

Interactive comment on “Assimilation of GNSS tomography products into WRF using radio occultation data assimilation operator” by Natalia Hanna et al.

Anonymous Referee #3

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In their paper, the authors discuss the assimilation of GNSS tomography products from two software (and different output variants) into the WRF NWP model during the severe precipitation event occurring in central Europe (29 May – 14 June 2013). This event is described in the paper Dousa et al. 2016, which presents the COST Action ES1206 (GNSS4SWEC) benchmark campaign. The authors uses the datasets (GNSS tropospheric products, NWP model data. . .) from that benchmark campaign as input for their study, either as input for their tomography or for comparing/validating their results.

The paper is generally well structured and well written. However, some points - listed here below - requires clarification, additional information, and/or improvements:

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- Acronyms for the dataset and model outputs: it is recommended to use - throughout the paper – acronyms that clearly identify the dataset (e.g. set1 → ANHYDRO_COR) or the model output (e.g. TUW solution 1 → TUW1).
- At several occasions, the paper somehow lack of providing reference numbers (e.g. requirements or typical uncertainties of measurements) that are necessary to properly interpret the findings. Please add them.
- One may ask himself why to carry out tomography on SWD, then assimilate tomography output in NWP models, instead of directly assimilating SWD in NWP models. Assimilating directly SWD in NWP is also one step less in the processing chain and so might be faster for operational purpose. I think a short paragraph in the introduction on this point would be an added value to the paper. Please elaborate on this.
- The authors mentions two assimilation operators. However it is not clear what are the difference between both and why they chosen GPSREF for their study. Please clarify this point.
- The horizontal resolution of the outer voxels are quite coarse for the type of phenomena targeted. Would it have improved the results if it was finer? If yes, why not having applied a finer resolution in the outer voxel? Also why not having included SWD from GNSS station in the outer voxels? (The benchmark campaign includes plenty of GNSS stations data in that zone).
- In the tomography, the authors carry out residuals screening. This is set to 120 times the RMS in the TUW case while it is set to 3 times the standard deviation in the WUELS case. Please indicate how you decided on these numbers and why they look quite relaxed in the TUW case compared to the WUELS case. (See also detailed comments).
- Several figures and tables can be improved (see detailed comments).
- Please mention why you chose to use the ALADIN-CZ (from the benchmark cam-

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paigned) for some part of the paper instead of using WFR model outputs (which sounds more consistent).

- The section on “intra-technique comparisons” can be completed by discussing all comparisons (see detailed comments) and providing more clear conclusions at the end of the section.

- The section on “diagnosis output” is missing some information and should end with clear interpretation and conclusions (see also detailed comments).

- The section “7.3 assimilation output results at simulation time”: I would recommend the authors to first start with a full comparison between the model results without assimilation and with assimilation over the complete domain (i.e. not restricting to the radiosonde location). This would first give an indication of the impact of assimilating the tomography output. This can take the form of typical skills and scores used in NWP impact studies or some statistical values along with a box plot of certain essential variables (temperature, relative humidity...). Also in the paper, please mention which exact temperature field you extract from the model. Then, in a second step, you can add the radiosonde comparison and some interpretation of potential biases...

- For the data assimilation, please mention if you have carried out any bias correction (typical in NWP data assimilation). If not: why not? If yes: please describe.

Detailed Comments can be found in the supplementary material.

Please also note the supplement to this comment:

<https://www.atmos-meas-tech-discuss.net/amt-2018-419/amt-2018-419-RC2-supplement.zip>

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2018-419, 2019.