

Impacts of climate change in the meteorological conditions during the period 2022 in Albania

Anira Gjoni¹, Enkelejda Kucaj¹, Gazmir Cela¹, Azem Bardhi¹, and Marilda Osmani²

¹ Department of Meteorology - Institute of Geo Sciences, Polytechnic University of Tirana, Albania

² Department of Chemistry, Faculty of Natural Sciences, University of Elbasan "Aleksandër Xhuvani", Albania

Abstract. The impacts of climate change on the meteorological conditions in our country, analysing the main climate indicators (temperatures, rainfall for the last year) will be addressed in this paper. In the last years, in our country, rising temperatures and seasonal rainfall anomalies were the two most encountered phenomena. The assessment of the meteorological conditions of each month during the last year and the comparison with the norm has enabled some conclusions to be drawn regarding different indicators of climate and its changes. Some of the results show an increase in the average annual air temperature by about +2.0°C, where in particular the summer season differ by +3.4°C, while precipitation marks a decrease around -13.1%, which is most pronounced in the season of winter by -30.4%. According to data analyses, the number of rainy days decreased by 18.8%. In recent years, due to the reduction in the number of rainy days and a lower cloud, there has been an increase of sunshine by about +5% in the area of Albania. The impact of these climate change indicators has had positive and negative impacts on various branches of the economy, such as energy, agriculture, transport, etc., but the most negative effects of the decrease of the precipitation and the increase of temperatures is related to droughts.

1 Introduction

Climate describes the average weather conditions for a particular place and over a long period of time. We study climate, its variations and extremes, and its impacts on a range of activities, including human health, safety and well-being to support evidence-based decision-making about how to best adapt to a changing climate.

Albania's climate has characteristic Mediterranean features, with mild winters with precipitation and hot, dry summers [1]. In recent years it has been noticed that it has acquired the characteristics of a subtropical climate [2].

Until now, changes in global climate have occurred naturally, over centuries or millennia, due to various atmospheric cycles [3]. Over the past decades, human activity has influenced changes in the atmospheric composition, thus causing global climate change.

The Copernicus Climate Change Service (C3S), implemented by the European Centre for Medium-Range Weather Forecasts (ECMWF) on behalf of the European Commission, releases its 2022 Global Climate Highlights: a summary of the past year's temperatures, greenhouse gas concentrations and significant climate and weather events. The summary shows that several high temperature records were broken both in Europe and across the world, while other extreme events such as drought and flooding affected large regions [4].

Europe saw its hottest summer ever recorded and several prolonged and intense heatwaves affected parts of western and northern Europe. C3S again underlines that

ERA5 concurs with other widely used temperature datasets that European temperatures have increased by more than twice the global average over the past 30 years and has the highest rate of increase of any continent in the world [5].

Long-term climate change is increasing the intensity and frequency of some of these events [6-8] and is causing sea level rise and ocean acidification. Urbanization and the spread of "mega-cities" mean that many of us are exposed to these risks. The world is not yet ready to adapt to these changes in weather and climate.

1.1 The problem and objectives

This paper does not deal with the fundamental causes of drought. Superficially one can say that drought periods are associated with periods of anomalous atmospheric circulation patterns, but the basic question concerning the physical reasons for the circulation anomalies remains.

Droughts are natural phenomena that occur naturally, but climate change has generally accelerated hydrological processes to make them faster and more intense, bringing more consequences, not the least of which is increased risk from forest fires [9, 10].

There are different types of drought that are studied, such as meteorological, agricultural, hydrological and socio-economic droughts; however, the lack of a unanimous definition complicates the study of drought [11, 12]. Drought indices are used as indicators to track and quantify drought; therefore, the correct formulation of

* Corresponding author: gjoni.anira@yahoo.com

robust drought indices is important to investigate drought characteristics under a warming climate.

The objectives of this article are to highlight the assessment of the meteorological conditions of each month during the last year and the comparison with the norm has enabled some conclusions to be drawn regarding different indicators of climate and its changes.

