

CLIMATE CHANGE AND LAND TEMPERATURES AND THEIR IMPACT ON AGRICULTURE AND SOCIETY: A GLOBAL INVESTIGATION

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Abstract

This article examines how climate change influences Earth's temperatures and affects communities worldwide. As temperatures continue to rise, so do economic challenges, making it critical to understand these shifts and create effective strategies for adaptation and mitigation. We highlight global and local initiatives addressing these issues, emphasizing their environmental and social benefits while underlining the need for cooperation between communities, governments, and international organizations. To support our analysis, we incorporate data from FAOSTAT and use advanced tools to present clear visualizations. We also rely on trusted sources, including specialized websites, to ensure our insights are accurate and current. By exploring the complex connections between climate, society, and the environment, this review calls for collaborative and integrated action to meet sustainability goals and build a more resilient future.

Key words: climate change, land temperatures, climate indicators, climate variations, global impact

INTRODUCTION

Climate change stands out as a defining challenge of our time, reshaping life on Earth in profound ways. Its effects are evident everywhere, from shrinking glaciers and rising oceans to the increasing frequency of extreme weather events, leaving no region untouched.

Against this backdrop, understanding and analyzing global temperature change becomes essential to develop effective adaptation and mitigation strategies.

In recent years, scientists have drawn particular attention to the climate crisis and global warming, presenting the need for climate change mitigation as imperative. The effects of climate change, society's vulnerability, and the urgent need for adaptation are gaining increased attention in both scientific research and media discussions [7].

Statistics from 2023 reveal notable temperature increases worldwide, with the Americas experiencing the highest rise at 4.17°C. These changes bring unique

challenges, such as intense heatwaves in the Americas and Africa and disrupted agriculture in Europe and Asia, showing the need for local, tailored solutions.

Climate change isn't just about the environment—it's affecting economies, public health, and food security. In Europe and Asia, rising temperatures are lowering crop yields and putting pressure on water resources, while urban areas in the Americas and Africa face extreme heat stress.

Agriculture in drought-prone regions like Dobrogea, Romania, has been particularly hard hit. Between 2016 and 2023, Dobrogea saw annual average temperatures above 11°C and rainfall between 351–450 mm [5, 6, 9, 13]. Similar issues affect Ukraine and Slovakia [4, 10]. Modern tools, like advanced information systems, can help farmers plan better despite these challenges [11, 12].

Across the EU, extreme weather over the past decade has reduced crop yields, increased costs, and hurt grain quality [7]. Romania has also faced rising temperatures, less rainfall, and worsening soil water deficits over the past 35 years [4].

Addressing these problems requires international cooperation, renewable energy adoption, ecosystem restoration, and raising public awareness [2]. The need for action is urgent to protect both people and the planet and ensure a sustainable future.

This article aims to examine how climate change affects global land temperatures, highlight key indicators, and propose sustainable strategies for adaptation and mitigation to protect the environment and secure a sustainable future worldwide.

MATERIALS AND METHODS

In order to carry out a detailed and comprehensive analysis of climate change and its impact on terrestrial temperatures, we used statistical data provided by FAOSTAT and various visualization tools. In this section, we detail the methods and materials used to collect, analyze and present the data, thus providing a solid basis for our conclusions and recommendations.

Data Sources

The statistical data used in this article comes from FAOSTAT, an internationally recognized database that monitors global climate change and temperature. The data provided cover land-based temperature changes for different regions of the world for the months of January, March, June, September and December of 2023.

Methods of analysis

Data collection: temperature change data were collected for each specified month, covering various geographical regions including Africa, the Americas, Asia, Europe and Oceania. These data were centralized and organized to facilitate comparative analysis and identification of regional and global trends.

Graphical visualization: To illustrate temperature changes and make them easier to understand, we created graphs using Microsoft Excel 365. The graphs shown include average temperature variations for each month and region, highlighting the seasonal and regional impacts of climate change. These graphical visualizations are essential to provide a clear and intuitive view

of complex data, making the information accessible and easy to interpret.

Graphs used

To support the analysis, we have created graphs illustrating the variations in mean land-based temperatures in January, March, June, September and December 2023 for different regions of the world. These graphs help visualize the impacts of climate change clearly and concisely, highlighting regional trends and anomalies.

