Morning Blues

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Clouds 1

Image description:

Cloud formations are one of the most common naturally occurring flow visualizations and in my opinion, one of the most beautiful. The fact that clouds are ever evolving and nearly every cloud is different in size, shape, and overall characteristics provides endless insight into the fluid flows within the atmosphere. The purpose of this assignment is to capture the fluid dynamic phenomenon as they occur in cloud formations. In addition, potentially new information can be obtained from the images captured given the developmental cycle of clouds under specific atmospheric conditions. The motivation for this assignment came from not only to capture the most beautiful and shapely clouds as possible, but also in a way that displayed various fluid flow phenomenon in one photograph. It was determined that the best atmospheric conditions to fulfill these desires was to capture an image when the atmosphere is stable, yet has higher wind gusts. These wind gust result in more complex atmospheric conditions and therefore more interesting clouds in the winter months. In addition, it was intended to capture the brightest blue sky possible to add contrast and coloration to the image.

Method for capturing Phenomenon:

The image seen on the title page was taken in Broomfield Colorado. In addition the image was captured at approximately 7:45 a.m. on Tuesday, February 14th. It was selected to take the image in the early morning due primarily to the sun not lying directly over the clouds which heightened the details of the lower (visible) portion of the clouds. In addition, during the Colorado winter months, the sky tends to be the most brilliant and bright in the hour following the sunrise. This is evident in the image by the large blue gradient running from the left upper corner to the right lower corner of the image as it is directed towards the horizon. The image was developed using the panoramic setting on the camera used in which three individual images are automatically stitched together to form one large image. Due to the arch shape developed when using the panoramic setting, the image appears to be pointed towards the horizon but the overall center of the picture is actually at roughly an 80-degree angle from cameras location. The directional plane of the image is running northeast pointed slightly towards the sunrise.

Clouds and phenomenon:

Through anaylsis of not only the image but the skew-T plot as well, it has been determined that the cloud formations primarily present in the image are that of Altocumulus. In addition there appears to be areas that resemble Altocumulus castellanus given the cloud has turrett appearing fetures and relatively flat bases with uprising tops. In addition, on the outer edge of the clouds there appears to be areas that culd be classified as Altocumulus floccus given the wispy nature of the formations. This was determined by first looking at the image in which you see relatively flat layers yet is made up of individual clouds with lighter and

darker components. In addition the clouds appeared relatively high which is characterisitic of Altocumulus cloud formations. The initial height approximated was roughly 14000 feet based off that fact that when looking west, you could see that the clouds were slightly above that of Longs Peak which is at an elevation of roughly 14300 feet indicating a cloud height of just above 14300 feet or 4300 meters. This middle atmospheric elevation is solidified when looking at the skew-T plot below (figure 1). From this plot it is evident that the two lines come closest at an bsolute elevation of approximately 4400 meters and give the mile high altitude of Colorado, a relative altitude of 2800 meters, indicating the highest probability of cloud formation. This aligns with the Altocumulus cloud formation because they are primarily developed at elevations ranging from 2000-7000 meters[1].

