Ann. Geophys. Discuss.,
https://doi.org/10.5194/angeo-2019-87-RC1, 2019

Annales Geophysicae Discussions

Interactive comment on "Observing geometry effects on a GNSS based water vapor tomography solved by Least Squares and by Compressive Sensing" *by* Marion Heublein et al.

Anonymous Referee #1

Received and published: 22 August 2019

In general i find the manuscript well written. I have some comments (see below). Some of them can be regarded major.

comments:

Abstract, L2: '... neutrospheric water vapor tomography...' please remove here and everywhere in the manuscript the word 'neutrospheric'.

Abstract, L5: '... The novelties of this research are 1) the comparison of the observing geometry's effects on the tomographic reconstruction accuracy when using LSQ resp. CS for the solution of the tomographic system and 2) the investigation of the effect of the signal directions' variability on the tomographic reconstruction.' I do not think that

these are novelties. Please see e.g. Bender et al. 2011, Zhao et al. 2019 etc. They also study impact of observation geometry. Also, see comment below.

Page1, L21: '... Therefore, a precise knowledge of the water vapor field is required for accurate positioning and deformation monitoring using GNSS and InSAR...' I do not agree. With the GNSS you estimate both position and state of the troposphere, i.e. you estimate SWD.

Page1, L22: '... However, the atmospheric water vapor distribution is difficult to model because it is highly variable in time and space.' This is true. Therefore, how can it be that you are trying to reconstruct it with 5 layers in the vertical only? This does not make sense to me. Explain to me the purpose of such water vapor field. It can not be weather forecasting. For example, i am sure that the number of vertical levels of the WRF (the weather research and forecasting) model you make use of is » 5.

Page 2, L11:'.. Yet, even after regularization, the observing geometry composed e.g. of the number and the geographic distribution of the GNSS sites, the SWD signal directions, and the voxel discretization still effects the quality of the tomographic solution.' With regards to the observation geometry you should mention the following papers:

Bender et al. 2011, GNSS water vapour tomography - Expected improvements by combining GPS, GLONASS and Galileo observations, Advance in Space Research

Zhao et al. 2019, Accuracy and reliability of tropospheric wet refractivity tomography with GPS, BDS, and GLONASS observations, Advance in Space Research

The conclusion from the first paper is '...'The reconstruction quality could not be improved considerably using the currently available technique...' Likewise, the conclusion from the second paper is '...Tomographic results also show that multi-GNSS observations can increase the accuracy of 3-d wet refractivity reconstruction but not as well as was expected when using currently available techniques...'

It appears that the problem in gnss tomography is not the observation geometry (!?).

Please start a discussion here.

Page 4, Line 8: equation 1, define dl.

Page 5, Line23: “...As Hscale is essential for defining an exponential decay with height, its value is determined within the solution of the tomographic system from a set of realistic values for Hscale between 1000 m and 2000 m .“ I do not understand this sentence. What is ’realistic’? Do you estimate this parameter in your lsq? Let me suggest something: if the wet refractivity follows equation 10 (a single scale height), then it is absolute sufficient to measure the ZWD (zenith wet delay) and the refractivity at the station N0 to retrieve the wet refractivity profile. The reason is that ZWD = N0* Hscale so that Hscale=ZWD/N0. There is no need for SWDs. Please start a discussion here.

Page 8, Line 7: “...From WRF, simulations of water vapor mixing ratio, temperature, pressure, and geopotential height are available at a 900m spatial resolution..“ provide a reference for WRF. Do i understand it correctly: the horizontal resolution of WRF is 900m?

Figure 3: i can not read the numbers. please increase the font size.

Figure 4 : “...in order to make the Euler refractivity decay with height visibly similar to the Euler letters used in the Compressive Sensing solution for modeling the refractivity decay with height ...“ Could you please add in the Figure a wet refractivity profile with a single scale height Hscale of say 2km for comparison? Thank you.

Figure 5: please increase the font size.

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