Gardner Nichols
Cloud 1 Report

For the second project in the flow visualization class at The University of Colorado, the task was to get an image of a cloud. The intent for the image in this report is to reveal some physics that most cloud-watchers might overlook. An unstable situation might be the best to visualize the physics, so cumulus clouds became my focus.

The image in this report was taken in Ashcroft, a small ghost town 10 miles south of Aspen, Colorado on October 3rd, 2015 at 2:23pm local time. The camera was pointing south towards Taylor Peak (pictured). With the camera at roughly 9500 feet looking at a 13400-foot peak about 1.5 miles away, the angle above horizontal was roughly 27 degrees.

The cloud in this image is quite obviously a cumulus cloud. The rest of the sky was scattered with cumulus or stratocumulus clouds at the time this picture was taken. The particular species of of cloud in the picture is estimated to be a cumulus humilis. The weather was constant sunshine and pretty clear skies with intermittent clouds throughout the day. There were no fronts, but it was somewhat windy throughout the day. A maximum wind speed of 10 miles per hour would be a good estimate. The weather was very similar the day before and the day after.

A Skew-T diagram was obtained from Grand Junction from 6pm the day the photo was taken. Although far away, the cloud matches what one would expect from the Skew-T diagram, which is shown in Figure 1.

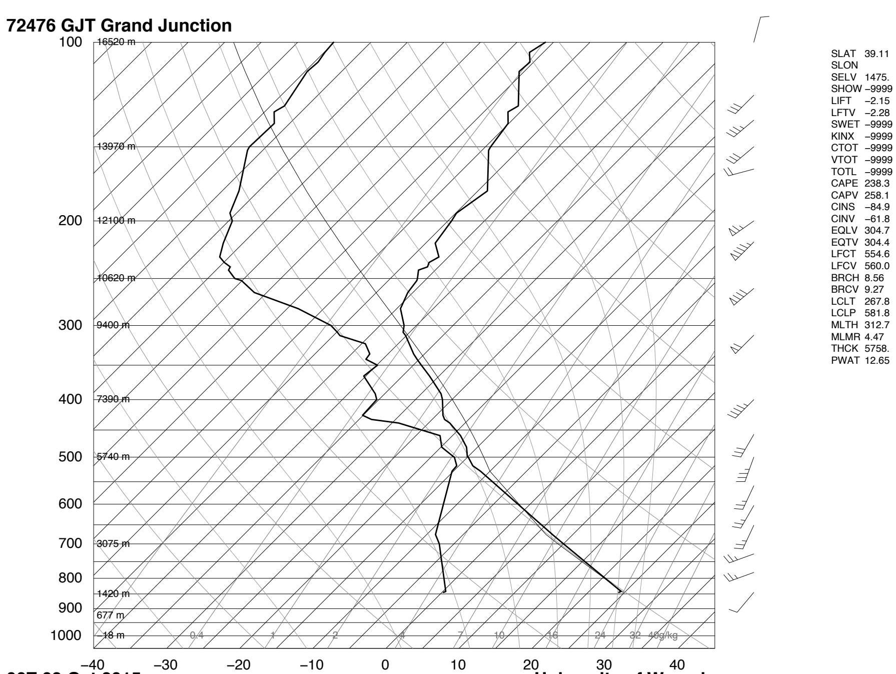

Figure 1: The Skew-T diagram from Grand Junction. Obtained from the University of Wyoming.

Taylor Peak's summit is at roughly 4000 meters, which is the start of an unstable area from Figure 1. Just above 4000 meters, the dew point and temperature come very close together in the unstable area. This correlates very well with what is seen in the image, which is shown in Figure 2. We can see in the image that the cloud is very close to the summit of Taylor Peak and according to the Skew-T diagram, perhaps 2000 meters separates the two. Figure 1 also states a cape of 238, which suggests instability. This instability is a result of the temperature line crossing the parcel lapse rate curve. This instability could result in a cumulus cloud, but it should be stressed that the Skew-T diagram is from an area that is far away and from 4 hours later in the day. The fact that this was taken in a valley could also be a source of criticism when comparing the Skew-T and the image because small weather systems are quite prominent when they are isolated in the mountains.

