Solar Eclipse Causes Decrease in Cloud Cover

Sofia Basto-Cabrera, Elana Farwell, Frankie Hargrave
7th/8th grade, CSEP, Medford Memorial Middle School, Medford, NJ, USA

ABSTRACT

After pivoting from precipitation to cloud cover, our team investigated how the 2024 solar eclipse affected cloud cover in regions of the United States experiencing totality. The first step was to pick five places that experienced totality during the eclipse. Our team picked Dallas, Cleveland, Montreal, Buffalo, and Indianapolis because they were far enough apart and all fell on the line of totality. Initially, we hypothesized that cooler temperatures during the eclipse would lead to increased condensation and subsequently more cloud formation. The team's original preference was to use data from CloudSat and CALIPSO, but it was discovered both had been decommissioned in 2023. A decision was made to use GOES-16 imagery and data. The team members looked for data. After analyzing cloud patterns before, during, and after the eclipse using various sources such as weather websites and GLOBE satellite data, the evidence did not support our hypothesis. The members of the team discovered a trend in the data that showed that cloud cover was highest prior to the eclipse and after. After realizing that our team's hypothesis was wrong, members of the team took a deeper look at what factors led to a decrease in cloud cover during the eclipse. This led the team to look at other parameters that could have affected cloud cover. The group looked at the decrease in temperature which caused less evaporation. The wind also might have played a role moving the clouds away from an area. The team then asked if this trend was followed in past eclipses and how other factors may have contributed as well to the drop in cloud cover. The team concluded that the solar eclipse caused a decrease in cloud cover, but may not have been the only factor present affecting these percentages.

HYPOTHESIS

If we observe the amount of cloud cover one hour prior, during, and after the solar eclipse, then there will be an increase in cloud formation because the change in temperature would cause more condensation in the atmosphere creating more clouds.

