We thank C. Li for his careful comment of our paper submitted to Ocean Science. We appreciate the thoughtful and constructive feedback on the paper, which has helped to significantly improve the manuscript. We have addressed all concerns in the revised manuscript, as documented in our point-by-point responses.

General Comment

The authors only use 120 day data in 2010 to analyze the near-inertial variation of SCSMOC (Figure 2), which seasons are these data from? But with mooring data, it is 120-day data since 1 April 2006. Can your model reproduce the near-inertial variations as you mooring data with the same time period? Do these phenomena also exist in other seasons and any other years? Is there any seasonality of the near-inertial variations? I suggest the authors also include some analysis from other years, to demonstrate that the near-inertial variation triggered by Kuroshio intrusion is a common feature of SCSMOC, not a specific phenomenon in your selected period.

Reply: Thank you for your careful review. We use 120 day model output since 00:00, 1 January, 2010 in Figure 2. As the reviewer suggested, we use the mooring data to validate the model output based on the spectral analysis, as shown in Figure A1.Because of no tide forcing in the model, the tide effects have been removed in the mooring data. Figure A1 shows that the model can reproduce the near-inertial variations as the mooring data with the same time period well. We also use the model data of four typical month (January, April, July and October) in three years(2000,2006,2010) to show whether near-inertial variations of the SCSMOC also exist in other seasons and any other years, as shown in Figure A2(2000), Figure A3(2006), Figure A4(2010).Our results show that these near-inertial variations of the SCSMOC exists in other seasons and other years. The near-inertial variations of the SCSMOC has a strong seasonality as shown in Figure A5.The analysis of other months or years cannot change our conclusion significantly, so we just use the 2010 data to depict the near-inertial variations of the SCSMOC.

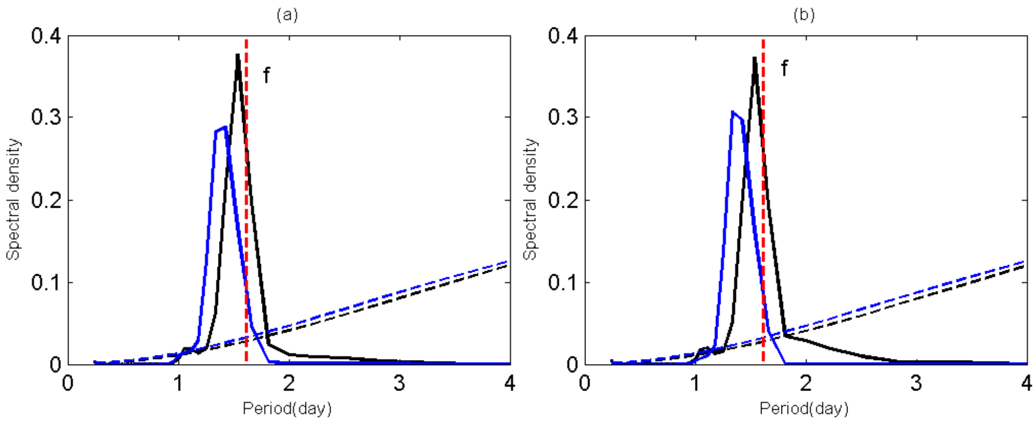

Figure A1 The power spectrum of zonal velocity (a) and meridional velocity (b) derived from the mooring (black line) and GLBu0.08 (blue line). The dashed black and blue line shows 95% confidence levels. The dashed red line represents the local inertial period. The tide effects have been removed in the mooring data.

