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Hydrology and Earth System Sciences
Discussions

Interactive comment on "On the role of operational dynamics in biogeochemical efficiency of a soil aquifer treatment system" *by* Shany Ben Moshe et al.

Shany Ben Moshe et al.

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We would like to thank Anonymous Referee 1 for the comments. We will account for them in a revised version of the paper, as we report in the following point–by–point reply:

Major comments (MC)

MC 1 -*Emphasize the important result: long DP → deep aerated reactive inter-*

val, throughout the results and discussion (is it first result of its kind?).

Autors' response - To the best of our knowledge, the presented results are the first to specifically show deep aeration following long DP in a SAT system. We, therefor, added this statement in the 'summary and conclusions' section. In addition, these findings are emphasized in the abstract, discussion and conclusions (L15, L190 and L289 respectively).

MC 2 -*The absence of reference to the flow in the column is annoying (e.g. flow rates, hydraulic properties of sediments; a simple 1D water flow model; more sophisticated flow of water and air model...). It is a controlled experiment in a column filed with porous medium, the hydrologist reader deserves a better acquaintance with this simple flowing system. The times of flooding and drying periods are meaningless without knowing the range of flow rates in the column. A calibrated model and simulations of different DP are a natural continuation of the research starting with the experiment, and can be in a following paper, but no reference of the flow condition in the column is not acceptable. Ponding and drying in a thick unsaturated-zone infiltration system is needed not only for the biochemistry, but also to sustain infiltration rates (see Ganot, Y.,R. Holtzman, N. Weisbrod, I. Nitzan, Y. Katz, and D. Kurtzman. 2017. Monitoring and modeling infiltration-recharge dynamics of managed aquifer recharge with desalinated seawater, Hydrol. Earth Syst. Sci., 21, 4479-4493).*

Autors' response - We fully accept the comment regarding the fluxes and added the appropriate values accordingly. Additionally, the manuscript of Ganot et al. (2017) is indeed important, and we have added reference to it in the introduction.
A numerical model,including water flow, solute transport, air movement as well as the main biogeochemical processes involved in the system was developed and calibrated. The results will be discussed in a separate manuscript that will hopefully be completed soon.

MC 3 - *Concentration units and naming chemicals entities – be consistent in naming and with units. Micro-molar than mg/l and in the N species is it as N or for the molecule?.I suggest use mg/l as C for DOC and mg/l as N for all N species thought the manuscript and say it explicitly. NO2- is an anion, "ammonium and NO3-", spell the chemical formula for the ammonium as well.*

Autors' response - According to the suggested, we made sure the chemical formula of ammonium is used throughout the text, with a few necessary exceptions in the M&M (i.e. "Ammonium test kit", "Ammonium chloride"). Concentration units of the results are consistently presented in mg/L, however, in the introduction we included some SHAFDAN concentration data in μM (the units used in the cited work). Since these numbers include analysis results and not only specific species (for example - DOC), we'd rather avoid the assumptions that are needed for the unit conversion.

MC 4 - *Figure captions are laconic. A figure and its caption should be much more standalone entities. For example: Figure 4 has no meaning for a reader without looking for "Experiment 3" in the text, while a few words can make it meaningful. Go over all captions.*

Autors' response -
The captions of all figures and tables were revised. The captions of Figures 2, 3, 4 and 5 were improved.

MC 5 -*Supplement - Sediment characteristics should be in the main text as part of dealing with comment # 2. A table of the chemical characteristics of all the water types should also be in the main text*.

Autors' response -

According to Referee 1's suggestion, water analysis results for the synthetic as well as the real TWW were moved from the supplementary material to the main text (Table 2 in the revised text). After careful consideration, we still believe that soil's characterization data belongs in the supplementary material for simplicity .

MC 6 - *Scientific-writing editing is needed. In many places a reference is referred to in both the beginning and the end of a sentence, synonyms with no explanation in abstract, typos, consistency (part 1 vs. – stage 1) if possible give meaningful names to the experiments – e.g. DP-240-SW or similar is better than meaningless experimant2/stage 2.*

Autors' response -
Scientific writing revision was performed for the manuscript. All the specific comments (SC) regarding writing editing were addressed. Experiments' names were changed to describe the DP and WW used (e.g. experiment 4 that involved DP of 240 min and real WW will be noted as - RW240)

Specific comments (SC)

SC 1 - *Abstract. Some numbers describing the main results in the abstract will help. For example in the deep layers DO stabilized on 1- 2 mg/l in the short DP and 3-4 mg/l for the long DP. Also % of removal of DOC TKN for the different DP.*

Autors' response -The abstract was re-edited. The revised version includes numerical values of the comparison between the DPs in terms of DO as well as water quality parameters.

