Clouds Two

Zack Stein
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MCEN 5151

Introduction

The purpose of this assignment stemmed from the course's lessons on atmospheric conditions and specifically clouds. We were asked to capture and analyze a cloud formation captured between February 19, 2014 and April 8,2014. The directions for clouds to capture were completely open-ended and allowed us to study many different formations before having to choose an image to capture. I took my capture early in this time period and was thrilled with the wide panoramic that I was able to capture from the top of the CU Engineering Center Tower. Boulder often has highly varied cloud formations due to the close proximity to the mountains.

Image Circumstances

The captured image was taken on March 10, 2014 at approximately 8:45am. I was riding my bicycle up to CU's campus when I caught glimpse of the beautiful wave cloud that had formed over the mountains. I felt that the way the sun was hitting the mountains from below the cloud layer really added something to the image and definitely help to contrast with the dark clouds above.

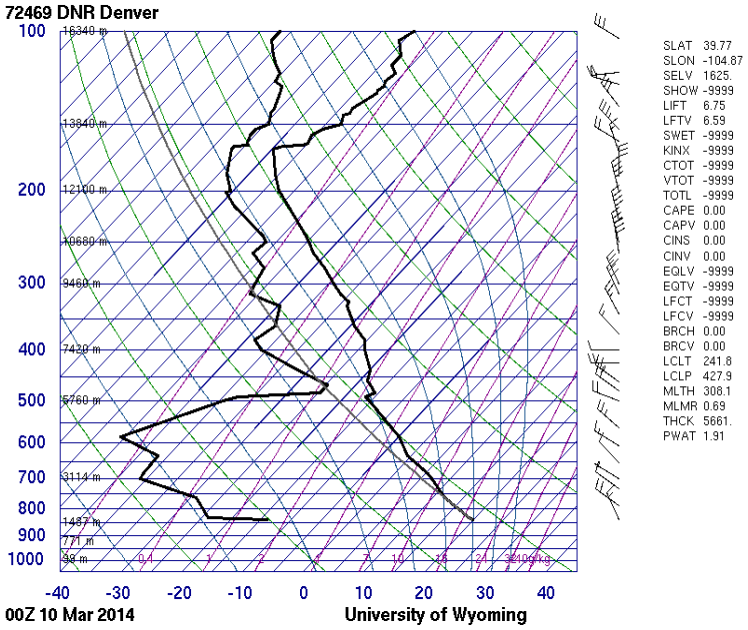

Figure 1- Skew-T diagram for 6am MST on March 10 (Oolman, 2014)

Cloud Analysis

In order to properly analyze the cloud formation seen in this capture, I used multiple resources to get the most complete understanding of the physics behind the image. Two of the first things I did to begin understanding this image was to get a copy of the skew-t diagram for Denver, Colorado on the morning of the 10th as well as the weatherspark history for March 10th. These two resources allow us to gather some basic information that the atmospheric conditions and temperatures for Boulder that morning. One thing that I found interesting was the lack of readings on cloud cover from weatherspark. As a result, I used cloud ceilometer data from CU's atmospheric research department. This can be seen in Figure 3 where it can be seen that there was cloud cover seen at approximately 5500 meters above the ground. From these resources, one can begin to gain a better understanding of the cloud formations being observed. From these resources and reviewing the captured image. It can be

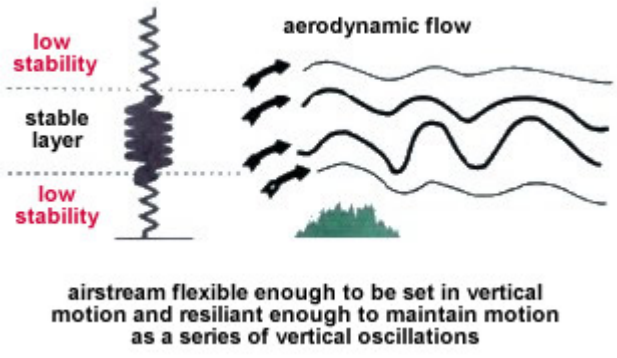

Figure 2 - Lee Wave Formation Diagram (PILOTFRIEND, 2000)

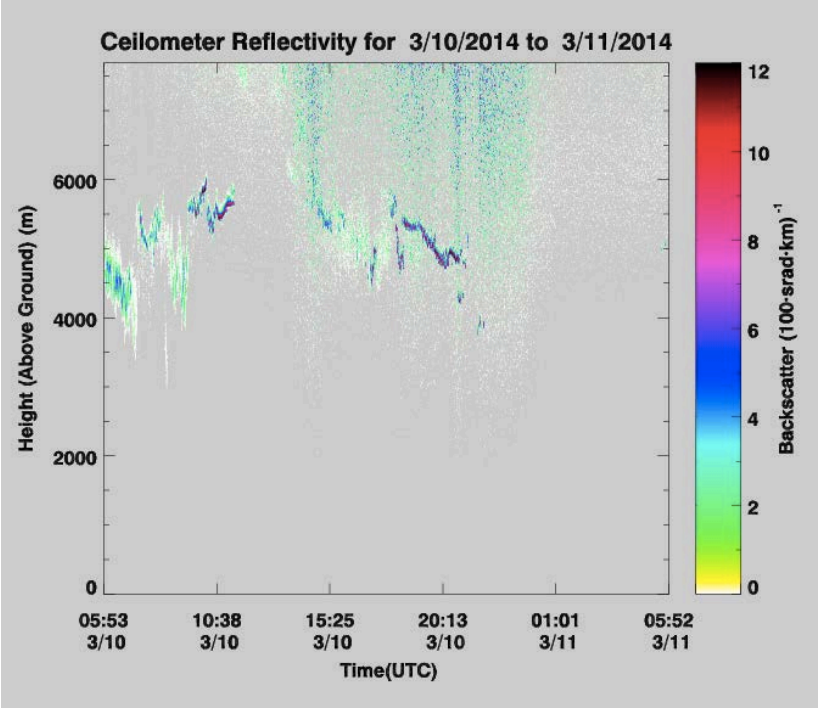

Figure 3-Ceilometer Reading from Boulder Colorado (Department of Atmospheric and Oceanic Sciences, 2014)

