1) The analysis and interpretation of section 3 is suspect (and possibly in other sections). Figure 1 clearly shows regular and artificial peaks at regular (frequency) intervals most likely resulting from the bandpass pre-processing of the data. The features look similar to those which would appear in data convolved with a square filter. I recommend that suitable prefiltering is done to minimise these numerical artefacts (i.e. using appropriate tapering methods).

The reviewer is correct that the signal was rectified to analyze the effect oonly on the amplitude of the time series. Nevertheless, it seems that this procedure created some doubt about the validity of our result. Therefore, we re analyze the data without rectifying the the signal and now report this result. We apologize for this confusion. The new figure is the following.

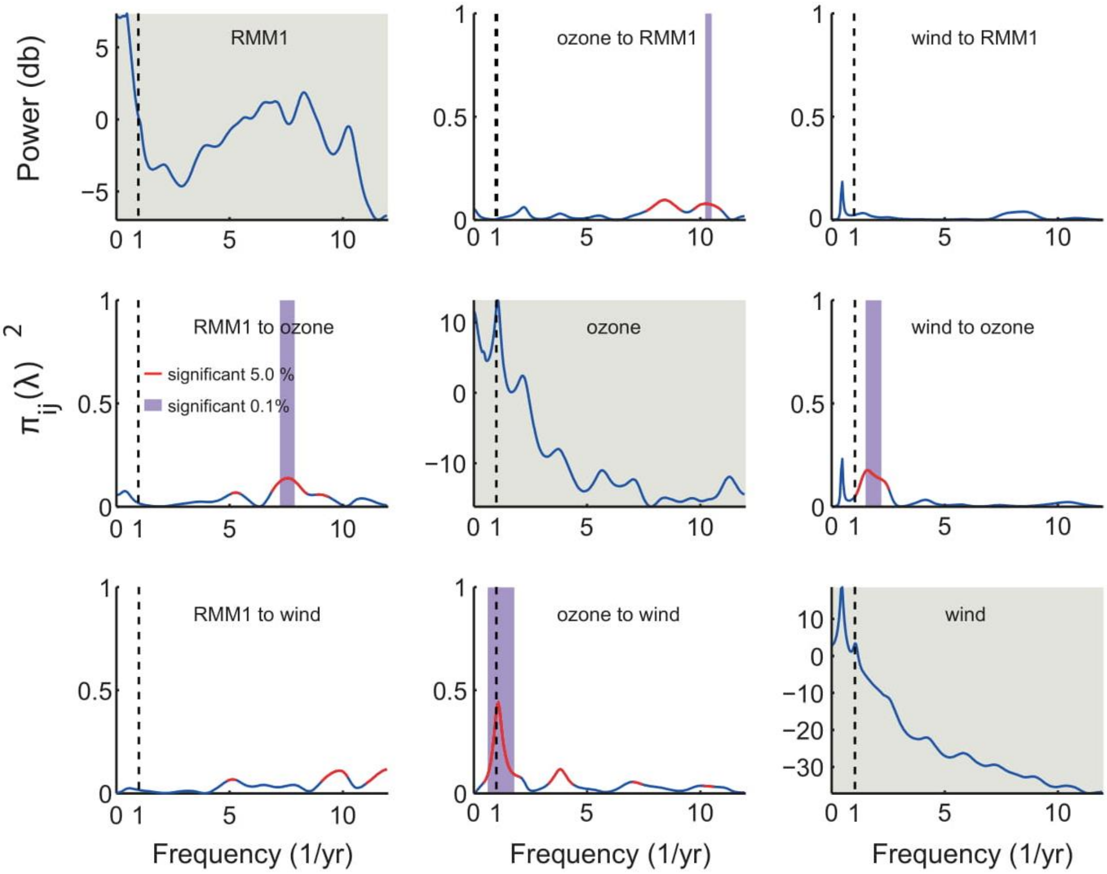

Figure 3.1.1: PDC analysis of the RMM index, QBO and ozone at the fast (intraannual time-scale).

