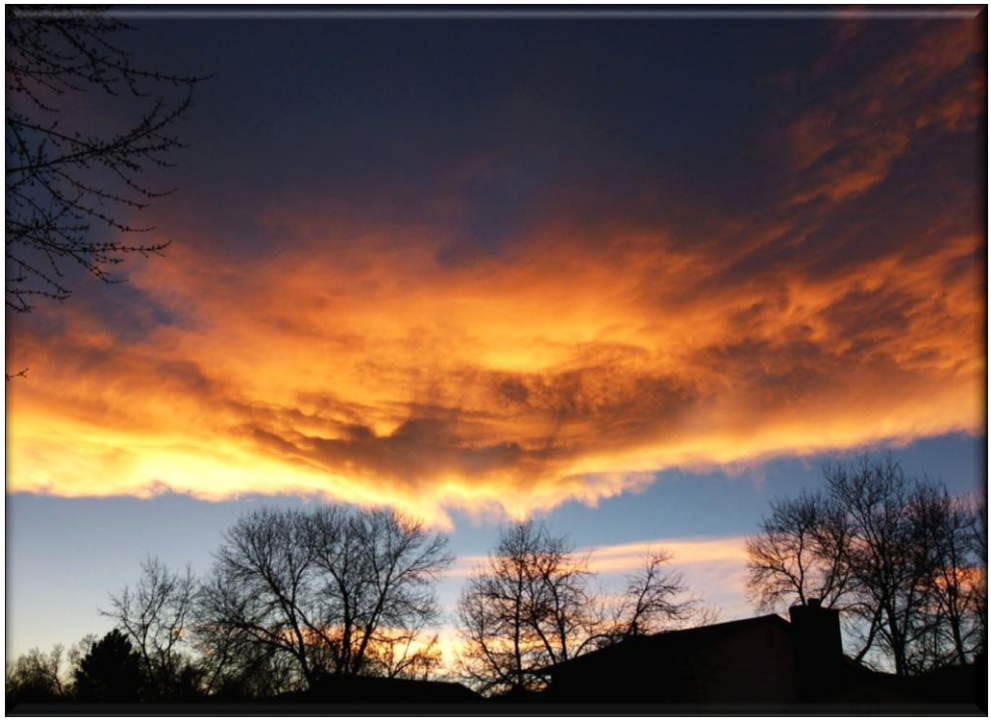
Clouds 2 Report



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I. INTRODUCTION

This report documents the physics of a cloud and the photography techniques used to capture a cloud image for the second of two cloud assignments of the Flow Visualization course at the University of Colorado at Boulder. The goal of this document is to describe the atmospheric sounding conditions and camera settings used to photograph the altocumulus-type cloud presented on the cover page (p. 1).

II. CLOUD PHOTOGRAPHY PROCESS

The cloud photo presented on p. 1 was chosen among over 100 photos taken for the assignment. The cloud described in this report was imaged from a neighborhood street in Louisville, Colorado on February 28, 2011 at 5:58 PM. A sampling of various clouds photographed at this time is presented below.

Figure 1. Clouds photographed February 28, 2011 at 5:58 PM

The first photo in Figure 1 was located due west and will be the focus of the remainder of this report. The camera lens was positioned approximately 45° from the horizon. The natural lighting from the sunset created a stunning illumination of the clouds present.

III. CLOUD DESCRIPTION

a) Cloud Type

The clouds photographed on p. 1 as well as in Figure 1 can be classified as the altocumulus genus of the lenticularis species due to their proximity to the west near the Rocky Mountain Foothills. it is speculated that the variety of the altocumulus is opacus because of the dark patches forming a gradient with the illuminated features[1]. Altocumulus clouds are often referred to as 'mountain wave clouds' because they are formed from cool air rising that is forced to pass over an obstacle such as a mountain. Because the photo was taken just over the Foothills lends further argument to classifying the cloud as an altocumulus. It is speculated that the composition of the clouds in question is mostly water vapor as opposed to ice crystals which are also possible in an altocumulus cloud.

b) Weather Conditions

The weather at the time of the photo chosen was clear and calm. Except for the patches of clouds photographed, the sky was very transparent as shown in Figure 1 and had been for several hours before and after 6 PM. No wind was apparent at ground level and no precipitation was present at the time of the photograph. The ground level air temperature was measured to be 63 °F as shown in the figure below.

