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Temporal and Spatial Variation of Climatic Comfort Zone Boundaries during Winter and Summer Seasons in Iraq

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Abstract

The study examines the temporal and spatial variation of climatic comfort zone boundaries during the winter and summer seasons in Iraq. The results indicate that during the month of December, there was a region of mild cold climate in the stations of Mosul and Kirkuk, with the percentage area of the mild cold region being 6.0% in the first period. In the second period, this percentage decreased to 2.7%. Additionally, a region of moderate (comfortable) climate appeared, covering 94.0% of the area in the first period, which increased to 97.3% in the second period. In January, the mild cold climate region accounted for 7.7% of the area in the first period, and the area decreased by 1.4% in the second period. The moderate comfortable region occupied 92.3% in the first period and increased to 98.6% in the second period. Notably, January, representing the middle of winter, showed minimal variations between the two study periods in terms of the comfort zone regions.Regarding the summer months, the mild cold climate region appeared in June, accounting for 4.3%. In the second period, it was limited to only two stations, Mosul and Kirkuk, with a percentage of 1.0%. The moderate climate region covered 95.7% of the area. In July, three stations fell within the hot region during the first period, accounting for 9.7%. However, in the second period, these stations shifted towards higher values, moving to the very hot region. The very hot region during the first period included five stations (Baghdad, Hay, Diwaniyah, Nasiriyah, Basra), covering a large area of 395,815.4 km2 and occupying 90.3% of the region. In the second period, all stations shifted to the very hot region, resulting in a significantly wider area of 438,295 km2, accounting for 100% of the region. These logical results indicate a trend towards increasing temperatures in Iraq.

Keywords*: Indicator, Comfort, Stress, Regions.*

Introduction

The world in general and Iraq in particular have witnessed rapid climate changes that have led to a significant increase in temperatures. This is a result of industrial activities and excessive exploitation of natural environmental resources, which has resulted in an increase in greenhouse gas concentrations in the atmosphere (Ni, Sun, Meng, Zhang, & Yang, 2022; Al Thuwaini et al., 2022). This has directly impacted human activities and vitality. It has become evident that climate change and its fluctuations, especially through extreme phenomena, pose a real burden on the environment, which provides humans with clean air and comfort. It constantly threatens human well-being. It is expected that the effects of climate change will increase in the coming years and decades based on current trends.

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Research Problem

Is there a change in the boundaries of climatic comfort zones in Iraq? (Koptleuova, Khairzhanova, Jumagaliyeva, Baiseuova, & Kurmangalieva, 2022)

Research Hypothesis

There is a change in the boundaries of climatic comfort zones in Iraq, and this is considered one of the negative outcomes of climate change in Iraq (Sopandi et al., 2023; Busroh & Khairo, 2023).

Research Objective

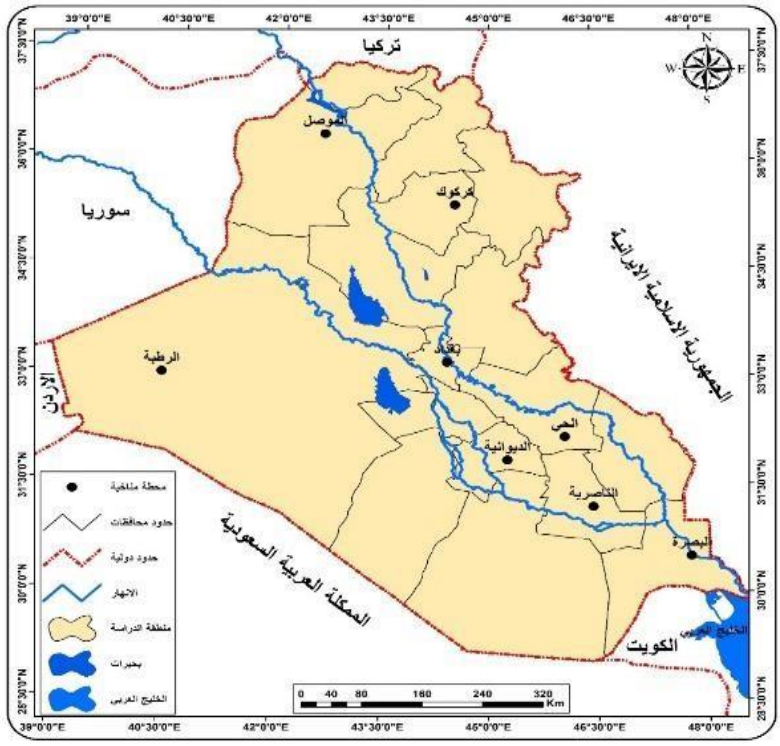
The research objective is to determine the climatic comfort zones in Iraq during specific study periods, specifically focusing on the first and second periods. The aim is to elucidate the disparities between these periods and provide an analysis of the extent of changes in the boundaries of the comfort zones. This will be accomplished by assessing the area of each zone during the first period and contrasting it with its transformation during the second period. (Al Doghan & Sadiq, 2023)

Scope of the Research Area

The study area is represented by Iraq, which is astronomically located between the latitudes ((05°29' - 23°37' N) and longitudes ((45°38' - 45°48' E). Please refer to Map (1) and Table (1) for further details. Geographically, Iraq is situated in the southwestern part of the Asian continent. It is bordered by Turkey to the north, Iran to the east, the Arabian Gulf and Kuwait to the southeast, Syria to the northwest, Jordan to the west, and Saudi Arabia to the south and southwest. Iraq encompasses five inland water bodies, namely the Arabian Gulf, the Mediterranean Sea, the Red Sea, the Black Sea, and the Caspian Sea. Some of these bodies of water are connected to Iraq, such as the Arabian Gulf, while others are located further away and are separated by high mountains and plateaus, which prevent their influences on Iraq's climate. Consequently, the impact of some bodies of water is extremely limited and does not extend beyond their coastal areas. This is particularly true for those bodies of water separated by high mountains and plateaus, such as the Taurus Mountains and the Anatolian Plateau with respect to the Black Sea, and the Zagros Mountains and the Iranian Plateau with respect to the Caspian Sea. Therefore, the climate of Iraq is characterized by its continental nature and the limited maritime influences on its climate. (Nazem et al., 2023)

