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Flow Visualization
3/1/06

Lenticularis of Boulder

Purpose

The purpose of this photograph is to capture and categorize a cloud formation. Cloud formations, like many other physical phenomena, have the ability to be both visually and scientifically appealing. Clouds are naturally beautiful. They can be viewed morning afternoon and evening. Clouds can be seen almost every day of the year, and yet a photograph of them can still be interesting both artistically and scientifically. The cloud photographed for this assignment will be identified and its formation and physical characteristics will be discussed. The photograph in this paper was taken during midday facing west with the flatirons in the foreground.

Figure 1: Photograph of altocumulus lenticularis cloud formation.

Cloud Classification

The cloud that I have chosen to present is a unique cloud formation because it is only commonly viewed on the downslope of mountains. This image was chosen for it uniqueness as well as its beauty (figure 1). This cloud would be classified as an altocumulus lenticularis, which is a form of stable wave cloud. This formation gets its name from the fact that its shape is round and convex, similar to that of a lens. It is classified as altocumulus because it is a mid level cloud, meaning that its height ranges from 6500-23000 ft above the ground. The mountains in the foreground are at an elevation of about 8000 ft, and the clouds in the photograph are just above them, so they are probably at around 9500 ft (from sea level) [1].

Lenticular clouds only form with a particular combination of atmospheric conditions, a few of these being mountains, high winds, and the right amount of water vapor in the air. This type of cloud only forms in mountainous areas because the mountains themselves aid in the cloud formation. In the foreground of the photo mountains can be seen. These mountains may have contributed to the cloud formation, but this wave cloud system was caused primarily by the much larger mountains that form the continental divide (not pictured) [2]. This is because the peaks that are pictured in the photo are only about 8000 ft [1], whereas the peaks that makeup the continental divide can reach greater than 14000 ft.

The clouds are created by the downslope on the lee side of the Rocky Mountains where the terrain transitions from 14000 ft down to only 5280 ft in Denver. The air is first forced up over the mountains and then as the ground falls, the air undergoes adiabatic expansion which causes cooling. This cooling forces the water vapor in the air to condense forming clouds. Lenticular clouds also need high winds to form. On the day that this photo was taken a high pressure front was moving into the area causing the high winds that occurred on this day (figure 1a) [3]. When windy conditions exist, wave cloud formations like this one form. Lenticular clouds form at the crests in the waves of air as it moves. This can be seen in the figure below (figure 1b). [4]