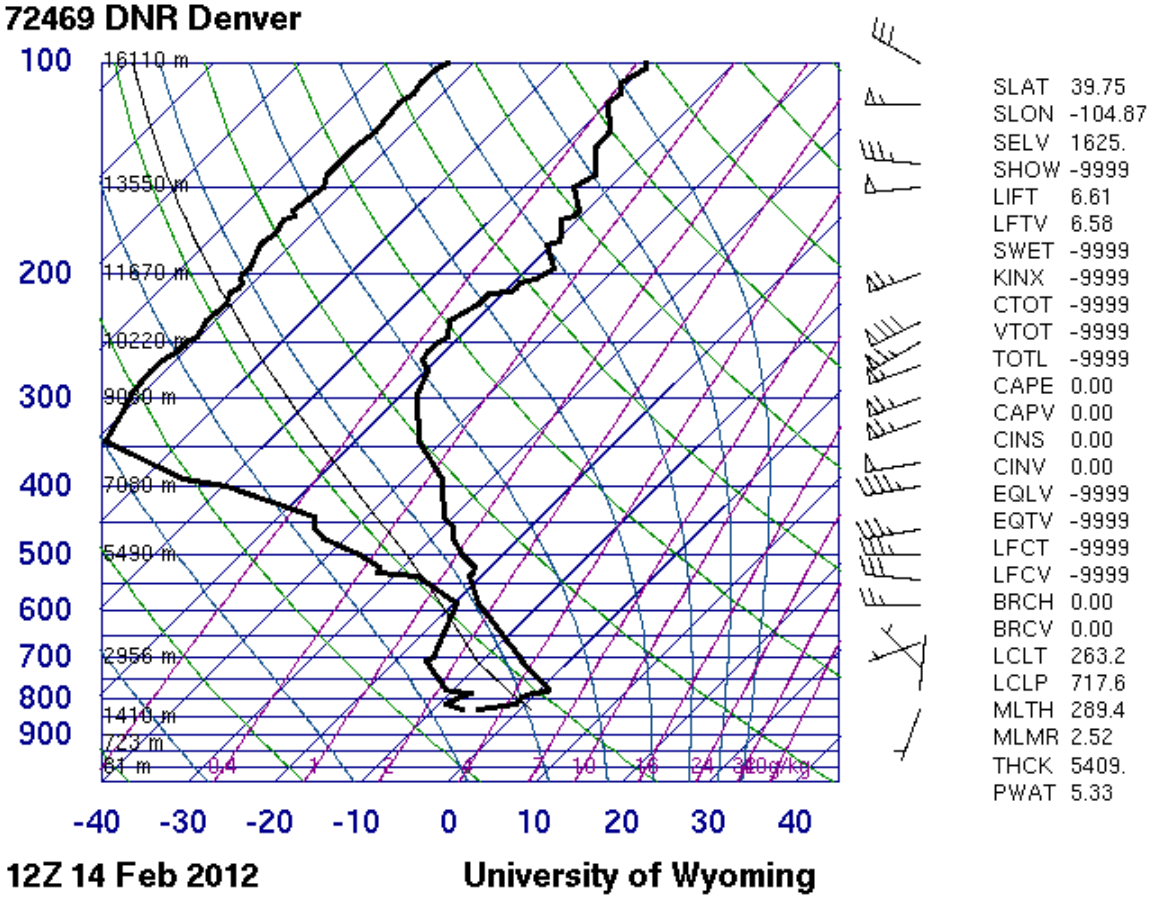

Figure 1: February 14th 6 a.m. Skew-T plot[3]

The cloud formations at the time the image was captured was cosistent with that of the image with sparatic clouds from the mountains to the horizon. The sky at the time was especially blue as evident in the title page image and the image has no post processing to enhance the blue coloration. There was no rain or snow on the day the image was taken, yet it was forcast that the winds would be approximately 20-30 mph. This accounts for the disipation of a few of the

clouds in the image which display the interesting physics the wind has on the jet stream and how the wind effects the fluid dynamics of the atmosphere. Though relatively breezy, the air in the atmosphere is considered stable which is evident when looking at the CAPE value of the skew-T plot. The CAPE value is zero which indicates complete stability of the air in the atmosphere. This stability information provides additional support to the conclusion that the clouds present on the day and time of the image are that of Altocumulus given they are formed in stable air at a middle elevation. The overall clouds presented in the image developed quite rapidly given the wind gusts and formed due to the higher than normal humidity rising in the atmosphere.

Photographic technique:

The photographic technique used to make this image was limited due to the use of a Kodak easyshare Z981 which is in essence a point and shoot camera. The camera saves its pictures in a digital format with a pixel quality of 14.1 megapixels. Though the camera has the option to adjust the exposure time and ISO the two cannot be adjusted at the same time. For the case of taking an image of the bright sky it was decided to keep the ISO at the 400 pre-set value and adjust the shutter speed. A faster shutter speed of 1/800 was set in order to capture as much detail as possible of the cloud formations. Due to the high wind the faster shutter speed proved to be beneficial in reducing motion blur. Though the field of view size is hard to approximate given the long distance and panoramic effect, it can be approximated when you approximate the width of the clouds closest to the camera. It was approximated that the largest cloud in the image is roughly double the elevation of the clouds. This is due to the fact that if you half the cloud you could approximate that the cloud would run from the ground to roughly the 4400 meter height. Therefore since the cloud runs nearly the width of the image, it can be roughly determined that the width of the image is 9000 meters. Since the photographic angle is so large and runs down to the horizon, the height can be approximated to be just under 4.5 km. This is based off the knowledge that an average height male can see roughly 4.8 km before they reach the horizon[2]. Therefore since the angle is near 90 degrees this distance is just slightly reduced. In addition since the cloud was nearly overhead, the distance from the camera to the cloud formation is slightly above its vertical height. Through Pythagorean theorem it was determined that this distance is approximately 4470 meters.

There was very little post processing done to the image due to the fact that the intent was to capture the cloud formation in a natural form without extensive editing. The image was simply cropped and edited to sharpen the image slightly while avoiding potential grainy formation. The original image pixel size is 5408 pixels wide and 1408 pixels in height and after cropping the image size is 3536 pixels wide and 1390 pixels in height. As previously stated the bright blues obtained in the image are simply due to the early morning photograph time and natural lighting.

Conclusions:

Overall this image successfully accomplishes the initial desires to not only to capture the most beautiful and shapely clouds as possible, but also take the image in a way that displayed various fluid flow phenomenon in one photograph. This was accomplished due primarily to the wind gusts present, which resulted in wind blow formations of the same Altocumulus clouds given the direction and speed of the gusts. From these gusts different atmospheric fluid characteristics can be seen in the title page image with thin wispy clouds pulling away from the large stereotypical Altocumulus formations demonstrating the variability in the atmosphere. These fluid physics are show quite well in the image given the higher shutter speed, which reduces the motion blur and shows clear flows within the formations. As with most good cloud image, questions are developed in which further research is required to answer. One question in particular that was formed was "why is there a clear section of clouds that is affected by the gusts while another seems highly formed"? My favorite aspect of the image is the blue gradient developed in the sky when combined with the highlighted clouds from the sun not being directly overhead. An aspect that I would like to change is the three images taken to form the panoramic effect. Significant cropping was needed to edit houses, cars etc… which would have been valuable pixel space to photograph more clouds. If this photo would to be attempted again, I would simply find a location with less surface detail such as houses to obtain the greatest span of sky and cloud formations. Overall I enjoyed this assignment greatly and gained a much greater appreciate of the physics that occur daily in our atmosphere.

Bibliography:

[1] "Altocumulus." *Windows to the Universe*. National Earth Science Teachers Association. Web. 01 Mar. 2012. <http://www.windows2universe.org/earth/Atmosphere/clouds/altocumulus.html>.

[2] "How Far Away Is the Horizon?" *Life's Little Mysteries*. Web. 01 Mar. 2012. <http://www.lifeslittlemysteries.com/16-how-far-away-is-the-horizon.html>.

[3]"72496 DNR Denver Skew-T." *Wyoming Weather Web*. Web. 01 Mar. 2012. <http://weather.uwyo.edu/cgi-bin/sounding?region=naconf>.