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# Reply on RC1

Ravi Kumar Meena et al.

Author 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-AC2, 2022

**Reply to Reviewer 1**

The manuscript analyzes the impact of a moving storm rainfall condition on the hydrograph characteristics using a programmable rainfall simulator. The authors present the results of different rainfall simulation experiments on the two hydrograph characteristics, the time to peak, and the peak discharge. The experiments were performed to test different scenarios in two different slopes and three different velocity conditions for both upstream and downstream storm direction.

This topic is very interesting, and the developed rainfall simulator system is very innovative. However, I think that the paper could be improved by the authors that would make it more attractive. Some aspects, mainly related to the developed rainfall simulator system are not clear, and others are not presented. The characteristics of the simulated rainfall are not well described, and the test to verify if it well reproduces the natural rainfall are not discussed. Those aspects are very important when using a rainfall simulator system.

**Reply: We are thankful to the reviewer for giving constructive feedback. We have addressed all the comments as best as possible in our manuscript. Further, we also want to mention that the details about the rainfall characteristics and the reasoning behind the selection of that intensity have been added in the first paragraph of the results and discussion section.**

- The rainfall simulation experiments were used to evaluate the peak discharge and the time to peak flow. Those two parameters are more influenced by the physiographic properties of the watershed, vegetation cover, flow dynamics, and soil water content at the begin of the rainfall event. Considering that the system includes a soil flume, why the authors didn't use it to simulate different soil water content conditions, for example?

**Reply: Thank you for your suggestion. Initially, we also planned to work with a specific moisture content of the soil but it very complicated to keep the moisture content constant for each simulation, and the sole purpose of the data presented in this manuscript is to show that the designed rainfall simulator is capable of**

**simulation moving storm with different storm movement velocities.**

- Why did you not include the system description in the main text? In my opinion, the mechanical innovations presented for this rainfall simulator is one of the most important part in the paper

**Reply: Thank you for your suggestion. We have added these sections in the paper instead of appendixes.**

- Did you analyze the characteristics of the simulated rainfall? Is the system able to simulate a natural rainfall?

**Reply: The maximum 3-min (simulated) rainfall intensity is 40 mm/h. The drop size distribution and kinetic energy of rainfall are not measured as we don't have a laser sensor. In terms of storm movement, yes, the simulator does have the capability to generate near-natural rainfall conditions. Further, we want to mention that the maximum 5-min rainfall intensity varies in the range of 12 mm/h to 109 mm/h in our Aglar experimental watershed, Uttarakhand, India (Nanda et al.,2019). So, the used intensity seems reasonable. We have mentioned same in first paragraph of Section 3.**

***Nanda, A., Sen, S., & McNamara, J. P. (2019). How spatiotemporal variation of soil moisture can explain hydrological connectivity of infiltration-excess dominated hillslope: Observations from lesser Himalayan landscape. Journal of Hydrology, 579, 124146.***

Specific comments

[L.25] More recent rainfall simulators have been developed but are not mentioned in the manuscript. Please add more recent references.

**Reply: Thank you for your suggestion. We did not include the recent designs because as per best of our knowledge most of the new rainfall simulator designs have a goal of portability and spray uniformity but those are not designed to simulate moving storms. However, we have added some recent references of portable rainfall simulators discussing about their uniformity coefficient (Section 3, first para).**

[L.64] The system description is not complete. What is the high of the system? Which intensities is the systems able to simulate? How did you verify if the system reproduces a real rainfall event? Did you verify the raindrops distribution? The characteristic of the simulated rainfall should be verified using a disdrometer, for example. The authors say that the system simulated "Near natural rainfall conditions" (abstract L.6], but I don't know what it means. The raindrop distribution should be investigated for all the simulated area.

**Reply: Thank you for your suggestion. We have added the relevant details as you mentioned in the above comment. Initially, we were planning to do the other studies too relevant to soil erosion but we were not able to acquire the laser rainfall analyzer for drop size distribution and terminal velocity, so we limited the study to general testing of moving storm rainfall simulator**

[L.104] What is the system precision? What is the intensity of the simulated rainfall?

**Reply: System pressure of the rainfall simulator at the time of simulation is 0.6 kg/cm$^2$ to simulate a rainfall with a mean intensity of 36 mm/h.**

[L.112] What is "Appendix C"? It is not presented in the paper.

**Reply: Thank you for pointing that out. We have already added the link of the code used in this study and Appendix C is a typo error. That correction has been made in the paper.**

L.120] What are the values for the coefficient of uniformity? Did you test the uniformity of the simulated rainfall for different rainfall intensities?

**Reply: We did the uniformity test for different rainfall intensities (at multiple points between the range of 36 mm/h to 606 mm/h with the minimum UC of 82 % and maximum UC of 91 %) but we only mentioned the uniformity coefficient result for the intensity used for this study.**

[L.125] How did you considered the wind effect during rainfall simulations? Is there any protection?

**Reply: We did not put any specific protection against the wind because this system is standing in an open space without a shade but within the closed walls of the department. All the simulations were performed while keeping that in mind that there should minimum influence of wind.**

[L.125] Is there any change of the soil surface after each experiment? Is there any change of the roughness, for example?

**Reply: Thank you for your suggestion. We did not analyze the changes in soil surface after each run for this study, but we will keep that in mind for further studies.**

[L.141] What is the mean intensity of the simulated rainfall? Why are you simulating this intensity?

**Reply: The mean intensity of the simulated rainfall is 36 mm/h.**

[L.147] How did you choose the rainstorm movement velocity?

**Reply: We have followed the studies of De Lima and Singh (2002) and De Lima and Singh (2003) for selecting rainfall movement velocities.**

[L.133] Please change "strom" to storm.

**Reply: Changed.**

[L.288]. check the reference: The style is not correct.

**Reply: Corrected.**