

# STRATOCUMULUS RADIATUS PEEKING OVER TREE TOPS



*CLOUDS SECOND, FALL 2023*

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MCEN 5151 – Flow Visualization

4 December 2023 at 2:11 PM

## INTRODUCTION

On December 4th, I looked up to see some remarkable stratocumulus radiatus clouds forming in the sky over Niwot, Colorado. I captured this image as a part of the Clouds Second assignment of the Fall 2023 iteration of MCEN 5151 – Flow Visualization at the University of Colorado – Boulder. My artistic intent for this image was to try to create a clean black-and-white image of clouds – an endeavor that proved more difficult than I anticipated. I also wanted to capture some of the winter clouds that form near the Front Range of Colorado. The orographic instabilities that affect cloud formation along the Front Range are captivating.

## CIRCUMSTANCES

I took this photograph in Niwot, Colorado ( $40.1039^{\circ}$  N,  $105.1708^{\circ}$  W) at 2:11 pm on December 4th, 2023, just a few days before a winter storm system rolled in over the Front Range. Niwot is located about 5190 ft. above sea level. I was facing 225 degrees southwest and aimed my lens to a point just over the tops of my neighbor's trees.

I took a few other photos of the sky that afternoon from different perspectives.



FIGURE 1: OTHER IMAGES OF THE SKY ON 4 DECEMBER AROUND 2PM.

## CLOUD IDENTIFICATION AND PHYSICS

In this image, we see a few different clouds: the clouds just above the trees are *stratocumulus radiatus*. You can also see the wisps of a *cirrus fibratus* in the center of the image. At the top edge, there is another *stratocumulus radiatus*. This could also be a *cumulus humilis* or *cumulus fractus*. In other parts of the sky, there were altocumulus lenticularis clouds, which are higher-altitude, orographic clouds (Pretor-Pinney, 2007).



FIGURE 2: CLOUD IDENTIFICATION

*Stratocumulus radiatus* are relatively low-altitude clouds, usually found between 2000 and 6500 feet above the surface (Pretor-Pinney, 2007; *Stratocumulus - an Overview | ScienceDirect Topics*, n.d.). The Skew-T diagram (shown below) on December 4<sup>th</sup> shows a blip around 3000 m. The ceilometer data confirms this height – there appear to be clouds around 3000 m between 6 pm UTC and 8 pm UTC. Given the altitude of Niwot, Colorado, we would expect to find stratocumulus around the altitude shown in the Skew-T plot. I believe the stratocumulus are of the *radiatus* variety because they appear as long rolls (WMO, n.d.-c). Stratocumulus clouds are typically found in unstable atmospheres (“Clouds 5,” n.d.). However, the Skew-T diagram and the CAPE of 0.0 indicate that there was a stable atmosphere in the afternoon on December 4<sup>th</sup>. Therefore, these clouds likely are orographic – forming from local instabilities produced by the mountains (i.e., they are mountain wave clouds) (“Clouds 5,” n.d.). Stratocumulus can form when there is a temperature inversion that cause cumulus clouds to join. We can see this inversion effect in the Skew-T diagram (the negative slope of the isotherm) (Pretor-Pinney, 2007; *Stratocumulus - an Overview | ScienceDirect Topics*, n.d.; Wood, 2015).

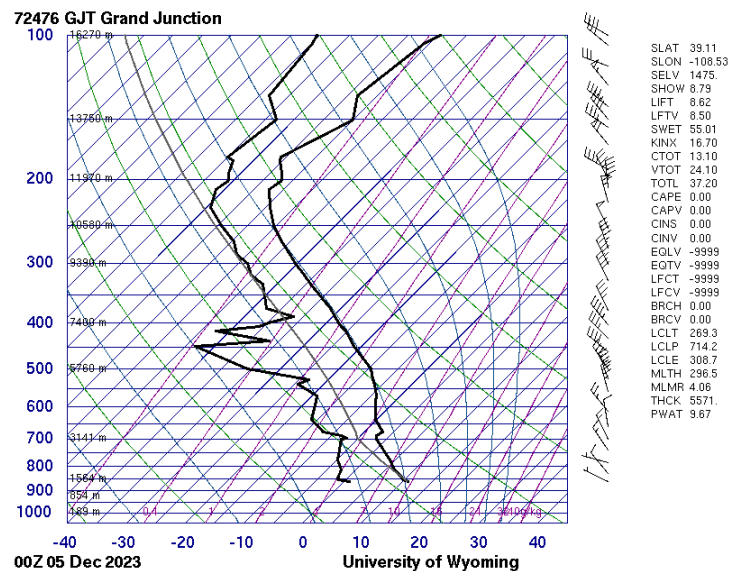


FIGURE 3: SKEW-T FOR 4 DECEMBER 2023

The stratocumulus clouds in this image appear to have some turbulence that is affecting the shape of the top of the cloud. The ragged or broken-up edges of stratocumulus could be called *Fractus-*

like (“Learn About Fractus Clouds,” n.d.). In the Skew-T diagram, the wind appears to be blowing from the Northwest at around 15 knots. However, just above 3000 m, the wind moves much more rapidly. This rapid increase in wind speed just above the stratocumulus layers may cause turbulence or shearing at the top of the stratocumulus we see in this image.

