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Earth System Dynamics
Discussions

Interactive comment on "Impacts of climate change on growth period and planting boundaries of winter wheat in China under RCP4.5 scenario" *by* Z. Sun et al.

Z. Sun et al.

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Dear reviewer and editors,

We really appreciate your helpful and valuable comments.

While we agree with the reviewer that the regression method lacks narration and some figures are misleading, we also think the reviewer has some misunderstanding that we want to explain. According to the comments of the reviewer, we have made modifications and explanations as follows:

(1) sowing date depends much on climate conditions before sowing, such as monthly

temperature before sowing and soil moisture, but not on the annual average or winter climate. The average minimum temperature of the coldest month (X3) is the month during winter-time when sowing has already occurred, how should it cause variations in sowing dates? Similarly, it is well-known that harvest date should depend on the thermal accumulations from sowing or anthesis, instead of the winter temperature indexes in the author's regression model.

Response: We don't agree with the point "the sowing date doesn't depend on the winter climate". Winter temperature could directly influence the start time and duration of winter wheat overwintering stage, and subsequently influence sowing date. The higher winter temperature, the later overwintering stage starts. If sowing date dose not postpone corresponding to postponed overwintering stage start time, winter wheat will convert from strong seedling period to vigorous growth period before overwintering stage, which will be more susceptible to freezing damage and induce higher mortality rate. Thus, proper timing of winter wheat sowing date to avoid freezing damage is one of the adaptation strategies to the coldest month temperature. Moreover, duration of overwintering stage directly influence the harvest date of winter wheat.

(2) How well does the MME perform against the observations remain a mystery. In addition to that, I am wondering why the authors do not use observed historical climate to build the regression model against sowing and harvest date.

Response: Winter wheat agroclimatic regionalization based on observed historical climate is already realized by previous literature. The main purpose of using IPCC AR5 simulations in this paper is to study long period climate change impacts on winter wheat planting boundary in the future, which is unable to achieve using historical records. This is also the innovation point of this study. Our former studies (Sun et al., 2015 and 2016) had dealt the the performance of MME: http://www.cnki.net/kcms/detail/11.3858.P.20151023.1335.006.html

(3) China Crop Climatic Division Cooperation Group (1987)'s research is non-

peerreviewed, 30-years-old and not accessible.

Response: Cooperation Group was a special working model of organizing almost all relevant scientists to do collective research of a special scientific task in 1960s to 1980s in China. For example, the new Nobelist Ms Youyou Tu was the leader of the cooperation group for artemisinin structure. Although theose groups published few papers, their research achievement were and still are very authoritative, much more authoritative than peer-reviewed papers by one or several scholars. China Crop Climatic Division Cooperation Group (1987)'s research results were reviewed and authenticated by several seminars and one formal appraisal that hosted by Chinese Academy of Agricultural Sciences, experts from Agriculture Zoning Office of the Ministry of Agriculture and Fisheries, State Meteorological Administration, Institute of Agricultural Zoning and Agricultural Natural Resources, Institute of Geography (now Institute of Geographic Sciences and Natural Resources), CAS and China Agricultural University have participated. It's considered higher authority than ordinary peer-reviewed literatures. Although it is 30-years-old, this literature is still of high authority and its results and indicators is being adopted in many studies (Jin et al., 1994; Duan, 2012; He and Zhou, 2012; Wang et al., 2012).

(4) the main conclusion of the paper is that the wheat agriculture should extend to such area in Xinjiang and Inner Mongolia.

Response: Winter wheat agroclimatic regionalization is a study of climatic possibility. Here we only consider whether climate restricts the crop planting, not considering soil and water. Xinjiang and Inner Mongolia really have the potential of planting winter wheat. In fact, extensive oasis farming in Xinjiang has confirmed that farming is practicable as long as soil and water conditions are satisfactory and climate is not the limiting factor.

(5) after reading section 2.2.2, I could not obtain any useful information on how they perform stepwise regression: is it forward, backward or recursive? what are the candi-

date variables? why are they instead of others?

