DEPARTMENT OF
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SGP Chamber Experiment during CLASIC

Don Collins

Crystal Reed

SGP size distribution time series

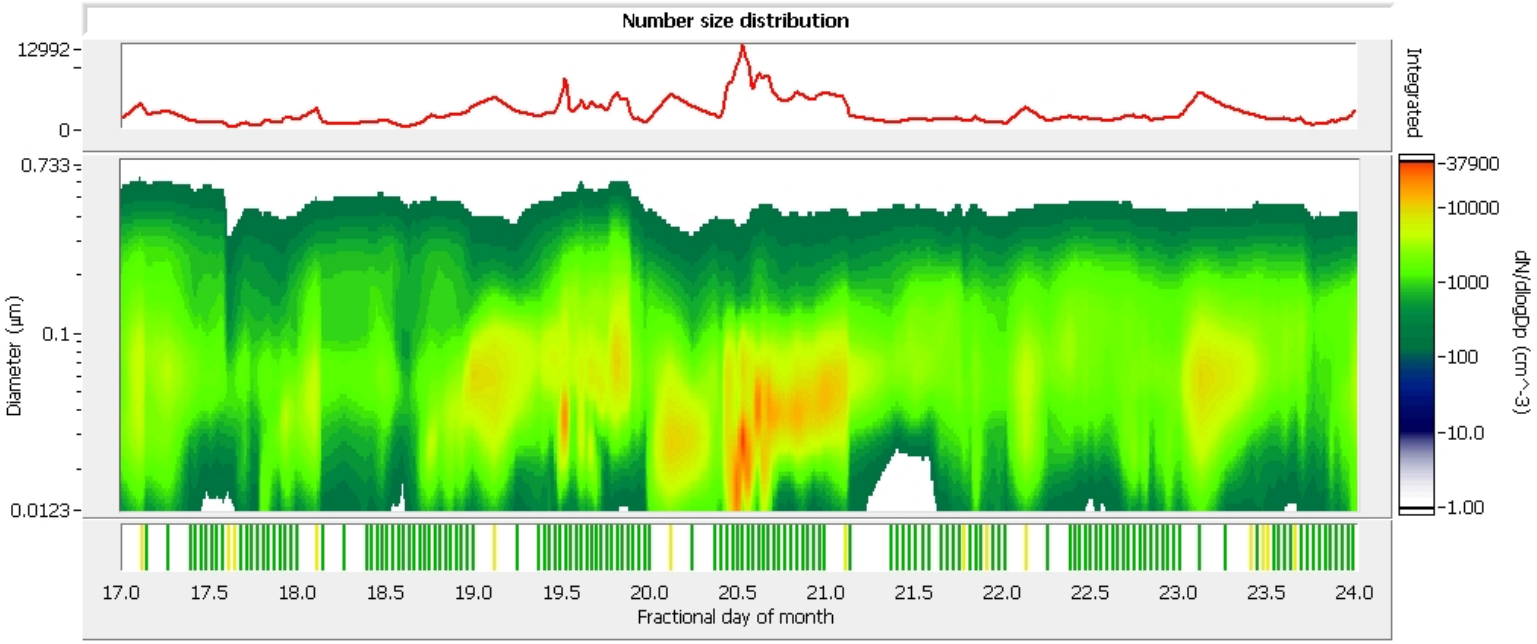
Previous observations

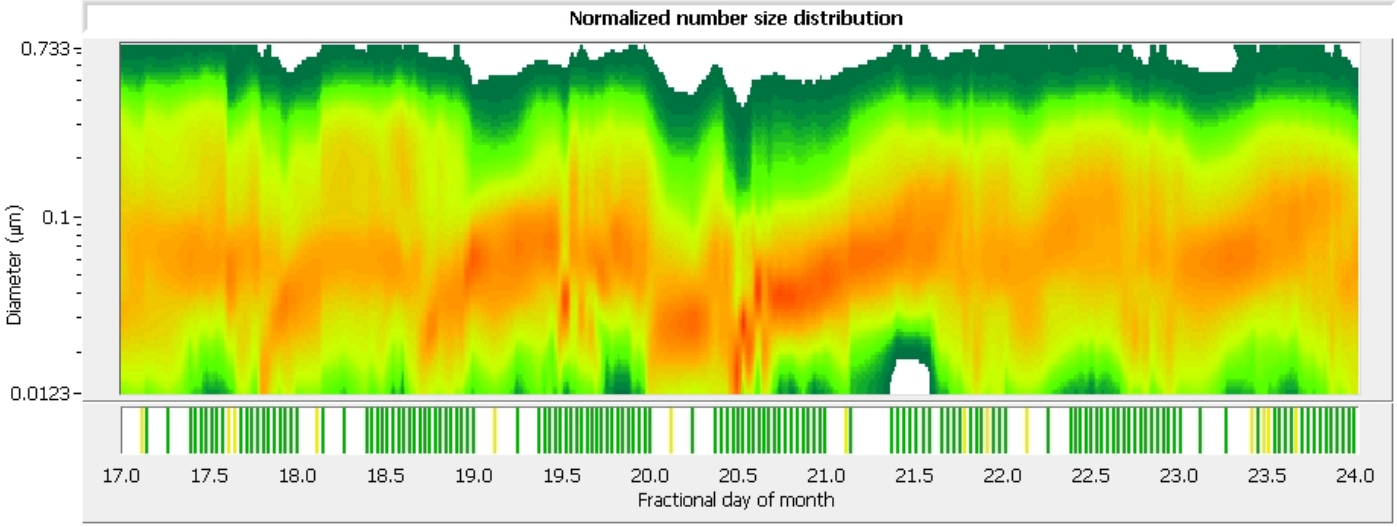
Design

Construction and testing

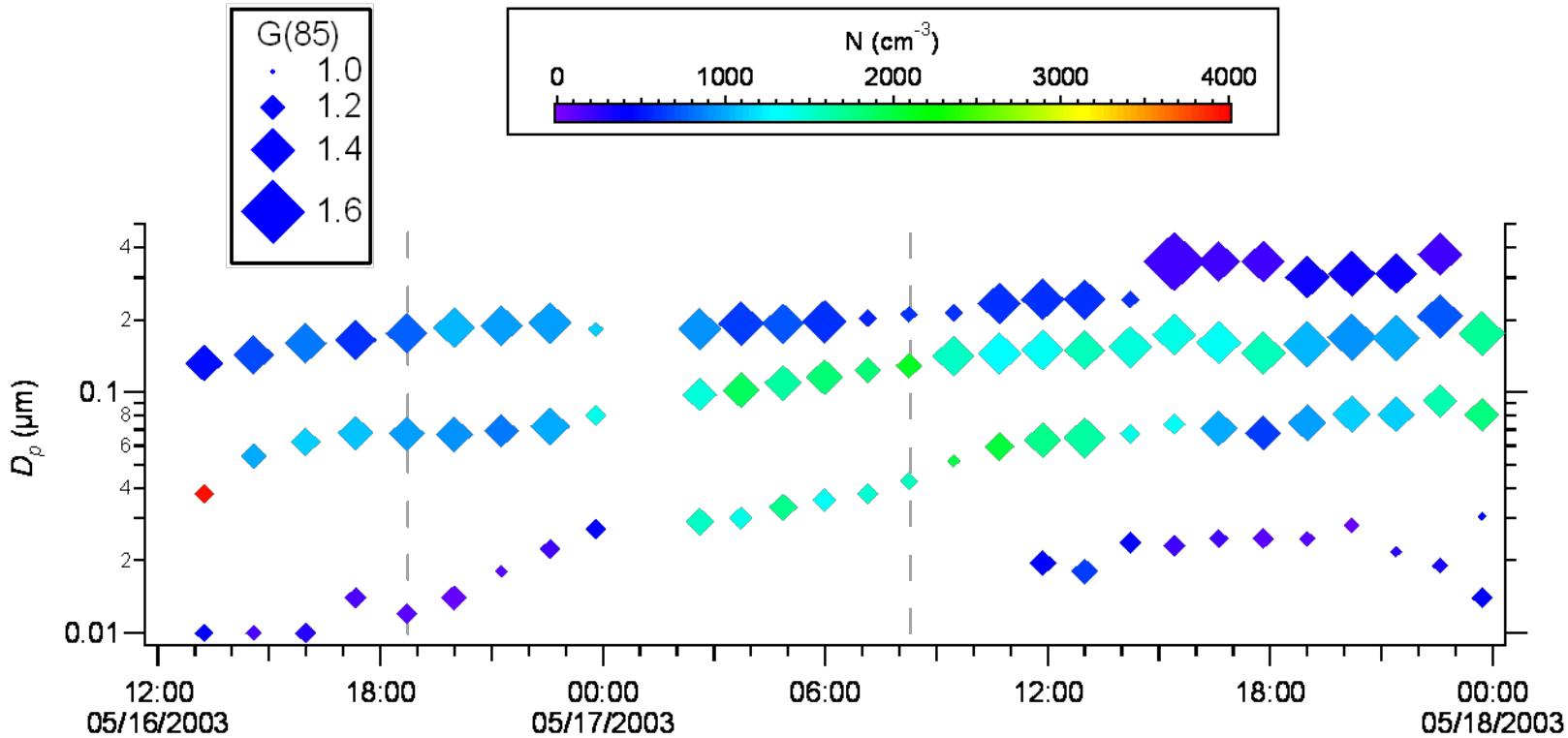
