Clouds 1

Cumulonimbus Calvus Incus

Ernesto Grossmann

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The mid-west of the United States is considered a major avenue for weather fluctuations, ranging from devastating tornadoes in the plains to thunderstorms in the mountains. The city of Boulder in Colorado, in particular, hosts every summer enormous thunderstorms. This is mainly due the low-humidity in the air and the hot temperatures during the day and confortable at night. Therefore, the cloud formations that originate at the foothills during this season are just spectacular. I wanted to capture this wonderful anvil type shape that normally thunderstorms clouds form. The classification given to these particular formations is cumulonimbus clouds.

As mentioned, the cloud image under the scope is classified as a cumulonimbus cloud, which is traditionally the thunderstorm cloud. Furthermore, this cloud belongs to the calvus incus species inside the cumulonimbus family. These enormous clouds tend to form individually or get help from neighbor clouds to form what is known as “multicell” and “supercell” storms [1]. As a parcel of air gets warmer than the surrounding environment, this one rises in an uncontrolled way, creating an unstable atmosphere. These extreme dense cumulus clouds rise until they condense and stabilize creating droplets, and furthermore, create ice crystals at the summit, giving the cloud its characteristic soft-top edges. The image was captured on July 31st, 2011 around 6:00 from Chautauqua Park. Figure 1 shows the skew-T plot for that specific date and time [2]. The thick black line to the right is the environment temperature while the one on the left is the dew point temperature. The angled blue, curved green, curved blue and thin black lines are the constant temperature, dry-adiabatic, saturated and adiabat lines.

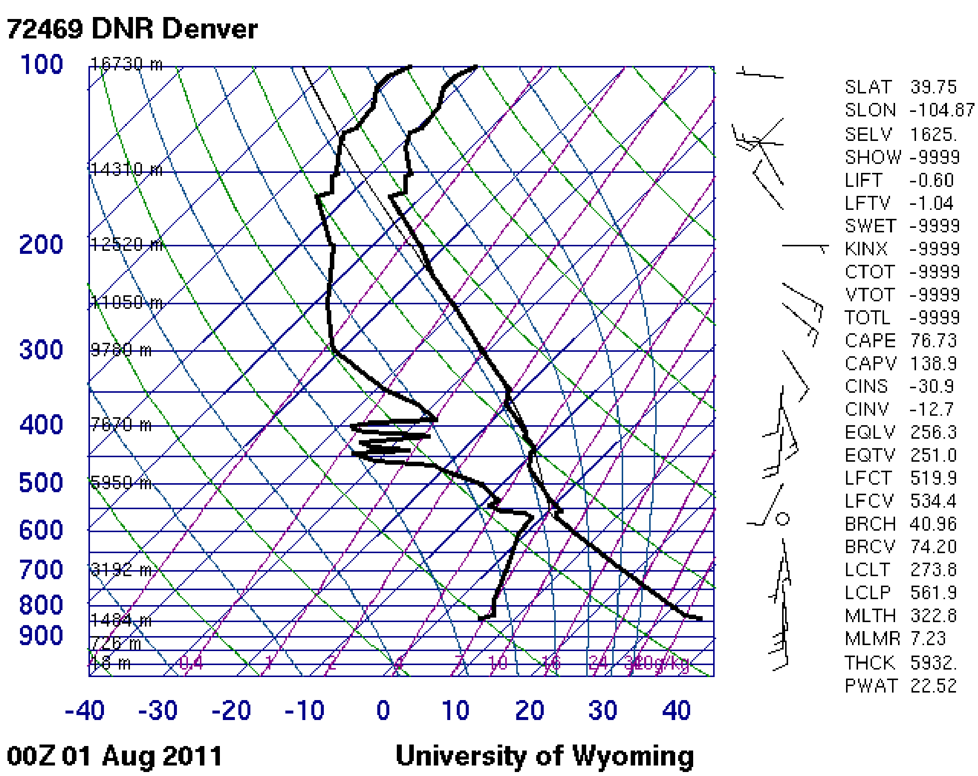

Figure 1. Denver's Skew-T plot for July 31, 2011

Source: http://weather.uwyo.edu/upperair/sounding.html

After analyzing the skew-T plot, it was possible to corroborate the unstable atmosphere and the actual cloud height formation. By looking at the plot, it is noticeable how the dew-point temperature decreases drastically reaching the same temperature as the environment, therefore, making it possible for a cloud to form at that elevation of approx. 4.2 Km (fig.2). Also, it is possible to estimate the size of the cloud plume by looking at a drastic decrease of the dew point temperature. In addition, as the cloud formed, the air was warmer than the surrounding environment creating an unstable atmosphere. Looking at the Convective Available Potential Area (CAPE) positive value at the skew-T plot can easily prove this statement by showing the area between the adiabat and the environment temperature line (fig. 3).

