CLOUDS SECOND

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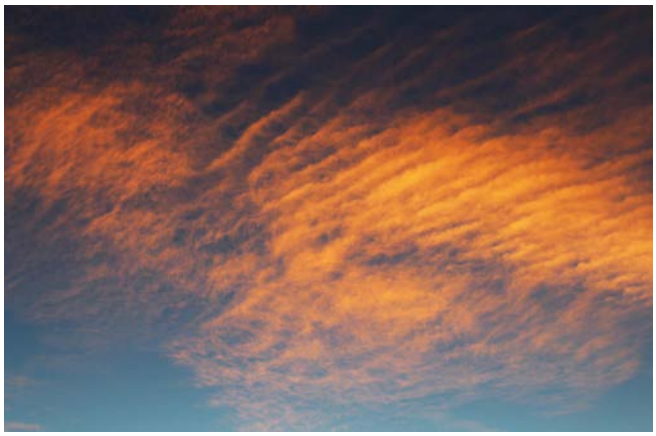

ABSTRACT

In this paper we shall look at how the above image was taken as well as the science behind the formation of these clouds typically occurs. The overall desired result of this piece was to successfully capture a unique cloud formation that is visually appealing. There were several conditions that improved the overall quality of this picture that includes the weather patterns that occurred around the time of this image as well as the colors that were inherent in the sunrise that morning.

Flow Visualization

The use of dynamic motion in photographs has always been interesting to people. This could possibly be due to the fact that the inherent qualities of a still image of a flowing process lends to the imagination of the viewer in such a manner as to make him or her feel like the picture is moving. Flow visualization is the process of making the physics of fluid flows (gases, liquids) visible [1]. In this paper we will explore how a still image of clouds near sunset can represent itself in such a way to display the flowing inherent dynamic nature of clouds.

Clouds

Clouds form when water vapor condenses into droplets and the surrounding air environmental conditions are in such a state as to allow the water vapor to be sustained in humidity. Clouds usually occur in either stable or unstable atmospheres. In stable atmospheres clouds occur at either high level, midlevel, or low level altitudes. In the high level altitudes clouds are called cirrus, which are typically thin and can reach heights of 20,000 feet [2]. As shown in Figure 1 there are sub categories within the larger Cirrus identification, which include cirrocumulus and cirrostratus clouds.

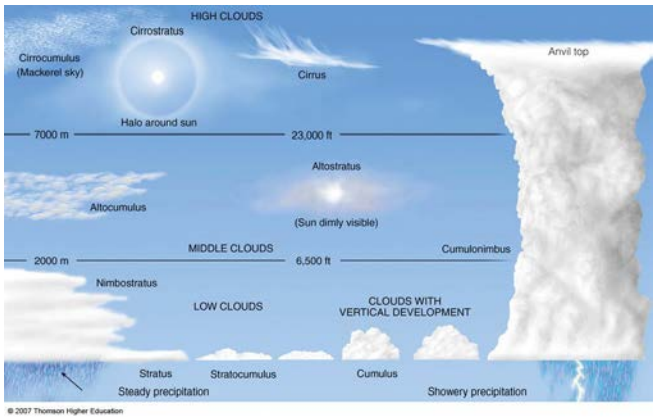

Figure 1: Cloud Types

The clouds that were in this piece were mainly altostratus undulatus clouds. These clouds usually form at an altitude between eight to twenty thousand feet. The undulatus refers to the wavy appearance of the clouds. Clouds form when the water vapor from a given source, usually from the evaporation process that occurs in large bodies of water, has something to attach itself to. This process allows the vapor to transition from a liquid phase to a solid phase, which a number of particles commonly called condensation nuclei or freezing nuclei can act in this function [5]. The clouds that are shown in this piece are essentially just a large collection of these condensation particles, which make up the majority of all clouds. In addition to the consistency of clouds, the clouds like the altostratus undulatus ones shown in this piece have a wave appearance where there are particles in higher and lower altitudes. These types of clouds occur usually in stable atmospheres and usually before an unstable atmosphere comes into the area. They are the result of pressure and temperature differentials that force air to carry varying amounts of condensation in a wave like pattern.

The local atmosphere was mainly stable which confirms the information that is contained in the below Skew T plot that was taken at Denver International Airport.

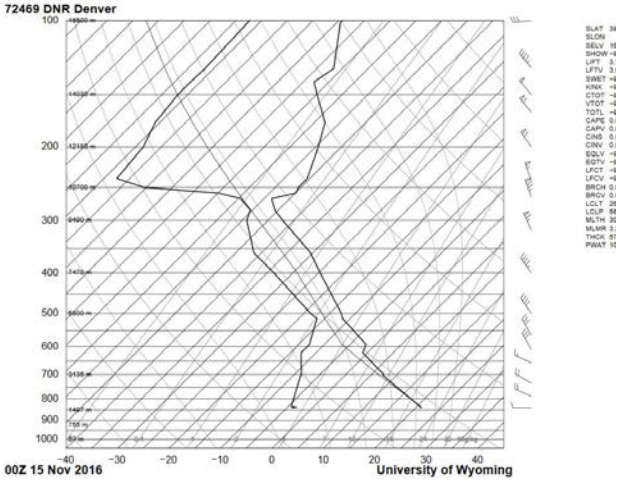

Figure 2: Skew T Plot – November 15, 2016

As it can clearly be seen in Figure 2 at 00Z on November 15, 2016 the atmosphere is stable. This is determined by looking at the 0.00 CAPE value that is on the right side of the plot. This measurement was taken several miles East of where the picture was taken, which indicates that this picture was captured in a stable atmosphere before a weather system was moving into the area.

