



Investigation of precipitation and temperature changes in Turkey in the last climate period

Taha Demirgöl¹, Cavit Berkay Yılmaz², Büşra Nur Zıpır³, Fatma Sena Horzum⁴, Muhammet Fatih Pehriz⁵, Vahdettin Demir⁶, Mehmet Faik Sevimli⁷

¹KTO Karatay University, Faculty of Engineering and Natural Sciences, Civil Engineering Department, Konya, Turkey, demirgultaha@gmail.com; cavitberkayilmaz@gmail.com; busranurzpr@gmail.com; senahorzum987@gmail.com; m.f.pehriz@gmail.com; vahdettin.demir@karatay.edu.tr; mehmet.faik.sevimli@karatay.edu.tr

Cite this study: Demirgöl, T., Yılmaz, C. B., Zıpır, B. N., Horzum, F. S., Pehriz, M. F., Demir, V., Sevimli, M. F. (2022). Investigation of precipitation and temperature changes in Turkey in the last climate period. 2nd Advanced Engineering Days, 69-71

Keywords

Precipitation
Temperature
Turkey
Climate period
Change

Abstract

Time-dependent changes in temperature and precipitation parameters can cause natural events such as drought and flood to turn into natural disasters, which can adversely affect living life and the economy. The aim of this study is to examine the changes in precipitation and temperature of Turkey between the last climate period (1991-2020) and the previous climate period (1981-2010). The precipitation and temperature data used in the study are long-term average data obtained from monthly average data. In the study, the changes in temperature and precipitation were examined in 81 province stations. In addition, interpolation maps were created for the variation of temperatures and precipitation according to location. When the old (574 mm) and new (573.4 mm) precipitation normals are examined throughout the country, it has been determined that there is a decrease of 0.6 mm. On a provincial basis, the highest decrease (586.4 mm-511.1 m) was determined in Erzurum with 75.3 mm (12.84%). The highest increase (1407.5 mm-1602.2 mm) was found in Rize with an increase of 194.7 mm (13.83%). It is observed that the annual average temperature normals tend to increase in all regions of our country. The highest temperature increase (3.6°C-4.3°C) was seen in Ardahan with an increase of 0.7 °C (19.44%). The only province with a decrease in temperature compared to the old normal (9.6°C-9.4°C) is Bitlis with a decrease of 0.2 °C (2.08%).

Introduction

Time-dependent changes in temperature and precipitation parameters cause irreversible deterioration in the hydrological balance with events such as drought and flood. These effects harm nature and the economy with the irregularities they create in terms of amount, intensity and time distribution on precipitation and temperature parameters in Turkey, which experiences many climates at the same time due to its geographical location. It is of great importance to examine the limited water resources management policies to be implemented in the future and to make future analyzes on these parameters.

There are many studies on precipitation and temperature parameters in Turkey. Büyükyıldız (2004), in her study on the precipitation data of the Sakarya Basin, reported that the 44 trends he determined were in the negative direction at a rate of 80% [1]. Partal (2003), in his study on precipitation data in Turkey, determined that there is a negative trend in the whole country [2]. Özfidaner (2007), in his study on precipitation data in Turkey, reported that there is a negative trend in winter and a positive trend in other seasons [3]. Ölgün (2010), concluded that annual precipitation variability in Turkey decreases regularly from south to north [4]. Demir (2018), in his study in the Black Sea region, determined a positive trend in the East and Central Black Sea region, and a negative trend in the West Black Sea region [5]. Yılmaz vd. (2021), determined a positive trend as a result of his study by examining the 57-year temperature and precipitation data of the Eastern Black Sea region [6].

Material and Method

Located between 26°-45° east meridians and 36°-42° north parallels [7], Turkey is among the countries in the risk group in terms of the possible effects of global climate change. As a result of the effects of climate change, drought in some regions and floods in others is very likely.

Material

Long-term monthly average temperature and precipitation data were obtained from the report of the General Directorate of Meteorology on "Temperature and Precipitation Normals for the period of 1991-2020" and dated 25.11.2021. The table containing the statistical information of the old and new normals all the provinces is given below (Table 1).

