

## THE EVOLUTION OF CLIMATE CHANGE IN THE WESTERN REGION OF ROMANIA AND THEIR INFLUENCE ON CROPS

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### *Abstract*

*In this paper, we have made an interpretation of how climate changes and certain risk factors have influenced the evolution of the climate in the western part of Romania. With the help of meteorological data provided by the representative stations in this part of the country, the influence of abiotic factors was analyzed for different study intervals. The first part of the paper presents a period with a normal multiannual evolution of the thermal regime, the pluviometric regime and extreme phenomena, and in the second part, the years with significant deviations are interpreted. The analysis of meteorological parameters was carried out for the representative stations in the western and northwestern areas of the country, stations belonging to the Banat Crișana Regional Meteorological Center, respectively those in the counties of Timiș, Arad and Bihor. The results obtained led to the formulation of some conclusions regarding the influence that these climate changes have on the crops in the analyzed counties.*

**Key words:** climate change, crops, meteorological stations, pluviometric regime, risk factors.

## INTRODUCTION

Of all the terrestrial geospheres, the atmosphere is the most unstable, the most fragile and vulnerable, being in a precarious balance. It is constantly exposed to meteorological and climatic imbalances, which, in turn, trigger other environmental disturbances in the chain. Since humanity has a direct interest in maintaining this balance (Bogdan, 2006).

Global warming is causing changes in different regions of the world that include increased frequency and severity of storms, hurricanes, floods, landslides, extreme heat or cold, droughts, water shortages, forest fires and other disasters(<https://www.mmediu.ro/categorie/schimbari-climatiche/1>).

At the European level, the main objectives regarding climate change are presented in the Convention on Climate Change (UNFCCC) and in the framework of the Kyoto Protocol (European Environment Agency, 2004). Chiper (2015) states that "the effects of climate change are negative elements for agriculture" because they propagate in agricultural territories.

South-west Romania, like the entire country, due to its geographical position in the temperate zone, is exposed to a wide range of

risk meteorological and climatic phenomena with the potential to occur throughout the year (Cristea, 2022; Drăghici, 1988; Durău, 2024; Mircov et al., 2024; Mihuț et al., 2024).

Along with Romania's geographical position in relation to the main pressure centers, the characteristics of the relief create great differences in terms of the genesis and distribution of atmospheric precipitation, both throughout the country and above Banat (Mihuț et al., 2024; Pop, 1988).

Banat is located in a very varied geographical setting, which includes relief forms whose altitude increases from west to east, like an amphitheater (Nichita et al., 2010).

For a correct assessment of the climatic conditions specific to a certain territory, a series of information related to climate, hydrology, geology, vegetation and soil properties is needed (Mihuț et al., 2024).

The present work aims to identify some meteorological indicators that most accurately express the extreme nature of the manifestations of atmospheric phenomena and for this we analyzed a ten-year interval, an interval in which certain climatic changes were highlighted.

## MATERIALS AND METHODS

In this paper, we analyzed the deviations of meteorological risk factors recorded at meteorological stations located in the Western part of Romania, stations belonging to the Banat-Crișana Regional Meteorological Center. We highlighted the data obtained from the stations in the counties of Arad, Bihor, Caraș-Severin and Timiș (Mircov et al., 2024).

The thermal regime, the pluviometric regime and certain aspects of the wind regime, a regime specific to the area in the South-West of Romania, the Coșava wind, were highlighted. A more detailed analysis of certain phenomena was made in order to capture exceptions, special situations or more significant meteorological elements.

## RESULTS AND DISCUSSIONS

The evolution of risk aspects in these years was presented for certain representative stations, for which we took into account the specific risk parameters. For the Banat area, the warmest month of the year is July, with average temperatures of 21.5°C and the coldest is January, when the average temperature reaches 1.5-2°C. The variation of the annual average temperature presents approximately the same aspect at all stations, the amplitude and the values encountered differ (Munteanu, 2001).

The highest values in the summer months are found at the southern stations with average temperatures of over 22°C at Moldova Veche and Banloc. The lowest average temperatures are recorded, except for the mountain stations, in the Bozovici depression area, where the temperature does not reach 20°C. January is the coldest month with averages between 0°C and 3°C, with the lowest value in the Bozovici Depression and in the Mureș Corridor at the Vărădia de Mureș station, due to an inversion, and the highest in the south, at Oravița and Moldova Veche.

The mountain area has the lowest temperatures, which is normal due to the altitude, the average in January reaching -8°C at Țarcu. For the analyzed interval, it can be observed that, in Timișoara, in July the average values exceeded 22°C, the highest value being recorded in 2021,

which was 25.7°C, and in 2022, when 25.2°C was recorded (Figure 1).

