CLOUDS - SECOND

Jeremiah Chen

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MCEN 4151

Professor Jean Hertzberg

Introduction

The purpose of this assignment was to continue to take images of cloud structures and analyze them. This assignment was the second part of the "Cloud series" for the MCEN 4151 – Flow Visualization course taught by Professor Jean Hertzberg at CU Boulder. As before, the clouds seen in the image provided would be analyzed to learn more about the conditions of the atmosphere at the time.

Image Conditions

The image was taken at the world famous Santa Monica Beach in Los Angeles, CA. The camera was facing Northwest and the image was shot at 2:57 PST on November 12, 2016. At the time the image was taken, the weather was sunny and the temperature was approximately 76.0°F with a dew point temperature of 44.1°F. Humidity was at 32% and barometric pressure was 30.01 in Hg (= 762.25 mm Hg). A wind speed of 6.9 mph was blowing towards the SSW [1]. The camera was angled about 10° above the horizon.

2:51 PM	**75.9** °F	**44.1** °F	32%	**30.01** in	**10.0** mi	SSW	**6.9** mph

Figure 1. Weather data for Santa Monica, CA about 6 min. before the image was taken [1].

Cloud Analysis

Figure 2. Primary cloud structure analyzed.

Given that the weather conditions were very sunny, the cloud structure seen must be one that exists in stable conditions. Looking at the general shape of the clouds and comparing it to ones shown on UCAR Center for Science Education's website, the cloud shown is most likely an altocumulus cloud [2]. Specifically, they are likely altocumulus stratiformis clouds. Altocumulus stratiformis clouds are usually an indicator that "weather is either changing from good weather to more unstable conditions, or having experienced a period of bad weather they are the last clouds to be seen as the unstable weather front passes on" [3]. They are found at medium altitudes between 6,000 and 20,000 feet. These clouds form as water particles are carried up into the upper atmosphere and the stronger winds in the middle atmosphere move the particles and form them into clouds.

When examining the Skew-T graphs for San Diego, CA (this was the nearest location to Los Angeles that had Atmospheric Sounding data) for November 12, 2016 at 5 PM PST, the CAPE value was 0.00 indicating a stable atmosphere [4]. The same was true for the graphs of November 12 at 5 AM PST, and November 13 at 5 AM PST as well. This indicates that the atmosphere for Southern California was consistently stable during the time the image was taken. Additionally, the barometric pressure throughout the day for Santa Monica stayed almost the same. Very little change in barometric pressure is an indicator of stable atmospheric conditions as well.

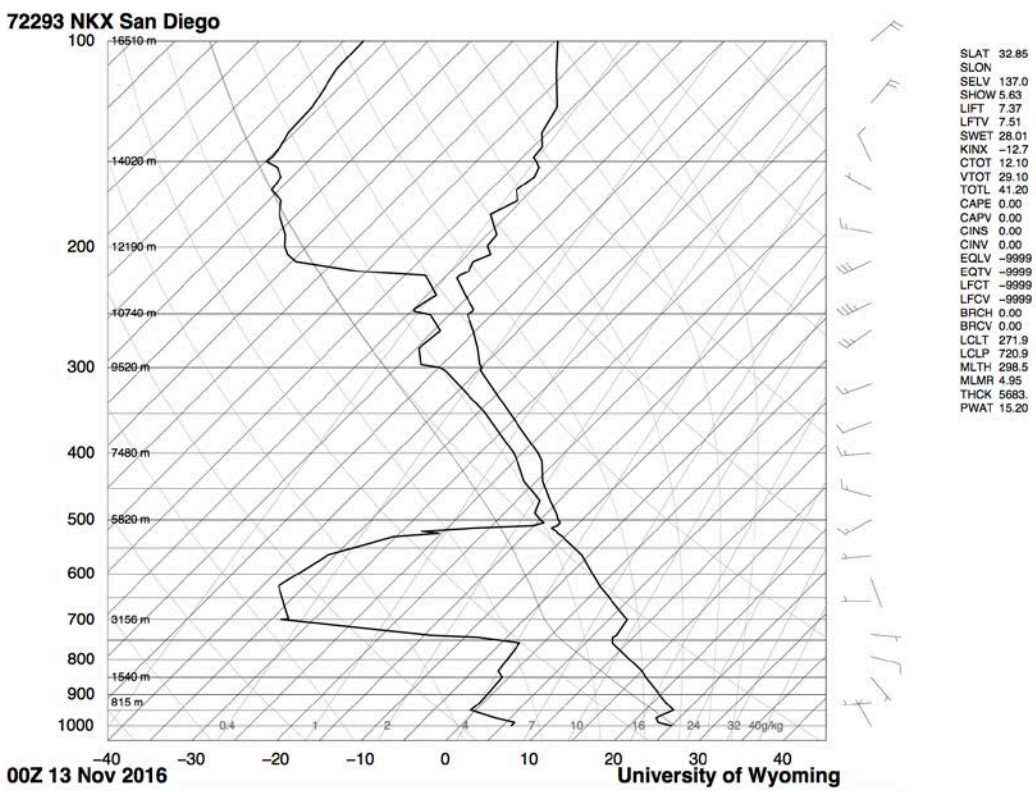

Figure 3. Skew-T diagram of San Diego taken at 5:00 PM, November 12, 2016 [4].

