

## ***Interactive comment on “Indications for a potential synchronization between the phase evolution of the Madden-Julian oscillation and the solar 27-day cycle” by Christoph G. Hoffmann and Christian von Savigny***

**Anonymous Referee #2**

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Review of the Article ‘Indications for a potential synchronization between the phase evolution of the Madden-Julian oscillation and the solar 27-day cycle’ by Christoph G. Hoffmann and Christian von Savigny

This study explored possible linkages between Madden-Julian oscillation (MJO) and the solar cycle in a 27-day timescale, using a total of 38 years data. It found some synchronising pattern under certain conditions. They identified a connection during boreal winter when QBO is in the easterly phase and MJO event strength is greater than 0.5. Such knowledge can be useful in improving predictive skills of MJO. It is an

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under explored areas of research and any advancement would greatly benefit climate science community.

It is a well-written paper and followed some in-depth analyses. It discussed various limitations of this study. I would recommend its publication after major revision.

Major comments:

1. Page 2, line 2: “The amplitude of the 27-day cycle is generally smaller than that of the 11-year cycle but can be on the order of 50% of the 11-year amplitude in the UV during strong events.” Probably authors would consider doing little discussions on cases if 27-day cycle matches with active or inactive phases of the 11-year cycle. Is there any connection with the 11-year cycle and how it is affecting results? Say, if the 27 day Max coincides with 11 year Min phase or 27 days Min with 11 years Max phases?

2. “We have used this to analyze the relationship under different atmospheric conditions (state of the QBO, seasons, MJO strengths), different solar cycle triggers, and different MJO indices and solar proxies.” – Authors could prepare a table for Boreal winter showing QBO phase, solar 11 years Max/Min and MJO phase. Also, include the number of sample points. This will be useful to address more on the limitation part.

3. Page 2, line 35: “In addition, there are also increasing indications for an entanglement of the MJO in teleconnections and, hence, for an influence of the MJO in the extratropics” Holton Tan effect (1980) suggested some special feature in solar 11-year cycle minimum and QBO easterly, during boreal winter. Labitzke van Loon (1992) also noticed a connection in upper stratosphere polar temperature during 11-year Minimum and easterly phase. Whether polar annular modes have any connection? Discuss those works. Holton, J. R., and Tan, H.C., (1980): The influence of the equatorial quasi-biennial oscillation on the global circulation at 50 mb, J. Atmos. Sci., 37,2200-2208. Labitzke, K. and van Loon, H., (1992): On the association between the QBO and the extra-tropical stratosphere, J. Atmos. Terr. Phys., 54, 11/12, 1453–1463.

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4. Labitzke, K. and van Loon, H., (1992), suggested QBO westerly solar Max in 11-year time scale also have the same influence in the upper stratosphere like solar Min/QBO Easterly in winter. Perhaps you could do little analyses using QBO westerly solar Max to check whether it is also the case for 27-day cycle.

5. Section 4.3.2: QBO phase 30 hPa or 50 hPa have any effect? Using QBO 30, boreal winter, solar Max/Ely, solar Min/Ely and solar Max/Wly are different to solar Min/Wly in solar 11-year time scale (Roy and Haigh, 2011; Camp and Tung, 2007). Those studies discussed that QBO 30hPa only indicate cold upper stratospheric pole for Solar Min/Wly in boreal winter. The rest three other combinations are warm. Is it also seen for 27 day timescale? Mention that you could verify that in future. Some analyses whether using two different QBO height give additional insight. Is it sensitive to the choice? Perhaps one plot using QBO 30 hPa?

Camp, C.D. and Tung, K. K., (2007): The influence of the solar cycle and QBO on the late-winter stratospheric polar vortex, *J. Atmos. Sci.*, 64, 4, 1268-1283, Doi:10.1175/JAS3883.1 Roy I, Haigh JD. (2011) The Influence of solar variability and the quasi-biennial oscillation on lower atmospheric temperature and sea level pressure, *Atmospheric Chemistry and Physics*, pages 11679-11687, article no. 11, DOI:10.5194/acp-11-11679-2011.

Minor comments:

1. Page 2, line 17: Give references for solar 'top down' and 'bottom up' mechanism. Discuss those mechanisms which are not that clear here. 2. Fig.1,5 and 12: shorten the legend. Discuss the details within the text. 3. Page 17, Fig. 7 legend: spelling of May 4. Page 6, line 9: "Not considered extrema belong mostly to solar 11-year minimum phases"- how minimum is defined? 5. Line 32: "Univariate indices like OMI in the analysis, but can hardly be seen with multivariate indices like RMM. A weaker dependence of the results on the underlying solar proxy is also observed. Why, please give more discussion. 6. Page 4, line 2: "the range of possible MJO periods starts

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close to the period of the solar 27-day cycle. And second, the mean periodicity of the MJO is with 50 to 60 days approximately twice that of the solar 27-day variability, which turns out to be of interest in the following" How many observations did you have? 7. Page 4, line 7: Future directions: "we aim at describing the statistical features of a combined inspection of both quasi-period processes as a basis for future research." Discuss whether the earlier comments using different QBO height and solar 11 year cycle gives some additional insight.

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Interactive comment on *Atmos. Chem. Phys. Discuss.*, <https://doi.org/10.5194/acp-2018-1050>, 2018.

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