《2026 Virtual Science Symposium Report》

# Global Warming is Causing Summers in Kaohsiung, Taiwan, to Become Increasingly Hotter Based on GLOBE Observational Records


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## Abstract

This research investigates the effects of global warming on summer temperatures in Kaohsiung, Taiwan. By analyzing average temperature data from May to July over a seven-year period (2018–2024), the study aims to determine whether there is a significant warming trend both globally and locally. The global temperature data is first examined to identify any general patterns of increasing summer heat. Then, the study focuses specifically on Kaohsiung, analyzing whether the same warming trend is evident. Finally, a comparison between global and local data is conducted to explore the relationship between global climate change and its specific impact on Kaohsiung. The findings provide evidence to better understand how global warming may be influencing regional climates, especially in subtropical cities like Kaohsiung. If the temperature continues to rise, what will Taiwan look like by the end of the century?


## Introduction of Literature

Taiwan will have no winter in the future, and summer will be extended to 7 months. After climate change has led to dramatic changes in the environment, we often hear news about "record-breaking rainfall" or "once-in-a-century drought". Extreme climate events are becoming more frequent, and humans will encounter many difficulties in adapting.

Is there a potential crisis in Taiwan's future governance? The answer is yes.

The climate system has been changed and is no longer the environment we are familiar with. Taiwan will have "no winter" as early as 2050. This means that days with long-term temperatures below 10°C will completely disappear.

The first "National Climate Change Science Report" released by the International Climate Development Think Tank in 2024 mainly predicts Taiwan's future climate change as follows:

1. The number of typhoons will decrease, but their intensity will increase;

2. The number of consecutive days without rainfall will increase, the intensity and frequency of drought events will increase, but extreme rainstorms will become the new normal.

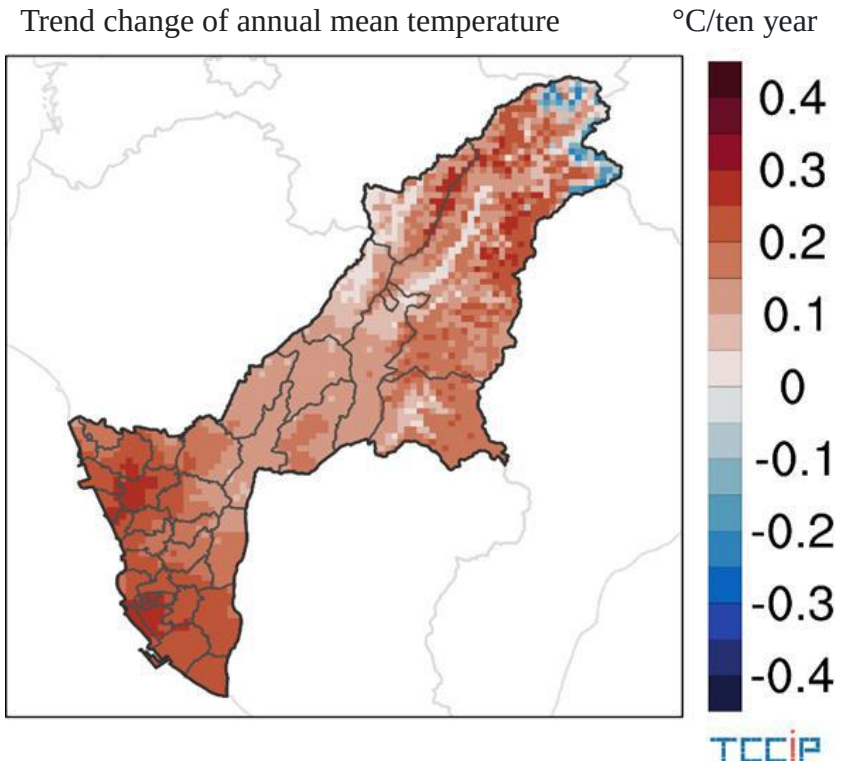
The global average temperature change shows that the global temperature has gradually increased since 1850, and the global average temperature has increased sharply since 1980, with frequent heat waves around the world. The National Climate Change Science Report 2024 pointed out that the annual average temperature in Taiwan has risen by 1.5℃ in the past 100 years (1900 to 2022), and the warming trend in summer and winter is the same as the annual average, which is 1.5℃/100 years. The long-term change of temperature in Taiwan is similar to the change characteristics of the global average temperature. The annual average temperature has never been lower than 24.2 degrees Celsius since 2015. From 2015 to 2020, it has repeatedly broken past high temperature records. The summer of 2020 is the hottest season in the history of the Central Meteorological Administration.

