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Flow Visualization
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Cloud Image 1 Report

The second assignment in Flow Visualization: A Course in the Physics and Art of Fluid Flow asked the student to photograph a cloud. My first intent when considering this assignment was to photograph clouds at either dawn or dusk because of the more interesting lighting available at those times. This proved to be more difficult than I anticipated so I abandoned the idea and instead tried to photograph a cloud directly in front of and blocking the sun. I thought that the sun's rays might illuminate features in the cloud that would be difficult to see otherwise. I also didn't see any similar pictures in the gallery of past year's images so I thought it would be interesting to see what the result would be.

The picture I ended up submitting was taken in the McGuckin Hardware parking lot in Boulder, CO on February 19th, 2011 at about 2:30 in the afternoon. I wasn't planning on taking any pictures in the parking lot but I saw that an interesting cloud was blocking the sun and I had my camera in the car so I decided to take a few shots. The cloud was almost directly overhead and slightly to the southwest. I would estimate the camera was pointing about 80 degrees from the horizontal when the image was taken.

I believe the cloud in the image is either a cumulus humilis or a cumulus mediocris cloud. My best guess on cloud type is cumulus mediocris because of the vertical development of the cloud (note: the vertical development can't be seen in my final submitted image but it can be seen in other images I took of the same cloud). The rest of the sky was fairly clear that day with only a few other small clouds from the cumulus family visible. Previously, the weather had been fairly stable for several days. However, a small front was approaching when I took the image; it rained a little bit the night of February 19th. It also rained a little on February 20th, the day after the image was taken. In the several days before the image was taken I remember cloud cover being sparse. However, there were some cumulus and altocumulus clouds visible in the sky in the days leading up to February 19th. Shown on the next page in Figure 1 is the skew-T plot for 6 a.m. on February 19th. Figure 2 shows the skew-T plot for 6 p.m. on February 19th. The first skew-T plot shows a stable atmosphere. The second skew-T plot also shows a stable atmosphere but it appears that the atmosphere is moving toward instability. Looking at the skew-T plot for 6 p.m. it appears that clouds would be expected around an elevation of 5000 m or 16000 feet (about 10000 feet above ground in Boulder). I observed cumulus clouds which are usually found at elevations of about 1 mile. This slight discrepancy can be explained by the fact that the skew-T plot shows data for 6 p.m. while the cloud was seen at about 2:30 p.m. Based on the stability and the general weather the day the image was taken I would expect cumulus clouds to be seen. Cumulus clouds tend to form on sunny fair-weather days and when I took the image the sky was bright and clear. The clouds I observed on the 19th of February may have been formed by orographic lift. When an air mass is forced upward by a change in land elevation the air cools quickly and the relative humidity can rise to 100% and create clouds. As the clouds I observed were right above the foothills there formation was likely due to the effects of orographic lift.[1]

