Author's responses to the Editor's comments

C.F. Schleussner et al.

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We would like to express our great appreciation to the editor for his diligence in handling our manuscript and contributing to its improvement in the most constructive manner. We corrected all remaining minor corrections and typos following his suggestions and also addressed his other remarks as listed below.

Comment 1:

Line 146 and line 148: This phrase " distributions for 1.5CC and 2C" is unclear. I assume this refers to distributions of a specific parameter of interest under the 1.5 and 2.0 time slices? Please clarify.

Response: That is indeed the case and we modified that accordingly by adding "indicator distributions"

Comment 2:

Do the indices evaluated by Sillmann et al. (2013a) include the four used here? If so it would be useful to clarify this, and if not, this should also be mentioned.

Response: That is the case and we included the following statement for clarification: "including the four indices investigated here"

Comment 3:

It is not clear in "We excluded these grid-cells for the CDF analysis for the respective regions. " exactly which cells are excluded. (the previous sentence only says "large share of ocean surface"). Clarify (perhaps referring to supplementary material)

Response: We thank the editor for pointing that out and we agree that this should be clarified. In fact, due to data limitations, we were not able to apply a surface threshold. Instead we excluded grid cells exhibiting extreme WSDI values of 150 days and more under a 2 °C warming. We changed the respective sentence to:

> *We correct for this potential spurious amplification by excluding all grid-cells with a WSDI greater than 150 days under 2 °C from the CDF analysis for the respective regions.*

Comment 4:

For Figures 2 and 3 it would be useful to clarify in the captions that the graph axles are identical (I presume) for all regions.

Response: That is indeed the case and has been clarified.

Comment 5:

The importance of extreme events is mentioned, to what extent is this included in the ISI-MIP simulations? If this is not well simulated by the crop models (or, indeed, the GCM results) then the results might not be representative of differences between the 1.5 and 2.0 degree cases. Consider if some comment might be useful on this point. (e.g., You are using the state of the art model comparison, and

you mention this – but it would be useful to summarize in the text a number of issues that may impact the results. Better connect this discussion to the ISI-MIP simulations and their strengths/weaknesses.)

Response: We thank the editor for raising this very good point and agree that this issue merits some discussion. While the five-GCM ensemble used as an input has been shown to perform well on the global scale (McSweeney et al., 2016), this has not been shown in relation to extreme events, where the bias correction method applied also introduces issues (Sippel et al., 2015). This applies only to the climatic aspects of extremes and there is limited confidence that the ISI-MIP crop models are capable of reproducing extreme impacts on crop yields that might be already substantial over the observational record (Lesk et al., 2016).
We therefore introduced the following paragraph in section 4:

> *This ensemble of five models has been shown to reproduce regional seasonal precipitation and temperature reasonably well (McSweeney et al., 2016) which is further improved by applying a bias correction (Hempel et al., 2013). However, the bias correction method is not designed to retain a physical consistent representation of extreme weather events (Sippel et al., 2015), and thereby the intercomparibility with the quantitative results reported in section 3 is limited.*

In section 5.3:

> *As discussed above, our crop-yield projections are subject to a range of uncertainties also related to extreme weather events. Uncertainties in both the bias-corrected climate model input (Sippel et al., 2015) as well as the impact model representation of such events (Deryng et al., 2014; Asseng et al., 2014; Lobell et al., 2012) limit the confidence in the projections of the effect of extreme weather events on crop yields. Observational evidence, however, indicates substantial impacts of specifically drought and extreme heat events on crop yields (Lesk et al., 2016). Given the pronounced increase in extreme heat events under global warming in general and also specifically between 1.5°C and 2°C (compare Figs. 2 and 3), our estimate of the absolute change in regional crop yields as well as the difference between 1.5°C and 2°C should be seen as a conservative estimate.*

and in section 8:

> *Given the substantial divergence in projections of specifically extreme temperature events between 1.5°C and 2°C, this renders our estimates of the differences crop yields rather conservative.*

Comment 6:

Line 427 Is this "risk of substantial reductions of 25 % (1.5 C) and 20 % (2 C) in the CO2-ensemble" correct? (The reduction is higher under 1.5 than 2.0?).

Response: This is indeed correct for the CO2-ensemble as for the NAS region the positive effects of increased warming and CO2-fertilization outweigh potential negative impacts of climate change on regional soy yields.

Comment 7:

Line 520 "The results for the 2C scenario are comparable with projections by Church et al. (2013) and Hinkel et al. (2014) for RCP2.6 (their Tables 13.5 and 4, respectively) that leads to a median GMT increase of about 1.6C above pre-industrial levels." is a bit confusing. Why does your 2 scenario lead to a median GMT increase of 1.6C? Please clarify.

Response: We agree with the editor that this sentence is indeed not clear enough as the 1.6°C warming relates to the RCP2.6 scenario. Furthermore, we found that this statement is to a great extent repetitive, which is why we decided to delete the sentence alltogether.

Comment 8:

Figure 15 is a nice summary of the work and, as such, its important that it be able to stand alone without reading the entirely of the paper. I asked the referees to take a look and I include their comments below along with mine.

Response: We thank both the editor and the referees for their comments to this figure and addressed their comments accordingly. This has greatly helped to improve the figure.

Kind regards,
The Authors