In 2090, Taiwan’s average temperature could rise by 4.5°C from pre-industrial levels, and even in the most optimistic scenario, it could rise by 2°C. Densely populated urban areas will

experience even greater warming due to the heat island effect.

The United Nations' State of the Global Climate 2023 report and the European Union's climate monitoring agency Copernicus Climate Change Service's Global Climate highlights 2023 both point out that 2023 has surpassed the high temperature records of 2016 and 2020, becoming the warmest year since 1850, with a warming of nearly 1.5°C (1.45 ± 0.12°C).

Kaohsiung City is geographically vast, with a total area of 2,951.85 square kilometers. It is the largest city in western Taiwan, including the Dongsha and Nansha Islands in the South China Sea. It borders Tainan City to the north, Pingtung County to the south across the Gaoping River, Taitung, Hualien, Nantou and Chiayi Counties to the east, and the Taiwan Strait to the west. It is divided into 38 administrative districts (including 3 aboriginal areas and 890 villages). The topography is ever-changing, covering a variety of terrain features such as oceans, coasts, cities, plains, suburbs and mountains. The overall terrain is high in the east and low in the west, with a terrain drop of 4,000 meters. According to the "Overview of County and City Climate Change 2024" jointly published by TCCIP and the Central Meteorological Administration, the average annual temperature in Kaohsiung from 1932 to 2020 is 24.7°C. After 1971, the annual average temperature rose by about 0.37°C every decade. In general, the cumulative increase in the past 89 years (1931-2020) was about 2.6°C, and the warming trend in the past 30 years and the past 50 years has accelerated significantly. In terms of the distribution of temperature rise in administrative regions, the warming trend in the flat administrative areas of Kaohsiung City is significantly faster than that in the mountainous administrative areas, with the maximum difference of more than 0.6°C per decade (Figure 1).




Source: Taiwan Climate Change Projection Information and Adaptation Knowledge Platform Project (TCCIP)

【Figure 1 Trend of annual average temperature change in Kaohsiung every ten years】

As global climate change intensifies, Kaohsiung City, located in the subtropical region and on the coast, faces challenges from multiple climate change factors, including heavy rainfall, drought, sea level rise and high temperature, which have far-reaching impacts and shocks on seven major areas of the city, including life-sustaining infrastructure, water resources, coasts and oceans, land use, energy supply and industry, agricultural production and biodiversity, and health.

## Research Questions

1. How has the average global temperature changed during the summer months (May to July) from 2018 to 2024?
2. How has the average temperature in Kaohsiung, Taiwan, changed during the same period and months?
3. What similarities and differences can be observed between global and Kaohsiung summer temperature trends from 2018 to 2024?

## Research Methods

To analyze local temperature trends in Kaohsiung, we used a Multi-Day Digital Max-Min Thermometer to collect observational data at the Cianjin1 Station. The following steps outline the proper use of the digital thermometer (as shown in Figure 2):

1. Preparation
   Ensure that the thermometer probe is clean and undamaged. For handheld devices, check that the battery level is sufficient.
2. Power On
   Press the power button to turn on the thermometer. The display will light up or show an indicator, confirming that the device is ready for measurement.
3. Temperature Measurement
   Place the probe at the target measurement location. Choose the appropriate type of probe (e.g., surface probe, insertion probe, or air probe) based on the measurement needs.
4. Reading the Temperature
   After a few seconds, the display will show the measured temperature. Some thermometers provide readings with one decimal place for increased accuracy.
5. Power Off
   After completing the measurement, turn off the thermometer to conserve battery power.
6. Cleaning and Maintenance
   After each use, gently wipe the probe with a dry cloth or appropriate cleaning agent. Avoid allowing liquid to enter the device during cleaning.


