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Introduction

- Droughts are comprehensive and complex naturally occurring hazards resulted in the loss of life and severe ecosystem damage.
- Drought event is a multivariate phenomenon & usually monitored based on single variables.
- Due to the complex nature of drought single variables approach do not represent the corresponding risk appropriately.
- Multidimensional copulas function can overcome this issue.

Data sources: Weather and Hydrological data

The meteorological dataset from ERA5 (for the period 1979-2017). These are:

- The maximum temperature at 2m (Tmax),
- The minimum temperature at 2m (Tmin),
- Precipitation,
- Evaporation and
- daily averaged soil water volume

Hydrological data (for the period 1979-2017)

The streamflow data for Po River Basin was collected from 5 hydrometric stations (Piacenza, Cremona, Boretto, Borgoforte and Pontelagoscuro).

Results

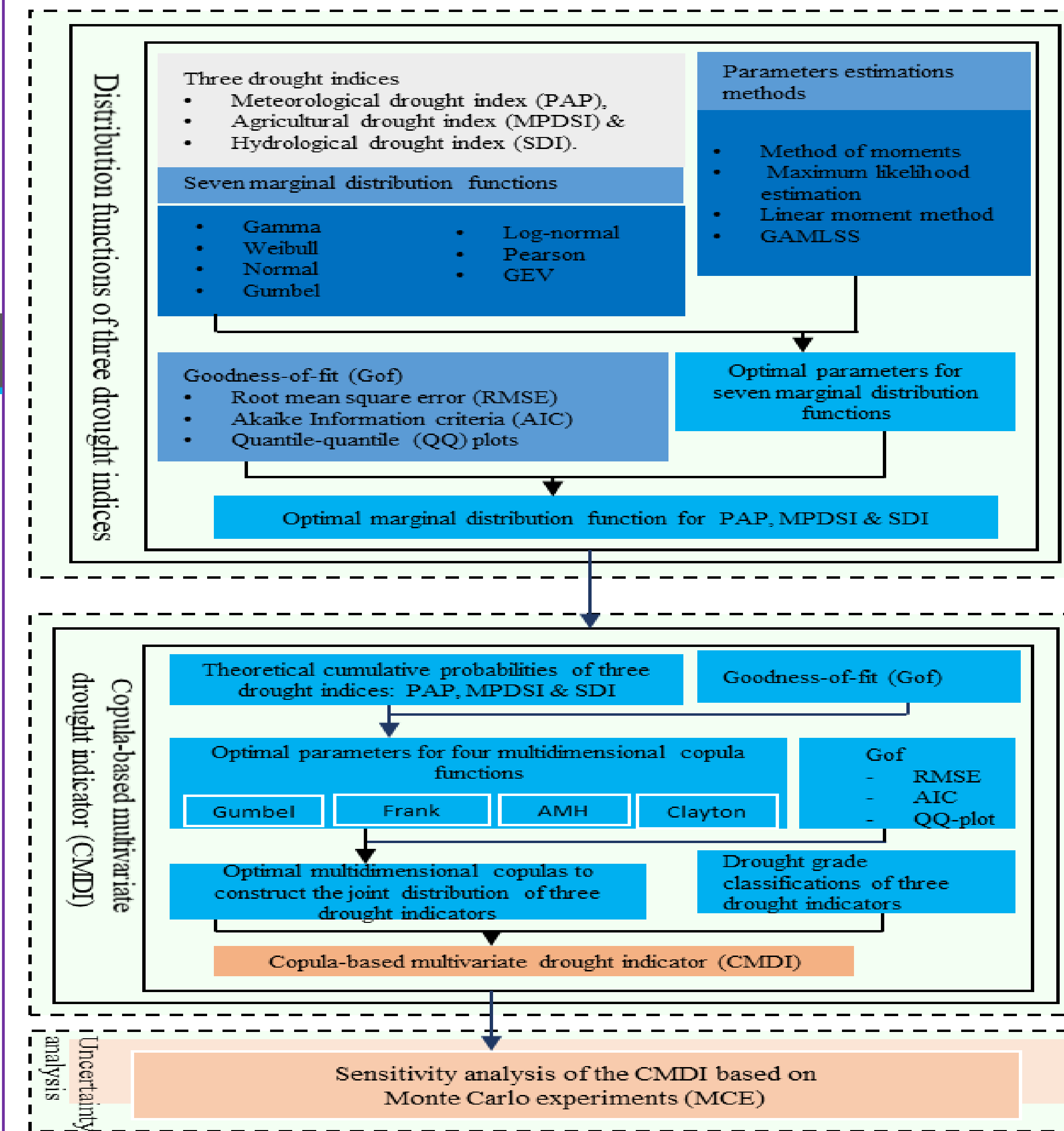
Marginal distribution to calculated PAP, MPDSI and SDI Based on GOF:

