MCEN 5151: First Cloud Image Report

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Introduction

This report is a general and elaborate recapitulation of what the cloud image—the first cloud assignment on MCEN 5151 Flow Visualization —has revealed. This assignment was intended to familiarize students with some basic facts of the glamorous atmospheric phenomenon in nature and equip them with some hands-on photographic experience to fine-tune their imaging techniques. I took the image in a cloudy yet nice afternoon in an attempt to identify the types of cloud shown in it and understand the physics behind these clouds.

Image Basics

This image, as you can see on the cover, was captured at 3:55PM MDT, Oct, 2nd, 2016 near the Athens Court in Graduate and Family Housing in CU Boulder. I was then standing on the 2nd floor of the court and facing south-west at the mountain. I tilted the camera a little bit at an inclination of around 45 degrees from horizontal to make sure the lens was facing the part of the sky where clouds kept conglomerating. I used the built-in compass app in my iPhone to identify the elevation of the point where the image was taken. It was 5,330 feet above the sea level, which is close to the elevation of Boulder county in the state of Colorado —5,430 feet above the sea level.

Cloud Physics

From a meteorological point of view, a cloud is an agglomeration of liquid droplets or frozen crystals. Clouds are formed by the saturation of air. An effective and convenient method of cloud visual identification has been widely adopted in meteorological observations. Ten types of cloud have been defined given the elevations of their presence. Cumulus means heap or pile. Stratus is the past participle of the verb meaning to flatten out or cover with a layer. Cirrus means a lock of hair or a tuft of horsehair. Nimbus refers to a precipitating cloud, and altum is the word for height.[1]

Table 1 Ten types of cloud and the elevations of their presence

TABLE 1.1 Genera and Étages of Clouds Identified Visually

Genus	Étage	Height of Cloud Base		
		Polar Regions	Temperate Regions	Tropical Regions
Cumulus				
Cumulonimbus				
Stratus	Low	Below 2 km	Below 2 km	Below 2 km
Stratocumulus				
Nimbostratus				
Altostratus	Middle	2–4 km	2–7 km	2–8 km
Altocumulus				
Cirrus				
Cirrostratus	High	3–8 km	5–13 km	6–18 km
Cirrocumulus				

Figure 1: Altocumulus stratiformis translucidus perlucidus in the late afternoon of 18 December 2007 at Horsham (West Sussex). This cloud is transparent and has gaps between the cloud elements.(© Richard Griffith.)[2]

The clouds in the picture should be identified as cumulus and altocumulus. From the image one can easily identify the cumulus clouds in that they always appear puffy, dense and sometimes resemble a cauliflower. In meteorology, the cumulus cloud is categorized as a type of low-level cloud. The formation of cumulus clouds has something to do with atmospheric convection. Cumulus clouds form as warm, moist air ascends, water vapor in the air condenses on particles into tiny water droplets. As this process goes on, these droplets accumulate and go upward, forming puffy, visible clouds up in the sky[3]. An unstable atmosphere is required in the forming of cumulus cloud, which is consistent with what the Skew-T diagram has revealed(The CAPE number was 252.8, unstable indicated). The elevation

of the cumulus clouds observed was expected to be around 3,000ft-4,000ft. Another type of cloud in this image is altocumulus. Altocumulus is a “white or grey, or both white and grey, patch, sheet or layer of cloud, generally with shading, com- posed of laminae, rounded masses, rolls, etc., which are sometimes partly fibrous or diffuse and which may or may not be merged; most of the regularly arranged small elements usually have an apparent width between one and five degrees.”[1] Altocumulus is a type of middle cloud and it can be observed at the altitude of 6,500ft-20,000ft between the warm and cold fronts in a depression. Altocumulus clouds appear to be less puffy and fluffy than cumulus clouds. They look more like pieces of plumage in lieu of lumps of marshmallow. The elevation of the altocumulus clouds observed was expected to be around 10,000ft-15,000ft.

