

Measurement of Surface Temperatures in Kinmen High School Campus

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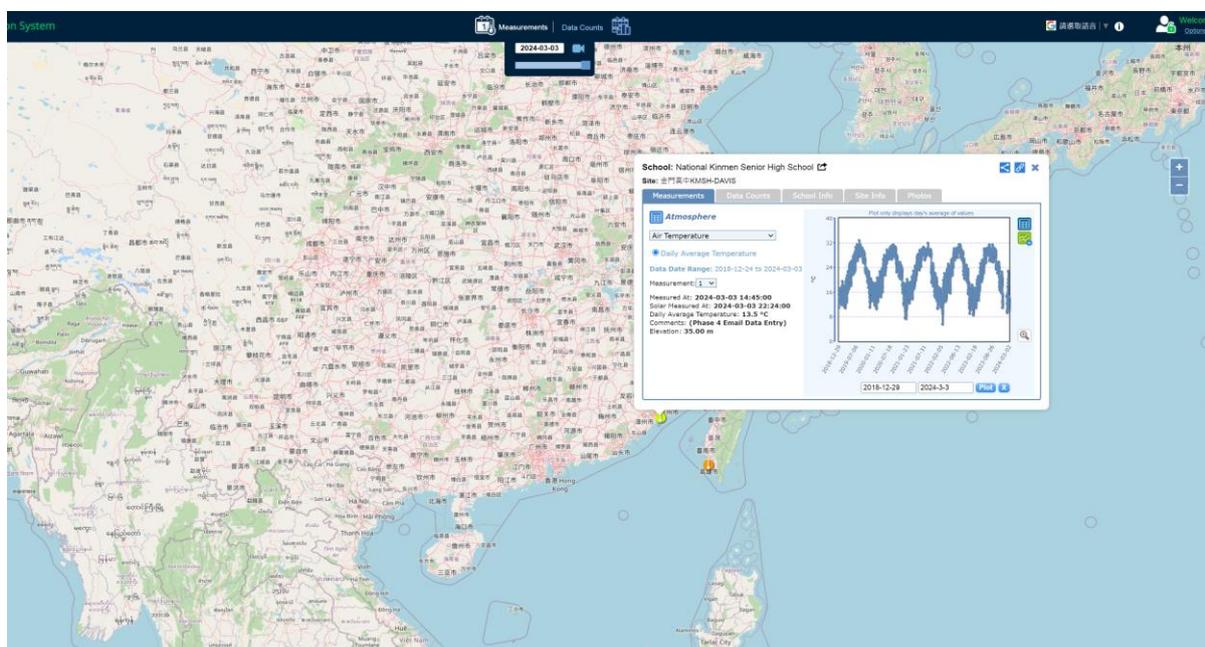
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1.Summary

The purpose of this experiment is to investigate the surface temperatures of different types of flooring materials. Our observations suggest that the variation in surface temperature is related to the weather conditions of the day. We are attempting to identify this relationship and have found that when the temperature difference is around 10°C, there are more clouds in the sky compared to when the temperature difference is greater than 15°C. Therefore, we want to examine whether it is possible to determine the cloud cover of the day based on the magnitude of temperature difference in the daily data.

Introduction of Kinmen:

Kinmen is located off the coast of Fujian Province, People's Republic of China, separated by the Taiwan Strait. This archipelago consists of the main island of Kinmen and several smaller surrounding islands. Geographically close to Fujian Province, it holds significant strategic importance for the Taiwan.



Campus introduction:

The high school we attend in Kinmen is the only regular high school on the island. Established in 1951, our campus features the Chiang Kai-shek Hall, which can accommodate up to a thousand people and serves as the school auditorium. With its three floors and four-pillar, three-arch Western-style facade painted white, it is affectionately referred to by students and teachers as the "White Palace" and is considered a spiritual landmark.



Campus location:



The focus of this observation is primarily on exploring the influence of various weather conditions such as weather patterns, humidity, cloud cover, and other factors on the surface temperatures of different materials. The observations are conducted weekly, primarily at the ecological pond and the playground.