【Figure 2　Multi-Day Digital Max-Min Thermometer】

## Research Results

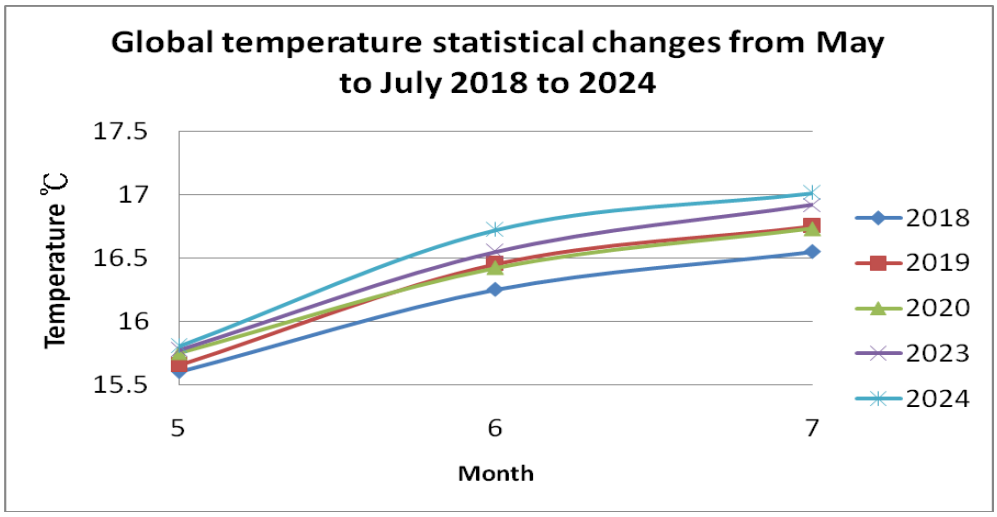
### 1. Trends in Global Average Temperature Change During Summer Months (May to July) from 2018 to 2024

The charts (as shown in Table 1 and Figure 3.) illustrates the global average temperature changes from May to July over a seven-year period, from 2018 to 2024. A consistent upward trend is observed from May through July each year, reflecting regular seasonal warming patterns. Among the data presented, the **highest average temperature** was recorded in **July 2024**, reaching approximately **17.1°C**, while the **lowest** occurred in **May 2018**, at around **15.6°C**. Notably, the years **2023 and 2024** exhibited significantly higher temperatures compared to previous years, indicating a continued rise in global temperatures. These findings are consistent with broader climate change trends and reinforce growing concerns about global warming. The steady increase in summer average temperatures over the observed years underscores the importance of ongoing climate monitoring and the urgent need for global mitigation strategies.

Unit: ˚C

| Year / Month | 2018 | 2019 | 2020 | 2023 | 2024 |
|---|---|---|---|---|---|
| 5 | 15.6 | 15.65 | 15.75 | 15.77 | 15.8 |
| 6 | 16.25 | 16.45 | 16.42 | 16.55 | 16.72 |
| 7 | 16.55 | 16.75 | 16.73 | 16.92 | 17.01 |

【Table 1. Global Average Temperature Statistics Table for May to July, 2018–2024】




【Figure 3　Statistics of global average temperatures from May to July 2018 to 2024】

(*Reference source: https://share.google/wTrZuYhbVzuQ2fOfw)*

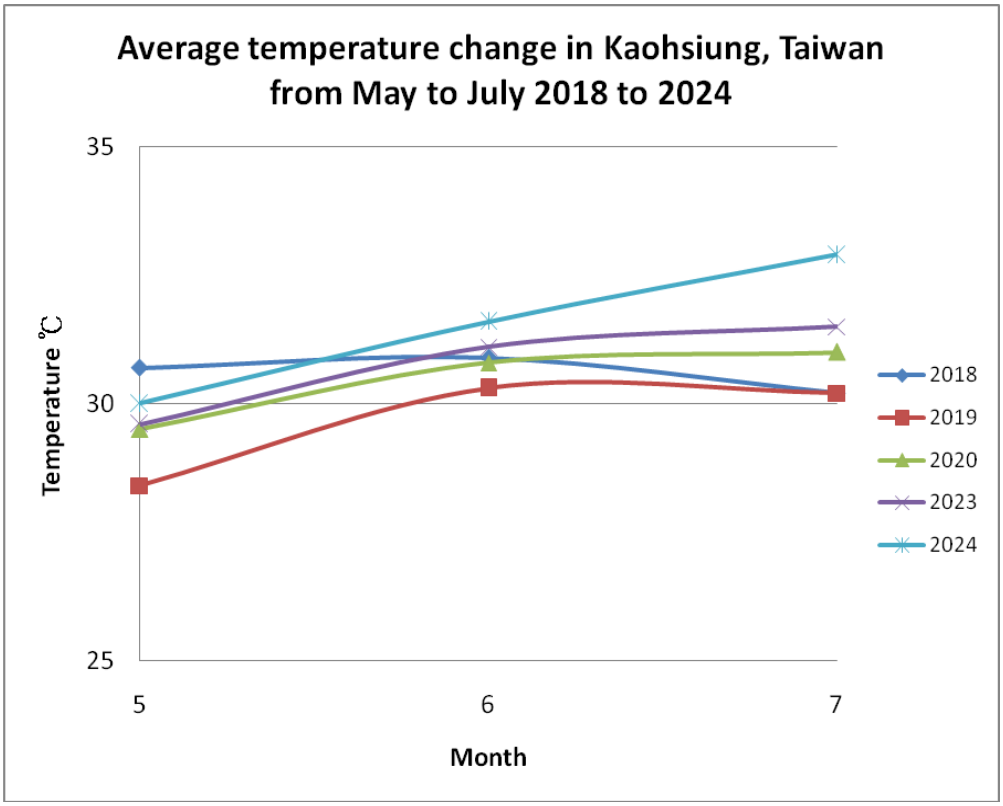
**2. Trends in Kaohsiung Average Temperature Change During Summer Months (May to July) from 2018 to 2024**

