

# THE ART AND PHYSICS OF CLOUDS FLOW VISUALIZATION FALL 2016

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## ABSTRACT

This paper describes the art and physics of clouds observed on October 19, 2016 at 1419 hours facing west in Boulder, CO. During the course of the Fall 2016 semester at the University of Colorado at Boulder, several types of clouds were observed under differing atmospheric conditions. The clouds observed on October 19 artistically produced the most compositionally and visually appealing image used for Cloud Assignment Number Two. The image compositionally frames mountain formed clouds with the University on the side borders of the picture, and the Front Range in the background.

Using data from the University of Wyoming atmospheric soundings, it was determined that the mountain clouds shown in the image are cumulus congestus, also referred to as towering cumulus. Cumulus clouds are consistent with mountain range cloud formations, and a light rainfall on October 19, 2016 was recorded which is indicative of congestus cumulus clouds. The atmospheric conditions were stable with a Cape Value of 0.00 and conditions show cloud formation at approximately 18,733 ft altitude. The atmospheric temperature was approximately -11 F.

The image was taken using a LG Stylo 2 camera. The focal length was 3.62 mm. The ISO was 50, and the exposure was 1/2792<sup>th</sup>. Post-processing using Photoshop included cropping, saturation and color adjustments using Photoshop.

## INTRODUCTION

The image was taken at the University of Colorado, in Boulder, CO facing west at an elevation of approximately 5,430 ft. The image was taken at 1419 hours on October 19, 2016. The camera had no tilt, and the image was taken parallel from the ground at a standard 90 degree angle. The University of Colorado compositionally frames both sides of the mountain cloud, cumulus formation, and the Front Range in the background complements the image.

### Cloud Type and Formation

The clouds observed are cumulus congestus [Ref 2]. The Skew-T plot (Figure 1) shows a stable atmosphere with a Cape value of 0.00. The other cloud formations observed in the surrounding areas of the sky were similar in formation. Weather observed included precipitation of 0.08 inches and temperatures of 57 F and 38 F [Ref 4]. Winds were negligible.

The altitude of the clouds was approximately 18,733 ft, which is consistent with the cloud heights expected.

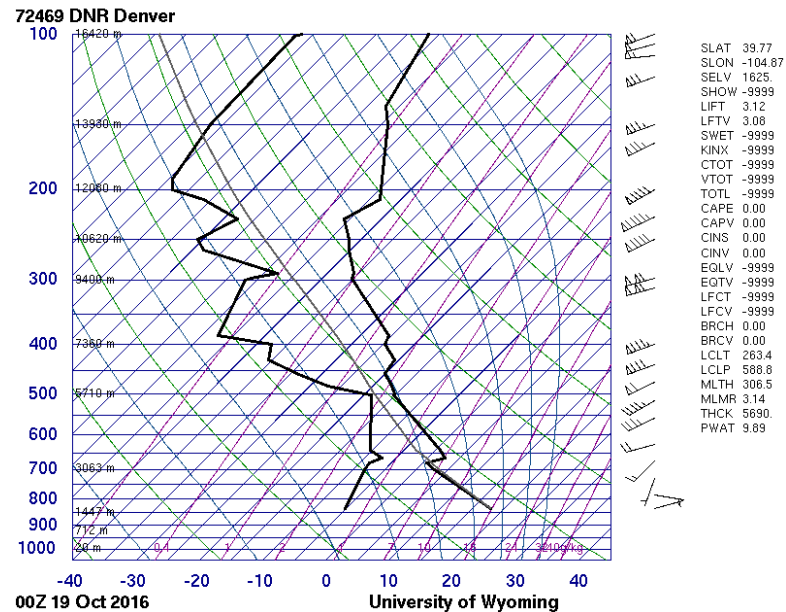


Figure 1: Skew-T Diagram October 19, 2016, 00Z [Ref 3]



Figure 2: Cumulus Congestus Cloud Picture by Gary Anthes/UCAR [Ref 5]

The physics of the clouds were determined using several sources. The clouds were formed from the Front Range mountain range as observed in the photograph

(Figure 5). Cloud types formed due to mountains include: stratus, lenticular, cumulonimbus, and cumulus [Ref 6]. Cumulus cloud formations are created when the mountain is warmer than the surrounding air - the air rises, cools, and forms water vapor which condenses in to a cloud [Ref 6]. From the University Corporation for Atmospheric Research (UCAR) resources, it was determined that the clouds observed visually appear to be cumulus congestus (also referred to as towering cumulus), with the top of the cloud resembling a cauliflower shape (Figure 2) [Ref 2]. Light rain may fall from cumulus congestus clouds, which is consistent with the weather October 19, 2016 with rainfall of 0.08 inches [Ref 4, Ref 5]. Cumulus congestus clouds are classified as clouds with vertical development and the bases of the clouds may form at altitudes of 3,300 feet up to 20,000 feet [Ref 2, Ref 7]. The Skew-T for October 19, 2016 shows clouds formations at approximately 18,733 feet which corresponds to the cumulus congestus cloud type (Figure 1). Cumulus congestus clouds are transitional clouds between cumulus mediocris and cumulonimbus clouds. Cumulus mediocris clouds form at low to moderate altitudes (approximately 1,500 – 10,000 feet) and are not associated with precipitation, and cumulonimbus clouds exhibit an anvil shaped top and often heavy precipitation [Ref 8]. Given the altitude of the cloud formation, cloud shape, and light precipitation, the cumulus congestus cloud type was determined.

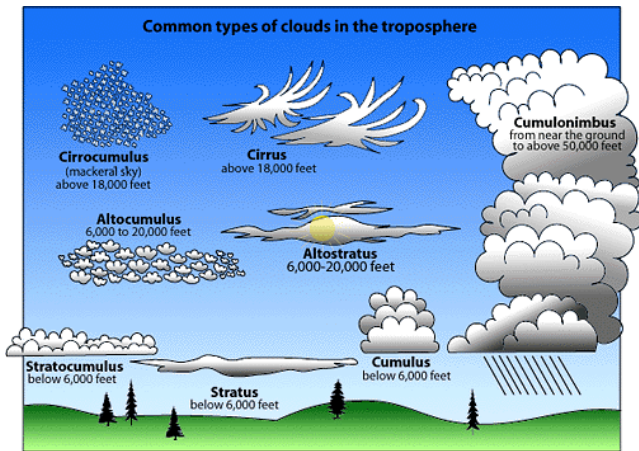


Figure 3: Common Types of Clouds [Ref 2]

### Photographic Technique

The photographic technique included the following equipment:

- LG Stylo 2 Camera Phone

The photographic settings used for the original image were:

- Focal Length: 3.62 mm
- ISO: 50
- Exposure: 1/2792 seconds
- Mode: Normal



Figure 4: Original Image

Post-processing included: cropping, saturation, and color adjustments (Figure 5).



Figure 5: Edited Image

### REFERENCES

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