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MCEN 4200: Flow Visualization

Spring 2011— Clouds 1

A mountain wave cloud was captured for the first cloud assignment. Clouds are caused when the temperature of the atmosphere drops below the dew point. This causes the water in the atmosphere to condense. This condensation diffuses the light, which allows the cloud to be seen.

This cloud was seen on February 17th, 2011 from the roof of the parking structure near the engineering center at the University of Colorado at Boulder looking to the south-west. The picture was taken just before sunset, around 7:00 PM. This means that some of the clouds at lower altitudes are in the shadow of the mountains and appear very dark, which adds nice contrast to the more well lit focus of the image. February 17th was a relatively warm day, but it was getting windy and colder, however, there was no precipitation. Overall, the atmosphere was relatively stable.

The cloud in the image was a mountain wave cloud. A mountain wave cloud occurs when air is forced upward due to the mountains. After it passes over the mountains, the air tends to oscillate as it tries to regain equilibrium. At the top of these oscillations, the air condenses as the local temperature approaches the dew point. This phenomenon is shown in the photo by the curved top of the cloud, and the flatter bottom. In the middle of the largest cloud, there is a shadow that demonstrates the curvature of the top. The skew-t plot from D.I.A. at 6:00 pm on the 17th of February, shown in figure 1, shows that the atmospheric temperature did not pass the dew point, which supports the claim that this is a mountain wave cloud. The photo also demonstrates anticrepuscular rays, which are caused by the rays of the sun shining through holes in the clouds and mountains.

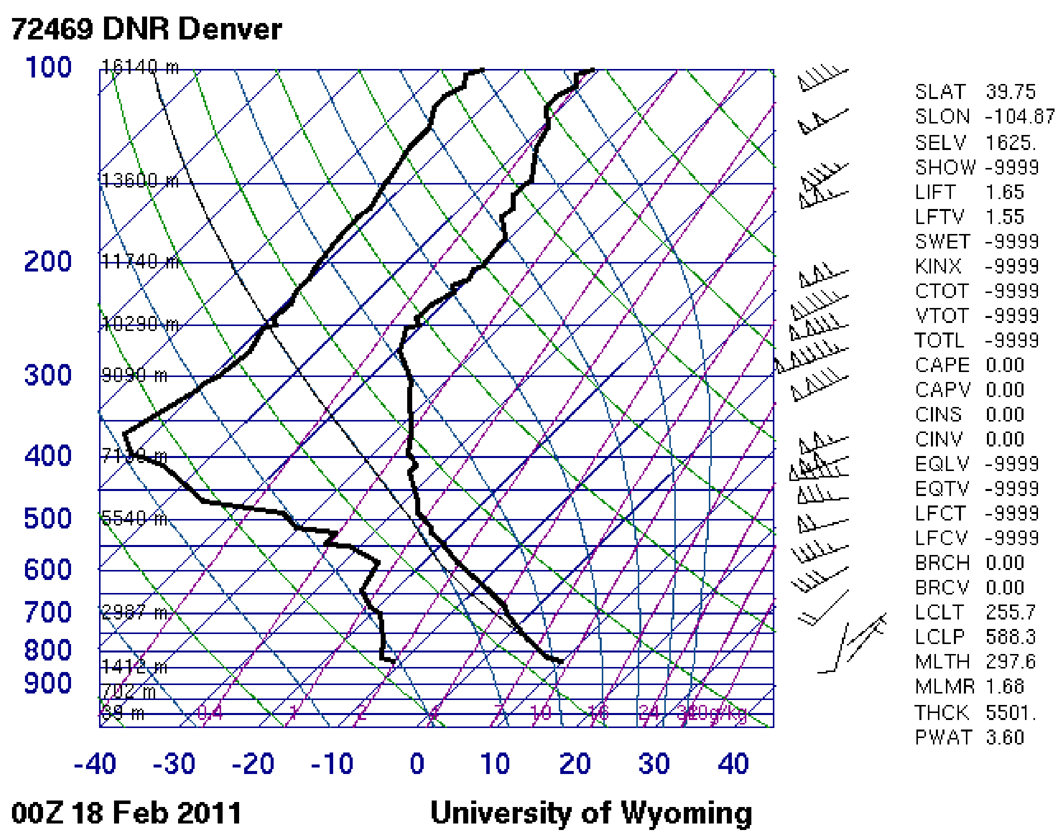

Figure 1: Skew-T plot for Approximate Time of Cloud

The cloud was at an approximate altitude of 14,000 feet, and a distance of 4 miles away. The focus of the lens of the camera was effectively at infinity, with a focal length of 22.35 mm. The image was taken using a Canon PowerShot SX20 IS with an exposure time of 1/250 sec, and an f-number of f/4.5. The image was not cropped once uploaded, which gives a final dimension of 4000x3000 pixels. Photoshop was used to increase the contrast of the image, which really brought out the colors and some of the definition in the cloud. The final image is much more dramatic than the original, seen in figure 2, due to this increase in contrast. Additionally, increasing the contrast brought out a lot of the texture in the cloud. It allows more of the detail to be seen, which reveals much more about the physics behind the cloud than can be easily seen in the original image. Overall, the Photoshop work made the image more dramatic and bolder without distorting the physics behind the cloud.

Overall, I think this image turned out well. I would have liked if some of the colors at the bottom had been more natural with less of a brownish tinge. But the bright colors of the cloud contrast nicely with the blue of the sky in the final image. The curves on the top and the flat bottom accurately portray what is happening with the air movement in the atmosphere and the oscillating after cresting the top of the mountain. It would have been interesting to capture more of a regular pattern that can sometimes be seen with the mountain wave clouds. But overall, the image turned out well with the colors and the shape of the cloud.

Figure 2: Original Image

Sources

"Atmospheric Soundings." *Wyoming Weather Web*. 20 Feb. 2011. <http://weather.uwyo.edu/upperair/sounding.html>.

"Crepuscular Rays." *Wikipedia*. 26 Feb. 2011. <http://en.wikipedia.org/wiki/Crepuscular_rays>.