The Photography of Clouds

Isis Peguero

October 16, 2015

The purpose of this assignment was to photograph clouds in hopes of capturing an extraordinary cloud. Because the amount and type of clouds in the sky vary each day, it was important to take as many pictures as possible. The purpose of my image was to capture nearby clouds as well as clouds in the horizon. I really enjoyed seeing different types of clouds in layers and in different parts of the sky. I also attempted to make the colors of the sky stand out. This was done by photographing clouds that were mostly white but still showed some shades of gray.

My image was taken from the eighth floor of the Engineering Center Office Tower balcony. On September 1st at around 6 PM, I was meeting my with my senior design team and as I looked outside I noticed that the clouds looked amazing. I had my camera and decided to take a few images. I attempted taking pictures at different angles and facing different directions. In most of the images that I captured, I was facing north and could not see the horizon, just the sky. This picture stood out to me because of the wide range of colors in the clouds. While looking at the horizon in my image, I realized that I was facing east and the Sun was behind me. Although you are not able to see the Sun in my image there are some anticrepuscular rays, which are rays of light from the sun that stream through cloud gaps. You can also tell that the clouds look very close to where I was standing. These clouds were at about 6000 feet from the ground. Considering I was on the eighth floor of the tower, I would estimate the angle to be about 35 degrees from the horizontal.

Most of the clouds in my image are stratocumulus clouds. Stratocumulus clouds are in low layers, they are typically at altitudes that range from 2000-6500 feet. They are clumpy and often vary in whites and dark gray colors and are continuous but have gaps in between them. The shape of the clouds are also well-defined at the base [1]. The weather on September 1st at 6 PM was about 82F and there was a wind of about 4.7 mph coming from the northeast [2]. There was no front approaching or chance of rain. The weather was very similar the day before and the day after. Clouds were present on August 31st but not many were present on September 2nd [2]. By looking at the skew-T diagram in Figure 1, we can see that there is a CAPE of about 340. This CAPE value is non-zero which means that there were unstable layers present. By looking at the skew-T diagram, we also see that for lower altitudes, the parcel line and the temperature of the atmosphere are overlapping. At around 4000 meters, we see that these two lines separate. As we move on the adiabatic line, we see that the parcel temperature is warmer than the atmospheric temperature. This means that there is a layer of unstable clouds. As we move higher in elevation, we see that the two lines cross each other and that the parcel temperature become colder. This happens at an elevation of about 10000 meters. At this elevation, we have a layer of stable clouds. We can also see where clouds are likely to form by looking at the skew-T diagram. This happens when the dew point temperature and the actual temperature are close to each other. We see that this happens at about 5000 meters. With these layers of stable and unstable atmosphere, we can expect stratocumulus clouds and that is what I have captured in my image.

