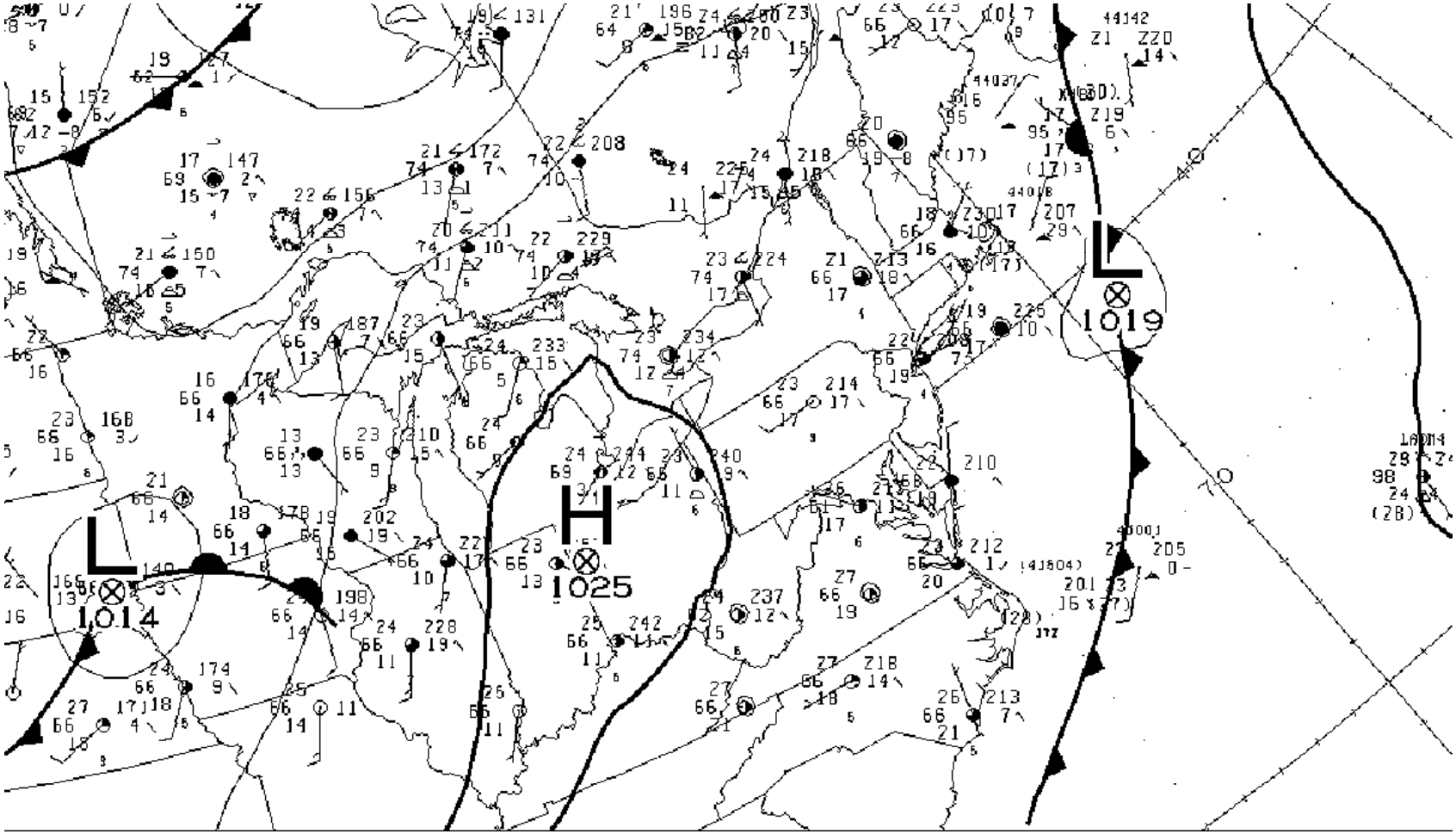
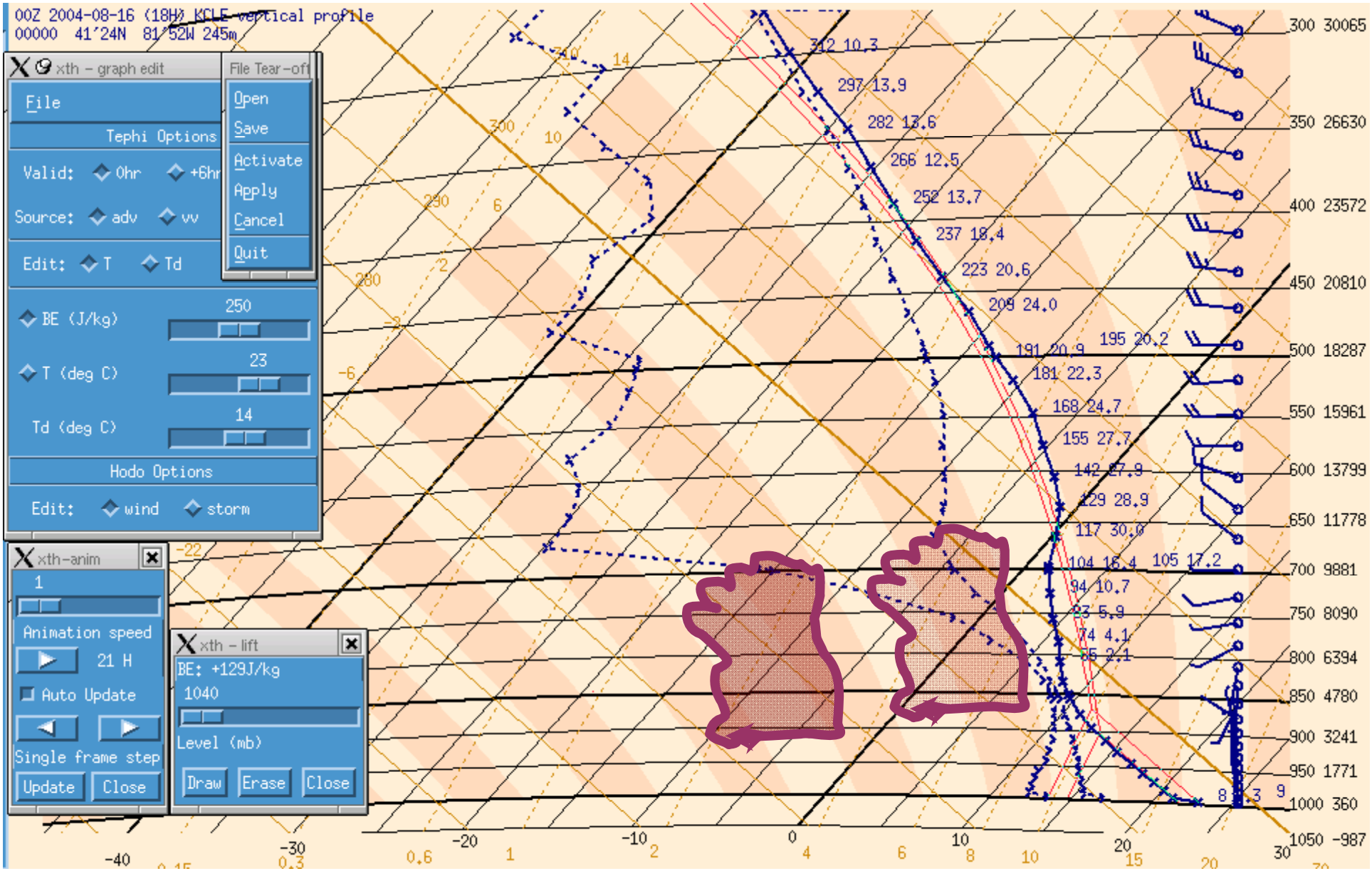
Case 6 – Cloud Chemistry - Towering Cumulus

