Clouds I: Concentration Gradient

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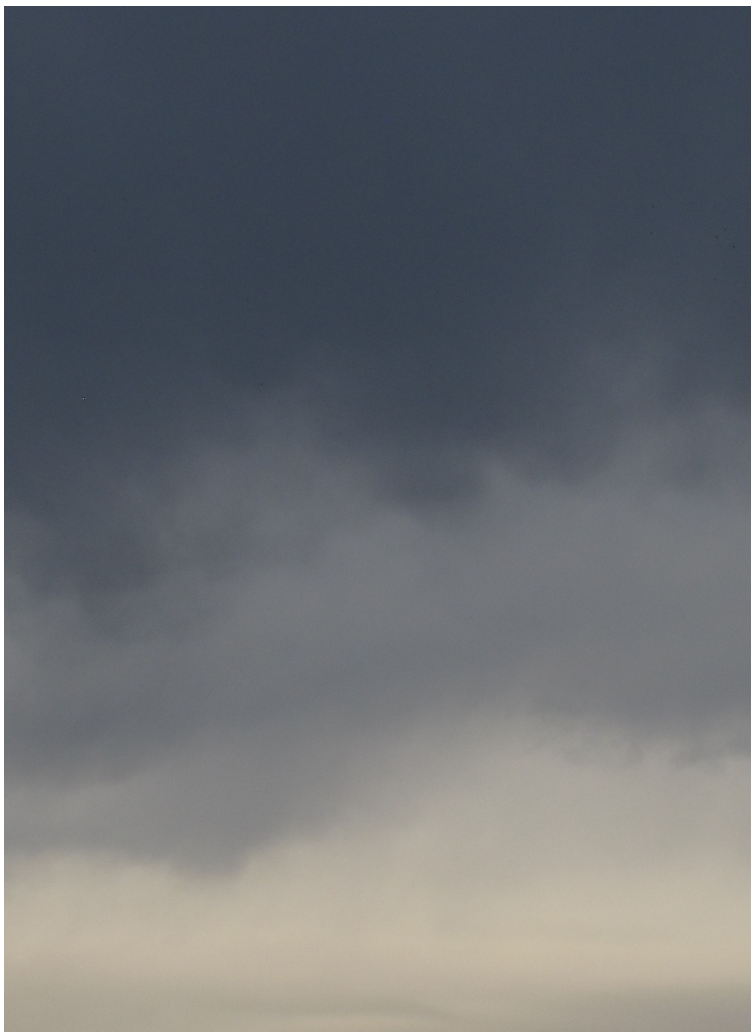

This image was created as a part of the *Clouds I* Assignment for the University of Colorado MCEN 4151: Flow Visualization course. This was the first cloud-based assignment of the Spring 2012 semester. The purpose of this assignment is capturing an image of a cloud, a medium though which various fluid phenomenon can be observed. This image was captured in order to demonstrate the gradient in cloud color caused by droplet concentration. During this photo shoot, approximately 30 photographs were taken.

The pictured set of clouds was captured from a westward facing direction on February 20, 2012 at 4:18 pm MST from the location at 40.01ºN, -105.26º E. The original image is shown in Figure 1. The camera location was approximately 2.5 miles from the base of the peaks shown in the background of Figure 1. The peak

pictured is approximately 1000 feet higher than the elevation that the camera was being held. Equation 1 shows the calculation of the angle of the mountain, which is approximately 42º above the horizon. This will later be used to determine the angle of the cloud with respect to the camera.

Equation 1

$$Mountain\ Angle = \tan\left({Height\ of\ Peak}/{Distance\ to\ Peak}\right) = \tan\left({1000}/{13200}\right) = 4.5º$$