Comments and interpretations

Based on the statistical data collected, we have produced unique and interesting commentaries that highlight regional trends and anomalies in temperature change. These commentaries provide valuable insights into climate impacts in different parts of the world and highlight the need for tailored adaptive strategies.

Conclusions of the methods used

Using a combination of statistical data from FAOSTAT and graphical visualization tools allowed a thorough understanding of global climate change. These methods were essential for identifying trends and anomalies in temperature change and for formulating effective adaptation and mitigation strategies. By clearly and comprehensively presenting the data and methods used, this article provides a solid basis for further discussion and analysis of climate change and its impact on terrestrial temperatures.

RESULTS AND DISCUSSIONS

The image uses intense colors such as red, orange, and yellow to highlight the areas most affected by rising global temperatures. The blue background of the oceans adds a strong contrast, highlighting the severity of the problem. Natural elements, such as the bright sun and a tranquil landscape with flowing water, symbolize both the beauty of our planet and its fragility in the face of climate change.

This vibrant palette conveys a sense of urgency and hope, suggesting that while the challenges are great, there is still a chance to protect the planet through coordinated and sustainable action.



Fig. 1. The global impact of climate change (a visual look at rising temperatures)

Source: Image built by using the keywords: climate change, global map, rising temperatures, rising sun, natural landscapes, forests, mountains, oceans [8].

Statistical data is essential for understanding how climate change affects land temperatures. In 2023, significant temperature increases were recorded across regions, highlighting the variability and complexity of the global climate system.

Using FAOSTAT data, we identified key seasonal and regional trends in Africa, the Americas, Asia, Europe, and Oceania [3].

These rising temperatures have far-reaching impacts on ecosystems, public health, and economies, stressing the urgent need for coordinated global action.

Graphs and statistics illustrate these changes clearly, emphasizing the importance of continuous monitoring and sustainable strategies. Key findings are summarized below.

Table 1. Dry temperature changes in various regions of the world (January 2023)

Unit = °C, description = estimated value			
Domain	Area	Element	Value
Temperature change on land	World	Temperature change	1.70
	Africa		0.83
	Americas		2.91
	Asia		1.07
	Europe		1.84
	Oceania		0.24

Source: FAOSTAT/DATA/ET [1].

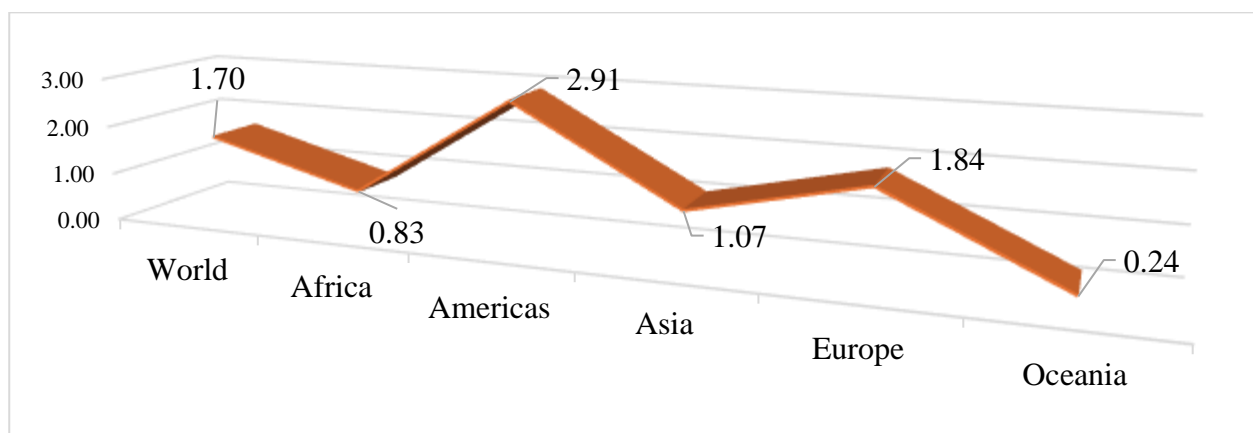


Fig. 2. Dry temperature changes by region (January 2023) (°C)

Source: Own design based on the data from FAOSTAT [1].

