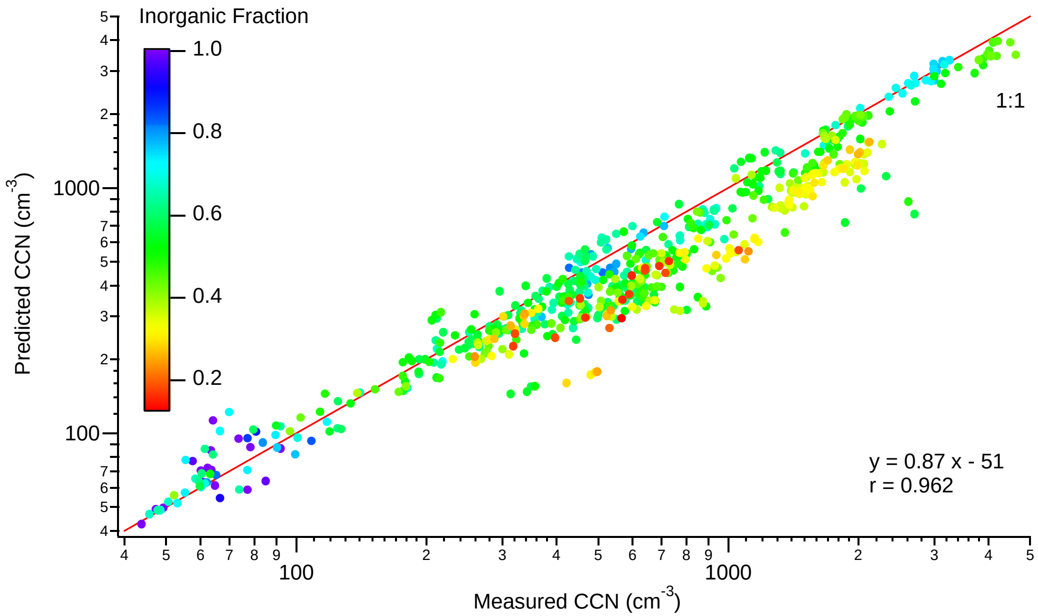
Outline

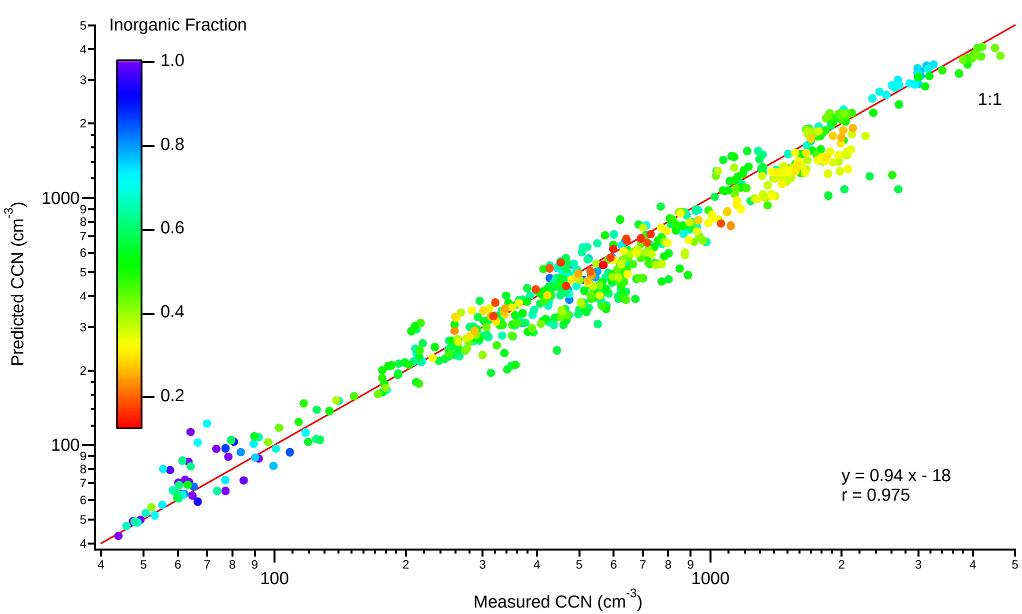
- Egbert 2007
  - Motivation
  - What was done
  - What we plan
  - A few results

- Whistler
  - Overview and motivation
  - Plans for May-June, 2008

Egbert 2005 CCN Closure



Assuming no participation of the organic



Assuming 60% of the organic participates in CCN activity

Aerosol Characterization at Egbert, Ontario Spring 2007 (EC's Centre for Atmospheric Research Experiments)

Science and Technology Branch
Environment Canada

VELUT ARBOR ÆVO

YORK UNIVERSITÉ UNIVERSITY

Objectives

- *characterize aerosol properties at a rural site through a comprehensive set of measurements*
- *identify sources and photochemical age*
- *attention to the hygroscopic properties (how do they participate in cloud droplet formation)*
- *to study particle nucleation and growth.*

University of Toronto
- Jonathan Abbatt
- Rachel Chang
- Greg Evans
- Cheol-Hyun Jeong
- Maygan McGuire
- Jennifer Murphy
- Raluca Popescu
- Nicole Shantz
- Steve Sjostedt
- Jay Slowik
- Sasha Vlasenko

York University
- Michael Mozurkewich
- Kristina Zeromskiene

Environment Canada
- Peter Brickell
- Frank Froude
- Armand Gaudenzi
- Chris Green
- Dave Halpin
- Zhimei Jiang
- Richard Leaitch
- Amy Leithead
- Shao-Meng Li
- John Liggio
- Anne Marie Macdonald
- Jason O'Brien
- Sangeeta Sharma
- Desiree Toom-Sauntry
- Allan Wiebe

Thanks to Jay Slowik and Sasha Vlasenko for providing their AAAR and AGU presentations

Egbert 2007 Instrumentation

<u>Particle Composition</u>
C-ToF-AMS (UofT)
V/W-ToF-AMS (EC)
PILS-IC (EC)
PILS-WSOC EC)
EC-OC (EC, UoFT)
ATOFMS (UofT)

<u>Particle Hygroscopic Growth</u>
Continuous Flow CCN Chamber (UoFT)
Static CCN (size selected - EC)
CCN-CVI-AMS
H-TDMA (YorkU)
Hygroscopic tandem nephelometers (EC)

<u>Particle Numbers, Sizes, Mass</u>
SMPS-nano (UofT)
SMPS-long (EC)
FMPS (UofT)
Number of Ultrafine CPCs (EC)
TEOM (EC)
APS (EC)

<u>Gases</u>
NOx, CO, SO2, O3 (EC)
NH3 (EC, UofT)
HCHO (EC)
PTR-MS (UofT)
Automated GC-FID (EC)

