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351-336
11.29.07
Image Assignment: Clouds 2

My second clouds submission for this class is an evolution on my first cloud image. I very much enjoy the colors and reliable formations created in the evenings and wanted to improve on the shortcomings of my last image. Specifically, I shot earlier in the evening allowing for a faster shutter speed and greater contrast within the image boundaries. Although the clouds themselves were rather unremarkable, I feel that I was able to crate an interesting composition using both a low-atmosphere cloud in shadow to create a sensation of depth in the image, and a color temperature gradient.

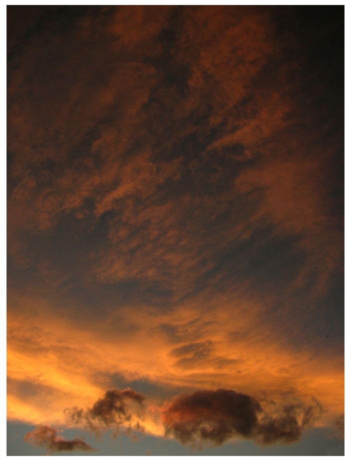

Figure 1 – Altocumulus at sunset

The series of images from which figure 1 was selected were taken from the same location as before, 13.7 km from the foothills of the Rocky Mountains in Boulder. Also consistent with the last image, I shot from the roof of a local building to help eliminate distracting ground-level features. The surface normal of the camera CCD was oriented 285 degrees west, nearly perpendicular to the foothills. The local elevation for the image was ~1,595m.

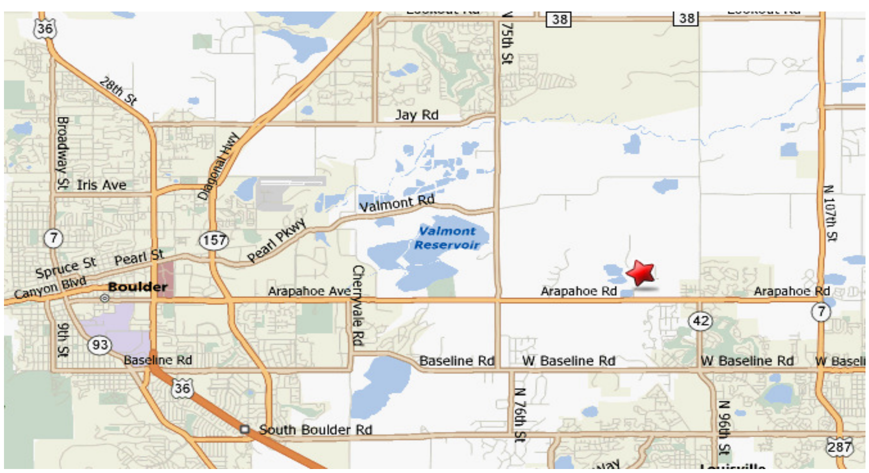

Figure 2 – Photographic Location (source: mapquest.com)

Local surface information provided by http://www.weatherunderground.com indicated the ground temperature was 22 C, local dew point -3 C, relative humidity ~24%, barometric pressure 1010 mbar (see appendix for complete source). Additional atmospheric sounding data from http://weather.uwyo.edu is shown as the modified skew-t plot figure 3.