Observation location



The sports field

The ecological pool



2. Research motivation

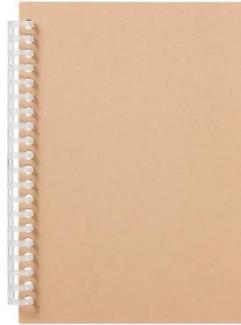
Our experiment this time was mainly prompted by a discovery where we noticed significant differences in temperature sensations while sitting on the playground track, grass, and concrete surfaces. Normally, one would expect the concrete surface to feel warmer compared to the other two. However, our measurements revealed the opposite of our expectations, prompting us to delve deeper into our research.

3. Research equipment and equipment

Thermometer gun



Notebook



4. Research methods

1. Weather conditions, temperature, humidity, and cloud cover were measured in two designated areas of the school (beside the ecological pond and on the playground).

2. Temperature readings were taken on different types of flooring materials (grass, concrete, and red PU track, we abbreviate it as PUR.) When sunlight was optimal, temperatures in shaded areas were also measured, and the temperature differentials were calculated.

3. Data was organized using spreadsheet tools and further analyzed.

5. Research results

Our weekly observation results are systematically recorded as follows:

Date: NOV 1

Max-Min: 24.4°C

Weather conditions: Bright sun

PUR Difference: 20.4°C

Temperature: 25°C

Cement floor difference: None

Humidity: 57%

Grass Difference: None

Grassland	Cement floor	PUR	PUR shadow
45.3°C	30.3°C	41.3°C	20.9°C



Today marks the first day of our observation, and the weather is very clear. We measured the temperatures of various flooring materials and observed a peculiar phenomenon. Normally, one might expect concrete surfaces to be warmer than others, but this was not the case. Surprisingly, after our initial measurements, we found that the temperature of the grass was actually higher than that of other materials by nearly 10°C. If you were to ask me which material to sit on, I would definitely choose concrete, as sitting on the grass was uncomfortably hot.

Date:NOV 8

Max-Min:11.7°C

Weather conditions: Sunny and cloudy

PUR Difference: None

Temperature:24°C

Grassland difference: 3.2°C

Humidity: 65%

Cement floor difference: 4.1°C

Grassland	Cement floor	Cement floor shadow	PUR
26.8°C	31.6°C	27.5°C	38.5°C



On the second day of measurements, although it was sunny, the sky was partly cloudy. Consequently, it was noticeable that there wasn't much temperature difference between the grass and concrete surfaces, both hovering around 25°C. However, there was a significant difference observed in the temperature of the PU track material. This indeed is a peculiar phenomenon. Interestingly, the temperature of the concrete surface was similar to that of the PU track. These observations warrant further investigation.

Date:NOV 15

Max-Min:8.8°C

Weather conditions: Cloudy

PUR difference: None

Temperature:24°C

Grass Difference: None

Humidity: 69%

Cement floor difference: None

Grassland	Cement floor	PUR
23.2°C	25.1°C	32.0°C

Date:NOV 22

Max-Min:23.5°C

Weather conditions: Sunny

PUR difference: 16.8°C

Temperature: 20°C

Grass difference: 20.9°C

Humidity:70%

Cement floor difference: 13.5°C

Grassland	Cement floor	Cement floor shadow	PUR
42.5°C	32.5°C	19.0°C	36.7°C

Date:NOV 29

Max-Min:21.3°C

Weather conditions: Cloudy

Grassland difference: 20.2°C

Temperature:22°C

Concrete floor difference: 6°C

Humidity: 62%

PUR difference:8.8°C

Grassland	Grass shadow	Cement floor	Cement floor shadow	PUR	PUR shadow
40.2°C	20°C	24.9°C	18.9°C	35.3°C	26.5°C



