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Earth System Science Data Discussions

# *Interactive comment on* "Atmospheric data set from the Geodetic Observatory Wettzell during the CONT-17 VLBI campaign" *by* Thomas Klügel et al.

**Anonymous Referee #1**

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General Comments

Overall I find that the dataset is of general interest to the space geodetic community. I think that 15 days of data is a too small dataset to be of interest to the meteorological community, given that it does not coincide with an extreme weather event.

One issue which I find difficult to judge concerns the following instruction to reviewers:

"Completeness: A data set or collection must not be split intentionally, for example, to increase the possible number of publications. It should contain all data that can be reviewed without unnecessary increase of workload and can be reused in another context by a reader."

This submitted dataset is acquired at the Wettzell VLBI station during the CONT17



experiment. There were approximately 30 stations participating in the different networks of the CONT17 experiment, meaning that a more complete dataset could include weather data from all these stations. From the geodetic point of view such a data set would be much more useful. Are the authors aware of if there are plans to publish similar data sets also from other stations? Ideally all data would be published as one dataset, although I realise that it may be a huge work load thinking about the logistics and that the atmospheric measurements are (probably) not a main focus at many stations.

An alternative data set would be to combine the atmospheric data from many CONT experiments at Wettzell. Wettzell has participated in CONT02, CONT05, CONT08, CONT11, and CONT14, see e.g. Teke et al. (2013) and Lu et al. (2017). Of course, a dataset including the available atmospheric data from all these experiments would be more "complete". On the other hand it is foreseen that this type of CONT experiments will continue to be carried out every three years.

The question is if it is meaningful to produce one additional atmospheric paper/dataset corresponding to each site and each experiment? I believe this is mainly an editorial question. In any case the dataset would benefit from describing it in this broader context. For example, among other things, include the references:

Lu, Cuixian, Xingxing Li, Maorong Ge, Robert Heinkelmann, Tobias Nilsson, Benedikt Soja, Galina Dick, Harald Schuh (2016). Estimation and evaluation of real-time precipitable water vapor from GLONASS and GPS, GPS Solut., 20:703–713, DOI 10.1007/s10291-015-0479-8.

Teke, Kamil, Tobias Nilsson, Johannes Böhm, Thomas Hobiger, Peter Steigenberger, Susana García-Espada, Rüdiger Haas, Pascal Willis (2013). Troposphere delays from space geodetic techniques, water vapor radiometers, and numerical weather models over a series of continuous VLBI campaigns, J. Geod., 87:981–1001 DOI 10.1007/s00190-013-0662-z.

Specific comments

Concerning the definition of atmospheric observations I note that when describing the instrumentation (in Section 2) you chose to neglect the GNSS and the VLBI observations. But in Section 4 you present the estimated ZTD from the GNSS observations, whereas estimated ZTDs from the VLBI observations are not included at all. I find this confusing because the space geodetic techniques have the advantage of not being based on emission measurements, possibly having the potential of producing stable long term time series for the ZTD (and indirectly the water vapour content). The bottom line is that VLBI and GNSS may be used to assess the absolute accuracy of the other meteorological sensors and should be described and included in the dataset.

I find Table 1 difficult to interpret. Each parameter is listed with an accuracy, but the accuracy is not defined (absolute traceable to SI, one standard deviation, or two, or three standard deviations?). The parameter SM is not shown in the map of Figure 1. The accuracy of R1 and R2 is stated to be 10 %. Precipitation is not measured in percentage. What is the unit that has this relative uncertainty? I also think that the table will be more clear if the 3rd line would be on the top (title line) and the acronyms on the line below.

The question of defining accuracy is also valid for the brightness temperatures measured by the radiometer (page 6, line 8). Is 0.5 K an absolute accuracy or x standard deviations?

On page 9 you refer to good agreement twice (lines 15 and 24). The word good is a rather subjective statement and have different meanings to different persons. I think it shall be avoided and instead specify the quality of the agreement in numbers, such as RMS differences and correlation coefficients.