Figure 2: The original picture before any editing was done.

Even with critical thinking, the image still matches the Skew-T diagram. The cloud appears at roughly 14000 feet. One can see from the Skew-T diagram that instable air begins at the summit of Taylor Peak. The cloud only forms when the temperature drops close to the dew point. A decent estimate would be that air rises in this case due to convective lift. The warm air from the valley floor rises up until an instability is created between the rising warm air and the relatively cooler surrounding air. The difference in air temperature wasn't too large because a larger cumulonimbus type cloud would be prominent. As the warm air rises, it cools down. When the air is cold enough to get close to the dew point temperature, droplets of water condense and latent heat is released, thus heating up the particles again and continuing the convective process found in Cumulus clouds [1]. This convective cycle looks like it is occurring directly over Taylor Peak. In Figure 2, one can actually see several dark areas in the cloud, one of interest being in the lower right side of the cloud. This is what appears to be a convective zone where the particles are in a horizontal cyclone of heating up and cooling down. It should also be stated that there wasn't any precipitation the day this photo was taken. This is due to the air temperature gradient being relatively small compared to nimbus type clouds. The original image reveals some interesting phenomena, but Figure 3 might reveal even more due to the color and contrast adjustments.

Figure 3: Edited version of the image.

As stated earlier, this picture was taken from a small ghost town looking up at Taylor Peak. This was a simple point-and-shoot affair with a Canon EOS 20D DLSR with a Canon 70-300mm lens. The original image was 3504x2336 pixels while the edited image came out to 3504x2112 pixels. The focal length used was 70mm, simply to get as much sky in the photo. The result of a 70mm focal length is a frame width of about a mile (5280 feet) at the cloud's position. The object was estimated to be roughly 1.5 miles away. The camera was set with an ISO of 100, aperture of f/5.6 and shutter speed of 1/800 second. All manipulations were done in Photoshop CS6. The first manipulation was to isolate the mountain and foreground using the Lasso tool. The mountains and foreground were edited using the "curves" tool. The input line was made steeper before a curve was manually formed. With the mountains achieving increased contrast and saturation, the clouds got a similar treatment. The cloud was manipulated with the goal of making the inside of the cloud more visible. The reason the foreground and clouds were separated was because the settings had to differ in order to effectively see both. The editing definitely helped the cloud become more dramatic while enhancing the visuals of convection within.

Speaking to the image, I am happy with the outcome. In all honesty, my camera was broken during this assignment and spent two weeks at Canon's service facility. This meant I had to borrow a camera that I was unfamiliar with. Regardless, I am happy with what the image conveys. I personally like that I was able to make the foreground and bright clouds both visible, something many other people struggled with. This method was a "double edged sword" however, because the edge along the foreground came out rough when inspected closely. One can easily see a thin disrupting line where the image doesn't seem to match. The solution to this would be simply taking more time to get a cleaner cut between the two separately edited portions. I think my image does a good job at revealing the unstable nature of cumulus clouds through the contrast within the cloud. Overall, my image fulfills my intent to create a dramatic piece that showcases some interesting phenomena and physics that one might overlook. The direction I'd like to go with this image is to get a cleaner line between the two edited portions, my only annoyance with this photo.

References:

[1]

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[2]

Pinney, Gavin, and Bill Sanderson. *The Cloudspotter's Guide: The Science, History, and Culture of Clouds*. Perigee Hardcover ed. New York: Berkley Pub. Group, 2006. Print.

[3]
http://weather.uwyo.edu/cgi-bin/sounding?region=naconf&TYPE=GIF%3ASKEWT&YEAR=2015&MONTH=10&FROM=0300&TO=0300&STNM=72476