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One-Year analysis of rain and rain erosivity in a tropical volcanic island

Rechou et al.

The article discusses vertical structures of rain and wind between 2009-2010 on the tropical island la reunion measured by a UHF 1290 MHz profiler. The studies is of great relevance for rain erosion, that might be a concern on the island. However, the title and the expected relevance are not adequately discussed. First the analysis focuses on rainfall in an areas of relative low rainfall (1000 mm/y) compared to areas where rain erosion might be relevant with rainfall of > 10,000 mm/y. Second the analysis's main focus towards the three case studies and one-year analysis is solely discussion in terms of comparing profiler with rain gauge data. Third rain erosivity is only mentioned in one short section. Since research objectives and main results are not clearly stated, it is not clear how this study can broaden our knowledge about tropical rain characteristics and how those relate to soil erosion in step terrain on a volcanic island. While the paper discusses the figures, the interpretation is completely left to the reader. Figures and text need major revision. An interpretation of the DSD parameter needs to be broaden also how results compare to DSD parameter retrieval from other studies. research objectives and main results need to clearly stated. The manuscript needs major revision before publication.

Main comments:

1) Authors should either exclude rain erosion from the title or need to include it in the analysis and discussion. Since the analysis of single profiler completely ignores the spatial variability of rain, which is essential considering the topography (Fig 2), I think the data set cannot be used for this ambiguous topic. Also, soil moisture, soil type, vegetation, inclination, wind-driven rain etc. need to be included in order to properly address this issue.
2) UHF profilers are not designed for measurements in heavy precipitation or DSD measurements, even though some of those quantities can be retrieved under special conditions. However, the paper needs to address some of those error sources such as reflectivity measurements and rain attenuation, quality of wind measurements during heavy rain etc. The results also need to be discussed remembering those error sources. For instance, all cases discussed in the paper have a vertical extend of 3 km which is caused by attenuation rather than true cloud top heights. The paper needs to include a section about the retrieval steps and qc of profiler measurements. Are the methods discussed at page 3252 used for this analysis - this needs to be clarified.
3) Due to the high spatial and temporal variability of rain, the calibration of radars is only useful for a long time series. It seems that the authors only used a short time period and not the entire year. However, more discussion and clarification about the radar calibration needs to be included. Furthermore, a figure showing scatter plots of all data (profiler vs rain gauge) needs to be included to support the argument that the radar is well calibrated.

4) Throughout the paper more details about the methods need to be included. For instance, are all analyses based on hourly mean data? What qc is applied to e profiler data? How are data handled when the rain gauge measures precipitation while the profiler is not? what is the qc procedure for the rain gauge data?
5) Sections 2.3 and 3.1 are confusing (see also commend #3). Why is the calibration done at 600 m profiler level, while the comparison is done at 800m. Second it is not clear what data are used for the calibration. If the same data set is used, then this would not make sense at all. Based on Fig. 5, is seems that there is a clear pattern of rain followed by no rain, the way the red bar are plotted looks strange (width of the bars and the white space) - The authors should check their code. Statistical values of median, spread etc between the profiler and rain gauge should be provided. In general what is the purpose of the statistics? Why are rain characteristics not analyzed based on the title. I understand the need to show at the profiler data are correct, but I doubt that rain gauge measurements (point measurements) are sufficient to be compared to vertical profiles. I would suggest that authors do a long-term calibration of profiler using rain gauge data and then discuss rain gauge, disdrometer, and profiler measurements in terms of rain characteristics as promised in the title.
6) What is the purpose of the case studies? what kind of events are those? Again since the measurements only reach up to a height of 3 km, are those low clouds, are the measurements limited to attenuation etc.? The measurements themselves look weird and noisy, e.g., on Fig. 8-2a at 1700 reflectivity is around 0 dBZ and fall velocity > 5 m/s, 3b 1530 wind max of 30 m/s at 3.5 km. So, before the authors start calculating DSD parameters the quality of the data has to be excellent, so far, that is not given by looking at the plots presented.
7) Secs. 3.2.2-3.2.4 are completely useless unless the authors show that their data are excellent quality (which needs to be done with another instrument than rain gauge) and that the derived parameter are trustworthy. Why don't the authors show the difference in DSD between the profiler and a disdrometer? Again, what is the purpose of those sections - the figures need to be interpreted and not just shortly discussed. It seems that the authors just show that they can calculate stuff with interpreting results, I.e., vertical structures of rain and how that relates to erosion.
8) What are the conclusions of this study?

Minor Comments:
1) Introduction: Previous studies should not just be listed in the introduction, but Results from those studies presented in the introduction should be discussed and how those results relate to the analysis done by Rechou et al. What are the objectives of the Rechou analysis?
2) P. 3251: line 13 What region is the Chen & Chen study for? Line 28 What time of the year is the jet stream close to the island?
3) P. 3252, 2nd par: what types of profilers were used? What does "good agreement" mean? What technique is used I this study?
4) P. 3254, quantify "strong precipitation", " most intense precipitation events"; topographic map would be helpful, maybe overlaid with the mean precip map.
5) Fig. 1: explain red dots, green trees. Where is North?

6) P. 3255: List of equations should come before they are discussed, e.g., after 1st par. Discussion about error sources should be included. For instance, what is the accuracy of the DSD parameter depending on the accuracy of reflectivity and fall speed?
7) P. 3256, line 23: vertical velocity is negligible compared to raindrop fall speed. Is this assumption true for tropical convection and strong orographic forcing such as over the island? These issues need to be discussed?
8) P. 3257, lines 1-4, what are those values based on?
9) P. 3258, 1st par: The discussion in this par is completely hypothetical without any justification? Authors claim that the differences between radar and rain gauge are purely due to atmospheric processes but never discussed in terms of instrument differences. For instance, if radar-based rain rate is lower than there is evaporation - why should there be strong evaporation in the tropics during a strong rain event when the gauge measures 15 mm/h while the profiler measures 4 mm/h? Fig. 5 should be discussed more scientifically and in more detail.
10) P. 3258, line 15. Explain typical differences?
11) Fig. 6, why is the rainfall rate max between 1.2-1.6 km? What ZR relationship was used?
12) P. 3259, 1par. Clarify this paragraph.
13) P. 3259, line 16: text mentioned wind shear but only wind is shown in fig 8 and further discussed. Line18, clarify "such a vertical structure"
14) P. 3262, line 1: vertical structure of rain rates and velocities have not been validated in this study. What is the basis of this conclusion?
15) P. 3262, line22, the maximum occurs between 1.2-1.6 km, however, the authors do not show that is is the same level of the mean trade wind inversion, therefore, this is not a conclusion of this analysis.
16) P. 3262, line 25: What is a weak and a strong DSD? This statements needs clarification. Also results need to be put in prospective of other DSD measurements in tropical convection.