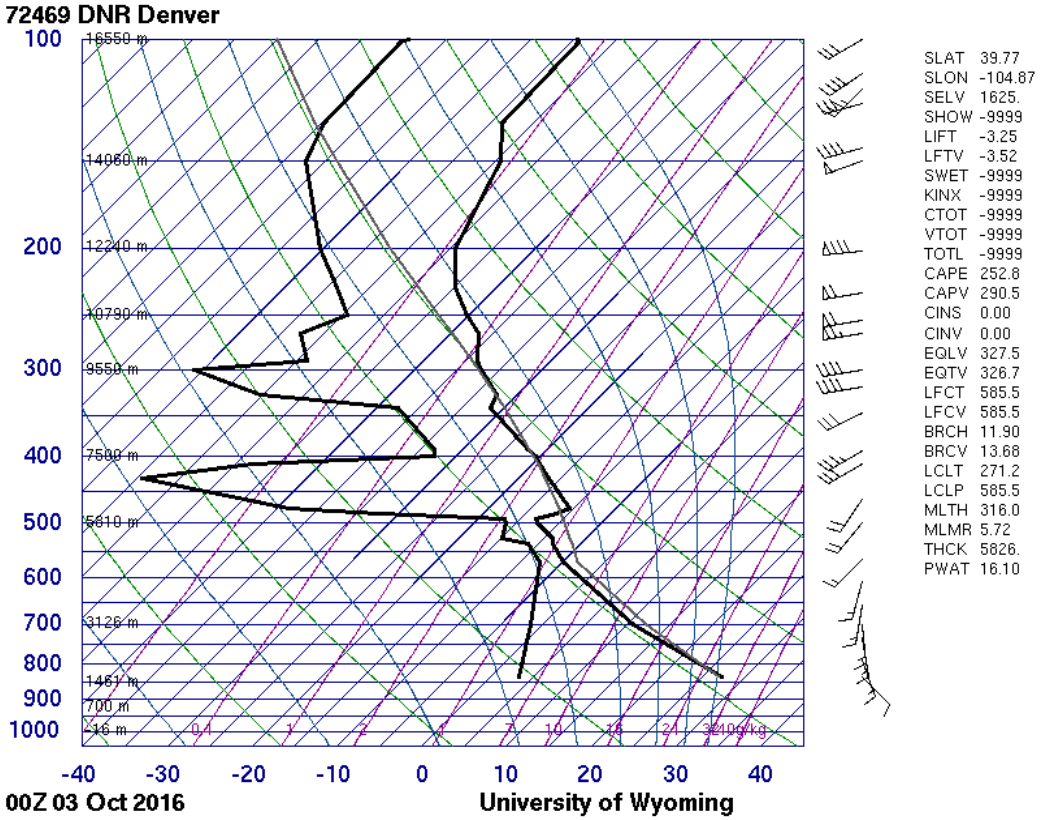

Figure 2: Skew-T Diagram

Photographic Techniques

I took the image with my iPhone 6s Plus and I think it did a good job even if doesn't have a professional lens. I was standing on the 2nd floor of the Athens Court and the camera was facing south-west towards the mountain. The distance from the clouds I was trying to capture to the smartphone lens was probably 5,000ft-6,000ft based on the visibility on that day. The lens has been tilted a little bit to make sure more clouds were presented in the image. The original image has a resolution of 4032x3024, a focal length of 4.15mm, an f number of f/2.2 and an ISO of 25. The image was edited using a popular app "Polarr Editor" and some parameters have been fine-tuned to improve the quality of the image.

Figure 3: The original image

Conclusion:

The image reveals two types of cloud that are fairly common in the atmosphere and the physics behind them has been demonstrated. I like this image because the clouds captured in it are aesthetically appealing. The high-quality lens on the iPhone rendered enough sharpness, giving extra clarity to the edges of the altocumulus clouds. The drawback of this image is that the clouds in the sky kinda messed up, which makes observations and cloud identifications more difficult and less accurate. Generally speaking, this image shows the types of cloud that can be expected in an unstable atmosphere and, to some extent, demonstrates the correlation between cloud formation and atmospheric stability.

Reference:

[1]Houze, R. A. (2014). *Cloud dynamics*. San Diego, CA, United States: Academic Press.

[2]Photographs of altocumulus (2013). *Weather*, *68*(5), 127–127. doi: 10.1002/wea.2119

[3]Cumulus cloud (2016). . In *Wikipedia*. Retrieved from https://en.wikipedia.org/wiki/Cumulus_cloud