Preliminary data

Conclusions



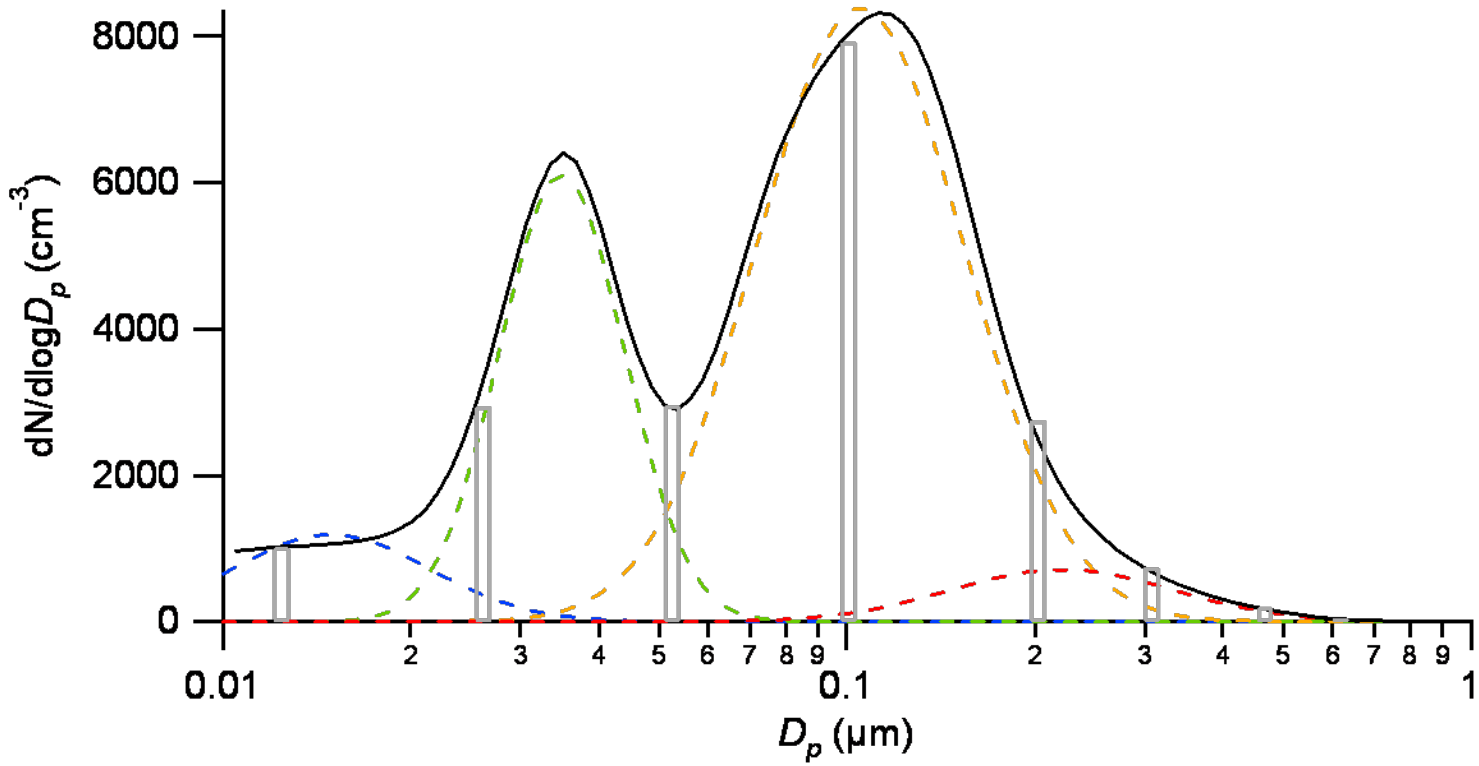


Analysis of growth episode

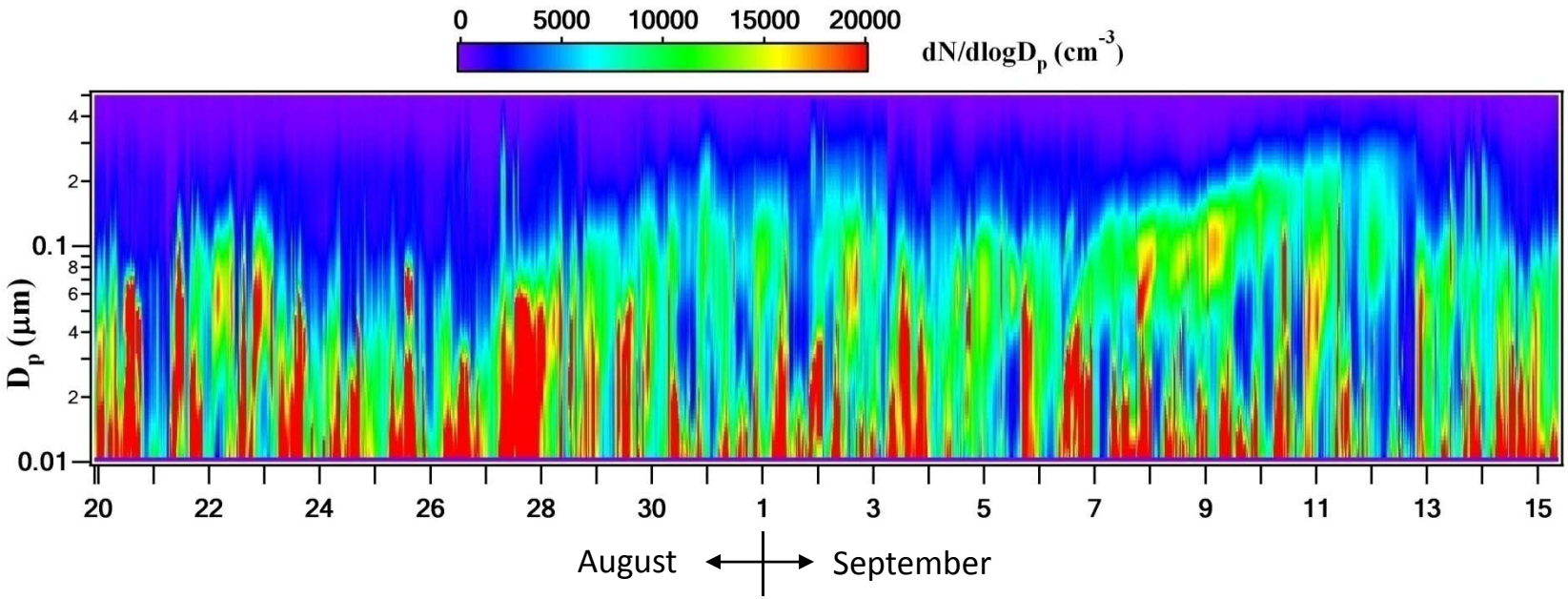


From Gasparini et al., 2006

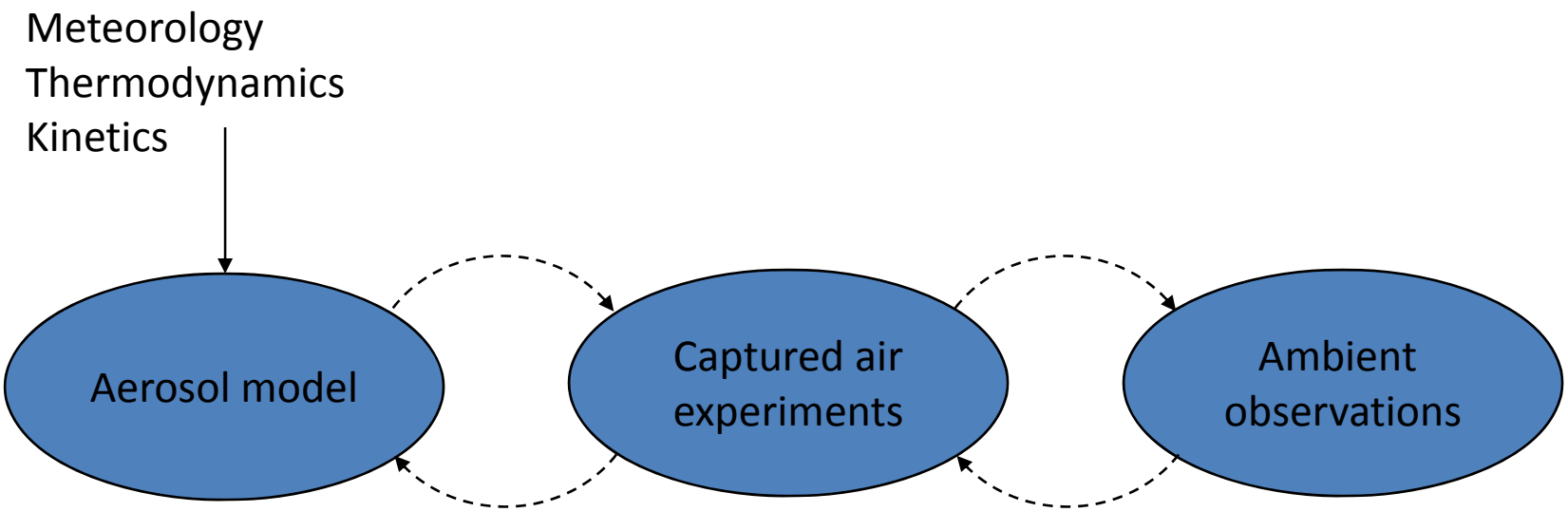
Challenges in using ambient measurments



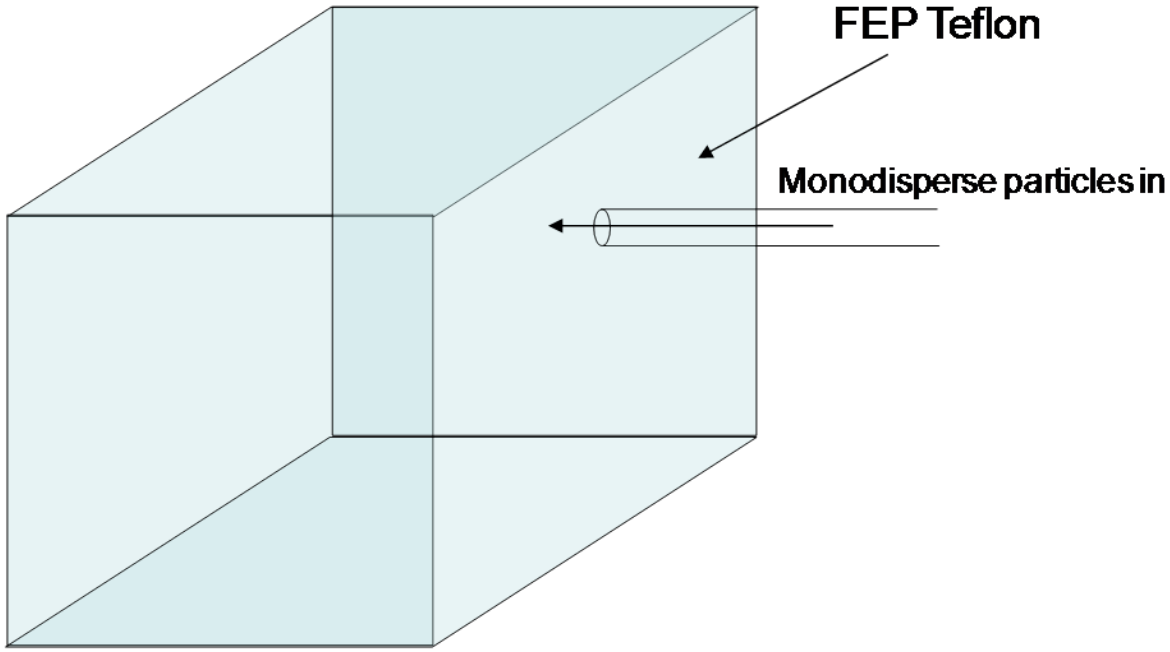
Even more substantial challenges in urban areas



