Clouds First Report

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MCEN 5151: Flow Visualization

University of Colorado Boulder

11/06/2023

Altocumulus Floccus

September 15th , 2023 - 6:51pm

Newton Court, Boulder, Colorado

Context and Purpose

This image and report is for the Clouds first assignment required in MCEN 5151: Flow Visualization course offered at University of Colorado Boulder in Fall 2023. This report analyzes the photograph of Altocumulus Floccus clouds as shown in the unedited featured image on the first page, contrasting it with a subsequent edited version to enhance visual clarity and contrast. The objective was to observe and document cloud formation while understanding and presenting the atmospheric conditions and fluid phenomena that give rise to such cloud formations as well as understand their significance in meteorology. This image is complemented by a second version with increased sharpness and adjusted shadows and highlights, providing a more vivid representation against the sky's blue backdrop.

Location and Time

The image was captured at 6:51 PM MDT on September 15, 2023, at Newton Court, Boulder, Colorado. The camera was directed roughly towards west at an elevation of approximately 60° to focus on the clouds' structure and form. The late evening timing offered a dynamic natural light hitting the clouds almost from the side and simultaneously offering a blue sky, aiding in the capture of the cloud's characteristics and ambient light balance while adding to the aesthetics.

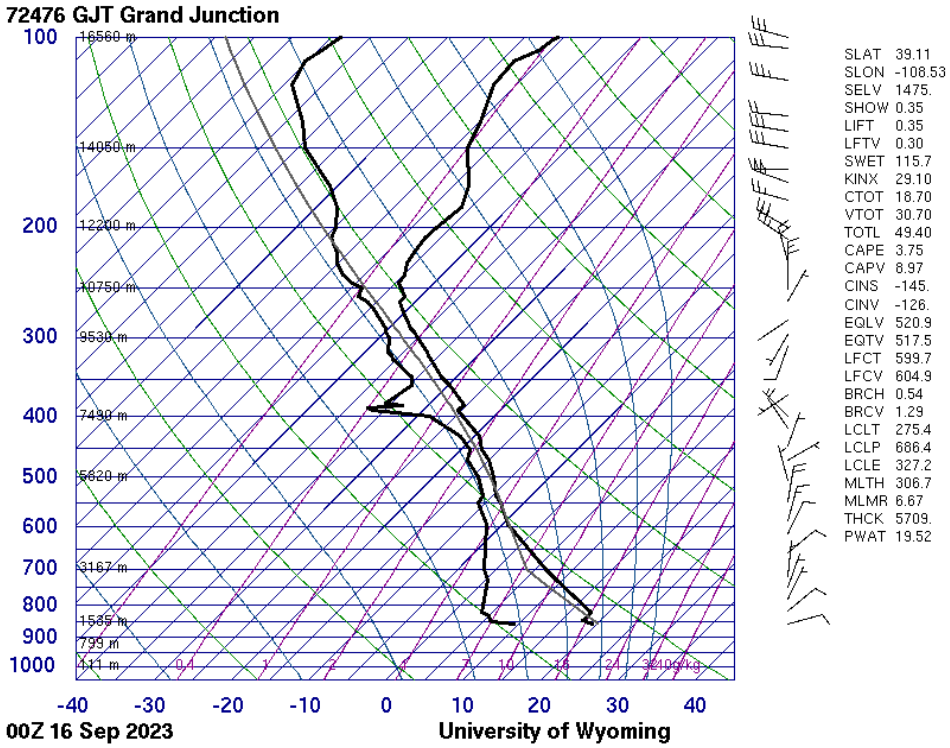

Figure 1 Skew-T Log-P diagram at 6pm, Sep 15th 2023, Grand Junction CO

Cloud identification and analysis

Upon examination of the image and accompanying Skew-T Log-P diagram from the University of Wyoming for Grand Junction[1], taken at 6 PM MDT, a key observation is made. The temperature and dewpoint lines indicate a high probability for cloud formation within the 3km to 7km altitude range. This altitude range, along with the discernible cloud morphology characterized by the cotton-like tufts[2], is indicative of Altocumulus clouds. The CAPE is seen to be 3.75, indicating an instability in the atmosphere, coupled with the probability of condensation at mid-level can lead to Altocumulus cloud formation. The Lifting Condensation Level Pressure (LCLP) shows the pressure at which condensation can occur in an air packet lifted from the ground[3]. Additionally, the LCLP is seen to be 686.4mBar, which corresponds to a height of approximately 3.2km, matching the earlier observation for cloud formation altitude. The ceilometer plot for Boulder from the SkyWatch Observatory[4] was also checked to observe the cloud base height at the time of capturing the image, which aligns with our previous observations of a base altitude of approximately 3km. These mid-level clouds, formed in an unstable atmosphere with a CAPE of 3.75 as seen in the Skew-T plot, did not precipitate and were a precursor to a stable evening with a slight drop in temperatures as the sun set.

