

## ***Interactive comment on “Decadal variations in atmospheric water vapor time series estimated using ground-based GNSS” by Fadwa Alshawaf et al.***

**Anonymous Referee #1**

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Fadwa Alshawaf et al. described the comparison between precipitable water vapour (PWV) estimated with GNSS, ERA-Interim data and daily surface measurements of temperature and relative humidity. They examined on trends obtained by fitting a straight line into 30-years of seasonally-adjusted PWV. Their results show a positive trends for more than 60 GNSS stations from area of Germany and positive correlation between PWV and temperature recordings.

In my opinion the paper is worth publishing in Atmospheric Measurement Techniques, however, some issues are missing and few points should be raised for a discussion and expanded.

Major comments: 1. Page 3, line 10: “Homogenous time series with an average length

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of 14 years are available from 84 sites”. The total number of sites is 278. What with the rest of stations? Are the time series also homogenous? A comment on homogenization is needed here: give a total number of epochs applied, a maximum change in trend, a maximum change in standard deviation. Please, quantify a task of homogenization. 2. Page 5, line 10: “We observed that the higher the GNSS antenna is located, the larger the bias.” How many stations are affected by this bias? Are the mean value and STD directly correlated with height? A comment on it is needed. 3. Page 8, fig. 4: site 0285: Where does the difference between Tm’s below 260K come from? A comment on it should be added. 4. Page 10, line 3: You mentioned seasonal and cyclic component of ZTD data. What do you mean by cyclic? What is the difference between seasonal and cyclic? Why two terms should be mentioned? I would prefer to name cyclic as seasonal as well. 5. Page 10, line 10: “It represents the irregular (stationary) stochastic component with short temporal variations.” The stationarity and short temporal variations are too optimistic to be assumed. In this way you input that the irregular component has no or little influence on determined parameters: trend and seasonal component. What if the stochastic component was correlated in time and in this way brought large uncertainties of trend and seasonals? 6. Page 11, fig. 6: The long-term variations you name as “trend component” may be related to noise model being far from white noise assumption you made. In fact, noise in PWV is close to autoregressive process. This is why the trend you estimate may be over/underestimated due to autoregressive trend and not necessarily real changes noticed in PWV data. Did you consider any other process being hidden in irregular component? A detailed comment on it should be added. 7. Page 13, line 1: “while a bias is observed in mountainous regions”. Can you quantify this bias? 8. Page 14, fig. 9: Can you add the errors of estimated trends? It would help a reader to judge on its significance. 9. You show results for 3 different stations. Can you please add the statistics for all stations examined? It would give the overall view on stations and their (dis-)agreement with ERA-Interim and meteorological data. 10. Can you provide errors of all values of trend/slopes provided within the text. Now, a reader is not aware of significance of each value given.

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Minor comments: 1. Time in figures is given in “years”, not “days”. 2. Page 1, line 10: “PWV trend component estimated from GNSS data strongly correlates with that. . .” give numbers to justify this “strong correlation”. 3. Page 1, line 12: “0.3-0.6” an error must be added here. 4. Page 1, line 18: “a mount”, change into “amount”. 5. Page 5, line 7: double “of” 6. Page 7, fig. 3: the caption of bottom axis is not visible.

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