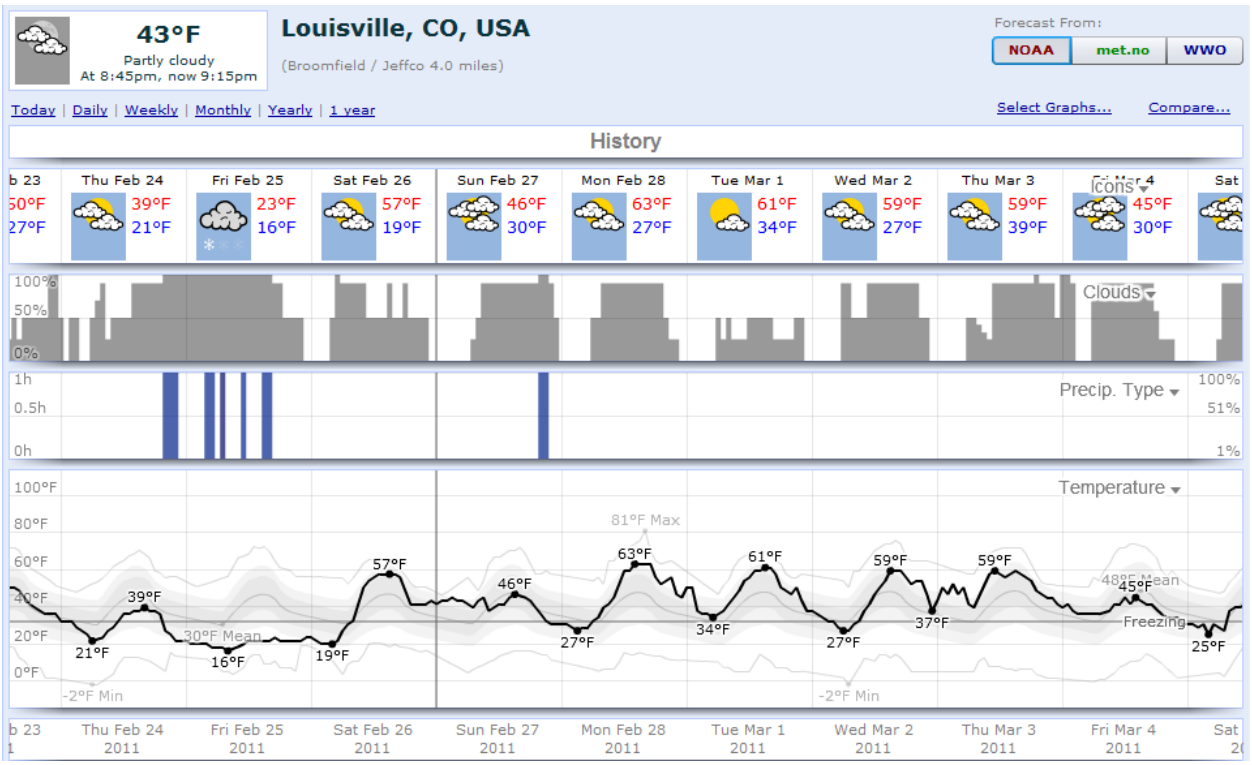

Figure 2. Weather data for Louisville, Co, February 24 through March 4, 2011[1]

c) Atmosphere Stability

Figure 3 shows the skewed temperature or skew-T plot for 6 PM weather in Denver on February 28, 2011 which closely matches the time of the photo (February 28, 2011 at 5:58 PM). The dark black lines in the plot represent measured temperature data (right line) and dew point data (left line) versus altitude, pressure, temperature and known adiabatic conditions. The data for this particular date and time suggest clouds forming at just over 6000 m (19,680 ft or 3.7 mi) elevation because the dew point and measured temperature are closest in proximity. This altitude confirms that the clouds spotted are altocumulus-type which typically forms between 6,500 and 18,000 ft.

