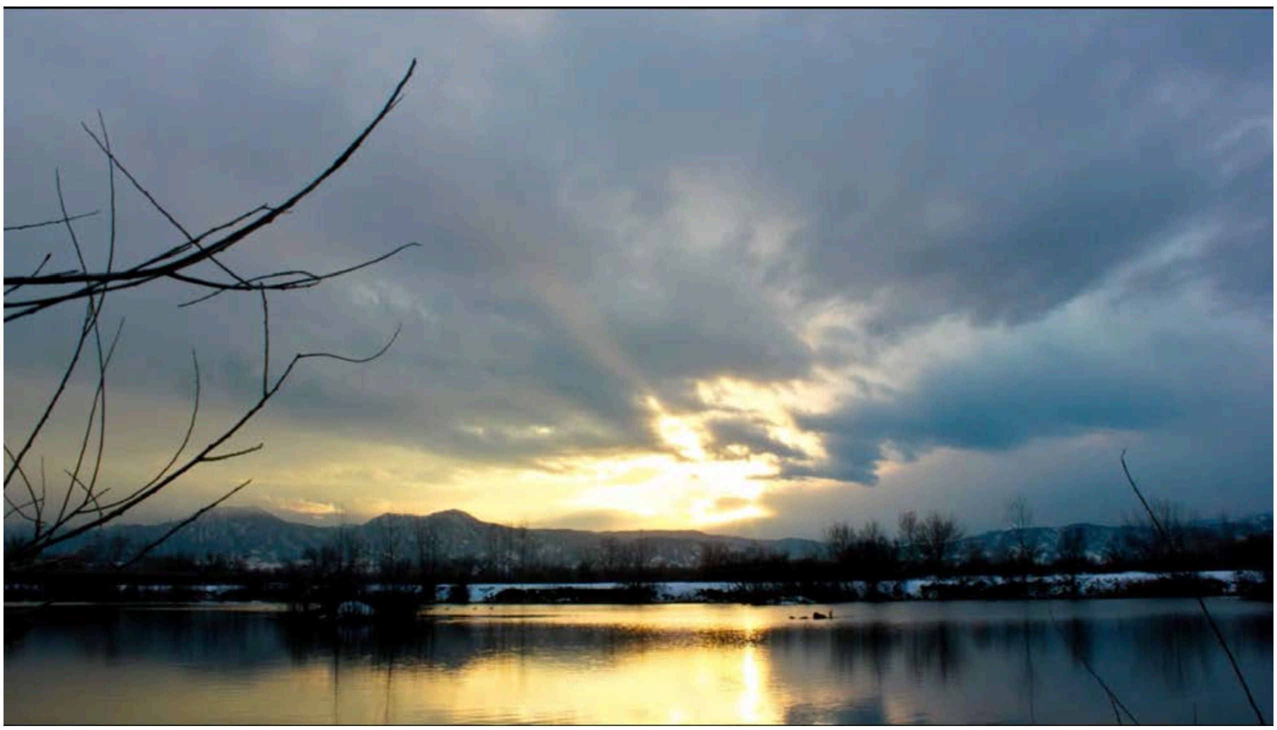
Clouds 1



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Introduction

This report documents the techniques used to capture and create a time-lapse video of clouds. A time-lapse video is created when sequential photographs are taken over an extended period of time, the photos are then played back at a chosen frame rate, creating a short video of a longer period of time. It is often very difficult to determine things such as time of day, wind direction, and other atmospheric conditions from a single photograph. These are exactly the things we can determine with time-lapse imaging [1].

This project is the first of two cloud visualization assignments for the Flow Visualization Course at the University of Colorado at Boulder in the spring of 2012. The goal of the assignment was to capture and identify cloud types using pictures or video. Screen shots of the video before and after post processing can be found in Appendix I at the end of this report.

Methods

This series of photographs was captured on February 17, 2012 between 5:00pm and 5:30pm, at the Walden Ponds Wildlife Habitat located in Boulder County, Colorado. From 1958-1970s this area was used for gravel mining until most of the desired resources were stripped. In 1974 the area was converted in to a wildlife habitat; the pits were allowed to fill with ground water, fish were stocked and plants and trees were seeded to create the area. The area to this day is monitored, maintained, and improved on by Boulder County [2].

Analysis

Classifying cloud formations can be accomplished by combining a few techniques. Analyzing a Skew-T plot for this day and time **(Figure 1)** reveals several atmospheric conditions and helps suggest the type of clouds one should expect to see and where it is located related to elevation.