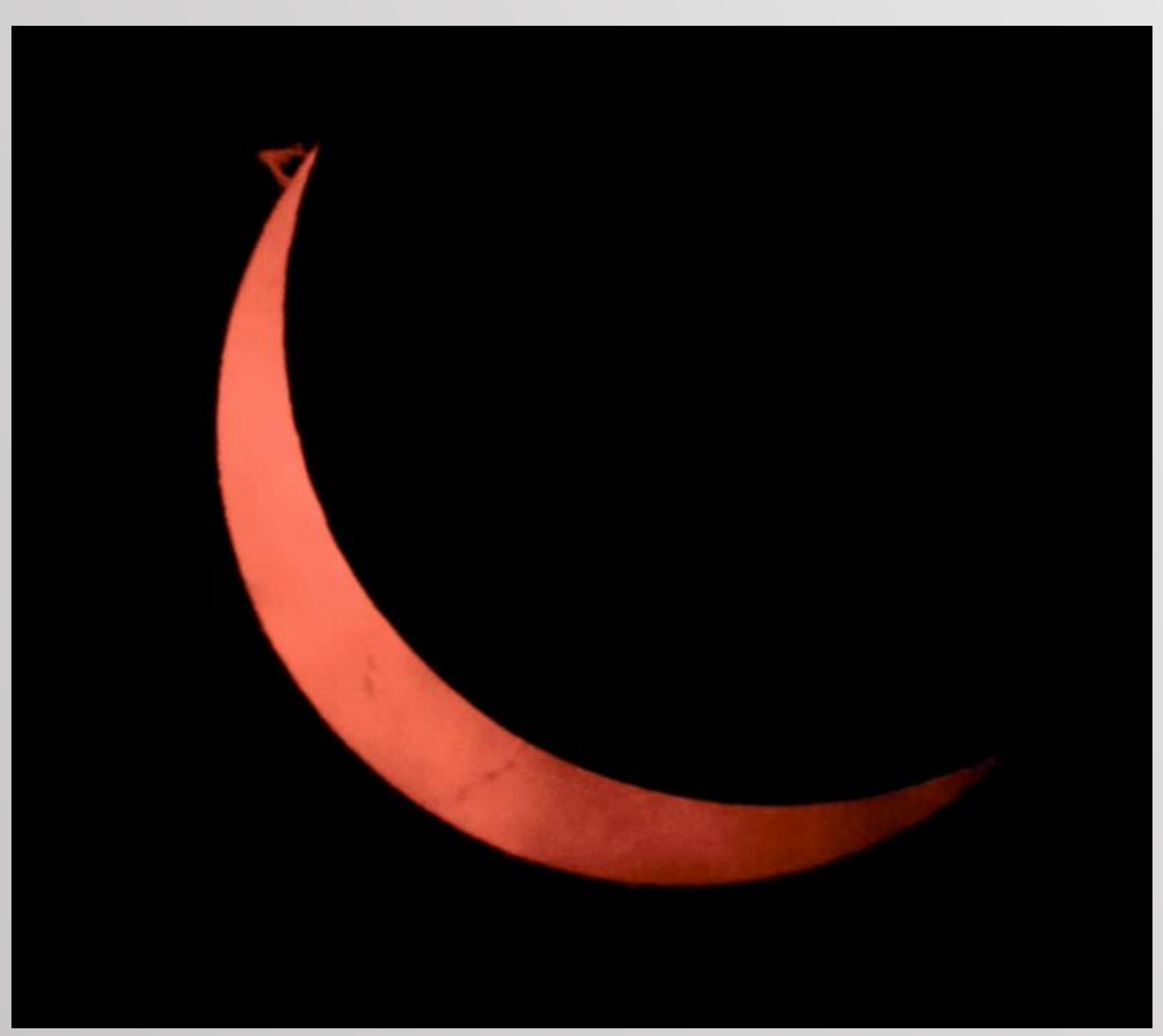


Image 1: Rare solar flare (upper left) during solar eclipse captured by a special telescope. This was taken at the Institute for Earth Observations at Palmyra Cove, NJ. Mr. Moore, the Institute's Executive Director and CSEP mentor was generous enough to share this image with us.

RESEARCH METHODS

As a group, our program decided to investigate the solar eclipse with relation to the six parameters of weather. All the groups randomly selected a parameter and our group got precipitation. The team got to work by coming up with a scientific question: How does an eclipse affect precipitation? However, after a week and a half of research, the members realized that there was very little information and data on the precipitation that occured one hour prior, during, or after the eclipse in places with totality. The group decided to deviate from this weather parameter which shows how the Scientific Method is not linear, but is iterative. We chose cloud cover. We immediately began to look weather websites, news channels, GLOBE partnership satellite data (specifically the GOES-R series), NASA and NOAA blogs, and other resources. As we looked at the satellites affiliated with GLOBE, we were not able to use CloudSat because it was decommissioned in December 2023, nor could we use CALIPSO as it was decommissioned in August 2023. The team also considered using JPSS which is very important for short-term and long-term forecasts, but GLOBE doesn't have that satellite on its partnership list yet. If GLOBE is considering adding another satellite, our group agrees it would be a great idea to consider JPSS.

