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Interactive comment on "Response of near-inertial energy to a supercritical tropical cyclone and jet stream in the South China Sea: modeling study" *by* Hiu Suet Kung and Jianping Gan

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The near-inertial motion associated with typhoons' passage is an important topic in the South China Sea. Most of previous research in this region are based on in-situ data. This manuscript provides a modelling study on the spatial and temporal distribution of near-inertial energy. It found an interesting modulation of the near-inertial energy by a jet stream in the South China Sea, with strong (weak) activities at places of positive (negative) vorticity (A1 and A2), and with large values at places even _400 km away from the cyclone track (C1 and C2). The investigation of energy budget provides valuable insights into functions of different terms (pressure work, viscous effect, and nonlinear terms) at different stages (forcing and relaxation) in different layers (upper 30, 30-200, below 200). This work merits publishing, however, some questions as follow should be considered.

Response: We appreciate the detailed reading and helpful comments from the reviewer, which are now integrated into the revised manuscript.

Specific comments:

1. The 6-hourly wind from CCMP is used to calculate the wind stress. Since the cyclone induces a wind stress changing rapidly with time, an interpolation from such a long time interval is unreliable and probably underestimates the KEin (Jing, Wu and Ma, 2015, JAOT). A time interval less than 1 hour may be necessary. Furthermore, the wind speed of a typhoon is probably underestimated in the CCMP data. Most of previous research reconstruct the cyclone wind from analytic expressions, such as Holland (1980).

Response: We agree that higher-frequency wind forcing and proper temporal and spatial interpolation methods may be required. Besides the availability of higher-frequency wind forcing data, it is not clear how numerical disadvantage of using realistic higher-frequency forcing may affect on resolving the TC-induced NIOs in numerical simulation. In addition, this study is a 'direct simulation" of TC induced NIOs in the South China Sea and analytic expressions TC may not be suitable. We have mentioned this in the revised paper (3.1).

2. The model employed has been well validated and used in several previous research, however, the process of a typhoon response is of short time scale, baroclinic, and intermittent. A validation with ADCP current data at some places is critical.

Response: The rigorous model validation of circulation and physics have been conducted by Gan et al. (2016a, b), which provides a level confidence for the ocean circulation (e.g. jet stream) and dynamics hub for this study.

The full-scale model-observation comparison is built on both availability of field measurement and advanced theoretical study. We compared the TC induced surface cooling from SST data (Fig. 3), and the rotary energy spectra from ADCP data (Fig. 4) in section 3.1. TC-induced surface cooling is reasonable in both intensity and the spatial coverage. Rotary spectra shows that the model can capture the inertial signal and simulate the low frequency current with reasonable intensity. In addition, we found that the correlation coefficients of near-inertial band-passed velocity between ADCP and model simulation at Wenchang station were 0.62 and 0.57 for east-west (u) and north-south (v) component, respectively, which indicated that the model captured reasonably well the NIOs under the influence of the background circulation of the SCS.

There existed inevitably the model-observation discrepancies, such as differences of velocity magnitude (~0.06 m s-1) at near-inertial band and rotary spectra at the higher frequency (Fig. 4). These discrepancies could have been caused by many reasons, such as the lack of mesoscale and sub-mesoscale processes in the atmospheric forcing field, the linear interpolation process of the atmospheric forcing (Jing et al., 2015), and not resolving the oceanic subscale processes by the current model resolution. However, these discrepancies will not undermine the discussion about the process and mechanism of near-inertial energy response to the TC and jet stream in this study.

Some of the above information are now integrated into the revised ms..

3. The much weaker KEin at A2 is considered to be due to the positive vorticity induced by the jet. Information on the horizontal and vertical scale of the background vorticity may be necessary. And usually the wind is the first order factor of near-inertial intensity. A comparison of wind time series between A1 and A2 makes sense.

Response: We include the vertical profile of the low-passed (3-day) vorticity at A1 and A2 in the revised Figure 10, which represents the vertical scale of the background vorticity. It shows clearly that the vertical scale of the KEni propagation is closely related to the vertical scale of vorticity.

4. The depth of 30 m is used as a boundary between upper and mid-depth layers. There is no clarification why 30 m is chosen, not 50 m or other values.

Response: We choose the 30 m as the maximum of domain-averaged N2 (buoyancy frequency) over the forced region located close to 30 m as Figure R1.

Technical comments.

1. Figure 1. The value of isobaths should be noted since you mention it in the text (Line 240).

Response: We revised Figure 1 accordingly.

2. Figure 5. The way to display different magnitudes is not good. Think about a better way. Response: Figure 5 intends to show both spatial and temporal information of rotary current vectors.

3. Line 221 When the mid-layer and upper layer are firstly mentioned, the exact depth range should be noted. The word ‘upper’ seems to represent a range much larger than 30 m. Maybe ‘surface’ or ‘top’ is a bit more appreciate.

Response: We modified wording accordingly.

4. Lines 273 and 315: Equations are not clearly seen.

Response: We modified the equation accordingly.

5. Line 393: ‘AJEin’ may be corrected to ‘AKEin’.

Response: We modified wording accordingly.

Please also note the supplement to this comment:
https://www.ocean-sci-discuss.net/os-2020-21/os-2020-21-AC1-supplement.pdf

Interactive comment on Ocean Sci. Discuss., https://doi.org/10.5194/os-2020-21, 2020.

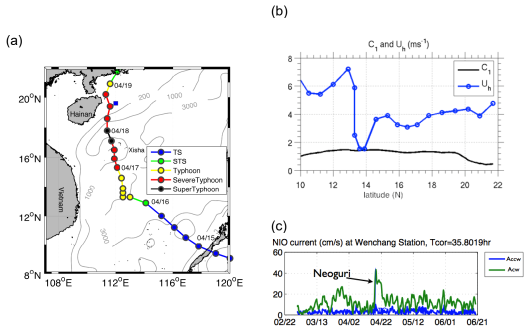

Figure 1 (a) Track of Typhoon Neoguri (2008) from JTWC; blue square represents Wenchang where there were ADCP observations; (b) translation speed (U_h, unit: m s^{-1}) and the 1st baroclinic wave speed (C_1, unit: m s^{-1}) along the TC track; (c) clockwise (A_{cw}) and counter-clockwise (A_{ccw}) rotary current amplitude (m s^{-1}) from current measurement at Wenchang. TS: tropical storm, STS: strong tropical storm.

Fig. 1.

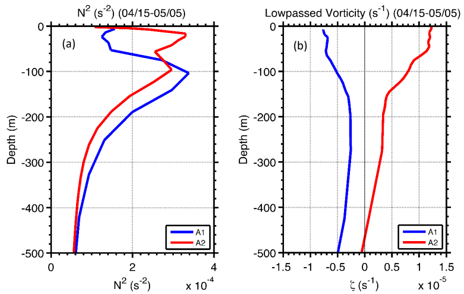

Figure 10 Time-averaged (a) N^2 (s^{-2}) and (b) low-passed (3 day) vorticity from April 15 to May 5 at locations A1 (red) and A2 (blue).

Fig. 2.

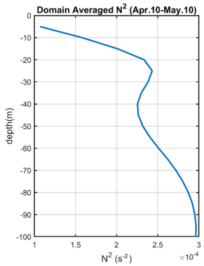

Figure R1. Vertical profile of domain averaged (forced region) buoyancy frequency N2 (s^{-2}) averaged from Apr. 10 to May 10.

Fig. 3.