Dear Reviewer #2 Thank you for taking the time to carefully review our manuscript and for your insightful comments. We appreciate your positive feedback on the study's contributions and your constructive suggestions. Below, we address your main comments and detail the revisions made. We consider this improved version of the manuscript is clearer and adequately responds to your concerns and sends an interesting scientific message.

Responses to comments of reviewer #2 notes, are as follows:

This is an interesting study of the statistical structure and behavior of tropospheric mixed Rossby-gravity (MRG) waves over the eastern equatorial Pacific during northern winter. Using EOF analysis, the authors have obtained some nice results related to the extratropical forcing of MRG waves within the westerly duct. However, I think that the zonal wavenumber 5-6 filtering they used is unnecessarily narrow, and this has the potential to distort the actual scales of MRG waves compared to what has been shown in past studies (see comments below). In addition, the descriptions of the methodology used are incomplete, and while I was finally able to back out what they are actually using in their approach, this should be made more obvious to the reader at the outset in Section 3.1. Furthermore, a lot of relevant literature has not been cited, and I think the authors need to compare their results to those from these past studies. I recommend revisions of this manuscript while taking into account the comments by line number below:

25: The term "WMRG" has also been used to identify westward propagating MRGs by Yang et al. starting in 2003, to distinguish from the eastward propagating EIGs of Matsuno's n=0 meridional mode. MRG-E has also been used to describe the eastward propagating side by Knippertz et al. (2022), for example. If you are going to use MRGW instead of simply MRG, then I think it would be important to make this point in order to avoid confusion.
R: We appreciate the suggestion and have updated it to MRGWs on L.25. (Now L.26-27).

29: I think it's important to distinguish convectively coupled MRGs in the troposphere from the free MRGs in the stratosphere. The early studies focused on MRGs in the stratosphere, and these have decidedly different scales from those in the troposphere (e.g., Wheeler et al. 2000, their Fig. 12; Yang references below; Kiladis et al. 2016).
R: We have updated it on L.25. (Now L.26-27).

33: MGWs => MRGWs.
R: We updated it to MRGWs on L.33. (Now L.36).

33: Kiladis et al. 2009 did not document lateral forcing but mentioned previous studies that did. More recent examples include Yang and Hoskins (2016), Yang et al. (2018), Kiladis et al. (2016), and Suhas et al. (2020). Suggest citing these here for completeness, as these will also become relevant below.
R: We appreciate the suggestion and have updated it on L.34-35.

89: Examples of different methods employed are discussed in detail in Knippertz et al. (2022).
R: We have updated it on L.89.

90: As was done in Kiladis et al. 2016.
R: **We have updated it on L.90.**

Based on what is stated on line 107, it appears that you are using a correlation matrix and not a covariance matrix for the EOF analysis. This should be stated here.
R: **Thank you for pointing this out. We used a covariance matrix, and we have now included a corresponding statement in the methodology section.**

91: Not evident in this statement is the important point that EOF analysis of propagating disturbances will generally yield two EOFs in spatial and temporal quadrature, which is why you can use the combined PC1 and PC2 as an activity index.
R: **We have now used EOFs of meridional wind component with zonal wavenumber 4-6 bandpass filtered in the 03-08 days^{-1} . We also calculated EOFs without bandpass filters and applied spectral analyses to the PCs. Results indicate that PC2 leads PC1 by around 100 degrees which implies quadrature between EOF1 and EOF2, and even more, that there is a signal of westward phase velocity.**

95: What is the basis for the spatial and temporal filtering? 2–6 days can be justified in the troposphere, but using only zonal wavenumbers 5 and 6 is very restrictive. In 1982, Hayashi had limited knowledge of the spatial scales of MRGs, which we now know are localized wave packets comprised of a number of zonal wavenumbers in both the troposphere and stratosphere. While spectra of meridional wind at 200 hPa do have power concentrated on wavenumber 5, the power is broad-band and extends especially to lower wavenumbers (Randel 1992). Indices based on antisymmetric OLR (Kiladis et al. 2009, 2016) or dynamically based indices (Yang et al. 2003; Knippertz et al. 2022) generally include wavenumber 1–4 components as well, and the structures of MRGs obtained in these studies are generally broader in scale than what is obtained here. I think you need to reconsider your filtering by including a broader zonal wavenumber range while testing the sensitivity of your results to these choices. It seems to me that including wavenumbers 1–4 initially would be a good test. In the 2–6 day period range, it is probably not necessary to only include westward propagating wavenumbers, but I suggest testing that approach as well. In other seasons, such as northern summer, this broader band filter would also include tropical depression (TD-type) disturbances that MRGs often morph into, but that should not be an issue during DJF.

