Altostratus Clouds North of Bear Peak near Boulder, CO

Andrew Scholbrock
University of Colorado at Boulder

March 2nd, 2011

Figure 1: Final image of altostratus clouds taken from the summit of Bear Peak looking north

The purpose of this image was to look at a variety of atmospheric conditions by studying different types of clouds, and determine how certain cloud types correlate to atmospheric conditions. Additionally it was also done to appreciate some of the nice aesthetic features of different clouds. Much time was spent looking up at the clouds, and if I saw something interesting I would photograph it. The problem was that much of the time I was not located in an ideal place and as such had objects in the foreground which is something that I set out to avoid. Hence in the final selection of my clouds the choices came down to images taken from times where I was specifically out looking to photograph clouds. In the final image selected I was located on top of Bear Peak, just west of Boulder, CO looking north. That day the sky was producing some interesting cloud formations as it was partly sunny up in the mountains and overcast elsewhere. The clouds captured in the image are that of altostratus type clouds.

As mentioned above, the image was taken from the summit of Bear Peak which is located between the Flatirons and South Boulder Peak just west of Boulder, CO. The mountain's elevation is 8,461 ft. or 2579 m. To access the trails that lead to the summit one can park at the National Center for Atmospheric Research Mesa Lab parking lot and take the Mesa trail to the Fern Canyon trail. The angle of which the image was taken was roughly horizontal. Much of the landscape was cropped out in the final image so that the clouds would be the central aspect of the image. The image was taken looking north towards Lyons, CO. It was taken in the afternoon at 1:17 PM on Saturday, January 15, 2011.

The main cloud type in the image is that of an altostratus cloud. Judging from my elevation (roughly 3,000 ft. higher than the Boulder area) and where the clouds where I would estimate that the height of the clouds were about another 4,000-6,000 ft. higher than I was putting them at an elevation somewhere around 7,000 to 9,000 ft above the surface. Typical altitudes for altostratus clouds are in the range of 6,500 to 23,000 ft. [1]. Hence my estimates are in agreement with the typical altitudes that these clouds are observed at. Another distinct feature of these clouds that helped me identify them as altostratus clouds was the fact that the clouds were very broad and covered a large area. Additionally the clouds were somewhat featureless towards the right of the image and somewhat fibrous towards the left. These features are again typical features that are seen with altostratus clouds [1]. In addition to analyzing the shapes and altitudes of the clouds, the atmospheric conditions were also studied. Figure 2 shows the atmospheric sounding data from the University of Wyoming that was collected at 6 PM on the same day that the image was taken [2]. From this plot we can see that the dry air temperature profile shows that the atmosphere is stable [3]. This is consistent with the 0 value for the CAPE analysis given on the right of figure 2 [3]. Although the dew point never touches the dry temperature, it is closest at an elevation of about 4,000 meters, or about 13,000 ft. This value is a little higher than what I estimated the cloud elevation to be. Also in the image the base of the cloud is very rough suggesting that the atmosphere is unstable. These discrepancies between what was observed in the clouds compared to the SKEW-T plot in figure 1 can be attributed to the fact that there was about a 5 hour time difference and about a 40 mile special distance in when and where the clouds were imaged versus where the sounding data came from. Without a closer temporal and spatial SKEW-T data any further comparison between sounding data and what was observed would be hard to achieve [4]. The weather on January 15th produced no precipitation. The weather before and after that day also did not vary that much meaning that there was no front passing through. The temperatures from January 13 to January 18 consisted of highs in the range of 46°F to 55°F and lows in the range of 30°F to 35°F [5]. Wind speeds were in the range of 10 to 20 mph [5]. In observing the rest of the sky I noticed that to the west over the mountains it was clearer, and there were some higher cirrus clouds. This difference is due to the fact that the terrain of the mountains has a huge impact on atmospheric conditions and can lead to different types of cloud formations [6]. As I looked at the edge of the clouds in my image it looked as though the cirrus clouds to the west were almost merging with the altostratus clouds. This may be due to some updraft winds which in turn cause the altostratus clouds to rise and begin to be composed of ice crystals in addition to water droplets [7]. The merging of the two clouds may also just have been from the fact that the two cloud types were so far away that it was hard to distinguish the edge of one cloud or another.

