# Cloud Image 1

Flow Visualization
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## Purpose:

Clouds are part of our everyday lives. They create shade, moisture, and beauty. Growing up in a state where the clouds and the mountains create perfect sunsets it is only natural to attempt the sunset for an initial cloud photography assignment. But as is the nature of any natural phenomena photography things can change in a matter of seconds. That is exactly what happened on this cloud photography excursion, the sun faded faster than anticipated and the beautiful sunset was all but gone when this photo was taken. This miscue should not take away from the meaning and purpose of this image. For those that do not know much about clouds or are looking to learn a bit more, may this paper serve the purpose of cloud education.

## Image Staging:

This image was taken from the parking lot of Casey Middle School in Boulder, CO at an elevation of roughly 5,280 miles above sea level. This middle school is situated on a hill facing south giving it a great view of the foothills and specifically the flatirons. The location was chosen to ensure an image that would be above many of the city buildings and allow for a clear view of the sunset sky. At exactly 5:47:54 pm on February 18th this cloud image was taken facing directly south, approximately parallel with the foothills. Due to the elevation of the hill it was only necessary to tilt the camera skywards a few degrees to capture the near entirety of the cloud. This time of day was just after the sun was low enough that the bottoms of the clouds would not be illuminated due to the shadow of the mountains.

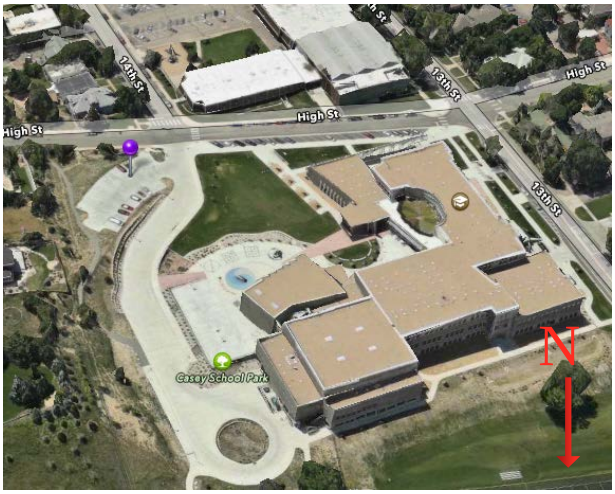

Figure 1: Photography Location

## Cloud Physics:

A cloud is formed when the surface of the earth is either heating or cooling and evaporation of moisture in the air effects the temperature profile of the atmosphere. This resultant effect of the profile causes vertical transport of moisture within the atmosphere and behold a cloud![3] This effect is illustrated in figure 2. The cloud pictured on the cover of this report is an altostratus cloud. An altostratus cloud is defined as, “mid-level layers of gray cloud, which are either featureless or fibrous in appearance, and typically extend over an area…”[1] As shown in this picture the cloud appears to extend many miles to the south from the clouds initial starting position. To the east the cloud extended for many miles but was far too large to be captured with this image. The features that are formed at the leading edge of the cloud are a result of a change in the dew point temperature as the cloud extended vertically in the atmosphere. As shown in

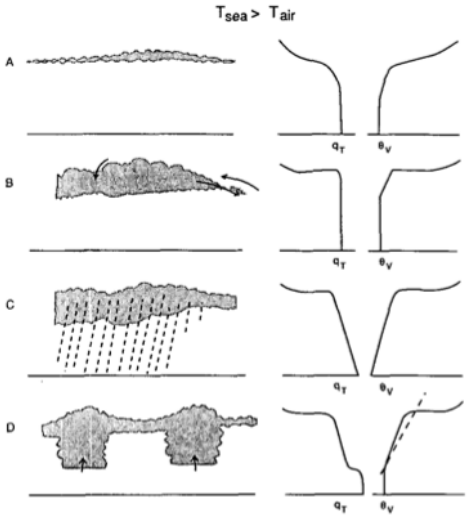

Figure 2: Cloud Formation[3]

