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Investigation of homogeneity test of annual total precipitation of Konya Closed Basin with standard normal homogeneity test

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Abstract
In this study, the homogeneity of the total precipitation data of 11 Meteorology observation stations located in the Konya Closed Basin was examined using Standard Normal Homogeneity Test (SNHT). The data used in the study are between 1972 and 2020. The analyzes were performed using the XLSTAT software at the 95 percent confidence interval and the results were mapped using the Inverse Distance Weighting (IDW) method. When the results were examined, it was determined that the data were homogeneous in only 1 of the 11 stations in the region (Niğde station). This result showed that the data in many stations in the study area did not come from the same cluster and the data may show an increasing or decreasing trend over time. The IDW map provides information about the spatial distribution of the results. When the IDW interpolation map of the results was examined, it was determined that the Niğde station located in the east of the study area was homogeneous, the stations in the other regions were not homogeneous and the SNHT p values were higher in the middle inner parts of the study area.

Introduction

In recent years, the demand for water has been steadily increasing. On the other hand, the limited water resources have revealed the need to use the existing resources at optimum levels to meet the needs [1]. For this reason, it is an important issue to make analyses that will ensure the effective use of water in water resource planning and projecting. The most important of these analyses is the trend analyses used to predict the future behavior of precipitation based on its past behavior. Trend analyses for precipitation are of great importance in terms of flood and drought studies as well as in terms of water supply [2]. The reliability of trend analysis is provided by homogeneity analysis. The fact that the data show a homogeneous distribution and come from the same population, in other words, the separation from the anthropogenic effects makes trend analyses more powerful.

In this study, the homogeneity of the annual total precipitation data recorded between 1972 and 2020 of 11 meteorological observation stations located on the borders of the Konya Closed Basin were examined. The most preferred Standard Normal Homogeneity Test (SNHT) method was used in the literature and the analyses were performed using the P test at 95% of confidence interval. In the implementation of the method, the XLSTAT program was used. In the end, the result map was made with the Inverse Distance Weighting (IDW) method.

Material and Method

Within the scope of the study, SNHT was applied to the annual total precipitation data of 11 meteorological observation stations located in the Konya closed basin. The obtained results were mapped by IDW method.

Standard Normal Homogeneity Test (SNHT)

This method developed by Alexandersson is used to test the homogeneity of many hydro-meteorological parameters [3].

Inverse Distance Weighting (IDW)

The IDW method was used to obtain the interpolation maps of the homogeneity test results. IDW is an interpolation method used to estimate the values of points or regions that cannot be sampled with sampling points [4].

Study Area

Konya Closed Basin, which is located in Central Anatolia in Turkey and covers a large part of Konya's territory, is one of the most important basins of the country in terms of agriculture. Semi-arid continental climatic conditions prevail in the basin. It is located between latitudes 36°51'N and 39°29'N and longitudes 31°36'E and 34°52'E. As a location, it is located between latitudes 36°51'N and 39°29'N. And longitudes 31°36'E [5]. The study area is shown in Figure 1.
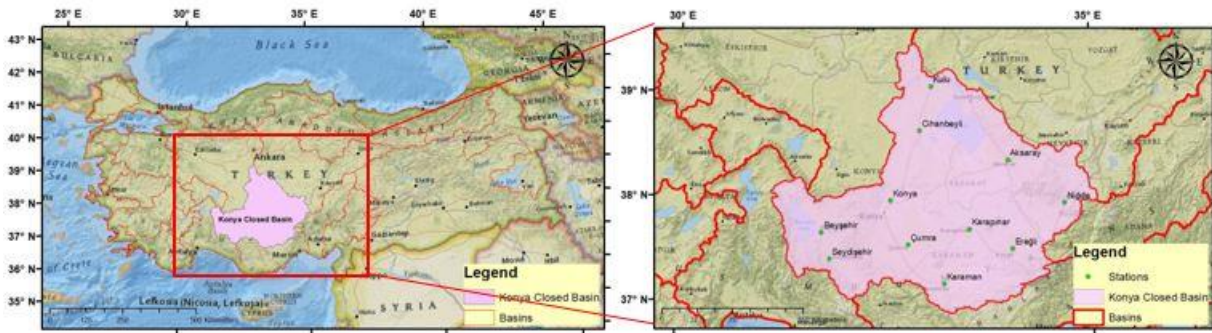

