Measuring Particle Number Rather than Particle Mass

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Improving PM10 Monitoring in NZ

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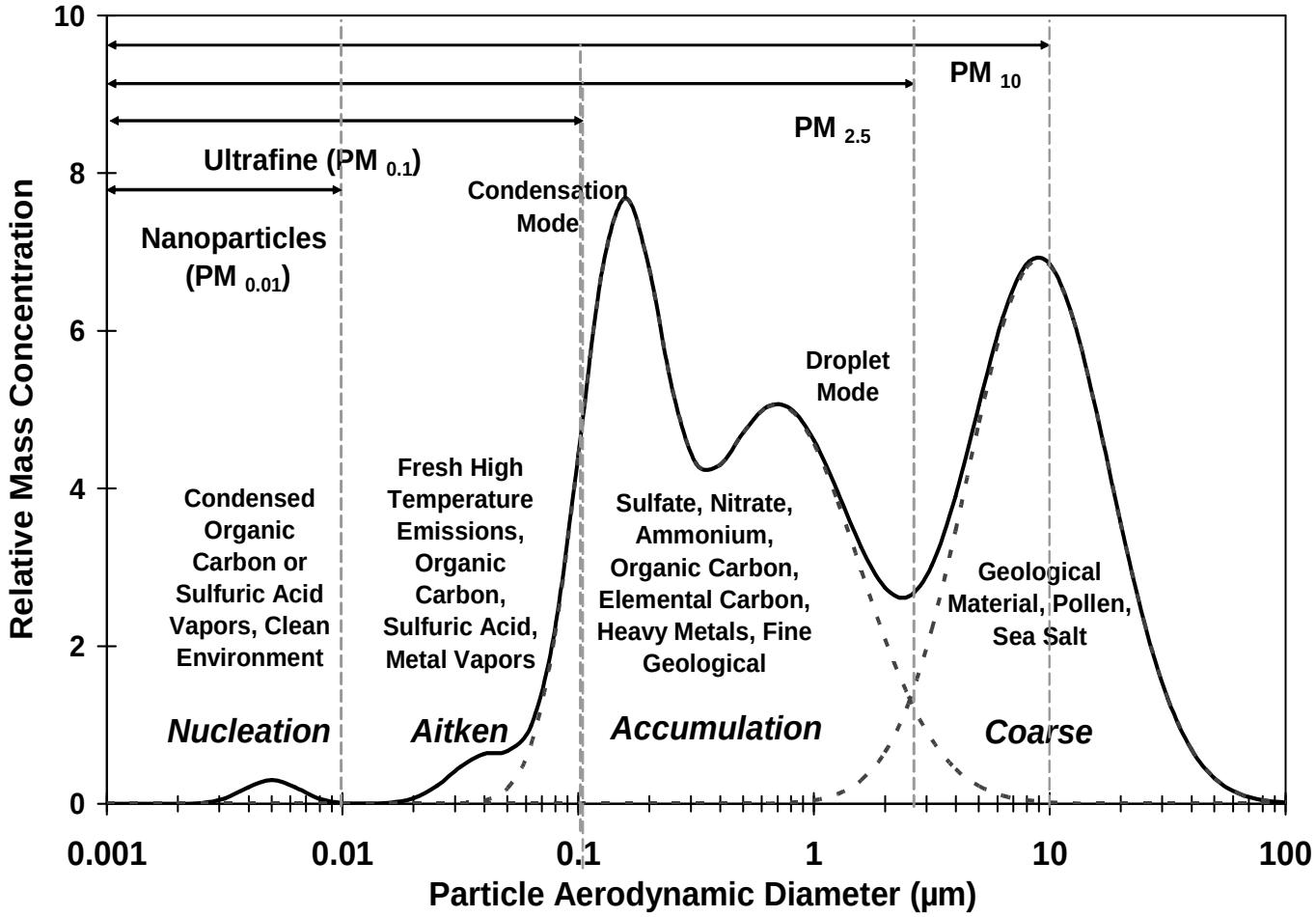
CSIRO Marine and Atmospheric Research