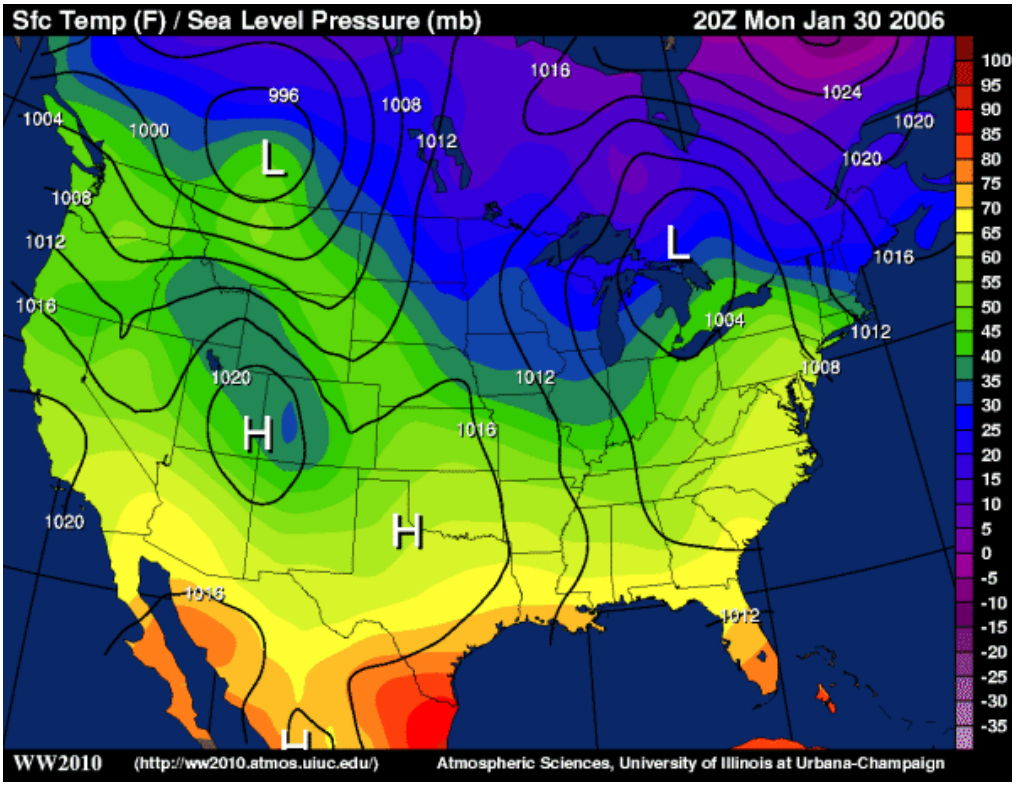

Figure 1. a) Picture of the temperature and pressures on the day and time the photograph was taken. [3].

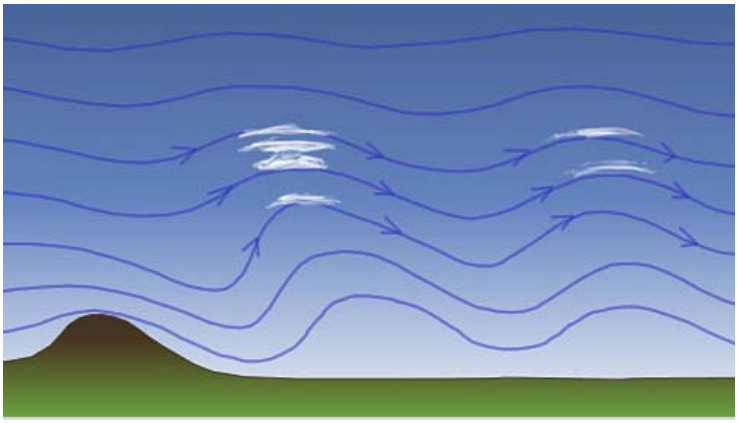

Figure 1. b) Picture of wave clouds forming a lenticular could. [3]

It is also important to note that lenticular cloud formations are a standing wave cloud, meaning that it is not moving, rather the air is moving though it. In some cases, lenticular clouds can form in multiple sets, creating a long stream of lenticular clouds. In this photograph, there are also some higher-level clouds present above the lenticular clouds, but due to the sun they are not identifiable.

Photographic Technique

This photo was taken from the balcony of the ITLL (Integrated Teaching and learning laboratory). It was taken on Monday January 30, 2006 at 1:48 PM on a windy but warm day. The camera was facing southwest towards the flatirons. Because the picture was taken during the winter, the days were short; therefore the sun was behind the cloud, which gave the cloud a nice lighting. The table below gives other pertinent information regarding camera settings (figure 2). The spatial resolution for this photo was found to be 4.647 ft/pixel. This is a standing wave so investigating the blur due to its movement is not practical. The cloud is moving within itself, but it would be difficult to estimate its speed, so no blur investigation could be done. The only light that is present in this picture is the light from the sun. Photoshop was used to eliminate two light poles that added some distraction to the image.

Photographic technique	**Value used**
Image height	3 miles
Image width	2 miles
Field of View	6 mi^2
Distance from object to lens	3.3 mi
Lens focal length	6.4 mm
Type of camera	Canon Powershot SD10 (4 Mpixs)
-Aperture	f/5.6
-Shutter speed	1/1000
-Film speed	ISO 100

Figure 2: Information regarding the photographic technique used for this photo

Conclusion

This image shows the formation of altocumulus lenticularis clouds, with the flatirons in the foreground. This type of could formation is caused by mountainous winds and other atmospheric conditions. The intent of this project was to capture an image that is both aesthetically appealing and has some atmospheric significant. This image fulfills both of these objectives. There are no distracting elements or imperfection in this image. I am happy with every aspect of this photograph.

References

[1] http://mapserver.maptech.com/
[2] Cloud Dynamics. Robert A. Houze, Jr. Academic Press: 19-22
[3] http://www.sundog.clara.co.uk/droplets/iridim4.htm
[4] http://ww2010.atmos.uiuc.edu/%28Gh%29/wx/surface.rxml