"Clouds 2"

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Flow Visualization MCEN 4228
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Due April 19, 2006

Context and Purpose

To me clouds can be considered among the most beautiful formations. Unlike the familiar profile of El Capitan in Yosemite National park, the beauty brought upon the world by clouds is not permanent however dynamic, forever changing in response to the earth's atmosphere. The motivation for this second clouds project was to capture and unusual formation of clouds not often seen in the Boulder area. Uniqueness can bring difficulty in capturing unusual cloud formations because of the large time gaps between specific occurrences, however, for this project a bit of luck brought a wonderful captured panoramic of low altitude clouds in Boulder, Colorado.

Background and Theory

Clouds are identified by an international standard based on the physical interpretation of the form of the cloud, strictly visual observation. Different types of clouds are split into three main height categories: Low, middle, high (Houze). The height is based off of AGL (above ground level) meaning that the height is measured from the surface of the earth to the cloud. The cloud featured in this image is considered to be in the low category consisting of clouds below 6600 feet. There are two subcategories in the low regimen: *cumuliform* composed of rapidly rising air currents creating a bubbling and towering aspect, and *stratiform* which are broad sheets of quiescent clouds with little or no vertical movement (Houze). *Stratiform* clouds can consist of fog, stratus, stratocumulus, and nimbostratus types. This photograph resides in two categories including fog and stratus. Fog is defined by a cloud whose base touches the ground including the intersection of a hill or mountain. The cloud is considered fog if the observer is standing within the cloud, in this case a couple hundred feet up the foothills. Fog is formed when a layer of air comes into contact with a cold surface. The second category consists of stratus cloud. Stratus clouds are comprised of a generally grey layer of cloud with a uniform base. Often times the stratus cloud is hard to completely observe from the ground because it creates a large blanket over the area making it difficult to see the upper portion (Houze). The cloud observed in the photograph is focused in a break of the fog/stratus cloud. Behind the observed view was a blanket of grey cloud suggesting that it resides as a stratus cloud.

The physical image was taken facing Northwest while driving along highway 93 about seven miles south of Boulder Colorado. The time was approximately around 7:00 am plus or minus about 15 minutes. The physical flow was moving at an estimated 10 mph taken from the Skewt-diagram given in Figure 1 below.

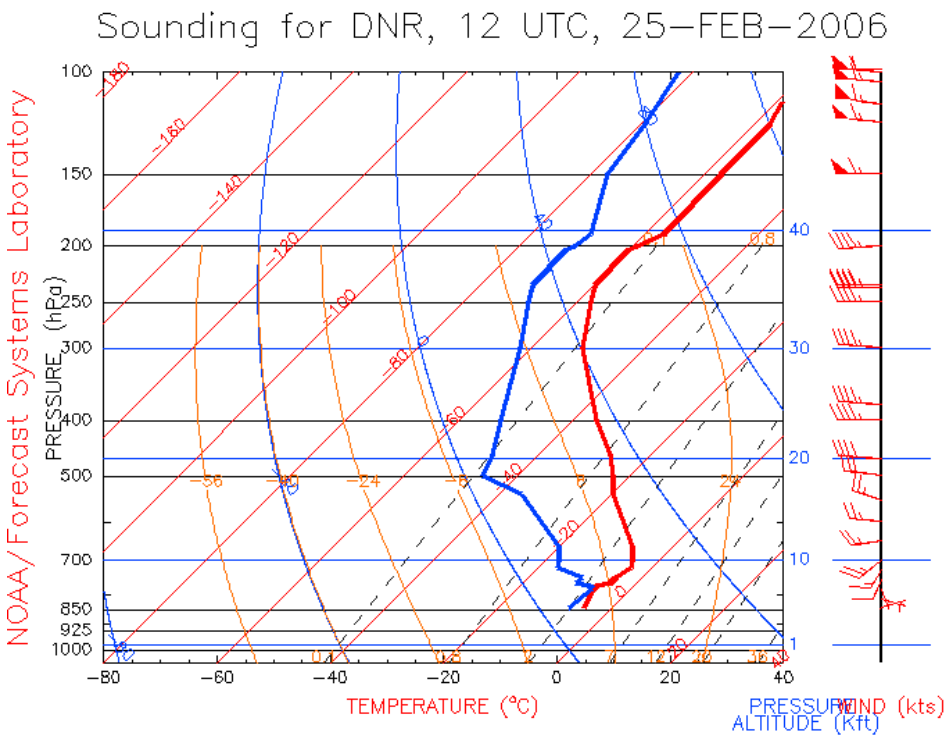

Figure 1: Skewt-Diagram for Denver Colorado[1]