R: **We have broadened the wavenumbers for the analyses to s= 4-6 and the temporal filtering to 3-8 days^{-1} . We also tested with spatial wavenumber 1-4 and temporal filtering 2-6 days^{-1} (See Figure A1). However this spatial pattern does not reflect the wind structure for MRGWs events. This spatial temporal domain acts as a filter to emphasize the signal of MRGWs only. Its is clear that other forms of variability in space and time are part of the wind field and tropical convection field. But the main objective is still to connect upper and lower tropospheric signals of MRGWs and convection only.**

Yes, the development of MRGWs into TDs is an interesting problem and our results (case study) appears to indicate that a transition to shorter wavelengths over the western Pacific occurs at lower tropospheric levels. However this would require further analyses on how such transition takes place.

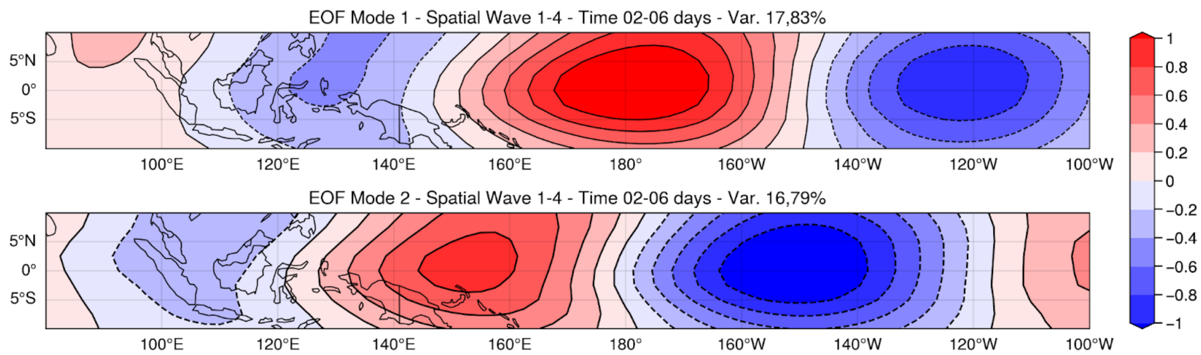

Figura A1 - First and second EOF for the 200 hPa space-time filtered anomaly of the meridional component of the wind field at 200 hPa for the December to February for the 1991 to 2020 period.

98:“MRGW”

R: We have updated it on L.102.

99:Was the meridional wind area-weighted by the cosine of latitude? While this may not make a difference at the latitudes used, it is still a standard practice that should be followed. Additionally, justification for the chosen domain should be provided.
R: Yes the cosine factor is included in the calculation of the divergence. The domain was selected based on previous studies like Killadis et al. 2016, Suhas et al. 2020. We have updated it on L.103-104.

101: It should be noted that PC1 would lead PC2 in the case of a westward-propagating disturbance.

R:In the updated EOF analysis PC2 leads PC1 by around 100 degrees (quadrature). This was the result of a spectral analysis between PC1 and PC2. L.106

102: What is the lagged correlation between PC1 and PC2? While it is likely quite high, providing this value would further justify using the combined first two EOFs as an index.

R:The coherence squared between PC1 and PC2 around the 6 days period is almost 0.8 and between the 5 to 8 days period is 0.66. L.107.

107: Consider pointing out that the standard deviation of PC1 will equal one when using a correlation matrix (or standardized input). I assume you are compositing based on local temporal maxima in PC1?

R: Yes, the standard deviation of PC1 is almost 1 and that is why we choose events with PC > 1.0 to compose the MRGW patterns.

