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

Anonymous Referee #1

General comments: This paper, based on work from the Inter-Sectoral Impact Model Intercomparison Project, integrates outputs from a suite of climate, crop production, hydrologic, and biogeochemical models to explore the impact of increasing food demand in a changing climate. To do so, they introduce a framework for evaluating tradeoffs between two uncertain outcomes. This is interesting and important. However, the manuscript fails to fully explain and explore the implications of the risk framework it introduces. Additionally, the paper uses the example of crop production and carbon storage in non-cropland as an illustrative tradeoff. The use of an example is helpful, but the manuscript itself focuses far too much on how the models inform the content of the illustrative question instead of exploring how the uncertainties among the models affect the conclusions.

Answer:

Modification of the "Decision framework" section:
We thank the reviewer for the constructive evaluation of our manuscript. We have fully revised the section describing the decision framework. The conceptual Figure 1 has been amended by a new Figure 2 providing a more detailed illustration of how the required information could be generated. Modifications are based on the concrete comments below and will be explained there.

Modification of the introduction and the abstract:
We modified the introduction and the abstract to be more explicit with regard to the general scope of the paper which is twofold:

1) Introduction of a general probabilistic decision framework allowing for the evaluation of agricultural management assumptions and mitigation measures under impact model uncertainties across different sectors. (The concept is now embedded into the context of the RCP / SSP scenario building process)
2) Illustrative study of potential trade-offs showing that the current impact model uncertainty generally ignored in integrative studies of climate protection and food demand must not be ignored in integrative studies as it may represent a major component of the overall uncertainty and requires a decision tool accounting for our limited knowledge of the biophysical responses.

Both points are summarized in the introduction:

“Based on an illustrative analysis of multi-model impact projections from different sectors, we show that the uncertainties associated with future crop yield projections, changes in irrigation water availability, and changes in natural carbon sinks are considerable, and must not be ignored in decision making with regards to climate protection and food security. Due to the high inertia of energy markets and infrastructures mitigation decisions are long term decisions that may not allow for ad hoc decisions in the light of realized climate change impacts (e.g. Unruh, 2000).”

and

“In this paper we will describe the additional steps required to provide a basis for robust decision making in the context of uncertainties in climate change impacts but not included into our analysis.”

R1.1 Specific comments: It is not at all clear what the risk assessment and decision framework introduced by the authors is. Though it is never explicitly stated, I assume that the framework the authors propose/introduce is the “associated” probability density function (4-15; Fig 1). The authors need to describe this framework at much greater length.

Answer:

Thank you very much for the helpful comment.

First of all we may have introduced confusion by the term “risk” that actually describes potential damages as “damage x probability of occurrence”. Our decision framework does not refer to (economic) damages. Therefore we decided to use the term “probabilistic decision framework” instead.

The intention is now explicitly described at the beginning of the associated section “A probabilistic decision framework”. In short it can be summarized by:

“Within this setting, we propose a probabilistic decision framework that allows for an evaluation of agricultural management options determining food production (e.g. with regard to fertilizer input, irrigation fractions or selections of crop varieties), in combination with decisions about the intensity of bio-energy production and protection of natural carbon sinks. The approach is designed to account for uncertainties in responses of crop yields and natural carbon sinks to management, climate change and increasing atmospheric CO_2 concentrations as represented by the spread of multi-model impact projections. Within this framework long term decisions could be based on the likelihood of fulfilling the demand for bio-energy production and natural carbon sinks while at the same time ensuring food security.”

The description of the simplified conceptual approach (Figure 1) is amended by a more concrete description of its implementation based on multi-impact model projections (see new Figure 2):

“Assuming that the uncertainties in projected crop yields, bio-energy production and carbon sinks can be captured by multi-impact model projections, the probability can be approximated in the following two step approach.

