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Flow Visualization
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Clouds 1

I find clouds to be one of the most interesting thermodynamic features that we encounter in our daily lives. They sit up in the sky completely out of touch yet beckoning you with its soft fluffy exterior. With my image, I hoped to capture the dynamic clouds that we get here in Boulder, Colorado. The presence of the Front Range of the Rocky Mountains creates a multitude of various weather patterns during the summer months. From towering cumulonimbus clouds that tend to develop in the afternoon, to the wispy cirrus clouds high in the atmosphere in the mornings, we have a unique variation in our cloud types. With my image, I chose to capture a particularly striking cumulous cloud during its development stage. Within the cloud, there was a large amount of texture and depth that I hoped to capture with my camera.

Figure 1: Cumulus cloud image after post processing.

My image was taken on August 31, 2015 at 12:10 in the afternoon. The picture was taken east of the University of Colorado: Boulder campus near 28th St and Colorado Ave. The camera was pointed in an eastward direction with an angle of 50°.

The cloud in my image is a cumulus cloud still in its development stage to a towering cumulus. Since the image was taken at noon, the skew-T diagrams aren't as helpful. I chose to use the 6am sounding[1], Figure 2, at DIA but I have included the 6pm sounding[1] in the appendix for reference. There was little CAPE in the morning and evening so the atmosphere was fairly stable. The days surrounding the creation of the image there was no measurable precipitation. Conditions were mostly

clear during those days as well. I would estimate the cloud height at the time to be about 4000m above the ground. Looking at the skew-T diagram, the dew point line on the left and the temperature line approach each other at around 5000m above sea level. This is quite close to that cloud level that I estimated when I took the image. As this is a cumulus cloud, you should expect some instability[2] but this was not reflected in the CAPE value.

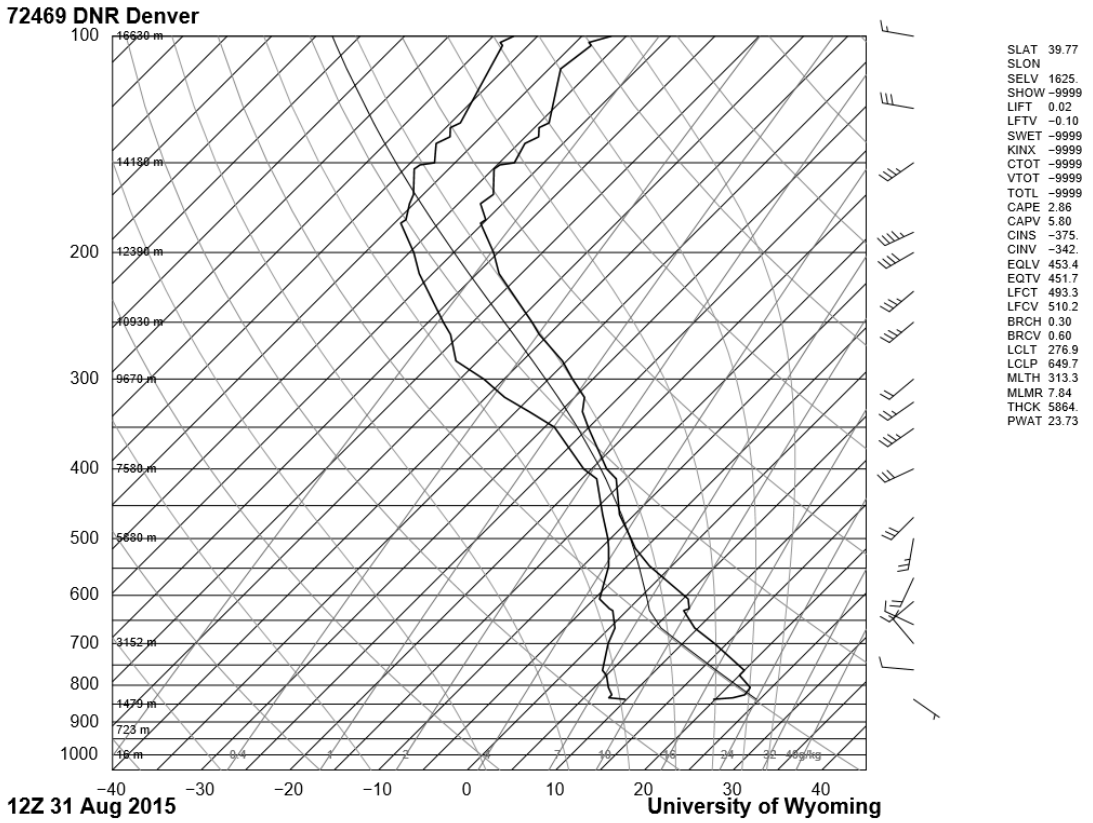


Figure 2: Sounding data taken at 6AM from DIA

The image was taken using a Canon DSLR Camera. In addition to the image specifications laid out in Table 1, I also employed the use of a circular polarizing filter (CPL) on the front of my lens. The polarizer increases the contrast in the sky and in the clouds but it can change some of the colors. For this particular image, I think the CPL filter works really well and I am glad that I used it. The post processing done on the image was very basic. The contrast was increased slightly to bring out the variation in the cloud and the color curve were used as a tool to also adjust the contrast on all the colors.

