Clouds First – Khalil Sidani

Flow Visualization: ATLS 5151-001 | October 19, 2026

Cloud type: altocumulus with mammatus and virga

Taken Wednesday, August 26, 2026, 7:26 PM MDT at the University Memorial Center at CU Boulder, looking east



(a) Final image (b) Unedited original

Figure 1. Looking east from the UMC at 7:26 PM MDT, about 15 minutes before sunset

Context and purpose

This image was taken for the Clouds First assignment in Flow Visualization at the University of Colorado Boulder, in which students photograph clouds throughout the first half of the semester and explain the atmospheric physics behind one chosen image. I photographed the sky whenever it looked interesting and chose this frame because it captures several distinct processes in one view. My intent with choosing this image as opposed to others was to show the underside of a thunderstorm system as it decayed in the evening.

Circumstances

The photograph was taken outside the University Memorial Center on the CU Boulder main campus at 7:26 PM Mountain Daylight Time on Wednesday, August 26, 2026, which is 01:26 UTC on August 27. The camera faced east, away from the setting sun, and was tilted upward about 30° above the horizontal. Because the Flatirons and foothills rise steeply just west of campus, the sun had already dropped behind the terrain as seen from the ground, so the campus was in shadow while the clouds overhead and to the east were still lit by direct sunlight.

Clouds, weather and atmospheric stability

Cloud identification: The dark gray rounded cloud elements are far larger than small cells of cirrocumulus and have shaded arranged with an irregular layer, which matches the altocumulus genus according to the WMO International Cloud Atlas (WMO 2017). The smoother rounded gold patches that are lit by the sun are mammatus, a supplementary feature that most often hangs from the underside of a cumulonimbus anvil (Schultz et al. 2006). Between the two, in the brightest part of the sky, fine fibrous streaks hang below the cloud elements are virga, precipitation that evaporates or sublimates as it falls. Because these clouds formed from the spreading and decay of the afternoon's thunderstorms, the overhead layer is best described as altocumulus clouds.

Weather: August 2026 was hot along the Front Range; Denver recorded its fourth-warmest August on record (NWS Boulder 2026), with daily rounds of afternoon thunderstorms. The forecast for August 26 called for a high near 86 °F (30 °C) and a 40% chance of showers and thunderstorms after 2 PM, with a few storms capable of large hail and strong winds (Hoodline 2026). On the evening of the 26th the NWS also had a Severe Thunderstorm Watch in effect until 11 PM MDT.

The closest radiosonde site to Boulder is Denver, but no sounding was available in the University of Wyoming archive for 00 UTC on August 27. I therefore used the nearest site with a sounding at that time, Grand Junction, Colorado (station 72476), launched at 00 UTC August 27, about 1.5 hours before the photograph (Figure 2; University of Wyoming 2026). Grand Junction is about 300 km west of Boulder, so its lowest few kilometers do not represent the Front Range plains.

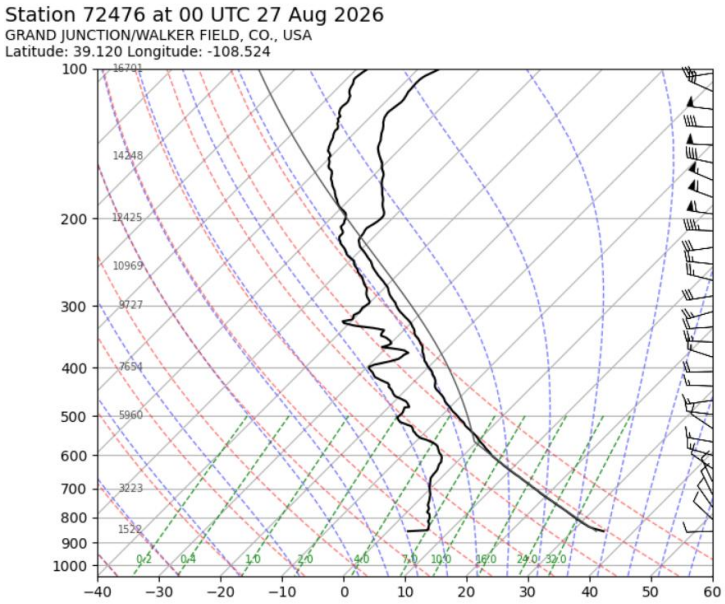


Figure 2. Skew-T log-P diagram for Grand Junction, CO (72476), 00 UTC 27 August 2026. Source: University of Wyoming (2026).

