CLOUD SECOND

MCEN 5151 Flow Visualization

Report Date: December 16, 2023

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Cloud Type: Cumulus Clouds

Photo Taken: November 24, 2023 @ 0758

Location: Airplane window on take off from Fort Lauderdale, FL

PURPOSE/BACKGROUND

The purpose of this assignment was to capture the fluid physics that formulate with clouds in the atmosphere from the second portion of the Fall 2023 Semester, beginning October 21st until December 8th. The cloud image could be taken on any date or time, at any location. My artistic intent was to find a unique cloud formation taken out of an airplane window as I planned on traveling and flying periodically throughout the period of the cloud assignment. I thought it would be interesting to capture a cloud with a square on point of view, from the same elevation. I cannot say I had a specific scientific intent as the physics of cloud formations are uncontrollable and random.

CLOUD CIRCUMSTANCES

The clouds depicted in this image are cumulus, which resemble fluffy cotton ball shapes. This image was taken during take-off from Fort Lauderdale Airport on November 24, 2023 at 0758. The elevation is estimated at 2,500 m which coincides with the proceeding description as these clouds are low level and reside below the airplane at the time of the photo. The camera was facing Northeast and pointed downward at approximately a 45-degree angle.

CLOUD DESCRIPTION

According to NOAA, cumulus clouds are “detached, generally dense clouds and with sharp outlines that develop vertically in the form of rising mounds, domes, or towers with bulging upper parts often resembling a cauliflower” (Commerce, 2023). The height of clouds is generally relative as it can be difficult to verify the exact vertical height of the base of a cloud in the troposphere. A cumulus cloud typically identifies as a low-level cloud which means that the base of the cloud resides at approximately two kilometers above ground level. (Rangno, 2003) Cumulus clouds form in the presence of condensation and can grow vertically with upward moving air parcels. These clouds can range linearly between three and 10 kilometers. (Koutsoyiannis & Langousis, 2011) The differential heating and converging air currents send warmer air upwards with ease ultimately forming the small scattered clusters of isolated clouds within large sky openings and categorizing the clouds as convective clouds. (Rangno, 2003) These clouds were in clusters scattered throughout the sky. It is hard to know how far these cloud clusters extended horizontally as it was taken from a plane window; however, the blue sky above the clusters from the original photo confirm these clouds as low-level cumulus clouds. The clouds were very close, approximately a few thousand feet, relative to the airplane because we traveled through the cumulus formations. The weather for the day following this image, predicted rain in the general area which would coincide with characteristics of cumulus clouds that can produce little precipitation or even develop into cumulonimbus clouds which bring thunderstorms. “Precipitation, however, usually begins to develop in cumulus congestus clouds if they are more than about 3 km thick over land and about 2 km thick over the oceans” (Rangno, 2003). It was hard to establish the thickness from an airplane window; however, I thought this image was unique as the airport resides right on the coast so this change from size over land and sea could have been observed during take-off.

One area to note is the wind exhibited during the day of the photo; as the elevation increased the winds significantly increased, also confirmed on the skew-T plot below by the wind vectors on the right side of the plot. The winds at the photo's elevation, where the cumulus clouds reside, was around 5 knots and increased to 50 knots by the time cruising altitude, 35,000 feet, was reached. The conclusion of this image's clouds to be cumulus is also supported from the Skew-T plot, Figure (1), pulled from the Miami Station in Florida on November 24, 2023 at 12Z. (Oolman, n.d.)

