

## ***Interactive comment on “The strength of the biotic compartment to retain nitrogen additions prevents nitrogen losses from a Mediterranean maquis” by T. Dias et al.***

**T. Dias et al.**

mtdias@fc.ul.pt

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Dear Prof Janet Sprent

We thank the anonymous referee number 2 for his/her comments on our manuscript “The strength of the biotic compartment in retaining nitrogen additions prevents nitrogen losses from a Mediterranean maquis” that we submitted for publication in “Biogeosciences, Special Issue: Nitrogen and global change”. Please find below the list of answers to the comments and suggestions.

Comment: It would be helpful if the authors explored the differential response to ammonium and nitrate a bit further as this is an important topic in the literature currently. For  
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example, can they extend their evaluation of the responsiveness to ecosystem to nitrate compared to ammonium beyond soil N availability to include plant response (and overall ecosystem response). The authors discuss these topics, but they could be presented a bit more prominently. Additional related questions could be addressed. Does the higher N retention in the nitrate additions indicate a bigger or smaller ecosystem response (presumably the N ended up in the plants in the NH<sub>4</sub> treatment altering the plants more and the soil less). Also, it is interesting to note that this seems to represent a different pattern from temperate forests with even deposition across the year where nitrate is the more mobile ion and is less likely to accumulate in soil. Answer: We agree that the experimental design we implemented has (Dias et al 2011a, b) potential and will be used (Dias et al unpublished) to assess the differential response of the vegetation to ammonium and nitrate. However, the present paper refers only to one year of N treatments and we think that addressing the differential response to ammonium and nitrate at such a short-term study could be speculative. We also consider that assessing the differential effects of nitrate and ammonium on vegetation would change the focus of the present approach.

Comment: The major problem that I had in reading this paper is that the authors keep asserting that the soil N availability in the autumn reflects the total N added up to that point. They point to table as evidence of this. In the three treatments, they report that they added 20 and measured 11, added 20 and measured 22, added 40 and measured 32 (µgN g<sup>-1</sup>). First of all, these values do not seem to “reflect the total N added” in any quantitative sort of way. Furthermore, the additions are described as 40 and 80 kg N ha<sup>-1</sup> yr<sup>-1</sup>, so it is unclear why, after a full year of treatments, only 20 and 40 kg of would have been added. This makes parts of the discussion unconvincing. Answer: As mentioned in Material and methods, we transformed the applied N treatments applied over the first year of experiment (corresponding to the N additions done on January, April and August 2007) into soil inorganic N concentrations (µg N g<sup>-1</sup> dwt) based on the following soil characteristics: 15 cm depth and 1.3 g cm<sup>3</sup> of density, resulting in ~2000 t of soil per ha. Therefore, the first year addition of 40 and 80 kg N per ha

corresponded to doses of 20 and 40  $\mu\text{g N g}^{-1}$ , respectively. The transformation of the applied N doses into soil inorganic N concentrations will be referred to as “total N added”, while the concentration of soil inorganic N in relation to the control determined in autumn will be referred to as “measured N”. We tried to clarify the text according to the comment.

Comment: title The strength of the biotic compartment to retain N additions prevents nitrogen losses from a Mediterranean maquis—it would sound less awkward to use “in retaining” than “to retain. Or “The strength of biotic compartment N retention prevents...

Answer: Accepted and changes accordingly: “The strength of the biotic compartment in retaining N additions prevents nitrogen losses from a Mediterranean maquis”.

Comment: 8042 8 unclear what is meant by “they reflected N additions in autumn matching the total N added”. See above. Answer: Comparison between the ‘total N added’ and the ‘measured N’ in autumn did not show significant differences for the 40AN and 80AN plots. Therefore, the N added to 40AN and 80AN plots reflected the cumulative N additions when N was added as ammonium and nitrate.

Comment: 25 It is more correct to say that demand has become uncoupled from N availability, not visa versa Answer: Accepted and changed accordingly.

Comment: 8043 4 It may be an oversimplification to suggest that N availability is synchronous with plant growth in temperate forest ecosystems. Counter examples include snowmelt N leaching prior to budbreak and post-leaf drop nitrate losses in the fall.