The figure caption mentions that the winds are bandpass-filtered, but is this also true for humidity and OLR? More details on the compositing technique are needed here.

R: Yes, specific humidity and OLR were band-passed filtered. It is now stated so in the figure caption.

110: The patterns compare favorably with those obtained by Wheeler et al. (2000) and Kiladis et al. (2009, 2016) using OLR or brightness temperature as the basis, including the diagonal tilt of the OLR signals. However, the circulation gyres appear to be smaller in scale, likely due to the wavenumber filtering applied here.

R: With the broadened wavenumber filter, and now, the vortex appears to be slightly larger than when we used the previous filter. Still zonal wavenumber 5 dominates the pattern.

124: I do not clearly see the quadrature relationship referenced in the text in Fig. 3. It seems more like divergence is out of phase vertically without much longitudinal displacement between moist and dry regions, as also reflected in the locations of the OLR anomalies.

R: We suppose you refer to figure 2, where we compare the composite pattern at various vertical levels. The phase difference between 200 hPa and 700 hPa is around 20 degrees. Considering the wavelength of wavenumber 5 MRGW is around 75 degrees, the upper and lower signals of the MRGWs are in quadrature.

138: From the scale, it is clear that these are lag correlations (not lagged regressions) for OLR.

R: You are correct, we calculated lag correlations.

However, how is the wind field being scaled using correlations? Does a vector length of "1" represent a perfect correlation for both uuu and vvv? Much more detail is needed here.

R: Thanks for your comment, we have added further information to explain the characteristics of figure 3. L.142-145. and in all lag correlation figure captions.

Additionally, are the "anomalies" bandpass-filtered to 2–6 days?

R: The anomalies are not filtered in the lag correlations.

144: Kiladis et al. (2009) does not show midlatitude coupling with MRGs, but Kiladis et al. (2016) does.

R: We have changed it in L.144. (Now L.150) .

147: In what sense does the omega equation hold? It appears that negative OLR occurs ahead of troughs, as expected.

R: This is correct, We have updated it on L.147. (Now L.154).

148: A phase speed of 10 m/s is significantly slower than the 15–25 m/s reported in previous studies. This may be due to the restriction to wavenumbers 5–6, which would inherently yield a slower phase speed based on MRG dynamics.

R: With the broadened zonal wavenumber filter, the estimated phase speed of the MRGW is around 15 m/s. We have updated it on L.148. (Now L.156).

150: Are you referring to the weak OLR anomalies off the west coast of South America in Fig. 3c? This does not appear to be a particularly strong signal.

R: We have deleted the reference about OLR anomalies over South America.

176: “Eastward group velocity”

R: We have updated it to "eastward" on L.177 (Now L182).

181: I believe you mean that the group velocity causes an MRG to form over the Atlantic, which then exhibits the characteristic antisymmetric specific humidity field associated with it.

R: You are right. The signal of the MRGW extends to the equatorial Atlantic due to the eastward group velocity. L.184-185.

215: You should reference Fig. 7 here. I do not understand why PC2 is being used for Fig. 7, as it cannot be directly compared with the circulation shown in Fig. 6c, for instance. Is there a justification for this?

R: We have changed this analysis to PC1.

219: A comparable statistical 200 hPa sequence for MRG activity farther west during DJF is also shown in Kiladis et al. (2016), their Fig. 16.

R: We have changed it in L.219. (Now L.225)

226: I do not see the humidity and OLR signals over southern Mexico that you refer to—are you referencing Fig. 6 or Fig. 7?

R: We changed to a correlation between PC1 and VIMFc and OLR, Figure 7.

234: Once again, are these anomalies bandpass-filtered to 2–6 days? This should be explicitly stated.

R: The anomalies are not filtered in the case study, we state so in the figure caption.

244: Do you mean it’s a standing wave?

R: The center of the clockwise circulation remains at the same longitude for only 2 days, so it is difficult to refer to it as a standing wave. To avoid confusion we have deleted that statement.

305: Please refer to Yang and Hoskins (2017) for a discussion of the eastward tilt in the height of MRGs within the westerly duct during December–February.

R: We have changed the statement in L.305. (Now L.320).

References

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