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## Simulating compound weather extremes responsible for critical crop failure with stochastic weather generators

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In 2016, northern France experienced an unprecedented wheat crop loss. This extreme event was likely due to particular meteorological conditions, i.e. too few cold days in late autumn and an abnormally high precipitation during the spring season. The cause of this event is not fully understood yet and none of the most used crop forecast models were able to predict the event (Ben-Ari et al, 2018).

This work is motivated by two main questions: were the 2016 meteorological conditions the most extreme we could imagine under current climate? and what would be the worst case scenario we could expect that could lead to even worst crop loss? To answer these questions, instead of relying on computationally intensive climate model simulations, we use an analogue based importance sampling algorithm that was recently introduced into this field of research (Yiou and Jézéquel, 2019). This algorithm is a modification of a stochastic weather generator (SWG), which gives more weight to trajectories with more extreme meteorological conditions (here temperature and precipitation). This data driven technique constructs artificial weather events by combining daily observations in a dynamically realistic manner and in a relatively fast way.

This is the first application of SWGs to simulate warm winters and wet springs. We show that with some adjustments both (new) weather events can be adequately simulated with SWGs, highlighting the wide applicability of the method.

While the number of cold days in late autumn 2015 was close to the plausible maximum, our simulations of extreme spring precipitation show that considerably wetter springs than what was observed in 2016 are possible. Although the crop loss of 2016 is not fully understood yet, these results indicate that similar events with higher impacts could be possible.

