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Atmospheric Measurement Techniques Discussions

Interactive comment on "A GPS water vapor tomography method based on a genetic algorithm" *by* Fei Yang et al.

Anonymous Referee #1

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The paper by Yang et al. (2019) introduces new methodological solution to the GNSS tomography ill-conditioned problem. Authors suggest to use of genetic algorithm that is applying optimization principle based on the minimization function of the slant residuals (y-Ax), and stochastic modelling of water vapour field evolution. The concept is sound, methodology quite innovative at least in the tomography community, but comparison with standard method reveals that there is a little or no improvement once the genetic approach is used. Moreover, competitive studies for the same location, shows better performance

p.16 "Xia et al. (2013) obtained a RMS of 1.01 g/m3 by adding the COSMIC profiles, Yao et al. (2016) obtained a RMS of 1.23 g/m3 by maximally using GPS observations and a RMS of 1.60 g/m3 without the operation, Zhao et al. (2017) achieved a RMS

of 1.19 g/m3 and 1.61 g/m3 considering the signal rays crossing from the side of the research area and a RMS of 1.79 g/m3 without this consideration, Ding et al. (2017) obtained a RMS of 1.23 g/m3 and 1.45 g/m3 by utilizing the new parametric methods and the traditional methods, Yao et al. (2017) achieved the RMS from 5 1.48-1.80 g/m3 using different voxel division approaches, etc, the total RMS of 1.43 g/m3 for the two time periods in this paper can be considered as a good agreement with the radiosonde data regardless of the weather conditions".

Therefore, two questions should be asked: are there any information left in the slants observations that can be utilized by the tomography framework, if positive, one might ask whether approach with introducing new algorithm to old parametrization will aid in the development of tomography processing. I suggest to address these two major questions in the revision process. Overall, the manuscript presentation quality is high, however few points need to be addressed (in addition to two major questions, stated above):

1. The genetic algorithm should be clearly explained and compared to the classic Least Square, Kalman Filter or Algebraic Reconstruction Technique solutions, reader need to understand the principles of approach and its application to the tomography problem. This comment is related to: The Introduction section where Authors only briefly p.3 l. 1-10 discuss differences between new method and standard methods, 2 Methodology where Authors should add one subsection discussing classic Least Squares applied in next section. 3. Experiment and Analysis, where reads would expect how Table 1 and steps discussed on pages 5 and 6 links to real data, It should be clear how choices of parameters from Table 1 translates into algorithm performance in more detailed, step-wise manner.

2.Comparisons with radiosondes fig 9, and with ECMWF fig 12 are corner stones of this manuscript. Therefore, it is difficult to understand why LS and Genetic algorithms were only compared to ECMWF but no to RS, as in fig 9. It should be done only for overlapping voxels. Why not to add to fig 9 two extra lines one for tomography LS and

one for ECMWF, this will clearly indicate the quality of retrieval in time.

3.The choice of research area to be one of the well-studied Hong-Kong cases has to be evaluated positively. However, division into rainy and rainless days is not supported by any meteorological analysis such as air mass origin, rain type, rain intensity, other associated phenomena. This is important as not all-weather types associated with rain will produce increase of SIWV. Moreover, there is limited evidence that the differences between so called “rainy” and “rainless” days are significant.

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