Geosci. Model Dev. Discuss., 7, C1707–C1712, 2014
www.geosci-model-dev-discuss.net/7/C1707/2014/

Geoscientific Model Development Discussions

Interactive comment on "The Global Gridded Crop Model intercomparison: data and modeling protocols for Phase 1 (v1.0)" *by* J. Elliott et al.

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Received and published: 11 September 2014

General comments:

This paper presents a project's approach to global gridded simulations for the period 1948-2012. The paper should be a useful reference for both crop modelers involved in the project and more broadly also for other scientists that aim at using the project's public outputs for their analyses. The methods and data sources presented in the paper can also be of use to other researchers conducting regional or global-scale crop simulations. The paper provides a great deal of detail on many of the assumptions that will go into the project's simulations, including clear descriptions of weather and crop data. The GGCMI project is mainly an improvement over the work presented in the so-called 'fast track' (mainly Rosenzweig et al. 2014).

My main concern is that the authors do not demonstrate the methodology, or even parts of it. The paper is currently limited to showing the input data. This is fine, but maybe not enough for a scientific paper. For instance, one can think of some evaluation exercise of the Rosenzweig et al. (2014) model output over the historical period, using either the Iizumi et al. (2014) or the Ray et al. (2012) datasets, or both. This can provide an idea of whether there is scope for improvement in model skill through using better model inputs or scope for uncertainty reduction by 'harmonising' inputs. Taking advantage of the same simulations, authors can also show the type of extreme-event analysis that would be done. This can help the authors in framing / contextualising a bit better their objectives, and would improve substantially the paper.

In addition, I suggest revisions be made mainly targeted at removing ambiguities and better contextualising phase 1 within the project and the project's objectives more broadly in the context of climate change impacts research.

Specific comments:

1. Relevance / context of the project. GGCMI phase 1 will conduct global simulations of as many crops as possible for a historical period with four main objectives. Authors could expand a bit on the three-year GGCMI project so that the reader gets a clearer idea of how next phases will build upon phase 1. It would also be useful to see at least a brief discussion (in Sect. 6) of how this project overlaps / feedbacks from / contributes to regional assessments that are currently being carried out / funded by AgMIP itself or by other programs (e.g. CCAFS). Moreover, the context of these analyses (i.e. global gridded simulations) within the impacts research literature should also be stated (also see point 2 below).

2. Relevance / context of project objectives. It is not entirely clear, why are some of these four objectives being researched. While items (2) and (4) are clear overarching needs and/or knowledge gaps, the hypothesis and/or context behind item 1 should be stated more explicitly. More specifically, what new knowledge is expected to be gen-

erated by running models with harmonised and non-harmonised inputs? For item 3 (uncertainties) it is not clear which uncertainties or why do the authors choose to quantify these? is there evidence suggesting they may be a major source of uncertainty in yield hindcasts? On the input weather one can also think of bias correction of climate model meteorology? why are these not being researched (from a climate change perspective they may be at least as relevant)?

3. L20-25 P4388: having in mind the four objectives stated at the beginning of Sect. 2 it does seem that running crop models where crops are not currently grown is unnecessary. Particularly for climate variability (obj. 4) and model evaluation (obj. 2) assessments. Maybe authors have a purpose for this (e.g. for further comparison to any future simulations that will be done in a follow up phase). However, as of now, why not just use some prescribed "crop mask" per crop and so in this way do not waste computational resources and facilitate further analyses? This is particularly important for northern hemisphere cereals such as wheat and barley whose climate requirements are unlikely to exist in large areas of the tropics. Vice versa for tropical crops not adapted to cold (e.g. cassava). The niches of the crops need to be maintained somehow. This brings confusion to the reader: for instance, in Fig. 4 (right) of this paper one can already see wheat in the Sahel.

