

EGU2020-7319

<https://doi.org/10.5194/egusphere-egu2020-7319>

EGU General Assembly 2020

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Mutual information applications to estimate the solar/geomagnetic signatures in the drought indices in the Danube basin

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The climatic condition for the dry or wet situations from 15 meteorological stations in the Danube basin has been evaluated using four indices: Palmer Drought Severity Index (PDSI), Palmer Hydrological Drought Index (PHDI), Weighted PDSI (WPLM) and Palmer Z-index (ZIND).

The overall temporal characteristic of the four indices has been analysed by means of the principal component of the Multivariate Empirical Orthogonal Functions decomposition (PC1-MEOF). Also, a simple drought index (TPPI) calculated as the difference between PC1 of the standardized temperature and precipitation, was considered.

To find the simultaneous influence of both solar and geomagnetic activities on drought indices in the Danube basin, the difference between synergistic and redundant components for each season was estimated, using the mutual information between the analyzed variables. The greater this difference is, the greater the simultaneous signature of the two variables in the drought indices is more significant, than by taking each of the two variables separately.

The solar activity was highlighted by Wolf numbers for the period 1901-2000 and for 1948-2000 by solar radio flux. For both periods the geomagnetic activity was quantified by the aa index.

The most significant results for the 100-year period were obtained for the autumn season for which the two predictors representing solar and geomagnetic activities, if considered simultaneously could be one of the causes that produce extreme hydroclimatic events. The analysis from 1948-2000 revealed that the simultaneous consideration of the two external factors is more significant in the summer and autumn time.