

REVIEW NUMBER 3

This work is very interesting for both geodetic and meteorological communities in the framework of the ES1206 COST Action. The description of the data collected is very detailed and the data itself very completed having included radars, WVR data, radiosondes and synoptic data apart of several gnss products.

However, the test of the quality of GOP and GFZ gnss products by the comparison of the ZTD gnss with the three models described and also the subjective comparison of ZWD or horizontal gradients maps against the models could be more complete by using the other observations you already have for any of the case studies you describe. In particular, in case of the comparison between the gnss ZTD vs the models, the results are difficult to understand if you don't study first how each model you present here performs in the case study, (if they are too humid or dry etc), because when comparing a product it should be with something you could trust (or if not knowing why).

Maybe not so many explanations and maps describing the weather on these two months are necessary, just a general description of the period and then a detailed explanation of the case study chosen to perform the comparisons.

Very good job anyway, and complicated to accomplish, many data and long period. Differences of hydrometeors sound very well for nowcasting purposes.

More comments:

2.2. P5, L18: Numerical Weather Prediction models

Manuscript changed (text corrected).

2.3. P6, L: 1-5: Not the best words to describe the weather, (Mostly ‘quiet’, heavy ‘raining’, larger region instead of large).

Manuscript changed (text reformatted). “These goals will be studied within future Benchmark activities, in particular to study gradients during normal and severe weather conditions while taking a full benefit of the Benchmark dense GNSS network.”

And what is Sect 0?

Manuscript changed (Sect 3.2 corrected).

3. P7, L2 and L5: Section 0? About this section, probably not so many individual case studies explanations are needed, just the ones you are comparing afterwards, (like 31 may for example).

Manuscript changed (Sect 5.3 corrected). As mentioned in the paper, more detailed studies using the whole Benchmark period or particular events are foreseen therefore we wanted to describe the meteorological situation in more detail to give a feeling what a dataset was collected.

3.1. Figure 2: The description on the text do not tell which stations the precipitation belongs to (It is said on the legend of the figure but not on the text). Also X-axis could be clearer. Apart of this, a detailed explanation of the precipitations amounts is given for may and june, and this plot is not very clear to see it.

Manuscript changed (Figure 2 edited). We added the name of the station on the text and we changed the X-axis, putting on it more days for clarifying.

P7, L21: Typo May 31-31

Manuscript changed (corrected to May 30-31).

P7,L25 and 26: Why aren't they inside the next section 3.2 if they are referred to june?

Manuscript changed (lines moved to the beginning of Sect 3.2).

3.2 P8, L 5-10_ 'Professional 'meteorological stations: are they referred to synop stations? Do the stations give the feeling on a rain episode?

Manuscript changed. Yes, these stations deliver the so-called synoptic measurement records encoded to bulletins according to World Meteorological Organization standards. Since the stations measure quantity of precipitations (in kg per m² per time interval), and their network is dense (see the number), they indeed give a good feeling on the precipitation activity.

4.1. Table 1, brief explanation may be needed in the text.

Manuscript changed. "Table 1 summarizes basic characteristics of GNSS data for individual countries including involved network names, terrain diversities by showing minimal and maximal ellipsoidal heights, and number of all stations providing GPS and GPS+GLONASS observations."

4.3. Table 2, brief explanation may be needed in the text.

Manuscript changed. "Table 2 summarizes all information collected for the Benchmark campaign from synoptic stations at each country: number of stations, provided meteorological parameters and their temporal resolution."

4.4. When you describe ALADIN-CZ model you don't explain if it has Data assimilation, what kind of D.A. and which data it assimilates. Better description of the data assimilation (especially sources of humidity) of the models used may be needed, so it may be easier to explain afterwards the biases/SD with one model or other.

The full model description would go out of the scope of the paper. ALADIN-CZ used at that time the so-called Digital Filter Blending method to obtain the upper-air initial conditions. In short, ALADIN fine-mesh guess was combined with 4DVAR data assimilation of the ARPEGE global model. Be aware, however, that biases are caused more by models' physics.

5.2 P14, L12, you say Table 1, isn't it 5?

Manuscript changed (Table 5 corrected).

5.2 P14 It could be interesting doing this comparison also with radiosonde (RS) data and gnss sites collocated with radiosondes: model-RSgnss.

We didn't aim adding the comparison of radiosondes here since there are plans for several other activities using the Benchmark campaign (see Sect 2.4). One aims at comparing methods of ZTD to IWV conversion in particularly ultra-fast products in support of NWP nowcasting. The evaluation of GNSS ZTD and IWV with external data sources such as radiosonde will be more suitable there.

5.3. P14, L 22; Section 0 again.

Manuscript changed (reference to Sect 3.2 corrected).

Figure 9: It could be interesting to compare these figure of ZWD of 31 may with another image, radar, satellite WV, or even accumulated precipitation the day after, that permit to do any other validation of this maps, looking to any correspondence with real data.

Yes, however, such detailed discussion is out of the scope of this manuscript which is already quite extensive. For this purpose, we introduced additional plans for exploiting the Benchmark dataset for specific topics (see Sect 2.4). We expect this will be covered within a specific focus on the support of RT and NRT separation of ZHD/ZWD and IWV map production. The discussion will include various additional aspects such as impact of height corrections, parameter conversions, description of different techniques and their sensitivity to contributions to different parts of the troposphere (e.g. lower or upper), and others.

6. P16, L23: This part could be inside section 5, and not in the conclusions.

Manuscript changed (Appendix B has been removed and the effect of hydrometeors is now presented in the Sect 5.5). Conclusion has been modified referring results about hydrometeors in Sect 5.5.