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351-336
10.11.07
Image Assignment 2: Clouds 1

My second submission for this class is derived largely from the reactions, personal and peer, to my first image. My goal was to capture an image that was foremost a beautiful picture. To this end, I shot at sunrise and sunset in the hopes of capturing the dim sunlight scattered by clouds. Specifically, my aim was to capture a sunset shot visualizing some of the amazing mountain-born clouds so typical in Boulder. In so doing I learned a lot about evening cloud formation and the utility of oblique lighting.

Figure 1 – Altocumulus undulatus at sunset

The series of images from which figure 1 was selected were taken 13.7 km from the foothills of the Rocky Mountains in Boulder. To gain ~4 meters (13') of elevation, I shot from the roof of a building on site. The surface normal of the camera CCD was oriented 310 degrees north by northwest. The local elevation for the image was ~1,595m.

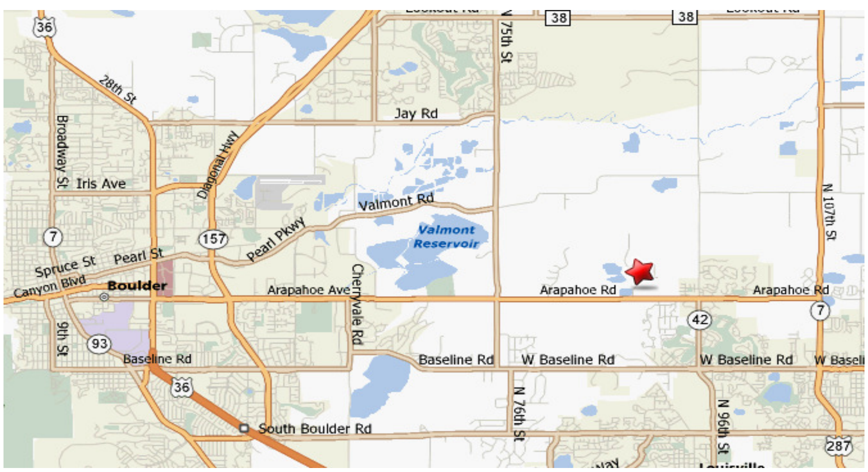

Figure 2 – Photographic Location (source: mapquest.com)

Local surface information provided by http://www.weatherunderground.com indicated the ground temperature was 26 C, local dew point 2 C, relative humidity ~32%, barometric pressure 1013 mbar (almost sea level pressure). Additional atmospheric sounding data from http://weather.uwyo.edu is shown as the skew-t plot figure 3.

