Measuring Particle Number Rather than Particle Mass

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Improving PM10 Monitoring in NZ

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CSIRO Marine and Atmospheric Research

www.csiro.au
Aerosol size distribution

- Number is only a small fraction of mass
Aerosol size distribution

mass, $dM/d\log d\ \mu g m^{-3}$

number, $dN/d\log d\ \text{mm}^{-3}$

diameter, $\mu m$

- mode 1
- mode 2
- mode 3
- PM0.15
- number distribution

PM0.15

0.01 0.1 1 10 100

0.15 1 10 100

25,000

20,000

15,000

10,000

5,000

-
Measurement methods: sizing

• **Aerodynamic Particle Sizer (APS)**
  - 0.5 to 15 µm aerodynamic diameter
  - Time of flight of a particle between two lasers whose beams are perpendicular to the accelerator flow
  - Expensive, simple to operate, complicated calibration, complicated data analysis

• **Scanning Mobility Particle Sizer (SMPS)**
  - 0.003 to 0.8 µm mobility diameter (with nano DMA)
  - Mobility of a charged particle in an electric field
  - Very expensive, simple to operate, complicated calibration, complicated data analysis

• **GRIMM**
  - 1 to 30 µm aerodynamic diameter
  - Light scattering of single particles
Methods: counting total number

- **Condensation Particle Counter (CPC)**
  - > 10 nm

- **Ultrafine Condensation Particle Counter (UCPC)**
  - > 3 nm

- **Condensation techniques used in 1888 by John Aitken**
  - Particles grow by alcohol condensing onto the particles as they pass through a region of vapour saturation. Detected by light scattering
  - Butanol, isobutyl alcohol and water
  - Other methods of particle growth include expansion
  - Water used as condensing vapour in most recent developments
  - Portable counters

- **Expensive, alcohol OHS issues, very simple to operate, low maintenance**
• **Potential health effects**
  - Heart disease, loss of lung function, stroke
    - Damage mitochondria?
    - Carry toxic metals and hydrocarbons to the brain?
    - Thicken blood?
    - [http://www.lawekly.com/ink/05/44/clear-kelly2.php](http://www.lawekly.com/ink/05/44/clear-kelly2.php)

• **Information about particle processes including sources of ultrafine particles and particle growth**
What’s being done in Australia?

- **DEH desktop study on health effects of ultrafine particles**
  - Concluded that data base is too limited for generalised conclusions on how ultrafine particles effect health and more studies required

- **NHMRC Ultrafine Particle Study**
  - CSIRO and Monash Dept. Epidemiology and Public Health
  - Cohort study, respiratory and cardiovascular effects on elderly people in Melbourne
  - UFP record at CSIRO’s BAQS
  - Measurement of UFP concentrations in homes of cohort members around time of health measurements
• No measurements of particle number concentrations or size distributions are carried out by Australian EPAs

• Research activities carried out by CSIRO and Universities (particularly QUT)

Cape Grim: long term CN and CCN record

Gras pers com, John.Gras@csiro.au
Hourly averages for each month
US Supersites: Fresno

29 March 2003

Chow and Watson, 2005
What’s being done in NZ?

• GRIMM focus on PM rather than size distribution

• NIWA, Ocean–Atmosphere Interactions Research Team
What else can be done?

- Partner with groups who have equipment
  - Organise an international experiment
  - Collaborate with overseas researchers who have access to lots of equipment
- Installation of UCPC (> 3 nm) for health impact research
Contact

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Thank You

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Overview

• Aerosol size distribution
• How do we do it?
• Why is it important?
• What’s being done overseas?
• What is NZ doing?
• What else can NZ do?
Aerosol Size Distribution

- Maximum number in small particles

Bayside Air Quality Station 4 August 2005 00:00 to 01:00