

# RACORO Campaign Journal- February 2009

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### Legend for Flight Plots:

- Aerosol
  - PCASP - Aerosol Size Distribution 100-3000 nm at 1 Hz
  - N3 - Ultrafine particle counter (UPC) D>3 nm at 1 Hz
  - N10 - Condensation particle counter (CPC) D>10 nm
  - N13 - Condensation particle counter (CPC) D>15 nm
- Cloud
  - CAS - Cloud drop size distribution 0.5-50 microns
  - 1D CIP - Cloud drop size distribution 25-1550 microns
  - FSSP - Cloud drop size distribution 0.3-47 microns
  - 2D CIP - Cloud drop size distribution 25-1550 microns
- Radiation
  - CM22 - SW radiometer
  - CG-4 - LW radiometer
  - SPN-1 - total and diffuse SW radiometer
  - IRT - infrared thermometer

# 20090203

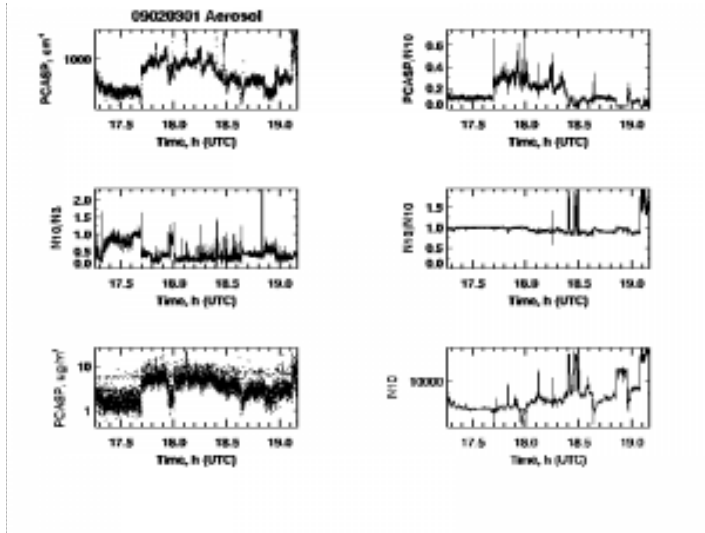
## Flight Summary

[Google Earth KML File](#)

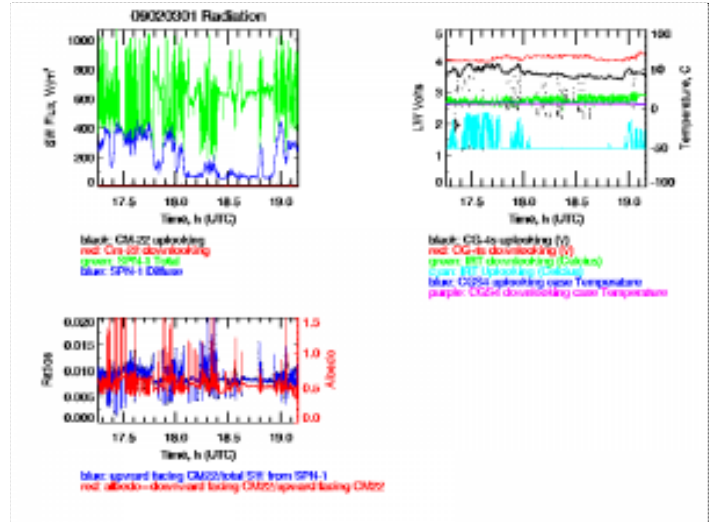
No flight(s) recorded.