Answer: Although we are aware that there are some documented studies on asynchronous temperate ecosystems (e.g. in alpine tundra there are large increases in the inorganic N pool during snowmelt - Brooks et al. 1998 - and the highest rates of N mineralization occur during late summer or early fall, after plant senescence - Jaeger et al. 1999), these are exceptions and not the most common situation (Augustine and McNaughton 2004). - Augustine, D. J. and McNaughton, S. J.: Temporal asynchrony in soil nutrient dynamics and plant production in a semiarid ecosystem. *Ecosystems*, 7,

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829-840, 2004. - Brooks, P. D., Williams, M. W. and Schmidt, S. K.: Inorganic nitrogen and microbial biomass dynamics before and during spring snowmelt. *Biogeochemistry*, 43, 1-15, 1998. - Brooks, P. D., Williams, M. W. and Schmidt, S. K.: Inorganic nitrogen and microbial biomass dynamics before and during spring snowmelt. *Biogeochemistry*, 43, 1-15, 1998. - Jaeger, C. III, Monson, R., Fisk, M. and Schmidt S.: Seasonal partitioning of nitrogen by plants and soil microorganisms in an alpine ecosystem. *Ecology*, 80, 1883-1891, 1999.

Comment: 11 Would any Fenn studies be relevant to cite here? Answer: Given that there are limited studies of N deposition impacts on Mediterranean-type ecosystems outside California (Ochoa-Hueso et al. 2011) we consider the studies by Fenn and co-workers as relevant. - Ochoa-Hueso, R., Allen, E. B., Branquinho, C., Cruz, C., Dias, T., Fenn, M. E., Manrique, E., Pérez-Corona, M. E., Sheppard, L. J. and Stock, D.: Nitrogen deposition effects on Mediterranean-type ecosystems: an ecological assessment. *Environmental Pollution*, 159, 2265-2279, 2011.

Comment: 14 “nonlimiting water availabilities” is awkward Answer: Accepted and changed into “less limiting”

Comment: 8045 2 Doublecheck the 145 kg N/ha/yr value (Fenn). This sounds too high to be deposition alone; was there an N addition as well? 7 why list both agricultural and predominately agricultural? It seems redundant. Answer: N deposition in the western United States ranges from 1-4 kg N ha<sup>-1</sup> yr<sup>-1</sup> over much of the region to as high as 30-90 kg N ha<sup>-1</sup> yr<sup>-1</sup> kg downwind of major urban and agricultural areas (Fenn et al. 2003). However, due to the highly variable and poorly understood spatial pattern of N deposition there are sites at slightly higher elevations that can receive up to 145 kg N ha<sup>-1</sup> yr<sup>-1</sup> (Fenn and Poth 2004). - Fenn, M. E., Haeuber, R., Tonnesen, G. S., Baron, J.S., Grossman-Clarke, S., Hope, D., Jaffe, D. A., Copeland, S., Geiser, L., Rueth, H. N. and Sickman, J. O.: Nitrogen emissions, deposition, and monitoring in the western United States. *Bioscience*, 53, 391-403, 2003. - Fenn, M. E. and Poth, M. A.: Monitoring nitrogen deposition in throughfall using ion exchange resin columns:

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a field test in the San Bernardino mountains. *Journal of Environmental Quality*, 33, 2007–2014, 2004.

Comment: 8047 10 shouldn't change over time be  $((P2-P1)/P1) \times 100$ ? Answer: We used the same formula as Sheppard et al. 2008. Sheppard, L. J., Leith, I. D., Crossley, A., van Dijk, N., Fowler, D., Sutton, M. A. and Woods, C.: Stress responses of *Calluna vulgaris* to reduced and oxidised N applied under 'real world conditions'. *Environ. Pollut.*, 154, 404-413, 2008.

Comment: 8048 6 what is the basis for this assumption about annual litter production? Answer: We used a value of annual leaf litter production for a Mediterranean maquis that is in the reference we cited (Schultz 2002). There are other studies that measured the annual production of *C. ladanifer* leaf litter that are within the same range (Simões et al. 2009). Finally, we also measured *C. ladanifer* leaf litter production and is in agreement with the value we used on the present paper. - Simões, m. P., Madeira, M. and Gazarini L.: Ability of *Cistus* L. shrubs to promote soil rehabilitation in extensive oak woodlands of Mediterranean areas. *Plant and Soil*, 323, 249-265, 2009.

