

SOIL Discuss., referee comment RC2
<https://doi.org/10.5194/soil-2022-1-RC2>, 2022
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Comment on soil-2022-1

Anonymous Referee #2

Referee comment on "Meso- and microplastic distribution and spatial connections to metal contaminations in highly cultivated and urbanised floodplain soils – a case study from the Nidda River (Germany)" by Collin J. Weber et al., SOIL Discuss., <https://doi.org/10.5194/soil-2022-1-RC2>, 2022

This study quantifies plastic particle abundance and heavy metal enrichment at four floodplain sites along a river in Germany in the soil depth profile down to 2 m and along a transect of increasing distance to the stream bed. No clear correlations were found between soil parameters or heavy metal enrichment and plastic abundance. Also, a clear pattern along the transect and along the river course was not observed. As seen in a few other studies, microplastic particles showed higher mean abundances in the upper horizon and decreased rapidly with depth. Interestingly, high accumulations of microplastic particles were found in different spots along the vertical profiles.

This is a very interesting study that expands sampling into a three-dimensional space and the results are valuable for publication. The results are displayed in a very precise and informative way with a lot of attention to detail. I think there is some improvement needed before publication though, mainly to organize the thoughts and intentions into a better structure.

I am somewhat missing clear objectives of the study. Why were plastics and heavy metals analyzed in the samples? What is the hypothesis that should be tested – what kind of relationship between the two metrics did the authors assume? What patterns were expected to be found in this study, along the river course, along the transect of increasing distance from the river, and along the soil profile? And why...? I appreciate that microplastic studies often need to have an exploratory nature due to the many contradicting results, but still, I think it would improve the paper if these points were addressed in a more coherent and clear way.

Introduction is rather lengthy. I suggest to eliminate information that is rather general, refer to the many reviews that are available, and focus here on the points that lead to your research question (spatial distribution, flood plain dynamics, connection to heavy metal contamination).

The conclusions are rather general, but not referring to the results.

Often the language is a little unclear/ambiguous. E.g. the term spatial distribution is used for different meanings: along the river, across the river transect, or along the soil profile. E.g., line 706: What is meant here by spatial distribution? The variation along the soil profile? Maybe it would be clearer to refer to each of the three dimensions investigated.

Specific points:

- Abstract: Try avoiding acronyms, explain enrichment factor
- Line 17: lower range of known concentrations where? In soils, floodplain soils, ...? This sentence does not make sense if you haven't read the manuscript.
- Lines 21 f: Why do we need info on spatial microplastic distribution for floodplain management?
- Line 30: correct typo "scapes"
- Line 38: check wording of this sentence
- Lines 52-59: one might expect that this paragraph leads to a hypothesis of an objective, something like: "Therefore, we wanted to find out...".
- Lines 70-72: not sure I understand the differentiation here in small-scale inputs and spacious inputs
- Line 75: "plastic abundance" instead of "spatial distribution of plastics"?
- Lines 82-92: this should be part of the discussion: putting own findings into context with literature
- Lines 97 f: not sure this is the correct reference. Also, I don't agree with this statement. Altered soil functions have only been found in the lab so far.
- Lines 101-108: is this a goal of this study? The temporal aspect is not really investigated here. Or can the sampled soil strata be somehow related to the time the sediment has been deposited?
- Line 112: replace "clear sequence" with "gradient"
- Lines 115 f: this sounds like a weak argument for the study. is it possible to find a stronger point?
- Lines 119 ff: These aims and hypotheses are coming somewhat "out of the blue". It would be nice if the introduction would be more funneled from the general knowledge via the knowledge gaps leading to the research goal.
- Lines 123 f: the terms spatial relationship and spatial correlation seem a bit misleading, since one would expect that spatial analyses are being conducted that are commonly defined as (statistical) analyses of georeferenced data.
- 2.1 Study area: This can be shortened to the points relevant for the aim of the study
- Lines 169 f: "geospatial approach" - this term is used here in a somewhat blurry way. Also, why does a landscape consist of soilscapes? The term soilscapes should be defined at first mention.
- Line 235: replace "as control" with "for correction"?
- Past and present tense are used inconsistently (e.g. in results section) - please correct throughout the manuscript.
- Terms are used inconsistently: plastic concentration, plastic load: I'd suggest to change these to "plastic particle abundance", since the results are based on number and concentration is more commonly used for masses.
- The order of subsections is vice versa in the methods and results chapter.
- Line 318: replace "organic (non-polymeric) with "natural organic matter"?
- Figure 2: Please explain the box plots (what quantiles are shown?) and increase the fonts. Replace "particle type" with "particle shape"
- Line 404: Mean values averaged over what?
- Figure 3: I am not sure I understand the meaning of cumulative sums. I suppose these

