In situ measurements of aerosol size distributions inside the Asian Summer Monsoon Anticyclone

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SSiRC AWI

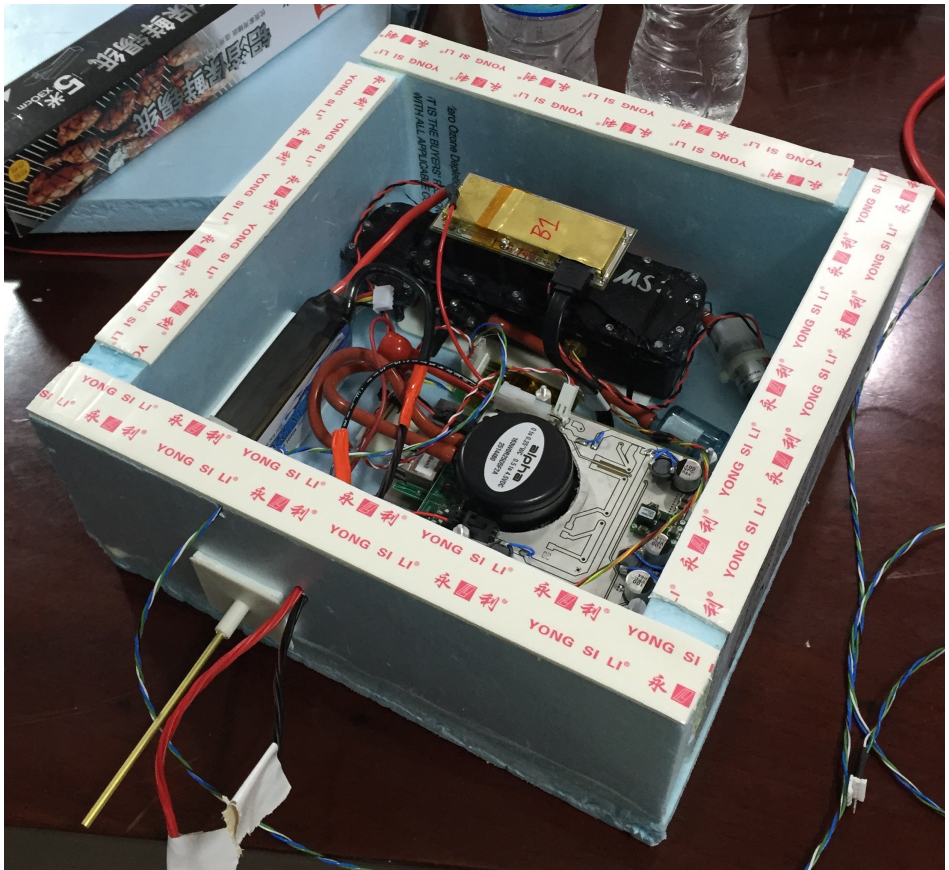
POPS description:

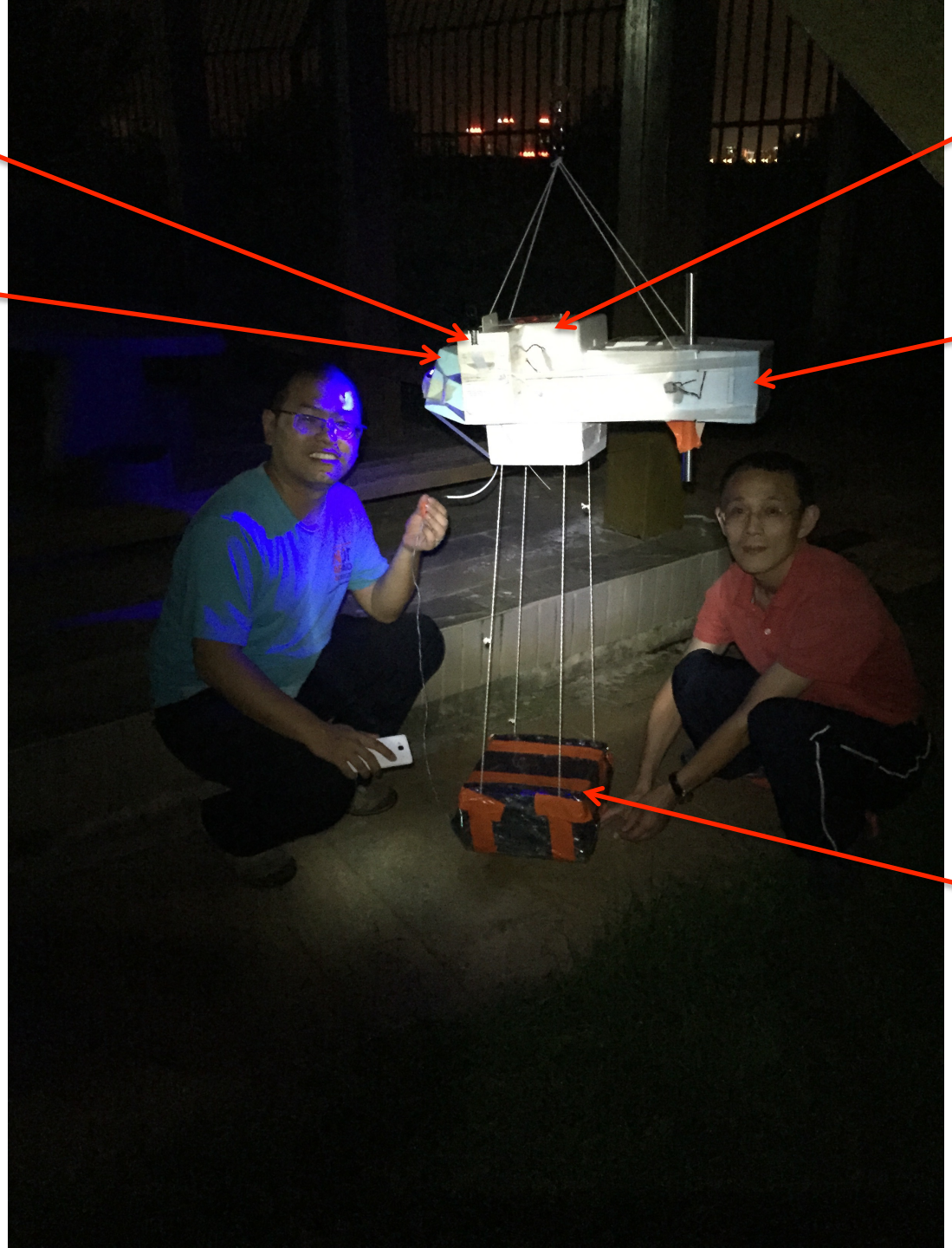
Size range: 140 – 3000 nm diameter (dry)