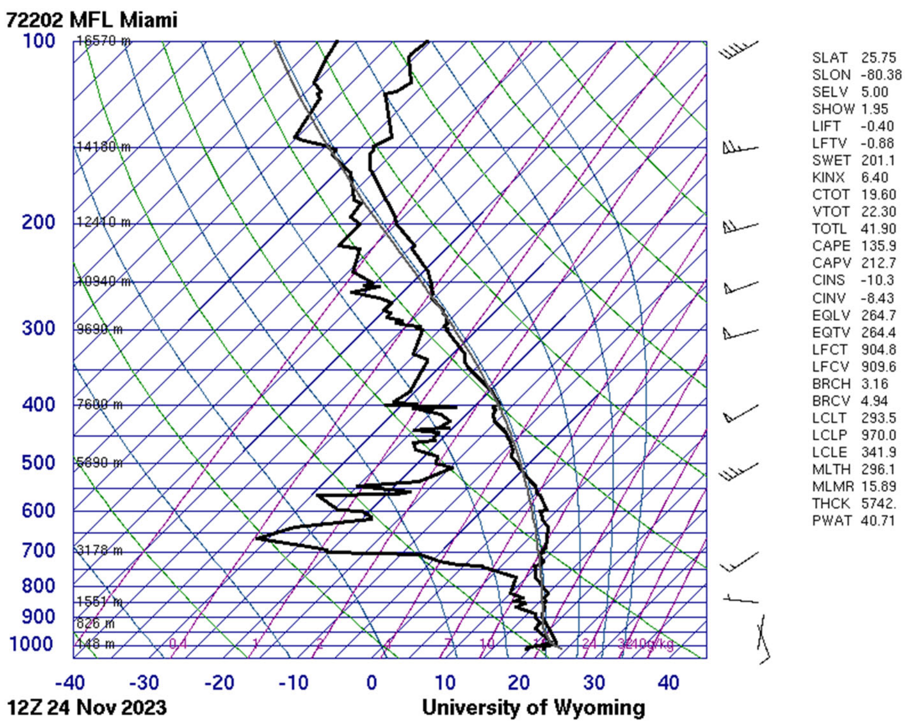

Figure 1: Skew-T Plot; Miami, FL Station on November 24, 2023 at 12Z

The atmosphere was very wet which is indicated by the small separation between the leftward dewpoint line and the rightward temperature line; this observation concurs with the frequency of the cumulus clouds throughout the week spent in Miami, FL. (Hertzberg, 2023) To identify the type of clouds depicted in an area from the skew-T plot, I looked at the section of the plot where the dewpoint and temperature line, left and right plot respectively, were the closest to each other; at this point one could expect there to be cloud formations. (Hertzberg, 2023) According to this skew-T plot, the closest regions occur between 500 m and 2,000 m and again around 13,000 m; however, this plot is fluctuating throughout the elevation variance which indicates a varying of cloud presence and cloud type. As defined by UCAR, Center for Science Education, "cumulus clouds have sharp outlines and a flat base at a height of 1000 m" (Cumulus clouds, n.d.) This weather pattern is a weakly unstable atmosphere, as the moist adiabat is steeper than the temperature line indicating an unstable system. Additionally, the convective available potential energy (CAPE) is equal to 135.9. According to the skew-T plot, which also proves this atmospheric system is unstable, small or medium cumulus clouds can be expected; this also concurs with the relatively inconsistent difference between the dewpoint line and the temperature gradient line as the elevation changes. (Hertzberg, 2023) This skew-T plot was taken in close proximity to the location of the clouds which is confirmation that the skew-T plot and the analysis on the type of clouds are likely accurate.

PHOTOGRAPHIC TECHNIQUE

Table 1 below indicates the type of camera and the characteristics of the image. I used the special apple feature of the wide camera feature on the iPhone camera. (iPhone 12 Pro - Technical Specifications, 2023)

Table 1: Camera Characteristics

Camera	iPhone 12 Pro 12 MP
Focal Length	26 mm
Aperture	f/1.6
Shutter speed	1/401
ISO	32
Other	Auto focus, no flash, wide camera

The initial image size was 3024 x 4032 pixels for a total size of 11 MB. Figure (2) shows the initial image before any editing.

Figure 2: Original, Unedited Image

After editing Figure (2) in Darktable, a free software program specific to editing of photographs, the final image is displayed in Figure (3). The first step in this editing process is to crop the airplane out of the image to bring focus solely to the clouds themselves. The next editing step was to make the clouds appear whiter and assume the gray scale as in the final image, the RGB curve was adjusted in two places. I purposely aimed to make the gray scale to bring out some ambiance of the photo. The input and output saturation percentages were increased to adjust for the contrast between the clouds and the ocean at the top of the image. Adjusting the blue-yellow contrast and the green-magenta contrast additionally brought out the colors of the gray scale. I tried to adjust the exposure setting to bring out the whites of the clouds but that became too vibrant and distracting to the rest of the image. The temperature scale moved to the right to bring out an evenness of color scale tones across the image. The final image is 2046 x 1759 pixels for a file size of 2.7 MB.

Figure 3: Final, Edited Image

CONCLUSION

I think this cloud image is very unique and different as it was taken from above vice below like most cloud photos. The color editing completed in post processing added a deep emotional vibe to the photo which I initially did not intend for but enjoyed after all. The artistic intent of this photo was met with the window plane perspective; there isn't much to say about the scientific intent as that was vague because you cannot control cloud formations in nature. Due to the perspective of the image and seeing both the cityscape and ocean through the clouds exemplifies and confirms the physical characteristics of the cumulus clouds. I think if I were to complete this assignment again, I would like to do a time lapse out the window so you could see the changing of the cloud types and formations as the altitude of the plane increased.

REFERENCES

Commerce, U. D. (2023, March 28). *Ten Basic Clouds* . Retrieved from National Oceanic and Atmospheric Administration : https://www.noaa.gov/jetstream/clouds/ten-basic-clouds

Cumulus clouds. (n.d.). Retrieved October 30, 2023, from UCAR Center for Science and Education: https://scied.ucar.edu/image/cumulus-clouds#:~:text=Cumulus%20clouds%20have%20sharp%20outlines,to%20look%20at%20the%20cloud.

Hertzberg, J. (2023, October 30). *Clouds 3: Skew – T and Instability*. Retrieved from Flow Visualization: https://www.flowvis.org/Flow%20Vis%20Guide/clouds-3-skew-t/

iPhone 12 Pro - Technical Specifications. (2023, May 10). Retrieved from Apple Support: https://support.apple.com/kb/SP831?locale=en_US

Koutsoyiannis, D., & Langousis, A. (2011). *Treatise on Water Science* (Vol. 2). (P. Wilderer, Ed.) Elsevier . doi:https://doi.org/10.1016/B978-0-444-53199-5.00027-0.

Oolman, L. (n.d.). *Skew-T Plots*. Retrieved October 20, 2023, from University of Wyoming College of Engineering; Department of Atmospheric Science: http://weather.uwyo.edu/upperair/sounding.html

Rangno, A. (2003). *Encyclopedia of Atmospheric Sciences.* (J. R. Holton, Ed.) Academic Press. doi:https://doi.org/10.1016/B0-12-227090-8/00112-3.