Undulatus Clouds

MCEN 5151: Flow Visualization | Boulder, CO | Captured Oct 1. 2026

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Introduction

The intent of this assignment is to capture the fluid dynamics we see everyday in clouds. Clouds are a flow visualization of the atmosphere that allow us to see many types of flow phenomena and weather characteristics. By looking at the clouds daily, it is easier to understand the connection between the atmosphere's fluid dynamics and a cloud's appearance.

Surrounding Environment

Table 1 describes the surrounding environment and orientation of the image.

Location	Boulder, CO
Direction	Southwest
Elevation (angle from horizontal)	30◦
Date	11/1/26

Time of Day	6:50 AM MST

Table 1: Orientation parameters

Cloud Identification

I've determined the clouds in the image are undulatus clouds, known for their wave patterns. This identification has supporting arguments from other documented undulatus clouds as well as the atmospheres skew T diagram.

The night before the photo, smaller rolling clouds were seen near the mountain line (captured by fellow classmates). In the morning of the photo there was evidence of rain with little wind. About an hour after the photo the dense undulatus cloud cover was patchy and mostly gone, with a few retained sections.

Figure 1 shows the closest skew T plot relating to these clouds taken at the Grand Junction station at 6pm on 9/30. From the skew T it appears the atmosphere is stable and cloud formation should appear at around 6 km. The clouds I experienced seemed lower, but this could be due to the distance from Grand Junction and the time between the skew T and the photo. Additionally from the skew T winds were going northeast, which roughly line up with the ripples in the image.

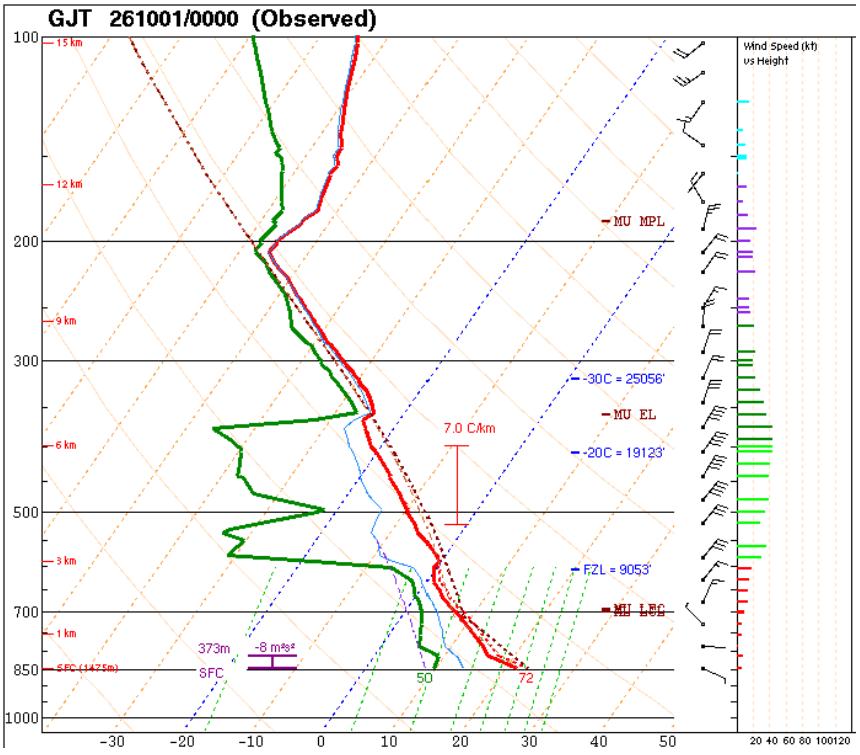

Figure 1: Skew T from Grand Junction station at 00Z 10/1/26

To form undulatus clouds, air near the cloud level oscillates up and down. As wind forces air up the air cools and condenses into a cloud band. When the cooling air begins to descend it heats up, evaporating the cloud and creates the clear gaps.

Photographic Technique

The goal while taking this photo was to capture the depth of the undulatus clouds in the distance. To do this I decided to capture a portrait photo to get the distant clouds near the horizon and the clouds above my head. This photo was taken on an iPhone 17 pro, so many camera settings weren't controlled. In Table 2 is a detailed list of the camera settings used to take this image.

Camera	iPhone 17 Pro
Estimated FOV	17◦ horizontal - 22◦ vertical
Distance from object to lens	6 km
Aperture	f/1.78
ISO	200
Shutter speed	1/121 s
Original size	4284 x 5712
Final size	4284 x 5712

Table 2: Photographic settings

Small amounts of post processing was done to the image. The main editing was adding contrast and adding a slight black and white layer. These edits were done to highlight the ripples in the clouds and darken the foreground objects at the bottom. Below is the original and final edited image.

Before Image

Edited Final Image

Conclusion

This image reveals the structure of undulatus clouds and clearly shows the fluid physics when undulatus clouds form. I like the dramatic perspective I captured in the image with the distant wave clouds near the horizon. If I were to improve this image I would include more trees and buildings in the foreground to frame the image better. It's difficult to properly frame cloud photos so the image has good composition while highlighting the clouds, which is definitely an issue I ran into. Overall I'm satisfied with the phenomena I was able to capture in the photo and have an idea of what improvements to make in the future.

Sources

Undulatus. (n.d.). Cloud Appreciation Society. Retrieved October 17, 2026, from https://cloudappreciationsociety.org/cloud-library/undulatus/

Whitt, K. K. (2022, April 7). *Undulatus clouds look like wavy rows*. EarthSky | Updates on Your Cosmos and World. https://earthsky.org/earth/undulatus-clouds-wavy-rows/