



Australian Government

Ansto



# fine particle aerosol sampling NEWSLETTER

Principal Investigator: Dr. David Cohen  
☎ +61 2 9717 3042 fax: + 61 2 9717 3257 e-mail: dcz@ansto.gov.au  
Technical Adviser: Mr. David Garton  
☎ +61 2 9717 3665 fax: + 61 2 9717 3257 e-mail: dbg@ansto.gov.au

✉ ANSTO Private Mail Bag 1, MENAI NSW 2234 AUSTRALIA  
<http://www.ansto.gov.au/environment/iba.html>

Number 38, July 2008

**aerosol** *n.* a colloidal dispersion of solid or liquid particles in a gas (air).

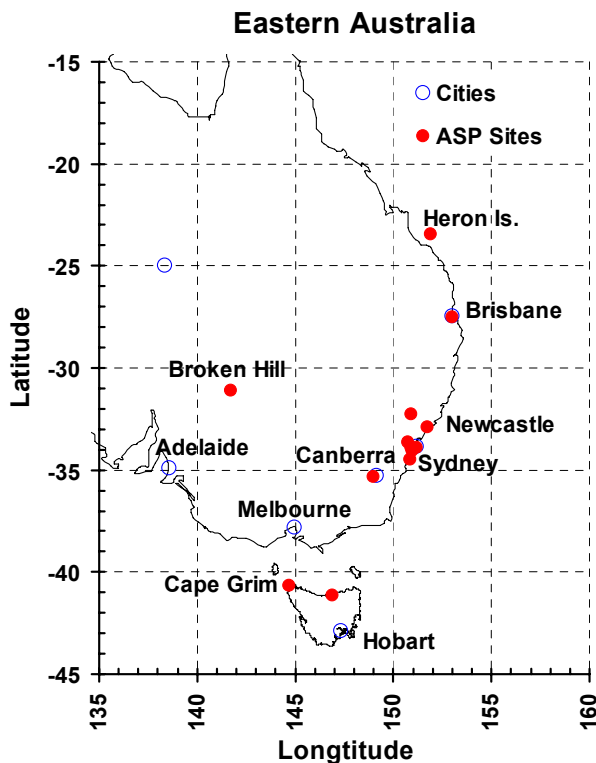
## A Long Term Fine Particle Database Along the Australian East Coast:

ANSTO has been applying ion beam analysis (IBA) techniques to the characterisation of ambient fine particles since the mid 1980's. With major funding from the Energy Research and Development Corporation (ERDC) in January 1991 we established 25 PM2.5 fine particle sampling sites throughout NSW and at Cape Grim in NW Tasmania. This ERDC funded project ran through to mid 1995. Since then we have established PM2.5 sites, which sample every Sunday and Wednesday for 24 hours from midnight to midnight, around Australia, across Asia and even in Croatia.

