

***Interactive comment on* “Silicon cycle in a temperate forest ecosystem: role of fine roots and litterfall recycling and influence of soil types” by Marie-Pierre Turpault et al.**

Anonymous Referee #1

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Review

Biogeosciences Discussions

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General comments

First of all I would like to thank the Associate Editor in charge for the opportunity to review the present manuscript entitled ‘Silicon cycle in a temperate forest ecosystem: role of fine roots and litterfall recycling and influence of soil types’. The authors (Turpault et al.) analyzed silicon (Si) cycling in three temperate forest ecosystems with

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different soil types (Dystric Cambisol, Eutric Cambisol, Rendzic Leptosol). In this context, Turpault et al. aimed to unravel the specific role of fine roots and soil properties on Si cycling. The authors found that fine roots potentially play an important role in Si cycling as their Si concentration seems to be comparable to the Si concentration of leaves. Furthermore, Turpault et al. found the Si concentrations in fine roots and leaves to be dependent on the concentration of dissolved Si in the soils. Turpault et al. concluded from their results that biological processes play a predominant role in Si cycling of the studied sites. In my opinion the article of Turpault et al. generally is of interest for the readers of BIOGEOSCIENCES. However, I identified several shortcomings of the manuscript which should be addressed before potential publication.

In general, the authors should:

- Use units following the rules of the 'International System of Units' (e.g., g kg⁻¹ and not g.kg⁻¹; Please check the whole manuscript on that because in almost all units these dots were used)
- add some literature that is most relevant to their article from my point of view and will help to present a more appropriate discussion of their results (please see my specific comments to the single sections below)
- reconsider the presentation of their results (in the current form I found reading of some subsections of the results section quite exhausting as the authors only repeat the data one-on-one as given in the Tables; I also miss a 'joining' of data, e.g., by some simple correlation analyses)
- rework some subsections (in the current manuscript there are some redundant passages in different subsections; Additionally, specific paragraphs should be displaced to corresponding subsections, e.g., methods should be given only in the Materials and Methods section)

Please find corresponding details on the different subsections listed below. I am really

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looking forward to reading the revised manuscript.

Abstract

I.16: Actually, there is at least one publication where Si pools of fine roots were determined (Maguire, T. J., Templer, P. H., Battles, J. J., & Fulweiler, R. W. (2017). Winter climate change and fine root biogenic silica in sugar maple trees (*Acer saccharum*): Implications for silica in the Anthropocene. *Journal of Geophysical Research: Biogeosciences*, 122(3), 708-715). So, please relativize your statement ('rare is known...'), for example).

I.21: I would recommend using DC, EC and RL for Dystric Cambisol, Eutric Cambisol and Rendzic Leptosol, respectively, instead of S1, S2, S3. If you follow my recommendation, please change this within the whole manuscript (and figures and tables).

Introduction

I.48: Please change '...Si in soils also had a biogenic origin...' to '...Si in soils can also be of biogenic origin...'. .

I.58: Please change '...transpiration have also influenced...' to '...transpiration also influence...'. .

I.65: I would recommend using the classification of BSi pools as given in Puppe et al. (2015) (Puppe, D., Ehrmann, O., Kaczorek, D., Wanner, M., & Sommer, M. (2015). The protozoic Si pool in temperate forest ecosystems – Quantification, abiotic controls and interactions with earthworms. *Geoderma*, 243, 196-204), i.e., zoogenic, phyto-genic, microbial and protistic Si pools.

I.70: From my point of view you should add Meunier et al. (2017) (Meunier, J. D., Barboni, D., Anwar-ul-Haq, M., Levard, C., Chaurand, P., Vidal, V., Grauby, O., Huc, R., Laffont-Schwob, I., Rabier, J., and Keller, C.: Effect of phytoliths for mitigating water stress in durum wheat, *New Phytol.*, 215, 229–239, <https://doi.org/10.1111/nph.14554>, 2017) and Puppe et al. (2017) (Puppe, D., Höhn, A., Kaczorek, D., Wanner, M.,

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Wehrhan, M., & Sommer, M. (2017). How big is the influence of biogenic silicon pools on short-term changes in water-soluble silicon in soils? Implications from a study of a 10-year-old soil–plant system. *Biogeosciences*, 14(22), 5239-5252) here as these articles also show the importance especially of small-scale phytogenic Si.

I.76: I guess you mean ‘sap’ instead of ‘soap’ here, right?

I.93: Please change ‘...soil conditions differ between...’ to ...soil conditions differ, whereas climate conditions, ...’.

