

## ***Interactive comment on “Global cotton production under climate change – Implications for yield and water consumption” by Yvonne Jans et al.***

### **Anonymous Referee #1**

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Overall, the manuscript is well-written and easy to follow. The authors' efforts on conducting a gridded cotton modeling study are commendable. However, I think some important elements, pertaining to climate change impacts, are missing. My main concern is that the authors did not account for the adverse effects of temperature rise, especially on growing season length and crop failure. This likely led to underestimation of the negative effects of climate change on yield and crop water consumption.

Specific comments:

Line 15: Please define VWC.

Line 19: Delete (and thus water stress).

Section 2: I did not see any details on model calibration. Did you have a set of param-

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ters you adjusted to match the FAO-yield? Did you follow any protocols for calibration, like changing parameters in sequence, first for yield, then for irrigation? Please explain the steps followed.

It appears that the cotton module is a new addition to the LPJmL model, has it been tested against detailed field data including in-season phenology, growth, leaf area, biomass, and yield?

Section 2: Did you apply any fertilizer? Not clear.

Line 130: Please define PFT and CFT, if not already done so.

Line 175: Why the 2090-2099 period? Typically a 30-year period is used to avoid extreme weather years, and to get average conditions. Please justify your choice. Also, the baseline period, against which the % increase is calculated, is not clear. Please specify the baseline period. Ideally, for a fair comparison, the length of years should be the same for the baseline and future periods.

Section 3.2: The authors did not mention phenology. Growing season length? How does increasing temperature affect cotton yield in your model? Shortening of growing season length is one of the major causes for yield reduction under climate change. Did you account for this?

Section 3.3: I find the term “virtual water content (VWC)” confusing. It distracts focus from the more relevant issue of “crop water consumption”. To help the reader, please add text on how the changes in VWC would affect crop water consumption.

Line 283: It is worth noting, cotton yield have increased over the years in part due to the use of high yielding crop varieties as a result of breeding efforts. One of the reasons behind the temporal variation in your study?

Section 4.2: Did you account for the effects of increasing temperature on growing season length? As previously mentioned, this is important for yield and irrigation water use, and needs to be considered.

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Line 313: “concluded” instead of “conclude”.

Line 324: Please justify simulating climate change impacts without accounting for yield penalty due to temperature increase.

Line 327: I would be careful in stating that “warmer temperatures will increase the length of growing season”. For cotton and other annual crops, increasing temperature is known to increase the rate of development, which causes the crop to mature earlier than it would at a lower temperature. Thus, this rapid development reduces the length of growing period, considering the same maturity-group cultivar is used.

Line 335-340: This section is confusing and I would caution the authors while comparing different studies. Please make sure the same matrix is compared across studies. Was it daily crop water use or seasonal; was it transpiration, evapotranspiration, or transpiration use efficiency? Please revise this section for consistency and technical accuracy.

It is expected that transpiration use efficiency would increase at higher [CO<sub>2</sub>], but the overall increase in biomass due to [CO<sub>2</sub>] enrichment, would trigger higher water consumption compared to the ambient [CO<sub>2</sub>] conditions.

Line 341: “Temperature” is another key driver of climate change impact on crop yield. Considering the crop was irrigated, rainfall likely did not have a major effect. So instead of using “direct climate change impacts”, I would use “temperature rise” effects.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2019-595>, 2020.