

## ***Interactive comment on “Biological and climatic controls on leaf litter decomposition across European forests and grasslands revealed by reciprocal litter transplantation experiments” by M. Portillo-Estrada et al.***

### **Anonymous Referee #2**

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The manuscript by M. Portillo-Estrada and co-authors, “Biological and climatic controls on leaf litter decomposition across European forests and grasslands revealed by reciprocal litter transplantation experiments” compared mass loss rates and changes in litter N over time across a European climatic gradient and demonstrates that the decomposition of both forest and grassland litter is more controlled by climate than it is by litter characteristics.

1. Does the paper address relevant scientific questions within the scope of BG? Yes, the paper attempts to determine climatic versus certain litter characteristic controls over

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decomposition dynamics which is important function of terrestrial carbon and nitrogen cycling.

2. Does the paper present novel concepts, ideas, tools, or data? In many ways the paper supports concepts that have been presented in countless forms and publications over the past 3 decades on the importance of climate on litter decomposition and that increases in temp and moisture increase decay rates. In this way there is not much novelty in the results. Further, current theory suggests that biology is an important component of litter decomposition (especially at the localized scale), yet this is entirely overlooked in this study, making it seem somewhat dated. However, an interesting aspect of the results is the generation of a simplified model with few variables that can predict decomposition. The intensive sampling during the first 30 days of decomposition at one of the sites is another interesting data set from this study and deserves to be emphasized more so throughout the MS

3. Are substantial conclusions reached? Some broad conclusions are made about the importance of climate in decomposition (already well known) and that climate is a stronger regulator than litter species on decomposition at these sites, and how climatic data is used (e.g., cumulative climatic temperatures rather than mean annual variables) can influence model outcomes.

4. Are the scientific methods and assumptions valid and clearly outlined? The experimental design was confusing. It took several reads before I realized that 1) ‘litter species’ was different from ‘litter origin’ and that species was sometimes the same regardless of origin and 2) that only grass litter was decomposed as grass sties and forest litter was exclusively decomposed in forest sites. I was unclear why soil moisture and temp were measured but not reported and uncertain about the decision to measure specific leaf area but not several other litter and soil traits that are important to decomposition. The use of the term ‘biological’ is misleading since it implies measurements associated with soil biota in most decomposition studies, yet these were not made. While limited soil parameters were measured (pH, soil texture), there did

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not seem to be an attempt to relate these to their other measurements, despite their potential important contributions to decomposition dynamics.

5. Are the results sufficient to support the interpretations and conclusions? Mostly. There are some connections made to N inputs from litter decomposition that are solely based on the ratio of final litter N to initial litter N that seem to be a bit of a stretch.

6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? Yes.

7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? Yes, though the authors could better link their findings to the wealth of work already previously conducted on climatic influences on litter decomposition from the last three decades (see work from Berg, McClaugherty, Mellilo).

8. Does the title clearly reflect the contents of the paper? No. I disagree with the term 'biological' in this case based on what is actually measured.

9. Does the abstract provide a concise and complete summary? Somewhat. Soil type, which comes up in the abstract, is barely discussed throughout the MS. Leaf area also seems to be a very minor component throughout the MS.

10. Is the overall presentation well structured and clear? No, I found the writing overall unclear and the introduction has little relevancy to the data and conclusions presented.

11. Is the language fluent and precise? No. It is advised the authors consider consulting a fluent English speaker to edit their MS.

12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? Yes

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? Perhaps consider including results showing the correlations for leaf area index and mass loss. If the authors want to continue using soil type as

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an aspect of their study then analyses that explore soil variables and decomposition variables could also provide valuable insight to their interpretations. As mentioned by another reviewer, a table describing initial litter traits would be useful.

14. Are the number and quality of references appropriate? Yes

15. Is the amount and quality of supplementary material appropriate? NA

#### Specific Comments

Title: Authors should consider replacing the term 'biological' with something more directly related to the litter origin and type. 'Biological' typically implies controls from soil biota but the MS is focused on litter leaf area index and origin (and to some degree quality through the use of different species- though differences in quality are not reported). Though plants and their litter technically represent biological inputs to the soil, litter traits are not generally considered biological controls on decomposition but rather an effect of "litter type". This comment applies throughout the manuscripts.