Sampling: 3 cm^3 s^{-1}

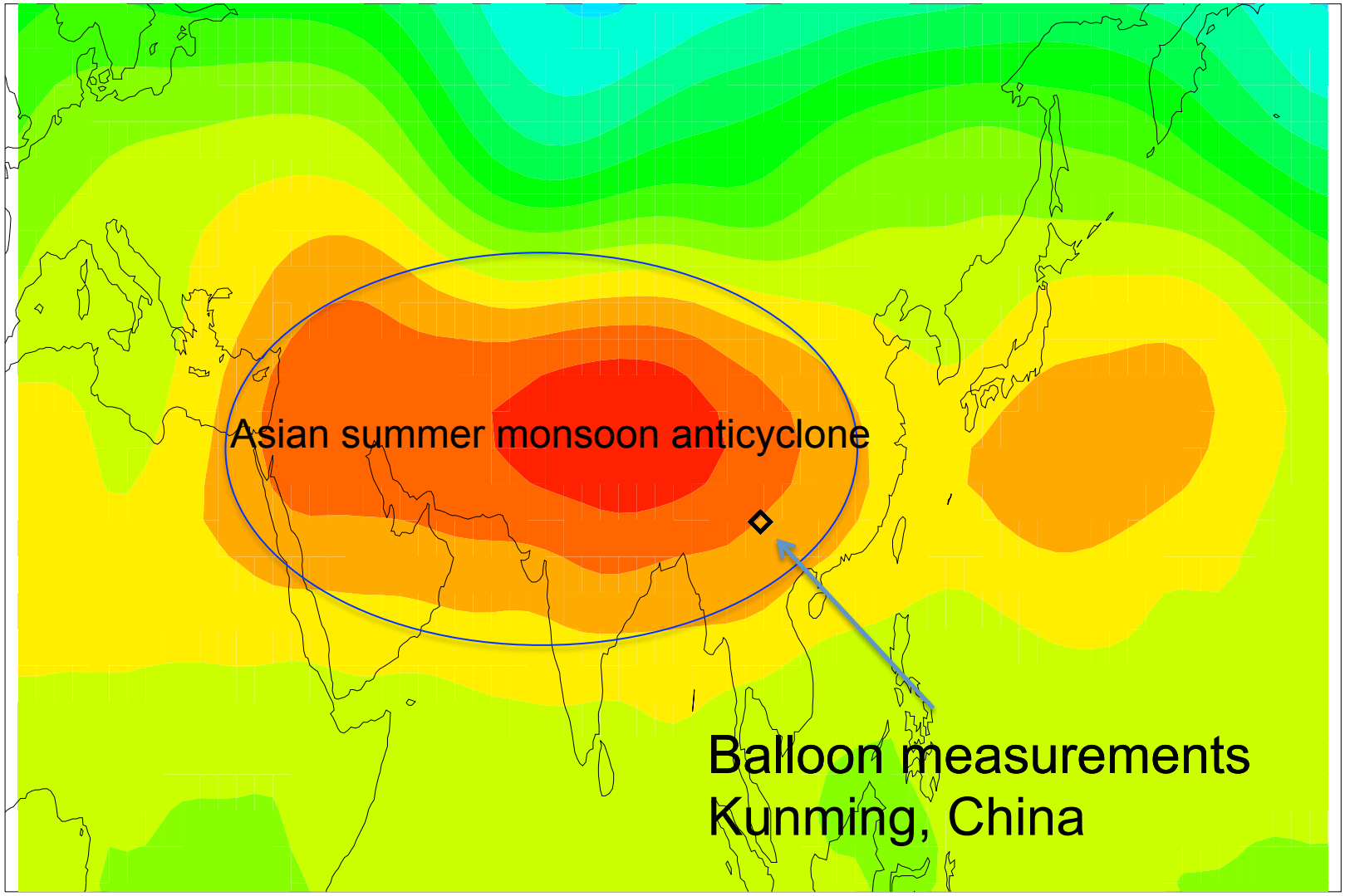
Weight: 1 kg

Communication:
8 size bins with O_3,
CFH, COBALD (limited
by the iMet bandwidth)