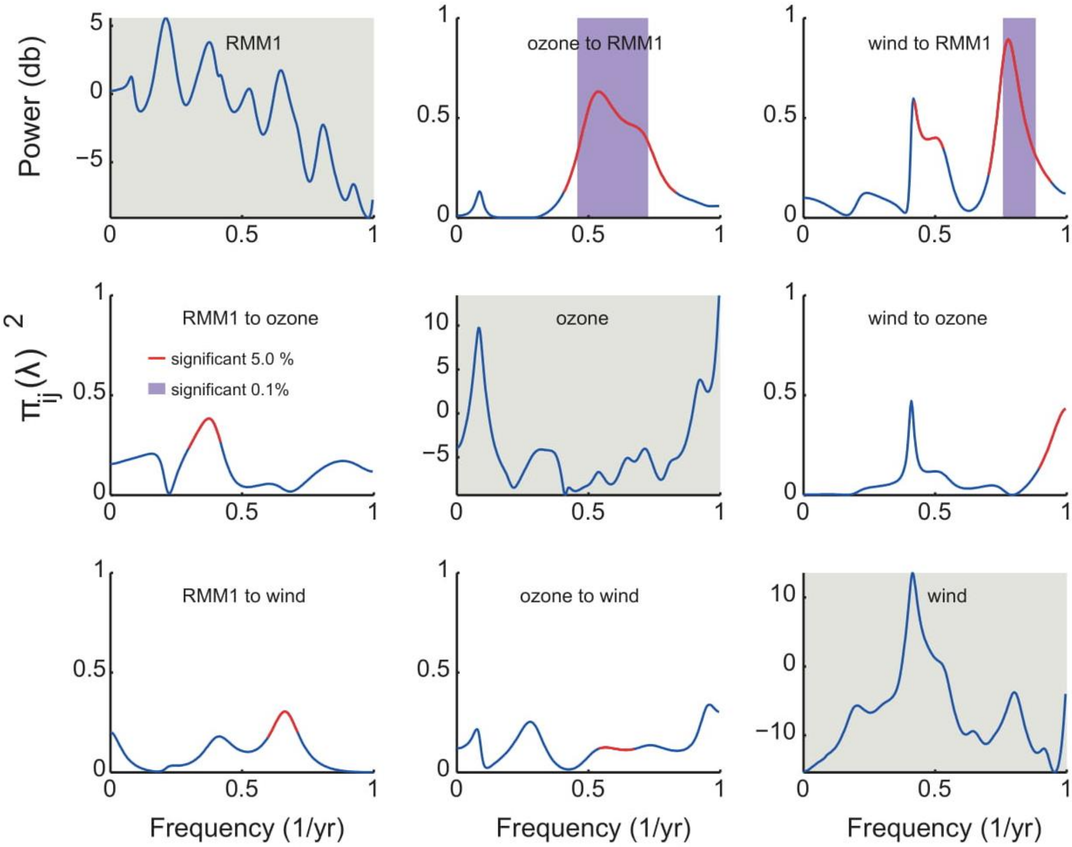

Figure 3.1.2: PDC analysis of the RMM index, QBO and ozone at the slow (inter-annual time-scale).

2) It seems to this reviewer that the annual cycle has been retained in the data. Presumably retention of the annual cycle and sub-harmonics will obscure attribution of causality between the various timeseries? Why has the annual cycle been retained and what impact will this have on the interpretation of the results?

We did not remove the annual cycle. The reviewer is correct to mention that the annual cycle is a dominant component of the all spectra investigated here, this however is not a problem once other spectral peaks of interest (i.e intraseazonal, biennial, interannual and decadal) are well represented by the parametric spectral estimation procedure. As explained in answer to question 7 of this reviewer our ability to well represent the spectral peaks of interest rely on the order of the auto-regressive model of choice.

3) The authors should provide figures for the timeseries used in the paper, before and after processing, including those short and long timeseries used throughout the manuscript.

Here we include a new figure with the corresponding time-series which will be included in the new version of the manuscript.

