Clouds Assignment One

MCEN 4228 – Flow Visualization

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While we can't always see it, there are all sorts of fluids phenomena going on around each of us at any given moment. However, one phenomenon that can often be seen is condensed water vapor above the ground, more commonly referred to as a cloud. For this first clouds assignment, we have been given the opportunity to take an image of any cloud or clouds that catch our attention in our daily travels. Then, after selecting an image, we are to investigate the physics behind our clouds by looking at an appropriate skew-T plot and extracting relevant information from it.

This image was taken on the January 24, 2010 at 4:20 PM. The camera was facing northwest, and was at an angle of about 30 degrees from the horizontal when the picture was taken. In the original image there were mountains at the bottom of the frame, but the mountains were cropped out because I felt they detracted from the image.

The cloud shown in the image is of the cumulus cloud family, and I believe it specifically to be a cumulus fractus. The rest of the sky had similar cumulus clouds as well when the picture was taken. The end of January is generally not a very warm time in Boulder Colorado, however the previous days had been nice and then next few days were nice as well with temperatures in the 40-50 degree range and no snow [1]. Below, Figure 1 shows a section of the skew-T plot for January 24th 2010 at 6:00 PM, less than two hours after the picture was taken. In the original image the cloud was not very high above the tops of the mountains, which are at an elevation of a little over 2000 meters above sea level. Cumulus clouds are generally reside at less than 2000 meters above the ground, which in Boulder is an elevation of 1500 meters. From these reference heights, the elevation of the cloud in the picture is probably about 3000 meters. Looking across at this elevation on the skew T plot in Figure 1, the temperature curve has a smaller angle between it and the horizontal isobars than the dry adiabatic curve does. Also the convective available potential energy (CAPE) is zero. This information indicates stability. For more information on determining stability, see reference number two [2]. The full skew-T plot is shown later in figure 2.

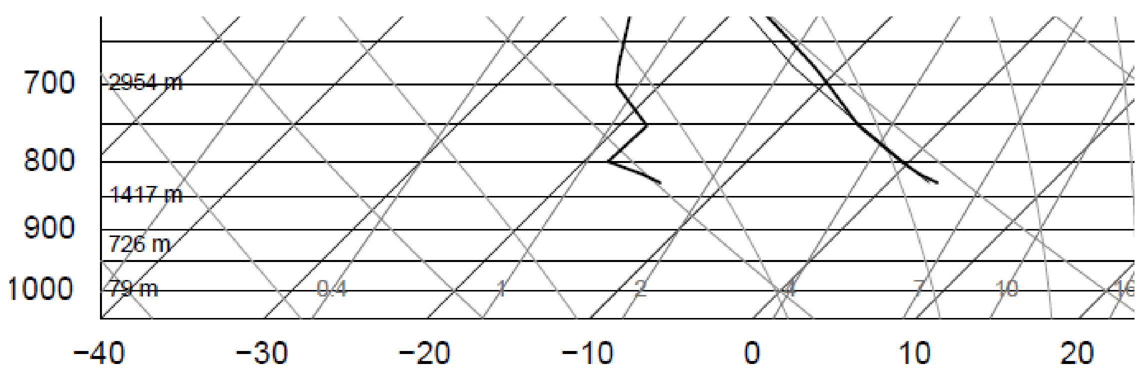

Figure 1

The field of view in this image is estimated to be 1500 meters. The distance from the camera lens to the cloud is about 5000 meters. The focal length of the lens for this image was 9.1 mm. The original and final image height and width were 3648 by 2736 pixels and 2547 by 2736 pixels respectively. A Canon Powershot XS120 IS, classified as a digital point and shoot camera, was used to capture the image. The exposure for this image was at ISO 80 with a shutter speed of 1/1000 sec and an aperture of f/3.2. Adobe Photoshop from CS4 software package was used to manipulate the image. These manipulations included cropping, and boost in contrast and vibrancy, and finally a color inversion. The original image and non-inverted final image are shown at the end of this report.

Clouds are something that most would find quite familiar, so submitting an image showing an ordinary cloud seemed rather dull to me. While editing the image in Photoshop I was experimenting with different techniques and I happened to try inverting the colors. The resulting transformation gave off a post-apocalyptic feel, which some may find dark or depressing, but I found rather interesting. For me, it was taking something ordinary and giving it a surreal twist. Also, the flow physics are still quite visible making the image worthwhile to look at from an engineering perspective. To further this image, I would need a higher quality camera that would allow me to experiment with different colored filters. Ansel Adams achieved the dark skies in his images using filters, and combined with the technology of today I believe an even more unique image could be produced.

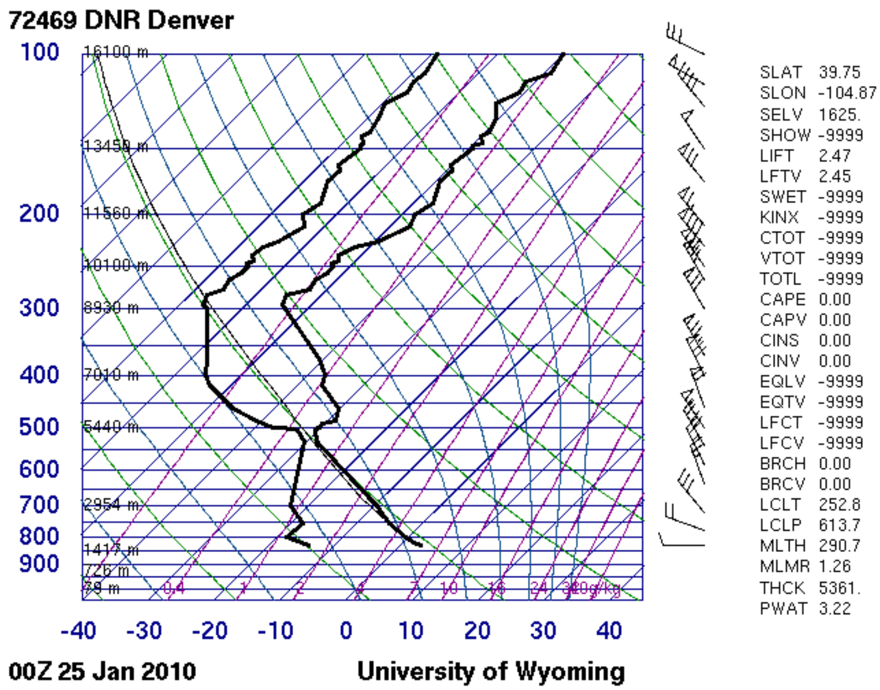

Figure 2

Original Image:

Final Non-Inverted Image:

References

[1] http://www.esrl.noaa.gov/psd/boulder/data.daily.html#Jan10

[2] http://www.atmos.millersville.edu/~lead/SkewT_Stability.html