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# Applications of the information entropy to quantify non-linear relationship between the precipitation in the Danube basin and the climate indices

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In this study, nonlinear connections between large scale atmospheric circulation patterns described by climate indices (North Atlantic Oscillation Index, NAOI; Greenland-Balkan Oscillating Index, GBOI; East Atlantic, EA; East Atlantic/Western Russia, EAWRUS; Arctic Oscillation, AO; Atlantic Multidecadal Oscillation, AMO; Scandinavian Pattern, SP; Southern Oscillation, SO) and the precipitation in the Danube basin, were tested based on the mutual information (MI). The results obtained by MI were compared with the Pearson correlation as a linear association metric. The analysis was separately performed for each season.
During the spring season, the both linear and nonlinear relationships between precipitation and climate indices had a low confidence level (CL), except for the GBOI for which the link is significant, but the non-linear relation is not statistically higher than the linear one.
For the summer, the GBOI, AO, EA and NAOI present a stronger significant non-linear connection with precipitation, while in case of the GBOI the linear relation is also significant.
In autumn, the AO, EAWRUS and GBOI have significant connections with the precipitation, but the non-linear measure is close to the linear one.
During the winter, the AO, EAWRUS and GBOI show significant connections (CL> 99%) with the precipitation, both for the nonlinear and linear measures. The NAOI has only a significant linear link with precipitation.
For the other climate indices considered in this study, namely the AMO, SP and SO, no statistically significant relationship with the precipitation in the Danube basin was obtained.
The degree of non-linearity of the connection between the Danube basin precipitation and the climate indices, depends on the season and on the intrinsic characteristics of the circulation patterns. The results of this study revealed that, to better describe the relationship between hydroclimatic phenomena, the nonlinear approaches are required.