A major focus is organic carbon and its water uptake

Anthropogenic VOC emissions

Biogenic VOC emissions

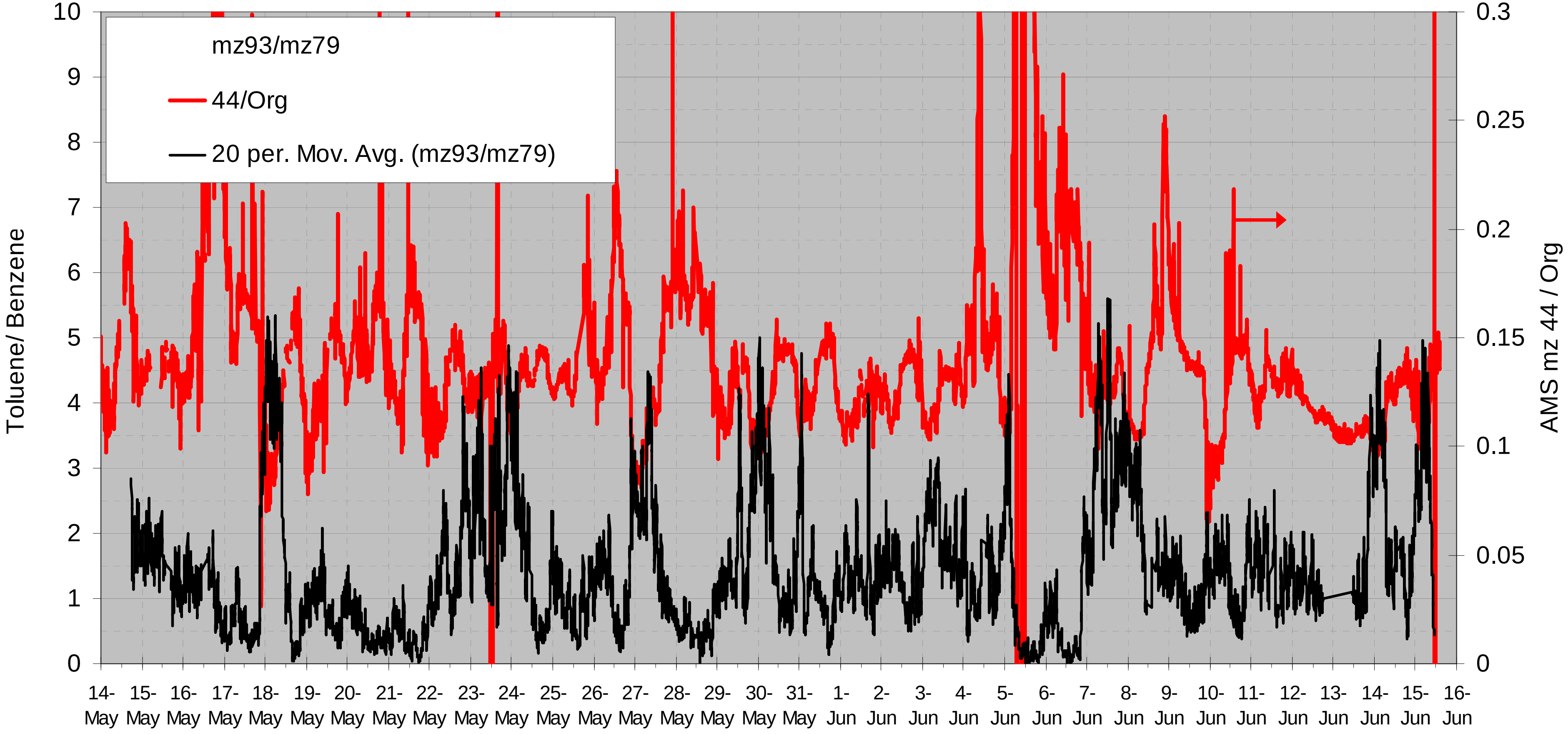
Oxidation by OH, NO_3, O_3

Products – OVOC (gas phase) + Oxygenated Organic Aerosol

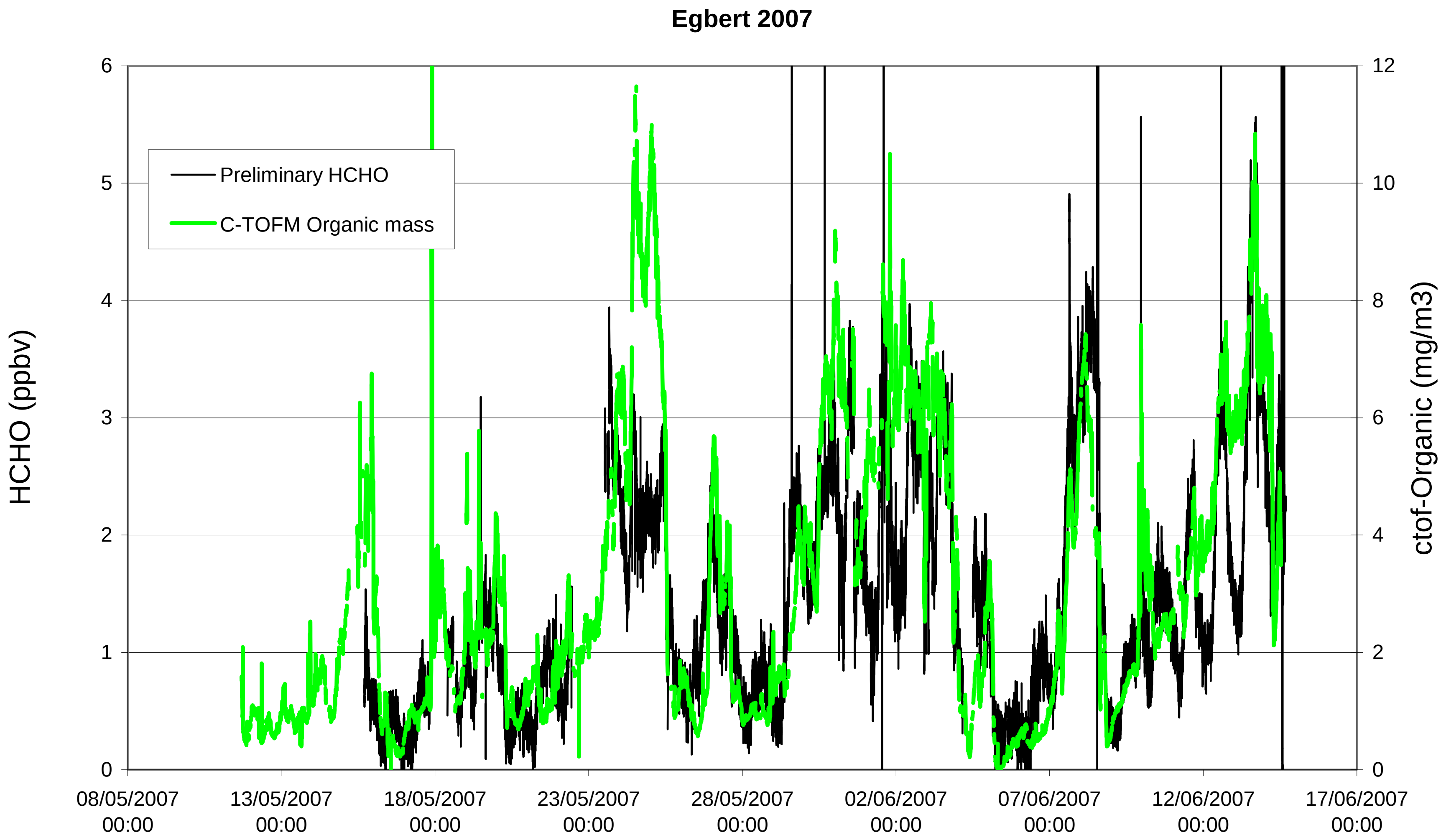
Also

- primary HC particle emissions oxidized during transport
- reactions with acidic sulphate and nitrate