Firstly, multiple crop model simulations (i) under the considered management assumptions and climate projections are translated into food production areas $L_{i,}$ fulfilling the considered demand (see yellow bars in Figure 2). The translation could be done by agro-economic LU models such as MagPIE (Lotze-Campen et al., 2008) or GlOBIOM (Havlik et al., 2011). The diversity of these models used to determine “optimal” LU patterns based on expected crop yields, could be considered as an additional source of uncertainty in LU patterns. It could be implemented into the scheme by applying multiple economic models i.e. increasing the sample of LU patterns to n = number of crop models x number of economic models. However, since the differences in LU patterns introduced by different economic models may be due to different “societal rules” for land expansion, this component may rather be considered as belonging to the “socioeconomic decision” space. In this case they can be handled separately from the uncertainties introduced by our limited knowledge about biophysical responses as represented by the crop models. Most agro-economic models also account for feedbacks of LU changes or costs of intensification on prices, demand, and trade (Nelson et al., 2013). Since in our decision framework demand is considered to be externally prescribed, one could even introduce much more simplified, but highly transparent, allocation rules driven only by maximum yields, assumed costs of intensification or land expansion, and intended domestic production.

Then, each individual food production pattern leaves a certain land area N_i for bio-energy production and conservation of natural carbon sinks ($N_i = T - L_i$, green bars in Fig. 2). Increased irrigation could reduce the required food production area, leaving more area for bio-energy production and conservation of natural carbon sinks; but potential irrigation is limited by available irrigation water. These constraints can be integrated using consistent multi-water model simulations (j) which provide estimates of available irrigation water. Combining these with the individual crop model simulations leads to an array of individual estimates of the required land area F_{ij}.

Secondly, each land area $N_{ij} = T_{ij} – F_{ij}$ has to be evaluated by a set of crop- and biomes-model simulations to test whether it allows for the required bio-energy production under the assumed management strategy and the required uptake of carbon. These individual evaluations (illustrated in Fig. 2 by green tickmarks for success and red crosses for failure) allow for an estimation of the probability of climate protection failure in terms of the number of failures per number of impact model combinations. Again alternative decisions on bio-energy production could change the probabilities. Note that the intensity of bio-energy production will also be constraint by the available irrigation water (van Vuuren et al., 2009). Thus, though not indicated in Figure 2, the evaluation may also build on multi-water model simulations similarly to the projected food production area.

For this kind of evaluation it is important that the required impact simulations are forced by the same climate input data, as done in ISI-MIP. Otherwise the derived LU patterns would be inconsistent. The flexible design of the ISI-MIP simulations furthermore allows for an evaluation of different LU patterns using a number of existing crop-model and biomes-model simulations, without running new simulations (see section 3)."

R1.2 What makes it a framework and not just a probability density function describing a sensitivity analysis?

Answer:
We hope that the aspect becomes clearer by the modifications of the text. We consider it a "probabilistic decision framework" as it allows for an assessment of any kind of management option against the background of prescribed demands in food, bio-energy and carbon sinks. The approach is now embedded into context of the RCP / SSP scenario process which underlines its "framework" character as described at the beginning of section 2:

"Let us consider a certain greenhouse gas concentration scenario and its associated climate response described by a General Circulation Model (GCM); e.g. the Representative Concentration Pathway RCP2.6 (van Vuuren et al., 2011) in HadGEM2-ES, or any other pathway or climate model. In addition there already is a framework to combine this RCP with different story lines of socioeconomic development (e.g. population growth, level of cooperation etc.), the Shared Socioeconomic Pathways (SSP, van Vuuren et al., 2013), by proposing different political measures e.g. bringing a high population growth in line with a low emission scenario. Here, we assume that certain demands for food, bio-energy, and natural carbon sinks have been derived based on this process of merging an SSP with the considered RCP. Food demand could, for example, be derived from population numbers and the level of economic development by extrapolation from empirical relationships (Bodirsky et al., submitted). Given this setting, we propose a probabilistic decision framework that allows for an evaluation of agricultural management options determining food production (e.g. with regard to fertilizer input, irrigation fractions or selections of crop varieties), in combination with decisions about the intensity of bio-energy production and protection of natural carbon sinks. The approach is designed to account for uncertainties in responses of crop yields and natural carbon sinks to management, climate change and increasing atmospheric CO2 concentrations as represented by the spread of multi-model impact projections. Within this framework long term decisions could be based on the likelihood of fulfilling the demand for bio-energy production and natural carbon sinks while at the same time ensuring food security."

R1.3 What is the rational behind what is incorporated within the pdf and what shifts the pdf?