Abstract: L1-5: replace 'to' with 'under'. 'Uncertainties' comes up twice. What is 'soil turnover'? Do you mean 'Carbon and/or nitrogen turnover'. It's not likely authors mean the replacement of the entire soil stocks. Consider something like this, 'Carbon (C) and nitrogen (N) cycling under future climate change is associated with large uncertainties in litter decomposition and the turnover of soil C and N. What are the future conditions (elevated CO<sub>2</sub>, altered precipitation regimes, warming)? Be specific, especially for what is relevant to the MS. L5-10: I would rethink the use of the term "biological" when discussing litter type and origin. Be specific about soil type (texture?).

#### Introduction:

P18055 L23-25: What is a typical grassland and forest? 'Most' grasslands and forest would be ok. L25-26: This makes me hesitant. Is the total N mineralization net or gross? The biological community has a considerable influence on both by affecting N turnover via differences in enzyme production and biota stoichiometry. Remove 'The'

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before 'site'.

P18056 L1-5: Why the link to plant nutrition? 'Precipitation regimes' is shorter than 'regimes of precip'. L5-12: Maybe use "elemental" or "chemical" composition instead of "mineral".

This section could be improved for making the rationale for the study. While the authors are correct in the factors they describe in affecting litter decomp, these are not relevant to their study (litter sterols and alkanoids, microbial community, leaf tensile strength etc). Instead there should be more support and focus for why and how leaf area and climatic conditions alter decomp and why these factors need to be understood under future climate decomposition.

L13-19: Check references throughout MS. These are not consistently in reverse chronological order. Provide some background on why current models need to be improved. What is new, different or better about the model provided here? L22: add 'one' after 'allows'. L25: No need to always have 'the' before 'decomposition'. L26: 'Throughout'? Maybe 'across'. L20-30: This can be improved to better outline why reciprocal transplant experiments are useful. The way this is written, it is confusing and vague. Same litter across climates combined with different litter types within a climate allows one to isolate the influences of litter traits and climate on decomposition. This study also seems to fall short in capturing the value of reciprocal transplant experiments. These types of experiments are interesting because they help determine how local variation in microbial communities and soil properties influence decomp. relative to litter traits and climatic variables. For example, pine needles might decompose better in a site with higher soil N availability relative to a site with lower N, or pine needles might decompose faster in sites previously exposed to pine needles due to microbial community adaptation to producing the necessary enzymes for phenolic breakdown of pine needles relative to a broad leaf forest. However, in this study neither microbial nor soil parameters are explored.

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P18057 L6: The case should be made for introducing a new model, especially a simplified one, when there are already several earth system models that predict litter decomp reasonably well (e.g. Bonan et al., 2013 Global Change Biology; Tuomi et al., 2009 Ecological Modeling).

Consider leading intro with discussion about future climate change (P18056 L16-18) and predicted changes in precip and warming and the need to understand how this will influence litter N and C turnover under different litter species. Better explain why the focus is on N and not C or both and why litter traits matter (leaf area, type). After the intro, I'm left wondering what the litter traits of interest are for this study since there are so many vague terms introduced such as "intrinsic characteristics, litter substrate characteristics, litter quality, traits, origin, etc) yet it is not specifically clarified what key aspects of litter are of concern in this MS. Specifically define and explain the litter and soil parameters that are of concern here. What is the relevance of 'origin' versus 'species'? In other words how does origin differ from climate? Remove the term biological throughout. Rather, make the clear link to moisture and temp and an important control on microbial decomposition. Provide some clear rationale as to why specific leaf area was the key measured and reported leaf trait.

