# Clouds Second – Boulder

**By: Mark Noel**

## Flow Visualization

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## Introduction

The following paper describes the physics and photography techniques used in my second cloud image for the fall 2016 flow visualization course. This image was taken over Boulder Colorado at sunset. For this image I tried to capture the beauty of western mountain sunsets.

## Image Circumstance

This image was taken on November 11th at 5:30 PM. The image was taken as the sun was setting in the sky. This created a beautiful spectrum of soft colors across the sky. The sky was a gray blue that contrasted well with the light orange, pink, and purple of the clouds. Scattering of sunlight due to small particles in the atmosphere causes the colors in the sunset. This is more likely to happen at dusk and dawn due to the further distance the light is traveling through the atmosphere to reach you. (Scherrer, 2016) The clouds wispy nature created an almost feather like appearance. For this image I was facing west and capturing the clouds as they passed over the east slope of the Rocky Mountains. The image was taken just outside of the Engineering Center at the University of Colorado Boulder. I was not planning to image clouds on this day but when I spotted the sunset, I grabbed my camera and started shooting. The mountains outside of Boulder worked wonderfully to frame the bottom of the image. Due to the lack of light the tower and mountains appear black and contrast well with the sky.

## Clouds and atmospheric information

The clouds in this image were created due to Orthographic lift. They initially look like altocumulus or high stratocumulus clouds but due to their location with respect to the mountains they are most likely Orthographic Clouds also know as mountain wave clouds. Orthographic clouds are formed when hills and mountains

force air to rise. These clouds happen often when warm wet air is forced up a mountain into a cooler environment forcing clouds and even precipitation to occur. (Houze, 2012). The day this image was taken it did not rain and was not windy. According to the Skew-T graph bellow the CAPE was 0. This indicates a stable atmosphere. That is what you would expect from this cloud formation. The image below shows the Skew-T plot.