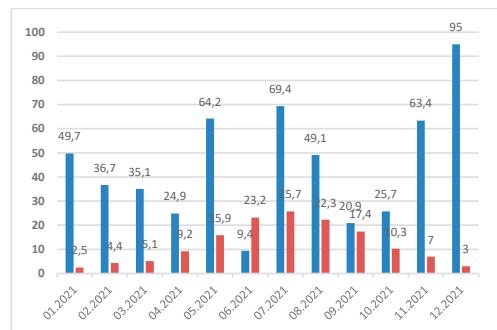


Figure 1. Thermal and rainfall regime recorded in Timișoara, in 2021 (The blue color - represents the average annual precipitation, in l/m<sup>2</sup>; red color - represents the average temperature in °C)

If we refer to the 2015-2025 period, we can say that for the western area, the lowest monthly temperature values were recorded in July 2016, 22.9°C, and in 2018, when we had 22.6°C (Figure 2).

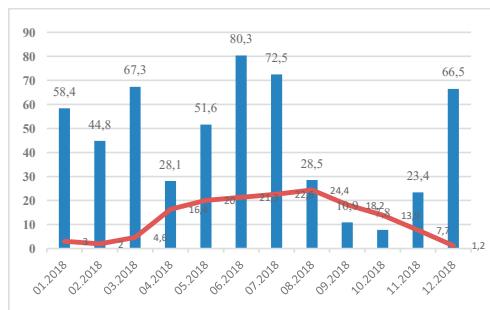


Figure 2. Thermal and rainfall regime recorded in Timișoara in 2018 (The blue color - represents the average annual precipitation, in l/m<sup>2</sup>; red color - represents the average temperature in °C)

Summer is dominated by formations related to the Azoric anticyclone and the Mediterranean cyclones, starting early, sometimes even in May, and lasting until September. The average temperature of the hottest month, July, varies between 21-22°C in the Oravița - Moldova Veche area and 8°C on the highest peaks. There are hot days, with maximums exceeding 35°C and tropical nights with minimums over 20°C (Moldovan, 2003).

For the analyzed interval, it can be observed that, in Timișoara, in July the average values

exceeded 22°C, the highest value being recorded in 2021, this being 25.7°C (Data provided by CMR Banat Crișana). This year, Timișoara recorded 16 hot days in the summer months. Compared to 2021, in 2018 there were 11 hot days during the summer, and in 2022, 12 days.

From the point of view of the rainfall regime, it can be observed that the least precipitation recorded in Timișoara was recorded in October, November, December of 2019, the period in which it rained only 57 l/m<sup>2</sup>, and this period continued in the spring of 2020, the year in which in April there were only 7 l/m<sup>2</sup>, and in May 29 l/m<sup>2</sup>, which led to certain decreases in sunflower and corn production (Barbu et al., 2003).

In Caraș-Severin County, in the area of Moldova Veche, two summer months of 2020 were noted for excessive rainfall, and we must particularly highlight the days of June 22, June 23, 2020, days characterized by strong instability, with convective rains over relatively extensive areas, locally significant in quantity. Regarding the average annual temperature of the area, we mention that it is higher (Figures 3 and 4).

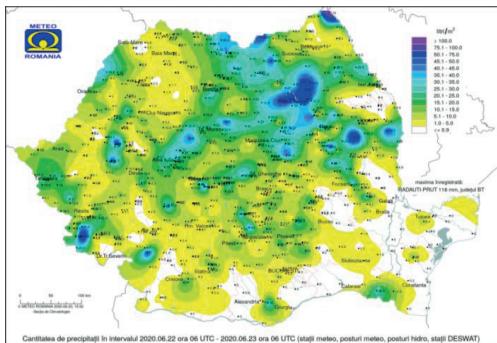


Figure 3. Amount of precipitation on 22/23 June 2020 (Synoptic code, Institute of Meteorology and Hydrology, Bucharest)

Due to the favorable climatic conditions in the fall of 2020 and the first months of 2021, in certain regions of Caraș-Severin County, in the Moldova Nouă area, high wheat productions were obtained in 2021, a quantity of 8.10 t/ha. It is worth noting the excess rainfall that was recorded in the first two months of 2021, in Oravița 157 l/m<sup>2</sup>, while in Moldova Nouă, 128 l/m<sup>2</sup> accumulated in the two months. In January

2021, the most rain fell on January 2, a quantity of 18.9 l/m<sup>2</sup>, in Moldova Nouă, and also on January 2, in Oravița 20.6 l/m<sup>2</sup> accumulated. In February, in Moldova Nouă it rained 10.0 l/m<sup>2</sup>, on February 26, while in Oravița, on February 17, 26.0 l/m<sup>2</sup> accumulated. Regarding the corn crop, the lowest quantity was obtained in 2022, more precisely 4500 kg/ha, due to the deficient rainfall regime in all regions, and in 2021 there were values between 7000-8000 kg/ha, while in 2020 10.000 kg/ha were obtained.

