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# *Interactive comment on* "Atmospheric observations with E-band microwave links – challenges and opportunities" *by* Martin Fencl et al.

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First of all, we would like to thank Dr. Guyot for his valuable comments and suggestions. Below are our reactions:

### General comments

1. *The introduction covers most important aspects but it omits to mention that attenuation by rainfall at these frequencies (E-Band) has already been investigated experimentally, e.g. by Shresta and Choi (2017) or Norouzian et al. (2020) for*



*instance (and maybe other papers). This literature is often going under the radar of the atmospheric community maybe because it is published in specific engineering and electronics journals (often IEEE). Yes, the objective of these studies was the optimal design of back-haul networks, as to minimise the occurrence of signal fading, instead of opportunistic measurement of rainfall. But nethertheless, experimentally this is the same setup and collected data, and often even formulations and theoretical approaches. I would in-clude a mention of their existence in the introduction, and eventually in the discussion if appropriate.*

   This is an interesting point. We are aware of E-band investigation being reported in the electrical engineering journals (often IEEE) and refer to two examples of this work in the Introduction at L51 (Hansryd et al., 2010; Luini et al., 2018) and two other examples in the section about wet antenna attenuation at L94-101 (Hong et al., 2017; Ostrometzky et al., 2018). The investigations of Hansryd et al. (2010) and Luini et al. (2018) have similar scope as the papers suggested by Dr. Guyot. We have been considering also referring to other works, nevertheless, the propagation studies aiming at community designing microwave link networks are mostly focused on long-term availability and lack evaluation in shorter time scales, which is critical for evaluating retrieval of atmospheric variables. We thus believe, that our relatively concise list of references on radio engineering investigations suffices as it, first, covers most important topics being previously investigated and, secondly, can provide further reading through referenced or citing studies. On the other hand, we might have missed some important point in the suggested references or some topic in the radio engineering literature and will be thus happy for a notice.

2. *L105: Which parameters values for the canting angle and temperature, and which model did you use for the T-Matrix calculations? You have to specify it here.*

   Thank you for notifying us of missing piece of information. Python implementation of the T-Matrix model suggested by Mishchenko and Travis (1998) was used. We will add a reference to this implementation (Leinonen, 2014) in the revised version of the paper. The calculation assumes temperature 10° C, canting angle 0°, drop shape being oblate spheroid, drop axial ratio according to Pruppacher and Beard (1970), and for drop smaller than 0.5 mm a heuristic approximation of Pruppacher and Beard's formula is used. We will provide this information in the revised paper.

3. *Effect of the k-R relation on the retrievals. Those are interesting results but I think the paper abstract does not reflect the actual results of this section. Typically, in Table 5: the performance criteria are actually quite similar between the use of ITU parameters and DSD parameters. Often only 0.01 differs for R2, and RMSE rarely exceeds 0.05mm h-1. So only based on this, one might think the parameters used are not of real matter. But when looking at Table 4 and the parameters per rain type (stratiform and convective, low and moderate rain rates) one sees the discrepancies. So it is the k-R relations for local DSD and differentiation for specific rain classes/types being used that has an impact on the retrievals at these frequencies. When lumped all together, ITU or specific DSD actually lead to similar retrievals outcomes. As the authors noted, including larger rain rates in the dataset would increase the differences in retrievals and the importance of the DSD on the retrievals at these rain rates.*

   The conclusions about sensitivity to drop size distribution are based on theoretical evaluation using attenuation and rainfall calculated from drop size distribution data. The effect of DSD is also demonstrated on real commercial microwave links (CMLs), nevertheless, other sources of errors, especially wet antenna attenuation (WAA) affect these results significantly. Moreover, our results are affected by the absence of heavy rainfalls during the experimental period (see Discussion section L589 – 595). This is the reason why only the longest CML is suitable for demonstrating DSD related errors, as stated in the Performance evaluation subsection (L319 – 324). The shorter CMLs are overly affected by WAA during light rainfalls to enable interpretations on DSD errors. We might stress this also



   when referring to Table 5 or at another place in the manuscript to avoid confusion. We are, however, convinced that results from the long CML are capable of demonstrating benefit of using parameters specifically derived for stratiform rainfalls. Although the improvement in the metrics is not large in absolute values it is significant in relative values. E.g. decrease in RMSE from 0.49 to 0.39 mm $h^{-1}$ by 73.5 GHz sub-link and from 0.31 to 0.24 mm $h^{-1}$ by 83.5 GHz sub-link is decreased by 20 % resp. 23 %. This is even more pronounced in relative error where improvement from -0.44 to -0.35 by 73.5 GHz sub-link and -0.17 to -0.08 by 83.5 GHz sub-link is an improvement by 20 % resp. 53 %. Later, we will consider modification of the manuscript in this direction based on reviewers' comments.

4. *At these frequencies, longer CML path lengths translates in higher sensitivities to light rainfall – but it also means a coarser spatial resolution for CML rainfall maps – this can be a drawback and can be highlighted.*

   The higher sensitivity of longer CMLs to total rainfall attention is intrinsic to all frequency regions and the investigation of rainfall reconstruction goes beyond the scope of this study. Investigation addressing specifically CML rainfall reconstruction errors is presented for example in Rios Gaona et al. (2015).

**Specific comments**

We would like to thank Dr. Guyot for tracking our manuscript for typos and shortcomings. We will address all of them in the revised manuscript as suggested.

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