The charts (as shown in Table 2 and Figure 4.) shows how the average temperature in Kaohsiung changed from May to July over the years 2018 to 2024. In each year, the temperature usually increased from May to July, showing the typical warming of summer. Among all the years, 2024 was the hottest, reaching over 33°C in July. This is much higher than the other years. In 2018, May started off warmer, but there wasn't much increase afterward. The results show that summers in Kaohsiung are getting hotter, which may be related to global warming. This reminds us how important it is to pay attention to temperature changes in our city.

Unit: ˚C

| 年度<br>月份 | 2018 | 2019 | 2020 | 2023 | 2024 |
|---|---|---|---|---|---|
| 5 | 30.7 | 28.4 | 29.5 | 29.6 | 30 |
| 6 | 30.9 | 30.3 | 30.8 | 31.1 | 31.6 |
| 7 | 30.2 | 30.2 | 31 | 31.5 | 32.9 |

【Table 2 Average Temperature Statistics Table for Kaohsiung, Taiwan, from May to July, 2018–2024】




【Figure 4　Statistics of the average temperature in Kaohsiung, Taiwan from May to July 2018 to 2024】

### 3. Comparison of the Average Temperature Changes in the World and in Kaohsiung, Taiwan from May to July 2018 to 2024

This section compares average temperature trends between global data and Kaohsiung, Taiwan, during the summer months (May to July) from 2018 to 2024 (as shown in Table 3 and Figure 5,6,7,8 and 9). The comparison includes the years 2018, 2019, 2020, 2023, and 2024. Data from 2021 and 2022 were excluded due to the COVID-19 pandemic, during which students were learning remotely intermittently and were unable to collect reliable and complete local temperature data.

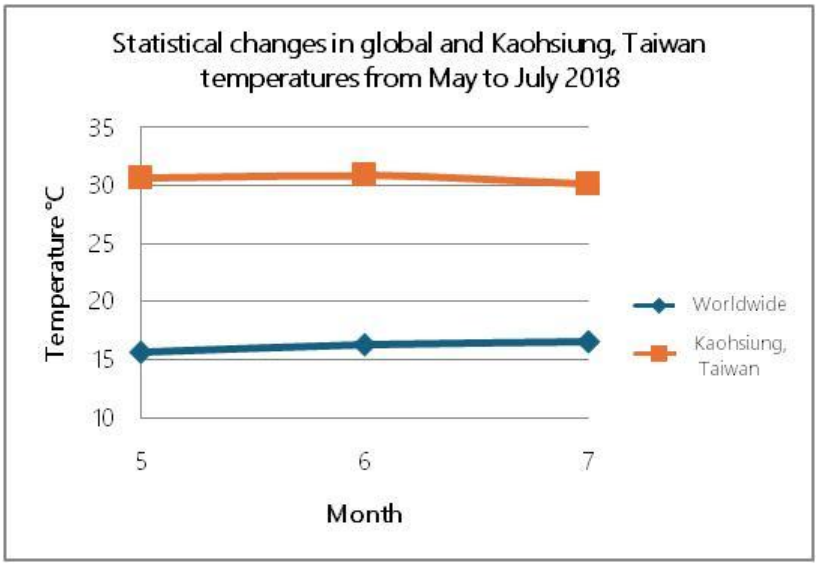
From the analysis, a similar pattern of temperature increase can be observed in both global and Kaohsiung data. In years when the global average temperature was higher—particularly in 2023 and 2024—Kaohsiung also experienced higher local temperatures. Notably, 2024 recorded the highest average temperatures in both the global and local datasets, suggesting a strong correlation between global warming trends and local climate impacts in southern Taiwan.

