

## ***Interactive comment on “The GGCM Phase II experiment: global gridded crop model simulations under uniform changes in CO<sub>2</sub>, temperature, water, and nitrogen levels (protocol version 1.0)” by James Franke et al.***

### **Anonymous Referee #2**

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The manuscript by Franke et al. documented a new AgMIP GGCM effort on simulating the crop responses to globally uniform environmental perturbations, including CO<sub>2</sub>, temperature, precipitation, nitrogen, and adaptation (CTWN-A). The simulation protocols are described in detail and key model outputs are made publically available. The authors made the first cut on data analysis to show the key characteristics of the simulated dataset. Overall, this manuscript is well organized and written. It also fulfills the scope of GMD and should be of great interests to the broader crop modeling and climate change adaptation community. I have the following comments for the authors

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to consider:

Firstly, I see the nitrogen application rates designed in Table 1 are largely not realistic, especially considering how nitrogen application rates differ for different crops. I am not sure if I misunderstood anything there, but please help to clarify this point.

Secondly, I found some critical information is missing in the current manuscript. For example, the differences among different models (especially those with the same base), the irrigation triggering rules in different models, key model inputs (such as cultivar information), model tuning method and model spin-up design. Please see later detailed comments.

Thirdly, there are 7 mandatory variables in Table 2. However, the authors only discussed yield, which I agree is the most important one for crop models. If the authors can have some discussions on other variables, it would be very interesting, even if the figures are dumped into supplementary materials.

More detailed comments are as following:

P2, L30-L31: the transition to “Global crop model experiments are needed for systematic climate change assessments” is a little wired to me. Are you talking about the same point with last sentence or not?

P3, L22: Folberth et al. (2016); Porwollik et al. (2017)-> Folberth et al. (2016) and Porwollik et al. (2017)?

P3, L25: (C3MP Ruane et al., 2014; McDermid et al., 2015)-> (C3MP) (Ruane et al., 2014; McDermid et al., 2015)

P4, L26: an additional 84 for irrigated ( $W_{\infty}$ )->an additional 84 for irrigated area ( $W_{\infty}$ )? Are those 84 cases for irrigated area only with the assumption that the irrigated area will not change or also for rainfed area too (to get rid of water stress in rainfed regions)? Please clarify this point. It would be really interesting to have a no-water-limitation case for rainfed area. Moreover, how does each model trigger irrigation? Does the irrigated

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amount differ a lot among models?

Table 1: There are three levels of applied nitrogen (10, 60, 200 kg/ha). Are those three levels uniformly applied for all the five crops? For soybean, we don't need that much nitrogen (200 kg/ha), right? For corn, is 10 kg/ha a too strong nitrogen limitation, especially for a few regions such as US?

P7, L5: it would be good to document the main differences related with crop growth among those sharing-a-common-base models, i.e. EPIC group (EPIC-IIASA, EPIC-TAMU, GEPIC, pEPIC), and LPJ group (LPJml, LPJ-GUESS).

P7, L24-L25: will the change of phenological parameters have a huge impact on yield for different models?

P7, L28: what's the "technical reasons" for CARAIB model? A note should be put on this.

P7L35-P8L1: how did modelers adjust those parameters? Was it manual tuning or automatic tuning? And should this tuning be conducted for every year and each location? Ideally, there should be a section in the appendix for parameter tuning to include related details (parameter space, and tuning method)

P9, L10: please move "(Note that several models do not output the anthesis date.)" after "the dates of planting, anthesis, and maturity", i.e. the dates of planting, anthesis, and maturity (Note that several models do not output the anthesis date).

P9, L8: 30-year or 31-year (1980-2010)? What's the model spin-up protocol?

P11, L20: no italic text in Table 3!

P11, L28: did you missed 510 ppm there?

P13, L26: For example, global correlation coefficients for maize in Phase I and Phase II are 0.89 and 0.74, respectively; for wheat 0.67 and 0.64, and for soybeans 0.64 and 0.59. (Compare to Müller et al. (2017) Figures 1–4 and 6.)-> For example, global

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correlation coefficients in Phase I and Phase II are 0.89 and 0.74 for maize, 0.67 and 0.64 for wheat, and 0.64 and 0.59 for soybeans, respectively (Phase I values are from Figures 1-4 and 6 in Müller et al. (2017))

P13, L27: Figure 2 should be Figure 2(c)-2(f)

Caption of Figure 5: There are two “all” in “Figure shows all all simulated grid cells for each model”

P19, L1: region. (For soybeans, temperature effects are more complex; see Supplemental Figure S5.)-> region (for soybeans, temperature effects are more complex; see Supplemental Figure S5).

P20, L10: Generally, the carbon fertilization effect (CFE) would be larger under drier condition than under wetter condition. Is this true in Fig. 6a and Fig. S7?? McGrath, J.M., & Lobell, D.B. (2013). Regional disparities in the CO<sub>2</sub> fertilization effect and implications for crop yields. *Environmental Research Letters*, 8, 014054

P21, L1-2: again, please check the use of parenthesis.

Section 5: I am glad that the authors discussed some of the limitations in the simulation exercise. One more point should be included there is about how to validate the simulated responses, especially considering that there are indeed some field experiments designed to measure the responses of crops to environmental manipulations.

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