The global average temperature rose by 1.70°C, signaling significant warming with potential impacts on ecosystems, agriculture, and human life.

The Americas saw the highest increase, 2.91°C, intensifying extreme weather and affecting water resources and biodiversity.

Europe (+1.84°C) and Asia (+1.07°C) also recorded notable increases, posing challenges

for agriculture, public health, and biodiversity. Africa (+0.83°C) and Oceania (+0.24°C) experienced smaller rises, but their vulnerability to climate change makes even modest increases impactful.

Rising temperatures highlight the need for stronger climate policies, tailored solutions, and efforts to boost community resilience.

Table 2. Dry Temperature changes in various regions of the world (March 2023)

Unit = °C, description = estimated value			
Domain	Area	Element	Value
Temperature change on land	World	Temperature change	2.12
	Africa		1.38
	Americas		1.09
	Asia		3.22
	Europe		4.07
	Oceania		0.91

Source: FAOSTAT/DATA/ET [1].

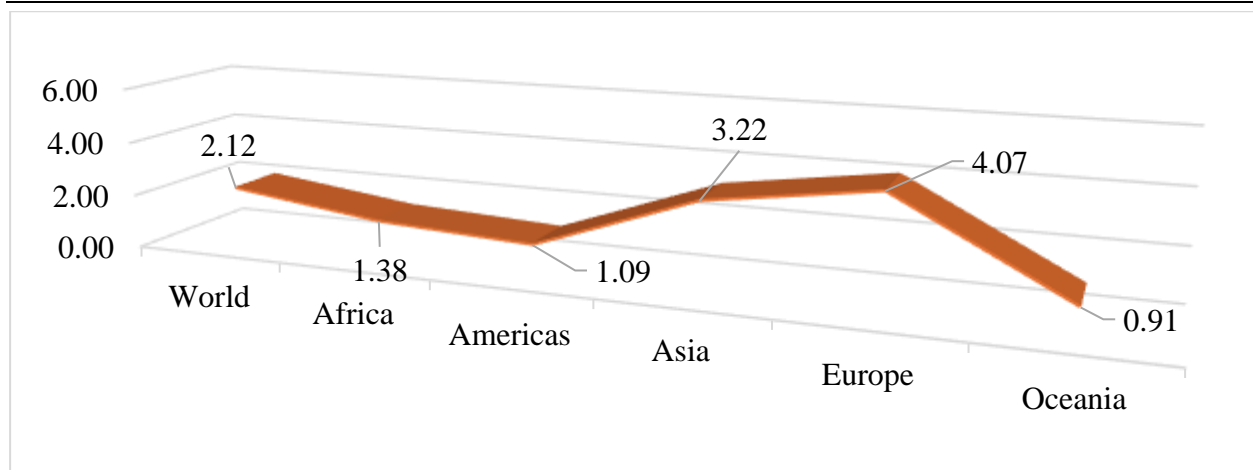


Fig. 3. Dry temperature changes by region (March 2023).
 Source: Own design based on the data from FAOSTAT [1].

This table and graph show temperature changes in different regions of the world for March 2023. The table provides exact temperature increase values, while the graph visually represents the data to make it easier to understand trends. The graph highlights how Europe experienced the largest

temperature rise (4.07°C), followed by Asia (3.22°C), while Oceania had the smallest increase (0.91°C). The inclusion of the graph helps to quickly see the ascending and descending order of temperature changes across regions.

Table 3. Dry Temperature changes in various regions of the world (June 2023)

Unit = °C, description = estimated value			
Domain	Area	Element	Value
Temperature change on land	World	Temperature change	1.54
	Africa		1.45
	Americas		1.59
	Asia		1.66
	Europe		1.57
	Oceania		1.01

Source: FAOSTAT/DATA/ET [1].