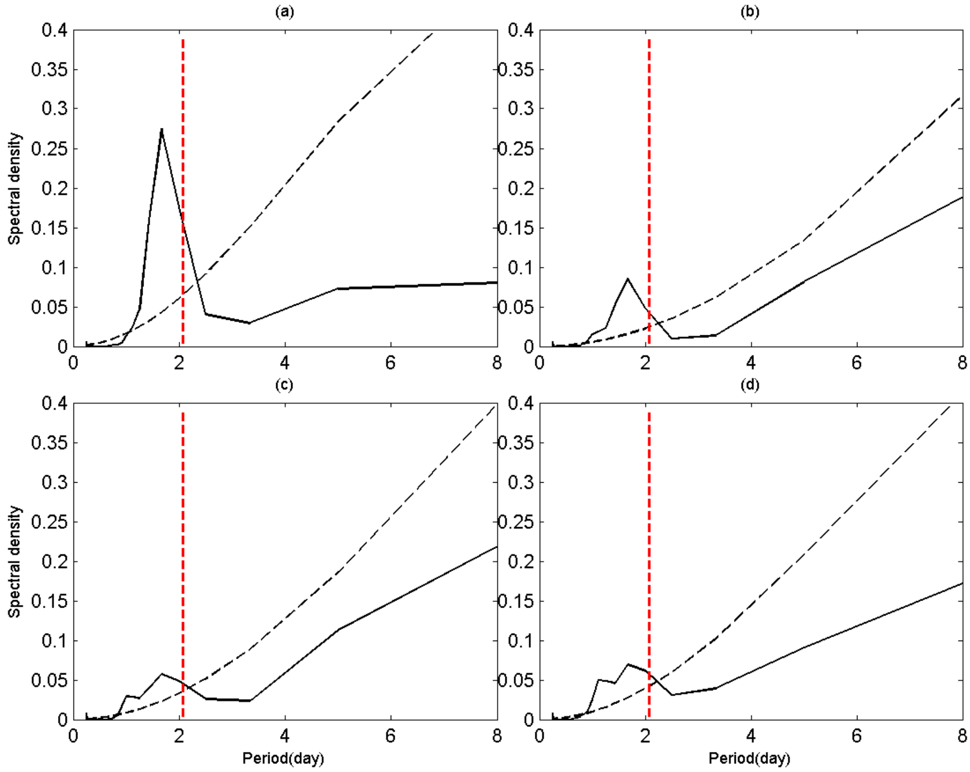

Figure A2 The power spectrum of SCSMOC at 1500m, 14°N in (a) January,(b) April, (c) July and (d) October in 2000. The dashed black line and red line show 95% confidence levels and the local inertial period respectively.

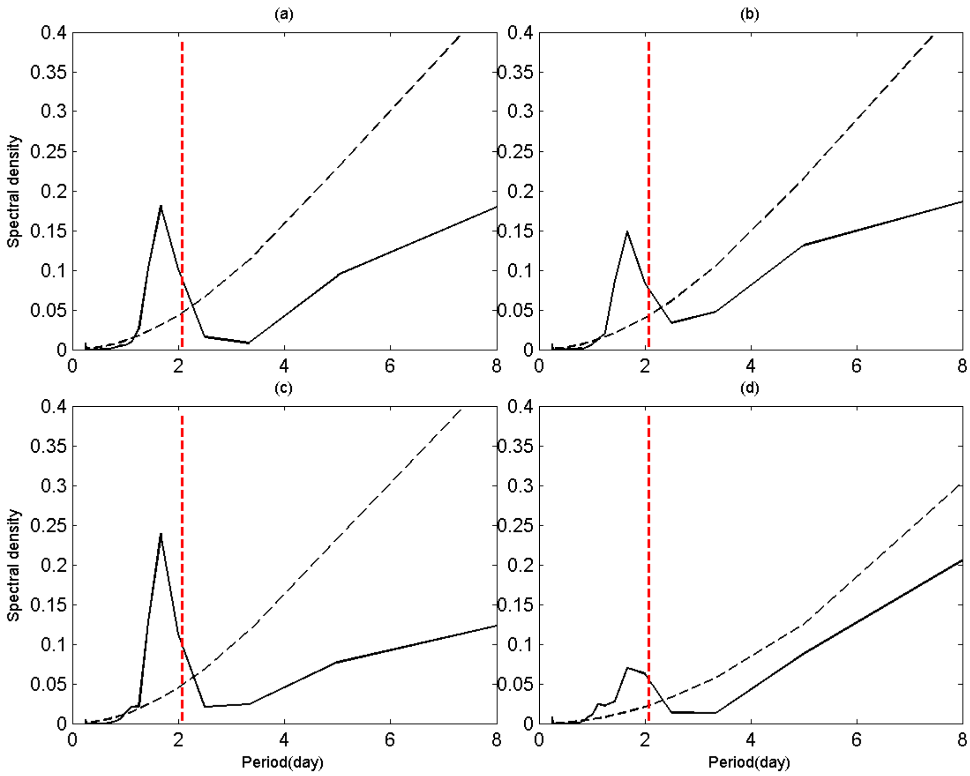

Figure A3 The power spectrum of SCSMOC at 1500m, 14°N in (a) January, (b) April, (c) July and

(d) October in 2006. The dashed black line and red line show 95% confidence levels and the local inertial period respectively.

