



Spatial and temporal variability of the thermal stress index in Romania

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Changes in the frequency and intensity of extreme climate events because of anthropogenic induced climate change have been documented in many scientific papers. The climate extremes usually analysed until now are those related to heavy precipitation, droughts, high temperatures expressed by various indices. It is known that, especially during summer, extreme weather conditions, when high temperatures are associated to high relative humidity, contribute to a high human discomfort. The index linking the two climate variables (air temperature and relative humidity) is commonly called "thermal stress index, temperature-humidity" (ITU), which has been less analysed, at least for Romania. ITU index is defined by the relationship $ITU = (TA * 1.8 + 32) - (0.55 - 0.55 * UM / 100) * [(TA * 1.8 + 32) - 58]$, where TA is air temperature and UM is relative humidity.

This study presents the characteristics of spatial and temporal variability of monthly/seasonal ITU values over the period 1961-2010. The monthly averages for May-September and summer averages (June-August) for 60 stations with complete observations, were considered. The statistical significance of linear trends and shifts in the mean (given by the Mann Kendall and Pettitt tests, respectively) as well as spatial mode of variability (using EOF analysis) are performed. The summer frequency of ITU values exceeding 80 units (threshold considered to be responsible for high impact on human health) has been also analysed using the same statistical techniques.

The results reveal statistically significant increasing trends (5% level) for the monthly ITU averages for May to August over the entire country and slightly decreasing for September (not statistically significant). The highest trends were identified for July (3.12 units/50 years) and August (3.25 units/50 years). An increasing trend was also identified for the summer frequency of ITU values exceeding 80 units with highest values over the extra-Carpathian regions, reaching 16-25 days/50 years in the South of Romania (Danube Plain). A strong increase shift was identified around 1987 year, which is in agreement with the shift in the extreme temperature indices in Romania (presented in other study). The trends in relative humidity will be also explored.

The EOF analysis reveals that EOF1 pattern, showing same sign over the entire country, explains 89% from the total observed variance. This result shows that a large-scale mechanism is responsible for the summer ITU variability. The correlation between the time series associated to EOF1 (PC1) of the summer ITU and PC1 of the T850 (large-scale temperature at 850 hPa) was performed, showing a significant strong correlation, as found for the extreme temperatures. This result shows a possible physical explanation of the ITU increasing trend. Other predictors will be also explored.

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