

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
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Comment on hess-2021-267

Anonymous Referee #1

Referee comment on "Identification of the contributing area to river discharge during low-flow periods" by Maxime Gillet et al., Hydrol. Earth Syst. Sci. Discuss.,
<https://doi.org/10.5194/hess-2021-267-RC1>, 2021

The authors applied an end-members analysis to identify and quantify stream contributions during low flow period in a headwater (<100 km²) Mediterranean catchment relatively poorly affected by human activity. The originality of the work are : (1) to focus the stream flow deconvolution to the low flow period which has been rarely done but seems relevant to understand the processes that sustain low flow in a context of global changes and of a Mediterranean climate where drought are known to increase already. (2) to compare and combine different methods for identifying the end-members: hypotheses-driven identification consists in associating an end-ember to each geological unit present in the catchments. The data-driven approach supports the first identification by applying a clustering and a principal component analyses to a set of groundwater samples collected throughout the catchments and for which concentrations in major elements have been analysed.

Four methods are conducted to infer the concentrations of each members: one use the temporally closest analyses of groundwater samples, another use the seasonal mean of these groundwater concentrations, a third uses the geographical mean of groundwater concentration by geological unit and the fourth experimentally produces a leachate of each geological unit and analyses its concentrations in major elements. The Four methods are compared in terms of end-members contributions and in terms of uncertainties.

In overall, I found the study well-designed and scientifically relevant for a publication in HESS. The result highlights the dominance for sustaining low-flow of a groundwater reservoir that has a small spatial extend and a relatively moderate/low contribution to the total flow. The approach combining different methods for end members identification and quantification (including the associated uncertainty) is applicable to other sites and seems relevant to link water contributions to potential geological reservoirs.

In details, I have some questions and several suggestions to improve the clarity of the

description (please see below) that should lead to relatively minor edits of the manuscript. My major critic would be that the article should include a short overview of the limits of the EMMA approach widely discussed in the literature (such as the assumed stability of the end members chemical composition and the need for objective methods to fix the number of end-members). This would not decrease the impact of the study as some of these limitations are either addressed here or less limiting because of the focus on low flows... I am not a native English speaker and this has to be checked with one but I think that the manuscript requires a little work for polishing the English.

L.15, p1 Aubé, 2017, can you provide more references?

L. 18, p1 add a space after "scarcity"

L. 26, p2 why "However"?

L. 31-32, p2 "due to the fact that many low flow studies work on small basins with a strong geological homogeneity": I think that the sentence is ambiguous. Studies investigating the origin of water have been rarely applied to low flow because hydrologists usually want to understand the processes of flow generation and therefore focus rather on the high flow periods or events. Water origin can be a relevant question even in catchments with homogeneous geology.

L. 79-81, p. 3, information has already be given.

L. 88, p. 3: correct "Montpellier" and "Figure 1)

L. 89, p3: I did not understand "This typical watershed of the Cévennes area". What is typical from what?

L. 91, p.4: Remove "The" before "Mediterranean"

L. 97, p. 4: Considering that altitude ranges between 250 to 1100 m is only one rain station enough? How does rainfall vary spatially?

L. 98, p. 4: "mica schists 1"?

L. 111-112, p.4: which type of sensor is used to monitor the stream discharge? did you use a rating curve? What is the monitoring time step?

L. 117, p.4 "rainfall events have a very low impact..." the authors should precise "during this low-flow period" I guess?

L. 130, p. 6 +L. 134, p.6: please use the standard symbol "pH" instead of "PH"

L. 133, p.6: why did you use a threshold of 0.25 μm for filtering? I think that usual thresholds are 0.45 and 0.20 μm used for particles and colloids respectively? Can you provide a protocol reference?

L. 134, p.6: "stored until analysis" can you describe briefly in which conditions?

L. 135, p. 6 can you provide a reference for the analysis protocol (for major ions concentrations)?

L. 137, p.6: what are the "two representative sites"? and what are "each reservoir"?

Table 1 p. 7: Could you report the ID of the sampling points in Map of Fig 1? (at least the stations that are monitored weekly) ?

L. 140, p.7: "sites" plural

L. 148, p.7 : « on several sections (4) » : are there four sections in the spatial analysis ?could you locate them in Fig. 1?

L. 152, p. 8: "also collected for analysis (Figure 1). An additional campaign was..." instead of "for analysing (Figure 1). In addition to monitoring...."

