

HOW GLOBAL CLIMATE CHANGE AFFECTS THE CLIMATE AND THE ENVIRONMENT IN ROMANIA

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ABSTRACT: Recent climate studies have signaled alarming fluctuations in the optimal functioning of the global ecosystem as a result of human intervention. Such changes are visible in the form of increased averages of annual temperatures by several degrees as well as in the emergence of extreme weather events and hydrological hazards

Keywords: heat waves; drought; aridization; ecosystem change;

Global climate change is having a significant impact on Romania's climate, with notable consequences on temperatures, precipitation, extreme weather events and ecosystems. According to the 2021 Intergovernmental Panel on Climate Change (IPCC) report, human activity is responsible for the rising temperature of the atmosphere, ocean and land. Compared to pre-industrial times, between 2010 and 2019 global temperatures have risen by 0.8-1.3°C, coinciding with the industrial era and increased pollution.

Important climate changes encountered in Romania are:

1. Rising temperatures. In the NASA database, Professor of Geophysics and Hydrogeology Constantin Crânganu of The City University of New York has identified 14 Romanian weather stations, including Iasi, Constanta, Sibiu, Vf. Omu, Bucharest Băneasa or Cluj-Napoca (fig. 1).

In the case of the above weather stations average annual temperatures are higher in Bucharest and lower in Sibiu. In order to make a comparison of the variation of annual temperatures, the anomalies of the variations in relation to a reference value-average temperatures from 1951-1980-were plotted (fig. 2).

Analysis of the temperature anomalies from the two Romanian stations suggests a rise in temperature of about 1°C in the period 1880-1920, followed by a cooling of about 0.5°C in the next 20 years and a further warming of 0.5°C in the period 1940-1960. The period 1960-1980 is marked by a lack of temperature anomalies, and between 1980 and 2020 the annual mean temperature anomalies in Romania increased by about 2°C, i.e. a rate of 0.5°C/decade.

For the future, in a pessimistic scenario, global average temperatures are projected to rise to 50C in 2100, in a medium scenario by 2050 heat waves (daily maximum temperature exceeding the

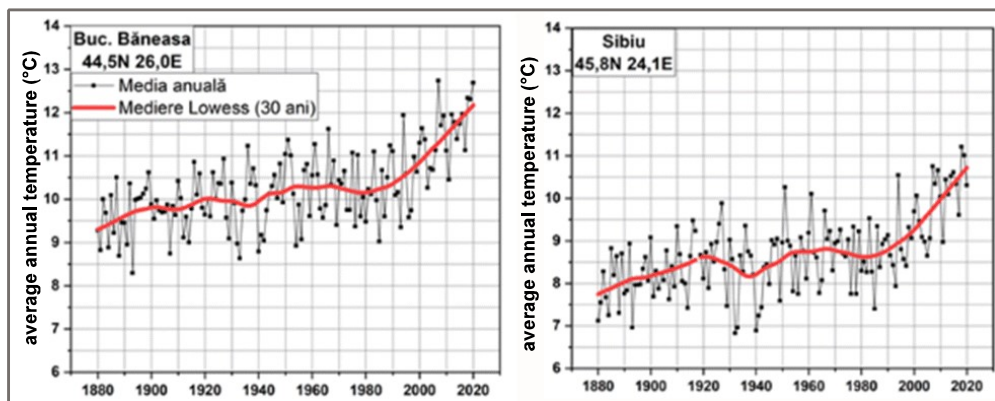


Fig. 1. Annual mean temperature variations from Bucharest Băneasa (left) and Sibiu (right) weather stations (Source Prof. Crânganu, C.)