## Flight Plots

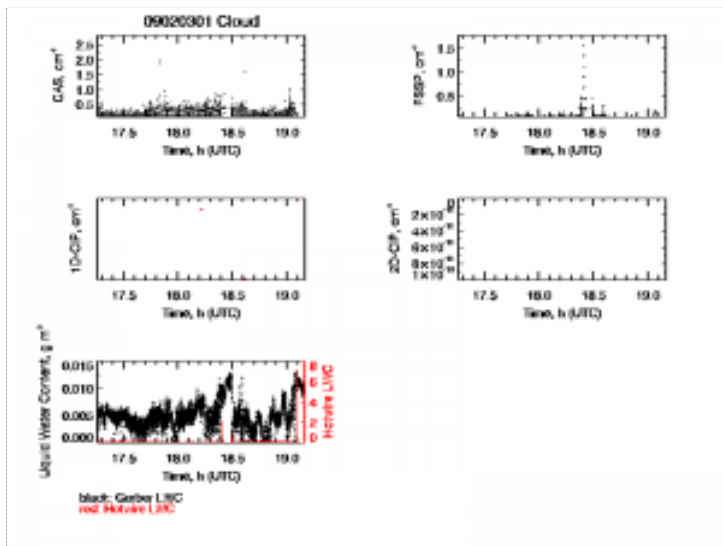
### Aerosol



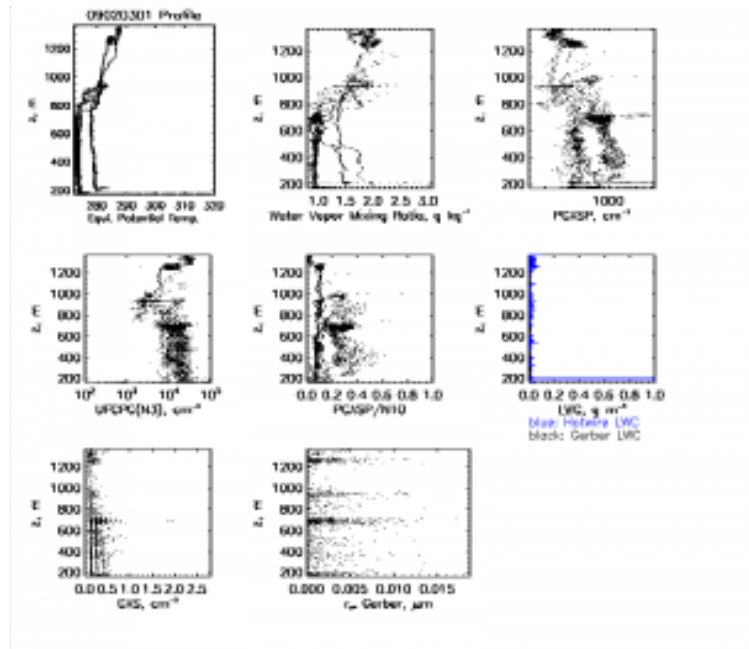
### Radiation



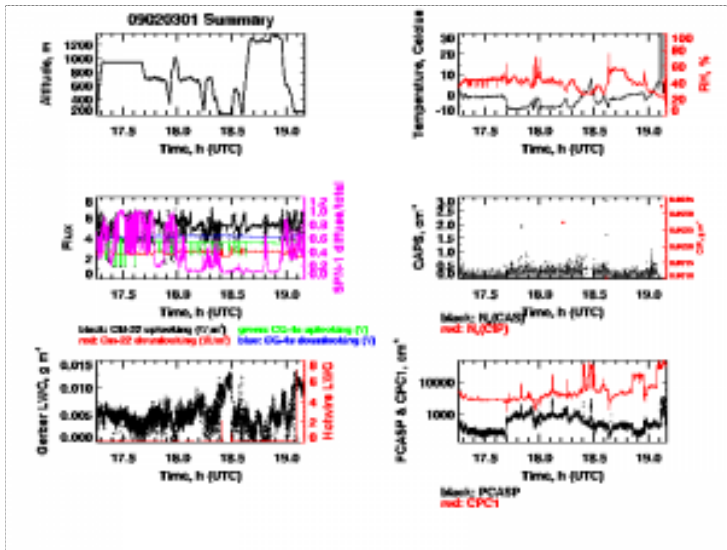
### Cloud



### Profile

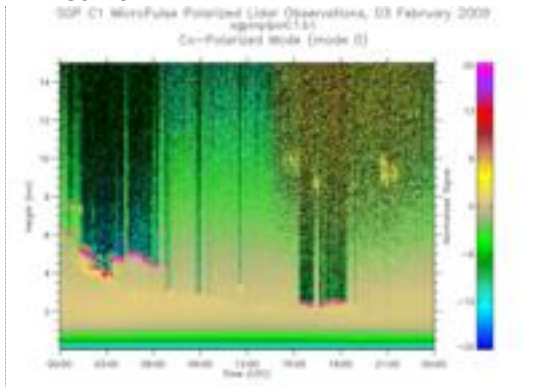


# Summary

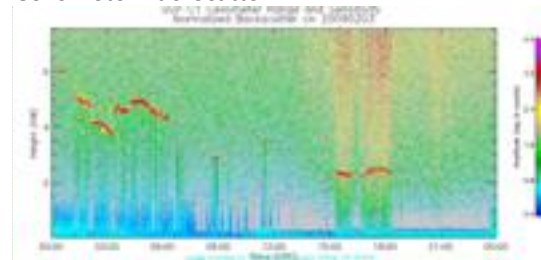


# SGP Plots

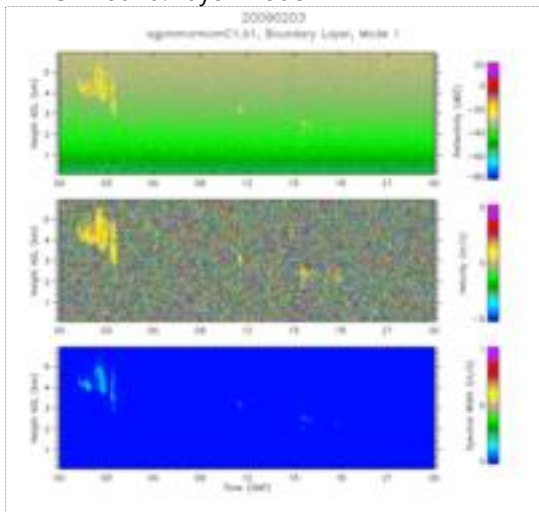
## MPL Co-Pol



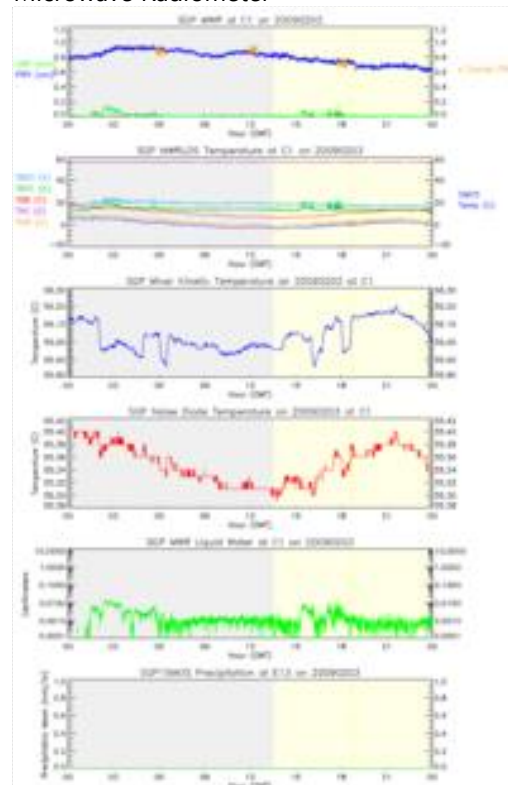
## Ceilometer Backscatter



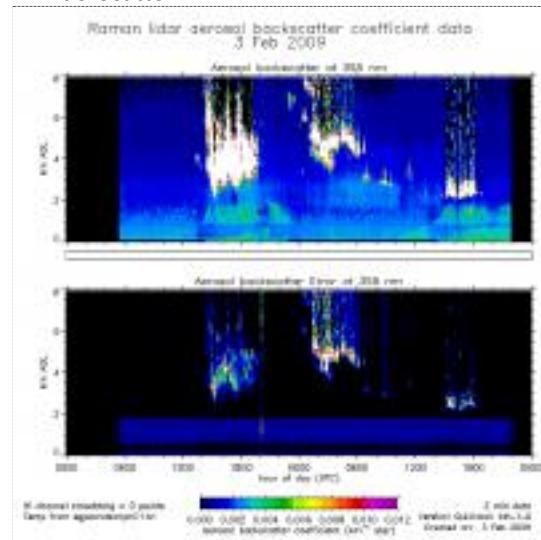
## MMCR Bound. Layer Mode



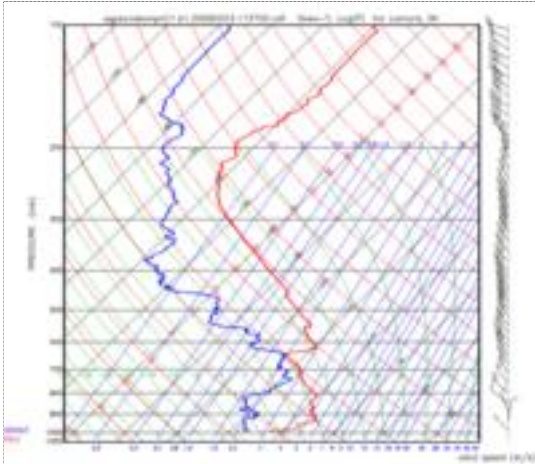
## Microwave Radiometer



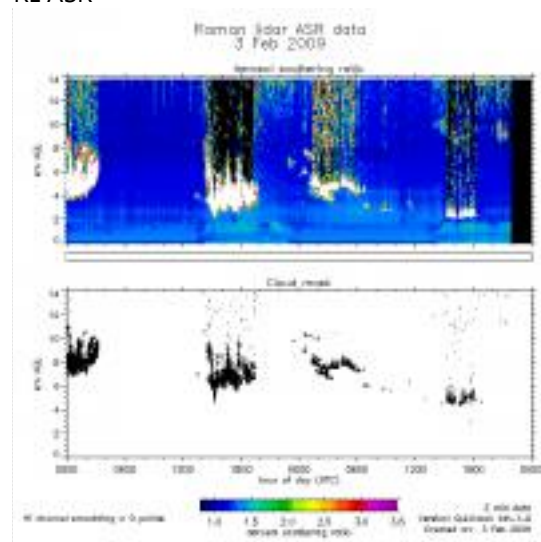
RL Backscatter



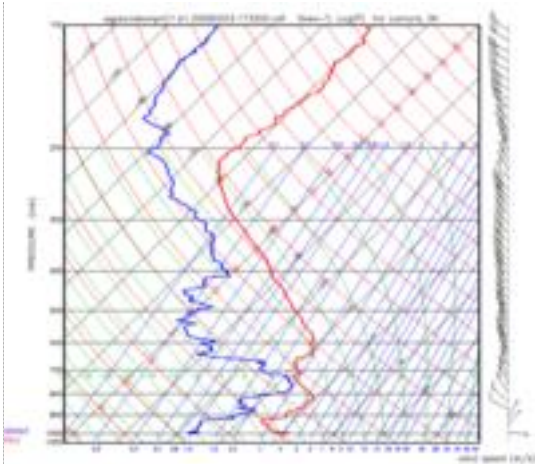
SONDE (11:30)



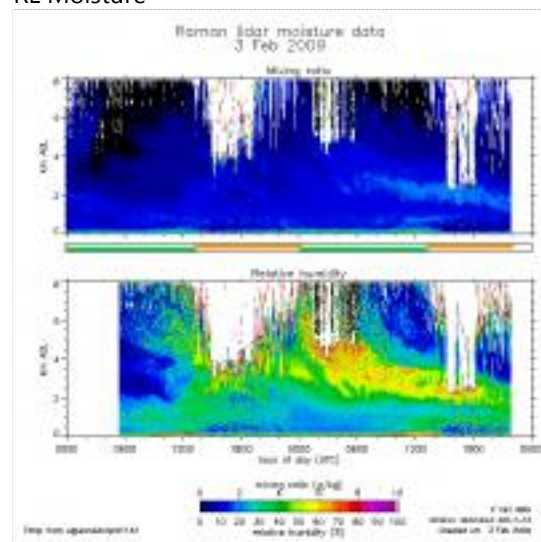
RL ASR



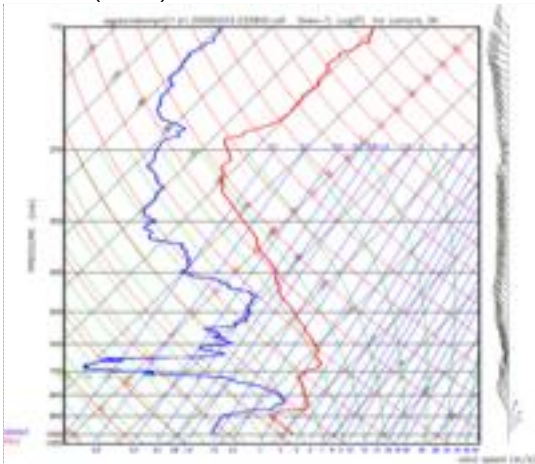
SONDE (17:30)



RL Moisture

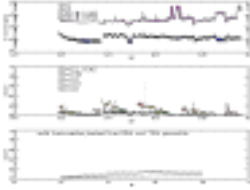


SONDE (23:30)

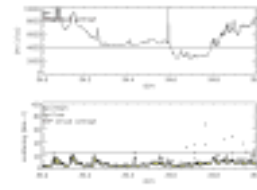


## CCN Activity

I've generated plots indicative of CCN activity from the Twin Otter CABIN and CCN files (i.e. CCN/CN as  $f(SS)$ ). I've also generated time series plots showing CN concentration and scattering at the ground (i.e. at SGP). I did not make a plot of CCN fraction measured at the surface so one can compare with that measured aloft because the surface CCN instrument was not doing normal SS scans. Elisabeth Andrews - 06 Apr 2009

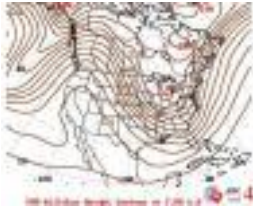


plot of CN and CCN and CCN/CN ratio as  $f(SS)$  from twin otter



plot of CN and light scattering at surface (SGP)

## Weather Maps



map232



OK City: 1/8 cloud coverage; 8-12 knots | Tulsa: Clear; 3-7 knots; 1228 mb | 47 F/18 F | Low pressure

# 20090206

## Flight Summary

Depart	Return	Hours	Synopsis	Google Earth
16:50 UTC	18:31 UTC	1.7	Test flight for cloud probe characterization	<a href="#">KML</a>
Flight hours to date		5.3		

Headed South, southeast at about 150 degrees. Over Shawnee, encountered a broken layer with bases about 3500' and tops 4500'. Chose an altitude of 4000' to work cloud layer maintaining a track of 150 degrees (+ or - 10 degrees) and was able to penetrate roughly 10-15 clouds. The track was then reversed to 330 degrees (+ or - 10 degrees) at 4000' and penetrated roughly 7-10 clouds. The clouds were dissipating to the northwest so the track was shifted about 15 nautical miles to the east, southeast where there were more clouds. We flew the 150 degree track and penetrated roughly another 10 -15 clouds. Reversed track again to 330 and penetrated another 5-10 clouds. Returned to Guthrie  
Temperature @ 4000' was 10 degrees C.  
Temperature in the thickest cloud was 8 degrees C  
Did not record wind direction or velocity.

## Weather Summary

Clear over the SGP; low-level broken clouds to the south of Guthrie.

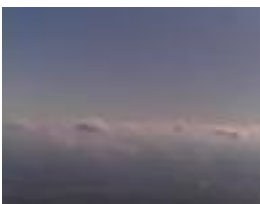
## Aircraft Instrumentation Status

See instrument readme files.

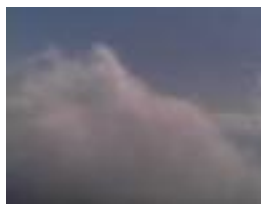
## Surface Instrumentation Status

NA (flight not over the SGP)