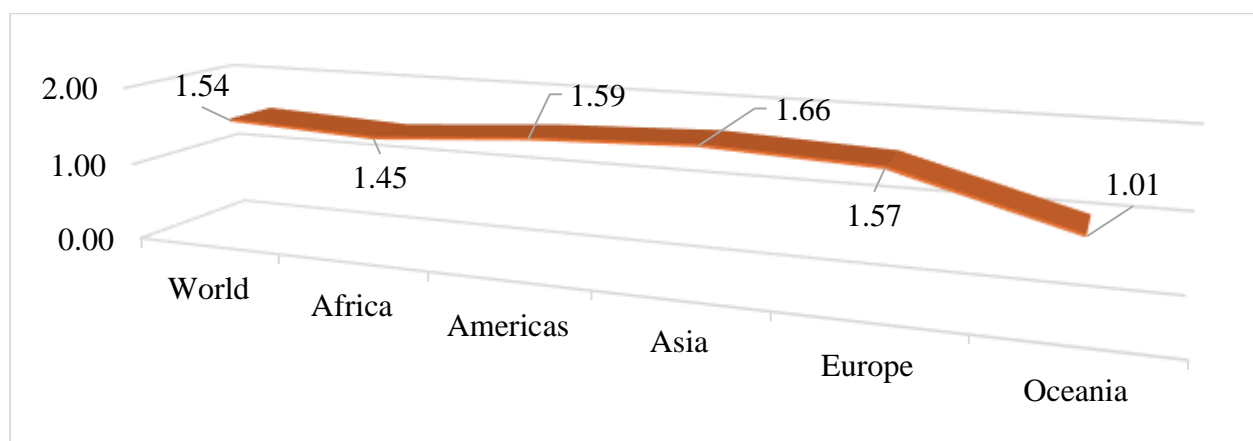


Fig. 4. Dry temperature changes by region (June 2023).
 Source: Own design based on the data from FAOSTAT [1].

This table and graph present temperature changes across global regions for June 2023. The table provides exact values, with the global average increase at 1.54°C. Asia recorded the highest rise at 1.66°C, followed closely by Europe (1.57°C) and the Americas

(1.59°C). Africa (1.45°C) and Oceania (1.01°C) showed smaller increases.

The graph complements the table by visually showing the slight variations in temperature increases, making it easier to see the trends across regions. Together, they highlight the uneven effects of climate change worldwide.

Table 4. Dry Temperature changes in various regions of the world (September 2023)

Unit = °C, description = estimated value			
Domain	Area	Element	Value
Temperature change on land	World	Temperature change	2.14
	Africa		1.74
	Americas		2.48
	Asia		1.87
	Europe		2.3
	Oceania		2.32

Source: FAOSTAT/DATA/ET [1].

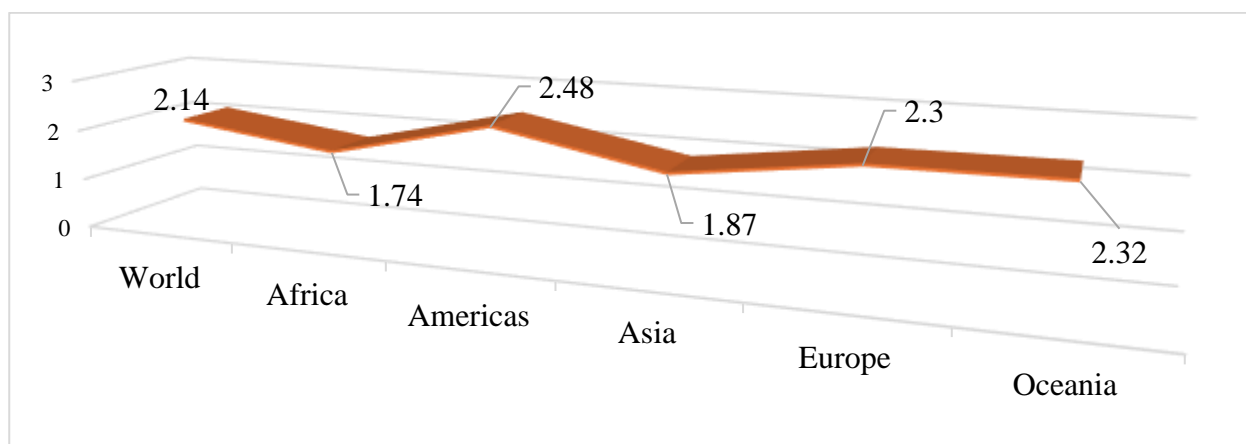


Fig. 5. Dry temperature changes by region (September 2023)

Source: Own design based on the data from FAOSTAT [1].

