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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.

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AC5

We thank the reviewer for the constructive comments helping to clarify the content of the paper. Please see our responses below.

Comment 1: "The paper describes the EOF method in detail, however, does not provide enough justification of using this method and what is the benefits of this method, compared to the conventional anomaly analysis. For example, normalized temperature anomaly time series at each level also can represent the relative strength of the tem-

perature variation at a given level, similar to that shown with EOFs. A few reasons can be included:

1. The EOF analysis can extract the major modes from small scale spacial and temporal variations. This is an important aspect of the EOF method, which can screen out sampling errors from irregular sampled data, i.e., GNSS RO observations.
2. The EOF analysis can be used to explore the structure of the variability within a data set in an objective way, and to analyze relationships within a set of variables. In this study, EOF2 method account the temperature at each level as independent set of variables and connect their modes to analyze the vertical structures of the temperature variation.

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Response 1: We agree that the motivation for using the EOF method can be augmented in the manuscript. Thank you for providing examples for improvement.

Concerning the benefits of EOF analysis compared to the temperature anomalies: Using the temperature anomaly time series directly to represent the temperature variation would require averaging the temperature field, which may cancel out certain patterns. In contrast, the EOF method acts on the whole input field.

See also response to Comment 2 from Referee #1, RC1.

We added to page 4, line 14:

"The EOF analysis can extract major modes from spatial and temporal variations."

Comment 2: "The meaning of eigenvectors can be explained to further use them in the reconstruction of the anomaly field."

Response 2: We changed page 5, line 7 from

"The output of the EOF analysis is a set of EOFs (EOF_{out}), PCs (PC_{out}), and their corresponding eigenvalues (λ)."

to

"The output of the EOF analysis is a set of EOFs (eigenvectors, in this context called EOF_{out}), PCs (PC_{out}), and their corresponding eigenvalues (λ)."

Comment 3: "The paper shows the linear correlations between PCs and ENSO, QBO, and F10.7 indices, respectively. I recommend to show those conventional indices along with newly suggested PCs from M2 at given levels (e.g., surface, 50hPa) in the your PC plots. It will be an effective way to demonstrate the similarities and differences of new indices."

Response 3: We agree that providing plots for the conventional indices will make it easier to compare with the ones suggested in the manuscript.

We added the corresponding time series from Niño 3.4 SST index, the QBO 30 hPa index, and the QBO 50 hPa index in Fig. 3 and Fig. 5.

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