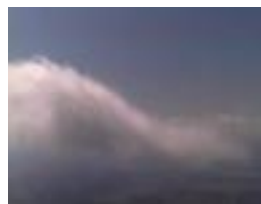
## Flight Images



2283 UTC



2347 UTC



2413 UTC



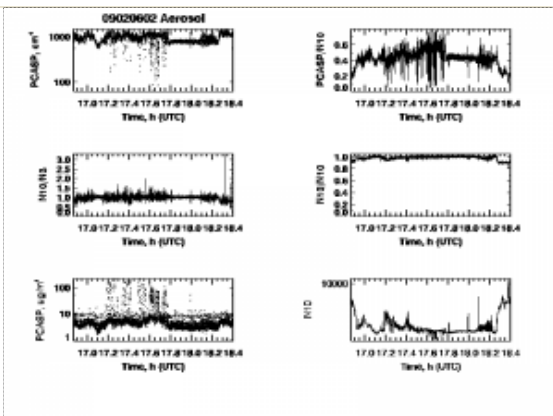
2497 UTC



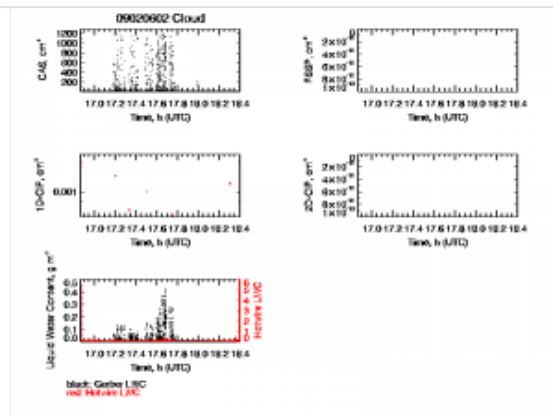
2735 UTC

## Flight Plots

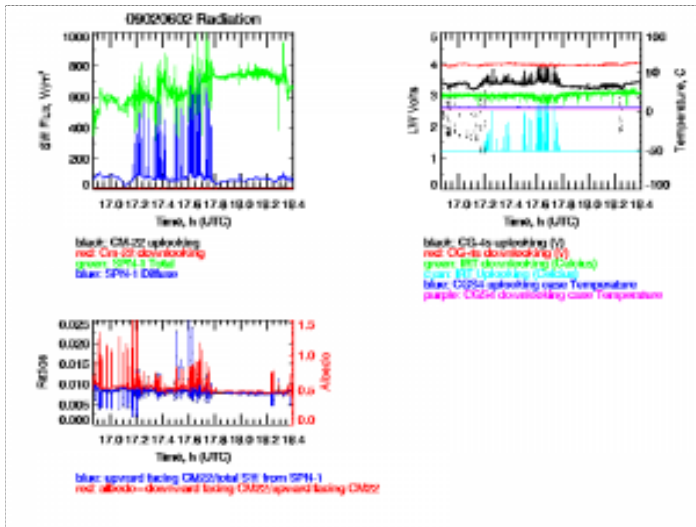
### Aerosol



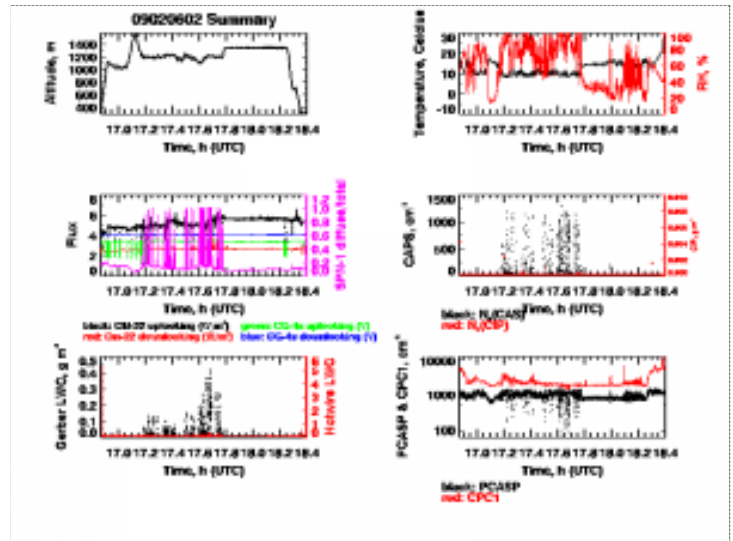
### Cloud



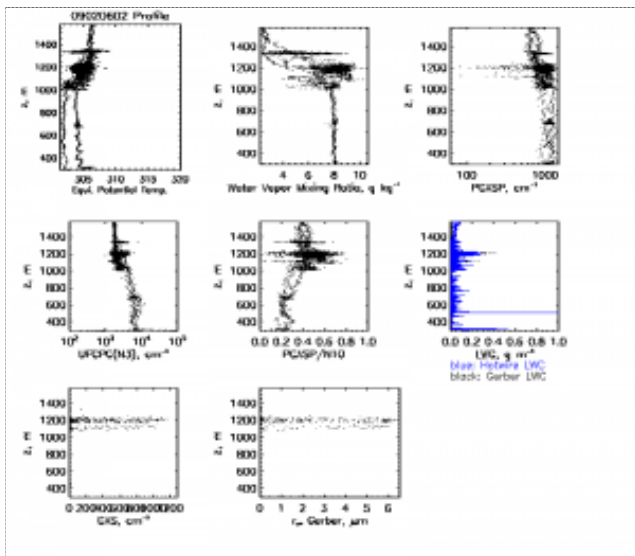
## Radiation



## Summary

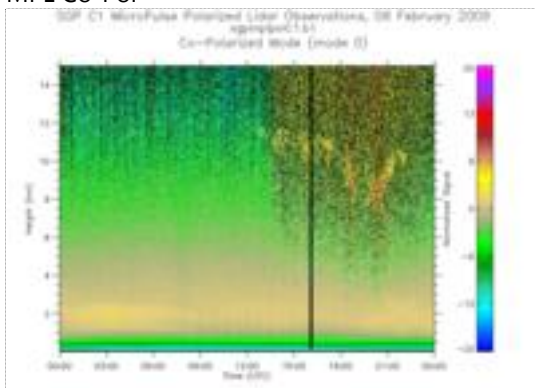


## Profile

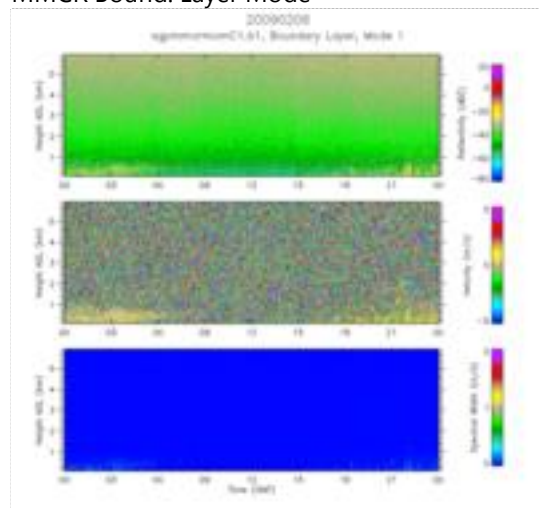


## SGP Plots

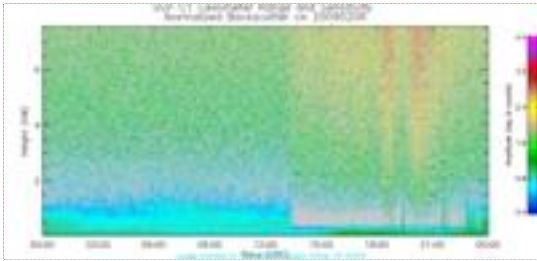
### MPL Co-Pol



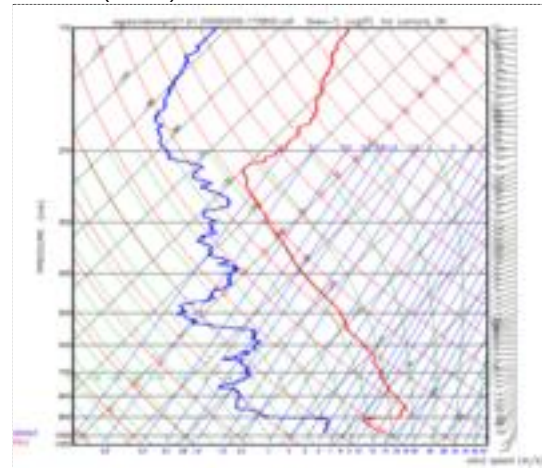
### MMCR Bound. Layer Mode



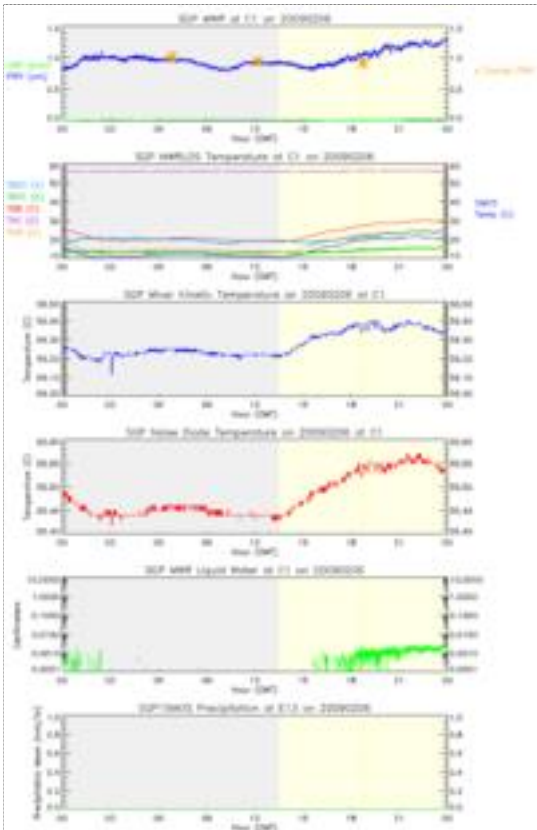
Ceilometer Backscatter



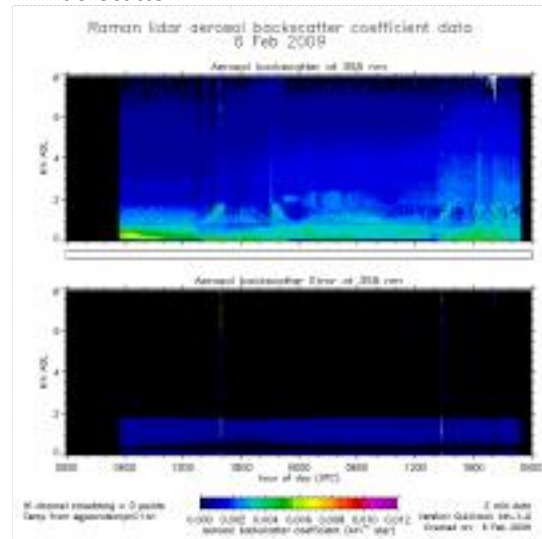
SONDE (17:30)



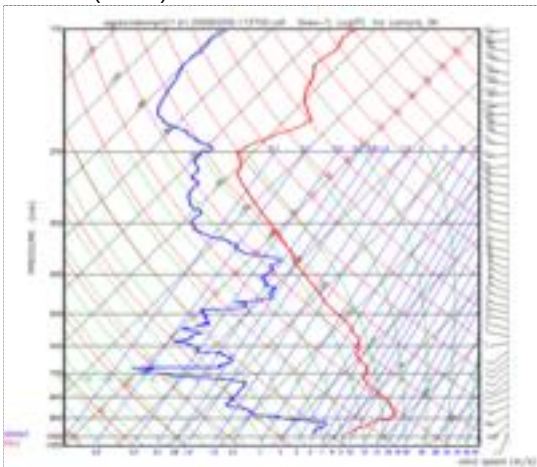
Microwave Radiometer



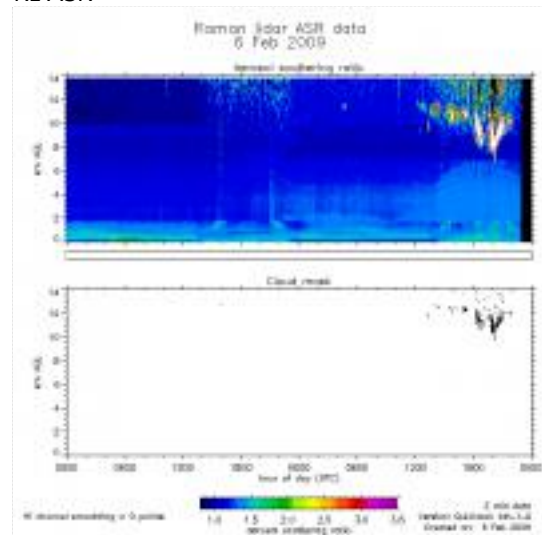
RL Backscatter



SONDE (11:30)

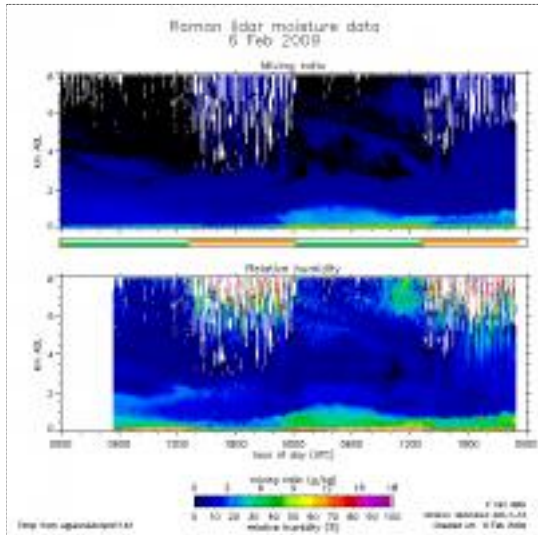


RL ASR



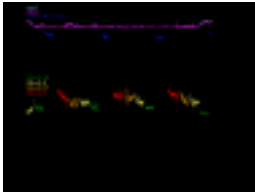


## RL Moisture

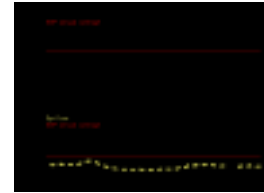


## CCN Activity

I've generated plots indicative of CCN activity from the Twin Otter CABIN and CCN files (i.e. CCN/CN as  $f(SS)$ ). I've also generated time series plots showing CN concentration and scattering at the ground (i.e. at SGP). I did not make a plot of CCN fraction measured at the surface so one can compare with that measured aloft because the surface CCN instrument was not doing normal SS scans. Elisabeth Andrews - 06 Apr 2009



plot of CN and CCN and CCN/CN ratio as  $f(SS)$  from twin otter



plot of CN and light scattering at surface (SGP)

## Weather Maps



map262



OK City: Clear, 13-17 knots | Tulsa: Clear, 8-12 knots; 1209 mb | 64 F/38 F

# 20090208

## Flight Summary

Depart	Return	Hours	Synopsis	Google Earth
18:12 UTC	21:51 UTC	3.7	Cloud triangles at SGP	<a href="#">KML</a>
Flight hours to date		8.9		

After departure the Twin Otter encountered some high cirrus, it was difficult to determine if there was a layer higher than the 5500' so they climbed through the bottom layer to determine if there was a higher layer to measure and realized it was a solid high cirrus layer so they descended to 3500' and then flew the clockwise pattern B-A-C-B-A at 3500' with temperatures at 11C and wind was 194 true @ 18 knots.