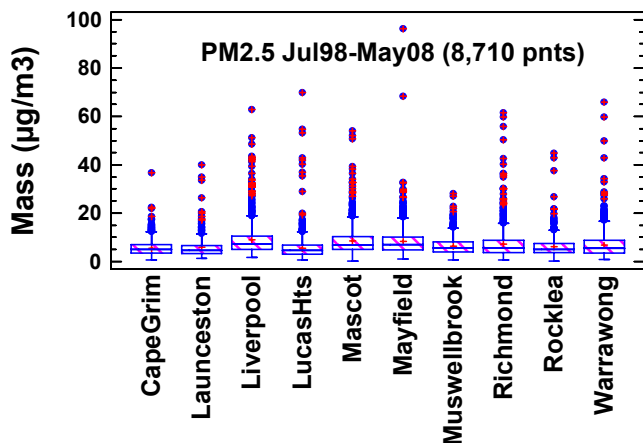


**Fig. 1.** ANSTO ASP sampling unit on Heron Island, Great Barrier Reef, Queensland, Australia.

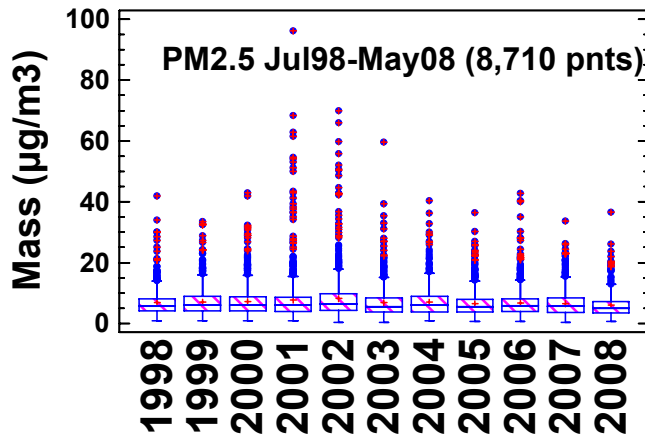
**Fig. 1** shows the ANSTO ASP sampler recently installed on Heron Island in the Great Barrier Reef as part of the Australian East Coast Aeolian Dust Sampling (AECADS) Project. **Fig. 2** shows the location of ANSTO ASP sites at which we currently analyse data along the east coast of Australia. Many of these sites have been sampling PM2.5 fine particles for more than 10 years and each filter has been analysed for over 20 different chemical species at ANSTO using



**Fig. 2.** Current ANSTO ASP sites along the Australian east coast.



**Fig. 3.** Box and whisker plots for daily PM2.5 fine masses for 10 Australian east coast ASP sites from July 1998 to May 2008



**Fig. 4.** Annual box and whisker plots for daily PM2.5 fine masses for Australian east coast sites for data from July 1998 to May 2008

the accelerator based IBA techniques described in detail on our WEB page (see in header at top of the front page of this [Newsletter](#)). Fig. 3 is a box and whisker plot of the PM<sub>2.5</sub> mass ( $\mu\text{g}/\text{m}^3$ ) for 10 of these sites for 24 hour data covering the period July 1998 to May 2008 inclusive. This 10 year period represents 8,170 filters. Fig. 4 shows the same data as Fig. 3 for all sites on an annual basis.

### What Do Box and Whisker Plots Tell You?

Box and Whisker plots show in graphical form the distribution of a particular measurement. The (+) sign within a box is the average value (mean), the horizontal bar within the box represents the median value within the distribution and the box itself contains 25% (lower bound) to 75% (upper bound) of the distribution of all measurements. The vertical whiskers above and below each box represent the  $\pm 95\%$  confidence intervals for the measurements, solid dots are outliers and extreme values.

The current Australian National Environmental Protection Measure (NEPM) for particles is  $8 \mu\text{g}/\text{m}^3$  for annual average and  $25 \mu\text{g}/\text{m}^3$  for a 24 hour maximum. Figs. 3 and 4 and Table 1 show that the 24 hr PM<sub>2.5</sub> NEPM goal has been exceeded 113 times at these 10 sites since July 1998 with the Liverpool, Mascot and Richmond sites being the main offenders. These three sites all lie within the greater Sydney basin. Many of the 2001, 2002 and 2003 outlier events, shown as dots in Figs. 3 and 4 were produced by the significant bushfires around Sydney during these periods.

