Master's Thesis offer (Stage M2 in France)

Generating climate extremes with stochastic models

Main advisers: David Métivier is permanent junior researcher (*chargé de recherche*) at INRAE Montpellier MISTEA. Thomas Opitz is permanent senior researcher (*directeur de recherche*) at INRAE Avignon BioSP.

When: Starting February 2026 (flexible) for 5 to 6 months.

Location: UMR MISTEA (Mathematics, Informatics, and Statistics for Environment and Agronomy), 2 Pl. Pierre Viala, 34000 Montpellier, France.

Teaser: Study and build generative models capable of simulating realistic high impact extreme weather events coherent over space and time.

Contact: Please send your application with a CV and a few motivational lines to: david.metivier@inrae.fr and thomas.opitz@inrae.fr. You may include links to scientific projects (even if unrelated), Git repositories, etc. Don't hesitate to ask questions about the internship (**do read the whole announcement first**!).

Context

Climate change is causing increasingly significant shifts in temperature and precipitation patterns, leading to more frequent and severe extreme weather events (floods, droughts, heatwaves, ...). These extremes can have profound implications for various sectors, including agriculture, water resources, and forest management. Understanding the statistical properties of these events is crucial for developing effective adaptation and mitigation strategies. Especially, several extreme events could occur simultaneously across multiple variables (**compound extremes**), with strongly amplified impacts. For instance, a heatwave (temperature) coupled with a drought (precipitation) can devastate yields, sometimes causing a total collapse for some crops.

Internship objectives and expected work

Stochastic Weather Generators (SWG) are statistical models that learn the climate variability and can generate synthetic sequences of weather data, such as temperature and precipitation, with the correct statistical properties. They are useful tools for assessing the impacts of climate change on various sectors, including agriculture and forestry. This internship aims to:

- First, study existing SWGs properties in terms of compound extremes. This part will be both theoretical and numerical.

- The goal is then to improve this ability to generate realistic compound extremes events either by developing new statistical models or modifying existing ones.

Perspectives The results of this work may be published in a scientific article and lead to developing an open source package.

Required Skills

- Strong knowledge in mathematical modeling and statistics. Extreme value theory is a plus.

- Skills and interest in scientific programming. The main programming language will be **Julia** (no prior knowledge required, but at least look up what it is); some modeling approaches will require using **R**.

- Interest in agronomy and/or climate issues.

Terms of the internship

The intern will work at the MISTEA lab (Montpellier) with David Métivier. The intern will also be supervised by Thomas Opitz at BioSP (Avignon). The intern receives a "*gratification*" around €600/month. The canteen is subsidized. We can help students find housing, but we sadly cannot pay for it, nor pay for the trip to Montpellier. However, we will pay for potential travel and accommodation for scientific visits to Avignon.