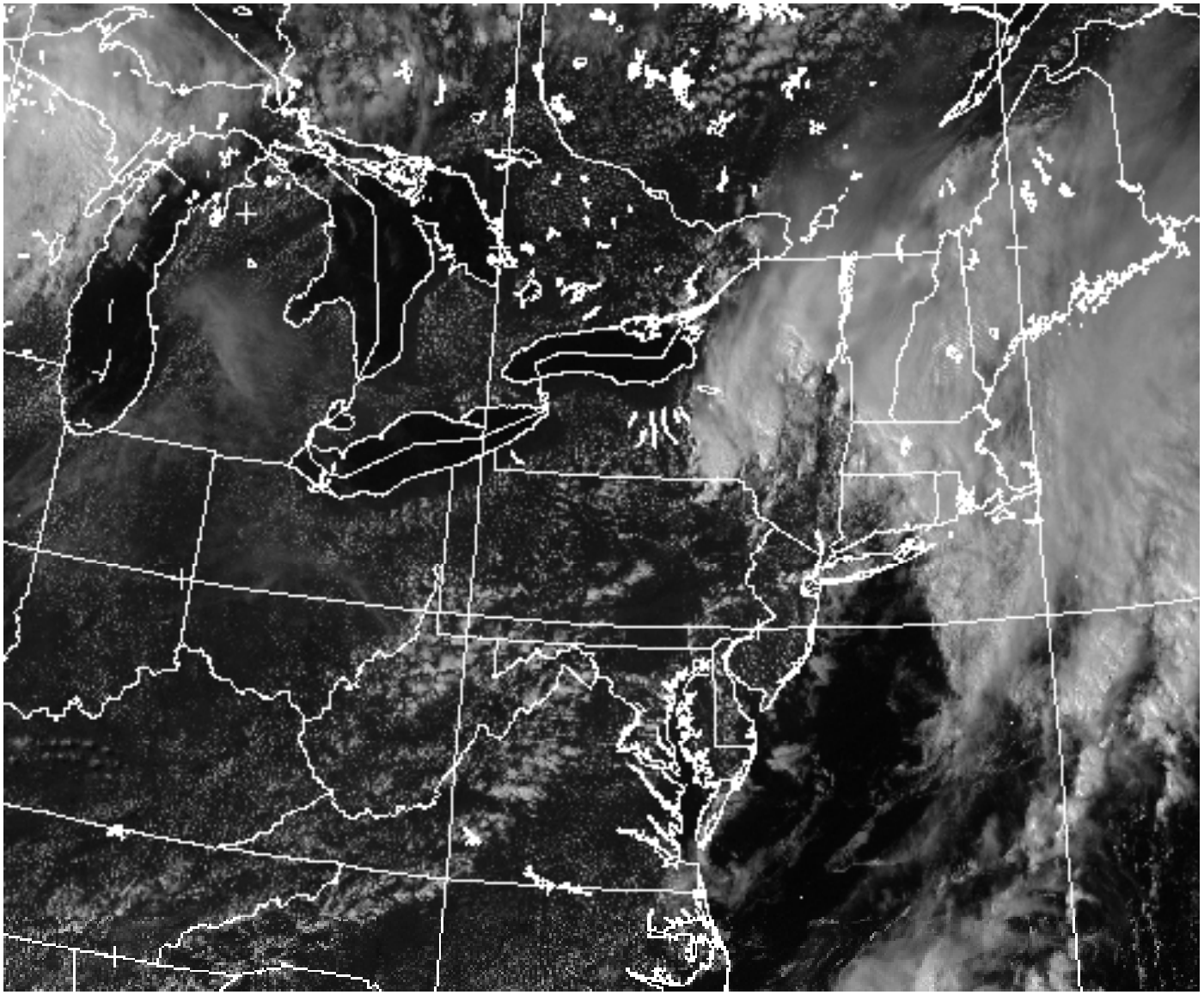
Surface Analysis
18Z 2004/08/16

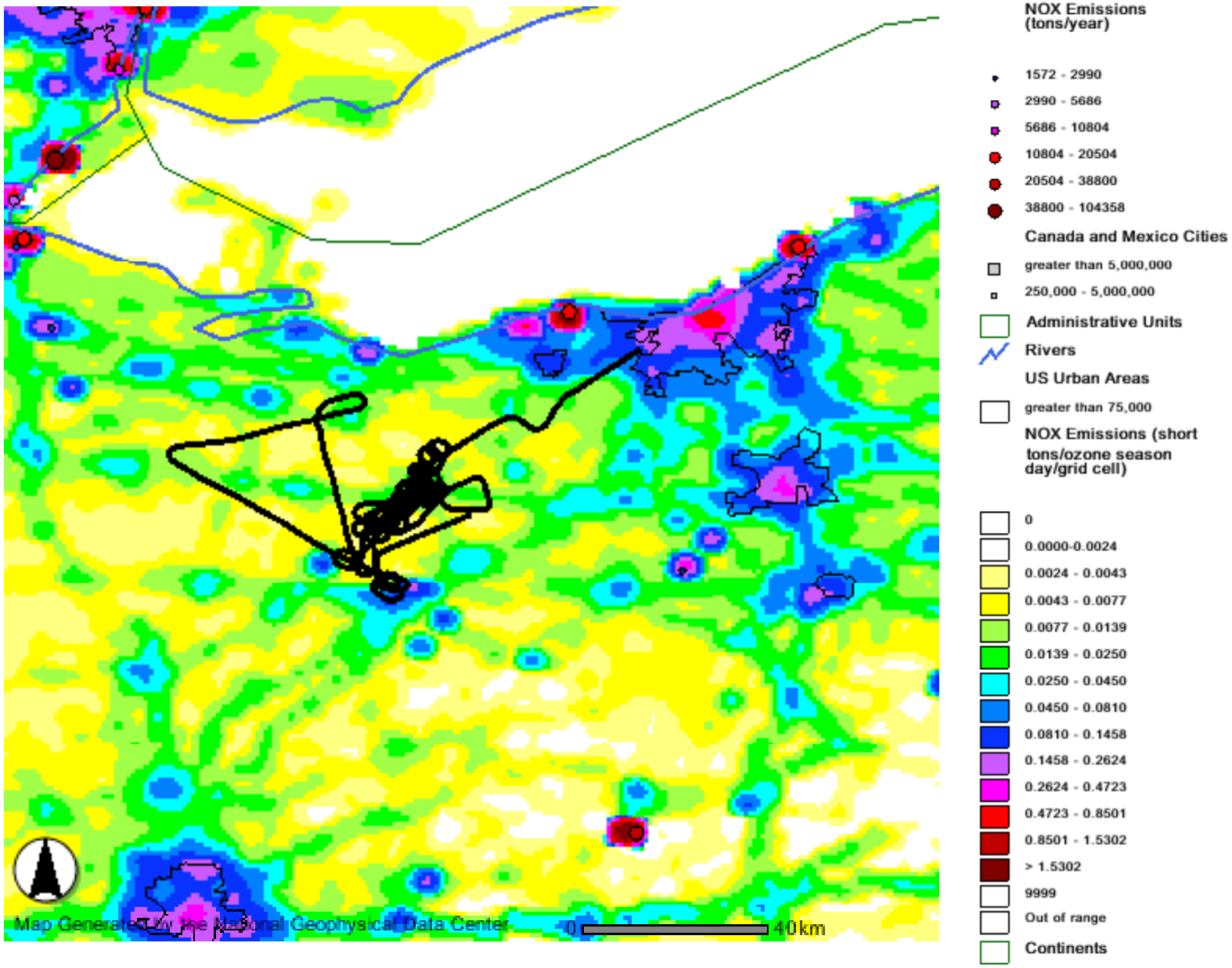


Cleveland – Monday 2 PM Local - Forecast

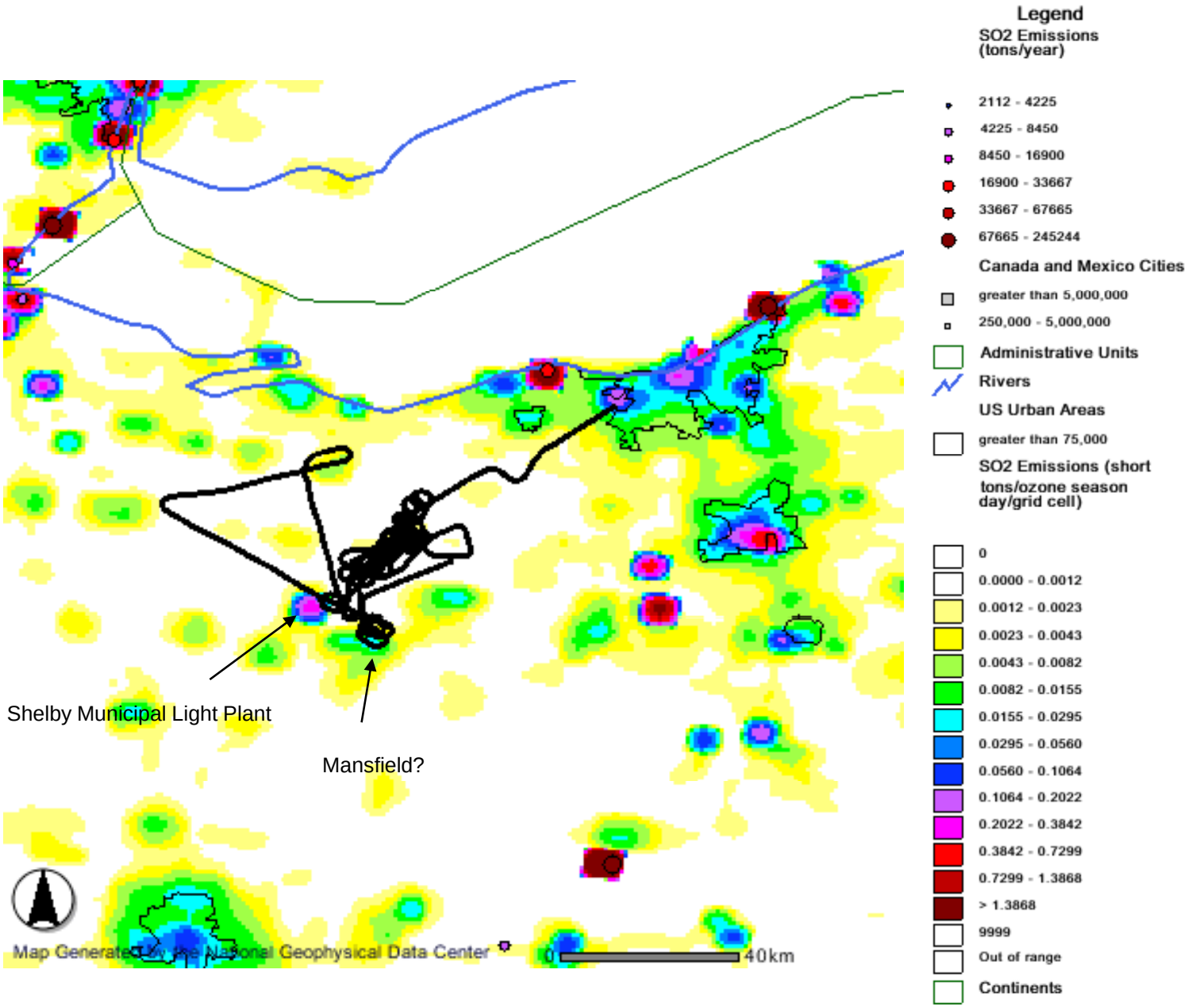


GOES-12 VIS 08/16/04 19:45:00





http://www.ngdc.noaa.gov/maps/interactivemaps.html



http://www.ngdc.noaa.gov/maps/interactivemaps.html

