

Interactive comment on “Litter decomposition rate and soil organic matter quality in a patchwork heathland of Southern Norway” by G. Certini et al.

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Anonymous Referee #3

Received and published: 30 August 2014 The problematic of this paper is about assessing soil organic carbon (SOM) stock, dynamics and chemical characteristics. These questions fall within the scope of SOIL. The aim of this article is to show a link between vegetation cover and soil organic matter composition and decomposition to, ultimately, use vegetation cover as a proxy of soil characteristics. The authors suggest that such a proxy could be used to assess soil C stock and their changes over time. To fulfill their aim, the authors set-up an in-situ decomposition experiment completed with plant and soil chemical analysis. The use of ^{13}C -PMAS MNR is particularly perti-

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nent as it is a good compromise in terms of time and relevance of the results between global analyses (such as Von Soest extraction), which may be not reliable for soils, and molecular analyses (such as HPLC- or GC-MS), which give very detailed compositional information, but are very time consuming. The study site is composed of patch of different wet heathland vegetation. The classification of the different soils composing the mosaic of the study field is well described. Although the results are representative of only one site, they are valuable as vegetation change in wet heathland and Sphagnum peatland is a worldwide issue with consequences on C stock and fluxes to the atmosphere. Results of SOM dynamics under different latitudes would help to understand the functioning of these ecosystems. This paper presents very interesting results on the interactions between environment and litter characteristics on SOM decomposition. In particular, it was interesting to show that *Molinia* litter lost more N in Sphagnum environment than in any other. This particular point was not developed enough. My first concern is about the statistics. ANOVAs were used, but not enough details were given. First, the response variables mentioned are soil pH and SOM. It is not clear what is meant by "SOM" and details should be added. For example: "soil pH, solid soil chemical characteristics (SOC, SON, C/N), soil water characteristics (DOC, TDN,) and SOM decomposition (remaining mass, litter C and N concentrations and litter C/N)". Second, it is not clear what kind of ANOVA was undertaken: was it a two-way ANOVA with litter type and decomposition site as factors? or one-way ANOVA with decomposition site as factor for each litter type separately? From the figure 3, we can assume that 3 one-way ANOVAs were undertaken as the same letters (a and b) were used for different litter type, but from the Figure 4, we can see that litter type and decomposition environment were compared at the same time, implying a two-way ANOVA. This has to be clarified. Third, there is no mention concerning the ANOVA assumptions of residual normality and more importantly variance heterogeneity. This should be checked and commented, and if necessary data transformation should be applied. The results of the ANOVA may be showed in supplementary materials. Fourth, there are no error bars on graphs. The quality of the graphs and the capacity of the reader to

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assess the results would be greatly improved by the addition of the standard error. My second concern is about the overall structuration and organization of the manuscript. On the whole, the text is well written (although too much colloquial expressions are used, see technical corrections), but the use of subparagraph would greatly help the authors to structure and improve their discussion and the reader to understand the research undertaken. In the results, subparagraphs could be: "3.1 Solid SOM characteristics, 3.2 Soil water characteristics, 3.3 SOM decomposition". In the discussion part, the subparagraphs should in few words synthesize the subject discussed. Also, many sentences in the results are actually discussion and should be removed or put into the discussion part (cf technical corrections below). Another problem is the use of *Sphagnum capitula* to undertake decomposition experiment. Usually, it is the stem section just beneath the photosynthesizing part that is used in *Sphagnum* decomposition study (see ref below). The use of capitulum causes problems: (i) this is not the plant part that is going to be decomposed in the next year, (ii) few or no data are available for comparison, (iii) because this is the active part of the plant, it may be possible that some photosynthesizing activity occurred during the decomposition process. Such issues should be acknowledged and addressed in the discussion. Also, some missing data would be interesting to add. For example, stock of C is repeatedly mentioned in the introduction. It would be good to use, if data available, the bulk density of each soil to assess a stock of C in the soil under study. Soil drainage is mentioned as a driving factor but no data are given about water table level or soil water content. The overall quality of the paper would be improved by adding such informations. Finally, in the context of vegetation change, different litter may decompose at the same time at the same location and the mixing of litter may not be additive (Gartner Cardon, 2004, *Oikos*, 104: 230–246). It can be either synergistic (stimulation of decomposition) or antagonist (inhibition of the decomposition). Although this aspect was not evaluated by the authors in their studies, litter mixing effect should be mentioned in the discussion as it is an important process often observed that can limit the use of vegetation cover as a proxy of SOM dynamics. 50% of plant A with 50% of plant B in the vegetation

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does not mechanically imply decomposition of 50% of litter A taken alone plus decomposition of 50% of litter B taken alone. This complexity of the soil system should be acknowledged in the discussion and use to make the discussion more conservative.

Technical corrections: Valid for the whole text: all latin names must be in italic

P268 - L6: the genus and species name of each plant should be written in full and in italic (the abbreviated name should be written in parenthesis and in italic if it is a Latin word)

P269 - LL10-11: do you have any reference to support this? P269 - L14: "however" not needed

P270 - L1: change "water rich" by "wet"

P270 - L11: add species names to all three genus; if more than one species, list them.

P271 - L22: which *Sphagnum* species?

P272 - L10: "couple of hectares", be more precise. This expression has different meanings depending on the country.

P275 - L8: air-dried litter is usually preferred (e.g. Bragazza et al., 2007, *Soil Biology & Biochemistry*, 39: 257–267). Is there a reason why 40°C was used?