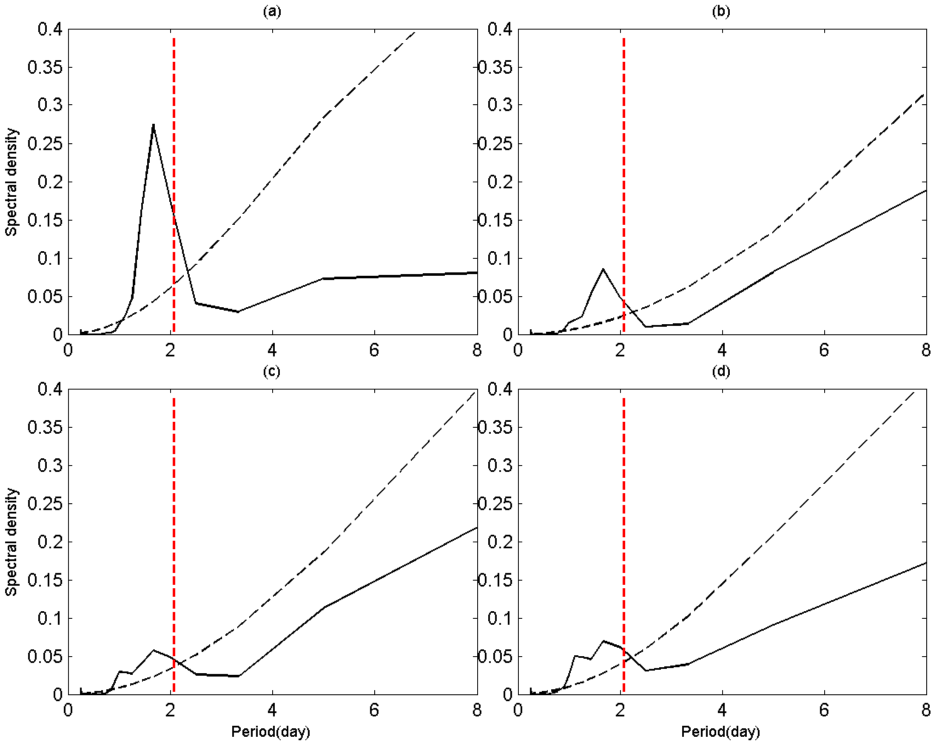

Figure A4 The power spectrum of SCSMOC at 1500m, 14^{o}N in (a) January,(b) April, (c) July and (d) October in 2010. The dashed black line and red line show 95% confidence levels and the local inertial period respectively.