The average annual isotherm of 110 delimits the Danube corridor. Due to these assessments, we signal the presence of biocenoses specific to the area. Thus, particularly intense air currents, of the bora type, locally called Coșava, develop. The Coșava wind has a turbulent character, and, according to the wind rose, the predominant directions are those from the east and west (Ghibedea, Băcanu & Lucia, 1982). The speed can reach up to 85 km/h, with gusts of up to about 135 km/h and 140 km/h, with an average duration of up to one day, sometimes even two days.

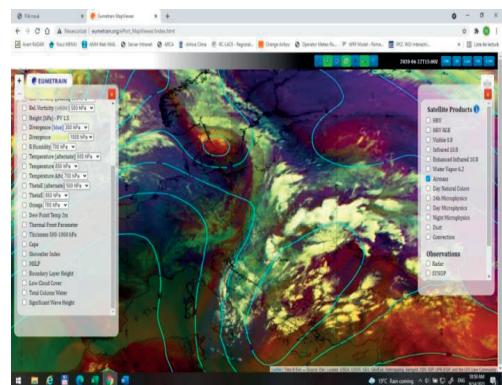


Figure 4. Satellite image (INFRARED-Air masses superimposed over the geopotential at 500 mb on 22.06.2020 ([www.theweatherprediction.com/blocking/](http://www.theweatherprediction.com/blocking/))

In the western part of the country, the highest amounts of precipitation were in Caraș-Severin, with 52 l/m<sup>2</sup> in Sasca, 42 l/m<sup>2</sup> in Oravița and 30 l/m<sup>2</sup> in Moldova Veche.

Starting with June 2020, when 87 l/m<sup>2</sup> were recorded, and until October, the rainfall regime reached 356 l/m<sup>2</sup>, while in two months, July and October, it rained over 100 l/m<sup>2</sup> in Timișoara (Figure 5).

If we take into account the values obtained from the meteorological stations in Arad and

Chișineu Criș, we can say that 2020 was the rainiest year, with two consecutive months in which the amount of precipitation exceeded  $100 \text{ l/m}^2$ . In June and July,  $255 \text{ l/m}^2$  of rain fell, more precisely, in June  $145 \text{ l/m}^2$ , and in July  $108.7 \text{ l/m}^2$  (Figure 5).

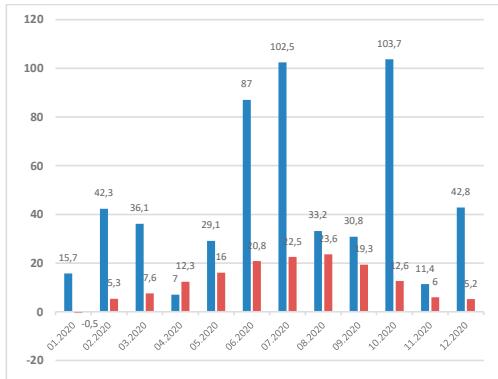


Figure 5. Thermal and rainfall regime recorded in Timisoara, in 2020 (The blue color - represents the average annual precipitation, in  $\text{l/m}^2$ ; red color - represents the average temperature in  $^{\circ}\text{C}$ )

In 2022, in September, we had a record excess of  $148.9 \text{ l/m}^2$ , but also a dry month during the summer, in June, when only  $3.5 \text{ l/m}^2$  were recorded. From a thermal point of view, we can say that in 2020 the thermal regime was the coolest, with an average temperature in January of  $-1.3$  degrees  $^{\circ}\text{C}$ , and the average in August was  $22.3$  degrees  $^{\circ}\text{C}$  (Data provided by CMR Banat Crișana).

At the Ștei meteorological station, in July 2022 a monthly average of  $22.7^{\circ}\text{C}$  was recorded, and in 2023, the value of  $22.2^{\circ}\text{C}$ , in August. If we also analyze the last years, we can say that during this period the pluviometric regime was deficient, while the thermal values were very high. The weather was warm in most of the country in the last two years, and in the western region there was a heat wave in extensive areas. The temperature-humidity index, the ITU index, reached and exceeded the critical threshold of 80 units in Banat and Oltenia, in most of Muntenia and Crișana, and locally in Dobrogea, southwestern Transylvania and southern Moldova.

