CLOUDS 1

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We can often learn a great deal from a still image of a cloud. However, a movie that captures the motion of the same cloud can tell us a great deal more. The intent of these movies is to demonstrate some basic principles of clouds and their motion, particularly in a mountainous environment. This is achieved via time-lapse photography, and common digital editing.

These sequences of images were captured with an interval between images of either six or fifteen seconds. Longer intervals can be used, but much information is lost when the interval is increased. To reproduce these sequences, it is essential to have a tripod, a timer, and a means of triggering the shutter remotely. It is also helpful to have an area that you can set up your camera for an extended period of time. Additionally, it is not necessary that the clouds you are intending to photograph are even present yet!

The first sequence, taken on October 1st, shows a strong altostratus body moving with winds aloft. The cloud fills the frame, and extends beyond the visual horizon. This indicates that its size is in excess of tens of square miles. Of note in the lower left-hand corner is a group of standing clouds over a mountaintop. Skew-T data from this period indicates cloud formation above 6000 meters, and very strong winds aloft, exceeding 100 knots at 12000 meters. Despite the formation of clouds and strong winds, this air mass may be considered stable, as all of the air is moving in the same direction, and there is no indication of rising air.

The second sequence, also taken on October 1st, shows the edge of the cloud mass in the previous video. It also shows a good example of short-lived cumulus clouds. As the easterly-moving air mass passes over the mountains, clouds are formed. When the air mass continues away from the mountains, these clouds rapidly dissipate. Although the movie does not demonstrate 'standing' clouds, it shows how quickly clouds can be formed and destroyed. The size of these clouds is around 1-2 square miles.

The third sequence was taken on October 5th. It is attempted to be as artistic as it is scientific. It shows the sun setting behind the Flatirons, and a few sparse cumulus clouds that are 'hanging in there' before the sun goes down. Interestingly, the clouds disperse as the sun goes down, showing that the warm, unstable air that is rising from the earth slows as the sun stops heating the earth. The maximum size of these clouds in only a few hundred meters across.

The fourth and fifth sequences were taken on October 7th, a day that was rain was forecast. It shows cumulus and cumulonimbus clouds underneath stratus clouds. One of the most interesting features in the fourth sequence is the demonstration of winds aloft. This movie clearly shows that winds are drastically different, both in velocity and direction, at different altitudes. This is indicated on the Skew-T plot by the fairly unorganized winds at lower altitudes, and very strong winds aloft. Of additional note is the vorticity in the cloud masses, particularly in the cumulus clouds, as they appear to be 'spinning' in fast-motion.

The fifth sequence was immediately prior to rainfall in East Boulder. It shows a building cumulus rain system over the mountains, slowly spreading further east. The rain becomes visible falling over the mountains and moves rapidly closer to the viewer. This also demonstrates different clouds and wind directions at different altitudes. The Skew-T plot for this day shows immediately unstable air at very low altitudes, which is precisely what the camera has captured.

In order to capture these sequences, a series of test sequences had to be shot. In this case, the test sequences were good enough to use, and were turned into the first and second movies. These shots were taken on top of the lot 436 parking structure on the University of Colorado, Boulder campus. The interval was 15 seconds, or 4 frames per minute. The shutter speed was fixed at $1/160^{th}$ of a second for both series, and the apertures were f/20 and f/16 for the first and second sequences, respectively. The third, fourth, and fifth sequences were shot from the top of the parking structure at Boulder Community Hospital, Foothills campus. The third sequence was also manually controlled, at $1/160^{th}$ of a second shutter speed, and an aperture of f/22. The last two sequences were shot on the cameras auto program mode. Typical shutter speeds and apertures for these shots were around $1/350^{th}$ to $1/750^{th}$ of a second shutter speed, and f/10 to f/22. The camera used was a Nikon D200 digital SLR, with an 18-200mm Tamron lens, at its widest angle. The images taken had pixel dimensions of 3872W x 2592H. All pictures were taken with an ISO setting of 100.

By far the most challenging portion of this assignment was compiling and editing the still images into a movie file. It was discovered that Windows Movie Maker (WMM) will stitch images together, but at a maximum frame rate of 8 frames per second. The resulting movie seems 'jumpy' and detracts from the fluidity of the clouds. The final procedure involved a program called VirtualDub to stitch the movies into an .avi file. This program allows a range of fps settings while compiling the video. WMM is then used to compress the .avi to a .wmv.

These movies have revealed to me just how awesome cloud movement is. Most people do not have the patience to watch clouds for an extended period of time, nor the memory to realize the significance of a small change in the cloud. I hope to show these individuals that there is more going on in the snapshot glances that they take of the sky above them. To improve these images, however, I would very much like to take a sequence of images that is an entire day long, to show the many different types of weather that can occur in such a short period.

Programs used:

Windows Movie Maker
VirtualDub – http://www.virtualdub.org