

Cloud First Assignment



By: Casey Cooter

Team Eta

MCEN 4151

Professor Hertzberg

3/23/2018

Introduction

This image was taken for the “Cloud First” assignment of the 2018 spring semester course “flow visualization” at the University of Colorado at Boulder. The assignment was to photograph an intriguing cloud, and then evaluate the cloud to learn more about the type and conditions that produced it. This report will contain information pertaining to the circumstances of which the cloud was taken, a deeper analysis on the environment of the cloud, and the details of how the cloud was photograph was taken.

Cloud Information

The cloud was taken on January 29th, 2018 at 5:23 PM MST. The photo was taken at Whole Foods Ideal Market, located at 1275 Alpine Avenue in Boulder, Colorado. The photo was taken in the back dock of Ideal Market, a place only accessible by the employees of the store. The city of Boulder is at a height of approximately 5430 feet above sea level. When the photo was taken, the camera was angled from the horizon of approximately 35 degrees, aiming towards the cloud.

Upon initial inspection, the cloud is believed to be an altocumulus standing lenticular cloud. While I was unable to frame the whole cloud in the photo due to my location, the large cloud was the only cloud in the sky. The photo reveals some of this detail, as one can see that there is bright sunlight from the west illuminating the cloud and the clear sky in the same direction. The overall climate on the day the photo was taken was warm spring weather, reaching a high of 59° F (27° C), and did not experience any form of rain or snow. This followed a warm front from 30 degrees on January 1st, 2018, where the temperature steadily increased. [1] The winds were light, ranging from 3 to 7 miles per hour in the north direction, with an average humidity of 50% in Boulder. [2] The Skew-T diagram for Denver on January 29th, 2018 at 6:00 PM MST can be found in Figure 1.

From Figure 1, we see that the Convective Available Potential Energy (CAPE) value is exactly 0.00. This means that the atmosphere is stable, and the cloud was not a storm which was forming, which explains why the cloud is not large and puffy, but much softer and flatter. What we notice from Figure 1 is that the temperature and dew point are closely related at heights of greater than approximately 6000 meters, and follow a similar trend in change as the altitude increases into the tropopause and stratosphere. We can also see that the wind was blowing Northwest of speeds from 20 to 60 knots, which is in the general direction of Boulder, Colorado. The chart shown in Figure 2 is data taken from a Ceilometer at the University of Colorado in Boulder. The image was taken at 5:30 PM UST, which is 11:30 PM in UTC. From the ceilometer information, we can see that at the time the image was taken, the ceilometer is detecting clouds between 5 and 8 km, or 3.1 to 5 miles. An altocumulus standing lenticularis cloud will tend to occur in this range, so the statement that it is an altocumulus standing lenticular is a sensible conclusion.

