Clouds First: The Misty Mountains

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Cumulonimbus/Stratocumulus

Image Taken: 30 Aug 2018 7:30pm – Fairplay, Colorado

Introduction

The image associated with this report was taken as a result of the "Clouds First" assignment for my Flow Visualization class at CU Boulder. The purpose of this assignment was to capture our first in a series of cloud images and in the process become familiar with types of clouds, as well as the physics behind clouds. As soon as I learned of the assignment, I started taking pictures of every cool cloud formation I saw, with whatever camera I had on me. The image shown in this report was actually taken with Samsung Galaxy 9 mobile phone camera, as I was driving back to Boulder, CO from my hometown of Durango, CO when I saw the pictured formation. The reason I chose this photo over many other photos taken with a nicer camera, is that it is the only image I was able to capture that did not contain a single man-made structure or object.

Background

As mentioned previously, this image was taken just outside of Fairplay, CO, headed Northwest towards Denver, CO. I took the image around 7:30pm on August 30, 2018 so the sun had just barely set behind the mountains (sunset was at 7:36pm technically), and the sky was beginning to darken. The weather on that day was fairly tame but heavier and heavier clouds had been developing all day. The image was taken from the highway with the shot angled parallel to the horizon and pointed roughly North/Northeast.

Cloud Types

The clouds seen in this image are most likely a combination of cumulonimbus and stratocumulus clouds, with the cumulonimbus being the dense cloud wall on the left and the stratocumulus being the thinner, higher cloud on the left. The first indication that we are seeing a cumulonimbus cloud is that we have a low but towering cloud structure that also reaches to the ground. The tendrils of cloud that can be seen reaching down almost into the trees is actually rain, as seen from a distance, confirming that this is in fact a storm cloud, or cumulonimbus cloud. Cumulonimbus clouds are often formed by a cold front coming through and pushing the warm air up, creating an unstable atmosphere. This is almost definitely what we are seeing here, as the Figure 1 below (taken above Denver) shows very cold temperatures above Denver with strong winds blowing south-west, towards Fairplay, which is exactly where this picture was taken. These cold winds were likely met with updrafts off the mountain, accelerating the accent of the warm air and rapidly forming a wet, dense bank of clouds over the mountains.

With cold fronts it is also common to see stratocumulus clouds just ahead of the front (which would be further southwest, or to the left, in this image) where the atmosphere has not yet become completely unstable. Without the same mass of upwards flowing warm air, as is found directly over the mountains, the clouds to the left in the image have had a chance to cool off on top, while remaining warm underneath. This mismatch of temperatures leads to unstable

conditions and forms your classic stratocumulus clouds. These observations are backed up by the fact that as we drove closer and closer to Denver, the sky became increasingly populated with clouds, although it is hard to say what sort of weather conditions followed the capturing of this image as we were only driving through.