At point A the Cirpas ascended just north of the central facility to 6500' and flew a leg A-C-B-A with temperatures at 5 C and wind was 180 true @ 37 knots. At point A we ramped down to 6000' in cloud. The leg between C and B had fewer clouds. The temperature in cloud was 4C.

They had more time and fuel so they flew another C to B leg at 5000' but there were few clouds and the ones present had higher bases @ about 5500'. Temperatures was 7C and wind was 190 true @ 40 knots.

At point A they began the ferry back to Guthrie. They climbed to 6000' to what looked to be mid cloud. There was multiple layers with little clearing between clouds.

After about 20 miles they climbed to 8000' but only stayed there about 5 minutes because of the descent into Guthrie. Tops in the descent were 7500' and bases were about 5500'. They did encounter light rain under the cloud deck on final approach into Guthrie.

## Weather Summary

High cirrus; a bit of rain on the final approach into Guthrie.

Sampled broken low-level cloud field with highly variable cloud top and cloud base heights.

## Aircraft Instrumentation Status

C-Migits didn't initialize correctly...was down from takeoff until the aircraft reached point B

2D-S: vertical arm not working

Radiometers: No MFRs

Partial Hydrorad data.

## Surface Instrumentation Status

No issues

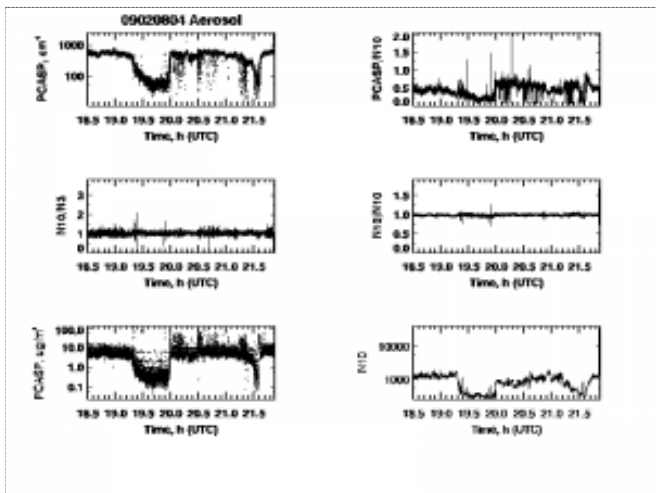
## Flight Images

No flight times for these pictures but are in order that they were taken.  
(in five colums, left to right)

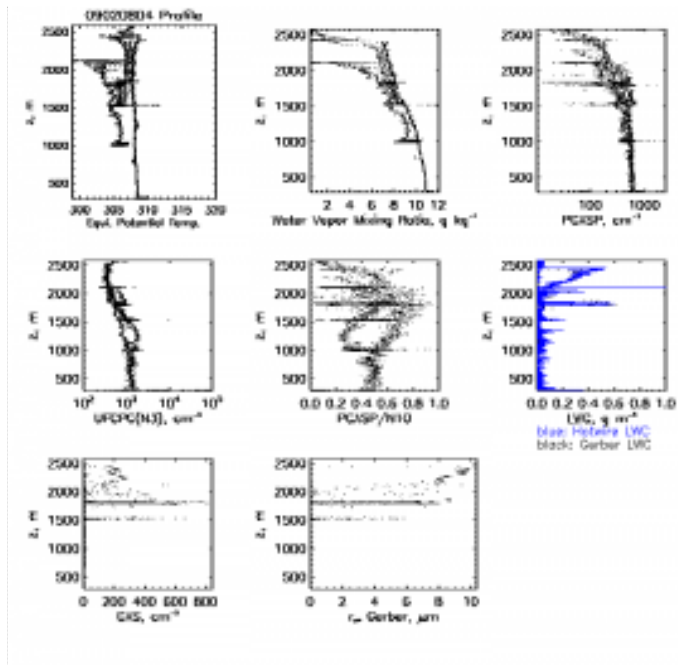


# Flight Plots

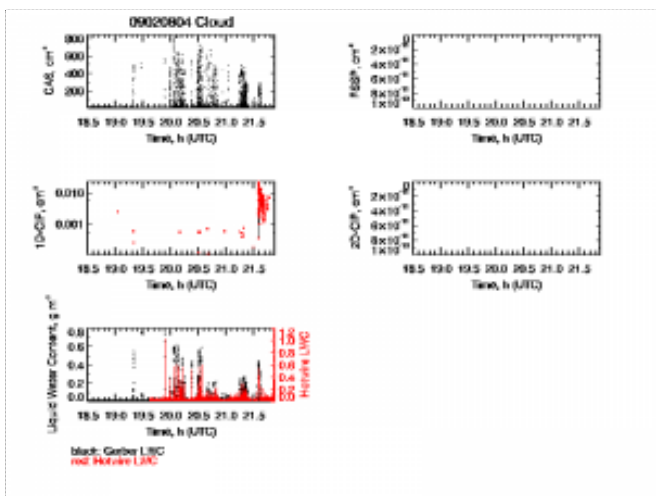
## Aerosol



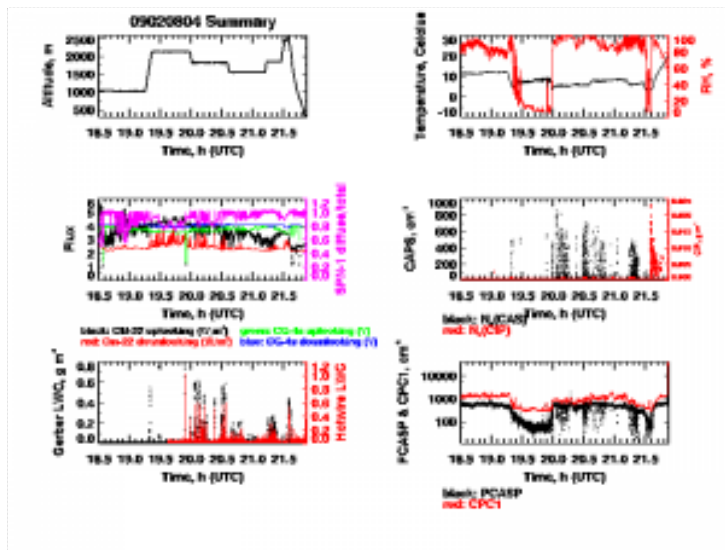
## Profile



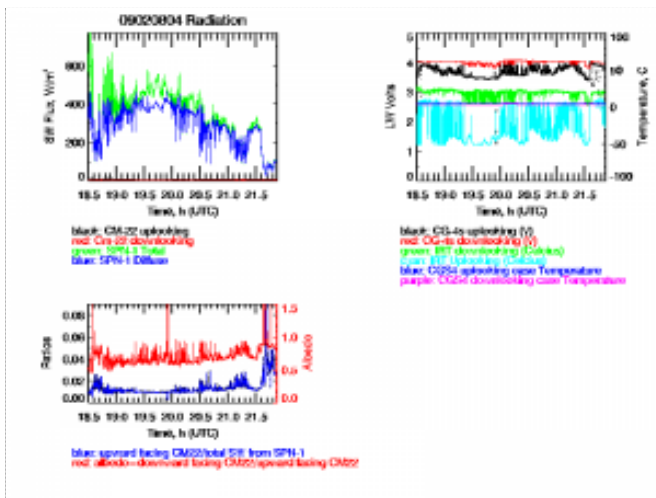
## Cloud



## Summary

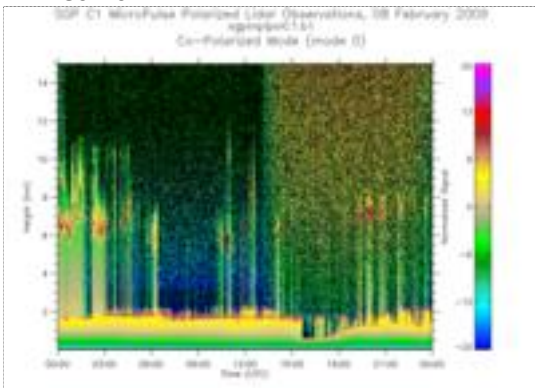


## Radiation

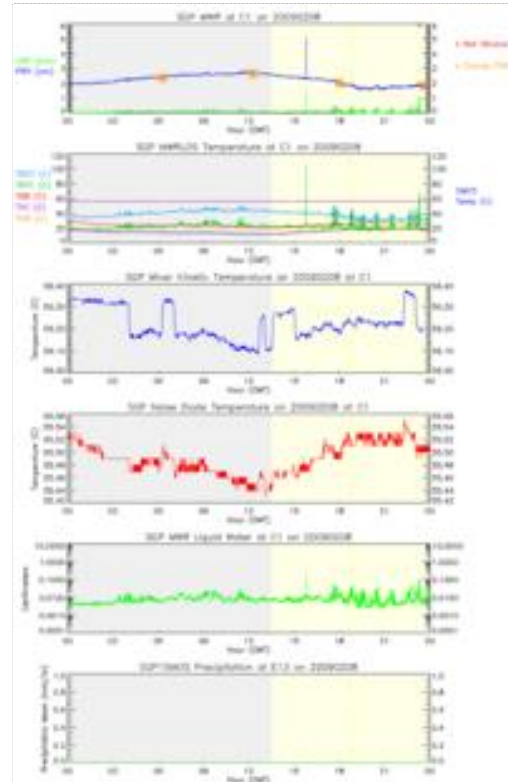


# SGP Plots

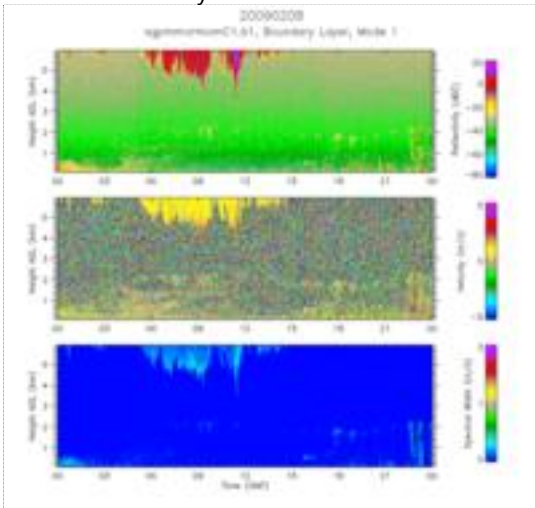
MPL Co-Pol



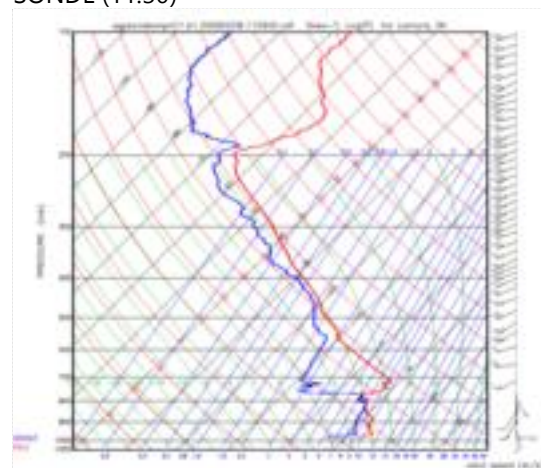
Microwave Radiometer



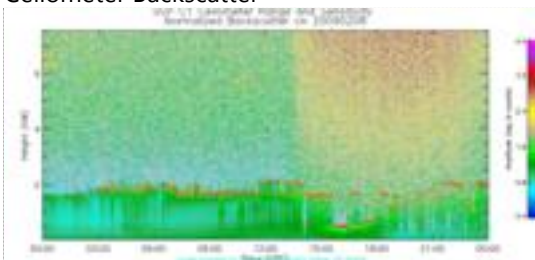
MMCR Bound. Layer Mode



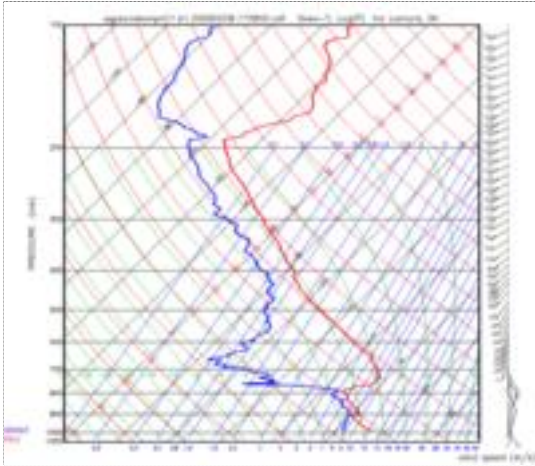
SONDE (11:30)