Applications in the field of human biometeorology require relevant assessments of the thermophysiological aspects of the atmospheric environment. Despite the availability of numerous models today, they are generally deemed unacceptable or their applicability is limited to a narrow range of environmental conditions. For humans, it is essential to maintain a core body temperature within a narrow range of approximately 37°C to ensure the proper functioning of internal organs and the brain, thereby enhancing comfort, performance, and health. (Kurniawan et al., 2022; Zeng & Li, 2022)

Figure (1): Meteorological stations included in the study



Source: Ministry of Transport, General Authority for Iraqi Meteorology and Seismic Monitoring, Climate Atlas of Iraq (1961-1990), Baghdad, pg. 5.

In 1999, the International Society of Biometeorology (ISB) established a committee called "Universal Thermal Climate Index (UTCI) Development" with the aim of deriving a global thermal stress index based on the most physiological thermal models. Notably, the European Cooperation in Science and Technology (COST) program made significant efforts in developing this index, particularly through its project number 730 in 2005. These endeavors were further enhanced by a group of prominent experts in the fields of human thermal physiology, physiological modeling, meteorology, and climatology. Their collective efforts culminated in the successful establishment of the current model for the Universal Thermal Climate Index (UTCI) in 2009. (Fatimah, Sridadi, Agustina, Yuliardani, & Utomo, 2022)

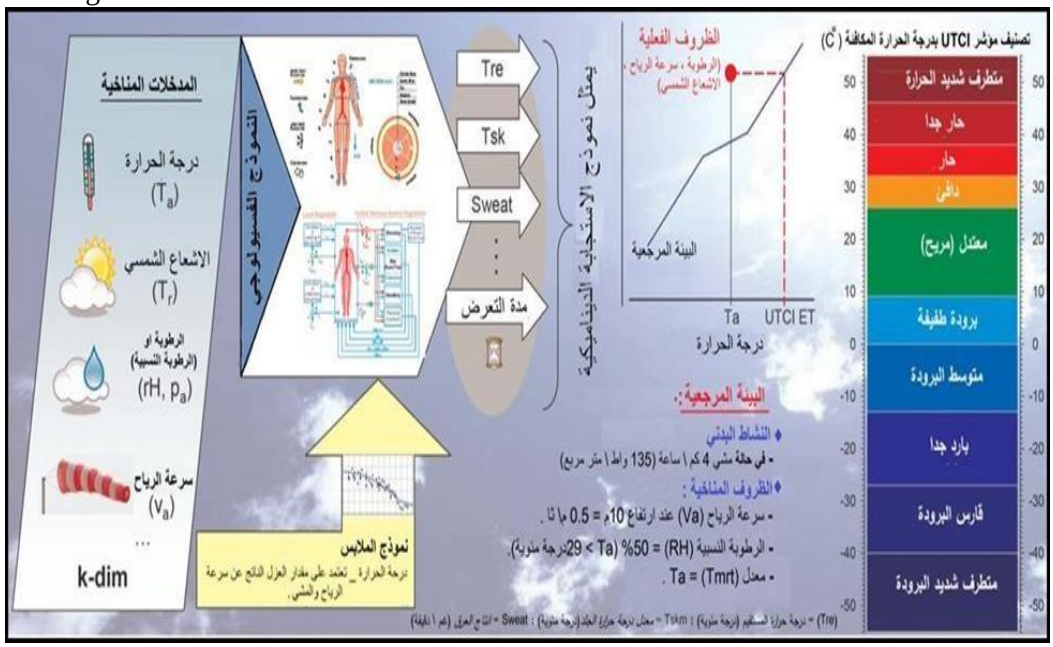
The global thermal climate index (UTCI) is applied according to the guidelines depicted in Figure 1 and the following mathematical equation (Błażejczyk et al., 2013):

UTCI = (Ta; Tmrt; va; vp) = Ta + Offset (Ta; Tmrt; va; vp)

Where:

Ta represents the ambient temperature or air temperature.
Tmrt denotes the average radiant temperature or solar radiation.
Va signifies the wind speed at a height of 2 meters, converted from 10 meters to 2 meters by multiplying the wind speed values by 0.78.
Vp represents the water vapor pressure or relative humidity.

Figure (2): The climatic requirements for the UTCI index and the actual dynamic response resulting from different conditions



Source: Bröde et al., (2010).

To calculate the global thermal climate index (UTCI) Software excel is designed to facilitate its calculation and extract its results easily, as shown in Figure (2).