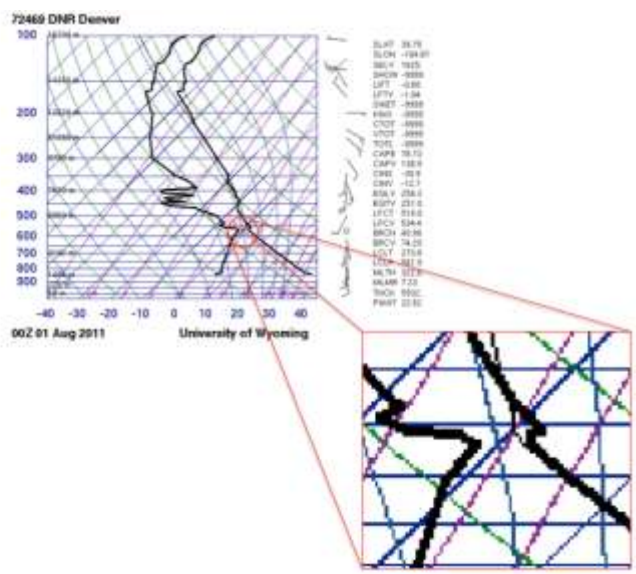

Figure 2. Skew-T cloud formation area

For some cases where the skew-T plot is not available it is possible to calculate the cloud base height by knowing the dew point temperature and the dry bulb temperature for a particular day. The following expression can be used to calculate the cloud base height [3]:

$$H_b = \frac{T_{db} - T_{dew}}{0.008021} \qquad (1)$$

Where T_{db} is the dry bulb temperature, T_{dew} is the dew point temperature, and H_b is the cloud's base height. Figure 4 shows the local weather data for Boulder on the day the picture was taken. The top of the chart shows the cloud coverage, below is the temperature intensity, dry bulb temperature plot, dew point temperature plot, wind direction, wind speed and the time frame. Based on the data, for 6:00 pm the dry bulb temperature was 95°F (35°C) and the dew point temperature was 37°F (2.8°C). The cloud base height obtained

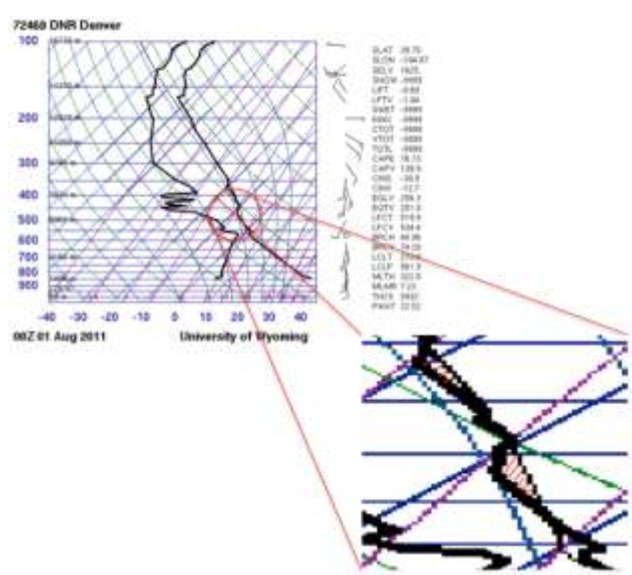

Figure 3. Skew-T unstable area

with (1) is 4.156 Km, which is close to the value estimated looking at the skew-T plot.