This consistency between global and local temperature patterns indicates that Kaohsiung's climate is closely tied to broader global changes. Such findings highlight the importance of local monitoring efforts as a way to understand and respond to global climate trends.

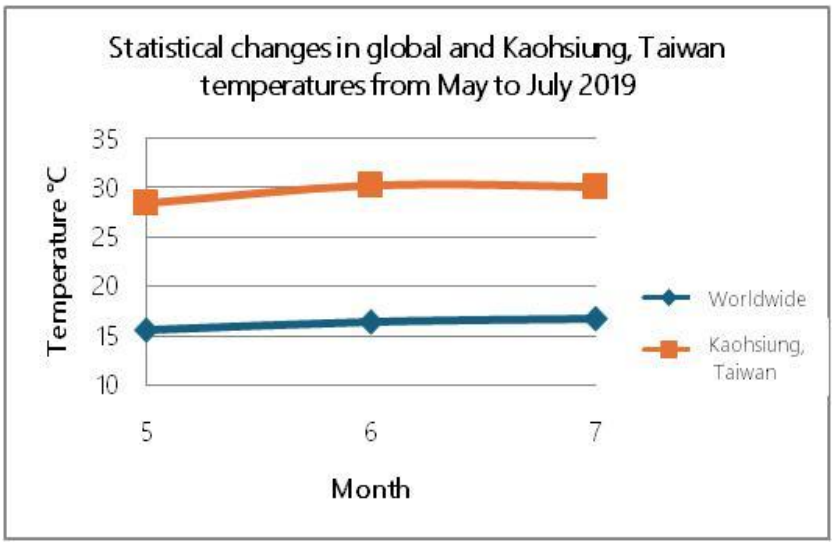
Unit: ˚C

| | 2018 | | 2019 | | 2020 | | 2023 | | 2024 | |
|---|---|---|---|---|---|---|---|---|---|---|
| month | Worldwide | Kaohsiung, Taiwan | Worldwide | Kaohsiung, Taiwan | Worldwide | Kaohsiung, Taiwan | Worldwide | Kaohsiung, Taiwan | Worldwide | Kaohsiung, Taiwan |
| 5 | 15.6 | 30.7 | 15.65 | 28.4 | 15.75 | 29.5 | 15.77 | 29.6 | 15.98 | 30 |
| 6 | 16.25 | 30.9 | 16.45 | 30.3 | 16.42 | 30.8 | 16.55 | 31.1 | 16.72 | 31.6 |
| 7 | 16.55 | 30.2 | 16.75 | 30.2 | 16.73 | 31 | 16.92 | 31.5 | 17.01 | 32.9 |

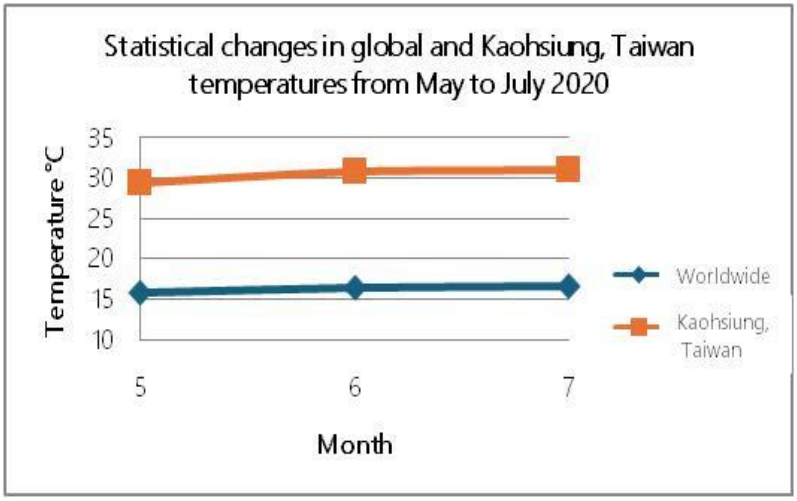
【Table 3 Statistics of the average temperature in the world and Kaohsiung, Taiwan from May to July 2018 to 2024】



