Earth Syst. Dynam. Discuss.,
https://doi.org/10.5194/esd-2020-32-AC2, 2020

Earth System Dynamics
Discussions
Open Access
EGU

Interactive comment on "Simulating compound weather extremes responsible for critical crop failure with stochastic weather generators" *by* Peter Pfleiderer et al.

Peter Pfleiderer et al.

peter.pfleiderer@climateanalytics.org

Received and published: 2 October 2020

The paper is based on a previous study (Ben-Ari et al., 2018) that identified two climatic conditions, more specifically not enough cold days in December of the year before harvesting and too much precipitation during the spring before harvesting, to be key factors in diminishing the wheat productivity in northern France for the year 2016. The paper works around these two compounded conditions and aims at exploring how extreme each of them actually is in terms of physical plausibility, finally establishing how rare this event of 2016 was and what are the odds of them happening again.

Printer-friendly version

Discussion paper

We thank the reviewer for reading our manuscript carefully and for providing constructive feedback which helped to improve the manuscript considerably!

In the introduction section, it would be perhaps interesting to explain the underlying factors that makes France a major wheat producer with high yields, maybe climate conditions or the practices used.

France is a major wheat producer due to its intensive agriculture generating high yields. Based on FAO data we changed the first sentence of the introduction to:

"France is one of the major wheat producers and exporters in the world, thanks to yields that are roughly twice as high as the world average (FAO, 2013)." (lines 22-23)

The methodology proposed by the authors, an adaptation of stochastic weather generators (SWG), is innovative in the field and duly addresses the original research question. In addition, it is data-driven based, suggesting a more flexible and cheaper approach to simulating extreme conditions with respect to the physical climate models.

Maybe explaining the methods before the data section would make more sense in this work?

We thank the reviewer for this suggestion. We agree that as it is now the data section is not written elegantly as we cannot directly refer to the part of our methods that requires the described datasets. However, the other way around we would have the same problem. We therefore prefer to stick with the methods section after the data section.

The authors mention the paper is designed following the storyline concept, however it seems a bit shallow and too implicit the theoretical conception, in spite of the main references being rightly cited. Some minor alterations in the section presentation (lines 57 – 64, especially this passage “In this paper, we construct a climate storyline of a warm winter followed by a wet spring that is likely to lead to extremely low wheat crop yield in France” could better demonstrate the rationale behind the storyline approach used and provide a clearer description of the importance of the storylines in the current work. In my perspective, it should be more explicitly explained that the starting point of the simulations stems from the 2015/2016 season and that the counterfactuals obtained are all based on these real occurrences.

> *The transition between the theoretical presentation of storylines and our own approach was a bit shallow indeed. We reworded as follows:*
>
> *“These storylines have the potential to be fed into impact models and to provide a tool to engage with stakeholders about their vulnerability (de Bruijn et al (2016), Symstad et al (2017)).”*
>
> *In this paper, we propose a methodology to compute scenarios of plausible extreme meteorological events. This is a first step towards the storyline of a compound event consisting of a warm winter followed by a wet spring that is likely to lead to extremely low wheat crop yield in France. This methodology is based on an ensemble of simulations of temperature and precipitation with a stochastic weather generator that we nudge towards extreme behaviour. The starting point of these simulations stems from 2015/2016, from which we derived counterfactual events, that could have happened instead of the observed event.*

On the data section, it would be profitable to justify the choice of averaging the rectangle encompassing the northern France (line 79). Ben-Ari, 2018 decided to average

the area within each department of the country and justified this by stating there was not much spatial variability within each of these departments. Perhaps a similar justification could be added so others can better understand the reason this decision was made.

We agree that a comment about this rectangular region would be helpful here. We included the following sentences: "This region also includes parts of the UK, Germany, Belgium and Switzerland and does therefore not exactly match the studied area of Ben-Ari et al. 2018. The seasonal meteorological conditions we study here are large scale events and averaging over a larger rectangle therefore seems appropriate." (lines 83-86)

Also, as we stated in a reply to the first reviewer: We agree that reanalysis data is not optimal. However, it is not very easy to get access to the Meteo France observational data and for this study, which is mostly a proof of concept we felt that using reanalysis data was sufficient. If we were to extend this study and feed our generated events into a crop model, we would need to use in situ data.

The paragraph starting at line 251, which describes the way precipitation data were grouped, could be possibly improved in a way to better explain the decision behind the 5-day selection of the data chunk length. It is understandable that 1 day would not work well and that 5 days are a good representation of a coherent time series, but what prevents the chunks from being longer or slightly shorter? According to figure A4, 4 or 7 days could work as well. Perhaps some explanation on this side to justify the parameter value selection would add some value to the work.

We fully agree that the 5-day chunks are a heuristic choice. As the reviewer points out other chunk sizes would also work. In the paragraph 266-272 we

shortly discuss the sensitivity of the results to the number of days before switching trajectories. We now added a sentence clarifying that there is a range of reasonable chunk sizes and that the 5-day chunks are a heuristic choice: "Note that taking 5-day chunks is a heuristic choice and that chunk sizes between four and seven days might work similarly well."

In addition, the following paragraph starting at line 261 behaves in a similar way but this time on the amount of precipitation alpha parameter and it is not exactly evident the choices behind selecting the chosen values. For both paragraphs, it is my opinion some further explanation on the reasoning behind the parameters choices will improve the general understanding of the work.

We thank the reviewer for the suggestion and agree that some more explanation on how parameters are chosen is required. We added the following paragraph:

"As for the other free parameters of the SWG, this sensitivity test does not directly justify the choice of the α parameter. It rather gives guidance on the values that would be appropriate choices for our application. In the end the parameter is heuristically chosen considering the trade-off of creating high precipitation events and keeping as much randomness as possible in our simulations." (lines 278-281)

In line 283 some reference would be welcome so that the cold days can be duly justified.

We added a reference to Ben-Ari et al. (2018) which is the main source of information for this event.

The conclusions section is clear and concise.

The last paragraph, line 321, holds a statement that could be better contextualized. Since the extreme events are within given scenarios, it is not exactly assessing all possibilities in the world (climatic or non-climatic). It may very well be it is not the purpose of the paper to account for that, but then it would be interesting to make explicit these limitations, such as the uncertainty of the scenarios, non-climatic drivers (pests, supply chain, management, economy and so on).

> *We reworded the last paragraph to reflect your point. It now reads:*
>
> *"This approach is rather flexible and could be adapted to simulate compound extremes using climate model outputs based on different scenarios of climate change. This could lead to a first evaluation of the impact of climate change on worst case scenarios of crop yields. This type of data has some limitations, related to the uncertainty of models and scenarios, and it fails to take into account non-climatic drivers of crop yields such as pests, supply chain, or economical concerns. We however believe it could be useful to estimate what could be plausible in terms of purely meteorological events, in a changing climate." (lines 345-349)*

Some minor mistakes encountered along the text:

Line 167: "the the";

> *Done*

Figure 6: "te black line";

> *Done*

Line 304: “Thompson et al” – no date;

Done