: Please provide sufficient details on model setup, configuration, data used, forces and boundary conditions. As the model is run fully in three dimension, time steps for baroclinic and barotropic runs should be defined separately.
- 5: Lines 143-147: Not clear. How could you obtain the hindcast outputs for late winter 2009 when you simulated the model using 2009 to 2013 data with three years of spin-up?
- 6: Lines 156-171: Write-up on validations is vague.
- 7: Lines 186-188: “The cross-shore component (Figs 3c and 3d) is much...spatial pattern. It flows offshore in the upper layer and onshore in the lower layer at Station 1.” What is seen in the figure is different from what is expressed here.
- 8: Errors are found in labelling Figure 4 and the explanation given on simulated and observed results is not clear. If the alongshore component is nearly one order of magnitude larger than cross-shore component, how could their fluctuation magnitudes be comparable (lines 206-207).
- 9: Line 235: “Second, according to the hydrostatic ...” This is ambiguous, please rewrite it.
- 10: Line 245: please define the mathematical form of the wind stress (at the sea surface ( $\tau_a$ ) and sea bottom ( $\tau_b$ )) used in the model.
- 11: Lines 263-264: Please elaborate this statement - “...which is fully in accordance with the conservation of potential vorticity”.
- 12: Lines 271: Explain why different cooling exists in both areas.
- 13: Lines 275-278: “The fact that the depth of the subsurface VMV...the effects of baroclinicity and wind friction...” Explain in detail this key finding.
- 14: Lines 311-312: “The currents fluctuated ..... occurred episodically”. What episodic events you are referring to?
- 15: Line 320: Suggest you calculate the mixed layer depth based on:  
“Lorbacher K, Dommenges D, Niiler PP, Kohl A. Ocean mixed layer depth: A subsurface proxy of ocean atmosphere variability. *J Geophys Res-Ocean*. 2006; 111(C7): 1978–2012. doi: 10.1029/2003JC002157.”
- 16: Lines 341-346: Hard to follow your explanation in the figures. Please plot them in different depths.
- 17: Under “3.3 Dynamic diagnostics”, you argued (based on Figure 12) that the Coriolis force is mainly balanced by the total pressure in both branches,...in the wintertime TWC. This is not convincing for the Taiwan Strait.

18: Lines 395-400: I am not convinced. You argue that “ ... the TSC mainly caused variations in the barotropic pressure gradients, which further ....” As I know barotropic pressure gradients is generated by a sloping sea surface and the pressure gradient is depth independent. Please clarify.

19: Lines 404-408: Confusing. Why is the negative Coriolis force associated with a northerly wind?

20: Lines 430-435: What is numerical tracer simulation and how is it connected with tracer assimilation? Please elaborate with their physical applications.

21: Lines 491-497: Did the episodic occurrence relate to the surge and lull periods of the late winter?

22: Lines 506-519: Description and explanation are vague.

23: Lines 552-558: Confusing. Suggest to use the late winter monsoonal flow patterns during the surge and lull periods as a basis to recast your findings.

### **Minor Comments:**

1: Line 10 : Is it 10 meter wind above sea surface ?

2: Line 30: should be “When a strong TSC intrudes towards the north of Taiwan,...”

3: Line 55: “continental shelf” instead of “continental shelves”

4: Line 120, “To investigate the currents ...ECS shelf, an unstructured-grid FVCOM was developed for...” should change to “...a 3d unstructured- grid FVCOM is developed for...”

5: Lines 124-125: “A regional refinement of the resolution (approximately 3 km) was specified ...” should be replaced by “A regional ...~3km is specified ...”.

6: Line 125: Add (GEBCO) after “The General Bathymetric Chart of the Ocean”.

7: Line 125 : Please specify number of grid points ( $m*n*1$ ) used in model configuration.

8: Line 130: Usually tide is used as boundary conditions and is not a driving force.

9: Section 2.2 Validation of the mean currents and synoptic fluctuations: “The mean current was ...”. What you mean by “the mean current” ? Amend “was” to “is”.

10: Line 180: “...for the observational period... ” Please specify the period.

11: Line 180 : “We defined the alongshore direction from southwest ( $218^\circ$ ) to northeast ( $38^\circ$ ), which is ...” It is very confusing please amend it.

12: Line 210: Section 2.3: “The Empirical ...” should be written as “The Empirical ..., as a statistical method, has been used to understand the synoptic fluctuations of the ... ”.

13: Page 11, Section “2.4 Momentum analysis” should be worded as “2.4 The governing equations”.

14: Page 18, Section 3.3 Dynamic diagnostics: “The seasonal mean of the water...”. What is exact period of this mean.

15: Page 19, line 405: “It indicates that strong winter monsoon can weaken...”. Replace “weaken” with an appropriate word.

16: Page 20, line 430: “Two section, one in the Taiwan Strait and another in ...” show transection.

17: Page 21, line 450: “Figure 14b shows the tracers ...”. Is it tracers or traces?