Do Cloud Shadows Affect Surface Temperatures on Earth?

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Science Type Project

all photos, graphs, images created by researcher unless indicated otherwise.

Abstract:

- The purpose of this project was to determine if clouds creating a shadow over an area would have an effect on surface temperature changes over the same area. The tested hypothesis was: that cloud shadows do affect the surface temperatures because the temperatures will vary when shadows are between the Sun and the surface. The expected response was that cloud shadows would affect surface temperatures, then temperatures would then decrease on cloudy days and increase on sunny days.
- Data was collected daily and recorded in the logbook for later analysis. An IRT, a noncontact infrared thermometer (Fluke 63 model), was used to measure the surface temperatures of each specific area over the period of one month. The surface temperatures measured included: street surface, sidewalk surface, grassy place, standing vehicle, and outside house wall. The same surfaces were used each time to ensure that the data was not skewed. Air temperature were captured using an IRT. Data was collected at the same time over the period of one month and recorded at the time of collection. Atmospheric data was gathered as to air temperature, sunny or cloudy days and noted. The results were analyzed and found to support the hypothesis: that cloud cover does indeed affect surface temperatures.

Introduction:

Do cloud shadows affect surface temperatures on Earth?

- Throughout history, people have always enjoyed watching clouds, whether it was to study what was happening or trying to see what kind of animal the cloud looked like. Do clouds have a purpose other than for recreational pastimes? Is it possible that clouds have a functional use as well?

- Shadows can be useful and serve many different functions. They can tell the direction of the Sun and the time of day, if you know how to read them. They can be used to predict types of precipitation and even for cooling the Earth's surfaces.

- This experiment was to determine if these same clouds would also affect various surfaces temperatures locally.

Introduction:

Do cloud shadows affect surface temperatures on Earth?

- The purpose of this project is to determine if clouds creating a shadow over an area affects a surface temperature change over the same area.

- Relevant literature suggests that the type of surface measured will predict its ability to change or remain the same when clouds are present.

- The hypothesis tested stated: that cloud shadows do affect the surface temperatures because the temperatures will vary when shadows are between the Sun and the surface. If cloud shadows affect surface temperatures, then temperatures will decrease on cloudy days and increase on sunny days.

- In order to determine if the hypothesis was valid, data from surface temperatures would need to be collected and a plan developed.

Methods:

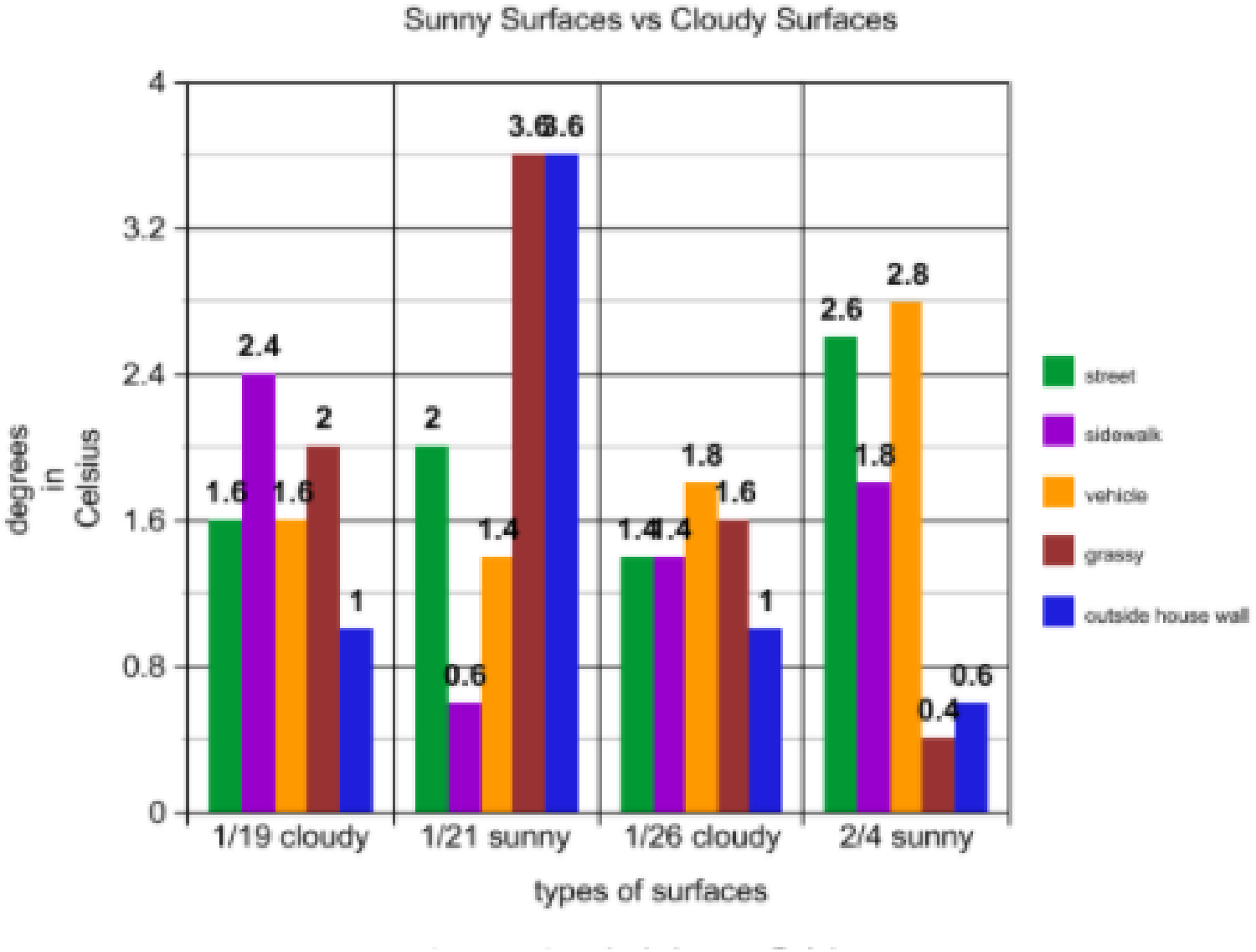
How was this experiment accomplished?

- The main equipment necessary for this experimental design was a Fluke 63 non contact IRT thermometer. IRT is what we called it. It uses an infrared laser beam to measure the temperature in either Celsius or Fahrenheit degrees. The researcher measured in Celsius. By using this device, it was not necessary to touch or even be particularly close to any object to obtain an accurate reading.
- Sites were selected for comparison: a grassy space, the street, sidewalk, a particular vehicle, and the front of a house. These would each be checked daily and temperatures measured at the same time. In this manner, only the atmosphere would provide the variable being manipulated. Cloud cover would be the determining variable as everything else would remain unchanged.
- Air temperature at the site would be obtained as well and compared between cloudy and non-cloudy days. The timeframe would be 24 days.

Results:
What were the results of your project?