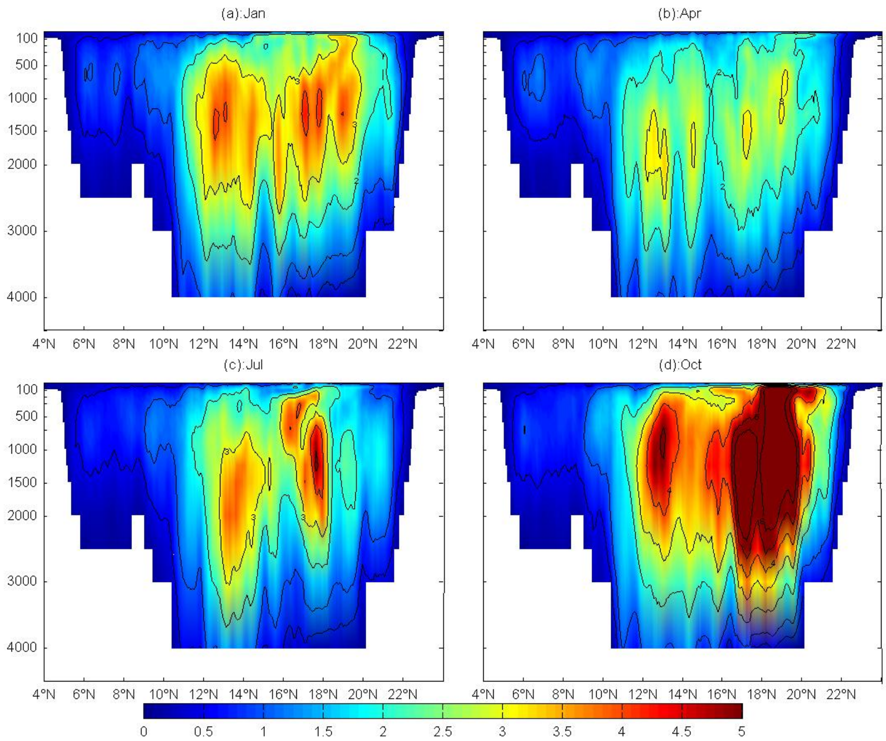

Figure A5 The standard deviations of the SCSMOC during (a) January, (b) April, (c) July and (d) October in 2010.

Comments

1. I suggest the author to revise the title of your paper, because the near-inertial variability of SCS MOC can also be observed in mooring data, which is shown in Fig. 7. And I am not sure whether is ok to call it near-inertial variability, which is a noise phenomena. My suggestion is “On the near-inertial variations of South China Sea meridional overturning circulation”.

Reply: Thank you for pointing out this poor wording. The title will be “On the near-inertial variations of South China Sea meridional overturning circulation”.

2. Line 2-3: “The near-inertial variability of … has been analyzed based on …” should be “We analyze the near-inertial variability of …”. “has been analyzed” sounds like the work has been done by previous studies.

Reply: We are sorry for this poor wording. We have updated this sentence as the reviewer suggested.

3. The introduction does not service very well. I cannot directly see what is you research questions? What is new? And why is important? I suggest the authors have a topic paragraph at the begging of the introduction.

Reply: The SCSMOC represents the connection between the deep circulation and the upper circulation in SCS. The Luzon Strait transport plays an important role in the SCSMOC, so we first depict the Luzon Strait transport in the first paragraph, and then we just describe the structure of the climatological SCSMOC. Finally, we just state the variability of the SCSMOC from the decadal scale to seasonal scale, but there is no study for the more high-frequency variability of the SCSMOC. Our study is inspired by the near-inertial variations of AMOC because near-inertial internal waves have been believed to be an important energy source for the diapycnal mixing in the ocean required to maintain the meridional overturning circulation (MOC) (Munk and Wunsch 1998; Blaker et al., 2012; Sévellec et al., 2013). We are just sorry for the sketchy statement in fourth paragraph in our introduction. And the fourth paragraph in our introduction has been revised.

Ref:

Munk, W., and C. Wunsch, 1998: Abyssal recipes II, Energetics of tidal and wind mixing. Deep Sea Res. I, 45, 1977–2010.

Blaker, A. T., Hirschi, J. J. M., Sinha, B., de Cuevas, B., Alderson, S., Coward, A., and Madec, G.: Large near-inertial oscillations of the Atlantic meridional overturning circulation, Ocean Model., 42, 50–56, 2012.

Sévellec, F., Hirschi, J. J. M., and Blaker, A. T.: On the Near-Inertial Resonance of the Atlantic Meridional Overturning Circulation, J. Phys. Oceanogr., 43, 2661–2672, 2013.

4. Line 22-26: I do not agree with the authors that SCS circulation in reality as described in the introduction is consistent with a highly simplified theory. They are different in many details. Stommel-Arons theory from 1960s has been developed to explain Atlantic MOC and global MOC, it is a basic theory for the global deep ocean circulation, and the theory for the deep circulation has been further discussed by Marotzke and Scott (1999) and Munk and Wunsch (1998). I am not sure whether you can really use Stommel-Arons theory to explain SCS circulation which is externally

mainly driven by Kuroshio intrusion and Asian monsoon system. The vertical structural of SCS MOC and Atlantic MOC are also different. The authors must be careful for your statements, which should be supported by our analysis or reference. ******Section 3. Characteristics of the near-inertial variability of the SCSMOC*************

Reply: We have read the analysis or references suggested by the reviewer carefully. The statement of SCS circulation related to the Stommel-Arons theory is mostly referred to Yuan,D,2002. He just related the SCS circulation to Luzon Strait transport through the vorticity balance between the vortex stretching and the meridional change of the planetary vorticity. Based on the simulation result, he just hypothesized that the simulated three-layer SCS circulation is consistent with the Stommel-Arons theory. We have checked the statement using recent studies. Actually, the deep cyclonic SCS circulation can be explained by the Stommel-Arons theory (Qu et al., 2006; Wang et al., 2009), but the application of the classic theory in the upper-layer SCS circulation is not so accurate as the reviewer suggested, although there are some scholars like Yuan to support this statement.

