Clouds First Report

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Altocumulus
February 27, 2018
10,000ft ASL, over the Flatirons

Flow Visualization
MCEN 4151
Dr. Hertzberg

This report details the methods used behind the creation of the image below in Figure 1. This image shows the pleasing aesthetic of a form of cumulus cloud, specifically, an altocumulus, that was formed as the result of a mountain wave. A big thank you to Ryan Neff for his piloting skills and assisting me in capturing this image.

Figure 1: Submitted image of Altocumulus clouds

This image was submitted for the Flow Visualization Spring 2018 Clouds First assignment. The intent of this image was to capture the beauty of clouds formed by mountain waves.

The picture was taken at approximately 1300hrs on February 27, 2018 and was captured at an altitude of about 10,000ft above-sea-level, from the cockpit of a Cessna 172 Skyhawk, a small fixed-wing aircraft. The angle is approximately 30 degrees above the horizontal, from a distance of about half a nautical mile, at a passing speed of about 63 knots indicated airspeed.

In order to get a baseline understanding of the atmospheric phenomena that allowed for the creation of the clouds shown, please refer to the schematic in Figure 2 below. The location of these clouds was directly about the Flatirons. Given the location and altitude of the clouds, it can reasonably be assumed that these clouds were indeed formed by mountain waves. In mountain wave cloud-formation (Figure 2) high-speed winds flow over the ridgelines of mountain ranges and "ripple" outward for miles. At the peaks of these waves, humidity is significantly higher than at other locations, allowing for condensation of water in the air into clouds. These clouds, officially, *altocumulus* is what is seen in Figure 1. [1]

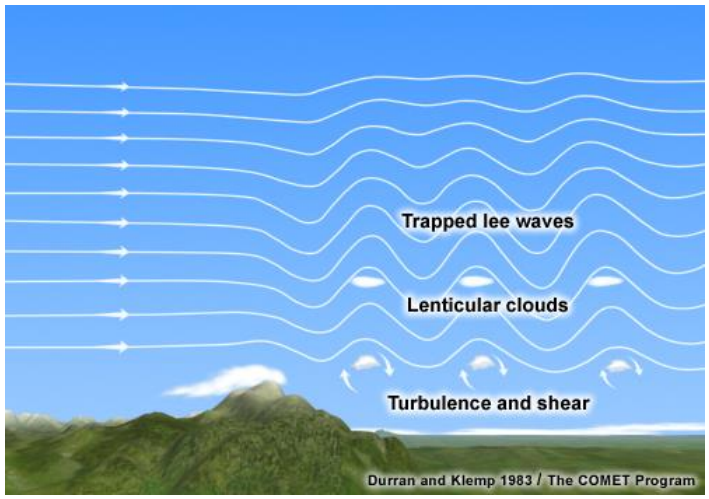

Figure 2: Diagram of mountain wave cloud formation

The rest of the sky that day was clear, and the only clouds in the sky were those immediately above the Flatirons. The atmosphere was relatively stable that day as well, and we can analyze the skew-T chart in Figure 3 below to confirm this. Note that the CAPE for this day was 0.00. Looking at this chart at the indicated altitude of approximately 10,000ft ASL (3048 m), we see that the lines for dew point and dry bulb temperature, originating at around -10 and 0 degrees Celsius, respectively, intersect. This is just above the isobar nearest to the altitude at which the clouds were observed (approximately 700 mbar). This intersection is where clouds can be predicted to form, and as expected, is where the clouds captured in Figure 1 actually formed. [2] Please note that the Skew-T chart provided was from the nearest NOAA station in Denver (DNR).

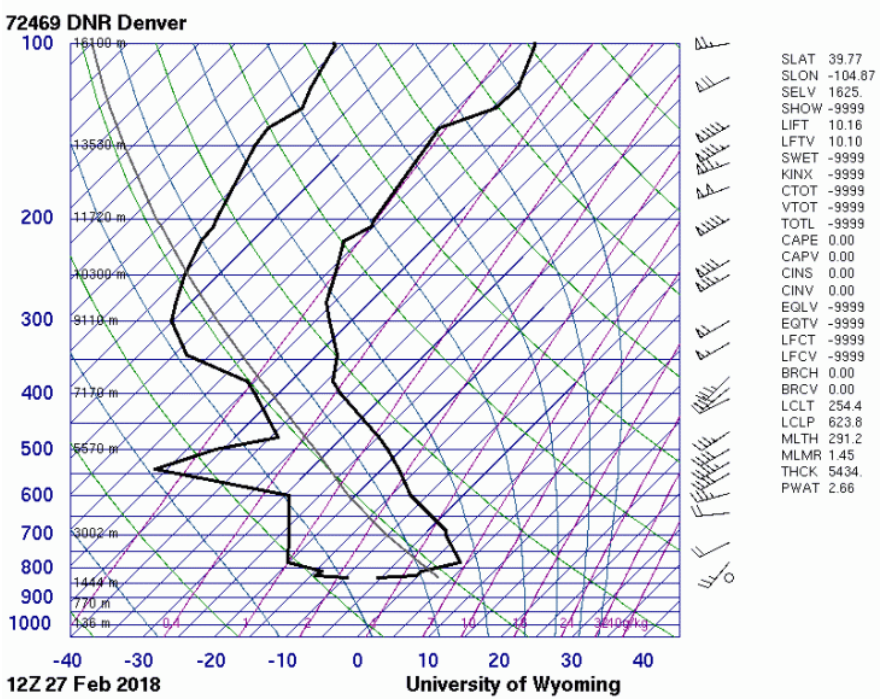

Figure 3: Skew-T chart for 2/27/18

The specifications of the photographic technique in capturing this image were as follows:

- The field of view was about 100 feet wide
- The distance of the cloud from the camera was maybe ½ nautical miles
- The camera used was a Canon PowerShot SXH30 HS point-and-shoot camera on aperture priority mode.
- The settings were as follows: F5.0, 1/1600. ISO100, with auto white balance.
- The image contrast and blue saturation were boosted in Photoshop CS2. See below in Figure 4 for a comparison.

Figure 4: Original picture (left) vs. edited image (right)
Image size: 4608×3456 px

This image reveals the beauty of mountain wave clouds. I like the brightness of the clouds provided by the light of the sun shining through them. Next time I'd probably like to improve usage of my camera in order to increase focus and resolution. All in all, I am quite pleased with this image and feel that it captures what I was intending to.

Works Cited & Consulted

1. Reynolds, James. "The Hidden Dangers of Mountain Wave Turbulence." *The Front*, Nov. 2011, www.weather.gov/media/publications/front/11nov-front.pdf.

2. Martin, Jim. "Skew T's - How to Read Them." 2015. http://flsc.org/portals/12/PDF/Read_Skew_T.pdf

3. "Altocumulus Lenticularis." *Altocumulus Lenticularis - Altocumulus - Names of Clouds*, www.namesofclouds.com/altocumulus/altocumulus-lenticularis.html.