Authors' response to Anonymous Referee #2 on "Multiple runoff processes and multiple thresholds control agricultural runoff generation" by S. Saffarpour et al.

We appreciate these useful reviewer comments and suggestions. We have addressed each comment separately. The following document has been structured as 1) the blue font indicates the reviewer's comment and 2) the black font shows the authors' reply.

General Comments: **The content of the article is relevant to the hydrological community and meets the focus of the selected journal. It investigates functional relationships between antecedent wetness and rainfall characteristics and the streamflow response of a small agricultural catchment in Australia. In doing so the authors aim at identifying multiple co-existing runoff processes and potential threshold behavior between catchment-states and streamflow response. The dataset, comprising of hydrometric and hydrochemical parameters has potential but needs more quantitative analysis in order to address the outlined themes.**

We thank the reviewer for outlining our research and highlighting its importance for the hydrological community.

My main suggestions to improve the manuscript are the following:

I acknowledge the idea to use a decision scheme based on properties and mechanisms to structure runoff processes such as in Figure1. However, such a scheme is designed to result in one dominant runoff process and not in multiple ones such as outlined in the title. (We all know, that processes co-exist in different degrees of intensity). Original versions of such decision schemes are designed for the point or plot scale. While I acknowledge the authors idea to extend it with the concept of connectivity and time scales, I think that this causes a mismatch of scales. At least the authors need to define very clearly what spatial and temporal scale they are considering (and stick to their definition) and what the landscape units are, between which they consider connectivity. I suggest to come up with a separate Figure for connectivity

This figure is intended to address hillslope scale processes and phenomena (i.e. connection to the stream). We will edit the discussion of the figure to reflect this. In undertaking that editing we will consider whether a figure on connectivity is needed.

The method section needs to provide more quantitative information. (e.g. soil profile, total number of Q, GW, NS, monitoring sites, procedure of manual sampling, delineation of the saturated area, lab-analysis devices used. (Using two different devices for analyzing isotopes can cause considerable difficulties in comparing or pooling data).

We will add these details to the methods section. As discussed in our response to reviewer 1, the two isotope analyzers were compared. Differences were controlled for and have limited impact here as the final analysis only used samples analysed by a single machine, with the exception of the uncertainty analysis.

The result section is descriptive and lacks statistical/data analysis to quantify the authors' statements and derive generally applicable results. Some results are based on one or a few selected events only, which is not representative to draw conclusions. I suggest to exploit the entire dataset the authors have at hand and calculate statistics over all events.

We have exploited the full data set already in terms of the hydrometric analysis. The ion and isotopic analysis addresses issues for specific types of events and we use all available data that can be analysed with reasonable uncertainty, as discussed in our response to reviewer 1. We will clarify this in the revised paper. We will provide some further statistical summaries of the various categories of events including statistical summaries of the rainfall characteristics and runoff responses.

Some parts of the result section are the authors' interpretation and better fit in to the discussion section. Terms are either not defined in the text (e.g., in the method section) or not used consistently and the term "threshold" is used in circumstances where "exponential relation" is more appropriate.

We will define and clarify terms in response to specific comments from this reviewer. We disagree with the suggestion that "exponential relation" is more appropriate. Runoff responses below the identified thresholds are zero, not just small as would be the case with an exponential relationship. Our use of the term threshold is also consistent with the literature.

The conclusions are drawn from one or two individual rainfall events and not logically derived from or supported by the results of this study. I would encourage the authors to refine and strengthen their analysis based on their dataset. I think it is good to discuss the findings in the light of Fig1. but as it is originally developed for point- or plot scale assessments it misses out the spatial (and temporal) heterogeneity across a catchment. – a fundamental aspect when analyzing thresholds and connectivity – and something that I think the authors try to address. For my detailed comments please see the provided pdf documents and summary of comments.

We plan to revise our discussion of Figure 1 to make it clear that we are intending it to apply at the hillslope scale and to capture the issues of heterogeneity mentioned.

In general, I think this manuscript has potential to be an interesting contribution to the hydrological society why I encourage the authors to work on a revised version.