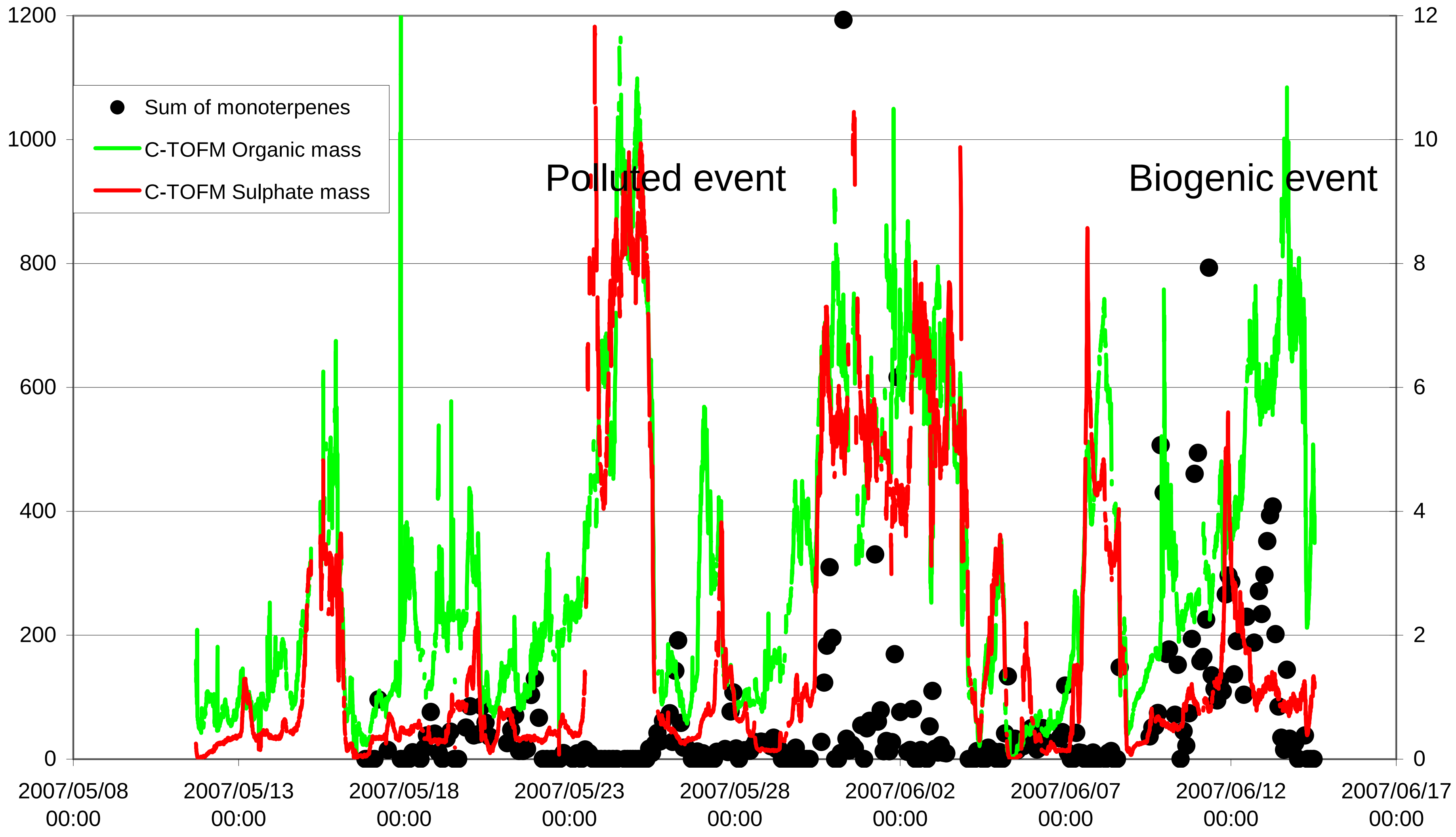
Links between VOCs and aerosol composition



Anne Marie's HCHO data and Jay's C-TOF Organic mass



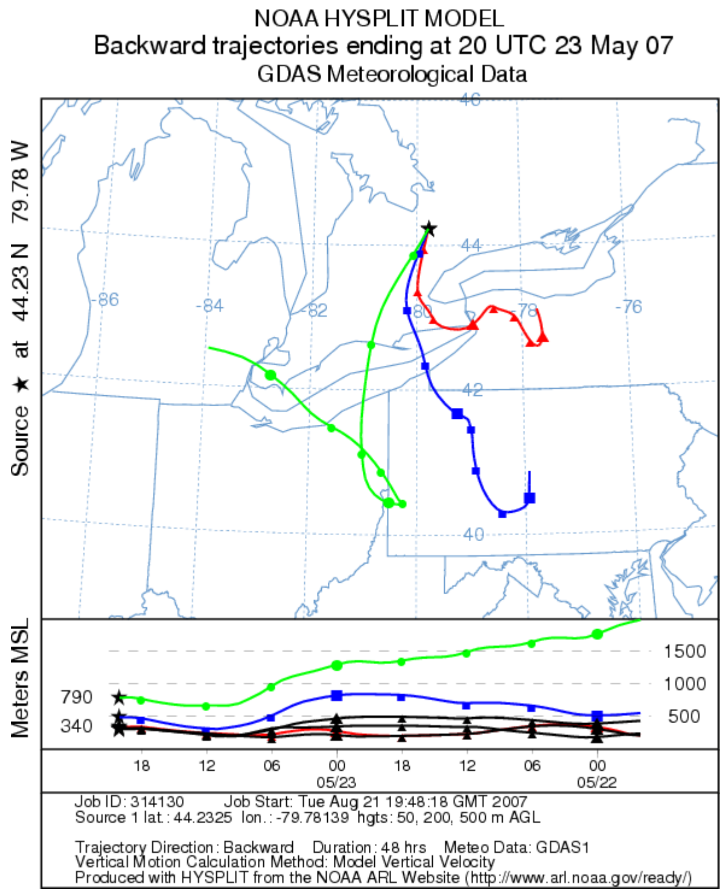
Egbert 2007



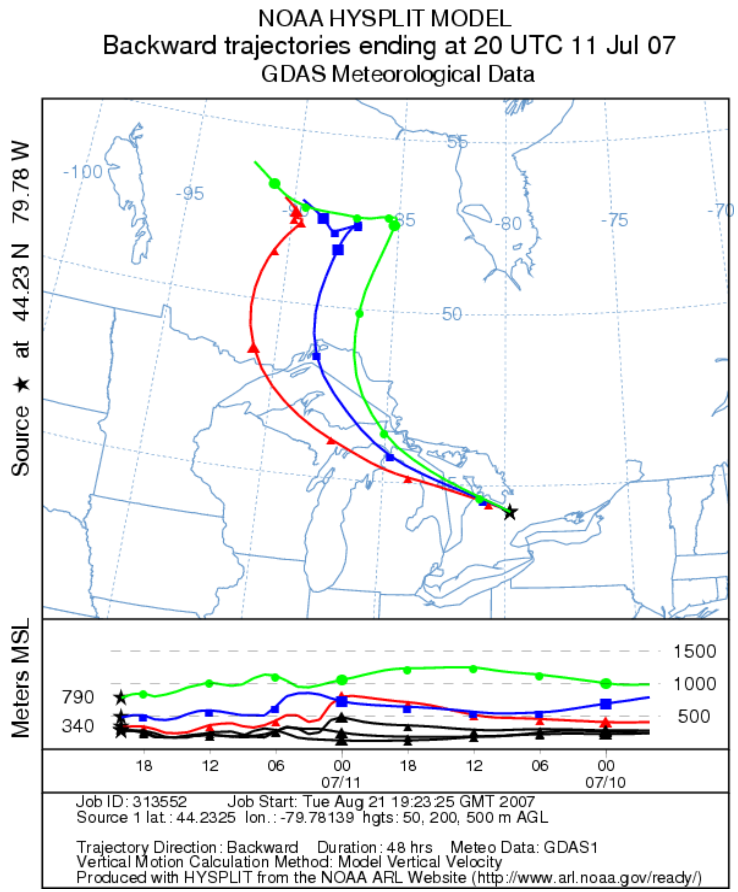
Sum of monoterpenes
C-TOFM Organic mass
C-TOFM Sulphate mass
Polluted event
Biogenic event
1200
1000
800
600
400
200
0
12
10
8
6
4
2
0
2007/05/08 00:00
2007/05/13 00:00
2007/05/18 00:00
2007/05/23 00:00
2007/05/28 00:00
2007/06/02 00:00
2007/06/07 00:00
2007/06/12 00:00
2007/06/17 00:00