Response: We agree with the reviewer on the comments about Section 2.2.2. To modify, we have rewritten this part as follows, introduced the procedures of stepwise regression in detail (Fig.1). The software we used is matlab (version: 7.10.0.499(R2010a)), developed by the MathWorks in USA.

stepwise(x,y,inmodel,penter,premove)

x: all potential influencing factors;

y: sowing/harvest date;

inmodel: is either a logical vector with length equal to the number of columns of X, or a vector of indices, with values ranging from 1 to the number of columns in X;

penter: entrance tolerance for the p-values of F-statistics, default is 0.05;

premove: exit tolerance for the p-values of F-statistics, default is 0.10;

In the matlab, first, the function of stepwise add the most significant factor with the biggest coefficients and t- statistic, and the least p value of the F-statistic into the model, then compute the summary statistics for the entire model, including R2, RMSE and F-statistic and so on (These statistics are updated with each step); Second, according to the p-values of any factors not in the model (p), make the next step. If $p < penter$, adds the most significant factor. If $p > premove$, removes the least significant factor. Third, when the regression reaches the minimum of RMSE, the function will terminate and get the influencing factors.

(6) The references cited do not reflect state-of-art understanding on the climate change impacts on wheat. It is also full of literature written in Chinese and non-peer-reviewed materials, the quality of which cannot be assessed.

Response: This study is focused on winter wheat planting boundary in China. It's normal that relevant studies are finished by Chinese and the publications are in Chinese,

thus there are many Chinese literatures referenced.

(7) In the Figure 1, 2 and 3, the distribution of fitted sowing/harvest date covers all land area in China, even including Tibet and deserts in northwestern China, where wheat cannot grow. This is misleading.

Response: We agree that this presentation is misleading. To avoid this misinterpretation, we have revised Figure 1, 2 and 3 (in the paper) to sowing/harvest date within possible planting boundary(Figure 2, 3 and 4 in the response letter).

Reference

Duan, J. Q., 2012. Rice planting distribution and its response to climate change in China. Chinese Academy of Meteorological Sciences, 42-43.

He, Q.J., Zhou, G.S., 2012. The climatic suitability for maize cultivation in China. Chin Sci Bull. 57(4), 267-275.

Jin, Z.Q., Fang, J., Ge, D.K., Zheng, X.L., Chen, H., 1994. Prospect to the impacts of climate change on winter wheat production in China. Acta Agronomica Sinica. 20(2), 186-196.

Sun, Z., Jia, S.F., Lv, A.F., Zhu, W.B., Gao, Y.C., 2015. Assesment on precision of temperature simulated by the IPCC AR5 GCMs in China, 1996-2005. Progress in Geography, 34(10): 1229-1240. DOI: 10.18306/dlkxjz.2015.10.003

Sun, Z., Jia, S.F., Lv, A.F., Zhu, W.B., Gao, Y.C., 2016. Precision estimation of the average daily precipitation simulated by IPCC AR5 GCMs in China during 1996-2005. Journal of Geo-information Science, 18(2). (In press)

Wang, P.J., Zhang, J.H., Xie, D.H., Han, L.J., 2012. Spatial characteristic analysis on planting area of winter wheat in China from 1961 to 2010. Journal of Natural Resources. 27(2), 215-223.

We hope that the amendments or interpretations can obtain a more accurate

manuscript. Thank the reviewer and editor again for comments and suggestions.

Kind regards,

Authors

Interactive comment on Earth Syst. Dynam. Discuss., 6, 2181, 2015.

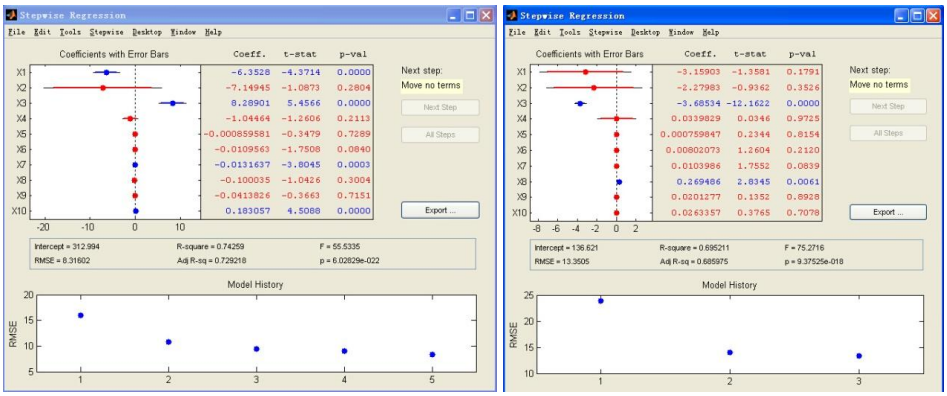

Fig. 1 the procedures of stepwise regression (left: sowing date, right: harvest date).