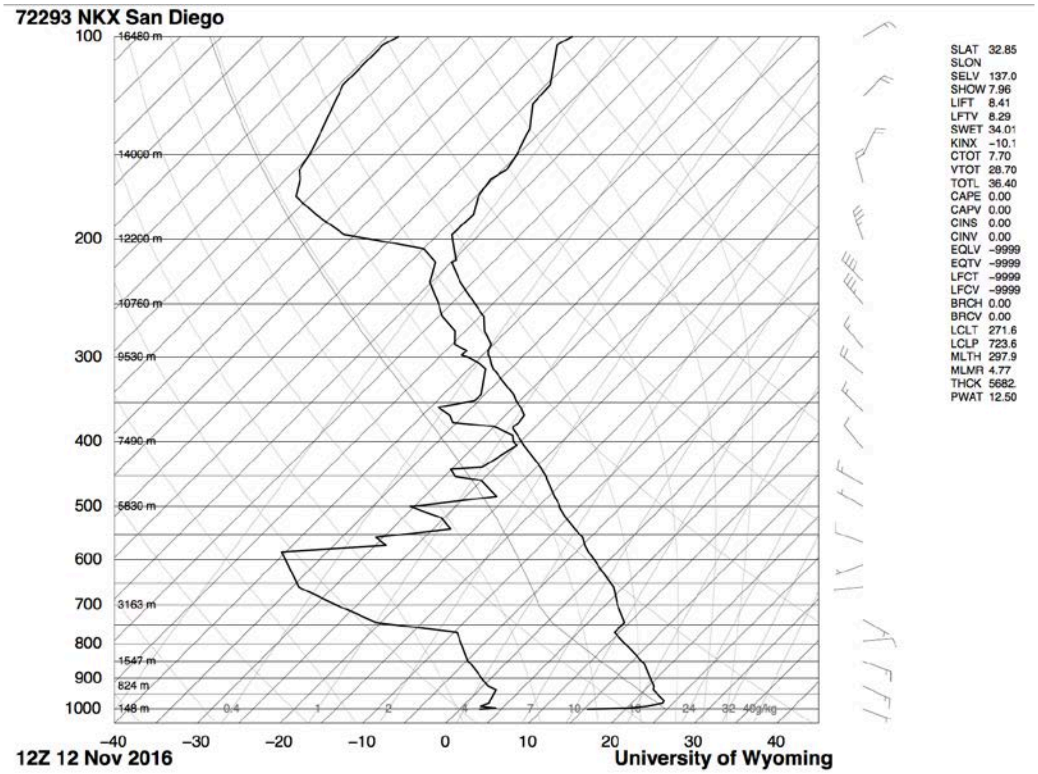

Figure 4. Skew-T diagram taken 12 hours before the one shown in Figure 3 [4].

