Reply to Interactive comment by Anonymous Referee #1 “A sprinkling experiment to quantify celerity-velocity differences at the hillslope scale”

Willem J. van Verseveld, Holly R. Barnard, Chris B. Graham, Jeffrey J. McDonnell, J. Renée Brooks, Markus Weiler

First of all we would like to thank Referee #1 for his/her evaluation of this manuscript and his/her suggestions will for sure improve this manuscript. Our answers (in blue) to the suggestions are written below each suggestion (black).

1. Specify meteorological conditions during the sprinkling experiment. I believe no rainfall events were registered in the 24-days experiment.

Yes, good point. We will describe this in more detail. Correct, no rainfall events occurred during the sprinkler experiment.

2. The description of the different sensors location can be improved. I would also recommend to improve Figure 1 and introduce acronyms for each type of sensors in the map.

We agree with the recommendation of the reviewer to improve Figure 1 and the associated description of the different sensors. We will modify the Figure and the associated text.

3. In your findings, soil moisture responded earlier than lateral subsurface flow to irrigation. Please comment on this.

Correct, soil moisture responded definitely earlier in the upper 30 cm. Below 60 cm soil moisture responded later than lateral subsurface flow. Apparently, antecedent wetness conditions were such (in combination with the soil depth profile increasing upslope, and applied irrigation intensity) that we observed this response pattern. At the same hillslope, McGuire and McDonnell (2010) found during wet conditions (winter) that peak hillslope runoff always lagged peak soil moisture at about 5 h.

4. Section 4.3 is very relevant and I think it could be rewritten a bit more clearly. Could you also report results in a Figure/Tabley

Yes, we agree it would be helpful to include the results in a Table of this paragraph, and rewrite this section a bit more clearly.

5. Table 2 could be improved by adding instrument depths.

Since this table is providing information on average vertical velocities (sampling depth/ response time), and already contains quite some number of columns we prefer to leave the instrument depths out of Table 2.

6. Discussion on immobile soil water fraction should be expanded and stated more clearly.

We agree with the reviewer that this is an important part of the Discussion, and we will elaborate more on the immobile soil water fraction and the link to our modeling and experimental results in the Discussion.

7. Are estimated celerities compatible with WS10 response to storm events?

Quite an interesting question but at the same time difficult to answer. Please note that our reported celerities are vertical celerities through the soil profile, and not lateral celerities, a component one also needs to take into account for lateral subsurface flow or streamflow. Furthermore the response time (or celerity) is also a function of antecedent wetness conditons, for example McGuire and McDonnell (2010) found during the winter period response times of 0.3-0.5 h for water content reflectometers at 100 cm depth, and thus much higher celerities than observed during our sprinkler experiment. Additionally, McGuire and McDonnell (2010) did find that hillslope peak runoff lagged soil moisture responses at 100 cm depth and different positions (up till > 25 m upslope) by about 5 h, indicating very fast lateral celerities (much higher than their observed vertical celerities). Although outside of the scope of our presented work, it would definitely be interesting to investigate this in more detail for the hillslope and WS10, for example by comparing the timing of peak rainfall or mass center of rainfall and the hillslope lateral subsurface flow and WS10 streamflow response.

Finally, the manuscript present numerous typos and reference to figures and Tables is often incorrect. I suggest a thorough revision of the writing.

Yes, we will make sure to correct typos and incorrect references to Figures and Tables.