2 Methodology

This article was created based on the analysis of current numerical and satellite climate data obtained by the Institute of Geosciences. Precipitation and air temperature data for 2022 are analysed and compared to the 30-year average, which shows how these to meteorological parameters has changed for the last year in Albania.

Several meteorological measurements have been selected for different climatic zones and subzones of our country, in which the differences for the same periods are evaluated.

Regarding the precipitation, they refer to a large number of meteorological stations which, according to the possibility and capacities of digitalization processing, the control and further verifications has reached up to about 90-100 meteorological stations every month, while the temperature has been processed from 20 to 40 meteorological stations. As for solar radiation, it is based on satellite products on a continental and regional scale. Of course, a larger number of surveys would make the achievements found more accurate and could help in a more complete panorama of the spatial distribution within the site of the observed changes.

In addition to this, a review of the literature related to climate change and negative effects of the decrease of the precipitation and the increase of temperatures is related to droughts.

3 Analysis of meteorological data in Albania

3.1 Air temperatures over the territory of the country during 2022

In order to analyse the maximum and minimum air temperatures, we have taken in consideration 40 meteorological stations distributed in the territory of our country, every month. Analysing the data shows that during 2022, the average maximum temperatures in our country increased by +3.1°C above the long-term average (1961-1990 rates). Figure 1 presents the data of the average maximum air temperature, selected for several meteorological measuring sites for different climatic zones and sub-zones of our country.

Table 1 Average maximum air temperature (°C).

Average maximum temperature (°C)		
No.	Months	Anomalies
1	January	+1.8
2	February	+3.2

3	March	+0.2
4	April	+1.8
5	May	+4.0
6	June	+5.2
7	July	+4.4
8	August	+3.7
9	September	+1.5
10	October	+3.5
11	November	+3.5
12	December	+4.6
Yearly		+3.1



Fig. 1 Average maximum air temperature.

For the same meteorological stations, an assessment was also made of the average values of the minimum air temperatures, which marked an increase/decrease of +1.0°C, over the multi-year average value (1961 - 1990 rate). Table 2 presents the data of the average minimum air temperature, selected for several meteorological measuring sites for different climatic zones and sub-zones of our country.

Table 2. Average minimum air temperature (°C).

Average minimum temperature (°C)		
No.	Months	Anomalies
1	January	-0.9
2	February	+0.5
3	March	-2.2
4	April	-0.2
5	May	+1.1
6	June	+3.0
7	July	+2.8
8	August	+1.4
9	September	+0.4
10	October	+0.5
11	November	+1.7
12	December	+3.4
Yearly		+1.0

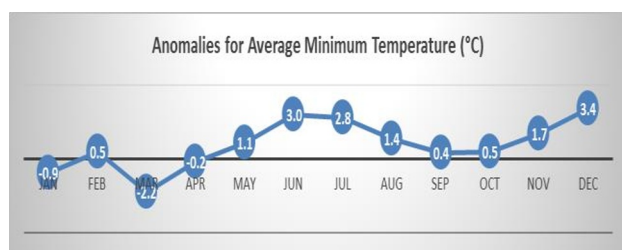


Fig. 2 Average minimum air temperature (°C).

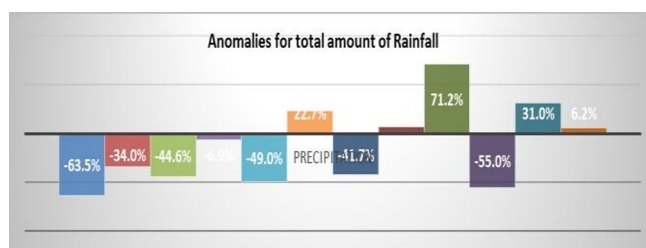


Fig. 3 Anomalies for total amount of Rainfall (%).

3.2 The amount of precipitation over the territory of the country during 2022

The main factors for rainfall formation in our country are regional and local factors. The physical-geographical position that Albania has makes it always located on the periphery of the influence of the 3 main baric centres at the continental level (Iceland cyclone, Azores anticyclone and Siberian cyclone). This geographical location makes it more protected against prolonged extreme situations and classifies our country in countries with Mediterranean climate. As for the local factors, they are mainly hilly-mountainous as part of the Albania mountain massif in the direction of the mountain ranges Northwest Southeast that affects the spatial distribution of precipitation. Also, our country in the west has the Adriatic and Ionian seas and in the east is bordered by mountainous terrain that has an impact on the geographical distribution of rainfall.

