The paper by Pengfei Xia et al. is very interesting, but has also very serious shortcomings in the first part (page 1-5).

The methodology section MUST be rewritten IN DEPTH. Basically:

Response: Thank you very much for your invaluable time and great efforts toward our manuscript. We are very appreciative of that all the comments have helped us a lot to improve the manuscript. We have carefully examined each comment and we have tried best to revise and restructure the manuscript based on the valuable comments and suggestions.

- The correct mathematical setting of eq.1 is that of the so-called Radon transform. Please have a look at the literature on this tranform (for example X-ray imaging) and mention some theoretical references.

Response: Thank you very much for your valuable comments and suggestions.

Eq.1 has been applied to GNSS meteorology for more than two decades, and we have referred to these literatures (Flores et al., 2000; Troller et al., 2002; Emardson and Webb, 2002; Champollion et al., 2005; Chen and Liu et al., 2014； Dong et al., 2018; Zhang et al., 2020, 2021). Thank you very much for your suggestion, We will do in-depth research on this equation in the future.

Reference

Champollion C, Masson F, Bouin MN, Walpersdorf A, Doerflinger E, Bock O, Van Baelen J. 2005. GPS water vapour tomography: Preliminary results from the ESCOMPTE field experiment. Atmos Res. 74(1-4):253-274.

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Emardson T, Webb FH. 2002. Estimating the motion of atmospheric water vapor using the Global Positioning System. Gps Solut. 6(1-2):58-64.

Dong Z, Jin S. 2018. 3-D water vapor tomography in Wuhan from GPS, BDS and GLONASS observations. Remote Sens-Basel. 10(1).

Flores A, Ruffini G, Rius A. 2000. 4D tropospheric tomography using GPS slant wet

delays. Ann Geophys-Germany. 18(2):223-234.
Troller M, Bürki B, Cocard M, Geiger A, Kahle HG. 2002. 3-D refractivity field from GPS double difference tomography. Geophys Res Lett. 29(24).
Zhang W, Zhang S, Ding N, Zhao Q. 2020. A tropospheric tomography method with a novel height factor model including two parts: Isotropic and anisotropic height factors. Remote Sens-Basel. 12(11).
Zhang W, Zhang S, Chang G, Ding N, Wang X. 2021. A new hybrid observation GNSS tomography method combining the real and virtual inverted signals. J Geodesy. 95(12).

- the decay with respect to altitude of temperature (linear) and water vapor contents (exponential) is not always true.

Response: Thank you very much for your commons.

It is actually that the decay with respect to altitude of temperature (linear) and water vapor contents (exponential) is not always true.

According to the statistical value of radiosonde from 2015 to 2020, the proportions of the decay with respect to altitude of temperature (linear) and water vapor pressure (exponential) from surface to 600 m are 57.3% and 66.2%, respectively.

inversion layers are common,as noted by the authirs themselves...but later in the paper.

Response: Thank you very much for your commons.

Our main purpose is to obtain the wet refractivity from the surface to 600m elevation based on GNSS tomography method. Although GNSS tomography fails to accurately represent the "inversion layer", the wet refractivity accuracy obtained by the optimized tomography technique is higher than that of the conventional tomography technique.

- even more important, and I would say a major flaw in the method is that its robustness with respect to small variations

Response: Thank you very much for your commons.

in the beta coefficient (eq. 7) and *a* and *b* (eq. 8) is not addressed. This MUST be

discussed and robustness established.

Response: Thank you very much for your commons.

β, a and b are the experience value that can be determined using radiosonde products. The main purpose of this manuscript is to demonstrate whether the urban heat island intensity can be monitored based on GNSS tomography method. In order to strictly controlled the entire algorithmic flow, then we will try to separate the atmospheric temperature from the wet refractivity using the variational analysis method in the future.

- The use of a "Kalman filtering" as a magic word to invert SWD values as Nw values. Kalman filtering is just another word for a least-squares process. In this particular case, the authors are technically doing a least-squares linear inverse problem. I urge them to have a look at the fundamental papers by Tarantola and Valette around 1980, that can be easily found, and especially the paper "inverse problems = Quest for information".

Response: Thank you very much for your commons.