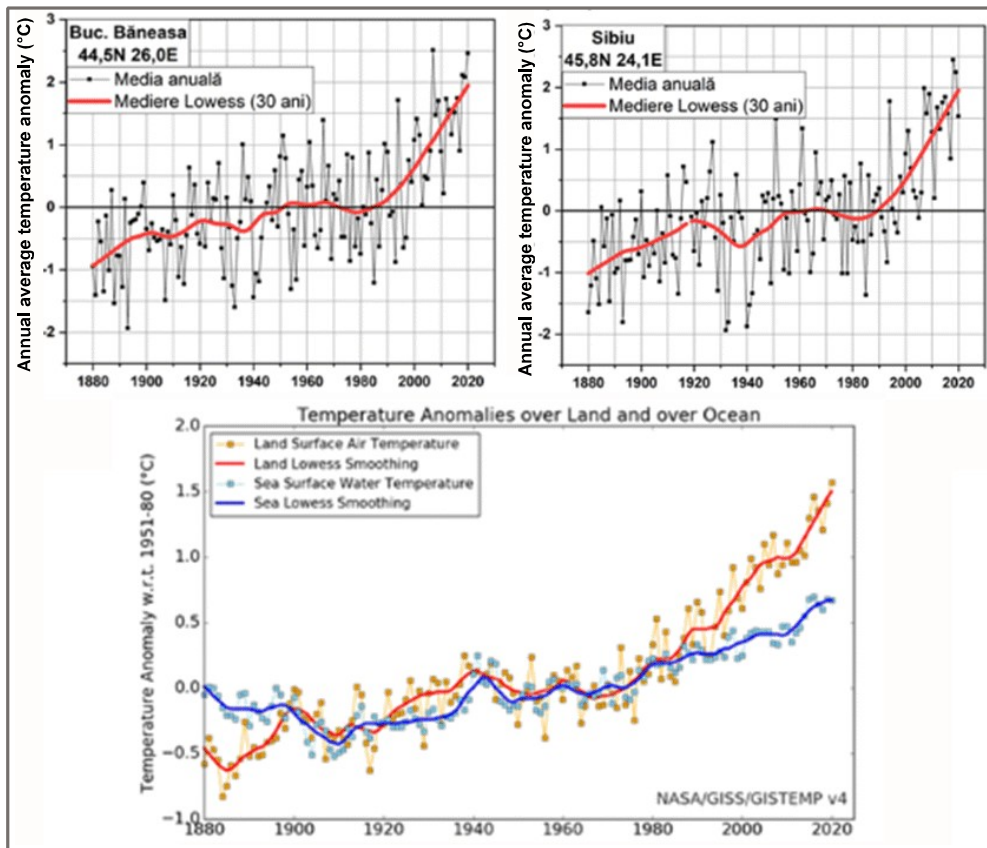


Fig. 2. Annual mean temperature anomalies from Bucharest Băneasa and Sibiu weather stations (top) compared to global anomalies from NASA GISS (bottom)
(Source: Prof. Crănganu Constantin)

average maximum temperature by 5 degrees Celsius for at least five consecutive days) will be twice as frequent in the north and west of Romania and three times as frequent in the south and south-east of the country compared to 2000. By 2100, heat waves will be four and five times more frequent respectively compared to just a century ago, according to researcher Viorica Nagavciuc from the „tefan cel Mare” University of Suceava (fig. 3).

2. Precipitation reduction. Following 1980, Romania experienced a series of dry years due to a decrease in precipitation, but also due to an increase in the average annual temperature in the Romanian Plain and the Bârlad Plateau. Due to the reduction in rainfall, the flow rates of most of the country's rivers decreased, especially in the south and south-east.

IPCC estimates indicate that the region to which Romania belongs will experience changes in precipitation: winters will become wetter and summers drier. As a result, seasonal precipitation

will increase in autumn, while in spring, summer and winter precipitation will tend to decrease in some regions in the east and south-east of the country. As rainfall intensity rates increase in short intervals, heavy rainfall episodes of more than 20 l/sq.m. accompanied by floods may become more frequent.

For the period 2021-2050, monthly summer precipitation is expected to decrease by up to 18%, the number of rainy days will decrease and rainfall will be heavy on rainy days. Snow depth has also decreased across the country. Compared to the period 1971-2001, the decrease in snow depth could be more than 80% in the west, center and south of the country, while in the mountains it could vary between 60-80%. The decrease in precipitation may lead to drought and reduced water availability for agriculture and other activities.

