Comment on
Global zonal wind variations and responses to solar activity, and QBO, ENSO during 2002–2019
by
Xiao Liu, Jiyao Xu, Jia Yue, and Vania F. Andrioli

This paper describes variations in zonal mean zonal wind related to the annual cycle, the semiannual cycle, a terannual cycle, the QBO, ENSO, solar activity, and overall trend during 2002-2019, in the layer 18-100 km and latitude band 50S – 50N. The data set analyzed, named "BU", was created from SABER temperatures. Results compare favorably with results from applying the same analysis technique to MERRA2 data. This paper shows that using zonal mean SABER data, supplemented by a single station of Meteor wind station data above 80 km in the tropics, does a good job of characterizing atmospheric variations zonal mean zonal wind variations at time scales longer than a month or so. Several interesting aspects are described, including an unusual response in the summer SH, which will be useful for other investigators to compare and maybe puzzle over. I recommend publication with minor revision, but have a few questions and a few recommendations for helping the reader to grasp the main approach more quickly.

1. It took me several pages (line 137) to figure out what part of the atmosphere you were going to investigate. I would recommend including the altitude range in the title and abstract. The title could be something like "Variation in global zonal wind in the layer 18-100 km due to solar activity, the QBO, and ENSO during 2002-2019". I would recommend also adding the latitude range 50°S-50°N to the abstract.

2. l33-37: It is hard to understand the mathematical sense of the relationships being described. Please explain more clearly. These include
"The responses to QBO shift from positive to negative and extend from the equator to higher latitudes with the increasing height." -What does this mean?
"The responses to ENSO and F10.7 are strongest (positive and negatively, respectively) in the southern stratospheric polar jet region below 70 km and exhibit hemispheric asymmetry."
"While above 70 km, the responses of BU to F10.7 and ENSO are mainly positive."
Perhaps it would be helpful to state, for example, that zonal winds are stronger in location x when y is happening.
"Both BU and MerU exhibit similar linear changes" – increasing? decreasing?

3. l32, SAO: It might be good to add Delisi and Dunkerton (1985) as a reference regarding the time asymmetry of the SAO. Did they or Garcia et al. show a N/S hemispheric asymmetry?
Delisi, D. P., T. J. Dunkerton, Seasonal variation of the semiannual oscillation, *J. Atmos. Sci.*, 45, 2772– 2787, 1988.

4. Introduction: It would be helpful to the reader if you described straight away what motivated you to do this study. (Why this data set?) Perhaps say that it is unique in that it involves SABER data and it targets the upper stratosphere to mesosphere. Please include information about what other wind climatologies have been made with SABER data. Perhaps include a statement as to how this study extends or goes beyond what was described in Smith et al. (2017).

5. l111-113: It might be helpful to include a sentence describing the nature of the diurnal tide bias that you find. For example, with sampling geometry of the LIMS instrument on Nimbus 7 ascending minus descending data orbit data can be used to estimate the tidal amplitude (e.g., Hitchman and Leovy 1986). Is there something like that in the SABER data?

6. BU data, section 2.1: What is the approximate vertical resolution? What is the latitudinal resolution of the data set? How do you treat the lower boundary condition on geopotential height at the 18 km level? How do you treat the singularity at the equator? If you interpolate across the equator, do you smooth in y, and if so, how far out in latitude?

7. Figure 1 caption and text: You show results which must be for particular locations, but you don't say where they are! Each of the responses varies in latitude and altitude. For Fig. 1g, please state information about altitude, latitude, and the meaning of coefficients within the figure caption, instead of above the plot. For each of the plots in the right hand column please state the latitude and altitude that you are referring to. In the text it seems important to clarify that these are sample points, not global indices, and that the response varies in space.

8. l187-188: Fig. 1b shows that there is only a strong response during boreal summer.

9. l188-189: Please say where these numbers pertain to and perhaps characterize how they vary in latitude/altitude.

10. Fig. 2, right hand panels: How would short vertical structures, such as those associated with the QBO, be perceived by SABER sampling? Can that contribute to the pattern shown, with reduced "explained variance" in the tropics?

11. l251: I would expect this to vary in space because the zonal wind anomalies are vertical integrals of meridional gradients in temperature anomalies, which may be caused by solar heating anomalies. If most of the modulation of solar heating is in the ozone layer then one could work out or anticipate the corresponding spatial variation in zonal wind anomaly.

12. Figs. 3 and 5: It seems unusual that during July in the SH there is a strong signal in both F10.7 and ENSO.

13. Fig. 7: The vertical scale of the anomalies associated with the QBO scale like the QBO, but what can account for the pancake structures in the ENSO anomalies in the lower panels?