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~Mirror Image of ~
Fair Weather Cumulus

The purpose of the Cloud flow visualization assignment was to photograph the naturally occurring and exceptionally beautiful phenomena of clouds. Clouds can be seen by anyone at any time. What the average observer does not realize is that there is an enormous amount of physics and fluid flow taking place as they look up at the clouds. The clouds that I imaged for this assignment are cumulus clouds. I saw these clouds while I was bicycling home and rushed inside to get my camera. They were quite stunning because of their massive shape. They seemed to resemble the waves of the ocean coming onto the shore. These are cumulus clouds. My goal when editing this image was to accent the depth of the cloud by adjusting the color curves and inverting the colors. The bottom half of the image was created by using the liquid filter in Photoshop, I wanted the image to look like it was being reflected in a lake and being distorted. I feel like I was able to capture this mode. My final image that was edited in Photoshop can be seen in Figure 1.

Figure 1: Cumulus Clouds Reflected

The setup for this picture was rather simple. I set up my tripod so that the camera was about 75^{o} up from the horizon and focused in on the clouds. A sketch of this can be seen in Figure 2. It was taken at approximately 1:30pm on January 30, 2006 in Boulder, Colorado. The surface temperature was 3^{o}C with a humidity of 34%. The wind was blowing from the west to the northwest at a speed of 18 km/hr.

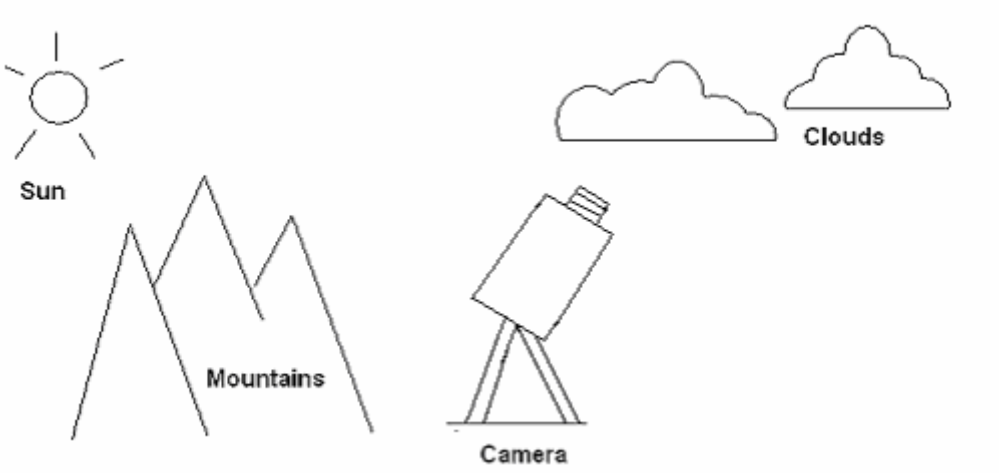

Figure 2: Camera Setup

The approximate Reynolds number and time resolution could not be easily calculated because the cloud did not appear to be moving. Because of this there was no way to know the velocity of the cloud. If one had a velocity they would use Equation 1 to find the Reynolds number.

$$R_e = \frac{\rho V D}{\mu}$$

Equation 1: Reynolds Number

V = Free-stream fluid velocity

D = Characteristic distance

ρ = Fluid density

μ = Fluid viscosity (dynamic)

The only lighting used was the light from the sun in the sky. The camera used a HP Photosmart C945 (VO1.60) digital camera. The focal planes resolution is in a unit of centimeters and has 5.3 mega pixels. The size of the field of view is estimated to be approximately 5 km. Cumulus clouds are a low range cloud normally around 2000 meters above the surface. The lens focal length was 38.2 mm. The original image's dimensions are 1952 x 2608 pixels and the final image's dimensions are3904 x 5216 pixels. The exposure specifications used for this picture were as follows: the exposure time was 1/216 second, the aperture value was set to 4.5 and the shutter speed was 1/216 second. The film speed was 150.

Several Photoshop techniques were used on the final image. The curves were adjusted and the colors were then inverted from one side to another. The bottom half of the image was modified using the liquid filter to create a feeling of a reflection in a lake. I wanted to give the clouds on the bottom of the picture a surreal feeling; so that the onlooker might think that the above clouds were from earth and the clouds on the bottom could have been taken from an alternate dimension. The original image can be seen in Figure 3.

Figure 3: The Original Cumulus Cloud

This is a vertically developed could. It was probably caused by upward moving thermals. As warm air parcels rise along the adiabat they cool. If the air reaches the saturation vapor pressure and there is a condensation nucleolus, the air will condense forming a cloud. Because of the way that the air is rising, cumulus clouds tend to grow vertically rather than horizontally. Fair weather cumulus clouds can exist for a relatively long period of time and can sometimes develop into a cumulonimbus cloud. Cumulonimbus clouds tend to bring thunderstorms. They have a flat bottom with rounded "cauliflower" like tops. While cumulus clouds are inclined to have crisp outlines, older clouds can have ragged and wispy edges like you see in my photograph. This is caused by evaporation along the cloud edges making the air around the cloud cool. This makes the surrounding air denser, producing a sinking motion outside the cloud. This is called cloud erosion. Normally cumulus clouds form in anti-cyclone weather zones where there is a relative increase in barometric pressure and there is a

central area of high pressure. Since we are in the northern hemisphere an anticyclone has a clockwise spiral direction of the air away from the central high-pressure area.

I think that my final image is striking and dramatic. The dark colors on the left sharply contrast the light inverted colors on the right. I think that the two color schemes bring out different cloud details. You can see the depth and texture in this image. Within the image there are both clearly defined edges and edges that look like they were smeared across the sky. I like this because it gives the clouds a dreamlike quality. The mirrored clouds were inspired when I was looking into a lake several days ago and noticed the distorted reflection of the clouds in the lake. I goal was to try and replicate this effect. Something else I like about this image is the white tree branches seen on the right hand side of this image. They remind me of a snowflake. Over all I am very pleased at the results from this image.

References:

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