Comment on esd-2021-40
Anonymous Referee #2

Referee comment on "Weather-induced crop failure events under climate change: a storyline approach" by Henrique M. D. Goulart et al., Earth Syst. Dynam. Discuss., https://doi.org/10.5194/esd-2021-40-RC2, 2021

Goulart et al. analyse weather conditions leading to soybean failure in the Midwest US using crop model data, training of a random forest model, and analysing a particular historical event and possible analogous events in the present day and future. The paper is well-written and clearly describes the approaches used and the results, and I enjoyed reading it. I have some comments particularly around the justification of the data used and the storyline approach, which I have noted below.

Specific comments

- I think the reasoning behind using a crop model rather than observations is sound, however you haven’t shown whether the model is reliable at modelling soybean yields in the US. Could you provide any references, or analysis (if there is observed data available), to show whether the crop model provides realistic results for soybean production in the region of interest and can reproduce some of the important impacts being considered in the paper (e.g. does the model represent the impact of hot and dry conditions on soybean plants well?)? It would then be relevant to reflect in the discussion section on how the model-based results are likely to compare to real-world crop failures.
- I assume all meteorological variables were considered at monthly scale for the analysis, but I don’t think this is explicitly stated anywhere. Is there justification for using this timescale that could be provided in the text? Did you consider shorter timescale events that may also cause crops to fail but would be averaged out when looking at monthly timescales (e.g. a short very dry period), or if there are periods of less than a month in the crop lifecycle when the soybean may be more vulnerable to particular weather conditions?
- Given that the paper is titled “a storyline approach”, I think the storyline analysis is quite limited. For the 2012 season, only the meteorological variable values are presented and the probability of failure calculated. Can you include more insight into the storyline of events, e.g. how did the weather impact the crop via changes to the soil moisture? How did the high DTR affect the crop? This information would help to provide a much more complete chain of events for the 2012 season, otherwise it is unclear to me how it is a storyline approach being used to identify the drivers of the
event. I think using the impact analogues as well as the event analogues is a very interesting approach and, as you note in the discussion, the impact perspective is likely to be of more interest to society. However it would be interesting to include analysis of how the storyline chains of events differ (compared to the 2012 season and to each other) in these cases leading up to similar impacts. There is some relevant discussion already in section 4 but describing the range of plausible storylines more explicitly would help to incorporate more of a storyline approach in the paper.

- In Figure 5a there is a pronounced jump in the observed data at return period of around 6 years. Are you able to provide any insight into why this might be?

**Technical corrections**

- Line 26: It seems strange to refer to Figure 2 in the text before Figure 1. Also this figure shows the mean yield rather than anything related to low yield in 2012. Combining information from Figure 9 might be relevant here to show the yield anomaly.
- Figure 2: Where does this mean yield data come from (is it from the model or is it observed data)?
- Line 28-30: Sentence starting “On a global level...” – I think there is a missing word or grammar check needed on this sentence
- Line 30: Change “Extremes” to “Extreme”
- Line 44-45: changing “to link” to “in linking” and “to explain” to “in explaining” would improve the readability here
- Line 166: Correct spelling of Matthews
- Line 184: I assume RF is the abbreviation for Random Forest but this needs clarifying
- Table C1: Need to define what the codes for the variables mean in this table or use their full names
- Line 234: Do you mean high correlations with the yield or between the variables?
- Figure 4: It would be easier for the reader to interpret the figures if you could change the axis labels to the full names of the variables. Also it is not clear what the small lines along the x axis correspond to.
- Line 267: Is the observed data mentioned here the yield data from EPIC-IIASA, rather than real-world observations?
- Figure 9a): Are these yield anomalies from the model or is other observed data used?
- Line 374: Do you mean Figure 10d here?