Changes in the Revision

(1) Some sentences are rewritten.

(2) Figure 1 (a), Figure 4, Figure 5 (c), Figure 6, are all replaced.

(3) Table 2 has been revised.

Responses to the Reviewer1's Comments

Thanks for the reviewer to provide very useful comments and suggestions,

and please see our responses in the following:

General comments

Comparison with ECMWF data

Thanks a lot for incorporating this, I think it really strengthens the manuscript. Last note that I can make about it, is that I think the authors forgot to mention this comparison in the methods (it is mentioned in the abstract, results and so on, but not mentioned as a testing method).

Response: Thank you for the comment. We have added this comparison in the Materials and methods section as follows: "To more comprehensively test the link's ability to invert water vapour density values, we compare the results with the ECMWF reanalysis (CMIP5 daily data on single levels, 2021). The data source is water vapour density converted from daily near-surface relative humidity (with a horizontal resolution of 0.125° x 0.125°) obtained from ECMWF." (Page 5 line 106–108).

Response to previous comment

"Lines 110–113: The moving average makes sense, I think. Have the authors, however, tested other moving window averages? I.e., where is the optimum and can we even go to higher temporal resolutions?

Response: Thank you for the comment. We tested different time windows and found that 60 minutes is the most appropriate. If the time window is lower than this value, the result after the moving average will not be smooth enough, and higher than this value will make the result after the moving average excessively smooth and distorted, and the hysteresis becomes obvious. Also, the time resolution after moving average is still 1minute."

Can I ask the authors to add their response (the one above) to the manuscript. I think it is valuable information to add to the methods sections where the 60-min window is introduced.

Response: Thank you for the comment. We have added this explanation to the manuscript (Page 6 line 124-126).

Colorblind-proof figures

Figures 4 and 6 are not colorblind proof. I would recommend the authors to make the figures colorblind proof (red - green is for instance a tricky one). Have a look at e.g. Crameri et al. (2020).

Response: Thank you for the comment. We have modified the Figure 4 and 6 to be color-blind proof (Page 11-12 line 228, Page 14 line 261).

Discussions section

Suggestion: could the authors say something about the operational availability of the required CML data to scale their method up to an operational method in their study region and elsewhere? Thus, how likely is it that we will be using this method operationally in the near future?

Response: Thank you for the comment. We have added relevant explanations to the Discussion section as follows: "The research results show that it is feasible to invert water vapor using millimeter-wave links, and this method can be extended to the monitoring of meteorological factors such as rain, snow, and fog. At the same time, it also provides a basis for atmospheric monitoring of commercial microwave links, which will help to promote applications in the field of meteorology in the future. This is a test link, but E-band links are expected to be widely used in 5G networks and smart city networking." (Page 15 line 286–290).

Specific comments:

1 . Lines 25 – 26 "Compared with ECMWF reanalysis, the link performs better in water vapor density estimation": Quantify this a bit, so how much better (what are the correlation values of the tested estimation techniques)?

Response: Thank you for the comment. We've re-written the sentence in the manuscript as follows: "Compared with ECMWF reanalysis, the correlation of the daily water vapor density estimation of the link has increased by 0.17, the root mean square error has been reduced by 3.14 g/m^3, and the mean relative error has been reduced by 0.33 %." (Page 1 line 25–27).

2 . Lines 70 – 74: This is a result of the study. Although it is fine to mention why this study adds knowledge to existing literature (e.g. keep the mentioning of the higher temporal resolution and that you compared the results with among others ECMWF estimates), it is better to leave the results for the results section.

Response: We agree with the comment. We've re-written the sentence in the manuscript as follows: "Finally, a comparison between the link inversion results and the ECMWF reanalysis is given. The resolution of the link estimation result is 1 minute, while the ECMWF is 1 day. Moreover, the time resolution in the previous studies (David et al., 2009; Alpert and Rubin, 2018) was also higher than 5 minutes. The link length used in these studies is 2-5 km, which is 4.8 km in this paper." (Page 3 line 72–75).