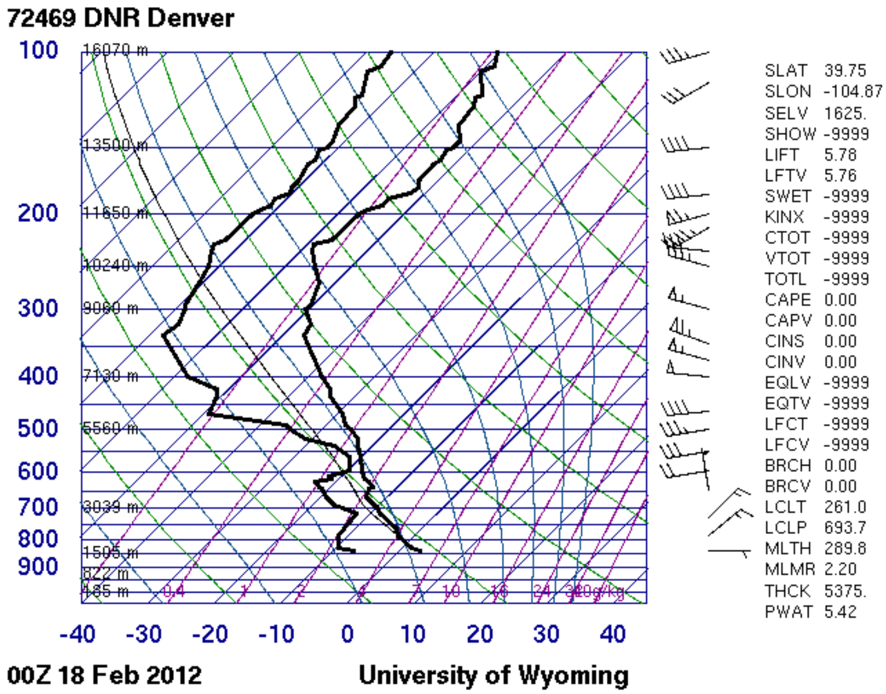

Figure 1. Skew-T plot for February 17,2012 at 6pm in Denver, CO [3]

This Skew-T indicates that clouds are of high probability and should appear in two locations, near 3,000 meters and again near 4,500 meters above sea level. Since this picture was taken at a base elevation of 1655meters the clouds are expected to be seen at 1345m and 2845m above ground level. The CAPE (or convective available potential energy) is 0.00, indicating a stable atmosphere.

Using the Skew-T information along with the previous, actual, and future weather history for this day **(Figure 2)** is also useful.

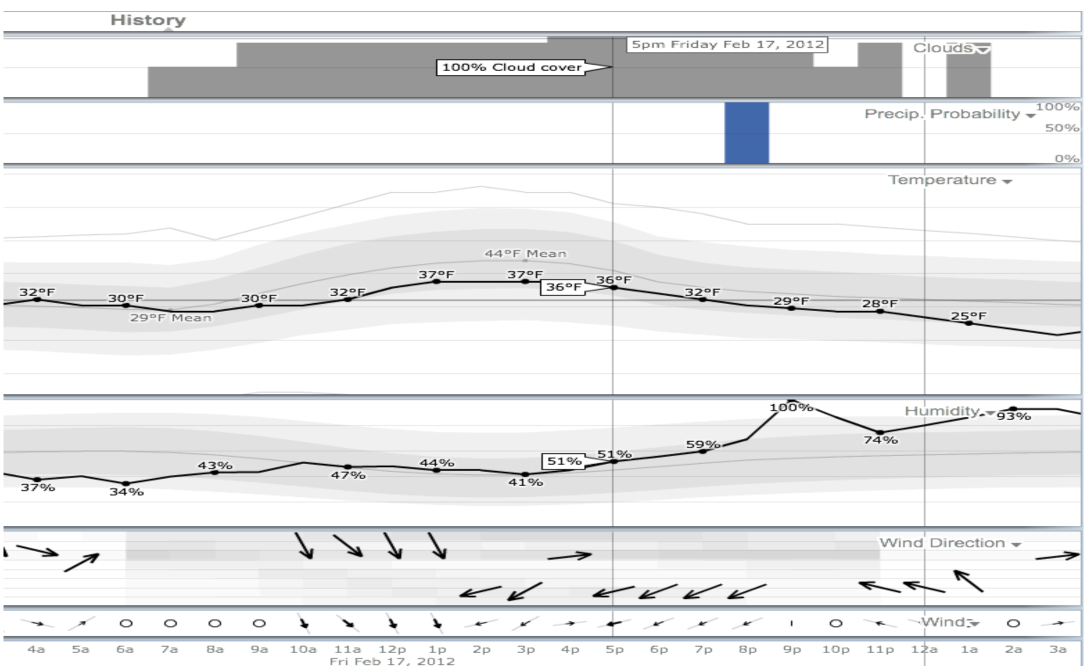

Figure 2. Weather History for February 17,2012 at 5pm in Boulder, CO [4]

This weather history report shows the cloud coverage and a changing wind speed and direction. The high wind speed from the Skew-T and the changing wind direction from the history report is likely the cause for the cloud formations to appear to be moving in contradicting directions. The Skew-T also indicates winds from the east and north at 3000 meters above sea level, corresponding the low cloud cloud direction in the right side of the video. It also shows strong winds from the south above 3000 meters above sea level, this also corresponds the higher clouds moving towards the camera as it faces west. Although this history report indicates a strong precipitation probability between 8 and 9 pm, no actual precipitation was seen or reported. It is also important to note the temperature of 36° F (2.2° C) and the humidity level of 51%.