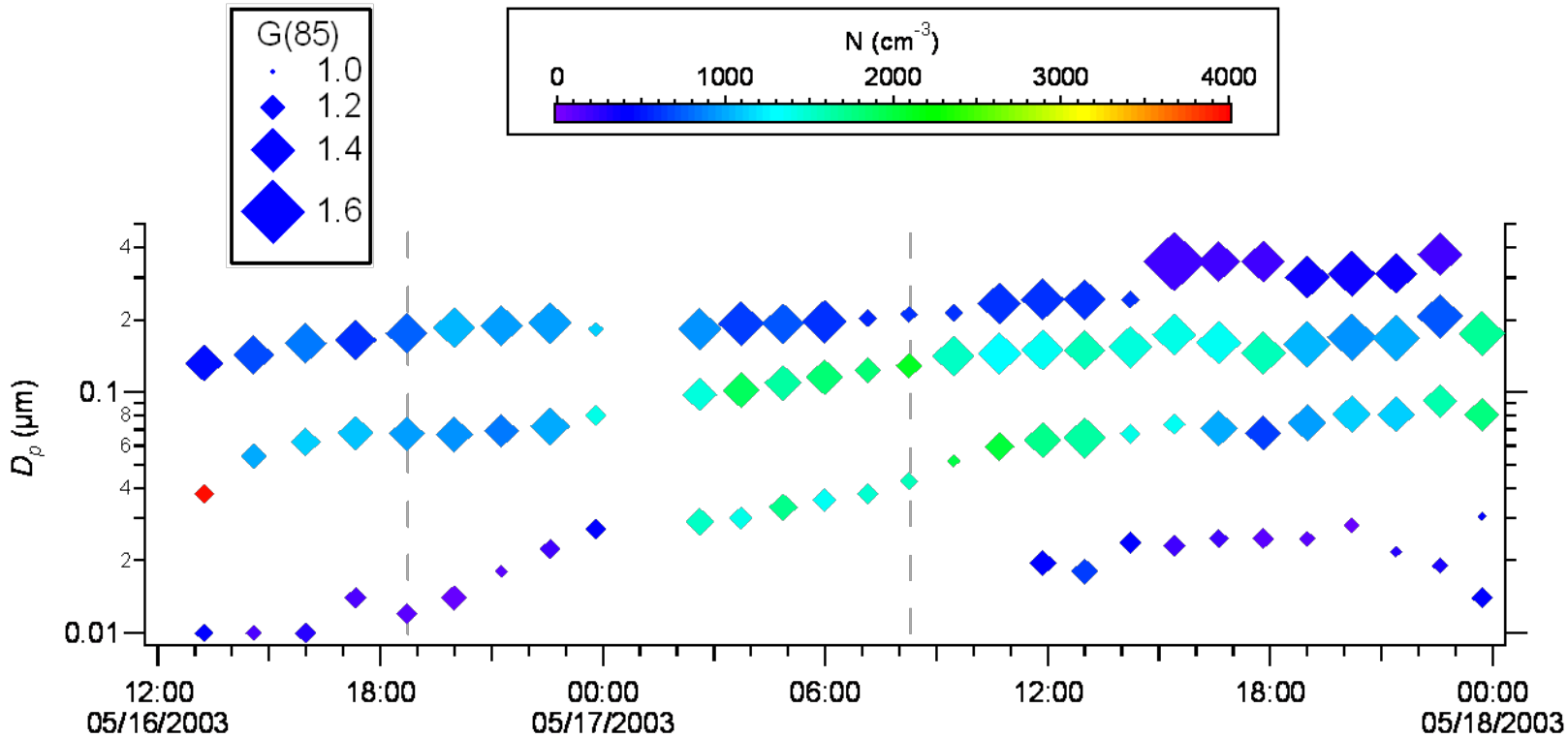
Captured air studies



Traditional captured air chamber

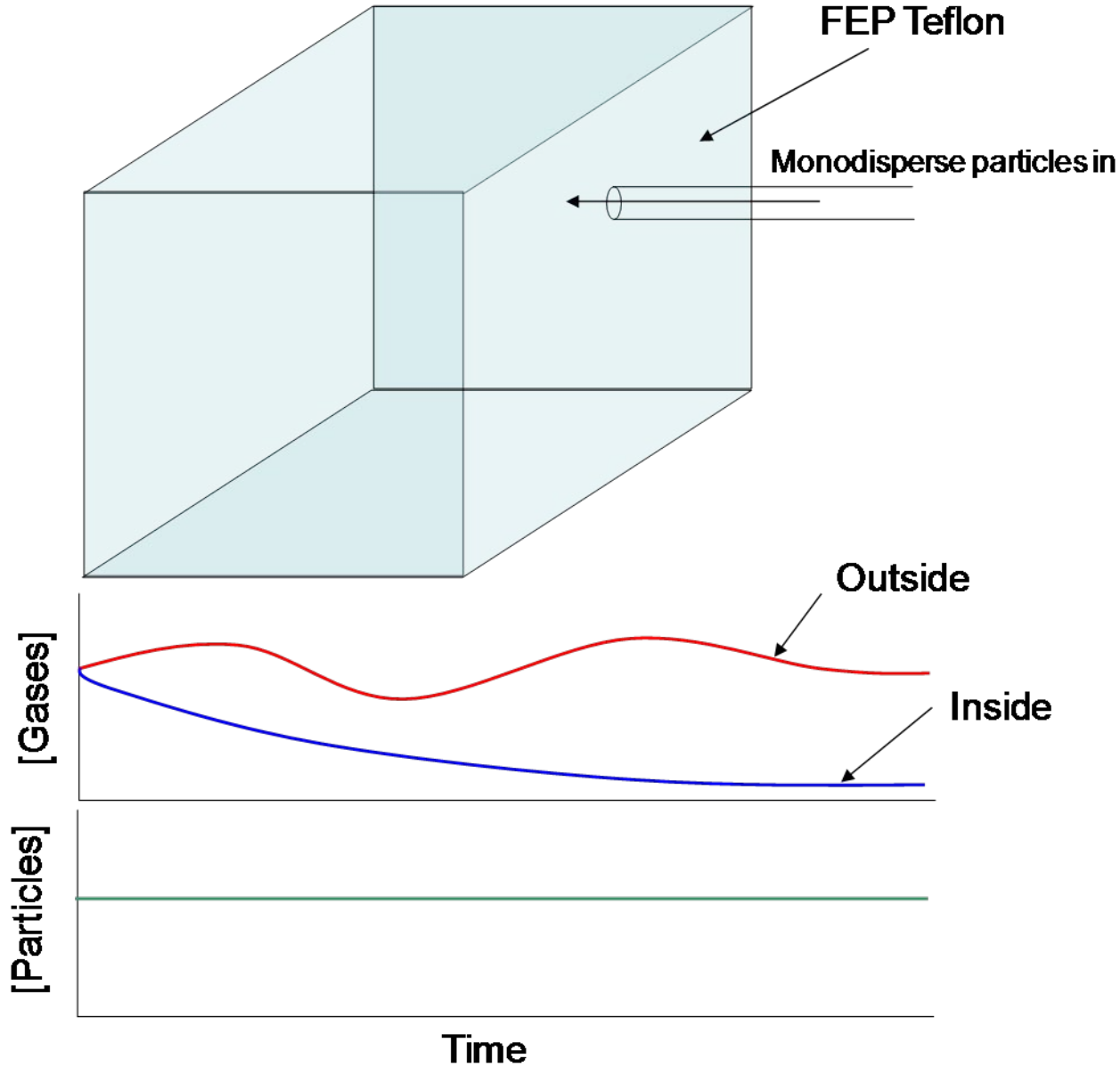


Analysis of growth episode

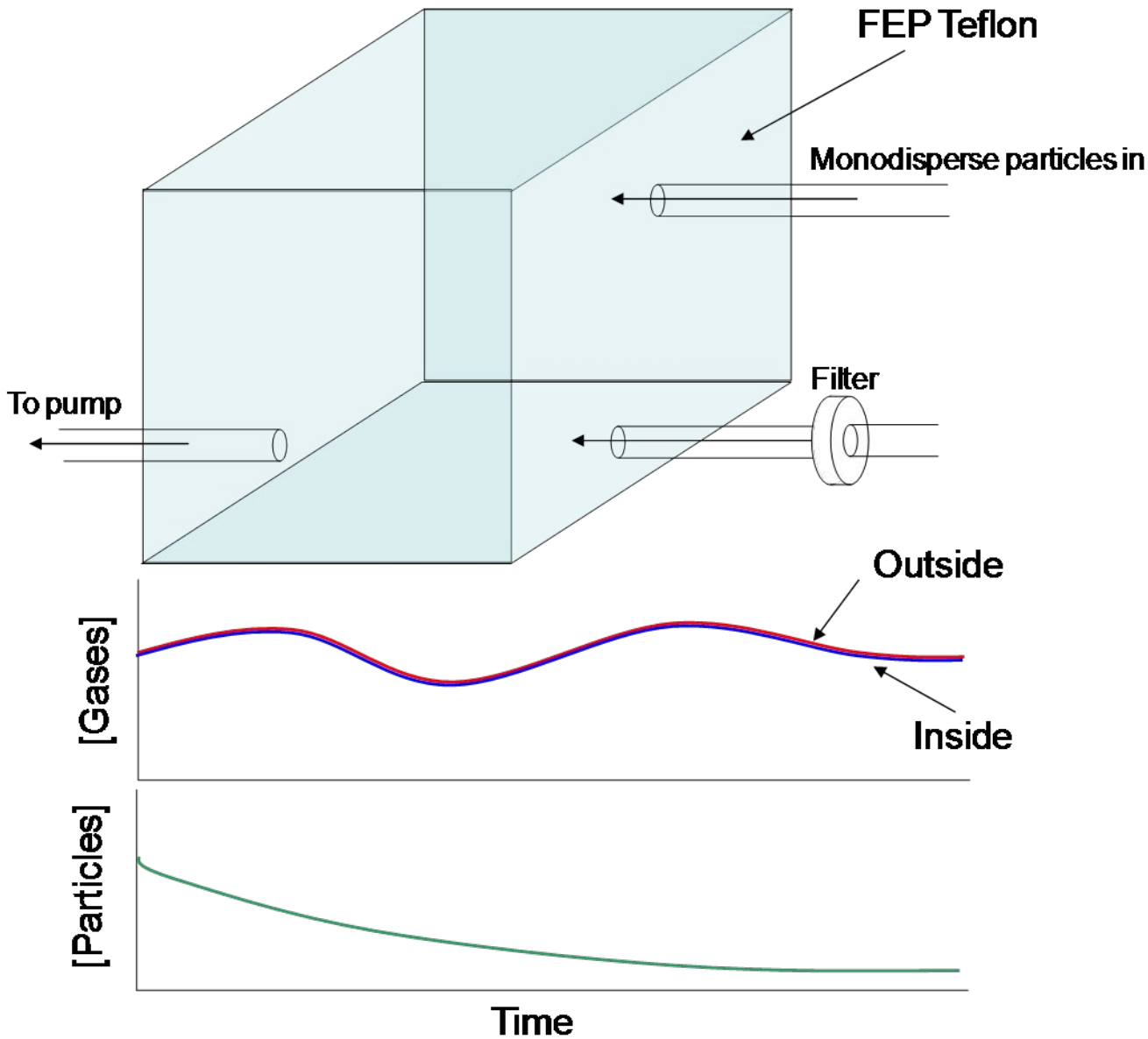


From Gasparini et al., 2006

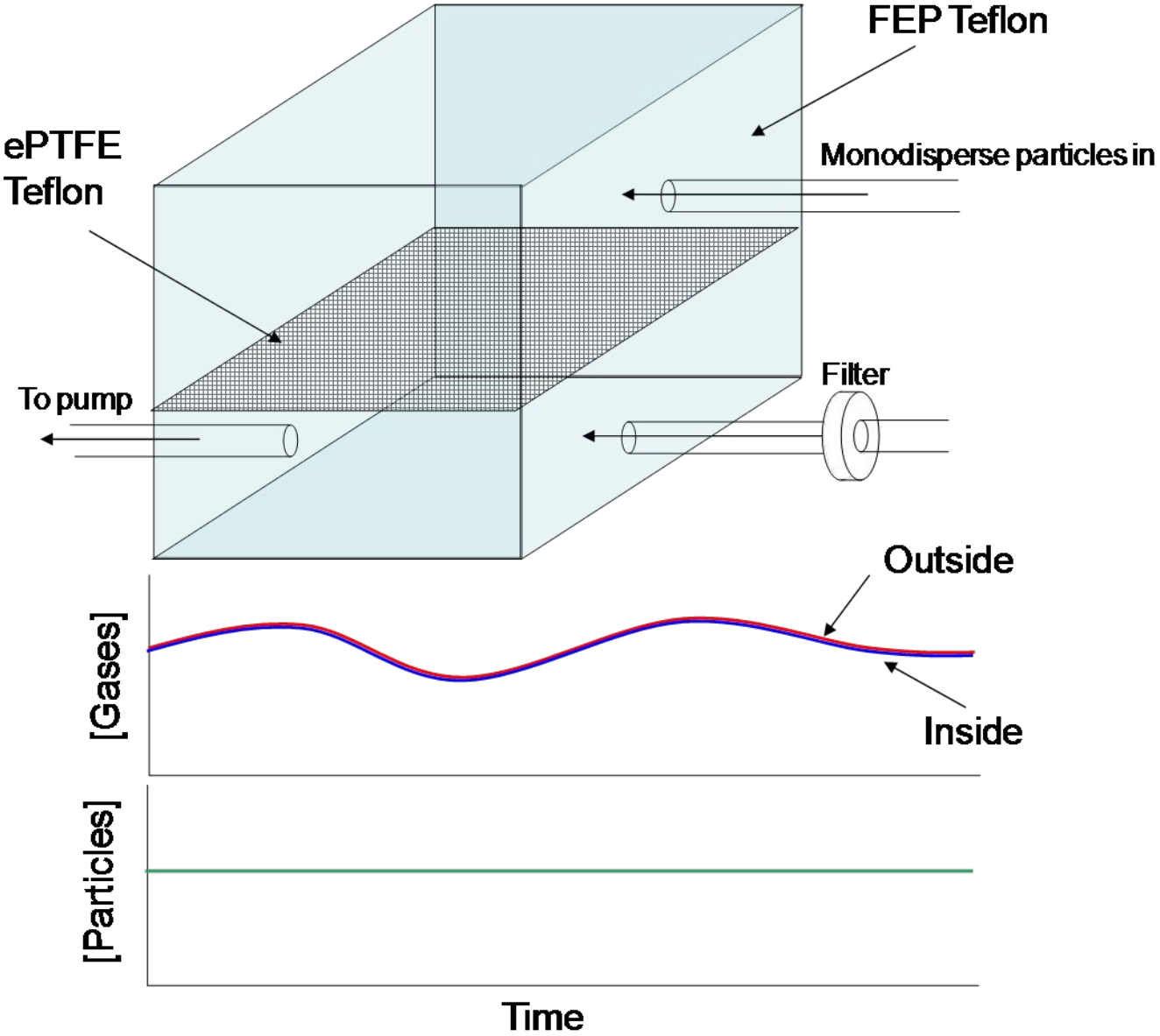
Traditional captured air chamber



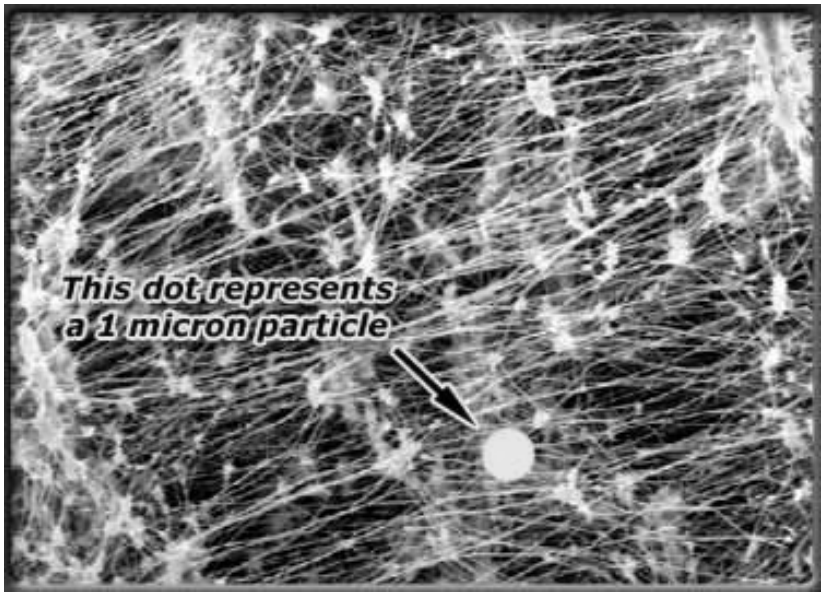
Continuously ventilated chamber



Atmospheric chambers for evolution studies



Expanded PTFE (i.e., Gore-tex)



0 ppb SO_2

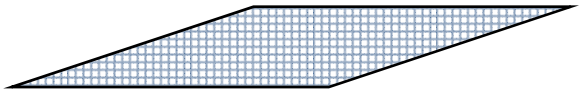
1 cm

1 ppb SO_2

$$J = -D\frac{dn_{SO_2}}{dx} = -\left(0.13\frac{cm^2}{s}\right)\left(\frac{\left(2.4\times10^{10}\,cm^{-3}\right)}{1cm}\right)\left(\frac{mol}{6.02\times10^{23}}\right)$$

