Responses to the Reviewer#1 Comments

(Referee comments in black; Responses in blue)

First, we would like to thank the reviewer for his/her fair and very valuable comments. In the following, we have addressed each reviewer comments in detail and have indicated how we might alter and update the manuscript given the comments. We hope that we have addressed all comments sufficiently, and we are looking forward to your feedback and your decision.

Comments by Referee #1:

1. *This paper presents a method for interactively teaching students about the unit hydrograph. The approach taken is simple, involving the students passing balls along defined flow pathways so that the result at the "catchment outlet" can be observed. It is a simple, low-cost method of demonstrating a simple case of "unit hydrograph".*
   We thank the referee for this statement, as it was exactly our intension to develop such a simple, easy to implement and cheap experiment suitable for demonstration within a lecture.

2. *Given the time needed to run each "experiment", I feel that a hybrid approach would be better, where the idea is introduced using a simple participatory demonstration as described here, but more detailed experiments are done through computer simulation. This is particularly the case when the time needed for a single experiment (including discussion) is between 30 and 90 minutes (page 9, line 4-5). 90 minutes is a considerable break in a 3 hour lecture, and suggests a more efficient method might be needed.*
   We fully agree with the reviewer that it is also necessary to have additional exercises (e.g. in the computer lab), where students do explicit calculations applying the unit-hydrograph concept. We also do that in our program within the course “Exercises in Hydrology”. The course is conducted separately, but organized in close cooperation. The lecture theatre experiment (as introduced in the paper) is a visceral aid that gives an additional visualization and participatory demonstration. The main goal is therefore to stimulate student interests and to help them in their scientific learning. The positive effect of experimental demonstrations on deeper understanding and learning has been found by a number of authors (e.g. Roberts et al., 2005, Savec et al., 2005) and → we will include these references in a revised version of the manuscript.
   Concerning the time of the experiment – we wrote 30-90min in the submitted manuscript –, we could repeat the experiment and, with the help of 2 student assistants, we were able to include the basic demonstration within a 15-20min time slot. When this time slot is well set, it is an ideal interruption of a 3h lecture.
   In the manuscript, we additionally describe variants of the experiment that can, but do not need to be performed. These variants are only described in case there is more time available. →We will make these points clearer in the revised version of the manuscript.

3. *The real question here is: how many such experiments are needed in order to provide a suitable improvement in student understanding? Can a combination of participatory and computer examples achieve the same effect in less time?*
   This is a very interesting question and depending on some funding, there might be a good chance over the next years to tackle this question. In general, a longer-term educational experiment would be required to answer this question thoroughly. The experiment will use some kind of split group approach and then analyze the exam/learning results for these different settings. As we have received the teaching award of our university for this experiment in the last year, our educational department had approached us in order to discuss such a long-term study to examine the effect. We apologize to admit that currently an answer to this question is out of scope. → However, we suggest briefly outlining and discussing such a longer-term investigation in the discussion.

4. *The paper gives a reasonable review of the history of the unit hydrograph. I consider that the authors are incorrect in saying that the effective rainfall is homogeneously distributed over the catchment (page 4, lines 2-3). This is not necessarily the case. What the UH concept considers is that the spatial distribution of effective rainfall doesn't change between events. It can be non-homogeneously distributed. This can be due to spatial variations in rainfall (e.g. due to topographic effects), or due to spatial variations in the fraction of rainfall that is converted into effective rainfall (e.g. due to topography, soils, vegetation). Considering the effective rainfall to be homogeneously distributed across the catchment is a simple case, but not really the requirement of the unit hydrograph concept.*
   We fully agree on this comment. The assumption of a uniform "effective precipitation" is very often made in many textbooks as a requirement (e.g. Maniak, 2016, p350). → However, we will modify and correct this part of the introduction.

5. *I think papers like this do have a place in HESS - but this paper needs a little more work in order to be of publishable quality.*
   We hope our comments and suggested adaptations will sufficiently address the comments made by Referee #1.

Literature:

Maniak, U.: Hydrologie und Wasserwirtschaft, eine Einführung für Ingenieure, 7.Aufl., Springer Vieweg, 2016

Roberts, J. R., Hagedorn, E., Dillenburg, P., Patrick, M., and Herman,T.: Physical models enhance molecular three-dimensional literacy in an introductory biochemistry course, Biochem. Mol. Biol. Edu., 33, 105–110, 2005.

Savec, V. F., Vrtacnik, M., and Gilbert, J. K.: Evaluating the educational value of molecular structure representations, in: Visualisation in Science Education, edited by: Gilbert, J. K., Springer, 269–300, 2005.