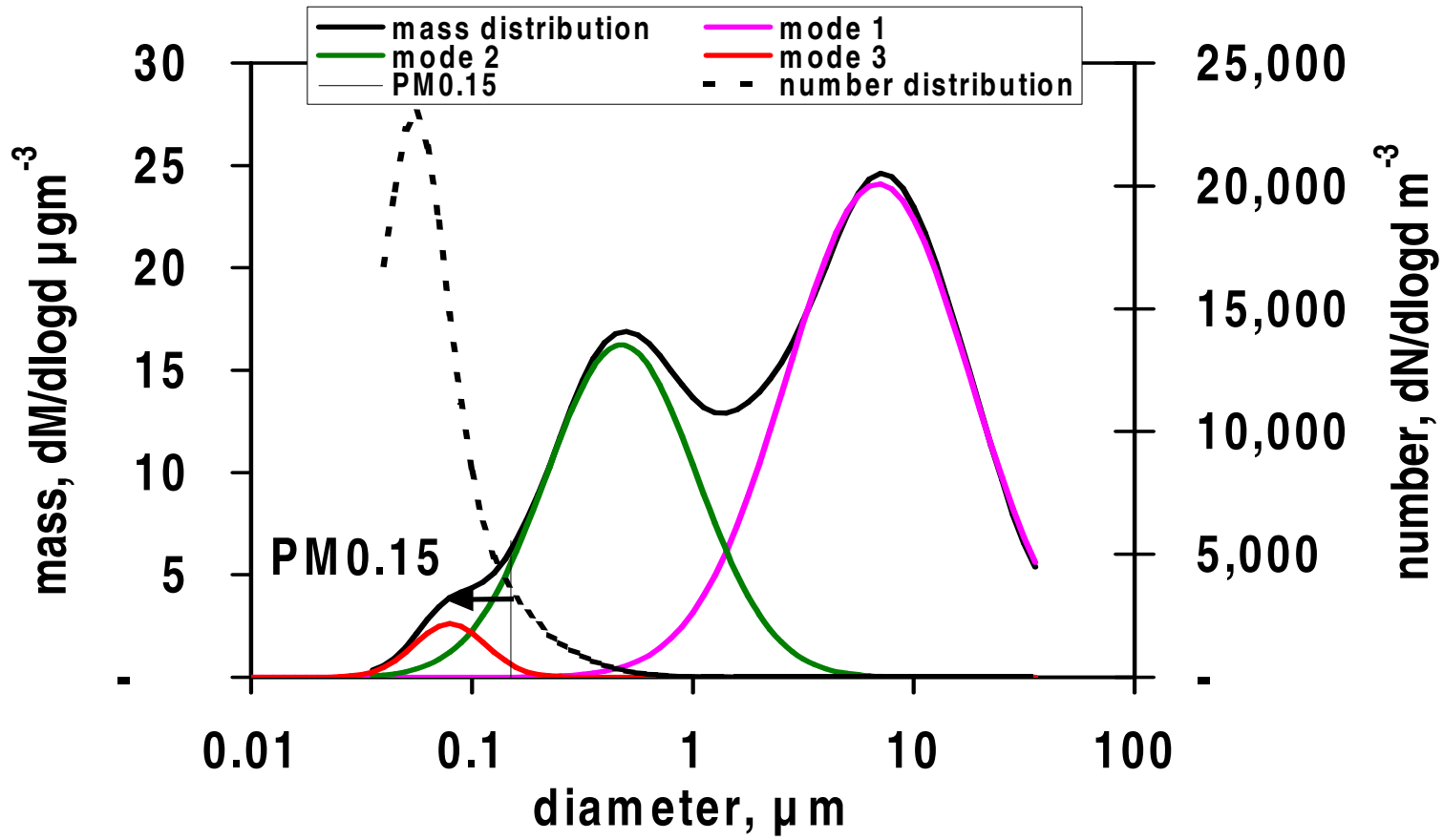
www.csiro.au

Aerosol size distribution

- **Number is only a small fraction of mass**



Aerosol size distribution



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

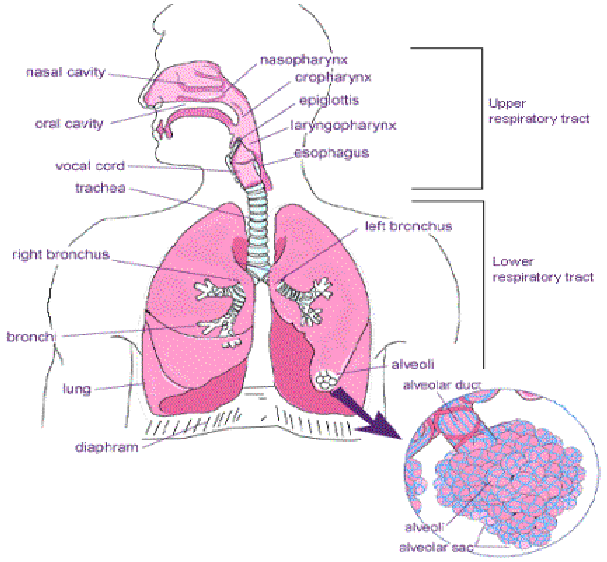
Methods: counting total number

- **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**

Importance

- **Potential health effects**