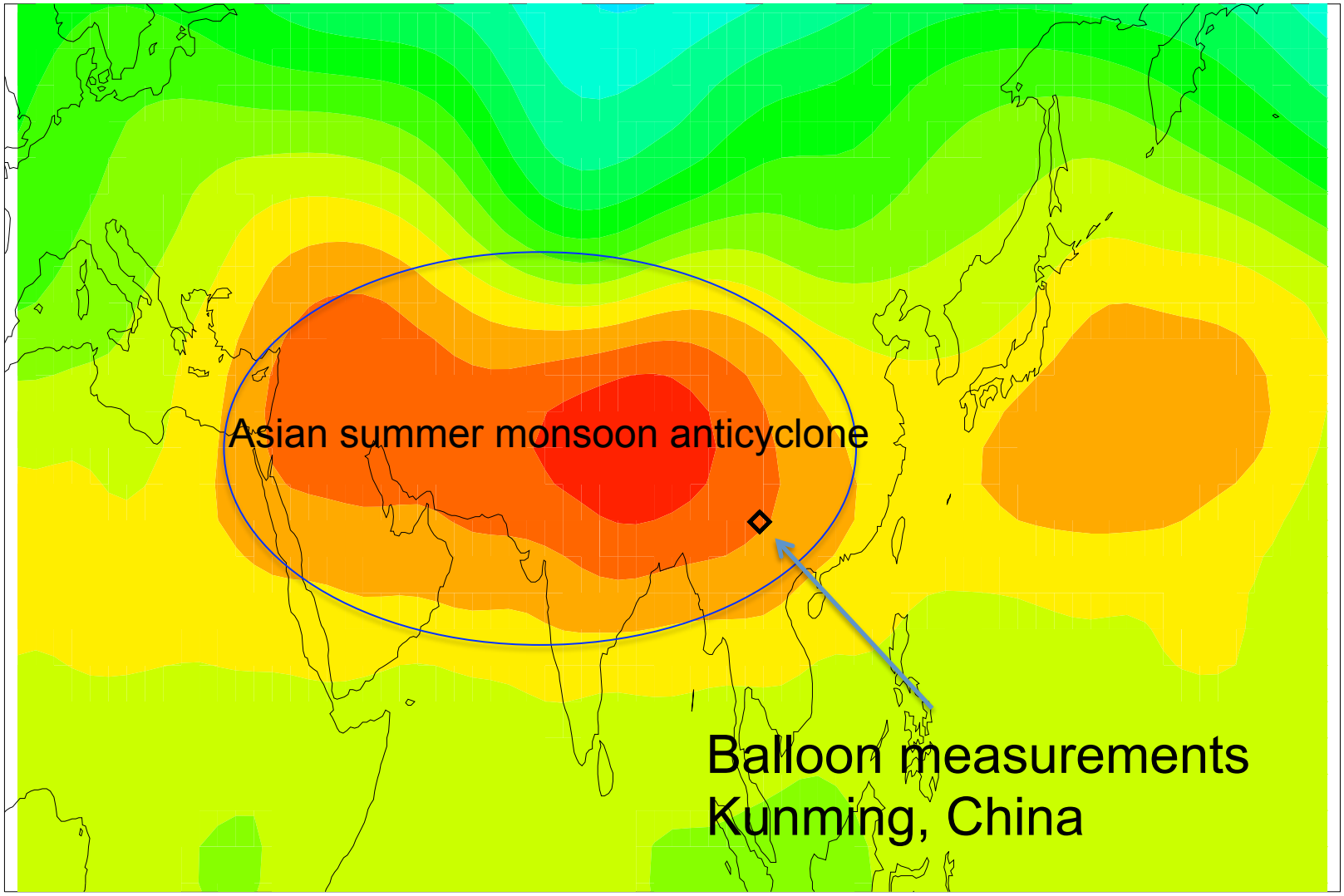



iMet
COBALD
O_3
CFH
POPS
(Printed
Optical
Particle
Spectrometer)