Set Up

To capture the picture a system was set up to establish a set of stable conditions as to which a quality picture could be captured.

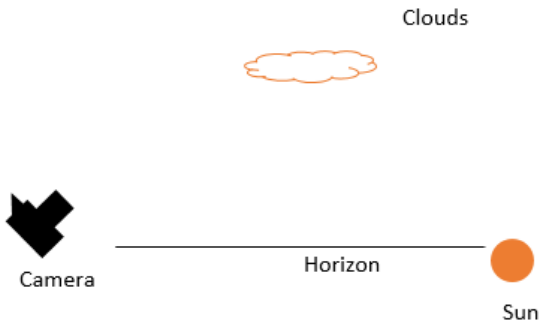

Figure 3: Picture Set Up

The camera was held in hand and pointed Easterly at approximately 7:40 AM which is near the end of the sunrise. The use of a stabilizing accessory such as a tripod was not needed because the clouds at this point were not moving too quickly and a high exposure time was not needed. The location that this picture was taken in was near the engineering center parking lot near Colorado Ave and Regent Dr in Boulder, Colorado. This location allowed for an adequate amount of the clouds that were the focus for this piece to be captured unobstructed by too many buildings or utilities.

Camera Set Up

The camera was also set up in a specific way to capture as much of the contrasting color and brightness as possible. The camera that was used in this piece was a Canon EOS Rebel T6 DSLR with an attached 18-55 mm lens. The lens attachment that was used was adequate due to the fact that the clouds were close enough that a lot of zoom was not needed. There were 4 main manual features on the camera that were used to maximize the quality of this picture. These features were the aperture (f stop or f/number), exposure time or shutter speed, ISO, and the exposure bias.

The aperture on a camera refers to the size of the opening in the optics which light passes through to capture an image. The size of the aperture is one of the major factors that affects the depth of field for any given image. With a small f stop the subject stands out and the background is blurred. The aperture stop is typically referred to as the f stop, which is a ratio of the attached lens's focal length to the diameter of the aperture opening. The range of f stops for the camera used ranged from f/3.5 to f/36. For this picture an f/stop of f/7.1 was used which is not particularly small but did allow an adequate amount of light into the camera to capture the desired details.

The shutter speed, also referred to as the exposure time, is the amount of time that the shutter is open when taking a given picture. This is important when considering whether the desired target is moving at a fast or slow pace. For a relatively slow moving object like a cloud moving across the sky a relatively fast shutter speed isn't necessary but it is quite helpful when trying to capture as much of the flowing cloud detail as possible. The range of shutter speeds on the camera used went from 1/4000 to 30 seconds. However, one drawback of utilizing a faster shutter speed is that it lets less amount of light into the camera. For this reason, a shutter speed of 1/100 of a second was used to balance the levels of light as well as the desired detail of the clouds.

The ISO sensitivity refers to how sensitive the camera film or in the case of a DSLR how sensitive the sensor is to the incoming light. ISO stands for International Standards Organization and this value just

refers to how sensitive the sensor is to a given value of incoming light. For the camera that was used the range of the ISO sensitivity went from 100 to 6400. This value is extremely important when taking pictures at relatively high level light conditions that the source light is not direct but being reflected off of the clouds. To balance the amount of light that was coming in with the details in the background and on the clouds an ISO of 100 was used. One drawback of using such a low ISO is that it can sometimes be too dark or not be able to capture so many different colors, but for this piece the ISO level that was used allowed enough light to come in to be able to capture as much detail and color as possible.

The final manual feature that was used was the exposure bias, which refers to the feature that allows the user to manually adjust the exposure that is measured by the camera's light meter. On the camera that was used to take the picture this ranged from -3 to 3, but an automatic setting was used. This is because on an artistic approach I as the artist didn't like what the over exposure and underexposure results were.

DISCUSSION & CONCLUSION

The desired result of capturing clouds during a sunrise with good detail was for the most part successful. The capturing of saturated colors of clouds in focus is what I as the artist desired and achieved with this piece. In future iterations of this type of work I would like to combine the successes I found in this piece with more interesting cloud types and shapes. This is because I personally found this cloud type to be a little mainstream. To this end I believe that further planning on my part to attempt to time the capturing of images with the weather would be helpful. Another possible improvement would be to explore in more depth with using the background of mountains or trees to give the viewer a sense of scale of the clouds that are captured. Overall I believe that I successfully achieved the initial goals that I had for this piece.

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