Comment: 8049 7 did N:P also increase? 9 Use caution in reporting non-significant changes 14-17 this text is not necessary since the treatment application was already described on p. 8045 19 "several occasions" This is unclear, weren't they only measured twice (summer and fall 2007)? It would be better just to give the seasons measured. 20 what is meant by "reflected the N added". I assumed that means  $N_{current} = N_{initial} + N_{added}$ , but this does not seem to be the case. Answer: Partially accepted and changed accordingly.

Comment: 8050 9 Was the apparent increase in % cover between 2007 and 2008 significant for the control and 40 trts? Why did it increase (including in the control)? Answer: The vegetation at the study site consists of a maquis that developed after a fire event (summer 2003) four years before the first N addition. Since at the beginning of the experiment plant community was in an early phase of succession plants (especially

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*C. ladanifer*) grew very fast to occupy the still 'free space'. As a result, plant cover increased from one year to the next. There was a significant difference between the increase in plant cover from control and plots receiving 40 kg N ha<sup>-1</sup> yr<sup>-1</sup> and that from 80 kg N ha<sup>-1</sup> yr<sup>-1</sup>. After four years of N additions *C. ladanifer*'s cover was not increasing but plant's height is (data not shown).

Comment: 8050 lack of litter response: any reasons to think that this might be altered with a longer period of fertilizer application? Answer: Data from the 2009, 2010 and 2011 show a clearer response of the litter response to the N treatments, i.e., litter from the C/N ratio of the 80AN treatment is significantly lower than that from the control.

Comment: 8051 It was be helpful for the reader to have some ranges for the comparisons in this paragraph (i.e. values reported in the literature) Answer: Accepted and introduced accordingly.

Comment: 22 This text beginning here is a little bit difficult to follow; it could be sharpened a bit. It does not seem incorrect to measure N availability in the spring per se. It sounds like that would give a sort of baseline of N availability for the ecosystem, while the autumn value (as the authors assert) is most significant for evaluating plant response and, thus, the overall impact of added N. Answer: Accepted and changed accordingly.

Comment: Table 1 what does "\*" signify? Answer: The asterisk in Table 1 refers to statistically significant differences between the two years. Only P, Mg and pH showed significant differences between 2007 and 2008.

Comment: Figure 1 I found the size of this figure to make it illegible in the printed version. Answer: Figure 1 was created along the vertical axis to facilitate its reading on a normal printed layout. However, in spite of the printed version having a square shape the variation of soil inorganic N availability over time can be seen.

Comment: Figure 2 the large axis scale for C:N makes it difficult to see changes.

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Maybe an axis break would be useful. Answer: To highlight the big difference and variation of the C/N ratio of leaves and litter we decided to maintain the graph as it was but included the mean values.

Comment: Also, please see attached comments on manuscript. I underlined awkward phrases with a wavy line. 8043 22 If “over time” refers to all the measurements listed (community composition and plant and litter N pools), it needs to go at the end of the sentence. Answer: The awkward phrases were changed accordingly. “Over time” does not refer to all the studied parameters; it applies mostly to soil inorganic N that was measured every season.

Comment: 8044 19 awkward: “whose” Answer: Accepted and changed accordingly.

Comment: 8046 15 what does fwt? In general, for an international audience, it is better to either spell out the abbreviation or define it at first use. (dwt, etc.) Answer: “Fwt” is the abbreviation of fresh weight. Accepted and changed accordingly.

Comment: 8053 4 correct to “respective Answer: Accepted and changed accordingly.

Comment: 8057 2 should be P. Neitlich, not O. Neitlich Answer: Yes it should. Changed accordingly.

Comment: Please also note the supplement to this comment: <http://www.biogeosciences-discuss.net/8/C3519/2011/bgd-8-C3519-2011-supplement.pdf> Answer: Accepted and changed accordingly.

Yours faithfully,

Teresa Dias

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Interactive comment on Biogeosciences Discuss., 8, 8041, 2011.