Comparison of Polluted and Biogenic Cases

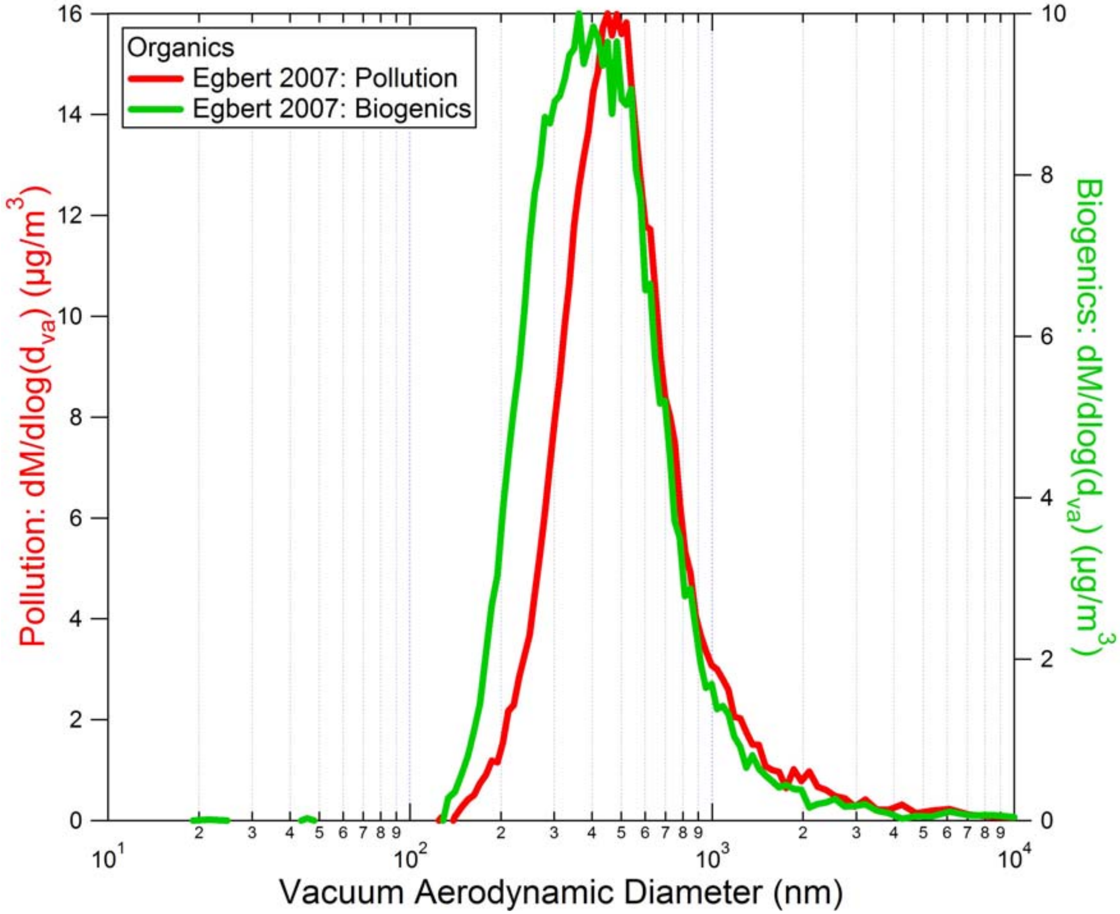
Egbert: Pollution



Egbert: Biogenics



Egbert: Polydisperse Distributions

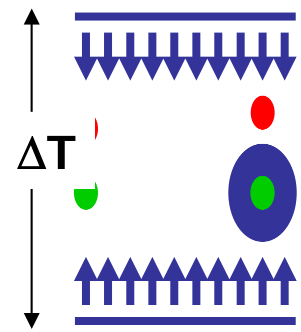


Polydisperse distribution of pollution particles is shifted to larger sizes relative to the biogenics. If particle size was the distinguishing factor between pollution/biogenic activation, the biogenics should have appeared <u>less</u> CCN-active.

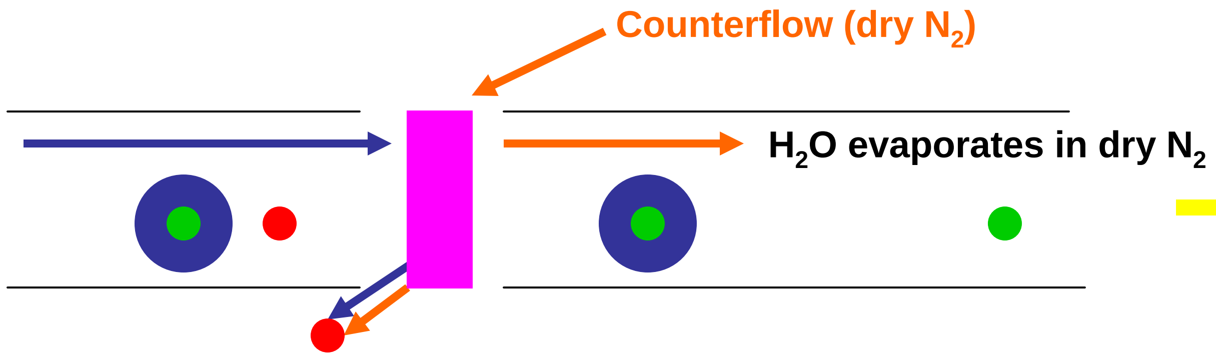
Residual CCN Composition

Atmosphere Aerosol

CCN Chamber

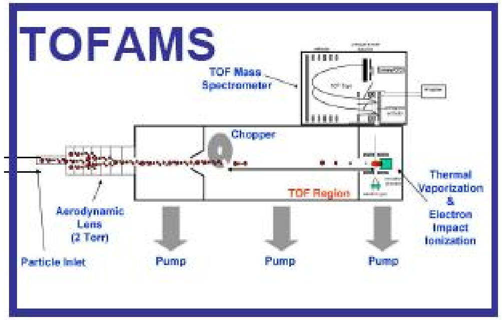


Counterflow Virtual Impactor



Only cloud droplets have sufficient momentum (i.e. size) to cross stagnation plane; input gas and non-activated particles are rejected.

