MCEN 5151, Project #5 Clouds Report 2, April 18th, 2011

Altocumulus Lenticularis: It's what's on the inside that defines a cloud

---

By P. A. C. MOUNTFORD

MCEN 5151 – Flow Visualization, Spring 2011
Prof. J. Hertzberg

School of Engineering and Applied Science, The University of Colorado, Boulder, Boulder, Colorado US

Introduction

It is often found that things are not always what they appear to be. An incorrect classification of clouds often results because of the idea that their looks represent their species. Although there exists different methods of cloud classification based on physical appearance, the behavior and regional properties of the cloud can also help you determine its species. Looking at the image above, it is first assumed that this cloud is of the cumulus humilis species. The classification was made after looking at Fig.1,2. The delicate fluffy appearance of both the cloud above and the cloud in Fig.1 was the reason for the assumed classification. Numerous types of clouds are observed in the Rocky Mountain region, especially in late winter. It is presumed that multiple types of clouds are being observed, when in actuality it is just a few species of clouds behaving differently. Instead of determining the cloud above on its physical appearance, the way in which it was formed and the region in which it appeared will be used as the deciding factor.

Cloud Classification

This picture was captured on March 24th,2011 around 12:00p.m. mountain standard time. This picture was taken at an elevation of approximately 12,000 feet just outside of Leadville, CO about 12 miles away as the crow flies. The reader should note that this cloud was captured at an elevation of 12,000' which is much higher than the altitude at which cumulus humilis clouds form. It was assumed that because this cloud was cumulus humilis because of its relative elevation to the mountain over which it was formed. Looking to Fig.3 and talking to Prof. Hertzberg, it was determined that the pressure at which the cloud formed would be too low for a cumulus humilis cloud to form at. The reader should know that this cloud was formed right over the mountain in the picture. This means that either a change in pressure or the effect of the mountain wave phenomena was the reason for the birth of this cloud. This cloud was estimated to of formed at 14,000 feet. This elevation of formation gives the suggestion that this cloud is a part of the altocumulus family. After much observation of other clouds formed in this region, it was determined that this cloud should be classified as:

Altocumulus Lenticularis

The reasoning for this classification is justified in the following analysis.

Looking to the skew-T plot in Fig.2, it is seen that the atmosphere was stable and that no clouds were formed over the Denver metro area at 6:00a.m. Most clouds that form over the Rocky Mountains on a day of high stability and no precipitation are commonly classified as altocumulus lenticularis. These clouds aren't formed because of a change in relative humidity in the atmosphere. They are formed because of the change in pressure and humidity due to the mountain wave effect. The mountain wave effect is a product of propagating waves traveling over the mountains due to the abrupt change in land elevation caused by the mountains.[6,7] Fig.5 presents an illustration of the mountain wave phenomenon. These waves cause a repeated change in air pressure which is spaced in a sinusoidal manner. These changes in air pressure are the reason for the formation of clouds above the mountains.

It is hard to see the cloud as an altocumulus lenticularis after observing Fig.4. These clouds tend to have a more lenticular, stretched out, appearance. Turns out that because of the nature and location of which this cloud was formed, it is an altocumulus lenticularis. The only way in which this cloud could've been classified as cumulus humilis is if the change in pressure from the cloud only being 2000' above the peak was greater than the change in pressure due to the mountain wave effect. This greater pressure would mean that the cloud is being formed because of the high pressure presented from being above the ground. The cloud would be behaving like a cumulus humilis cloud that formed right above sea-level.

Camera Setup

Camera – Canon PowerShot A560
Distance from focus to lens – Roughly 2000 Feet
Focal Length – Not Sure (Point and Shoot)
Exposure Time – Not Sure (Point and Shoot)
Aperture – Not Sure (Point and Shoot)
Sensitivity – Not Sure (Point and Shoot)
Image dimensions – 1404 x 2345
Field of View – Approximately 8000 Feet
Flash – No Flash

Image Processing

The processing of this image comprised of cropping the image as desired and adjusting the contrast curve to give the cloud a more drastic color variation.

References

[1] Skew T Plot: http://weather.uwyo.edu/upperair/images/2011021200.72469.skewt.gif

[2] Cloud Types: https://culearn.colorado.edu/webct/urw/lc5116011.tp0/cobaltMainFrame.dowebct

[3] Cloud Species: https://culearn.colorado.edu/webct/urw/lc5116011.tp0/cobaltMainFrame.dowebct

[4] Lenticularis: https://culearn.colorado.edu/webct/urw/lc5116011.tp0/cobaltMainFrame.dowebct

