Mark Rizzuto
MCEN 4228 – Flow Visualization
November 28, 2007

Clouds 2

The objective for this photograph was to image the condensation of water vapor in Earth's atmosphere commonly referred to as clouds. This image captures the intersection of several high altitude cirrus clouds and a thin contrail that floats parallel to these clouds. It was taken not long before sunset, around 4 pm, with the camera facing south. The sun, which is setting in the west, is dim as it approaches the horizon. This creates a contrast between the sky and the clouds that reveals the distinct characteristics within the clouds. Under normal conditions, the contrail may not even be apparent as it would blend in with the cirrus clouds. With these lighting conditions, the vortices within the contrail are made visible, and it is clearly distinguishable from the surrounding clouds.

This image features a cluster of cirrus clouds with a contrail that runs parallel to these clouds. The skew-T plot (found in Appendix) shows a convergence of the moisture and temperature profiles between 10 and 12 km. Cirrus clouds form high in the atmosphere, usually above 6 km. The skew-T plot supports the assumption that these are cirrus clouds. "Cirrus clouds are characterized by thin, wisplike strands" (1). They "are composed of ice crystals that originate from the freezing of supercooled water droplets. Cirrus generally occur in fair weather and point in the direction of air movement at their elevation" (2). "The word *cirrus* comes from the Latin word for a tuft or curl of hair" (3). The clouds depicted in the photograph are very much curled, especially the ones towards the top of the image. Cirrus clouds are often "so thin that sunlight can pass right through

them" (3). The skew-T plot (Appendix) shows a temperature curve that has the same slope as the adiabatic curve at one point, and a slightly steeper slope than the adiabatic curve at another. This means that the atmosphere was marginally stable to stable at the time the photo was taken. Cirrus clouds are often indicative of stable weather, which again supports the conclusion that these are cirrus.

The contrails in the image "are condensation trails and artificial cirrus clouds made by the exhaust of aircraft engines or wingtip vortices which precipitate a stream of tiny ice crystals in moist, frigid upper air" (4). These "clouds" are made up of soot, water vapor, and tiny ice crystals. Within the contrails are ripples that are the result of vortices created by the wings traveling at high speeds through the air. The contrail in this image actually gives a bit of information about the plane that produced it. It is an average sized contrail, meaning it came from a medium sized jet aircraft. The contrail is more faded towards the left side of the image and more prominent on the right, meaning the left side was created before the right side. Because this photo was taken in a southern direction, the plane must have been flying across the sky from east to west.
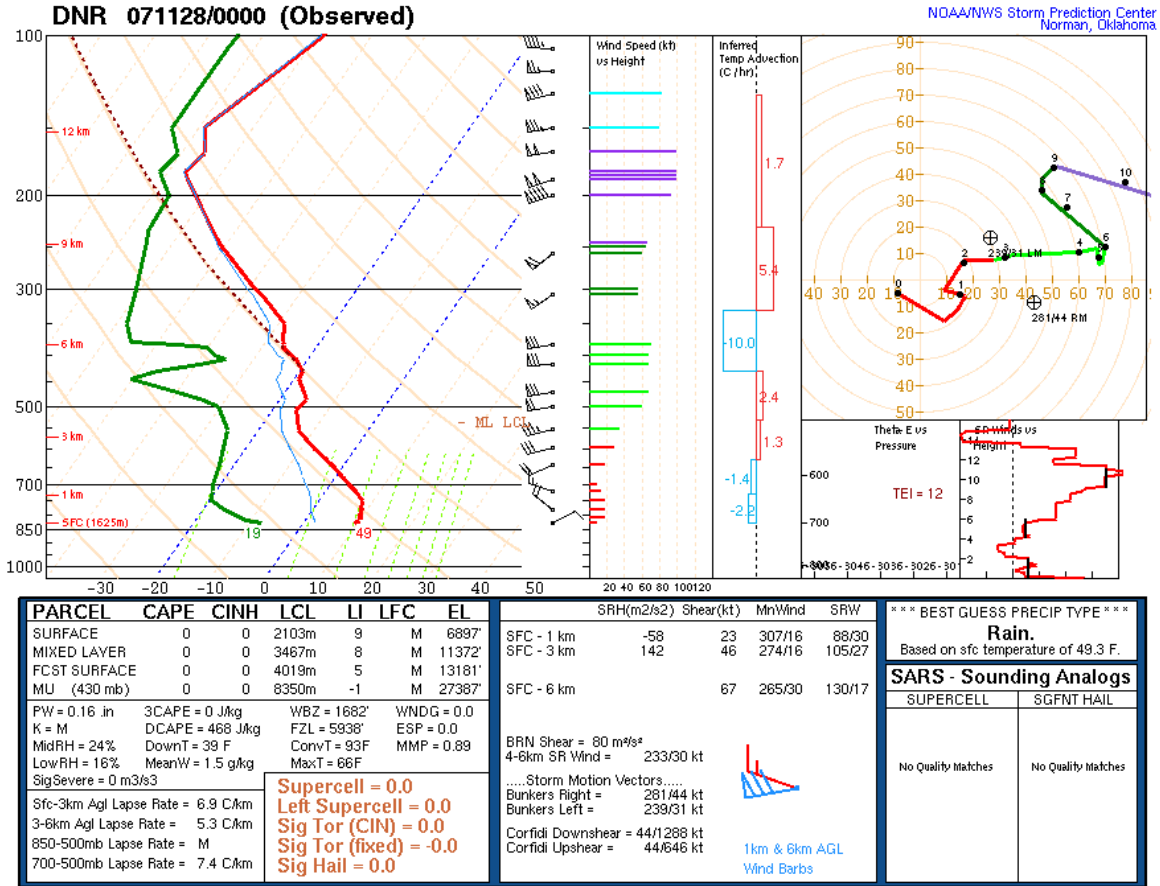
The image was taken slightly before sunset to give a good contrast between the sky and the clouds. The only light source in this image is the sun. The clouds lie in the southern sky, and the sun is setting in the west (which would be towards the right side of the image). Because these clouds are high in the atmosphere, and the sun is below and to the right, the undersides of the clouds are illuminated.