4. L1-10 P4389: crop duration is a key output for understanding differences across models, particularly when these are driven by mean temperatures. All annual crop models should be capable of providing this as an output. In addition, perhaps authors should somehow indicate how many models (or by percentage) can provide each output.

Technical corrections:

1. L5, P4386: unless described briefly (i.e. what it is and how is it different to GGCMI) a reference to AgGRID may confuse the readership.

2. L21, P4386: consider using regional-scale process-based models. Hybrid may be

too ambiguous.

3. L22, P4386: ditto above, why not just use 'statistical models', instead of 'purely empirical'?

4. L27, P4386: 'modelling groups', rather than 'modelers'

5. L6, P4387: "such as" brings about some unnecessary ambiguity. Be specific. List clearly which uncertainty sources are being quantified.

6. L10 P4387: productivity, not production

7. L19-20 P4387: one would expect a relationship between the two measures (importance to food security / economies / livestock feed and number of models, or likelihood a model exists). It is likely that each criterion would yield the same list separately, hence it seems redundant to use both (with FS and/or economic importance being the independent variable). Besides, it seems reasonable to think that, as long as >=3 models simulate a particular crop (to allow for inter-comparison), the existence of many models should exert little impact on establishing the scientific problem / priorities. Also, the brackets on "(primarily global)" seem unnecessary.

8. Table 2: # models for priority 1 states 15-20 models. How can a crop achieve 20 individual model simulations when Table 1 lists 18 crop models?

9. L18 P4388: "For the purposes of various analyses". Which analyses? if described in this paper please ref. the section. If not described in this paper then please do so, or state briefly what is meant by "various".

10. L16 P4389: or maybe also to be able to interpret the differences in simulated yields?

11. L18-20 P4391: This is unclear. While it makes sense to think of a growing season for comparability across models, observational datasets are generally based on the reporting standard of FAO, which uses whatever the countries report. In this scheme,

yields reported in one year correspond to crops harvested in that year. It is not "artificial", as authors state. Authors are advised to cross-check their statement against the FAO reporting standard.

12. It does seem a bit strange that the paper first describes simulation outputs and only after that describes the inputs.

13. L25-27 P4392: this statement is inconsistent with (actually contradicts) the purpose of the comparison of input meteorological datasets itself.

14. Table 11 should clarify whether 'standard' (for wheat and barley) means spring.

15. L6 P4394: sugarcane is harvested beyond 12 months in many places across the tropics

16. L13 P4394: LAI will not be zero for indeterminate crops

17. L3-12 P4394: it does seem like too many assumptions for areas in which no model evaluation can anyway be performed, and for which little scope exists for inter annual variability assessments.

18. L1-4 P4396: unclear whether this is done for each input meteorology dataset or using which met data?

19. L21-25 P4397: why has this been done? clearly, it will affect simulations of models that account for nutrient availability and/or uptake, mainly across the developing world. If this procedure is inconsistent with observations then what is the expectation with regards to model evaluation?

20. Sect. 4.1. Perhaps it would be good to include some basic quality checking for the yield data (see for instance wheat in the Sahel, Fig. 4 right). In addition, FAOSTAT reported yields also have known issues.

21. L17 P4399: "various analyses". Please specify

22. Sect. 4.2.2. Detrending of FAOSTAT data may imply the need to detrend yield simulations as well, if climate change driven yield trends for the period analysed are observed in the simulations.

23. Sect. 4.2.3 be consistent with terminology: validation vs. evaluation. Validation suggests universality (not this case), hence it seems best to use the term evaluation.

24. L6-8 P4401: It is unclear how this will be achieved only with yield simulations and observations. You need an entire series of prognostic variables and measurements in order to conduct such an assessment. It also seems unlikely that regional-scale evaluation of yield simulations can drive model improvement. Far more detailed data are needed for such task.

25. L14 P4401: "stakeholder", please clarify / expand.

Interactive comment on Geosci. Model Dev. Discuss., 7, 4383, 2014.