Clouds 2 – Ski Touring and Windy Clouds

Cole Smith
Flow Visualization – MCEN 5151
December 10, 2022

Figure 1: Clouds 2 image captured by Cole Smith

Context and Purpose

The intent of this image was to capture the unique cloud phenomena that I had been seeing in various forms all day while ski touring in the Caribou area near Eldora, CO. The winds were extremely high on this day, so the clouds were quickly changing and moving, and they seemed to be either incoming storm clouds or post-storm clouds, that were carrying a lot of wind-blown snow. I quickly snapped this picture at the top on the skin track where the clouds looked particularly spectacular yet ominous. In the foreground the trees that we were touring through can be seen. In the background, three different types of cloud formations can be seen. I've identified these formations as a Foehn cloud wall, an altocumulus lenticularis mountain wave cloud, and a cirrostratus undulatus cloud formation.

Circumstances

This image was taken near Caribou close to Eldora, CO on November 27th, 2022, at 1:45 PM at about 10500ft of elevation. While I didn't measure the exact angle of elevation from horizontal, I would estimate based on the position of the horizon line within the frame of the image that the angle of elevation lies in the range of 0-5 degrees above horizontal. The direction faced in this image is southwest looking across the mountain range towards Eldora, then beyond the cloud formations of note.

Cloud Identification

These clouds are either incoming storm clouds or post-storm clouds, and could potentially be both as winter storms occurred a few days prior to, and after this image was taken. The clouds were also accompanied by very strong easterly winds that was picking up and blowing snow. This blown snow is the first sort of 'fog-like' cloud formation that can be seen in the midground as the hazy looking low-hanging cover over the mountains. After identifying them in conjunction with Prof. Hertzberg, the fluffy clouds seen in the bottom half of the image coming up over the distant mountains are a Foehn cloud wall. Above that, the rippled yet uniform cloud in the top half and top right section of the image is an altocumulus lenticularis mountain wave cloud formation that is moving this way because of high winds. Finally, in the top left of the image I believe that the formation may be cirrostratus undulatus because of how thin the dispersion of clouds is and the high winds during the image

Based on the Skew-T graph there are some obvious indications that we would be likely to see clouds. The winds that we were observing throughout the day that were heavily affecting the cloud formations and movements are captured in the Skew-T as a strong eastward wind from about 3000m all the way up to the top of the measured altitude. We could expect to see the most likely formation of clouds around 4500-5500m as this is the most proximal point between the measured temperature line and the dew point line. This would most likely be indicative of the altocumulus lenticularis mountain wave cloud formation, that would be hovering around 15000-18000ft. The next most likely elevation where clouds might occur based on the diagram would be at around 2500-3000m which means that since the atmosphere is stable, yet Foehn wind conditions exist, we could reasonably expect to see a Foehn cloud wall formation. Due to several intertwining factors, perhaps wind direction, wind intensity, and humidity, these clouds form as we would expect them to within reason. Finally, the cirrostratus undulatus clouds seen in the image are not captured in any readily identifiable way on the Skew-T diagram. This shows that, except for a more distant and subtle formation, the Skew-T graph is representative of what is going on in the image despite the fact that it's measuring Western Slope weather as opposed to Front Range weather.