Table 1: Image Specifications

Estimated Field of View	800ft
Distance to Lens	5300m
Lens Focal Length	35mm
Lens Specifications	EF-S 18-55mm 1:3.5-5.6 IS STM
Exposure Specifications	1/200 sec. f/9 ISO 100
Type of Camera	Canon
Image Size	4488px x 3104px

Figure 3: Original unedited image.

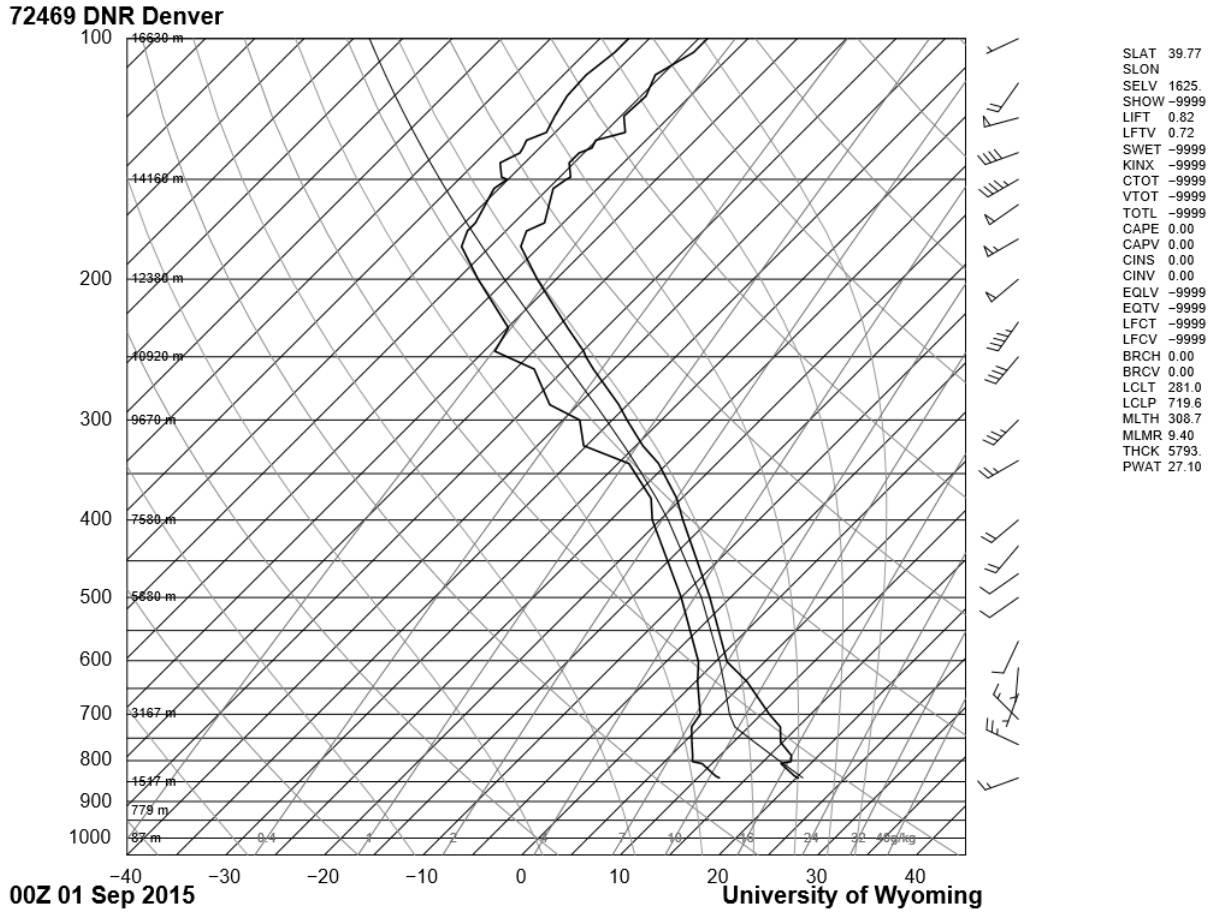
Overall I think the image is successful. I was able to capture the very dynamic nature of the a single cloud. There a numerous structures that are visible on the bottom of the cloud and the shading growing from dark at the base to a lighter top gives a very nice aesthetic. If there is anything to be improved, perhaps then next time I will try to include a reference to the ground or have a wider FOV giving me more clouds in the image.

References

[1] Atmospheric Soundings: Wyoming Weather Web (2015). Retrieved October 14, 2012 from University of Wyoming, Department of Atmospheric Science Web site: http://weather.uwyo.edu/upperair/sounding.html

[2] Cloud physics, Atmosphere layers, intro to Skew-T. Atmospheric instability (2015), Retrieved October 15, 2012 from Flow Visualization: University of Colorado Web site: http://www.colorado.edu/MCEN/flowvis/course/Lecture2015/11.Clouds1.pdf

Appendix


72469 DNR Denver
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300
400
500
600
700
800
900
1000
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14160 m
12380 m
10920 m
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7580 m
5680 m
3167 m
1517 m
779 m
87 m
0.4
1
2
4
7
10
16
20
32
48g/kg
−40
−30
−20
−10
0
10
20
30
40
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University of Wyoming
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LIFT 0.82
LFTV 0.72
SWET −9999
KINX −9999
CTOT −9999
VTOT −9999
TOTL −9999
CAPE 0.00
CAPV 0.00
CINS 0.00
CINV 0.00
EQLV −9999
EQTV −9999
LFCT −9999
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LCLT 281.0
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MLMR 9.40
THCK 5793.
PWAT 27.10