Editor's comment on

Stocker and Joos

"Quantifying differences in land use emission estimates implied by definition discrepancies"

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As editor I thank Stocker and Joos for carefully adressing the issues raised by the reviewers. I feel the paper is now much more concise. Nevertheless, when reading the re-submitted paper I still stumbled about the few points below that I would like to ask the authors to address before publication.

- In section 2.1 you intend to revisit estimates of *e*LUC according to method D1 in Pongratz et al. 2014. But what you describe includes also method B of Pongratz et al. 2014, covering in particular the emission estimates of Houghton. I consider it completely legitimate to extend or modify meanings, but please make such changes explicit.

- Eqn. (5) in line 175: To have a self-contained paper, I would appreciate if you would derive eq. (5) explicitely instead of refering only to Gasser and Ciais (2013). I ask for this also because thereby the assumptions implicit to your approach would get transparent: It took me a while to find out that your formulas are valid only for LUC and FF perturbations starting out from equilibrium with no land use present. – Only by this transparency one can understand your remark in line 206.

- Upon request of the reviewers you included the additional terms arising from the combined action of LUC and FF (denoted by δ_{nat} and δ_{agr} in your paper). You interprete these terms as "non-linearities", suggesting implicitely that the other terms (e.g. in Eqs. (6)-(1)) represent the linear contributions. Please re-think this interpretation for the following reasons:
  In line 191 you make the splitting $\Delta f^{FF+LUC} = \Delta f^{FF} + \Delta f^{LUC} + \delta$. This splitting can be interpreted in two ways: (1) As a Taylor expansion where Δf^{FF} and Δf^{LUC} are linear in the strength of FF and LUC perturbations, respectively, so that δ covers all remaining nonlinear terms. (2) As a splitting in the sense of factor analysis (as in Pongratz et al. 2014), i.e. Δf^{FF} comprises the full nonlinear Taylor expansion in the strength of only FF, while Δf^{LUC} the full nonlinear expansion in the strength of only LUC, so that δ comprises only those nonlinear terms mixed in FF and LUC. Following Stein and Alpert (1993) this latter term was called "synergy" in Pongratz et al. 2014 (and denoted as σ). The interpretation of your splitting affects how the different flux components of *e*LUC that you specify in eqs. (6) to (10) must be extracted from simulations.

As far as I understand you want to employ the first interpretation, but your actual handling of simulation results is different: The simulated fluxes F^{FF} and F^{LUC} already contain nonlinearities in the FF and LUC forcing, respectively, to all orders. Hence the matching of the black curve (F^{FF+LUC}) and red curve ($F^{FF} + F^{LUC}$) in Fig. 1 until the early 21st century is not indicating linearity in the forcings, but additivity in the flux components, meaning that the particular non-linearities showing up in the "synergies" between FF- and LUC-forcings are small. In fact you never test for linearity in the forcings in your paper.

- Line 195: I think $eLUC$ should read $eLUC_{E2}$. If not: Why not?

- Line 263: I failed to derive eqn. (14) on my own. Please provide a justification for this equation.

- In lines 200-203 you refer to your simulations before you have introduced them. I suggest to shift these few lines to the results section.

- Lines 203-205: These lines come a bit as a surprise, because in line 191 you already introduced $A_0\Delta F^{FF}_{nat}$ as F^{FF}_0.

- Lines 421-424: The text in these lines entered the manuscript in response to remarks of Reviewer #1, but I fail to understand them. In these lines you argue that including the eRSS term in eLUC is "misleading in view of the actual reduction of land C sinks due to reduction of natural vegetation". You continue "This reduction of the residual sink due to the replacement of natural by agricultural vegetation . . . " – I do not understand why "the replacement of natural by agricultural vegetation" could change the residual sink. The residual sink differs by including or excluding eRSS in eLUC, but not by changing the vegetation.

- Please make in Fig. 1 labels and caption consistent: The label of the red curve is $F^{FF}_0 + \Delta F^{LUC}_0$ but in the caption you refer to it as $F^{FF}_0 + F^{LUC}_0$. I know that $F^0_0 = 0$, but it confuses on first sight.

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