3. Increase in extreme weather events. Changes in the average temperature and precipitation regime lead to extreme events such

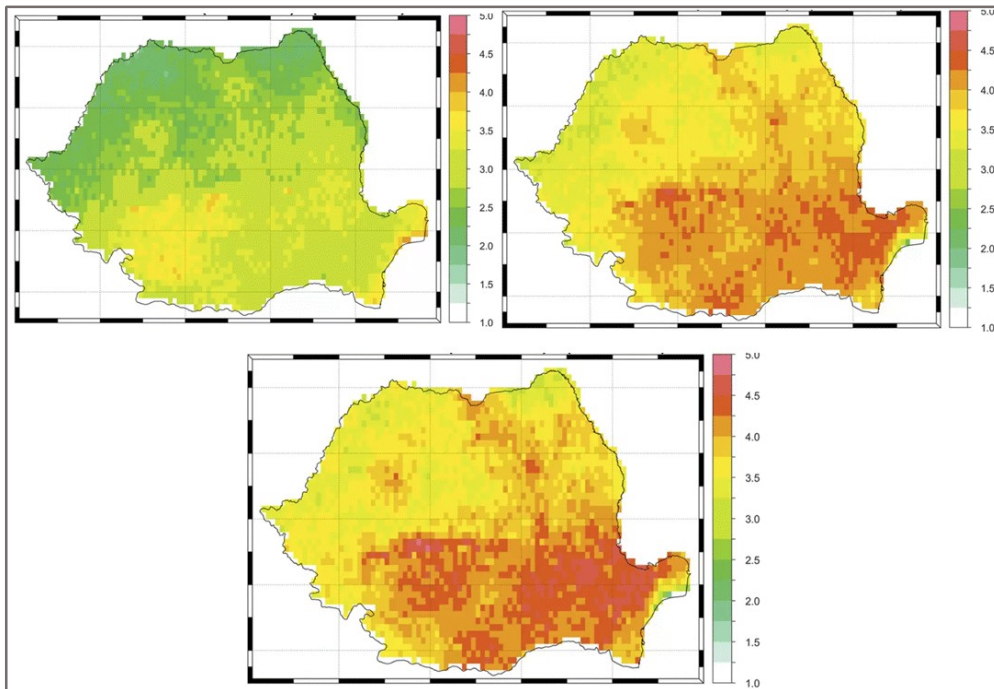


Fig.3. Heat wave anomalies for 2021-2050 (top left), 2051-2070 (top right) and 2071-2100 (bottom) (Source: Dr. Viorica Nagavciuc)

as increased intensity and frequency of heat waves and warm season (convective season) phenomena such as tornadoes, intense wind, large hail, lightning and floods, the latter especially in mountainous areas such as the Apuseni Mountains, Southern Carpathians, Northern Eastern Carpathians, the impact of which is also amplified by deforestation of slopes. Tornadoes occur most frequently in south-eastern Romania, hail is reported in mountainous areas, especially in the north-west of the country, and cloud-to-ground lightning strikes are most frequently detected in the south-east and produce the highest lightning fatality rate.

In large urban agglomerations, the effects of climate change are amplified by the artificial built environment which causes, for example, the formation of the city's heat island.

Due to the isolation of the ground from the atmosphere, surface runoff is amplified and urban flooding is also amplified.

Green spaces and lakes acting as reservoirs promote water infiltration into the ground and reduce the impact of urban flooding.

Increasing global average temperatures increase evaporation and the capacity of the atmosphere to retain water vapor. The intensity of

extreme precipitation events on a global scale will increase by 7% for every one degree increase in global average temperature. For a 1.5°C increase in global average temperature the amount of precipitation associated with these events will increase in the future to 10.5% and 32% for a 4°C increase.

In June 2023, the US National Oceanic and Atmospheric Administration (NOAA) announced the El Niño phenomenon, which for Romania means a long and sunny autumn. This weather phenomenon will bring a new wave of extreme temperatures, strong storms, floods and vegetation fires, which could make 2024 the hottest year on record. 3 July 2023 was the warmest day ever recorded by meteorologists globally, according to data from the US National Center for Environmental Prediction, with an average global temperature of 17.010 C recorded at a time when several heat waves occurred in several regions of the world. According to researchers, climate change, combined with the emergence of the El Niño weather phenomenon, is to blame for this record temperature.

4. Changing characteristics of the seasons.

Such significant climate changes however will not eliminate the occurrence of the four seasons in

Romania. Some changes are likely to become permanent: spring is starting earlier, the long hot summer is lengthening into autumn, and winter becomes shorter and milder. Because spring is early and snow cover has shrunk, soil water reserves are negatively affected.