Answer:
These aspects were not clearly specified in the previous version of the manuscript. Now we explicitly restrict the description to a setting where the pdf incorporates uncertainties due to our limited knowledge of crop yield and biomes responses to a given climate change scenario and specific management options. Shifts in the pdf represent modifications in the management assumptions:

"The red pdf (f) in the upper panel of Fig. 1 describes our knowledge of the required food-production area given the management option to be assessed under the considered RCP and climate model projection. The width of the distribution is fully determined by uncertainties in crop yield responses to the selected management and changes in climate and CO2 concentrations. Intensification of production, for example by increasing irrigation or fertilizer use, shifts the pdf to the left, since less land would be required to meet demand."

And similarly:

"The blue pdf (c) illustrates our knowledge of the required land area to be maintained as natural carbon sinks, or used for bio-energy production, in order to fulfill the prescribed demands. In this case, the width of the distribution depends on, for example, uncertainties regarding the capacity of natural carbon sinks, the yields of bio-energy crops under climate change, and the efficacy of the considered management decisions. Assuming higher efficiency in bio-energy production per land area shifts the distribution to the right."

R1.4 For example, why does it integrate the uncertainty from demand and crop models but not from crop management?

Answer:
We hope that the modified text makes this point clearer. Within the new setting uncertainties in demand are not included in the pdf. Instead it only represents uncertainties in biophysical responses. Different management options translate into shifts of the pdf.

R1.5 And how is it both for a prescribed global-warming level yet incorporates uncertainty from climate change?

Answer:
In the new version of the text it has been clarified that the considered application is restricted to a specific RCP-climate model combination.

R1.6 Is the framework flexible enough to incorporate anything in the pdf and the choices the authors made about inclusion versus "shifting" are simply illustrative?

Answer:

In general, other factors than biophysical uncertainties could be included in the pdf. However, we consider it particularly appealing to distinguish between uncertainties in human decisions and uncertainties due to a limited knowledge of biophysical processes. In fact the former kind of "uncertainty" can be better described by "options" that have to be evaluated before deciding for one of them. Therefore this separation has been highlighted in the new version of the text:

"Assuming certain demands for food and energy (point 1), individual societal decisions (point 2) have to be evaluated and adjusted in the context of the competing interests. Here, we focus on the question of how the uncertainty in (bio-)physical responses to societal decisions (point 3) can be represented in this evaluation."

R1.7 If some impacts are off scale and swamp all other uncertainties, it would make sense to exclude them from the pdf and instead "shift" it, but it's not clear this is the case here, and it's certainly not stated.

Answer:

We consider it particularly appealing to distinguish between "management options" represented by shifts in the pdf and "biophysical uncertainties" as represented in the width of the distribution. See above.

R1.8 Similarly, for the natural carbon sinks pdf, a huge number of important factors remain fixed – is this again arbitrary and illustrative?

Answer:
We hope we could clarify the new setting by the modifications of the text. See above.

R1.9 I am not particularly convinced by the authors stated tradeoff of food for land (N = T–F), especially because it's not clear they can or wish to consider intensification.

Answer:
Intensification is included as a way to shift the pdf of the required food production area left, i.e. less land is required for food production. Similarly, bio-energy production could be intensified meaning that less land is required to fulfill the associated demand represented by a shift of the blue pdf to the right. We hope that is clear from the modified version of the text:

"The red pdf (f) in the upper panel of Fig. 1 describes our knowledge of the required food-production area given the management option to be assessed under the considered RCP and climate model projection. The width of the distribution is fully determined by uncertainties in crop yield responses to the selected management and changes in climate and CO2 concentrations. Intensification of production, for example by increasing irrigation or fertilizer use, shifts the pdf to the left, since less land would be required to meet demand.

The blue pdf (c) illustrates our knowledge of the required land area to be maintained as natural carbon sinks, or used for bio-energy production, in order to fulfill the prescribed demands. In this case, the width of the distribution depends on, for example, uncertainties regarding the capacity of natural carbon sinks and bio-energy crops under climate change and considered management decisions. Assuming higher efficiency in bio-energy production per land area shifts the distribution to the right."

R1.10 If I am correctly interpreting the framework, the authors need to discuss how or if the framework is useful if there is not a direct one-to-one tradeoff between two things. I assume, however, that the point the authors wish to make here is that what matters is how and where the two pdfs overlap. Indeed, this is interesting. But the implications of the shape and relative position of the two pdfs need to be made much more clear.

