Cloud Second Report, Caidan Caswell. MCEN 4151

Cloud Type: Lenticular, Date: October 21, 2024, Time: 6:45 PM, Location: Boulder, Colorado

Figure 1: Post-Processed Cloud Image

Context and Purpose

This image was captured as part of the second cloud assignment for my flow visualization course (MCEN 4151). The intent was to document and analyze a unique cloud formation using atmospheric data from a skew-T plot. The assignment provides insights into atmospheric dynamics and the relationship between weather conditions and cloud formation.

Circumstances

The photo was taken near Boulder, Colorado, facing west with the Rocky Mountains in the foreground. It was captured on October 21, 2024, at 6:45 PM, during the golden hour just before sunset. The vibrant lighting highlighted the smooth, lens-shaped lenticular cloud. This type of cloud often forms in stable atmospheric conditions over mountainous terrain when moist air flows over the peaks.

Cloud Analysis

The observed cloud is a lenticular cloud, as indicated by its distinct, layered, lens-like structure and smooth edges. These clouds typically form in stable atmospheric conditions and are associated with mountain wave activity. Using the skew-T diagram from Grand Junction (GJT) for 00Z on October 21, 2024, we can analyze the atmospheric conditions that contributed to this formation.

The skew-T diagram shows a Convective Available Potential Energy (CAPE) of 123.7 J/kg, indicating low atmospheric instability. The Lifted Condensation Level (LCL) is at approximately 761.0 hPa, which corresponds to a cloud-base altitude of about 2,000 meters. This aligns with the typical altitude of lenticular clouds observed near mountainous regions. The data also indicate strong winds at higher altitudes, which are conducive to the formation of mountain waves necessary for lenticular cloud development.

Lenticular clouds form due to the interaction between the westerly winds and the topography of the Rocky Mountains, including the Flatirons near Boulder. As moist air is forced upward over the mountains, it cools and condenses upon reaching the dew point, creating the smooth, lens-shaped appearance characteristic of lenticular clouds. The isolated nature of the cloud patch can be attributed to localized wind dynamics and moisture availability, as well as the specific shape and height of the Flatirons, which influence the formation of mountain waves. Stable atmospheric conditions, as confirmed by the skew-T diagram, prevent vertical mixing and allow for the distinct layering seen in lenticular clouds.

Photographic Technique

This image was captured using an iPhone 15 Pro. The camera was positioned about 15 feet from the nearest foreground object, with the cloud several kilometers away. The lens was set at a 24mm focal length, with an ISO of 32, an aperture of f/2.2, and a shutter speed of 1/932 seconds. The wide depth of field ensured sharp focus across the foreground and background. Minimal post-processing was applied, limited to adjusting contrast and brightness to emphasize the cloud's texture and color.

The final image resolution was 3024 x 4032 pixels. The composition captures the cloud’s shape and the surrounding landscape, providing context for its formation and emphasizing its prominence in the sky.

