

Interactive comment on “The greenhouse gas balance of European grasslands” by P. Ciais et al.

Anonymous Referee #2

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A substantial piece of work is presented by the authors. The greenhouse gas (CO₂, CH₄, N₂O) balance of European grasslands is assessed on the basis of a number of field studies and thoughtful modelling analysis. A balanced discussion weighs arguments for granting confidence or doubt to various aspects of the work. So far, my congratulations!

Regrettably in the last section, Conclusions, the steam seems to have been lost. It is merely a re-iteration of key results and a call for more research in this field. Such conclusions do not do justice to the previously described work. Bolder conclusions are necessary.

A key result of the study is that 70-80% of sequestered C is off-set by additional emissions of CH₄ and N₂O. Here, it has to be mentioned that a large part, if not all, sequestered C may be released to the atmosphere at any time in future when land use

C3149

changes again to either arable crops or to a less intensive grassland management than today. In contrast, CH₄ and N₂O emitted in the meantime can not be “re-called” from the atmosphere by future land use change. For illustration we may imagine the following, not unlikely, scenario:

A grassland sequesters during the next 20 years 1400 g C m⁻² (20 yr x 70 g m⁻² yr⁻¹). During the same time, it emits an equivalent of 1050 g C m⁻² (75% of 1400 g C m⁻²) in form of additional CH₄ and N₂O. After 20 years, land use changes to one with a lower equilibrium concentration of C in soil (e.g. grassland-arable rotation). Even, if only 50% of the previously sequestered C is lost as a result, the overall balance in terms of GWP already becomes clearly negative (net source, equivalent to 350 g C m⁻²).

Hence, grasslands may be a net sink for greenhouse gases at the moment. But, almost inevitably, the day will come when liabilities in form of additionally emitted CH₄ and N₂O exceed benefits of C sequestration. Say, we encourage today maintenance or even extension of the current grassland area in Europe on grounds of greenhouse gas mitigation. Then, we condemn already the next generation to either stay with this form of land use or to make themselves guilty of making things worse than they would have been without our mitigation initiative.

This conclusion is the most important message that I can derive from the results of the study. None of the uncertainties in the discussed manuscript is likely to put this general conclusion into question. I would encourage the authors to include this conclusion in a revised version of the manuscript and also to think about other general insights that can be derived from the substantial experimental work and modelling they have performed.

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C3150