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Atmospheric Measurement Techniques Discussions

Interactive comment on "An urban microwave link rainfall measurement campaign" *by* Thomas C. van Leth et al.

Anonymous Referee #3

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Summary:

This manuscript presents results from a comprehensive field experiment studying error sources for rainfall retrieval with microwave links. The paper is well structured and well written, expect for some places where the writing should be made less monotonous. The conclusion are a bit vague, though. However, in my opinion, this is more a shortcoming of the writing and less of the experimental setup or the analysis. In summary, this manuscripts provides an important contribution and should undergo a minor revision to be published in AMT.

General comment:

The discussion of the causes, implications and possible mitigation strategies for the

different effects should be more detailed in section 5. In particular the consequences when using data from a large number of operational microwave links from a cell phone network, where no ground truth is available to detect and accurately mitigate the caused errors, should be addressed. It would be important to, at least, estimate the magnitude of the different effects on rainfall retrieval from typical operational microwave link networks.

The title and the abstract do not hold much information about the main goal and findings of this study, the search for explanations of the fluctuations of the received signal level. I recommend that the findings, which are a bit vague, but nevertheless very important for the community of researchers that derive rainfall information from microwave links, are presented clearer already in the abstract.

Specific comments:

Title: The title should reflect the actual topic, investigation of the microwave links errors, a bit more.

page1, Line 18: With all the "and"s this sentence is a bit hard to understand

Page1, Line 25: Why not start a new paragraph here (instead of one sentence before) for the part of the abstract which summarizes the results.

Page1, Line 27: I would not call "temperature" an "attenuating phenomena". As you show in the manuscript, it can have a big effect on the RSL, but not by adding attenuation. It is more likely to be bias from the electronics. Maybe you could reformulate here.

Page1, Line 28: The summary of the conclusions should be more detailed. What is the order of magnitude of the different error sources, etc?

Page 1, Line 36: Instead of "regional" precipitation distribution, writing "local" or just "spatial" fits better here.

Page 1, Line 38: Since the height of the radar observation above ground is very close to the ground near the radar, and can be a lot higher than 1000 meters far from the radar, I would not write "roughly 1000 meters“ but maybe mention that it can be more than 1000 meters far from the radar or in complex terrain

Page 2, Line 1: "arsenal“ sounds a bit colloquial.

Page 2, Line 10: Do you mean "back then“ instead of "since then“

Page 2, Line 13: A bit monotonous: "This. . . This. . . This..“

Page 2, Line 25: Add a comma after "Therefore. . .“

Page 2, Line 25: Is "research. . . into. . .“ correct english?

Page 2, Line 25: When speaking about "microphysical aspects“ of the "retrieval algorithm“ I would think more towards the em-wave scattering of individual drops and not the error sources you are investigating here. Hence, I feel the term “microphysical” is misleading here.

Page 3, Line 31: Add comma after "on the other“

Page 4, Line 24: Is the Nokia link working in both directions? If yes, what is the frequency difference?

Page 4, Line 32: Is the difference of only 176 MHz between the Nokia and the dual-pol RAL link really enough to make sure they do not interfere? To be more precise, do you know the band-pass filtering characteristics of both systems?

Question regarding the systems: Multipath effects can also cause large fluctuations in the received signal level. This effect will be different for different propagation settings, i.e. different frequencies and different antennas. What is the antenna size, beam width and gain for the used systems? Maybe a table with the details of the systems would be good.

Page 4, Line 35: "This provides for comparison in the case of,. . .“. Is the term, "to provide for comparison“ correct English?

Page5, Line 7: Since you did not monitor the TX power, how about (temperature) drifts of the transmitter?

Page 5, Line 11: Is "in this way“ correct english?

Page 6, line 27: You use temperature observations for deriving the terminal velocity (as stated in section 4.1.1), but here you use a constant temperature of 15 degree Celsius. Why? In particular for 38 GHz, temperature difference e.g. between summer and winter, will impact the extinction cross section and hence the k-R relation.

Page 7, Line 4: You should discuss how do the derived k-R parameters compare to the ones from the literature here.

Page 7, Line 6: It is a bit misleading that you write that you are "closely following“ Overeem et al., but some sentences later write that you use a completely different way (which is fine for this experiment) to detect rain events.

Page 7, Line 13: "would not be relevant here“, maybe better write "is not applicable here“

Page 8, Line 10: Are you sure this is "background noise“, hence stemming from the electronics? It could also stem from propagation differences of the systems, e.g. because of different beam widths or slightly different alignments. Both of these could result in different propagation conditions resulting from diffraction/refraction from the ground (buildings, trees, etc.).

Page 9, Line 1: Add a "a“ after "probably“

General question: Doesn’t the additive bias mainly stem from the very simple baseline determination?

General question: What is the correlation and bias of the disdrometer and the gauge

next to it?

Page 10, Line 4: The precipitation intensities should not only be "taken with a grain of salt“. Their absolute values are, as you explain a little later, completely unusable. Maybe the dynamics indicate a little the dynamics of the precipitation event. But the problem most likely is that your 30-second disdrometer aggregations are too short and only contain a very small number of drops. Hence there is a lot of sharp isolated peaks which might probably stem from individual large snowflakes the disdrometer detected during on 30-second period.

Page 10, line 16: Maybe, if available, you could add possible explanations for this effect if, as you write, the snow deposit alone cannot explain it.

Page 11, line 15: It is not clear from the text whether the periods with high humidity are also removed for the calculation of correlation including rainy periods.

Page 11, line 15: "temperature dependence . . . is still roughly consistent. . .“. First of all, the term "still roughly consistent“ is a bit vague and should be rephrased. However, judging from table 1, there is a clear decrease of the correlation if rainy periods are included and a further decrease when only considering rainy period. I think, this should be reflected in the text. Nevertheless, the correlation of, e.g. -0.4 for rainy periods only, is surprisingly high.

Page 11, line 26: Does dew really build up a thin layer on the antenna or does it also form small droplets, as shown for the spraying of the antennas?

Page 11, line 41: Fog cannot generate an attenuation of 3 dB for such short links at frequencies of 38 GHz and below (please check the references you cited). Hence, I do not understand why the you consider fog as a possible source in this sentence.

Page 13, line 19: ". . .no lingering attenuation,. . .“ This comma should be moved after "..in both cases. . .“.

Page 14, line 2: The comparison of the different parameters would fit better in section

4.1.3 where the actual analysis is explained. In the conclusion section I would not expect the presentation of new results or data.

Page 14, line 43: Will the data of the experiment be made available after publication?

Fig 5: "RAL 38 V“ appears two times in the legend. Colors of RAL 38H and RAL 26 change between plot "a“ and "b“

Fig 7: Why not use the same color for the different microwave links as in the time series plots, e.g. Fig 6.

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