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Cloud 1 Assignment
2/28/2013

Flow Visualization Spring 2013

Mountain Wave Cloud

The purpose of this assignment is to capture an image of a cloud and the flow of air that formed the cloud. Along with getting an image we were asked to identify the cloud type and look at the stability of the atmosphere at the time of the cloud. My image is of a cloud forming over the Flat Iron ridge line near Chautauqua Park on February 16, 2013. I took a series of images as the cloud first started to form over the ridgeline which made it easier for classification.

When I captured this image I was standing in the parking lot of Chautauqua park looking west over the mountain, the cloud was just north of the 1st flatiron. The ridge line is at about 6400 ft though the cloud was probably another 1500 ft above that though. I took the image on February 16th, 2013 at 4:17 pm.

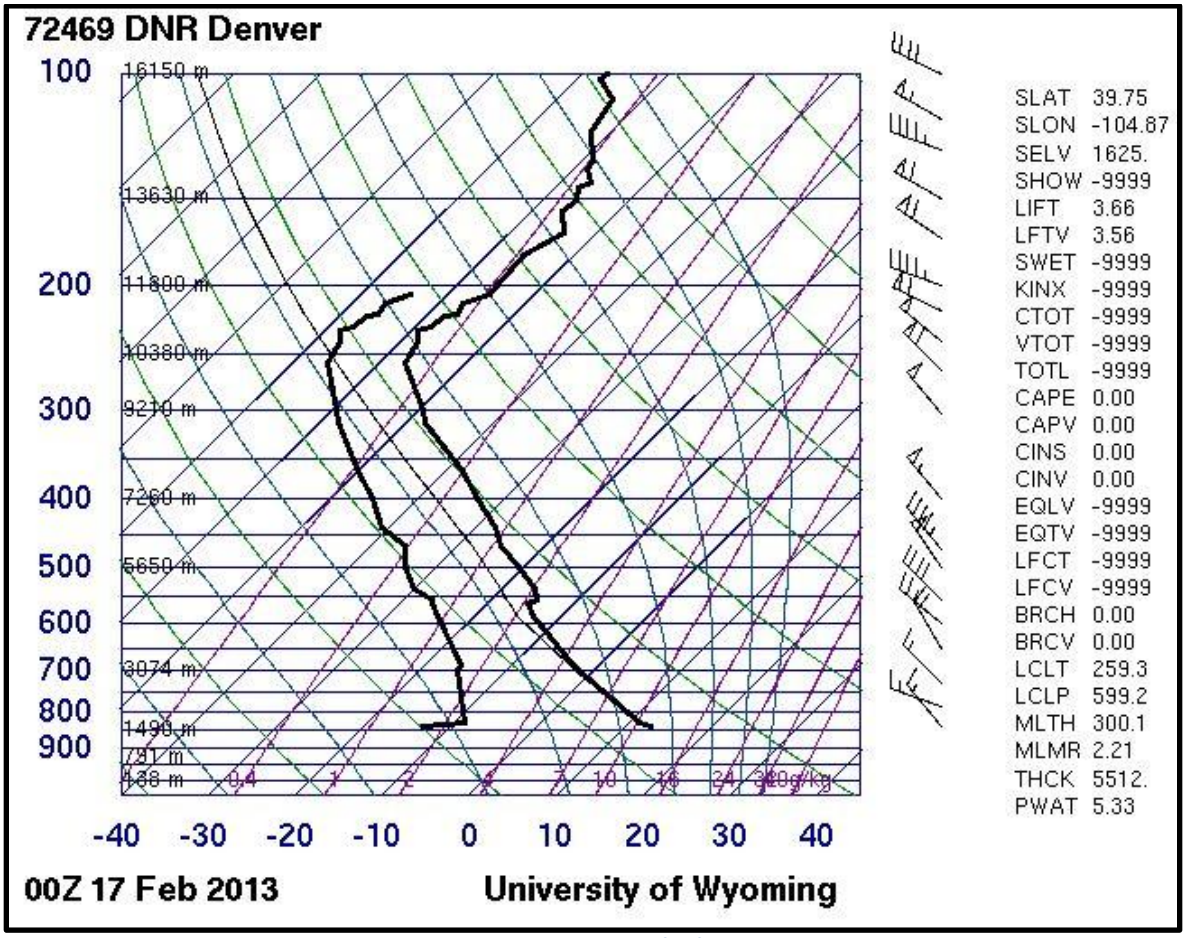

Figure 1: Skew-T Diagram For 2/16/13 at 6:00 pm

From looking at the Skew-T diagram the atmosphere appears to be stable, the CAPE is zero which is the main indicator that things are stable. The cloud that I observed was the product of a mountain wave, which can happen in both stable and unstable atmospheres, though had the atmosphere been unstable I would have expected there to be more clouds across the whole ridgeline. My observations are consistent with what the Skew-T diagrams, and backs up my classification of the cloud being a stratocumulus. I have decided as part of my classification of cloud type that I would also calculate the Froude number, to look at what the possibilities of wave formations happening at that point in time.

$$Froude\ \# = \frac{V}{\sqrt{gH}}$$

$$V = Wind\ Velocity = 15\ mph = 6.7\frac{m}{s}$$

$$g = gravitaional\ force = 9.8\frac{m}{s^2}$$

$$H = Height\ of\ Mountain = 6400ft = 1950.7\ m$$

$$Froude\ \# = \ .05$$

The Froude number is <<1 so there is likely to be no oscillation of the air after passing over the mountain range. This is consistent with what I observed as well, though there was cloud formation right above the mountain there were no lee wave cloud formation on the leeward side of the mountain, which would be more likely had the Froude number been close to 1.

For my image I used my Nikkor AF-S 70-300mm lens with my Nikon D40 camera. Below are the settings that I use for this image.

Focal Length	70mm
F-Stop	F/5.6
ISO	100
Shutter Speed	1/320 sec
Pixels (original)	3872 x 2592
Pixel (PhotoShop)	2524 x 2238

I changed very little from the original image to my final submission ion in PhotoShop, all that I did was crop the picture down so that it was more focused on the cloud and adjusted the color curve a little bit too bring the details of clouds out as much as possible.

Figure 2: Final Cloud Image

Over all the image came out almost exactly as I want it to for my final version, I choose this image of all the one that I took that day because of the interesting flow through the middle of the image that create these small vortices. I thought that it really showed how the air was moving and creating this cloud. I wish I had been able to look closer in on one of these vortices to really look at the detail of say a single one, but I was not capable of that sort of zoom with my camera and lens. I feel as though my image fulfilled the requirement for our class assignment and made me look at how easily clouds come and go. While I was taking my images this cloud formed and dissolved a couple times. For the image that I took I would not change much, but had I gotten a day where I could have captured an image of more layers of distinct clouds I feel like my image would have had more life. Though I feel like my image really looks at the flow of the cloud I feel if I had more time to get an image I could have gotten a more exciting photo. For my next cloud image I hope to be able to take picture on multiple days so that I look at a wider variety of cloud types and formations.

Source:

Newman, John Nicholas (1977). *Marine hydrodynamics*. Cambridge, Massachusetts: MIT Press. ISBN 0-262-14026-8., p. 28.
(I looked at the info through http://en.wikipedia.org/wiki/Froude_number)