Methods:

The experimental design is difficult to follow because of the interchangeable use of 'origin' and 'species'. This is how I interpret it: There are 6 sites (4 forest and 2 grasslands) representing different climates and soil characteristics. The dominant litter species (2 of which are grasses and 4 of which are tree foliage (deciduous and coniferous) from each site were reciprocally transplanted. Consider explicitly laying out experiment (as well as in Table 1) by treatments- number of sites categorized by dominant plant species and climate, and litter origin, categorized as grass, deciduous, and coniferous foliage. Consider finding a way to distinguish origin from species since species differ by origin but are also similar with different origin (Pine, for example). Also, it's a bit confusing because this isn't a complete reciprocal transplant experiment since the grass litter is

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only decomposed at grassland sites and the forest litter is only decomposed at forest sites.

P18058 L5: remove 'microbiological' since really it is just soil temp and moisture that are measured. Microbiological is misleading. L16: the 'second day' of what? Every two days is clearer.

P18059 L16: This intensive sampling time for the Hyytiala site comes out of nowhere. Perhaps consider a sentence or two in the introduction describing the importance of exploring early decomposition and mass loss rates. L20: change 'along' to 'throughout'. L19: The colon is unnecessary.

P18060 L 19-23. Introduce specific leaf area at the beginning of this paragraph so the reader understands what parameter this protocol refers to early on.

P18061 L3-4: Potential microbial attack. Note that is also represents exposure to other factors such as aggregation and erosion. L15: Why not also the grassland sites?

Results:

P18063 L11-12: First days of all the sites or only the Hyytiala site? For all the other sites the first collection was at one month so the first days would not be captured. Please clarify.

P18064 What happened with the soil temperature and moisture data? A recently published litter decomposition study (Bradford et al. 2015 Journal of Ecology) points to the importance of localized soil temp and moisture as being potentially important, often overlooked factors in determining decomposition variability.

P18064 L16: Site not 'sited'.

P18066: Perhaps I missed something but shouldn't there be some model validation or results for how well the model fits the observed data for Mr, C and N? What is the purpose of the model? So few parameter were measured (beyond climatic variables)

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that it's difficult to conclude that certain environmental or litter variables are not better predictors of decomposition over others parameters and since there is no model validation one cannot conclude that such a model which largely only uses air temp and precip to predict mass loss is an accurate one.

Discussion:

P18068 L1-5: These data of the early days of decomposition are some of the more novel aspects of the study yet receive little attention in the analysis of results and rationale in the intro. L5: "lose" not 'loose'. Consider citing Cotrufo et al. 2015 Nature Geoscience or Soong et al 2015 Biogeosciences for discussion on the amount of mass loss attributable to DOC leaching. L10-12. This doesn't make sense the way it reads. What was shown? What is 'they'? L27: What 'energy'- litter carbon? heat? What about the soil moisture data that was measured to corroborate this?

P18069 L1-5: this is the classical theory of decomposition dynamics presented in the works of Berg, McLaugherty and Mellilo over the last few decades. L21: what is 'these'? Use soil biota or something similar. 'Be' instead of 'been'. L25-26. Not necessarily- While N may be translocated from the soil into the litter layer during decomposition it does not necessarily mean that more N is stored in the soil. Rather, there is a movement of N from the soil into the litter layer. Secondly, under warmer and wetter climates microbial activity should be faster with subsequently faster cycling of nutrients and mineralization rates even if there is an import of N from microbial biomass into the litter layer.

P18070 L14: Why is litter mass loss, C and N the most interesting traits of decomposition? Avoid subjective language like this. L16: Where were the results showing that the model worked? L17: the use of 'Seen' doesn't make sense here. L22: Benefited not beneficiated. How could land use be included as a model factor when essentially these were separated experiments (litter decomposed in grassland versus litter decomposed in forests were analyzed separately and litter treatments could not be compared across

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the two land uses)?

P18071 L5: Allowed who? You need a subject. 'Input energy' is a strange term- why not just use temp and describe in intro how temp is important in catalyzing decomposition reactions. L10 Shown not Showed. L20: extrapolating.

Figures:

Fig 1: Error in the description. Should be e-f instead of where the first '(g)' is. Were attempts made for using a two-pooled model for estimating 'k' made? These data suggest that it might be a better fit.

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Interactive comment on Biogeosciences Discuss., 12, 18053, 2015.