Clouds 2

MCEN 5151

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1 Introduction

The purpose of this assignment was to explore different types of clouds and understand the underlying physics. To capture a variety of formations, I took multiple pictures throughout the past month. I settled on this image due to the contrast in the different regions of the clouds and because the mountaintops added extra interest to the composition. This image was captured on November 24th 2021 at 5:11pm near Fairplay, Colorado. It was a cloudy day with cooler temperatures.

2 Cloud Physics

The cloud in this image can be classified as a cumulonimbus cloud. The cumulonimbus cloud is unique because it can span all 3 cloud levels, so their altitudes can span 2,000-52,000 ft [1]. It is also the main type of cloud responsible for precipitation as implied by its name- cumulo, meaning heap and nimbo meaning rain in latin [1]. Due to the connection with precipitation, this type of cloud is short lived and disappears quickly after releasing its precipitation.

Fairplay, Colorado is prone to very cold temperatures and heavy amounts of snow during the winter months. The right hand side of this image shows the beginning of a storm as there are very dark regions. To the left, blue sky is still visible, so we can determine the storm is moving to the left in the reference of this image.

The University of Wyoming Department of Atmospheric Science has two atmospheric sounding locations in Colorado, located in Denver and Grand Junction. Unfortunately, both of these locations are about 2 hours outside of Fairplay, Colorado. The distance between Fairplay and Denver is slightly less than the distance between Fairplay and Grand Junction, so the reference sounding data was taken from Denver, CO. Below is the corresponding Skew-T diagram for the photograph.



Figure 1: Corresponding Skew-T diagram. The left most black line represents the dew point, while the right most black line represents the actual temperature. The gray line is the parcel lapse rate. Diagram obtained from University of Wyoming Department of Atmospheric Science's website, [2]. It is important to note that Fairplay is about 2 hours outside of Denver, CO.

It is worth noting that since the data presented in figure 1 applies to Denver, there are differences between the conditions shown and the actual data if it were collected from the location of the image. However, we can still use this data to estimate the height of the clouds, corresponding wind speed, and the stability of the atmosphere.

When the dew point is close to the actual temperature, condensation occurs and thus a cloud forms. Therefore, a cloud is likely to form when the dew point and actual temperature lines are close together on the Skew-T diagram [3,4]. From the diagram we can determine the cloud likely formed around 5590 m above Denver ground level. The wind speed at this height can be estimated as 50 knts southwest. The CAPE (convective available potential energy) value of 0.00 indicates a stable atmosphere.

3 Photographic Technique

This photo was taken with a Nikon D3300 DSLR camera with an 18-55mm lens. Below is a table summarizing the camera settings used for this image.

Property	Value
Shutter Speed	$1/250 \sec$
Focal Length	31 mm
ISO	200
Aperture	f/8
Pixels	6000 x 4000

3.1 Post Processing

The post-processing of this photo was done using Darktable. The horizon on the photo was a bit lopsided, so the photo was rotated slightly and cropped. I increased the contrast and adjusted the highlights/shadows to create more dimension. The final step was to apply a color correction. This took the white/yellow tinges in the clouds and made them a warm pink/orange tone. I thought this added a nice contrast with the blue and purple tones of the image. Below are the original image and the final edited image.



Figure 2: Original image without edits.



Figure 3: Final image including edits.

4 Final Thoughts

The final image provides a unique image of a cumulonimbus cloud. Cumulonimbus clouds are a rarer cloud type as they are short lived, so it was exciting to capture one before a storm. The location of the image added extra interest to the composition as the mountains could be seen below the clouds. I am happy with my choice to add a color correction since it makes it look more fantastical. I also really like how the upper regions of the image are so dark since it evokes a daunting storm. The cloud physics of the image are unique and interesting and I am pleased with the composition of the photo.

5 References

[1] "Learn about Cumulonimbus Clouds." What's This Cloud, https://whatsthiscloud.com/cloud-types/cumulonimbus/.

[2] "Atmospheric Soundings." University of Wyoming, http://weather.uwyo.edu/upperair/sounding.html.

[3] "Skew T's: How to Read Them." FLSC, http://flsc.org/portals/12/PDF/Read-Skew-T.pdf.

[4] "Skew-T Parameters." Skew-T Parameters and Indices, https://www.weather.gov/source/zhu/ZHU-Training-Page/convective-parameters/skewt/skewtinfo.html.