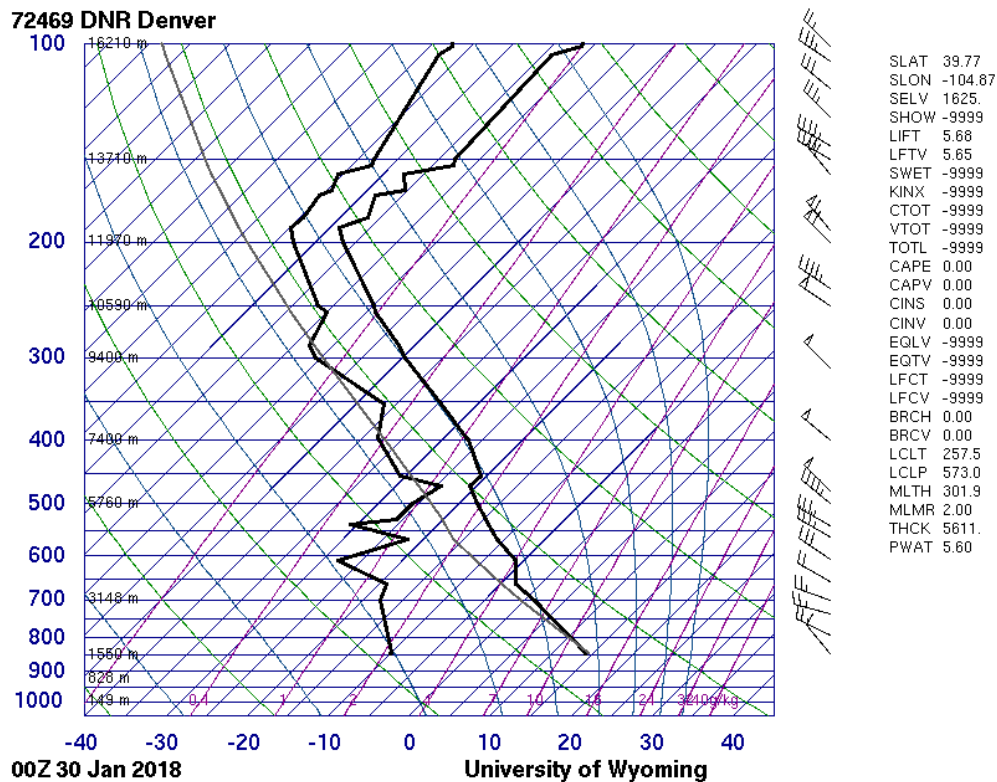


Figure 1: Skew-T diagram for Denver, Colorado at 6:00 PM MST [2]

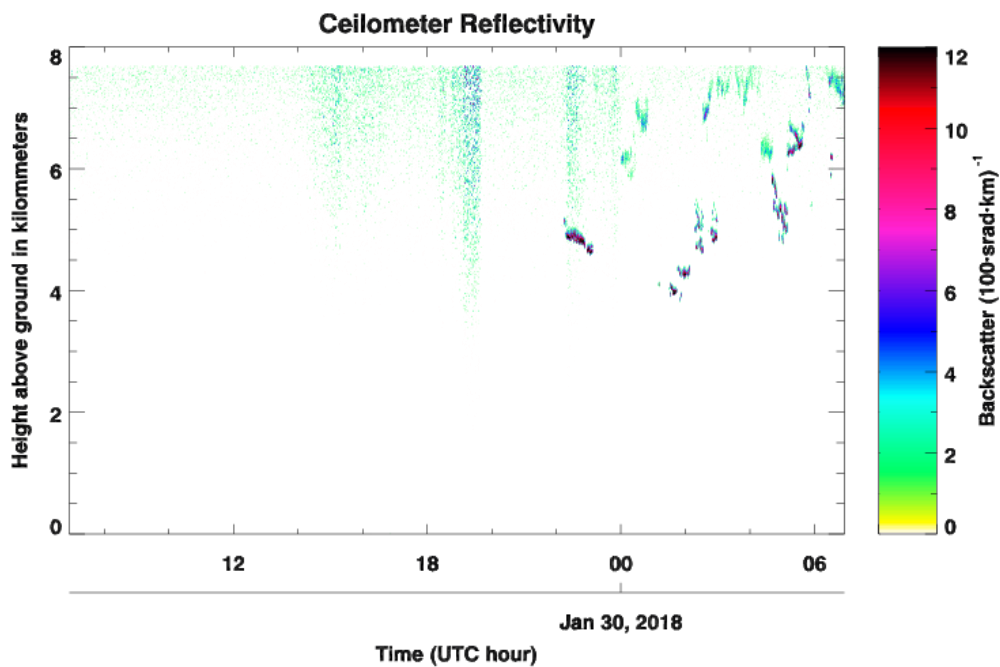


Figure 2: Skywatch Data from the University of Colorado, Boulder [3]

