University of Colorado - Boulder

MCEN 5151 Flow Visualization

Clouds Second Report

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1 Introduction

1.1 Image Summary

This photo, taken from Twin Lakes in Gunbarrel, CO, was shot facing approximately south on Friday, November 22nd, 2024. The photography altitude is about 5000 feet above sea level, so the Skew-T diagram for that day indicates clouds around the 5000-8000 feet AGL point. This suggests that the clouds covering a large section of the sky are either stratocumulus or altocumulus/altostratus clouds. No lightning was observed, nor was there much or any precipitation, suggesting the cloud was not a cumulonimbus or nimbostratus cloud.

1.2 Motivation

The most common cloud images are taken at sunrise or sunset; capturing a striking image of clouds in the middle of the day is more difficult. The clouds captured in this image have an uncommon structure, like something out of a science fiction movie where the villain is controlling the clouds and a portal is about to open up to let in aliens. Clouds also evolve quite quickly, this image captures a fleeting moment in the life of this cloud formation.

2 Methodology

2.1 Test Setup

This image was taken from the northern bank of a small reservoir pond; this allowed for an uncluttered line of site right to the clouds without requiring the image to be taken from a high vantage point. The particular cloud was to the south, so the image looks out over the pond. The sun is well in the south and was fairly near its peak in the winter sky, as this image was taken around 1:43 PM. The cloud is very thick and so blocks all the light, and the trees are quite backlit; the sky underneath the clouds (which is in full sunlight) looks like a sunset because of the high contrast editing.

2.2 Visualization Technique

Visualizing clouds is just about pointing a camera up! Nothing to it. The image contrast is altered to bring out the depth of the cloud layer.

2.3 Photographic Technique

The photo was shot on a Canon EOS 6D Mark II using an EF 28-135mm f/3.5-5.6 IS USM lens at a focal length of 50mm, f/4.5, ISO 100, and three shutter speeds (the image is an HDR composite): 1/4000, 1/1000, and 1/250. These settings correspond to a +/- 2 stops HDR setup. The HDR image was generated using Adobe Lightroom Classic. The combined raw image can be seen in Figure 2.3.1; notice that there are four birds in the center of this image, but that there are only two in the report cover image. In reality, 2 birds were moving



Figure 2.3.1: Compressed JPG of the original, unedited HDR RAW file.

from left to right as the images were shot. The compositing algorithm included them twice. Figure 2.3.2 shows a third of each image included in the HDR image; a normal exposure, an underexposure, and an overexposure. Notice again that there are only two birds in the middle of the frame. The original images have a resolution of 6264x4180; the cropped final image is 4959x3306 pixels. The cropping was done to move the center of the circle to the upper right third vertex, which made for a more powerful framing. The image was heavily edited post HDR-combining to boost the contrast of the clouds and draw out the dark structure. Editing included adjustments to contrast, highlights, whites, darks, and shadows, a slight increase in exposure, and extensive manipulation of the light curve.

3 Flow Discussion

Shot at a ground altitude of approximately 5000 feet, the image looks towards clouds that fill much of the southeastern quarter of the sky. The skew-t diagram for that day (Figure 3.0.1) indicates there is a large cloud layer between 10 and 15 thousand feet above sea level; this places the clouds between 5000 and 8000 feet above ground level, indicating that they are most likely a large stratocumulus or altostratus formation. There was no precipitation or lighting, which rules out both nimbostratus and cumulonimbus clouds, despite the size and apparent anger of the cloud formation. According to the skew-t diagram, the atmosphere was stable that day, but there appeared to be some local instability in the cloud. Observing it over time revealed what seemed like a rotation around the axis of the imaged cloud circle, with the clouds flowing up over the top of the circle faster than they flowed underneath. This made the cloud look like a rolling wave heading west to crash upon the rocks of the Flatirons.



Figure 2.3.2: The three raw images, set side-by-side for comparison.



Figure 3.0.1: Grand Junction, CO Skew-T diagram for November 22nd, 2024

4 Conclusion: Revelations

Clouds are a striking, powerful force, the scale of which is hard to comprehend, let alone effectively image and visually communicate. What they reveal about the atmosphere is easily missed, and they are too often thought of as a bad sign. Clouds are vessels of great beauty that bring much more life than they do death; without rain and snow, there could be no ponds for geese and photographers to hang out at.

5 Acknowledgements

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