Luna Rising

Cloud One Report

MCEN 4151 – Flow Visualization

February 28, 2011

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Introduction

As the first cloud assignment in this class, the goal was to capture an image of clouds so as to research and learn more about the physics of the formation and movement of clouds. As a secondary goal, it was my intention to take a beautiful and interesting image that would demonstrate fluid flows taken advantage of everyday by myself as well as many others. The assignment has forced more awareness of the weather and artistry of nature found daily in the sky. It was this artistic beauty that drove my intentions in this assignment knowing that the technical aspect could follow. Figure 1 shows the final image.

Figure 1: Final image portraying altocumulus lenticularus clouds and move above the horizon

The image was taken on February 17th at about 5:30pm on top of the Engineering parking structure. The sun was beginning to set on the western horizon while the moon was cresting the eastern horizon. The full moon occurred on February 18th, so this image captured, essentially, a full moon just above the horizon. I was struck by the color and size of the moon as the day was ending and had to include it in the image of the beautiful clouds surrounding it. The dramatic nature of the image was compounded by the setting sun and the color cast by it. Furthermore, the Denver smog lends an ominous feeling as well as color to the horizon and moon itself. Because this is a Flow Visualization class, I wanted to make the moon a secondary subject in the image, placing it in the bottom corner so as to focus on the equally interesting cloud formations.

Altocumulus Lenticularus

A major goal for this assignment is to correctly identify the clouds being depicted in the image. To aid in this identification is the abundance of information in the skew-t plot for the location and time of the clouds. Figure 2 is the skew-t plot for Denver on February 17th at 6pm. It provides the closest location available and was collected only half an hour after my image was taken. Therefore, it is a good approximation of the atmospheric conditions in Boulder at that time.

Notice that the CAPE is 0.00 indicating no precipitation. CAPE, or convective available potential energy, expressing the potential for severe weather and is representative of the amount of buoyant energy

available to speed up a parcel of air vertically. It is also an indication of stability and in this case indicates a stable atmosphere with no precipitation.

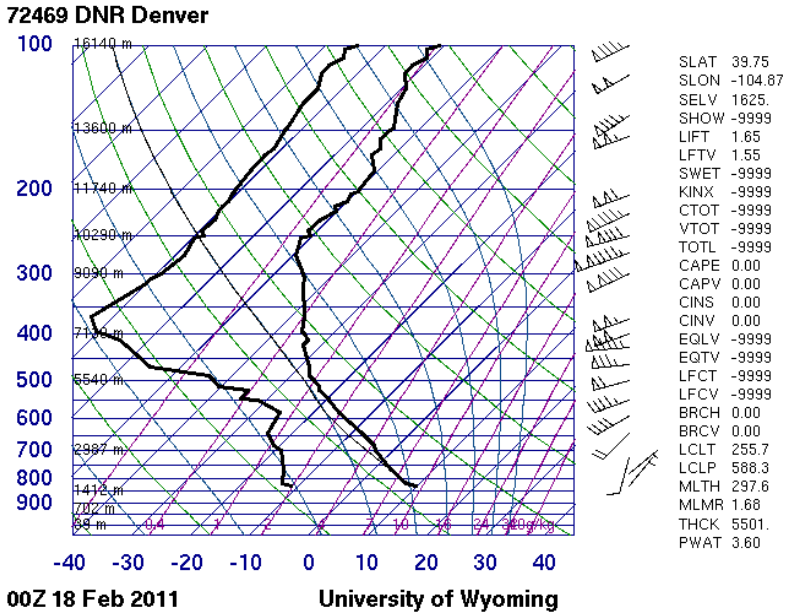

Figure 2: Skew-t plot from Denver on February 17th at 6pm

More appropriately, stability can be found by comparing the slope of the virtual temperature to that of the dry and saturation adiabats (see Figure 2). In this case, the virtual temperature is almost parallel but slightly steeper than that of the dry adiabat (green line) as it is rising towards the beginning. At the point of saturation the slope changes and should be compared to the saturation adiabat (curved blue line). Notice that the slope is steeper than the saturation adiabat, therefore, both indicate that the atmosphere is absolutely stable.