Photo Information

The photograph itself was taken with an LG G4 smartphone, which produced an image of 5312 x 2988 pixels. The camera had an exposure time of $1/40^{\text{th}}$ of a second, ISO-51, and an F-stop of f/1.8. The focal length of the camera used for this photo for the LG G4 is 4mm. As was previously determined, since the cloud was the subject, the distance from the camera to the cloud in question is approximately 4 miles. It is difficult to estimate the vertical distance the photo was taken, especially since the subject was a cloud. However, based on the scenery, we can estimate the horizontal distance to be approximately 500 meters, or 1640 feet. The original image can be seen in figure 3

To enhance the image, some post-processing was performed to better highlight the image, the image processing package "GIMP" was used to edit the image. To preserve the information content, post-processing was kept to a minimum. One of the first changes was cropping. The original image can be seen in the following Figure:

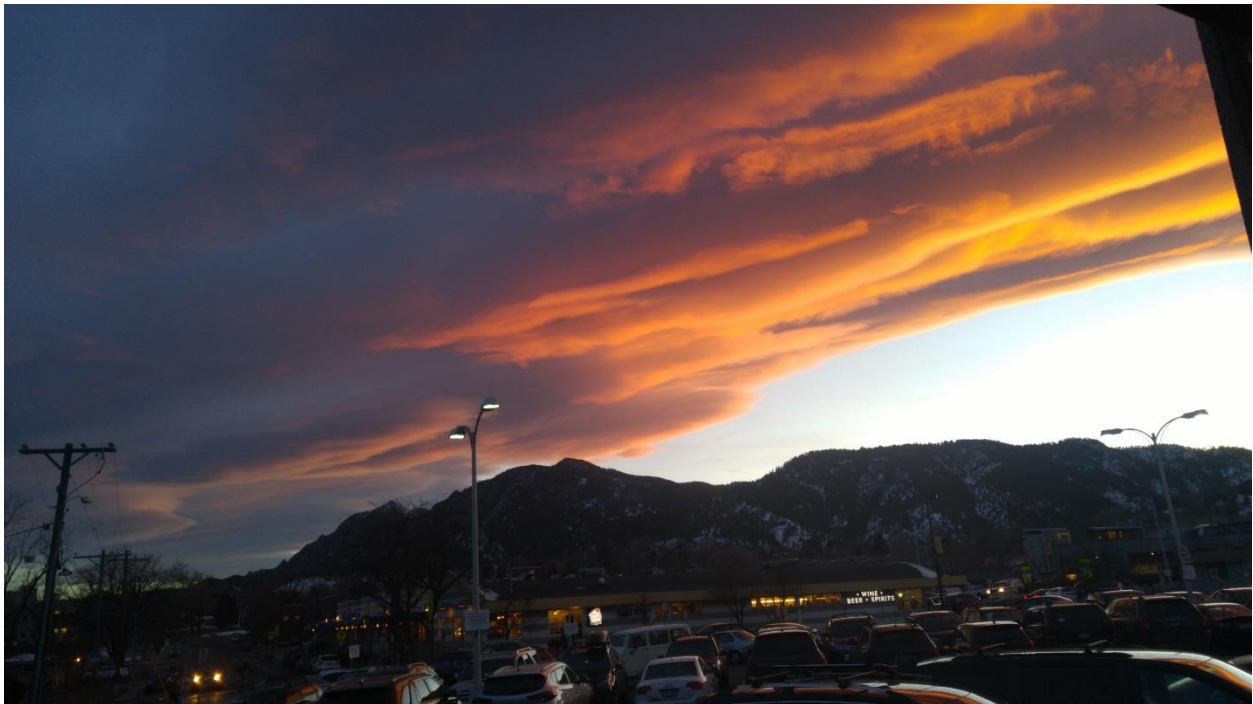


Figure 3: Original cloud image taken at Ideal Market

During shooting, the angle the photo could be taken was limited by the location. Much of the distracting content was cut out of the image, where the final resolution is now 4659 x 2160, as this removes much of the distracting elements. The street lamps and light pole were left in, as I feel that they serve as a neutral anchor to the rest of the image. To improve the crispness of image edges, the GIMP filter "unsharpen mask" was applied, with a radius of 4.0, amount of 0.95, and a threshold of 2. Since the image was taken with a phone camera, this helped to reduce noise. While defining edges more clearly. Since I did not wish to make the image feel unnatural, I did not stretch contrast or change color balances. The original intent (both artistic

and scientific) was to highlight the cloud and colors of nature, so changing the colors would take away from this intention. The final image is seen in figure 4.



