

Reviewer #2

Dear Dr. Raphaldini,

Thank you very much for your positive evaluation of our manuscript and your constructive comments and suggestions. Below please find your comments in bold font followed by our responses.

In addition, we have enclosed a draft of the revised manuscript, which incorporates the reviewers' comments, as detailed in the point-to-point responses.

Yours sincerely,

Peishan Chen, Katharina M. Holube, Frank Lunkeit, Nedjeljka Žagar, Yuan-Bing Zhao, and Riyu Lu

Minor issues.

1. lines 137–138: I did not understand the meaning of the phrase “This means that the sum of Rossby, Kelvin, MRG, WIG and EIG modes in physical space corresponds to the inverse of the complete xv signal.”.

Response: Thank you for your comment. We have revised this sentence in the manuscript to make it clearer:

"This means that the original physical field corresponds to the inverse transform of all modes (the sum of Rossby, Kelvin, MRG, WIG, and EIG modes) from wave space to physical space."

2. line 160: If I understand correctly formula (1) was not used in figure 1, how “horizontal wind anomalies at 150 hPa and 850 hPa in the tropics associated with OLR variability” is defined?

I understand that figure 1 can be constructed from formula 1 by inverting it in physical space, but how was the figure originally constructed?

Response: You are right, the horizontal winds in Fig. 1 are climatological winds of the total

circulation (panels e and f), the sum of Rossby modes and the Kelvin waves (a and b), and the sum of IG modes and MRG waves (c and d), without regression (Eq. 1). For the different modes, the climatological winds are obtained by applying the inverse transform from wave space to physical space for the mean of the mode coefficients in JJA during 1979–2021. Figure 1 aims to visually introduce the climatological features of these modes and illustrate the 3D normal mode decomposition method.

We have added to the description of Fig.1:

"The climatological winds are obtained by applying the inverse transform from wave space to physical space for the time-averaged spectral expansion coefficients in JJA during 1979–2021."

3. Line 200: Wouldn't this result also depend on the dominant zonal wavenumber of the Rossby and Kelvin waves (as large k components will average out close to zero and small k's with wavelengths larger than the box will have averages different from zero)? Do you have that information?

Response: We fully agree with you that the Rossby and Kelvin waves with small zonal wavenumbers are dominant. We have analyzed the global variance of Rossby and Kelvin waves with different zonal wavenumbers associated with the SWNPI (Fig. A1), and the modes with small wavenumbers have larger global variance. Fig. A2 shows the horizontal circulation of $k=1-3$ Rossby and Kelvin waves, which are generally referred to as planetary scale waves. The results show that the amplitude of zonal wind anomaly in $k=1-3$ Rossby waves is about 76% of the total Rossby waves (Figs. A2a,b and Figs. 3a,b), and that of the $k=1-3$ Kelvin waves nearly contribute 78% to the total Kelvin waves (Figs. A2c,d and Figs. 3c,d). Therefore, the sum of $k=1-3$ Rossby

and Kelvin waves (Figs. A2e,f) resembles the pattern shown in Figs. 3e and 3f.

We have included Fig. A1 and Fig. A2 in the SI (new Figs. S6 and S7), and we have added to Section 3.1:

"This result is mainly contributed by planetary-scale ($k = 1-3$) waves, which exhibit a similar pattern to the total Rossby and Kelvin wave signals (Figs. S6 and S7)."

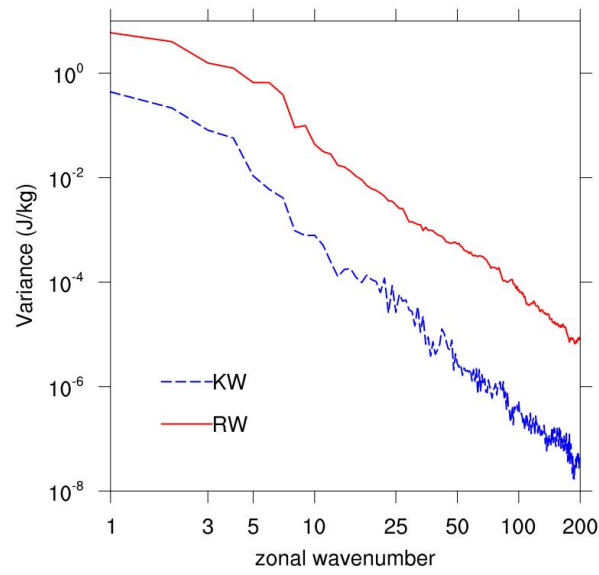


Figure A1. Global variance of Rossby waves and Kelvin waves associated with the SWNPI as a function of zonal wavenumber.

