Clouds 1

Jacob Varhus
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Jacob Varhus
MCEN 4151: Flow Visualization
University of Colorado Boulder

The following paper outlines the processes and procedures used to capture and image of a standing lenticular cloud created by a mountain wave as well as the weather phenomena that created it. Weather charts and Skew-T diagrams are analyzed and compared to what is seen in the image. It then goes into detail of the editing performed to after the image was created.

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I. Introduction

This image was taken to satisfy the requirements of the "Clouds 1" assignment of MCEN 4151 Flow Visualization taught by Professor Jean Hertzberg. It was intended to capture the dominant lenticular cloud caused by a strong mountain wave; however multiple cloud phenomena were also captured in the process. Multiple images were captured on the same day from the same location both of this cloud and of others in the area. This cloud was chosen because of its interesting physics phenomena as well as visual appeal.

II. Image Circumstances

The image was taken just northwest of the Boulder Reservoir from the location marked in Figure 1 by the blue marker. This location has the GPS coordinates 40.08571667, -105.23211667 and an elevation of 5,212 ft. The cloud was located southwest of the shooting position over north-central Boulder. All images were captured around 2:30 PM Mountain Time using a Cannon PowerShot G9 with a circular polarized lens.

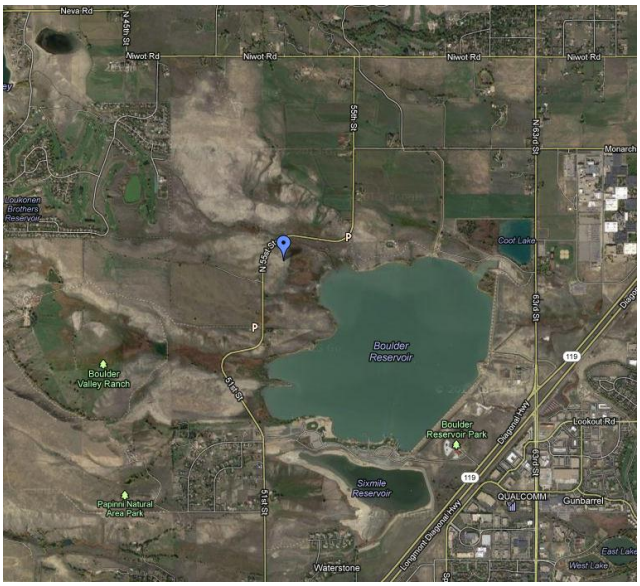

Figure 1: Image Location

III. Cloud Description

The cloud dominating the image is a standing lenticular cloud which has been created by a mountain wave caused by the west wind coming over the mountains. The presence of a mountain wave is further reinforced by the tight cap clouds over the foothills which indicate fast ground winds over the mountains. The puff above the standing lenticular cloud is created by excess moisture that has condensed in the area of low pressure above the dip in the mountain wave and has become trapped between the wave layer and tropopause. Many contrails are visible in the background of the image. These contrails indicate high moisture content in the upper atmosphere.

At the time of image capture the weather was sunny with scattered clouds and winds were moderate out of the west. No precipitation was experienced previously in the day or later in the evening. According to Figure 2 the picture was captured just on the eastern edge of a cold front which explains the strong westerly winds aloft which created the mountain wave.

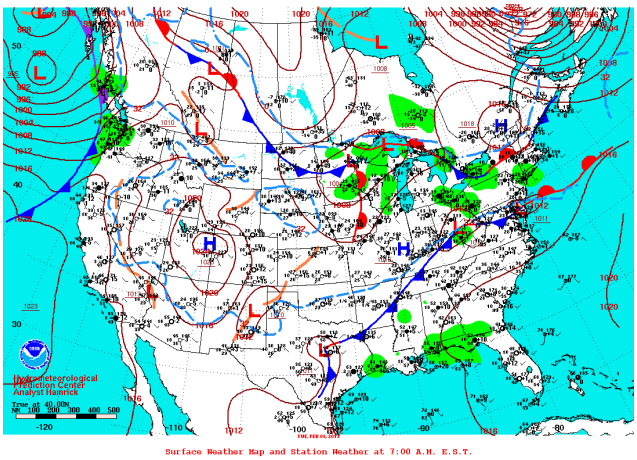

Figure 2: Surface Weather Chart [1]

Inspection of the Skew-T in Figure 3 reveals that the atmosphere was stable as the actual temperature and adiabatic curves are diverging. According to the Skew-T clouds will be most likely to form at an altitude of 6,200 m which is about 20,000 ft. However the cloud imaged has been created by pressure differences created by the mountain wave and is most likely much lower than 20,000 ft.

