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Objective local weather types with applications in climate change detection and impact studies

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Objective classification of daily weather is performed for 9 stations of Poland and vs. 5 of Hungary based on 30 years periods (1966-1995 and 1961-1990, respectively). Initially, eight weather elements were pre-selected, and reduced to four, by Factor Analysis based on strong correlation between the elements. They are the mean temperature, relative humidity, cloudiness and wind speed. The omitted elements are diurnal temperature amplitude, water vapour pressure, (logarithm of) precipitation and sunshine duration. The redundant elements are further used for validation of the classification efficiency. Next, hierarchical cluster analysis is performed, having tested various other approaches, leading to six classes as most frequent optimum in the 12 months and 14 stations of analysis. Finally, the types have been re-defined by the method of K-means clustering with fairly differing 6 types in the Hungarian stations and in southern Poland and 8 types for the majority of Poland. The monthly cluster means are arranged according to cloudiness which exhibits the strongest difference between the classes. The obtained local classifications are compared to the macro-circulation types, based on variance "explaining" capacity concerning the above four basic and four independent variables. In overwhelming majority of the 12 months and 13 stations and 8 variables, the obtained local types reduce the variances more effectively than the compared Péczely (1957) types for Hungary, the Litynsky (1969) for Hungary and the amalgamated Hess-Brezowsky (1969) types (Mika et al., 1999, based on objective classification of average sea-level pressure maps derived by Bartholy and Kaba, 1990) for both countries. The 30 years series are further extended until 2010 based the same distance functions as in the K-means clustering. These local types are important tools in understanding the role of weather in the environmental indicators, by climatic generalisation of short samples by stratified sampling and in detection of climate change in terms of weather. Examples of both aspects will be presented in the study. I.e. frequency variations of the individual types are analysed and efficiency of the local types are also verified against various human mortality data, as well, as air pollution indicators. The study has been supported by the TÉT 10-1-2011-0037 Polish-Hungarian bi-lateral project.
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