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Interactive comment on "Comparison of inorganic nitrogen uptake dynamics following snowmelt and at peak biomass in subalpine grasslands" *by* N. Legay et al.

N. Legay et al.

nicolas.legay@gmx.com

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We would like to thank Referee #2 for the constructive comments. We addressed all the remarks and amended the manuscript accordingly to include all suggestions.

General comments:

The reviewer made a number of specific and technical points to support his general comments and we addressed them as follows:

1. P.8889 14-19. The microbial crash in response to air-temperature freeze-thaw cycles has been supported in the lab, but rarely in the field. In the refs provided here,

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the concept that freeze-thaw cycles drive the thaw microbial biomass collapse is a hypothesis. More recent literature suggests that soil freeze-thaw cycles in the field are dampened, microbes may not be sensitive to these dampened cycles, and that osmotic pressure changes and predation may be the driver of the thaw microbial collapse.

Reply: We agree that air-temperature freeze-thaw cycles might not be the only explanation for a soil microbial crash. We added the effect of osmotic pressure changes in the manuscript (P3, L58). We also updated the list of citations (Jefferies et al., 2010; Edwards and Jefferies, 2013; Zhu et al., 2013) (P3, L56-58 & 59-60).

2. P.8889 20-22. Provide reference

Reply: Accepted: We provided 3 references among which 2 have been published recently (P3, L63-64).

3. P.8892 4. Provide precipitation record for longer time span (at least since 2005) 4-6. What years are the temp records from?

Reply: Accepted: We added precipitation and temperature records from 2004 to 2010 (P7, L127-128).

4. P.8893 25. MB15N is usually based on the total 15N in the fumigated vs. non-fumigated. What proportion of the MBN is extractable IN? How is this inorganic N stored in the microbial biomass? Any N that has been immobilized by microbes and incorporated into amino acids over the 48 h incubation period will not be recovered with this method.

Reply: Accepted: The reviewer is absolutely right. We apologized for this typo. Indeed, we actually determined 15N microbial biomass based on the total 15N in the fumigated vs. non-fumigated. We revised the sentence in the new version consequently (P9, L184-185).

5. May explain low MBN uptake (p.8904) in spring if microbes seasonally partition storage and biomass, and especially if microbial community structure changes between

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these two time periods (or years?).

Reply: This assumption cannot be retained since our methodology was correct as previously suggested by the reviewer.

6. P.8895 5. 48 h is a long time for measuring gross mineralization and probably resulted in microbial recycling of 15N. Error (underestimate of gross cycling rates as it reduces the soil solution 15N dilution rate, underestimate of MB15N), probably exacerbated by seasonal difference in microbial mineralization vs. immobilization.

Reply: We took into account the reviewer's remark in the text by incorporating two sentences (see P8, 163-166 & P11, L229-234) to explain the choice of 48h sampling time based on a previous experimentation at our site (Robson et al., 2007) and on methodological advices by Stark (2000).

7. P.8897 20-24. Repeat of text above (on p.8895).

Reply: Accepted: The reviewer is right. We suppressed line 287 to 298 and also modified the rest of the paragraph to avoid repetition (see P14-15, L299-300). We also changed "seasonal effect" for "seasonal contrast" in the title 3.2 (P14, L298).

8. P.8898 1-2. Difficult to accept – there is so much interannual and intra-annual variability in soil DIN pools.

Reply: We are aware that it is difficult to accept the validity of seasonal variations study with measurements realized at different years. Nevertheless, the study of Edwards and Jefferies (2013) showed that nutrient concentrations (e.g. inorganic N) have similar patterns over the years with comparable changes of microbial biomass and nutrients between winter, spring and summer. To take into account the justified skepticism of the reviewer, we modified the text to emphasize the fact that we simply compare two contrasted periods from two different years and that we have not tried to measure a dynamic (P15, L309&311).

9. P.8900 5-8. It is not clear how the difference between per area and per g MB differs

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so much, when MB does not differ - is this driven by changes in BD? See also p.8903 (line 16) – driven by changes in microbial density?

Reply: Different units have been used for plant N uptake (expressed per gram of biomass) and for MB (per gram of soil), that is probably why reviewer 2 find it a little confusing. The fact that there is difference between specific microbial N uptake rate and gross microbial N uptake rate, and not between microbial biomass per gram of soil and per field area, also results from the use of various units. Microbial biomass (pool of N in microbial biomass) was expressed per g of soil or per surface area whilst microbial uptake rate (fluxes of N from soil to microbes) was expressed per g of microbial biomass or per surface area. To avoid any confusion for the readers; we added a sentence (P10, L211-213) in which the various units of N uptake are detailed.

10. P.8901 10-12. This is not inconsistent - those studies found high nutrient pools during snow melt, that crashed at the end of snowmelt. You are measuring after snowmelt, so it is predictable that nutrient pools would be low.

Reply: The snowmelt dynamic in subalpine environments is somewhat different from the alpine or arctic. In the revised methodological section (see P7-8, L 147-153), we better specified the condition of the study sites at the sampling period by adding soil water content data, references and personal observations which all confirmed that we sampled during the late thaw period (according to Edwards and Jefferies, 2013). In consequence, we modified a sentence (P19, L395 & 396) by suppressing “nevertheless” and changing “decrease of” for “difference in”.

11. P.8901 12-17. The references for this ‘contradiction’ come from different biomes from this study (Arctic, boreal), with the exception of Bardgett 2002 and Brooks 1996, which may explain the discrepancies. Also, there may be a reference contradiction here as the same paper is cited on both sides of the contradiction (Edwards 2006).

Reply: We agree that the papers cited for that comparison, in the previous version of the manuscript, were mainly from different biomes. We updated the list of citations with

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one more study from a similar biome (Bardgett et al. 2005) to reinforce our argument about this “contradiction” (P19, L400). We agree that the paper of Edwards et al. (2006) was cited on both sides of the contradiction by mistake, and we made the proper corrections.

12. P.8901 24. This recovery rate is not unusual in field injections – what was the recovery rate in 2005?

Reply: In 2005, the recovery rate of 15N was of the same order of magnitude that in 2010 (from 60 to 70%). We added this information in the text (P20, L408).

13. P.8903 19-27. Studies that measure the microbial biomass at high frequency over thaw show that the microbial crash is during snowmelt, not after, so your spring sampling period is after the microbial community has already stabilized for the growing season.

Reply: As detailed above (reply #10), our sampling matches with the late thaw period as described in Edwards and Jefferies (2013).

14. P.8905 5. Smaller DIN pools are less important than the different consumption rates (which explain pool sizes), which should be emphasized here.

Reply: Accepted: We changed the sentence accordingly and focused on N fluxes rather than N pools (P24, L493-494).

15. P.8905 6. the word ’decrease’ here suggests that this sample period was part of a continuous timeline - a bit of a stretch here (also confusing). How about "at the end of snowmelt soil DIN consumption was high and dominated by plant uptake; at peak biomass soil DIN consumption was lower and dominated by microbial immobilization".

Reply: Accepted: We changed our sentence using the one proposed by the reviewer (P24, L495-497).

Interactive comment on Biogeosciences Discuss., 10, 8887, 2013.