Figure 4: Final image for the cloud first assignment. This image was cropped and sharpened to improve the overall image.

Conclusion

While the original photo did have distracting elements, and the whole cloud wasn't able to be framed, I still appreciate the impact the photo has. The colors and mountains in the background give the photo a lot of pleasing visuals. The sun was hitting the clouds in the perfect way. Boulder's unique altitude and atmosphere make it possible to see clouds like this up close quite regularly, providing a unique video opportunity. In the future, better location and photograph equipment would have greatly improved the photo. However, given the circumstances, the photo still turned out nicely, and illustrated a unique cloud.

References

- [1] "Boulder, CO." *AccuWeather*, 29 Jan. 2018,
www.accuweather.com/en/us/boulderco/80302/december-weather/327347.
- [2] "Weather History for KBDU - December, 2017." *Weather Underground (10.226.243.89)*, 29 Jan. 2018,
www.wunderground.com/history/airport/KBDU/2017/12/2/DailyHistory.html.
- [3] "Skywatch Observatory." *Skywatch Observatory*, skywatch.colorado.edu/, 29 Jan. 2018

Image Assessment Form

Flow Visualization

Spring 2013

Name(s): Casey Cooter

Assignment: Cloud First

Date: 23 March 2018

Scale: +, ! = excellent √ = meets expectations; good. ~ = Ok, could be better. X = needs work.
NA = not applicable

Art	Your assessment	Comments
Intent was realized	+	
Effective	+	
Impact	+	
Interesting	+	
Beautiful	+	
Dramatic	+	
Feel/texture	+	
No distracting elements	√	Could be better
Framing/cropping enhances image	!	

Flow	Your assessment	Comments
Clearly illustrates phenomena	!	
Flow is understandable	!	
Physics revealed	√	Not full frame
Details visible	!	
Flow is reproducible	N/A	
Flow is controlled	N/A	
Creative flow or technique	N/A	

Publishable quality	√	
---------------------	---	--

Photographic/video technique	Your assessment	Comments
Exposure: highlights detailed	!	
Exposure: shadows detailed	!	
Full contrast range	!	
Focus	!	
Depth of field	!	
Time resolved	!	
Spatially resolved	!	
Photoshop/ post-processing enhances intent	!	
Photoshop/ post-processing does not decrease important information	!	

Report		Your assessment	Comments
Collaborators acknowledged		N/A	
Describes intent	Artistic	!	
	Scientific	√	
Describes fluid phenomena		√	
Estimates appropriate scales	Reynolds number etc.	√	
Calculation of time resolution etc.	How far did flow move during exposure?	NA	
References:	Web level	!	
	Refereed journal level	!	
Clearly written		!	
Information is organized		!	

Good spelling and grammar		!	
Professional language (publishable)		!	
Provides information needed for reproducing flow	Fluid data, flow rates	N/A	
	geometry	NA	
	timing	NA	
Provides information needed for reproducing vis technique	Method	NA	
	dilution	NA	
	injection speed	NA	
	settings	!	
lighting type	(strobe/tungsten, watts, number)	!	
	light position, distance	!	
Provides information for reproducing image	Camera type and model	!	
	Camera-subject distance	!	
	Field of view	!	
	Focal length	!	
	aperture	!	
	shutter speed	!	
	Frame rate, playback rate	NA	
	ISO setting	!	
	# pixels (width X ht)	!	
	Photoshop and post-processing techniques	!	
	"before" Photoshop image	!	