The more accurate statement of the SCS circulation should be based on the Yang-Price potential vorticity constraint (Yang, J. and J. F. Price, 2000; Yang, J. and J. F. Price, 2007).For the deep and intermediate SCS circulation, the steady Yang-Price PV constraint is

$$\frac{\overline{Q}_L f_L}{H_L} = -\lambda \oint_c (\overline{u}_h \cdot l) ds \quad (1)$$

Where $\overline{Q}_L$ is the deep or intermediate Luzon Strait transport, f_L is mean latitude of the deep or intermediate Luzon Strait, and H_L is the deep or intermediate layer of the Luzon Strait. For the semi-enclosed SCS deep basin, when there is a positive PV transport into the basin by the deepwater overflow through the Luzon Strait, the SCS deep circulation becomes cyclonic so that friction can generate a flux of negative PV to satisfy the integral balance. For the intermediate SCS basin, a negative PV transport into the basin by the intermediate Luzon Strait transport, so the SCS intermediate circulation becomes anti-cyclonic (Lan et al,2013&2015).

For the upper-layer SCS circulation, the steady Yang-Price PV constraint is,

$$\frac{\overline{Q}_L f_L}{H_L} - \iint \frac{\nabla \times \vec{\tau}}{\rho_0 h} dxdy = -\lambda \oint_c (\overline{u}_h \cdot l) ds \quad (2)$$

Where $\vec{\tau}$ is wind stress vector and h is the depth of the upper-layer SCS. For the climatological upper-layer SCS, both the Kuroshio intrusion through the Luzon Strait and the wind stress curl play a role in the dynamic of the upper-layer SCS circulation (Xu et al,2014).

Based on the above statement, the statement in the manuscript will revised using Yang-Price PV constraint which is more applicable in the three-layer SCS circulation.

Ref:

Yuan, D.: A numerical study of the South China Sea deep circulation and its relation to the Luzon Strait transport, Acta Oceanol. Sin., 21, 187–202, 2002.

Yang, J., and J. F. Price, 2000: Water mass formation and potential vorticity balance in an abyssal ocean circulation model. J. Mar.Res., 58, 789–808, doi:10.1357/002224000321358918.

Yang, J., and J. F. Price, 2007: Potential vorticity constraint on the flow between two basins. J. Phys. Oceanogr., 37, 2251–2266,doi:10.1175/JPO3116.1.
Wang, G., Xie, S. P., Qu, T., and Huang, R. X.: Deep South China Sea circulation, Geophys. Res. Lett., 38, L05601, doi:10.1029/2010GL046626,2011.
Qu, T., Girton, J. B., and Whitehead, J. A.: Deepwater overflow through Luzon strait, J. Geophys. Res.-Oceans, 111, C01002, doi:10.1029/2005JC003139, 2006.
Lan, J., Zhang, N., and Wang, Y.: On the dynamics of the South China Sea deep circulation, J. Geophys. Res.-Oceans, 118, 1206–1210, 2013.
Lan, J., Wang, Y., Cui, F., and Zhang, N.: Seasonal variation in the South China Sea deep circulation, J. Geophys. Res.-Oceans, 120, 1682–1690, 2015.
Xu, F. H. and Oey, L. Y.: State analysis using the Local Ensemble Transform Kalman Filter (LETKF) and the three-layer circulation structure of the Luzon Strait and the South China Sea, Ocean. Dynam., 64, 905–923, 2014.

5. Line 10: Why do you define the SCSMOC index as the streamfunction at a depth of 1500m at 14°N? How good is your index in representing SCSMOC variations? And will other index of SCS MOC change the conclusion of the present study?

Reply: We use SCSMOC index as the stream function at a depth of 1500m at 14°N, because this point is far away from the Luzon Strait. We have checked the SCSMOC index in the different latitude and depth, as shown in Figure A6 and A7. Actually, the analysis of the index of the SCSMOC in other latitude and depth is nearly the same to the stream function at a depth of 1500m at 14°N for the near-inertial variations of SCSMOC, and cannot change our conclusion of the present study.