Time-of-Flight Aerosol Mass Spectrometer

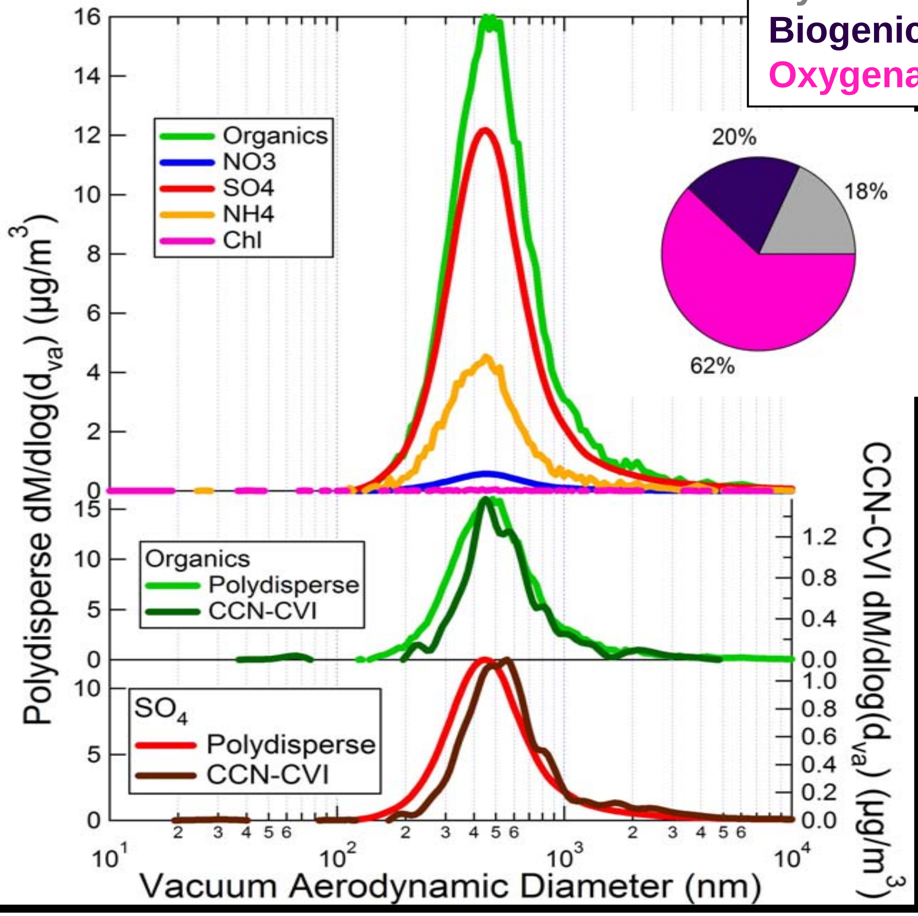


- **Non-refractory composition**
- **Aerodynamic sizing**

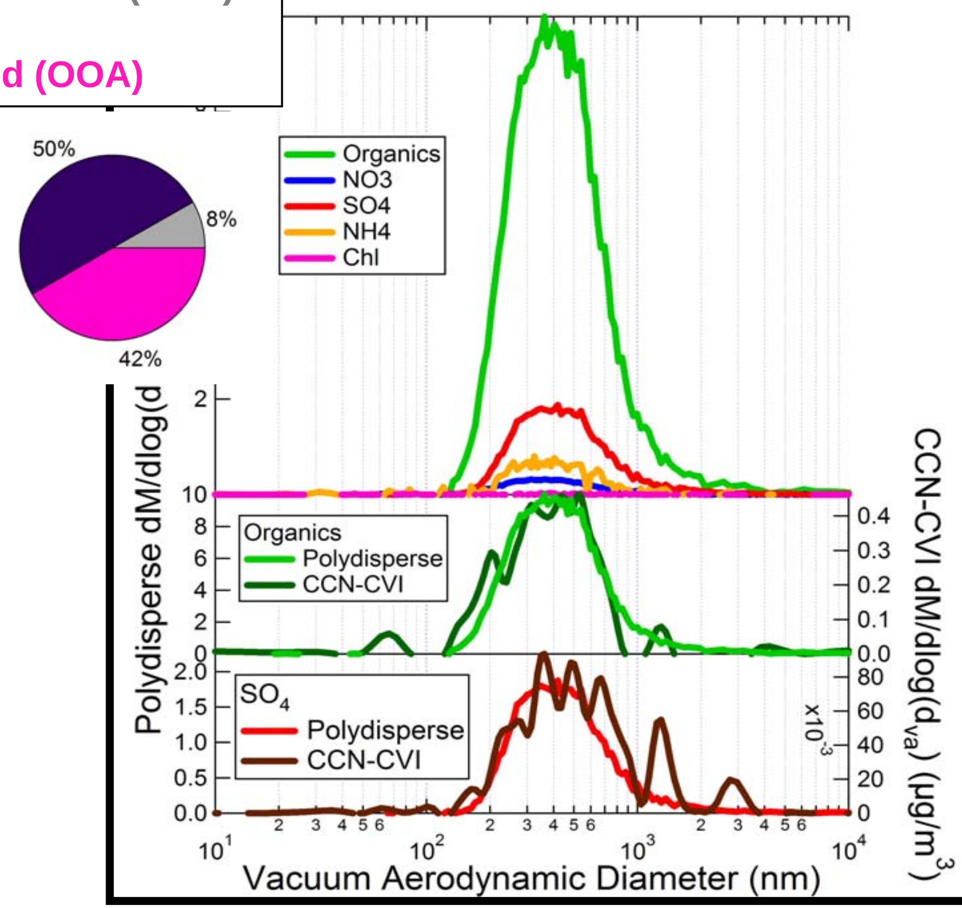
Egbert 2007: Pollution Event *Egbert 2007: Biogenic Event*

Organic PMF Analysis
Hydrocarbon-like (HOA)
Biogenics
Oxygenated (OOA)

Size Distributions



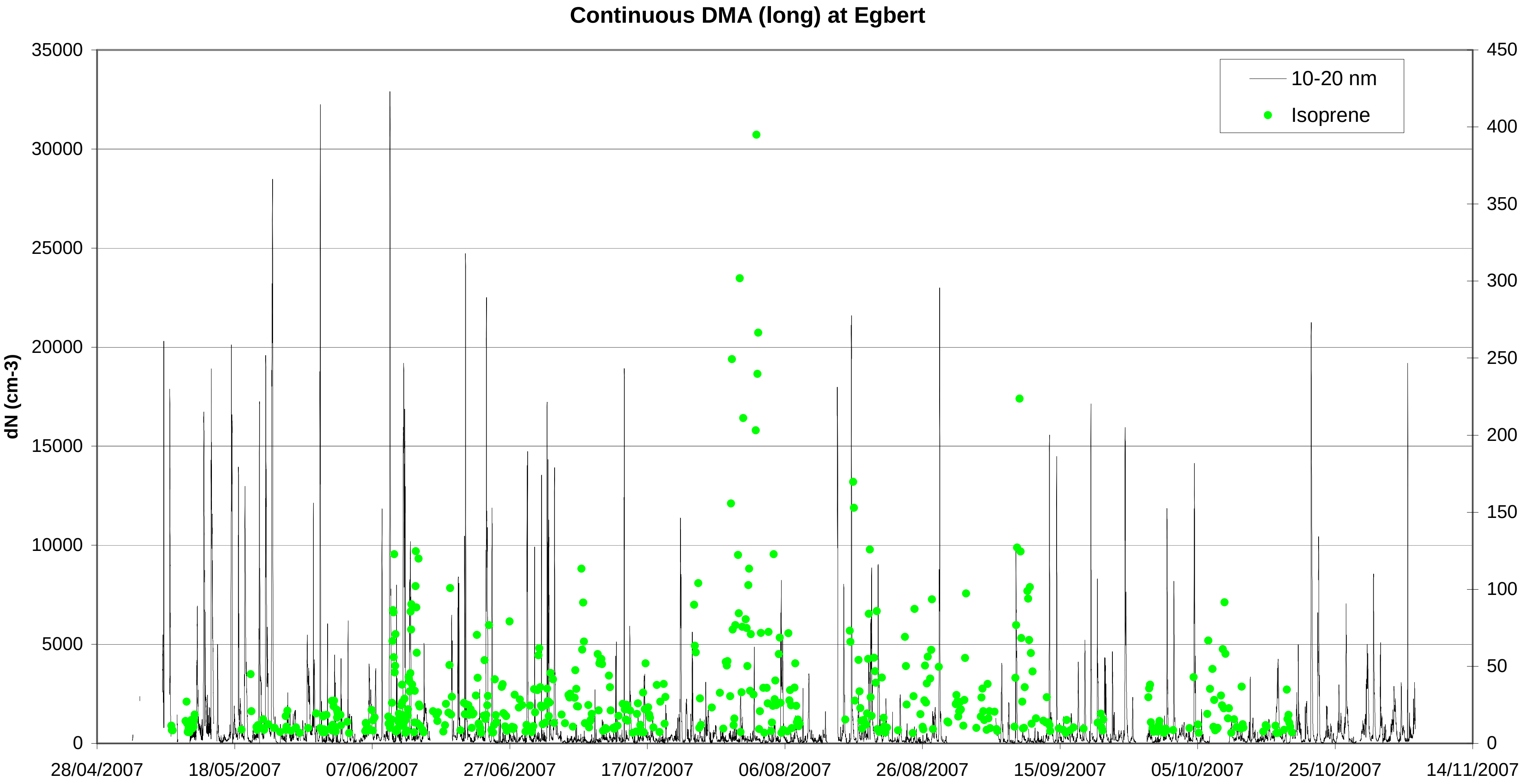
Size Distributions



Polydisperse and CCN-active particles have same composition. CCN-active particles are shifted to larger sizes.