- Weibull and Gamma are the most appropriate marginal distribution function to fit the monthly PAP.
- The Weibull and lognormal marginal distribution functions are optimal for the monthly SDI and MPDSI values, respectively.
- Weibull, Lognormal, and Pearson fit the monthly PAP, SDI, and MPDSI values in the Po Valley River Basin best.
- Gamma, Gumbel, and Weibull fit the monthly PAP, SDI, and MPDSI values in the Spercheios River Basins best.

Objective

- The aim of this paper is to develop reliable designing, monitoring and prediction indicators for the proper assessment and intervention of drought risk by nature-based solutions (NBS).
- A copula-based multivariate drought indicator (CMDI) was constructed by combining meteorological, agricultural and hydrological variables.

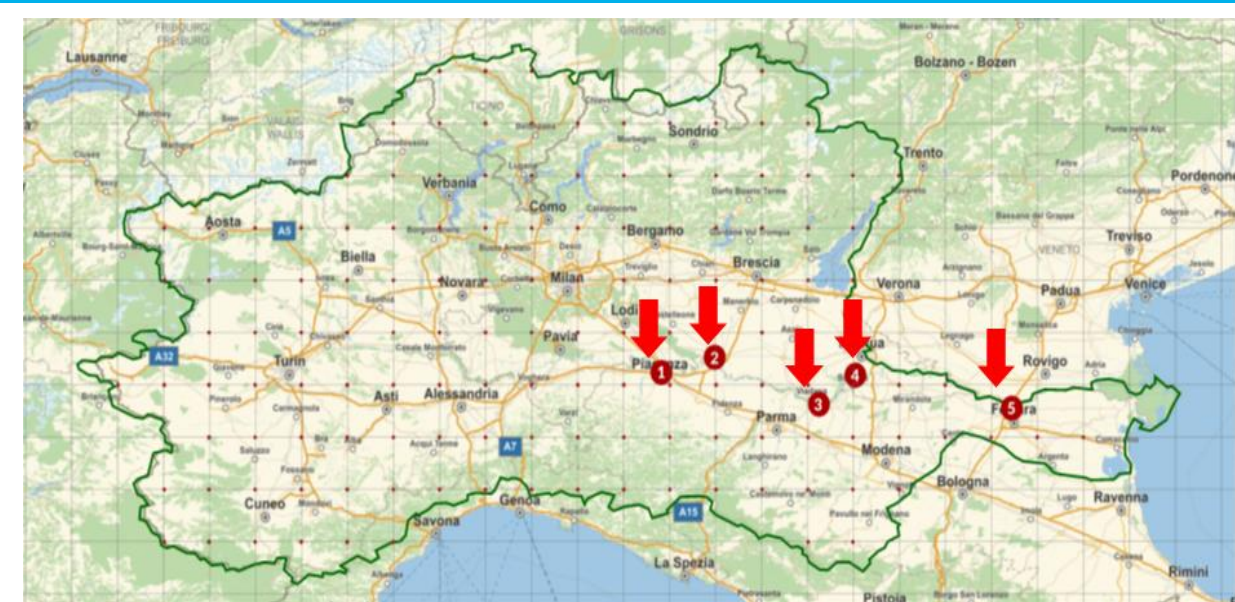
Methodology



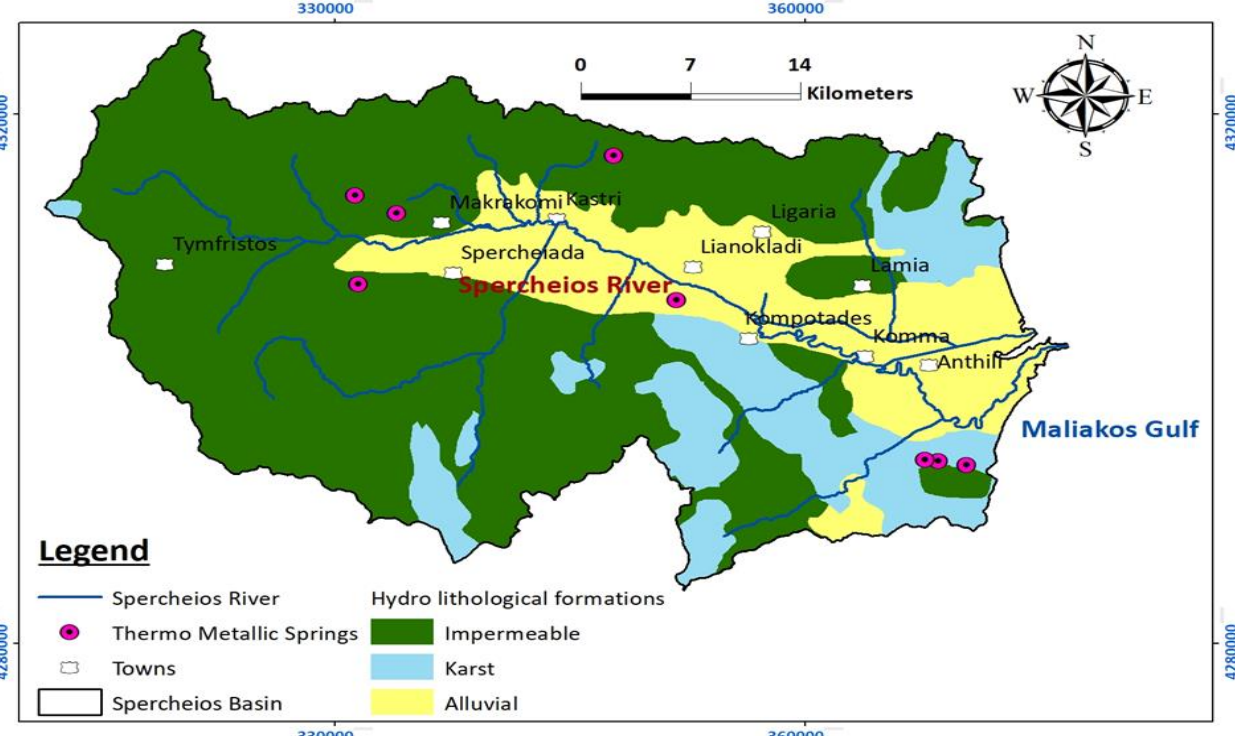
Construction of the nonlinear multivariate drought index Based on GOF:

- Gumbel, Frank and Clayton copula functions are the best to construct the CMDI in the Po Valley River Basin.
- Frank, AMH and Clayton copula functions are the best to construct the CMDI in the Spercheios River Basins.

Study area



Hydrological stations in the Po Valley Basin, Italy



Hydrological stations Spercheios River Basin, Greece

Summary & Conclusions

- CMDI showed moderate, severe and extreme drought frequencies in the two selected catchments.
- CMDI captured more severe to extreme drought occurrence than the considered single drought indicators.
- The analysis of CMDI appropriately represent the complex and interrelated natural variables.
- Monte Carlo experiments confirmed that CMDI is a more robust and reliable approach for assessing, planning and designing a nature-based intervention for drought risk.
- Overall this paper can provide a reliable way to develop indicators to design NBS for any non-linearly related HMHs.

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