Flow Visualization Cloud Assignment #2

Unstable Cumulus at Copper Mountain

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The purpose of this assignment was to capture an image of clouds reacting to the different variables of the atmosphere. Clouds are a fascinating fluid phenomenon that shows how the atmosphere is reacting to changes in temperature, wind, humidity and several other factors. Clouds constantly change shapes and sometimes appear to be rapidly moving. This photo above was taken in the Rocky Mountains where the clouds swiftly flew across the sky and resulted in different weather conditions by the minute. Brief openings of blue sky allowed the sun to radiate heat that instantly warmed me up, followed by dark cumulus clouds that perspired rain and hail at times. The extremely unstable atmosphere defined what weather conditions can be deep in the mountains of Colorado during the spring. Unfortunately, I did not have my digital camera during this moment, so this image was taken with my camera phone. The photo lacks some resolution that a digital camera would have provided and limited my techniques a bit since I was not able to adjust the shutter speed and aperture, but the quality of the image is still decent. The setting and conditions when the image was taken along with the unmistakable large cumulus clouds made me choose to submit this photo among numerous others snapped with my camera.

The image was taken at Copper Mountain in Summit County, Colorado. These clouds were captured at about 4:00 p.m. on March 29, 2013 facing northwest. The sky was filled with similar clouds in every direction, but the position on the mountain allowed for an elevated view where these clouds

could be seen for miles in that direction. This view allowed the camera to be pointed horizontally and not angled more than a couple degrees from the ground. The sun was constantly popping through the clouds and then quickly being covered again by the thick, dark masses.

The temperature on the day the photo was taken was in the mid 50's (F) and the gusts of winds ranged from about 10 to 20 mph [1]. Weather on the previous day and following day were very similar and there were not any notable fronts that were approaching, but just partly cloudy skies. The clouds seen in the image appear to be of the cumulus type from inspection of the photo. They are puffy and there are several sizes of them grouped together. The height at which the clouds appear to be also suggests they are cumulus clouds. This height is inferred by viewing the skew-T diagram [2] seen in figure 1 where the temperature line and dew point line come close together at around 6000 meters. The conditions on the mountain during the time this photo was taken were very strange. The sun would temporarily shine through the cumulus clouds and would instantly warm the surface. This would only be momentarily as the clouds would then pass in front of the sun and the wind and temperature would feel very brisk. Strangely, on some parts of the mountain, the dark clouds would spit some snow and even hail for short periods of time. This would be followed by more sun and blue skies. In other words, the conditions were very inconsistent and it appeared to be a very unstable atmosphere. The Convective Available Potential Energy (CAPE) value from the skew-T plot shows a value much greater than zero which supports the assumption of an unstable atmosphere.