  - Heart disease, loss of lung function, stroke
    - Damage mitochondria?
    - Carry toxic metals and hydrocarbons to the brain?
    - Thicken blood?
    - http://www.laweekly.com/ink/05/44/clear-kelly2.php



- **Information about particle processes including sources of ultrafine particles and particle growth**

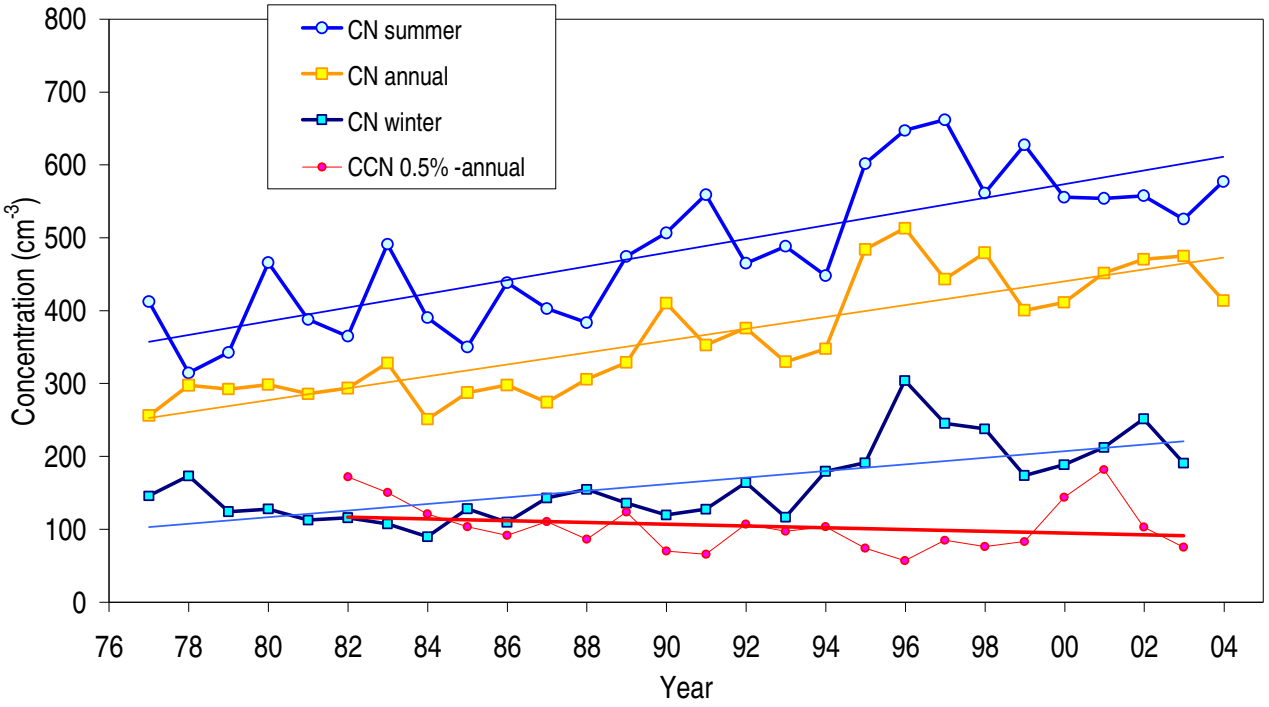
What's being done in Australia ?