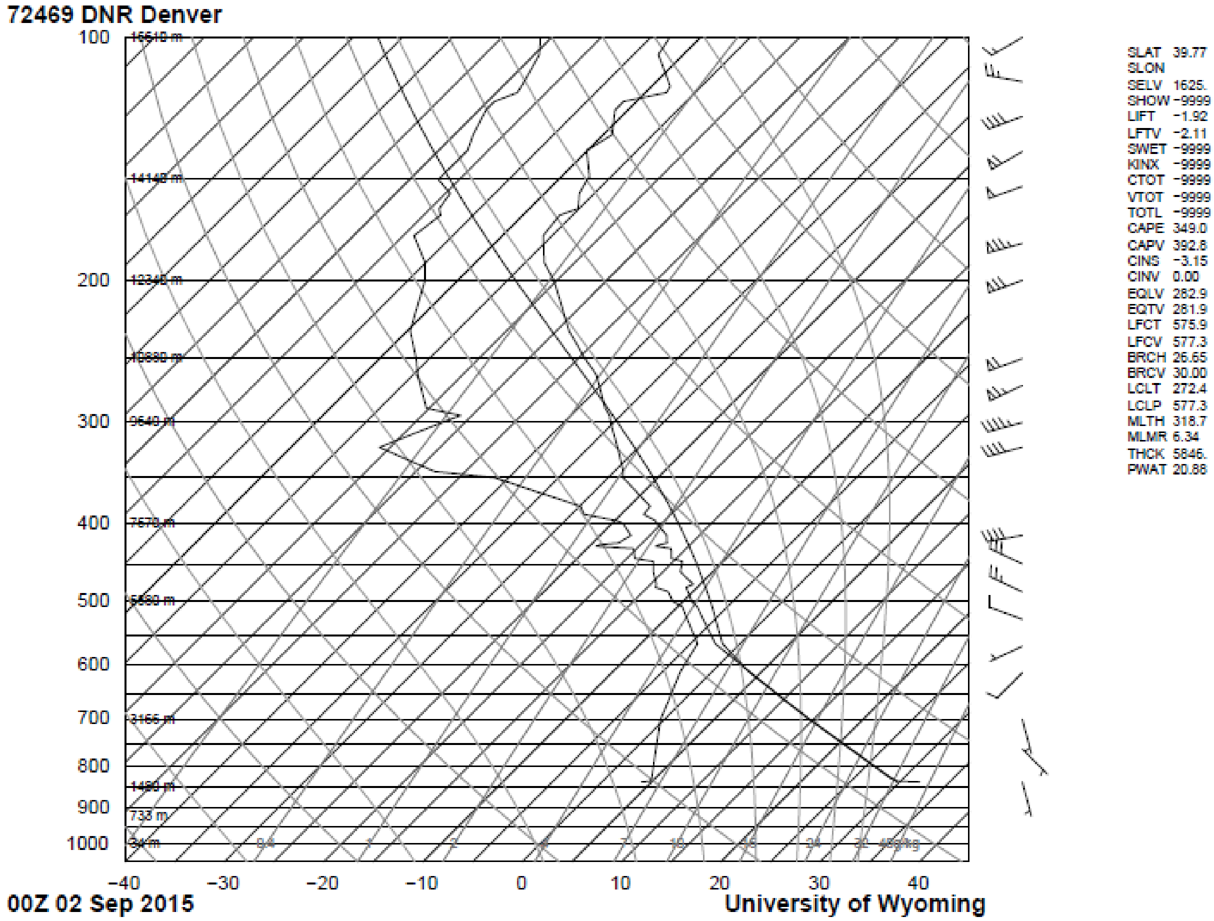

Figure 1: Skew-T Diagram for September 1st, 2015 from Denver, Colorado

Stratocumulus clouds form when there is a temperature inversion in the atmosphere. In most atmospheres, air gets colder with height but this is not the case with a temperature inversion. In this case, the air in the atmosphere gets warmer or remains at a constant temperature with elevation gain. Weak thermal currents then travel from the surface of the Earth to the clouds and stop moving vertically at the bottom of the temperature inversion. The currents then move horizontal along the clouds and this causes the cumulus clouds to spread and create altocumulus clouds [1]. The Reynold's number for a cloud is rarely laminar because of the size. The exact number can be calculated by using the following properties of density of 0.5 g/m^3. The viscosity of clouds can be estimated using that of water, 0.000894 Pas. The speed can be estimated to be the wind speed at that time of the atmosphere, in this case 4.7 mph, or 2.1 m/s. The size of this cloud will be estimated as 5 miles, or 8047 meters horizontally. This was calculated by taking the north-south distance from the Jennie Smoly Biotech Building to the Valmont Power Plant and using it as a scale for the entire image. Using these values, we get a Reynold's number of

$$Re = \rho v L/\mu$$

$$Re = \frac{(0.0005\frac{kg}{m^3})(2.1\frac{m}{s})(8047m)}{.000894Pas}$$

$$Re = 9451$$

This Reynold's number is larger than the critical 4000, which confirms that the cloud is a turbulent flow due to its large size.

The image is most at focus on the clouds at the top front. The power plant that is seen in the distance is the Valmont Power Plant and it is about four miles from the Engineering Center Office Tower. We can estimate the distance from the clouds to the lens by using the angle from the horizontal of 35 degrees and the distance of the clouds from the ground from the skew-T diagram of 5000 m. Using trigonometry, we find that the approximate distance from the clouds to the lens is about 8717 meters. The camera that I used for this was a Nikon P510 which is a digital point and shoot. The original images are taken at 4608x3456 pixels and it was not cropped. The focal length of my lens ranges from 4.3-180 mm. The f/-number of the camera lens ranges from f/3-5.9. In my captured image, the aperture was F3.2, the ISO was 100 and the shutter speed was 1/1250 of a second. This shutter speed combined with only the slightest movement made for a sharp image. In post-processing, I adjusted the curves by making an S-curve in order to bring out the blues and dark grays in the clouds. I also did this to make the crepuscular rays more visible. I also adjusted the contrast a little bit to make the image sharper.

I really enjoy my image. Looking at clouds is something that I've always enjoyed but I never really thought about photographing them. I believe this image does a great job of capturing the different layers of clouds and how cloud types can vary with altitude and distance. I believe that the different colors of clouds in the image do a great job in describing stratocumulus clouds. I also really like that the horizon is visible in the distance of my image. I like that there is enough Earth to give perspective to the height and distance of the clouds. In my critiques, there were a few comments suggesting that I crop out or edit some of the features at the surface of the ground but I believe that these features, such as the power plant, add even more perspective to my image. I truly enjoyed photographing this cloud and I believe I learned quite a bit about how stratocumulus clouds are formed. I will now look at stratocumulus clouds and feel good knowing that I have some knowledge on how they are created. Upon starting this project, I really wanted to capture some images of clouds during sunset. The few times I attempted, there weren't enough clouds to capture the image that I really wanted. I wanted to do this because of color, I was very excited to see what colors the clouds would bring out. For my next image, I will try to get more colors, weather it is during sunrise or sunset.

[1] Pretor-Pinney, Gavin. *The Cloudspotter's Guide: The Science, History and* Culture of Clouds. New York: Penguin Group, 2006, Print.

[2] "WeatherSpark Beta." Beautiful Weather Graphs and Maps. Web. 1 Sept. 2015.