

Authors' Response

25. November 2021

5 We thank all the reviewers once again for the constructive feedback which helped us improve the discussion of the results and overall readability of the manuscript. We have taken careful note of the technical corrections and implemented them in the revised manuscript. The locations of these corrections are detailed below next to the suggested technical corrections. Reviewer comments are preceded with "RC" and our response is the italicised text following the reviewer comment. Upon proof-reading the manuscript, we also noted several additional locations where we deemed modification of phrasing to be appropriate considering consistency of language/wording, ease of readability, and referencing. These
10 modifications are noted separately at the end of this response.

15 RC: The section in L754-763 illustrates in which systems spatial heterogeneity is important. It is not entirely clear to me why the authors compared shallow systems to deep subsurface systems here- did they want to state that spatial heterogeneity is less important in deep subsurface systems? If so, it would help to state this explicitly in the text.

*The intention of these lines was to suggest physical systems where spatial heterogeneity may play a role, keeping in mind our description of dominant flow processes. This is why we preceded the examination of shallow and deep subsurface systems by the description of the dominant flow process (P27: L727-
20 "advection dominated system ..."). Keeping in mind the reviewer's suggestion, we have added a clarification that these systems are mere examples:*

*L730-732- "... In contrast, in the deep subsurface microbial activity is lower and rather relies more often on inputs from the matrix material, which is ubiquitous and does not rely on transport for access to nutrients or energy gradients. It must be noted that this generic description of dominant processes serves to give examples for reactive systems for the purpose of our discussion and may vary from site-to-site depending
25 on specific site characteristics."*

Technical corrections:

RC L35: Do the authors mean terminal electron acceptors?

L52- Corrected

30 RC L52: I think there should be an "and" between the two citations.

L51- Corrected

RC L72: The authors could use "account for" instead of "vary between".

L70- Corrected

RC L112: "several studies" instead of "several studied"

35 *L108- Corrected*

RC L146: "effectively upscaling" instead of "effective upscaling" (or, alternatively: "effective upscaling of these")

L141- Corrected

RC L160: "a" instead of "and"

40 *L154- Corrected*

RC L267: "in addition to these dissolved" instead of "additionally, to these dissolved"

L260- Corrected

45 RC L509: delete ")"

L492 - Corrected

RC L645: I don't understand "though sub-sampling scale heterogeneities will not be resolved". Maybe there is a missing word?

L614-615- We realized that the phrasing was quite complex, so we have rephrased as follows:

50 *“even though heterogeneities at scales lower than that resolved by the sampling scheme will remain unobserved.”*

RC L659: Do the authors mean that the relative composition is similar in the cited studies and herein?

L628-629- We meant that the representation of the functional groups in the immobile fraction is similar to that in the mobile fraction. Considering the ambiguity induced, we rephrased the sentence as follows:

55 *“Our results suggest that the relative composition of species in the mobile and immobile subcommunities is however similar...”*

RC L757: "receives" instead of "received"

L727- Corrected

RC L759: "does not" instead of "doesn't"

60 *L729- Corrected.*

Authors' corrections:

L11- Updated email address of the corresponding author.

L98 – “settings” instead of “setting”

65 *L114- “depending on the sampling resolution” instead of “depending on sampling resolution”*

L173- “The reaction network also accounts for...” instead of “..., and as well as for the...”

L174- “, lumping all...” instead of “The latter lumps all...”

L188 – “Hainich CZE” instead of “Hainich Critical Zone Exploratory”

L200, L211, L229 – “Jing et al., 2018” instead of “Jing et al., 2017”

70 *L212-:L216- The references added during the review stage were missing from the bibliography. We have now corrected this issue.*

L274 – “...ratio of the transport time scale...” instead of “...ratio of the advective transport time scale...”

L332- “DO” instead of “oxygen”

75 *L378 – “...field and increase in...” instead of “field, and increasing ...”*

L527- “... it captures varying microbial respiration and growth regimes...” instead of “... it captures varying respiration and microbial regimes...”

L540 – “This compensates for our approach” instead of “This approach compensates for our approach”

L729- “... relies more often on inputs... ” instead of “... relies on inputs ...”