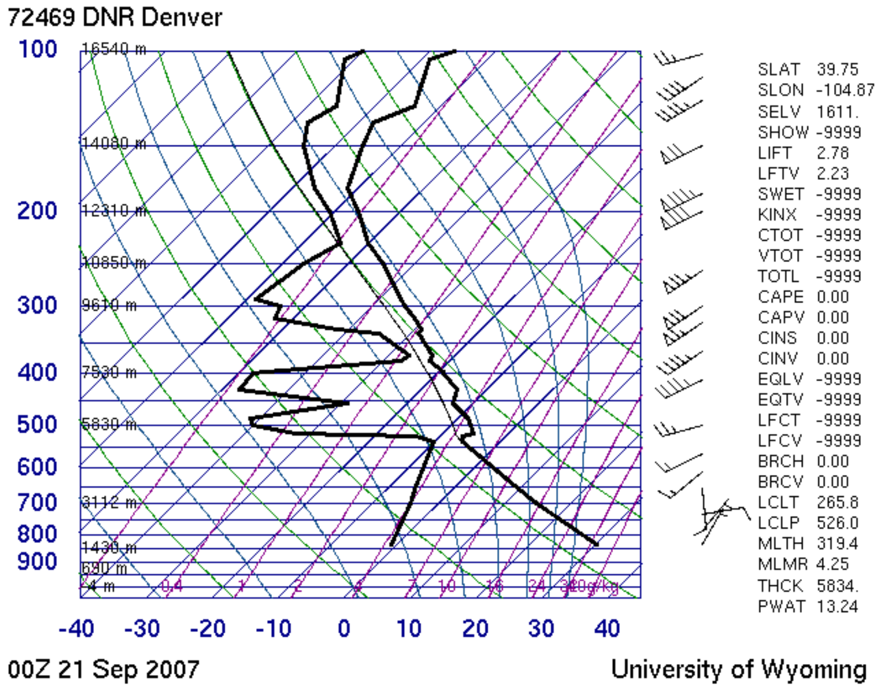

Figure 3 – Skew-t plot for Denver: 5:00 pm local time, September 20

The local time of the images was only 1:45 difference from figure 3, thus no bracketing of the sounding data was performed (see appendix for the preceding and following skew-t plots). There are several features of figure 3 of specific interest to my image. First, note the lifting condensation level (LCL) at ~5,490m. This is the level at which the water vapor, in an air parcel brought from ground level, will condense and form clouds. Subtracting the local elevation places my observed clouds in the 'middle clouds family' named altocumulus. Additionally, note the wind vectors near the LCL. Although the direction remains roughly constant as west or west southwest, the magnitude at the LCL is 39-72kph while the next highest flag indicates 94-126kph . This difference in speed can induce viscous shearing between atmospheric layers and contribute to a 'roll-like' or undulating surface texture. Finally, note the relative positions of the adiabatic packet line and the actual local air temperature trace near the LCL. Two significant observations can be made. The local air temperature is greater than the packet, making the packet cooler and more dense than its neighbors. At the same time the rate of change of the adiabatic packet line is much greater than the local temperature trace. Both of these phenomena, combined with the relative humidity data in the previous page indicate a stable atmosphere where cold dry air is sinking. This is corroborated by the barometric pressure increase at the end of the day shown in figure 4.

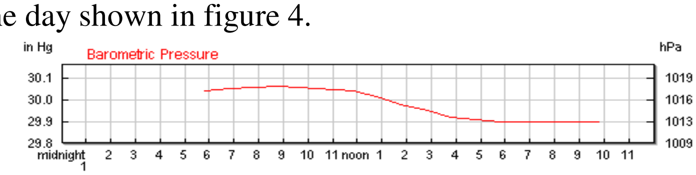

Figure 4 – Timeseries data: Barometric pressure at shooting location (note: 1hPa = 1mbar) (source: wunderground.com)

There are two visualization concepts converging in my image. The flow itself was made visible as light reflected off the condensed water vapor forming the cloud. The beautiful red color was produced by increased scattering of non-red light wavelengths. The scattering is performed by low atmosphere contaminants that are always present. However, the effect is increased in the evenings and at dawn because the sun's rays must travel further to reach our eyes, offering more opportunities for the photons to be deflected (http://www.weatherquestions.com).

Vital statistics for this image:

Field of view:	~1.5 x 2km
Distance from object to lens:	~3895km
Lens focal length:	5.8mm, F-Stop 2.8
Camera used:	digital, pixel dimensions 2288x1712, Nikon Coolpix 4100, resolution 300x300”. Exposure: aperture value 3.0, shutter speed (exposure time) 1/68 sec, ISO rating 50, exposure bias value 0.0
Photoshop processing:	Image was cropped to enhance framing, despeckle filters was used to soften 'grain' of image. I believed this filtering was acceptable because the spatial resolution was not on the order of single pixels.

I believe this image shows the early formation of an altocumulus undulatus. I am pleased that the atmospheric data and physics support my hypothesis. Especially, because the image I selected from the session's pictures does not depict the classic undulatus waves. I found that the evening shadows provided fantastic opportunities to frame my shots using the silhouettes of local foliage and structures. I also am pleased with the way that the evening sun sets areas of differing heights in light or shadow. I believe this helps to visualize the flow more effectively. As before, I was limited primarily by the camera and it's ability to resolve the entire depth of field using the available light.