In order to make an assessment on the amount of precipitation over our country during 2022, there have been taken in consideration 90-100 meteorological stations distributed throughout the territory, every month. By comparing them with the multi-year average, we notice that we have a decrease in the amount of precipitation by -13.1%, as shown in the table and figure below.

Table 3. Anomalies for total amount of Rainfall (%).

Anomalies for total amount of Rainfall (%)		
No.	Months	Anomalies
1	January	-63.5
2	February	-34.0
3	March	-44.6
4	April	-6.9
5	May	-49.0
6	June	22.7
7	July	-41.7
8	August	+6.9
9	September	+71.2
10	October	-55.0
11	November	+31.0
12	December	+6.2
Yearly		-13.1

Another important parameter to take in consideration to face the droughts is the number of days with rain in a row.

Table 4.

Anomalies for number of days with rain (%)		
No.	Months	Anomalies
1	January	-47.7
2	February	-27.0
3	March	-47.4
4	April	-14.8
5	May	-38.5
6	June	-17.7
7	July	-48.2
8	August	+35.6
9	September	+31.7
10	October	-42.4
11	November	-2.0
12	December	-6.9
Yearly		-18.8

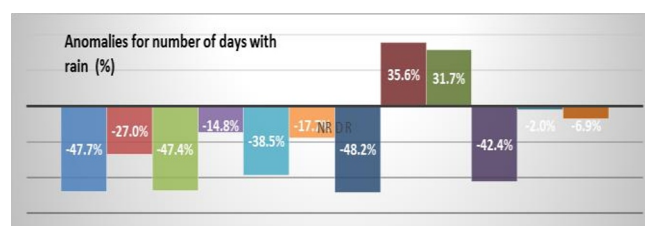


Fig. 4 Anomalies for number of days with rain (%).

4 Conclusions and Recommendations

The results of the data taken into consideration in this paper shows:

An increase in the average annual air temperature by about +2.0°C, where in particular the summer season differs by +3.4°C.

Precipitation marks a decrease around -13.1%, which is most pronounced in the season of winter by -30.4%. According to data analysed, the number of rainy days decreased by 18.8%. The decrease of precipitation amount and the number of rainy days has direct impact on draughts. An added negative impact in that type of deficit is related also with the increase of evaporation.

In recent years, due to the reduction in the number of rainy days and a lower cloud, there has been an increase of

sunshine by about +5% in the area of Albania, which is important for the promotion and encouragement of the implementation of technologies related to the use of this potential for conversion and production of solar renewable energy.

Due to these results, the worst impact of these meteorological parameters is in draughts.

Droughts are natural phenomena that occur naturally, but climate change has generally accelerated hydrological processes to make them faster and more intense, bringing more consequences, not the least of which is increased risk from forest fires. There are different types of drought that are studied, such as meteorological, agricultural, hydrological and socio-economic droughts; however, the lack of a unanimous definition complicates the study of drought. Drought indices are used as indicators to track and quantify drought; therefore, the correct formulation of robust drought indices is important to investigate drought characteristics under a warming climate. Because different drought indices show different degrees of sensitivity to the same level of continental warming, the robustness of drought indices to changes in temperature and other variables should be prioritized. A formulation of drought indices without considering factors governing the background condition may lead to drought artefacts under a warming climate.

All these facts are important elements that have to be taken in consideration regarding the policy to maintain ready the irrigation systems and use effectively the water resource. Not to be neglected is also the fact that in some reservoirs the water is used for fish production and in some other for potable water for the near urban areas and some other areas the water resource is used for the national and international market. The only one primary suggestion related to minimize those change and mitigate the damages is to try to contribute and supporting the climate factors that provide possibility not only to decrease those climate change, but also to have a better environment and more possibilities for a stable and secure development of the country economy, such is forestation efforts.

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