Answer:
Yes, the critical point is that there is an overlap of the two pdfs. Given any extent F of food production area the red pdf in Figure 1 allows for a quantification of the probability that the extent is sufficient to fulfill the demand (represented as the grey area under the curve, where the required food production area is larger than the exemplary extent). At the same time the considered exemplary extent F leaves only a certain area N = T-F for conservation of natural carbon sinks and bioenergy production. For this area it is also possible to estimate the probability of climate protection failure, i.e. the probability that more area is needed to fulfill the demand of bioenergy and carbon sinks. The probability of climate protection failure given that food demand will always be fulfilled is the average of the probabilities of climate protection failure weighted according to the pdf describing the required food production area as described by the formula. As the grey area is not really needed in the formula we deleted it from Figure 1 to avoid confusion.
The newly introduced description of the practical implementation of the description framework based on multi-model impact projections may make the evaluation process much clearer. In addition the above explanation is added to Figure 1.

R1.11 The authors never explain in the text what the "exemplary area" is, for example, though presumably what is interesting and novel about this approach is that the shape and overlap of the tradeoff pdfs, and thus what the height and slope of the pdfs look like around the "exemplary area," tells us something about how hard or precarious a tradeoff will be. It is not a problem that the authors don't "provide a full quantification of the different pdfs" (5-17) given that the example is meant to be illustrative, but they need to discuss the implications of different pdfs and how their findings inform them.

Answer:

We hope the implications are more explicit in the modified text (see above). The exemplary area indicated in Figure 1 is not related to the illustrative area discussed in the "Results" section. In Figure 1 it could just be any extent of required food production area as we just want to explain how the associated probability of climate protection failure can be derived.

R1.12 The introduction is very focused on the food production/carbon sink tradeoff. However, the bulk of the paper and the research questions introduced in the second to last paragraph focus on this only to a limited extent. The questions and paper seem to be much more focused on 1) how much land is actually required to grow the food demanded, and 2) how do the uncertainties inherent in the different specific models and different model-types affect this. It would be helpful to the reader if the introduction laid this out.

Answer:

We hope that the scope of the paper is much clearer now based on the modifications of the text described above.

R1.13 Throughout the paper, a clearer focus on the uncertainties revealed by the model intercomparison would be helpful. Thus, I suggest the authors focus less on the findings of the models vis a vis the illustrative questions and more on what the uncertainty illuminates. For example, it's not news that crop production on current agricultural land won't feed the future (8-25). What's interesting is how big the spread is among the models, in conjunction with the fact that the crop models appear relatively insensitive to the choice of climate model – I would like to see the authors focus on that.

Answer:

Yes, the aim of the second part of the paper dealing with the ISI-MIP projections is to show that the uncertainty in impact model projections is highly relevant and must not be ignored which finally means that a decision framework as the one described in the first part of the paper is necessary to evaluate long term mitigation decisions.

We hope that this focus is much clearer from the modification of the abstract and introduction of the paper. In the "Results" section we also make this aspect more explicit now. In particular the introductory questions have been adjusted accordingly:

"We use simulations from 7 global gridded crop models (GGCMs, Rosenzweig and Elliott, 2014), 11 global hydrological models (Schewe et al., 2013), and 7 global terrestrial bio-geochemical models (Friend et al., 2013; Warszawski et al., 2013b)) generated within ISI-MIP to address the following questions:

1) how large is the inter-impact model spread in global crop production under different levels of global warming assuming present-day LU patterns and present day management (see Table S1, SI)?; 2) how can multi-water model projections be used to estimate the

potential intensification of food production due to additional irrigation and how does the induced uncertainty in runoff projections compare to the uncertainty in crop projections?; and 3) how large is the spread in projected losses in natural carbon sinks and stocks of an illustrative future LU pattern that gives a certain chance of meeting future food demand?"

R1.14 I would also like to see a clearer focus on the qualities of the models that cluster or suggest particular outcomes. The paragraph at 9-15 begins to do this, but it would be helpful if the authors drew the point out more explicitly instead of making the reader work for it. I assume the focus is on uncertainty largely because this is a model intercomparision study. If I am wrong about the focus of the paper and it is indeed meant to focuse on the findings of the illustrative food vs. carbon question, the authors need to explain why a MIP was necessary and should rephrase the title and other parts of the introduction. In addition, the bar is then much higher for the authors to defend the assumptions made in the models.