The field of view in this photo is the sky so it is quite large. Although the field of view cannot be directly measured, the width can be estimated to be a few miles (probably between two and three). The skew-T plot shows a convergence of the moisture and

temperature profiles between 10 and 12 km, which is where cirrus clouds are typically found. Therefore, the distance from the camera to the subject depicted in this image is between 10 and 12 km. The focal length of the lens was 8.0 mm. The camera used was a Kodak DX7630 Zoom, a digital camera. The original image width was 2856 pixels and the height was 2142 pixels. The ISO setting was 100, and the shutter speed was 1/181 seconds. Although the clouds are not traveling very fast (probably only a few miles per hour), they do move enough that a fast shutter is required to prevent motion blur. The aperture was set to 3.5 to allow enough light in. Photoshop was used only slightly. The brightness was reduced, and the contrast was intensified slightly to further reveal the cloud features. Nothing else was changed from the original.

The image illustrates both the wispy and hair-like appearance that cirrus clouds can have and also the streaky veils that can form. It also shows a common contrail marked by vortices created within streaks of soot and water vapor by an airplane's wings. The image was taken as I was on my way to a group meeting in the engineering center. I prefer to photograph clouds right at sunset because it is at this time that the clouds take on beautiful and fascinating colors. This photo, however, was taken about an hour before sunset. If you look closely, hues of orange and purple are barely visible. I would have waited for these colors to become more pronounced, but I needed to leave. If I were to take this image again under perfect conditions, I would have liked to capture it at a slightly later time. However, the image reveals interesting information about the clouds, the contrail, as well as some information as to where the plane that formed the contrail was headed. For these reasons, I am pleased with the image that was taken.

Appendix

DNR 071128/0000 (Observed)

Wind Speed (kt) vs Height

Inferred Temp Advection (C/hr)

1.7
5.4
-10.0
2.4
1.3
-1.4
-2.2

- ML LCL

SFC (1625m)   19   49

Theta E vs Pressure

TEI = 12

SR Winds vs Height

239/31 LM
281/44 RM

PARCEL	CAPE	CINH	LCL	LI	LFC	EL
SURFACE	0	0	2103m	9	M	6897'
MIXED LAYER	0	0	3467m	8	M	11372'
FCST SURFACE	0	0	4019m	5	M	13181'
MU (430 mb)	0	0	8350m	-1	M	27387'

PW = 0.16 .in	3CAPE = 0 J/kg	WBZ = 1682'	WNDG = 0.0
K = M	DCAPE = 468 J/kg	FZL = 5938'	ESP = 0.0
MidRH = 24%	DownT = 39 F	ConvT = 93F	MMP = 0.89
LowRH = 16%	MeanW = 1.5 g/kg	MaxT = 66F	
SigSevere = 0 m3/s3			

Sfc-3km Agl Lapse Rate = 6.9 C/km
3-6km Agl Lapse Rate = 5.3 C/km
850-500mb Lapse Rate = M
700-500mb Lapse Rate = 7.4 C/km

Supercell = 0.0
Left Supercell = 0.0
Sig Tor (CIN) = 0.0
Sig Tor (fixed) = -0.0
Sig Hail = 0.0

	SRH(m2/s2)	Shear(kt)	MnWind	SRW
SFC - 1 km	-58	23	307/16	88/30
SFC - 3 km	142	46	274/16	105/27
SFC - 6 km		67	265/30	130/17

BRN Shear = 80 m²/s²
4-6km SR Wind = 233/30 kt

.....Storm Motion Vectors.....
Bunkers Right =   281/44 kt
Bunkers Left =   239/31 kt

Corfidi Downshear = 44/1288 kt
Corfidi Upshear =   44/646 kt

1km & 6km AGL
Wind Barbs

* * * BEST GUESS PRECIP TYPE * * *
Rain.
Based on sfc temperature of 49.3 F.

SARS - Sounding Analogs

SUPERCELL	SGFNT HAIL
No Quality Matches	No Quality Matches

References

1. Wikipedia. (2007, November 29). *Cirrus Cloud*. Retrieved November 29, 2007

   from http://en.wikipedia.org/wiki/Cirrus_cloud.

2. University of Illinois. (2007, November 29). *Cirrus Clouds*. Retrieved November

   29, 2007 from

   http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/cld/cldtyp/hgh/crs.rxml.

3. Rice University. (2007, November 29). *Types of Clouds*. Retrieved November 29,

   2007 from http://schoolscience.rice.edu/duker/weatypeclouds.html.

4. Wikipedia. (2007, November 29). *Contrails*. Retrieved November 29, 2007 from

   http://en.wikipedia.org/wiki/Contrail.