- **DEH desktop study on health effects of ultrafine particles**
  - http://www.deh.gov.au/atmosphere/airquality/publications/health-impacts/pubs/health-impacts.pdf.
  - 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

Monitoring particle number concentration

- 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



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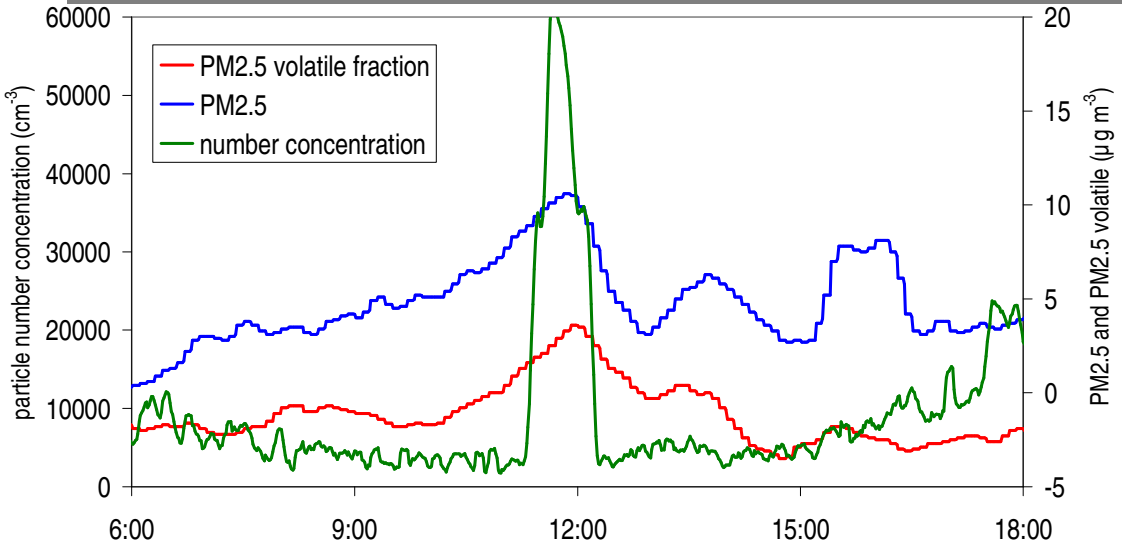
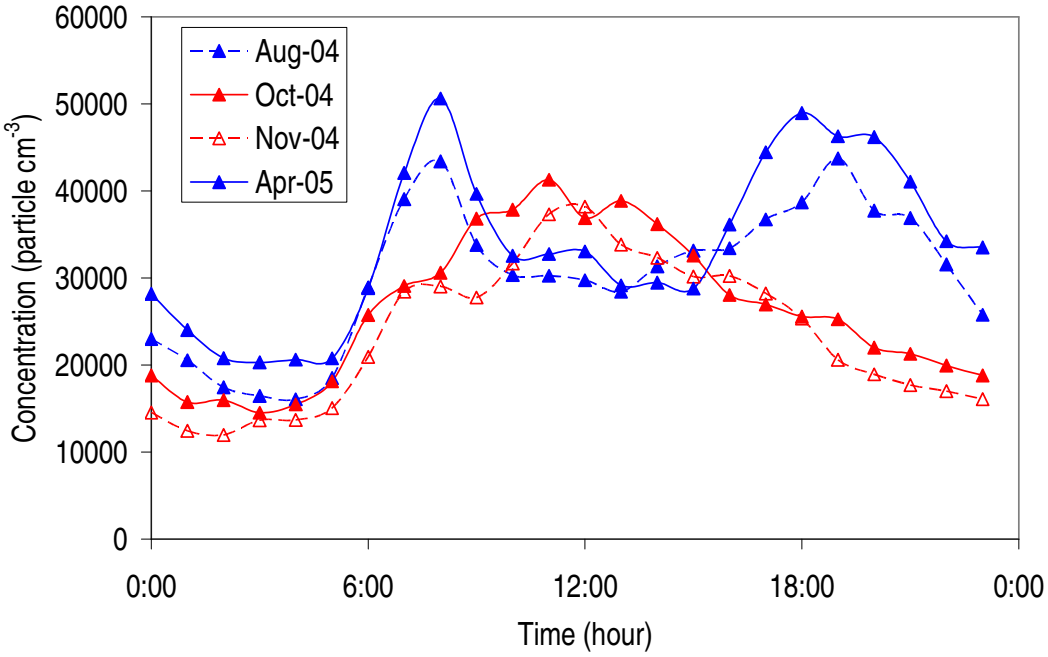
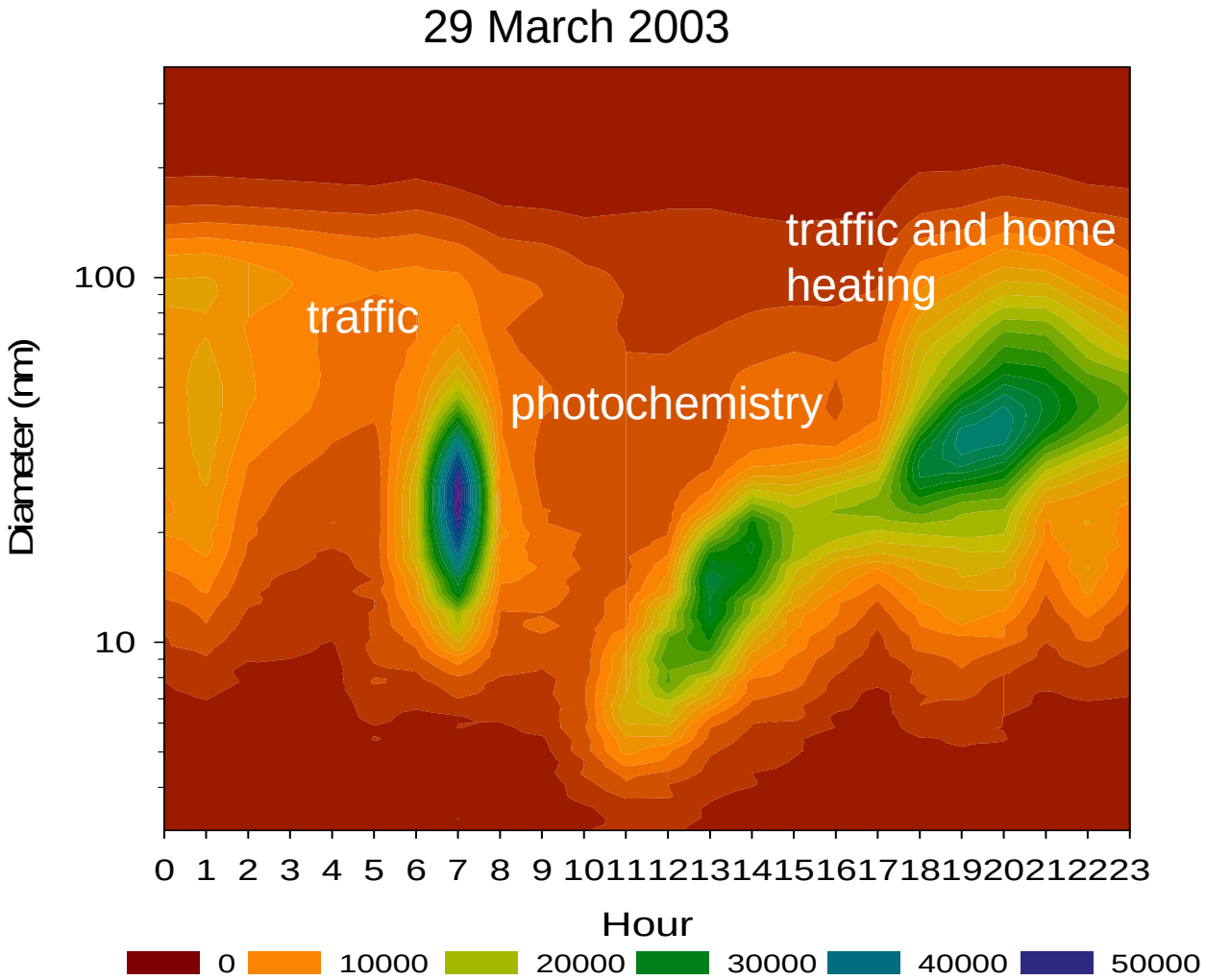


24 August 2004



Hourly averages for each month

US Supersites: Fresno



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**

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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**