

Interactive comment on “HydroMix v1.0: a new Bayesian mixing framework for attributing uncertain hydrological sources” by Harsh Beria et al.

Anonymous Referee #3

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General comments: The study of Beria et al highlights the importance of isotope mixing modelling to overcome spatio-temporal variability inherent in end-member sampling data. To underline its use, four case studies are assigned to evaluate the modelling performance. The results underline that modelling approaches can help to better understand uncertainties and the constraints of sampling number against flux magnitudes related to runoff components. The study is an important contribution to the isotope hydrology and maybe of use also for other disciplines. Beside few specific comments, two major aspects need to be addressed before the manuscript is ready for acceptance:

- It remains unclear how the model is initiated and which data coming from field data

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or other studies were used. In this context, I recommend to report more experimental data, on which you rely in a second step to drive your modelling approach.

- the study partly relies on the mixing model of precipitation and snow, not snowmelt. While snow and snowmelt have different isotopic signatures, it is conceptually more correct to use snowmelt for mixing models to estimate its contribution to groundwater. I strongly recommend to better justify why snow instead of snowmelt was used to infer the meltwater supply of groundwater if you cannot extend your calculations to snowmelt.

Specific comments: Page 2, Line 37: Please consider to address also the assumptions of mixing models and the corresponding violation. This aspect may also help to justify Bayesian mixing approaches you describe well. Page 5, Line 3: Please add here that the case studies you report later refer to mountainous (high-elevation) catchments. Page 5, Line 17: Please clarify the time-integrated processes you refer to. Page 8, Line 14-15: How is the sine function defined? How do you derive the amplitude and time lag? Page 8, Line 22: Please add some references to justify the temperature boundaries you have chosen? Other common boundaries are -1 to 3°C or -1.5 to -1.5, for example. Page 10, Line 39: Please clarify, to which small glaciers do these area proportions of 4.4 % and 10.1 % belong to? Page 11, Line 20: It is well known that the isotopic signature of snow is isotopically much more negative and thus much different from the one of snowmelt, which actually forms the 'true liquid' runoff component. Beside, which logistical constraints did prevent from sampling? Snowmelt sampling can easily be carried out by installing PCS collectors or grab sampling the dripping snowmelt. Table 1: What do you mean by top snowpack layer? Page 12, Line 34-35: Please rephrase and clarify here. The catchment average isotopic ratio does not simply depend on the elevation gradient, which may hold better for precipitation variabilities. But on the presence of the snowpack and where the snowpack is isothermal so that melting could start. Figure 3: What do you mean by “different random seeds”? Please see also the general comment regarding the modelling initiation. Page 15, Line

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4-8: Please consider moving this paragraph to section 3.2 Table 4: How do you justify the values of precipitation isotopic lapse rate? Can you provide field data or further references on experimental data? Figure 6: How did you define the number of days on which rainfall, snowfall and snowmelt occurred? Please rephrase Page 17, Line 17. Page 20, Line 3-59: Please rephrase. Figure 9: Please enlarge axis tick labels. Why did you use different x axis scales? Page 22, Line 7: What is small sampling number in your opinion? Page 22, Line 31: I do not see how sediment dynamics fit in here. Sediment dynamics may be coupled with specific runoff components or also decoupled.

Typing errors: Page 1, Line 29: Please change to “that effectively weight” Page 21, Line 17: Rephrase to “tracer data being available”

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