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Climate types in Slovenia, based on climate normals, trends and variability

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The motivation for the study came from the need to determine reference climate stations in Slovenia that would well describe changes of meteorological variables due to climate change and be representative for the present climate of wider area. Long-term mean monthly values, long-term trends and inter-annual variability of monthly values were the key variables considered in the study. Such regionalization should optimally describe climate and climate change characteristics since 1961. Although the primary purpose of the study was to determine representative climate stations, the regionalization has given an important insight into the spatial climate variability of the region as well.
Gridded climatology of Slovenia (period 1981–2010) was used for the regionalization. Using gridded values of homogenized time series for key climate variables (air temperature, precipitation and snow cover) in the regular kilometre grid, covering the entire territory of Slovenia, gridded trends and interquartile ranges of the same key variables over the period 1961-2011 enabled us to construct climate regionalization with statistical approach. The annual cycle of all variables is described by mean monthly or seasonal values.
Regionalization was performed combining two statistical methods. Number of input variables was reduced using factor analysis, then k-means clustering methodology was used to define regions. Despite the fact, that the regions and the boundaries between them were determined using statistical methods it is important to notice that the approach could not be entirely objective, but partly based on a good knowledge of climate characteristics in the Slovenian region.
At first regionalisation was performed separately for climate normals, temporal trends and inter-annual variability. Spatial variability of climate normals, trends and inter-annual variability does not show direct connection to each other, but all of them are very important for climate regionalization as each provides us with a unique climate information. The difference in spatial pattern of all individual aspect of climate (normals, trend and variability) indicated the need to include them all in regionalisation. Due to very high number of key variables and their low cross-correlation even with factor analysis the data structure could not be simplified to a degree to get stable solutions in clustering procedure. For regionalisation in 4 to 6 clasess there were 2 to 5 different solutions for each of them and their spatial pattern differed to a high degree. The analysis showed that stable classification is possible in case it is simplified into 3 classes or very fragmented into high number of classes (more than 9), even that some statistical criteria (elbow method) didn't directly suggest those to be the optimal solution.