The atmosphere was unstable. On the Skew-T, the lifted air parcel (thin gray line) ends up warmer than the surrounding air (right-hand black line) from about 5 km up to about 12 km above sea level. Warmer air is less dense, so once air near the ground is pushed up to the point where its moisture condenses (about 5 km), it keeps rising on its own, this is what builds thunderstorms. Below that level the air was hot and very dry: the temperature and dewpoint lines are far apart near the ground. Rain or ice falling into this dry air evaporates before reaching the ground, which is the virga in the image. Higher up, near 8–9 km, the two lines nearly touch, so the air there was close to saturated; this is the layer where the storm anvils spread out and where the mammatus formed.

Cloud heights estimation and predictions: The sounding shows clouds forming at about 5 km above sea level, which fits the dark, lumpy altocumulus overhead (WMO 2017). The mammatus sit higher, near 8–9 km, where the storm anvils spread out. From the photo, they were roughly 35–70 km east of campus, close to where severe thunderstorm warnings had been issued earlier that evening. A conditionally unstable profile with a dry layer predicts this weather with afternoon thunderstorms and gusty outflow, whose anvils spread downstream and leave altocumulus and anvil debris behind as they decay in the evening. The observed clouds agree with this prediction.

Cloud physics: Mammatus form when cold, heavy cloud air sinks into drier air below it, making rounded pouches about 1–3 km across that last roughly 10 minutes (Schultz et al. 2006). The main cause is ice falling from the anvil and evaporating in the dry air, which cools that air so it sinks (Kanak et al. 2008); radiation heating the anvil base may also help (Garrett et al. 2010). Virga is the same idea lower down: rain falls into dry air and evaporates before it reaches the ground.

Photographic technique

The photograph was taken handheld with the 24 MP main camera of an iPhone 17 Pro (24 mm full-frame-equivalent focal length, f/1.78), giving a field of view of about 57° horizontally by 72° vertically in portrait orientation. The overhead altocumulus was roughly 7 km from the camera, and the mammatus near the bottom of the frame roughly 35–70 km away. Exposure was 1/788 s at f/1.78, ISO 80, 0 EV, with automatic focus. I faced away from the sun so the clouds would be lit from the side rather than silhouetted and tilted the camera up to fit everything while keeping the buildings as small silhouettes for perspective. Editing in GIMP was kept simple: Shadows-Highlights to keep the bright glow near the horizon from washing out, a gentle S-curve in Curves for contrast and a small boost in color. The final image is 4284 x 5712 pixels. The unedited original is shown in Figure 1(b).

Discussion

The image shows an afternoon thunderstorm near the end of its life in a single frame. I like the color gradient from the cool, dark altocumulus at the top of the frame to the warm, sunlit mammatus at the bottom. I like less that the mammatus, the most interesting feature physically, occupy only the bottom part of the frame and are small and slightly soft, while the dark overhead layer takes up much of the image. The contrast between the lumpy convective elements and the smooth hanging lobes fulfilled my intent of capturing the decaying storm. A single still cannot show how fast the lobes were descending or how long each one lasted. Next time I would use a tripod to keep the low-light exposure sharp, and shoot a time-lapse so the formation and sinking of individual lobes could be measured directly. A Denver sounding or a campus ceilometer record would also help with the height estimates.

References

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AI notice: Anthropic's Claude Opus 5.5 was used for rewriting and proofreading; it was also used to learn the different cloud types and how to name them. It was also used for ensuring proper citations when using sources.