$$= 5.2\times10^{-15}\frac{mol}{cm^2 s} = 5.2\frac{fmol}{cm^2 s}$$

0 ppb SO_2

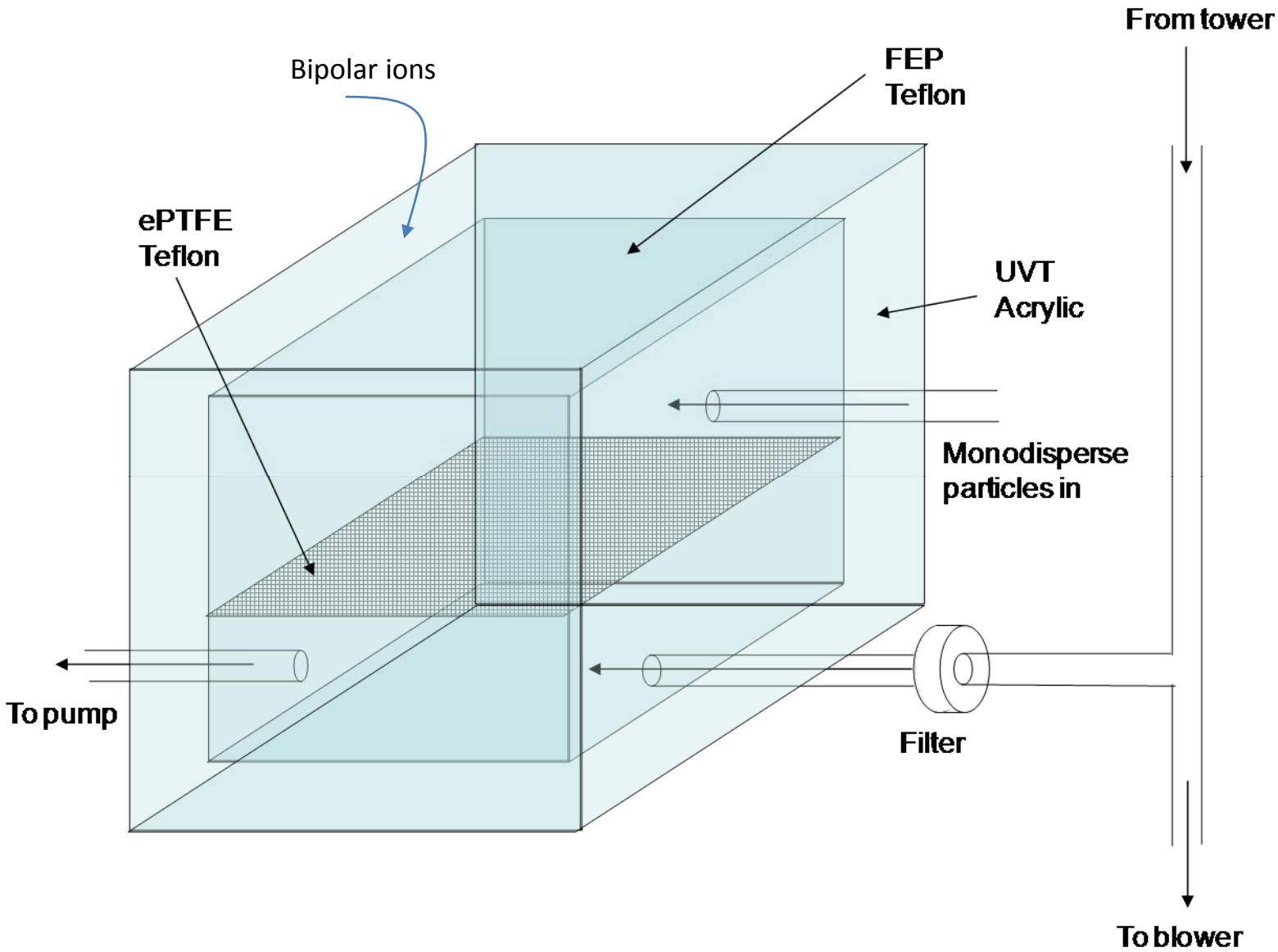


1 ppb SO_2

$$J = -\mu\Delta\chi_{SO_2} = -\left(669\frac{fmol}{cm^2 s\ ppbV}\right)(1\ ppbV)$$

$$= -669\times10^{-15}\frac{mol}{cm^2 s} = 669\frac{fmol}{cm^2 s}$$

Final design with UV-transparent outer box



Transmission through acrylic and FEP

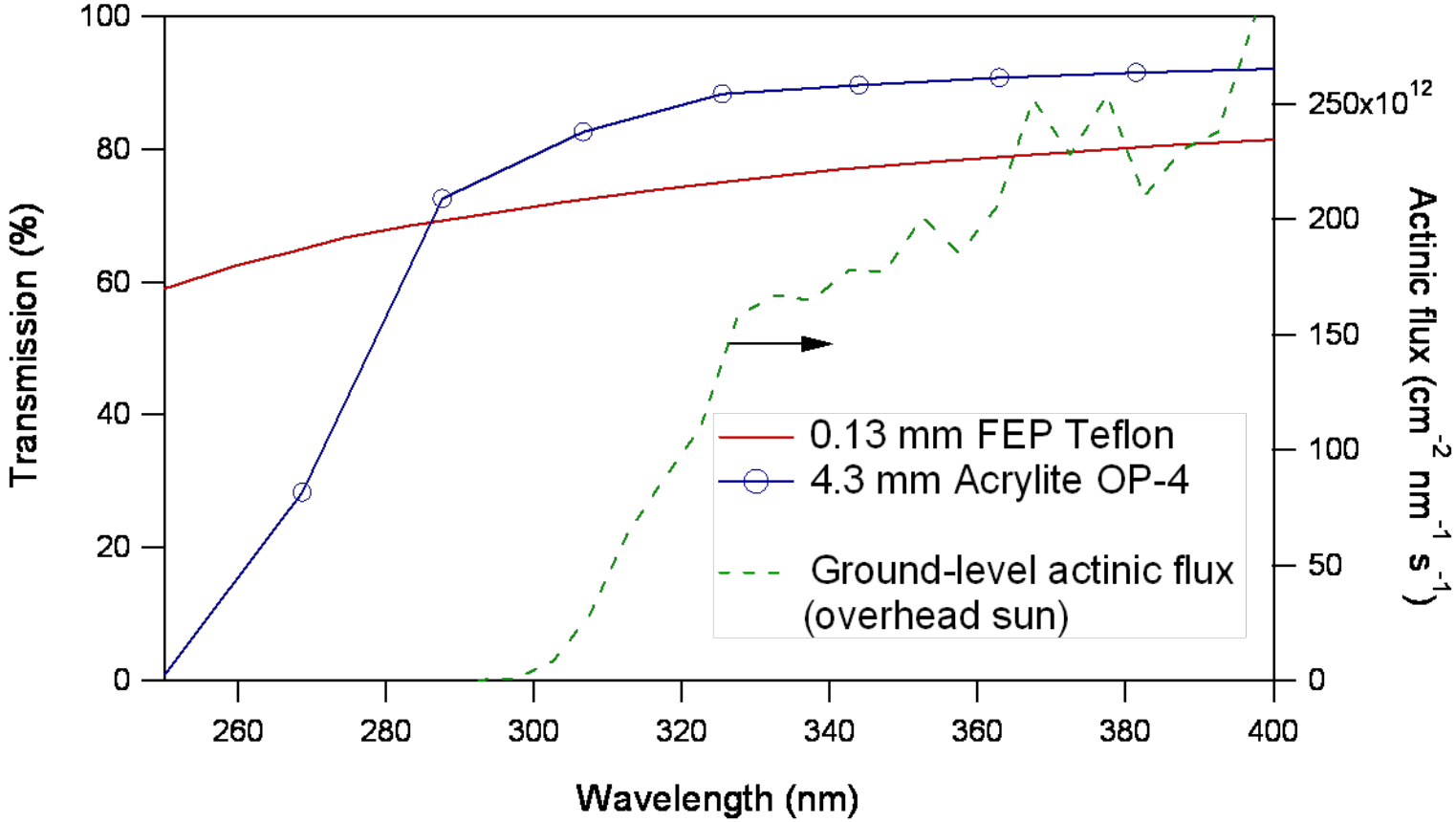
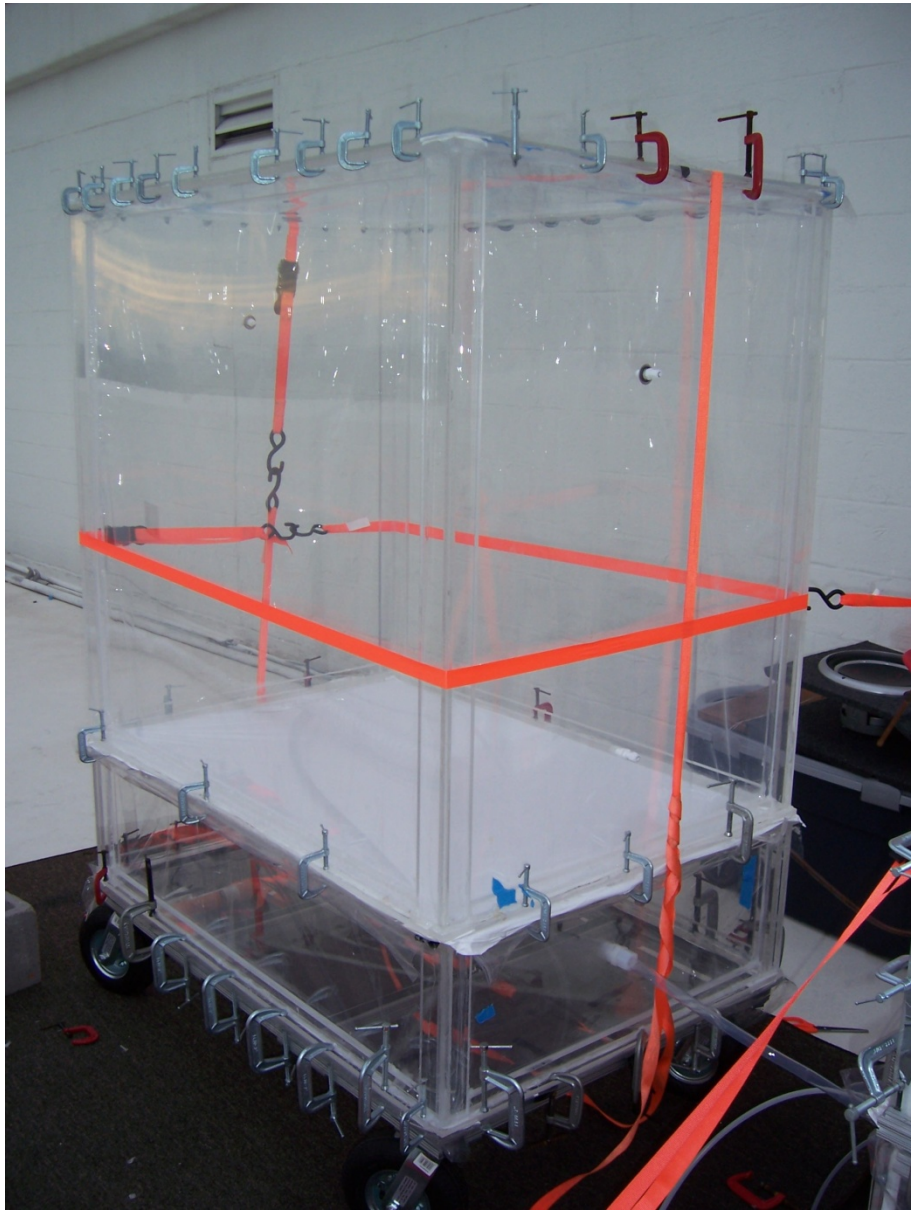
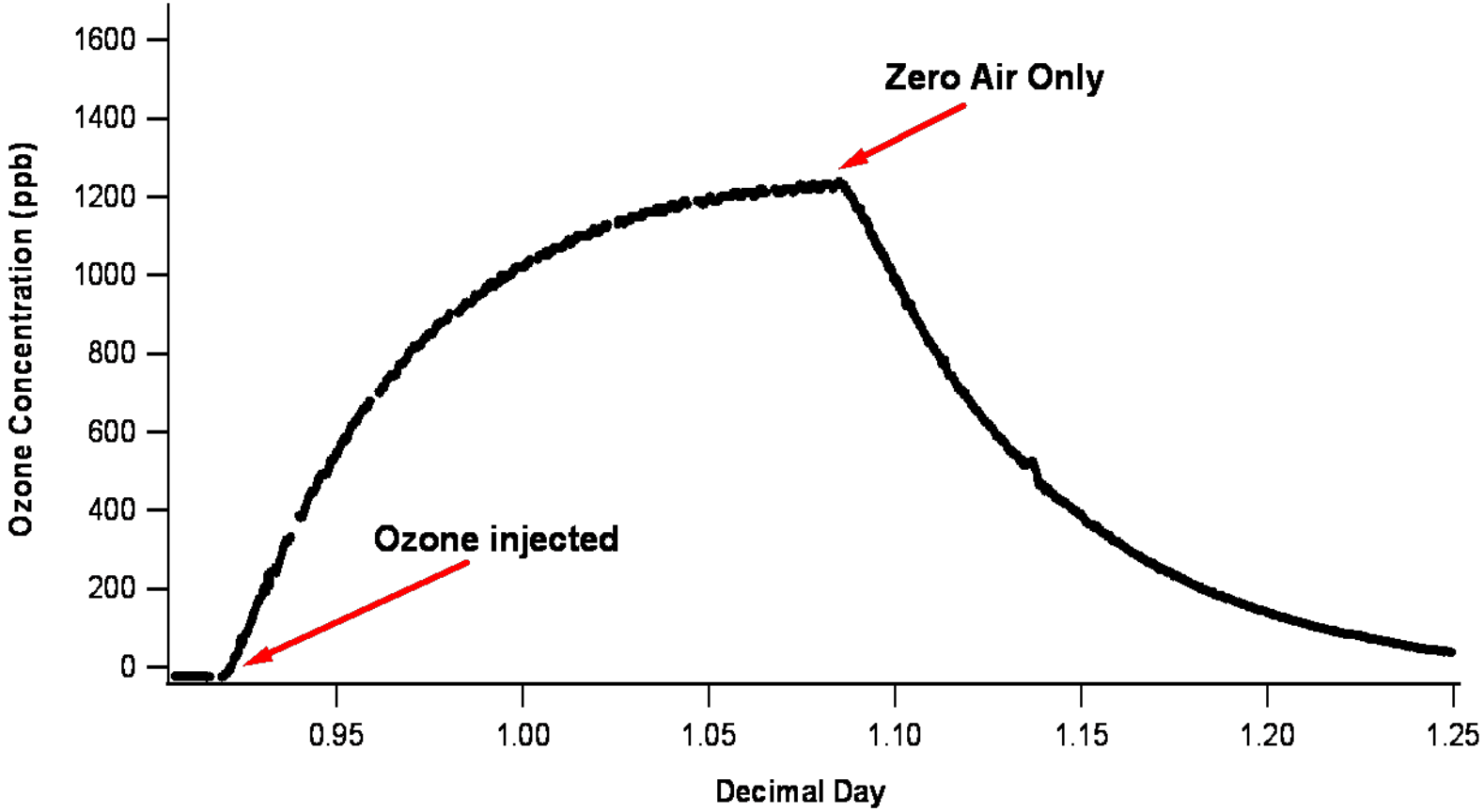


