Biogeosciences
Discussions

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Interactive comment on "Reviews and syntheses: Carbon use efficiency from organisms to ecosystems – Definitions, theories, and empirical evidence" *by* Stefano Manzoni et al.

Anonymous Referee #3

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The manuscript is descriptive without a very extensive data analysis. However, the synthesis is new (I've never read about such large comparison of CUE across biological systems and biological scales) and interesting (I particularly like the fundamental Fig. 6). So, I think the manuscript is suited for publication without a data re-analysis.

However, there are key points that need to be improved (do not underestimate them, even are just text improvements). The Theory (paragraph 2) and definitions are fundamental in this paper, yet are not fully clear.

*for all biological systems, you use the term CUE. However, as well reported in Table 2, for some systems other terms are used. Furthermore, CUE is associated to a specific

variable/system (plant and community CUE=NPP/GPP). It would have been much less confusing (and more relevant) if you were proposing an overarching (new) efficiency term, and not 'impose' the one used for some systems to all cases.

*your attempt of generalization (paragraph 2) is not always easy to follow because each domain (plant, micro-organisms, ecosystems etc.) has is own specific definitions and terminology. It would be easier if you, before generalize (so before paragraph 2.1), describe the specific ways CUE is calculated for each of the five 'scales' you synthesize in Fig 6, thus an extension of Table 2. And then, when you generalize, make several examples. For instance, what is 'Output' (Eq. 1) for the five scales?

*There are the definitions used in the field-specific literature (Table 2) and you add other definitions: CUEapparent, AE, NGE, GGE, CUE ecosystem (extremely confusing: NPP/GPP or NEP/GPP?). Make some choices (can the definitions be reduced?) and clarify.

*For some cases, you mention the possibility of negative CUE, but for plant (CUE=NPP/GPP) it would not be possible because NPP>0 or =0). Similarly, turnover has a meaning for microbes and another for plants (e.g. in forests, turnover refers to the annual leaves, branch or root turnover and it is added in NPP, Clark et al 2001 Ecological Application 11(2), pp. 356–370).

Other remarks

*Your main key syntheses were (from abstract): (i) CUE increases with improving growing conditions, (ii) CUE decrease due to turnover, (iii) CUE decreases with increasing biological and ecological organization. Write them also in Conclusions (instead of generic sentences from L497 to L505) with the key reasons/explanations.

*L320-321: as in plants CUE= NPP/GPP and seed production is accounted in NPP, I do not understand your point . . .

*L503 can be move above where you discuss applicability of CUE values.

*You do not make reference to Campioli et al 2015 Nat Geo. However, that synthesis can be useful, not only for the additional dataset on CUE (that they consider BPE there) but for comparison of ecosystems of different complexity (e.g. natural grassland vs. cropland monoculture). Also there are various suggestions for practical use of CUE/BPE in that paper.

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