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Comment on hess-2022-100

Weiquan Dong (Referee)

Referee comment on "Transit Time index (TTi) as an adaptation of the humification index to illustrate transit time differences in karst hydrosystems: application to the karst springs of the Fontaine de Vaucluse system (southeastern France)" by Leïla Serène et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-100-RC1, 2022

Title: *Transit Time index (TTi) as an adaptation of humification index to illustrate transit time differences in karst hydrosystems. Application to the karst springs of Fontaine de Vaucluse system (Southeastern France)* by Serène et al. and was submitted to **Hydrology and Earth System Sciences** (https://doi.org/10.5194/hess-2022-100. Preprint. Discussion started: 31 March 2022)

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The authors presented the Transit Time index (TTi) as a potential natural transit time tracer for the groundwater residence time within the range of 0-6 months based on the data of karst springs and their catchments of Fontaine de Vaucluse system (Southeastern France). The TTi appears an advance from the previous Humification IndeX (HIX) as initially proposed by Blondel et al. (2012). The TTi has the potential to provide a cost-effective transit time tracer for the groundwater residence time within the range of 0-6 months compared to artificial tracers, which will fill the gap of the natural transit time tracers for a short range of 0-6 months. The authors presented basic spring and catchment settings, detailed how TTi was derived, and conducted principal component analysis (PCA) to determine TTi components (Tyr, P1, H1&H2) and other variables related to the transit time (electrical conductivity, discharge, magnesium, and silica contents). The authors concluded that the TTi is more sensitive and can identify freshwater arrivals in mixtures. Therefore, the TTi has the potential to be a supplemental tracer to artificial tracers and is likely useful for assessing the vulnerability of the aquifer which is the fast response to the recharge. However, besides the comments noted on the manuscript, I do have 3 suggestions for this manuscript before accepting it for publication:

1) I would like to see more detailed hydrogeology (karstification types), groundwater movement, and catchment delineation because this information is the base used to validate the TTi results.

2) Perform hydrograph separation to quantify the storm flow and base flow for the storm events in different seasons, because this information is also helpful to interpret the TTi results.

3) Double-check the positive correlation between electrical conductivity (CE) and spring discharge, which is very unusual compared to other karst springs.

Finally, I would also like to suggest that the authors conduct the artificial tracer tests for the springs investigated in this manuscript and validate the TTi with the artificial tracer test results. However, this suggestion is not required for accepting this manuscript for publication.

Please also note the supplement to this comment:
https://hess.copernicus.org/preprints/hess-2022-100/hess-2022-100-RC1-supplement.pdf