INTRODUCTION

The purpose of this image was to satisfy the second cloud assignment for the Flow Visualization course at CU-Boulder. The intent was to create a time-lapse video of cloud formations. Specifically, I wanted to capture cloud formations that occurred in a relatively small time span and examine the vast array of formations that could occur almost simultaneously. A secondary goal was to capture the short lifespan of fair-weather clouds as they form and dissipate. I believe the time-lapse compilation I created was successful in achieving these goals.

CIRCUMSTANCES

All of the videos and images used in this compilation were taken between 3:00pm and 6:00pm on Sunday, April 10 in the City Park neighborhood of Denver, Colorado. The direction the camera was facing varied. Portions with the mountains and/or the downtown skyline were taken looking west. The opening shot as well as the section time-stamped 0:29-0:34 were captured facing east, which happened to be the direction of the more overcast sky for much of the day. The other clips were looking almost directly up, for example the section where the different cloud layers are moving different directions.

CLOUD FORMATIONS

It turns out that this day in particular was an interesting one to be studying the clouds. It was a mostly cloudy day for most of the day before and during the filming of this video. The weather reports called for rain showers around 4:00 pm, which never happened, at least where I was in Denver. For the most part, the clouds captured here were situated between 5,000 and 10,000 feet in altitude, classifying them as cumulus and stratocumulus clouds. Had the atmospheric conditions eventually resulted in rainfall, we would have seen cumulonimbus formations, but as I said before, where I was in Denver, this did not occur. We do, however, get a feel for the dark grey ominous feeling of these clouds in the section from 0:29-0:34. The specific formations observed range from cumulus congestus to humilus to fractus. Essentially all forms of cumulus clouds are captured in this compilation video. We also see a variety of stratocumulus stratiformis. These include most of the higher level clouds captured. A collection of cumulus congestus and humilus are shown in the opening sequence. You can see the puffy middle age clouds move rather quickly, as this clip was only about 12-15 minutes of real time. The section time-

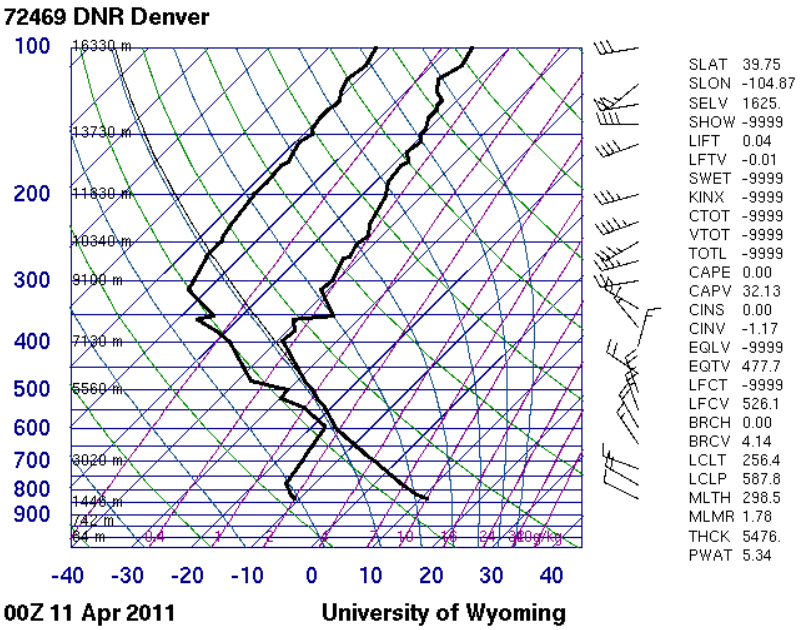

Figure 1: Skew-T for Denver on April 10, 2011 at 6pm[1]

stamped 0:18-0:24 clearly demonstrates the formation of cumulus clouds on the right side of the screen. Several of the clips show the low-level cloud cover of stratocumulus stratiformis. These clouds tend to create ceilings of clouds formed by clumps of "cloudlets", which are just what they sound like.[3] For example, the irregular cloud ceiling in the foreground of the image at 0:18 represents a stratocumulus stratiformis formation. The Skew-T plot provided by the University of Wyoming for the atmosphere on this day matches the estimated height of these clouds as it shows the temperature and dew point lines nearly intersecting at 2000-3000 meters. As far as the stability of the atmosphere goes, we can see that at this exact time, the atmosphere was relatively stable (CAPE = 0.00).