Photo of chamber



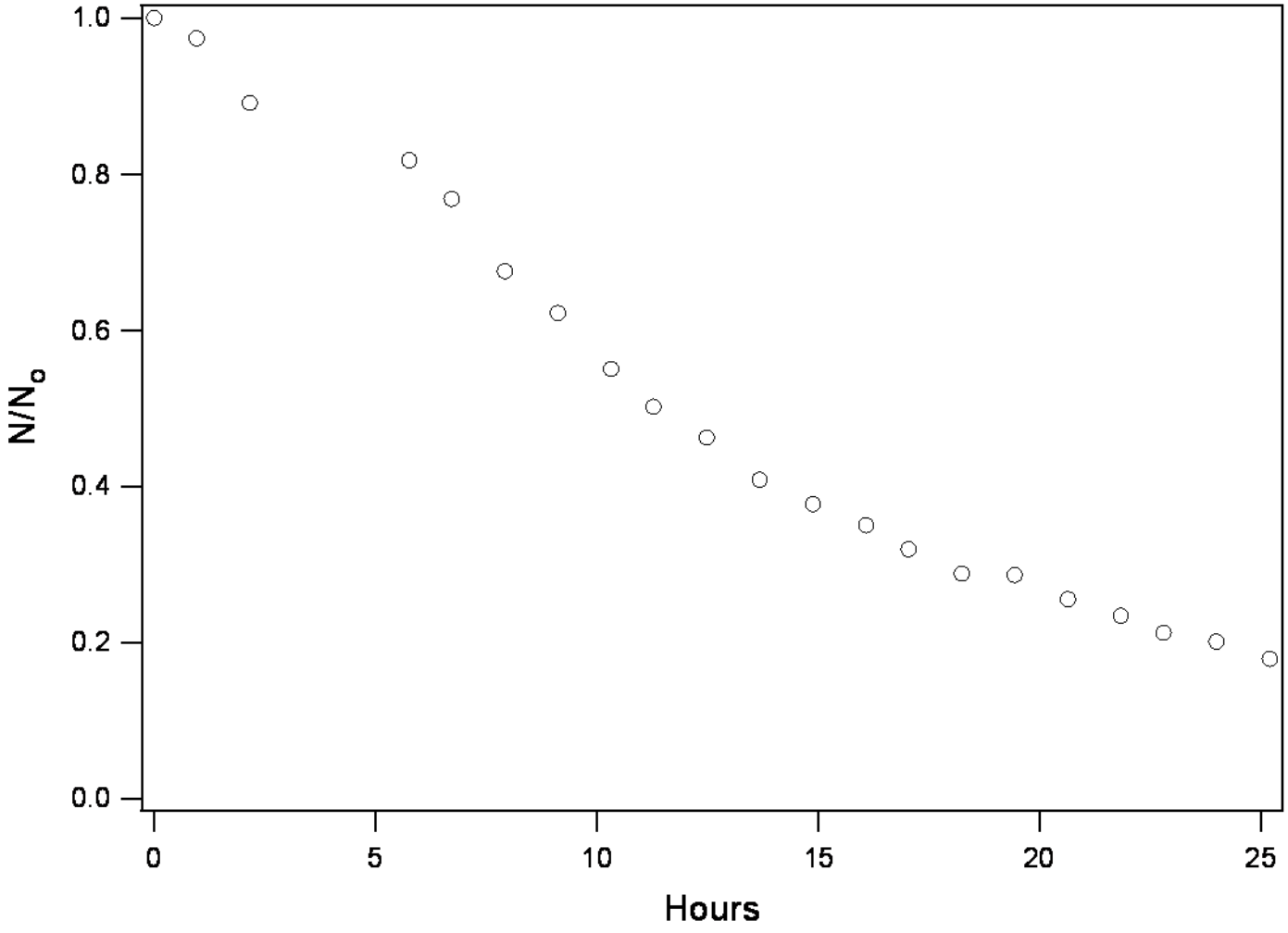
Response to step change in ambient concentration



Summary of gas penetration experiments

Compound Analyzed	Instrumentation	Penetration Efficiency [Chamber]/[Outside]
ozone (O_3)	Thermo Scientific O_3 Analyzer	~92%
ethanol (C_2H_5OH)	Proton Transfer Reaction - Mass Spectrometer	>99%
acetic acid (CH_3COOH)	Proton Transfer Reaction - Mass Spectrometer	>99%
toluene (C_7H_8)	Proton Transfer Reaction - Mass Spectrometer	>99%
nitric oxide (NO)	Thermo Scientific NO_x Analyzer	>99%
sulfur dioxide (SO_2)	Thermo Scientific SO_2 Analyzer	>99%

