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Interactive comment on "Soils from cold and snowy temperate deciduous forests release more nitrogen and phosphorus after soil freeze-thaw cycles than soils from warmer, snow-poor conditions" *by* Juergen Kreyling et al.

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Anonymous Referee #2 The manuscript addresses the effects of FTC magnitude and frequency on the shortterm release of nutrients by conducting a three-factorial gradient experiment. Although the experimental design is simple, the hierarchical regression analysis was applied to detect the underlying response patterns in the threefold interactive gradient experiment. Therefore, the manuscript is more innovative from the perspective of analytical methods. I think that the manuscript is particularly well-written. The figures are excellent and do a great job of summarizing your results.

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Reply: Thanks a lot for this positive feedback and your constructive critique below!

1. Here are some minor suggestions. Abstract Line 14: Generally speaking, we use “intensity” instead of “magnitude”

Reply: Both terms have been used in the past and a quick search through the Web of Science does not provide arguments for one or the other in terms of their frequency of occurrence. We have selected the term based on the general framework of disturbance ecology, which characterizes a disturbance by its duration, abruptness, magnitude and frequency (White & Jentsch 2001 Progress in Botany). We now stick to this wording. Not being native English speakers, though, we would be open for good arguments to change the wording.

2. Line 20: change “higher frost” to “higher FTC”

Reply: Changed as suggested.

3. Line 29-30: The unit representation is incorrect, there is no subscript and superscript. Please check the full text.

Reply: Checked and corrected throughout the text.

4. Introduction Line 55: delete “(FTC)”

Reply: As the abbreviation was already introduced in line 43 we now use the abbreviation here and deleted the full term.

5. Line 94-96: Compared to nitrogen, there is less description of phosphorus. Could you add more descriptions about phosphorus.

Reply: True. We have added a few lines on this topic, now at lines 100ff.

6. Materials & methods Line 104: Can you clarify what you mean by “FTC magnitude”; delete the second “FTC”;

Reply: We have added a short definition (“the minimum temperature reached during

the freezing phase of an FTC"; line 113).

7. Line 128: The collection date and depth of soil samples are not clarified. Soils sampled in different seasons have different properties, such as soil water content, soil microbial biomass, soil nutrients, and so on. Soil microorganisms also show different tolerance to changing temperature in different seasons. So, the unrealistic time of soil collection will affect the experimental results. In addition, why should the soil be stored for 16 weeks before starting the experiment? This may change the original physical and chemical properties of the soil.

Reply: To our own surprise, we indeed missed to report the sampling depth and have added this now (line 139: 0-10 cm soil depth) – thanks for spotting this! We have also specified the timing of sampling and the experimental treatments there. The timing was based on the rationale that sampling should occur before natural frost events might happen while the treatments were timed for February when typically the most intensive FTC take place in our study area. We have clarified this rationale at lines 139ff.

8. Line 130: 10 grams of soil seems to be a bit less, which leads to greater intensity and rate of freeze-thaw cycle than under field conditions.

Reply: We specifically went for this relatively small amount in order to ensure homogeneous temperature dynamics throughout the samples. Otherwise the buffering effect that you correctly describe would interfere with our FTC treatments in a way that the exact minimum temperature per sample could not be determined, as it would differ within the sample. Such 'controlledness' is the basis of laboratory experiments and with our sample size we can guarantee that the sample conditions (the temperature of the sample) actually reflected the scenarios that were simulated by the climate chambers, because the samples responded almost immediately to the climate chamber temperature. As stated in the text, we aimed at exploring the discrete and causal relationship between soil temperature and nutrient release which can best be investigated with small soil samples in an ex situ approach. We have now added a short

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rationale for the relative small sample amounts (line 144).

9. Table 2: change “PO42–P” to “PO43–P”; The value of soil moisture is a dot instead of a comma Line 145-146, 158: Could you show the pattern of freeze-thaw cycle with a figure? (Wang, et al., 2015. Effects of freeze-thaw cycles on the soil nutrient balances, infiltration, and stability of cyanobacterial soil crusts in northern China. Plant and Soil (Figure 2))

Reply: We have corrected the inconsistencies – thanks for spotting! We have furthermore added a graphical representation of the FTC treatments to the Appendix A of the paper for clarification.

10. Line 197-198: Please explain in detail how to use the AICc to determine the best model

Reply: We have added a short explanation at lines 212ff.

11. Line 232: Please explain the abbreviation of AICc

Reply: We have now introduced this abbreviation already at line 212, but have also added it to the table captions.

12. Results Line 239: Explain abbreviations in the legend (“FTC”)

Reply: Done.

13. Line 261: Change “were” to “was”

Reply: Done.

14. Discussion Line 315-330: In the paragraph about FTC effects, you discuss potential mechanisms leading to increases in inorganic N and P. The whole discussion did not involve the discussion about phosphorus. Could you add some discussion about phosphorus.

Reply: We have added a short paragraph on implications for N:P imbalance at lines

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406ff.

15. Line 336: delete the second “FTC”

Reply: Done.

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