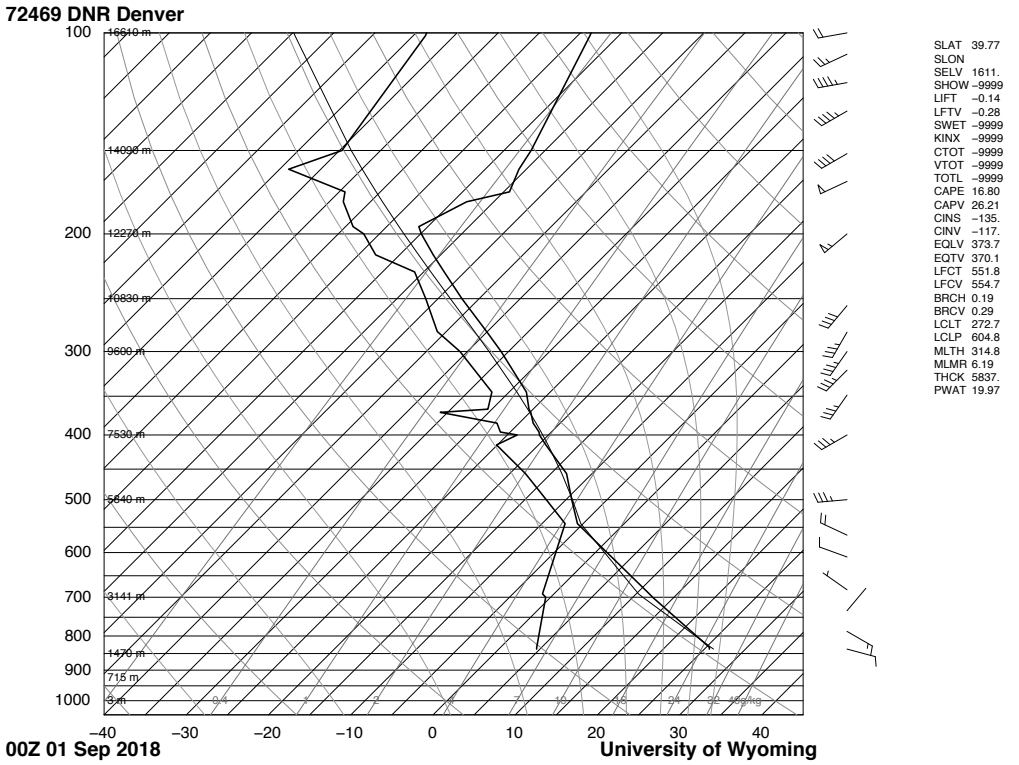

Figure 1: Skew-T of Atmosphere Above Denver, CO

Again referencing Figure 1 above, we can see that the atmospheric temp vs. altitude line (on the right) very closely follows the dew point line (on the left) for a large range of altitudes, starting around 5,500m, all the way up to around 11,500m. This indicates a large range of altitudes at which clouds are liable to form and that they may start forming at a relatively low altitude. This aligns well with the estimation of cumulonimbus and stratocumulus clouds being evident in the image as cumulonimbus clouds typically form at very low altitudes but stretch all the way up to the highest cloud forming altitudes while stratocumulus clouds generally form at the same altitude as the base of cumulonimbus clouds. This is exactly what we are seeing in the image, which most likely puts the stratocumulus cloud and base of the cumulonimbus cloud at around 6,000m with the very top of the cumulonimbus cloud sitting at around 10,000m.

Photographic Technique

This image was taken from the road, looking out over the mountains to the North. As mentioned before I was driving through Fairplay, Co when I noticed the pictured cloud formation over the mountains and decided to stop and capture it. I chose this image over a number of others that I took of the same formation as I felt it best encapsulated the transition

of the dense cloud wall hanging low over the mountains to the higher floating clouds further ahead of the front. I would estimate that the first row of hills is roughly two miles away from where the picture was taken and the larger mountain range in the background is roughly ten miles away. The image was taken with a Samsung Galaxy 9, Model SM-G96OU and the settings were as follows; Focal length: 4.3mm, F#: 1.5, ISO: 160, Shutter Speed: 1/94s. The original and edited image share the same size of 4032 x 1960 pixels.

All of the postprocessing was done in Photoshop CS5, although I did not do a ton of editing as I found it was very easy to loose information from the edges of the already light clouds. The bulk of the editing I did was to edit out the car and road in the foreground and then darken the mountains so that they were more of silhouettes and did not take away from the clouds. I upped contrast slightly and reduced brightness and white balance in an attempt to reduce the white-washing from the setting sun on the left side of the image. The last thing I did was to apply a blue overtone to the image to give it a "mystical" look. I toyed with drastically changing the color of the clouds for dramatic effect, as the pure white of clouds lends itself well to such changes, but decided to keep the image more realistic. I have included the original, unedited image below for reference.

Unedited Image

Reflection

Overall, I really like the way this image turned out. I think it is a strong demonstration of what a cumulonimbus cloud is supposed to look like and was excited to realize how well it follows the expected cloud physics after doing some research. I am curious to see what the actual sounding data for this region looked like on this date, as the data I have is for Denver but I feel I was successful in extrapolating accurate information from that data.