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Biogeosciences Discussions

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.

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Dear Prof Janet Sprent

We thank the anonymous referee number 1 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: Introduction: It is not clear to me what the term "ecosystem asynchronous" means because I can see in the data that the situation under control conditions, or

natural conditions with no N addition, there is no an increase in the availability of soil N in autumn. This only happens in the case of N addition. Perhaps the authors should better explain the meaning of the term since any reference is included with regard to this topic. Answer: In synchronous ecosystems, nutrient mineralization and plant production are closely coupled in time and this occurs in many terrestrial ecosystems. Typically, mineralization rates of limiting nutrients, particularly of nitrogen, during the growing season determine nutrient availability while pools of mineral nutrients remain low and relatively constant. Although several previous reports suggest nitrogen mineralization has the potential to vary seasonally and out of phase with plant production, such a phenomenon has been poorly documented (Augustine and McNaughton 2004. Temporal asynchrony in soil nutrient dynamics and plant production in a semiarid ecosystem. Ecosystems, 7, 829-84). Examples of asynchronous ecosystems are alpine tundra (Brooks et al. 1998. Inorganic nitrogen and microbial biomass dynamics before and during spring snowmelt. Biogeochemistry, 43, 1-15), Mediterranean-type annual grasslands in California (Jackson et al. 1988. Plant and soil nitrogen dynamics in California annual grassland. Plant and Soil, 110, 9-17) and semiarid savanna (Augustine and McNaughton 2004). In N-limited Mediterranean-type ecosystems the N flux is out of phase with plant growth (Jackson et al. 1988) and under increased N deposition the temporal pattern of soil inorganic N availability will depend on pre sampling climatic conditions that influence N mineralization, the biological N demand and the likelihood of N losses (e.g. NO3- leaching, runoff, NH4+ volatilization, denitrification) and/or the level of N deposition of the present system (Padgett et al. 1999. Changes in soil inorganic nitrogen as related to atmospheric nitrogenous pollutants in southern California. Atmospheric Environment, 33, 769-781). According to the referee's comment we are introducing a reference in the text to support the concept. - Augustine, D. J. and McNaughton, S. J.: Temporal asynchrony in soil nutrient dynamics and plant production in a semiarid ecosystem. Ecosystems, 7, 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. - Jackson,

L. E., Strauss, R. B., Firestone, M. K. and Bartolome, J. W.: Plant and soil nitrogen dynamics in California annual grassland. Plant and Soil, 110, 9-17, 1988. - Padgett, P. E., Allen, E. B., Bytnerowicz, A. and Minich, R. A.: Changes in soil inorganic nitrogen as related to atmospheric nitrogenous pollutants in southern California. Atmospheric Environment, 33, 769-781, 1999.

Comment: Experimental design and fertilization schedule: Between lines 5 and 15 there seems to be some confusion regarding the time at which the first addition of N occurs. On one hand, it seems that it took place in January, but then the authors state that three applications were made equal in spring, summer and autumn, which is unclear. From Figure 1, it appears that there were 4 applications but this is not clearly reflected in the text. I suppose that four applications were made and this must be clarified in the text. Answer: The first N application was done on January 2007 which corresponded to the middle autumn/winter N addition and, as the experiment is still running and because at the last soil sampling date the 4th N addition had already been made it was included on Fig. 1. We corrected the text in order to clarify both issues.

Comment: Calculations: In the formula given to calculate changes over time, it is unclear to me why the denominator is divided by 2. This should be explained better. 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: Soil responses to N additions: There are differences in the explanations with regard to the moments at which soil sampling took place. (the end of October in the text, whereas, in Figure 1a, the asterisk marks the beginning of October and in figures 1b, 1c and 1d, it is mentioned as in November 2007. The authors must clarify this point since the beginning of the rains may have a great influence on the N washing. It is very important to know whether the autumn sampling took place before or after the start of the rains. Answer: The soil was sampled at the end of October and

therefore the asterisk was misplaced. The location of the asterisk was corrected in Fig. 1-a. As for the remainder graphs on Figure 1 it seems that soil sampling occurred on November because it was on the 24th of October. And indeed on autumn 2007 soil sampling occurred just before the heavy rains started which may not be clear from the picture since it includes total monthly precipitation and not daily precipitation. There had already been some rain after the summer drought but not heavy rains (Fig. 1-a).

Comment: Cistus ladanifer responses to N additions: Again, here it is not clear to me whether the experiment started in January 2007 or in spring 2007. This must be clarified. Answer: The experiment started with the first N addition, on winter 2007 (January). However, the first sampling of plant leaves and plant cover occurred on spring because it corresponds to the time of highest biological activity in Mediterranean-type ecosystems.

Comment: Under my point of view, there is at least one question that must be clarified in relation to part of the main conclusions of this work. The authors argue that "the results of this study suggest that most of the added inorganic N was retained in this N-limited Mediterranean maquis, affecting its structure and function". But later on, the authors explain that the N added was retained in the biotic compartment during the growing season, and returned to the soil after the dry period after the decomposition of litter in the fall. To me, the litter cannot be considered as a compartment for retention of nitrogen in the N-cycle, but a temporary place until the mineralization occurs in the fall. This N that comes from litter mineralization is surely washed out from soil after the first raining in the fall, and therefore not retained in the system. This divergence of opinion must be answered before the paper is accepted for publication. Answer: The present data suggest that the added N was retained in the biotic compartment during the growing season due to the changes in the N concentration of C. ladanifer tissues (leaves and litter). However, C. ladanifer is a summer semi-deciduous species and therefore almost all its leaves are shed during the summer. We agree that the N-enriched litter can be considered as a temporary compartment for retention of N until

the mineralization occurs in the fall. We hypothesize that after being incorporated into the biotic compartment the fate of N in autumn will depend on the relation between climatic conditions (mainly water regime Fig. 1-a) that influence N mineralization and immobilization (by plants and microorganisms) rates. If heavy rains occur at a time of high decomposition rates and low biological N demand the likelihood of N losses (e.g. NO3- leaching, runoff, NH4+ volatilization, denitrification - Padgett et al. 1999) is high. At the end of October 2007 the previous 'soft' rain events and the mild temperatures allowed N mineralization and biological uptake but not significant N losses through leaching.

Comment: Fig. 2: The foot text of this figure must have the explanations for both graphs a) and b). Answer: Changed accordingly.

Comment: Fig. 4: This Figure needs the same revision than Fig 2. Answer: Changed accordingly.

Yours faithfully,

Teresa Dias

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