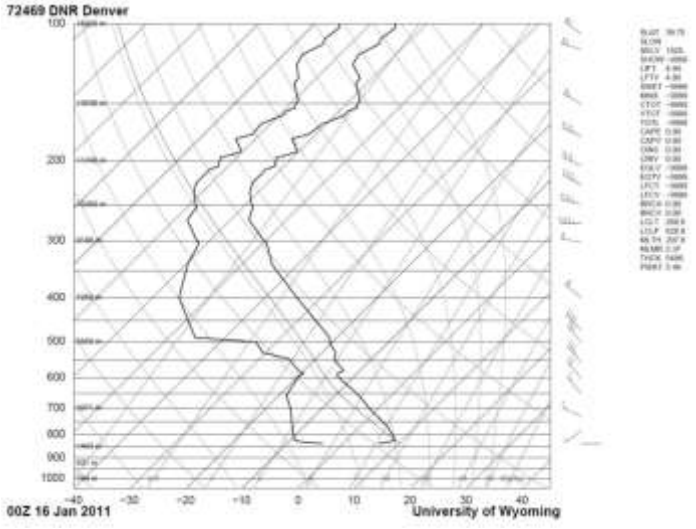

Figure 2: Atmospheric Sounding Data from the University of Wyoming for the Denver area at 6 PM of the day that the clouds were photographed [2].

To photograph the image I used a digital Panasonic DMC-ZS7. I chose this camera because it is small, portable and lightweight making it ideal to carry along with me at all times, especially while hiking. The other nice aspect of the camera is that it is equipped with a GPS unit that geo-tags where each image was taken. The size of the field of view is hard to guess as it was a landscape shot looking north from the top of a mountain. If I were to estimate the field of view I would have to say that it is on the order of about ten miles as I can see some of the mountains in Rocky Mountain National Park in it as well as some of the plains northwest of Lyons, CO. The distance from the object (say where the focal plane is, near Lyons, CO) to the lens is about twenty miles. The focal length of the lens was 4 mm. The original image size in pixels was 4000 pixels wide by 3000 pixels high. This was then cropped down to the final size of 3987 pixels wide by 1887 pixels high. In exposing the image an aperture of f/3.3 was used along with a 1/640 second exposure time and an ISO of 125. The aperture and exposure time were manually set while the ISO was determined by the camera. Additionally a manual focus was used (set to infinite mode) and I forced the camera not to use its flash. Post processing was then done on a computer using the open sourced program GIMP version 2.6. In GIMP the image was first converted from a JPEG to a TIFF image without any compression. The next step was to increase the contrast using GIMP's "curves" feature. With this done the saturation of the image was then increased. Finally some small specs were removed using GIMP's smudging tool.

What is neat in the image is that the underside of the surface of the clouds is very rough and creates a gloomy almost ominous feel to them. Additionally the lower clouds in the image also seem to have a distinct edge on the left side which roughly follows the edge of the mountains. This shows that terrain can play a huge role in the atmosphere even though the clouds are much, much higher than the surface of the earth. My intent in capturing some clouds, determining how to classify them, and appreciate the aesthetic qualities of clouds were all realized through this project. To improve the image I think that I would like to experiment with the aperture of my camera in order to see what different depth of field effects would play on producing an image. Additionally I would like to go hiking at higher elevations and hope to capture an image where the cloud ceiling is below me.

References:

[1] G. Pretor-Pinney, "Altostratus," in *The Cloudspotter's Guide: The Science, History, and Culture of Clouds*, New York, Perigee/Penguin Publishers, 2006, ch 6, pp. 136 – 149.

[2] SKEW-T Weather, University of Wyoming, College of Engineering, Department of Atmoshperic Science, <http://weather.uwyo.edu/upperair/sounding.html>, Last accessed March 3, 2011.

[3] Haby, Jeff, "SKEW-T Basics", <http://www.theweatherprediction.com/thermo/skewt/>, Last Accessed: March 3, 2011.

[4] Andersson et. al., "Global Observing System Experiments on Operations Statistical Retrievals of Satellite Sounding Data," Monthly Weather Review, American Meteorological Society, Vol. 119, No. 8, pp. 1851-1865, 1991.

[5] Weather Underground Archived Weather History. <http://www.wunderground.com/history/airport/KBJC/2011/1/23/MonthlyHistory.html#calendar>, Last Accessed: March 3, 2011.

[6] R. Yu et. al., "Climate Effects of the Deep Continental Stratus Clouds Generated by the Tibetan Plateau", Journal of Climate, Vol. 17, pp. 2702-2713, July 1, 2004.

[7] G. W. Paltridg et. al. "A case study of ice particle growth in a mixed-phase altostratus cloud", Australian Meteorological Magazine, Vol. 34, Issue 4, pp. 149-154, Dec. 1986.