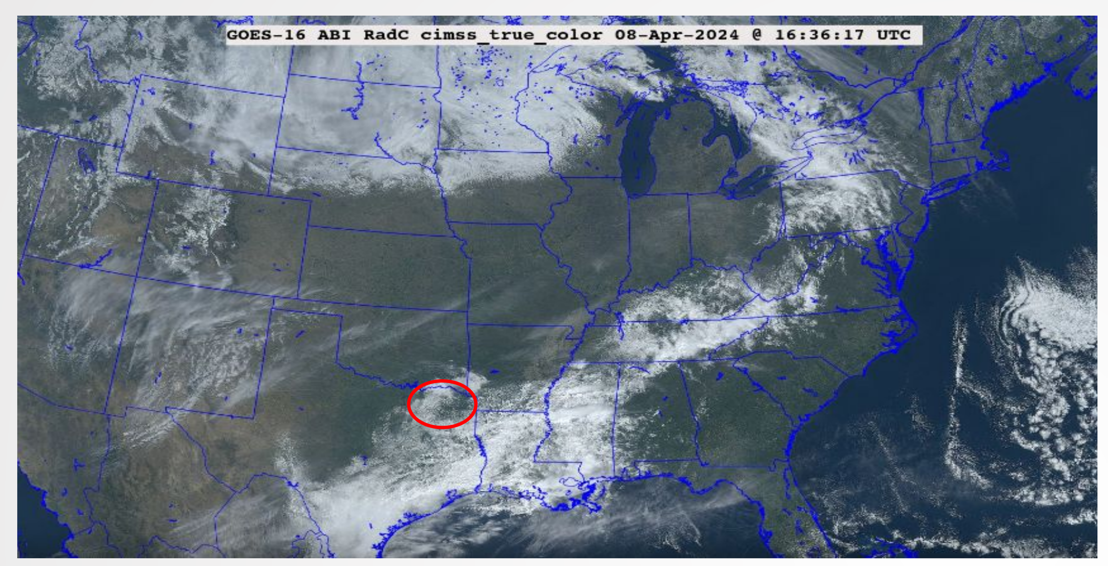
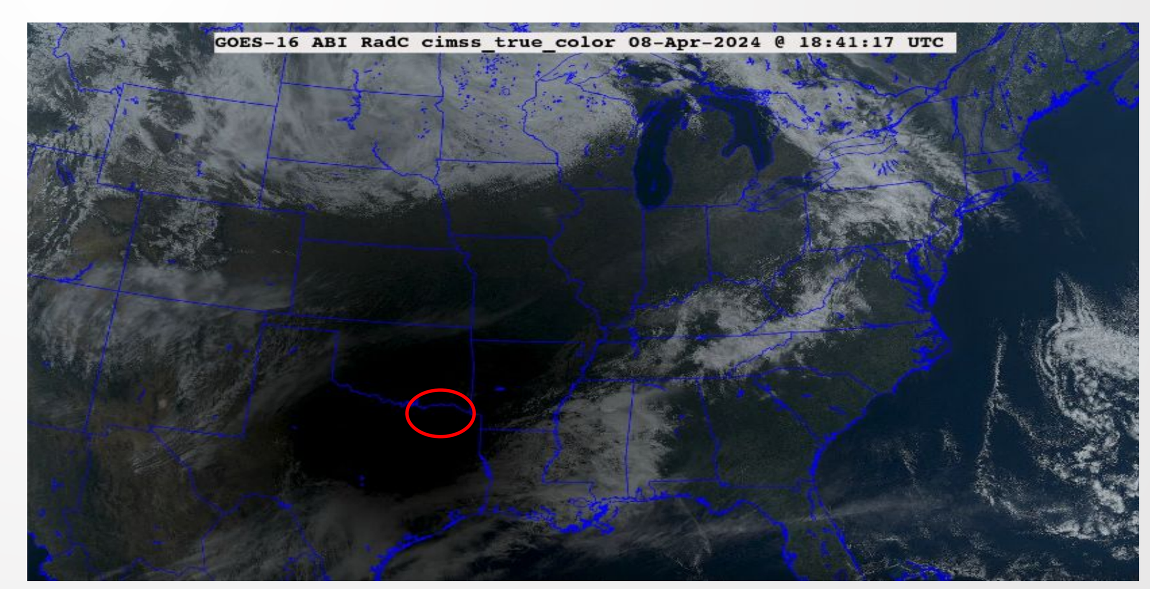


Image 2: In the GOES-16 satellite image (which is a GLOBE satellite) we can see the clouds are shown as white parts of the image. The brighter and more white, the more clouds there are. In the red circle we see that there is a lot of white indicating that there are clouds in the region at that time.

Image 3: In the GOES-16 satellite image (which is a GLOBE satellite) we can see that the dark shadow that is casted upon the circled region. This is because the solar eclipse is passing over it. This place experienced totality. The clouds are not visible in this scene because of the shadow.