Answer:
The intention of the paper is to show that the impact model uncertainty is a major component of the overall uncertainty of climate impact projections that has to be addressed in integrative studies e.g. related to the food vs. carbon question. As such it is beyond the scope of the paper to provide an explanation for model differences within individual sectors but rather to show how sector specific multi-model simulations could be combined to address cross-sectoral questions in a probabilistic manner. We hope that this scope is clearer from the modifications of the paper described above. We particularly highlight this aspect of the cross-sectoral integration in the in the section on irrigation potentials where the text has been modified in the following way:
"Using different means of intensifying crop production on existing crop land, the red uncertainty distributions in Fig. 1 can be shifted to the left. As an example, we show how multi-water-model simulations could be combined with crop-model simulations forced by the same climate input to estimate the uncertainties in the potential production increase due to expansion of irrigated areas, using only present-day agricultural land."

There already is a number of sector specific studies of the ISI-MIP simulations for example in the ISI-MIP PNAS special issue that focus exactly on the question why projections may differ in the individual sectors. Thus, the carbon residence time has been identified as a main source of the overall uncertainty in vegetation carbon projections based on the ISI-MIP biomes models (Friend et al., PNAS, 2014), crop models has been separated in different families and it has been shown that the handling of nutrient constraints and their effects on CO_2 fertilization may be responsible for large parts of the model spread (Rosenzweig et al., PNAS, 2014), or the accounting for the CO_2 fertilization effect in water model projections has been shown to be highly relevant in drought projections (Prudhomme et al., PNAS, 2014).

R1.15 Overall, the results and discussion vis a vis the relative uncertainties among the specific models and among model types are interesting but very hard to follow. First, it would be very helpful if the numerical findings were presented as figures in addition to being listed in the text. Second, it would be clearer if the authors focused on one crop at a time and walked the reader through the full range of uncertainties associated with that crop.

Answer:
We have added two tables with a comparison of 1) the crop model induced spread to the climate model induced spread of global production at different levels of global warming assuming present day land use and irrigation patterns (MIRCA2000) and 2) the crop model induced spread to the water model induced spread assuming additional irrigation under accounting for water availability on present day land use patterns. We hope that highlights the focus of the results section on the quantification of the impact model induced uncertainties in climate impact projections showing that it represents a major component of the overall uncertainty that must not be ignored in integrative studies.

As the four panels of Figure 3 are fully analogous we would like to keep them as they allow for a direct comparison of the results across the different crops.

R1.16 As it is currently presented, the emphasis ends up being on the different performances among the different crops. Third, I'd like to see more interpretation and discussion of the results. For example, does the spread among models occur because some models are intrinsically more similar, or because there is indeed more uncertainty in some types of models? It would be helpful to the reader if the authors more clearly laid out the differences in assumptions and uncertainties among the models (something akin to the annotated tables in the supplement) and why they matter, with less emphasis on the particulars of the uniform assumptions among the models.

Answer:
We hope that the modifications of the introduction and the main text clarify the scope of the paper (see answer to point 14).

R1.17 The authors use a land use change model (MAgPIE) to spatialize cropland expansion. Apparently land use models were not part of MIP. This doesn't undermine the study in any way, but the authors need to discuss how using a single land use model with many, many assumptions introduces substantial uncertainty, especially because it appears to be playing off the nature of the GCMs (11-25).

Answer:
It is true that the economic model used to determine the "optimal" land use pattern given certain pattern of expected crop yields represent another source of uncertainty that could be represented in the general scheme described in the introductions. This source could be

easily included in the implementation scheme by applying multiple economic models increasing the sample of land use patterns to n = number of crop models x number of economic models used to derive the patterns. However, as the differences in land use pattern introduced by economic models may be due to different "societal rules" for land expansion this component may rather be considered as belonging to the space of "socioeconomic decisions" and be handled separately from the uncertainties introduced by our restricted knowledge about biophysical responses as represented by the crop models. Most agro-economic models also account for feedbacks of land use changes or costs of intensification on prices and associated demands. As in our decision framework demand is considered to be externally prescribed one could even think about much more simplified but highly transparent allocation rules driven only by maximum yields, assumed costs of intensification or land expansion and potential intentions for domestic production. An associated discussion is added to the description of the integrative decision scheme.

R1.18 Technical comments: Why is bioenergy production invoked in the abstract and introduction but not addressed in the paper.

