Afternoon Clouds in the Indian Peaks Wilderness

MCEN 5151 Flow Visualization - Clouds First Report

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Statement of Meaning While viewed as a mundane object in the sky by many, clouds can actually be surprisingly complex when surrounding weather and atmospheric conditions are considered. The images in Figure 1 were taken in the Indian Peaks Wilderness area on September 21, 2025 to highlight the complexity and beauty of cumulus, cirrus, and lenticular clouds. Multiple types of clouds exist in this image at various elevations, and show a variety of textures, light levels, and shapes against a blue gradient backdrop.

Location and Conditions The picture in Figure 1 was taken in the Indian Peaks Wilderness area within the state of Colorado on September 21, 2025 at 2:29 pm in the afternoon. I took these pictures while I stopped for lunch in a scree and boulder field with an elevation of 3800 m on a hike down from Mount Audubon. My phone camera was angled upward at roughly a 30° angle from the horizon in the south-southeast direction when I took the photo.

Clouds and Weather In this image (Figure 1), altocumulus lenticularis, cumulus humilis, cumulus fractus, and cirrostratus undulatus are present.[1]–[4] These clouds can be identified visually in this image, though the plot in Figure 2 corroborates some of these identifications.[5] In the upper middle part of the image, there is a thin sheet-like cirrus cloud that has some visible waves (or undulations). I identified these clouds as cirrostratus undulatus because they were sheet-like (stratus) with some undulations (undulatus) and were high up in the sky (cirrus). In the middle of the image, there is an altocumulus lenticularus cloud. This type of cloud often forms because of orographic (landscape) effects. The mountain range over which this cloud resided helped to force air upward where it cooled and condensed into this cloud shape. In the bottom layer of the image, there are some cumulus humilis and cumulus fractus clouds. Cumulus humilis clouds are "humble", low lying cumulus clouds that do not extend very far vertically. Cumulus fractus clouds are a more fragmented variety that forms and dissipates quickly. On the day of the hike, these clouds were constantly forming and breaking up around the mountain peaks (around 4000 – 4500 m). High speed winds with gusts of at least $13\,\mathrm{m\,s^{-1}}$ helped to drive these clouds toward the valley in the east.

About half an hour after this picture was taken, some of the cumulus clouds over the mountains grew thicker and released some light rain — though this rain really fell as ice pellets at elevations higher than about 3700 m. The precipitation did not last long and dissipated as the cumulus clouds broke up again. These types of clouds and precipitation patterns are common in the Rocky Mountains, though warmer air in the summer can lead to the formation of thunderstorms.

At the time the image in Figure 1 was taken, the atmosphere was stable. The plot in Figure 2 shows a CAPE value of 6.71, which supports this. When the atmosphere is unstable, a much larger CAPE value can be expected (in the hundreds or even thousands). Because the CAPE

value is 6.71 and because the slight instability occured around 5000 m, one might suspect that cumulus clouds (which usually form in unstable conditions) would be present at this elevation. In my image, cumulus clouds were indeed present around this height. The Skew T plot (Figure 2) has two thick, bold black lines as well as a gray line between them. The rightmost black line shows the temperature measured by a weather balloon as it ascended from Grand Junction, CO, while the leftmost black line shows the dewpoint. At an elevation around 4000 m, these to lines almost touch, which means that the air at that elevation could readily condense and form clouds. The cumulus clouds in the image that I took would be present at this elevation. A rightward turn in the rightmost black line around 5000 m also supports the idea that clouds were at this elevation: the temperature of air increases when water condenses and leaves it. These turns are also present around 7500 and 10,800 m, supporting the idea that altocumulus and cirrus clouds are also present in the picture.

Photographic Technique The clouds image was taken with the the Google Camera app using the default zoom (1x) and a focus distance of 3.96 m. I tried to get my phone to focus on the cloud details, though I guess it only thought it needed to focus 3.96 m away. This could be a little problematic, as the clouds were *much* further away than 3.96 meters, though perhaps the focus distance was at the "hyperfocal" distance of the lens.[6] The lens in the Pixel 6A phone has a fixed aperture of f/1.7, a focal length of 27.9 mm (35 mm equivalent), a minimum focus distance of 0.1 m, and a view angle of $65.6 \times 51.6°$. The 12.1 megapixel digital image sensor has an area of 23.9 mm and produces images at sizes up to 4032×3024 pixels, which was the size of the original image. The post-processed image retained these dimensions because I didn't crop the image. Exposure was automatically set by the Google Camera app with an ISO of 69 and a shutter speed of $\frac{1}{23387}$s. Post processing of the photo in Darktable increased the blue color of the image using the RGB curves tool in an effort to enhance the color of the sky for dramatic effect.

Analysis and Reflection While this image shows multiple cloud types clearly, the scene could have been better captured with a different camera setup. The limited resolution of the cell phone camera (Google Pixel 6A) used to capture the scene could have prevented some of the smaller details in the image from being fully spatially resolved. Even though these details would not show up in this PDF well (due to size limitations), they could still have helped with cloud identification. Thankfully, these details weren't blurred out in this image because of poor time resolution. The shutter speed was $\frac{1}{23387}$s, which was more than fast enough to capture the faster moving cumulus fractus clouds at the bottom of the image.

A video recording or timelapse video of the clouds could have provided a more detailed view into the fluid flow that happened within and around the clouds. I remember this cloud changing shape even over the short period of time (minutes) that I spent eating my lunch — had I set up a tripod camera and captured a timelapse video, I would have been able to comment further on what happened while the clouds were forming and dissipating. While that would have been rewarding, I did not have a tripod that I could have easily carried in my backpack on my hike.

