University of Colorado - Boulder

MCEN 5151
Flow Visualization

Clouds First: Altocumulus Because They're Alto

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I Introduction

Clouds are some of the most accessible ways to visualize fluid flows. You can see them anywhere in the world, you just need to look up! Cloud formation requires specific atmospheric conditions, and small changes in these conditions affect the types of clouds that are seen. We are lucky here in Boulder to have very dynamic weather with plenty of opportunities to see unique types of clouds.

This is the first of two cloud assignments for Flow Visualization. The requirements for these photos are relaxed. Because we can see interesting clouds at any time we can use any camera to capture them. I spend much of my time riding my bike around the Front Range, over the last few weeks my camera roll has been filled with clouds I've seen. Some early in the morning when it is cold out, others as a storm moves in to Boulder and I am trying to get home before it rains. The one I finally settled on came in the evening when the sunset illuminated some wispy parallel clouds right over my head.

II Methodology

II.a Test Setup

I was at Tantra Park in South Boulder for Cyclocross practice. Most of the day had been cloudy and we were ready to head home as it was getting too dark. As we were packing up the sky lit up and some exciting clouds were finally revealed. The photo was taken at 6:46 PM on September 30th, 2026. I was facing straight West with the camera inclined at $\approx 10^{\circ}$ to keep the horizon in frame.

II.b Visualization Technique

The clouds themselves are the technique! They allow us to see air movement in the atmosphere, as long as the conditions allow them to form. There are few variables that we can control here, as you wait for one to be perfect the other will have changed. I took advantage of my chance to see interesting cloud phenomena with some beautiful lighting.

II.c Photographic Technique

Camera	Apple iPhone 16		FOV	69° [1]
Type	Smart Phone		Distance to Object	N/A
Original Image	8064x6048 pixels		Aperture	f/1.6
Final Image	4389x2926 pixels		Shutter Speed	1/122 second
Focal Length	26mm equivalent		ISO	50

Table 1: Photo Specifications

I only had my phone in my pocket on this ride, but would have loved to have something nicer to capture this sunset and clouds. The final picture was edited in DarkTable where

I bumped the contrast just enough to make the mountains darker against the sky while keeping colors realistic. I also cropped out the bottom of the photo because this is not about the landscape!

Figure 1: Cropped Original Image (left) compared to Edited Image (right)

III Flow Discussion

I believe the clouds I captured in this photo are altocumulus. The lumpy appearance, rather than smooth streaks, suggest an unstable atmosphere and cumulus clouds. They are broken into lines and a little wispy, which makes me think they deserve the alto- prefix. A higher cirrocumulus would appear thinner, while a lower stratocumulus would be more continuous.

These visual observations can be compared to a Skew-T Diagram, seen in Figure 2. This photo was taken late on September 30th, meaning the best sounding data will be from 00 UTC for the following day.

The dewpoint and temperature lines convergeat an elevation around 3000-4000m, so we could expect to see clouds here. This is right in the middle of the range that NOAA defines for altocumulus clouds, 2400-6100m [3]. Now what about stability? We can choose a point and follow a path parallel to one of the dry adiabat lines to see that it ends up a similar temperature, if not slightly cooler, than the environmental temperature line plotted. This points to a stable atmosphere, which disagrees with our previous prediction. This is where we need to acknowledge that while Grand Junction is relatively close to where this photo was taken, lots can change while crossing the continental divide, and many atmospheric variables are likely different here in Boulder. Model data could be useful here, but no one stores model data this long after. Next time I am capturing interesting cloud photos I will make sure to find some model data before it is too late.

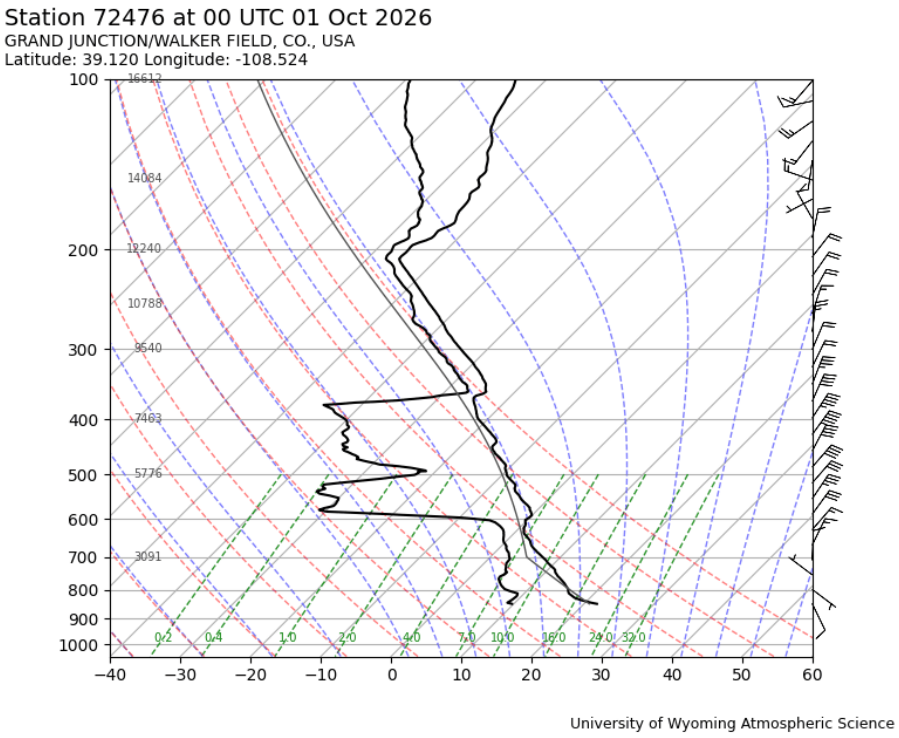

Figure 2: Skew-T at Time of Photo, Station 72476 (Grand Junction) [2]

IV Conclusion

My observations and conclusions that the clouds in my photo were altocumulus were reinforced by my group in our photo critiques and by the subject matter expert that joined us. Many other students used photos from this same night and identified the clouds in the same way. I like the combination of interesting clouds and beautiful colors in my image, although for the next clouds assignment I would like to find something more unique. We are fortunate to have many pretty sunsets here in Boulder and I think there are other phenomena I would enjoy capturing and learning more about. I find watching how quickly clouds change along the Front Range and the way they interact with the geography interesting, a timelapse or video that can show this is what I am hoping to capture for the second clouds assignment.

References

[1] SPQR. *The real info regarding angle-of-view on iPhone cameras*. https://pixelcraft.photo.blog/2023/06/16/the-real-info-regarding-angle-of-view-on-iphone-cameras/. Crafting Pixels. Accessed: October 19, 2026. June 2023.

[2] Department of Atmospheric Science University of Wyoming. *Upper Air Soundings*. https://weather.uwyo.edu/upperair/sounding.shtml. Accessed: 2026-10-19.

[3] National Weather Service. *Glossary: Altocumulus*. https://forecast.weather.gov/glossary.php?word=altocumulus. Accessed: 2026-10-19.