Jeffrey Pilkington
Flow Visualization
Clouds 2
16 April 2013

Purpose:

This image was taken for the second clouds assignment for the flow visualization course at the University of Colorado at Boulder. My approach to this project was to try to capture a cloud that I was interested in learning more about. I decided to attempt to photograph a cirrus cloud. I took pictures throughout the semester to try to capture this type of cloud. The final product was a cirrocumulus undulates cloud formation I was able to capture.

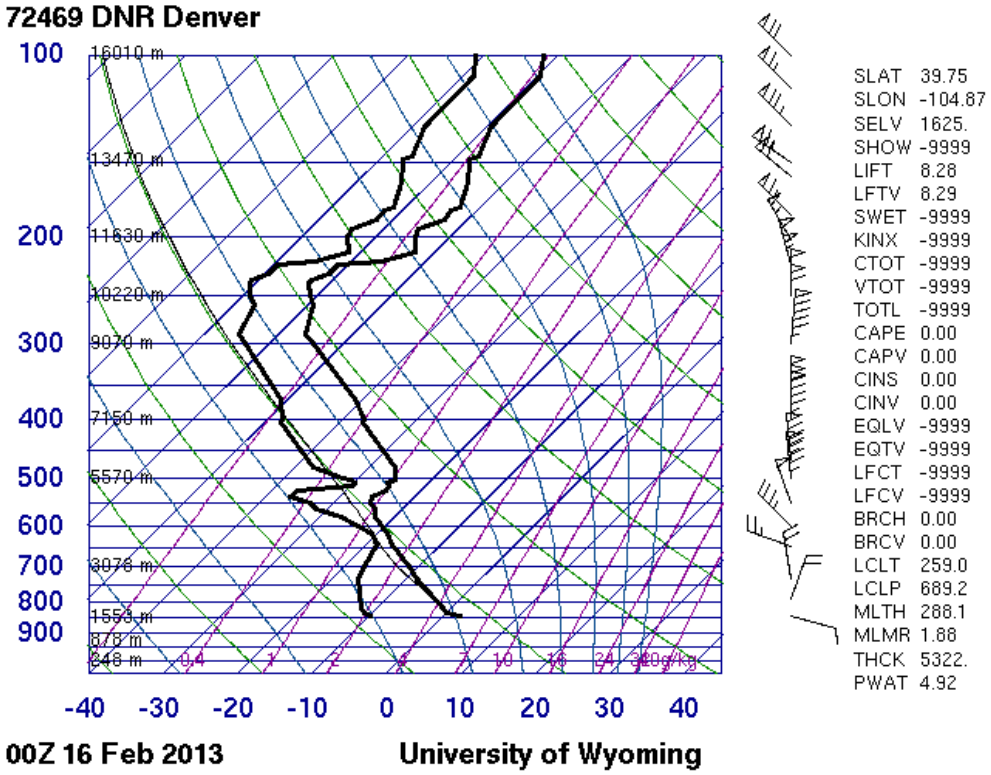
Circumstances:

This image was taken on February 15 2013 at about 1:30pm. I was directly beneath the cloud formation; the camera was pointed directly towards the sky. This photo was taken at a scenic view pull-off on Flagstaff Rd. Several mountain wave clouds were forming and dissipating beneath the photographed cloud so it took patience to capture the cirrus cloud above the mountain wave clouds. The "bottom" of the photo is directly west.

Cloud Identification:

The cloud in the photograph is a cirrocumulus undulates cloud. Cirrocumulus clouds are high altitude tropospheric clouds [1] Typically these clouds occur between 5000-12000m, which is consistent with the skew-T plot for the day that shows that the clouds were at 11000m. The skew-T plot shows where the clouds are likely to form when the temperature and dew point lines come close to touching each other. Typically cirrocumulus clouds have a short lifetime because they form into cirrostratus clouds. Cirrocumulus clouds contain super cooled liquid droplets that form into ice crystals because of the low temperatures in the cloud. This freezing causes them to form into cirrostratus. [2] The photo captures the cirrocumulus (upper half of the photo) transitioning into cirrostratus clouds (lower half of the photo). Typically cirrocumulus clouds may indicate bad weather usually within 12 hours. [3] The undulates is apparent in the photo as the cloud appears to have long uniform "fingers" extending to the upper left corner of the photo. The undulation patterns in the clouds are a result of gravity waves in the atmosphere. As the air rises and falls in a wave like pattern the moisture in the air condenses at the peaks of the wave (and is visible as a cloud) and the troughs of the wave vaporizes and the cloud disappears. [4] This oscillating pattern gives the resulting undulating appearance of the clouds.

The weather in boulder was quite mild. It was approximately 44 F when the picture was photographed. The wind speed was 5 mph from the south. There was very high visibility (10.0 Miles) and the relative humidity in the air was 38%. [5] The CAPE in the skew-T is 0, which means that the atmosphere is stable. The diagram also shows the stability in the atmosphere because at all times the temperature line is above the adiabatic, meaning that if a parcel of air was perturbed it would continue back and assume its original position. According to the skew-T plot the clouds were most likely at approximately 11000 m above the surface of the earth. [6]



Photographic Technique:

This photograph was taken using a Kodak Easyshare z915 digital camera. The photo is 3648 x 2736 pixels. The photograph was taken with an F-stop f/9.6, an exposure time of 1/640 second, an ISO speed of 100, focal length of 12mm. The distance from the object to the lens is about 11000 m since the cloud was directly overhead. The contrast in the image was increased using the curves command in Photoshop. Before and after photos can be seen in the figure below.

Conclusion:

This image is a really interesting capture of a high-level cirrocumulus cloud transitioning into a cirrostratus cloud. The gravity waves are clearly depicted in the cirrocumulus undulates cloud in the upper left corner of the photograph. I

think that the wispy nature of the clouds created by the ice crystals is really beautiful. I think the deep blue sky brings out the undulates much better and it is easier to tell that the cloud is undulates. I wish I could have stayed and observed the cloud activity

References:

[1] Funk, Ted. "Cloud Classifications and Characteristics". *The Science Corner*. NOAA. Retrieved 6 February 2011.

[2] Pretor-Pinney, Gavin, and Bill Sanderson. *The Cloudspotter's Guide: The Science, History, and Culture of Clouds*. New York: Berkley Pub. Group, 2006. Print.

[3] *Common Cloud Names, Shapes, Altitudes*. BBC Weather Centre, 2000. Web. <http://nenes.eas.gatech.edu/Cloud/Clouds.pdf>.

[4] Tai-wai. "Educational Resources." *Educational Resources*. N.p., n.d. Web. 14 Apr. 2013. <http://www.weather.gov.hk/education/edu01met/01met_clouds_hk/ele_cloud03_e.htm>.

[5] "WeatherSpark Beta." *Beautiful Weather Graphs and Maps*. N.p., n.d. Web. 28 Feb. 2013.

[6] "Atmospheric Soundings." *Atmospheric Soundings*. N.p., n.d. Web. 28 Feb. 2013.