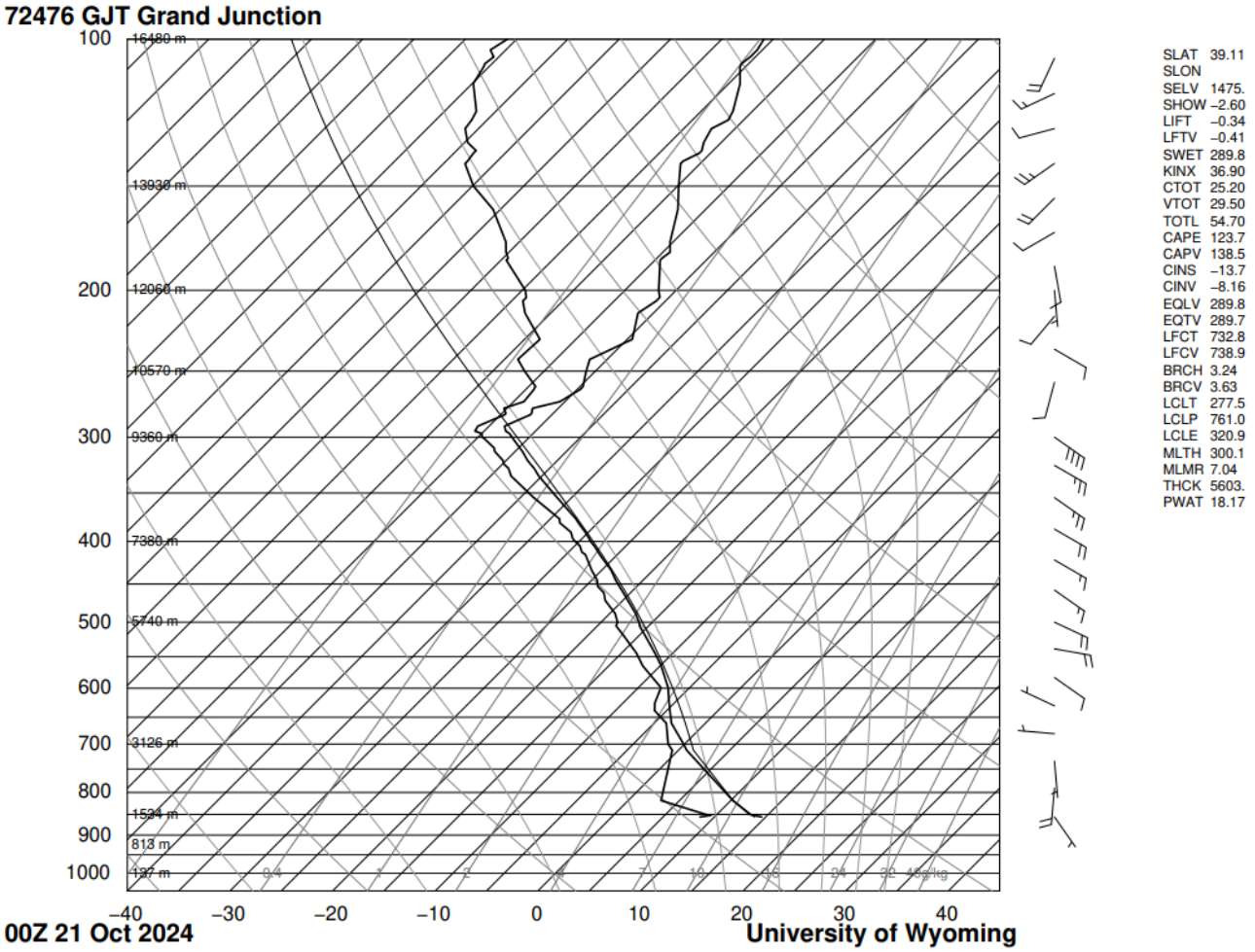

Figure 2: Skew-T Diagram, 21 Oct 2024

Image Analysis

The smooth, lens-shaped structure of the lenticular cloud stands out against the clear evening sky, providing a dramatic contrast. The cloud's formation well illustrates the interaction between stable atmospheric layers and the mountainous terrain. The skew-T data support the observed stability and wind patterns necessary for this type of cloud.

While the image effectively captures the lenticular cloud's distinct structure, a wider angle might have added more context by including additional elements of the surrounding terrain and sky. Future explorations could focus on capturing such clouds under varying lighting conditions or during different times of the day to explore their full dynamic range.

References

- Atmospheric Sounding Data: University of Wyoming Sounding for 00Z, October 21, 2024.
- Skew-T Plot, Grand Junction (GJT), University of Wyoming.
- Cloud Identification Guide, American Meteorological Society.
- "Mountain Wave Clouds: Mechanisms and Conditions," National Weather Service.
- "Topographical Influences on Cloud Formation," American Meteorological Society