Altocumulus Clouds

Cloud First 2019, MCEN 5151
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Author: Matt Knickerbocker
http://www.flowvis.org/2019/08/29/cloud-first-matt-knickerbocker/
Photo of Altocumulus clouds captured:
7:30 pm, August 29th, 2019, Boulder, Colorado

Introduction

The purpose of this paper is to document and describe the physics involved and the process that was followed to capture a cloud image as a requirement for the first cloud photo assignment of MCEN 5151 - Flow Visualization called Cloud First. The original post can be found at the link on the title page. The task of the assignment was to capture a clear photo of an identifiable cloud. The intent of the photo I took for this assignment was to observe the form of an altocumulus cloud.

Cloud Context

The cloud photo was captured in Boulder Colorado near Table Mesa Drive. The camera was facing south and held at a small elevation angle of approximately 5 degrees above the horizon. The time and date of the photo was approximately 7:30 p.m. on August 29th, 2019. At the time that the cloud was observed, I was not equipped with my DSLR camera, therefore I had to capture the photo using my iPhone X which performed satisfactorily.

Cloud Description

The photo contains both altocumulus and cumulus cloud forms, however the main subject was meant to be the altocumulus clouds. The surrounding background was a mostly clear blue sky with some visible mountains in the lower right of the image. On the ground, the outside temperature was approximately 76 degrees Fahrenheit, the wind was approximately 8 miles per hour from the east, and the humidity was approximately 40 percent [1]. Additionally, there was no recorded precipitation on the day of the photo nor the day before. The cloud conditions on the day before were also hazy and partly cloudy. There were no fronts approaching and the skew-T plot from an hour before the photo was taken is shown in Figure 1 below. This plot displays the atmospheric information around the time of the photo which can be used to deduce further information about the cloud. The CAPE value, which indicates the stability of the atmosphere, was at 389 which implies that the atmosphere was unstable at the time of the photo.

Clouds form when water vapor in the air condenses into water or ice. This condensation occurs when the air temperature falls below the dew point. The skew-T plot shows a region at around 5,910 meters (19,390 feet) where the dew point and air temperature sharply move towards each other. This region is a likely candidate for cloud formation and since altocumulus clouds can form at altitudes of up to 23,000 feet, this is a likely altitude that the cloud in the photo was at. Altocumulus clouds are composed of a mixture of ice and water that make up the many rounded clumps in the photo. Since the air temperature at 5,910 meters was roughly 0 degrees Celsius, it makes sense that there would be both ice and water in the air at that altitude. Since the atmosphere was unstable, this indicates that there were pockets of rising warm air. Altocumulus clouds can form from pockets of rising moist air which are then cooled by gentle turbulence [3]. Based on these observations, it can be assumed that the cloud in the photo was in fact of the altocumulus type. There is a possibility that the cloud is actually a cirrocumulus since they share many characteristics with altocumulus. However, it is difficult to say with certainty without knowing the precise altitude of the cloud in the photo.