Aug 13, 2015: NCEP 100 mb hgt



Aug 14, 2015: NCEP 100 mb hgt

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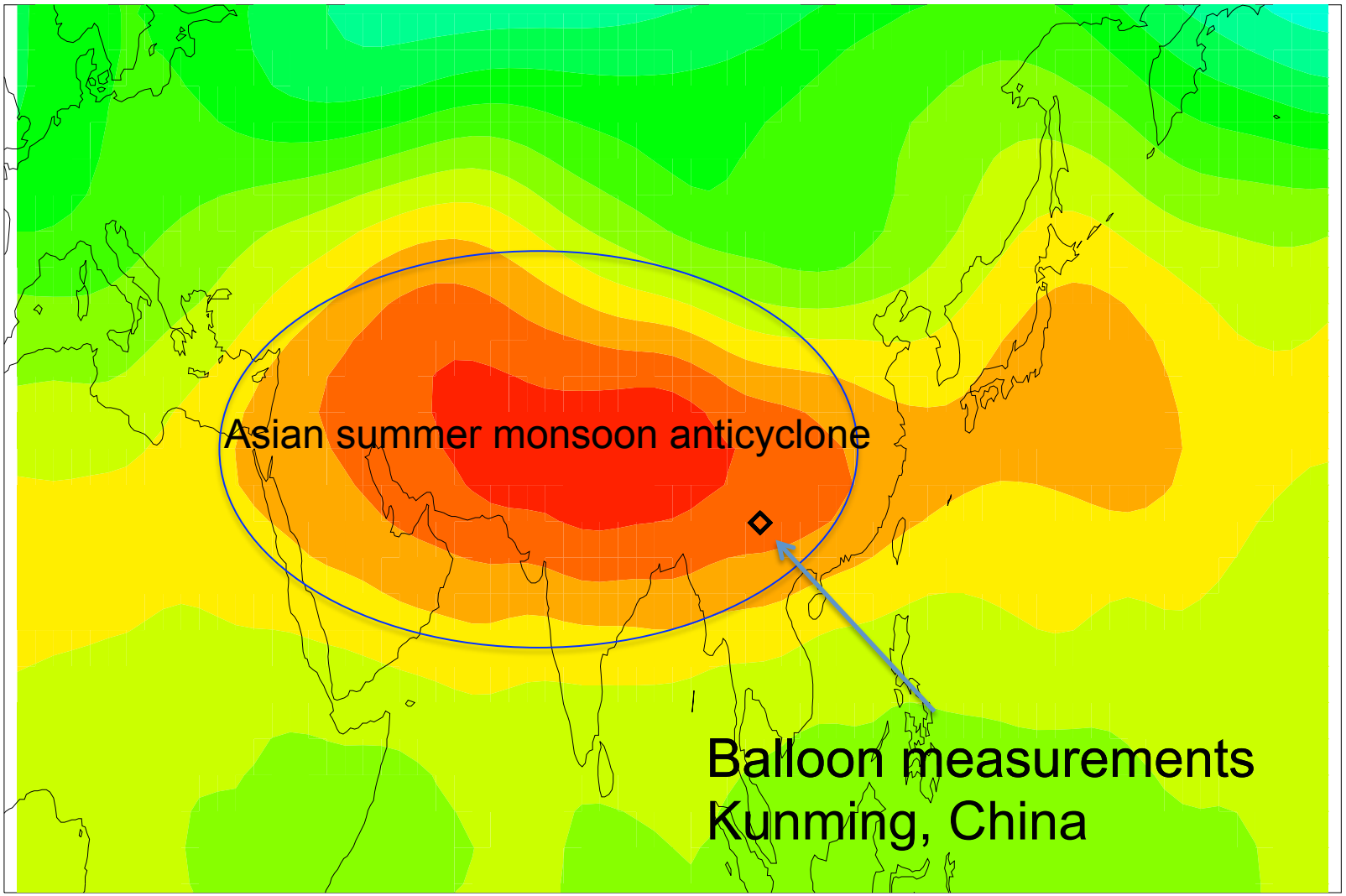
