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Atmospheric Measurement Techniques Discussions

Interactive comment on "Retrieval algorithm for rainfall mapping from microwave links in a cellular communication network" *by* A. Overeem et al.

Anonymous Referee #4

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SUMMARY

The manuscript describes retrieval algorithm for rainfall mapping from commercial microwave links (MWLs) of cellular communication network and provides step by step account how to apply it on MWL data: from preprocessing of a single MWL to a rainfall spatial reconstruction from multiple MWLs. The methods presented have been already published (Overeem et al., 2011, 2013), which authors acknowledged, and the manuscript thus does not reveal new scientific findings. Its main contribution to the scientific community lies in i) publishing complete computer code for preprocessing MWL data and reconstructing rainfall maps from them and ii) it provides a two days dataset of MWLs and reference weather radar.

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GENERAL COMMENTS AND RECOMMENDATIONS

Although the manuscript does not present novel concepts, neither tools nor data the author's intention to provide computer codes and data to promote and enhance MWL rainfall estimation is beneficial and deserves attention. The concept of rainfall retrieval from commercial cellular MWLs has been suggested about a decade ago (Leijnse et al., 2007; Messer et al., 2006) and since then there has been a number of manuscripts published investigating different issues of this topic (many of them also in AMT). To the reviewer's knowledge this is for the first time that comprehensive MWL dataset from real cellular network is published. This is mainly because of the legal status of data which belongs to cellular operators who usually consider both MWL positions and data as confidential information and are not willing to provide it to third parties. Form this point of view the manuscript together with supplements provided address relevant scientific topic which is worth publishing within the scope of AMT and which has potential to enhance progress in MWL rainfall research and bring attention to this topic. However both manuscript and the computer scripts provided need major revisions to fulfill this mission and enable scientific community to benefit from the given dataset and methods.

The reviewer suggests restructuring this manuscript in a way to provide rather than step by step "cookbook" how to run R scripts, comprehensive statistical description of given dataset and deep discussion about limits of suggested algorithm and its transferability to different conditions. New structure should also clearly separate methods and results (which are now mixed).

The form of provided scripts enables reconstruction of results discussed in the manuscript. However all scripts are hardcoded and thus running them with different dataset or with different thresholds requires lot of script reading and coding from a potential user. The reviewer suggests recoding all the provided scripts into a library of functions with well-defined and documented input parameters and outputs. The documentation to the scripts should be provided as a separate supplement. The reviewer also suggest to provide a documentation (or appendix of the manuscript) to the

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dataset with description of provided data in terms of their structure and formats in form of a separate supplement. Authors should also consider providing computer scripts and documentation through some of the repositories such as GitHub which are well suited for code sharing and maintaining and include tools such as versioning, etc.

Although such changes require lot of additional work the reviewer believes that this work is worth to fulfill the author's goal, i.e. promoting of MWL rainfall monitoring.

SPECIFIC COMMENTS

p.8193, 5–8. As most of the current networks use automatic transmit power control, thus transmitted power has to be also provided.

p.8194, 8–9. Transmit powers are constant or may be constant? Is this unknown information?

p.8194, 12. Communication links are mostly full-duplex. Is it so, that you do not have information about second direction, or there are really some links which are not full-duplex?

p.8194, 23–25. Is this gap relevant for presented results? If yes, please comment on it in more detail. If not, omit it.

p. 8195, 4–8196,-3. Data format issue should rather be addressed in a dataset documentation provided in supplementary files (as suggested in general comments).

p. 8195, 19–23. An information about ATPC has little to do with "Data format used in code". Consider moving it into different section.

p. 8197, 3–6: Could you comment on consequences when b would not be close to 1? For selected frequencies it can differ from 1 by +- 20 %, that is not so little considering that b is the exponent in power law relation between specific attenuation and rainfall and the fact that strong rainfall can cause specific attenuation of several tens of dBs.

p. 8199, 6–7. Why radius of 15 km? Please comment on this threshold and be more

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specific how you've come to this value. Is this threshold same for different climatic conditions? Does the MWL density plays role when determining this threshold?