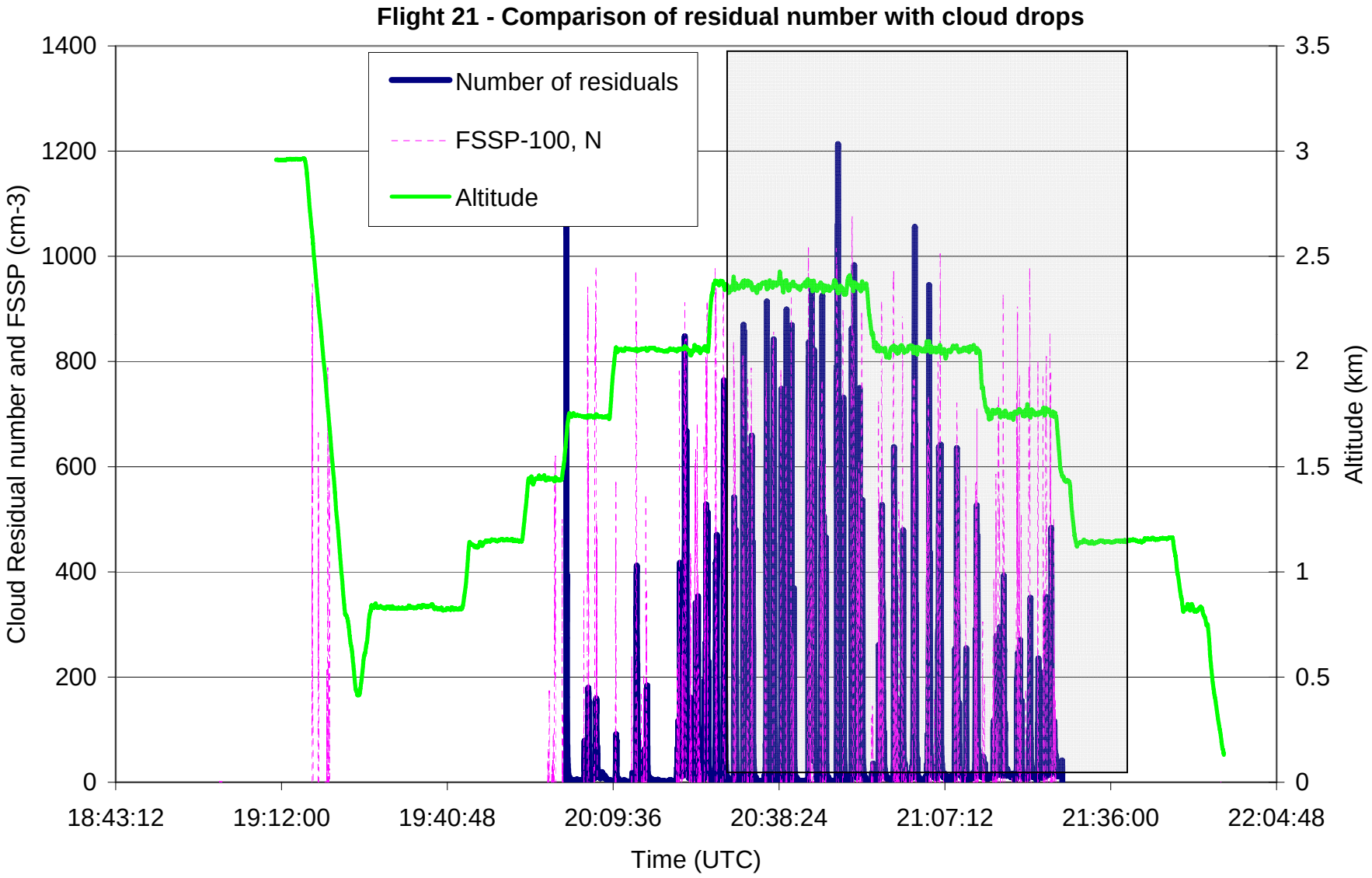
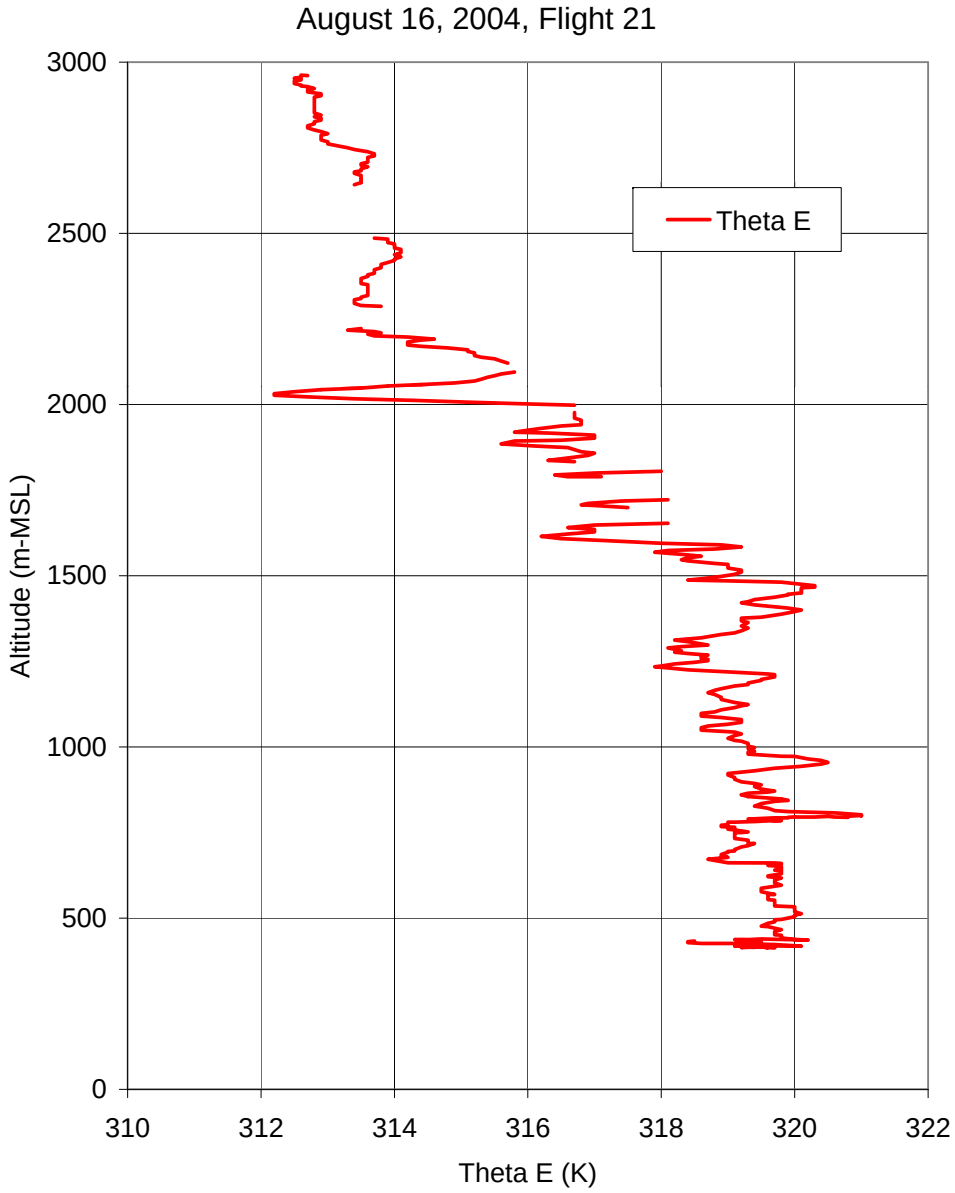

Flight 21 - Comparison of residual number with cloud drops
Number of residuals
FSSP-100, N
Altitude
Cloud Residual number and FSSP (cm-3)
Altitude (km)
Time (UTC)
1400
1200
1000
800
600
400
200
0
3.5
3
2.5
2
1.5
1
0.5
0
18:43:12
19:12:00
19:40:48
20:09:36
20:38:24
21:07:12
21:36:00
22:04:48