*Cirrus* clouds are high-altitude clouds located between 16,500 – 45,000 ft above the surface. In the Skew-T diagram, there is a second blip around 11,000 m, which would fall in the expected altitude for cirrus (Pretor-Pinney, 2007). A cirrus cloud’s fall streak distinguishes it. At the altitudes cirrus clouds exist, high winds cause the clouds to dissipate quickly. In the Skew-T diagram, the winds appear to be blowing around 45 knots – significantly faster than the wind speeds at the surface.

*Fibratus* species of clouds are characterized by narrow, mostly straight white filaments (“Learn About Fibratus Clouds,” n.d.; WMO, n.d.-a). The cirrus clouds we see here could also be of the *uncinus* species because of the hook-like or comma-like curve to a few filaments (WMO, n.d.-b).

## PHOTOGRAPHIC TECHNIQUE

I captured this image on an OM System (i.e., formerly Olympus) TG-7. The TG-7 is a “tough” camera, a point-and-shoot camera designed for underwater photography. Despite being a point-and-shoot camera, the photographer can control a number of settings on this camera. To capture this image, I used the P program, meaning that the shutter speed and aperture were set automatically; however, I altered the exposure value (EV) to be -0.3 EV, meaning I deliberately under exposed the image slightly. I set the ISO setting at its lowest value: 100. The camera chose

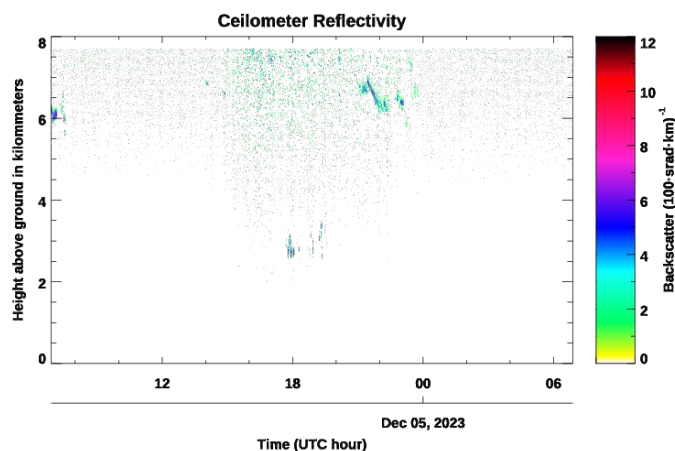


FIGURE 4: CEILOMETER FOR 4 DECEMBER 2023

Table 1: Camera and Image Settings	
Camera	Olympus TG-7 (point and shoot tough camera)
Lens	Built-in lens
Focal Length	14.62mm (82mm for 35mm conversion)
ISO Speed Rating	ISO 100
Exposure	1/800
F number	f/4.3
Camera Modes	P Program, Normal Exposure Program, Pattern Metering Mode
Raw Image Size	4000 x 3000
Edited Image Size	4000 x 3000
Edited Resolution	314 pixels/inch



an exposure of 1/800 and an aperture of f/4.3, which is sufficient to capture the scale of the cloud and limit any motion blur from the cloud movement. I zoomed in slightly to cut out some hanging power lines. Therefore, the focal length was set at 14.62mm (and 82mm equivalent).

## POST-PROCESSING



FIGURE 5: BEFORE EDITING

FIGURE 6: AFTER EDITING

To edit this image, I used the OM Workspace app provided by OM Systems. This is partly because OM has moved to proprietary software to edit and view the RAW images. I did not crop any part of this image. To get a black-and-white image, I applied a monochrome filter with an additional “Red” filter to darken the sky further. While this was already a striking image, I opted for a “Blue” hue because the slightly blue hue over the monochrome filter made the sky look more dramatic and brought out some of the detail in the cirrus clouds. Finally, increased the contrast in the image to its maximum to bring out some of the shadows in the crenulated tops of the stratocumulus clouds.

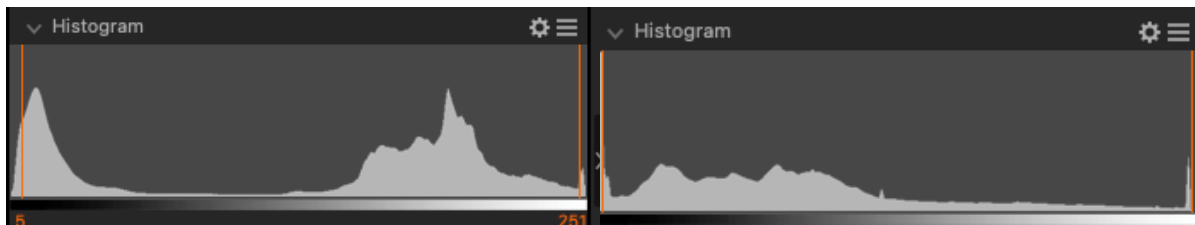


FIGURE 7: BEFORE EDITING

FIGURE 6: AFTER EDITING

## CONCLUSION

This image of orographic stratocumulus rolls above my neighbors’ trees was an experiment in photography and editing. This was my first time using the TG-7 camera and my first black-and-white cloud image. I tried editing several cloud images I took on this same day (and other days), trying to create a clean black-and-white image. I wanted the monochrome filter to augment the drama of the image and elucidate the detail in the clouds featured. I think the editing effectively captures this balance of drama and detail.

## REFERENCES

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