Cloud 1
Assignment

Christopher Skallerud
March 1, 2006
Flow Visualization

The purpose of this assignment is to observe, photograph, and understand the fluid dynamics of clouds. The setting in Boulder, CO provides an opportunity to see even more fluid phenomena in clouds due to the elevation and near by mountains. For this assignment, the focus was to try and capture some of the effects that the mountains may have on clouds.

The image was taken on February 21, 2006 at 4:15pm and was taken on the roof of a four story building. The cloud was positioned northwest of the building as is passed over the flatirons. From the Skew T plot in figure 1, you can see that the cloud activity would be mostly stable. However, if you look closely at the lower part of the plot, you will see that everything under approximately 2960 meters shows a slight insatiability in the atmosphere. From figure 1 you can also see that the speed of the winds increase as you go farther up in the atmosphere.

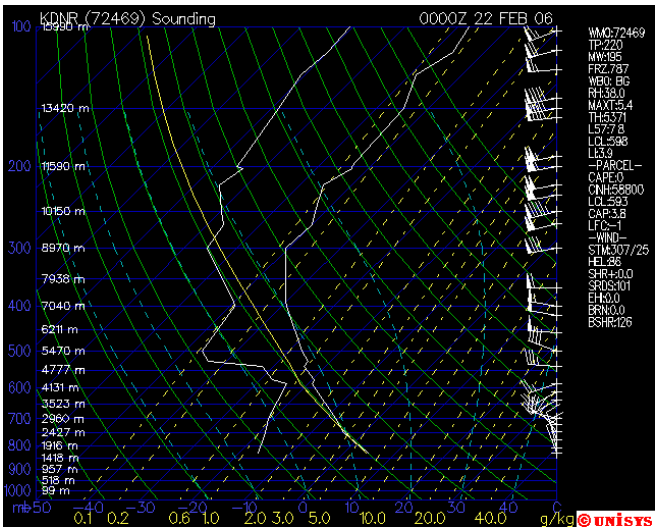

Figure 1: Stew T plot with in 1.5 hours of the photo

When first comparing the Skew T plot to the image of the cloud in figure 2, one would not expect to see a Cumulus type of cloud. Since the Skew T plot shows a stable atmosphere, the resulting cloud must be a result of some mountains effects. This leads to

the conclusion that the cloud in figure 2 must be a mountain wave cloud. The cloud was being pushed over the flatirons from the foehn winds in the mountains. This would make the cloud look more unstable. The mountain causes parts of the cloud to try and tear away. As a result, the farther away from the flatirons the cloud got, the cloud would begin to dissipate. Estimating the height of the cloud and its distance across the ground the depth of field can be found to be approximately 5.66 km. From the Skew T plot the cloud could have an estimated speed of 15.5 m/s. Knowing that the pixel field of view and the aperture speed, we can find the temporal resolution. The temporal resolution shows us that the object will move .15 meters. Since the pixel field of view 2.5 meters, when compared to the distance the object will move, the motion blur will not be a concern.

Figure 2: Final Image of Cloud

The visual technique was to obtain a photo later into the afternoon. In order to take good pictures of for this assignment it was vital to have a clear view of the sky. For this reason, the roof of a 4 story apartment building was used. Sunlight was used as the only means of lighting.

The photographic technique for this case relied on the use of a Sony DSC-P92 Cyber-shot 5 Mega Pixels digital camera and some slight Photoshop processing. The image was taken approximately 5.66 km away from the object with a focal length of 18 mm. The focus for the image had been manually set at infinity. The ISO was set at 100 while the shutter speed was 1/100. The aperture was set at a value of 2.8. The only Photoshop manipulation done to the picture was to adjust the levels.

The image reveals a great fluid phenomena relating how clouds may be affected by mountains. The mountain wave is manipulated into a type of cloud that is unexpected when looking only at the Skew T plot. As a result of this, I would classify the mountain wave cloud in figure 2, as a Cumulus Humilis (also called cumulus fractus) or Stratocumulus. I like the image for its artistic properties as well. Not only can you see an excellent image of the cloud in the sky, but special features were captured that had not been planned to be part photo. The flatirons are a great scale of how close the cloud was to the ground. Also, a Contrail was captured in the picture, but was not noticed until the photo was opened on the computer. The image shows how mountains can affect a clouds fluid flow and in doing so create another fluid phenomena.

References:

1) http://quark.physics.uwo.ca/~lkagan/Lecture%20Notes_files/lect-10.pdf

2) http://weather.unisys.com/upper_air/skew/skew_KDNR.html

3) http://weather.unisys.com/upper_air/skew/details.html

Original Image

Final Image

The Pixel Dimensions - X:2592 Y:1944
Resolution - X:72 Y:72