**Figure 1.** Konya Closed Basin and stations

Results

The homogeneity of the data was analyzed by obtaining XLSTAT software, selecting SNHT from the analysis section on this software, and using the total precipitation data of all stations. All data in the analyzes were continuous and analyzes were performed at 95% of the confidence interval. The results of the analyzes are given in Table 1. The IDW map of the analysis results is shown in Figure 2.

Table 1. SNHT p values and hypothesis states

Station Name	Period	SNHT (P value)	Hypothesis
Aksaray		0.417	Ha
Beyşehir		0.072	Ha
Cihanbeyli		0.427	Ha
Çumra		0.843	Ha
Ereğli		0.421	Ha
Karaman	(1972-2020)	0.603	Ha
Karapınar		0.304	Ha
Konya		0.63	Ha
Kulu		0.158	Ha
Niğde		0.026	H_0
Seydişehir		0.111	Ha

Figure 2. IDW map of analysis results
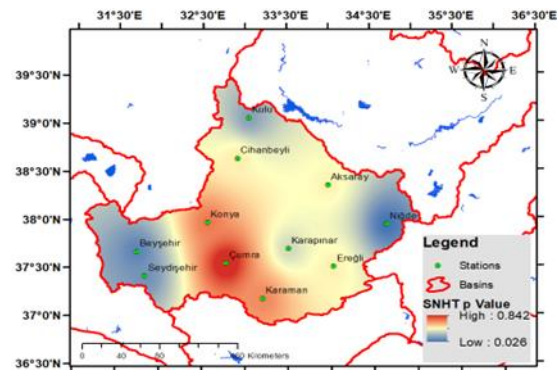
In Table 1, the p-values and hypothesis states of the SNHT were compared according to the critical value of 0.05 at 95% of the confidence interval. Stations that exceed this value are inhomogeneous stations, while stations below this value are homogeneous stations. In Figure 2, IDW map of the results is examined, the only homogeneous station in the east of the study area is Niğde. When the distribution of the p values of the test in the region was examined, the p values were close to the critical value at the Seydişehir, Beyşehir (west of the study area) and Kulu stations (north of the study area) after the Niğde station, while the highest p values were obtained at the Çumra station (in the middle of the study area).

Discussion

In their study, Zeybekoğlu and Keskin used the homogeneity control of the annual maximum precipitation data for Turkey using the homogeneity analyzes Pettit, Buishand, Von Neumann and SNHT tests. In the study, the reliability of 103 stations was analyzed [6]. Arıkan and Kahya analyzed precipitation data in Turkey with SNHT and other Homogeneity tests. As a result of their studies, it was observed that there was no homogeneity in 3% of the stations evaluated [2]. It was observed that there was no homogeneity in the Niğde station in the study and it was compatible with the findings of our study. Demir investigated the trend of changes in water level, precipitation, temperature, evaporation and groundwater trends in lakes and sinkholes located in Konya Closed Basin. As a result of the study, the trend of precipitation and other parameters was indicated [7].

Conclusion

Investigating the precipitation change in a region is important for the management of water resources. When examining the precipitation change, trend analysis of the data is usually made in the time series. Homogeneity tests are applied as the reliability and support of these analyzes. In this study, the homogeneity test, which is the preliminary stage of the trend analysis study planned to be carried out in the future, was carried out by using the annual total precipitation data in the Konya closed basin. In the study, the method was carried out using the XLSTAT software and the homogeneity of the stations was determined by the critical p test at 95 percent of the confidence interval. At the end of the study, it was determined that the data was homogeneous in only 1 station (Niğde) out of 11 stations with a data length of more than 30 years in the region. The results were also mapped with the IDW method, and it was determined that the p values were lower in the northern and western parts of the region.

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