Aaron Lieberman
Cloud Image 1: Flow Visualization

Sunset Mountain Rolling Cloud

Clouds can be one of the most spectacular phenomena in the world. Clouds can make some of the most impressive shapes in the morning, afternoon, and even at night. By taking photographs of clouds and examining the physics behind cloud formations, a lot of information can be revealed about the atmosphere and the weather both before and after the photograph. After taking many photographs of different clouds at different times of day, my final image was chosen. My final image clearly reveals the time of day it was taken and displays a colorful and artful display that also illustrates the underlying physics behind it.

The image of the cloud was taken near downtown Boulder, Colorado near the flatirons on February 16, 2013, at around 5:50 p.m. which was around sunset. This is why the cloud in the image exhibits an orange hue because the Sun's light was reflecting off of it to give it a great color. The cloud photographed was hovering low right over the flatirons in northwest Boulder. Since I was just east of the flatirons, I pointed the camera southwest at an angle of about 45 degrees from the horizontal to capture the silhouette of the flatirons and the cloud.

The cloud photographed was quite low in the sky, and it appeared to hover just over the flatirons in Boulder. At this sort of elevation and position, the cloud can be concluded to be an altocumulus lenticularis or mountain wave cloud [3]. It was incredibly interesting to see the cloud change formations as quickly as it did. It was quite thin and wispy and the westerly wind speed of about 11.4 miles per hour was rapidly influencing its shape formation [4]. Only seconds after taking the photograph, the cloud disappeared altogether. On February 16, 2013, when the image was taken, there was essentially no other clouds in the sky, and as described above, this cloud itself was not in existence for long. The day the photograph was taken was a warm and calm winter day. The maximum temperature that day was 54 degrees Fahrenheit and when the picture was taken it was about 48 degrees Fahrenheit [4]. The day before, February 15, 2013, was also a mild winter day with little cloud cover and a high temperature of 43 degrees Fahrenheit [4]. The day after was a beautiful and uncommon cloudless winter day in Colorado with a high temperature of 61 degrees Fahrenheit [4]. The Sket-T diagram shown below in Figure 1 shows the stability of the atmosphere on the day and time the photo was taken, at about 5:50 p.m. on February 16, 2013 [1]. Although the Skew-T diagram depicts Denver's atmosphere, it is a close representation of Boulder's atmospheric stability. The atmosphere displayed parcel stability since the CAPE number is equal to 0. This means that there was little to no acceleration in the updraft of the atmosphere. It also displayed latent stability because there was no storm the day before, the day of the photograph, or the day after the photograph. Because there was little to no saturation in the atmosphere on the day the photograph was taken and there was no rapid decrease in dew point with elevation, the atmosphere was also convectively stable [2].

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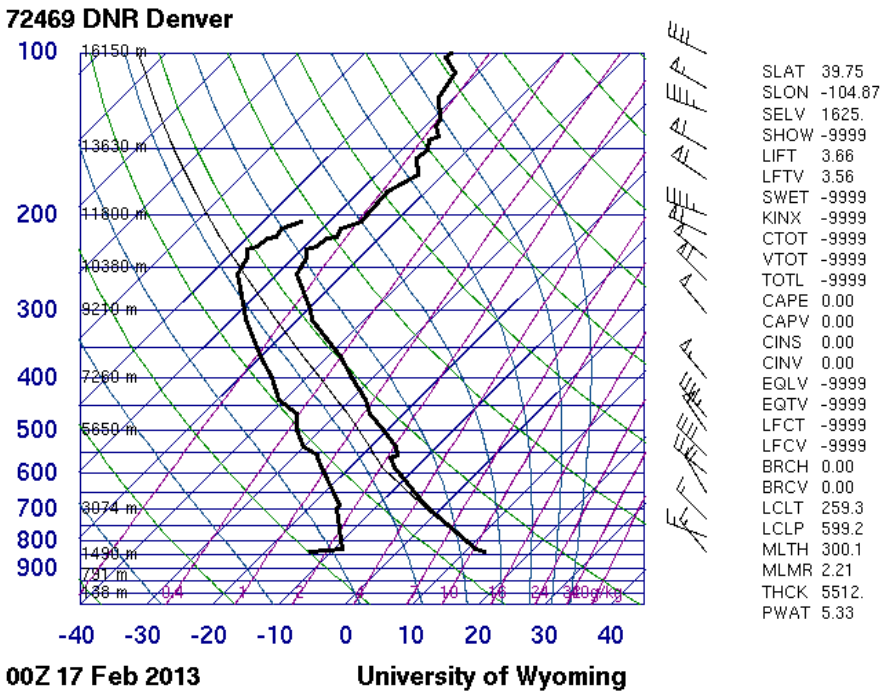

Figure 1: Skew-T Diagram for Denver at 6:00 p.m. February 16, 2013

Since the temperature on February 16, 2013, did not reach dew point at any point in the atmosphere, it is expected that the sky was nearly cloudless. In the elevation range of Stratocumulus clouds of about 5,000 to 10,000 feet (about 1,500 to 3,000 meters), [3] the Skew-T plot shows no signs of precipitation. This explains the almost cloudless day and why the cloud disappeared so quickly after photographing it. Also, as seen in Figure 2 of the unedited image, there is a slight vortex on the right side of the cloud. This is probably because at the elevation the cloud was at, the wind was pushing it west and up into the atmosphere at the same time.

Figure 2: Unedited Photograph

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Based on being about 450 feet away from the tip of the flatirons, the field of view seen in the original image is about 88 feet in width by 66 feet in height, respectively. The lens focal length when taking this picture was 24.5 millimeters. The aperture was f/5.9, the shutter speed was 1/169 seconds, and the ISO setting was set to 80. These settings were used to capture the colors of the cloud in the dimming light since the sun was setting at the time of the photograph. The width and height of the original image was 4,224 by 2,816 pixels respectively, whereas the edited image width and height are 2,988 by 1,378 pixels respectively. The camera used to take the photograph was a Samsung ST65 digital point-and-shoot camera. Little editing was done to the original image. The original image was cropped in PhotoShop to concentrate the view on the cloud itself as seen in Figure 3, although the silhouette of the flatirons in the original image does provide a different aura to the photograph. The only other alteration made to the photograph came from adjusting the curves tool in PhotoShop. The curves tool was only adjusted slightly to darken the sky behind the cloud and bring out the orange hue in the cloud.

Figure 3: Edited Image

Overall, I am very pleased with how the original and final images look. The original image shows a great silhouette contrasting the flatirons of Boulder to the sky in the background and the singular bright orange cloud displayed. The final image shows a closer, more contrasted view of the cloud. In the edited image, the details of the cloud become more apparent, and the vortex seen on the right side of the cloud is effectively highlighted. To improve this image, a time lapse of this cloud could have been recorded. As stated previously, the cloud changed shape so fast and disappeared so quickly that each image of a time lapse would have revealed a drastically different shaped cloud. Also, capturing more of the flatirons below the cloud could have provided a nice foreground for the image.

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References

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[3] "The Cloud Collector's Reference." *The Cloud Collector's Reference*. N.p., n.d. Web. 20 Feb. 2013.

[4] "WeatherSpark Beta." *WeatherSpark*. N.p., n.d. Web. 20 Feb. 2013.