are the abundances shown in table 1 summed up over the three depths. But that would mean that 5, 2, and 3 samples are summed up for the 0-50 cm, 50-100 cm, and 100-200 cm, respectively, so the upper stratum is overrepresented. Wouldn't it be more intuitive to show mean abundance across each profile to compare the sites?

- Figure 6: I like the panel a a lot. But it might be clearer if the zoomed-in plots were removed. Also, consider to only keep 6a in the main paper. Instead of 6b, I'd rather like to see soil depth plotted against EPO age. Also, the gap in the size range from 2-10 mm strikes me. Is this an artifact of the analysis method? It should be discussed.
- Lines 476 f: Please delete: "with individual increased concentrations in deeper soil layers"
- Lines 494 f: replace "association" with "correlation"
- Lines 496 f, 506 f: according to figure 5a, the relationship between soil depth and number of MP is not linear, or only linear down to approx. 60 cm and then rather constant. Could this be included in the model?
- In the discussion, where the results are put into context with literature, I am missing the point that in general, particle abundances in different locations are hard, if not impossible to compare, since size and mass is not accounted for that can vary greatly depending on the origin, time of accumulation etc. of the plastics.
- Line 533: But Piehl et al found lower abundances
- Lines 566 ff: consider citing Koutnik et al. (2021) for a review of MP abundance in different soil types
- Lines 659 f: high levels of plastics in topsoil cannot explain accumulation in topsoils if the amount of translocated plastic is not known
- Line 669: "The direction of movement of the plastic deposits must therefore originate from the river" – why? What about agricultural activities, as stated earlier?
- Lines 675 f: but what about bioturbation, translocation to deeper soil?
- Lines 682-690: this is in logical contrast to the theory of sediment dating.
- Line 698: delete "spatial or statistical"
- Lines 700 f: meaning the emission of heavy metals from plastics?
- Lines 701 ff: I'm not sure what is intended here. If heavy metal as additives in plastics likely play no role, why should it be further studied?
- Line 707: What is the meaning of "significant outliers"?
- Line 723: What is the meaning of "(functions of some plastic pieces still recognizable)"?
- Line 734: Consider replacing "plastic content in floodplain deposits" with "the microplastic abundances found in this study"
- Lines 744 ff: I am not sure I understand this. In the discussion the authors state that the MP abundance even in the upper soil layers is low compared to e.g. agricultural soils in literature. So, it seems that MP are not a prominent issue in flood plains, as other pollutants like heavy metals.
- Line 754: a risk assessment usually does not follow legislation, but legislation follows an assumed or assessed risk
- Lines 768-770: this is true and a well-known problem, but it doesn't relate to the study.
- Lines 771-773: I think this is a little far-fetched in light of the comparably low levels of plastic contamination found in this study, and the positive effects on biodiversity and flood mitigation of river bed restoration.
- Lines 774-776: Also, this statement is general and not concluded from the study results.

References

Koutnik, Vera S., Jamie Leonard, Sarah Alkidim, Francesca J. DePrima, Sujith Ravi, Eric M. V. Hoek, and Sanjay K. Mohanty
2021 Distribution of microplastics in soil and freshwater environments: Global analysis and framework for transport modeling. *Environmental Pollution*, 274:116552.