Figure (3): The formula for calculating the global thermal climate in a programExcel

Input Data:				البيانات المدخلة:
Ambient temperature(C)	24.6			درجة الحرارة المحيطة (م) = درجة حرارة الهواء (م)
Globe temperature (C)		or Solar Radiation (w/m^2)	512.2	الحرارة الاشعاعية (م) او الاشعاع الشمسي (واط/م٢)
Dew point (C)		or Relative Humidity (%)	40.7	نقطة الندى (م) او الرطوبة النسبية (%)
Wind Speed (m/s)	3.0			سرعة الرياح (م/ثا) على ارتفاع ١٠ متر
Output:				النتائج
UTCI	29.5	Needs ambient temperature, globe temperature OR solar radiation, dew point OR relative humidity and wind speed.		UTCI = مؤشر المناخ الحراري العالمي
WBGT(outdoors)	20.5	Needs ambient temperature, globe temperature OR Solar radiation, dew point OR relative humidity and wind speed.		
WBGT(indoors)	18.7	Needs ambient temperature, dew point OR relative humidity and wind speed.		
Mean Radiant Temperature	55.8			
Formulas:				
WBGT(indoor)	WBGTi = 0.67 * Tnwb + 0.33 * Ta - 0.048 * Log(ws) * (Ta - Tnwb) using the Bernard method and for indoor windspeeds up to 3m/s			
	Where Tnwb (natural wet bulb temperature) is calculated from Td by iteration, ws is the wind speed and Ta = ambient temperature.			
WBGT(outdoor)	WBGTo = 0.7 * Tnwb + 0.2 * Tg + 0.1 * Ta using the Liljegren method to calculate Tg and Tnwb			
	Where Tnwb (natural wet bulb temperature) is calculated from Td by iteration, Tg = globe temperature, Ta = ambient temperature.			
UTCI	Is given by the regression equation found at www.utci.org			

Source: The researcher based on a programExcel.

Table (1): Description of Global Thermal Climate Index values (UTCI*

The description	The value
Extreme heat	higher than 46
Strong heat	37.1-46
hot	31.1-37
warm	25.1-31
moderate ()	8.1-25
slight coolness	0-8
Moderate cold	(1- , 13-)
Strong cold	(13.1-, 27-)
Very strong cold	(27.1-, 40-)
Extreme cold	less than (40-)

Sources: (Pecelj, et al. 2020, p. 5)

Results of the application of the Universal Thermal Climate Index (UTCI)

First: Winter Season

December

Upon analyzing the Global Thermal Climate Index during the month of December, it becomes evident that there is a clear spatial variation among the stations within the study area. Additionally, there is a temporal variation between the two study periods, as observed from Table 2 and Map 2, indicating distinct differences in the regions of the Global Thermal Climate Index during the secondary study period. This can be clarified as follows:

Both the first and second periods exhibited a noticeable variation in values, encompassing a region of slight cold climate in the stations of Mosul and Kirkuk. The area of the slight cold region reached 26,225.89 square kilometers, accounting for 6.0% during the first period. In the second period, the same region prevailed in the same stations but with different values, tending towards an increase. The area occupied was 11,713.7 square kilometers, representing 2.7%. Additionally, the moderate (comfortable) climate region appeared during the first period in six stations (Baghdad, Ar Rutbah, Al Hayy, Ad Diwaniyah, An Nasiriyah, Al Basrah) with varying values. It covered an area of 412,069.1 square kilometers, accounting for 94.0%. In the second period, this region included the same stations, but the values tended towards an increase, indicating rising temperatures. The area recorded was 426,581.3 square kilometers, representing a higher percentage compared to the first period at 97.3%.

From this month's data, it is evident that the changing conditions are characterized by a convergence of temperature variations. There is a minimal spatial difference in the comfort region, while the moderate region slightly expands into the slight cold region.

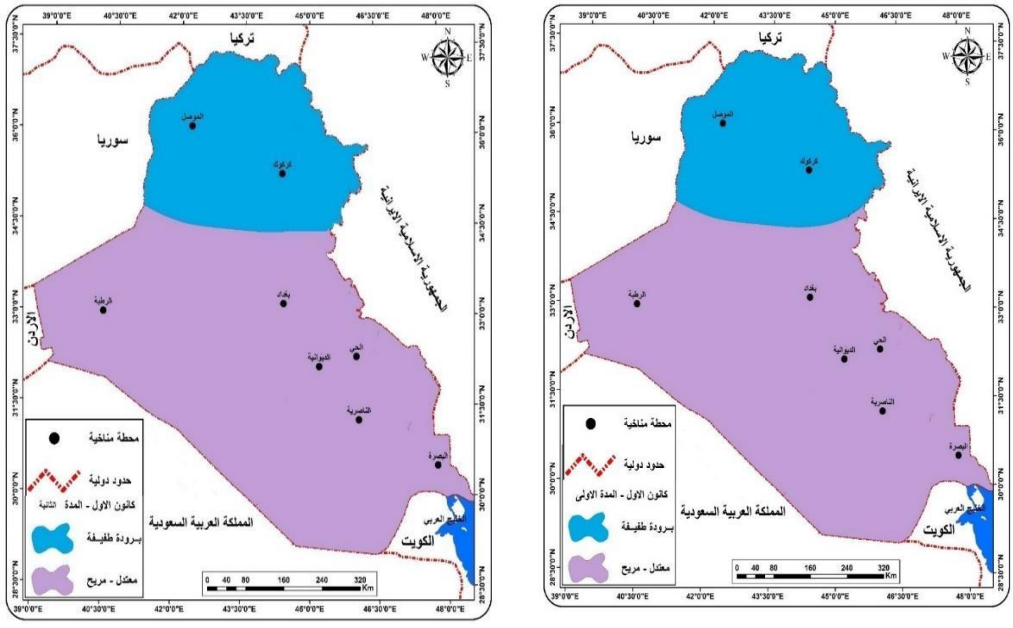
January

Through the analysis of the Global Climate Index during the month of January, it becomes evident that there is a clear spatial variation among the stations in the study area. Furthermore, there is a temporal variation between the two study periods, as observed from Table 3 and Map 3, which indicate distinct differences in the regions' Global Climate Index. This can be clarified as follows:

* The colors in the table are the same colors in the original foreign research, so they were adopted in drawing the map as well.