P276 - LL6-7: the end of the sentence is a results interpretation that should be put into the discussion.

P276 - L7: "mimicked" and "sort of" are more colloquial than scientific words. Please change.

P276 - L17: "anyway" to be changed or removed

P276 - L13-14: as there are no significant differences, you cannot say that or mention it as a trend.

P277 - L2-26: results interpretation that should be put into the discussion.

P278 - L8-15: decomposition results. Usually, the decomposition rate "k" is assessed by fitting a decomposition model to the observed data (Rovira and Rovira, 2010, *Geoderma*, 155: 329–343). Calculating such a rate (at least the most common: exponential negative) would ease comparison with other studies.

P279 - L2: "maintain memory": not adequate for soils, should be changed

P279 - L10: explain why

P279 - L11-12: SOM content between soils was not significantly different. Use "tended to be richer" than "was richer".

P281 - L7: misunderstanding: sphagnum are not necessarily hard to decompose, instead they induce processes that prevent the organic matter decay (Hájek et al, 2011; Ballance et al., 2012, *Carbohydrate Polymers* 87: 1326–1332). The sentence should be restated.

P281 - L8: Hájek instead of Hájek

P281 - L10: "home-field advantage" is too colloquial, to be changed.

P282 - L1: add reference, e.g. Taylor et al., 2001, *Journal of Ecology*, 89: 126–144

P282 - L7:

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"anyway", too colloquial, to be removed P285 - L4: coma missing: "J., and" P285 - L13: Hájek instead of Hajek P285 - L25: coma missing: "W., and" P286 - L14: check if "calluna" is written that way in the original paper P286 - L15: coma missing: "I., and" P286 - LL27-30: place Trumbmore et al., 2009 before Trumbmore et al., 2010. P286 - L31: coma missing: "I., and" P287 - L1: coma missing: "I., and" P287 - L4: coma missing: "A., and" P287 - L7: coma missing: "S., and" P287 - L21: coma missing: "K., and" P292 - Fig. 2: the scale should be added to help the reading of the upper spectra, alternatively, successive gray and white bands corresponding to each main chemical shift regions would ease the interpretation of the graph.

Replies to Referee #3

We have rewritten the statistics paragraph and specified better what we really did with data. On the other hand, we decided to continue to show trend lines in graphs devoid of error bars, which hamper reader's understanding and do not add anything compared to the letters indicating significant differences at the different dates. Passing to the second concern of the Referee, the one about the overall structuration and organization of the manuscript, we reorganized the manuscript to also fulfill the requests of the other three referees. Hence, for this purpose we inserted subheadings for facilitating the readability, while some sentences in the Results were actually removed or moved to the Discussion section. The implications of using of *Sphagnum capitula* in the decomposition study is acknowledged and although we cannot redo the experiment we have discussed these problems in examining the results of our study more thoroughly. Interesting is the comment about the stock of C in the soil under study. Actually, we measured the bulk density of each topsoil, thus we could calculate their C stock. Nonetheless, we decided to not do it because it would be a partial datum, which does not account for the whole C stock of soil. Moreover, we were not interested into the quantitative implications, but the qualitative ones only. As suggested by the Referee, we acknowledged in the Discussion that different litter decomposing at the same time at the same location and the mixing of litter may not be additive and that in our case

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Sphagnum could have suffered antagonistic effect (inhibition of the decomposition) by *Calluna* and *Molinia*. And, in this regard, we cited the enlightening review by Gartner and Cardon, 2004. However, we do not understand why this non-additive effect should prevent the use of vegetation cover as a proxy of SOM dynamics. Technical corrections: - P268 L6 and the whole text: all Latin names were written in italic. - P269 - LL10-11: we honestly believed the assertion an obvious one, nonetheless we inserted a suitable reference to support it. - P269 - L14: "however" was removed. - P270 - L1: "water rich" was changed to "wet". - P270 - L11: species names were listed. - P272 - L10: actually, the sampled area was approximately one hectare. - P275 - L8: the material used for filling the litterbags was oven dried (35 °C to constant weight, not 40 °C) to standardize the *modus operandi*. Actually, 35 °C is a plausible ambient temperature. - P276 - LL6-7: the end of the sentence was removed. - P276 - L7: both "mimicked" and "sort of" were substituted with more formal words. - P276 - L13-14: not mentioned as a trend anymore. - P276 - L17: "anyway" was removed. - P277 - L2-26: this part was moved to the Discussion - P278 - L8-15: we carefully read the paper by Rovira and Rovira, 2010. Nevertheless, we judged the measurements done during the decomposition experiment not enough for the calculation of decomposition rates. - P279 - L2: "maintain memory" was changed to "reflect". - P279 - L10: an explanation was provided. - P279 - L11-12: the sentence was reorganized and the word "richer" is not present anymore. - P281 - L7: The referee's comment is correct. The sentence was modified accordingly. - P281 - L8 and P285 - L13: ok, Hájek instead of Hajek. - P281 - L10: "home-field advantage" was removed - P282 - L1: the reference Taylor et al., 2001, *Journal of Ecology*, 89: 126–144 was added - P282 - L7: "anyway" was removed - All missing commas were inserted in the reference list. - P286 - L14: *calluna* was Capitalized - P286 - LL27-30: there was no reference Trumbore et al., 2010. - Figure 2. A scale in the upper spectra has been added.

Please also note the supplement to this comment:

<http://www.soil-discuss.net/1/C140/2014/soild-1-C140-2014-supplement.pdf>

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