L. 155, p. 8: "discharge measurements WERE carried out by SALT DILUTION METHOD on the tributaries and BY exploring the velocity..."

L. 160, p. 8 "analyses"

L. 165, p.8: "End-members" capital mark

L. 167, p. 8: "principal component analysis WAS applied"

L. 173, p. 8: Please revise English "To confirm the defined hydrogeochemical end-members"... "It aimed (past) to strengthen the previous definition of the end-members by an inverse approach"?

L. 176-177, p. 8 : present tense is used instead of past

L. 179, p. 8: could you provide some details about the rock samples collection method?

Figure 3: In title replace "experimentation " by "experiment", in legend "Granite" with "e" , add also please the number of samples for each substrates : Limestone (3), Granite (1) And add the number of replicates

L. 196, p. 10, remove the point after "alkalinity"

L. 200, p.10: "one of the objectives WAS"

L. 202, p. 10: "the number of required tracers WAS... "

L. 206, p. 10 "End-member..." capital mark

L. 208, p. 10 "our approach USED..."

L. 218, p. 10: I did not understand here? How much parameters did you use?

L. 222, p. 10: "The objective WAS..."

L. 241, p. 11: I missed in this section the quick description of the software and packages used here (for PCA, clustering, EMMA and GLUE analyses)

L. 243 to 251, p. 11: is this paragraph new? useful? necessary?

L. 254, p. 11 + L. 270, p. 12: "Piper diagram" with a capital mark

L. 254, p. 11: "are identified" visually?

L. 256, p. 11 : "with the composition of 3 groundwater"?? the three? Which?

L. 276-277, p. 11 : Is there a missing end-member then?

L. 279-280, p.11: Figure 5 does not show seasonal variation, does it?

L. 285, p. 11 : "close to the observed signatures from groundwater samples"

Figure 6: please find a transparency or something to make the GW sample less visible compared to the leachate.

L. 303, p. 14: not shown?

Figure 7: caption : "Silhouette Values to define the optimal numbers of clusters"

L. 313, p. 15 : "inertia curves..on the thre classes" ?? I do not understand

Table 2 caption "clusters"

L. 336, p. 16 "due to their low frequency of detecting..." replace by " because often below the detection limits" ?

L. 337-339, p. 16 formulation looks strange, isn't it?

L. 340, p. 16 "to add tracer to the tracers chosen by the end-members" : what do you want to say here?

Figure 9: more contrasted colors would be easier to read

Table 3: "pH" instead of "PH", what is illustrated using bold characters in the column/line titles? In the table itself?

L. 349, p. 18: the collection of rainfall water should be presented in the material and method section, at this stage we do not know that some rainwater has been sampled

L. 354, p. 18 precise in the subsection title "of time-window method "

L. 361, p. 18 what does mean "minus 10%", is it inferior to 10%?

L. 365, p. 18 "coherent with the increasing tourism activity" , I don't think so : usually WWTP rejects are constant throughout the year (unless the tourism increases drastically the population in summer?), but this constant reject is less diluted in summer low-flow period because natural stream flow is lower...

Figure 10: please add the associated uncertainties, is 2018 in upper panel and 2019 in the bottom panel? If so it should be written in the caption.

Figure 11: "black represents the contribution of WWTP"? It appears "yellow" in my pdf

L. 414, p. 21: where can we see the conductivity of these higher/lower contributions?

L. 417-421, p. 21 : These sentences should be in the Mat and Method section

L. 426, p. 21 : "less than 0.1 l/s/km²"

Figure 12: using same colors for geological map and flow contributions is ambiguous, 7 is not readable, 3 is not numbered

L. 450, p. 23 : what concentration does increase?

L. 456-459, p. 23: Nevertheless, as here you try to identify low flow contributions it remains relevant as low flows are rather associated to the period where contributions are poorly diluted and residence times highest?

L. 475, p. 23: How do you explain the increase of standard deviation here?

L. 497, p. 23: Precise when this specific flow calculations have been conducted (to which period are they associated)

L. 517, p. 25 : Does "The Valat des Oules" correspond to a number provided in Figure 11?

L. 523-525, p. 25: then the Quartz and black micaschists reservoirs are supposed to be fissured layers of micaschists only without contribution of a weathered layer?

L. 535, p.25 "analysis provided"

L. 541, p. 25: "allowed us"

L. 552, p. 25 : do you mean a higher anthropic impact on the water quantity or on the water quality?