

Clouds 1

MCEN 5151

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10/20/2021



1 Introduction

The purpose of this assignment was to explore different types of clouds and understand the underlying physics. I took multiple pictures of cloud formations in a variety of settings in an attempt to capture something interesting. I chose this as the final image due to the level of detail I captured. I also thought this provided an interesting perspective. Even though I took this photo from the ground, it looks as if you're in the clouds. This image was captured on October 6th, 2021 at 3:52 pm in Arvada facing southwest. It was a cloudy day with cooler temperatures.

2 Cloud Physics

The clouds in this image can be classified as stratocumulus clouds. Strato is latin for layer, while cumulo is latin for heap, so they generally present in a layer of puffy clouds [1]. It is uncommon for this type of cloud to create precipitation and they tend to form at low altitude (2,000 ft to 7,000 ft) [1].

Stratocumulus clouds have a variety of associated species, varieties and features [1]. The clouds in this image are likely of the species stratiformis. This species of stratocumulus presents itself as a horizontal layer of clouds, which is the most common species of stratocumulus clouds [5]. Below is the corresponding Skew-T diagram for the photograph.

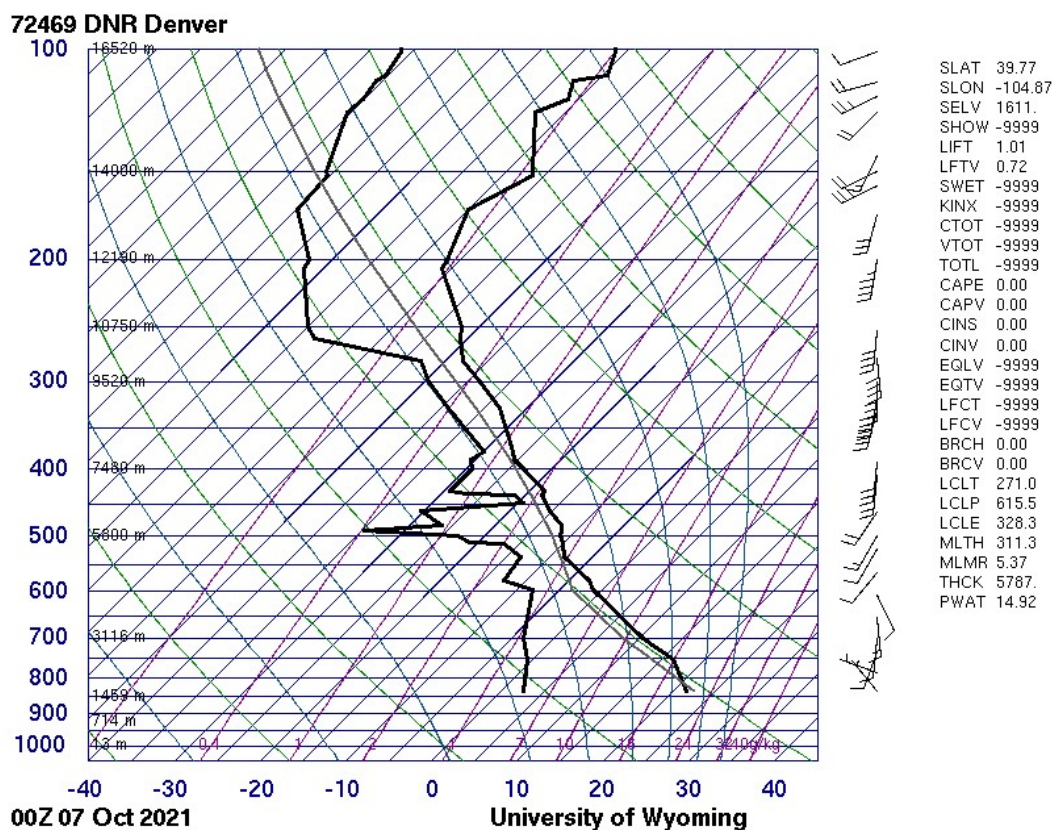


Figure 1: Corresponding Skew-T diagram. The left most black line represents the dew point, while the right most black line represents the actual temperature. The gray line is the parcel lapse rate. Diagram obtained from University of Wyoming Department of Atmospheric Science's website, [2].

It is worth noting that the data presented in figure 1 applies to Denver, so there may be slight differences between the conditions shown and the actual data if it were collected from the location of the image

(Arvada). 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 clouds likely formed at a height of about 6640 m above Denver ground level. The wind speed at this height can be estimated as 30 knts south/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. Although this picture was taken on a cloudy day, it was still relatively bright outside. A low ISO was chosen as to not saturate the image with white. Below is a table summarizing the camera settings used for this image.

Property	Value
Shutter Speed	1/640 sec
Focal Length	55 mm
ISO	200
Aperture	f/11
Pixels	6000 x 4000

3.1 Post Processing

The post-processing of this photo was done in Darktable. Since this photo was taken on a cloudy day, I decided to make it monochromatic. The original photo was mainly composed of gray pigments, but there was a blue tinge to the photo that was unfavorable. I decided to apply a black and white filter to eliminate the blue hue. I also cropped the photo so that the focus was on the highlighted cloud in the middle of the field of view. The last editing step was adjusting the highlights and shadows so that there was a stark contrast between the different regions of clouds. 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 detailed look at stratocumulus stratiformis clouds. It was interesting to see how the stability of the atmosphere as well as the wind speeds/directions affect the movement and formation of various clouds. I really like the contrast between the highlights and shadows in this image and the level of detail you can resolve. I am also very happy with the post-processing of this image since it provided a clear focal point.

5 References

- [1] “Learn about Stratocumulus Clouds.” What’s This Cloud, <https://whatsthiscloud.com/cloud-types/stratocumulus/>.
- [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>.
- [5] World Meteorological Organization. “Stratocumulus Stratiformis (SC Str).” International Cloud Atlas, <https://cloudatlas.wmo.int/en/species-stratocumulus-stratiformis-sc-str.html>.