

# Alto cumulus over Boulder, Colorado



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## Introduction:

Most clouds are perceived as weather like thunderstorms, tornados, or snow, but few people realize the simple, yet very complex beauty of clouds in their everyday lives. While they may seem plain because we look at them every day, they are far from ordinary. Many people don't actually "see" the clouds, but merely notice the shadows they cast on their picnic or walk. In fact, clouds provide key clues to weather patterns and atmospheric conditions. They have been studied and observed for centuries and are an art that is impervious to the changing world. They are everywhere in the world and their beauty can be admired by everyone in the world at almost any second of any day. All these things contribute to the beauty of the sky. This image captured is just a mere instant of the ever-changing masterpiece when the Colorado sky contained a particular pattern illuminated by the setting sun. This report will dive into some of the methods used to photograph the clouds and the post processing, as well as the physics behind the formation of the clouds and atmospheric conditions that were present.

## Methods and Post Processing:

The photo was taken on Feb 18, 2011, at 5:49pm, just after the sun had sunk behind the mountains at 5:40pm but before the full civil sunset which was predicted at 6:08pm<sup>1</sup>. It was taken facing southwest from North Boulder Park in Boulder Colorado at about 40° above the horizon. The picture was taken with a Panasonic DCM-TZ3. The shutter speed was 1/400 seconds with a focal length of 4.6mm (28mm equiv.). The f stop was 8.0 with an ISO of 100. The image is 3072 x 2304 pixels. Only the contrast was increased during post processing of this image to make the mountains more of a shadow and to make the clouds stand out from the sky. In the image, the silhouette of the Flatirons to the left and Dakota ridge to the right can be seen behind the scattered clouds in a mostly cloudless sky. Throughout the day the weather was mostly mild with only a few scattered clouds. There were no fronts approaching in the forecast for the near future, although a cold front had recently passed. The temperature was about 45°F, typical for a Colorado February. The skew-T plot from the Denver International Airport weather station shows no temperature low enough to form clouds, although the image was taken about 30 miles from where the weather balloon data originates.

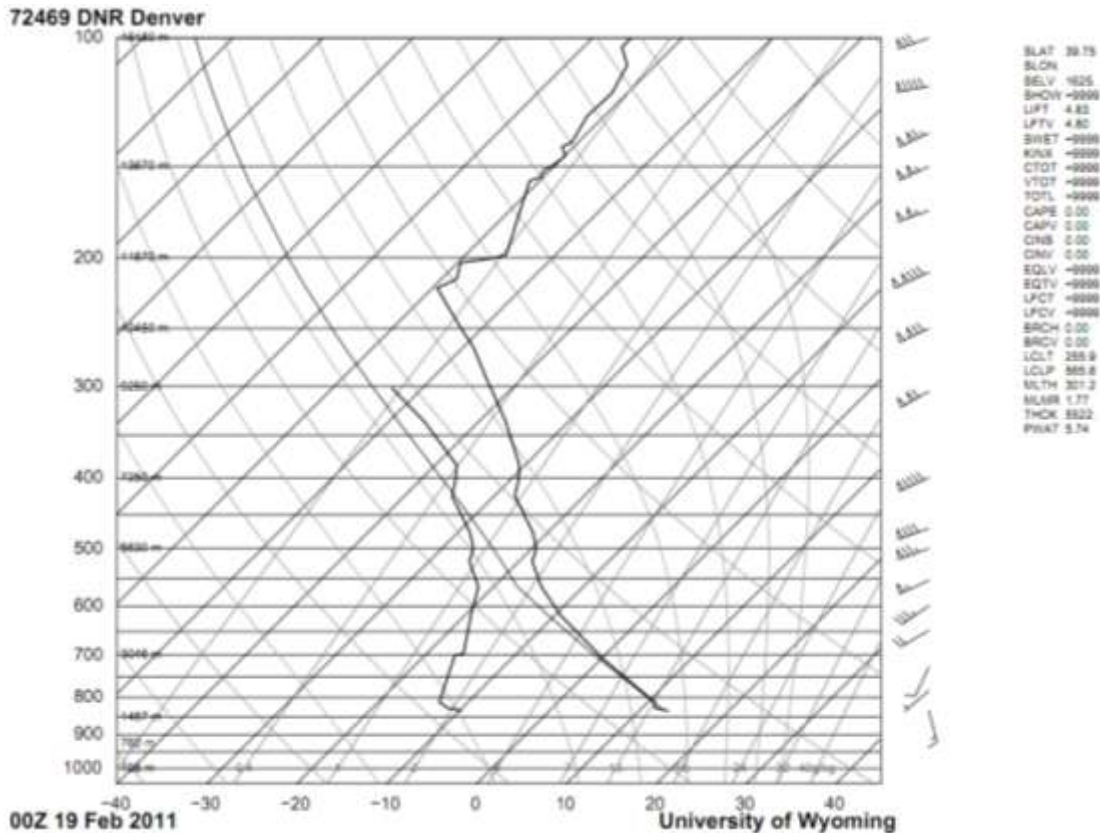


Figure 1 - Skew-T Plot from Denver<sub>3</sub>

The skew-T plot in Figure 1 shows that the temperature measured by the weather balloon never crossed the dew point, but came closest between 5,000 and 7,000 m (16,500ft to 23,000ft) above ground. The balloon was sent up at 5pm on the 18th, so the atmospheric conditions at the time the image was taken are similar to the skew-T. The Convective Available Potential Energy (CAPE) and Planetary Boundary Layer (PBL) values from the plot are both zero which indicates a stable atmosphere during the day.