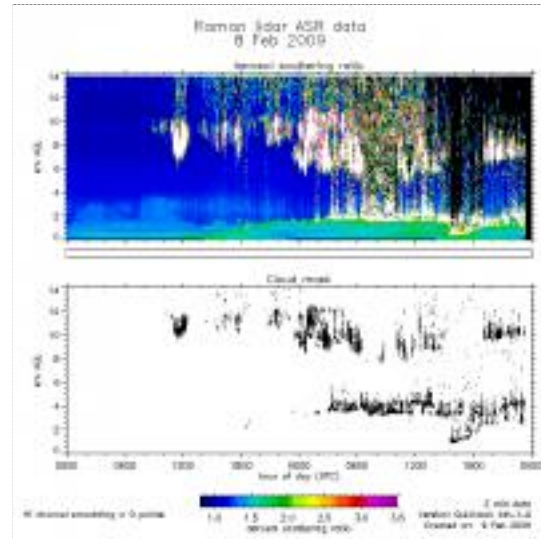
Ceilometer Backscatter



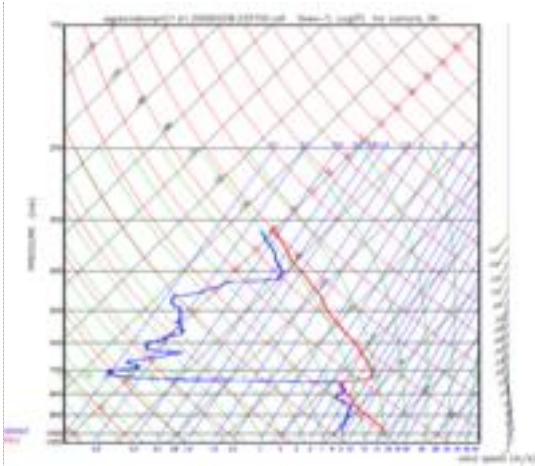
SONDE (17:30)



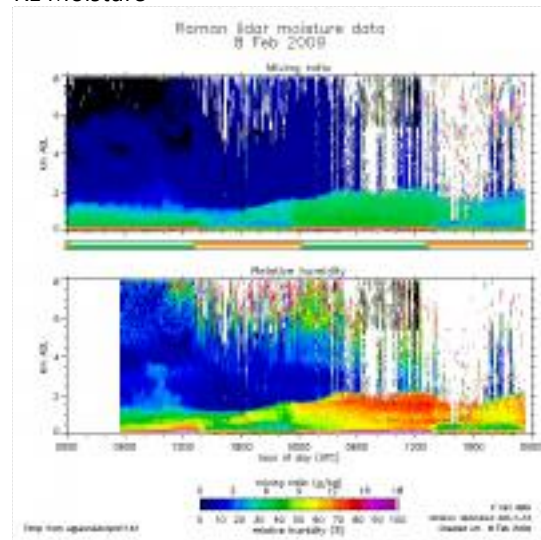
RL ASR



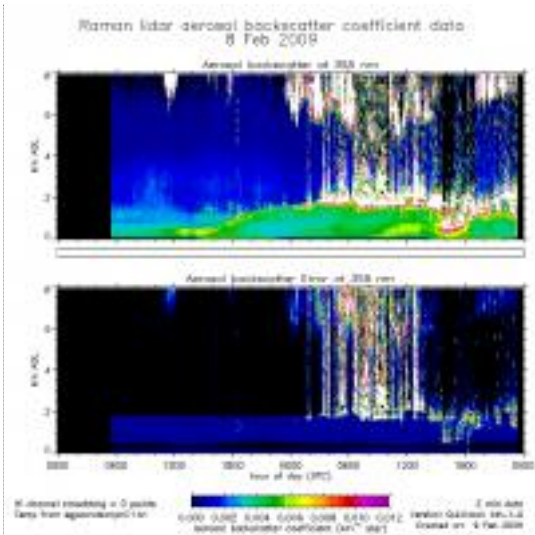
SONDE (23:30)



RL Moisture



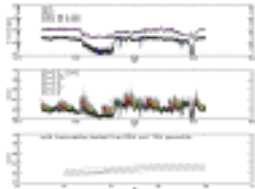
RL Backscatter



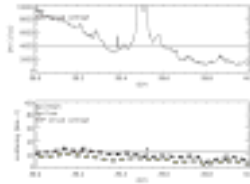
## CCN Activity

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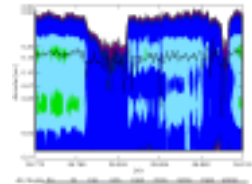
The last plot shows: I've made size distribution contour plots from the DMA operated by TAMU on the Twin Otter. These plots are overlaid with a line indicating the CCN activation diameter at 0.2% SS based on the CCN measurements on the Twin Otter. To do this, I cumulatively summed the DMA number concentration backwards from largest to smallest diameter bin. I identified the bin diameter where the cumulative summed concentration was closest to the measured CCN concentration and chose that as the CCN activation diameter. Elisabeth Andrews - 24 Apr 2009



plot of CN and CCN and CCN/CN ratio as  $f(SS)$  from twin otter



plot of CN and light scattering at surface (SGP)



TAMU DMA size distribution and CCN activation diameter

## Weather Maps



map282



OK City: 1/8 cloud coverage; 3-7 knots | Tulsa: Overcast; 8-12 knots; 1183 | 67 F/49 F

# 20090217

## Flight Summary

Depart	Return	Hours	Synopsis	Google Earth
16:18 UTC	18:58 UTC	2.7	Cloud triangles at SGP	<a href="#">KML</a>
Flight hours to date		11.6		

RACORO Flight notes for 02/17/2009

Departure time = 1618

Arrival time = 1858

Total time = 2.7 hours

Leg 1 - from Guthrie to Southern Great Plains sight.

After departure, we climbed to the base of the cloud to determine its height. We determined the base to be 2700' MSL. We then descended to 2200' MSL, at cloud base – 500', and continued our ferry to the SGP. The clouds looked broken to scattered and it was hazy with about 10 miles of visibility.

Temperature was 8 degrees C.

Wind was 196 degrees true at 30 knots.

Leg 2 – Spiral ascent just north of the SGP.

About 10 miles from the SGP, we began a ramp descent to over fly the SGP wings level at 500' AGL. We flew over the SGP at 500' to a point about a mile to the northwest and initiated a spiral ascent. In the spiral ascent, the cloud bases were at about 2700' MSL and the cloud tops were ragged at 3600' MSL. We continued a spiral to cloud top plus 1500' to 5100' MSL. (NOTE at the cloud base, the temp. was 8 degrees C, at 4000' the temp. was about 15 degrees C and at 5100' the temp. was 13 degrees C). We decided to descend back into the cloud before they dissipated and chose an altitude of 3100' MSL. We flew the entire pattern, A to C to B to A, between 3100' and 3300' MSL and penetrated as many clouds as possible. I would guess we spent about 15 to 20 minutes penetrating clouds. The in cloud temp. was about 6 degrees C and the out of cloud temp. was about 8 degrees C.

During the leg from A to C I decided to continue tracking East to penetrate as many clouds as possible. We also flew the C to B leg about 3 miles east of the original track as there were more clouds in that area. About halfway through this leg, the clouds began to dissipate significantly. At point B I made a 270 degree turn toward the East to physically see if there were any more clouds to search out and determined they were very thin and obviously dissipating quickly.

We flew from B back to A at 3300' MSL and noted a definite haze layer at this altitude.

Wind was 221 degrees true at 46 knots.

Leg 3 – 500' AGL over the SGP.

I decided to conduct some low passes over the SGP. We ramped down to 500' AGL and made three passes, wings level over the SGP. The over fly times noted may not be exact:

Pass one was at 1735 UTC

Pass two was at 1740 UTC

Pass Three was at 1745 UTC

Leg 4 – A-C-B-A pattern at top plus 500' MSL.

Due to a lack of low level cloud and cirrus cloud, we decided to fly a patter at 500' above the cloud for the radiometer guys. In the climb we noticed a few very small clouds with rough bases at 3500' MSL and rough tops at 4000' MSL. We flew the patter at 4500' MSL. There was still a haze layer around 3500' MSL.

Temperature was about 14 degrees C.

Wind was 262 degrees true at 47 knots.

Leg 5 – Point A to Guthrie.

At point A we headed back to Guthrie at 4500' MSL. There was a high cirrus layer to the south.

Temperature was 14 degrees C.  
Wind was 265 degrees true at 48

Note in the descent to Guthrie the Temperature at 4000' and 3500' MSL was 17 degrees C.

## Weather Summary

Broken to scattered clouds with haze on departure; visibility about 10 miles.  
Measured a dissipating cloud system with notable haze present between clouds.

## Aircraft Instrumentation Status

2D-S vertical appears to not be working  
No Hydrad data.

## Surface Instrumentation Status

Sondes: No 17:30 sounding.

