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Trends and variability of joint distribution extreme climate indices over Thessaly plain, Greece

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The objective of this study is to assess and analyze the trends and variability of joint distribution extreme climate indices over Thessaly plain, Greece. Taking into consideration that the surface temperature is projected to rise over the 21st century and the mean precipitation will likely to decrease in mid-latitude dry regions according to IPCC 2014, we confronted the challenge to study the joint distributions of the two meteorological variables over Thessaly plain because they reflect weather conditions better than temperature or precipitation statistics taken separately.

Thessaly is the most intensely cultivated and productive agricultural plain region in Greece. Thessaly's total area is about 14,036 km2, which represents almost 11% of the Greek territory. Regarding the geomorphology, the ground is 50% mountainous-hilly and 50% flat, irrigated by Peneus, the third largest river in the country, which flows through the axis east-west. The elevation ranges from 0 m to 2800 m, with mean elevation being about 500 m.

The four combined extreme climate indices, based on air temperature and precipitation, concern Cool/Dry days (CD), Cool/Wet days (CW), Warm/Dry days (WD) and Warm/Wet days (WW), defined by the exceedances of the joint quartiles of temperature and precipitation using the 25th and 75th percentile levels in order to capture a larger number of events. More specifically, the CD index is defined as the number of days with the daily mean air temperature (TG) below the 25th percentile of the daily mean temperature (TG25) and simultaneously the daily precipitation (RR) below the 25th percentile of the daily precipitation amount (RR25). Accordingly the other indices are defined; namely, CW index (TG<TG25 and RR>RR75), WD index (TG>TG75 and RR<RR25) and WW index (TG>TG75 and RR>RR75). The daily meteorological datasets used in this study concern the high resolution gridded daily mean temperature and precipitation datasets (0.25o x 0.25o), based on the E-OBS project.

The findings revealed significant spatial and temporal patterns of the examined joint distribution variables over Thessaly plain, during the examined period (1950-2010). It is worth noting that even in a small spatial scale with complex topography and land sea interaction, local factors and mechanisms combined with the observed climate change contribute in the configuration of the spatiotemporal variability of the combined extreme climate indices. This kind of analysis could help more stake holders to take action towards mitigation of the impacts of extreme weather conditions.

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