

The relationships between atmospheric circulation and surface climatic elements in Europe

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Abstract

The variability of atmospheric circulation is the most important factor determining the changes in surface climatic elements. In this work, the relationship between atmospheric circulation and surface climatic elements like the temperature and the precipitation amounts and occurrence over the European region and some other climatic elements in central Europe is focused. The atmospheric circulation during the year is represented by modes of low-frequency circulation variability in sea level pressure (SLP) and 500-hPa heights (Z500) obtained by using statistical method “Principal component analysis”. The Pearson correlation coefficient is used to describe the relationship between modes and climatic elements.

Four circulation patterns in Z500 over Euro-Atlantic sector influence climate in Europe all over the year: the North Atlantic Oscillation (NAO) pattern, the East Atlantic (EA) pattern, and two Eurasian patterns (EU1, EU2). There were found patterns in SLP that strongly correlate with modes of the Z500 and influence surface climate similar way. Statistically important correlations of modes in Z500 and SLP with maximum, minimum and mean temperature, precipitation amounts and occurrence of precipitation at European stations were identified in all seasons. In addition, several modes have strong influence on duration of sunshine, relative humidity, cloud cover, wind speed and direction in central Europe. The sign and magnitude of correlations can be explained through synoptic structures of modes, the shape and the magnitude of their cells.

The comparison of six different NAO index definitions including scores of modes from PCA is the aim of the second part of this study. The correlations with surface climate elements at European stations were used to illustrate the influence of individual NAO indices. Although all NAO indices mutually strongly correlate and seem to represent atmospheric circulation the similar way, it is clear, that in summer only indices based on scores of NAO modes can do that the right way.