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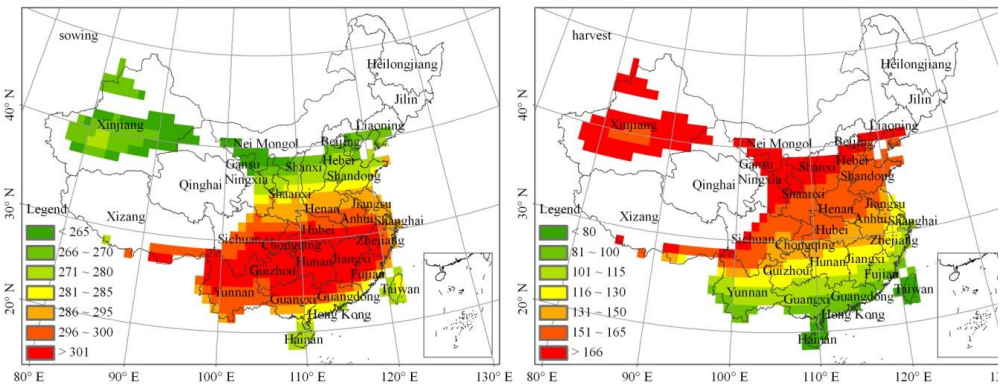

Fig. 2 Distribution of sowing and harvest date of winter wheat in China at base period.

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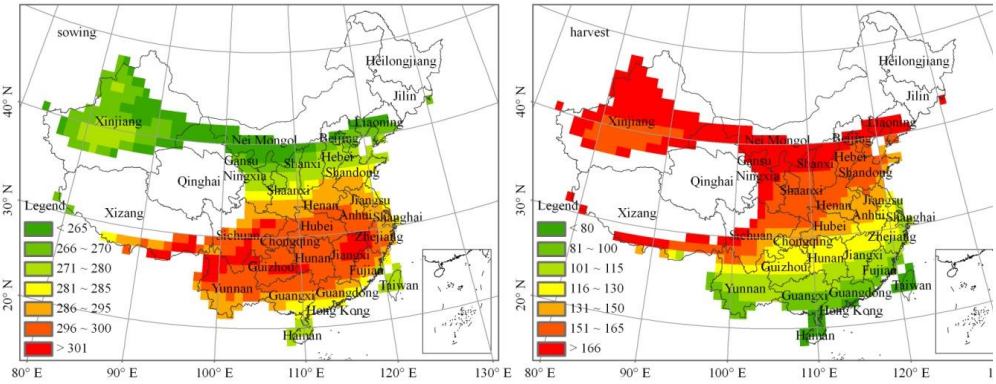

Fig. 3 Distribution of sowing and harvest date of winter wheat in China in the 2040s.

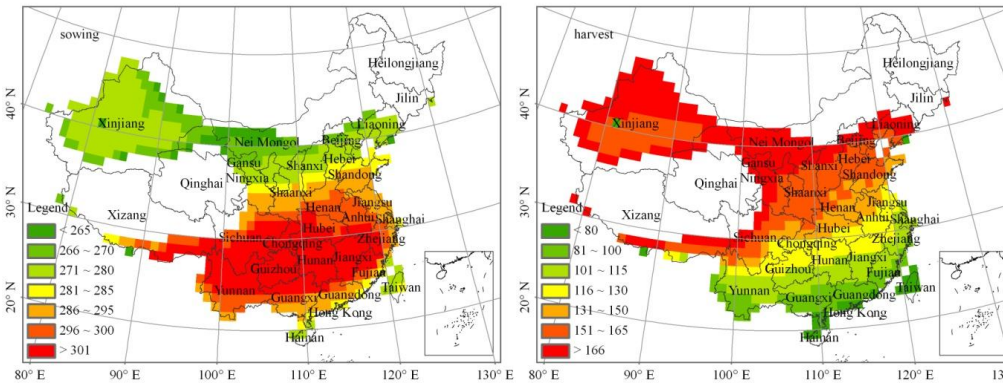

Fig. 4 Distribution of sowing and harvest date of winter wheat in China in the 2070s.