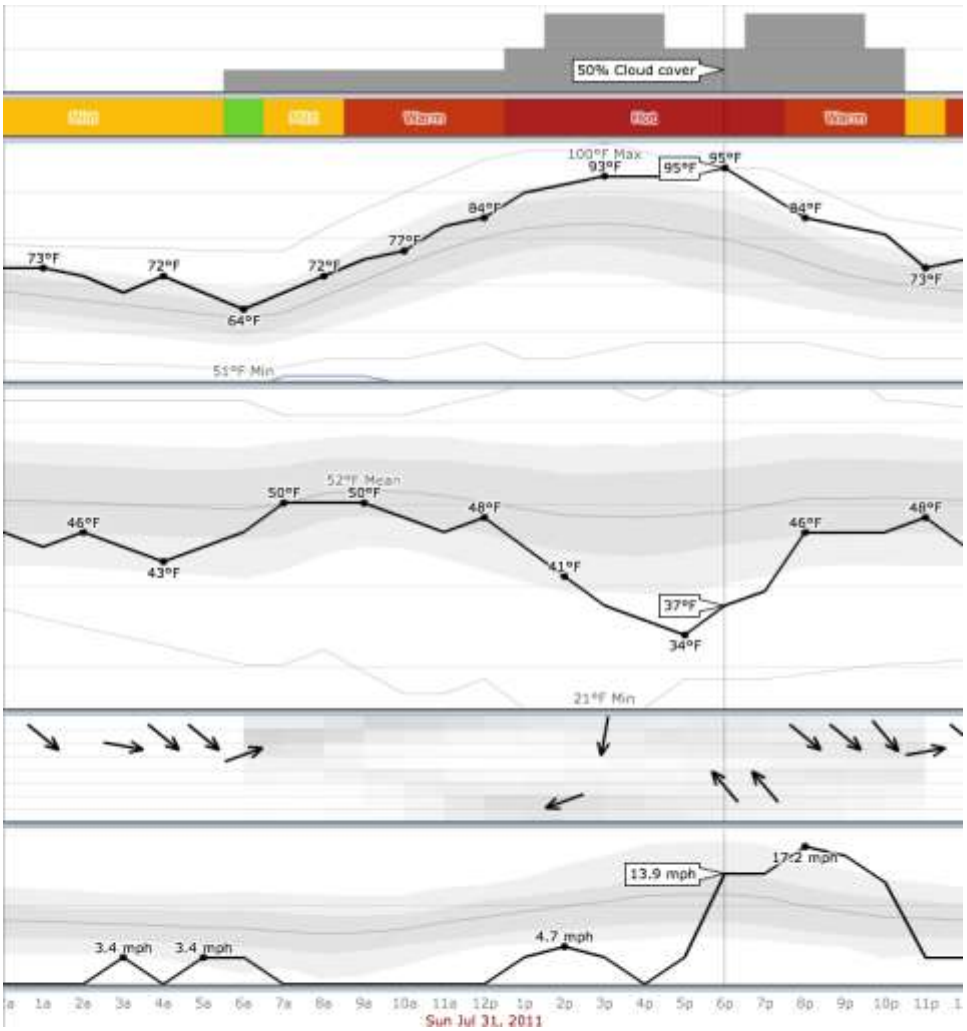

Figure 4. Boulder's weather data for July 2011

Source: http://weatherspark.com/

Photographic Technics

To capture the image a Nikon D5100 DSLR camera was used in manual mode to have more control over the image exposure. The lens attached to camera was an 18-55mm focal length range lens with an aperture range of f/3.5-5.6. The process of taking the shot wasn't that hard at all due to the fast shutter speed. The latter is the main reason why a tripod was not needed for this task. In addition, an aperture of f/11 was set to have a bigger depth of field in order to capture in focus the cloud at the distance. To enhance the picture, Adobe Lightroom was applied to increase the contrast, increase a little of saturation and sharpness. For this case in particular, the noise reduction option was used to decrease the graininess on the picture. The following table shows all the specs of the image.

Table 1. Image Specs

Date and Time	July 31st, 2011 6:00 pm
Camera	Nikon D5100 DSLR Camera
Lens	Nikkor 18-55mm f/3.5-5.6
Aperture	f/11
Shutter Speed	1/125 sec
ISO	100
Focal Length	55mm
Direction	North
Location	Chautauqua Park, CO

Clouds can take many beautiful forms, but within all the different type of clouds, the cumulonimbus family is perhaps the most imposing one. My intention was to capture the power and the instability that characterizes this type of clouds. What I like about my picture is the composition, showing the foothills in the low left corner and the massive anvil shape cloud covering the rest of the frame. In my opinion, the image shows all the physics behind the formation of a cloud, specifically a cumulonimbus cloud. Its puffy look and soft edges at the top are the mere representation of the air rising in an uncontrolled way, reaching a stable stage at the top. Furthermore, I'm pleased knowing that my image and the weather data collected matched almost perfectly. The following figure shows the final and original version of the image, respectively.

Figure 5. Final and Original version

References

[1] The Cloud Collector's Reference. Retrieved February 25, 2012 from http://cloudappreciationsociety.org/collecting/mick-ohrberg/
[2] Atmospheric Soundings: Wyoming Weather Web (2012). Retrieved February 25, 2012 from University of Wyoming, Department of Atmospheric Science Web site: http://weather.uwyo.edu/upperair/sounding.html
[3] WolframAlpha, Retrieved February 25, 2012 from, Web site: http://www.wolframalpha.com/input/?i=cloud+base+height&f1=97+°F&f=CloudBaseHeight.Tdb_97+°F&f2=37+°F&x=9&y=8&f=CloudBaseHeight.Tdew_37+°F
[4] SKEW-T, LOG-P DIAGRAM ANALYSIS PROCEDURES (2007). Retrieved February 24, 2012 from, Web site: http://www.met.tamu.edu/class/atmo251/Skew-T.pdf