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
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.
Thanks to Jay Slowik and Sasha Vlasenko for providing their AAAR and AGU presentations
Particle Composition
C-ToF-AMS (UofT)
V/W-ToF-AMS (EC)
PILS-IC (EC)
PILS-WSOC EC)
EC-OC (EC, UofT)
ATOFMS (UofT)

Particle Hygroscopic Growth
Continuous Flow CCN Chamber (UofT)
Static CCN (size selected - EC)
CCN-CVI-AMS
H-TDMA (YorkU)
Hygroscopic tandem nephelometers (EC)

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

Gases
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

Toluene/ Benzene

AMS mz 44 / Org

mz93/mz79

44/Org

20 per. Mov. Avg. (mz93/mz79)
Anne Marie’s HCHO data and Jay’s C-TOF Organic mass

Egbert 2007

HCHO (ppbv)

ctof-Organic (mg/m³)

Preliminary HCHO
C-TOF Organic mass

00:00 00:00 00:00 00:00 00:00 00:00 00:00 00:00 00:00
Comparison of Polluted and Biogenic Cases

**Egbert: Pollution**

NOAA HYSPLIT MODEL
Backward trajectories ending at 20 UTC 23 May 07
GDAS Meteorological Data

**Egbert: Biogenics**

NOAA HYSPLIT MODEL
Backward trajectories ending at 20 UTC 11 Jul 07
GDAS Meteorological Data
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 less CCN-active.
Residual CCN Composition

Atmosphere Aerosol

Counterflow Virtual Impactor

H₂O evaporates in dry N₂

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

CCN Chamber

ΔT

Time-of-Flight Aerosol Mass Spectrometer

- Non-refractory composition
- Aerodynamic sizing
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

Continuous DMA (long) at Egbert

- 10-20 nm
- Isoprene
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.
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

**Graph 1:**
- **x-axis:** Mass Concentration (μg/m³)
- **y-axis:** Altitude (m-MSL)
- Lines represent:
  - **Red:** Sulphate
  - **Green:** Organics
  - **Blue:** Nitrate

**Graph 2:**
- **x-axis:** Number (cm⁻³) and Mass Cn's (μg/m³); Ozone (ppbv)
- **y-axis:** Altitude (m-MSL)
- Lines represent:
  - **Black:** Number >1μm
  - **Red:** Sulphate
  - **Green:** Ozone/100
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

Objective - 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.