Table 1. Descriptive Statistical Information on Old and New Precipitation and Temperature Normals

	Old precipitation normals (1981-2010)		New precipitation normals (1991-2020)	
	Precipitation (mm)	Temperature (°C)	Precipitation (mm)	Temperature (°C)
Mean	618.97	13.09	619.08	13.55
Maximum	1407.5	19.5	1602.2	20.2
Minimum	352.3	3.6	349.2	4.3

In Table 1. the average of the precipitation normals for the provinces increased from 618.97 mm to 619.08 mm. Temperature normals increased from 13.09°C to 13.55°C.

Inverse Distance Weighting (IDW) Method

The Inverse Distance Weighting (IDW) is an interpolation method used to create data from the data that cannot be sampled by the exemplary points, wherein the creation of these data depends on the interpositional distance and formula applied by considering relations with various points [8].

$$f(x, y) = \sum_{i=1}^n w_i f_i \quad (1)$$

$$w_i = \frac{h_i^{-p}}{\sum_{j=1}^n h_j^{-p}} \quad (2)$$

In Equations 1 and 2;

p; is taken as a power parameter and denoted by exponent,

h_i; represents the spatial distance between the sample points and the interpolation points,

w_i; represents the weights and the sum of their values must Equation 1,

f_i; represents the known height value [9-10].

Application

Determination of precipitation and temperature normals and analysis of changes are of great importance for Turkey, which is highly sensitive to the danger of drought [11]. These analyzes play a key role in the studies to be carried out in terms of water management. In this study, the data of precipitation and temperature normals of 81 provinces were visualized using the IDW interpolation method.

IDW interpolation maps of old and new precipitation and temperature normals are shown in Figures 1, 2, 3 and 4.

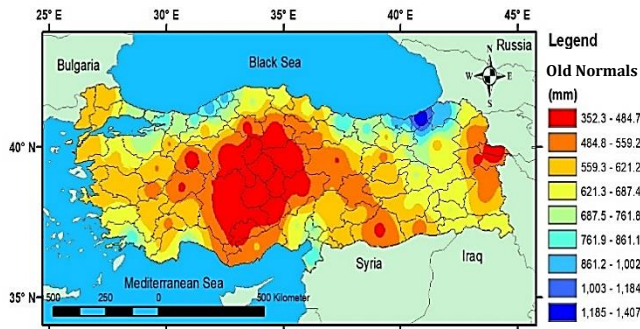


Figure 1. Old (1981-2010) Precipitation Normals

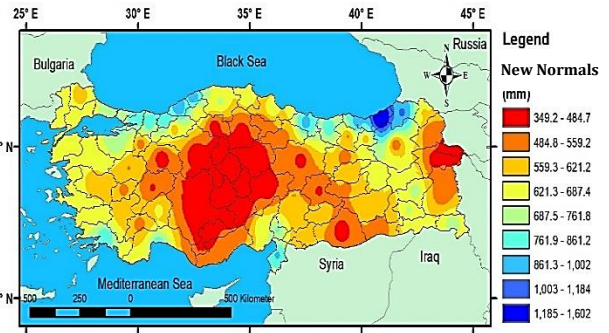


Figure 2. New (1991-2020) Precipitation Normals

When Fig. 1 and Fig. 2 are examined, it is seen that the highest precipitation normal and the highest increase were in Rize with a difference of 194.7 mm and a percentage of 13.83% new normal- old normal/old normal for example $((1602.2\text{mm}-1407.5\text{mm})/1407.5\text{mm})$. On a provincial basis, the highest decrease was seen in Erzurum with a difference of 75.3 mm and a percentage of 12.84%.