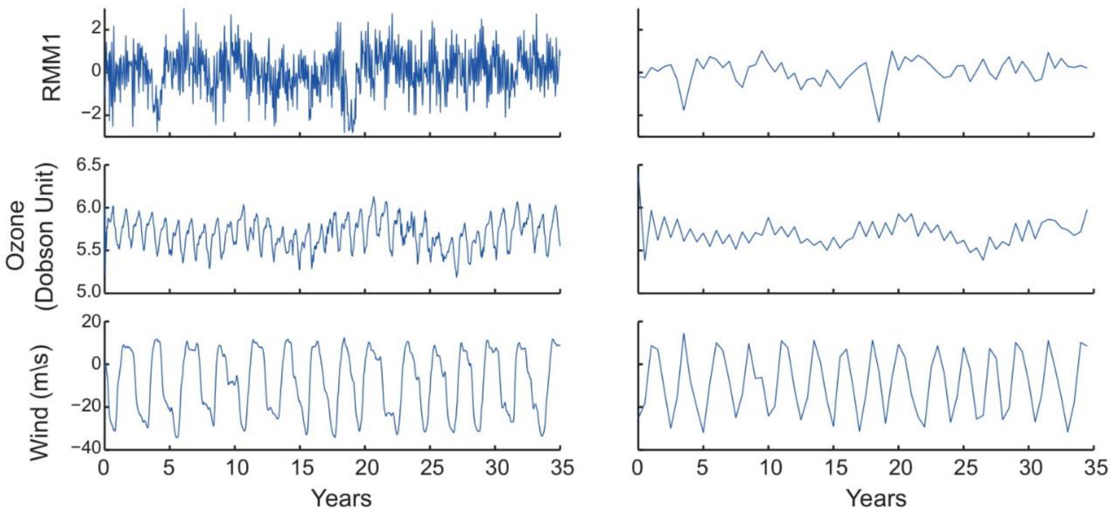

Figure 3.3.3: Time-series of the RMM index, stratospheric zonal wind at 30Mb and equatorial ozone.

4) The authors have not justified the use of indices thought relevant for MJO-QBO connections, namely MJO indices and the westward propagating gravity wave modes (and various others wave modes). There are a number of competing mechanisms for explaining the observed correlations between the MJO and QBO. A number of these do not explicitly involve waves, but rather upper tropospheric temperature, wind-shear or static-stability. The title of the paper suggests a focus on waves, but this needs to naturally come following an appraisal of the various mechanisms first.

The study of QBO effects on the MJO gained a lot of interest in the last few years, since new evidence pointed out to this connection (see Yoo, C., & Son, S. W. (2016). Modulation of the boreal wintertime Madden-Julian oscillation by the stratospheric quasi-biennial oscillation. *Geophysical Research Letters*, *43*(3), 1392-1398.). Since then several articles explored both the physical mechanisms behind this interaction as well as consequences to weather and climate. One of the main factors that plays a factor in the QBO-MJO connection is the difference in the static stability at the Tropopause region depending on the phase of the QBO (see Nishimoto, E., & Yoden, S. (2017). Influence of the stratospheric quasi-biennial oscillation on the Madden–Julian oscillation during austral summer. *Journal of the Atmospheric Sciences*, *74*(4), 1105-1125.). Hendon et. al 2018 suggests that negative temperature anomalies at the tropopause region at the eastern QBO act act to destabilize the upper troposphere in phase with MJO associated convection, thus reinforcing the MJO event (see Hendon, H. H., & Abhik, S. (2018). Differences in vertical structure of the Madden-Julian Oscillation associated with the quasi-biennial oscillation. *Geophysical Research Letters*, *45*(9), 4419-4428.). Alternative mechanisms that could contribute to this stratosphere-troposphere connection include the downward reflection of planetary waves (see Lu, H., Scaife, A. A., Marshall, G. J., Turner, J., & Gray, L. J. (2017). Downward wave reflection as a mechanism for the stratosphere–troposphere response to the 11-yr solar cycle. *Journal of Climate*, *30*(7), 2395-2414.) and effects on tropospheric Rossby wave-guides and teleconnection patterns (see Feng, P. N., & Lin, H. (2019). Modulation of the MJO-related teleconnections by the QBO. *Journal of Geophysical Research: Atmospheres*, *124*(22), 12022-12033.).

