Cotton Ball Clouds over Boulder

By Chris Ostoich
March 1, 2006

The appearance of clouds in the atmosphere is a complicated phenomenon. The form of a cloud is both regulated by the complicated fluid mechanics and thermodynamics within the cloud and the flow of the air outside. However, for all of its complication, a lot can be known about a cloud from a quick picture. A freeze frame of cloud captures the beauty of the cloud while giving a lot of information about the scientific principals that create the features in the cloud. Although every cloud has scientific merit, many pictures of different clouds were taken to find one that both exhibited a lot of information about the cloud and was aesthetically pleasing.

The cloud image presented was taken at 11:11:34 on Tuesday, February 21, 2006. The SkewT plot for this time frame is shown below in figure 1.

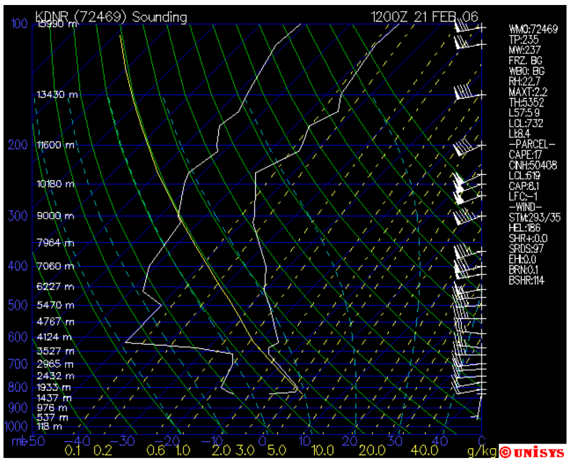

Figure 1: SkewT plot of the atmospheric conditions in Denver for 10 am on 2/21/06.

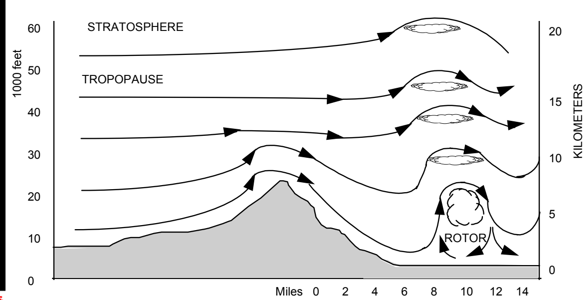

Figure 2: Schematic of the flow situation to produce the lenticular cloud over Boulder [1].

The information given by the SkewT plot shows that the altitude of the cloud is most likely 2 kilometers or 6,500 feet above the ground at Denver International Airport. It gives the wind velocity at this altitude to be 31 to 39 knots. The cloud is stable at this altitude which places it around the low to middle étage. The cloud is classified as a lenticular cloud that is downwind of the mountains. The air could possibly be elevated by the presence of wind rotor as shown in figure 2 above. The evidence to support this classification is the fact that the elevated air over the Continental Divide created a Foehn cloud, as can be seen in figure 3. Videnov [2] mentions that a rotor can result on the downwind side of a Foehn cloud.

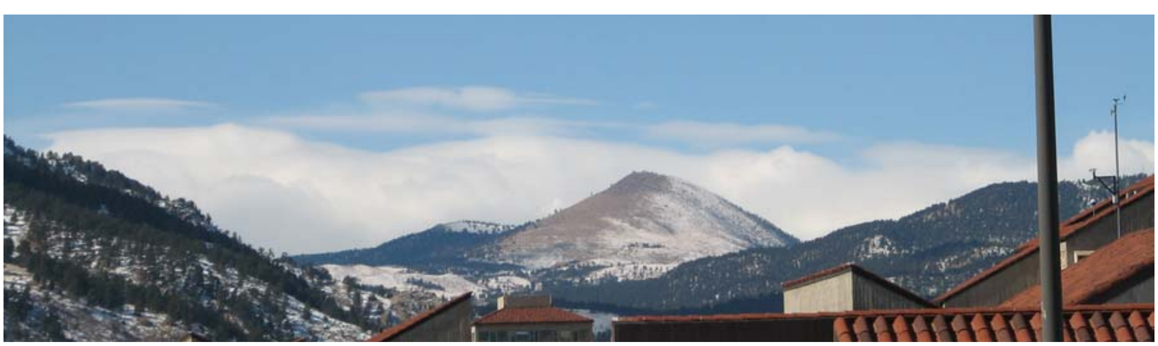

Figure 3: Foehn cloud caused by the elevated air flowing over the Continental Divide.