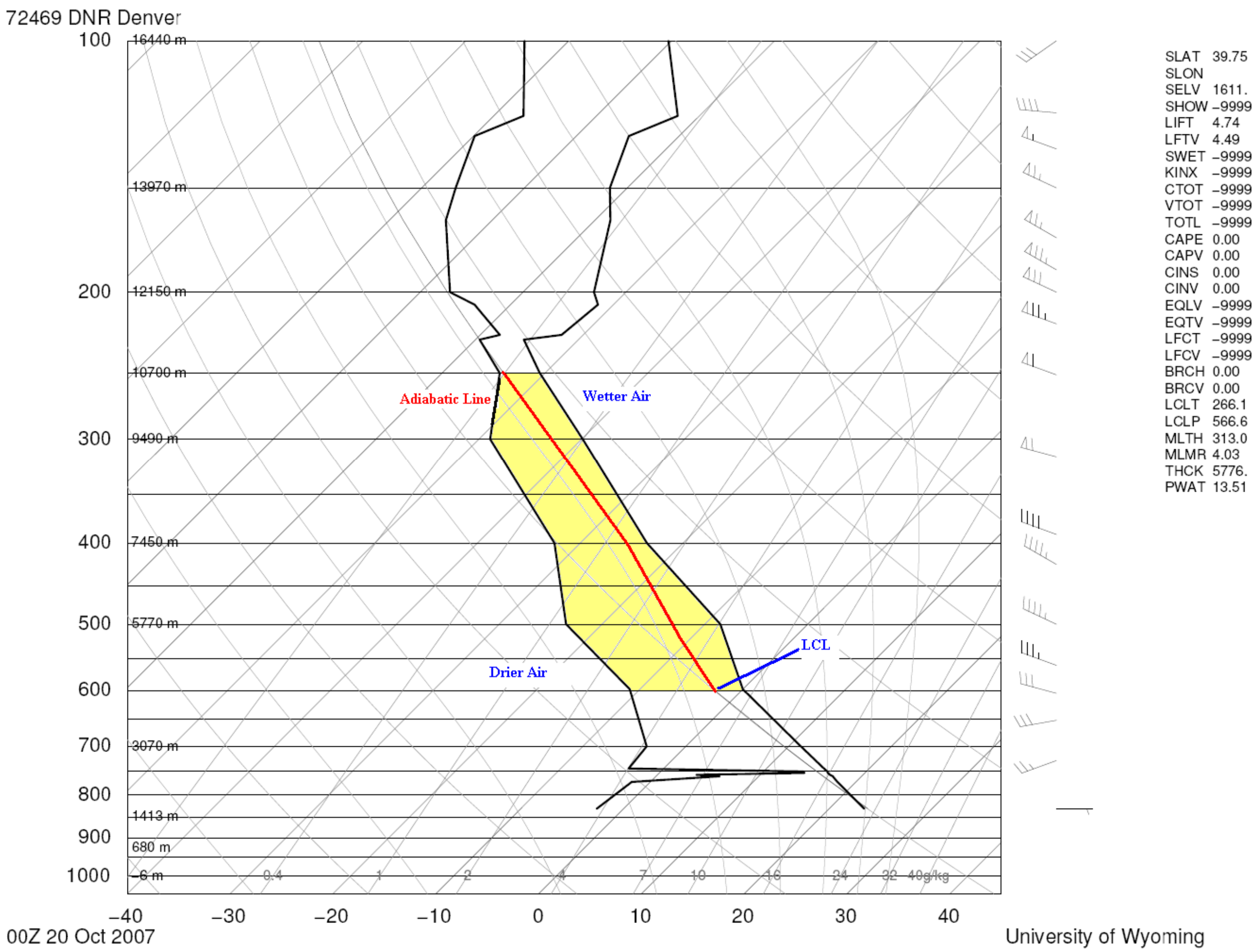

Figure 3 – Modified skew-t plot for Denver: 5:00 pm local time, October 19

The following discussion of the atmospheric data for figure 1 refers to a single data point at 5:00 Boulder local time; no bracketing of the data was performed due to the proximity of the skew-t sounding data to the shooting time. First, note the lifting condensation level (LCL) at ~5,095m denoted by the slope change of the adiabatic packet line. The LCL is an indicator of the elevation at which the water vapor, in an air parcel brought from ground level, will condense into visible could formations. Thus the LCL marks the lowest elevation of the main cloud in my image and subtracting local elevation, places my clouds in the *alto* family of middle clouds. Next, the skew-t plot shows a humidity gradient within the atmospheric layer where my clouds formed. This is shown by the relative separation of the dew point (far left dark line) and local air temperature lines. Interestingly, as the moisture content of the air increases in the elevation range of my clouds, there is a region of instability between 5770-7450m. The instability is marked by the relative slopes of the adiabatic line and the local air temperature trace. Where the adiabatic line has a steeper slope, any air parcels moved from that location will be warmer then their surroundings and continue to rise. This current is the instability that gives cumulus clouds their texture and shape. It is in this range of moist, unstable air, that my altocumulus formed. Finally, note the wind vectors in the unstable region. They have both constant magnitude and direction, allowing for cloud formatin without *undulatus* (shearing) or *fractus* appearance.