Particle concentration decay



Subset of measurements made on June 21

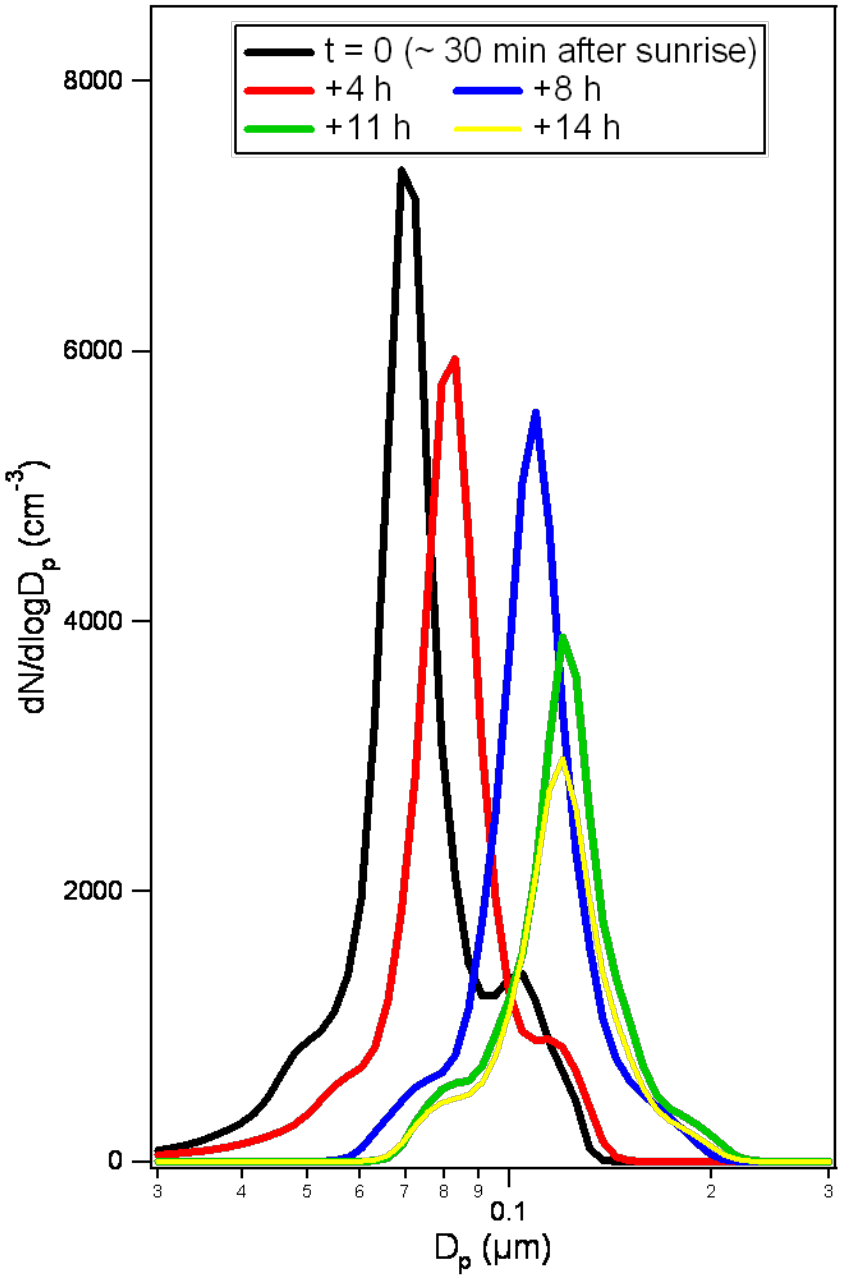
Previous observations

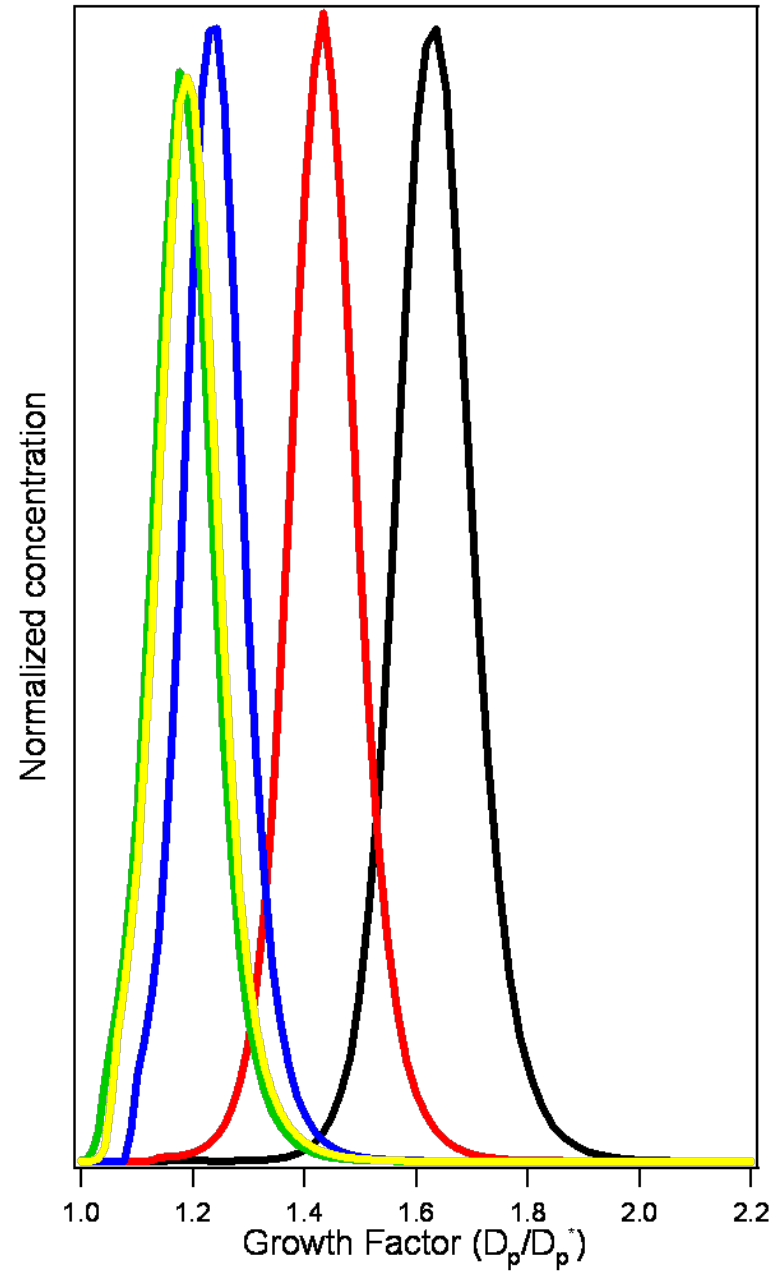
Design

Construction and testing

Preliminary data

Conclusions





Results from all 3 experiments and 1 control

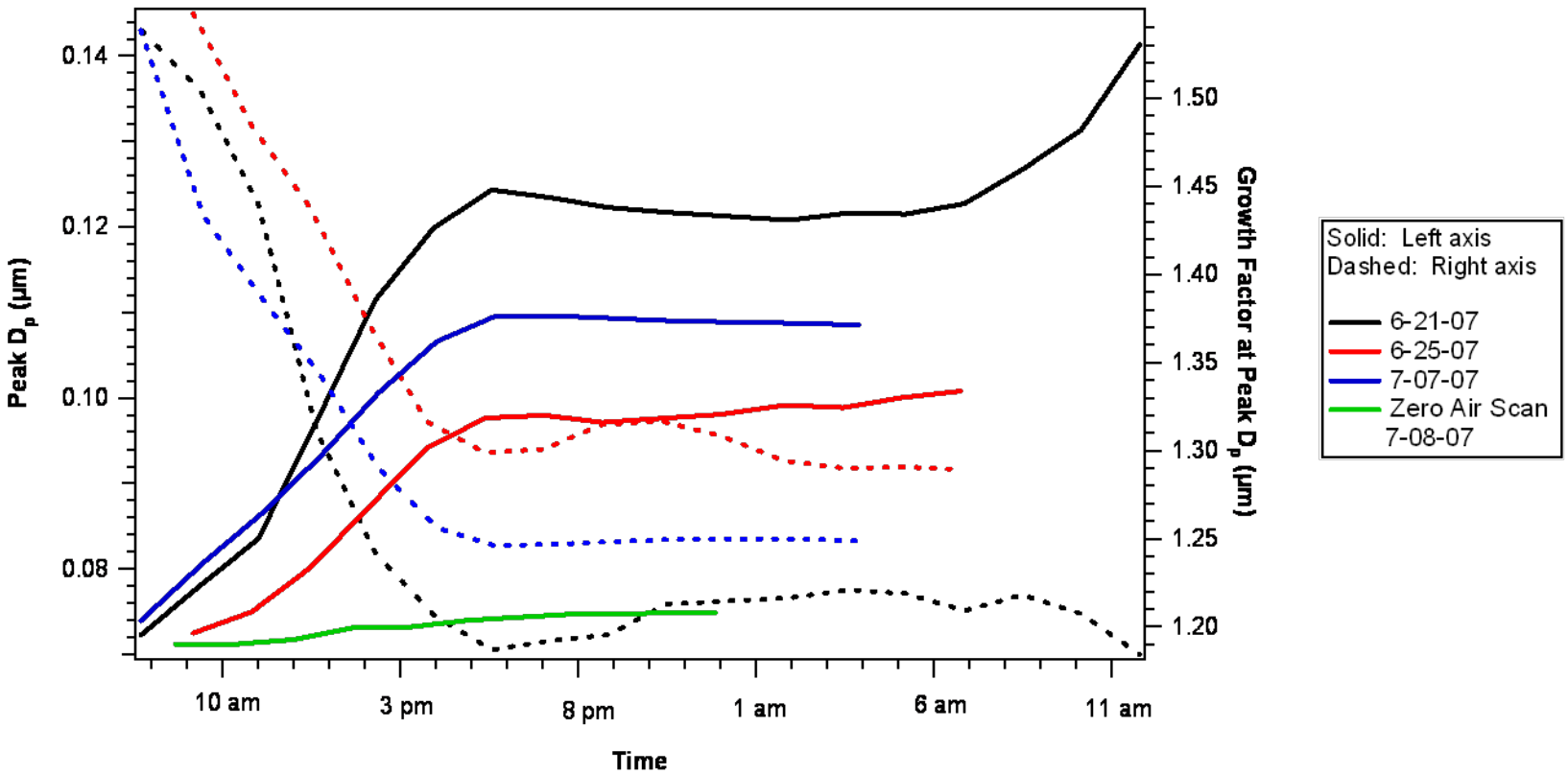
Previous observations

Design

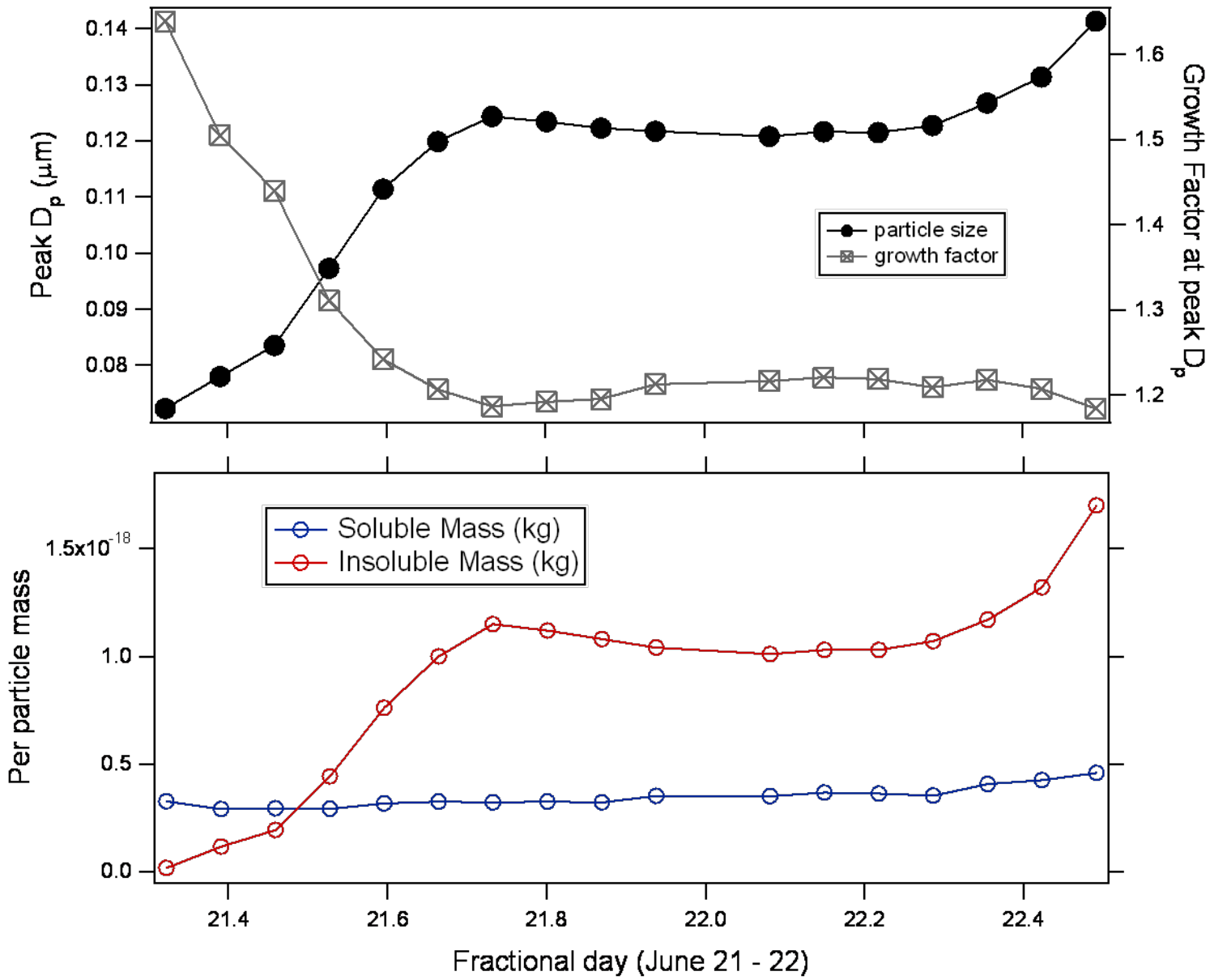
Construction and testing

Preliminary data

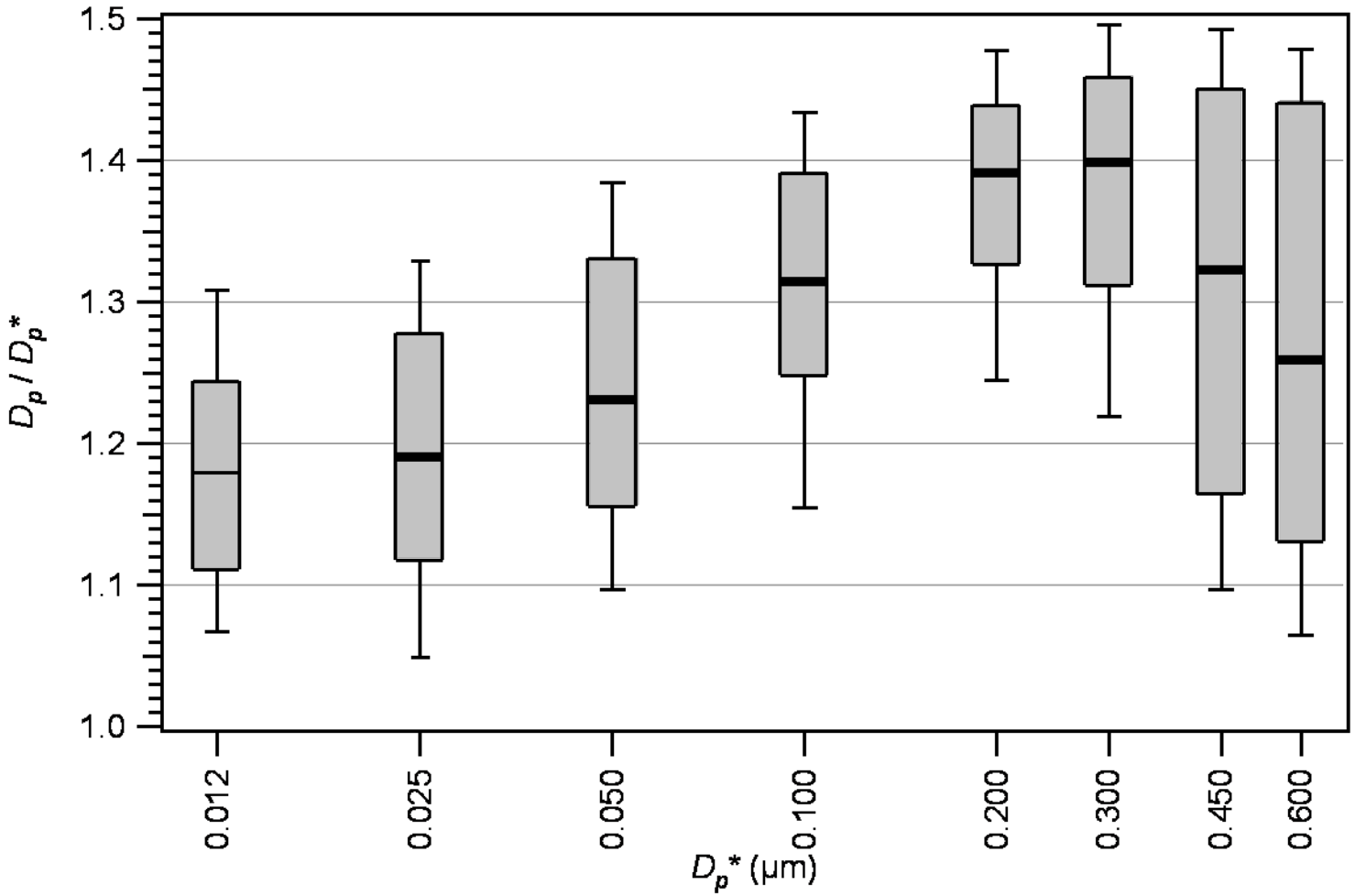
Conclusions



Further analysis of June 21 – 22 experiment



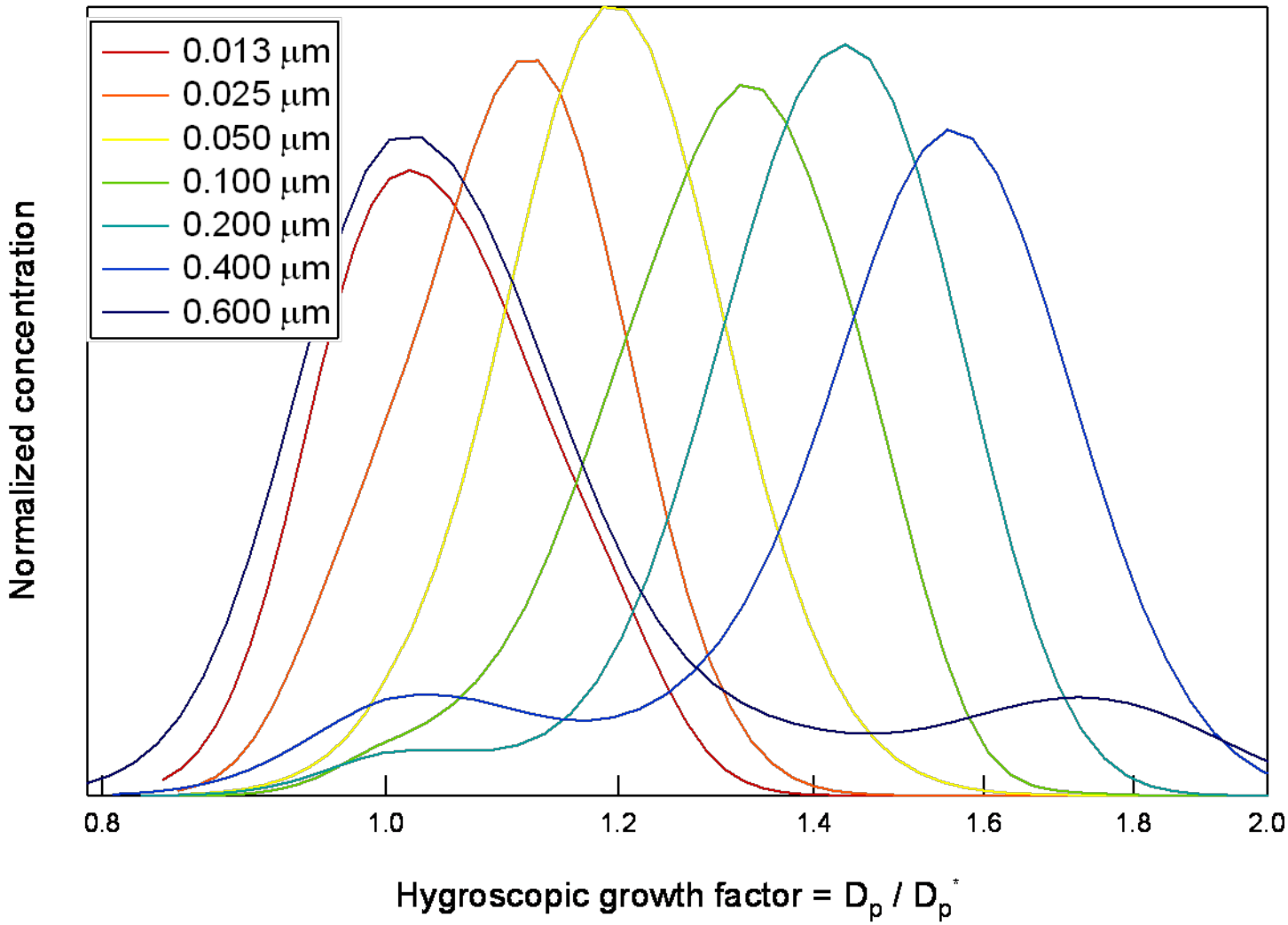
Consistency with ambient measurements



From Gasparini et al., 2006

Consistency with ambient measurements

June 21



Summary and conclusions

- A recently developed chamber was first successfully used at the SGP site during the CLASIC IOP.
- Three ~1 day experiments and one control experiment were completed during the study.
- During each of the three experiments, particle growth was accompanied by significant reduction in hygroscopicity.
- The observations suggest growth was dominated by condensation of SOA that was sparingly hygroscopic.
- Nighttime decrease in particle size and increase in particle hygroscopicity suggests some semi-volatile organic species partition into the aerosol.
- Subsequent analysis will focus on integrating these data with surface and aircraft measurements made during CLASIC.