

Responses to Community Comments to ‘Characterising runoff processes for Australia: Insights from a parsimonious rainfall-runoff event identification method’ (EGUSPHERE-2025-6241)

Our responses are in blue and proposed revision are underlined.

Yiwen Mei

I would like to thank HESS Discussions for providing such a great platform for interactive discussions with authors. I apologize for any additional workload this may create for the authors. I was not officially invited to review this manuscript, but the topic aligns closely with my research interests, which is why I took the opportunity to offer my perspective.

The manuscript “Characterising runoff processes for Australia: Insights from a parsimonious rainfall-runoff event identification method” by Khoie introduces a new parsimonious (two-parameter) rainfall-runoff event identification method called RVEIM. Unlike existing pairing methods, which typically search for rainfall events preceding a runoff event, RVEIM starts the search from a rainfall event and looks forward for the corresponding runoff event. It also employs a variable-length searching window, in contrast to the fixed-length windows used by other methods. RVEIM was applied to 467 Australian catchments, and the resulting event identifications were compared to those obtained using the “local maxima method” (though no citation was provided for this method). The comparison focused on event characteristics such as the number of events per year, runoff coefficient (RC), event length, and event volume.

Overall, the manuscript is well-written. However, I have two major comments that I would like to discuss with the authors, along with several specific comments and editorial suggestions annotated in the manuscript.

We sincerely thank Dr Mei for taking the time to read our manuscript and provide constructive comments through the HESS Discussions platform. We appreciate the positive assessment of the manuscript and the thoughtful suggestions provided. We respond to the main comments below.

Validation strategy for event identification:

The manuscript compares the number of events, event length, and event volume between RVEIM and the local maxima method (Figure 6). One finding is that RVEIM-derived characteristics exhibit lower interannual variability. The manuscript interprets this as evidence that RVEIM introduces less “uncertainty” than the benchmarking method. I question this interpretation because it is reasonable to expect fewer events, shorter durations, and lower flow volumes during dry years. Higher variability in the benchmarking method may actually reflect a better representation of contrasting hydrological conditions between dry and wet years. The fact that RVEIM produces similar event characteristics regardless of wet or dry conditions does not, in my view, appear to be a favorable outcome.

Thank you for this important comment. We agree that higher variability in event characteristics may, in some cases, reflect a method’s ability to capture contrasting hydrological conditions between wet and dry periods.

In our analysis, rainfall-runoff events are identified across the full range of hydrological conditions throughout the full record of individual catchments. It should be clarified that the variability shown in Fig. 6 reflects differences in long-term average event characteristics across catchments, rather

than interannual variability within individual catchments. Therefore, the boxplots primarily capture variability associated with event identification uncertainty across catchments.

We also note that this pattern is observed consistently across catchments spanning different hydroclimatic conditions, including both relatively dry and wet regions, suggesting that the observed differences are not driven by specific climatic regimes but reflect systematic differences in how events are defined and filtered by the methods.

Importantly, the interpretation of variability should be considered together with physical plausibility of the identified events. While higher variability of event characteristics may indicate sensitivity to changing event identification, it may also be associated with unrealistic event definitions. For example, *local maxima* shows variation of around 0 to 40 for the annual number of rainfall-runoff events for catchment 306119 (Fig. 6a). However, for the same catchment, the percentage of RCs > 1 shows variability between 0% to 80% (Fig. 7) which is not only highly uncertain but frequently challenges the physical plausibility of identified rainfall-runoff events.

Another finding concerns the event runoff coefficient (RC). The manuscript reports that RVEIM yields significantly fewer instances of RC > 1 compared to the local maxima method (Figure 7). I agree that a method producing fewer violations of RC > 1 is preferable. However, a key point here is ensuring that both methods start from the same baseline, particularly in how baseflow is separated from streamflow when calculating RC. Both methods use the Lyne-Hollick filter for baseflow separation, but I would like to know whether the same alpha parameter values were used for both methods when producing the comparison in Figure 7. If different values were used, this could explain the observed differences in RC > 1 occurrences.

Thank you for this important observation. We agree that being consistent about *alpha* parameter sensitivity makes a fair comparison between methods. We will perform an additional sensitivity test for the *alpha* parameter in the *local maxima* method.

Additionally, I note that no mathematical definition of RC is provided in the manuscript. I assume that the event RC is calculated as the ratio of quick-flow volume (streamflow minus baseflow) to rainfall volume. Clarifying this would be helpful.