Figure 14 - Profiles of theta-e and relative humidity



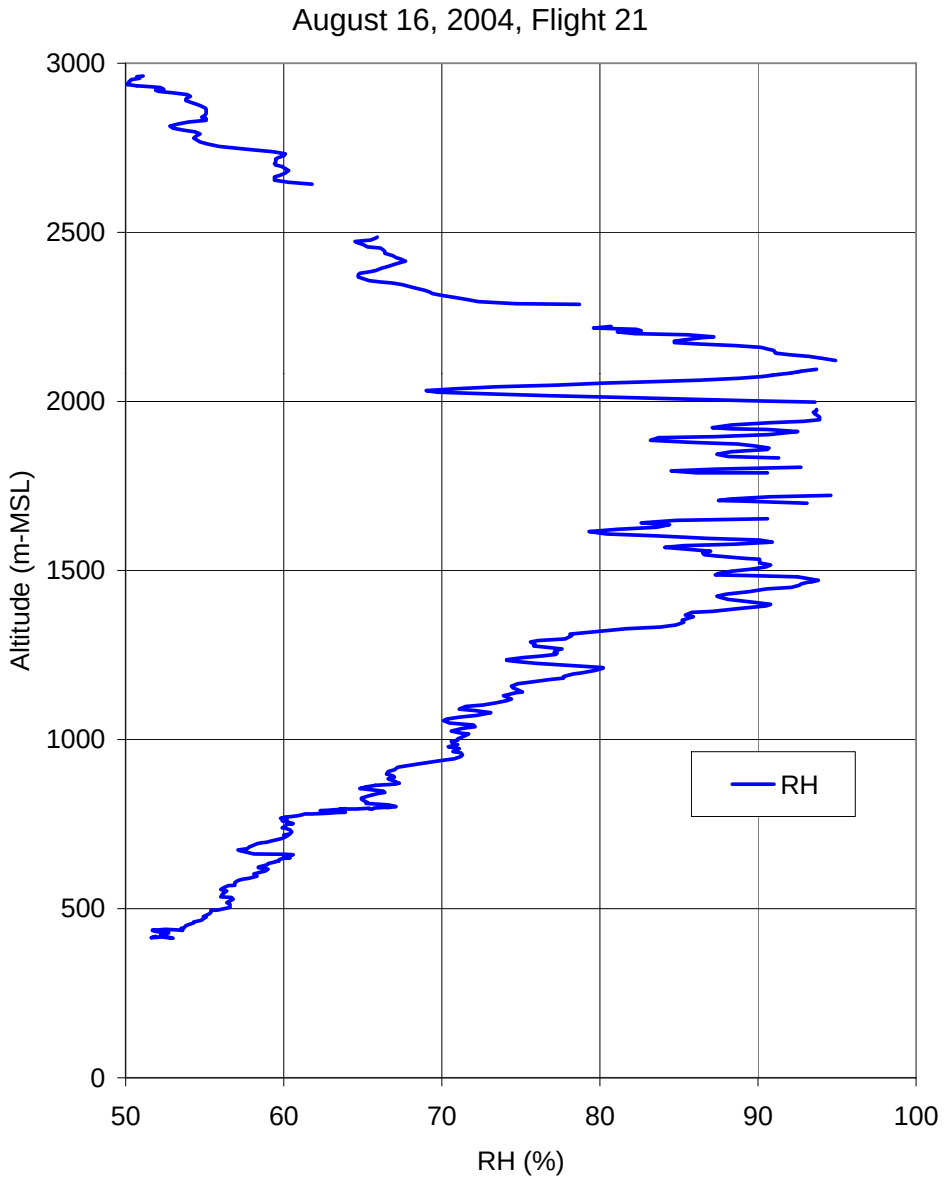
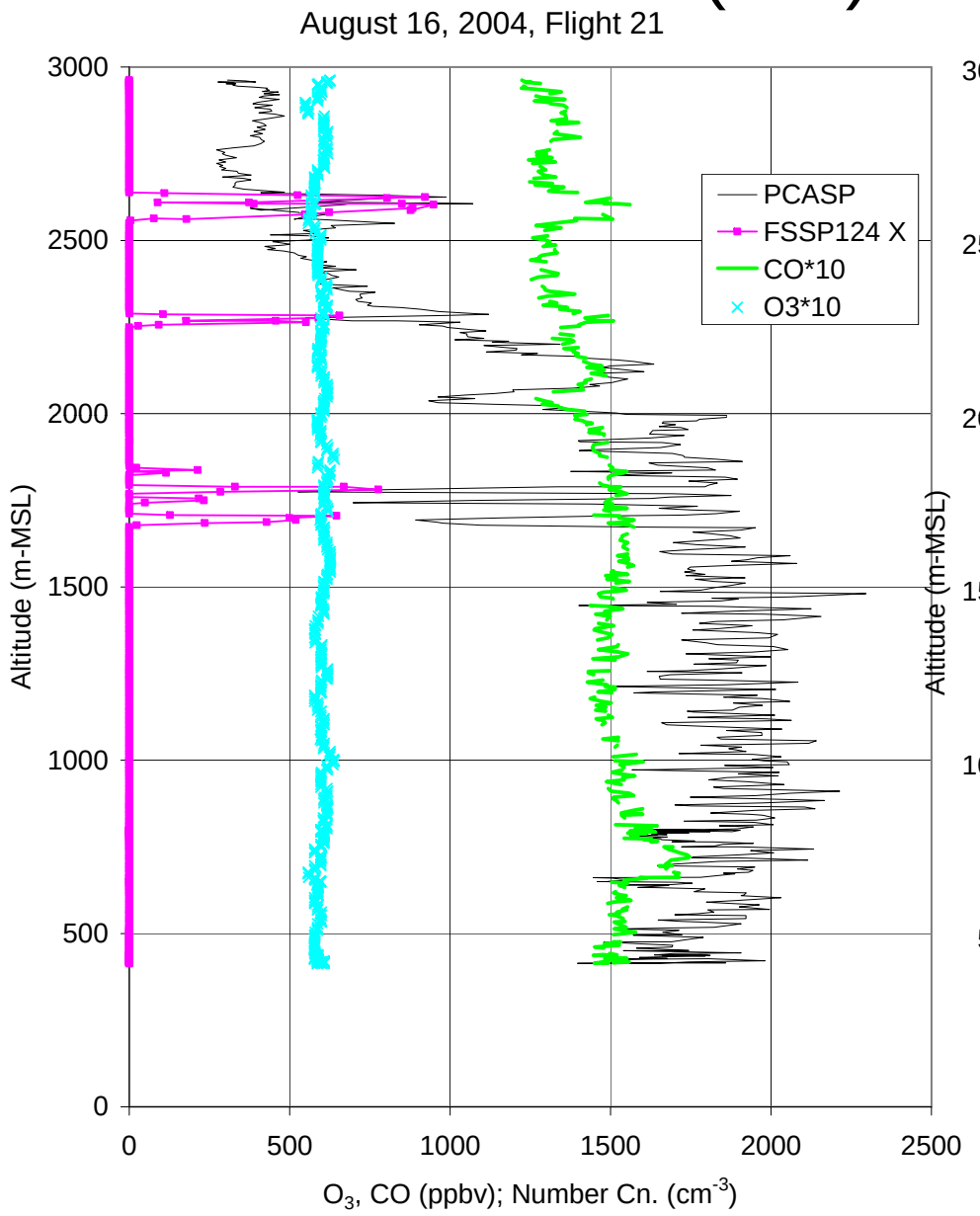


Figure 15 - Vertical profiles of droplet number (FSSP), CO (x10) and O_3 (x10)



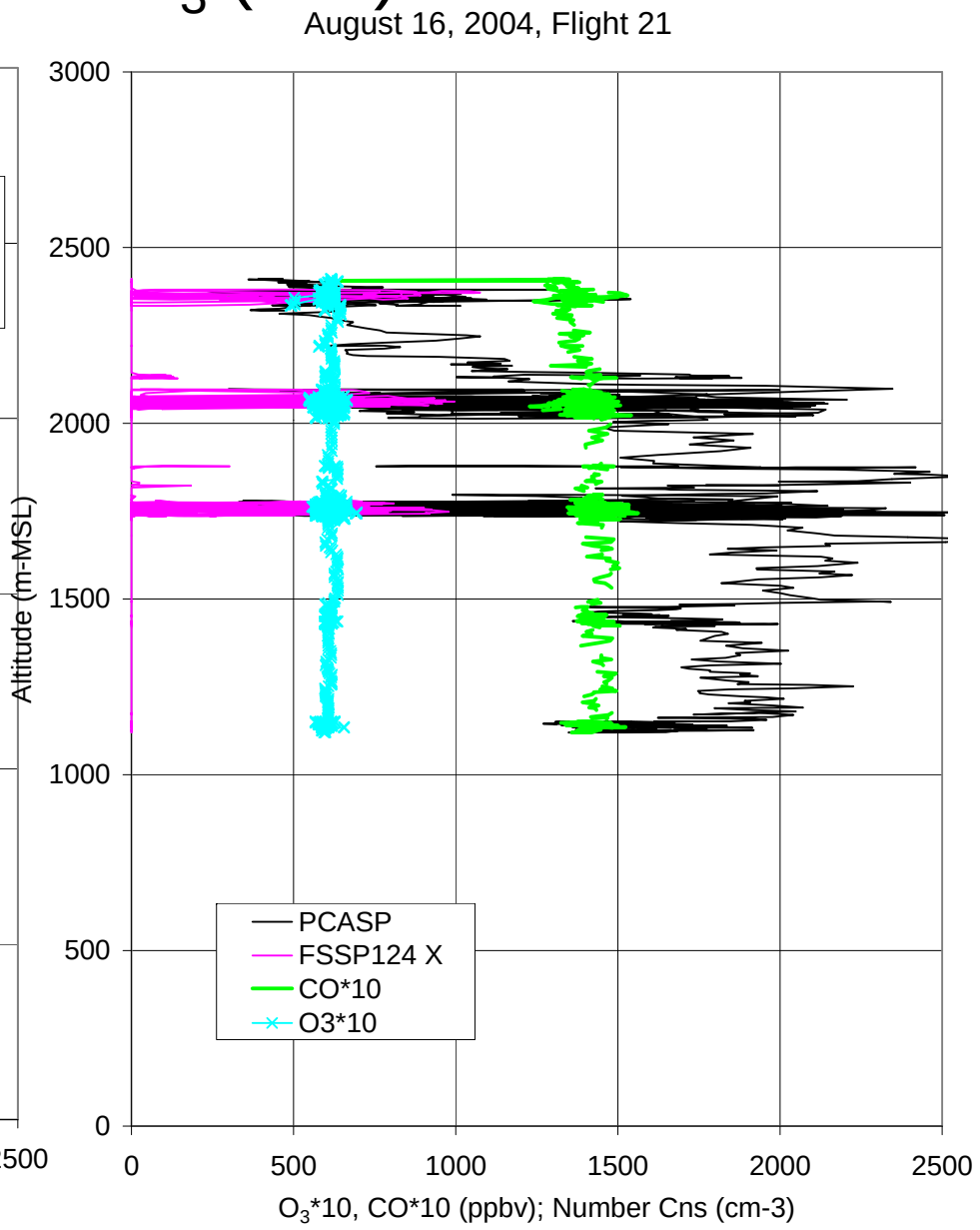
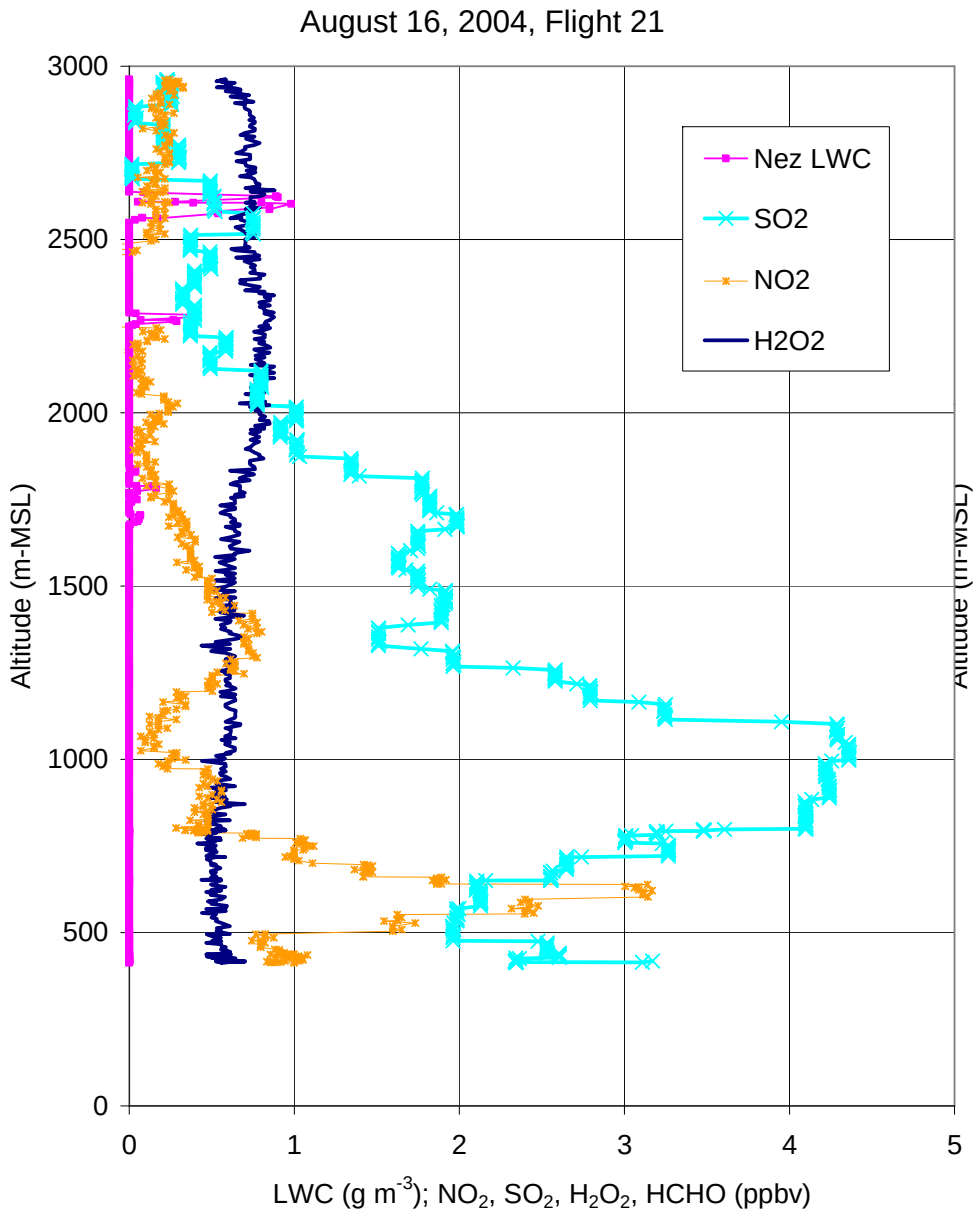