In the tomographic approach, the observation equation is ill-conditioned as satellite signals do not pass through all voxels, causing the non-uniqueness of the tomography solutions. In order to solve this issue, a variety of reconstruction algorithms have been developed. They may be generally grouped into two categories. One is the iterative reconstruction technique (IRT) such as the algebraic reconstruction techniques (ART) (Wen et al., 2010; Bender et al., 2011), the multiplicative algebraic reconstruction techniques (MART) (Stolle et al., 2006; Jin et al., 2008) and the simultaneous iterative reconstruction techniques (SIRT) (Liu et al., 2010). Another is the non-iterative reconstruction technique (NIRT) such as the singular value decomposition technique (SVD) (Flores et al., 2000; Champollion et al., 2005; Notarpietro et al., 2011). In addition, the Kalman filtering (Nilsson andGradinarsky, 2006). So far, it is a very common method to solve GNSS tomography using ‘Kalman filtering’(Dong et al., 2018; Ding et al., 2018; Zhao et al., 2020), so we did not describe in detail how to solve the tomographic equation using ‘Kalman filtering’ in the manuscript.

Reference.

Bender, M., Dick, G., Ge, M., Deng, Z., Wickert, J., Kahle, H. G., Raabe, A. and Tetzlaff, G. 2011.

Development of a GNSS water vapour tomography system using algebraic reconstruction techniques, Adv. Space Res., 47, 1704-1720, doi:10.1016/j.asr.2010.05.034, 2011.

Champollion, C., Masson, F., and Bouinm, N. 2005. GPS water vapour tomography: preliminary results from the ESCOMPTE field experiment, Atmos. Res., 74, 253-274.

Ding N, Zhang SB, Wu SQ, Wang XM, Zhang KF. 2018. Adaptive Node Parameterization for Dynamic Determination of Boundaries and Nodes of GNSS Tomographic Models. Journal of Geophysical Research: Atmospheres. 123(4):1990-2003.

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Flores, A., Ruffini, G., and Rius, A. 2000. 4D tropospheric tomography using GPS slant wet delays, Ann. Geophys., 18, 223-234.

Jin, S. G., Luo, O. F., and Park, P. 2008. GPS observations of the ionospheric F2-layer behavior during the 20th November 2003 geomagnetic storm over South Korea, J. Geophys. Res., 82, 883-892.

Liu, S. Z.,Wang, J. X., and Gao, J. Q. 2010. Inversion of ionosphere electron density based on a constrained simultaneous iteration reconstruction technique, IEEE T. Geosci. Remote, 48, 2455-2459.

Nilsson, T. and Gradinarsky, L. 2006. Water vapour tomography using GPS phase observation: simulation results, IEEE Trans. Geosci.Remote Sens., 44, 2927-2941.

Wen, D. B., Liu, S. Z., and Tang, P. Y. 2010. Tomographic reconstruction of ionospheric electron density based on constrained algebraic reconstruction technique, GPS Solut., 14, 251-258.

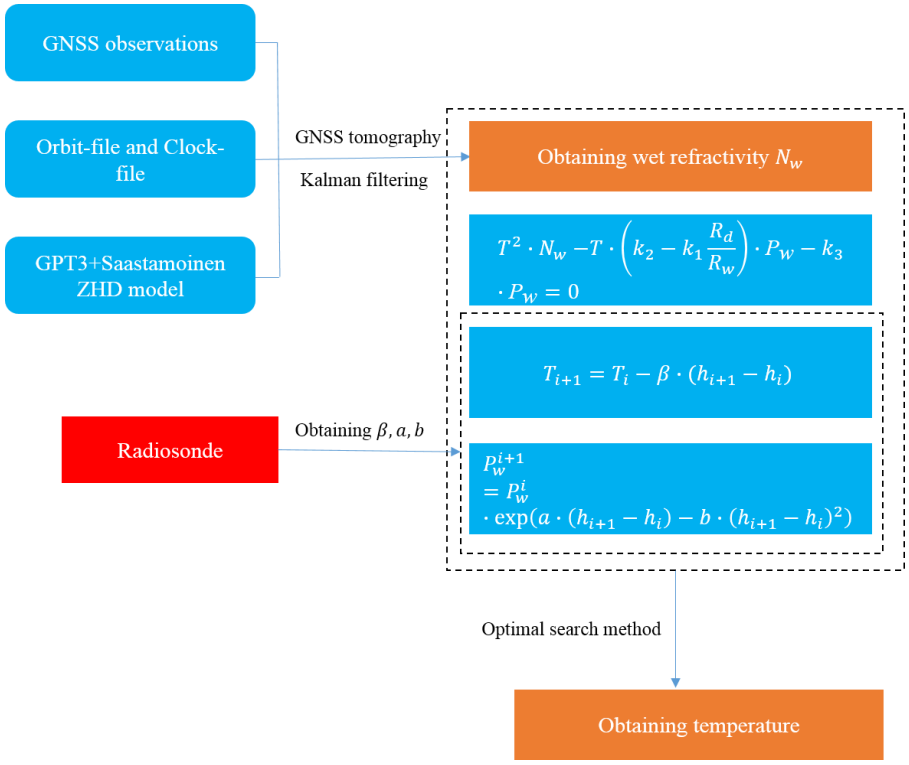
Zhao Q, Yao W, Yao Y, Li X. 2020. An improved GNSS tropospheric tomography method with the GPT2w model. Gps Solut. 24(2).

