

## ***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 #2**

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The manuscript by E.W. Tian et al is a very focused study on an interesting, however, very narrow, topic which is in the scope of ACP. The paper is, on the whole, well organized and written in a very clear style. Some major issues I raised in the context of the initial submission have been successfully remedied before this discussion paper has been resubmitted. My major concern is that the predictors analyzed (ENSO and QBO) explain only a fraction of the observed H<sub>2</sub>O anomalies and, in more general terms, that only incremental new evidence is provided for relations between ENSO and QBO, which, as far as I can judge, have been known before. To make the paper acceptable

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for ACP, it will be necessary to highlight which new insights have been gained.

More specifically: On p4 l22-24 it is stated that "some fundamental physical or dynamical processes controlling UTLMS water vapor and its variability are not well represented or even missing in the climate models and reanalyses". However, since only about half of the H<sub>2</sub>O anomalies is explained by QBO and ENSO (p12 l3-4), the results do not provide any clue what the key to solving the problem with the models and reanalyses actually is.

p. 5 l. 19: Are these uncertainties 1 sigma or two sigma? Are these uncertainties used in the manuscript? Do these uncertainties survive the averaging process mentioned on p. 6 l4 because they are chiefly systematic or are they random and thus cancel largely out during the averaging?

p. 6 l 10 -15: The method how short-handed anomalies are isolated through the difference between 12-month and 42-month running means is not clear to me.

On p. 7 l 13 a normalization of the indices is mentioned but the rationale behind this action is not clear. Isn't normalization implicit part of each correlation analysis?

On p. 7 l 14 linear regression analysis is mentioned. Have the authors investigated if the relatively poor explanatory and predictive power of the regression model used might be due to the assumed linearity? Could it be that ENSO or QBO have nonlinear influence on water vapor? Only from the fact that linear correlation with ENSO and QBO indices do not satisfactorily explain the observation it cannot be concluded that other processes are needed. Nonlinear interaction or coupled ENSO-QBO interaction has not been ruled out.

p9 l1-2: The explanation of small interannual water vapor anomalies at the first and last several months of the data record by limitations of the band pass filter is not very clear. Does this refer to the running means mentioned before? Is this simply a boundary effect occurring where the width of the filter exceeds the range where data are available? Isn't

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a running mean a low-pass filter rather than a band-pass filter?

p. 12 | 3-4 and elsewhere: The relation between  $R^2$  and the explained variance holds only under certain assumptions (linearity, Gaussian distributions). A critical discussion of this issue is needed.

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