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## Comment on hess-2021-502

Jorge Isidoro (Editor)

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Editor comment on "A contribution to rainfall simulator design – a concept of moving storm automation" by Ravi Kumar Meena et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-502-EC1>, 2021

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### General comments

The paper discusses the development and preliminary testing of a pressurised rainfall simulator. The simulator consists of an automated nozzle control system coupled to a pressure regulator mechanism, allowing it to automatically control rainfall intensity and simulate storm movement. The preliminary tests were carried out with a soil flume.

I would like to congratulate the authors for this very interesting manuscript, which is a step further in rainfall simulation. However, there are some flaws – in my opinion – that could/should be addressed for the sake of easiness of reading and scientific soundness. Figures and tables, however, are clear to understand and useful, as they are a key-element to understand the authors' point-of-view. There are some issues regarding scientific soundness or, at least, lack of clarity. Some of these issues are referred to below in the "specific comments". Referred literature is relevant but it lacks recently published information on rainfall simulators development. Some citations seem to be casuistic, and I've only noticed one reference (de Lima and Singh, 2003) to be strongly discussed/compared with this paper's findings. Moreover, there are some flaws in the references list.

Apart from research, rainfall simulators can be useful tools for visualisation and pedagogical purposes. Moreover, this paper presents an important advance in rainfall simulation. Two different parts can be identified in the paper: 1) the description of the device itself (construction of rainfall simulator, electronics, coding, operational control, ...), and the preliminary tests conducted (use of a soil flume, rainfall intensity uniformity assessment, analysis of surface runoff hydrographs, ...). My major criticism to the paper is that I find these two parts to be somehow confused along the text, i.e., despite the quality of the English being very good I did not like the way the paper is organised. The next paragraphs, presented as questions, further detail my concerns:

Q1 – A soil flume was used, with the capability to gauge surface flow, sub-surface flow, and baseflow. However, only surface flow hydrographs were presented. Why? If these flows were not to be analysed and discussed, why is this detail about the soil flume presented? I would suggest, at least, to clearly state in Section 2.2 (Design of soil flume) that only the surface flow data is analysed in the paper.

Q2 – Why was a soil flume used? If the paper is (supposed to be) focused on the rainfall

simulator, why did not the authors use a much simpler impervious surface?

Q3 – Why did the authors present the very interesting electronic control system(s) as appendixes? This is the main novelty of the paper! There are many papers regarding rainfall simulation. However, there are no papers regarding rainfall simulators with the capabilities and automatisations of this one.

Q4 – During the simulated rainfall experiments, which were the criteria to consider the beginning and the end of discharge?

### **Specific comments**

[Title] “Innovatory [...]” is ambiguous... maybe something like “A contribution to [...]” could sound better.

[P.1; L.4] “Near natural rainfall conditions”. What do the authors mean by this? And how can you assure that the artificial rainfall produced by this novel rainfall simulator is similar to natural rainfall? There is no raindrop analysis (e.g., drop spectra analysis), and the only analysis of rainfall characteristics regards the rainfall intensity spatial uniformity. In my opinion, the authors cannot assure that the simulator produces “Near natural rainfall conditions”, at least by the information provided in the paper.

[P.2; L.26] Why is estimating the impact of poultry litter application on water quality of particular importance? I am not saying it is not important, but for sure I would think of other uses for a rainfall simulator first, such as soil erosion (after all, the authors used a soil flume...) or drainage/flood simulation. This is an example of what I find to be a casuistic citation, as I cannot find anything else on the paper minimally related to poultry litter application.

[P.2; L.32-33] The authors state the “Drip formers are used for small plot area, and low-intensity rainfall studies whereas pressurized nozzles are used for large scale field studies (10 to 500 m<sup>2</sup>)”. However, this pressurised rainfall simulator is to be used with plots smaller than 10 m<sup>2</sup>. Can the authors comment on this?

[P.2; L.53] It is not clear how the “efficiency evaluation” is performed.

[P.3; L.73] I do not agree with stating that “A uniform spray coverage [...]”, as the spatial rainfall distribution is (factually) not uniform. The CUC analysis is presented only in Section 3 (Results and discussion), and just for one rainfall intensity scenario. This is by no means enough to state that this rainfall simulator can produce uniform spray coverage... in fact, one of the major problems of pressurised rainfall simulators. The paper does not prove that this rainfall simulator can produce uniform spray coverage.

[P.4; L.81] Base flow is incorrectly used here. It should be “groundwater flow” or “deep sub-surface flow” (the latter is better). “Baseflow” is the part of streamflow that is sustained between precipitation events, and that flows to streams by delayed pathways. It has nothing to do with the flow physics detailed in this paper.

[P.4; L.103-104] Did the use of flexible hoses to supply water from the feeder tank to the nozzles resulted in difficulties to maintain a steady pressures, mainly when opening/closing the valves? I suggest looking at Isidoro and de Lima (2015) and comparing the advantages/disadvantages of this novel system regarding pressure stabilisation.

Hydraulic system to ensure constant rainfall intensity (over time) when using nozzle rainfall simulators. Hydrology Research (2015) 46 (5): 705–710.

DOI: 10.2166/nh.2015.087

[P.8; L.147-148] "However, very little runoff was generated for velocity of  $6 \text{ m min}^{-1}$  [...]". Is this true both for the upstream and downstream storm movement tested scenarios?

[P.13; L.231] Please explain better "A stop cock valve was used to develop a servo-operated valve due to its low operational torque requirement".

[P.13; L.232] Please check this. Torque unit (SI) is Nm.

[P.14; L.250] What do the authors mean by "bypass flow"? Please detail this further.

### **Technical / typos / orthography comments**

[P.2; L.52-53] I suggest using "The following parameters are considered [...]" instead of "Following scientific parameters are considered [...]"

[P.4; Figure 2 caption] I suggest adding "(not in scale)" to this figure's caption.

[P.4; L.91-92] Please check this sentence.

[P.4; L.93-94] I suggest using "Bluetooth Module (BM)" instead of "Bluetooth module (BM)".

[P.4; L.102] I suggest using "Pressure Regulating System (PRS)" instead of "pressure regulating system (PRS)".

[P.4; L.102-103] I suggest using "Proportional-integral-derivative controller (PID controller)" for ease of understanding.

[P.5; Table 1] Why are the nozzles not listed on this table?

[P.6; Figure 4 + caption] I suggest using "soil flume" instead of "study area".

[P.6; L.112] Appendix C is missing on the paper. However, L.226 (P.13) shows a link for the software code. Is this the code supposed to be presented in appendix C?

[P.9; L.158-159] There is an error in the citation... it should be "de Lima and Singh (2003)".

[P.10; L.169] Please use "6 m" instead of "6m".

[P.10; L.177] Is it 82.00 % ? (All other values show two decimal places).

[P.10; L.178] Please use "3 m" instead of "3m".

[P.11; L.187] I suggest using "[...] could never contribute to generating runoff [...]" instead of "[...] could never generate runoff [...]".

[P.11; Table 3] I suggest using  $\times 10^{-3}$  in the table's last column.

[P.13; L.209] I suggest using "[...] and three different moving storm velocities" instead of "[...] and three different velocities".

[P.13; L.214] I suggest using "[...] and three different moving storm velocities" instead of

"[...] and three different velocities".

[P.15; L.265] Please check this line of text where a reference (?) [23] is incorrectly presented.

[P.17; L.288] Please check this reference. The first author's last name is "de Lima". (It is correctly presented in L. 281).

[P.17; L.290] Please check this reference. The first author's last name is "de Lima". (It is correctly presented in L. 281).