Date:DEC 6

Max-Min:6.7°C

Weather conditions: Cloudy

Grass Difference: None

Temperature:18°C

Cement floor difference: None

Humidity: 66%

PUR difference: None

Grassland	Cement floor	PUR
27.3°C	20.8°C	27.5°C



Date:DEC 13

Max-Min:10.1°C

Weather conditions: Overcast and cloudy

Grassland Difference: None

Temperature: 18°C

Cement floor difference: None

Humidity:78%

PUR Difference: None

Grassland	Cement floor	PUR
32.8°C	22.7°C	24.6°C

Date:DEC 20

Max-Min:6.0°C

Weather conditions: Cloudy

Grass Difference: None

Temperature:15°C

Cement floor difference: None

Humidity: 68%

PUR difference: None

Grassland	Cement floor	PUR
14.5°C	15.5°C	20.5°C

Today's weather is extremely cold, so the temperature differences we observed were not significant. Interestingly, this time, the temperature measured on the grass was even lower than that on the concrete surface. Combining this observation with our previous data collected when the weather temperature was 19°C, we can infer that the specific heat capacity of grass may be smaller compared to other materials, as its temperature fluctuates more easily.



Date:DEC 27

Max-Min:6.0°C

Weather conditions:Sunny and cloudy

Grassland difference: 20.0°C

Temperature:15°C

Cement floor difference: 9.9°C

Humidity: 68%

PUR difference:7.7°C

Grassland	Grass shadow	Cement floor	Cement floor shadow	PUR	PUR shadow
36.6°C	16.6°C	26.8°C	16.9°C	22.8°C	15.1°C

Date:JAN 09

Max-Min:16.4°C

Temperature:16°C

Cement floor difference: 7.9°C

Humidity: 78%

Grass difference: 16.4°C

Weather conditions: Sunny

PUR difference:11.6°C

Cement floor	Cement floor shadow	Grassland	Grassland shadow
21.3°C	13.4°C	30.5°C	14.1°C

PUR	PUR shadow	playground grass
26.2	14.6	27.8

Date:FEB 7

Max-Min:1.7°C

Temperature: 12°C

Cement floor difference: 7.9°C

Humidity: 87%

Grassland difference: 16.4°C

Weather conditions: Overcastsky with rain

PUR difference: 11.6°C

Cement	Grassland	PUR
13°C	11.3°C	11.8°C



Date:FEB 14

Max-Min:21.5°C

Temperature:18°C

Cement floor difference: None

Humidity:76%

Grassland difference: 20.6°C

Weather conditions:Sunny

PUR difference: None

Grassland	Grass shadow	Cement floor	PUR
39.1°C	18.5°C	35.3°C	40.0°C

Date:FEB 21

Max-Min:36.2°C

Temperature:18°C

Cement floor difference: 12.4°C

Humidity: 96%

Grass difference: 32.2°C

Weather conditions: Sunny

PUR difference: 19°C

Cement floor	Cement floor shadow	Grassland	Grassland shadow	PUR	PUR shadow
37.7°C	25.3°C	60.0°C	27.8°C	44.3°C	25.3°C

Today, we encountered a rather peculiar phenomenon. The temperature of the day was 18°C, which was similar to some of the previous data. However, the temperature measured on the grass this time was significantly higher than in previous instances, which surprised us greatly. We speculate that this discrepancy might be related to the humidity or cloud cover. Perhaps, from here, we can consider that both humidity and cloud cover on a given day could influence the data collected. This could be a new angle to explore further.