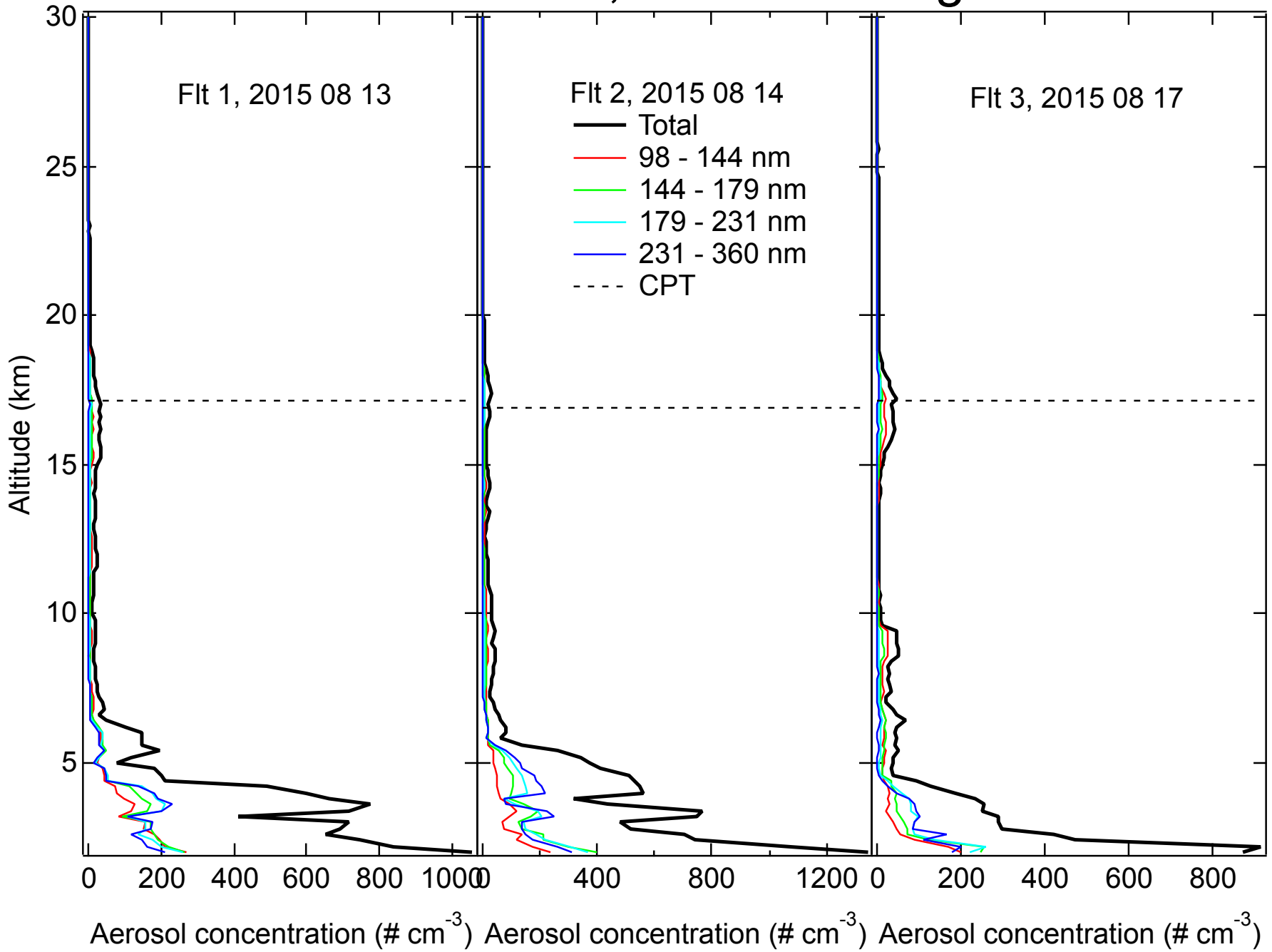
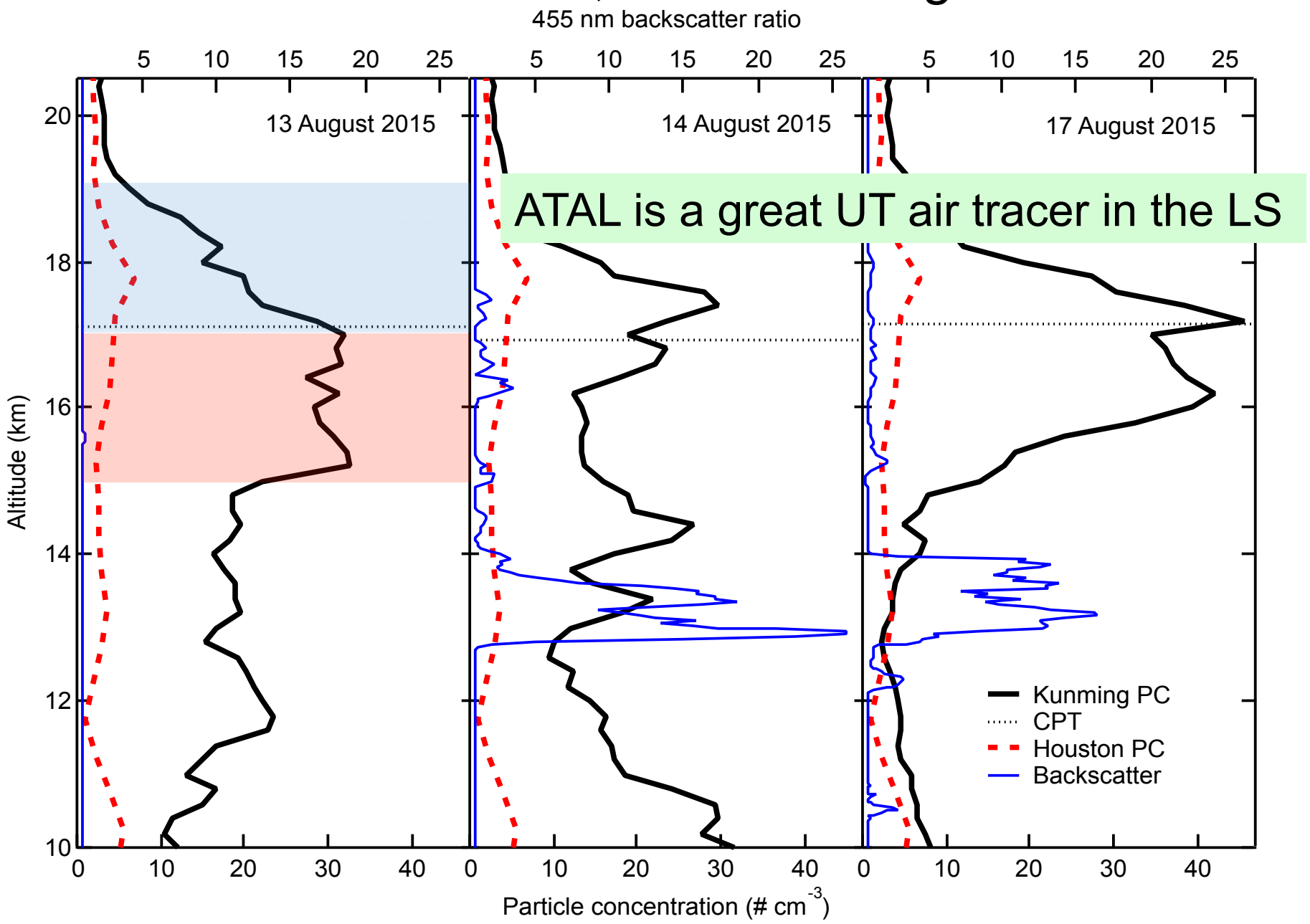
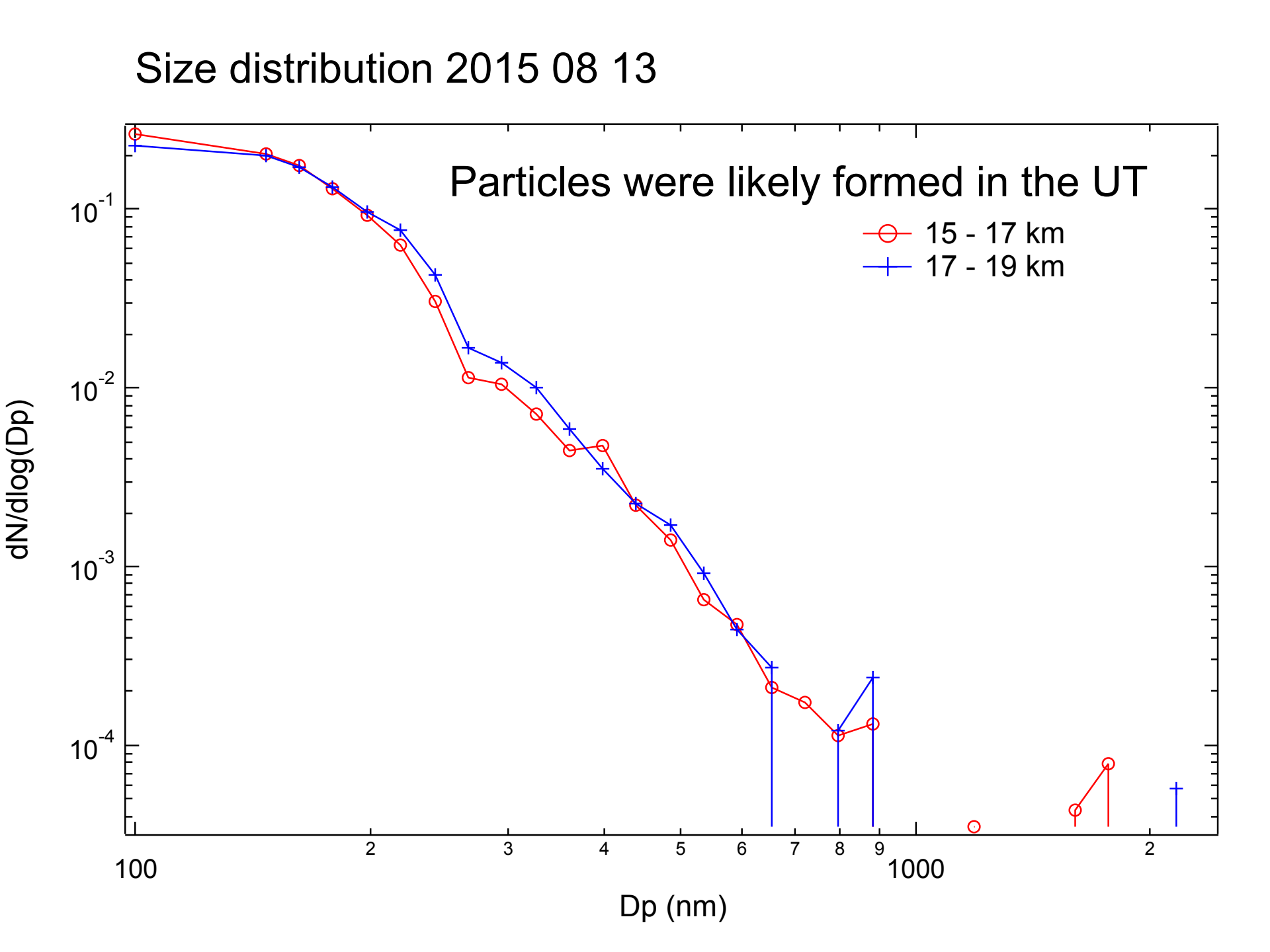
Ozone Depletion
IT IS THE BUYERS'
WITH ALL APPLICABLE

