

Interactive comment on “The uncertainty of the atmospheric integrated water vapour estimated from GNSS observations” by T. Ning et al.

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This paper discusses all the components of the uncertainty in the Integrated Water Vapour (IWV) data derived from ground-based Global Navigation Satellite Systems (GNSS) measurements. This is a very useful manuscript for the atmospheric science community, documenting the error sources and the way to quantify all the uncertainty components for the GNSS IWV data clearly and thoroughly. The manuscript emphasizes its contribution to the Global Climate Observing System (GCOS) Reference Upper Air Network (GRUAN). This is good. But, I think that it is valuable for all the GNSS IWV data providers and data users. The abstract may be revised accordingly.

Other than this, I only have very minor comments.

C3171

page 8819, lines 17-20. The physical background for the IWV measurements using the GNSS may be explained a little bit more, for those who are interested in atmospheric water vapour but not familiar with the GNSS. Which frequencies of radiowaves are used for the GNSS? (cf. "L1" and "L2" at page 8828, line 9.) What is the primary unit for the ZTD, ZHD, and ZWD (sec or meter; and are they converted using the speed of light in vacuum)? What causes these delays? Also, satellite orbit is mentioned suddenly at page 8820, line 11. But, I think this should be discussed together with the ZTD, etc. so that the readers can know the basics of the GNSS IWV measurements.

page 8821, line 1. A new paper has recently appeared which give some updates of the GRUAN activities: Bodeker et al., BAMS, 2015, 10.1175/BAMS-D-14-00072.1

page 8821, line 6. Spell out "GFZ" here, rather than p. 8832, lines 12-13.

page 8822, line 12. Define "C" and mention S_A-B, S_A-C, and S_B-C, so that the readers would understand this sentence more easily.

page 8824, line 15, Eq. (10). "M" has been already used. Why not use "N"?

page 8824, line 19, Eq. (11). I (el) need to be defined.

page 8826, line 7. The term "radial" orbit error may be confusing because Table 2 also has "Radial," but probably this has a different meaning. "Along track" and "cross track" may be much better terms if they mean what they seem to mean. Also, why the radial orbit error maximizes at zenith angle of zero and the tangential orbit error at 45 degree?

page 8826, line 21, and other places. The station names should be explicitly written first, and then define acronyms if necessary.

page 8827, line 17. Why these are compensated each other? Why these have opposite signs? Do you have any physical explanation?

page 8830, lines 11-12. Are the monitoring and management of the vegetation around

C3172

the GNSS receiver also necessary?

page 8837. There are different versions of ECMWF reanalyses (e.g., ERA-15, ERA-40, ERA-Interim, and more to come). So, specify that this is ERA-Interim, and cite the following paper:

Dee, D. P., Uppala, S. M., Simmons, A. J., Berrisford, P., Poli, P., Kobayashi, S., Andrae, U., Balmaseda, M. A., Balsamo, G., Bauer, P., Bechtold, P., Beljaars, A. C. M., van de Berg, L., Bidlot, J., Bormann, N., Delsol, C., Dragani, R., Fuentes, M., Geer, A. J., Haimberger, L., Healy, S. B., Hersbach, H., Hólm, E. V., Isaksen, L., Kállberg, P., Köhler, M., Matricardi, M., McNally, A. P., Monge-Sanz, B. M., Morcrette, J.-J., Park, B.-K., Peubey, C., de Rosnay, P., Tavolato, C., Thépaut, J.-N., and Vitart, F.: The ERA-Interim reanalysis: configuration and performance of the data assimilation system, *Q. J. Roy. Meteor. Soc.*, 137, 553–597, doi:10.1002/qj.828, 2011.

Table 1. E should be epsilon, and B should be M?

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