II.95-102: From my point of view this paragraph belongs to the Material and Methods section.

I.104: Please replace ‘where’ by ‘because’.

Materials and Methods

I.107: Please change ‘referred’ to ‘referred to’.

I.108: Please add ‘located’ after ‘is’.

I.113: I would recommend giving the meanings of these abbreviations here.

I.114: Please change ‘are’ to ‘were’ and add ‘calculated’ before ‘from’.

I.117: Please add the scientific name of sycamore maple (*Acer pseudoplatanus*?).

I.142: Please add ‘at 130 cm height’ after ‘circumferences’.

II.154/155: Do you mean: ‘Subsequently, the branches were separated...’?

I.155: Please add ‘in’ before ‘diameter’.

I.160: I would recommend deleting ‘(at least fifty kg of soil sample)’.

I.169: I guess you mean ‘20 cm depth’, right?

II.171/172: Do you mean ‘element concentration’ instead of ‘mineral content’?

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I.172: Please add the magnification used for microscopical analyses.

I.174: Did you check these samples, e.g., by SEM-EDX, to ensure that you removed all soil particles (especially the ones on a μm -scale)?

I.216: Please change 'spectroscopy' to 'spectrometer'.

I.232: Please add 'Titanium' before 'Ti' and set 'Ti' in brackets.

I.243: You already introduced 'C130' as abbreviation before (l. 142).

I.265: Please replace 'D(X)' by 'DSi'.

I.278 & I.279: Please change 'C1.30' to 'C130'.

I.310: Please replace 'are' by 'were'.

I.318 & I.320 & I.326: Please replace 'kg of Si by $\text{ha}^{-1}\cdot\text{y}^{-1}$ ' by 'kg Si $\text{ha}^{-1}\text{y}^{-1}$ '.

I.332: How did you analyze the amorphous Si fraction (alkaline extraction)? I cannot find it in the M&M section.

I.335: Why did you use 'year' as a factor here? You generally assume Si pools, in- and outputs to be more or less equal each year (otherwise you would not calculate means for the analyzed period 2012-2015), so you should not expect any time-related effects, right?

I.337: If your data are not normally distributed (as you said before) you should use nonparametric tests only (i.e., the Mann-Whitney U test instead of the Student's t-test). Statistical analyses: From my point of view you should also use some simple correlations (Spearman's rank correlation) to detect relationships within your data. If you find (and you will find, I am quite sure) significant correlations you can have a closer look at these relationships using some more elaborated statistical tests.

Results

I.348: Do you mean 'Aged' instead of 'Altered'?

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I.348 & I. 349: I would recommend using 'testate amoebae' instead of 'amoebae'.

I.373: The numbers did not change after calculation? Please check again your calculations.

Results: I know the results section of a paper often is not like a thriller. However, you should try to make it at least easy to read. So please do not only repeat the data as they are already given in the figures and tables because this is quite exhausting to read. Please rework your results section (from my point of view, subsection 3.1.6 is a good example how to present you results in a more appropriate way).

I.414: Please use powers of 10 for such big numbers.

II.451-454: Please avoid to give redundant information (see 3.2.2) and to 'jump' between your figures (try to refer to every figure only one time).

II.456-459: Where can I find this information (Fig., Table?)?

Discussion

II.461-464: I would recommend deleting this paragraph.

I.473: You should discuss your results in the context of the results of Maguire et al. (2017) here.

I.484: Do you mean 'Sommer et al. (2013)' instead of 'Sommer et al. 2003'?

I.497: I would recommend using 'Mineral soil content' instead of 'Soil pollution'.

I.502: Please give an example for biological activities (e.g., bioturbation by earthworms).

I.503: Please replace 'Si pollution' by 'Si input'.

I.505: What did they study, dust deposits or Si in the litterfall? Please be more precise.

I.507: A space is missing between 'et al.' and '2017'.