Thank you for this comment. We will add a sentence in line 248 to clearly define the RC as it is the first appearance of RC in the methodology. We suggest the revision of lines 247-248:

“The characteristics here are the volume of paired runoff events, the number of rainfall-runoff events, and the RCs. In this study, RC is calculated as below:

$$RC = \frac{Q_{tot} - Q_{base}}{P}$$

Where, RC is event runoff coefficient, Q_{tot} is total streamflow volume during runoff event (ML), Q_{base} is the baseflow volume during runoff event (ML), and P is the rainfall volume, calculated by the rainfall depth (mm) multiplied by the catchment area (km²).”

Finally, I believe there are other validation approaches that could strengthen the analysis. Event characteristics should covary with catchment physiographic conditions. For example, one might expect fewer events in larger catchments or lower peak flows in more elongated catchments (Shen et al., 2016). Exploring such relationships could provide additional insight into the performance of RVEIM.

Thank you for this valuable suggestion. We agree that relationships between event characteristics and catchment properties could provide additional insight into the performance of RVEIM. We

would like to emphasize that Figure 10 reveals a clear climatic gradient in event runoff coefficients (RCs), with drier catchments dominated by low RC events and wetter catchments showing higher and more evenly distributed RCs. The ECDF shapes shift systematically from steep (arid) to gradual (humid), consistent with a transition from infiltration- to saturation-excess runoff, with tropical regions showing mixed behaviour. This physically consistent covariation between RC distributions and climate align with established rainfall-runoff mechanisms and thus provides a physically-based validation of the event identification approach.

Novelty and transferability of RVEIM:

The manuscript claims three novelties for RVEIM: (a) it is parsimonious, requiring only two parameters; (b) it is rainfall-centered, initiating the search from rainfall rather than runoff events; and (c) it features a variable-length searching window. The authors suggest that these features make RVEIM more transferable than existing methods. I do not see a clear connection between each of these claimed novelties and enhanced transferability.

Regarding point (a), having fewer parameters could imply that the method is less adaptable to catchments with hydrological regimes that differ substantially from those used in method development. For instance, would RVEIM be suitable for snow-influenced catchments? Regarding point (b), whether the search begins from rainfall or runoff appears to be a design choice rather than a feature that inherently improves transferability. I see no clear advantage of one approach over the other in this regard.

Moreover, RVEIM is designed for daily time-series data. However, there are existing event identification methods developed for hourly data (e.g., Mei and Anagnostou, 2015; Thiesen et al., 2019). Given that sub-daily rainfall and streamflow data are available for Australia, I wonder whether RVEIM could be adapted to use higher-resolution inputs, and if so, what advantages or challenges that might present.

Thank you for this thoughtful and constructive comment. The discussion in the manuscript will be amended to discuss the transferability as per the comments below.

The three mentioned features of RVEIM (parsimony, rainfall-centred identification, and a variable-length search window) may not individually guarantee improved transferability. However, their combined use is intended to better reflect the underlying runoff generation process, compared to methods that are purely based on statistical rules to identify rainfall-runoff events (e.g., eventMaxima).

Regarding a) - the parsimonious structure limits the sensitivity of the method to parameter choices. Together, these features enable a more consistent and physically meaningful identification of rainfall-runoff events across different hydrological conditions. On your concern about the applicability across different hydroclimatic regimes, we acknowledge that RVEIM has performed well across a wide range of hydro-climatic conditions in rainfall-driven catchments (as demonstrated over Australia). For regions with significant snow influence, where runoff generation is not directly linked to a rainfall, the current formulation of RVEIM may be less appropriate. This could be assessed in future studies, and we will add acknowledgement of this limitation to the revised manuscript.

Regarding b) and c), the advantage of a rainfall-centred approach mimics the physical cause of runoff events, while the variable-length search window ensures events with different timing and duration can be well captured. These are especially helpful for catchments where rainfall events generate runoff responses with varying timing and duration, a rainfall-centred approach ensures that each

independent rainfall event is treated as a potential driver of runoff, while the variable-length search window allows the method to adapt to both fast and delayed responses.

Regarding your final query about the temporal resolution, while RVEIM has been developed for daily data, its conceptual framework is not restricted to this scale. The method relies on the identification of independent runoff events for their corresponding independent rainfall. Therefore, considering that an independent rainfall event can be defined at sub-daily resolutions, RVEIM could be extended to sub-daily data. As per our response to Reviewer #2, we will add a discussion in the revised manuscript to clarify the potential applicability and limitations of *RVEIM* for sub-daily data.

Thank you for considering my comments. I hope they contribute constructively to the improvement of the manuscript.

Yiwen Mei

References

- Wasko, C., & Guo, D. (2022). Understanding event runoff coefficient variability across Australia using the hydroEvents R package. *Hydrological Processes*, 36(4 %@ 0885-6087), e14563.
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