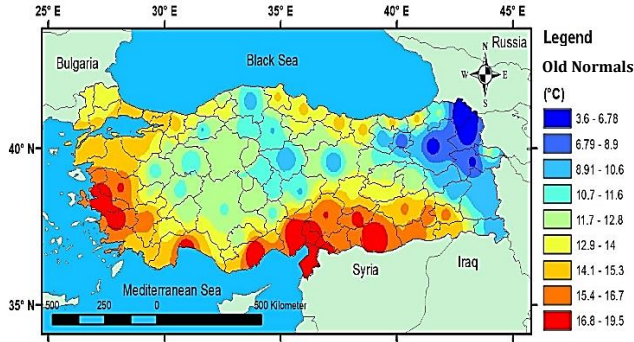


Figure 3. Old (1981-2010) Temperature Normals

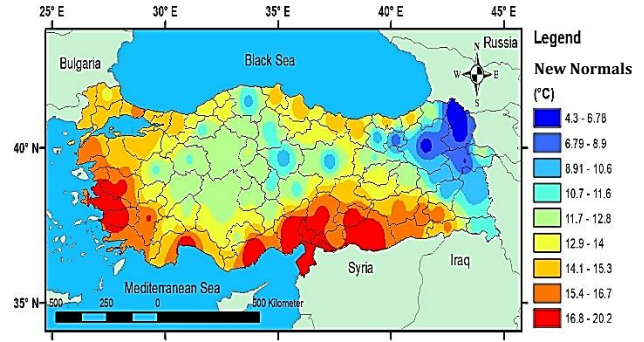


Figure 4. New (1991-2020) Temperature Normals

When Fig. 3 and Fig. 4 are examined, it is seen that there is an increase in temperature in all provinces except Bitlis. The highest increase on a provincial basis was seen in Ardahan with a difference of 0.7 °C and an increase of 19.44% $((4.3^{\circ}\text{C}-3.6^{\circ}\text{C})/3.6^{\circ}\text{C})$. The only province with a temperature decrease was Bitlis with a difference of 0.2 °C and a decrease of 2.08%.

Conclusion and Discussion

The changes in precipitation and temperature of Turkey between the new climatic period (1991-2020) and the old climatic period (1981-2010) were analyzed by mapping with the IDW interpolation method. As a result of the examination, it was determined that the precipitation normal throughout the country decreased (from 574 mm to 573.4 mm) by 0.6 mm (0.1%).

It was observed that annual temperature normals tend to increase (from 13.09°C to 13.55°C) by 0.46°C equal (3.51%) change in all regions of our country.

In the literature, it is stated that a 30-year period is sufficient to comment on the climate situation by examining the precipitation and temperature parameters of a region [12]. However, examining longer periods allows us to make clearer comments.

In this study, Turkey's climate interpretation was made by examining 30 years of precipitation and temperature data of the General Directorate of Meteorology for Turkey.

References

- [1] Büyükyıldız, B. (2004). Sakarya Havzası yağışlarının trend analizi ve stokastik modellenmesi. Doktora tezi. Selçuk Üni. Fen Bilimleri Enstitüsü, Konya.
- [2] Partal, T. (2002). Türkiye yağış verilerinin trend analizi. Yüksek lisans tezi. İstanbul Teknik Üniversitesi
- [3] Özfıdaner, M. (2007). Türkiye yağış verilerinin trend analizi ve nehir akımları üzerine etkisi. Yüksek lisans tezi. Çukurova Üni. Fen Bilimleri Enstitüsü, Adana.
- [4] Ölgen, M. K. (2010). Türkiye'de yıllık ve mevsimsel yağış değişkenliğinin alansal dağılımı. Ege Coğrafya Dergisi, 19/1, 85-95.
- [5] Demir, V. (2018). Karadeniz Bölgesi yağışlarının trend analizi. Yüksek lisans tezi. OnDokuz Mayıs Üni. Fen Bilimleri Enstitüsü. Samsun.
- [6] Yılmaz, C. B., Demir, V., & Sevimli, M. F. (2021). Doğu Karadeniz Bölgesi meteorolojik parametrelerinin trend analizi. Avrupa Bilim ve Teknoloji Dergisi, 24, 489-496.
- [7] Berberoğlu, S., Çilek, A., Dönmez, C., Akif Erdoğan, M., Ersoy, M., Akin, A., & Şatir, O. (2014). İklim değişikliğinin Türkiye'de çevresel risk dağılımına etkisinin konumsal modeller yardımıyla tahmini.
- [8] Taylan, E. D., Damçayırı, D. (2016) Isparta Bölgesi yağış değerlerinin IDW ve kriging enterpolasyon yöntemleri ile tahmini. İMO Teknik Dergi, 7551-7559.
- [9] Krige DG (1951) A statistical approach to some basic mine valuation problems on the witwatersrand. J Chem Metall Min Soc 52(6):119-139
- [10] Shepard D (1968) A two-dimensional interpolation function for irregularly-spaced data. In: Proceedings of the 1968 23rd ACM national conference. ACM'68, pp 517-524. ACM, New York, NY, USA
- [11] Cebeci, İ., Demirkıran, O., Doğan, O., Karagöz, K., Öztürk, Ö., & Elbaşı, F. (2019). Türkiye'nin iller bazında kuraklık değerlendirmesi. Toprak Su Dergisi, 169-176.
- [12] Bayazit M (1981) Statistical Methods in Hydrology. Istanbul Technical University Press,