Cloud Project 2

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MCEN 4228: Flow Visualization

"Parallel Contrails" depicts three lines of condensation in the air, running nearly perfectly parallel. The top line of the image is a freshly formed trail from a passing jet, while the bottom two lines are contrails that have been in the sky for some time. The image is a good example of the forms that contrails take and the progression of their form with the passing of time.

Contrails are formed by the condensation of water vapor from jet engines as they pass through the sky. The water vapor leaves the jet engine as exhaust and if the atmosphere is cool enough will form into water crystals. The water crystals then form the clouds seen in the photo. Also in the image are a few cirrus clouds, mostly to the right, that give the white hew to the picture.

The skew-T plot for the time nearest to the photo is given in Figure 1. This plot is for 6 PM. The plot indicates a slightly unstable atmosphere from the ground to an elevation of approximately 15000 feet. Elevations above 15000 feet show the air temperature following a similar path to the adiabatic line, indicating that the atmosphere is marginally stable at all higher elevations. Also at 15000 feet, the dew point skews toward the air temperature, indicating that clouds are likely to be forming at this altitude. The wind at the estimated altitude of the contrails was approximately 40 knots. The wind was coming from the west-north-west consistently at all altitudes.

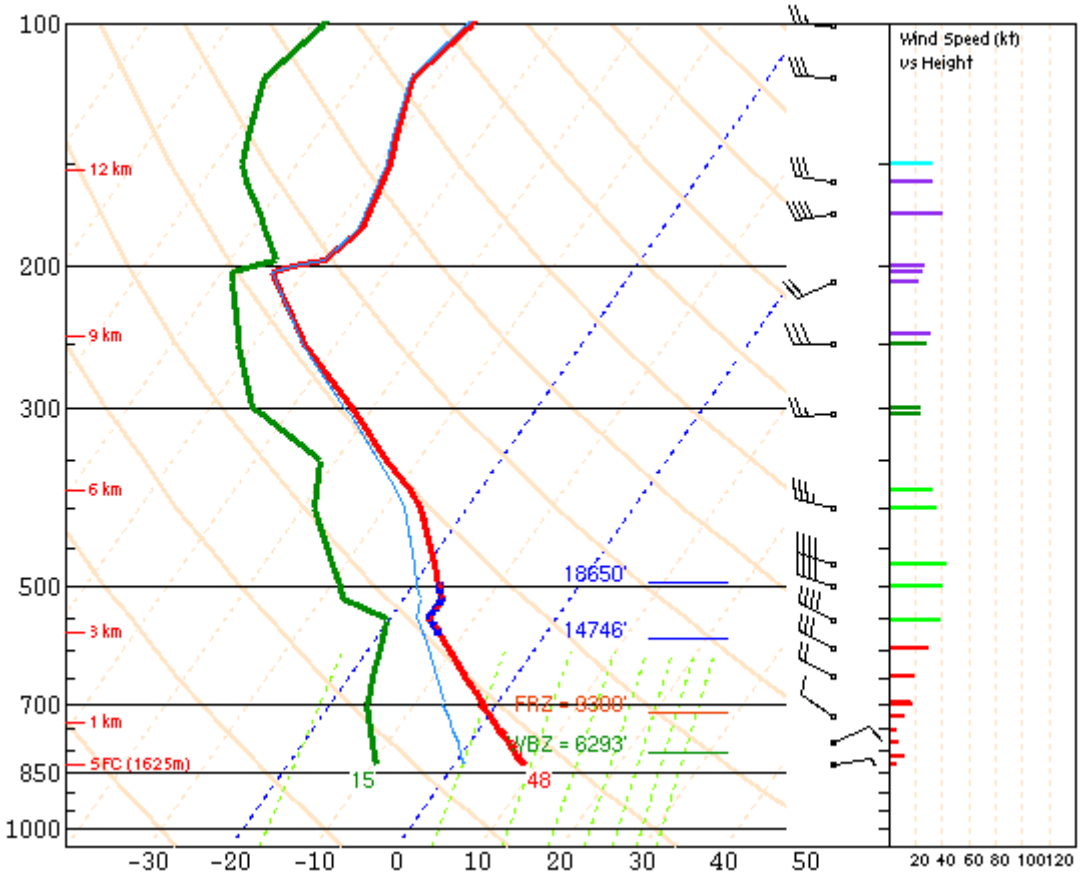

Figure 1: Skew-T Plot for Denver, CO on November 25th, 2007 at 6 PM

The photo was taken on Sunday, November 25th 2007 at approximately noon. The contrails were viewed from the intersection of 28th Street and Arapaho Avenue in Boulder, Colorado facing south. The clouds are illuminated by sunlight that is entering the photo from the west, or through the right side of the image. The camera data and settings are given in Table 1.

Table 1: Photographic Parameters	
Camera	Nikon D40x
Lens	Nikkor 18-200 mm VR
Resolution	3264 x 1397 pixels
Focal Length	65 mm
Aperture	f/4.9
Shutter Speed	1/250 sec
ISO	100

Using the aperture and the estimated elevation the clouds the length of each of the three contrails is estimated to be 8000 feet. Due to the distance that the image is from the

camera lens, the spatial resolution is relatively small. It is estimated that the clouds only move five pixels during the entire 1/250 second exposure.

Adobe Photoshop was used to edit the image. The levels were altered to bring out the contrails and bring the blue of the sky out from behind the cirrus clouds. Additionally, the image was cropped so that the only clouds present in the image were the contrails.

The image is a good representation of typical shapes that contrails take. The parallel orientation of the clouds makes it easy to see the changes in form that contrails can take with time. It was also fortunate to get a fresh new contrail in the image that was also passing in the same direction as the previous clouds.