One can classify these cloud types by combining and considering all of this data. The higher clouds, seen above in the majority of the film, are Altocumulus Stratiformis. Altocumulus is the Genus, described as layers of rounded clumps or rolls. Stratiformis is the species, indicating the clouds are extended over a large area. [5] Although much of the lower cloud formation is not completely visible in the video, seen developing to the right and closest to the camera, are Stratocumulus clouds. These are described as low rolls of clouds and are often seen with gaps between them[4].

Photographic Technique

The camera was placed on a tripod about 20° from the horizon at the east end of a pond, with the lens facing west. This technique provided a great view of the still landscape and the moving clouds overhead. The sun provided the beautiful natural lighting on this day, as it set below the distant mountains and as it's reflection was cast across the water below. The positioning of the camera was chosen to simulate what a person would see on this day if they were sitting on the waters edge, watching the sun set as the clouds developed and moved across the sky. The mountain range in the horizon is estimated to be 6.5 kilometers across, and about 10 kilometers away.

An 18.1 mega-pixel DSLR camera was used and captured the sequence of photographs. The camera was a Canon EOS Rebel T2i body, housing the high resolution CMOS sensor, with a Canon EFS 18-55mm f/3.5-5.6 IS II lens [6]. The camera also took advantage of an open source 3rd party software addition called Magic Lantern. Magic lantern and other 3rd party software additions often unlock a variety of photographic and video features not normally accessible without a more expensive camera or additional hardware [5]. More information on Magic Lantern and the download can be found here:
http://magiclantern.wikia.com/wiki/Magic_Lantern_Firmware_Wiki

The additional software allowed the use of a built in intervalometer. An intervalometer is used to command the camera to sequentially take a photo at programmed time spacing interval. This spacing can is set by the user and can be anywhere from every second, every minute, every 24 hours, or anywhere in between and beyond depending on the rate in which the photographer would like to capture the movement.

Using the time-lapse technique reduces the frame rate when recording, but uses 20 to 30 frames per second during play back [7]. For this time-lapse the camera was programmed to take a photograph every 3 seconds for 30 minutes, capturing 740 images. The photos were taken using the highest .jpeg resolution possible for this camera rather than the RAW format. This technique provided the minimum amount of image compression possible, while allowing the camera time to store the image and to provide an ample amount of storage space for such a large number of pictures.

The camera was set to aperture priority, or Av mode on Cannon cameras, and the ISO was set at 400. This took into account of the varying levels of light as the sun set, to create the smoothest lighting transfer and minimizing the amount of flickering when the images are played back later. This being said, the only setting that was automatically controlled by the camera was the shutter speed. The shutter speed transitioned from 1/200s at the first photo when the lighting was brightest, to 1/13s at the last photo when the lighting level was much less.

Post processing was done using Adobe Lightroom 3. Lightroom 3 allows a series of images to be imported into one project. The user can then edit one image and apply those settings to the rest of the images in the project. Once imported, the photos were cropped to 16:9, ideal for video playback, and the angle of the cropped area was rotated slightly to straighten the horizon line. The blacks were brought down to -3, vibrance was increased to +47, and clarity to +20. Once the settings were applied to all of the photos, the images were then exported as a .mp4 video, with a playback rate of 25 frames per second to give the smooth video playback of the image collection.

Conclusion

This video grabs the viewers attention and gets them wondering how and why the different clouds could be moving opposite of each other. The lighting provided by the sun setting behind the mountains displays mesmerizing rotating rays peering from behind the clouds. It also displays a transition of vibrant colors highlighting the natural beauty of the clouds above, the snow touched mountains in the horizon, and wind ruffled water below. The developing clouds and moving water show the physics of flow visualization in a unique way. The interesting thing about cloud time-lapse photography is that you really don't know exactly what you are about to capture and how the clouds might change, develop, or move. The author's expectations and intent were met and surpassed by the final video.

This video could be improved primarily by further applying post-processing techniques. A de-flickering algorithm could be applied to further smooth play back.

A beginning and ending transition may be applied, and a fitting soundtrack could also enhance the viewing pleasure and produce a more final product.

Capturing clouds, sunsets, and time-lapse photography are not easily produced, and techniques vary greatly given the surroundings and personal preference. The techniques applied and described in this report give one way this can be executed to produce a similar quality video.

References

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Appendix I

Before:

After: