

## ***Interactive comment on “Parameters sensitivity analysis for a crop growth model applied to winter wheat in the Huanghuaihai Plain in China” by M. Liu et al.***

### **Anonymous Referee #2**

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1. The manuscript provides new findings from the parameter sensitivity of the EPIC crop growth model and for wheat in a major growing region of China. This topic fits within the GMD's scope as “describing the development of new parameterisations or technical aspects of running models”.

2. The manuscript does not contain major novelty or innovation in my view. The methodology involves applying the EFAST global sensitivity analysis technique to the EPIC model. The manuscript does not report on any major, significant extensions or enhancements related to such methods and/or models. How to best apply sensitivity analysis to new data in terms of site selection to span range of soil zones and other spatial variables and other application context decisions regarding the choice of lead-

C2054

ing inputs related to key output variables and tuning the methods to apply to a given region and crop type requires a degree of novelty. While I consider sensitivity analysis an essential and invaluable tool in modeling crop response to the environment, I don't see any major significant methodology or application novelty advancement, or major new insights stemming from the reported work as it is currently reported in the manuscript. I do think this research and associated findings, nonetheless, do relate to two important needs that could be highlighted and supported better, namely: 1) to enable reporting of sensitivity metrics related to crop yield predictions generated by complex agricultural/crop models, and 2) to guide and improve the use and ‘upscaling’ of site or point specific time-series model input data to regional-scale prediction to support regional agricultural stakeholder and policy-related decision making. To this end, I highly recommend that the authors state how their work provides a novel approach or application that links more specifically with these two major aims within the broader research domain. The authors should state more explicitly what the consequences of their findings are for regional-scale crop yield model prediction (related to use of dynamic crop models versus statistical methods, for example), and highlight how use and selection of station/point data and sensitivity at each site related to the broader goal of identifying leading variables across a region (e.g., agricultural area polygons) to help validate regional model predictions or to serve as more input data that is more spatially or temporally referenced to regional environmental variability to improve predictions generated by regional-scale models. In general, the authors need to better relay to readers the major implications, consequences, outcomes and impacts of this research work.

3. If the major concerns/ issues regarding innovation and specific contribution of the work reported in the manuscript can be sufficiently addressed, as noted in point 2) above, I do consider that the paper could represent a sufficiently substantial advance in modeling science.

4. In the Results and Discussions section, the authors should identify more clearly

C2055

and discuss the phenological assumptions of the EPIC model as it pertains to the BN1, BN2, BN3 parameters, where the sensitivity analysis findings reportedly indicate that interactions are important. It is crucial that justification for the number of MC runs/model executions and nominal parameter ranges used is provided. Otherwise, the variation of sensitivity indices may not represent the true sensitivity, because the full parameter space (i.e., of the 22 selected variables) has not been explored. It is not clear how this was determined in the current study, nor how the choice of these major simulation parameters compares to what is used in other studies. Also, what degree does applying EFAST have on the number of sensitivity runs, compared to other sensitivity analysis techniques?

5. In the Conclusions, both data and model/simulation limitations need to be made explicit/stated more clearly for readers. Often obtaining reliable data with sufficient length of record is difficult (e.g. a typical limitation), the fact that 10 sites are available and used in this study is a definite positive aspect. Also, while crop yield is a major output of crop models, given the interaction of yield with water availability, why was an output linked with water from EPIC not also explored? Would it help interpret the range of values found in the first-order sensitivity index across the sites? Some justification needs to be provided.

6. How the EFAST technique/code was coupled to the EPIC model needs to be discussed in greater detail as part of reproducibility of the results either with the same or other input datasets. Also, as shown in Table 3, the first-order sensitivity indices of the 22 parameters are highly variable across the 10 selection stations – it is crucial to assess how significant such variability is. Is there a significance level that can be cited or determined to compare the values against? This would provide additional support for the findings and the variation of the sensitivity indices for reference and guidance on work being conducted in other regions and using other models and sensitivity analysis techniques as part of cross-applications.

7. The authors give credit to methodology papers, but I think could cite many re-  
C2056

lated recent studies on parameter sensitivity of crop models. For example, I recommend the authors consider citing some other recent work on sensitivity and crop models: N.K. Newlands et al. Understanding crop response to climate variability with complex agroecosystem models. *International Journal of Ecology*, 2012:12, doi 10.1155/2012/756242.

8. I recommend the authors specify the “EPIC model” in the paper title.

9. The abstract needs to indicate and highlight the major insights, implications, consequences, outcome of the analysis findings, beyond what is already known.

10. The paper is fairly well structured, but needs to clarify methodology and data aspects better for readers (as mentioned in various points above).

11. The language is fluent and precise.

12. The mathematical formulae, symbols, units etc. are correctly defined and used.

13. I recommend the authors include a new figure showing inter-annual time series (or statistical distribution) of major climate variables (temperature, precipitation, incident solar radiation) for specific sites pooled by region (could pool by soil type (as was identified as a major reason the sites were selected across the study region). Were there any data gaps or non-stationarity in these time-series? It would be very worthwhile to test stationary assumptions of the model input data. Are all station record lengths the same?

14. The number of reference is appropriate, but linkage of findings to other recent sensitivity analyses conducted on crop models in China, Canada and elsewhere need to be acknowledged and discussed linked with the paper’s sensitivity findings.

15. I recommend supplementing this technical paper by providing code that others could use or modify to perform sensitivity on other crop models and inter-compare results across different regions, crop types, etc..

Other supplementary comments/notes:

Page 3868, line 6-8: "Due to uncertainties associated with yield estimates in a regional assessment, field-based models that perform well at field scale are not accurate enough to model at regional scale". This is an important area of research, however, this comments is far too general and needs to be made more specific (or be supplemented) by indicating the particular advance or contribution and its novelty related the specific work and findings contained within this manuscript.

Page 3876, line 21 and page 3877, line 19: replace "emergency" with "emergence"  
Page 3873, line 14: Insert "The" before "EPIC".

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Interactive comment on Geosci. Model Dev. Discuss., 7, 3867, 2014.

C2058