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Flow Vis Spring 2013

Clouds 2 Report

Figure 1: Image of clouds above Boulder taken at 12:55 PM April. 8th, facing southeast

The photo seen above in Figure 1 is my submission for the second cloud photography assignment in the spring 2013 section of Flow Visualization at the University of Colorado Boulder. The assignment was simply to capture some interesting clouds in a manner that exemplifies some cloud physics. After preparing a whole separate image, I was walking home from class and spotted what appeared to be Kelvin-Helmholtz instability along the top edge of the clouds pictured. This seemed far more interesting than the picture I had taken previously (mountain wave clouds). I do wish that I had been able to get home sooner because even in the few minutes it took me to walk home, the clouds started to dissipate and the phenomenon was less visible.

This image was captured at 12:55 PM on March 8th, 2013. I took it from the 3rd floor of my apartment building, on a balcony, facing southeast. My apartment is located in the heart of

Boulder, CO near Aurora and 30th, for those familiar with the city. The camera was pointed upwards about 15 degrees from horizontal.

There appear to be a couple different cloud types in the image, but the focus of the image is the horizontal line of clouds in the middle of the image with the same repeating formation along the top. I believe these to be altostratus clouds. I base this assumption on a few different things. The convective available potential energy (CAPE) figure on the SKEW-T diagram pictured at right in Figure 2 is zero, indicating a stable atmosphere. Also, this diagram indicates that clouds would have started to form around 4000 meters (~13,000 feet) all the way up to 10,000 meters (~32,000 feet). The clouds lack the appearance of cirrus clouds and do appear to be low in the sky, leading me to the conclusion that they are altostratus clouds which formed between about 4,000 and 6,000 meters.

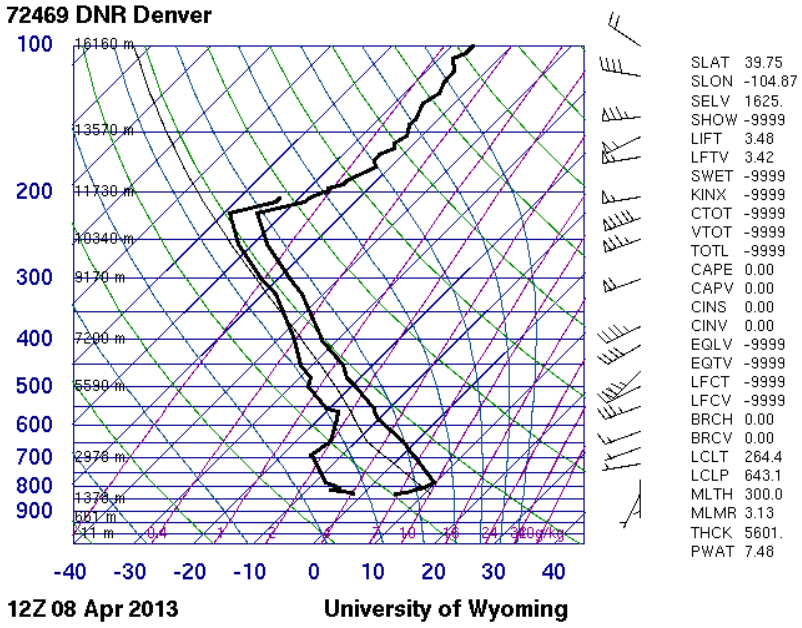

Figure 2: SKEW-T diagram 4/8/13, 6 PM, Denver

The SKEW-T diagram in Figure 2 also indicates the wind was blowing to the east at the altitude of these clouds. This supports my observation of a Kelvin-Helmholtz like phenomenon on the top of the cloud formation pictured. This instability is observed when shear forces induce vortices in a fluid flow. The wind passing over this cloud appears to have formed at least 5 visible vortices of the same shape and size. In the minutes before I could capture this image, the instability was even more visible.

I took this image with a Canon EOS Digital Rebel XS in aperture priority mode with the following settings:

- Shutter Speed: 1/1250 second
- Aperture: F/8
- Focal Length: 41 mm
- ISO Speed: 200
- Flash: No
- Exposure Bias: 0

The final image was 3888x2592 pixels, which provided more than enough resolution to observe the phenomenon I was looking for. The field of view here is quite large. The full image has multiple building in it, to give an idea of scale. My best estimates (based on shadows of other clouds in the sky) are that this is a very large cloud, possibly a mile long or more. I did not do much to the image in terms of post processing. My only goals were to bring out the details white cloud against the blue sky and I did so by adjusting the contrast, brightness, and tone curves using a free program called RawTherapee.

Overall, I am not as happy as I could be with my capture of this particular cloud phenomenon. It is a great example of the old adage: timing is everything. What I saw was a very defined line of identical vortices in the sky, what I photographed was but a shadow of this. Still, it is a very interesting image and I will always be looking for this phenomenon now. I think I achieved the goal of the assignment by showing some interesting cloud physics; I only wish I could have captured this instability sooner. To develop this idea further, I might try and learn where this phenomenon is more likely to occur and time my photo shoot better. In this case, it is probably better to be good than lucky.