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Cloud #1 - MCEN 5151
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The second project of the Flow Visualization class was titled "Cloud #1." The goal of this assignment was to provide a fascinating cloud photo, identify the species of clouds and explain why the clouds are present using meteorological data (SKEW-T chart). I wanted to capture some high clouds such as cirrus since they show amazing, defined streaks that are contrasted by a blue sky. The weather did not produce any cirrus clouds. Instead I took multiple pictures throughout the week of February 11.

The photo location was the front of my house in Broomfield, CO. My house has a nice view of the mountains and a large open space for cloud pictures. The photo was captured on 15 February at roughly 1550 (the camera time was off by one hour). That day had a slight overcast with the sun peaking through often. The camera was facing west and roughly 75 degrees from the horizon. The neighborhood is around 5400 feet above sea level.

Figure 1: Submitted image for project

From the image it looks like there are three distinct cloud Genus. The first species is the Cirrocumulus stratiformis undulatus, and it is located at the top of the photo. Cirrocumulus are characterized by high patches of layers of tiny cloudlets that appear as white grains and are generally regularly spaced, arranged in ripples, see Figure 2.[1] These clouds are typically 16500 feet or higher. Since the temperature and dew point lines are nearly touching at two spots on the SKEW-T plot in Figure 4, it is very likely that the clouds were at 15000 feet and 36000 feet in a stable atmosphere. The data on the SKEW-T plot is two hours after the capture of the photo. These cloudlets are formed by choppy winds and high moisture levels in upper troposphere, usually showing a sign of poor weather coming if there are large numbers of them.[5] No poor weather followed the clouds in the image. The wavelike motion is developed by the air being forced over mountain ranges.[1]

Figure 2: Example of Cirrocumulus stratiformis[2]

Figure 3: Example of Altocumulus undulatus[3]

The next species is the Altocumulus stratiformis undulates, which would be on the bottom of the image. These clouds are characterized by mid-level layers that are in the shape of rolls.[1] The undulates is a variety that had cloudlets arranged in nearly parallel lines. The SKEW-T supports this since these clouds are typical from 6500 to 18000 feet. Also, the wind at the 15000 feet level was mostly northerly, and this is probably why the rolls run east to west since they are perpendicular to the wind. These clouds are mid-level atmospheric disturbances and wave propagation typically caused by mountains.

The third cloud type is not obvious to identify. According to Weatherspark.com, the cloud ceiling at 1600 on 15 February was 9000 feet with 90% cloud cover. So this could not be a Stratus fractus as originally thought since these exists only up to 6500 feet. The next possibility is that it is an Altostatus translucidus. An Altostratus is described as a mid-level layer of grey clouds that are either featureless or fibrous in appearance and extend over a large area, and they exist from 6500 – 23000 feet.[1] The variety of translucidus further describes the cloud as thin enough to show the position or the sun or moon.[1] I believe that this is the best fit that can

be determined by the meteorological data and SKEW-T chart even though the cloud is really more white than grey. On 14 February there was a lot of cloud cover with a ceiling ranging from 1900 to 12000 feet, and less than 0.1 of precipitation as snow.

The size of the field of view is not easy to estimate, but I approximate that it is two to four miles square. The distance from the cloud to the camera is estimated to be 10000 feet to the closest cloud and 31700 feet to the furthest. Basic trigonometry was used to calculate the distance. The camera used was a Canon PowerShot SD870 IS and was used in the auto mode since there was plenty of light and time to capture many images. The F-stop was f/13, and the focal length was 11 mm. The exposure time was 1/320 of a second, and the ISO was set to 80. The original image was 3264 pixels wide and 2448 pixels high. The image was minimally modified using Canon's photoshop program ZoomBrowser EX. The blue was brightened a little, and the contrast was darkened some to show the dark lines behind the clouds.

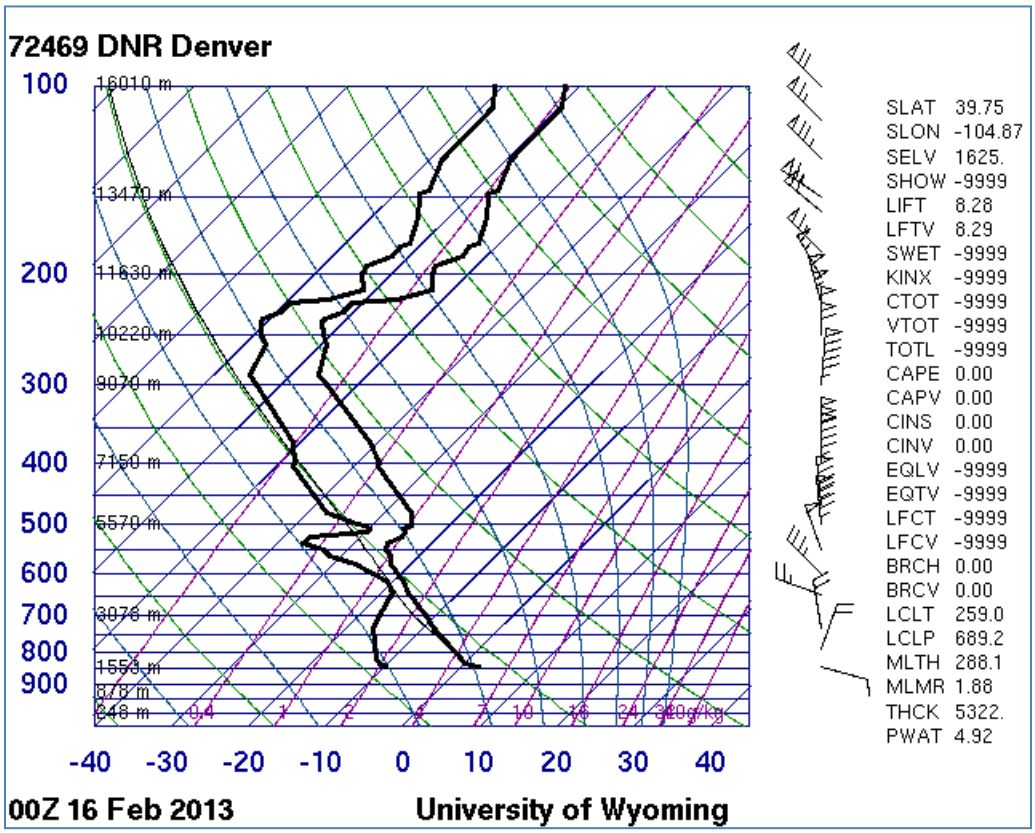

Figure 4 : SKEW-T for Denver at 1800 MST on 15 February[4]

The image reveals that clouds can exist together, layered by different elevations. I like the clearness of the two clouds but desired to have better clarity on the smooth, transparent cloud. The physics are well shown by the cloud characteristics with the Skew-T and meteorological data. I did fulfill my intent, but I want to improve by better planning in timing and location of picture. Beforehand I was relying on opportunistic shots.

References

[1] Pretor-Pinney, Gavin. The Cloudspotter's Guide: The Science, History, and Culture of Clouds. 2006.

[2] The Cloud Appreciation Society website: http://cloudappreciationsociety.org/collecting/stephen-burt/.

[3] The Cloud Appreciation Society website: http://cloudappreciationsociety.org/collecting/tomislav-kordaso/.

[4] Skew-T chart obtain from http://weather.uwyo.edu/upperair/sounding.html.

[5] http://nenes.eas.gatech.edu/Cloud/Clouds.pdf.