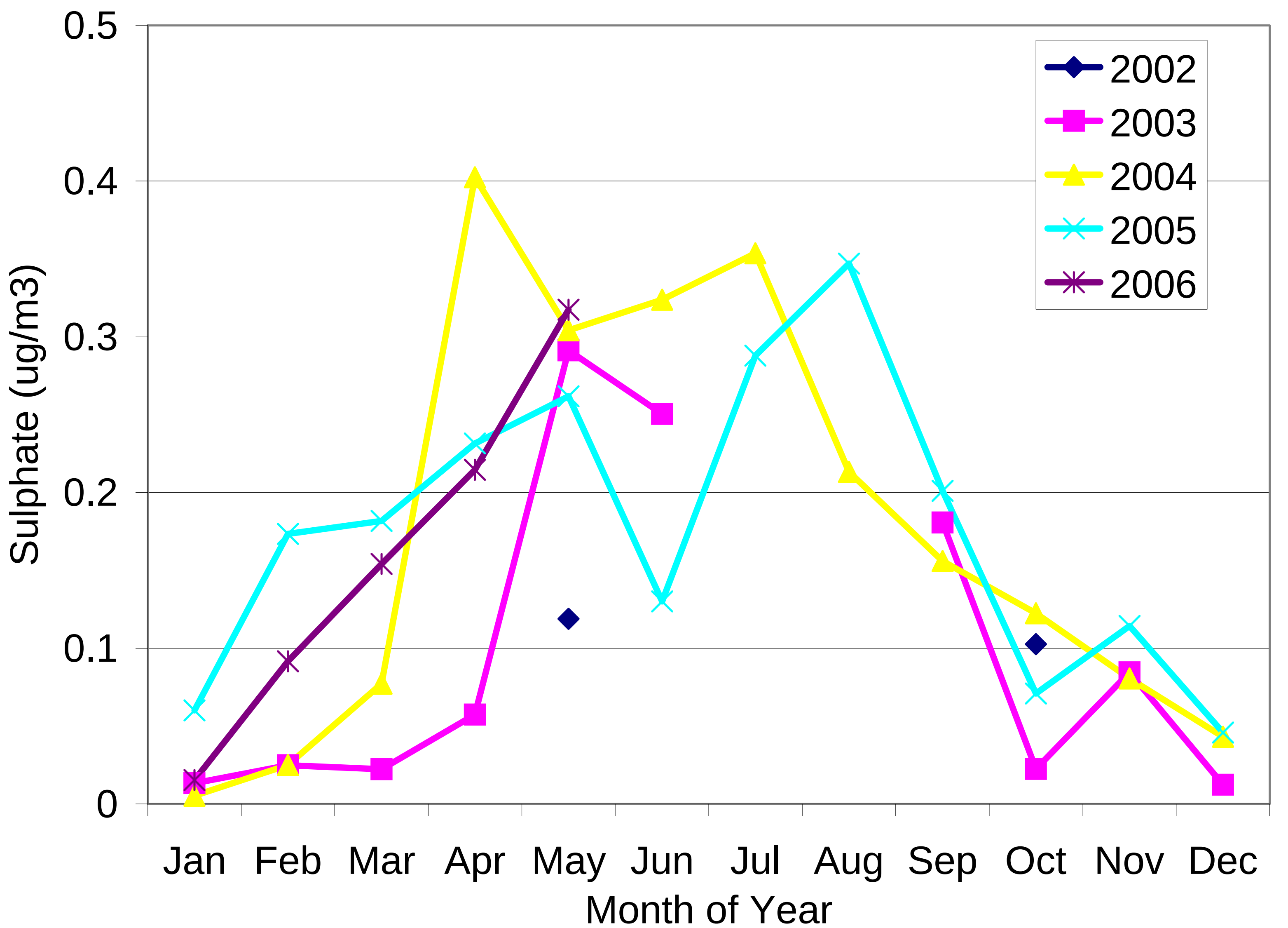
Polydisperse and CCN-active particles have same composition, but no size difference. Biogenics activate more readily, despite less sulfate and less oxygenated organics.

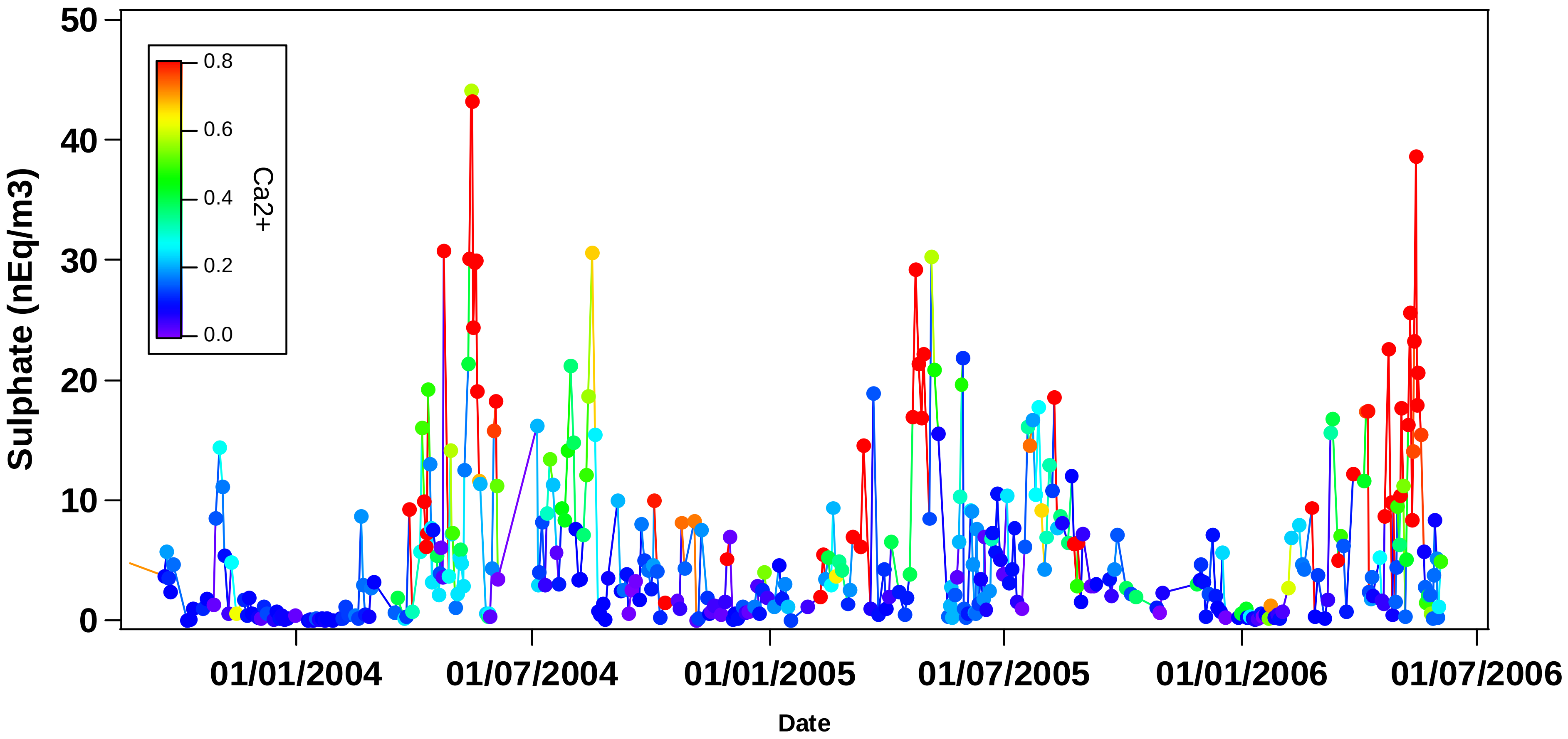
Particle nucleation at Egbert



Whistler Peak (A.M. Macdonald, PI)

- CO, O_3 and aerosol measurements at the peak of Whistler Mountain since 2002.
- Whistler peak is used for monitoring changes in the NH free-troposphere aerosol and for the measurement of aerosols from the Asian and African continents reaching Canada (e.g. Sahara desert dust, McKendry et al., JGR, 2007).
- In the late spring and summer, the valley aerosol at Whistler can be largely of biogenic origin due to the extensive forests.

