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How to integrate explanatory variables, non-stationaries and dependencies in multivariate risk analysis problems

ABSTRACT

The statistical modelling of current and future extreme events is crucial because of their multiple impacts, covering a broad range of topics such as coastal flood hazard, heatwaves or heavy rainfall. The assessment of uncertainties is particularly relevant in the study of rare events.

The main goal of this talk is to propose and detail different case studies that leverage multivariate extreme value theory in the context of non-stationarity. In addition, we will explain how dependencies in multivariate risk analysis can be model within a unifying framework. In particular, the common element of our three examples will be the joint modelling of extremes with the multivariate Pareto distributions.

The first example will focus on a stochastic simulator/emulator that, given offshore wave conditions (such that peak direction, peak period), produces jointly offshore and coastal extreme high significant wave heights a quantity measuring the wave severity and which represent a key feature in coastal risk analysis. The performances of the proposed generators are illustrated on simulated data and then applied to the simulation of new extreme oceanographic conditions close to the French Brittany coast using hindcast sea state data. This is a joint work with J. Legrand, P. Ailliot and N. Raillard.

Another example will be dedicated to the modelling of compound events for which a combination of explanatory variables, not necessarily extremes, can lead to an extreme event. Again, we will propose to treat this question within a multivariate Pareto distribution setup. As an illustrative case study, we will analyse extreme river streamflows with respect to precipitation, soil moisture content and other variables. This is a joint work with M. Brunner.

If time allowed, the last example of multivariate Pareto modelling will focus on extreme event attribution. More particularly, the question of maximising causality evidence for CMIP precipitation data will be addressed. This is a joint work with A. Kiriliouk.