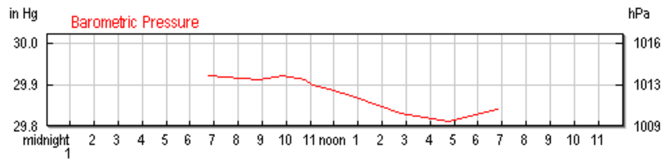

Figure 4 – Timeseries data: Barometric pressure at shooting location (note: 1hPa = 1mbar) (source: wunderground.com)

A final piece of evidence in support of my altocumulus identification is the decrease in pressure at the Earth's surface as shown in figure 4. This is indicative of an atmospheric instability driving air upwards which leaves an area of lower pressure below.

As in any cloud picture, the flow in my image was made visible through light reflected off condensed water vapor in the atmosphere. In figure 1, areas that are light in color represent upward flow driven by temperature differences in air parcels, while dark regions (without clouds) describe cool air descending. The light produced by the setting sun's rays produces beautiful colors, but more importantly to seeing the flow, highlights and shadows areas of the cloud at different elevations. This helps to see texture in the cloud that might otherwise go unnoticed.

Vital statistics for this image:

Field of view:	~2.5km x 2km
Distance from object to lens:	~15.3km
Lens focal length:	5.8mm, F-Stop 2.8
Camera used:	digital, pixel dimensions 2288x1712, Nikon E4100, resolution 300x300”.
Exposure:	aperture value 3.0, shutter speed (exposure time) 1/241 sec, ISO rating 50, exposure bias value 0.0
Photoshop processing:	Tip of pine bow removed bottom right using clone stamp, despeckle filter 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. Color curves were adjusted to increase contrast.

I am very pleased with my altocumulus picture. I believe it is the best image I have produced thus far in terms of photographic and aesthetic content. I am pleased that I was able to eliminate much of the grain present in my last image and still shoot in the lower light of the evening. Although the cloud itself is unremarkable in the physics it shows, I am more confident in its identification and feel that I learned a great deal about surface-level indicators during that process. I fully intend to continue sunset photography after this project as I have found it to be the most satisfying cloud work I did this semester.

Appendix:

Temperature:			
Mean Temperature	**64** °F / **17** °C	-	
Max Temperature	**75** °F / **23** °C	**61** °F / **16** °C	**86** °F / **30** °C (2003)
Min Temperature	**53** °F / **11** °C	**38** °F / **3** °C	**19** °F / **-7** °C (1984)
Degree Days:			
Heating Degree Days	1		
Growing Degree Days	14 (Base 50)		
Moisture:			
Dew Point	**28** °F / **-2** °C		
Average Humidity	24		
Maximum Humidity	33		
Minimum Humidity	18		
Precipitation:			
Precipitation	**0.00** in / **0.00** cm	-	- ()
Sea Level Pressure:			
Sea Level Pressure	**29.88** in / **1012** hPa		
Wind:			
Wind Speed	**22** mph / **35** km/h (WNW)		
Max Wind Speed	**32** mph / **52** km/h		
Max Gust Speed	**44** mph / **71** km/h		

Averages and records for this station are not official NWS values.

T = Trace of Precipitation, **MM** = Missing Value

Source: NWS Daily Summary

Seasonal Weather Averages

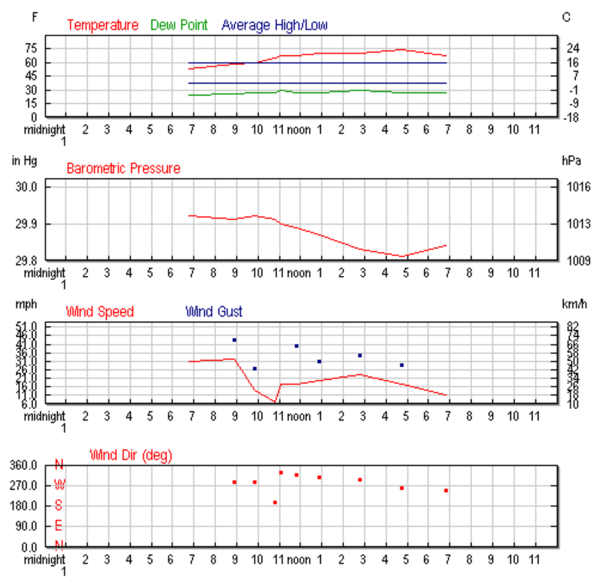

Figure 5 – Simple atmospheric data information for shooting location (wunderground.com)