References

[1] WMO. "Altocumulus lenticularis (Ac len)," International Cloud Atlas. (), [Online]. Available: https://cloudatlas.wmo.int/species-altocumulus-lenticularis-ac-len.html (visited on 10/20/2025).

[2] WMO. "Cirrostratus undulatus (Cs un)," International Cloud Atlas. (), [Online]. Available: https://cloudatlas.wmo.int/varieties-cirrostratus-undulatus-cs-un.html (visited on 10/20/2025).

[3] WMO. "Cumulus fractus (Cu fra)," International Cloud Atlas. (), [Online]. Available: https://cloudatlas.wmo.int/species-cumulus-fractus-cu-fra.html (visited on 10/20/2025).

[4] WMO. "Cumulus humilis (Cu hum)," International Cloud Atlas. (), [Online]. Available: https://cloudatlas.wmo.int/species-cumulus-humilis-cu-hum.html (visited on 10/20/2025).

[5] "72476 GJT Grand Junction Observations at 12Z 21 Sep 2025 - 00Z 22 Sep 2025." (), [Online]. Available: https://weather.uwyo.edu/cgi-bin/sounding?region=naconf&TYPE=GIF%3ASKEWT&YEAR=2025&MONTH=09&FROM=2112&TO=2200&STNM=72476 (visited on 10/21/2025).

[6] "Hyperfocal Distance." (), [Online]. Available: https://www.dofmaster.com/hyperfocal.html (visited on 10/20/2025).

(A) Compressed Unedited Photo

(B) Compressed Edited Photo

Figure 1: Clouds captured at 2:29 pm MDT on September 21, 2025 in the Indian Peaks Wilderness in Colorado.

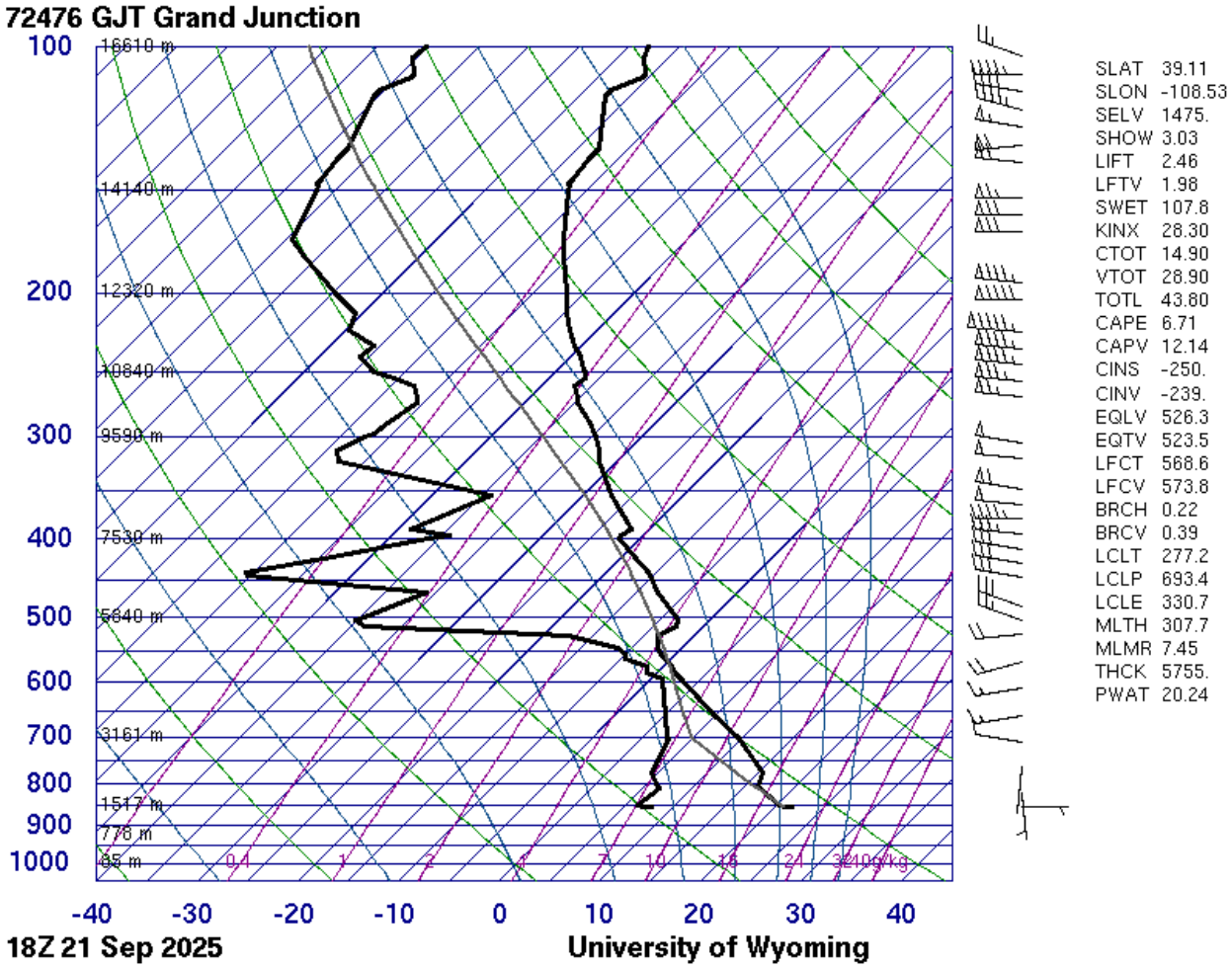

Figure 2: Skew-T plot from Grand Junction, CO at noon mountain time.