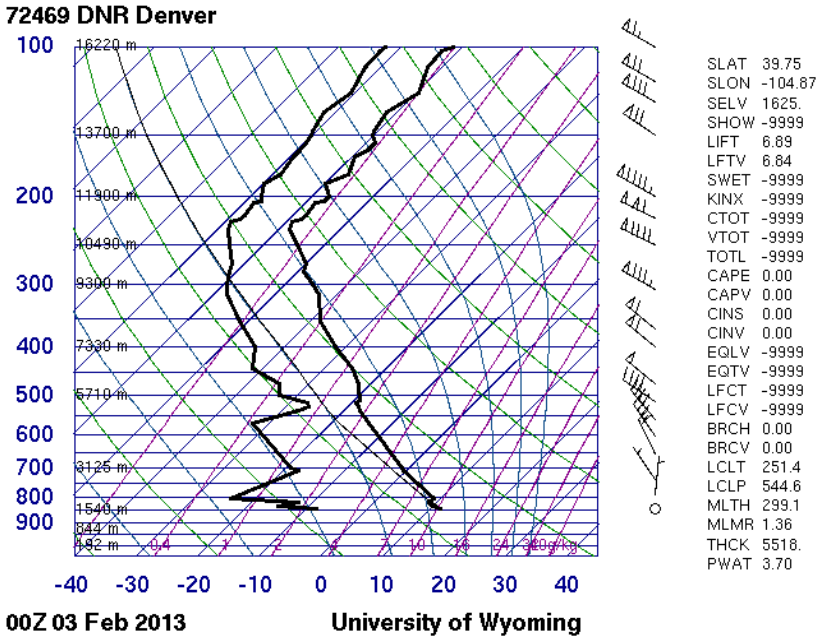

Figure 3: Skew-T Diagram [2]

IV. Photographic Technique

The images were taken with a Cannon PowerShot G9 camera with a circular polarized filter attachment. The aperature was set to its maximum f/8.0 to provide the best depth of field. The focal length was focused to infinity at 7.4 mm. The ISO was set to 100 for high sensitivity, which resulted in a shutter speed of 1/200 seconds. The final image's dimensions were 3877 x 2340 pixels which were reduced from 4000 x 3000 in the original image. Figure 4 shows a comparison of the original and final images.

Figure 4: Original (Left) and Final (Right) Image

The primary adjustment made to the image was cropping and removal of unwanted items. As can be seen in the original image, much of a parking lot was captured as well as the lens filter in the left hand corners. The

bottom part of the image was removed leaving only the foothills for effect. The capture and compare tool was used to remove unwanted fence posts, power lines, and the top of the vehicle from the image as well as to fill in the top left hand corner of the image. After cropping the contrast curves were adjusted to bring out the details in the clouds and bring out some of the colors.

V. Conclusion

In conclusion, the image was able to capture many cloud formations and weather phenomena and allowed for some interesting comparisons with weather data. If the image were to be recreated it would be interesting to attempt to take pictures of the same cloud over a period of time in order to visualize the changes. Also, while processing the image in Photoshop the monitor being used must have been different than others as the image looked very different on that computer than it does on every other. The computer used for editing made the image look much brighter and less grainy.

VI. References

[1] H. P. C. National Centers for Environmental Prediction, "Daily Weather Maps," 5 February 2013. [Online]. Available: http://www.hpc.ncep.noaa.gov/dailywxmap/index_20130205.html. [Accessed 5 March 2013].

[2] U. o. Wyoming, "Department of Atmospheric Science," 5 February 2013. [Online]. Available: http://weather.uwyo.edu/upperair/sounding.html. [Accessed 18 February 2013].

[3] M. J. Moran, H. N. Shapiro, B. R. Munson and D. P. DeWitt, Introduction to Thermal Systems Engineering, John Wiley & Sons, Inc., 2003.

VII. Acknowledgements

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