

Interactive comment on “The relevance of uncertainty in future crop production for mitigation strategy planning” by K. Frieler et al.

Anonymous Referee #2

Received and published: 12 January 2015

In their analysis the authors apply different crop growth models to assess uncertainties of crop production on current agricultural land and for a land use scenario under a range of climate projections and agricultural management options (in terms of levels of crop irrigation). Additionally they apply a set of bio-geochemical models to analyze the carbon losses due to the projected land-use change. The authors present an interesting study design which from my point of view is inconsistent in parts. Also the paper itself is hard to follow and lacks detail to fully understand how the analysis was done. Altogether I think the paper needs major revisions.

The title of the paper refers to mitigation strategy planning. The authors need to explain in more detail how such a planning process might look like and how exactly the addressed uncertainties should be incorporated into it (who is responsible for this global

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planning process? Which level of detail does it have etc.).

In the introduction the authors describe a risk-assessment framework that applies pdfs. Here I would expect a broader overview of possible approaches to quantify risks and the potential role of models within those frameworks. The description of the particular framework used within the study should be moved to the “data and methods” section. It should also be stressed that it is applied only in a qualitative manner (“... shifts the red uncertainty distribution to the left.”). Moreover I think the equation $N = T - F$ is far too simple as other ecosystem services are not included. If maximizing carbon storage is the only goal this should be stated clearly and needs to be discussed in more detail. Also the last paragraph of the introduction should be moved to the following section.

The description of the input data in section 2 is incomplete. E.g. MIRCA is not even mentioned (which is the reference year for the base cropping pattern? 2005?). In this context also the uncertainties due to the spatial data sets should be shortly addressed later in the discussion. The description of the impact models is incomplete, too. The GGCMs should be listed in a table in the main text. A short description of the hydrology models and bio-geochemical models and how they are applied within the study context should be added.

The result section is very hard to follow. The authors should describe in more details their results and (either here or in the previous section) how the simulation experiments were conducted. To be honest I don't like the kind graphics used in Figure 2 and in the supplement. For me it's not intuitive to interpret the overlay of the relative change of two different variables change in production and change in demand). The description of the socio-economic scenario (SSP2) should be moved from section 3.1 to the previous section and needs to be described in more detail (population growth, growth of demand for agricultural products, GDP development etc.).

Section 3.2 is not very clearly written. Are all GGCMs combined with output from all hydrology models? What is the main message? One of my main points of criticism

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is related to the use of the MAGPIE model results (section 3.3). For me it is not clear if the crop pattern within the MIRCA dataset the same as the base year pattern used by MAGPIE. If this is not the case, the calculated land-use changes should not be used for the analysis as the starting conditions are influencing the MAGPIE simulation results which may explain the large differences between the location of some crop types between the respective data sets. It should also be discussed that the MAGPIE cropland pattern depend on the LPJmL crop yields, e.g. in a proper study design LPJmL needs to be replaced by the different crop models to get consistent results. This point needs to be addressed within the discussion.

In section 3.3 it should be noted that the 1995 base map is the same as used for the MAGPIE simulations but (I suspect not the same as used for the base cropping pattern). In my opinion this part is only very weakly linked to the rest of the study and can be dismissed. Although there is a reference to the pdf of the risk assessment framework the authors do not explain or even discuss how trade-offs between carbon sequestration and food production should be assessed.

The discussion should be more detailed: e.g. a comparison to other existing studies needs to be included; the drawbacks and limitations of the current study design should be addressed more clearly (see comments above); application of the risk assessment framework need to be discussed.

Interactive comment on Earth Syst. Dynam. Discuss., 5, 1075, 2014.