Cloud 1 Image Report

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The purpose of this image and its enhancements is to show the nature and beauty of clouds and develop the skills necessary for capturing them on film. Clouds are rapidly changing and every cloud image is unique. Therefore, it is very important to capture a worthwhile image of a cloud at the moment the cloud is present since the condition can never be perfectly duplicated. To ensure at least one quality image of the cloud described in this report was captured, a large number of exposures were taken. It was unfortunate the camera was not able to zoom out far enough to capture the full cloud formation, so rather the most interesting part was centered in the image. The final image shows evidence of the clouds formation and has many aesthetic qualities.

This image was taken on January 13th, 2011 at 3:41PM at the Eldora Ski Resort just outside Nederland, Colorado. The terrain is very mountainous with steep slopes and high peaks. The altitude of the shooting location was 9,300 ft above sea level. The shot was taken from a ski lift upwards at an angle of approximately 45 degrees. The camera was facing to the east away from the sun.

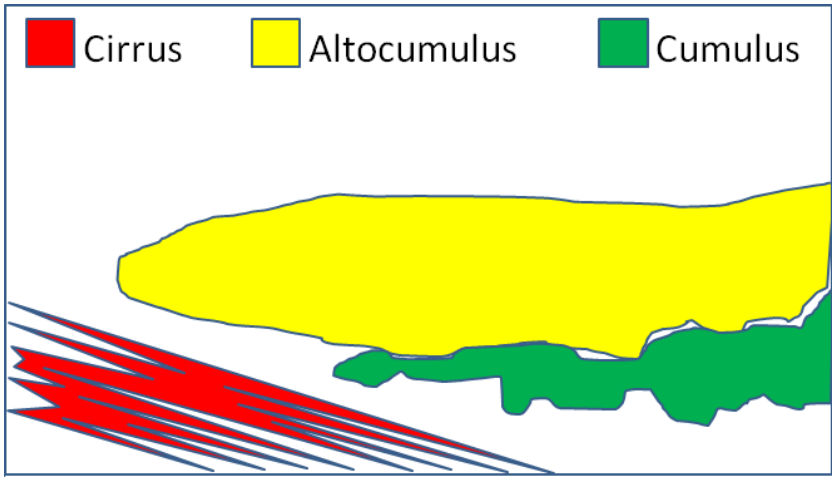

Figure 1: Cloud definition

There are three cloud types shown in the image. There are cirrus clouds in the background, altocumulus lenticularis clouds in the center of the image, and some small cumulus clouds in the foreground as defined by figure 1. The temperature was 50 degrees with a surface wind speed of around 15 mph. The skewT data for weather on the date of image capture is shown in figure 2. This weather data is collected from Denver International Airport (DIA) via a weather balloon released at 6:00 PM mountain time. Generally, skewT plots show what altitude clouds are forming at based on where the two thick black lines come into contact. However, in this plot the two lines never come into close proximity, implying no clouds formed on this day. Obviously this cannot be the case since three different types of clouds are clearly seen in the picture. This discrepancy is most likely due to distance between the weather station and the picture location. Eldora Ski Resort is 70 miles west of the DIA weather station, and is

nested deep within the mountains where the terrain can cause various weather anomalies. The skewT plot does confirm the temperature on that day, and indicates a stable atmosphere.