Another clue for the classification of these clouds is the height that they are forming and, again, the skew-t plot can shed light on the matter. When the two solid lines (isobars and isotherms) are found closest together, it is an indication that clouds are forming at that altitude. From the skew-t plot given, a rough approximation of the height of cloud formation is 5,000 meters, indicating medium-level tropospheric clouds. Because these clouds look like the easily identifiable cumulus, they can be identified as altocumulus based on their height and appearance.

To further explore the classification, more of the weather should be looked at to understand the formation of the clouds and which types are to be expected. The weather on February 17th was calm and the skies were clear. In the afternoon, the wind picked up a little bit and was blowing from the west as it usually does in Boulder. The clouds depicted in the image were formed over the Flatirons and, at the time of the image, you would have seen a much larger density of clouds in that area. However, these were taken much farther down the line where the cloud formations were beginning to disperse. These clouds can therefore be classified as altocumulus lenticularis. They are formed when moist, stable air flows over the mountains and, as the temperature drops and reaches the dew point, the moisture

condenses and forms clouds. As these clouds continue to move away from the mountains and into the trough, the temperature increases and the condensed water can return to a vapor and disperse. The image taken is more on the dispersal side of this progression as indicated by the wispy clouds on the leftmost side.

Visualization Technique

Because I have no experience taking pictures of clouds, my approach to this image was using the automatic exposure settings on the camera and hoping the image would turn out. One of the original images in the panorama taken is shown in Figure 3. The original image is very washed out and the colors are not very nice. I believe if I knew more about the proper techniques for taking such a picture, the original image would have turned out much nicer, requiring much less editing. As it was, I took this image and increased the contrast and changed brightness's between successive images in the panorama to match each other. I also decided to clone-out the crane because it distracts from the clouds and doesn't add anything to my intentions. More specification can be found below.

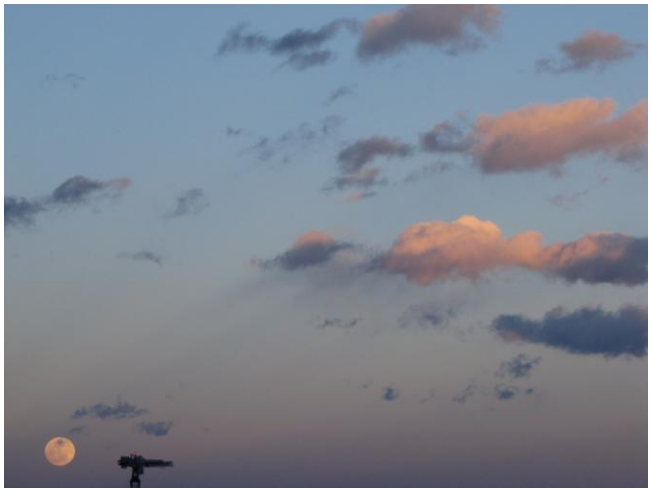

Figure 3: Unedited image of left side of panorama

- Distance from object to lens: 6000 meters (clouds), 350 million meters (moon)
- Camera: Canon PowerShot SX20 IS
- Lens focal length: 29.3mm
- Image dimensions: each original – 3000x4000 pixels, final – pixels 8292x2946 pixels
- Exposure specifications: 1/250 sec. shutter speed, f/4.5, 160 ISO
- Post-processing: image cropping, color contrast – curves, cloaning image irregularities and crane
    - one original image shown in Appendix C

Conclusion

My goals and intentions for this assignment were fulfilled as I was able to capture a beautiful image and learn a great deal about the physics involved in the fluid flow. I believe the image reveals a great deal

about this physics as well as the beauty and aversion of human impacts on the world. The smog created in and around Denver creates a gloomy darkness on the horizon yet illuminates many colors during sunset that wouldn't be as amplified without it. I struggled in deciding if I should include the crane in the image which would magnify this juxtaposition, but decided against it to get rid of the distraction. In the end, even the moon doesn't add to the role of this class; flow visualization. I'm content with the image yet would like to know more about the techniques in capturing clouds. For the next assignment I plan on learning more and not using automatic settings to take the images.

References

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