By the way (for the authors), are you doing a linearization of the inversion problem around eqs. 5 and 7? How do you weight a priori information, if any? Please add the relevant equations and do not stay in the vague of "Kalman filtering".

Response: Thank you very much for your commons.

After obtaining the wet refractivity profile based on the GNSS tomography method, the temperature was estimated by the optimal search method using eqations (6), (7) and (8).

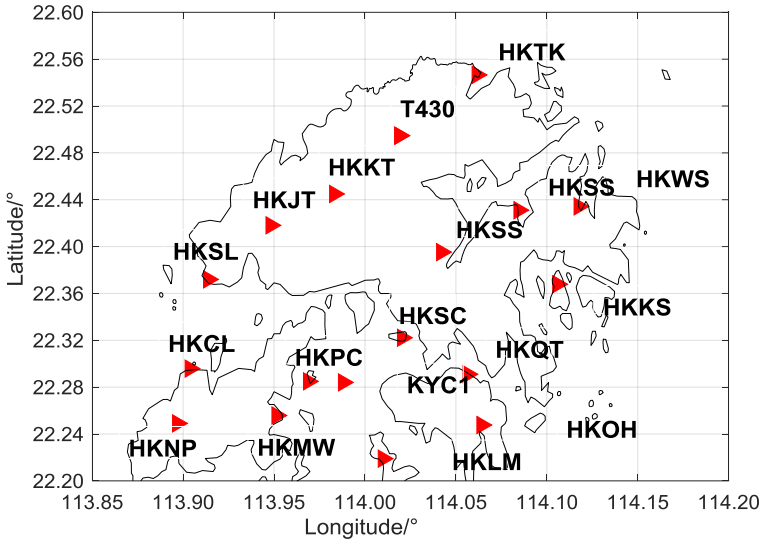
The fifth-generation reanalysis model (ERA5) could provide temperature and water vapor partial pressure, which were selected as the initial values in this study. The flow chart of data processing is as follows:



Minor points:

- please add contouring of the topography in Figure 1.

Response: Thank you very much for your commons. Figure 1 has added the contouring of the topography.



- please describe in a few sentences what is GNSS RO. Are you using COSMIC-2 data?

Response: Thank you very much for your commons. We added the detail of RO events happened in Hong Kong.

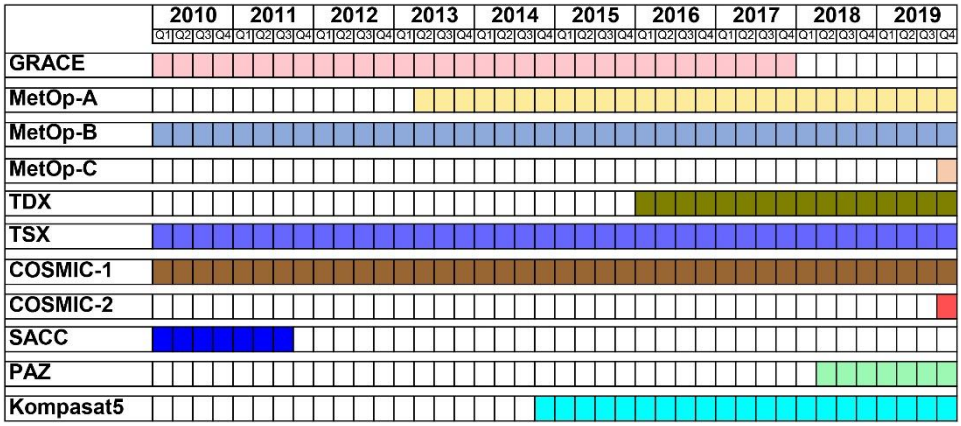


Fig.1. Selected radio occultation products and the corresponding time span. 'Q' means quarterly.

Table 1. Detail of RO events happened in Hong Kong

The range of selected RO events	21.2 ℃N-23.6 ℃N; 112.85 ℃E-115.15 ℃E
Mean number of RO events	1.3/day
The type of RO events	post-processed data products
The level of RO events	Level2

At this point, my recommendation is to reject and resubmit once these major issues have been fixed, or at minimum major revision, to be sure that the second part of the paper is reliable.

Response: Thank you very much for your commons.

If there is an inappropriate answer, please put it up again, I am very happy to answer and revise the manuscript again. Thank you very much.