Figure 16 - Vertical profiles of LWC, SO_2, NO_2, H_2O_2 and HCHO



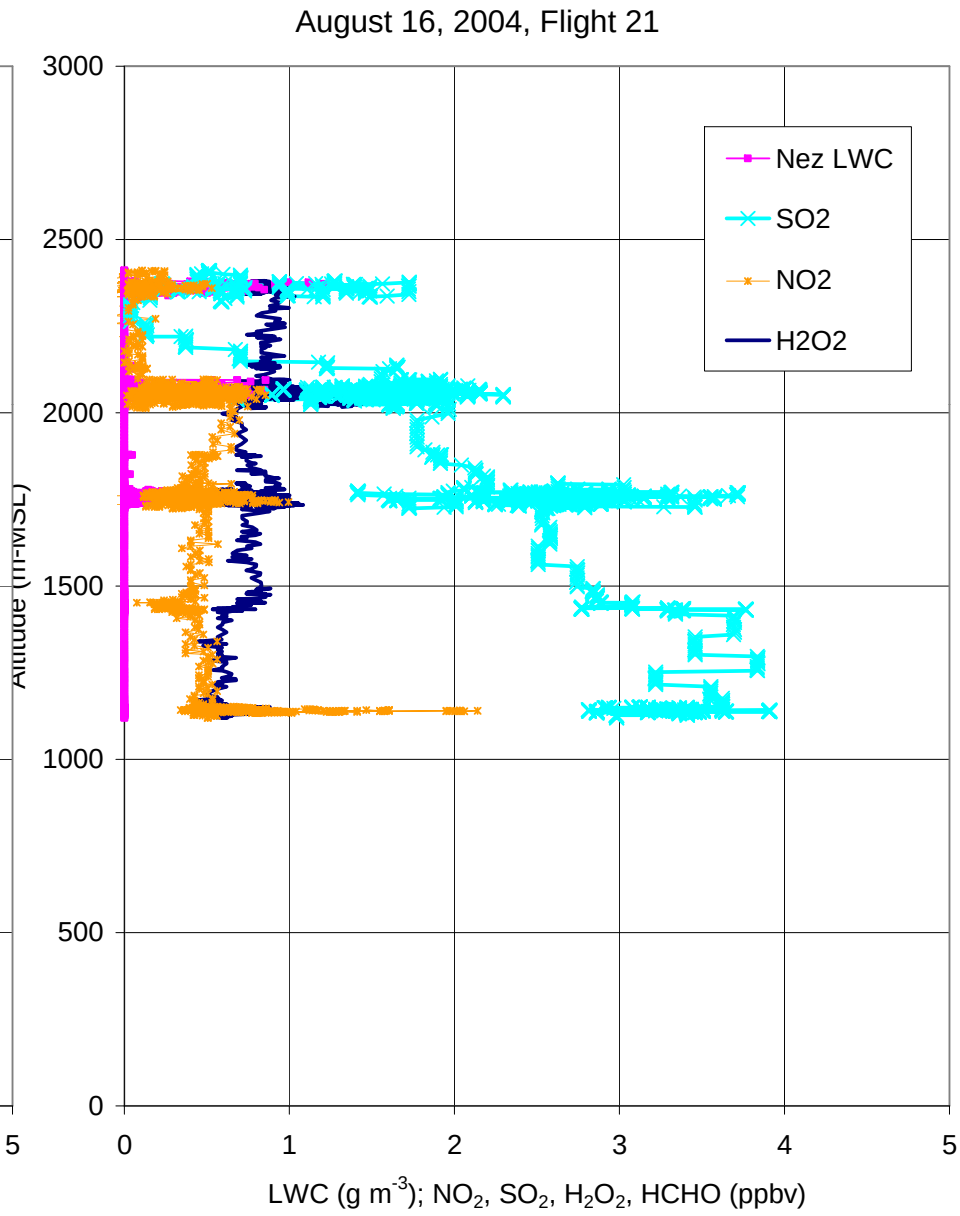


Figure 18 - Below-cloud N_a and CO

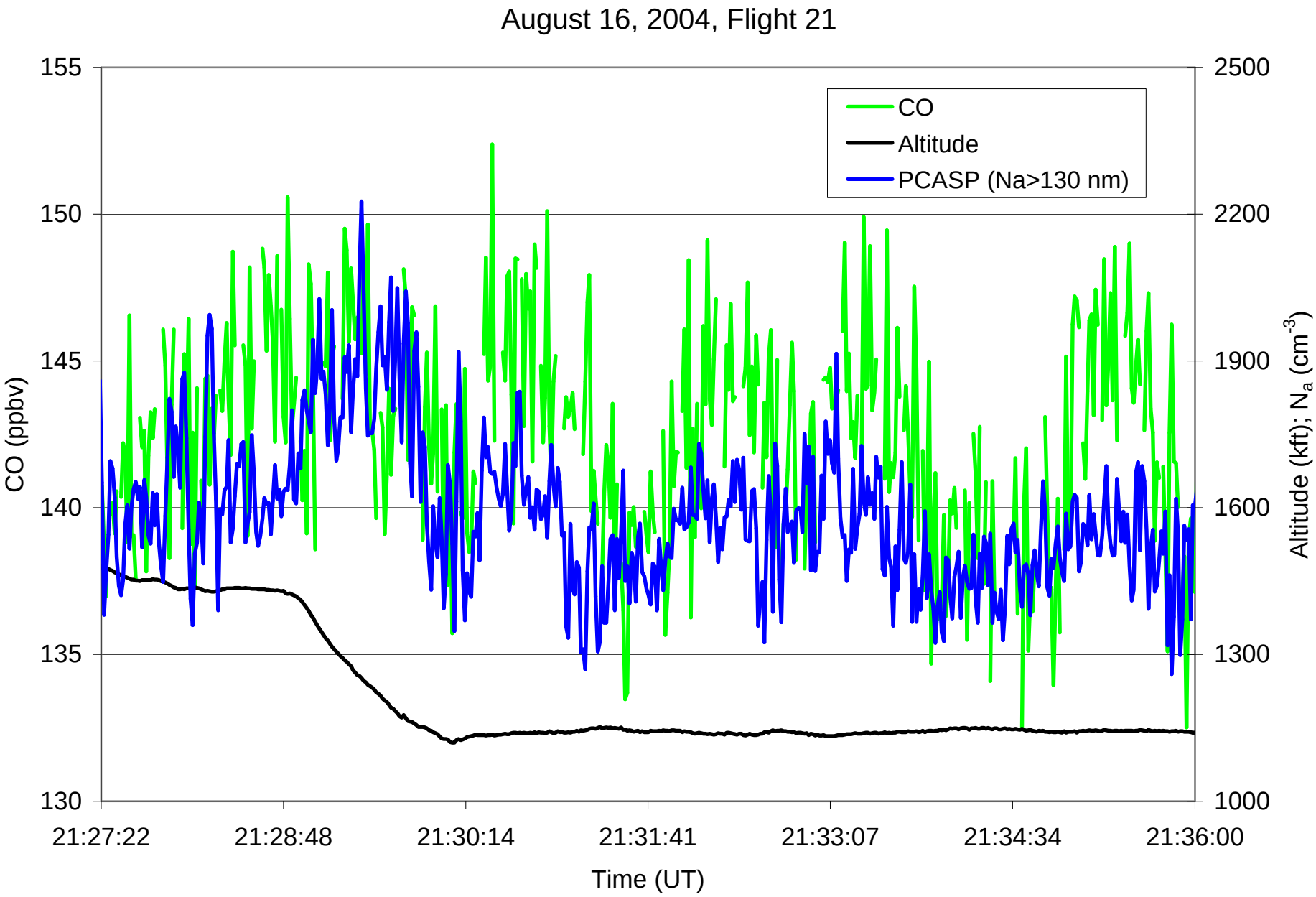


Figure 21 - In-cloud SO_2 and LWC

August 16, 2004, Flight 21

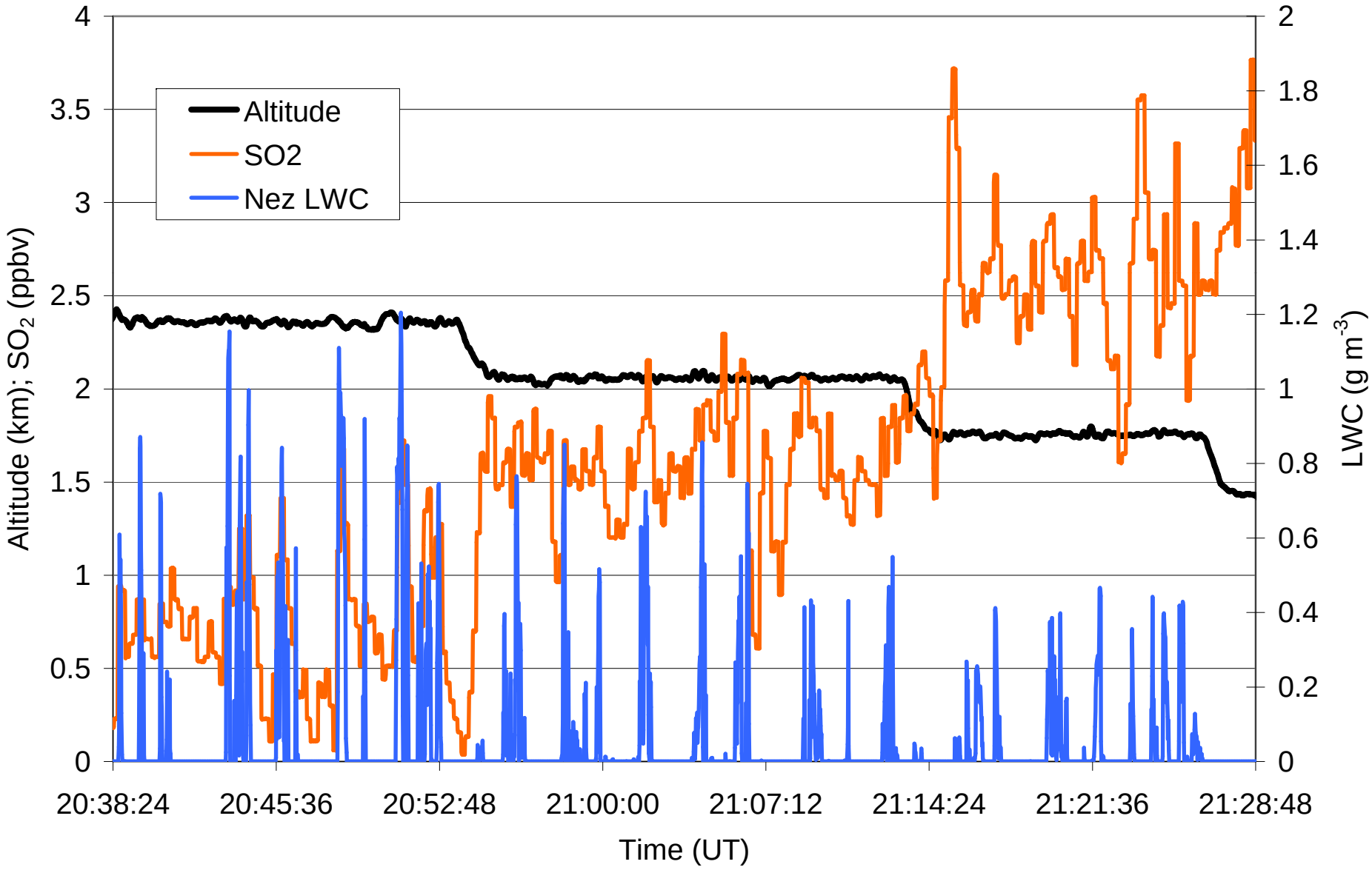