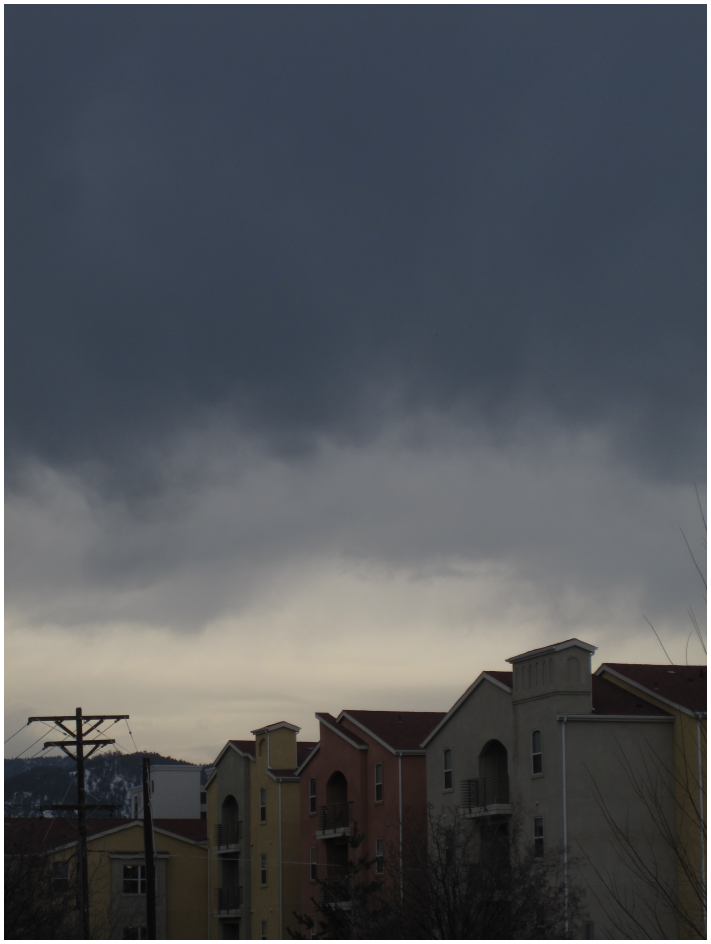

Figure 1: Original Clouds I image

This image contains two clouds. The background is a stratocumulus cloud that ranges from the lightest to darkest colors in the color gradient. Stratocumulus is one of the most common cloud formations in the world (Stratocumulus 2009). This is a low-lying cumulus cloud that sometimes produces rain (Stratocumulus 2009). The middle of the image contains another, smaller cloud. This is likely a cumulus fractus cloud. Cumulus fractus clouds form in an unstable atmosphere. Cumulus clouds usually only take form for approximately 15-20 minutes and cumulus fractus forms as the cloud is dissipated (Cumulus Fractus 2012).

The unstable conditions that lead to the formation of stratocumulus or cumulus fractus clouds were present on February 20. On this day, there was cloud cover to the west that did not stretch across the sky. The cloud cover was mostly to the north and west. The mean temperature on February 20 was 32ºF and the maximum temperature was 37ºF. The day before had the same mean and high temperature. The day after, February 21, had a mean temperature of 36ºF and a maximum temperature of 46ºF. Although no precipitation was recorded on February 20, this photograph was taken before a light misty rainfall that lasted approximately 1 hour. This time of day was not windy, although westerly winds were present later in the evening. Figure 2 shows the skew-t plot for the date and time of this photograph (Atmospheric 2012). Based on observations at the time of the photograph, it is likely that the lower, cumulus fractus cloud was at a lower altitude of approximately 300-500 m. The clouds in the background of the image may be at the height indicated by the plot. The CAPE is 0, which indicates a stable atmosphere. This is contradicted by the presence of clouds characteristic of unstable conditions. Based on the angle of the mountains (determined in Equation 1), the angle of the clouds pictured in the final image ranges from 6º to 20º above horizontal.