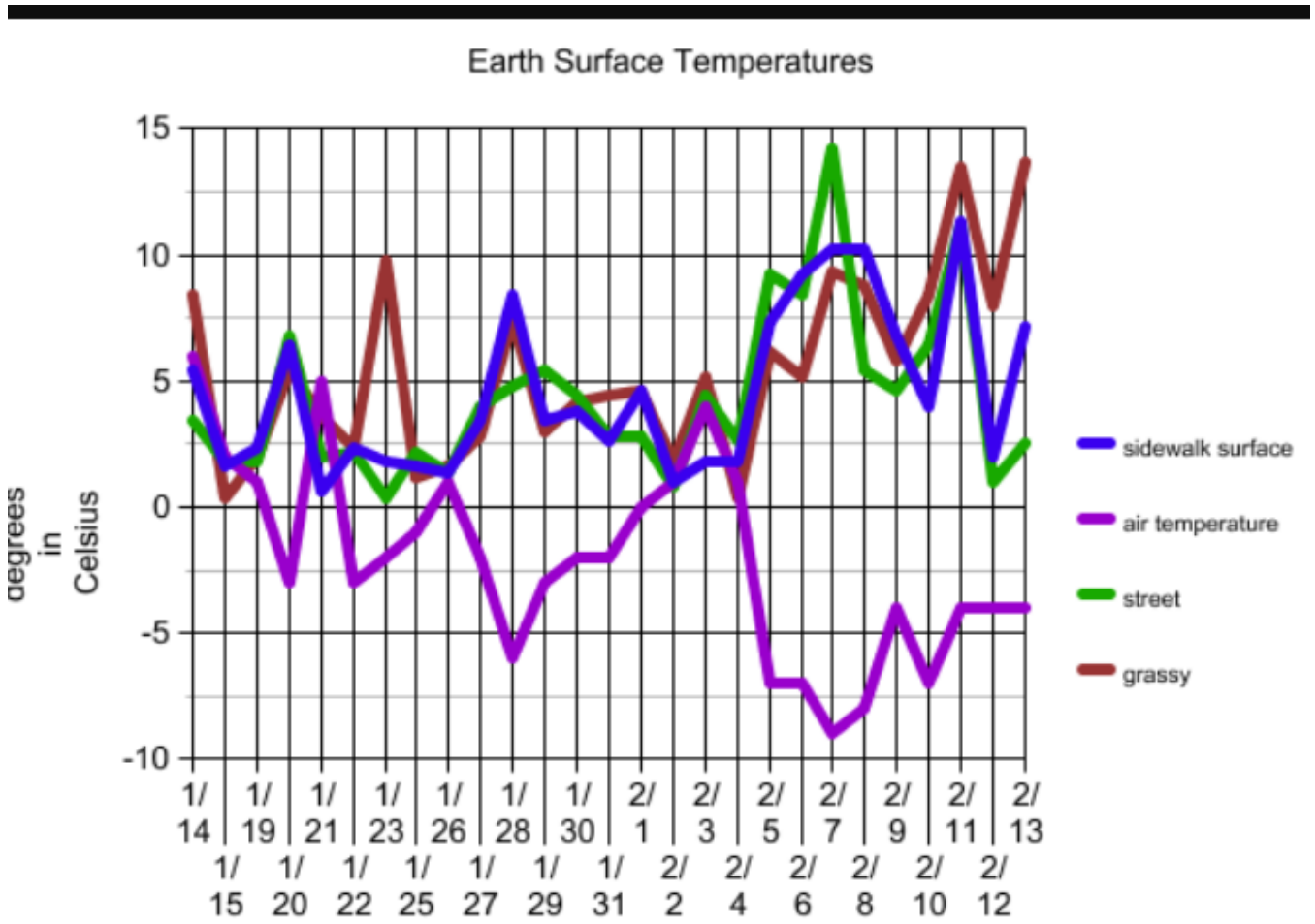
- There were only 9 sunny days and 15 cloudy days. These temperatures were compared and cross-checked with weather temperatures to validify the temperatures taken with the infrared thermometer (IRT).
- The temperatures taken of the same surfaces consistently showed higher temperatures when the days were sunny. Increased temperatures were always acquired on the eight sunny days. The cloudy days were consistently decreasing in temperature measurements for these same surfaces. The time these temperatures were taken were the same each day.
- It appears that the data supported the hypothesis, that temperatures would decrease on cloudy days and increase when the sun was shining.

Results:
What do these mean?