Figure 25 - CO, LWC and vertical gusts at 2.35 km

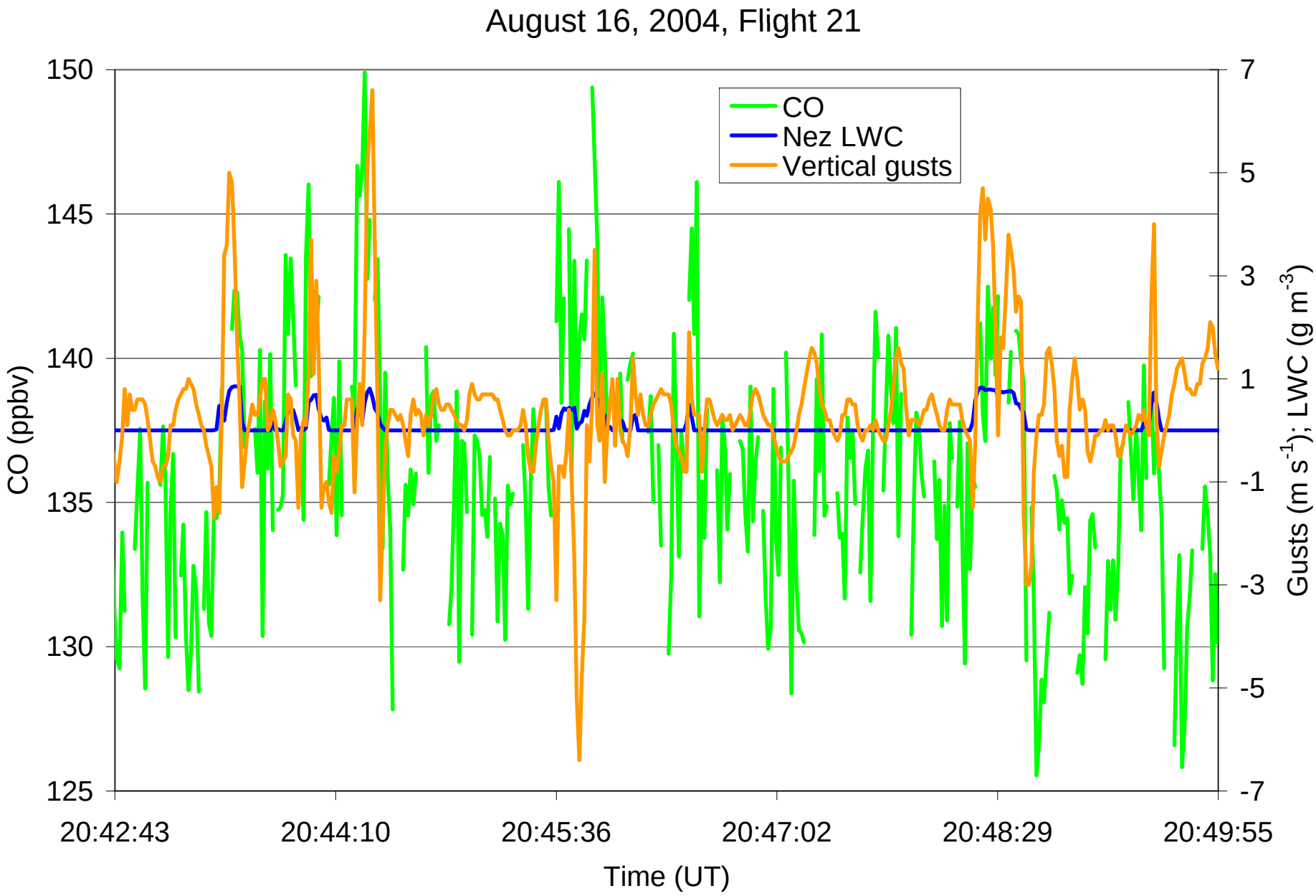


Figure 26 - Nitrate and sulphate in bulk cloudwater samples; NO_2 and SO_2

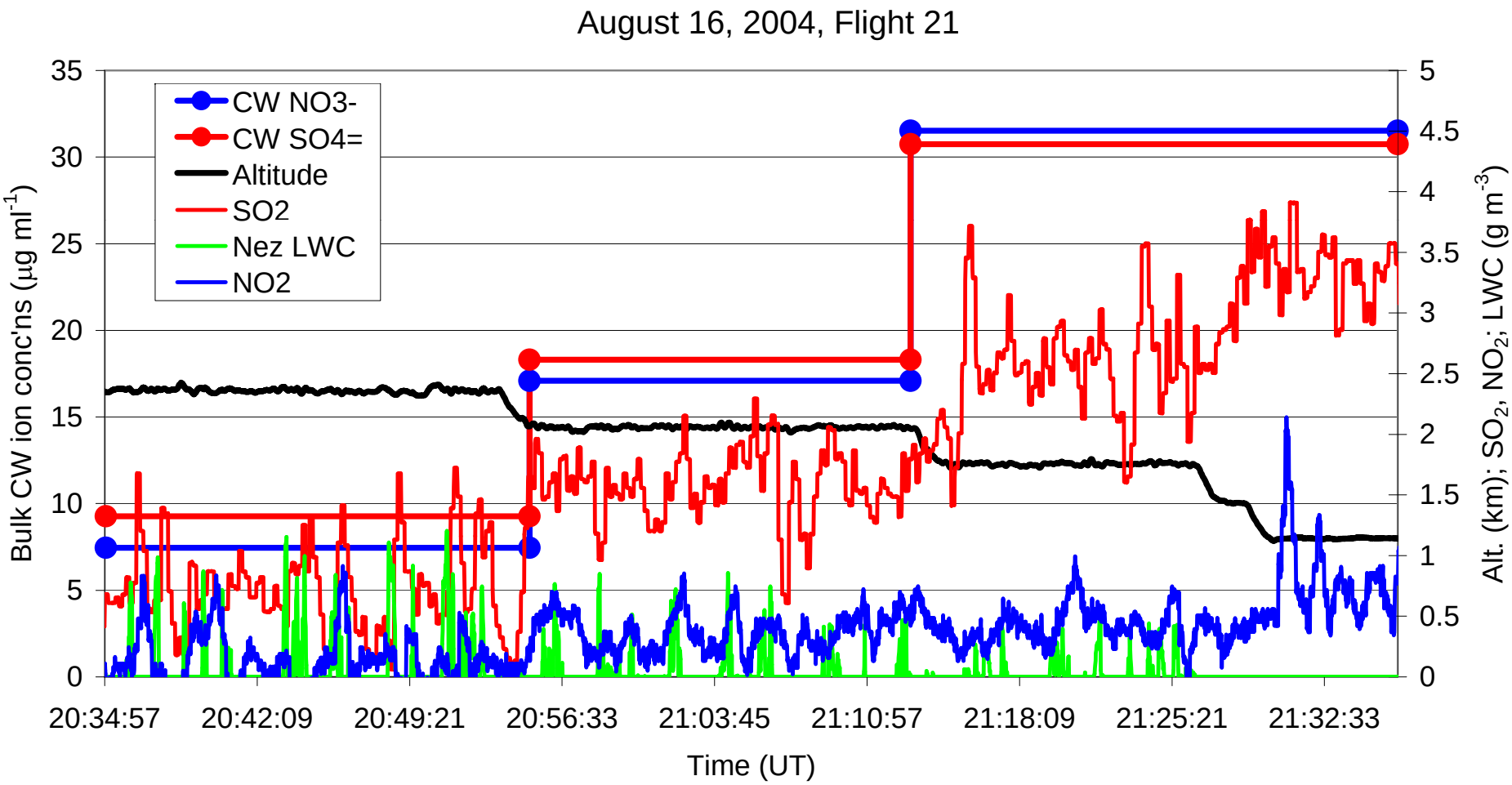


Figure 27 - Nitrate and sulphate in bulk cloudwater and in cloud droplet residuals (AMS behind CVI): MVD of droplets 8-12 μm

