Review of Manuscript No. doi:10.5149/amtd-6-3249-2013

One-year analysis of rain and rain erosivity in a tropical volcanic island from UHF wind profiler measurements

by A. Réchou, M. Plu, B. Campistron, and R. Decoupes

General Comments and Recommendation

This study is focused on the analysis of UHF profiler data in terms of the characteristics of rainfall experienced on the tropical island of La Réunion. The topic per se would be of interest; however, the manuscript in its present form is not in shape to be accepted for publication. There are too many aspects of this study that require substantial work (as detailed below), which prompts me to recommend rejection of this manuscript at this time. Despite that, I would like to encourage the authors to seriously reflect upon my comments and consider submission of a substantially reworked manuscript at some point in the future.

Major Concerns & Questions

1) Soil erosion is a rather complex problem involving many spatially and temporally varying aspects of the rainfall (drop size distribution and intensity) and associated wind (horizontal and vertical), water at the surface (both standing and flowing), vegetation cover, and the soil characteristics. Since the title mentions "rain erosivity", it would be useful to at least point out this complexity in the introduction and referring to papers by Brian (2000), Kinnell (2005), and Iserloh et al. (2013), and references therein. Moreover, significant erosion and landscape changes are often the result of catastrophic events (e.g., impacts of a tropical cyclone).

2) How typical is the year of rainfall discussed compared to long-term records? Also, how typical are the three presented cases? Some elaboration on that may help getting a broader perspective of how representative the results are.

3) Some further discussion of the data processing and quality control is needed. For example, what are the criteria used to remove suspicious data or not applying the raindrop spectra parameter retrieval? Looking at Figs. 8 – 11 it appears as if the retrieval was applied not only to rainy echoes but also to profiler data that didn't contain any rainfall. Those values obtained for marginally or not raining echoes are not to be trusted.

4) This study lacks thorough error/uncertainty analyses. For example, the raindrop spectra parameter retrieval is sensitive to vertical winds encountered. Assuming a zero wind effect is likely not a valid assumption rendering the subsequent analyses highly suspicious. Some discussion of the impact of wind errors is needed for the reader to get a sense of how much to trust the shown results. Moreover, some of the techniques discussed in Section 1 "Introduction" enable simultaneous estimation of the ambient air motion and raindrop spectra (e.g., Williams 2002). Why were they not explored?

5) I was underwhelmed by the discussion of the presented figures. Please expand the digestion of the results and carve out meaningful take-home messages. For example, are the observed variability and differences in raindrop spectra parameters typical and how do they relate to the underlying rainfall processes, etc. Moreover, the figures need work to make them more legible (see details below).

Minor Concerns & Suggestions

6) The thesis by Robert (1986) seems to be a key reference in terms of the characterization of rainfall experienced on the island of La Réunion, but unfortunately that document is not widely accessible. Are there no other refereed papers available that could be cited instead (or in addition)?

7) Page 3252, line 10: Replace "Gossard (1988, 1990)" with "Gossard (1988) and Gossard et al. (1990)".

8) Page 3252, line 25: It would be good to make reference to Ulbrich (1983) regarding the gamma function description of the raindrop size distribution.

9) It would be appropriate to cite one or more papers that have used rain gauges or disdrometer to calibrate profilers in Section 2.3 "Radar Calibration". The approach used by the authors is not novel in that regard. In addition, some discussion about sampling volume differences and the effect of spatial and temporal variability of rainfall on the comparison of profiler and rain gauge data would be useful here.

10) Page 3257, line 15: Looking at Fig. 4 I see rain rates approaching 30 mm/h, but not 40 mm/h. Maybe I am missing something?

11) Page 3258, lines 6 – 7: "The high precipitation rates in June may be explained by the passage of fronts . . ." This sounds speculative, but I am sure that could be properly answered whether indeed it is the case. There are other places throughout the manuscript as well where less speculative (i.e., more definite) expressions would help sharpen the discussion.

12) Page 3258, line 23: It would be beneficial to add a reference with regard to the trade winds limiting a vertical growth of clouds.

13) Page 3261, line 27: That paper by Smith (2003) doesn't address any raindrop spectra parameter relationship and thus is inappropriately cited here.

14) The paper by Steiner and Smith (2000), and references therein, would be highly relevant to the discussion in Section 3.2.4 "Kinetic energy fluxes", especially with regard to relating radar reflectivity to the vertical kinetic energy flux of raindrops.

15) It might be beneficial to have some native English speaking person edit the manuscript to smooth out stylistic language problems and typos (too many to be pointed out individually).

16) Figure 1: Please explain all the symbols shown in this figure.

17) Figure 2: How was this rainfall map derived? What are the underlying data (e.g., satellite, radar, and/or rain gauges)?

18) Figures 4 and 5: Please use the same color for indicating the UHF-based versus rain gauge rainfall rates. Also, the legend at the bottom of Fig. 4 is not readable (the same is true for the center panels in Fig. 10). Does the "duration" in Fig. 5 refer to hours/day or hours of an event?

19) Figure 6: A two-panel figure (one panel each for the dry and wet season) might be better. That way the mean and standard deviation can be shown directly (i.e., no need to plot a quantity "mean + standard deviation"). What are the corresponding rain gauge values? It would be helpful to include these values as well.

20) Figure 7: It would be helpful to point out which of the islands is La Réunion.

21) Figures 8 – 11: These figures are way too small to be properly absorbed by a reader. Also, the choice of color scale should be improved; for example, the human eye gets drawn to the red color, but as far I can tell this is not were the key information in a panel is. Furthermore, the color scale saturates in many places (e.g., vertical particle velocity) where I was trying to see relevant structures.

Additional suggested References

Brian, R. B., 2000: Soil erodibility and processes of water erosion on hillslope. *Geomorphology*, **32**(3 – 4), 385 – 415.

Iserloh, T., W. Fister, M. Marzen, M. Seeger, N. J. Kuhn, J. B. Ries, 2013: The role of wind-driven rain for soil erosion – An experimental approach. *Zeitschrift für Geomorphologie*, **57**, 193 – 201.

Kinnell, P. I. A., 2005: Raindrop-impact-induced erosion processes and prediction: A review. *Hydrological Processes*, **19**(14), 2815 – 2844.

Steiner, M., and J. A. Smith, 2000: Reflectivity, rain rate, and kinetic energy flux relationships based on raindrop spectra. *Journal of Applied Meteorology*, **39**(11), 1923 – 1940.