Answer:
Currently multi-crop model projections are only available for the four main food crops discussed in the paper. A discussion of the uncertainties in bioenergy production would require the inclusion of other crops. Therefore it is currently not possible to address the uncertainties of bio-energy production in a similar manner. We have modified the sentence in the introduction. It now reads:

"In this study we restrict our analysis to an illustration of the relevance of impact model uncertainties in the evaluation of different LU patterns and management assumptions and how this relates to crop/food production and natural carbon sinks/stocks"

R1.19 Please define a food production unit.

Answer:
We have added an associated Figure to the SI (see Figure S7).

R1.20 It would be very helpful to the reader to have a compact table with a list of the models used instead of having to go to the supplement.

Answer:
A short version of the tables in the SI has been added to the main text.

R1.21 Within the results and discussion, there are frequent references made to moving the pdf to the left or right (10-25). No context is provided, however – even if they can't quantify the shift of the pdf, does the action in question move the pdf relatively a lot or a little?

Answer:
Based in the current ISI-MIP crop model simulations it is only possible to estimate the effect of additional irrigation from the consistent water model simulations. Its effect cannot be put into perspective of other measures of agricultural intensification as there are no runs where the fertilizer input has been systematically varied. That could be a very valuable addition to the available simulations mentioned now in the conclusion.
Given the relatively small effect of additional irrigation on current land use pattern one may assume that it may not shift the pdf of the required land for food production a lot. However, the relatively small shift in production cannot directly translated into potential shifts of the red pdf as irrigation may have larger effects on land area that is currently not used for food production.

R1.22 More quantification and discussion of what various numbers mean would be helpful. The authors state that it "remains unlikely" that current cultivated land is sufficient (10-25). Do they mean 51% or 90%?

Answer:
We have deleted the associated statement as we want to avoid the quantitative statement with regard to the sufficiency of the current agricultural land area. Providing exact numbers here (as could be derived from the fraction of data point above the associated demand line) may introduce some overconfidence in the overall assessment that is for example restricted by the fact that the crop model projections do not all start at the present day level of production and we only compare relative changes in production to relative changes in demand. That is a critical limitation of the available simulations as mentioned in the introduction. Is generally makes the analysis illustrative.

R1.23 The paper states a 60% irrigation efficiency is used for all models (10-5). Is runoff available to downstream irrigators? I imagine this is very important, especially given that in a non-trivial number of places water withdrawals already far exceed the somewhat arbitrary cutoff of 40% of available water. Realistically, assumptions such as no runoff and using no more than 40% of water are fine give the focus of the paper on model intercomparision, but if the focus is on the findings then the assumptions need to be clearer, better explained, and better defended.

Answer:
The focus of the paper is definitely on the model intercomparison i.e. the quantification of the inter-impact model spread of the projections and how that may be handled in integrative studies. The highly simplified approach considered here could be easily expanded

given better assumptions about the fraction of water that will be used in individual Food Production Units.
In general the runoff aggregated across a river basin is simply used as a measure of the irrigation water "generated" within this river basin. However, as one river basin may be split up in several FPUs part of the irrigation water available within an FPU might not be generated within the same FPU but transported from an upstream FPU. To account for the transported water we proceed in the following way (see section 3.1 of the SI):

1. The overall amount of water generated within a river basin (aggregated runoff) is re-distributed within the same river basin according to the discharge values. In this way the overall amount of water does not change but is "concentrated" in the rivers.

2. The re-distributed runoff is afterwards aggregated over the FPUs that might only cover part of the river basins.

Many of the figures, particularly in the supplement, are so small and dense that they are unreadable. Lines with different marker symbols look identical.

R1.24 Supplementary figure 5: Are the bars and dots are the same as the ones in Figure 2 (not figure 1)? Also, there are no bars.

Answer:
The bars and dots are the same as in Figure 2 of the main text. We have modified the number and adjusted the small bars to make them better visible.

R1.25 Irrigation water availability point 3 twice (supplement 12-22)

Answer:
I am sorry. I could not find the issue.

R1.26 Spread of alpha parameter –refers to Figure 3 but this is clearly not the subject of main text 3 or S3 (supplement 16-8).

Answer:
The number has been adjusted.

R1.26 Supplementary figure 8. The dark blue square and light blue triangles are basically unreadable. As presented, they are identical.

Answer:
The symbols have been adjusted.