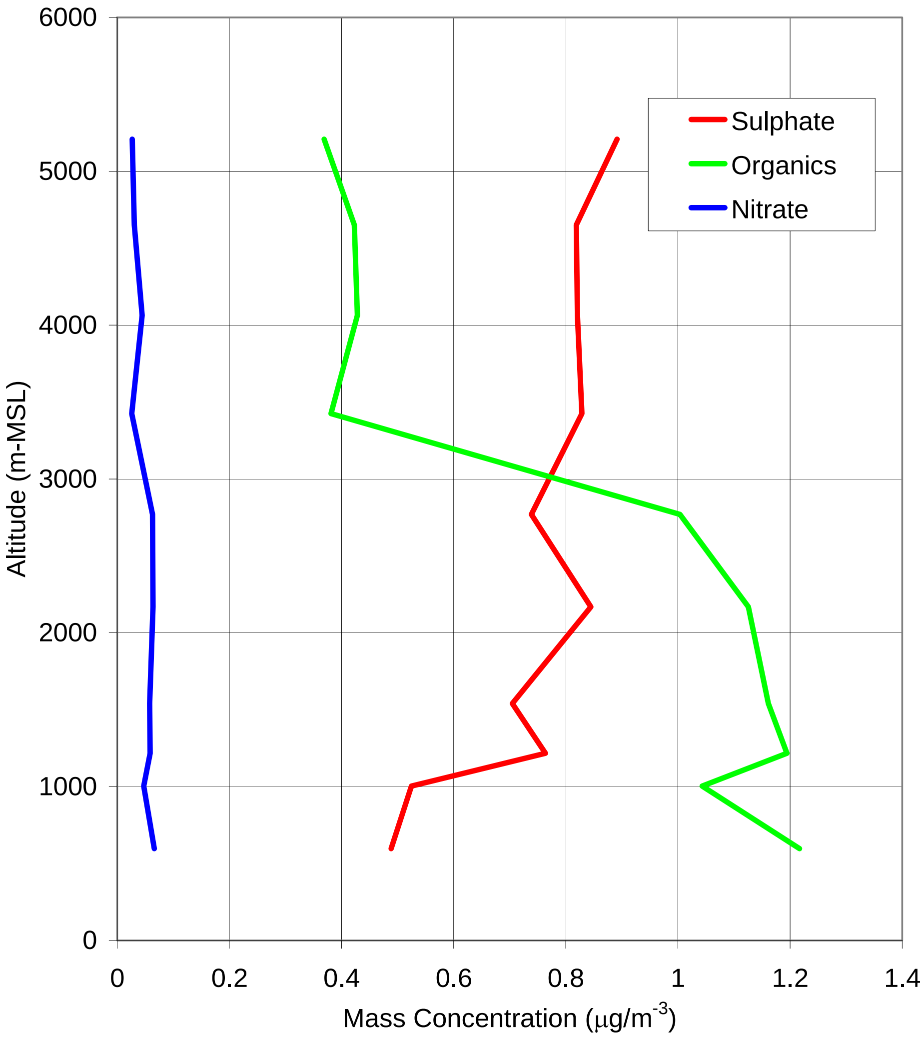

0.5
0.4
0.3
0.2
0.1
0
Sulphate (ug/m3)
2002
2003
2004
2005
2006
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month of Year



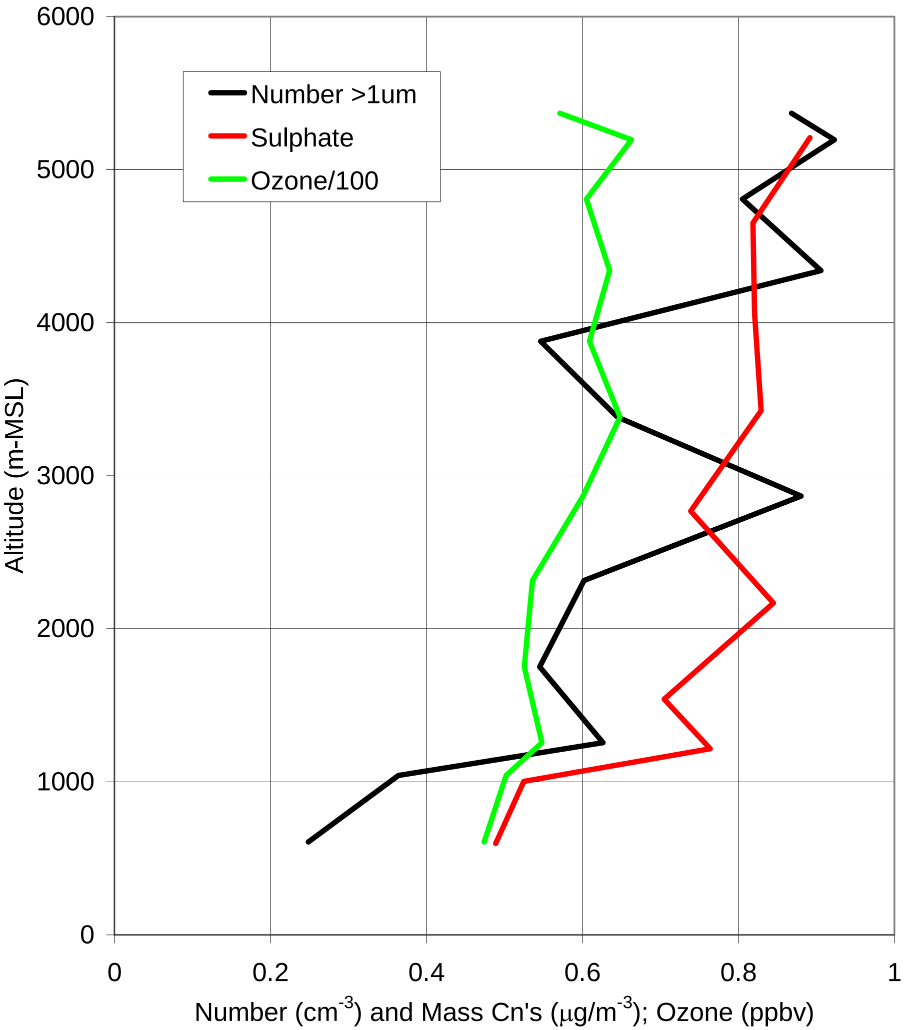
Sometimes low sulphate and high ca and vice versa. This combined with the OPC/DMA results can help us understand the dust events.