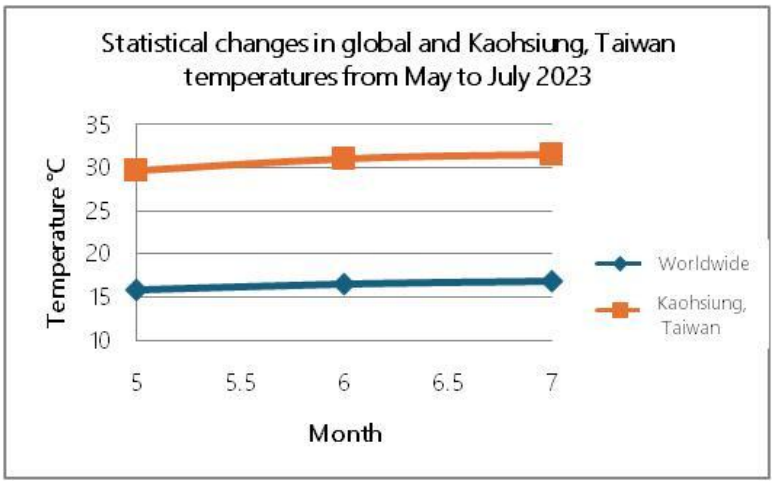

【Figure 5. Statistical changes in global and Kaohsiung, Taiwan temperature from May to July 2018】



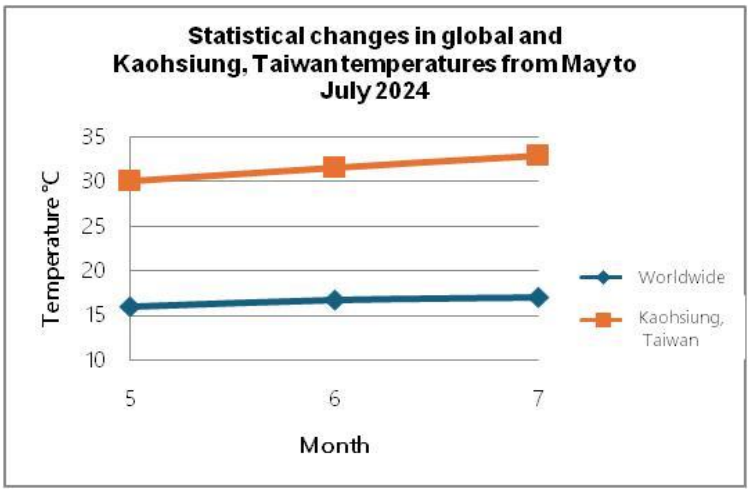

【Figure 6. Statistical changes in global and Kaohsiung, Taiwan temperature from May to July 2019】




【Figure 7. Statistical changes in global and Kaohsiung, Taiwan temperature from May to July 2020】




【Figure 8. Statistical changes in global and Kaohsiung, Taiwan temperature from May to July 2023】




【Figure 9. Statistical changes in global and Kaohsiung, Taiwan temperature from May to July 2024】