You comment on that radiometer data are more or less useless to infer water vapour content, liquid water content, and wet delay during rain. Actually, also when large drops of liquid water are present in the sensed volume of air, the accuracy will be worse. A



similar effect is if water drops are present on the feed/mirror of the radiometer, which will often be the case for some time also after that the rain has stopped. In Figure 9 you have two outliers (blue dots). It may be worthwhile to investigate if these are in connection to a rain shower or large amounts of the liquid water content.

A relevant question for this type of (data) manuscript is how far it is reasonable to take the data analysis? Had it been a regular scientific paper I would have argued that instead of just using retrieval coefficients for the radiometer data from radiosonde data obtained in Munich, it would be required to at least also compare these coefficients from the ones that can be obtained from the launches carried out at the Wettzell site. On the other hand, one reason for publishing a dataset is to inspire others to use it. This could be one such task.

On page 5, line 20 and in Table 5 you use the parameter Tk_{BB} referred to as blackbody temperature which is not defined. Given that it in the dataset is about 10 K warmer than the ambient temperature it cannot be the effective temperature of the atmosphere that is used to calculate the optical depth at the observed frequencies (which also is frequency dependent)?

The dataset (described in Table 5) should, where possible, have an uncertainty attached to each parameter. For example, uncertainties in the observed sky brightness temperatures propagate and give, together with uncertainties in the retrieval coefficients, uncertainties in the inferred parameters.

Technical Corrections

I find that the font size in all figures is unnecessarily small. The size could in general be say 30-50 % larger in order to improve the readability.

page 2, lines 5-6: The weather model data are not acquired at Wettzell. Suggest to rewrite as: ... atmospheric observations were acquired at the Geodetic Observatory Wettzell, where three radio telescopes contributed to three different networks which

have been established for this campaign. These data were supplemented by weather model data. The data set is made ...

page 2, line 22: Referring to the IVS home page the appropriate general reference to the IVS is: A. Nothnagel, T. Artz, D. Behrend, Z. Malkin, "International VLBI Service for Geodesy and Astrometry – Delivering high-quality products and embarking on observations of the next generation", Journal of Geodesy, Vol. 91(7), pp. 711–721, July 2017. DOI 10.1007/s00190-016-0950-5

page 2, line 10: all –> many

page 2, line 13: -temperatures –> cloud temperatures

page 2, line 16: resolution –> resolutions + is very different –> are very different

page 3, line 1: radiotelescopes –> radio telescopes

page 4, line 4: humidity –> humidity,

page 5, line 21: phase delay –> path delay (I guess it is expressed in units of length and not in degrees since the phase delay depends on the carrier frequency)

page 6, Table 2: units are missing

page 6, line 13: blue –> clear ?

page 6, line 18: no year –> (2018) (according to the reference list)

page 6, line 26: delete "exact" (which means without error and that cannot be true)

page 7, line 2: for water –> for water in hPa ?

page 9, line 14: around the launch site –> mainly to the east of the launch site

page 9, line 24: define or write out cc ?

page 9, line 26: temperature –> temperature,



page 11, Figures 4 and 5: RMS difference is a better parameter compared to cc to describe the quality of the agreement because it is not so strongly depending on the dynamic range of the measured values. Also you may refer to Table 4 in the figure captions? I am used to see height on the x-axis and the measured meteorological parameter on the y-axis in this type of meteorological graphs.

page 12, line 26: for a good and a poor coincidence –> of one better and one worse agreement

page 12, Table 4: write out "RMS error" and "RMS difference" ?

page 13, Figure 7: add also the ideal line for a perfect agreement ?

page 13, line 5: waht is the unit of s ? Reference?

page 14, line 1: measured –> inferred from the measured sky brightness temperatures

page 15, line 16: (Emeis, 2000) is not in the list of references

page 16, line 3: Bevis –> Bevis et al.

page 17, Figure 11: It would be informative to add values for the RMS differences in addition to the correlation coefficients.

page 19, Table 5: 68% –> 68 %

page 20, line 16: J. Applied Meteorology –> J. Appl. Meteorol.

page 20, line 21: Elegered –> Elgered

page 20, line 22: Radio Science –> Radio Sci.

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