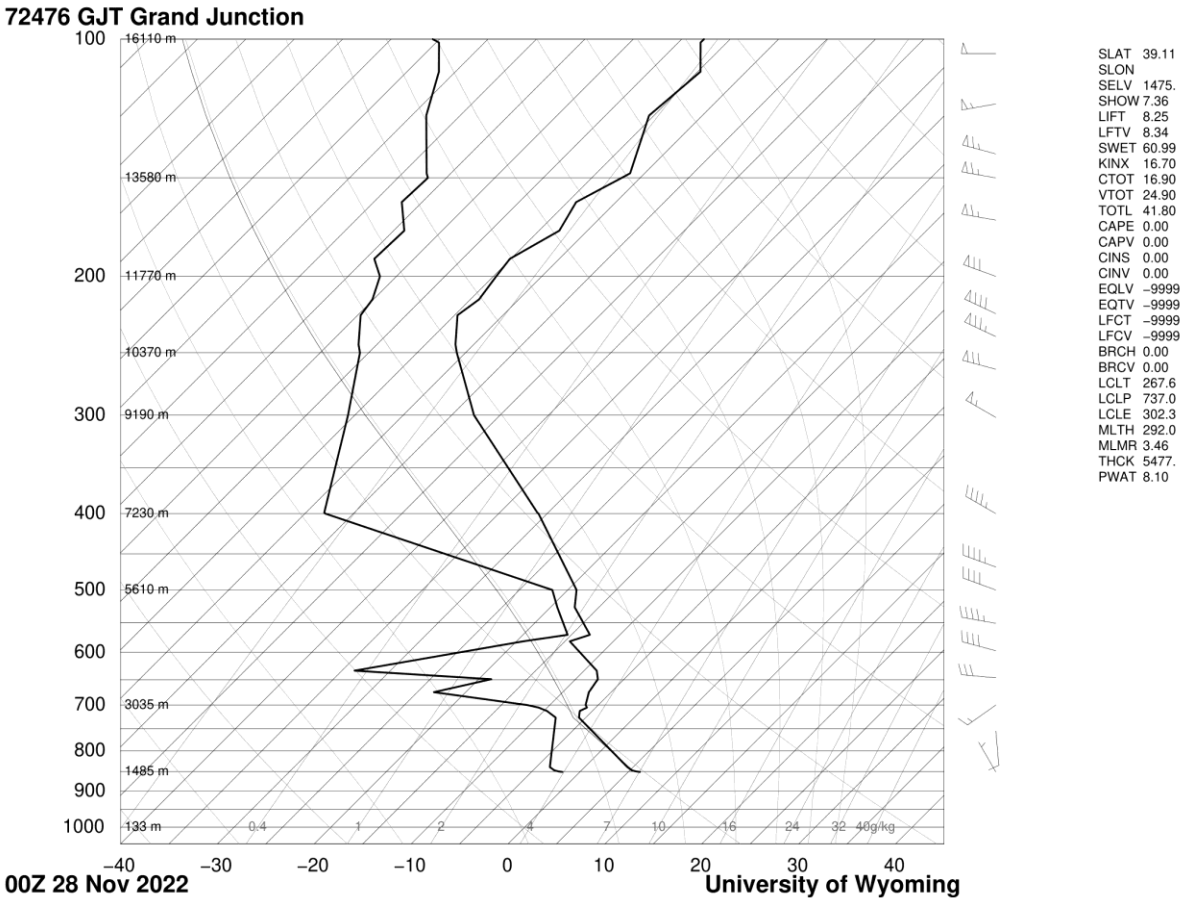

Figure 2: Skew-T diagram from Nov 27th, 6:00 PM MST in Grand Junction, CO [1]

Photographic Technique

The abstract photographic technique used here is non-zoomed normal exposure photo mode on my iPhone 13 Pro. The size of the FOV is very difficult to quantify due to the scale and varying depths within this image, however I would estimate that in the foreground the width is ~50 ft, in midground along where the mountains drop below the clouds the width is 2-3 miles, and the height of the image is unquantifiable as it goes off into the clear sky. The distance from the object to the lens was primarily 1.5-5 miles but most likely extends beyond this based on the extensive depth of the clouds within the image. The lens focal length was 6mm. The camera used was the iPhone 13 Pro Wide Camera, and it was capturing images in HEIF format. My original photo is 3024 x 4032 pixels and 1.98 MB, and the exported high-quality post-processed photo has 2802 vertical pixels instead of 3024 but is a PNG file and is 64.7 MB large. The aperture was f/1.5, shutter speed was 1/19231, and ISO was 40. In terms of post-processing on my image I used the contrast brightness saturation tool to turn up contrast a bit, brightness down a bit, and saturation up a decent amount. I used the rgb curve to generally bring the mids a bit darker, the sharpen tool to make the trees look crisper, and the crop tool to remove unnecessary parts at the bottom of the photo. The ISO, focal length, FOV, image size, file type, and aperture

were all those automatically chosen by my iPhone 13 Pro's normal photography mode given the imaging conditions and camera lens used.

Image Insights

This image reveals a unique view of three cloud types all in 'close' proximity to each other within the frame of the same image. I really like how this image demonstrates three different distinct cloud phenomena that can occur during stormy or post-stormy conditions. Additionally, I like how there is also an element of perspective and context in the bottom third of the image, with the trees telling the story of looking out from a vantage point through the forest at these formations, and the ski area in the midground reflecting the activity that I was doing when I captured this image, backcountry ski touring. The main thing that I dislike about this image is more subjective than an objective thing about the image itself but is that I feel that it doesn't capture the full enormity and imposing look of these clouds in person, especially given how fast we saw them moving throughout the time we were out there. However, I do think that this image still does manage to properly capture the fluid physics of these three distinct formations, and even show some fascinating interplay between the regions. I'm left with no questions in regard to this image, and I partially fulfilled my intent of capturing these fascinating clouds. However, in the future I would like to improve the sense of scale that's captured in the images, allowing them to better convey the scale that I mentioned previously, whether this be through editing, camera settings, or the lens used.

References

[1] *Atmospheric Sounding Data*. University of Wyoming Department of Atmospheric Science, 2022, http://weather.uwyo.edu/upperair/sounding.html.

[2] "Föhn (Foehn) Wind." *WeatherOnline*, https://www.weatheronline.co.uk/reports/wxfacts/The-Foehn-foehn-wind.htm.

[3] "Föhn Wall." *WeatherOnline*, https://www.weatheronline.co.uk/reports/wxfacts/Foehn-wall.htm.