[5] Prof. Jean Hertzberg

[6] Mountain Waves: http://www.google.com/imgres?imgurl=http://www.lentic.net/about/lentic/files/page5_1.png&imgrefurl=http://www.lentic.net/about/lentic/&h=236&w=500&sz=58&tbnid=wPw7ljLc6DkgjM:&tbnh=61&tbnw=130&prev=/images%3Fq%3Dlee%2Bwaves&zoom=1&q=lee+waves&usg=__5-mxZCJQBz3_BHDBihcEaJNl_Ok=&sa=X&ei=e69uTeDDJYP_8Aay29T8Dg&ved=0CEQQ9QEwBw

[7] Lee Waves: Tokgozlu, A; Rasulov, M.; Aslan, Z. (January 2005). "Modeling and Classification of Mountain Waves". *Technical Soaring* **29** (1): p. 22

Figures

Figure 1: Cumulus Humulus Clouds.[3]

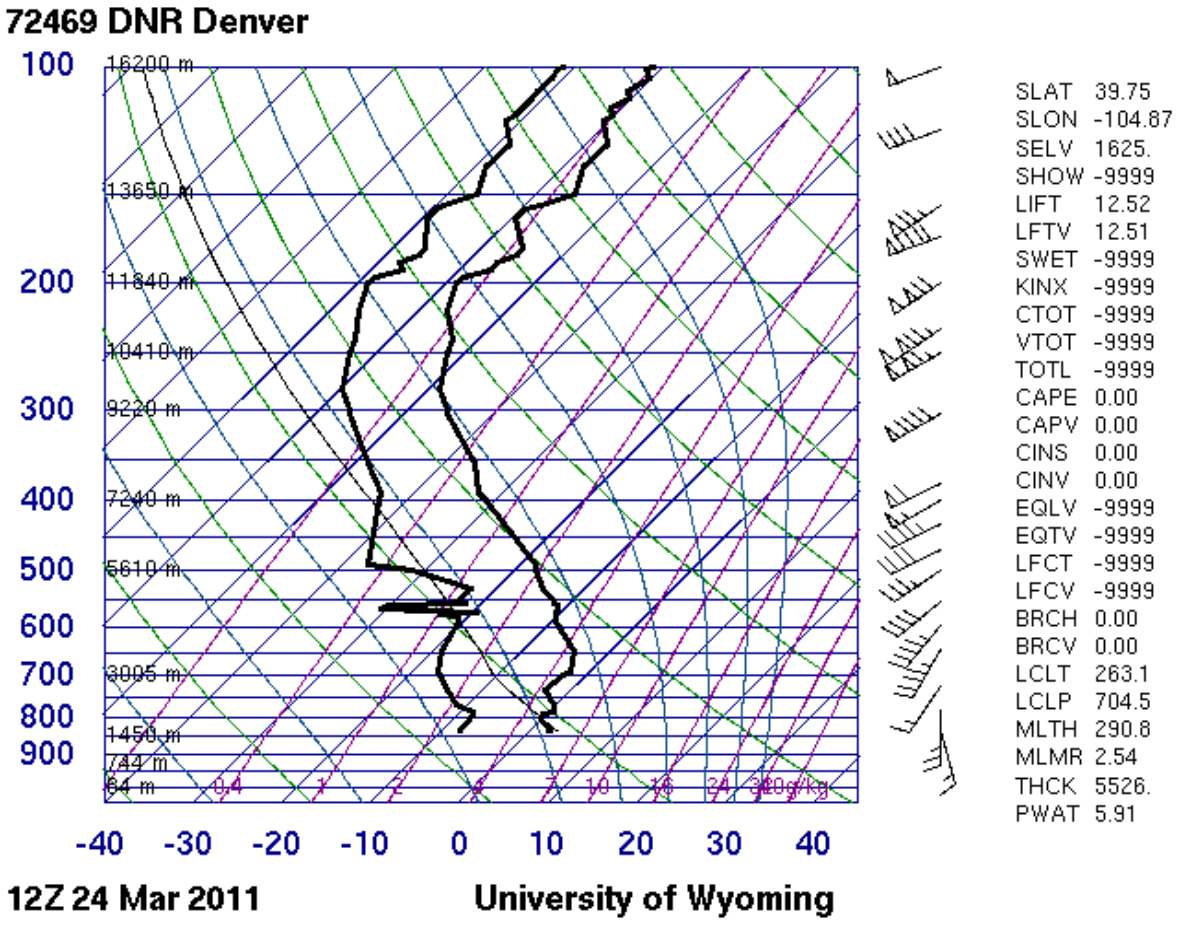

Figure 2: Skew T plot for March 24th, 2011 at 6:00a.m. for Denver, CO.[1]