Analysis:

From the approximate altitude of the “mid-level” clouds and the shapes of the cloudlets, it appears to be an altocumulus formation halfway between the ground and the top of the troposphere. Within the altocumulus genus, the large coverage area, clumps, and shadows in the clouds make the species stratiformis. Finally, the parallel nature of the cloudlets across the sky would put the clouds in the undulatus variety. Therefore the image is of altocumulus stratiformis undulatus clouds<sub>2</sub>. Typically the altocumulus stratiformis are caused by chaotic eddies and thermals in the atmosphere as seen in Figure 2.

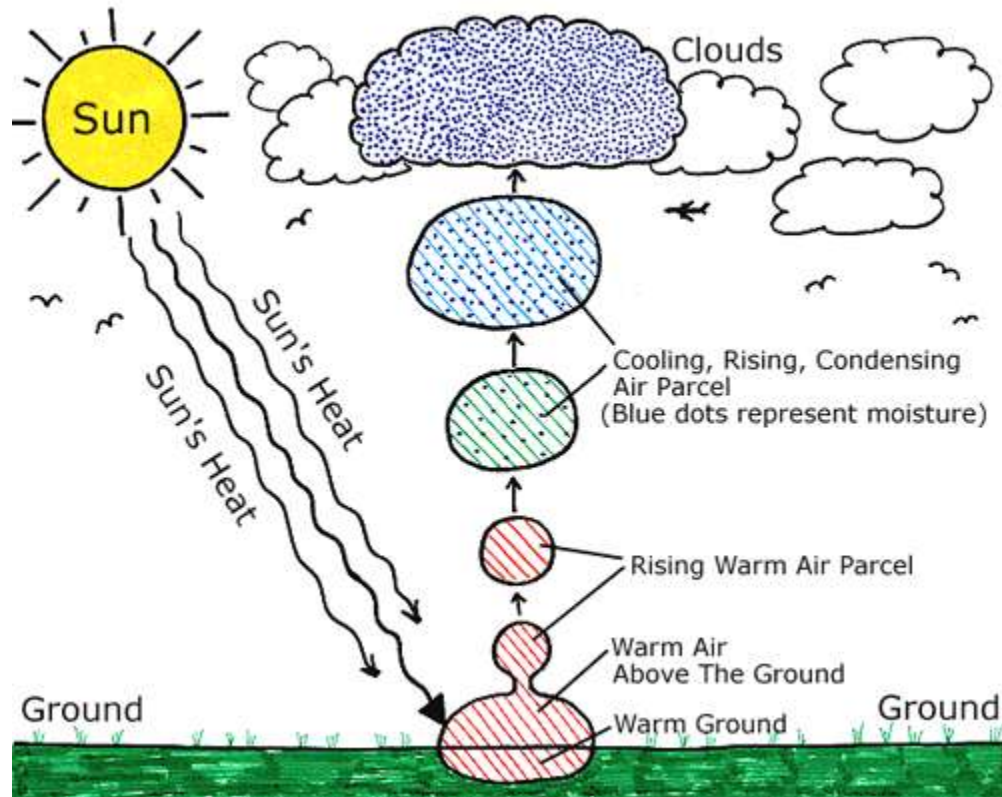


Figure 2- Formation of clouds due to thermals<sub>4</sub>

Since these altocumulus clouds are low enough to feel the effects of the warm ground air parcels rising and condensing, they form into shapes. The wind patterns also help them form the parallel arrangements seen in the image.

Conclusion:

What seemed to be a normal evening over North Boulder Park really held many small clues to finding out what the atmosphere was doing that day and the beauty that it can hold. The image shows particular formation rather well, while still having some artistic splendor in it. The mid-sunset timing provided great lighting for the formation to be seen and accurately captured, therefore the intent of the image was fulfilled. Even though the image was taken by an amateur photographer as a first attempt to capture the magnificent Colorado sky, it still portrays the brilliance of the clouds. The more time spent photographing the sky and being mindful of the clouds will allow better and better images to be produced in the future.

References:

1. U.S. Naval Observatory, Astronomical Applications Department, Sun and Moon Data, 2011.  
[http://aa.usno.navy.mil/data/docs/RS\\_OneDay.php](http://aa.usno.navy.mil/data/docs/RS_OneDay.php)
2. Pretor-Pinney, The Cloud Spotter's Guide, The Science, History and Culture of Clouds. The Berkley Publishing Group, 2006, New York NY.
3. University of Wyoming College of Engineering Department of Atmospheric Science. Atmospheric Soundings. <http://weather.uwyo.edu/upperair/sounding.html>
4. McKemy, Dan. Climate Education. North Carolina State University, Raleigh, NC.