In both the first and second periods, there was a variation in values, encompassing a slight cool climate region between the stations (Mosul, Kirkuk, Al-Rutbah) with values ranging from 7.5 to 7.9. The area of this

Figure (4): Universal Thermal Climate Index (UTCI) during the month of December for the first and second study periods**.**



Source: The Ministry of Transport, the Iraqi General Authority for Meteorology and Seismic Monitoring, Atlas of the Climate of Iraq (1961-1990), Baghdad, and the data of Table (2) and the ProgramArcGIS 10.8.

Table (2): The area (km 2) and the percentage (%) of the thermal comfort regions in Iraq during the month of December

Region	First term			Second term		
	weather stations	The ratio percentile %	Space km2	weather stations	The ratio percentile %	Space km2
slight cold	Mosul Kirkuk	6.0	26225.89	Mosul Kirkuk	2.7	11713.7
Moderate Cold (comfortable)	Baghdad Rutba District Diwaniyah Nassiriya Basra	94.0	412069.1	Baghdad Rutba District Diwaniyah Nassiriya Basra	97.3	426,581.3
Total	-	100	438,295	-	100	438,295

Source: The researcher based on map (2) and programArcGIS 10.8.

Region during the first period was 33,709.23 km², occupying 7.7% of the total area. It is noteworthy that the area decreased during the second period, covering only two stations

(Mosul, Kirkuk) with varying values. The area within this region extended approximately 6,066.1 km², representing 1.4% of the total area.

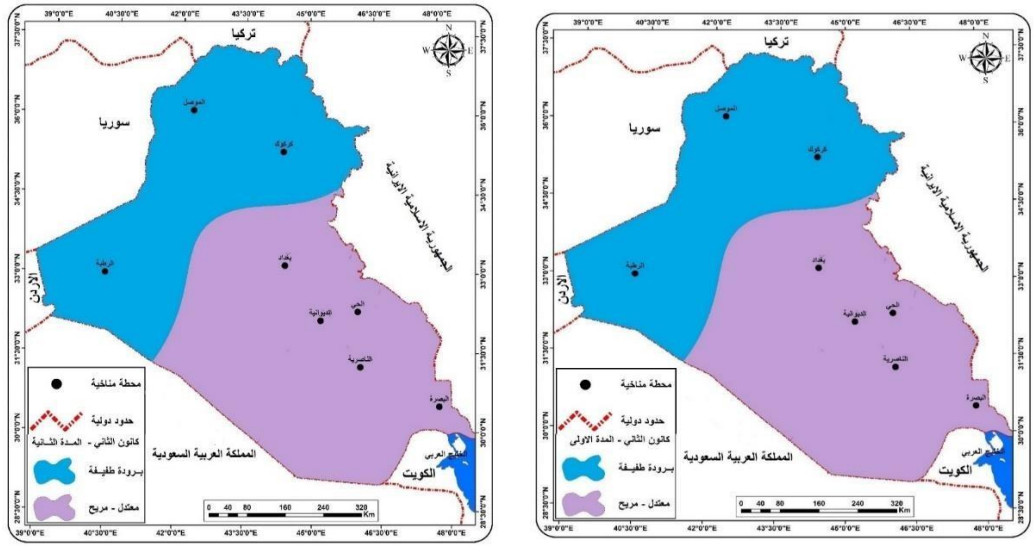
As for the moderate and comfortable region, it included the stations (Baghdad, Al-Hay, Al-Diwaniyah, Al-Nasiriya, Basra), but with varying values. The area occupied by this region reached 438,295 km², accounting for 92.3% of the total area. It is also evident that this region expanded to a larger extent, encompassing the stations (Baghdad, Al-Rutbah, Al-Hay, Al-Diwaniyah, Al-Nasiriya, Basra) with an area of 432,228.9 km², representing 98.6% of the total area.

It is apparent that the month of January, which represents the middle of winter, also experienced minimal variations between the two study periods in the comfort climate regions. When compared to the changes in autumn, the differences between the two periods are almost negligible in terms of magnitude.

February

Through the analysis of the Global Climate Index during the month of February, it is evident that there is a clear spatial variation among the stations in the study area. Additionally, there is a temporal variation between the two study periods, as observed from Table 4 and Map 4, which indicate distinct differences in the regions' Global Climate Index. This can be further clarified as follows: Regarding the second study periods, the first period included the stations (Mosul, Kirkuk, Al-Rutbah), which were within the region of slight cold climate. The area covered during this period was 18,729.9 km², representing 4.3% of the total area. In the second period, it was limited to only two stations (Mosul, Kirkuk), accounting for 1.0% of the total area. As for the moderate climate region, it encompassed the remaining stations (Baghdad, Al-Hay, Al-Diwaniyah, Al-Nasiriya, Basra) with an area of 419,565.1 km², representing 95.7% of the total area. In the second period,

Figure (5): Global heat index (UTCI) during the month of January for the first and second terms