Aug 17, 2015: NCEP 100 mb hgt

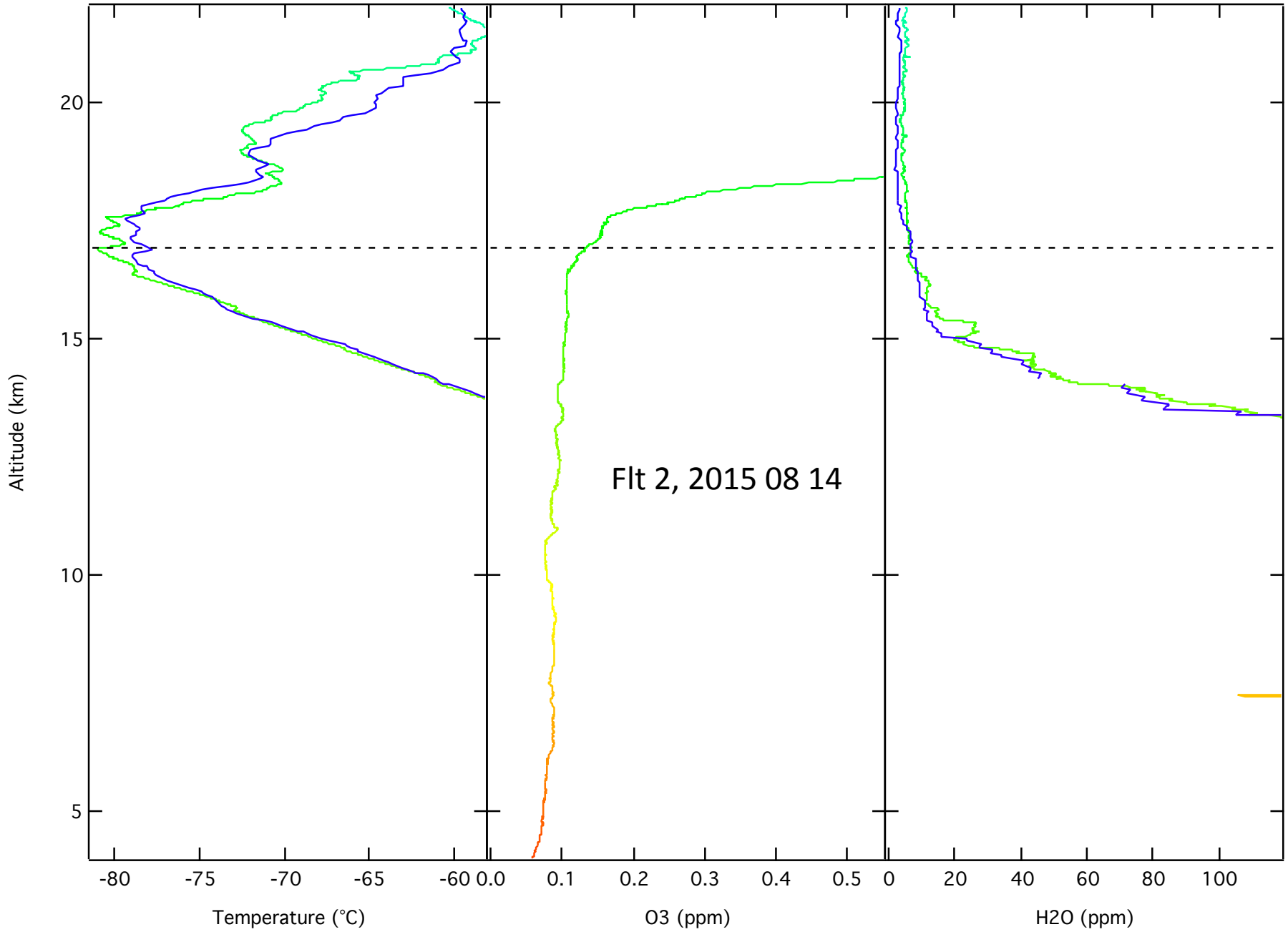


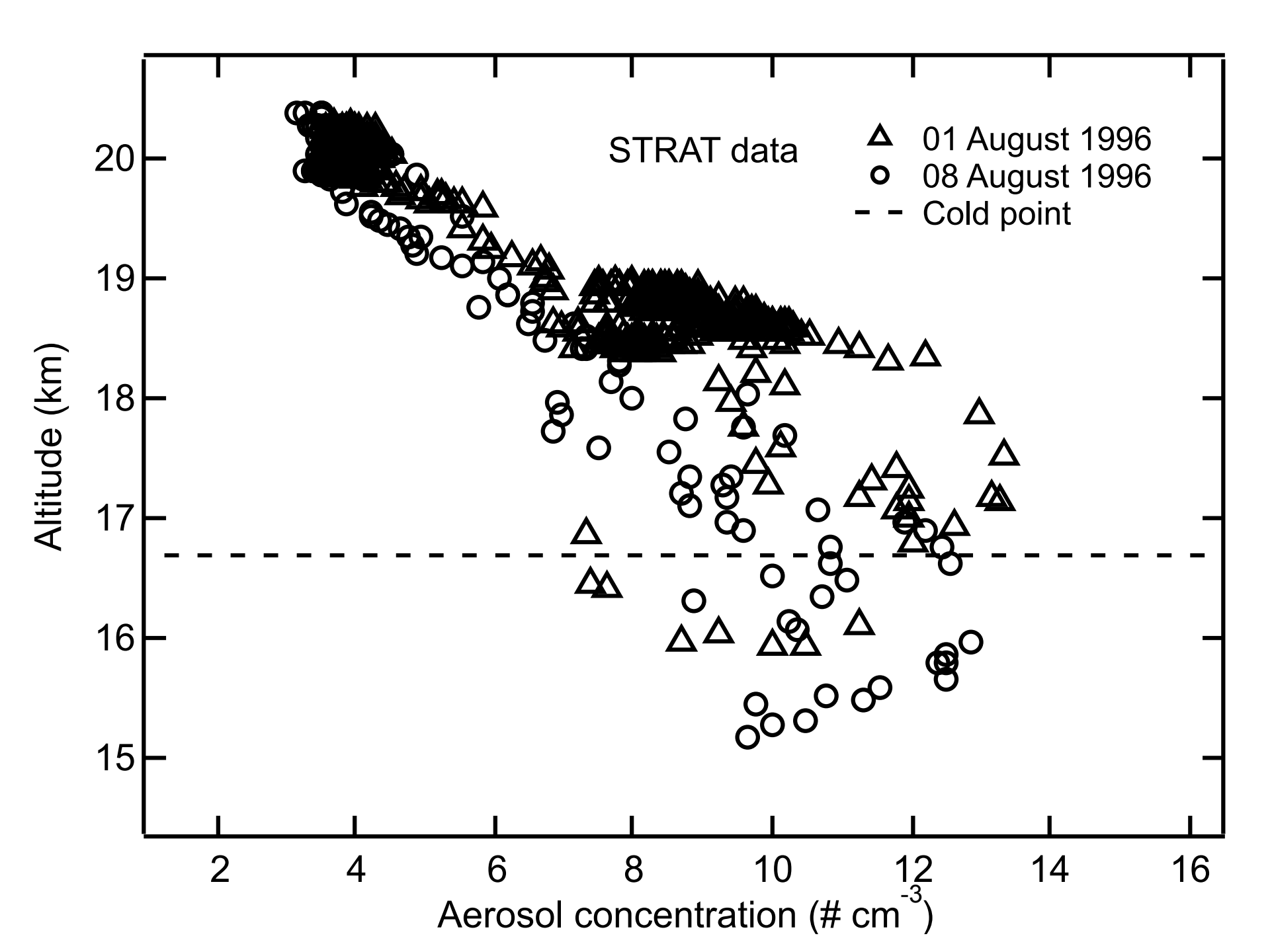

Ascent data, 200-m average
Flt 1, 2015 08 13
Flt 2, 2015 08 14
Flt 3, 2015 08 17
Total
98 - 144 nm
144 - 179 nm
179 - 231 nm
231 - 360 nm
CPT
Altitude (km)
30
25
20
15
10
5
0
200
400
600
800
1000
1200
Aerosol concentration (# cm-3)
Aerosol concentration (# cm-3)
Aerosol concentration (# cm-3)