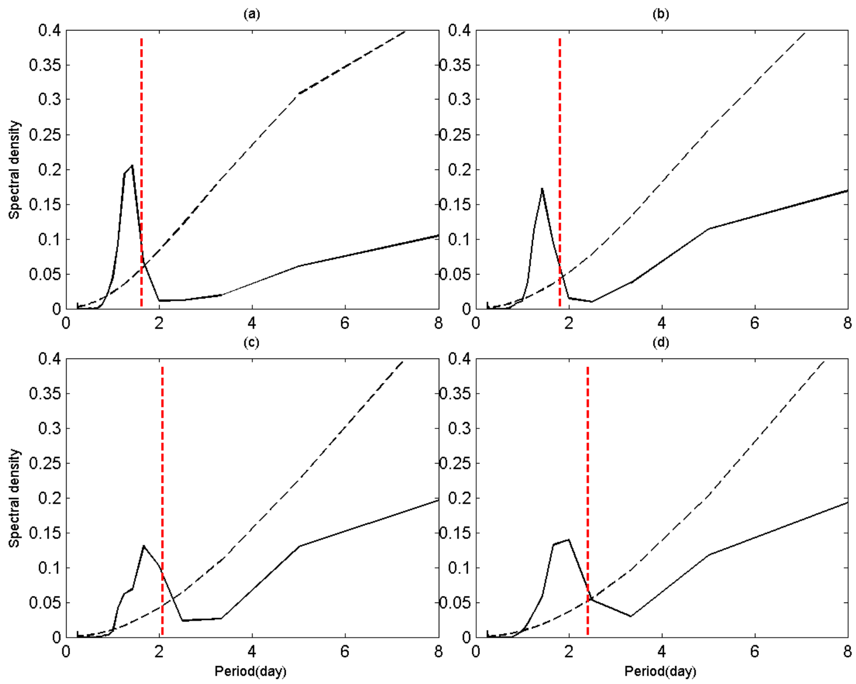

Figure A6 The power spectrum of SCSMOC at 1500m, **18°N**(a),1500m, **16°N**(b),1500m, **14°N**(c) ,and 1500m, **12°N**(d) during January in 2010. The dashed black line and red line show 95% confidence levels and the local inertial period respectively.

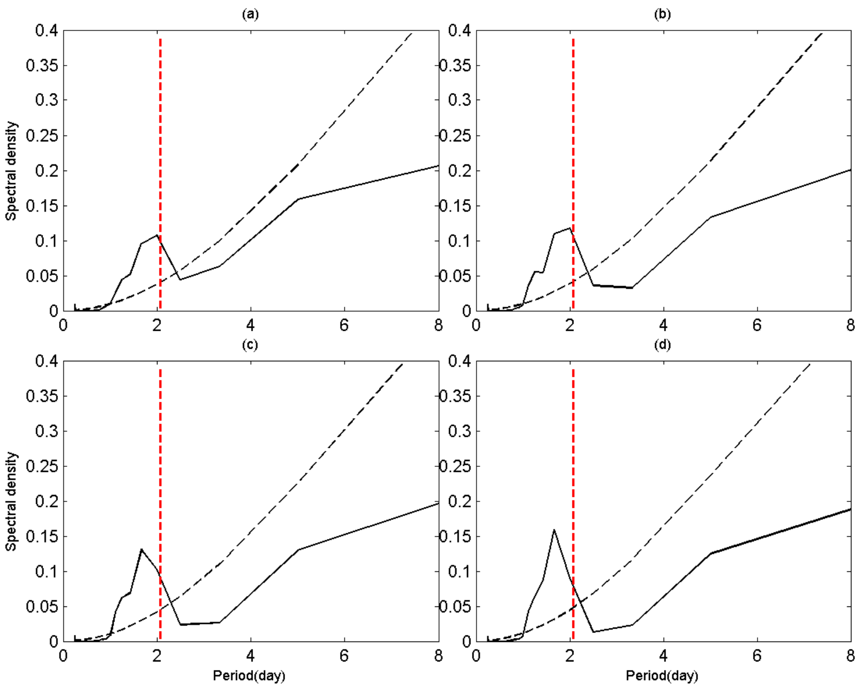

Figure A7 The power spectrum of SCSMOC at **500m**,14°N(a),**1000m**,14°N(b),**1500m**, 14°N(c) ,and **2000m**, 14°N(d) during January in 2010. The dashed black line and red line show 95% confidence levels and the local inertial period respectively.