The air that created the Foehn cloud flowed down the side of the mountains and created the warm wind, a high of 42 degrees on that day. The air was again elevated, as in figure 2, to create the cloud that was photographed. The wispy edges of the clouds indicate high winds at that altitude.

The picture was taken from the top of the engineering center parking lot. The camera is facing east and is pointed approximately 70 degrees from the horizon. The light source used was the sun, which was to the right of the frame. The situation can be seen in figure 4 below.

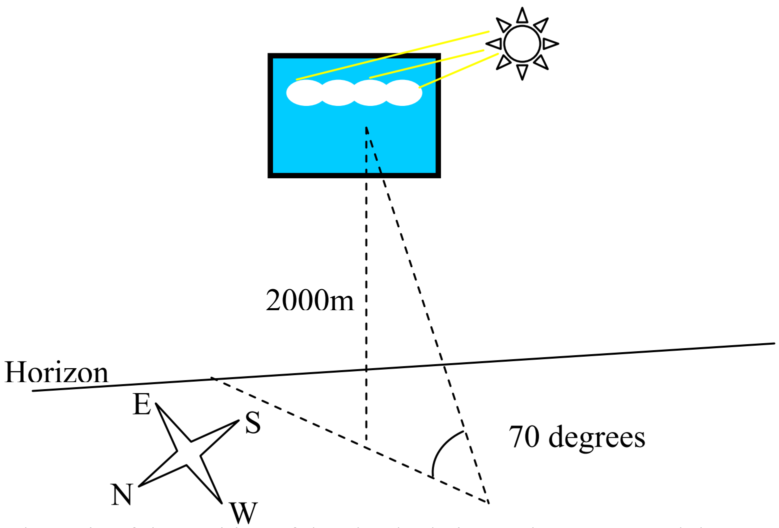

Figure 4: Schematic of the position of the cloud relative to the camera and the sun.

The camera used to photograph the cloud was a Canon PowerShot S2 IS. The image is 2592 pixels wide by 1944 pixels high. The lens on the camera had focal lengths of 6.0-72.0 mm with aperture settings from f/2.7-3.5. The camera was set to **P** mode, which set the shutter speed and aperture automatically but allowed the photographer to manually focus the camera. The focus was set to infinity while the shutter speed and aperture were set by the camera to be 1/1000 s and f/4.0, respectively. The distance from the camera to the cloud was estimated at 2128 meters. No Photoshop processing was done on the picture.

When Skew-T data from weather.unisys.com and photos are taken into consideration, a lot can be inferred about the flow physics associated with the weather over Boulder on February 21, 2006. The mentioned resources suggest that the wind came down the mountains and warmed causing the moisture that makes up the clouds above the mountains to evaporate. The air then became elevated above Boulder due to a wind rotor. According to the Skew-T plot, the elevated wind cooled and the moisture condensed and created the lenticular cloud in the image. The wispy edges of the cloud indicate the high wind speed at the elevation of the cloud.

I chose this image due to its beauty. I like the large contrast of the bright white clouds against the deep blue backdrop. The wispy or frayed edges of the cotton ball looking clouds reveal more detail the longer you stare at them. The one thing that I wish was different about the image is that the cloud type photographed were a little less common. However, although the cloud seemed like a simple occurrence, the possible explanation that I found for the cloud proved to be very interesting. My intent to find a visually appealing fluid flow and try to explain the physics behind it was realized. A possible direction that could be followed in developing the idea further is taking a video of the evolution of the cloud over time. This would give more insight as to what the cause of the cloud was.

Reference

[1] Kessler Air Force Base Naval Technical Training Unit Student Text wwwnt.cnet.navy.mil/nttu/ag_links/ag_links2002/physics/stdttxt/ST-104_cover.doc Accessed 02/26/06

[2] P. Videnov, A. Tzenkova, A. Gamanov, Some Results from Atmospheric Sounding in Cases with Foehn in Sofia Valley, National Institute of Meteorology and Hydrology, Bulgarian Academy of Science, Sofia, Bulgaria