Brian Haug
MCEN 5151

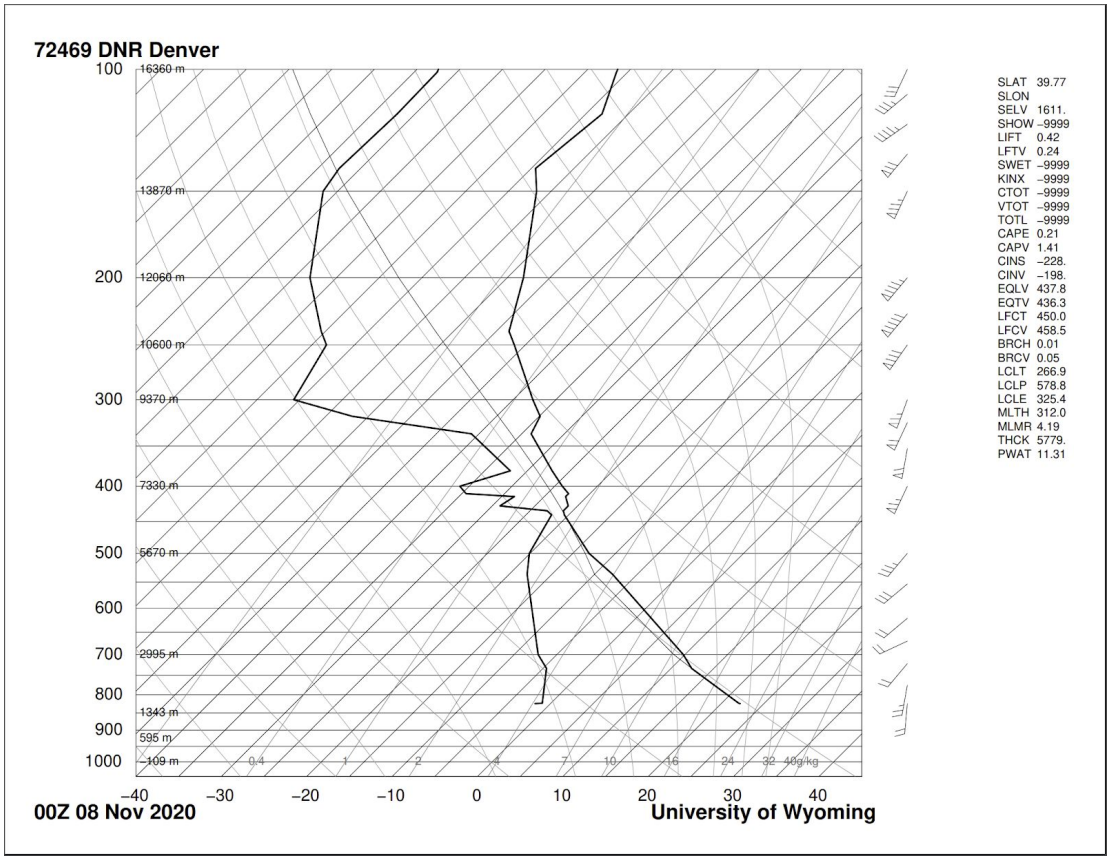
Flow Visualization
December 8th, 2020

Clouds Report #2

(Final Edited Image 1300 x 521 Pixels)
Image Taken 11/7/20 at 4:00pm Near South Boulder Rec Center

This report will outline as well as discuss the fluid dynamics and visualization techniques shown in the image above. This was either the fourth image video assignment or second cloud assignment for “Flow Visualization” at CU Boulder. I chose an image from the second cloud assignment in an attempt to mix things up and learn more about clouds. Since this class began, I have had a watchful eye on the clouds in Boulder always ready to take a picture. However, this image definitely snuck up on me as I was out at the park when I saw these wonderful clouds over the front range. I didn't have my good DSLR camera with me so I had to take it with my iPhone. I took a normal picture but upon inspection it was underwhelming. Instead I used the panorama mode to increase the amount of pixels in the image so editing and especially cropping would be easier later.

This image was taken in Boulder, Colorado looking west towards the Flatirons near the South Boulder Rec Center. Taken at 4pm, the sun was slowly retreating back behind the Flatirons and highlighted the mountains and clouds nicely. This image was taken near horizontal at about 5300 feet of elevation.



Skew-T Diagram for Denver on the 7th of November at 6pm[]

Looking at the skew-T plot for this day at 6pm, there is a clear pinch point between the temperature and dew point lines at about 6,000 to 7,500 meters. Although this might be the case, the clouds do not appear that high in the sky. The ones in the edited image show the large low clouds as they took up three fingers in the height test, meaning they are low clouds. I believe the skew-T diagram is misleading here because the clouds are seen directly over the mountains and could easily be mountain wave clouds or altocumlus lenticularus clouds. These specific clouds are formed when air that has been traveling along earth's surface faces an obstruction. Looking at the skew-T diagram we can see the wind is blowing from towards the west at about 3000m. In this case, the wind is blowing towards the front range from the east, hits the mountain, and then causes the air to rise. If the temperature at the top of the wave drops below the local dew point, moisture in the air may condense to form these lenticular clouds [2]. Although these measurements were taken in Denver, we can conclude that there could have likely been an overlap between the temperature and dew point lines at the top of the first set of mountains on the front range that would produce these clouds.

Looking at the weather for the days preceding this image, there was no drastic change until after the picture was taken. On the 9th of November, there was a snow system that moved through the area producing a few inches of snow. The cumulus clouds that appear in this image are common proceedings to weather events such as thunderstorms or snow. Lenticular clouds

can often be associated with an incoming storm[3]. The incoming weather system could also be part of the result of the imperfect atmospheric stability, a CAPE of 0.21.

Original Image (8988 x 3832 Pixels)

Edited Image (1300 x 521 Pixels)

This image was edited in darktable to help focus the image and touch up some spots. There was a large crop done because the size of the initial image would allow the image to stay clear. In this cropping, it was crucial to limit the amount of distracting details. Compared with the original image, it is clear that there was a lot of distracting landscape in the bottom of the image. The RGB curve was also set in a concave up facing in order to slightly darken the image. The soccer post in the image was also removed with the touchup tool which was very distracting on the mostly black mountain background.

Camera	iPhone Xs
Aperture	f/1.8
Exposure	1/1299 seconds
Focal Length	4mm
ISO	25

Table 1: Metadata

This image reveals the complexities of clouds as well as partially how to categorize them. The editing takes a very large image and cuts it into a much more manageable size. It is interesting to see how these clouds interact with the mountains because there seem to be two different clouds in this image. I wish this image was taken in such a way that it didn't show as much ground in the original image.

References

[1] *Atmospheric Soundings*, weather.uwyo.edu/upperair/sounding.html.

[2] "Altocumulus Standing Lenticular Clouds". *National Weather Service*. NOAA. Retrieved 9 March 2018.

[3] Green, Stewart. “Weather Signs of an Incoming Storm.” *LiveAbout*, www.liveabout.com/weather-signs-of-incoming-storm-756025.