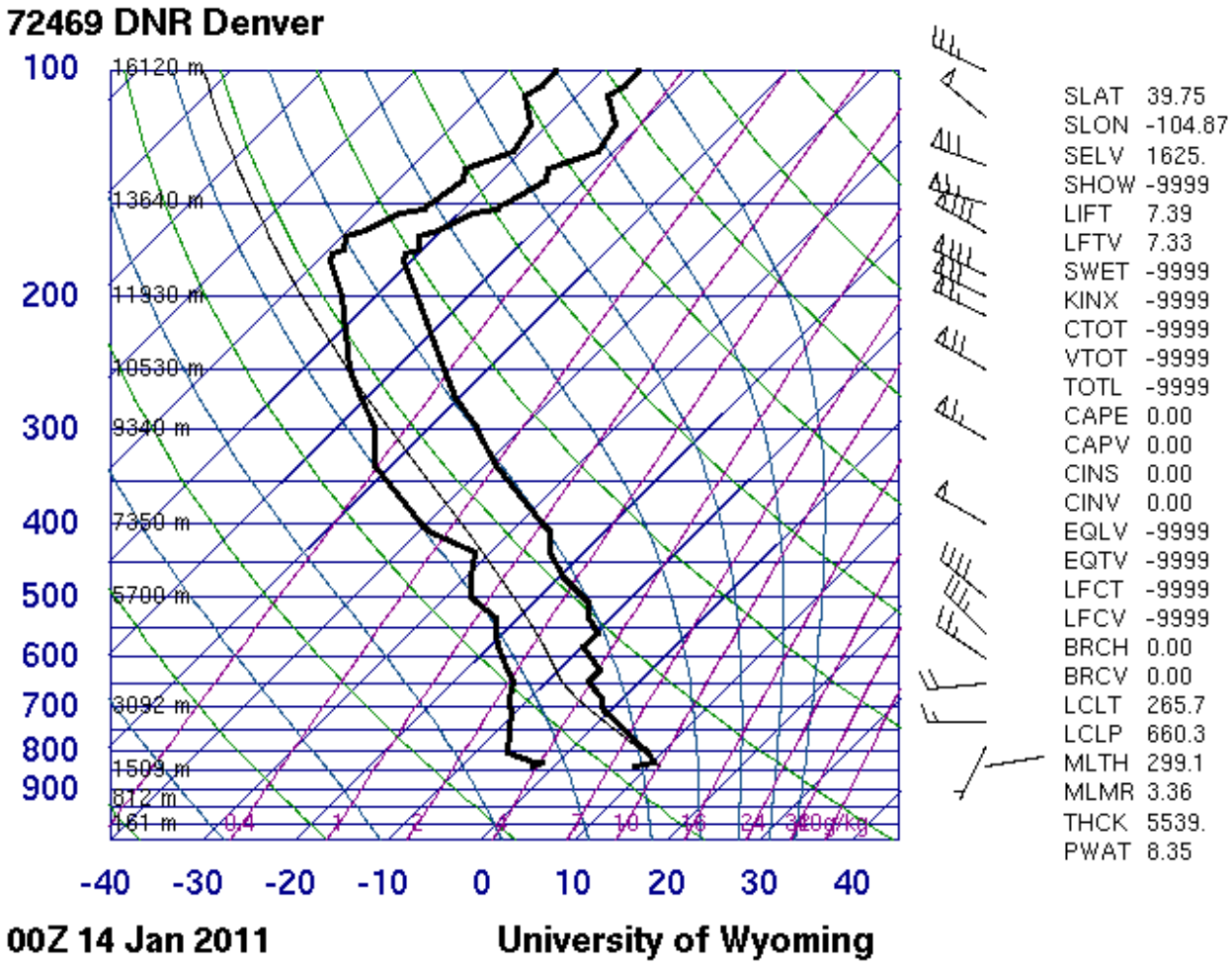

Figure 2: SkewT plot for DIA on 1/13/11 at 6PM (image time and date in Zulu)

The cirrus clouds seen in the lower left side of the image are results of tiny ice crystals on the order of 10 micrometers thick forming at an altitude of around 26,000 ft.[1] These transparent wisps of clouds could have been blown in by the jet stream or merely formed from contrails of aircraft passing through.

The altocumulus cloud in the center of the picture is the highlight of the image. These types of clouds are commonly seen in mountainous regions such as this region at Eldora. Wind blowing over the mountains causes updrafts that carry moisture with it. Since the ambient surface temperature was above freezing that day, the moisture could have been a result of snow getting picked up and melted. As the moisture moves up in altitude, the temperature may drop down to the dew point creating a lenticular cloud. In this case of this image, the

moisture most likely rose up to around 20,000 and condensed to make an altocumulus cloud. The higher temperatures at the base of the mountain combined with the lower temperature towards the top cause massive convective currents that pull moisture skyward.[2] This correlates to the skewT plot in figure 2 where the two black lines make a slight peak towards each other around 6096 meters (20,000 ft). The altocumulus lenticular cloud takes on a streamlined shape in the direction of the wind.

The smaller orographic cumulus clouds in the foreground are created by a similar process at a lower altitude. Warm updrafts rise from the surface carrying moisture with them. As soon as they are in the colder air directly above the peak of the mountain they quickly condense into small puffs of cumulus clouds and drift downwind. These clouds were moving noticeably faster than the clouds in the background and seemed much closer to the ground.

This photograph was taken with a Canon PowerShot SD1200 IS digital camera. A smaller, lighter camera was used since it needed to be carried at all times for immediate response to instant cloud formation. The size of the field of view is difficult to gauge in cloud applications, but the largest altocumulus cloud is estimated to be on the order of one to two kilometers long. The smaller cumulus clouds are estimated to only be 1,500 ft away, the altocumulus clouds are estimated to be about 10,000 ft away, and the cirrus clouds are assumed to be at least 17,000 ft away. To resolve each of these clouds the focus was set at infinity with a minimum aperture value of F2.8. Since a large field of view was required, the minimum focal length of 35 mm was set for a wide shot. ISO value was set at 80 since ample light was available. The shutter speed was set at $1/100^{th}$ of a second since the clouds were nearly stationary. The original and final image pixel dimensions were 3648 by 2048 and was unaffected by editing. Photoshop 5.5 software was used to enhance the image. Power lines in the lower right corner were removed using the clone stamp tool. The contrast was also increased to deepen the blues of the sky and lighten the cloud to make it more eye catching. The original image is shown in figure 3.

Figure 3: Original Image

The final product is a stunning cloud image that fully reveals the cloud physics as well as perfectly displaying its underlying beauty. Many observations have been made on what its shape represents, but the most common observation is that it resembles a futuristic spacecraft shooting towards the left and exhausting gases out of its belly. This is a model image showing three different cloud types; cirrus, altocumulus, and cumulus. The skewT weather data is a little questionable, due to the lack of evidence of cloud forming conditions. However, this is likely due to the effects of the mountains on the weather that cannot be accounted for in weather balloon measurements. The purpose of capturing an interesting cloud photo and analyzing the related weather patterns was fulfilled. If these conditions became present again, a greater effort to capture the full cloud pattern would be made. The panoramic image stitching tool would also be tested to see if multiple side-by-side shots could be spliced into one final image.

REFERENCES:

[1]"Cirrus Clouds". Clouds. University of Richmond. Retrieved 29 January 2011. http://chalk.richmond.edu/education/projects/webunits/weather/cirrus.html.

[2]R. Damiani, J. Zehnder, B. Geerts, J. Demko, S. Haimov, J. Petti, G.S. Poulos, A. Razdan, J. Hu, M. Leuthold, and J. *French. Cumulus Photogrammetric, In-situ and Doppler Observations: The CuPIDO 2006 Experiment.* BAMS, June 2007.