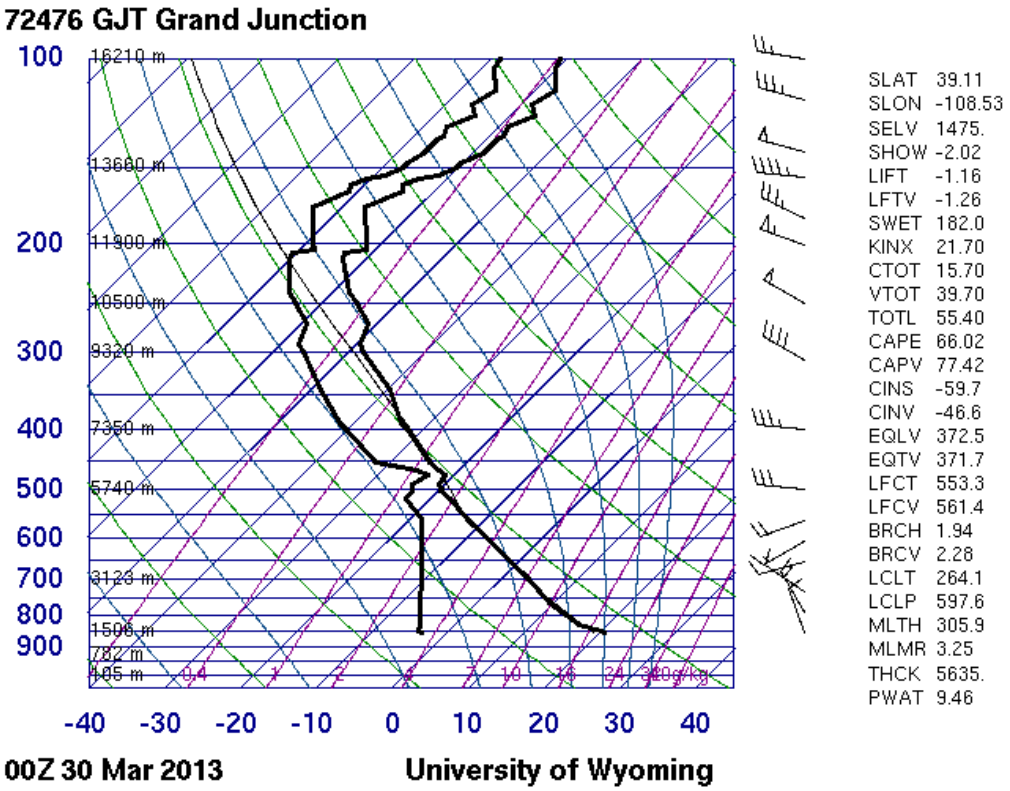

Figure 1 - Skew-T diagram

Given that my camera limited my techniques available when the picture was taken, a few editing techniques were used to improve the original image to the best of my ability. The curves feature was used and an "S" shaped curve was made to increase the contrast of the image. The brightness of the image was also slightly increased to make the clouds and sky really stand out since that was the focus of the image. The image was also cropped once again due to the intentions of drawing the viewer's attention to the sky. The bottom of the original image also contained a road that I thought took away the feel of nature and open space felt by looking at the picture. The comparison of the original photo and final image after editing can be seen in figure 2 below:

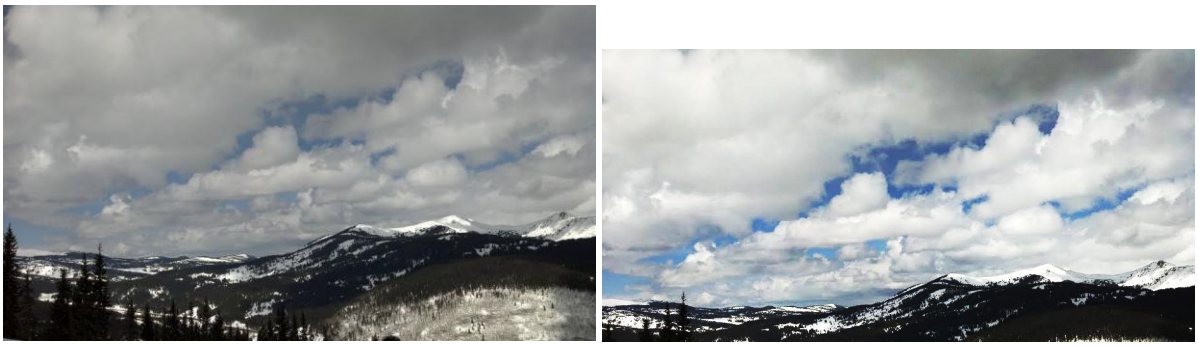

Figure 2 – Images Before (Left) and After (Right) Editing

Additionally, the limited photographic techniques are represented and summarized in the following table:

Date and Time	March 29, 2013 at 4:00 p.m.
Type of Camera	DROID 2 Phone Camera
Pixels of Camera	8 MP
Direction/Location	Northwest/Copper Mountain Resort, CO
Original Photo Dimensions	1/125 sec
ISO	960 x 541 pixels
Photoshop Processing	• Slightly increase brightness • Increase contrast making "S" shaped curve • Crop bottom of image

This image reveals numerous cumulus clouds in an unstable atmosphere at Copper Mountain in early spring. Weather in the spring in Colorado has always fascinated me as it can feel like a hot summer day followed by a blizzard the next day. This variation in weather was presented in a few hours. I think the photo here gives the reader an excellent visual representation of what the conditions I described were on this day. I believe this was a moderate example of how unpredictable and inconsistent the

weather can be in the Rocky Mountains at this time of year and am curious of how intense the variations can be. Clouds move fast in winds aloft in the mountains and I would be interested in recording video of some of these conditions so people can see an even clearer representation of what I have discussed in this report.

References

1. "Weather in Copper, CO." *Weather Spark Beta*. N.p., n.d. Web. 14 Apr. 2013. <weatherspark.com/#!graphs;a=USA/CO/Copper>.
2. Atmospheric Soundings: Wyoming Weather Web (2012). Retrieved January 11, 2013 from University of Wyoming, Department of Atmospheric Science Web Site: http://weather.uwyo.edu/upperair/sounding.html
3. Cloud Classification and Characteristics Retrieved February 25, 2013 from http://www.crh.noaa.gov/lmk/?n=cloud_classification