PM <sub>2.5</sub> ASP Site 1998-08	Where	Mass ( $\mu\text{g}/\text{m}^3$ )	NEPM Exceed	Ammon. Sulfate%	Black Carbon%	Soil%	Org.%	Salt%
Cape Grim	Tasmania	5.6 $\pm$ 3	1	19 $\pm$ 11%	5.0 $\pm$ 3%	2.1 $\pm$ 1.1%	7.5 $\pm$ 14%	43 $\pm$ 21%
Launceston	Tasmania	5.9 $\pm$ 5	4	18 $\pm$ 10%	8.1 $\pm$ 3.1%	4.7 $\pm$ 3.7%	15 $\pm$ 17%	25 $\pm$ 17%
Liverpool	Sydney	9.0 $\pm$ 7	36	24 $\pm$ 13%	20 $\pm$ 8%	5.7 $\pm$ 4.1%	22 $\pm$ 17%	11 $\pm$ 12%
Lucas Hts	Sydney	5.3 $\pm$ 5	9	31 $\pm$ 14%	16 $\pm$ 8%	5.5 $\pm$ 4.9%	17 $\pm$ 33%	14 $\pm$ 15%
Mascot	Sydney	8.5 $\pm$ 6	18	23 $\pm$ 11%	21 $\pm$ 10%	5.4 $\pm$ 3.5%	19 $\pm$ 20%	16 $\pm$ 15%
Mayfield	Newcastle	8.3 $\pm$ 6	11	23 $\pm$ 10%	16 $\pm$ 6%	8.7 $\pm$ 6.4%	18 $\pm$ 18%	14 $\pm$ 14%
Muswellbrook	Hunter Valley	6.4 $\pm$ 4	2	29 $\pm$ 14%	15 $\pm$ 6%	8.1 $\pm$ 7.2%	22 $\pm$ 19%	7.1 $\pm$ 10%
Richmond	Sydney	7.2 $\pm$ 6	18	28 $\pm$ 16%	15 $\pm$ 6%	5.1 $\pm$ 4.5%	24 $\pm$ 19%	7.3 $\pm$ 10%
Rocklea	Brisbane	6.2 $\pm$ 4	4	22 $\pm$ 11%	19 $\pm$ 8%	6.7 $\pm$ 5.5%	24 $\pm$ 19%	9.4 $\pm$ 11%
Warrawong	Wollongong	6.9 $\pm$ 5	10	29 $\pm$ 12%	15 $\pm$ 6%	9.8 $\pm$ 11%	14 $\pm$ 26%	16 $\pm$ 14%
<b>All Sites</b>		<b>8.7<math>\pm</math>5.3</b>	<b>113</b>	<b>25<math>\pm</math>13%</b>	<b>15<math>\pm</math>8%</b>	<b>6.3<math>\pm</math>6.4%</b>	<b>18<math>\pm</math>22%</b>	<b>16<math>\pm</math>18%</b>

**Table 1.** Average PM<sub>2.5</sub> masses and compositions for 10 Australian east coast sites from July 1998 to May 2008.

Table 1 also provides estimates of the major percentage compositions of the fine fraction at each of the sites. The average fine particle mass across all sites for the 10 year period was  $(8.7 \pm 5.3) \mu\text{g}/\text{m}^3$ , just above the annual NEPM goal of  $8 \mu\text{g}/\text{m}^3$ . The average fine particle composition was, 25% ammonium sulfate, 15% black carbon (BC), 6.3% soil, 18% organic matter and 16% sea salt. The high error values of Table 1 reflect the seasonal variations across the time periods considered and not the measurement errors which were typically less than or of the order of 10%. There are a range of different sources producing these chemical components and these have been discussed in detail for some of these sites in previous [ASP Newsletters](#), see for example [ASP Newsletters No 33, 34, 35 and 36](#). Copies of recent [ASP Newsletters](#) are also available as PDF files from our WEB site (see front page).

This [Newsletter](#) demonstrates that we now have an extensive fine particle database covering several sites along the east coast of Australia spanning the period from 1998 to 2008. Indeed ANSTO has now analysed over 40,000 fine particle filters for over 20 different chemical species from hydrogen to lead using its unique IBA techniques. If you need more information please contact us through any of the contact addresses below or visit our WEB page.

#### Short Term US EPA NAAQS Standards for Airborne Particulate Matter

Index (NAAQS)	TSP ( $\mu\text{g}/\text{m}^3$ )	PM <sub>10</sub> ( $\mu\text{g}/\text{m}^3$ )	PM <sub>2.5</sub> ( $\mu\text{g}/\text{m}^3$ )	Air Quality
0 to 50	0 - 75	0 - 50	0 - 15	Good
51 to 100	76 - 260	51 - 150	16 - 65	Moderate
101 to 200	261 - 375	151 - 350	66 - 150	Unhealthy
201 to 300	376 - 625	351 - 420	151 - 250	V/Unhealthy
> 300	> 626	> 421	> 251	Hazardous

Source : US EPA July 1997 Documents.

#### Australian NEPM for PM<sub>2.5</sub>

$8 \mu\text{g}/\text{m}^3$  annual and  $25 \mu\text{g}/\text{m}^3$  24-hr average



Want more information on how ANSTO can help you with your Fine Particle air sampling and characterisation?

Contact: [Dr. David Cohen](#)

+61 2 9717 3042

fax: +61 2 9717 3257

e-mail: [dcz@ansto.gov.au](mailto:dcz@ansto.gov.au)

[sto.gov.au/ansto/environment1/iba/index.html](http://sto.gov.au/ansto/environment1/iba/index.html)

Further information can be obtained from our WEB site or by contacting David Cohen at the addresses given.