Here we investigate a different class of mechanism, namely the role of wave interaction. Nonlinear wave interaction is believed to have a role in the initiation of an MJO event though the interaction between the tropics and extra-tropics (see section 6.4 of Khouider, B., Majda, A. J., & Stechmann, S. N. (2012). Climate science in the tropics: waves, vortices and PDEs. *Nonlinearity*, *26*(1), R1.). This interaction takes place by by the coupling between equatorially confined modes, the baroblinic Rossby waves, and non-confined modes, the barotropic Roosby waves. Inspired by this type of mechanism we investigate whether the interaction between QBO-related modes with MJO-related modes could have a role in the MJO-QBO connection.

5)The various horizontal/vertical normal modes used to construct QBO and MJO patterns and timeseries need to be captured somewhere (e.g. supplementary materials) as they feature prominently in the analysis.

In our analysis we have used no truncation on the zonal wave- number with K=32 and vertical index up to M=43. The selection of modes is made on the type of the mode (rotational or inertio-gravity). On the meridional index, for the MJO only the first three modes symmetric wind structure with respect to the equator (indices n=1,3,5) were used for the rotational mode and the Kelvin mode (eastward inertia-gravity with meridional index n=1).

6) There is a lot of various missing information on the figures (labels, units, tickmarks etc), which has mostly been identified in the points below. All figures need to be improved for future review.

In the new version of the manuscript we have included corrected versions of the figures.

7) The spectra look very smooth; has any smoothing been applied to the power spectra? If so, how has this been achieved?

Yes, the whole PDC analysis relies on a autoregressive estimation of the spectra, this means that the choice of the autoregressive order will determine the smoothness of the spectra. The lower the chosen model less spectral peaks will be captured by the parametric estimate of the spectra, meaning that only the dominant spectral peaks will be represented, conversely high order models will be able to capture the fine structure of the spectra. In our analysis the order of the autoregressive fitting was in the range 10-15, and were well adjusted according to the Portmanteau test. This means that the resulting spectra will be fairly smooth.

8) Figures 8-11. What physical mechanism will causally link wave modes on interannual to decadal timescales? What hypothesis is being tested?

In our analysis we have calculated the energy time-series associated with normal modes and tested the causality between these energy time-series. We regard this as an evidence for nonlinear wave interaction similar to the barotropic-baroclinic Rossby wave interaction that plays a role in the initiation of the MJO (see Majda, A. J., & Biello, J. A. (2003). The nonlinear interaction of barotropic and equatorial baroclinic Rossby waves. *Journal of the atmospheric sciences, 60*(15), 1809-1821.).

9) Can the authors put forward a plausible physical mechanism linking the Himalayas near 30-40N and two equatorially confined phenomena – MJO and QBO? Furthermore, how should this mediate the observed statistical relationship between the QBO and MJO?

In the present version of the manuscript we have removed this section of the article and replaced it by a composite analysis showing the evolution of each normal mode component of the MJO following the suggestion of Reviewer #2. However, the idea here is that the strong divergence associated with these topographic gravity waves would act as a source of barotropic (in the troposphere) Rossby waves that could interact with the MJO via tropical-extra tropical interaction. We however acknowledge that this is still highly speculative and think that the composite analysis brings much more information on the process.

10) The authors have looked at large scale circulation processes in assessing longtime scale relationships between the QBO and MJO. What though are the roles for small-scale gravity waves in linking QBO and MJO connections?

One of the possible roles of small scale gravity waves is related with their vertical propagation, which is known to be a major mechanism for the QBO, therefore differences on the vertical wave propagation could in principle affect both the QBO and tropical convection (associated with the MJO) (see Piani, C., Durran, D., Alexander, M. J., & Holton, J. R. (2000). A numerical study of three-dimensional gravity waves triggered by deep tropical convection and their role in the dynamics of the QBO. *Journal of the atmospheric sciences*, *57*(22), 3689-3702.).