Clouds Second

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Introduction and Context

The purpose of this project was to extend our techniques of visualizing flows from classic fluids, to everyday flows; clouds. This is the second cloud photo I took, and with expanded knowledge of meteorology, I found a more interesting phenomenon this time. Clouds are a fun image to analyze because of the meteorology as well as flow physics available to study. My submission is of streaking cirrus clouds in a stable morning atmosphere.

This image was taken at the Thorncreek Golf Course in Thornton Colorado on November 6, 2016. The foreground of the image is the Thornton GP Cyclocross bike race, which I was competing in. I had recently finished my race when I took this photo, and I grabbed my camera to take photos of my friends who were still racing but ended up taking more photos of the spectacular clouds on the day than of the race. The clouds really captured me because cirrus clouds do not usually appear so dense and with such clarity. I took about 50 photos of the clouds with both my DSLR and my iPhone, and actually ended up using the iPhone photo.

Cloud Physics

Cirrus clouds are some of the higher clouds in the atmosphere, characterized by their wispy appearance and bright white appearance. These particular clouds stretch almost across the entire sky plane, indicating that they are likely to be powered by the jet stream. Jet stream caused cirrus clouds occur when a warm front reaches as high as the jet stream, which in North America is at about 20,000 feet. The cold, fast moving air in the jet stream creates a horizontal shear with the warmer, moister air in the warm front and causes the streaky wispy clouds that are characteristic of cirrus clouds. Cirrus clouds can

also form without the influence of the jet stream, where a warm front meets colder air above.

However, seeing such broad and expansive cirrus clouds such as these is only common when the warm front reaches the jet stream altitude. Other evidence that the jet stream is responsible for this formation is the prevailing direction of the clouds. This photo was taken facing west-southwest, which would be facing almost directly into the prevailing direction of the jet stream over Colorado in November.

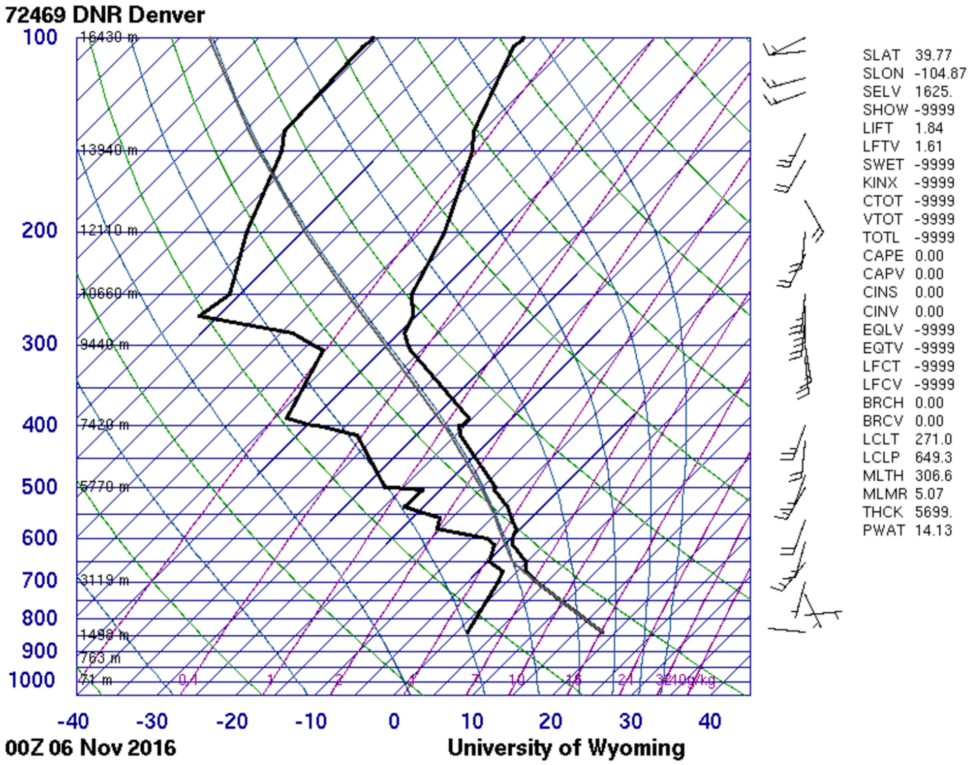

Figure 1: Skew T

Further evidence of these conclusions can be found in the skew-t plot for the day. The skew-t shown here, the 6AM sounding, was recorded less than three hours before the photo was taken. It shows a huge velocity change for the wind at around 23,000 feet, which is consistent for the jet stream. Until that point, wind velocity was fairly steady, and would not have caused the cirrus clouds shown in the photo. Furthermore, the cape value of 0 indicates that the

atmosphere was stable, and that it was unlikely that a major front was moving through and causing these clouds on its own. Therefore, I concluded that the warm air in the front was moving slowly enough not to cause an unstable atmosphere, but still interacting with the jet stream to form the visible clouds.

Photographic Technique

I took approximately 60 photos of this cloud phenomenon on the day, most of which I took with my Canon DSLR camera, but some shots I snapped with my iPhone 6s Plus, which has a great camera. When going through and editing my photos, I discovered that I liked the photos I had taken with my phone more than those I had taken with the camera! I believe this is a result of my failure to use proper settings for the day. The DSLR photos all had washed out foregrounds or backgrounds, and never captured the full color and dynamic range that my iPhone managed. Additionally, the built in iPhone camera settings are spectacularly good, and consistently produce good photos.

Distance to Subject	10-15 miles
Focal Range	Infinity
ISO	25
Shutter Speed	1/5128th sec
Aperture	F2.2
Focal length	4.15mm

Table 1: Camera settings

Post processing was almost non-existent with this photo. I decreased the saturation in the image to get back some of the more natural blue in the sky, and upped the contrast to get the structure of the clouds to be more highlighted. Other than that, the image is almost original.

Conclusion

I am very happy with the final results of this photo. I did not have flow visualization in mind the morning that I took these photos, but as soon as I saw the depth and breadth of these cirrus clouds I knew I had to get a good photo. I like how much of the sky I captured, and how far back and above the viewer it seems to reach, without eliminating the foreground. I also like how there is only one cloud type visible in the image, it really helped me to analyze the cloud types without interference. I got a bit of feedback suggesting that I crop out the foreground, but I think that the foreground provides some very important context to the image, providing a horizon and a focal point that the clouds can all seem to point to. In addition, I like the action in the foreground. This photo is one of my all time favorites because I love bikes, and in this photo I got to mesh my passion with flow visualization in an unobstructive way.

Finally, I was shocked that I went with my iPhone photo over my camera photo. I bought my camera to take the best pictures possible, but it goes to show that without the experience necessary to use the right settings at the right time, an expensive camera can sometimes be inferior to the phone in you pocket. I think that in the future I will take a lot more photos with my phone in interesting and difficult photography scenarios in the hopes of catching a gem like this photo.

References

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