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Assessing the Likelihood of High-Impact Co-Occurring Weather Extremes in Europe

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Using a newly developed copula-based stochastic weather model, MYRIAD-SIM, this research estimates the likelihood of high-impact co-occurring extreme weather events. By analyzing European case studies of extreme weather conditions, such as hot and dry periods or wet and windy events, we identify the prevailing factors during these events that resulted in impact. The stochastic weather data allows us to assess the frequency and likelihood of these extreme conditions, providing critical insights into their potential recurrence that allows for a better management of the associated (financial) risk.

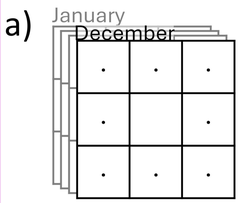
Sharing is encouraged

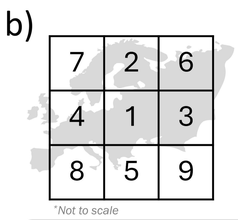
Conference Abstract

This presentation participates in OSPP

Outstanding Student & PhD candidate Presentation contest

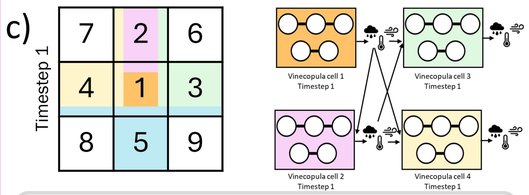
The MYRIAD-Stochastic vIne-copula Model



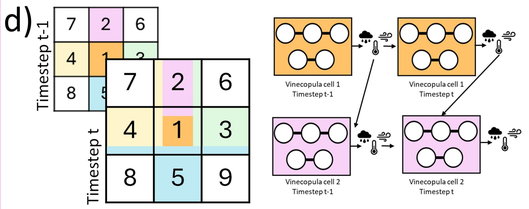


a) Best fit distribution for each grid cell for each month and each Variable:

b) The grids on the area of interest are numbered. This numbering determines the sampling order.



c) In timestep 1 (t=1), the model sequentially samples each grid cell based on previously sampled neighboring cells using pre-fit vine copulas. E.g., the variables in cell 2 is sampled based on 1 using a specific vine copula.



d) In the subsequent timesteps, each grid cell is sampled using the same order as in t = 1, and their value in the previous timestep. For example, cell 2_t is sampled based on 1_t and 2_{t-1}, using a vine copula.

MYRIAD-Stochastic vIne-copula Model (MYRIAD-SIM):

Is a stochastic weather generator

That models spatiotemporal dependencies

For a variety of variables

Using vine copulas in the VineCopulas Python package[1]

VineCopulas

Powered by VineCopulas

Return Period Method

Case selection

- Cases are selected based on high impact
- The case involves multiple hazard drivers
- The case unfolds through time

Return period condition

For each case, the weather conditions that was driving the impact is identified as a proxy for similar (impactful) conditions.

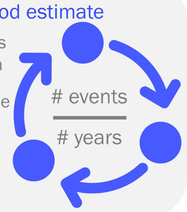
Model run

The model is fit and run for:

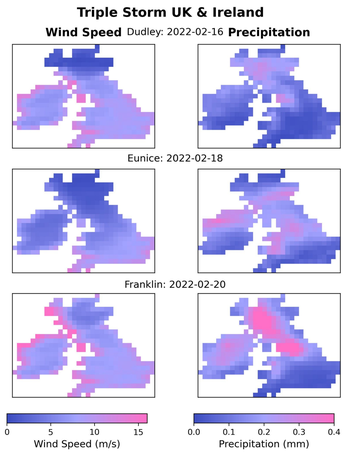
- Area of interest
- Variables of interest
- Resolution of interest
- 1000 years

Return period estimate

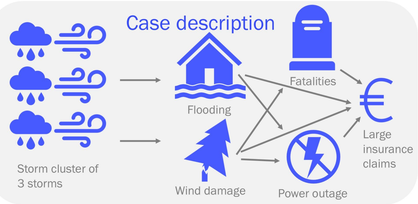
- Apply proxy conditions to the stochastic data
- Count how often these conditions are met
- Derive initial return periods



Case 2: triple storm, UK & Ireland

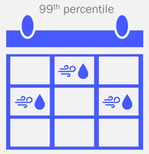


Case description



Proxy condition

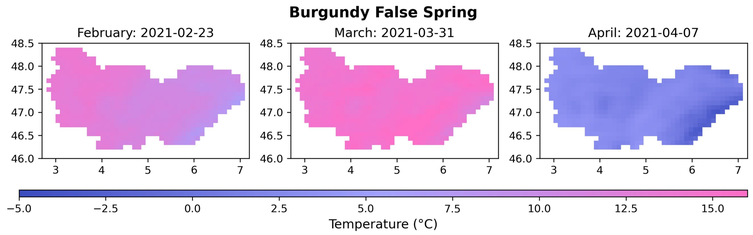
3 storms in 6 days. E.g., Wind and rain above 99th percentile



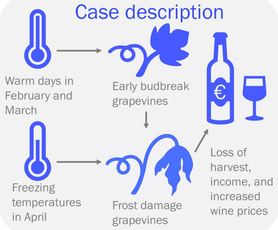
Return period estimate

*initial estimate

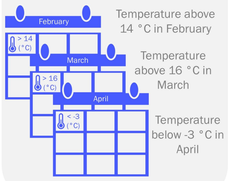
Case 1: false spring, Burgundy, France



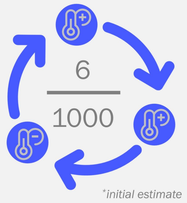
Case description



Proxy condition

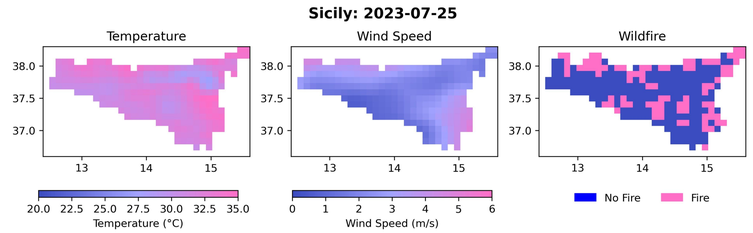


Return period estimate

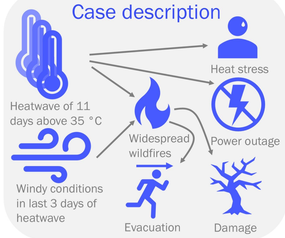


*initial estimate

Case 3: heat, wind and fire, Sicily, Italy



Case description



Proxy condition

11 consecutive days above 30 °C and wind above 4 m/s in the last 3 days

Return period estimate

*initial estimate

Get in touch

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1. Claassen, J. N., Koks, E. E., de Ruiter, M. C., Ward, P. J. & Jäger, W. S. Vinecopulas: an open-source python package for vine copula modelling. Journal of Open Source Software 9, 6728 (2024).

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