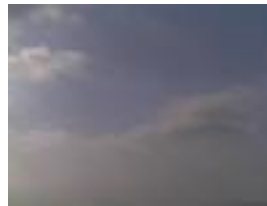
## Flight Images



1638 UTC (DAQ)



1542 UTC (MH)



1711 UTC (JB)



1727 UTC (DAQ)



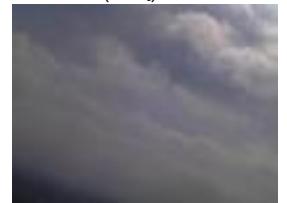
1648 UTC (DAQ)



1703 UTC (DAQ)



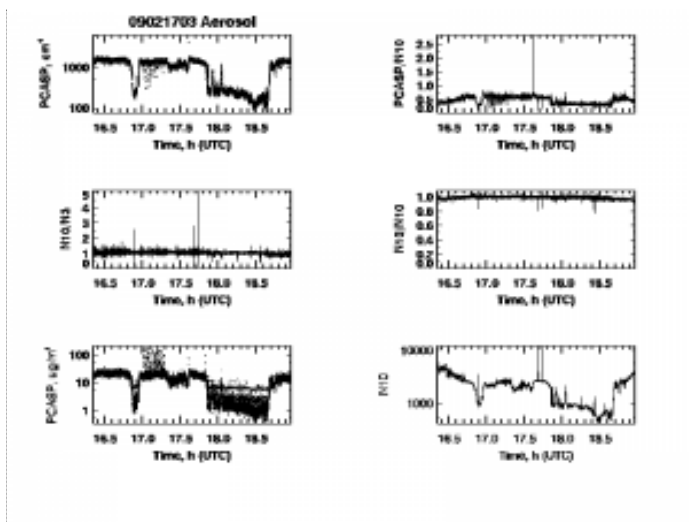
1723 UTC (JB)



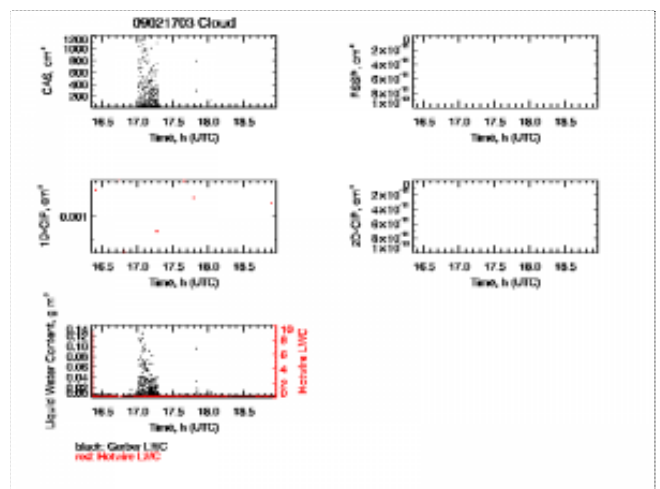
1735 UTC (JB)

## Flight Plots

### Aerosol

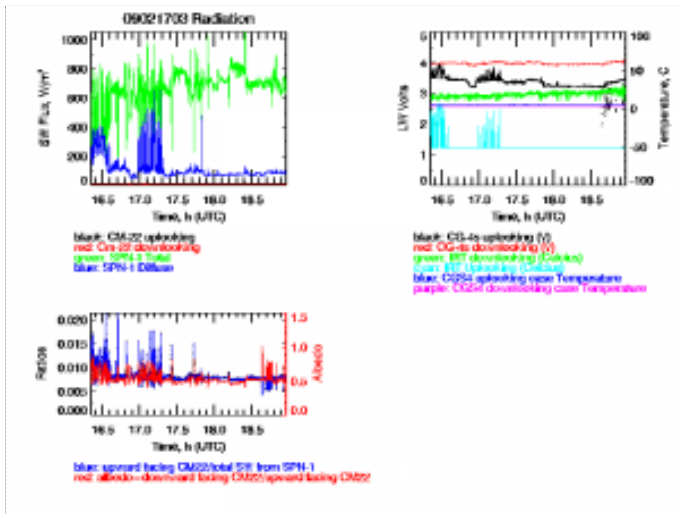


### Cloud

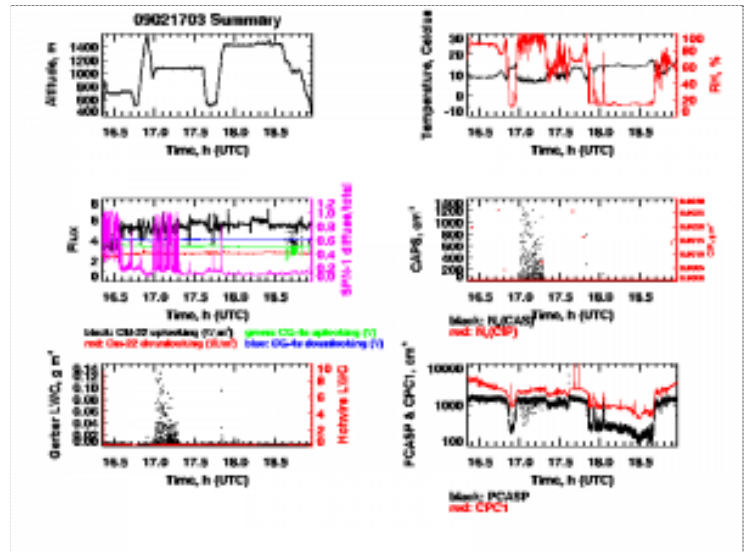




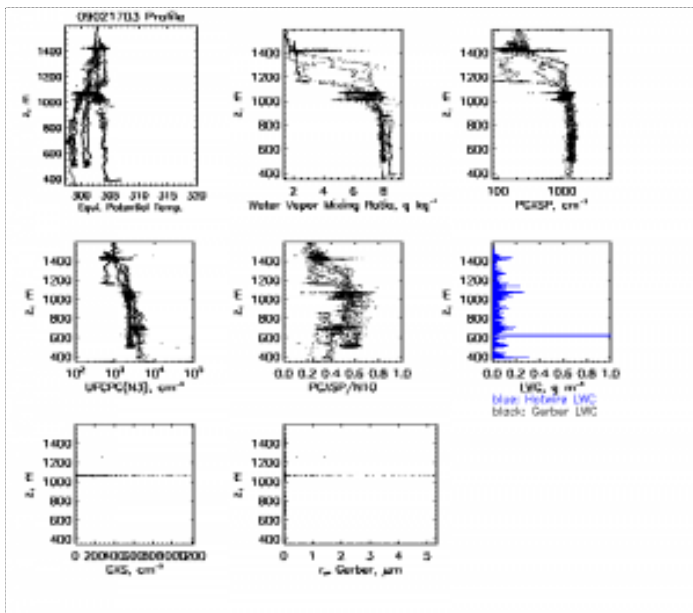
## Radiation



## Summary

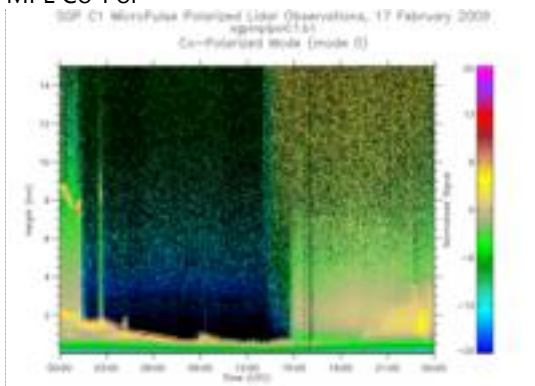


## Profile

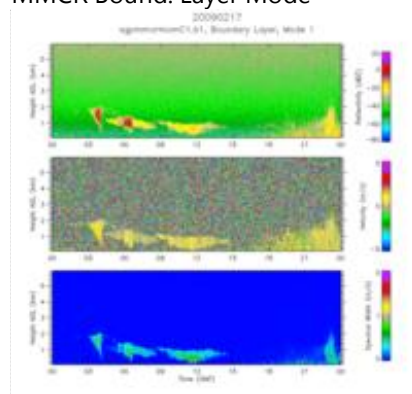


## SGP Plots

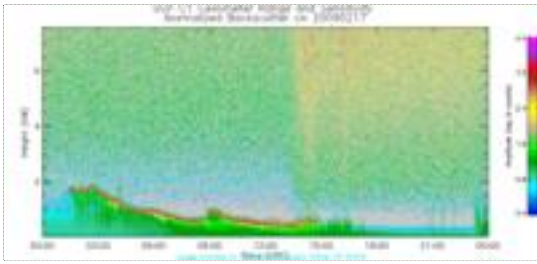
### MPL Co-Pol



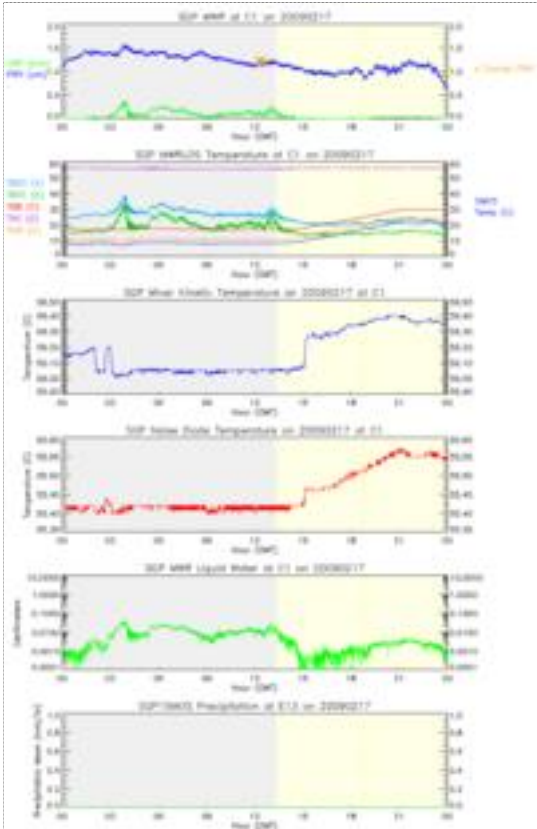
### MMCR Bound. Layer Mode



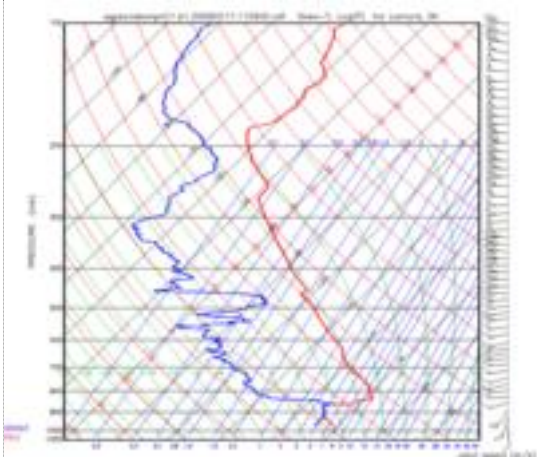
Ceilometer Backscatter



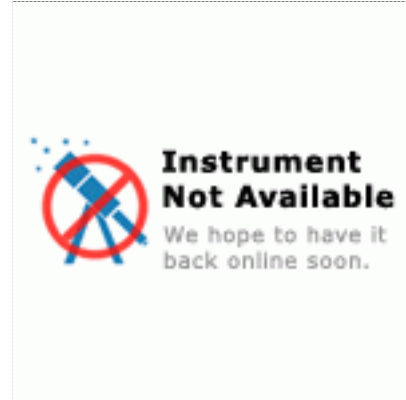
Microwave Radiometer



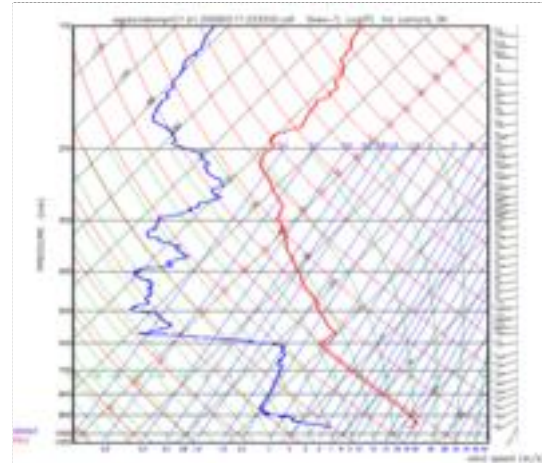
SONDE (11:30)



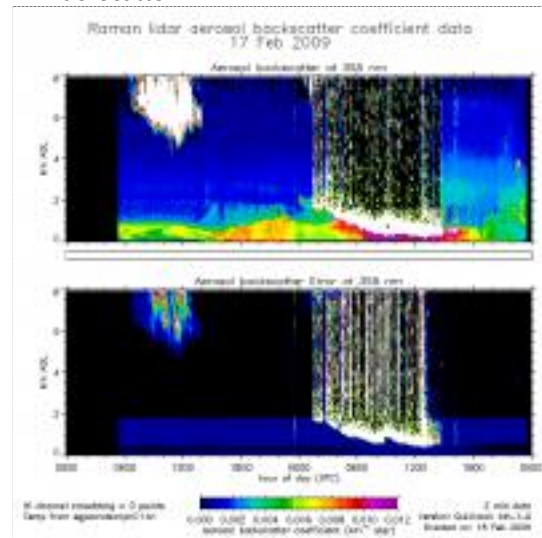
SONDE (17:30)



