Answers to referee comments on "An improved vertical correction method for the inter-comparison and inter-validation of Integrated Water Vapour measurements" by Olivier Bock et al., Atmos. Meas. Tech. Discuss., 2022.

Anonymous Referee #3

We thank the referee for the comments and provide below a point by point answer. Referees' comments are repeated in black, and our answers are given in blue. The corrections made in the manuscript are also indicated.

1) You assume that the 'standard procedure' for the vertical interpolation follows the simple exponential law provided in the introduction of the manuscript, i.e., 2km scale height for IWV. Who defined this to be the 'standard procedure'? In literature (also see next comment) I find different 'standard procedures'. E.g. you may use weather model data, and calculate the interpolation coefficients or lapse rates from there. That's it. In fact in the end of the manuscript you mention that you are going to make use of ERA5.

Nowhere in the paper is this method referred to as the 'standard procedure'. We write that it is a "widely used one" (Line 48) and cite a few papers that used it. The 2-km scale height quoted in Appendix A is from the ITU 2017 reference standard atmosphere, but this value is just quoted as an example. Otherwise, empirical values determined from measurements by various authors are also given in the Introduction.

We agree that if coincident weather model data would be available, the correction could be directly calculated in this way. However, it is not clear a priori what vertical resolution from the model data is required to achieve a good correction. To provide a first insight, we tested the method with a degraded version of our radiosonde data. We found that for 50-m and 100-m resolutions, the results are only very slightly degraded (see also our answers to Referee #2). We added a note in the conclusion to mention this result around Line 453:

"A few additional trials showed that with a vertical resolution of 100 m, very good results are still achieved (e.g., bias error smaller than 0.1 kg m-2)."

Our idea with the ERA5 is rather to provide a global climatology of monthly correction coefficients rather than direct IWV corrections.

Note that one clear advantage of the proposed empirical correction method is to avoid the need for coincident, high resolution, weather model data.

2) Your procedure could be useful for the vertical correction of the so called zenith wet delay, right? In some processing schemes a priori zenith wet delays are applied (they are typically provided from gridded numerical weather model data) but a vertical correction is required. Can you comment on this in the introduction. Here are some useful papers:

Böhm, J., Möller, G., Schindelegger, M. et al. (2015) Development of an improved empirical model for slant delays in the troposphere (GPT2w). GPS Solut.

Dousa, J., and Elias, M. (2014), An improved model for calculating tropospheric wet delay, Geophys. Res. Lett.

Yes, the procedure would similarly apply to ZWD correction. We mentioned it in the Introduction of corrected manuscript around Line 41 and at the end of the Conclusions.