In September 2023, the global temperature increased by 2.14°C. This marks a return to the higher values observed in the earlier months of the year, emphasizing the seasonal variability of global warming (Table 4, Figure 5).

Africa recorded a temperature increase of 1.74°C, which is higher than in June. This indicates an intensification of the effects of climate change on the continent, which is already experiencing droughts and water shortages.

The Americas saw a 2.48°C increase, the highest on record this year for the region. This increase may contribute to worsening extreme

weather events such as hurricanes and wildfires.

Asia saw an increase of 1.87°C, confirming the continuing warming trend. This can affect vital crops and cause extreme events such as floods and heat waves.

Europe has seen an increase of 2.3°C, one of the largest regional increases. This may lead to significant disruptions in agriculture, water resources and public health.

Oceania recorded an increase of 2.32°C, significantly higher than in June. This can affect marine and terrestrial ecosystems, contributing to coral bleaching and other ecological changes.

September temperature rises coincide with the harvest season in many regions, affecting crop yields and crop quality. Farmers need to adjust their practices to cope with these conditions.

Cities in the most affected regions, such as Europe and the Americas, need to invest in resilient infrastructure to cope with heat waves and ensure the thermal comfort of their residents.

Table 5. Dry Temperature changes in various regions of the world (December 2023)

Unit = °C, description = estimated value			
Domain	Area	Element	Value
Temperature change on land	World	Temperature change	2.44
	Africa		1.49
	Americas		4.17
	Asia		2.02
	Europe		1.09
	Oceania		1.57

Source: FAOSTAT/DATA/ET [1].

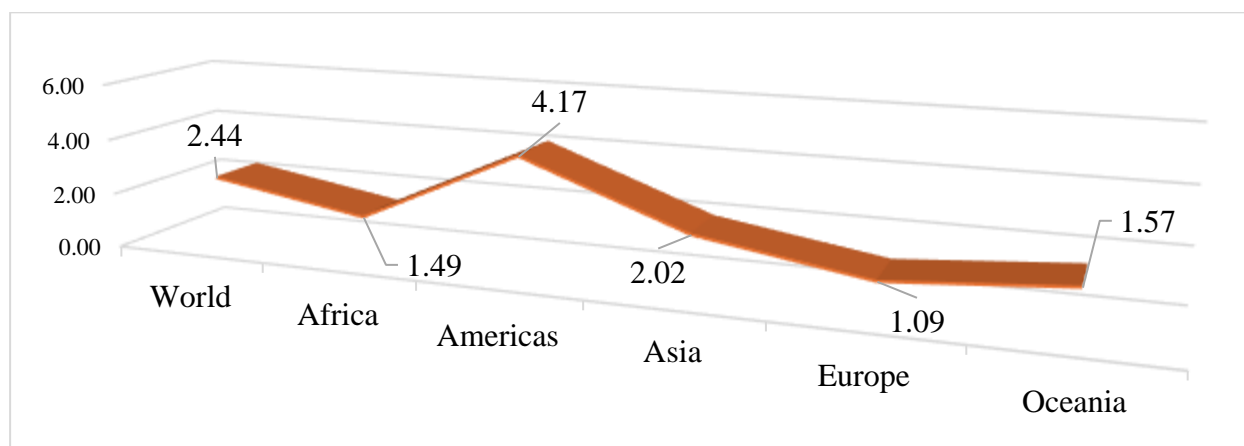


Fig. 6. Dry temperature changes by region (December 2023).

Source: Own design based on the data from FAOSTAT [1].

This table and graph present temperature changes across global regions for December 2023. The table shows the highest global average increase at 2.44°C, with the Americas recording the largest regional rise of 4.17°C. Asia follows with a 2.02°C increase, while Africa (1.49°C), Oceania (1.57°C), and Europe (1.09°C) show smaller but still significant changes.

