Earth System
Dynamics

Discussions

EGU

Interactive comment on "Diverging land-use projections cause large variability in their impacts on ecosystems and related indicators for ecosystem services" *by* Anita D. Bayer et al.

Anonymous Referee #1

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This study analyzes an ensemble of future land use projections arising from a set of 5 LUMs/IAMs. These land use projections are then translated into changes in ecosystem services (ES) using the LPJ-GUESS model. One of the main conclusions is that there is a large spread in land use projections (and therefore ES) and that most of this spread originates from structural model differences (i.e. choice of LUM/IAM) rather than from socio-economic assumptions (i.e. choice of scenario storyline within a given model). Overall, this is an interesting study which makes an important point about the large uncertainties associated with future land use projections and their potential causes. However some aspects of the manuscript could still be improved and require additional clarifications.

I found the whole discussion about the role of the baseline level very hard to follow. I understand from the analysis that there are very different starting states in 2000-2004 across the models. But does it affect the conclusions of the study or not? One could for instance intuitively expect that in a model starting with lower present-day natural vegetation there would more room for future expansion. More specifically, in which way is the baseline level taken into account when looking at relative changes (L236-239)? And where is the assumption that "Effects of differences in the modeling protocol of CLUMondo/LUH1/LUH2 and IMAGE/MAgPIE simulations for projections of ecosystem dynamics affect especially the base level of ES indicators in 2000-2004 and the relative deviations over time, which this study is focused on, only to a small degree" coming from? This last sentence by the way is so convoluted that I might just have misinterpreted its meaning. On that same issue, it is somewhat disturbing that the IPSL-based climate forcing has been bias-corrected, implying a sort of harmonization between observed and projected climate, while no harmonization was performed for the land use forcing. Why not following the same logic for both climate and land use?

I have been wondering whether the positive trend in some ES indicators could be affected or even reversed if fires were properly accounted for. Referring to fire and other processes, section 4.2 has a rather elusive statement: "Because these processes are only to some degree implemented in LPJ-GUESS (see, e.g., Pugh et al., 2019), this could further increase the regional variability in ES indicators as indicated in this study." Something more explicit would be welcome, such as clarifying upfront in section 2.2 how fires are accounted for in the model.

The conclusion that "some scenarios show questionable and possibly unrealistic features in their LULC allocations" could warrant some more in-depth evaluation of historical trends to be fully supported. Although this might be an ambitious task, the discussion could at least outline some evaluation strategies that should be deployed in future studies in order to pinpoint more specific deficiencies.

I am still confused about the procedure by which crops are prescribed in LPJ. The

total crop fraction evolves according to the given land use scenario, I assume, while the particular mixture of crop types is prescribed to be constant in time after 2006 (table S1). If this mixture is constant in time, then how was it possible to represent crop adaptation by "simulating the adequate selection of suitable crop varieties under changing climate" (section 2.2)?

Could you please clarify if NPP is aggregated over all ecosystem types including crops? I suppose this is the case, which would imply that there is some information overlap between the NPP and crop productivity indicators. Would it be possible to show some disaggregated results for NPP (i.e. separately for the 3 types of vegetation represented in LPJ)? It might help to reveal some ecosystem-specific responses.

L31-33: please provide an uncertainty range for all variables along with the median value.

L229: Could you clarify how C storage from CCS was quantified, given that BECCS is not represented in LPJ (table S1)?

L244: it would be nice to include table S2 in the main text.

L256-260: this part would fit better in the method section. Moreover, it would be good to include a cross-walking table in the method section to explain how the land classes of the respective LUMs/IAMs were translated into the 3 main types in LPJ. i.e., this needs to be clarified not only for CLUMondo.

Fig 3: please add the units for all variables.

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