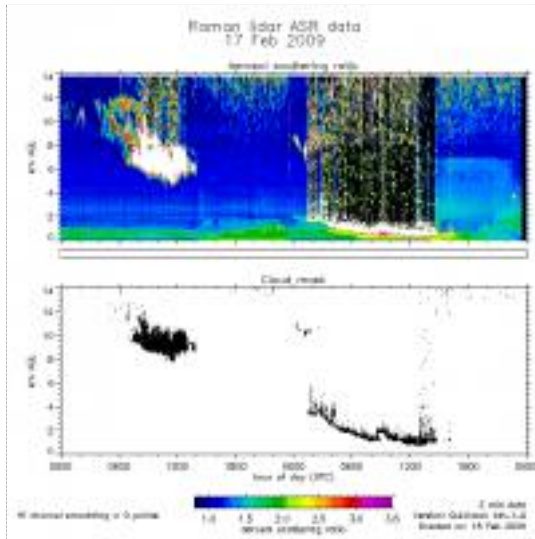
SONDE (23:30)



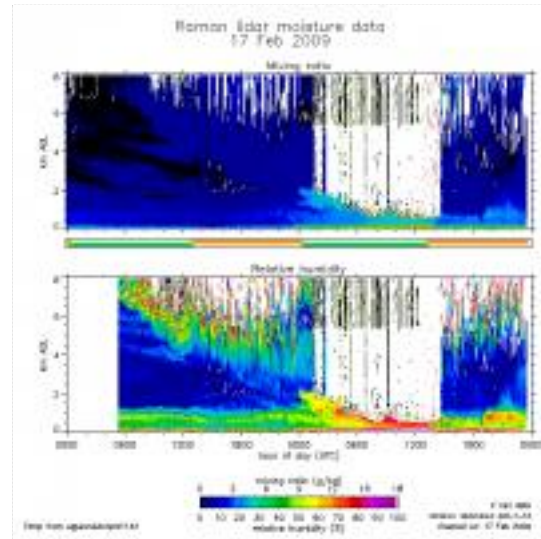
RL Backscatter



RL ASR



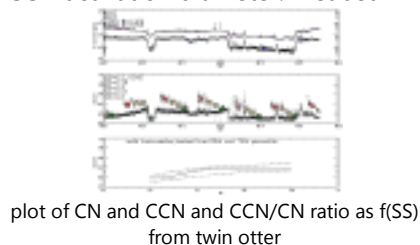
RL Moisture



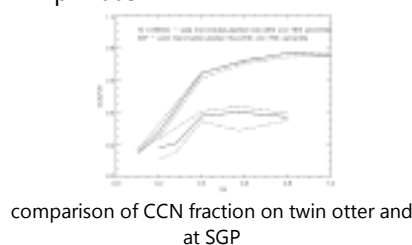
**CCN Activity**

I've generated plots indicative of CCN activity from the Twin Otter CABIN and CCN files (i.e. CCN/CN as f(SS)). I've also generated time series plots showing CN concentration and scattering at the ground (i.e. at SGP) and CCN fraction measured at the surface so one can compare with that measured aloft. Elisabeth Andrews - 06 Apr 2009

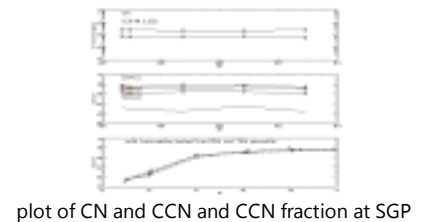
The last plot shows: I've made size distribution contour plots from the DMA operated by TAMU on the Twin Otter. These plots are overlaid with a line indicating the CCN activation diameter at 0.2% SS based on the CCN measurements on the Twin Otter. To do this, I cumulatively summed the DMA number concentration backwards from largest to smallest diameter bin. I identified the bin diameter where the cumulative summed concentration was closest to the measured CCN concentration and chose that as the CCN activation diameter. Elisabeth Andrews - 24 Apr 2009



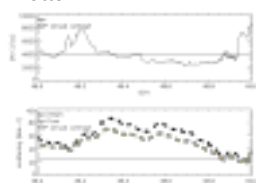
plot of CN and CCN and CCN/CN ratio as f(SS) from twin otter



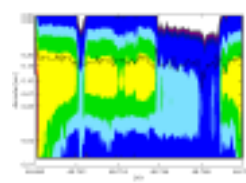
comparison of CCN fraction on twin otter and at SGP



plot of CN and CCN and CCN fraction at SGP



plot of CN and light scattering at surface (SGP)



TAMU DMA size distribution and CCN activation diameter

**Weather Maps**



map2172



OK City: Broken; 8-12 knots | Tulsa: Clear; 13-17 knots; 1218 mb | 51 F/32 F

# 20090226

## Flight Summary

Depart	Return	Hours	Synopsis	Google Earth
16:07 UTC	18:00 UTC	1.9	Cloud sampling east of Guthrie	<a href="#">KML</a>
Flight hours to date		13.5		

We initially canceled the science flight due to a lack of clouds that we could fly into. We decided to test some of the systems and fly to where there were clouds.

We did a slant climb to 12,500 initially to the Southwest. There was a cloud field to the East, so we continued in the climb on a Easterly heading. We finished the climb and began a slant descent. Started into clouds around 1650.

We stopped the descent and ran a cloud leg for ~5 minutes. Tops of the clouds were ~4100 and bases were 3500. We weaved in and out at 3700. Started of the leg was 1650.

We continued the decent to near the surface and did a slant climb up ( start of second profile was about 1700.) through the clouds to 12,500 (1730) and then back down to Guthrie.

The cloud field ended up being 65 nm East of Guthrie.

## Weather Summary

Mostly clear sky with high cirrus. Sampled thin, broken stratocumulus field

## Aircraft Instrumentation Status

DMA computer is locked up and was not able to turn on (may be laptop)

CIP recording was not turned on until 1645

D2-S shut off in flight for short period of time. It was restarted (only a couple minutes). Data looks good.

No Hydrorad data.

## Surface Instrumentation Status

NA (flight not over SGP)