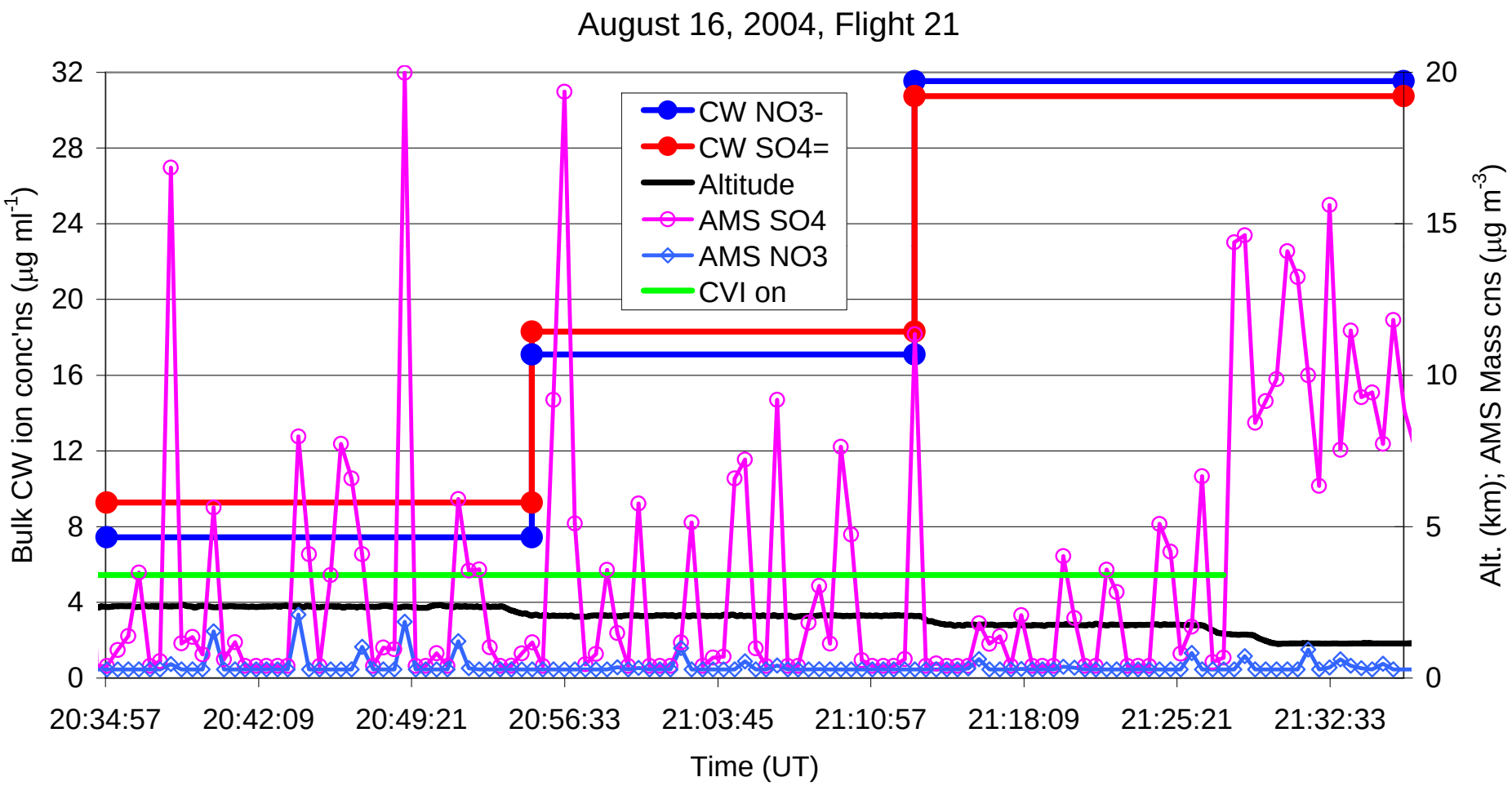
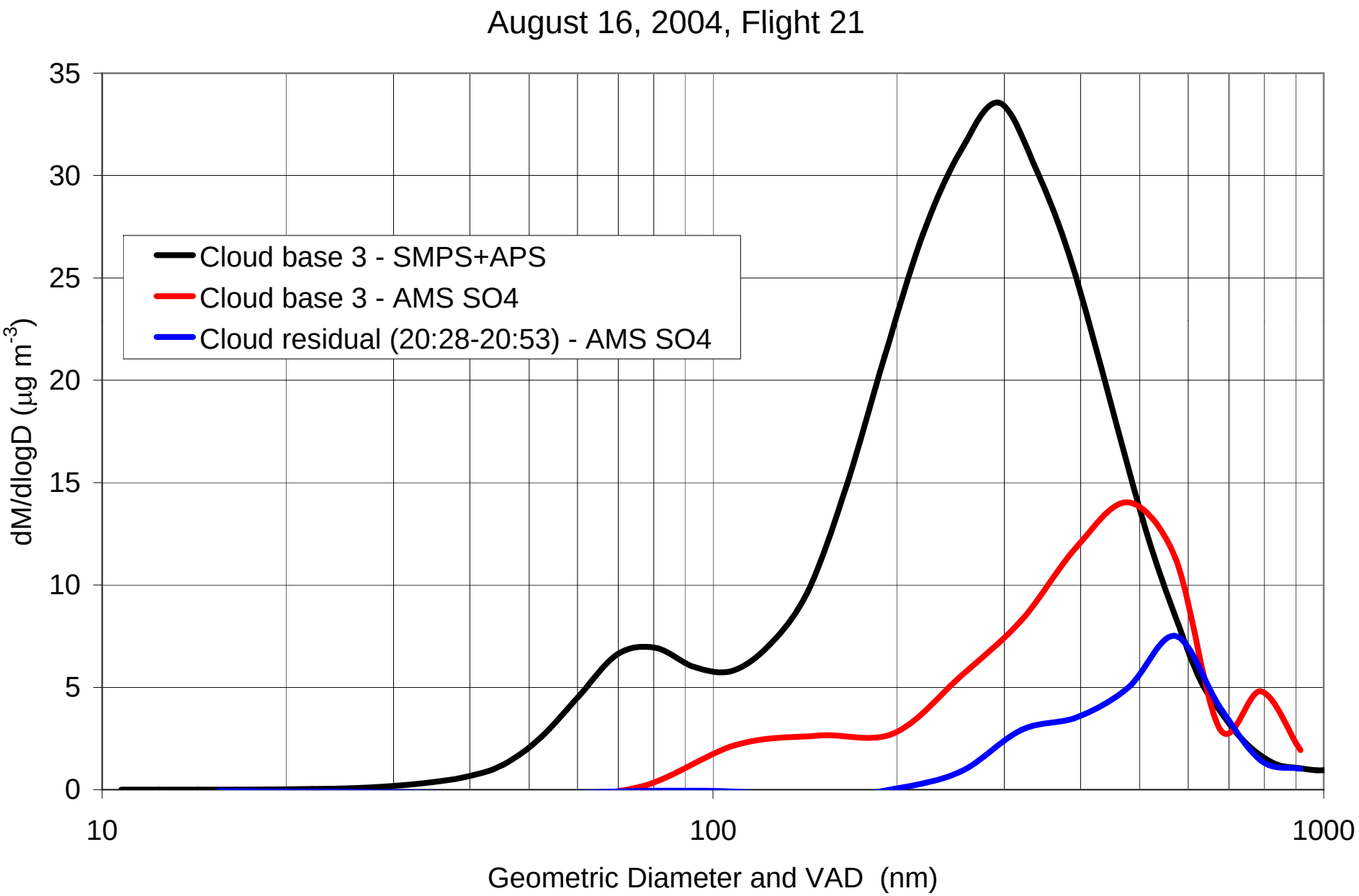
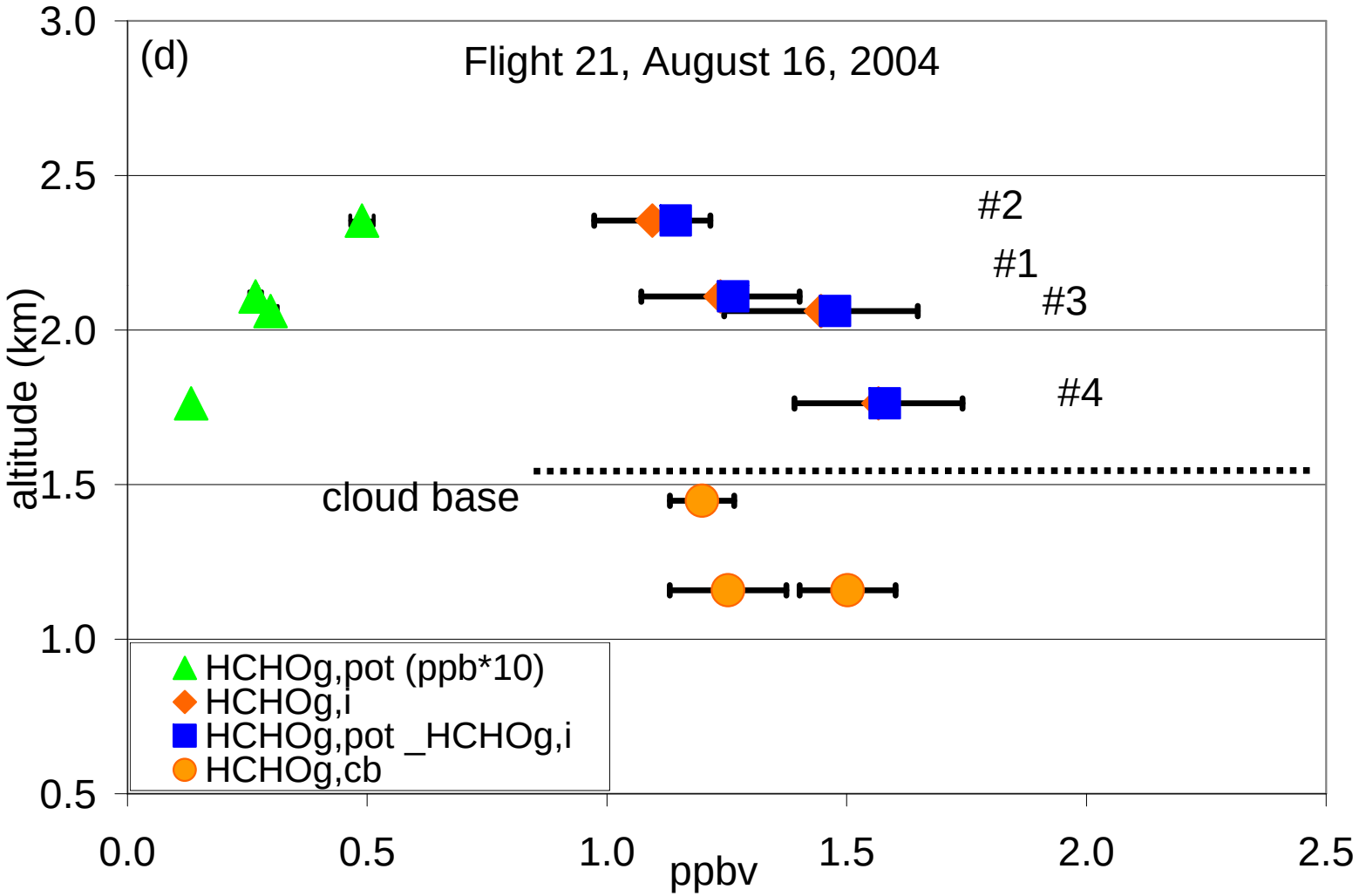
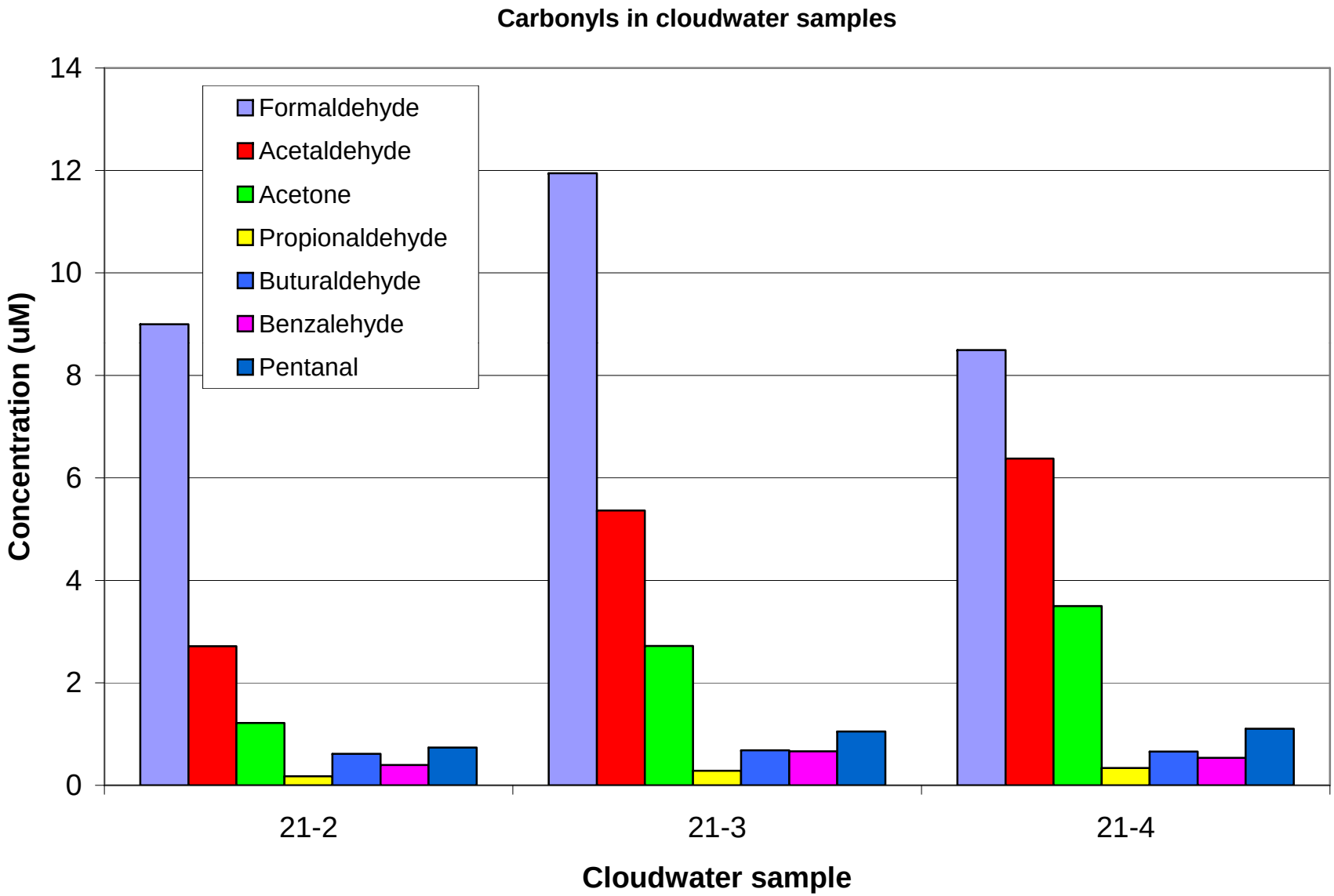


Figure 30 - Particle mass size distributions



HCHO from Amy's paper




Carbonyls in cloudwater samples
Concentration (uM)
14
12
10
8
6
4
2
0
Formaldehyde
Acetaldehyde
Acetone
Propionaldehyde
Buturaldehyde
Benzalehyde
Pentanal
21-2
21-3
21-4
Cloudwater sample

- Some questions to address:
  - How much sulphate is produced in cloud, and to what extent does this affect the boundary layer sulphate?
  - How does NOx influence the chemistry in this case, and does H2SO4 production in aqueous-phase lead to nitrate exclusion in droplet residuals? Is ozone reduced slightly in cloud?
  - How is the aerosol number/mass distribution changed in this situation?
  - How do the dynamics of the Cu affect the chemistry? Does the entrainment of air with increased H2O2 and reduced SO2 into a cloud with lower H2O2 and higher SO2 change the rate of sulphate production? The peak LWCs are low relative to adiabatic, how does this impact sulphate production?
  - How do the models scavenge carbonaceous compounds, and is an increase in HCHO relative to other carbonyls predicted? How can CO be used to indicate cloud processing?