becoming denser, it begins to rush downward due to natural convection. In turn, a turbulent region of air is created. The combination of these two phenomenon together creates a region of turbulence just past the mountainous region as seen in the captured image. This region is known as a rotor (Heise, 2010). The rotor region can be seen at the very end of the clouds where there is an obvious turbulent region. This cloud type, the lee wave clouds, can often be seen in Boulder due to its close proximity to the mountains with a valley located just on the other side of the Indian peaks.

Capturing the image

Since this image was captured on my way to school one day, I was not as prepared as I would liked to have been. As a result, I had to use my IPhone's camera. While it does not take completely awful images, it was far from ideal. In order to get a better overall picture, I decided to use multiple exposures and stitch them together using Photoshop. The camera's settings were approximately (each photo has slightly different values) as follows: Focal Length 4.2mm, f-stop 2.4, ISO 50, Exposure 1/600. These settings were used to produce the photo seen in Figure 4. The field of view for this photo is

concluded that the clouds seen are what is known as Lee wave clouds (Heise, 2010). These clouds are formed when winds hit a mountain within a partially stable atmosphere. The stable and unstable layers of air act like strong and weak springs that create vertical oscillations within the atmospheric layers as seen in Figure 2. The rapid rising of the damp air forms these clouds over the mountain where the moisture condenses into a cloud (Ka-hon, 2012). Once the moisture is no longer within the air, the dryer air cools more rapidly due to the lower heat capacity. With the cooler air

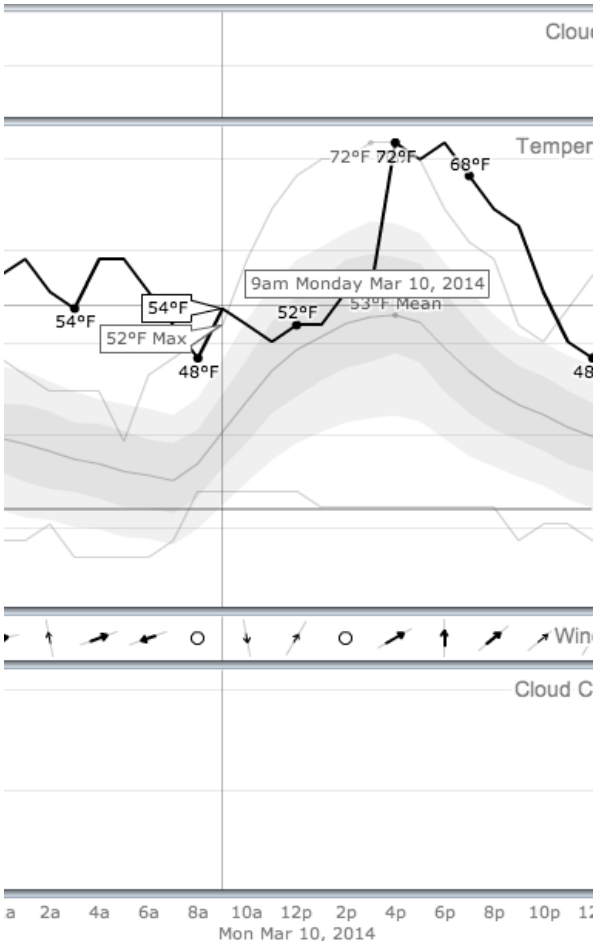

Figure 4 - Weatherspark screenshot for January 26 (Diebel & Norda , 2014)

somewhat difficult to determine due to the large variation between the foreground and the background. The mountains can be seen in the distance and span for more than 5 miles. The subject of the image, the cloud is more than likely about the same distance as the mountain span of around five miles. The cloud spanned from the top of the frame all the way to the mountains making for a cloud with a length of approximately 5 miles to the edge

Figure 5 - Original Pre-processed image

seen in the figure. After taking the image, a small bit of post processing was used in order to ensure that the exposure differences between the images is not apparent. I also used the sharpening tool to increase the sharpness as the window that I had to take the photos out of was slightly smudged creating an out of focus image. The sharpening removed the majority of the issues in this regard. Besides these two things, I only increased the contrast in order to make the mountains and clouds stand out more significantly from the bright foreground of the university.

Final Thoughts

While I was not thrilled to be capturing the image with my iPhone, I am most definitely satisfied with the final photo. I think that creating a panoramic helped to remove some of the setbacks with using the iPhone. While the lighting and focus were not completely perfect with the original image, I was able to do enough post processing to create an image that is well framed and offers a unique capture of the bright foreground with a deep intense set of rotor clouds above. I am glad that I was able to capture the sun at the perfect position in order to illuminate the foreground just perfectly while also allowing for enough light to see the cloud layer with great detail. Overall, I am thrilled with the composition of the photo since it brings together such a varied set of colors and subjects.

Works Cited

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