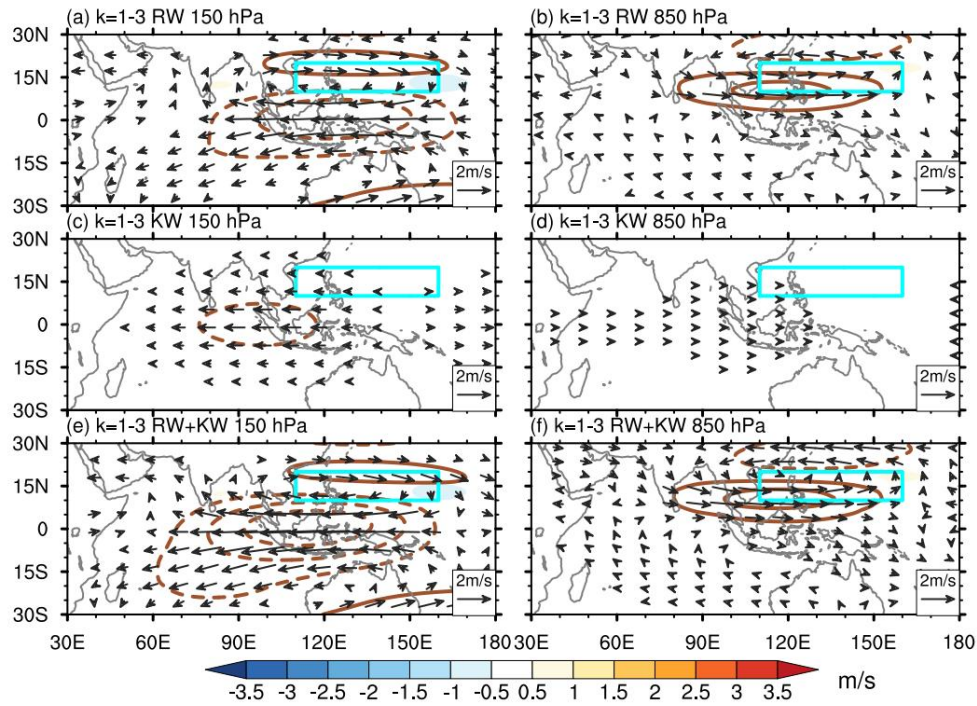


Figure A2. Horizontal wind anomalies of $k=1-3$ (a–b) Rossby waves, (c–d) Kelvin waves and (e–f) the sum of Rossby waves and Kelvin waves at 150 hPa and 850 hPa associated with the OLR variability over the SWNP region. Shading denotes the meridional wind whereas full and dashed contours represent the westerly and easterly zonal winds, respectively. The contouring interval for the zonal wind is ± 1 m/s, and the zero contour is omitted. The contouring interval for the meridional wind is ± 0.5 m/s starting at ± 0.5 m/s, as shown by the colorbar. Vectors indicate the horizontal wind anomalies with magnitudes greater than 0.2 m/s and 0.1 m/s at 150 hPa and 850 hPa, respectively. The blue box denotes the SWNP region.

4. Figures 8 and 9: I was wondering if it is possible to summarize the finding of these two figures in a single figure showing some time series as a function of the lags? For instance the integrated values of $|u(t)|^2$ and $|v(t)|^2$ for the zonal and meridional velocities of each type of mode.

Response: According to your suggestion, we calculate the U^2 of Rossby waves and Kelvin waves, V^2 of IG waves and MRG waves averaged over the Maritime Continent, and kinetic energy of Rossby and IG waves averaged over the southwest Indian Ocean to make a summary of Figs. 8

and 9 (Fig. A3). We have added figure A3 to the revised manuscript (new Figure 10), and we have added to the text (Lines 331-336):

"These results are summarized in Fig. 10 comparing time-longitude diagrams of the Rossby and Kelvin wave, IG and MRG wave, and the SH Rossby and IG wave energies. It shows that the Rossby waves exhibit a westward shift and play a dominant role in the equatorial zonal wind anomalies compared with Kelvin waves (Fig. 10a). On the other hand, Fig. 10b highlights the leading contribution of MRG waves to the westward-propagating cross-equatorial flow over the tropical Maritime Continent. Furthermore, both IG waves and Rossby waves over the southern Indian Ocean after day 0 are shown in Fig. 10c."

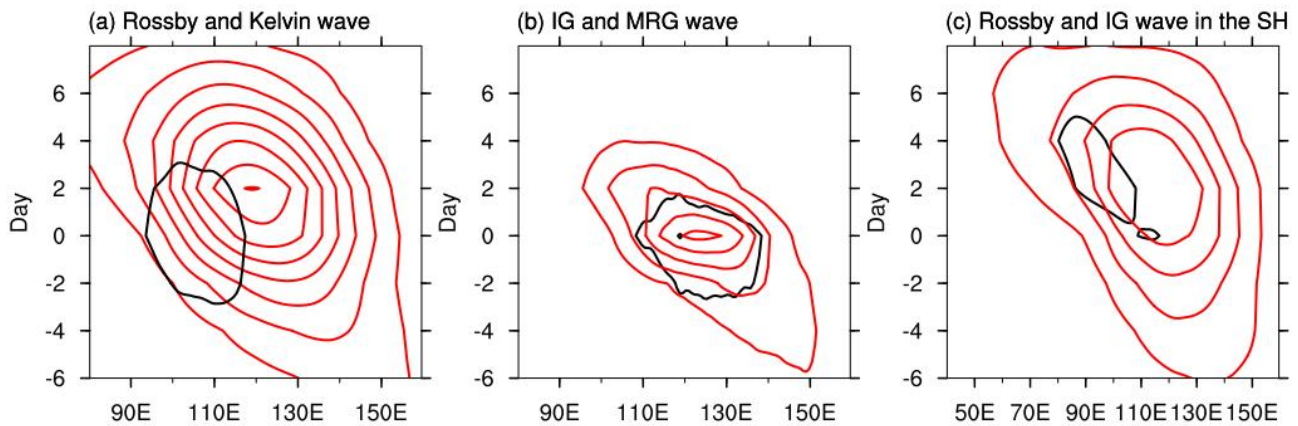


Figure A3. Time-longitude cross sections of different modes at 150 hPa. (a) U^2 of Rossby (red Lines) and Kelvin (black lines) waves averaged over 15°S–15°N, (b) V^2 of IG (black lines) and MRG (red lines) waves over 0°, (c) Kinetic energy of Rossby (red lines) and IG (black lines) waves averaged over 20°S–0°, respectively. The contouring interval is 1 m²/s² for (a) and is 0.5 m²/s² for (b) and (c).