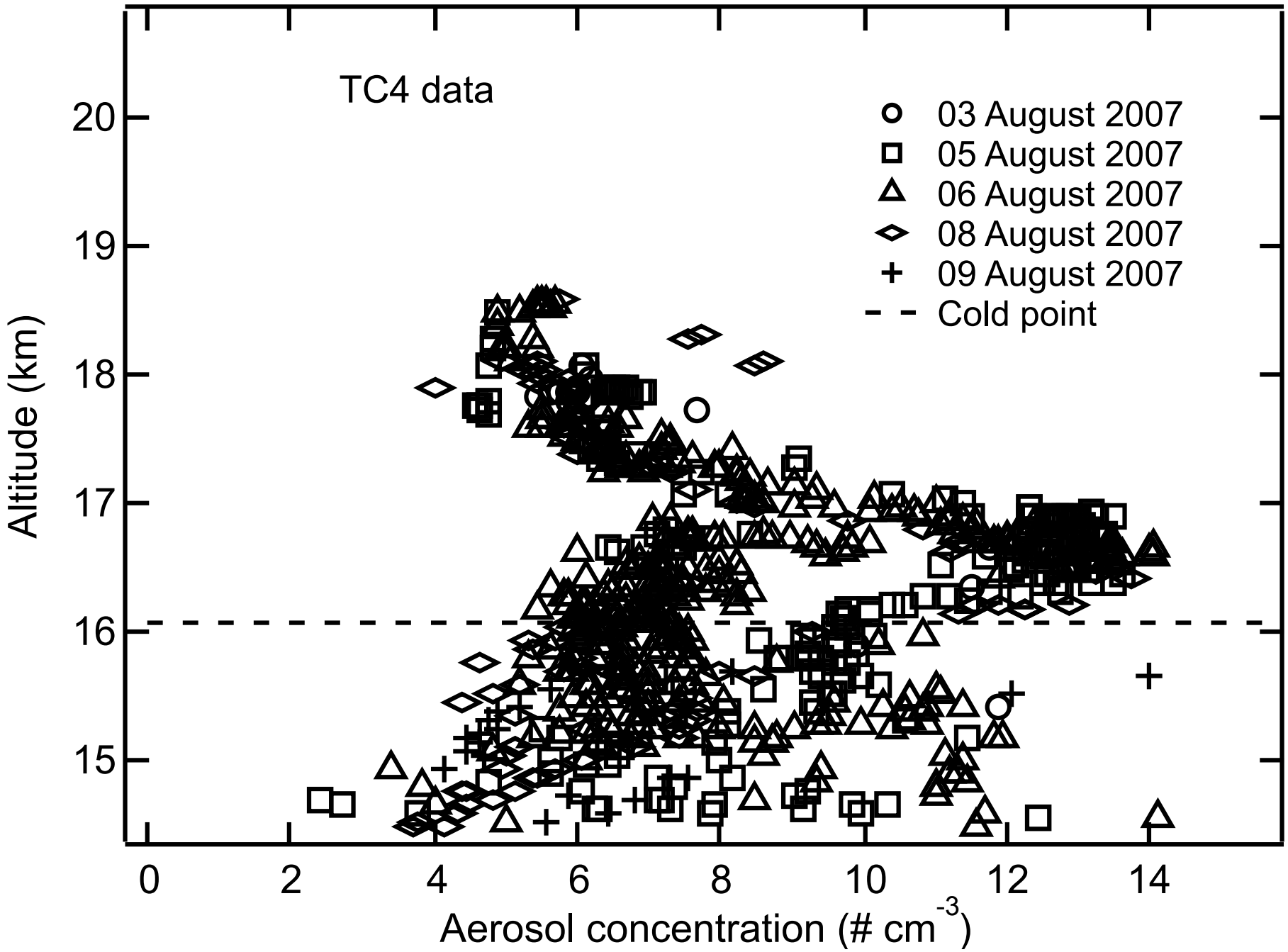

Ascent data, 200-m average
455 nm backscatter ratio
5
10
15
20
25
13 August 2015
14 August 2015
17 August 2015
ATAL is a great UT air tracer in the LS
Altitude (km)
20
18
16
14
12
10
0
10
20
30
40
Particle concentration (# cm-3)
Kunming PC
CPT
Houston PC
Backscatter


Size distribution 2015 08 13
Particles were likely formed in the UT
15 - 17 km
17 - 19 km
dN/dlog(Dp)
10^{-1}
10^{-2}
10^{-3}
10^{-4}
100
2
3
4
5
6
7
8
9
1000
2
Dp (nm)

T, O_3, and WV


Altitude (km)
20
15
10
5
-80
-75
-70
-65
-60
Temperature (°C)
0.0
0.1
0.2
0.3
0.4
0.5
O3 (ppm)
0
20
40
60
80
100
H2O (ppm)
Flt 2, 2015 08 14


STRAT data
01 August 1996
08 August 1996
Cold point
Altitude (km)
Aerosol concentration (# cm^{-3})
20
19
18
17
16
15
2
4
6
8
10
12
14
16


TC4 data
03 August 2007
05 August 2007
06 August 2007
08 August 2007
09 August 2007
Cold point
Altitude (km)
20
19
18
17
16
15
0
2
4
6
8
10
12
14
Aerosol concentration (# cm-3)