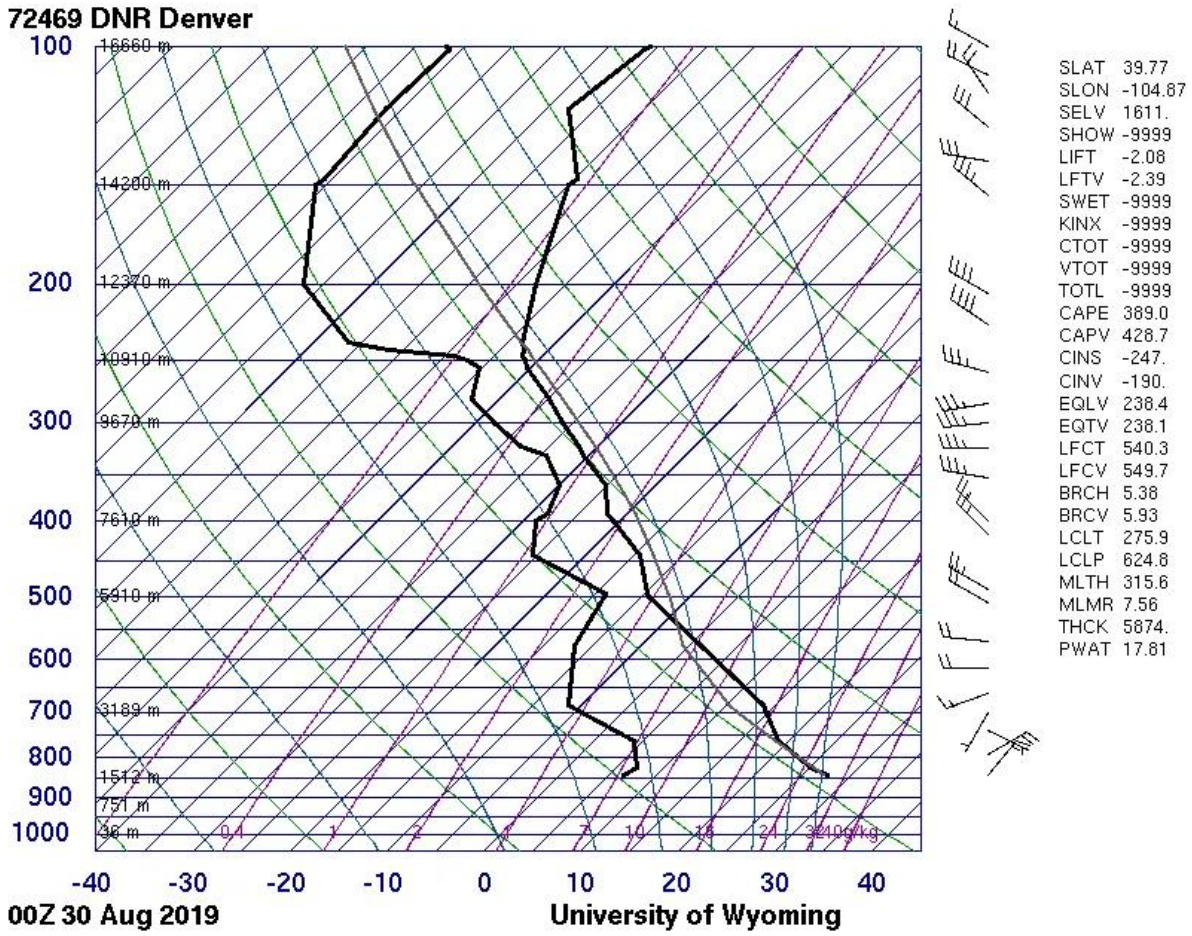

Figure 1: Skew-T plot from August 29th, 2019 [2].

Photographic Technique

The camera used to produce the photo was a hand-held iPhone X. The photo was shot with a resolution of 3906 x 4604 pixels at a lens zoom of 4 mm. The field of view was roughly 2 by 2 kilometers with the camera lens positioned about 8 kilometers from the cloud. The lens used was the stock iPhone X wide angle lens with an aperture of f/1.8. The exposure was produced using an aperture value of f/1.8, an ISO of 80, and a shutter speed of 1/505 of a second. The goal of the photo was to capture the form of the cloud while also keeping some of the surrounding background visible to provide more context to the image. Some post-processing of the photo was performed, and screenshots of the original and final photo can be seen below in Figures 2 and 3, respectively. The photo was slightly cropped (3906 x 4336) and the white balance, contrast, and saturation were slightly adjusted in order to enhance the color of the clouds and the surrounding sky. All of these edits were performed through the use of the GNU Image Manipulation Program (GIMP).

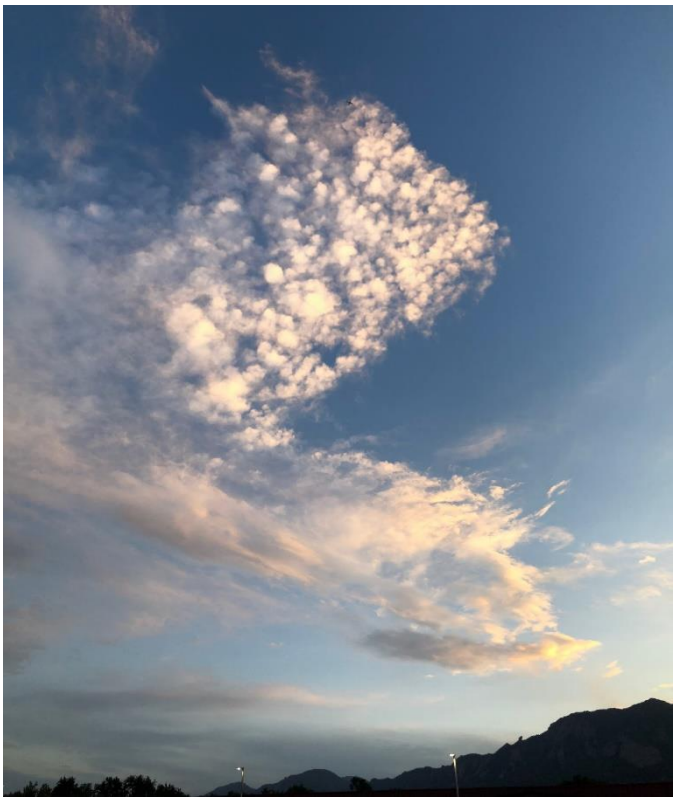

Figure 2: Original Photo.

Figure 3: Final Photo.

Conclusion

The photo of altocumulus clouds that was captured reveals a clear example of cloud physics while also displaying the beauty of the Earth's atmosphere. The form of the altocumulus clouds are clearly shown with their small rounded clumps that are tightly grouped together. I personally enjoy the range of colors in the photo with the clouds being illuminated in the sunset light. I also find the shape of the clouds to be interesting as the shape reminds me of a sock puppet face. Finally, I like the subtle appearance of the airplane and the mountains in the photo, these small details add some context and texture to the frame. Overall, I am very happy with the photo and I think it turned out quite well. I do think the physics could be better revealed if the altocumulus clouds were the only type visible in the photo. Additionally, having a measurement of the actual cloud altitude would allow for a more accurate description and categorization.

References

[1] National Weather Service, Archived Climate Reports, Accessed 26 Oct 2019. https://w2.weather.gov/climate/index.php?wfo=bou

[2] University of Wyoming, College of Engineering, Dept. of Atmospheric Sciences Sounding Data, Accessed 11 Oct 2019.

[3] Met Office, Weather & Climate, Altocumulus clouds, Accessed 26 Oct 2019. https://www.metoffice.gov.uk/weather/learn-about/weather/types-of-weather/clouds/mid-level-clouds/altocumulus