SC 2 - *L13 – major comment (MC) 6*

Autors' response - Corrected according to the comment (Addressed in MC 6).

SC 3 - *L18 "pseudo" why pseudo? It's a real reactor.*

Autors' response - A classic reactor typically is seen as a well-controlled, fully engineered and completely mixed system. We use the term 'pseudo-reactor' here to distinguish SAT from such reactor.

SC 4 - *L24 MC 6 typo*

Autors' response - Corrected according to the comment (Addressed in MC 6).

SC 5 - *L38 I would say: local stream and the Mediterranean sea*

Autors' response - We accepted referee's suggestion.

SC 6 - *L41-42 MC 6*

Autors' response - Corrected according to the comment (Addressed in MC 6).

SC 7 - *L51-52 MC 6*

Autors' response - Corrected according to the comment (Addressed in MC 6).

SC 8 - *L52 – explain TKN = organic + ammonium nitrogen*

Autors' response - An explanation for the term TKN was added.

SC 9 - *L53 MC 3*

Autors' response - Corrected according to the comment (Addressed in MC 6).

SC 10 - *L81 delete "roughly"*

Autors' response - Corrected according to the comment.

SC 11 - *"Untraditionally" not clear*

Autors' response - The reasoning behind the use of glucose as the carbon source in the synthetic wastewater is explained in L96-98. However, we accept that the use of the word 'Untraditionally' is not necessary and hence it was omitted.

SC 12 - *L100 rael→real*

Autors' response - Corrected according to the comment.

SC 13 - *L104 Table 1 - MC 5, MC 6*

Autors' response - Was addressed in MC 5 and MC 6.

SC 14 - *L105 "H4H8N2O3" should be I believe C4H8N2O3*

Autors' response - Corrected according to the comment.

SC 15 - *L114-115 MC 3, MC 5*

Autors' response - Was addressed in MC 3 and MC 5.

SC 16 - *L123 TKN defined before*

Autors' response - Corrected according to the comment.

SC 17 - *Figure 2 caption: 1) what panel for what depth (a, b,c..)? 2) The initial (residual) WC ($\sim$ 15%) looks high for the sandy sediments in the column, explain.*

Autors' response - 1) Caption was improved and the letters (a-e) were associated with the corresponding parameters. 2) Albeit the fact that the soil profile is mostly sandy, it has non-negligible silt and clay content (see Table S5). Additionally, since the DP are not long enough for complete drying of the soil profile, the measured data doesn't reflect the residual WC even in the end of the DPs.

SC 18 - *L173 numbers do not fit the figure (12-18%) and not logical, larger DP $\rightarrow$ smaller WC makes more sense.*

Autors' response - We thank referee 1 for the attention. We corrected the numerical values.

SC 19 - *Figure 3 - MC 4 (big time). After making the figure +caption a standalone entity I would consider adding. At the caption: "note the convergence of the deep sensors to $<$ 2 mg/l after the short DP versus convergence too $>$ 3 mg/l in response to the long DP." or similar – MC1*

Autors' response - Was addressed in MC 4. We thank Referee 1 for the caption addition suggestion.

SC 20 - *L203 "($\sim$0.04..." are these the outflow concentrations? The inflow are orders of magnitude higher. Clarify.*

Autors' response - These are indeed outflow concentrations, it is mentioned in the text (L202). To make it clearer, the sentence was improved: "Outflow NH_4^+, DOC and TKN concentrations during experiment RW240 ($\sim$ 0.04, $\sim$ 1.65 and $\sim$ 0.62 mg/L respectively) were significantly lower compared to their inflow concentrations"

SC 21 - *L204 missing a concentration (for NH4 I believe)*

Autors' response - We thank referee 1 for the attention. Corrected according to the comment.

SC 22 - *L 220-221 MC 6.*

Autors' response - Corrected according to the comment (Addressed in MC 6).

SC 23 - *L 240-241 MC 6*

Autors' response - Corrected according to the comment (Addressed in MC 6).

SC 24 - *L252 Long FP means infiltration rates will decrease due to wetting front reaching some less permeable layers at depth. Draining the top sandy layers is*

essential also for maintaining high infiltration rates not only for the biochemistry.

Autors' response - Addressed in MC 2.

SC 25 - *Figure 5 – in what depth is the ORP probe at Shafdan? MC 4*

Autors' response - The depth of the field ORP measurements is mentioned in L223. However, we added it to the caption of figure 5.

SC 26 - *L278 delete "quality"*

Autors' response - Corrected according to the comment.

SC 27 - *L296 Why "pseudo"? same as comment #3*

Autors' response - Addressed in SC 3.

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