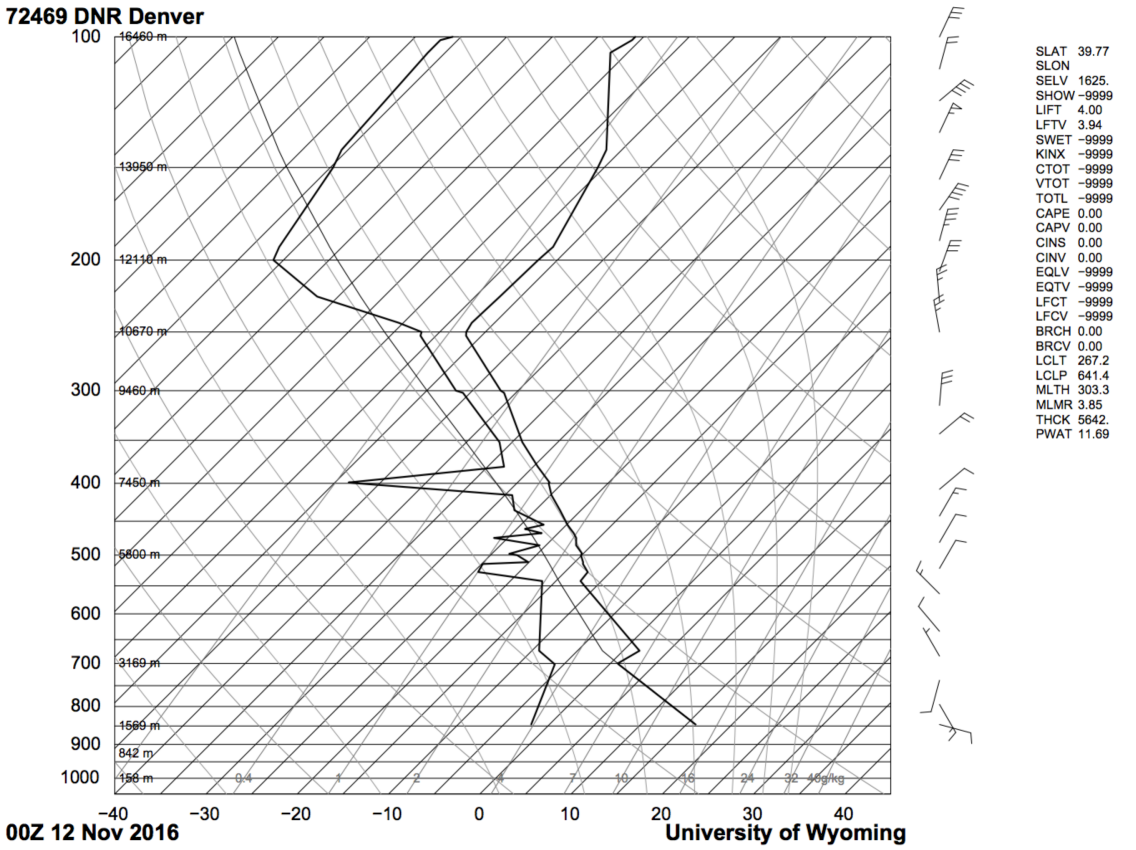


Image 1 – Skew-T Plot

This skew-T plot was taken from Denver international airport. Although the Skew-T was from Denver it is likely similar to the conditions in Boulder. By reading the Skew-T plot we can determine that it was about 16 °*c* at ground level about 1,600m. The top of the flatirons is 2,484 m. The clouds were forced to rise over the mountains and it is easy to see in the image that the clouds are quite a bit higher then that. At the highest point these clouds would be likely at about 7,000 m and a

temperature of about -20 °*c*. The weather for this day was sunny except for the few clouds near the mountains. These clouds and the weather conditions made for a wonderful photo.

## Photography technique

There were several interesting issues to deal with when taking this image. First it was getting dark, which made it a bit tricky to find the right balance of settings. Because this image was a spur of the moment image I did not have a tripod and there were obstacles to contend with. In the end I did manage to find setting that allowed enough light without making the image grainy or blurred. The focal length was 55mm. The lens I was using is called The Cannon EF-S 18-55mm f/3.5-5.6 IS II. The camera I used is a DSLR Canon EOS Rebel T3. The original raw image was 2,848 pixels high and 4,272 pixels wide. The final image after cropping and editing was 2,618 pixels high and 3,163 pixels wide. The IOS setting was IOS1600. This IOS was chosen to provide enough sensitivity to capture the dim light while not becoming grainy. The aperture was set at F5.6 with a shutter speed of 1/800. After the photo was taken I was able to deal with many of the objects in GIMP photo editor. I brightened the sky and darkened the foreground slightly using the contrast map. In cropping, I removed several lampposts, trees, and roofs that detracted from the image. I then used color cloning to remove all light sources in the foreground. Estimating the size of an image of the sky is quite difficult. Above in this paper I gave an estimate for the size of the clouds but for understanding the way I framed the image I will reference the foreground. The base of the image is a walking path about 30 feet wide and a lamppost about 15 feet high can measure the height. Below is my unedited image, which clearly shows the objects and lights in the foreground.

Image 2 – Image Before Editing

## Conclusion

I am excited about the results of my final cloud image. I am proud that through the course of this semester I have learned how to us a DSLR camera and correctly adjust setting for different situations. I have never done any photo editing before this course and now feel confident when making adjustments. I don't feel that there is much that I want to change with this image. I like how the colors came out and the play between the foreground and sky. It would have been nice to have a tripod but the focus was still fairly sharp. Overall I am very pleased with this image.

## Bibliography

Houze, R. A. (2012). *OROGRAPHIC EFFECTS ON PRECIPITATING CLOUDS.* Seattle: the American Geophysical Union.

Scherrer, D. (2016). *Why is the sky blue, why are sunsets orange, and what color is the Sun?* Stanford: Stanford Solar Center and NASA.