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Interactive comment on "Influence of station density and multi-constellation GNSS observations on troposphere tomography" *by* Qingzhi Zhao et al.

Anonymous Referee #1

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General comments: This manuscript discusses the impact of the number of GNSS stations and the use of single/multiple GNSS constellations on the tomography results. For this purpose, this study conducts a lot of tomography experiments in Hong Kong. This study may have some reference significance, but still has some deficiencies. My major concerns are your experiment designs and key results. I have specified these points and other comments in the specific comments. In addition, the language needs significant improvement. Though I have pointed out some, there are still many other problems.

Specific comments: Lines 62-63: In most past studies, multi-constellation GNSS ob-

servations are simulated with ideal data which cannot reflect the real conditions of multi-constellation GNSS observations. Please be more careful to say this and check the recent publications

Line 159-161: The specific principle is such that: increasing the 159 coverage rate of voxels penetrated by satellite signals and optimising the design matrix of the 160 observation equation. This is your criterion to determine the best horizontal division of the voxels. But it is not clear to me how you assess the state of the design matrix. From lines 157-167, I cannot make a sense of what your adaptive method to determine the horizontal division is. I am also not convinced why you choose scheme 3.

Lines 227-231: I don't think the experiment and the statistics in Table 3 support your conclusion since your experiment is poorly designed and the comparison is not fair at all. I am surprised why you design such a comparison rather than single-GNSS (14 sites) vs. multi-GNSS (14 sites) and multi-GNSS (10 sites) vs. multi-GNSS (14 sites)?

Line 263-265: station HKSC is near the radiosonde station, therefore, the reconstructed atmospheric wet refractivity from different cases nearby the location of radiosonde station are relatively accurate and undifferentiated. Is this because that HKSC always has enough observations? Do you use the radiosonde data of the tomographic epoch as the a priori information?

Figures 7 and 8: difficult to distinguish the different lines. Try to use more differentiable color.

Table 8: the presented results surprised me. The all-GNSS scheme does not even outperform the Galileo-only scheme! I also don't think the close distance between the radiosonde station and the HKSC station can explain the negligible RMSE differences among the 9 schemes. Again, is it due to that you use the radiosonde of the tomography epoch as the a priori values?

Lines 15-16: the expression is very confusing, please be specific and accurate. Lines

17-19: the expression is too general and inaccurate, please be specific. Try to revise it to something like “The results show that densification of the GNSS network plays a more important role than using multi-constellation GNSS observations in improving the retrieval of . . .. . .”. Lines 19-22: the expression is redundant. “Compared to the tomographic result from the 19 multi-constellation GNSS. . .. . . when the 21 data from the other four stations are added”. Line 22: “more” -> ”additional” Lines 26-29: unreadable expression Line 35: delete “with which” Line 37: “some” -> “finite” and delete “different directions” Line 39: “proved” -> “proven” Lines 42-45: poor expression Lines 47-49: try to simplify the expression and be accurate. Line 50: what does the “sparse filling” mean? Be specific Lines 51-54: you never talked about “design matrix” and its link with the previously mentioned disadvantage before this expression. Though I can understand you, most readers will get lost here. Try to give a clear logic link. Line 55: “modeling” -> “model” Line 56: delete “in which” Line 59: “way of solving such” -> “way to solve this” Line 60: “increasing the density of the GNSS network. . .. . .also is a . . .. . .” -> “densifying the GNSS network. . .. . .is another. . .. . .” Lines 70-71: these two different things are incomparable Lines 74-77: rephrase this sentence Line 80: “detailed” -> “detailedly” Line 92: “former” -> “latter” Line 93: “the latter” -> “the ZWD” Line 109: delete “, and a linear expression can be listed as”, it is redundant Line 118: “not all of the unknown wet refractivity values are estimated” -> “not all of the unknowns can be determined” Line 133: “statistically” -> “statistical” Line 157: delete “which able” Line 159: delete “such” Line 160: specify “coverage rate” Line 188: delete “stations, as presented by triangles of different colour in Figure 1,”, redundant Line 200: delete “the” Line 203: “doubled to tripled” -> “double to triple” Line 204-205: R-14 is also evident Line 385: “IGAR” -> “IGRA”

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