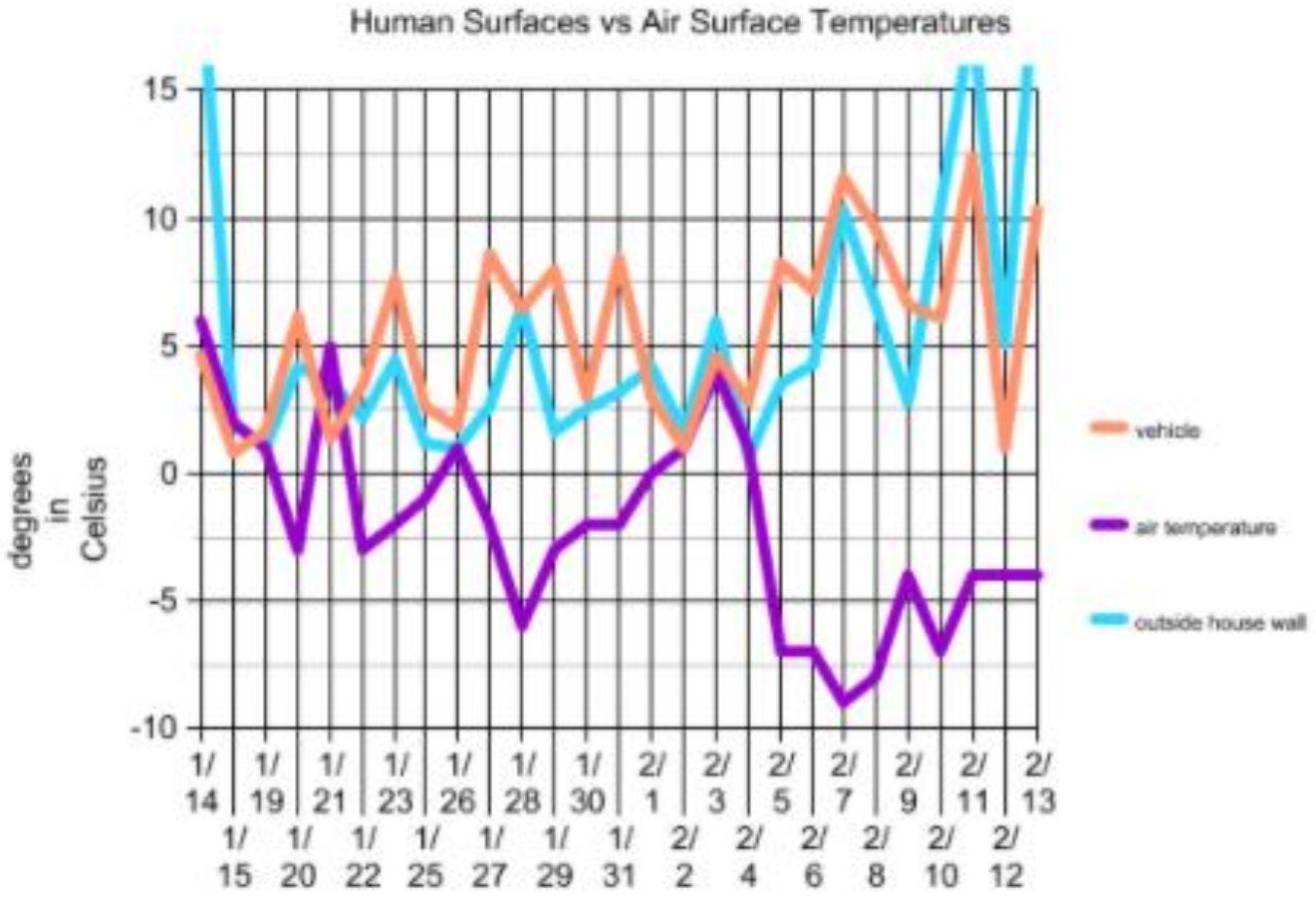
- There were days that had the same air temperature. These days were selected and the surface temperatures graphed for analysis.
  - The data showed that on the two cloudy days, all surface temperatures were lower than the sunny days, even with the same air temperature!

Results:



These daily graphs show the variance between surface temperatures throughout the time tested.

Results:



These daily graphs show the variance between surface temperatures throughout the time tested.

Discussion:
How can we interpret these results?

- It would seem simple to see once you visualize the graph. The data does show that clouds affect the surface temperatures,
- It should be noted that this sample is very small and only four days were found with the same air temperature that could be compared. Although there were more sunny days, there were no comparative temperatures between sunny and cloudy.
- A much longer time frame needs to be developed to fully validate the hypothesis. Four days of data is not enough for a strong support and neither is it enough to disprove the hypothesis either.
- Technically the data would be considered inconclusive on a larger study. Further research is necessary.

Conclusions:
What do these results mean?

- In conclusion, for this research, the data does support the hypothesis. In a larger study, the data might change. It is unknown.
- This data would be useful for a number of organizations where temperature and the lack of cooling methods would be an issue. This data would serve to prove that clouds are a necessary functional part of climate and weather, not just a pleasant way to spend a lazy afternoon.
- It would be prudent for city planners to find other ways to create shadows that might help cool an urban environment, such as trees or canopies to help keep places cool without expending as much energy.

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