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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Interannual variations of water vapor in the tropical upper troposphere and the lower and middle stratosphere and their connections to ENSO and QBO" *by* E. W. Tian et al.

Anonymous Referee #1

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1 Summary

This paper reports on the impact of ENSO and QBO on tropical UTLS and MS water vapor (WV) variability in the tropics using a longer observational data record from MLS. The paper can be followed easily, however, there are some serious issues and some clarifications needed. Most of the results (Figs 1-4) are not very new and basically confirming previous studies, only Fig. 5 showing the composite anomalies for the different combination of QBO (eeasterly/westerly) and ENSO phases (warm/cold) are

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nice results but not unexpected.

2 Major issues

- When talking of time lag between QBO and WV, this lag is here defined with the respect to the 30 hPa QBO index. This may differ for QBO indices at other altitude levels. A quantitative statement is needed how the lag changes when changing the pressure level of the QBO index. The comparison with previous studies are hampered as the latter apparently mostly used the 50 hPa index. So it would be recommendable to use the 50hPa index. The authors did not provide a justification why the 30hPa QBO index was their preferred choice.
- A weakness of the paper is that the the linear regression is mainly done with respect to QBO and ENSO only. This is reasonable for obtaining the optimized time lag. The r^2 values barely reach 0.5 for each of the indices alone, so it would be interesting to have a more complete multiple regression attempting to explain more completely the WV variances (as compared to the MLR limited to QBO and ENSO). It is evident from Fig. 4 that the residuals (after removing the QBO and ENSO components) still show large variances. A more complete MLR with additional factors may enhance the detectibility of the QBO and ENSO factors, when they are rather weak. In the introduction the effect of the BDC is mentioned as one important factor for WV variability. Even though BDC is related to QBO, the Dressler et al. 2014 paper gets a high correlation in their regression model combining BDC, QBO, and ENSO (or Delta T) with observations at least for 82 hPa.

3 Minor issues

p. 1, l. 20: "The phase lag is based on the 30-hPa QBO index and should be different from that found by previous studies based on the 50-hPa QBO index" The results presented in the paper regarding the phase lag should be reported in a way that can be directly compared with previous studies, so I strongly suggest to use the 50-hPa QBO index instead (see major comments).

p. 2., l. 12: Another good reference on the strong water vapor feedback is Riese et al. (doi:10.1029/2012JD017751, 2012, see their Fig. 1)

p. 3., l. 19: "... impact on the tropical UTLMS water vapor is mainly through the QBO's influence on the tropical tropopause temperature that regulates the amount of upper tropospheric water vapor entering the stratosphere". Here it would be good to mention that the BDC plys a role here as well since the QBO modulates the extratropical wave activity, an important driver for the BDC, that influences the tropical cold point tropopause temperature.

p. 4., l. 4: "They found that the evaporation of convective ice from increased deep convection as the troposphere warms plays an important role in the tropopause water vapor variability". The sentence before suggests that this was derived from MLR applied to observations, but indeed Ye et al. (2014) used a combination of observations and models to come to this conclusion.

p. 6, l. 21: The MEI ENSO index is a two-month average, whence it is a lagged index itself. This should be mentioned here.

p. 8, l. 14: "monthly mean tropical water vapor anomalies" (add "mean")

p. 8, l. 25: "... may be regulated by QBO" Is there any doubt that QBO is one of the main driver of this variability, so I suggest to use something else than "may be".

p. 10, l. 16: change "suggests" to "confirms" (as this is in agreement with earlier

studies).

p. 10, l. 24: " as result of the impact from the QBO". One should mention here that BDC also plays a role here (see my earlier comment).

p. 11, l. 18: change "by mainly QBO instead of ENSO" to "mainly by the QBO"

p. 11, l. 23: discussion of the green line in Figure 4. As discussed in the major points, the residuals show large variability, so an improved MLR could minimize this variance and improve the signal form the QBO and ENSO, where they are weak.

p. 12, l. 7: "This issue is beyond the scope of this paper and will be investigated in the future." I disagree here as this should be done here to improve the paper (see major comments).

p. 12, l. 22: "interannual tropical water vapor anomalies tend to be larger" (add "be")

Fig. 1: units for the wind is missing, "standard departure" should be replaced by "standard deviation".

Fig. 3.: physical units (months) for shifts are missing, color legend has no label (r^2).

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