In 2023, it rained sufficiently in the first five months, the hectoliter weight of wheat decreased and that is why we had a lower production compared to 2022. In the first four

months, in certain localities in the vicinity of the city of Arad, over  $400 \text{ l/m}^2$  were recorded, which was a year with excess rainfall for this period, in the last ten years. There were days when it rained and  $30-35 \text{ l/m}^2$ , in five days, in March and over  $30 \text{ l/m}^2$  were recorded in 4 days in April.

Due to the favorable climatic conditions, both in terms of temperature and rainfall, specific to the Chișinău Criș and Arad areas, in the fall of 2020 and the first months of 2021, the highest corn production was achieved, an amount of 8000 to 9000 kg/ha, to corn culture. It is worth noting the excess rainfall recorded in the first two months of 2021, in Chișinău Criș  $137 \text{ l/m}^2$  were reported, while in the first four months of 2023 it rained  $410 \text{ l/m}^2$ . This favorable rainfall regime will give a production of approximately 9100 kg/ha, in the fall of this year. Also this year, a quantity of 5200 to 6000 kg/ha was obtained for wheat, while the production for rapeseed was 3480 kg/ha.

On July 21, 2023, a strong storm was recorded in Arad County. It rained  $39 \text{ l/m}^2$ , but this rain was followed by the entry into the region of a front accompanied by clouds with high vertical extension, of the Cumulonimbus type, clouds accompanied by heavy hail. This phenomenon compromised certain productions, especially in the sunflower crop, where productions between 1400 kg/ha and 1500 kg/ha were obtained.

We must also note a situation recorded at the end of 2023, when it was particularly hot throughout the country, in the last decade of the year. In the western region of our country, on 26.12.2023 - 27.12.2023, the following daily records were recorded, values that represent the highest daily values in the entire series of observations recorded on this calendar date at certain stations, such as: Banloc (15.6 compared to  $14.2^{\circ}\text{C}$ ), Bozovici (13.4 compared to  $12^{\circ}\text{C}$ ), Jimbolia (14.3 compared to  $13.5^{\circ}\text{C}$ ), Lugoj (15 compared to  $14.7^{\circ}\text{C}$ ), Moldova Veche (15.8 compared to  $14.5^{\circ}\text{C}$ ), Sânnicolau Mare (14.4 compared to  $13.6^{\circ}\text{C}$ ), Vf. Cuntu (9.8 compared to  $9.4^{\circ}\text{C}$ ), In mid-August 2024, between 12.08-14.08, in certain stations in Timiș and Arad counties, thermal minimums between  $20^{\circ}\text{C}$  and  $27^{\circ}\text{C}$  were reported, in Șiria. Towards noon, in Moldova Veche there were  $38.3^{\circ}\text{C}$ , compared to the previous record, the value of  $37.8^{\circ}\text{C}$ . At the mountain station in

Caraș-Severin county, in Țarcu, the record of 15.2°C was reported, while in Timișoara, the minimum was 21.6°C.

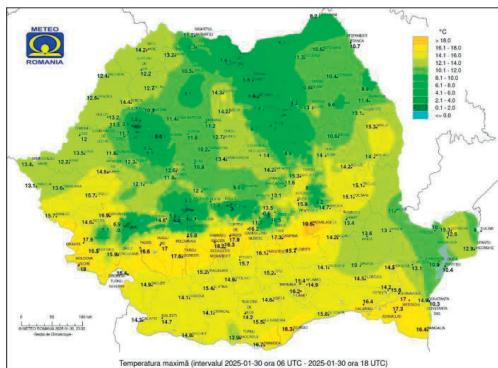


Figure 6. Maximum temperature recorded on 30.01.2025, at 6 pm  
(Synoptic maps, CMR Banat Crișana, Timișoara)

The minimum temperature was equal to the highest value in the entire series of observations at this date. The last decade of 2025 was also characterized by particularly warm weather for the end of January, so that the daytime thermal values were up to 12-13°C higher than the multiannual averages of the period. On 30.01.2025-31.01.2025, 16.9°C were reported in Caransebeș, compared to 15°C, in Moldova Veche 18°C, compared to the record of 16.5°C, while in Oravița it was 17.6°C, compared to 16.2°C (Figure 6).

## CONCLUSIONS

Southwestern România, like the entire country, due to its geographical position in the temperate zone, is exposed to a wide range of risk meteorological and climatic phenomena with the potential to occur throughout the year, the evolution of the thermal and pluviometric regimes in the western area being factors that decisively influence agriculture in the region.

Following the studies carried out in the Western and South Western part of Romania, we can affirm the fact that, due to the favorable rainfall conditions in 2020 and the first part of 2021, the productions obtained in the corn crop were clearly superior compared to the other years studied.

Another favorable year for the corn and wheat crop was 2023, the year in which the amount of

precipitation was over 400 l/m<sup>2</sup>, the amount recorded in the first four months in certain areas of the West.

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