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- I.509: Please add 'that of' after 'than' and give references for these data.
- I.510: Diverse taxa of testate amoebae synthesize SiO₂-platelets for shell construction, but they do not possess a skeleton.
- I.511: Actually, testate amoeba shells represent the protozoic Si pool in soils and not the zoogenic one (which is represented by sponge spicules) (see Puppe et al. 2015).
- I.512: I would recommend changing 'zoogenic pool could represent half. . .' to 'testate amoebae may use half . . . for shell synthesis'.
- I.513: I would recommend deleting 'in Europe' as Sommer et al. (2013) only analyzed one site (in Germany).
- I.518: Another output flux is only likely if you assume balanced in- and outputs in general. From my point of view your data clearly indicate an accumulation of BSi in the organic layers. Please give some more references here to support your findings.
- II.520-522: Please give some references to support your assumption.
- I.524: In general, the amorphous Si fraction includes pedogenic and biogenic Si.
- I.525: I would recommend adding Puppe et al. (2015) here as they analyzed testate amoebae and corresponding Si pools in detail.
- I.527: What do you mean with 'Si-amorphous'?
- I.529: Please replace 'until' by 'down to'.
- I.532: Do you show these relationships in the results section? If not, you should do so.
- II.534/535: Do you have data on this? If yes, you should present them in your paper. If not, please give some references to support your assumption.
- I.541: What do you mean with 'biogenic origin'? Please clarify.
- I.542: Please change 'plant' to 'plants'.

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I.550: I would recommend stating here that BSi in general is more soluble than soil minerals (Frayse and co-workers did some nice experiments on this).

I.552: What about deforestation as an important Si output (anthropogenic desilicification)? Please also discuss this important factor and give corresponding literature.

I.563: Please replace 'amoebae' by 'testate amoebae'. Do you have an idea about the population size of testate amoebae at your site (individual numbers)?

II.564-566: Please avoid to give redundant information.

II.571/572: Please change '. . .strong influence of biological partners, mainly fine roots, and processes in the Si cycle' to '. . .strong biological influence mainly of fine roots.'

II.576-579: Please avoid redundant information.

I.577 & I.578: Do you mean ' 3×10^3 ' and ' 0.7×10^3 ' here?

II.580-583: It is known that the concentration of dissolved Si is a key factor for Si concentrations of plant components (as you also write in your introduction). So please give corresponding literature here and do not highlight this result as a new one. Furthermore, there is also a phylogenetic factor, i.e., phytolith production is probably more influenced by the phylogenetic position of a plant than by environmental factors like temperature or Si availability. In this context, you should also discuss and cite, for example, Hodson et al. (2005) (Hodson, M. J., P. J. White, A. Mead & M. R. Broadley (2005). Phylogenetic variation in the silicon composition of plants. *Annals of Botany* 96, 1027-1046).

I.583: Please add 'in soils' after 'concentrations'.

I.584. Why Si concentrations are higher especially in these plant components (leaves: transpiration termini; Roots: special protection of relatively fast growing fine roots)? Please give a more detailed discussion here and add corresponding literature.

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I.596: Please be careful with statements like 'the complete Si cycle'. I would recommend using 'the Si cycle' instead.

I.601: Please replace 'to give dissolved Si' by 'in the form of dissolved Si'.

I.603: Please add 'on a decadal time scale' after 'biogeosystem'.

I.606: Please add 'concentrations' after 'Si'.

II.608/609: I would recommend using 'release' or 'instead of 'production'.

Figure captions

Fig. 1: Did you use EDX for elemental analyses?

I.760: Please replace 'amoebae' by 'testate amoebae'.

I.761: Please change 'altered' to 'aged' and replace 'testate amoebae' by 'testate amoeba shells'.

I.774: Please replace 'Histograms' by 'Bars'.

Tables

I.792: Please replace 'Are presented the mean values... ' by 'Presented are the mean values... '.

I.798: Please specify which differences were evaluated (DC vs. EC vs. RL?).

Table 3: Why did you test only the total soil depth on statistical significance? Interestingly, the upper compartments are quite comparable at the three sites, only in the deeper soils (30-90 cm) there seem to be significant differences.

Table 4: I cannot find any letters marking statistical significances.

Better use 'Si concentration' for Si in g kg⁻¹ or mg l⁻¹ instead of 'Si content'.

What about the mineral composition of the different soils? It would be nice to have also

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data on this.

Figures

Fig. 1: What are the black arrows pointing at (micrograph c)? Please specify or give uniform arrows.

Fig. 2 & 3: Why do you use single data of four years in one diagram (Fig. 2) and means with standard deviations in another one (Fig. 3)? I would recommend unifying the presentation of your results.

Fig. 5: Please correct the unit of dissolved Si.

Fig. 6: As you can go full color in this journal I would recommend using different colors for data of the different sites.

Fig. 6: Please correct the values of soil Si pools ($\times 10^3$).

Fig. 6: What about soil pH effects? I especially wonder at Si drainage values of S3 (0-10 cm). You should also give a more detailed discussion on this aspect.

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