5. Impact on agriculture. Climate change can affect agricultural production through extreme temperatures, drought and pest infestation. This can have an impact on food security and the country's economy. In 2022, the Ministry of Agriculture announced that more than one million hectares of agricultural land were affected by drought, out of a total of 14 million hectares of agricultural land in use. Thus, in many counties, wheat, barley or rapeseed crops sown in October

could not even sprout due to lack of water - this despite the fact that the country's annual rainfall has not decreased.

What has changed at the country level is the distribution of precipitation, with high amounts of precipitation in short time intervals and low amounts of precipitation in long time intervals. In Romania, there are arid areas that will become extensively more arid and areas with above-average precipitation that will experience even more precipitation in the future. In Dobrogea, the Danube Plain and the Podi ul Moldovei, the most obvious change is reflected by the rapid advance of drought conditions. Aproximately 60% of the country's surface, including agricultural and forest areas, is in the



Fig. 4. Invasive species in Romania: on the left ragweed (*Ambrosia*), native to North and South America, on the right the dogwort (*Nyctereutes procyonoides*), native to Asia



Fig. 5. NASA map of vegetation fires in Europe for 2022
(affected area of Romania was 162 518 ha)

(Source: <https://jurnalul.ro/bani-afaceri/economia/incendii-paduri-seceta-931144.html>)

process of aridisation, as is already the case in Oltenia, where about 6% of Dolj county is classified as desert. If small benefits to local climate changes are to be mentioned, one can account for the cultivation of exotic crops in the now sandy soils, such as: figs, sesame, castor, cotton, kiwi, persimmon and dates.

6. Ecosystem changes. Romania's ecosystems, such as forests, grasslands and wetlands, are affected by climate change. Animal and plant species are migrating to northern regions and to higher altitudes, while various invasive species are adapting to the new environments, multiplying and competing with native species, replacing or destroying them. Ticks, the Asian tiger mosquito and other disease carriers pose a real threat to human health because of the diseases they transmit: encephalitis, Lyme disease, West Nile fever, danga fever, malaria, etc. Marine species,

including commercially important fish, are also migrating north. These changes affect various economic sectors such as agriculture, forestry and fish farming, and the migration of some species can disturb the ecological balance (fig. 4).

7. Forest fire risk. Rising temperatures and falling rainfall increase evaporation from the ground, which can exacerbate drought and create conditions for forest fires, putting forests and biodiversity at risk (fig. 5).

To address these challenges, Romania and other countries are working to implement measures to adapt to climate change and reduce greenhouse gas emissions to limit the rise in global temperatures. Actions such as reducing carbon emissions, promoting renewable energy and conserving natural resources are essential to minimise the impact of climate change on the climate and the environment.

References

1. Bojariu, R.; Chițu, Z; Dascălu, SI; Gothard, M; Velea, L; Cică, R; Burcea, S; Dumitrescu, A; Marin, L; Crăciunescu, V S; Mătreacă, M; Ahiaiesei, V; Irasoc, A; Niță, A; Bîrsan, M-V, 2021, *Climate change - from physical foundations to risks and adaptation*. Revised and added edition, Printech Publishing House, Bucharest, Romania.
2. Retrieved from <https://www.infoclima.ro/acasa/cum-influeneaz-schimbriile-climatice-fenomenele-meteorologice-extreme>, accessed 18.09.2023.
3. Retrieved from <https://www.contributors.ro/in-ultimii-40-ani-temperatura-medie-anuala-din-romania-a-crescut-cu-circa-2c/>, accessed on 18.09.2023.
4. Retrieved from <https://www.antena3.ro/meteo/efecte-el-nino-romania-fenomen-inceput-prima-data-dupa-7-ani-679322.html>, accessed on 18.09.2023.
5. Retrieved from <https://www.eea.europa.eu/ro/highlights/schimbarile-climatice-reprezinta-un-factor>, accessed 18.09.2023.
6. Retrieved from <http://www.mmediu.ro/categorie/schimbari-climatice/1>, accessed 20.09.2023.
7. Retrieved from <https://mindcraftstories.ro/mediu/cum-se-schimba-clima-in-romania-acum-si-in-viitor/>, accessed 20.09.2023.
8. Retrieved from <https://jurnalul.ro/bani-afaceri/economia/incendii-paduri-seceta-931144.html>, accessed 28.09.2023.