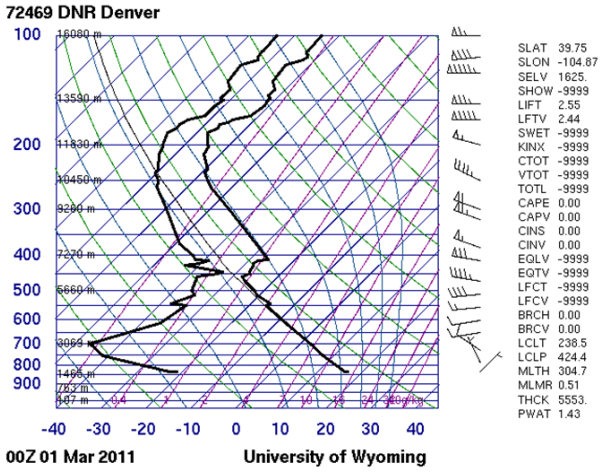

Figure 3. Skew-T plot for 6 PM weather data in Denver, Colorado[2]

From the data the atmosphere appears to be stable. The air temperature decreases with elevation as expected at a faster rate than the saturated adiabats (curved blue lines) until cloud formation at 6000 m. The CAPE index (stands for Convective Available Potential Energy) of zero in the plot also suggests a stable atmosphere which means that the parcels of measured air did not transfer much heat into the surrounding air as the molecules were cooling during expansion while rising.

IV. PHOTOGRAPHIC TECHNIQUES

a) Camera Settings

The altocumulus cloud was photographed using a 14.1 megapixel Panasonic Lumix DMC-FZ100 digital camera. According to the elevation of the clouds estimated in Section 3, the location of the camera lens to the clouds was approximately 6000 m. A focal length of 6 mm was used; a wide field of view was chosen in order to capture the background of trees and houses framing the cloud. The field of view is approximated to be 100 yds. A fast exposure speed 1/125 s was used to capture the quickly-changing lighting form the sunset. An f-stop or aperture size of f/3.6 and an ISO setting of 100 were used to gather as much natural lighting from the cloud as possible.

b) Image Post Processing

Adobe Photoshop CS5 was used for post processing of the cloud image. The original 4320 x 3240 pixel JPEG image was imported into Photoshop to begin post processing. The image was then cropped to 4320 x 3132 pixels in order to remove the lights from the houses near the bottom center of the photo. The contrast was then adjusted from zero to 60 in order to deepen the rich colors from the sunset illumination. The original image and post processed image are shown left to right in the figure below.

Figure 4. Cloud image before (left) and after (right) post processing.

V. IMAGE ANALYSIS AND CONCLUSIONS

The image accurately captures an altocumulus cloud. The image reveals a very alien craft appeal that is typical with altocumulus lenticularis. The jagged tops and proximity to mountains accurately depict the rising, cooling air overcoming an obstacle to form these type of clouds. Overall, the goals of the assignment were met. The cloud image could be improved by including the lower-altitude cumulus clouds that were present further east of where the image was taken.

VI. REFERENCES

[1]Norda, Jacob and Diebel, James. "WeatherSpark, Interactive Weather Charts." WeatherSpark. 2011. Accessed 16 April, 2011. <http://weatherspark.com/#!graphs;a=USA/CO_80027/Louisville>.

[2]Oolman, Larry. "72469 DNR Denver Sounding." University of Wyoming. 2011. Accessed 10 April, 2011.<http://weather.uwyo.edu/cgibin/sounding?region=naconf&TYPE=GIF%3ASKEWT&YEAR=2011&MONTH=01&FROM=2900&TO=2900&STNM=72469>.

[3]Pretor-Pinney, Gavin. "The Cloudspotter's Guide." New York: Perigee, 2006.