Source: The Ministry of

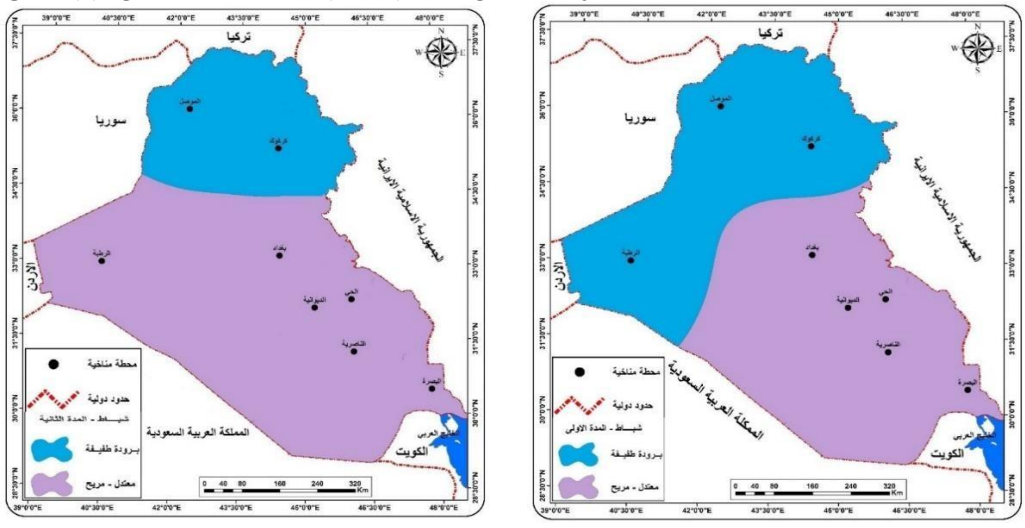
Table (3): Area (km2) and percentage (%) of the thermal comfort regions in Iraq during the month of January

Region	First term			Second term		
	weather stations	The ratio percentile %	Space km2	weather stations	The ratio percentile %	Space km2
slight cold	Mosul Kirkuk Rutba	7.7	33,709.23	Mosul Kirkuk	1.4	6066.1
Moderate Cold (comfortable)	Baghdad District Diwaniyah Nassiriya Basra	92.3	404,585.8	Baghdad Rutba District Diwaniyah Nassiriya Basra	98.6	432228.9
Total	-	100	438,295	-	100	438,295

Source: The researcher based on Map (3) and the programArcGIS 10.8.

The same stations, along with Al-Rutbah station, were included in this region, which witnessed an area of 434,117.6 km², accounting for 99.0% of the total area. By examining the explanations for the change in the winter comfort region, it is notable that the month of February experienced a greater change compared to the months of December and January. This change manifested spatially as a contraction of the slight cold climate region and an expansion of the moderate temperature region. This significant change was observed predominantly in western Iraq and parts of the northern central region.

Figure (6): global heat index (UTCI) during February for the first and second terms



Source: The Ministry of Transport, the Iraqi General Authority for Meteorology and Seismic Monitoring, Atlas of the Climate of Iraq (1961-1990), Baghdad, and the data of Table (4) and the ProgramArcGIS 10.8.

Table (4): Area (km2) and percentage (%) of the thermal comfort regions in Iraq during the month of February

Region	First term			Second term		
	weather stations	The ratio percentile %	Space km2	weather stations	The ratio percentile %	Space km2

slight cold	Mosul Kirkuk Rutba	4.3	18729 .9	Mosul, Kirkuk	1.0	4177. 4

Source: The Ministry of

Region	First term			Second term		
	weather stations	The ratio percentile %	Space km2	weather stations	The ratio percentile %	Space km2
Moderate Cold (comfortable)	Baghdad District Diwaniyah Nassiriya Basra	95.7	419,565.1	Baghdad Rutba District Diwaniyah Nassiriya Basra	99.0	434,117.6
Total	-	100	438,295	-	100	438,295

Source: The researcher based on map (4) and programArcGIS 10.8.

Second: the summer season

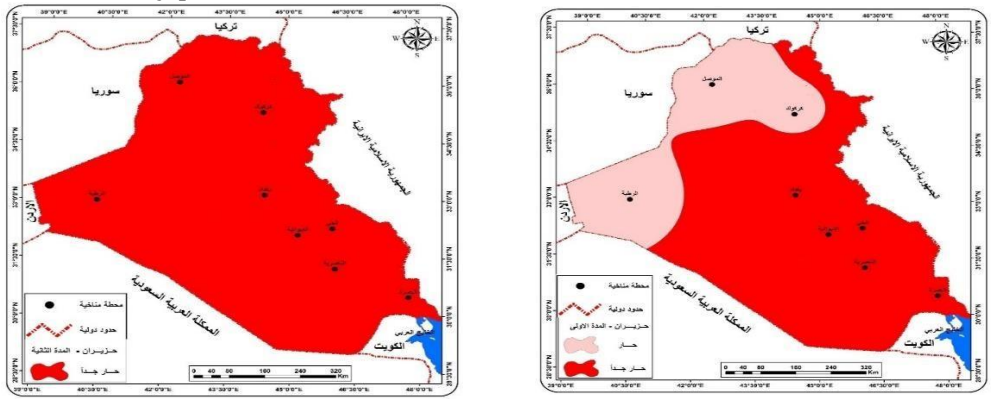
June

Through the analysis of the Global Climate Index during the month of June, it is evident that there is a clear spatial variation among the stations in the study area. Additionally, there is a temporal variation between the two study periods, as observed from Table 5 and Map 5, which indicate distinct differences in the regions' Global Climate Index. This can be further clarified as follows:

Regarding the first and second study periods, three stations fell within the hot region during the first period, covering an area of 42,479.6 km², representing 9.7% of the total area. However, in the second period, their values shifted towards higher temperatures, indicating a transition to the very hot region. As for the very hot region during the first period, it encompassed five stations (Baghdad, Al-Hay, Al-Diwaniyah, Al-Nasiriya, Basra) with a significant area of 395,815.4 km², occupying 90.3% of the total area.

As for the second period, all stations moved to the very hot region, so that the area became very wide and was at the rate of (438,295) km 2, at a rate of (100)%. This summer month witnesses that the conditions of summer heat are clear in a negative and significant manner during the second period compared to the first period, as the very hot region dominates all of Iraq after there was a spatial share of the hot comfort region, and this undoubtedly expresses the magnitude of climatic warming in summer.

Figure (7): Universal Thermal Climate Index (UTCI) during the month of June for the first and second study periods.



