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Atmospheric Measurement Techniques Discussions

Interactive comment on "Atmospheric QBO and ENSO indices with high vertical resolution from GNSS radio occultation temperature measurements" *by* Hallgeir Wilhelmsen et al.

Anonymous Referee #1

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The main purpose of the paper is to demonstrate that the GNSS data can be used for studies of tropical atmospheric variability in both the stratosphere and the troposphere. Using tropical temperatures from GNSS measurements the authors produce QBO and ENSO indices by several versions of principal component analysis. These indices are then discussed and compared to traditional indices.

I find that the paper contains some interesting results and that it is relatively well written. I have a few major points that the authors should address before I can recommend that the paper is accepted.

Major comments:

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1) The authors stress the high vertical resolution of their data (line 2 in abstract and line 17 in section 5). However, I don't think it is demonstrated anywhere in the paper that this is important. Actually, in section 4.1 it is mentioned that the patterns from M1 are not sensitive to the vertical resolution.

Would the same results be obtained if the analyses were performed with re-analysis data (e.g., NCEP or ERA)? If this is the case – and I think the authors should check – then the importance of the GNSS data may not be so high.

2) In the principal component analysis the authors include the latitude information. Normally when the QBO is studied from the winds latitudinal means are used. What is the reason for not using latitudinal means in this study? Does it make any difference?

3) Can anything be said about the coupling of the ENSO and the QBO? The method M1 includes all levels both in the troposphere and in the stratosphere so I wonder if it would be possible to gain insight into the proposed connection between these two parts of the atmosphere.

Minor comments:

Page2, l5: The new paper by Dunkerton (10.1002/2017JD026542) could be included here.

Page2, l18: The paper by Christiansen et al. (10.1002/2016GL070751) suggesting a coupling between ENSO and QBO could be cited here.

Page2, l26: This sentence is unclear.

Section 2, l26: How many grid-points with missing data do you have? " .. boundaries ..": But the data-set is global?

Page 3, top: How much does this prior knowledge influence the temperature in the tropopause? Is it a large part or can the ENSO be seen in the raw GNSS data alone?

Section 3.1, line 4: Does the centering matter? Is this not already included when you

use the covariances?

Page 6, l4: Antipodal? Is this the right word?

Page 6, l8-13. I found it hard to follow this. What does "this pattern" refer to? Is there a QBO pattern in the stratosphere with a longitudinal structure?

It might be a good idea to merge section 4.6 with sections 4.1 ad 4.2. Many of the questions that arise reading sections 4.1 and 4.2 are answered in section 4.6

Fig. 1: How is the tropopause calculated?

Fig. 2: Perhaps the standard pressures corresponding to these vertical levels could be given.

Perhaps the last sentence in the abstract and the sentence in section 5 beginning with "We provide .." should be removed. They sound as if you want to sell me a used car.

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