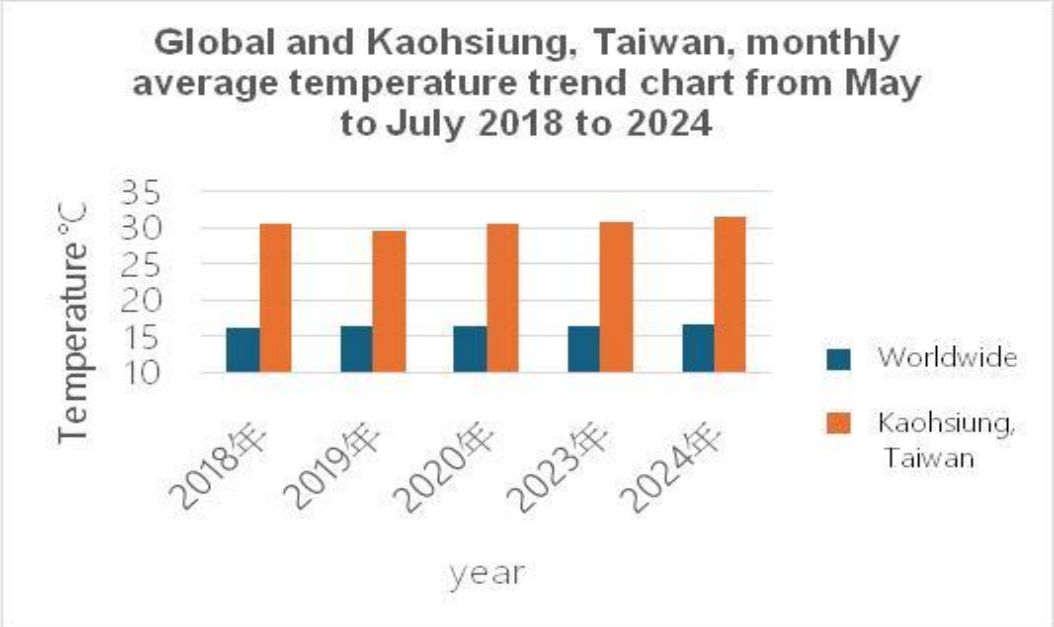
## Discussion

1. This study analyzes temperature trends from 2018 to 2024. Due to the COVID-19 pandemic, in-person learning was suspended intermittently in 2021 and 2022, making it impossible for students to collect accurate and complete on-site temperature data. Therefore, those two years are excluded from the analysis.
2. From the observed trends in monthly average temperatures from May to July, both globally and in Kaohsiung, Taiwan (as shown in Table 4 and Figure 10), we can see a general warming pattern. Although Kaohsiung experienced a slight drop in average summer temperatures in 2019 and 2020 compared to 2018, there has been a clear increase since 2023. This suggests a turning point in the local climate, with summers becoming noticeably hotter in recent years.

Unit: ˚C

| Year / Month | 2018 | 2019 | 2020 | 2023 | 2024 |
|---|---|---|---|---|---|
| Worldwide | 16.13 | 16.28 | 16.3 | 16.41 | 16.57 |
| Kaohsiung, Taiwan | 30.6 | 29.63 | 30.43 | 30.73 | 31.5 |

【Table 4. Trend of monthly average temperature from May to July 2018 to 2024 in the world and Kaohsiung, Taiwan】



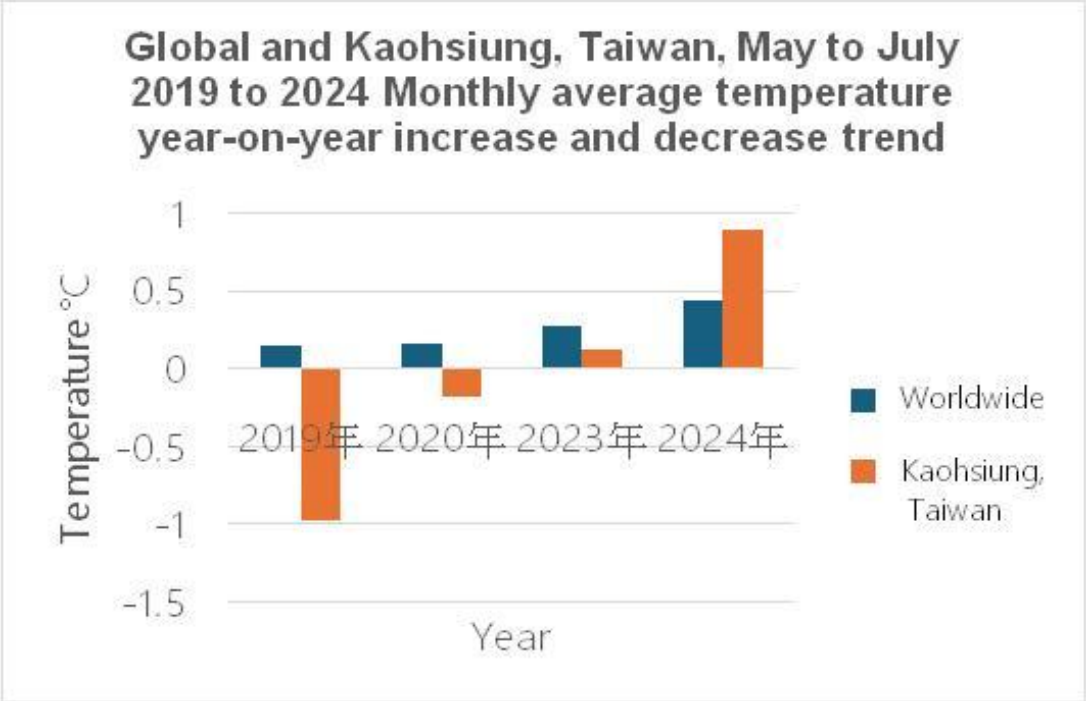

【Figure 10. Trend changes in the global and Kaohsiung, Taiwan's monthly average temperature from May to July 2018 to 2024】

3. Advances in technology have brought about rapid industrial growth, but they have also led to increased greenhouse gas emissions. These emissions are a major driver of global warming. Using 2018 as a baseline, global average temperatures have shown a gradual year-on-year rise (as shown in Table5 and Figure 11). This long-term warming trend is contributing to more extreme and frequent climate events worldwide, including rising summer temperatures in Kaohsiung.