Source: The Ministry of Transport, the Iraqi General Authority for Meteorology and Seismic Monitoring, Atlas of the Climate of Iraq (1961-1990), Baghdad, and the data of Table (5) and the ProgramArcGIS 10.8.

Table (5): Area (km2) and percentage (%) of the thermal comfort regions in Iraq during the month of June

Region	First term			Second term		
	weather stations	The ratio percentile %	Space km2	weather stations	The ratio percentile %	Space km2
Hot	Mosul Kirkuk Rutba	9.7	424 79.6	-	-	-
Strong heat	Baghdad District Diwaniyah Nassiriya Basra	90.3	395, 815. 4	Mosul Kirkuk Baghdad Rutba District Diwaniyah Nassiriya Basra	100	438 ,29 5
Total	-	100	438, 295	-	100	438 ,29 5

Source: The researcher based on Map (5) and the programArcGIS 10.8.

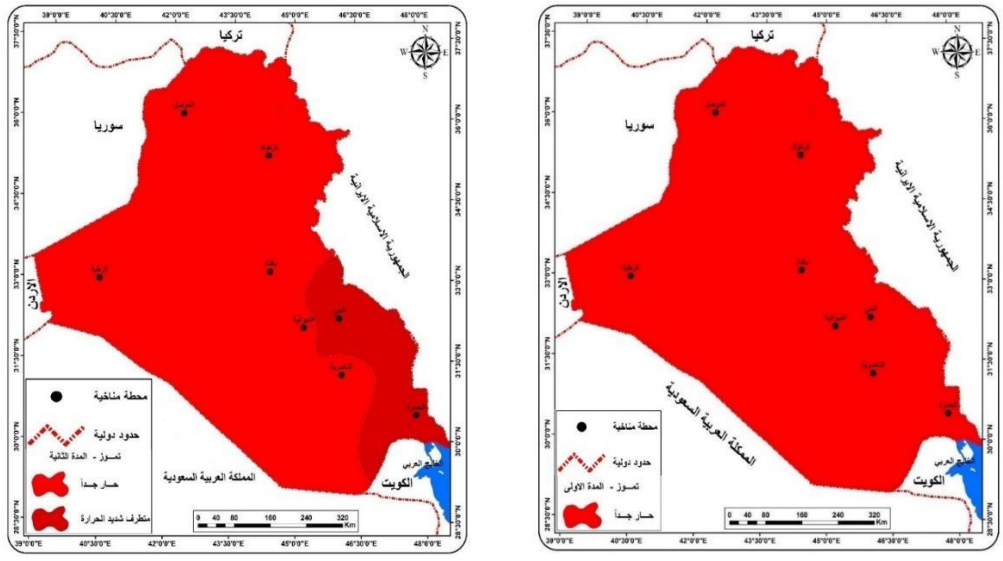
July

Through analyzing the Global Heat Climate Index during the month of July, it is evident that there is a clear spatial variation among the stations within the study area. Additionally, there is a temporal variation between the two study periods, as observed from Table 6 and Map 6, indicating distinct differences in the values of the Global Heat Climate Index across the secondary study periods. This can be further clarified as follows:

Both secondary study periods experienced variations in their values. All stations fell within the extremely hot region, covering an area of 4,382,295 square kilometers, accounting for 100% of the total area. It is worth noting that the values tended to increase during the second period, with most stations located within the extremely hot climate region, including Mosul, Tikrit, Baghdad, Diwaniya, and Nasiriyah, covering an area of 382,140.1 square kilometers, accounting for 87.2% of the total area. These stations were particularly close to the extremely hot and highly temperature-intensive region, with values of 45.4, 45.6, and 45.6, respectively, indicating a significant proximity to the Global Heat Climate Index value of the extremely hot region, which is 46.1. This region covered an area of 382,140.1 square kilometers, accounting for 87.2% of the total area.

The extremely hot climate region encompassed the stations of Al-Hayy and Basra, with values of 47.7 and 46.4, respectively, covering an area of 56,154.9 square kilometers, accounting for 12.8%. This month, which falls in the middle of summer, naturally ref lects the climate of Iraq, indicating that July is one of the uncomfortable months. However, it was not devoid of climatic changes and the spatial expansion of conditions related to tropical warming. The extremely hot climate region appeared spatially in southern Iraq, overlapping with the extremely hot region.

Figure (8): global heat index (UTCI) during the month of July for the first and second terms



Source: The Ministry of Transport, the Iraqi General Authority for Meteorology and Seismic Monitoring, Atlas of the Climate of Iraq (1961-1990), Baghdad, and the data of Table (6) and the ProgramArcGIS 10.8.

Table (6)T: area (km2) and percentage (%) of the thermal comfort regions in Iraq during the month of July

Region	First term			Second term		
	weather stations	The ratio percentile %	Space km2	weather stations	The ratio percentile %	Space km2
Strong heat	Mosul Kirkuk Baghdad Rutba District Diwaniyah Nassiriya Basra	100	438,295	Mosul Kirkuk Baghdad Rutba Diwaniyah Nassiriya	87.2	382140.1
Extreme heat	-	-	-	District Basra	12.8	56154.9
Total	-	100	438,295	-	100	438,295