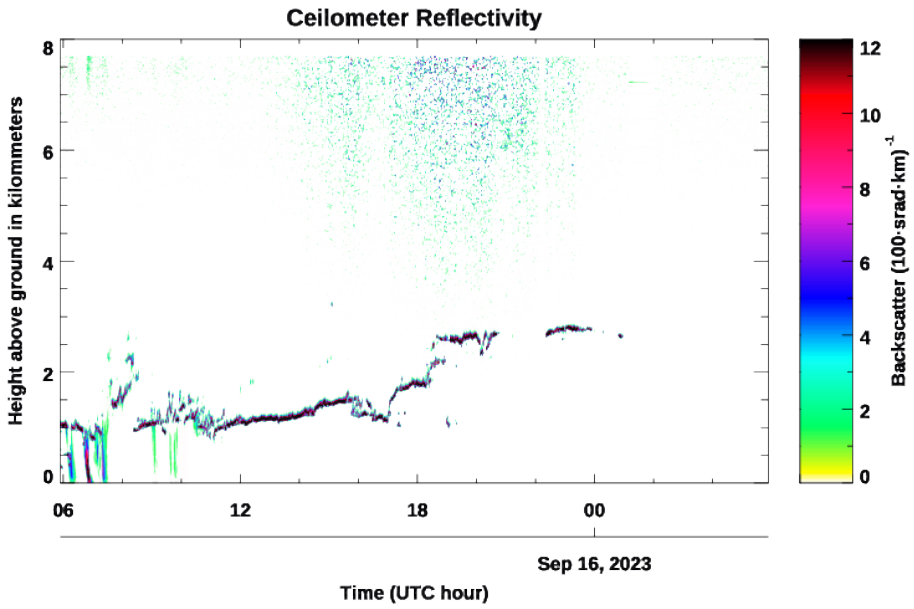

Figure 2 Ceilometer reflectivity plot, Sep 15th 2023, Boulder CO

Photographic Technique

The image was capture using a Google Pixel 6 smartphone camera, with a focal length of 6.81mm, an aperture of f/1.9, and a shutter speed of 1/1133 seconds which ensured the capture of the clouds' texture without motion blur, while an ISO of 37 maintained the image's natural luminosity without introducing noise. These settings were chosen to provide a crisp image while working within the constraints of a mobile phone camera's dynamic range and lens characteristics. The composition of the image while capturing it was carefully chosen to not include any obstruction present in view, and capture multiple cloudlets to give an overall filled

effect in the resulting image. The resolution of the image is 2560X1920p. The image was post-processed using Darktable to increase the global sharpness, as well as improve the shadows and highlights.

Figure 3 Unedited Image from the Camera

Figure 4 Post Processed image using Darktable

Image and visual analysis

The resultant image reveals the intricate cotton tufts like formations of Altocumulus Floccus clouds, with the edited version emphasizing the details and providing a more dramatic view. While the unedited image serves as an authentic and aesthetically pleasing visual on its own, the enhancement underscores the cloud's edges and depths against the sky. Fluid physics are depicted to a satisfactory degree; however, the limited dynamic range and fixed lens of the mobile phone camera constrain a fuller representation of the atmospheric dynamics at play. The captured image met its intent to identify and observe Altocumulus clouds, yet deeper dive into the various lighting and weather conditions is needed to expand the scope of cloud behavior documentation. I am planning to include using a camera with adjustable optics and perhaps capturing a time series to portray the evolution of cloud formations over time for future endeavors.

References

[1] "Atmospheric Soundings." Accessed: Nov. 06, 2023. [Online]. Available: http://weather.uwyo.edu/upperair/sounding.html

[2] "Altocumulus clouds," Met Office. Accessed: Nov. 06, 2023. [Online]. Available: https://www.metoffice.gov.uk/weather/learn-about/weather/types-of-weather/clouds/mid-level-clouds/altocumulus

[3] "Clouds Notes," Flow Visualization Guidebook. Accessed: Nov. 06, 2023. [Online]. Available: https://www.flowvis.org/links/

[4] "Skywatch Observatory." Accessed: Nov. 06, 2023. [Online]. Available: https://skywatch.colorado.edu/