6. Line 20-24: "The pattern of the near-inertial variability of SCSMOC is very similar to the near-inertial variability of the Pacific Ocean or Atlantic. And the period corresponding to the power peak of the AMOC is mostly at near inertial periods (Komori et al.,2008), which indicates that the near-inertial signal of the SCSMOC is not unique in nature."How can you make such a conclusion? The amplitude of the standard deviations are different, and the location of the maximum are different, and SCS MOC has two maximum center of the standard deviations, but Atlantic MOC only has one. As I said, your statements and conclusions must be drawn with evidence. Every phenomenon can be unique in nature by itself.

Reply: We are sorry for the sketchy statement. We just deleted the sentence of "which indicates that the near-inertial signal of the SCSMOC is not unique in nature". For clarity, we have changed the sentence of "And the period corresponding to the power peak of the AMOC is mostly at near inertial periods (Komori et al., 2008), which indicates that the near-inertial signal of the SCSMOC is not unique in nature." into the statement of "The imprint of NIGWs in AMOC is also stacked with regularly alternating positive and negative cells in the depth between 500 to 4000m and within the latitude between 10 and 40°N (Komori et al., 2008;Blaker et al., 2012; Sévellec et al., 2013). The period corresponding to the power peak of AMOC is at super-inertial periods, which is similar to that of the SCSMOC."

The another point is that the imprint of NIGWs on AMOC has been found mostly triggered by wintertime storm tracks in mid-latitude, then the near-inertial phase velocity is larger than that in SCS in low-latitude because of beta effect. There are more statements for this point in Sec.4.

7. Your analysis of mooring data (Fig. 7), which is shown in this section, should appear earlier. Do you also find similar result of model reanalysis data if you also use 120 days data since 1 April

2006 as the Fig. 7? Maybe the authors can also evaluate the reanalysis data with the mooring data.

Reply: Strictly speaking, the observational system in full depth used as the validation of the simulated SCSMOC should consists of some typical latitude section cross the South China Sea like Rapid Climate Change–Meridional Overturning Circulation (RAPID-MOC) at 26.58^{o}N in Atlantic. The previous study also suggest that the near-inertial AMOC variability is nearly invisible to AMOC-observing systems because of high-frequency observational sampling for near-inertial variation (Blaker et al., 2012 ;Sévellec,et al., 2013). Most of observational data focus on the 18^{o}N section in the SCS, and the observational depth is just shallow then 2000m. Especially, We have no such observation system for the monitoring of the near-inertial variations of SCSMOC. We just put the analysis of the mooring data in the part of Discussion to show that there are also near-inertial variations in the deep SCS in observation. As the reviewer suggested, we use the mooring data in deep SCS to validate the model output, as shown in Figure A1.The power spectrum of the model output is similar to that of the observation data. And the model can produce the near-inertial variations in the deep SCS, which can validate the near-inertial variations of SCSMOC in our model data to a certain extent. We will replace Figure 7 with Figure A1 in the final manuscript.

Ref:

Blaker, A. T., Hirschi, J. J. M., Sinha, B., de Cuevas, B., Alderson, S., Coward, A., and Madec,G.: Large near-inertial oscillations of the Atlantic meridional overturning circulation, Ocean Model., 42, 50–56, 2012.

Sévellec, F., Hirschi, J. J. M., and Blaker, A. T.: On the Near-Inertial Resonance of the Atlantic Meridional Overturning Circulation, J. Phys. Oceanogr., 43, 2661–2672, 2013.