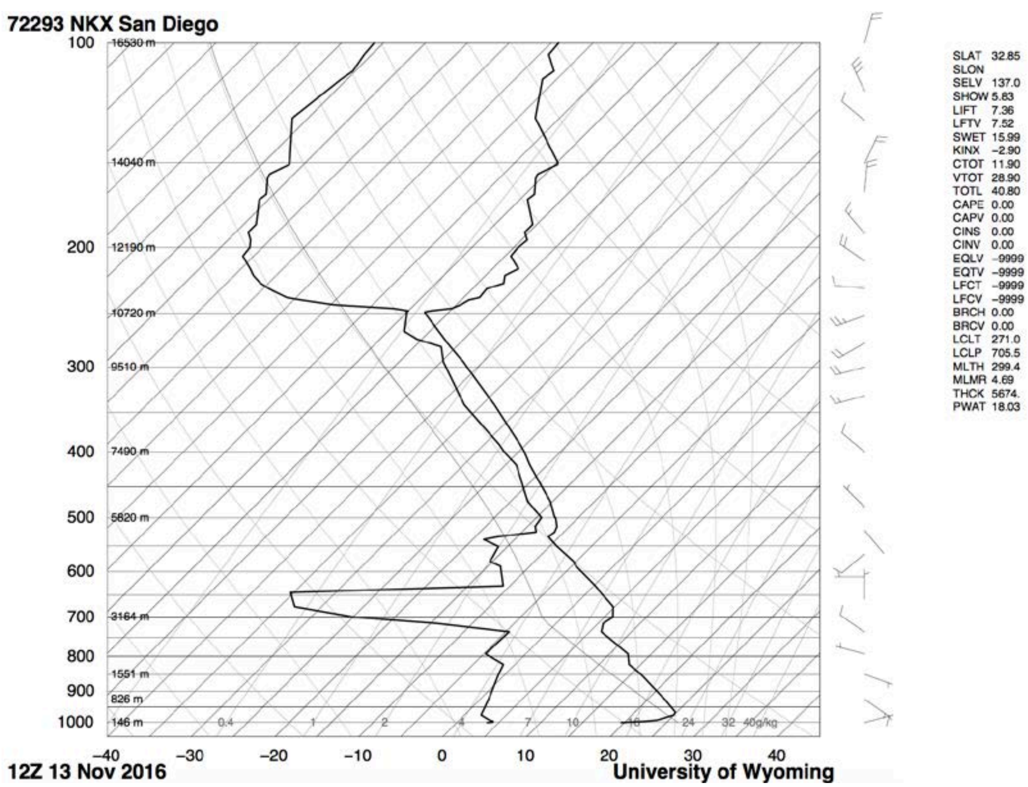

Figure 5. Skew-T diagram taken 12 hours after the one shown in Figure 3 [4].

The closest two points on the two lines of the Skew-T graph are used to predict where clouds are most likely to form. Looking at Figure 3, the altitude at which the dew point line (left) is closest to the environmental sounding line (right) is at about 5800 m or ~19,000 feet. This is consistent with the height at which altocumulus stratiformis clouds are found.

Figure 6. Barometric pressure throughout the day in Santa Monica [1].

One possible explanation of why these clouds were present despite the stable conditions is that the clouds were located over the ocean. It's very possible that a storm had been occurring over the ocean that was not captured by the data shown in the Skew-T diagrams. There is a chance that a storm in the ocean had moved on and the clouds were the remaining indicators of it, per the definition of altocumulus stratiformis clouds.

Photographic Techniques

The camera was used for this image was the one located on an iPhone 7 Plus with a 28 mm lens. ISO was set to 200 with an f-stop of f/1.8. Shutter speed was 1/4166 s. Focal length on this phone is set to 3.9 mm. The low f-stop number contributed to the final image not being as sharp as possible. The original image had a resolution of 4032 x 2268 pixels. The final image had the same resolution as the original as it was not cropped.

Post-processing techniques were heavily used in order to increase focus on the cloud structure. In the original image, the presence of smog in Los Angeles' atmosphere made it difficult to distinguish the cloud from the pollution. Levels were changed in the image and contrast was significantly increased while brightness was decreased. This made the pollution darker while making the clouds more prominent and visible. After all editing was finished, the feeling of the image was completely changed. In the original, the image was light colored and reflected the sunny weather very well. However, the final image gave off a very stormy, dark and menacing vibe; the complete opposite of the original.


Figure 7. Comparison of original (left) and final (right) images.

Conclusion

The image was interesting as it captured a cloud structure that is typically not found in Boulder, CO in the fall. Despite the image not being very sharp due to the limitations of a cell phone camera, the overall structure can still be seen. Furthermore, the overall editing process was enjoyable as the alterations made completely changed the ambiance of the image from the light, sunny mood of the original to the turbulent, ominous and powerful feeling of the edit.

If this assignment were to be redone, a more suitable camera would be used in order to capture a clearer and sharper image. A time lapse video would be easily done and would show how the proximity to the ocean affects what cloud structures will form.

Appendix

[1] Weather History for Santa Monica, CA, "*Daily Weather History Graph*," November 12, 2016. [Online]. Available: https://www.wunderground.com/history/airport/KSMO/2016/11/12/DailyHistory.html?req_city=&req_state=&req_statename=&reqdb.zip=&reqdb.magic=&reqdb.wmo= [Accessed 29 November 2016].

[2] UCAR Center for Science Education, "*Cloud Types*," 2012. [Online]. Available: http://scied.ucar.edu/webweather/clouds/cloud-types [Accessed 29 November 2016].

[3] Names of Clouds: Get your clouds right, "Altocumulus Stratiformis," [Online]. Available: http://namesofclouds.com/altocumulus/altocumulus-stratiformis.html [Accessed 29 November 2016].

[4] University of Wyoming, "*Department of Atmospheric Science*," November 12, 2016. [Online]. Available: http://weather.uwyo.edu/upperair/sounding.html. [Accessed 29 November 2016].