## Flight Images



1647 UTC



1648 UTC



1650 UTC



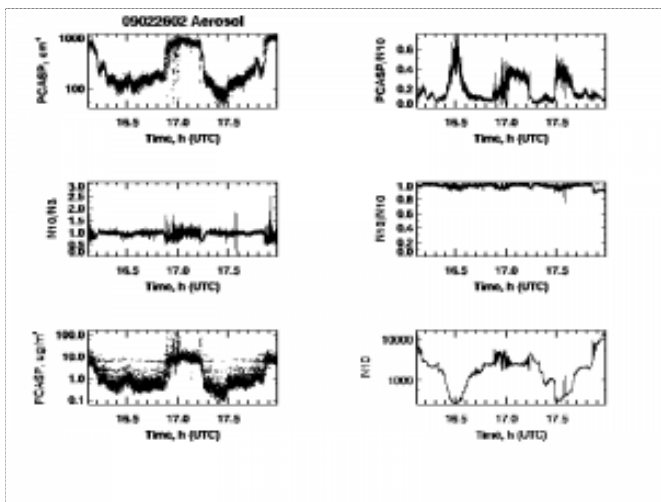
1653 UTC



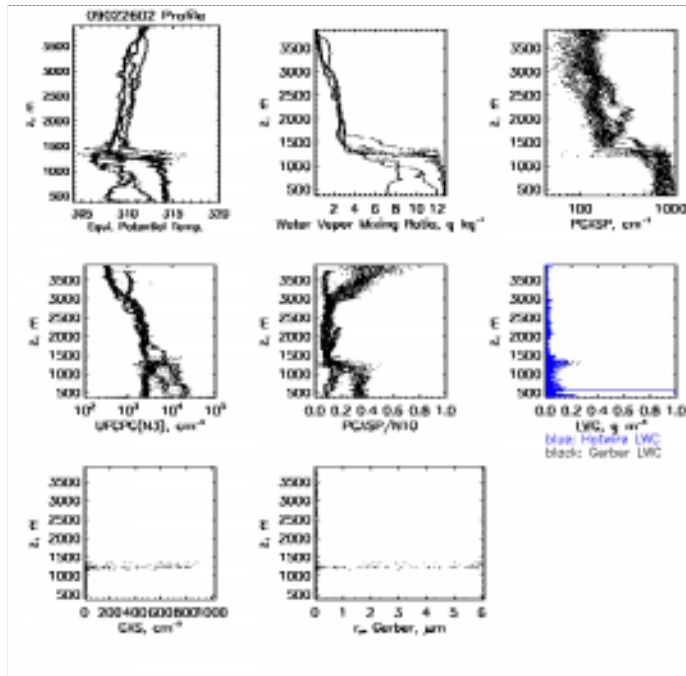
1704 UTC

# Flight Plots

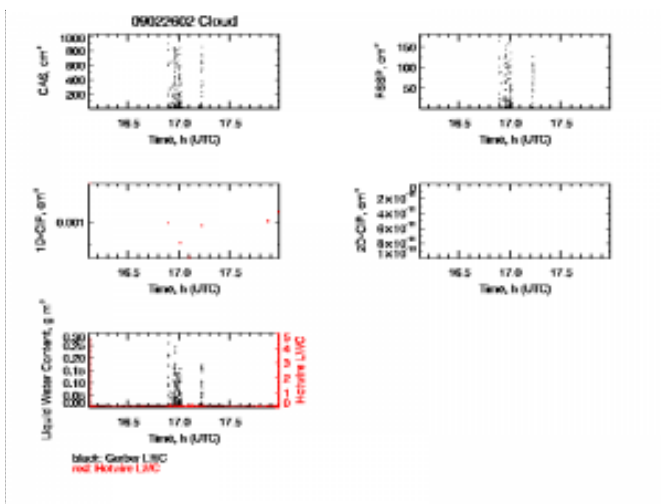
## Aerosol



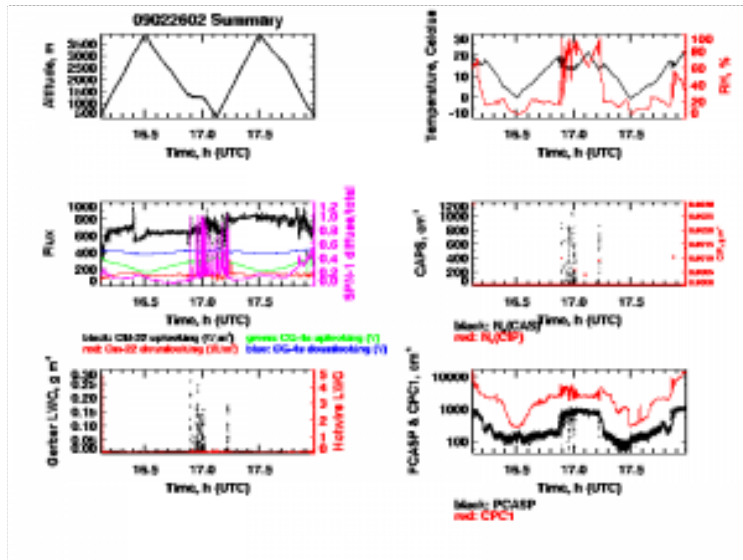
## Profile



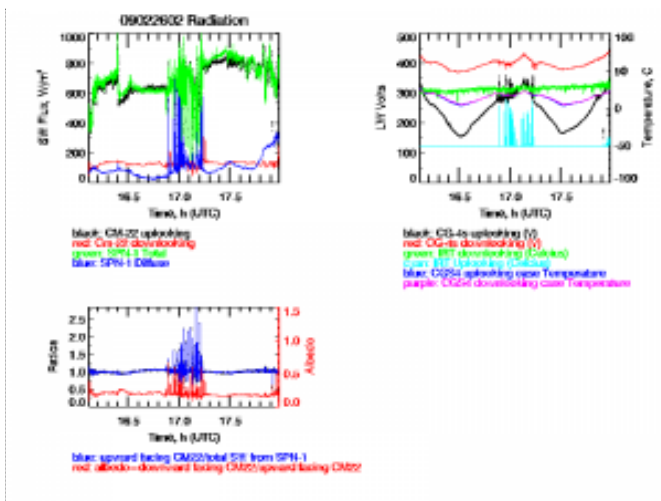
## Cloud



## Summary

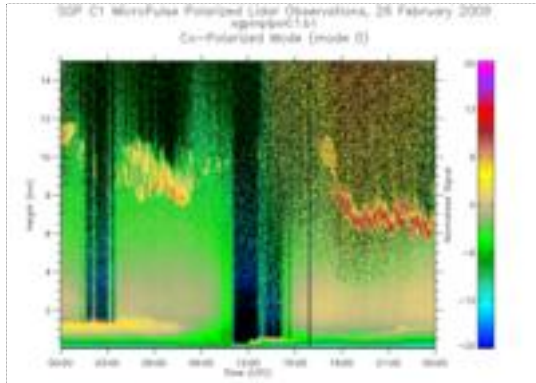


## Radiation

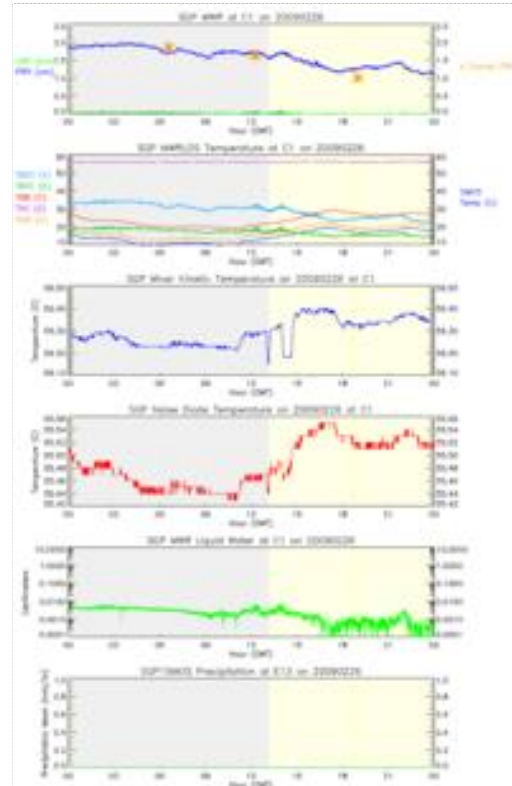


# SGP Plots

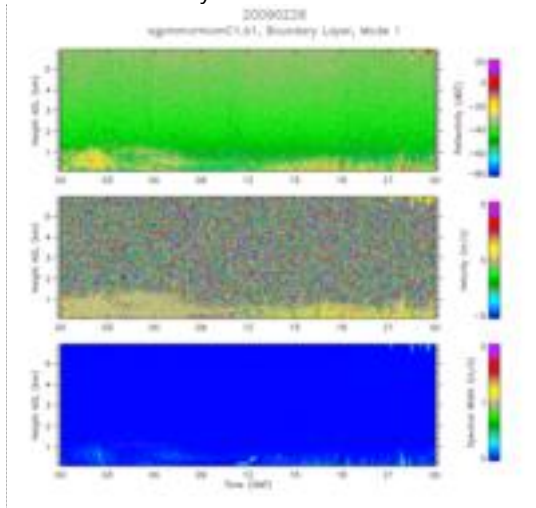
MPL Co-Pol



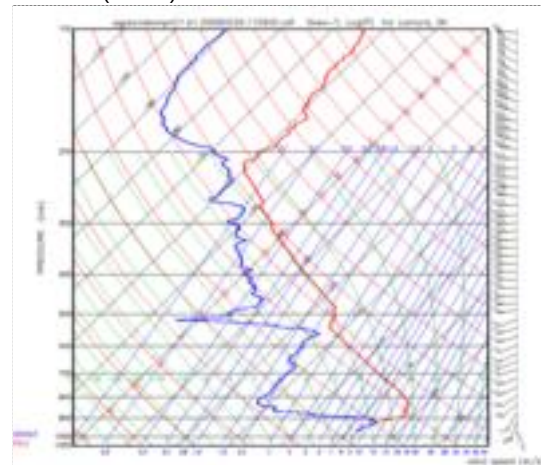
Microwave Radiometer



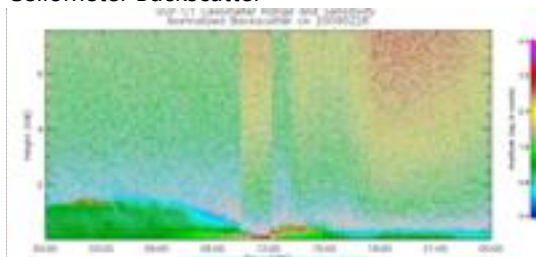
MMCR Bound. Layer Mode



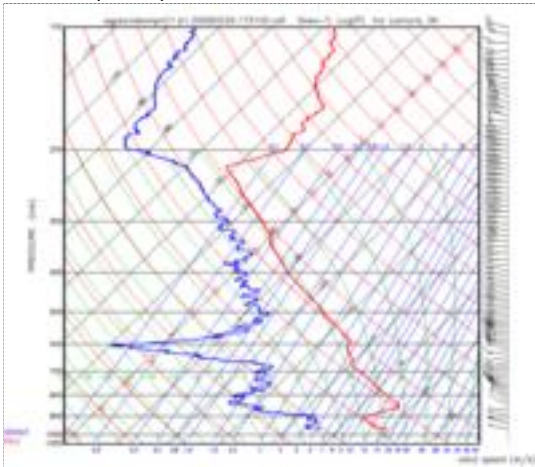
SONDE (11:30)



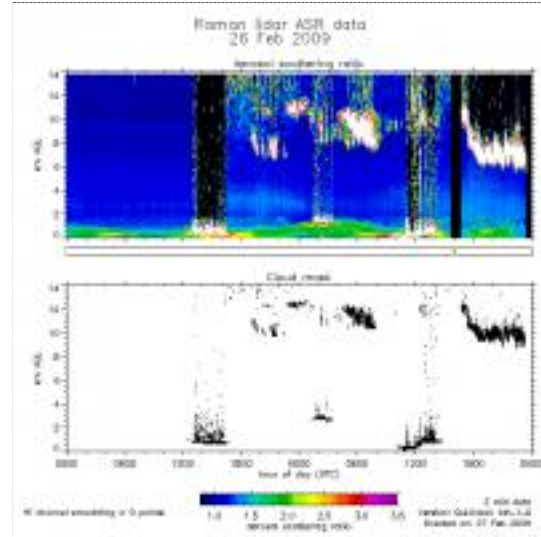
Ceilometer Backscatter



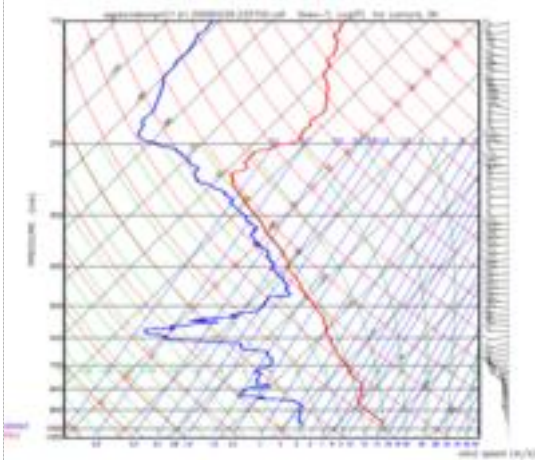
SONDE (17:30)



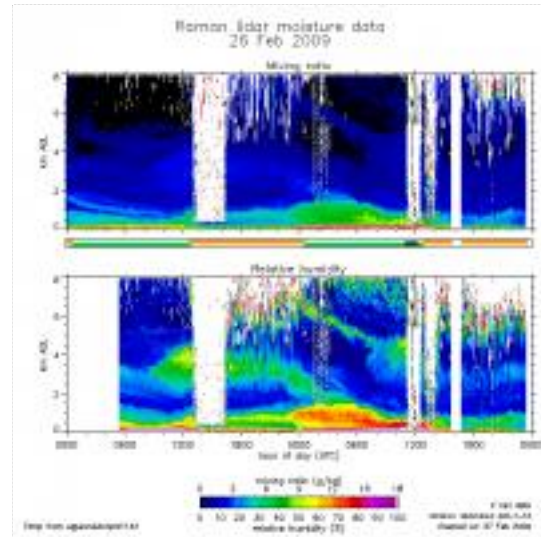
RL ASR



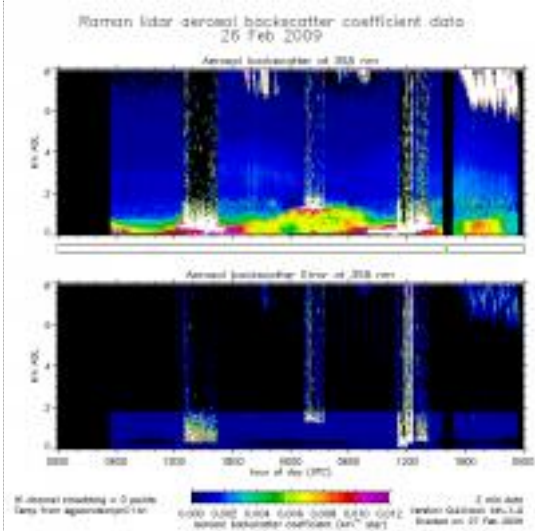
SONDE (23:30)



RL Moisture

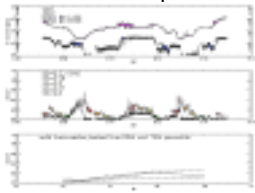


RL Backscatter

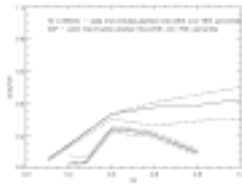


## CCN Activity

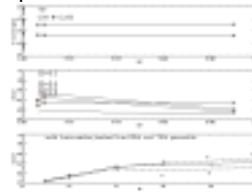
I've generated plots indicative of CCN activity from the Twin Otter CABIN and CCN files (i.e. CCN/CN as  $f(SS)$ ). I've also generated time series plots showing CN concentration and scattering at the ground (i.e. at SGP) and CCN fraction measured at the surface so one can compare with that measured aloft. Elisabeth Andrews - 06 Apr 2009



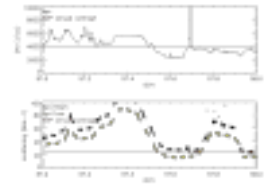
plot of CN and CCN and CCN/CN ratio as  $f(SS)$  from twin otter



comparison of CCN fraction on twin otter and at SGP



plot of CN and CCN and CCN fraction at SGP

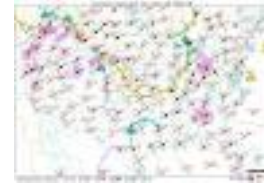


plot of CN and light scattering at surface (SGP)

## Weather Maps



map2262



OK City: Broken; 8-12 knots | Tulsa: 1/8 cloud coverage; 8-12 knots, 1131 mb | 66 F/52 F