



EGUsphere, referee comment RC3
<https://doi.org/10.5194/egusphere-2022-857-RC3>, 2023
© Author(s) 2023. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on egusphere-2022-857

Anonymous Referee #2

Referee comment on "Bayesian parameter inference in hydrological modelling using a Hamiltonian Monte Carlo approach with a stochastic rain model" by Simone Ulzega and Carlo Albert, EGU sphere, <https://doi.org/10.5194/egusphere-2022-857-RC3>, 2023

General comments

This manuscript presents a Bayesian framework for forward and inverse problems and presents the Hamiltonian Monte Carlo (HMC) as a scalable inference method for calibration of models to noisy time series. The paper details an application of this framework in stochastic rain models based on time series observations of rainfall-runoff. The paper provides a case study of a single storm event over a single catchment, and although the paper is technically well written, it currently reads more like a technical note rather than a research article. Overall, the implications of the study were unclear – floods are mentioned briefly but discussion of whether this approach holds up when considering 1. different hydrological modelling approaches, 2. climate variability and non-stationarity, 3. different catchment types and antecedent conditions, and 4. flash floods, could further strengthen the argument for using this novel approach.

This paper is more akin to a technical report and is therefore not entirely suited for HESS audiences as a research article in its current form. However, the approach detailed in the paper and its suitability to model real world hydrological impacts are of interest to HESS audiences. Thus, the manuscript could be strengthened with some **moderate revisions** and reframing; to demonstrate the superiority of this methodology and approach, where the application of such an approach is most beneficial, and, what the implications of using this approach are in terms of hydrological services to aid decision makers. The inclusion of the above would go most of the way to addressing "relevant scientific questions within the scope of HESS" as well as providing more tangible implications for the reader.

Unfortunately, as a reviewer I only have an option to choose between minor and major revisions so I chose major to reflect the fact that the effort required to address my comments would be greater than that of addressing minor comments. However, I suspect that the effort needed to revise this manuscript would fall somewhere in between – i.e. moderate revisions. I sincerely hope these comments and the more specific ones below are helpful to the authors.

Specific comments

- I was not sure what the benefits of this approach are versus other methods. For example, why is this approach beneficial over other hydrological modelling approaches, such as hydraulic or other physics-based approaches (e.g. flow routing) or conceptual models (e.g. pipe flow simulations) in terms of computational efficiency and accuracy. For example, could you run this simulation in real time for now casting?
- What catchment conditions is this method suitable for? I assume modelling storm water is the reason for choosing an urban catchment for a case study, but perhaps the paper could be strengthened by stating that explicitly and focusing on the difficulty of modeling storm water runoff accurately.
- What applications is this methodology suited for? Floods are briefly mentioned and storm water is the focus, but does this methodology enhance the modelled accuracy of any other flood impacts such as inundation?
- The methods section takes up the bulk of the paper, even allowing for the fact that the focus is on the novelty of the method. Could some of the details be put into supplementary information? It is unclear as to how novel the methodology or framework proposed is given that a prior paper on the HMC has been published. Could the authors please highlight what is “new”?
- The case study description is a bit light on in detail. I could not discern the reasons why the single storm event and catchment were chosen from the case study description. A reader is likely to be skeptical as to the broad applicability of any method when only one catchment and event are modelled, can the case study be expanded to include multiple events and/or multiple catchments? In addition, the reasons for the two ScX datasets could be made clearer to the reader in the case study description. Also is there a third case that could be explored? No Sc1 or Sc2 data?
- Figure 3 could be further or more thoroughly explained in terms of the whys – e.g. why does gamma show the largest shift? Is it due to, for example, the event characteristics or catchment characteristics or both?
- The comparison between poor quality and good quality rainfall is a bit confusing (Figures 5-6) but looks like an interesting result? It appears that the discharge data alone is enough to provide good predictions for the rainfall. What is the purpose of using Sc2 then – can the authors please explain this in detail? Also, it would be good to know whether this is the case across the board (i.e. more than one event in one catchment).
- Results overall: A discussion of the limitations and applicability/suitability of the method along with the implications of its use would strengthen the paper. The figure discussions could be improved by relating the results to the characteristics of the event and catchment. Could the authors please detail a real-world application using this approach (e.g. nowcasting of storm water runoff during an event)?

- In considering the citations and reference list, it appears to me that the authors have considered all the major technical HMC and related publications (although I am far from a leading expert in the field of HMC), however I note here, that in addressing the above and general comments, more citations for the background and contextual information will need to be included.

Technical comments

Given that the paper could be improved and strengthened by reframing and providing more context for the reader, and thus would need moderate revisions, I have not gone through the manuscript with a fine-tooth comb, however I have picked a couple of things up:

References: Some references need fixing, for example, some papers are missing titles.

Edits: Line 290: construct e reversible should be "construct a reversible"