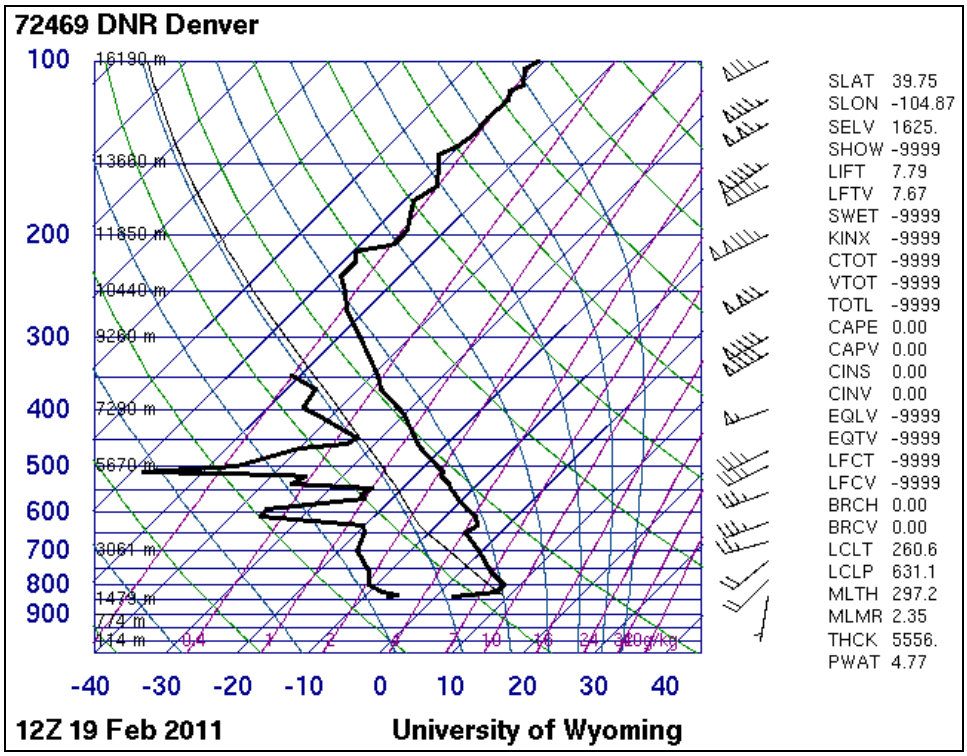

Figure 1: 6 a.m. skew-T

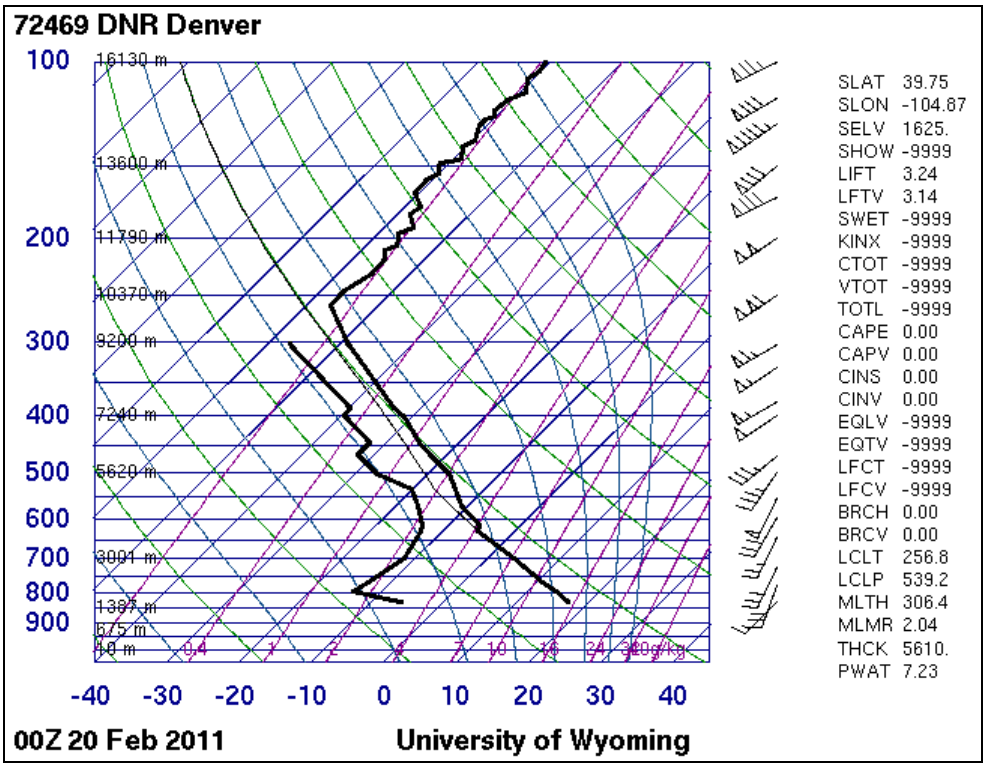

Figure 2: 6 p.m. skew-T

Based on the fact that the cloud was almost directly above me and the fact that cumulus clouds are expected to be found around an elevation of 1 mile I would say that the distance from the cloud to the camera lens was about 1 mile and possibly a little more. The lens focal length was 37.0 mm and the actual lens was an EF-S18-55mm f/3.5-5.6. The camera was a Canon Eos Digital Rebel XTi. The original and final images are both 3888 pixels wide and 2592 pixels high. The aperture value was f/22, the shutter speed was 1/200 sec, and he ISO was set to 100. When taking the image I picked such a high f number because I was looking directly at the sun through the cloud so I knew there would be plenty of light. The settings I had gave a good image but I would have also liked to have taken a few images using a smaller f-number and a faster shutter speed. The original image can be seen below in Figure 3 and the final image can be seen in Figure 4 on the next page. The image was not cropped. The only post-processing done in Photoshop was the use of auto-contrast and the healing brush. I also upped the vibrance on the image slightly to bring out some of the texture of the cloud.

Figure 3: Original Image

Figure 4: Final Image

Because the cloud is directly in front of the sun, the sun's rays are revealing textures and features of the cloud that would be difficult to see if the sun was in another position. I especially like the texture that can be seen in the cloud at the top right corner of the image. Also, although it is difficult to see in this small picture, the sun's rays are creating a faint rainbow encircling the sun. I especially like this effect and may explore it further in my next cloud image. As this image is zoomed in close to the cloud it is difficult to see the overall cloud shape and the physics beyond the cloud formation. It's a bit of a trade off between seeing the overall shape of the cloud and seeing the details and textures of the cloud. If I was to take this image again I might zoom out slightly to reveal more of the overall cloud shape. I would like to develop this idea further by taking pictures of other types of clouds blocking the sun to see if any interesting internal textures or patterns can be revealed. I think, for example, that photographing a mountain wave cloud using this technique would produce some very interesting results. Overall, this assignment helped me get a basic understanding of clouds. Looking up in the sky is much more interesting now that I have some idea of cloud types and the physics beyond cloud formation.

References

[1] *The Cloud Appreciation Society*. Ed. Gavin Pretor-Pinney. Web. 03 Mar. 2011. <http://cloudappreciationsociety.org/>.