

Interactive comment on “Cereal-legume mixtures increase net CO₂ uptake in a forage system of the Eastern Pyrenees” by Mercedes Ibañez et al.

Anonymous Referee #1

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General comments on work of Ibanez et al This article presents the CO₂ exchanges between vegetation cover and the atmosphere as a function of their diversity and environmental variables over 6 years of study. The choice of vegetation cover and its management with herbivores was reasoned in a very relevant way in relation to agricultural practices and agro-ecological issues. The results clearly show the positive effect of maintaining plant cover throughout the year on the fixation of C and its storage into the ecosystem. The authors analyse the mechanisms of C fixation in agrosystems in some detail. Therefore, the findings of this manuscript are important, timely and of interest of BG readers. Nevertheless, the manuscript in its present form suffers from many limitations that need to be carefully considered before any decision can be made regarding its publication. There are serious shortcomings in the description of studied

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sites and methods. There is no description of the treatments of the agricultural practices, the number of replicates per treatment, the size of the plots and more generally of the experimental design. The status of studied sites are unclear. Are the studied sites experimental sites managed by the research team or fields from farmers that the research used in their experiment? Concerning the measurement of CO₂ exchanges, the existence of a flow tower is mentioned, but we do not understand how one sole flow tower will make it possible to monitor the CO₂ exchanges induced by different plant covers.

The description of the yield estimation method is imprecise, even though this variable is essential for estimating the agronomic relevance and carbon balance of the studied plant covers. Authors wrote that yield was estimated (Table 1) considering the productivity reported by the manager and in situ samplings after oven drying plant material at 60 °C until constant weight. How did the manager proceed to estimate the yield? How was the forage production estimated in the presence of grazers? How did you manage the space-and-time variability in yield (Frequency of measurements etc)? Section 2.1 of the M&M section.

Some findings seem to not be supported by the data, or the data are not enough clearly presented. In the summary the authors write “Overall, cereal-legume mixtures enhanced net CO₂ sink capacity of the forage system, while ensuring productivity and forage quality” but when we read the description data L320-322 on the ecosystem C storage “The most negative NBP was detected in the wheat monoculture in 2015 (NBP $\approx -108 \text{ g C m}^{-2} 321$, Fig. 7), followed by the oat and vetch mixture in 2017 (NBP $\approx -67 \text{ g C m}^{-2} 322$, Fig. 7).” the key role of legumes does not appear.

L42 It seems to me that the word “voluntary” can be removed L46 What do you mean exactly with “beside the yield”? We do not see the link with the main idea of the sentence that these systems store C. Maybe you would like to say you accounted the C exported by harvests in the final C balance that indicated that these systems fix C in biomass and soils? Need to be clarified. L86-89 It is an interesting approach to sug-

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gest working hypotheses at the end of the introduction. However, these hypotheses are given without explanations on the expected cause-effect link and thus have little scientific value. Please better introduce these hypotheses. L165 Could you define SWC again to help readers in the forest of acronyms. L176-182 Based on the absence of SWC effect in the null model, did you also removed the SWC from the diversity model before analysis? If yes I am not it is correct because the effect of SWC might appear when the diversity of plants are accounted. More generally, don't you find strange this lack of effect of SWC although the availability of water seems very limiting for ecosystem functioning in Mediterranean basin? L330-331 You should be more specific on the effect. The diversity stabilized the NEE over the environmental fluctuations supporting the insurance-hypothesis of biodiversity. L365-369 This sentence is too long and contains too many ideas to be understood. Please split it in several distinct sentences and clarify ideas. L377-379 Concerning your statement "This is in agreement with our second hypothesis, cereal-legume mixtures having more negative NEE (Table 2) due to higher photosynthetic rates, but not higher respiration rates.". In fact it is not so obvious. If I am not wring, you have one mixture with legumes (the last one of the Tables) inducing positive NEE, that is, losing carbon. Therefore, I am not completely convinced by your statement for the moment. L389 and at many other places it seems that your text is shifted on the line, is there a problem with text formatting? L398-404 I find this part to follow. . . I do not see well the logical link between the beginning and the end of the paragraph. What is the main message here? L405-414 A similar comment here. We do not well understand what have been measured/observed, what are speculations. Could you better separate the different ideas and identify the list of things to do to better assess the carbon balance of these various agricultural practices.

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