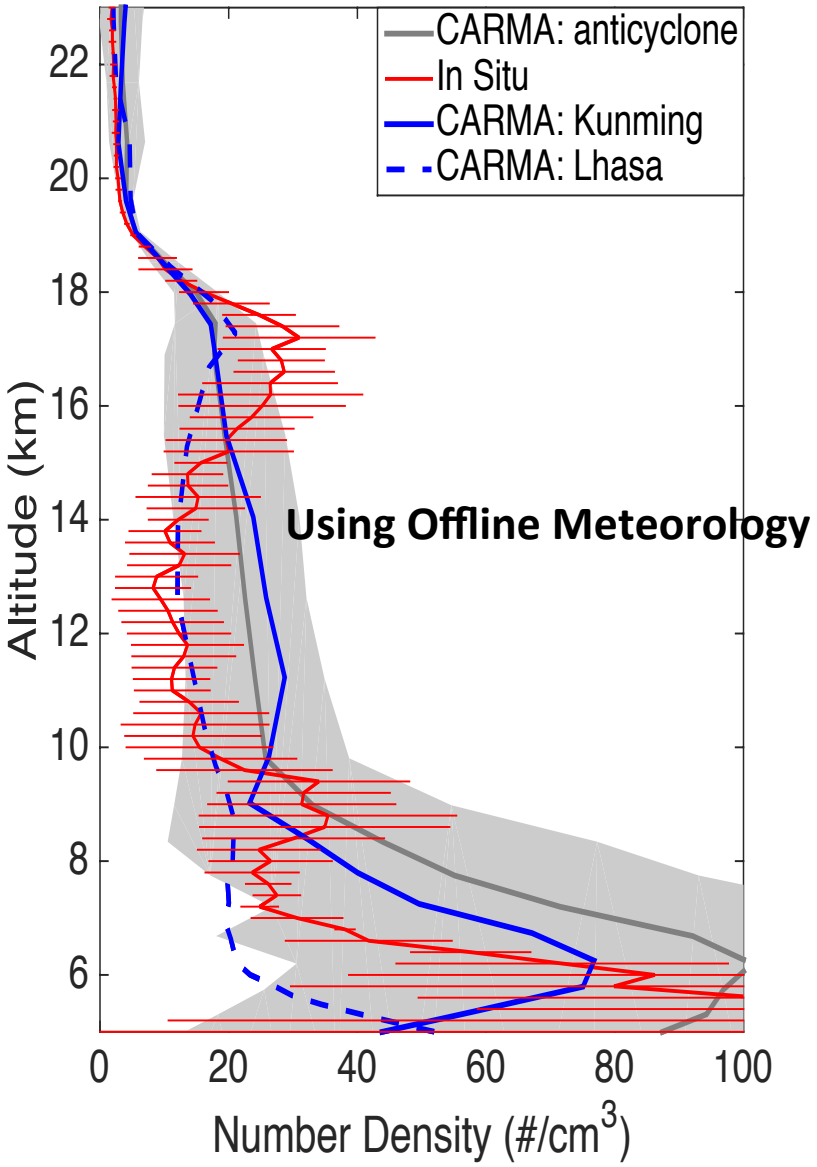
• In a general sense the ATAL is NOT unique!
  - Brock et al., *Science* (1995)

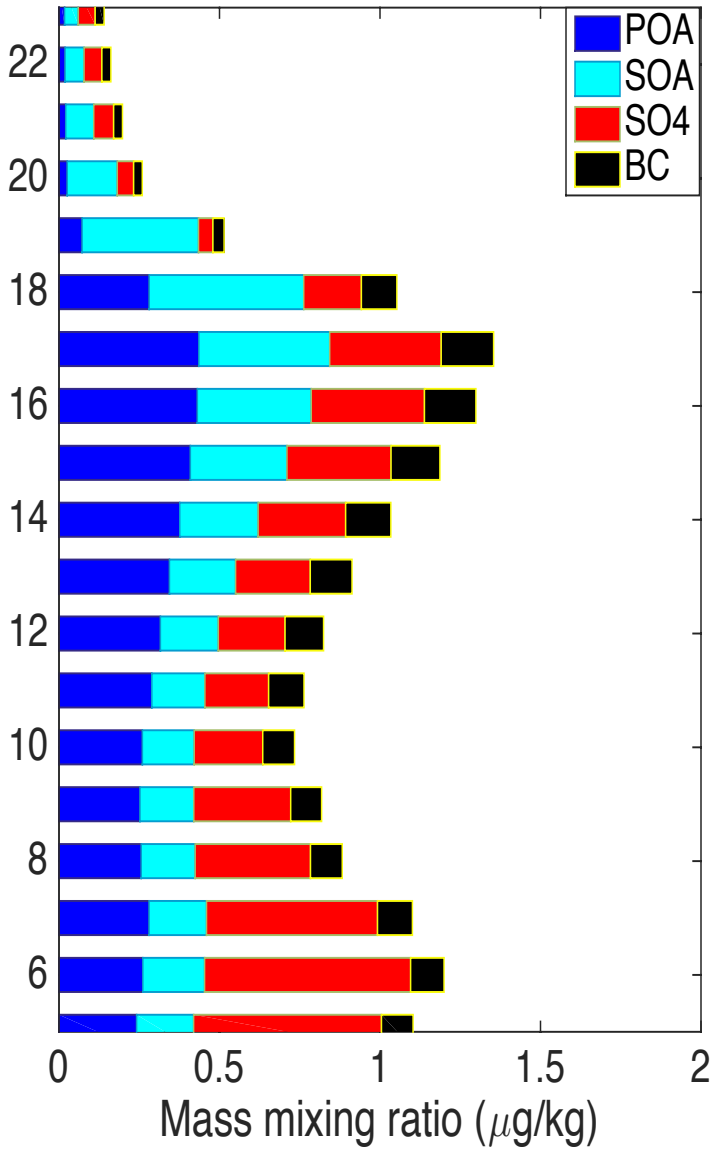
• The air in the ASMA, similar to the air in the tropics, is trapped and moving upward slowly.

• Condensables have sufficient time to form new particles or condense on existing particles.

• Tropical aerosol layer too thin to be detected by satellites?

Model compare well with in-situ measurements at Kunming, Aug. 2015





Yu et al., 2016

Conclusions

1) ATAL appears to be robust feature

2) The particle enhancement has implications (additional heating)

3) In the ASMA LS these particles are a good tracer of the tropospheric air
   - Size distributions suggest formation/growth in UT
   - Tropospheric air is moving up into stratosphere

4) ATAL is similar to the tropical aerosol layer

5) Model results compare reasonably well with the in situ data

6) Organics may dominate in the aerosol composition