

Atmos. Chem. Phys. Discuss., referee comment RC2  
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## Comment on acp-2021-797

Anonymous Referee #2

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Referee comment on "Characterisations of Europe's integrated water vapour and assessments of atmospheric reanalyses using more than 2 decades of ground-based GPS" by Peng Yuan et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-797-RC2>, 2022

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### General Comments

The work presented in the manuscript gives an overall summary of applications of ground-based GPS observations in Europe of estimated time series of integrated water vapour (IWV), which to my knowledge is unique. It is broad in the sense that it deals with temporal scales from sub-daily to decades, while many previously published results often focus on one particular "signal", e.g. diurnal, annual, trends. As far as I can tell there are no new results in the manuscript, i.e. results that are different from what is already published. Three times it is stated that the results are "in line" with previously published results (lines 222, 323, and 399). Of course, it is also an important part of research to verify earlier findings, but if possible, I would appreciate if there was more emphasis on noted differences compared to earlier results. I am afraid I cannot help with the details. It is an impressive reference list and for me it is impossible to get a reasonably complete overall knowledge during the time allowed for the review.

### Specific comments

L108: I do not understand the meaning of "integration rate of 95 %"? Can you explain what is being integrated?

L112: You report that the observations were weighted based on the elevation angle. Is it not important how the weighting was done (a weighting function including sine and cosine terms)?

L192: It is mentioned that homogenisation was done as described by Yuan et al. (2021). I

think such a process is critical and it deserves some more detail in your paper instead of having to go through the reference. For example, do you allow breaks to be inserted in the GPS IWV time series at a specific time epoch even if there has been no change noted in the log file for the hardware or the environment at the site?

L262: My interpretation is that you determine the amplitudes of the diurnal signal as the peak-to-peak value regardless of when the peaks occur. This makes me wonder if the results will be different if instead the phase and amplitude of the sine wave with a 24 h period is estimated, e.g, through the method of least squares. (In some studies also a semidiurnal term, a period of 12 h, is estimated.) It will be of interest if you comment on this, at least for a couple of sites in different climate zones?

L268: You find a correlation between the diurnal amplitude and the station height. Since station height (I guess) correlate with the site's distance to the ocean, another approach would be to correlate the amplitude with this distance. It is well known that the ocean (as long as there is no ice) acts like a low pass filter on daily variations in temperature and humidity.

L315: This whole section seems questionable if it is worth to be published? Do the GPS IWV data yield any new findings? Given the very high correlation between IWV from GPS and from the reanalyses, it seems as all the reported patterns, and their time dependences, will be seen by using reanalyses data only?

#### Technical Corrections

Line (L)1+: You use the American spelling of vapour, although ACP is a European journal?

L97: ... IWV -using ... ?

L17: 2%-18% --> 2 %-18 % (similar changes to be carried out many times in the manuscript)

L154: IWVs --> The IWV values ?

L157: reanalyses Compared --> reanalyses. Compared

L203: IWVs are --> IWV for all sites and days are ?

L398: (29.5°E, 40.8°N), --> (29.5 °E, 40.8 °N), (see also L447-448)

L444: 0-0,4 --> 0.0 – 0.4 ?

L446: 0,4-1 --> 0.4 – 1.0 ?

L480+: doi links are missing for almost all references and the established standard acronyms for journals are not used.

Figure 2: The yellow colour is not ideal. I suggest to use cyan or magenta instead. You may also consider to use darker colours in Figures 5 and 8. Different colours in these figures are not really needed for clarity, although it may look nicer compared to have it all in black.