Figure 3: Altostratus Cloud

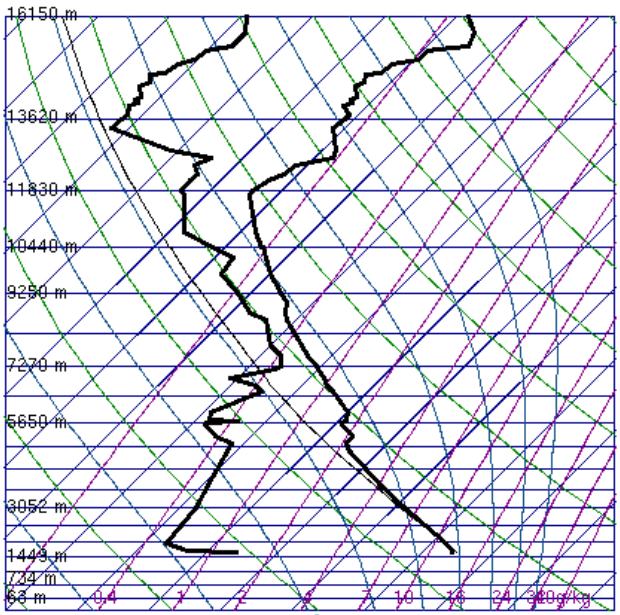


Figure 4: Skew-T 00Z Diagram[2]

the skew-T diagram from 00Z 2/19/14, figure 4, the atmosphere was stable but the dew point line is quite jagged. This dew point

temperature dictates where a cloud is capable of forming and because it is jagged it can result in a layered cloud appearance like the one shown in this image. The black line that is to the left in the image indicates the dew point temperature in the atmosphere and the black line to the right indicates the actual temperature in the atmosphere as the weather balloon ascended.[2] When the right line of actual temperature crosses with the dew point temperature it results in the formation of clouds. In this skew T there is no crossing of the lines but this data discrepancy may be due to the fact that this image was taken when the sounding data was being taken at a site roughly 40 miles away. The day of this image was relatively clear with few clouds until the evening which may explain this difference. Looking at the sounding data it can be estimated that the cloud height in this image was about 5600 m and this height falls within the range defined by an altostratus cloud,[1] 2000 - 7000m. Looking at what factors define and control clouds it is not surprising that sounding data or weather ceiling heights give discrepancies. Figure 5 shows a nice flow chart of the factors of clouds and how they interact. First there is radiative heating and cooling and this can effect the internal dynamics of the cloud via the turbulent entrainment and mixed-layer convection, or it can influence the condensation and evaporation which is directly tied to the cloud microphysics. Second the internal dynamics of a cloud directly causes the condensation and evaporation in the atmosphere and then can be effected by the cloud microphysics with phase changes that affect buoyancy production in the cloud and the stability of the cloud. Last the microphysics of the cloud is also effecting the radiative heating and

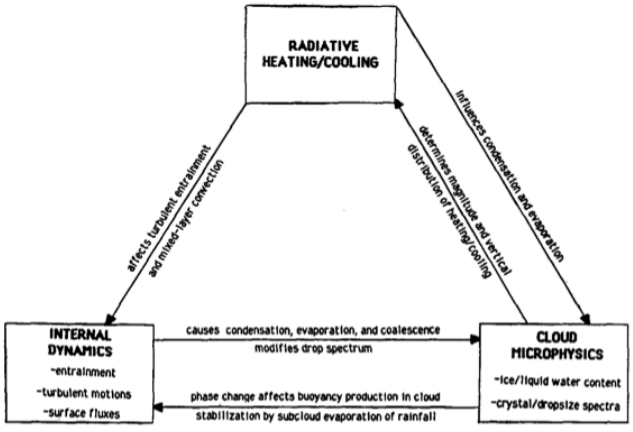


Figure 5: Cloud Effects Flow Chart[4]

cooling through the control of the magnitude and vertical distribution of the radiative effects. All of these effect are acting on a variety of scales from km to mm so variations along a time and length scale are expected.

## Photo Technique:

To capture this image a Nikon D5000 was used with a lens of focal length 18mm - 55mm. This specific image used a shutter speed of 1/15 of a second with a corresponding aperture of *f* 5.6. This shutter speed is considerably slow but in an attempt to achieve as much depth of field as possible, the compromise was made. The choice to use an ISO 200 was made in an effort to minimize noise and grain as much as possible.

