Clouds 1

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Flow Visualization

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Introduction

Clouds can possess great beauty and large contrasts of colors, shapes, and patterns. Clouds, being composed of small droplets of water suspended in the atmosphere, are great candidates for flow visualization. The purpose of this assignment was to capture a cloud in an interesting and intriguing image that visualizes the physics behind the formation of the cloud. While working on this assignment, I took many pictures of clouds prior to capturing this specific image. There were many images that I enjoyed, but I found this image to be the most interesting.

Body

This image was taken in Boulder, Colorado at 4:40 PM on February 22, 2009. This image was taken facing northwest on top of a hill five minutes southeast of town that overlooks the entire city. The camera was angled approximately 25 degrees above the horizontal plane. The sun was to the left behind the clouds providing an amazing contrast by backlighting the clouds.

According to the skew-T plot from February 22 at 6:00 PM, the atmosphere was stable throughout all elevations, meaning that only stratus clouds should be able to form in the atmosphere. The skew-T plot shows that clouds are most likely to form between approximately 5000m to 7000m (16,400 ft to 23,000 ft.), and the wind is blowing west in the area where cloud formation is most probable. I estimate that the cloud out in front is at approximately 18,500 ft, or about 5,600m. The clouds in the background are at a similar altitude, possibly a small amount higher. Judging from the picture and the skew-T plot I believe that the backlit cloud in the center is an altostratus cloud, and the other clouds in the image are also altostratus clouds. The cloud in front has separated from the rest of the cloud group and has been backlit by the sun. It can be seen that the cloud is relatively thin, which corresponds to stratus clouds, and is at the correct altitude to be classified as an altostratus cloud. I believe the background clouds are altostratus because they form a uniform sheet of clouds that extends back into the mountains, and are in the correct height region to form altostratus clouds. The sheet of the altostratus cloud is generally not exceedingly thick and sunlight can generally penetrate

through these clouds. Altostratus clouds form under stable conditions where a large body of air rises in elevation and condenses to form a cloud. As the air mass gains elevation and drops in temperature, the air mass becomes saturated and condenses to form a large uniform sheet of clouds that can be rather expansive. Condensation occurs because the amount of water vapor an air mass can hold decreases with a decreasing temperature.

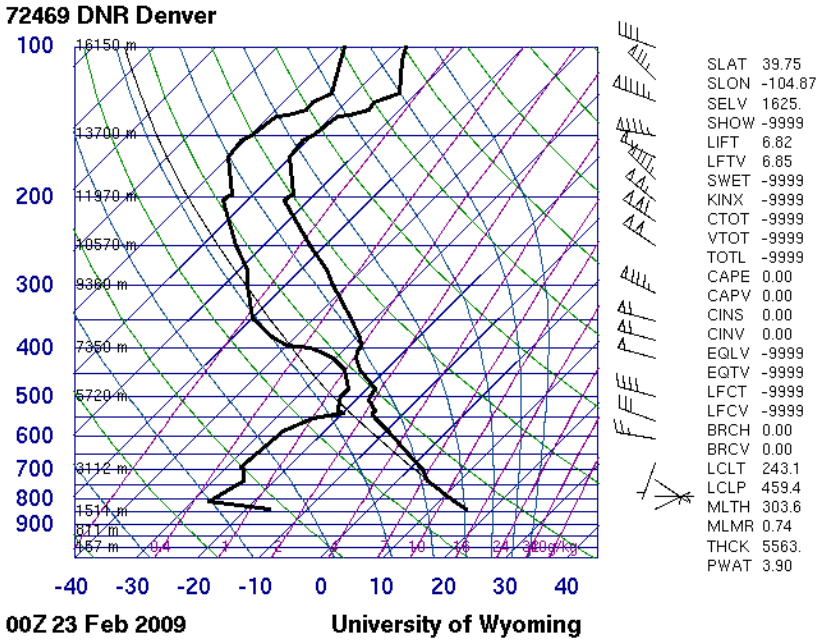

Figure 1. skew-T plot from February 22 at 6:00 PM

Technique

The field of view in the photo was approximately four to five miles. The distance from the clouds to the lens was approximately five to seven miles. The focal length of the lens was 15.1 mm. The camera used was a Sony Cyber-shot digital camera. The final image after editing had an image width of 3,070 pixels and height of 1,739 pixels. The original image had an image width of 3,072 pixels and a height of 2,304 pixels. The aperture was set to f/8.0. The shutter speed was set to 1/125th of a second. The ISO speed was set to 100. In iPhoto, the contrast was slightly adjusted and the image was then cropped.

Conclusion

The image taken reveals a stable atmosphere where altostratus clouds can be identified with the help of a skew-T plot. I really enjoy the way that the sun backlights a single cloud in front of the rest of the clouds. I wish that I could have had a larger color scheme in the image, but I do like the gloomy and ominous feelings I get from looking at it. I do think that the fluid physics are shown well. It is easily seen that the cloud in front is thin, corresponding to a stratus cloud, and the clouds in the background span for miles back into the mountains, as stratus clouds typically do. I do wonder if there are more physics and different cloud formations occurring than I was able to identify. This image did fulfill my intent and I was very satisfied with the overall image. I would have liked to get an image that incorporated more of a horizon, but I was trying to emphasize the single backlit cloud in front. Using a wide angle lens could have helped to give more of a panoramic view of the image.

Resources

http://weather.uwyo.edu/upperair/sounding.html

http://en.wikipedia.org/wiki/Altostratus_cloud