Synoptic Classification Models of Precipitation in the Coastel Areas of the Caspian Sea

Omosalameh Babaee *
Assistant Prof., Dep. of Geography, Payame Noor University
Ebrahim Fattahi
Associate Prof., Atmospheric Science and Meteorological Research Center (ASMERC)

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Extended Abstract

Introduction

Atmospheric circulation patterns play the main role in the natural phenomenon occurring on the earth, especially in temperate regions. Some atmospheric circulation patterns cause wet periods and others cause low water and dried periods. Thus, because the annual occurrence of drought and wet events result from the general circulation of the atmosphere, recognizing atmospheric circulation patterns are explained, to some extent, for the possibility of evaluating these phenomena before occurance. Studies show that the floods and droughts phenomenan are influenced by atmospheric circulation patterns. Given the close relationship between the patterns and climatic elements, we can also attribute the extreme climatic events, such as floods and droughts, and dried and wet periods, to changes in atmospheric circulation patterns. In this study, from average daily data balance of 500 and the sea level pressure over the period 1960 to 2008 at two degrees intersection of the reconstructed data setshave been used. The selected range covers all systems affecting the area under study during the year. This range consists of 408 cells from 20 to 60 degrees in north latitude and 10 to 70 degrees in east longitude. Total daily rainfall data from selected synoptic stations over the statistical period 1960-2008 were used to assess the role of the patterns in rainfall. Many climate scientists dealing with variables with different scale or large volumes of data employ reduction variable and data strategy by principal component analysis (PCA), (Gadyial, S. and R. N. Lyengar 1980, Kalkstein. S. *et al*. 1998).

∗E-mail: F_babaee@pnu.ac.ir Tel: +98 9123180576

Methodology

Factor analysis is a statistical technique that establishs a especial relationship among a large number of variables that are seemingly unrelated. It is under a hypothetical model and gathers all the variables in the similar groups. This method retains significant and main components in the same groups and reduce the variables. One of the results of factor analysis is to reduce data dimension. Computational steps of the main component analysis is as follows:

a) The data and variables Selection. b) The second stage of a data matrix p × n formation where n is the number of days and p is the number of variables. In the third stage since the selected meteorological variables of the unit are different (For example, C, hPa, meters per second, and so on), a correlation matrix was used as input for the main component analysis. Data correlation matrix are calculated according to the following formula. The fourth step is used to determine the number of factors by Catel test. Loadings matrix was calculated in the fifth stage. Loadings show the relationship between the factors and the primary variables.

The relationship between atmospheric circulation patterns and rainfall

To evaluate the relationship between atmospheric circulation patterns and rainfall, the following index is applied. This index defines the conditional probability of rainfall occurnece and rainfall intensity in a circulation pattern. The index defines a measure of the relative share of the pattern rainfall in total. Where ni is the number of days with i patterns and Ri is the total rainfall during that days and n is the number of days in the period of the study. If PI<1.

Or even much smaller than the unit, the weather or type pattern i does not greatly affect the area rainfall. Thus, an increase in the frequency of occurrence of such a pattern, reduces rainfall and subsequently, causes drought in a region. If the PI in the statistical method is greater than the unit, then chance of rain (probability of precipitation) also increase and wet periods will be prevailed. For example, precipitation takes place when weather is wet and there is an acsending factor, these conditions are provided by atmospheric circulation patterns.

Results and Discussion

In this study, using PCA and clustering, eighteen circulation patterns according to the sea level pressure and 500 hPa level atmospheric condition have been identified over the study area. The results of this study show that there are significant differences in the arrangement of patterns, the weather type frequency and the way they move towards the study region. The PI index is a appropriate criterion to evaluate the Conditional probability of rainfall and rainfall intensity. If the PI index calculated for a wheather type much smaller than unit, wheather type does not play a role in precipitation of that station or region. Therefore, an increase in the frequency of occurrence of such a pattern in a period reduces rainfall and makes the drought events in that region.

Conclusion

Due to the PI index and the annual frequency distribution of atmospheric circulation patterns, the results can be summarized as follows. Atmospheric circulation patterns of CP1, CP4, CP5,

CP12, and CP15 are part of the patterns leading to heavy and pervasive precipitation. Atmospheric circulation patterns of CP7, CP13, CP16, CP17, and CP18 are part of the patterns leading to moderate precipitation. Atmospheric circulation patterns of CP2, CP8, CP9, CP10, and CP11 are part of the patterns leading to drought, Atmospheric circulation patterns of CP3, CP6, and CP14 are part of the patterns leading to drought. In terms of the annual frequency distribution, atmospheric circulation patterns of CP3, CP5, CP13, and CP15 are active in all seasons of the year, atmospheric circulation patterns of CP2, CP6, and CP10 are active in summer, atmospheric circulation patterns of CP1, CP8, CP9, CP11, CP12, CP14, CP16, CP17, and CP18 in winter, spring and fall and atmospheric circulation patterns of CP7 is active in the spring and fall.

Keywords: ***Atmospheric Circulation Patterns, Clustering, North Caspian Sea, PI Index, Principal Component Analysis.***