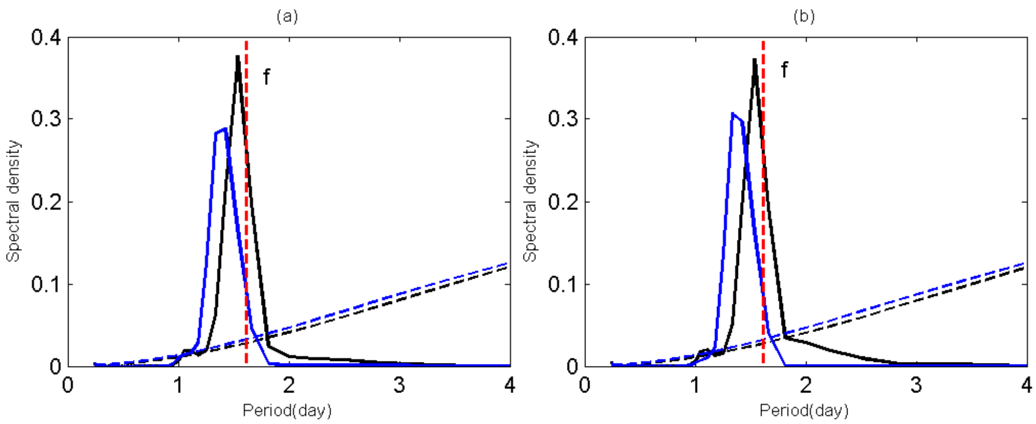

Figure A1 The power spectrum of zonal velocity (a) and meridional velocity (b) derived from the mooring (black line) and GLBu0.08 (blue line). The dashed black and blue line shows 95% confidence levels. The dashed red line represents the local inertial period. The tide effects have been removed in the mooring data.

8. Line 23: “However, the imprint of NIGWs on SCSMOC : : :”. “However” should be deleted. The imprint of NIGWs on MOC in Atlantic and SCS are related to high frequency winds.

Reply: We are sorry for this poor wording. “However” in Line 23 has been deleted.

9. “An average of about 7 TCs (tropical cyclones) pass through the Luzon Strait from the Northwest Pacific Ocean each year: : :, including strong wind-induced near-inertial energy input into the ocean (Fig. 8c), so TCs could also be drivers of the NIGWs near the Luzon Strait”. How many TCs pass SCS in July 2010? You may put the pathway of TCs in July 2010 on Fig. 8c. Otherwise, I do not know how can you draw a conclusion on the influence of TCs.

Reply: We are sorry for the sketchy statement. There were two TCs passing through the region near Luzon Strait on July 2010, as shown in the Figure A8.We have plotted the best track of TC derived from the Joint Typhoon Warning Center (JTWC) in Figure A8. We will replace Figure 8 with Figure A8 in the final manuscript.

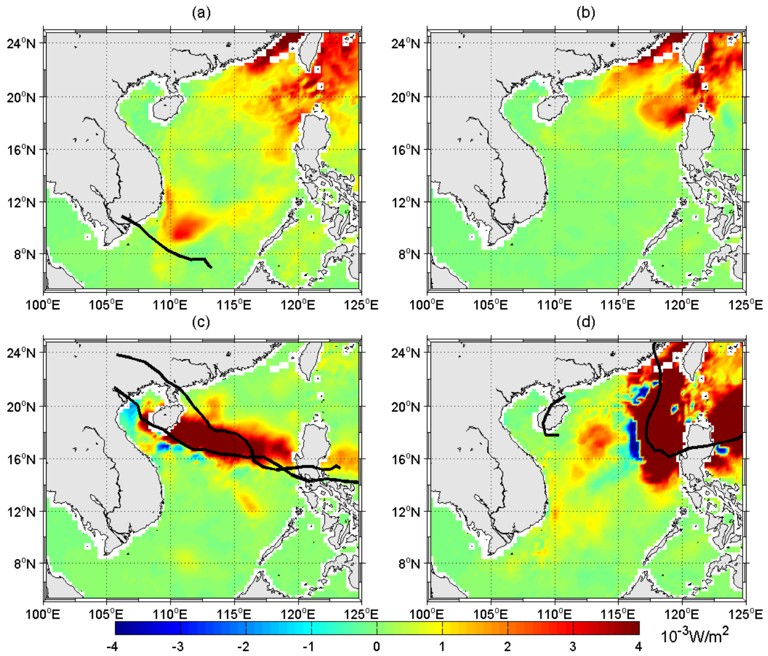

Figure A8 Spatial distribution of the monthly mean near-inertial energy input by wind in (a) January, (b) April, (c) July and (d) October in 2010.The black line is the best track of TC derived from the Joint Typhoon Warning Center (JTWC).