Unit: ˚C

| year<br>month | 2018 | 2019 | 2020 | 2023 | 2024 |
|---|---|---|---|---|---|
| Worldwide | 16.13 | 0.15 | 0.17 | 0.28 | 0.44 |
| Kaohsiung, Taiwan | 30.6 | -0.97 | -0.17 | 0.13 | 0.9 |

【Table 5 Trend changes in the global and Kaohsiung, Taiwan's monthly average temperature from May to July 2018 to 2024】




【Figure 11 Changes in the global and Kaohsiung, Taiwan's monthly average temperature from May to July from 2018 to 2024】

4. In 2024, the global average temperature reached 15.10°C—a record high—while Kaohsiung experienced daily high temperatures of around 31°C from May to August. This clear rise in both global and local temperatures highlights a strong connection: as the Earth continues to warm, Kaohsiung’s summer climate is also becoming significantly hotter. This supports our research title and underscores the urgent need for climate action at both global and local levels.

## Conclusion

Based on the findings of this study, it is clear that global warming is causing summer temperatures in Kaohsiung, Taiwan, to rise steadily, with the trend continuing to worsen in recent years. The data show a close link between global climate change and local temperature increases, especially during the summer months. According to the latest *National Climate Change Science Report*, Taiwan may experience longer summers in the future, along with an increase in the number of extremely hot days.

To effectively respond to the impacts of global warming, we recommend taking action in the following key areas:

1. Carbon Reduction:
   Actively reduce greenhouse gas emissions by promoting clean energy, energy-saving practices, and low-carbon lifestyles.
2. Urban Design and Planning:
   Improve city environments by expanding green spaces, planting trees, and designing buildings that reduce the urban heat island effect.
3. Disaster Prevention and Adaptation:
   Strengthen coastal defense systems and improve infrastructure to better prepare for rising sea levels, extreme heat, and potential natural disasters.
4. Education and Public Engagement:
   Raise public awareness about climate change and encourage individuals, schools, and communities to take part in environmental protection and carbon reduction actions.

By understanding the impact of global warming and taking meaningful steps, we can work together to create a more sustainable and livable future for Kaohsiung and beyond.

## Refereces


1. CommonWealth Magazine, published on April 22, 2025
2. Taiwan's Climate Change Analysis Series Report in 2024 - Extreme High Temperature and Impact in Taiwan under the Warming Trend (National Science and Technology Council Taiwan Climate Change Estimation Information and Adaptation Knowledge Platform))
3. Kaohsiung City Climate Change Adaptation Implementation Plan (Approved Version), January 2015.

《Optional Badges》

**I Am a Collaborator**

This research project was completed collaboratively by a team of three members, with each person taking responsibility for specific tasks, including literature review, data collection, and data analysis. Throughout the process, we worked closely together, divided tasks fairly, and maintained clear and effective communication. Our strong teamwork and collaborative efforts demonstrate that we fully meet the criteria for the Collaborator badge.

**I Make an Impact**

Our research shows that global warming is making summers in Kaohsiung hotter and hotter. By comparing world temperature data with the temperatures we recorded at our school, we found a clear pattern: when the Earth gets warmer, so does Kaohsiung. We made an impact because we used science to understand a real problem that affects our lives—hotter summers. We also shared our findings with others so they can learn how climate change is happening right here in our city. Finally, we gave ideas for action, like planting more trees, using less energy, and telling more people about climate change.We care about the future of our city and our planet, and we want to help make it better. By doing this project, we didn’t just learn something—we helped others learn too. That’s why we believe we deserve the "I Make an Impact" badge.

**I Am a Data Scientist**

In our research, we used real data to understand how global warming is affecting Kaohsiung’s summer temperatures. Like true data scientists, we collected temperature data from both global sources and our school’s observation station and organized the data by year and by month (May to July from 2018 to 2024). We created charts and graphs to show how temperatures changed over time, both globally and in Kaohsiung amd found patterns-- when global temperatures went up, Kaohsiung’s temperatures also increased. Because we used data to explore a real-world problem, ask questions, and find answers, these practices align well with the selection criteria for the Data Scientist badge.