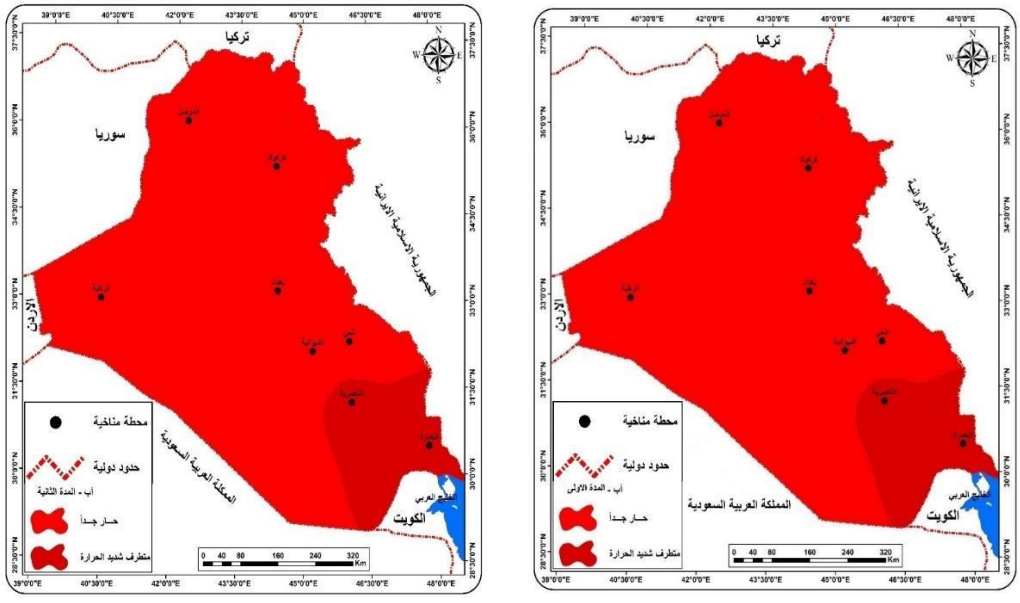
Source: The researcher based on map (6) and programArcGIS 10.8.

August

Through analyzing the Global Heat Climate Index during the month of August, it is evident that there is a clear spatial variation among the stations within the study area. Additionally, there is a temporal variation between the two study periods, as observed from Table 7 and Map 7, indicating distinct differences in the values of the Global Heat Climate Index across the secondary study periods. This can be further clarified as follows: During both the first and second periods, the extremely hot climate region prevailed in stations such as Mosul, Kirkuk, Baghdad, Rutbah, Al-Hayy, and Diwaniya, covering an area of 430,521.7 square kilometers, accounting for 98.2% of the total area. In the second period, it can be observed that the same stations occupied the same region, but with a tendency towards higher values, covering an area of 386,349.6 square kilometers, accounting for 88.1% of the total area. The extremely hot and highly temperature-intensive region covered a smaller area, including the stations of Nasiriyah

and Basra, spanning an area of 7,773.3 square kilometers, accounting for 1.8%. It is worth noting that these stations extended within the same region during the second period but with different areas and values, with an area of 51,945.39 square kilometers, accounting for 11.9%. Despite the lack of climatic comfort and dominance of the extremely hot region, the extremely hot climate region also becomes apparent in the south during the month of August. All these variations can be explained within the summer season or extending towards the autumn and spring seasons due to the magnitude of changes in the tropical atmospheric system, which continues to exert a strong influence on Iraq. This has contributed to the reduction of temperature conditions and the emergence of the hot and extremely hot climate region in the middle of summer.

Figure (9): Global heat index (UTCI) during the month of August for the first and second terms



Source: The Ministry of Transport, the Iraqi General Authority for Meteorology and Seismic Monitoring, Atlas of the Climate of Iraq (1961-1990), Baghdad, and the data of Table (7) and the ProgramArcGIS 10.8.

Table (7): Area (km2) and percentage (%) of the thermal comfort regions in Iraq during the month of August

Region	First term			Second term		
	weather stations	The ratio percentile %	Space km2	weather stations	The ratio percentile %	Space km2
Strong heat	Mosul Kirkuk Baghdad Rutba District Diwaniyah	98.2	430521.7	Mosul Kirkuk Baghdad Rutba District Diwaniyah	88.1	386,349.6
Extreme heat	Nassiriya Basra	1.8	7773.3	Nassiriya Basra	11.9	51,945.39
Total	-	100	438,295	-	100	438,295

Source: The researcher based on map (7) and programArcGIS 10.8.

Conclusions

1. The research findings indicate that the month of December included a region of slight cold climate in two stations (Mosul, Kirkuk), with a minor cold region covering 6.0% of the total area during the first period. However, the second period witnessed a decrease, reaching 2.7%. Additionally, a moderate and comfortable climate region occupied 94.0% of the area during the first period, which increased to 97.3% during the second period.
2. The study also revealed that the month of January included a slight cold climate region, accounting for 7.7% of the area, and the coverage decreased by 1.4% in the second period. The moderate and comfortable region occupied 92.3% during the first period and increased to 98.6% during the second period. It is evident that January, representing the middle of winter, also experienced minimal variations in the duration of the climatic comfort regions.
3. As for the summer months, a slight cold climate region appeared in June, representing 4.3% of the area. However, during the second period, it was limited to only two stations (Mosul, Kirkuk) with a coverage of 1.0%. The moderate climate region occupied 95.7%.
4. Furthermore, it is evident that in July, three stations were within the hot region during the first period, covering 9.7% of the area. However, they shifted towards higher temperatures during the second period, indicating an extremely hot region. In the first period, the extremely hot region included five stations (Baghdad, Al-Hay, Diwaniyah, Al-Nassiriya, Basra) with a substantial area of 395,815.4 km², occupying 90.3%. In the second period, all stations moved to the extremely hot region, resulting in a significantly larger area of 438,295 km², covering 100%. These logical results indicate a trend towards increasing temperatures in Iraq.