CLOUD PHYSICS

The cumulus and stratocumulus clouds captured here were formed as the earth's surface was heated by the sun, which heated the air just above the surface, which then rose to reach the cooler air where it condensed. Once the temperature of the cooling air reaches the dew point (shown in the Skew-T plot), water condenses out of the air and forms a cloud. As the air continues to rise, it continues to condense, which is why many cumulus clouds tend to have significant height. The winds on this day were relatively high (ranging from 10-30 mph). This explains why many of the clouds here exhibit the fractus stage of a cumulus cloud, as the wind rips through the cloud, removing its puffy, clearly defined borders.[4]

PHOTOGRAPHIC TECHNIQUE

Clearly the technique used to capture these fluid phenomena was time lapse. In order to show the cloud movement, it was necessary to show the footage at a much higher rate than real time. In most cases, the video depicts between 30 and 40 times speed. I used two cameras to capture the footage. First was a Nikon EOS 7D with HD video capacity. I captured 15-minute segments of video then sped them up using Final Cut Pro. It is important to note that all editing was done using the program Final Cut Pro. The other camera I used was a Sony EX1R, with time-lapse feature. Essentially I set the camera to take one picture every second and to playback at 30 frames per second. In other words, this footage was typically showing 30 times normal speed. The estimated distance from the object (clouds) to the lens ranged from one mile (for the direct overhead shots) to about 50 miles (shots of clouds of mountains). Other aspects like focus, light adjustments, shutter speed for individual images, etc. were adjusted on a case-by-case basis for each clip.

IMAGE MANIPULATION USING FINAL CUT PRO

As I said before, all editing was done in Final Cut Pro. The main manipulations involved playback speed changes and the addition of filters. I also used some color correction to make certain colors stand out or to achieve a black and white feel. For almost all of the clips I adjusted the contrast to make the darks a bit darker. This made the light whites of the clouds and the shady bottoms play off each other all the more.

CONCLUSION

I believe this time-lapse does a great job showing the ever-so-slow flow of clouds. I like how I was able to show several stages of the cumulus and stratocumulus cloud formations. It is interesting to see such a depiction of clouds because although we see them in our day-to-day lives, we never really see the movement of clouds. The cumulus species of clouds seems especially interesting to capture in such a way because their life span is so short. From formation to dissipation it is often less than an hour that these clouds exist. Therefore the 15-minute clips captured here in this video show a significant portion of their lives. In terms of the project, I am quite happy with the artistic outcome. I feel that the filters and contrast manipulations (while maybe a little over-done in some points) helped to make this project a bit more attention grabbing to a viewer. I also feel that the song (Kanye West – "Drive Slow") was an interestingly appropriate addition as "driving slow" is essentially what the clouds are doing. If I were to do another cloud video like this, I think I might try to capture a single clouds life from formation to dissipation, but perhaps film it from different angles. A day with higher, longer lasting clouds would probably be more appropriate than the day I happened to film the sky.

References

[1]University of Wyoming. '"Atmospheric Soundings." http://weather.uwyo.edu/upperair/sounding.html
[2]WeatherSpark. "Interactive Weather Charts." http://weatherspark.com/#!graphs;a=USA/CO/Denver
[3]The Cloud Appreciation Society. "The Cloud Collector's Reference." http://cloudappreciationsociety.org/collecting/
[4]American Meteorological Society. "Glossary of Meteorology" http://amsglossary.allenpress.com/glossary/search?id=cumulus1