Dear Editor and Reviewers

We are very pleased to have your comments concerning our manuscript entitled "Statistical analysis of dynamic behavior of continental shelf wave motions in the northern South China Sea" (egusphere-2023-1274). Thank the editor and reviewers for taking time out of your busy schedule to review our paper and provide constructive comments on it.

We have read and dealt with all the comments carefully. The revised manuscript with all comments highlighted with blue fronts has been uploaded, and point-to-point responses to the reviewer's comments are present following.

Response to Comments of Reviewer 2 （Red font in the manuscript）

[Comment 1] Introduction. Instead of very broadly describing sea level variations in the SCS and their relationship with for example ENSO, I think the authors should get quickly to the core content focused in this manuscript. For instance, the authors can review relevant studies on CSWs and ATWs in the China Seas or in global shelf seas, summarize the state-of-the-art understandings of general dynamics and regional oceanography, and propose outstanding issues particularly the ones that will be addressed in the present study. Also, listing a number of studies as in the second paragraph of Introduction is not an ideal way to summarize current understandings; rather, they should be organized in a sound and logic way.

Response: We appreciate for Reviewers' warm suggestion. We tried our best to improve the introduction and made some changes.

Line 36:

Continental shelf wave (CSW) is a type of topographic Rossby wave (TRW) trapped in the continental shelf with amplitudes ranging from several tens' centimeters to more than one meter (Aydın and Beşiktepe, 2022; Clarke and Brink, 1985; Heaps et al., 1988; Morey et al., 2006; Mysak, 1980; Robinson, 1964; Zheng et al., 2015). CSW is a sub-inertial motion with a wavelength much greater than the depth (Li et al., 2015; Schulz et al., 2011). It propagates along the shelf with the coast on its right (left) in the northern (southern) hemisphere (Clarke, 1977). During the impact of typhoon, an excessive flooding in the coastal zone could be induced by a propagating CSW that added to the locally wind-generated surge (Dukhovskoy and Morey, 2011; Han et al., 2012). Therefore, CSW is particularly important for coastal sea-level variations.

CSW is generally generated by large-scale weather systems moving across or along the shelf (Thiebaut and Vennell, 2010). CSW events have been reported by previous investigators lasted from 2 days to 2 weeks (Chen and Su, 1987; Li et al., 2015; Li et al., 2021; Zheng et al., 2015). The phase speed of CSWs depends on the bottom topography, ranging from 5 to 20 m s-1 (Li et al., 2015; Li et al., 2016; Shen et al., 2021). CSWs could be taken as barotropic motion in a homogeneous coastal area. While in a stratified ocean, it could be classified into coastal trapped wave. If the bottom boundary is flat, it propagates as a Kelvin wave. Overall, they are resulting from conserving potential vorticity over the shelf (Chen et al., 2022; Quan et al., 2021; Wang and Mooers, 1976).

[Comment 2] Section 3.1 & Fig. 2. The authors identify sea level signals with periods shorter than 40 d as CSWs while those longer than 40 d as ATWs, and state that they "show remarkably different characteristics". However, the remarkable difference is not clearly discernable from Fig. 2. In particular, I do not see evident discontinuity around the period 40 d in Fig. 2b. The authors need to illustrate more clearly what specifically the "remarkably different characteristics" Moreover, instead of showing all the resolved periods in a single panel, I suggest plotting certain period bands of interests in different panels with enlarged views of the details and adding auxiliary lines when needed to illustrate for example the content in L168-170.

Response: Thanks for your comment.

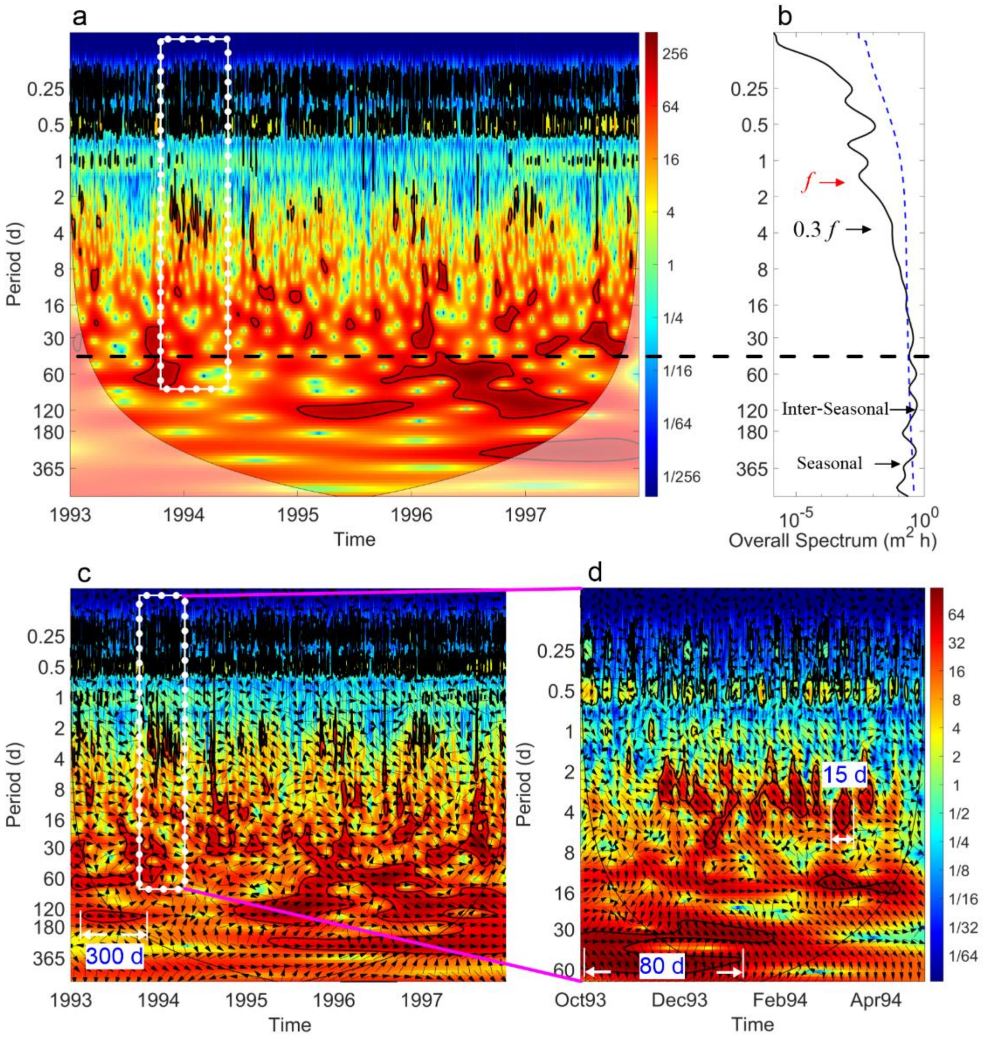
(1) About "remarkably different characteristics". We explain the difference in the following sentences. As shown in Line 312 "In the period band shorter than 40 d, the signals at station Xiamen lag that at station Kamen about 15 h." and Line 318 "In the period band longer than 40 d, the phase of signals between Kanmen and Xiamen is a little complicated."

One can see the arrows point bottom left in the period less than 40 d. In the period band longer than 40 d, one can see direction of arrows is in disorder. For example, the arrows in the lower period band point left in 1996 and point down in Fig. 5d. The time lag calculated from the direction of arrows is $\Delta T = Period\frac{phase}{2\pi}$. In different periods with the same phase angle, let *period*=10 d for CSW, and *period*=100 d for ATW, then the time lag for ATW is 10 times more than that of CSW. Then, the phase speed of ATW is much less than that of CSW. The disorder of arrows for ATW indicates there is no evidence for propagating of ATW.

We think we should provide a supplementary explanation.

Line 323: In the period band shorter than 40 d, one can see the arrows point bottom left uniformly. The uniform phase lag indicates the fixed time delay of the signal between two tidal gauge station. While, the direction of arrows is in disorder in the lower period band, which indicates there is no evidence for propagating.

(2) We have added auxiliary lines into Fig. 5.



[Comment 3] This is related to the previous comment. I think the governing equations and wave solutions derived in Section 4 are more clearly for CSWs than for ATWs. This could be overcome by indicating ATWs more explicitly in Section 4.2. For example, making subsection titles of Section 4.1 and 4.2 more parallel (e.g., "Governing equations and wave solutions for CSWs/ATWs), explicitly indicating Eq. (21) is the solution for ATWs and Fig. 6 is the theoretical ATW profiles (rather than "normalized SSH ..."), etc. This would also help readers to more easily understand what theoretical ATWs refer to as described in L482.

Response: Thanks very much for this comment and suggestion. The title of the manuscript indicates we focus on CSW. Moreover, Csanady (1978) and Lin et al. (2021) gave an excellent result for ATW. In the manuscript, we present the cross-shelf structure of ATW using satellite observation data. We have cited these references and we think the main point is enough for analysis in the manuscript. All things considered, we added minor changes.

Line 279:

The normalized SSH in the cross-shelf direction of ATW for tracks 12, 88, 114, and 190 are shown in Fig. 4. One can see that the trapped sea level in the cross-shelf direction decays quickly from 1 at the coastline to ~0.2 at the edge of the continental shelf (~200 km), and 0.1 at a distance of 300 km. The ATW amplitude decays offshore with a scale equal to the deformation radius, and L = ~100 km in the study area, which is much less than the local Rossby radius of deformation (~600 km). Under different wind stresses, the amplitude of ATW evolves similarly to that in Fig. 3a. As Track 240 is not perpendicular to the coastline, it is beyond the scope.

[Comment 4] L188-190. I understand that the China Seas are overwhelmed by northeasterly in winter and by southwesterly in summer. But coastal trapped waves (CTWs) should propagate equatorward (with the coast on the right side) in any season. How come seasonal signals at Xiamen would lead that at Kanmen in summer? In which form of coastal waves would sea level variability propagate poleward from Xiamen to Kanmen? Normally when wind direction is opposed to the propagation direction of CTWs (in summer for China Seas), alongshore wind would play a limited role in regulating coastal sea level variability downstream (in the sense of propagating CTWs).

Response: Thanks for your valuable comment. The explanations to the comments are as follow.

As shown in Fig. 5c, one can see direction of arrows is in disorder in the lower period band. For example, the arrows point upper left in the period of 120 d in 1995. While that point down left in 1997. The disorder should be caused by the wind forcing. We have divided these seasonal signals into ATW (Line 313).

CSW will propagate along the coast from north to south as shown in Fig. 5d. No evidence indicates that CSW would propagate reversely.

[Comment 5] Lower, not higher, percent values of significant level mean more significant. So here I think it is "larger than" instead of "less than".

Response: We think this is an excellent suggestion. We have corrected that in the Lines 299 and 428.

[Comment 6] L246-247. The "long-wave assumption" seems to assume that the cross-shelf length is much smaller than along-shelf length (*l*/*L*<<1). Why would it lead to du/dt=0?

Response: We sincerely thank the reviewer for careful reading. Let we use a simple case:

$$\frac{\partial u}{\partial t} - fv = -g\frac{\partial \eta}{\partial x} + \frac{\tau_s^x - \tau_b^x}{\rho H} \qquad (A1)$$

$$\frac{\partial v}{\partial t} + fu = -g\frac{\partial \eta}{\partial y} + \frac{\tau_s^y - \tau_b^y}{\rho H} \qquad (A2)$$

(A1-A2) can be nondimensionalized by:

$x = lx^*$

$y = Ly^*$

$u = Uu^*$

$v = Vv^*$

$U = l/T$

$V = L/T$

$t = Tt^*$

$\delta = l/L \ll 1$

In (A1), $\frac{\partial u}{\partial t} = \frac{U}{T}\frac{\partial u^*}{\partial t^*} = \frac{l}{T^2}\frac{\partial u^*}{\partial t^*} \ll f\frac{L}{T}v^*$, therefore, it is equivalent to simply putting $\frac{\partial u}{\partial t} = 0$.

[Comment 7] Fig. 4 is not referenced in the main text.

Response: We sincerely thank the reviewer for careful reading. We have added relevant content into the manuscript.

Line 233: The solution of phase speed for CSWs is shown as Fig. 2. The zero-crossing points for each curve present the phase speed of CSWs. The first zero-crossing point on the right hand of each curve points out the phase speed of mode-1 CSW, e.g., c = 7.6 m s^{-1} for track 190.

Line 382: Black and green curves in (c) represent the dispersion relation (from Fig. 2) for the topographic profiles along tracks 12 and 190.

[Comment 8] L483-484. Descriptions in these two lines only apply to Track 12. Is this correct? If yes, this needs to be illustrated more clearly in the texts.

Response: Thank you for your reminder. We have corrected the information.

Line 530: The amplitudes of ATWs in track 12 are 0.04 m, -0.06 m, -0.05 m, and 0.10 m in January-March, April-June, July-September, and October-December. That in track 88 is relatively larger, e.g., 0.13 m in October-December. While, the minimum amplitude occurs in track 114.