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Earth System Dynamics
Discussions

Interactive comment on "Impact of environmental changes and land-management practices on wheat production in India" *by* Shilpa Gahlot et al.

Anonymous Referee #2

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This study uses the land surface model, ISAM, to examine the effect of different environmental factors, including atmospheric CO2, temperature, nitrogen fertilization, and irrigation on spring wheat production in India. First, the authors implemented spring wheat processes in ISAM by updating C3 crop parameterizations. After calibrating and validating the updated model against available observations, ISAM is applied to explore environmental and land management factors on Indian wheat production. It is found that during the last 30 years, increasing atmospheric CO2, addition of nitrogen fertilizer, and irrigation act to increase the production of spring wheat, but increased growing season temperature causes a loss of wheat production due to increased heat stress. Regional scale analysis of environmental factors and land management practice shows that Indo-Gangetic plain is the best region for growing spring wheat in India,

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and Northwestern India is the least productive region for wheat growth.

This study makes a useful contribution to boost our general understanding in the effect of environmental change and land management on crop yields and production. The manuscript is in general clearly written. I recommend its publication after the following issues are addressed.

Lines 61-63: This sentence is hard to read. Please rephrase.

Line 105: How big is the wheat experimental site?

Lines 139-140: What are these major plant functional types?

Line 179: Where 'the climate driver' data come from? Also, the reference of Meinshausen et al., 2011 is missing.

Line 225: Section 3.2 Here the effect of a single factor (CO2, temperature, etc.) is obtained by subtracting the simulation that includes the effect of all factors (CTRL) from the simulation that excludes the effect of a certain factor. Thus, the effect includes interactions with other factors. How would it compare with the sole effect of a certain factor by keeping other factors constant? (For example, suppose a simulation in which only atmospheric CO2 changes to represent the CO2 effect). Some discussion on this issue would be helpful.

Also, what are the nonlinear interactions among different factors? Does the sum of individual effects add linearly to the combined effect? The authors stated that changes in atmospheric CO2, irrigation, fertilizers, and temperature led to 39%, 15%, 20% and -16% changes in countrywide production. So, what explains the residual change in wheat production that are not attributed to these factors? Some discussions should be added.

Lines 256-257: '2' -> 'two'

Lines 431-432: This sentence lacks a context. How does this study imply that ISAM

will likely to provide better estimate of terrestrial carbon flux?

Table 1: For the experiment STEMP that assumes no temperature change, I assume other climate fields such as precipitation and humidity change with time. If so, to what extent changes in other climate fields such as precipitation and soil moisture contribute to the 'direct' heat stress effect? Some discussions should be provided.

Table 3: statistic test should be done on the trends shown here.

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