

MCEN 4151
Flow Visualization
Clouds First Report

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1 Introduction

The purpose of this image is to exhibit the natural beauty and physics of a cloud. For my photo I wanted to capture the dynamic nature of clouds moving over the mountains. In order to accomplish this I choose to create a time-lapse consisting of 1,672 photos played back at 30 frames per second. Clouds rolling over a mountain range create a very interesting phenomenon known as mountain wave clouds which will be explained later in this report.

2 Image Specifications

The images were taken on the roof of my parent's house in Monument, Colorado. The camera was on a tripod facing southwest at an elevation around zero degrees from horizontal. The pictures were taken on September 4th starting at 10:20 AM to 12:40 PM.

3 Cloud Type

This time-lapse exemplifies the physical phenomena of mountain wave clouds. These types of clouds form when stable air flows over elevated land features. The mountains in this time-lapse create the atmospheric internal waves that start right above the Front Range and can be seen extending through the foothills. A Skew-T diagram shown in Figure 1 indicates a CAPE value of 0.00 meaning there was a stable atmosphere while these images were shot.

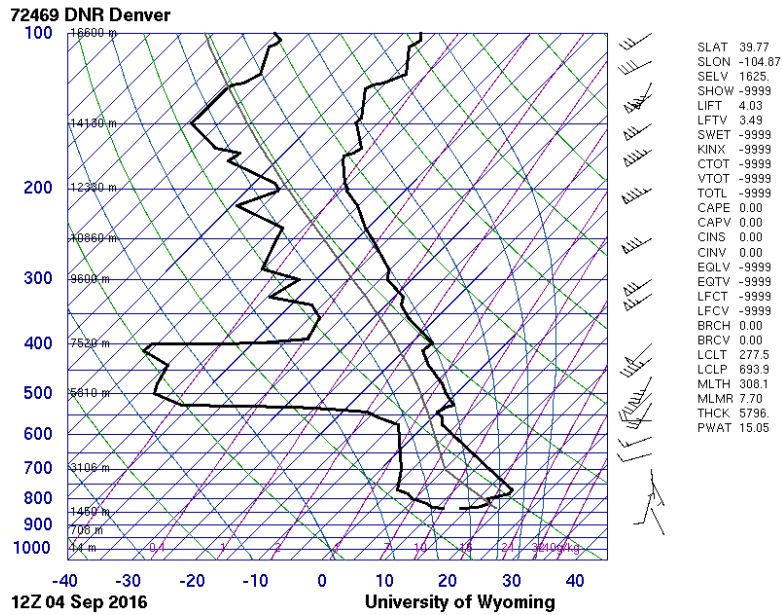


Figure 1: Skew-T diagram from September 4th in Denver

When the air rolls over the mountains, it experiences a repeated uplift and decent. The clouds then form when there is enough moisture in the air at the crest where the temperature is lowest. During the decent of the weave, the clouds heat up adiabatically and evaporate. This repeated behavior forms the clear patches of clouds that are spread out across the sky.

4 Photographic Technique

A wide field of view was used to capture as many clouds as possible rolling over the Front Range. The camera was approximately 20 miles from the top of Pikes Peak and captured about 25 miles of the Front Range. The Canon Rebel T4i was used with an 18-55mm image stabilizing lens adjusted to a 22mm focal length. The original images captured were 5184x3456 pixels which were later reduced to 1920x1080 pixels for optimal video playback and compatibility. Exposure time was set at 1/400 sec with an F-stop value of f/13 and ISO-100 for every photo to preserve consistency between the photos. An original photo can be seen in Figure 2.



Figure 2: One of the original untouched images

All post processing was done in Photoshop where brightness/contrast and curve setting were changed as shown in Figure 3 and 4.

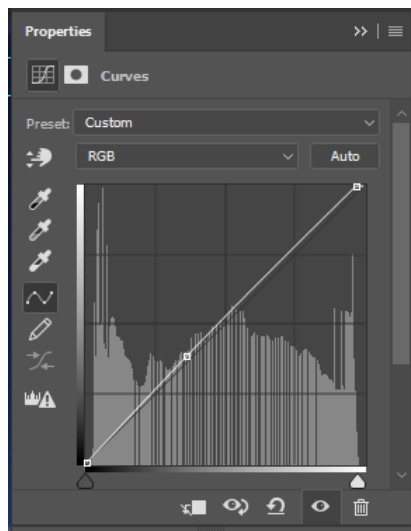


Figure 3: Curve properties

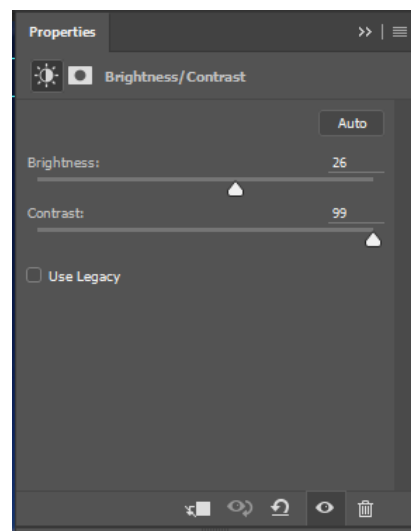


Figure 4: Brightness and Contrast properties

Photoshop allows you to select a folder of photos and then arranges them in order to be played back at a certain frame rate. Audio tracks and a few fading effects can then applied before the final video rendering.

5 Conclusion

The phenomena mountain wave clouds produced is clearly revealed in this time-lapse. I really like how you can see cloud patches where the peaks of the waves are. The fluid physics are evidently visible by the spacing of clouds in the sky that start over the Front Range. The way the clouds just form out of no-where still amazes me and I would like to learn what exactly is taking place there. To develop this time-lapse in the future, I want to take more photos from the top of the mountains looking over the plains of eastern Colorado instead.