Based on the information provided, we have compiled the following table:

	Temperature	Humidity	Weather conditions	Cement floor	Cement floor shadow	Grass	Grass shadow	Red PU track	Red PU track shade
NOV 01	25°C	57%	big sun	30.3°C	NONE	45.3°C	NONE	41.3°C	20.9°C
1NOV 08	24°C	65%	Sunny and cloudy	31.6°C	27.5°C	26.8°C	23.6	38.5°C	NONE
NOV 15	19°C	69%	Cloudy	25.1°C	NONE	23.2°C	NONE	32°C	NONE
NOV 22	20°C	70%	Sunny	32.5°C	19°C	42.5°C	21.6°C	36.7°C	19.9°C
NOV 29	22°C	62%	Cloudy	24.9°C	18.9°C	40.2°C	20°C	35.3°C	26.5°C
DEC 06	18°C	66%	Cloudy	20.8°C	NONE	27.3°C	NONE	27.5°C	NONE
DEC 13	18°C	78%	Cloudy	22.7°C	NONE	32.8°C	NONE	24.6°C	NONE
DEC 20	15°C	68%	Cloudy	15.5°C	NONE	14.5°C	NONE	20.5°C	NONE
DEC 27	18°C	61%	Sunny and cloudy	26.8°C	16.9 °C	36.6°C	16.6°C	22.8°C	15.1°C
JAN 09	16°C	78%	Sunny	21.3°C	13.4°C	30.5°C	14.1°C	26.2°C	14.6°C
FEB 07	12°C	87%	Cloudy and rainy	13.0°C	NONE	11.3°C	NONE	11.8°C	NONE
FEB 14	18°C	76%	Sunny	35.3°C	NONE	39.1°C	18.5°C	40°C	NONE
FEB 21	18°C	96%	Sunny	37.7°C	25.3°C	60°C	27.8°C	44.3°C	25.3°C

We found that clouds and sunlight have an impact on temperature variations. Therefore, we compiled a table showing whether there was sunlight and the temperature difference between the highest and lowest recorded temperatures for each observation, with the same material being used.

	Max-Min	Cement floor Difference	Grassland Difference	PUR Difference	Sun exposure situation
NOV 01	24.4°C	NONE	NONE	20.4°C	Obvious
1NOV 08	11.7°C	4.1°C	3.2°C	NONE	Obvious
NOV 15	8.8°C	NONE	NONE	NONE	Not too obvious
NOV 22	23.5°C	NONE	20.9°C	16.8°C	Obvious
NOV 29	20.2°C	6.0°C	20.2°C	8.8°C	Obvious
DEC 06	6.7°C	NONE	NONE	NONE	Not obvious
DEC 13	10.1°C	NONE	NONE	NONE	Not obvious
DEC 20	5.0°C	NONE	NONE	NONE	Not obvious
DEC 27	21.5°C	9.9°C	20.0°C	7.7°C	obvious
JAN 09	16.4°C	7.9°C	16.4°C	11.6°C	Obvious
FEB 07	1.7°C	NONE	NONE	NONE	Not obvious (light rain)
FEB 14	21.5°C	NONE	20.6°C	NONE	Obvious
FEB 21	34.7°C	12.4°C	32.2°C	19.0°C	Obvious

Discuss:

We found a significant correlation between the temperature difference (ΔT) and the cloud cover in the sky on the days we measured. For example, on November 1st and February 21st, there were few clouds in the sky, resulting in temperature differences of over 20°C . Conversely, on November 15th and December 6th, when there were more clouds, the temperature differences were not as pronounced as on less cloudy days. Therefore, we can boldly hypothesize that the temperature difference data can be used to determine the amount of cloud cover on a given day.

Another noteworthy observation is that under the same temperature conditions (25°C), the temperature difference between grass and concrete was nearly 15°C when exposed to direct sunlight or sunny weather with clouds. However, the temperature on concrete surfaces remained relatively constant. From this, we can deduce that the temperature of grass is influenced by direct sunlight, while the temperature of concrete is more related to ambient temperature.

Conclusion

1. There is a certain relationship between the temperature difference data and the cloud cover on the given day.
2. The temperature of grass is influenced by sunlight; as the sun becomes stronger, the temperature of the grass increases. Conversely, it is less related to the ambient temperature of the day.
3. The temperature of concrete is associated with the ambient temperature of the day. Under the same intensity of sunlight, the ambient temperature becomes a crucial factor determining the temperature of the concrete surface. This is in contrast to grass, where sunlight is the determining factor.