Clouds Second Report

Anders Hamburgen

Cirrus and Cumulus Clouds
Taken 6:07 p.m. on 10/25/2022
Flagstaff Mountain – Boulder, CO

MCEN 4151 – Flow Visualization

10/23/2022

This is my submission for the second Cloud Image assignment for MCEN 4151, Flow Visualization. I've been watching the sky all semester to capture the interesting clouds we see in Boulder. This image was taken on a hike up the hill behind my apartment on a chilly, late-October evening. There were many different types of clouds in the sky that evening, but this swath of cirrus clouds sliced open by an airplane's contrail caught my attention. I framed the photo to capture as much of the bank of clouds as I could while keeping some of hill above me in view for reference.

I live close to the trailhead to hike up Flagstaff Mountain. Even on the busiest days of the semester I try to take 30 minutes to run up to the first viewpoint by the Flagstaff House restaurant. I saw these clouds partway up the trial near the bottom. I faced directly west and angled my phone camera up approximately 45° from the horizontal. It was 6:07 p.m. on 10/25/2022 when I took the photo, and as I write this in mid-December, I can't help but miss the extra daylight we had even a couple months ago.

There are two types of clouds in this photo. The first are the cirrus clouds interrupted by the contrail. These are probably at an altitude of 10,000 m above sea level. The fact that the contrail disturbs the clouds is a serious clue about their elevation, given most jets fly at that altitude. The other clouds are cumulus, and are smaller and fluffier and closer to me, the observer. These look to be quite a bit lower in altitude and could be just 1,000 or so meters above me. Figure 1 is a Skew-T plot from Grand Junction, Colorado on the west side of the continental divide. The plot is generated from weather balloon data collected at 6:00 pm on October 25th, just seven minutes before I took my photo.

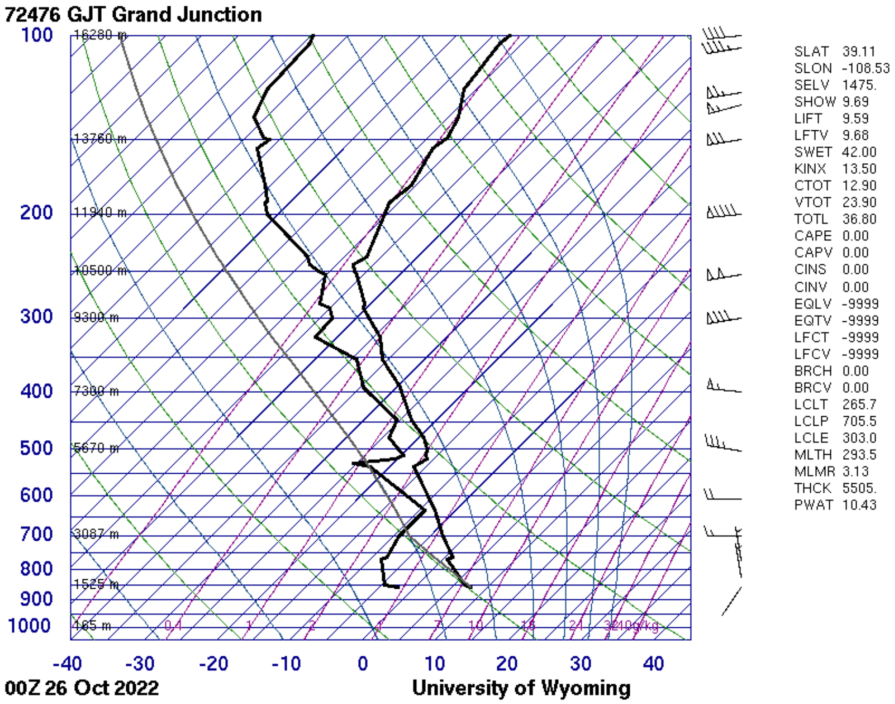

Figure 1: The Skew-T chart, derived from data collected by a weather balloon in Grand Junction, CO at 6:00 p.m. on September 16th.

Clouds are likely to exist where the temperature line on the right jogs close to the dewpoint line on the left [3]. This Skew-T in Figure 1 indicates the possibility clouds at a large range of elevations, say 3,000–10,500 meters. Of course, Grand Junction is far away from Boulder, and with a massive mountain range between the locations, it's difficult to draw any real conclusions from this Skew-T. The CAPE index is a clue that the weather in Grand Junction might have been similar on this day. A CAPE of 0 atmospheric stability [3], which would agree with the conditions I observed in Boulder. It was a relatively calm and chilly evening with no wind. There may have been a cold front on its way. Cirrus clouds are commonplace in these circumstances. I would like to point out that there appears to be a vortex in the cirrus clouds in the top center of the frame, and I wonder if the contrail created this vorticity.

This photograph was taken with my iPhone XR, which does not have the best camera. The field of view is approximately 1 kilometer based on the width of the swath of hill in the foreground. My distance to the clouds is probably on the order of 10 km for the cirrus, and 1 km for the cumulus. The iPhone XR has a fixed 4.25mm focal length and f/1.8 aperture. This photograph was taken with a shutter speed of 1/1634 seconds and an ISO of 25. The original image, unedited, is shown below in Figure 2.

Figure 2: Raw, unedited original capture. 4032 × 3024 px.

I made minor changes before arriving at the final, edited image. The most notable alteration was the RGB curve, which I decreased slightly in the first half of the curve and increased slightly more in the second half. I also increased the digital sharpness a small amount and changed the white balance to look more pleasing. The image did not require cropping.

This is a cool picture because of how much is going on. I really enjoy the ribbed texture of the cirrus clouds and am excited that I saw them after being interrupted by an airplane, which left a contrail and possibly induced vorticity in the clouds. The contrail generates a strong visual diagonal in the frame, which I also enjoy. The bright cumulus clouds in the foreground add a nice element of variety to the photo and offer a different texture to look at. I may choose to re-edit this photo to brighten the foreground a little bit, but overall, I'm quite pleased with my choice in this photo as my submission (I saw a lot of cool clouds this semester), and think its unique elements make it stand out.

REFERENCES/BIBLIOGRAPHY

[1] – Hertzberg, Jean. MCEN 4151 – Flow Visualization, University of Colorado at Boulder. *Clouds 1: Names.* Fall 2022.

[2] – Hertzberg, Jean. MCEN 4151 – Flow Visualization, University of Colorado at Boulder. *Clouds 2: Why Are There Clouds? Lift Mechanism 1: Instability.* Fall 2022.

[3] – Hertzberg, Jean. MCEN 4151 – Flow Visualization, University of Colorado at Boulder. *Clouds 3: Skew - T and Instability.* Fall 2022.