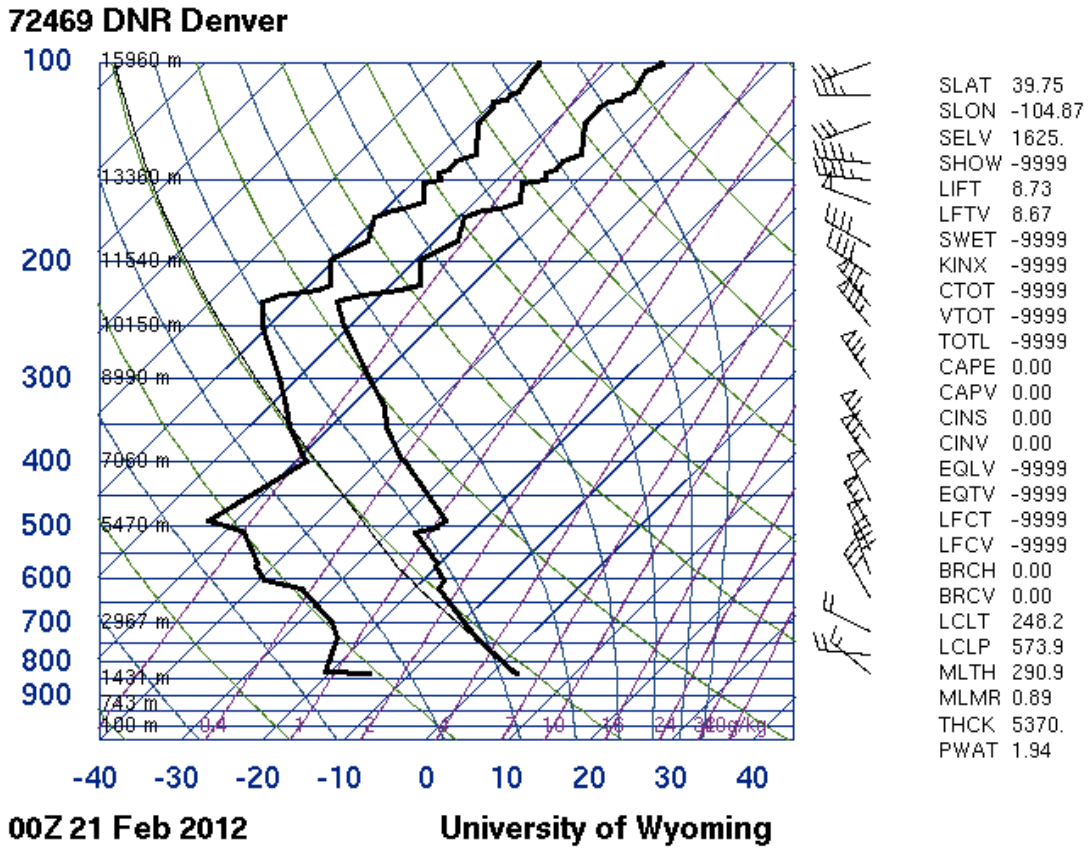

Figure 2: Skew-T plot for February 20, 6 pm MST (Atmospheric 2012)

Using local references (some are outside the field of view), it is possible to estimate the size of the field of view. The field of view is probably approximately 4000 feet

wide and 1 mile in height for the original image pictured in Figure 1. This was a 3000 x 4000 pixel image. The cropped image is 1517 x 2083 pixels. The cloud in the foreground was approximately 1 mile from the camera while those in the background were farther than 3 miles from the lens. The camera used to capture this cloud was a Cannon DIGITAL IXUS 100 IS with a focal length of 17.6 mm. The exposure specifications for this image include an aperture of f/5.8, shutter speed of 1/250 and ISO 80. A low sensitivity was used in order to decrease the noise on the image. A fast shutter speed was selected in order to cut down on motion blur from the camera since the low lighting did not lend itself to sharp images. These settings were helpful when capturing the detail in the coloration of the clouds so that the only manipulation to the original image was cropping rather than altering the coloration.

This image shows the extremes in the color gradient of clouds as sunlight shines through them. I like how the image is focused on the nearby cumulus fractus cloud, making the entire image appear as though it is only one cloud. The blurred edges and dull focus on the stratocumulus cloud in the background gives attention to the color rather than the cloud itself. The change in color shows how light is absorbed by clouds with respect to the concentration of water contained in a particular formation. To improve this image, it would be nice to experiment with stereo imaging and focus on both the cloud in the foreground and the cloud(s) in the background.

Sources

"Atmospheric Soundings." *Atmospheric Soundings*. Web. 08 May 2012. <http://weather.uwyo.edu/upperair/sounding.html>.

"Cumulus Fractus." *The Cloud Appreciation Society | Uniting cloud lovers around the world*. N.p., n.d. Web. 7 May 2012. <http://cloudappreciationsociety.org/collecting/janice-smith/>.

"Stratocumulus." *The Cloud Appreciation Society | Uniting cloud lovers around the world*. N.p., n.d. Web. 7 May 2012. <http://cloudappreciationsociety.org/collecting/claudia-harsch/>.