References

Al Doghan, M. A., & Sadiq, M. (2023). Effects of Emerging Technological Innovation on Carbon Dioxide Emissions: Examining the Moderating Role of Foreign Direct Investment. *International Journal of Economics and Finance Studies, 15*(3), 1-21. Retrieved from https://sobiad.org/menuscript/index.php/ijefs/article/view/1623

Al Thuwaini, S., Khan, M. N., Ahmad, S. R., Shabbir, M. S., Rehman, M. Z., & Khokhar, I. (2022). The effect of customer service quality on customer satisfaction in the Gulf Cooperation Council's Islamic Banking Industry. *Cuadernos de Economía, 45*(127), 20-31. Retrieved from https://cude.es/submit-a-manuscript/index.php/CUDE/article/view/212

Al-Dazii, S. A. K., Jawad, B. A., Hussein, A. A., (2007). Summer Rains (Sudden) in Iraq – A Study of the Total Climate. Al-Ustad Journal, University of Baghdad, College of Education, 61.

Błażejczyk, K., Jendritzky, G., Bröde, P., Fiala, D., Havenith, G., Epstein, Y., Psikuta, A., Kampmann, B. (2013). An introduction to the Universal Thermal Climate Index (UTCI). Geographia Polonica, 86(1).

Bröde, P., Jendritzky, G., Fiala, D., & Havenith, G. (2010). The Universal Thermal Climate Index UTCI in Operational Use. Windsor, UK, London.

Busroh, F. F., & Khairo, F. (2023). Fear-Based Law Enforcement (A Study of the COVID 19 Pandemic in Indonesia). *International Journal of Criminal Justice Sciences, 18*(2), 115-126. Retrieved from https://ijcjs.com/menu-script/index.php/ijcjs/article/view/692

De Blij, H. J., & Muller, P. O. (1996). Physical Geography of the Global Environment (2nd ed.). John Wiley & Sons.

Dix, H. M. (1981). Environmental Pollution: Atmosphere, Land, Water and Noise. Binghamton Ballon Press, Inc.

Fatimah, N., Sridadi, A. R., Agustina, T. S., Yuliardani, W. I., & Utomo, P. (2022). Does leadership matter in sustaining team performance during a crisis? The case of insurance companies in the Covid-19 era. *International Journal of Operations and Quantitative Management*, *28*(2), 563-575. Retrieved from https://submissions.ijoqm.org/index.php/ijoqm/article/view/103

Kaiser, D. P., & Qian, Y. (2002). Decreasing trends in sunshine duration over China for 1954–1998: indication of increased haze pollution. Environmental Pollution, 29(21), November.

Koptleuova, K., Khairzhanova, A., Jumagaliyeva, U., Baiseuova, G., & Kurmangalieva, A. (2022). Contrastive analysis of cross-linguistic interference of trilingual oil workers. *Eurasian Journal of Applied Linguistics*, *8*(1), 13-27. Retrieved from https://ejal.info/menuscript/index.php/ejal/article/view/123

Kurniawan, K., Supriatna, J., Sapoheluwakan, J., Soesilo, T. E. B., Mariati, S., & Gunarso, G. (2022). The analysis of forest and land fire and carbon and greenhouse gas emissions on the climate change in Indonesia. *AgBioForum*, *24*(2), 1-11. Retrieved from https://agbioforum.org/menuscript/index.php/agb/article/view/133

Lindsey, R., & Dahlman, L. (2021). Climate Change: Global Temperature. NOAA Climate.gov. Retrieved March 15, 2021, from https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature

McVicar, T. R., Roderick, M. L., Donohue, R. J., Li, L. T., Van Niel, T. G., Thomas, A., Grieser, J., Jhajharia, D., Himri, Y., Mahowald, N. M., Mescherskaya, A. V., Kruger, A. C., Rehman, S., Dinpashoh. (2012). Global review and synthesis of trends in observed Terrestrial near-surface wind speeds: Implications for evaporation. Journal of Hydrology.

Ministry of Transportation, General Authority for Iraqi Meteorology and Seismology. (Year). Climate Atlas of Iraq (1961-1990). Baghdad.

Nazem, S. N., Abid, M. M., Gdheeb, S. H., Altememy, H. A., Al Jouani, I. S. H., Mohsen, K. S., . . . Rasol, M. A. (2023). Cybersecurity Determinants in Iraq's Digital Workplace: Attitude, Policy, and Compliance Roles. *International Journal of Cyber Criminology*, *17*(2), 1-19. Retrieved from https://cybercrimejournal.com/menuscript/index.php/cybercrimejournal/article/view/184

Ni, H., Sun, Y., Meng, Y., Zhang, J., & Yang, Y. (2022). Effects of Psychiatric Issues and Early Enteral Nutrition Therapy on Anxiety and Quality-of-Life of Patients with Gastric Cancer. *American Journal of Health Behavior*, *46*(6), 595-599. doi:https://doi.org/10.5993/AJHB.46.6.1

Pecelj, M. M., Lukić, M. Z., Filipović, D. J., Protić, B. M., & Bogdanović, U. M. (2020). Analysis of the Universal Thermal Climate Index during heat waves in Serbia. Natural Hazards and Earth System Sciences, 20(7), 2021-2036.

Sopandi, E., Anwar, S., Habibah, N., Manurung, S., Alia, N., & Hendrawati, S. (2023). The Role of Digital Literacy and Its Relation with Performance of Madrasah Aliyah Students. *Eurasian Journal of Educational Research*, *104*(104), 16-32. Retrieved from https://ejer.com.tr/manuscript/index.php/journal/article/view/1221

Zeng, S., & Li, L. (2022). Analysis and Countermeasures of related factors between mental health and physical exercise of Law College Students. *Revista de Psicología del Deporte (Journal of Sport Psychology)*, *31*(1), 17-25. Retrieved from https://rpd-online.com/index.php/rpd/article/view/631