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Several investigations have been carried out in 2014, involving different fields, as outlined below.

Assessment of droughts (see [1]).
Droughts, like floods, represent the most dangerous, and costly, water cycle expressions, with huge impacts on society and built environment. Droughts are events occurring over a certain region, lasting several weeks or months, and involving multiple variables: thus, a multivariate, multi-site, approach is most appropriate for their statistical characterization.

In this methodological work, hydrological droughts are considered, and a multivariate approach is proposed, by regarding as relevant variables the duration and the average intensity. A multivariate, multi-site, frequency analysis is presented, based on the Theory of Copulas and the joint Survival Kendall's Return Periods, by investigating the historical drought episodes occurred at five main river sections of the Po river (Northern Italy), the most important Italian basin.

The tool of Dynamic Return Period is used, and the new concepts of Hazard Trajectories and Fans are introduced, in order to provide useful indications for a valuable multi-site real-time assessment of droughts.

Maritime Engineering (see [2]).
A frequent statistical problem in many coastal and off-shore engineering situations is to estimate the probability of structural failure expressed in terms of Return Period and Design Quantile. Usually, only the univariate approach is carried out to quantify the risk of failure. However, coastal and off-shore structures typically fail because of the occurrence of a critical combination of all the variables at play in a single sea storm: thus, it may be important to consider the joint occurrence of dangerous conditions.

The present manuscript provides practical guidelines in order to carry out a sensible multivariate analysis of the available data, including a randomization procedure to cope with repeated observations. In addition, suitable strategies for performing multivariate design are presented and discussed. A practical case study is used to show the application of the techniques illustrated throughout the paper, and a preliminary rubble mound breakwater design is also carried out.

REFERENCES

1. G. Salvadori and C. De Michele, Multivariate real-time assessment of droughts via copula-based multi-site Hazard Trajectories and Fans. *J. Hydrol*, 1–15, 2014. doi: 10.1016/j.jhydrol.2014.11.056.
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