Cloud First Report

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Assignment: Cloud First Report
Course MCEN 5151-001 Flow Visualization
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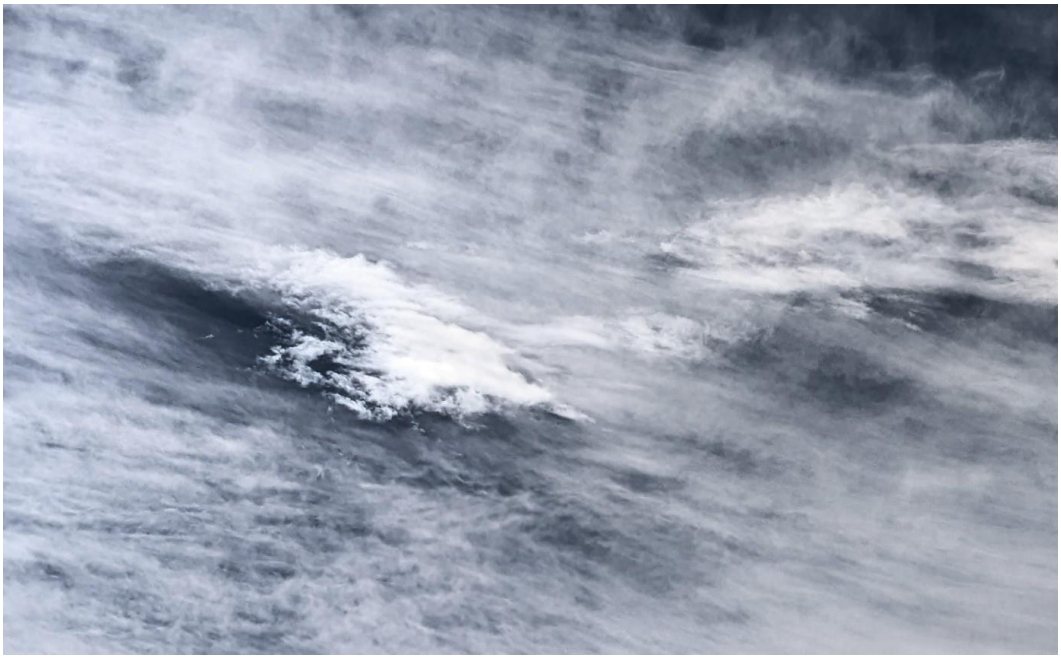

Figure 1. Cirrus Clouds in Boulder, CO on 30 September 2023

Background

The purpose of this image was to capture the visual representation of fluid dynamics that affect clouds, influencing how they look and what information they convey. I deliberately focused on the textured look of the cirrus clouds with an altostratus cloud in the foreground in this picture because they directly demonstrate the weather patterns that have moved through the area as well as those that are incoming. Data collected throughout this process was also used to confirm my identification of the clouds. I also wanted to highlight the contrast between the sky and the clouds, which yield a visually pleasing textured look.

Location Information

Table 1 contains the photograph location, time, cloud type, camera direction and distance information.

Location	Shanahan Mesa Trail, Boulder, CO
Date	30 September 2023
Time (MST)	11:04 AM
Type of Cloud	Cirrus
Camera Direction	Facing South
Camera Angle	10 degrees above the horizon

Cloud Characteristics

There are two types of clouds captured in the image, cirrus, and altostratus. The cirrus clouds comprise most of the background of the photograph, meanwhile there is an altostratus cloud in the foreground. The altostratus cloud can be identified in the photograph because it is lighter and fluffier in appearance than the cirrus clouds. Meanwhile, the cirrus clouds are wispy and have vortices [1]. This assertion is supported by the Skew T Diagram in Figure 2 which shows the weather data captured in Grand Junction, CO. Grand Junction, CO, the location of the closest weather station that generates these charts, is approximately 190 miles from the photography site [2]. Per the Skew T Diagram, clouds are expected to be at altitudes around 12,500 meters and 7,500 meters because this is where the temperature and dew point soundings are closest. The temperature sounding is indicated by the line on the right while the dew point sounding is indicated by the line on the left [3]. Per the National Weather Service, cirrus clouds are frequently found at altitudes above 9,000 meters and altostratus clouds are found at altitudes of 5,500 meters to 9,000 meters [4], confirming the observed cloud identification.