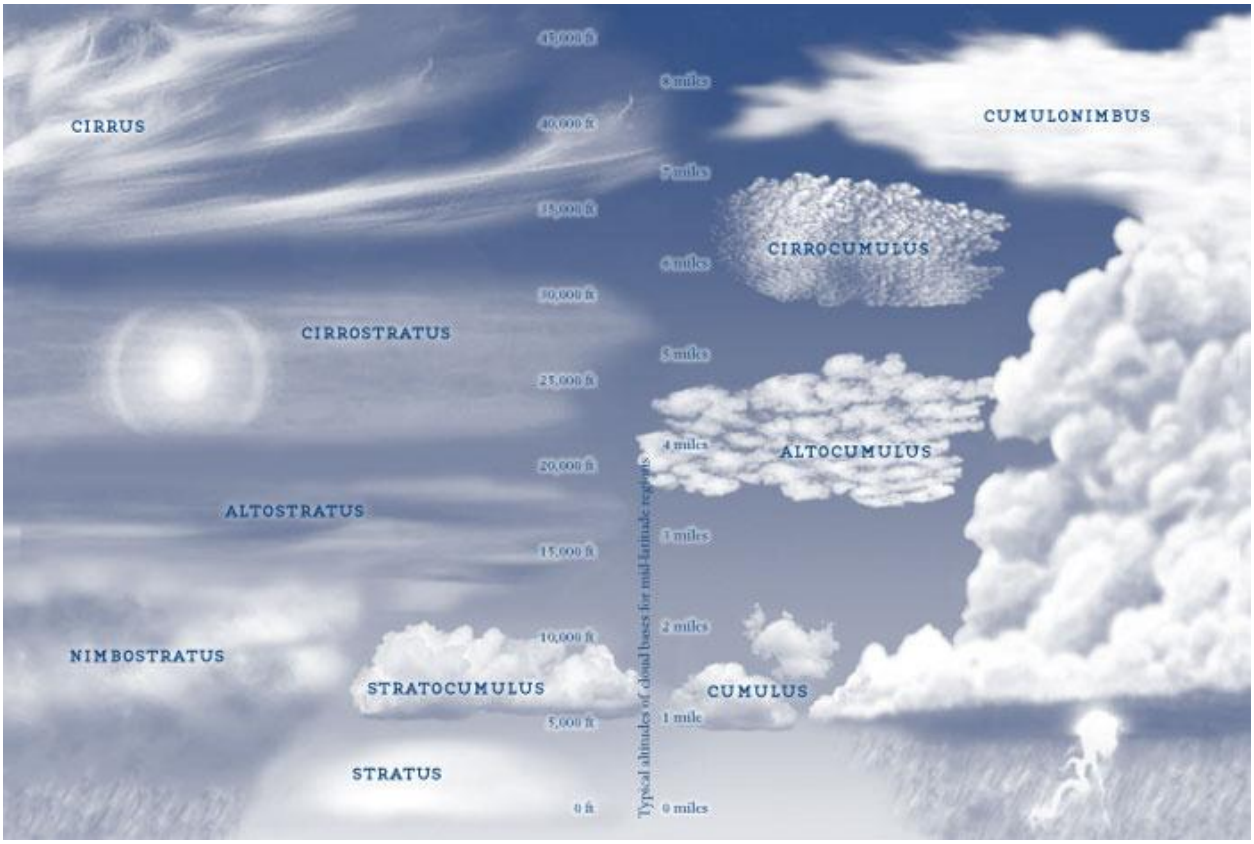

Figure 3: Visual representation of the different types of clouds that can occur in our atmosphere.[2]

Figure 4: Lenticularis clouds forming over a mountain range.[3]

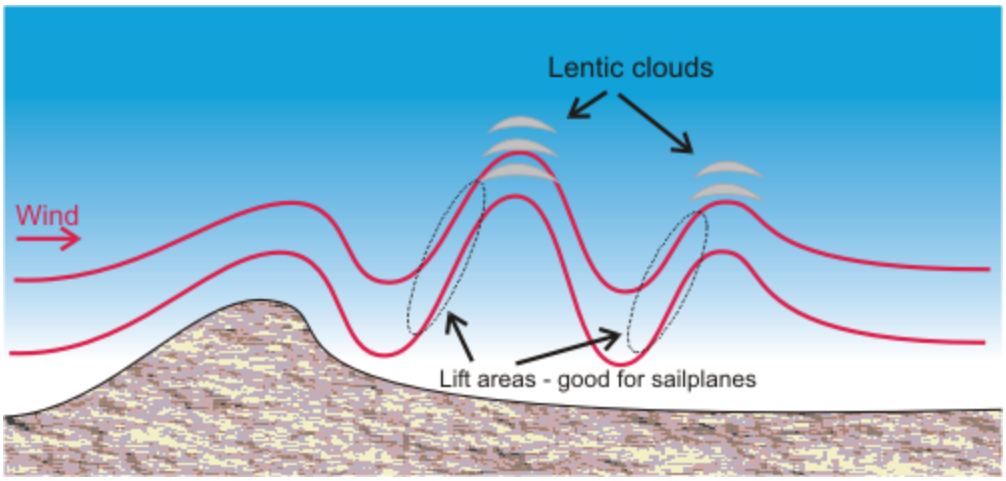

Figure 5: Visual representation of why lenticular clouds form due to mountain waves.[6]