

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

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This manuscript examines seasonal conditions in 2015-2016 in northern France using a type of stochastic weather generator. Technically I think everything in terms of the analysis is probably good, worth publishing, and not in need of modification. However, there were a number of aspects of the write-up that did not quite make sense to me, so I would request some work on the write-up.

There are two main issues. The first is that the logical order is often confusing. An example is in the abstract, where one sentence says that extreme weather caused a certain low wheat yield, with the following sentence declaring that the connection has

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not been demonstrated yet. This is a contradiction. But if the sentences switched order, and with the addition of a "however" and some qualifiers in the second sentence, the contradiction would be lost, and I think the result would state what the authors intend. I have highlighted specific examples below.

The second issue is that this is supposed to be a demonstration of a certain technique to the problem of compound weather extremes. I am not clear though how the "compound" aspect really enters. The manuscript examines two types of events independently. The only connection is that the real-world motivating events occurred within a year of each other and that they may have been involved in the poor wheat yield that year (although it is not quite clear how). How is this "compound" and not just two events? If the interest is on seasonal weather events that affect wheat yield then why not also examine dry springs, hot summers, etc.? I do not see any connection between the two types of events as they are examined within the paper (i.e. ignoring that the motivating events happened to occur in the same year). In the hypothetical situation that the manuscript were split in two, each with one analysis per event type, would anything be lost from the current manuscript? What is it? This seems a salient concern for a special issue on compound events.

One additional note that may or may not be relevant. My understanding is that ESD requests interdisciplinary submissions. This manuscript presents an analysis of climate data using a new statistical tool, but beyond that I do not see any interdisciplinarity.

Specific comments:

lines 1-4 It would seem more logical to me to switch the order of these two sentences. "The cause of this extreme event.... However, this event was likely in part due.... Here we focus on a compound...."

lines 9-13 These sentences seem more appropriate for a methods section within the main text. While I can see a possible way in which they address the second question, these lines do not indicate how the method might address the first question.

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line 19 "of 2016" -> "of 2016's"

line 22 "producer and exporter" -> "producers and exporters"

line 23 France's trade balance in 2016 was -14.95 billion USD, which was actually higher than any year since 2006, except barely 2015. So -2.3 billion USD does not seem a "dramatic impact" to me.

line 26 What is "oec"?

line 35 "gained a lot of attention" from whom? The reference is six years old.

line 44 Why is reanalysis data relevant here? There is good in situ monitoring of seasonal temperature and precipitation in France going back many more decades.

line 56 "non-stationary" -> "non-stationarity"

line 57 This is effectively "stress-testing" and using scenarios, and has been standard practice in catastrophe analysis and emergency preparedness since well before process-based models were available or sufficient data for training empirical were available.

lines 71-72 I am not following this. What uncertainties are we talking about here? You are setting up conditions to mimic 2016, so is the uncertainty just a measure of how well you succeeded?

line 93 "raw" sounds like not detrended, but then that contradicts the rest of the sentence.

lines 79-80 Which also includes all of Belgium and bits of the UK, Germany, and Switzerland (I think we can ignore Luxembourg).

line 102 At the end of what season? Is this something that is run for a season?

lines 103-104 Well... that depends on the size of the perturbations.

line 105-106 But if you delete one simulation, and then replace it with another plus a

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perturbation, if the number of simulations is not large with respect to the number of days of simulation, then do you not end up with the case that your multiple realisations are essentially all the same except for the end? e.g. if you are simulating December-February with 30 simulations, then in the end the realisations will all be identical in December, only diverging some time in late January and February?

lines 119-120 Why Z500 for one season and SLP for the other, and different regions?

lines 154-157 You claimed above that an advantage of your approach is that it does not need the crazy amount of simulation taken by e.g. the weather@home approach. But 68000 years (or perhaps 68000\*5 months) is not any smaller. But then it is unclear still whether you are using climate model output or reanalysis output (both are implied above). But with reanalysis output I do not see how one can "start independently" 1000 time series if there are only 79 values to start with (1 Decembers during 1950-2018).

line 159 "chosen a region" -> "a chosen region"

Figure 3 caption, lines 2 and 4 "for 3 days" -> "for three more days"

lines 166-169 This will get you partly there. But I wonder if it would work even better if you restricted possible switches to when it is not raining in either the original or new trajectories? This would avoid leaving or arriving in a trajectory during the middle of a potentially heavy rainfall event. The weighting mentioned in lines 170-171 seems to oppose your desire for physical consistency, by deliberately arriving into an imminent or potentially in-progress precipitation event.

line 181 Is this a strong test?

line 184 Or did the presence of only a few cold days "lead" to the abnormally warm winter?

line 188 Does detrending Z500 but not temperature complicate things?

line 200 Is the 4-significant digit precision of "4221" supported?

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line 229 Something is wrong here. Grammar?

line 236 "noa"?

lines 241-245 Perhaps you could elaborate on why this analysis is included (as with the similar analysis for the warm December). With my understanding of midlatitude dynamics at that time of year, it is hard to imagine a wet spring in northern France that would not involve low pressure just to the northwest of northern France (as in the figures). So is this a check that the method is working?

lines 255-259 One thing that is nagging me here is that if wet events are due to the passage of a low pressure system, then as a general rule some high pressure must pass by before another low pressure system can. (yes, it is more complicated, but just thinking of canonical mid-latitude flow). I think your method, by requiring similarity on SLP and having the 5-day segments, probably works toward ensuring this in the static case. I am less clear on the dynamic case. If this is not ensured, then can this still be considered physically-based? Anyway, some commentary on that point here or early would be useful.

line 266-267 But it might be dynamically? Would one expect the same large-scale synoptic systems to be responsible for rainfall in April as in August?

line 282 "the most relevant" -> "a more relevant"

lines 286-287 Your analysis does not suggest anything about whether "the mechanism that led to the crop failure in 2016 is... understood" nor "therefore... more extreme crop losses".

lines 287-288 "Especially": Did you examine other periods than April-July?

line 291 How so "similar to a summer heat wave"? In that in order to get warmth in northern France one needs to have flow from the subtropics?

lines 294-295 Which "weather event" of the "series of passing storms"?

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lines 295-296 How does not having persistence make simulation a major challenge?

lines 296-297 How were "success" and "reasonableness" defined? I do not recall this being assessed. Line 298 suggests that it was not too.

line 305 What does "considerable chance of unprecedented winter rainfall" mean?

line 310 There is some dependence here on what you mean by "crop model". Models of crop behaviour can be process-based or based on empirical observation in controlled conditions. I am not sure anything based on correlation of observed yield against observed weather, which seems to be what you are referring to here, would normally be termed a crop model.

Figures A1, A3 Please describe the box and whiskers. I am confused by the double boxes (red and blue) within one set of whiskers.

Figure A2 caption, line 2 "the parameter we choose" -> "the value used in the analysis"

Figures A4, A5, A6 Please describe the box and whiskers.

Figure A7 Are the colours, etc. the same as in the previous plots?

Sincerely, Dáithí Stone

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