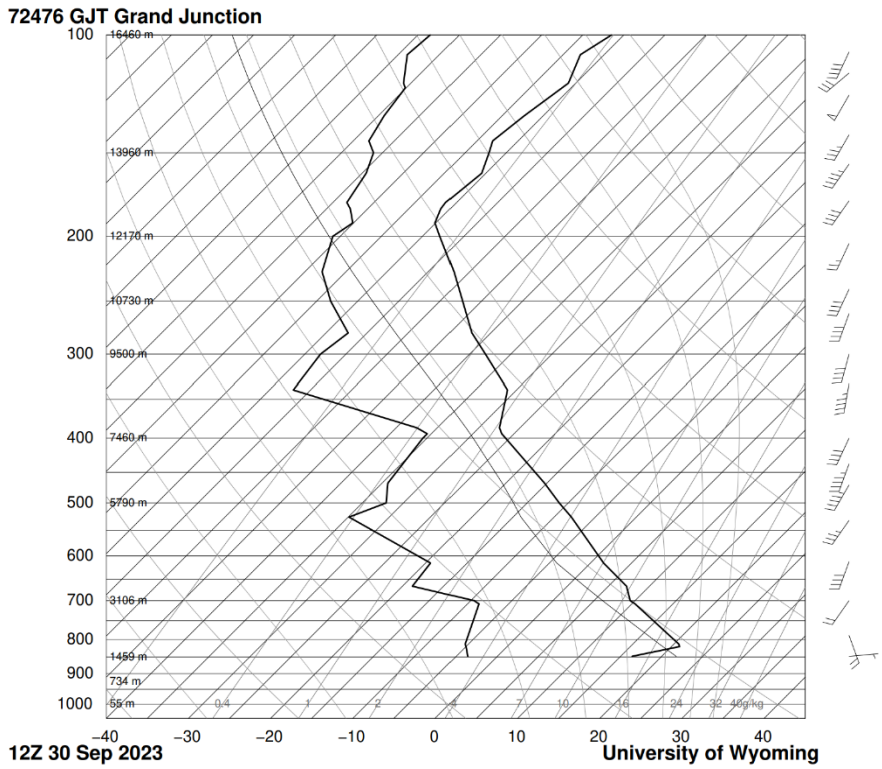

Figure 2. Skew T Diagram for Grand Junction, CO on 30 September 2023 1200Z [6]

The size of the identified clouds is also supported by the Skew T Diagram. Moisture in the air is identified by analyzing the distance between the temperature and dew point soundings. The two soundings are relatively far apart which indicates that the air is relatively dry, resulting in less cloud formation since there is less moisture present. Furthermore, the atmosphere is relatively stable. Atmospheric stability is determined by comparing the consistency of the distance between the temperature and dew point soundings [3]. Additionally, it is indicated by the CAPE value in figure 2. A value on zero indicates the atmosphere is stable. On 30 September 2023, the distance between the sounds stays relatively consistent throughout and the value is zero, indicating a stable atmosphere. This is confirmed by the weather reports for that day as well as the surrounding days which all have similar high temperatures, low temperatures, and no precipitation [5].

Visualization Techniques

To capture this image, I spent a lot of time looking at the clouds and determining what type flow I wanted to capture. I found that I particularly liked how the cirrus clouds looked in contrast with the sky and ultimately targeted those clouds when they were present. I attempted to frame the photograph using the surrounding landscape and trees without modifying the camera's zoom to limit any pixelation from using digital zoom as opposed to manual. I also wanted to include the framing to help contextualize the image.

Photographic Techniques

While a lot of time was spent determining what type of flow I wanted to capture, the actual photograph selected one of the two I took that day. The camera used to take this photograph was my Google Pixel 6 which has a 50 MP camera. The photograph selected had the camera characteristics listed in Table 2.

Table 2. Camera Specifications for the Photograph

Specification	Description
Aperture	f/1.9
Exposure	1/5376
ISO	47
Focal Length	6.81 mm

Once the photograph was selected, it was edited to better demonstrate the desired flow visualization techniques. The original photograph, seen in Figure 3, dimensions were 4080 pixels wide and 3072 pixels tall. Initial attempts at editing were focused on attempting to emphasize the flow without cropping out the landscape and tree framing, however due to issues contrasting the entire image, they were later cropped to emphasize the flow. The image final image was cropped to 1389 pixels wide and 856 pixels tall. Next, an s-curve was added to the RGB curve. The intent of this adjustment was to accentuate the turbulent flow of the clouds by increasing the contrast of the cloud itself, as well as the sky behind it.

Figure 3. Original Phone Image

Conclusions

This process was interesting because it made me reflect on whether the artistic components of the photograph were more important than the scientific characteristics. While the framing, in my opinion, made for a more well-rounded photograph, I felt that the scientific characteristics were lost when they were kept. In particular, the small vortices and the textured look were lost, which I believe were an

important part of the fluid mechanics behind this photograph. With my next attempts at capturing clouds, I want to use my digital camera as opposed to my phone to see if this will help improve some of the photograph's characteristics. Similarly, I want to try to capture an image at a different time of day to see if the light adjustment will help reveal any additional information.

References

[1] WMO. "Cloud Classification Summary." *International Cloud Atlas*, 2017, cloudatlas.wmo.int/en/cloud-classification-summary.html. Accessed 26 Oct. 2023.

[2] "How Far Is It? - Straight Line Distance Calculator." *Www.gps-Coordinates.net*, www.gps-coordinates.net/distance. Accessed 25 Oct. 2023.

[3] Hertzberg, Jean. "Clouds 3: Skew - T and Instability." *Flow Visualization*, www.flowvis.org/Flow%20Vis%20Guide/clouds-3-skew-t/. Accessed 26 Oct. 2023.

[4] US Department of Commerce, NOAA. "Cloud Classification." *Www.weather.gov*, National Weather Service, www.weather.gov/lmk/cloud_classification. Accessed 25 Oct. 2023.

[5] "Boulder Colorado Monthly Mean Maximum Temperatures 1893-Present: NOAA Physical Sciences Laboratory." *Psl.noaa.gov*, psl.noaa.gov/boulder/data.daily.html#Sep23. Accessed 26 Oct. 2023.

[6] Oolman, Larry. "Atmospheric Soundings." *Weather.uwyo.edu*, University of Wyoming, weather.uwyo.edu/upperair/sounding.html. Accessed 25 Oct. 2023.