

Response to

Anonymous Referee #2

---The referee's comments are quoted in black, and our responses in *blue italics*.---

This paper succeeds in showing the relative contributions to the spread of crop yield projections from impact models, climate models and scenarios. Further, it also succeeds in demonstrating that there is potential utility to functions relating change in GMT to yield impacts in the future. Clear and precise outlining of methods and data availability makes the results of this paper easily traceable and its contents easily replicable by fellow scientists.

This paper would benefit from further discussion of methodological limitations. In particular, the following points should be addressed:

i) 5 GCMs are used to obtain climate projections. The authors should discuss the representativeness of these 5 GCMs with regards to the CMIP 5 ensemble.

Reply: McSweeney and Jones, 2016 (<http://dx.doi.org/10.1016/j.cliser.2016.02.001>) investigated how representative the 5 ISIMIP GCMs are of the full CMIP5 ensemble. They find that the ISIMIP subset probably underestimates the total uncertainty in future climate impacts attributable to GCMs for many regions. On the other hand, they also conclude that it's not possible to represent much more of the total uncertainty with any other set of 5 GCMs; in other words, the ISIMIP subset is basically as good as one can get with only 5 GCMs. We will add discussion of this aspect to the revised paper.

ii) Section 5 describes projected increases in regional crop yield variance. This section should also include a discussion of the extent of uncertainty present in these projections of rising variance.

Reply: As far as the uncertainty can be quantified in terms of model agreement, our analysis serves this purpose by showing (in Fig. 11) the percentage of model combinations agreeing on a change in variance. In regions with light colours the uncertainty between models is higher than in dark-coloured regions, where most models agree on a change in variance. Regarding the ability of the models to realistically capture yield variability in the first place, we refer to more dedicated studies such as Frieler et al. 2017 (doi: 10.1002/2016EF000525) who quantify the portion of observed variability that can be reproduced with the GGCMs.

The summary section should incorporate discussion of the above two points in relation to the strength of the conclusions drawn.

Reply: Thank you for the suggestion. We will add discussion of these points to the revised manuscript.

In addition to elaborating on methodological limitations, the following points require clarification and elaboration respectively:

Lines 393 – 394: The use of the word “likely” needs to be clarified here. Please provide a definitive answer as to whether or not very low present-day yield potential in these regions is leading to division by values close to zero.

Reply: We will verify this again and rephrase if necessary.

Lines 396 – 405: Please give an explanation, or hypothesis for the negative effects of CO₂ in the two “potentially important” regions mentioned.

Reply: We have changed the regression for emulator method b) (equation 2) slightly to allow for a more robust determination of the CO2 effect and the additive correction term a0 in equation 2. The negative effects in the two “potentially important” regions were an artefact where the previous regression resulted in a high correction term and a negative effect. This is no longer the case in the fixed method.

In terms of mathematical formulae, symbols, abbreviations and units, the following should be addressed:

Lines 169 onwards: Please use a clearer term for fixed CO2 than YnoCO2.

Reply: We will consider using Y_{fixedCO_2} instead of YnoCO2 as a clearer term.

Lines 340 and 350: Please describe what a1 represents in each equation in word form.

Reply: a1 represents the magnitude CO2 fertilization effect in both equations. It is the part of the yield change attributable to the difference in atmospheric CO2, as opposed to yield change driven by changes in climate variables.

Line 434: Please correct the use of <> in this equation.

Reply: Thanks, we will correct this.

In terms of changes to figures, the following should be addressed:

Figures 2,4,6,7 and 8: All of these figures need to be much larger to increase their readability. If possible, each figure should be on its own page.

Reply: We will rescale these figures to the full page width in the revised layout (approx. 7 inches wide). This will make them larger than the current layout. We will also check all font sizes and increase them where necessary.

Figure 5: This figure is only for the LPJML model, please explain the rationale for model selection or point to where other model results can be found.

Reply: Whenever a figure shows results from just one GGCM we use LPJmL as an example in the main article. Alternative versions of these figures for the other GGCMs are available in the Supporting Information. However, it seems that we missed to provide alternative versions of Figure 5. We will add these, and apologize for the omission.