

MCEN 5151 Clouds 2 Report

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I. Purpose and Methodology

This is the second cloud image report for the Fall 2021 Semester of Flow Visualization, and the purpose here was to capture the cloud formations as a cold front was moving in over the mountains in Boulder, CO.

This image was taken on Wednesday December 8th, 2021 at 6:18pm, from the parking lot of an apartment building at 22nd and Canyon pointing towards the east at approximately a 45 degree angle to the ground.

II. Cloud Details

First looking at the skew-T diagram shown in Fig. 1, the lines close in on each other around 5000m and stay closed in until around 10,000m where they open up again. This indicated that the cloud formation begins at 5000 and stretches upwards quote a ways, leaving an assumption that this is a cumulonimbus formation.

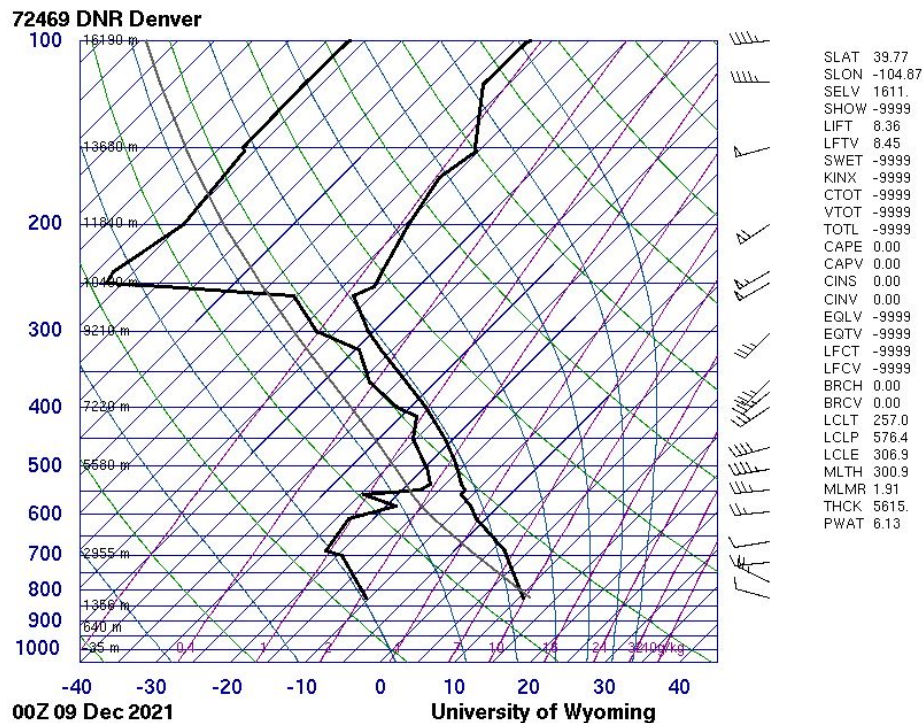


Figure 1. Skew-T diagram of Denver at 6:00pm on Decemebr 8th, 2021

Then, based on appearance, it also appears that there is a little bit of dissipation at the top of the clouds which looks to the eye like a bit of altostratus clouds topping off the cloud stack. The skewT supports this when it is seen that the clouds formation ends at around 10,000m which is the altitude one would expect altostratus clouds to be forming. In addition, while storms often follow in the wake of cumulonimbus clouds and there was no precipitation, this was the first day of a large cold front moving in, which resulted in precipitation later in the week. Because of this, there were higher winds in the area and at the level of these clouds, which can be seen in the wind flags on the right side of the skew-T.

Moving onto discussion of the stability of the atmosphere, since it was a cold front moving in, it is expected that there is a stable atmosphere. Stable atmospheres often correspond to high winds and cold air, as colder air is less prone

to turbulence due to its higher density. Through the CAPE value of 0.00, it is noted that this is a stable atmosphere as was expected from the cold air and high winds.

III. Image Details

This photo was taken with a Canon EOS Rebel T6i DSLR camera, which allowed for manual focusing zoom adjustments. Because the parameters for outdoor photography are well set on this type of camera, an auto image detection mode was used to set the exposure settings outside. These settings were set as seen in the table below.

Variable	Value
F Number	4.5
Camera	Canon EOS Rebel T6i ??
Shutter Speed	1/60
ISO	100

These parameter made for a great lighting scenario since the photo was taken near sunset where natural lighting for outdoor photography is the best, and the result was an image with a lot of room to work with in post-processing since there was not a lot of over-exposure in addition to a lot of the colors in the photo being present and able to manipulate.

Since the raw photo data had very good lighting, the only changes that were made in post processing, using darktable, was to change the RGB curves to bring out some contrast and enhance certain color palettes. Mostly, there was a lot of interesting natural contrast to work with since only one half of the cloud was being lit by the setting sunlight, and the lower half of the cloud was dark to begin with. Then, the light from the sun at sunset had a lot of warmth in it that was brought out to contrast the dark grays and blues of the sky and the lower cloud. The original and the processed photo are shown below.



Figure 2. Initial image from the RAW file



Figure 3. After post processing

IV. Results

Overall, the image came out very nicely with the lighting and color addition in post-processing. Scientifically this image is not as dense as some others although there are some things I think would be interesting to investigate in the future. For example, it would be curious to investigate what type of circumstances go into capping off a cloud stack with altostratus clouds and what conditions make that possible. Then, right at the beginning of the dark portion of the cloud in the lower part of the photo, there are some interesting trails coming off of the cloud that almost look like the start of vortex structures in clouds, so it would be interesting to investigate vorticity in cloud formations.