3 . Lines 118 – 119 "Since the quantization resolution of the equipment we have used is 1 dB and the quantification resolution of the water vapor density calculated by the weather station is 0.01 g/m3 , the resolution of the two data is inconsistent.": This sentence still requires some extra information, e.g. why is the resolution of both data sets inconsistent?

Response: We agree with the comment. This is because the GUI of the wireless communication device cannot display the received signal level with higher accuracy, resulting in the link's estimated water vapor density value with a lower quantification

resolution than that calculated by the weather station. We've re-written the sentence in the manuscript. (Page 6 line 124-126).

4 . Lines 225 – 228: Besides the good results that have been reached, also discuss the mean values and the moments when the estimation is not as good. That won't make the story weaker (not at all, actually), but gives an honest overview of the results.

Response: Thanks for your comment. We've re-written the sentence in the manuscript as follows: "In other words, the highest and lowest monthly correlation are 0.95 and 0.63, the highest and lowest root mean square error are 1.88 and 0.35, and the highest and lowest mean relative error are 0.27 and 0.05. June has the highest correlation and the root mean square error and mean relative error are also low. But January, February, and May 2021 have lower correlations." (Page 13 line 235-238).

5 . Lines 255 – 260: also add the expected effect this has on the presented results.

Response: Thanks for your comment. We have added the expected effect this has on the presented results as the following: "This will reduce the accuracy of link inversion of water vapor density. As shown in Fig. 4, the results of the link inversion have the same trend as the measured values of the weather station, but they are not always consistent." (Page 15 line 270-272).

Technical corrections:

1 . Line 25 – RMSE and relative error values: This is still missing the unit.

Response: Thank you for the comment. We have added units to the manuscript (Page 1 line 25).

2 . Line 40 – "measurement": measurements

Response: Thank you for the comment. We have corrected this error in the manuscript (Page 2 line 42).

3 . Line 90 – "transmit": transmission

Response: Thank you for the comment. We have corrected this error in the manuscript (Page 3 line 91).

4 . Line 105 – "60 dry periods with a duration of 1440 minutes": 60 dry periods with a duration of 1440 minutes per period.

Response: Thank you for the comment. We have corrected this error in the manuscript (Page 5 line 110).

5 . Line 215 – "(Climate Overview of Hebei Province)": Is this a reference? If so, the year is missing.

Response: Thank you for the comment. We have added year to the manuscript (Page 11 line 224).

6 . Line 244 – “Fig. 6 show”: shows.

Response: Thank you for the comment. We have corrected this error in the manuscript (Page 14 line 254).

7 . Line 247 – “averaged daily”: averaged per day.

Response: Thank you for the comment. We have corrected this error in the manuscript (Page 14 line 257).

8 . Line 256 – “point measurement”: point measurements.

Response: Thank you for the comment. We have corrected this error in the manuscript (Page 15 line 266).

9 . Line 275 – “better than ECMWF”: which product of ECMWF?

Response: Thank you for the comment. We have corrected this error in the manuscript (Page 15 line 291).

10 . Line 285 – “high density”: high spatial or temporal density?

Response: Thank you for the comment. We have corrected this error in the manuscript (Page 16 line 301).

11 . Line 294 – “while the ECMWF is 1 day”: while this 1 day for the tested ECMWF product.

Response: Thank you for the comment. We have corrected this error in the manuscript (Page 16 line 310).

12 . Line 306: How do you propose to do that?

Response: Thank you for the comment. We have rewritten this sentence in the paper as follows: “We can try adding a temperature variable to the process of estimating the water vapor density.” (Page 16 line 322).

13 . Figure 1: on the x-axis of sub figure (a) the degrees N are mentioned. This should be degrees E.

Response: Thank you for the comment. We have corrected this error in figure 1 (Page 4 line 95).

14 . Figure 5 and 6: Something seems to go wrong with the dates on the x-axis, the spacing is no longer uniform. Besides, don’t forget to add the units of the RMSE and MRE to the skill scores in figure 6.

Response: Thank you for the comment. The smallest scale on the x-axis is the day, not the month. Each month does not contain the same number of days, so the month scale is not uniform. We have added units in figure 6 (Page 14 line 261).