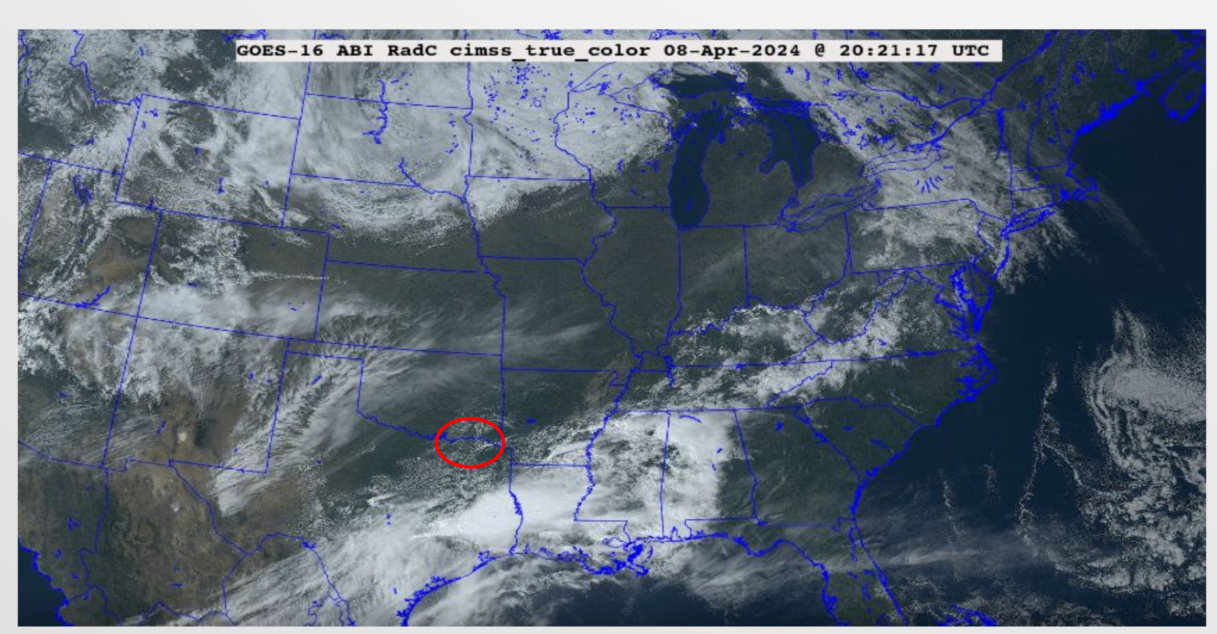


Image 4: In the GOES-16 satellite image, we can see that right after totality, the white in the red circle was reduced in density and brightness. This indicated a reduction in cloud cover.

REFERENCES

Cappucci, Matthew. "Solar Eclipses Can Make Their Own Weather. Here's How. - The Washington Post." The Washington Post, www.washingtonpost.com/weather/2024/04/04/total-solar-eclipse-weather-atmosphere/. Accessed 1 May 2024.

"Indianapolis, IN Weather History." Weather Underground, https://www.wunderground.com/history/daily/us/in/indianapolis/KIND. Accessed 1 May 2024.

Lindstrom, Scott. The North American Total Eclipse of April 2024 — CIMSS Satellite Blog, CIMSS, 8 April 2024, https://cimss.ssec.wisc.edu/satellite-blog/archives/57818. Accessed 1 May 2024.

NASA. "Make a Cloud in a Bottle." Student Project: Make a Cloud in a Bottle, https://www.jpl.nasa.gov/edu/learn/project/make-a-cloud-in-a-bottle/. Accessed 1 May 2024.

"NOAA Satellites View Total Solar Eclipse | NESDIS." NESDIS, https://www.nesdis.noaa.gov/news/noaa-satellites-view-total-solar-eclipse. Accessed 1 May 2024.

RESULTS

The Effect of Location and Time on the Amount (%) Cloud Cover

Location	Cloud Cover %		
	Time (1 hour)		
	Prior to eclipse	During eclipse	After eclipse
Dallas	65%	62%	63%
Cleveland	73%	71%	76%
Montreal	74%	69%	71%
Buffalo	52%	52%	53%
Indianapolis	42%	43%	45%

Chart 1: The team used this table to collect data. The data shows that during the eclipse in three places the cloud cover decreased and in Buffalo it stayed the same. Then, after the eclipse the percentage of cloud cover increased again, showing that there was more clouds after the eclipse.This numerical data shows that there is inconsistency and maybe cloud cover is affected by other factors.

DISCUSSION AND CONCLUSIONS

After reviewing the images and realizing that after a solar eclipse the percentage of cloud cover can either increase or decrease, we researched this further. The team realized that cloud cover was not directly affected by the solar eclipse rather by the effect of the eclipse on the temperature. The reduction in radiation makes the ground or surface of the Earth cool, causing air to stop rising. The stopping of the air rising leads to a stop in the constant convection cycle which is how cumulus clouds are made. Cumulus clouds are the fluffy clouds that grow vertically. Another parameter of weather that affects cloud cover during an eclipse is the increase in wind. The winds pick up and the patterns change due to the shadow that the moon casts on the Earth. The wind then makes the clouds move to a different place clearing the skies in the areas or location with totality. Knowing all this information we came to a finalization that our hypothesis wasn't supported or refuted. Instead, we found out that cloud cover was dependent on other parameters of weather that were affected by the eclipse. Knowing we had not collected data which supported or didn't support our hypothesis, our team thought of some next steps we could take to continue researching our scientific question. First, we could collect and analyze a lot more data from previous solar eclipses and see how the data from each compares to each other. Second, we could ask ourselves how cloud cover varied from one year to another? How places with totality and without totality compared? Also, how location plays a part in the solar eclipse and the cloud cover percentages, etc. Third, is to create an experiment to gather more data. An experiment that our team could do to test our hypothesis is we could make a "cloud" using a clear container, warm water, a metal tray, ice, a spoon, and a match. After creating 2 bottles with "clouds" in them, one of them will be placed in the fridge (imitating temperature drop) and the other will be put outside on a sunny day (to compare to the colder temperatures). After waiting 10 minutes in the assigned temperature, observe the clouds and take notes on how the different temperatures affected the clouds. The purpose of this investigation would be to prove that the decrease in temperature would cause the clouds to disappear or vice-versa.