A focal length of 29.0 mm was necessary to fill the frame with the entirety of the cloud leading edge. A focal length of 29.0 mm leads to an approximate field of view of several miles in the vertical direction by just a mile or so in the horizontal direction.

After the image was taken and uploaded on the computer it was chosen to alter the color spectrum in the Camera Raw feature within Adobe Photoshop. The original image is shown below in figure 6 next to the post processed image. In the Camera Raw window it was chosen to use the color spectrum of gray scale. This was an aesthetic choice to bring more contrast into the image and make the layers of the cloud leading edge more apparent. In addition to making the

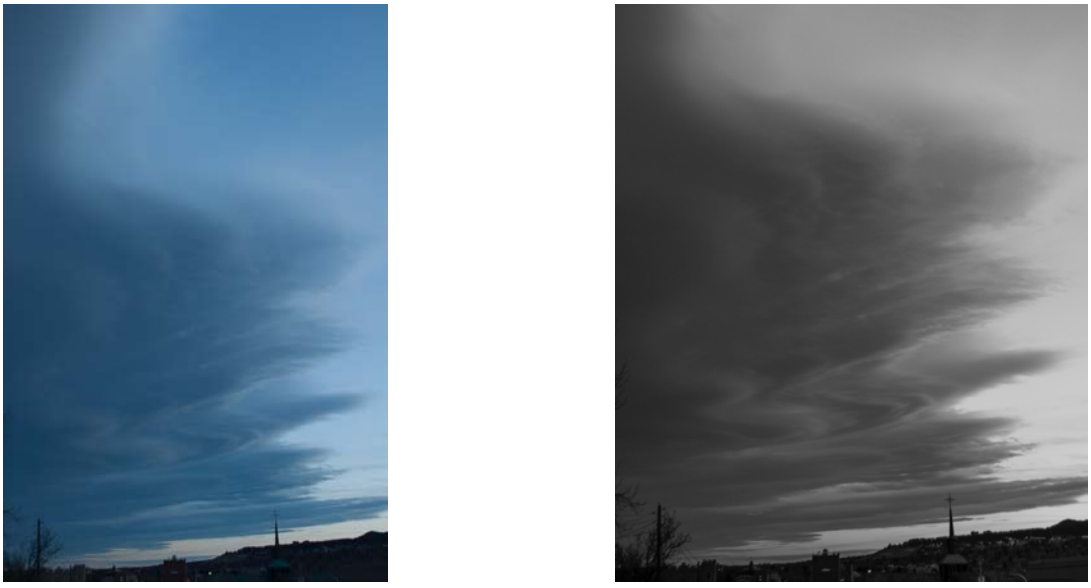

Figure 6: Before and After Post Processing

image gray scale, saturation and contrast within the image was increased. To make the sky separate from the cloud tonality the highlight and shadow sliders were increased in value to brighten the sky compared to the cloud.

## Conclusion:

This image reveals that timing is everything when photographing clouds. Colors, shapes, and locations can change from minute to minute and being in the right place at the right time is crucial. Although the sunset was missed a dramatic image was created that adequately illustrates the leading edge of an altostratus cloud. In addition to illustrating the cloud type itself additional knowledge of the cloud structure and its defining features were gained. Reception to the image

from the class was all around good with only minor changes to framing requested. In the next go around of this picture timing will be better accounted for to achieve the desired image.

## References:


1. Pretor-Pinney, Gavin. *The Cloud Spotter's Guide*. Pergee Press, 2006. Print.
2. "Sounding Data." . University of Wyoming. Web. 27 Feb 2014. <http://weather.uwyo.edu/upperair/sounding.html>.
3. Paluch, I.R., and D.H. Lenschow. "Stratiform Cloud Formation in the Marine Boundary Layer." *Journal of the Atmospheric Sciences*. 49.19 (1991): 2141-2158. Print.
4. Curry, Judith. "Interations among Turbulence, Radiation and Microphysics in Arctic Stratus Clouds." *Journal of the Atmospheric Sciences*. 43.1 (1986): 90-106. Print.