The exposure time was set to 1/400th of a second suggesting that the cloud moved .0326 feet during the exposure of the photograph. To give an estimation of the scale of the cloud the Reynolds number was approximated using Equation 1.

$$Re = \rho V d / \mu \qquad (1)$$

Where,
ρ is the density of the air
V is the velocity of the cloud
d is the orifice diameter
μ is the dynamic viscosity

The Reynolds number calculated using the density calculated from Figure 1 is given to be 472852 suggesting a very turbulent flow. The approximate height AGL of the stratus cloud is 200-300 feet.

Visualization Technique

Techniques used to capture cloud formations are very different compared to within a studio. The technique used to capture the supplied image was fairly simple. The camera was set to focus on infinity to enable the clouds to be in focus. The blanket of clouds shielded the suns natural light making the photograph shallow in tones and contrast. This was compensated for after the shot within Photoshop discussed in the next section of the report. The photograph was taken from a moving vehicle and the time allotted to take the photograph only allowed for the automatic mode of the camera to be used. No external lighting was used to take the photograph.

Photographic Technique

Technique is limited when taking pictures of clouds in comparison to that of more complicated objects within a studio. The use of filters can alter the lighting and change the contrast of the image, but most often beautiful images of clouds come with just taking a plethora of photographs. In the case of this photo, only a few pictures were taken limited by the changing terrain caused by being within a moving vehicle. The technique behind this photograph is attributed to the post photograph editing rather than during the actual time the picture was taken. The photograph turned out to be quite flat in contrast and bland in colors. The picture was edited by first cropping out the foreground of the image to rid of the motion blur of the road and passing fences. The picture was also rotated slightly counterclockwise to make the horizon more horizontal. The auto color, and contrast function within Photoshop were used to help balance out the picture. The levels were done manually to produce the final image.

- Field of view: .6 mile
- Distance from object to lens: ~1500 feet
- Camera: Digital, Canon PowerShot S400 Elph
- Exposure: Aperture F2.8, Exposure $1/400^{th}$ sec
- Resolution: 2560x1920

Image Context and Conclusion

The cloud featured in this photograph was of two types: fog or stratus depending on the orientation of the viewer. From the perspective of the camera the cloud was considered to be stratus because of its blanket like form over the Boulder area. Calculating the Reynolds number suggested that the flow within the cloud was turbulent because of the large diameter and low dynamic viscosity. Clouds of this low height are not common to the Boulder area raising the curiosity of why and under what conditions these very low residing clouds form.

The image taken reveals the uncommon occurrence of low altitude cloud formations in the Boulder foothills. It shows the beauty of the start of the mountains breaking through the blanket of grim cloud. What stands out in the image is the protrusion of the mountains in the break of the cloud. It has a similar encompass affect to that of a circle of light breaking through a blanket of clouds often seen in African landscapes. The intent of this image was a profound success. Not only was the cloud formation unusual to the Boulder Front Range but also turned out to be very beautiful and inspiring.

The downside of taking the picture within a moving vehicle is that more time could not have been taken to setup the camera properly. The shot turned out very well, but I would have liked to setup a tripod and taken a panoramic of the Front Range of Boulder to capture more of the blanketing effect the cloud had. A great aspect of this image is that the panoramic affect was still captured through the use of Photoshop's cropping tool. The definition of the image is high enough that after altering the photo it still holds its clarity.

References

1. Radiosonde Database Access,"United States of America" Feb 25 2006, http://raob.fsl.noaa.gov/.

2. Houze, Robert A. Jr. *Cloud Dynamics*. Seattle, Washington: Academic Press