Appendix:

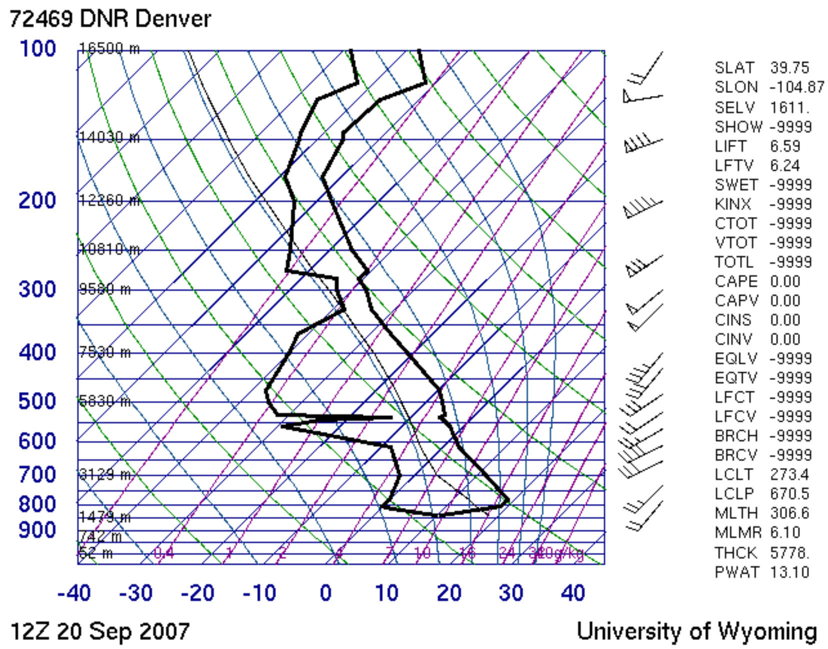

Figure 5 – Skew-t plot for Denver: 5:00 am local time, September 20

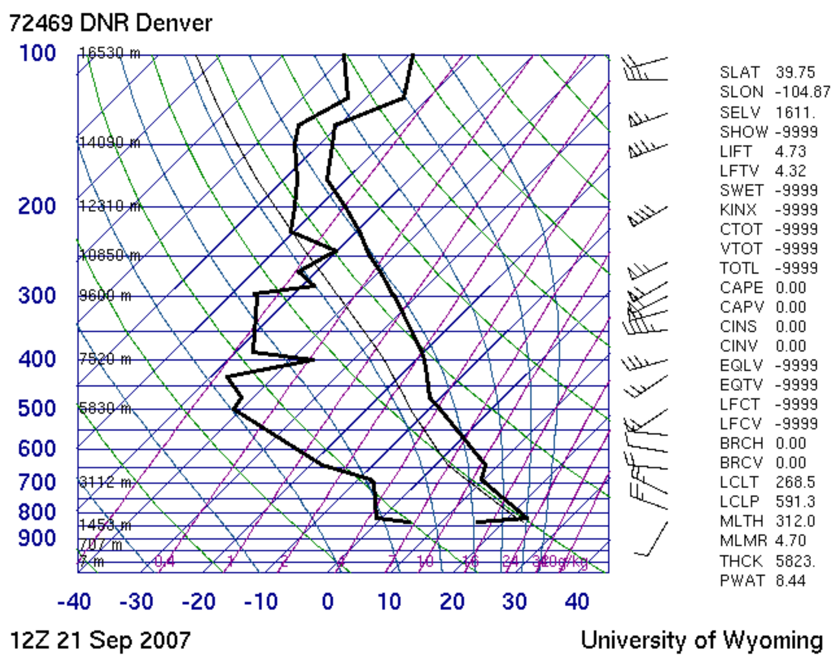

Figure 6 – Skew-t plot for Denver: 5:00 am local time, September 21