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(Multivariate) Anatomy of a Climate-Hydrology Model: How Well Does it Perform?

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One of the ultimate goals of climate studies is to provide projections of future scenarios: for this purpose, sophisticated models are conceived. The outputs of such models are used to investigate the impacts on related phenomena such as floods, droughts, etc. To evaluate the performance of such models, statistics like moments and quantiles are used, and comparisons with historical data are carried out. However, this may not be enough: correct estimates of some moments/quantiles do not imply that the probability distributions of observed and simulated data match. Furthermore, the climate literature is replete with terms like credibility/plausibility/reliability, i.e., vague expressions, too often used to support and justify (in a non-objective way) the outputs of climate-hydrology models: clearly, this may adversely affect the environmental risk assessment from an Economic and Insurance point of view. In this work, a distributional multivariate approach is outlined, also accounting for the fact that climate variables are often dependent. Suitable statistical tests are described, providing a non-parametric assessment exploiting the Copula Theory. These procedures allow to understand (i) whether the models are able to reproduce the distributional features of the observations, and (ii) how the models perform (e.g., in terms of future climate projections and changes). The proposed approach is appropriate also in contexts different from climate studies, to evaluate the performance of any model of interest: distributional methods to check a model per se are sketched out, investigating whether its outcomes are (statistically) consistent.

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