Intex-B – Mean of Whistler Profiles

Average of AMS data from April 22-May 15

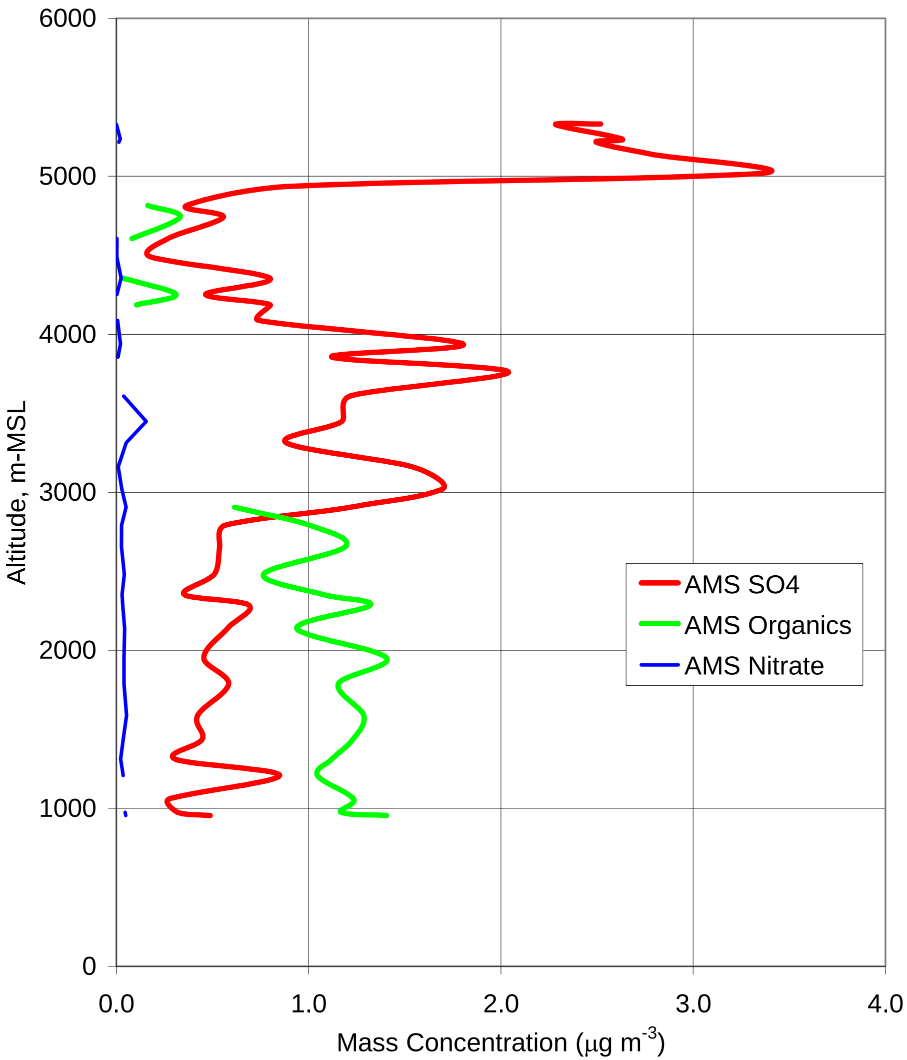


Average of AMS data from April 22-May 15



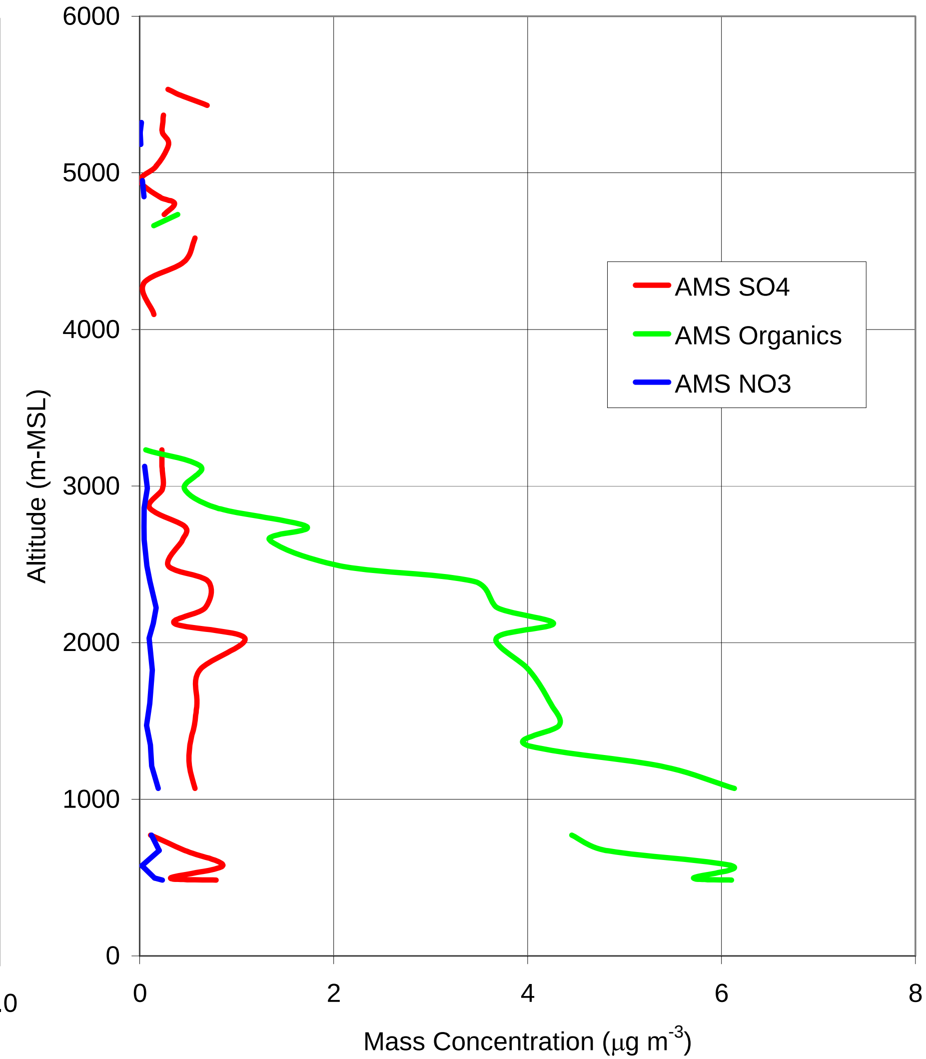
Transport aerosol

Intex-B, Flight 14, May 3 pm [LT], 2006



Local BL aerosol

Intex-B, Flight 33, May 17 [am], 2006



Proposal for May-June 2008

Objecitve - Study how the natural biogenic aerosol takes up water and can affect cloud droplet nucleation.

Plan -

- Conduct measurements at the Whistler peak site and at a site lower in the valley over 4-5 weeks during May-June.
- Because of the unique cloud-topped BL development in this area, the lower site would be primarily an aerosol particle sampling site and the peak would sample both aerosol particles and cloud particle residuals as the clouds ascend through the peak site. After cloud reached above the peak site, then because the peak is above the tree line it would be sampling an aerosol that had aged more than that at the lower site, thus providing a short-term Lagrangian type study of SOA formation.
- We will solicit participation from some other groups with like interests:
  - EC AURAMS modelling group (Craig Stroud) to conduct simulations with AURAMS
  - Allan Bertram (UBC)
  - Tom Jobson (PNNL)
  - Lynn Russell (Scripps)
  - Sonia Kriedenweis (CSU)

Instrumentation -

- At the peak site, in addition to the on-going measurements, we would like to add:
  - UofT's C-TOF AMS with CVI
  - a PTR-MS (PNNL or EC)
  - special filters for aerosol chemical speciation (EC).
- At the lower or valley site, we would put
- EC's W-TOF AMS
- EC's PILS
- UofT's PTR-MS
- Particle size distribution instruments
- CCN chambers
- Some filter sampling.