p. 8200, 7. The threshold values are though introduced in Overeem et al. (2013) however there is no description how they were obtained. Could you comment on these thresholds and specify if they are network/link specific or/and climate specific and how one should obtain them for different dataset?

p. 8200, 20–25. For this threshold holds the same which was stated in the previous comment.

p. 8201, 13–p. 8202, 9. Could you comment on this threshold? How would it change for different time step? Shouldn't this threshold differ according to the distance of evaluated link to neighboring links?

p. 8204, 6–10. Many of the MWLs included in the analyses are 10 km or longer. Is the assumption about limited error caused by b different from 1 still valid?

p. 8205, 10–14. Difference between a and b for different vertical and horizontal polarization is not negligible. Why don't you distinguish between different polarizations?

p. 8206, 14–p. 8207, 17. The structure and content of the paragraph is confusing. Especially mixing of methods and results.

p. 8207, 25–26. Berne et al., (2004) clearly shows that significant part of spatial correlation within shorter time steps comes for spatial structure of convective cells whereas within longer time steps larger precipitation patterns influence the spatial correlation. Thus extrapolation of time intervals from 1 h to 15 minutes seems suspicious. Can you comment on this?

p. 8208, 20–21. Shouldn't be the spacing of observation taken into account? What if most nearest observations are only in one direction (e.g. for some MWL nearby a city).

p. 8210, 4–6. Lengths of MWLs differs significantly in provided example (from hun-

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dreds of meters up to twenty or even more kilometers). How does this assumption influence the error of algorithm? Shouldn't be long MWLs considered by more points?

p. 8210, 20–25: The discussion about errors caused by different MWL density is very vague. The density of MWL network in cities and outside of them differs in order of magnitude or more. Could you address more specifically how does the MWL density influence performance of the algorithm? Is there e.g. some critical density under which reconstruction cannot be performed? And on the other hand is there some density threshold when more MWLs do not bring any additional improvement? How does the network topology influence its ability to capture different rainfall spatial patterns? Figure 7 shows reconstruction of strong rainfall over cities with dense MWL network. How successful would be the reconstruction at areas with lower MWL coverage?

p. 8211–p. 8215: The conclusion section should address the most important conclusions. Most of the content of this section should be therefore moved to Discussion section, which is now missing completely in the manuscript.

p. 8212, 23–26. Why should one use MWL rainfall maps if high quality radar data would be available?

p. 8212, 27–p.8213, 1. How can experiment on one commercial link of given frequency, polarization, length and other specifics help to calibrate Aa and alpha of many different MWLs around the whole country?

8213, 1–12. How satellite data should be employed to calibrate Aa and alpha? If satellite data can be used for calibration of MWL rainfall model what is the advantage of calibrated MWLs compared to satellite products?

8213, 19–8214, 2. Whole paragraph is confusing and should be move to different section or to the appendix. It is not a conclusion of a manuscript.

8214 14–15. The information about variable types should be a part of the script documentation and not a part of the conclusion section.

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8215, 8–11. Van de Beek's et al., (2012) assumption about stationarity and isotropy of rainfall spatial structures was done for longer time steps and will be probably strongly violated for shorter time steps (15 min). This fact should be addressed in the manuscript especially in terms of errors coming from the assumption.

8215, 19–21. The contribution of interpolation methodology to the errors is dependent on MWL density in an area of interest. Is the contribution of interpolation error minor also in sparsely covered areas?

8215, 22–25. This information should be part of a script documentation rather than placed in the last paragraph of manuscript where reader expect some overall conclusion, the selected most important conclusion or summary of conclusions.

LITERATURE CITED IN THE REVIEW

Van de Beek, C. Z., Leijnse, H., Torfs, P. J. J. F. and Uijlenhoet, R.: Seasonal semivariance of Dutch rainfall at hourly to daily scales, Adv. Water Resour., 45, 76–85, doi:10.1016/j.advwatres.2012.03.023, 2012.

Berne, A., Delrieu, G., Creutin, J.-D. and Obled, C.: Temporal and spatial resolution of rainfall measurements required for urban hydrology, J. Hydrol., 299(3–4), 166–179, doi:10.1016/j.jhydrol.2004.08.002, 2004.

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