The graph visually emphasizes the sharp increase in the Americas compared to other regions, making it easier to understand the magnitude and distribution of these changes. Together, they highlight the uneven impacts of climate change and the need for region-specific solutions.

Ways to address temperature changes

The dramatic changes in temperature, highlighted by significant increases in various regions of the world in 2023, call for effective strategies to balance and combat their effects. Here are some unique and innovative strategies:

S₁. Implement urban green infrastructure

Cities can reduce the urban heat island effect by developing green infrastructure such as green roofs, green walls and extensive urban parks. These solutions not only reduce local temperatures but also improve air quality and provide recreational spaces for residents.

S₂. Agroforestry and sustainable reforestation

Tree planting and agroforestry development in agricultural areas can help stabilize local microclimates and reduce extreme temperatures. This not only protects soil and conserves water, but also provides shade and habitat for biodiversity.

S₃). *Advanced irrigation and water management systems*

Implementing smart irrigation systems, which use sensors to monitor soil moisture and optimize water use, can help combat the effects of drought and maintain plant health in high temperatures.

S₄). *Promoting renewable energy*

The transition to renewable energy sources, such as solar, wind and geothermal, can reduce greenhouse gas emissions and mitigate the human contribution to climate change. Investments in green energy infrastructure are essential for a sustainable future.

S₅). *Ecosystem restoration schemes*

Restoring degraded ecosystems, such as wetlands and forests, can help absorb carbon dioxide and moderate local temperatures. Ecological restoration projects help make ecosystems more resilient to climate change.

S₆). *Climate education and awareness*

Educating the public about the impacts of climate change and what they can do to help mitigate it is crucial. Awareness campaigns and educational programs can change

behavior and encourage individual and collective action.

S₇). *Use of reflective building materials*

In urban areas, the use of reflective construction materials for roads and buildings can reduce heat absorption and contribute to lower ambient temperatures. It can also reduce energy needs for cooling in summer.

S₈). *Integrated public policies and international collaboration*

Governments must adopt integrated public policies that address climate change from multiple perspectives: economic, social and environmental. International collaboration is essential to share knowledge and resources and to coordinate global efforts to tackle climate change.

S₉). *Adopting passive cooling technologies*

In architecture, the adoption of passive cooling technologies, such as natural ventilation and the use of thermally efficient materials, can help to maintain thermal comfort in buildings without requiring high energy consumption.

S₁₀). *Climate monitoring and prediction systems*

The development and use of advanced climate monitoring and prediction systems can help to anticipate extreme climatic events and adequately prepare communities. These systems can provide essential data for informed decision-making.

S.W.O.T. Analysis

Table 6. The S.W.O.T. analysis of efforts to balance and combat dramatic temperature changes

Strengths	Weaknesses
Climate change is a global priority, driving policies and action. Technologies like renewable energy and smart irrigation offer real solutions. Partnerships between countries strengthen efforts to combat climate change.	High upfront costs make green solutions less accessible. Many regions, especially developing ones, lack access to sustainable technologies. Unique regional challenges complicate global strategies.
Opportunities	Threats
Rising demand for green products creates jobs and drives innovation. Funding for sustainable projects makes green solutions more achievable. Climate monitoring systems can boost resilience to extreme weather.	Extreme weather events increasingly damage communities and infrastructure. Economic issues like poverty limit adoption of sustainable practices. Political instability can weaken long-term climate efforts.

Source: Own determination.

By tackling weaknesses and threats while leveraging strengths and opportunities, we can create effective strategies to fight climate change and build a sustainable future. This S.W.O.T. analysis offers a clear overview of the key challenges and opportunities in global climate action, as summarized in Table 6.

CONCLUSIONS

The 2023 data shows significant temperature increases, such as +4.17°C in the Americas, highlighting the urgent need to address climate change as it disrupts ecosystems, economies, and daily life globally.

Each region faces unique challenges-extreme weather in the Americas or agriculture adaptation in Asia and Europe-requiring local strategies alongside global efforts.

Green infrastructure, renewable energy, ecosystem restoration, and agroforestry are essential for reducing emissions and stabilizing climates.

The data confirms that climate change demands immediate and creative solutions. By acting decisively, we can protect the planet and secure a sustainable future for generations to come.

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