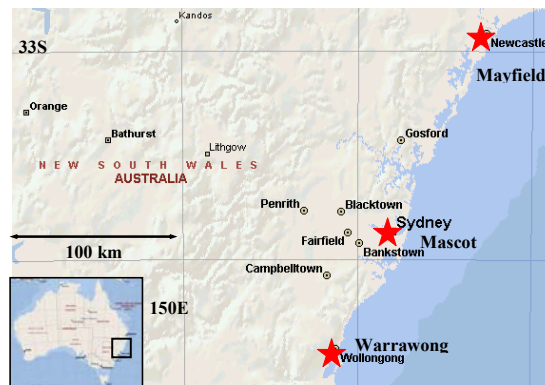


aerosol *n.* a colloidal dispersion of solid or liquid particles in a gas (air).

Welcome to the New Financial Year 2006-07

The Australian Nuclear Science and Technology Organisation has been applying nuclear techniques to the measurement and characterisation of fine (PM_{2.5}) particle ambient air pollution for over 15 years. Typically in any one year we are sampling PM_{2.5} particles at around 15 to 20 different sites around Australia and at selected sites across Asia. To date, using Ion Beam Analysis techniques at ANSTO, we have analysed over 36,000 fine particle samples for more than 25 different elements, including the key elements present in air pollution H, C, F, Na, Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn and Pb. This broad range of elements allows us to quantitatively identify fine particle sources such as sea spray, windblown soil, automobiles, smoke from biomass burning and emissions from combustion processes such as coal burning for power generation. Fine particle data for State of the Environment reporting by Local Councils or industrial groups can also be provided. See our WEB site (listed in the header above) for more information and data relating to this program.

One of the popular services we provide on a regular basis every 6 months is the **Fine Particle Summary Sheet Analysis** for key sampling sites in NSW. Currently we have unique long term PM_{2.5} records going back more than 10 years for sites at Warrawong in Wollongong, Mascot in Sydney and Mayfield in Newcastle. These three sites (see stars on the map opposite) are representative of urban ambient air in regions of NSW which include over 4 million people along the eastern sea board of the NSW coast.



The average ambient fine particle mass data for these three key sites for the years from 2000 to 2005 inclusive are given in Table 1 below and plotted on the reverse side of this Newsletter in Figs. 1 to 4. The NEPM annual and 24-hour goals are shown as horizontal dashed lines in the plots.

Table 1 shows the measured annual average PM_{2.5} masses with ± 1 standard deviation for each of the three sites for each of the years between 2000 and 2005 inclusive. The large standard deviations reflect the seasonal variations in the data and not the measurement errors which were typically much less than ±10%. The corresponding maximum 24 hour PM_{2.5} mass concentrations are also given in the Table. The current proposed PM_{2.5} fine particle National Environmental Protection Measure (NEPM) for Australia is 8 µg/m³ for annual average and 25 µg/m³ for the 24-hour maximum value. Comparisons with the values of Table 1 show that this NEPM annual goal was exceeded at Warrawong in 2002, at Mascot in 2000, 2001, 2002 and 2004 and at Mayfield in 2000, 2001, 2002 and 2004. The 24-hour NEPM fine particle goal of 25 µg/m³ was exceeded on 8 days at Warrawong, 14 days at Mascot and 11 days at Mayfield during the six-year period from 2000 to 2005 inclusive.

Table 1. Annual Average and 24-hour maximum PM_{2.5} masses for 2000 - 2005

PM _{2.5} Average (µg/m ³)	2000	2001	2002	2003	2004	2005
Mascot	9.3±6	9.3±8	9.0±5	7.6±5	8.0±5	7.5±5
Mayfield	8.1±5	9.6±12	9.3±6	7.4±5	8.1±4	7.2±4
Warrawong	6.8±5	6.5±5	8.0±7	6.9±5	6.3±4	6.5±5
PM _{2.5} 24hr max (µg/m ³)						
Mascot	31	54	24	20	33	27
Mayfield	30	96	33	22	27	22
Warrawong	28	27	43	33	16	20

Table 1 above and the plots below show that the maximum 24-hour exceedances were the highest in 2001 – 2002. These were the years most severely affected by the bushfires across NSW during Christmas 2001 and spring-summer 2002 and dust storms from inland Australia in 2002.

The major chemical components of PM_{2.5} aerosols namely, sea spray, wind blown soil, sooty or black carbon, ammonium sulfate and organics are also plotted in Figs 1 to 4 on the reverse side of this Newsletter.

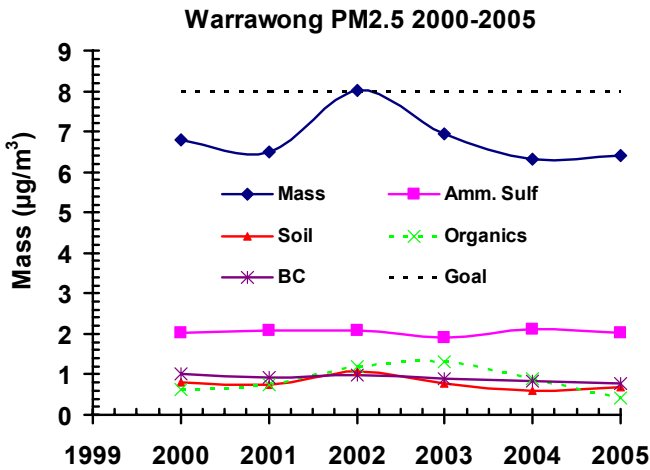


Fig. 1. PM_{2.5} ambient aerosol data for Warrawong 2000- 2005

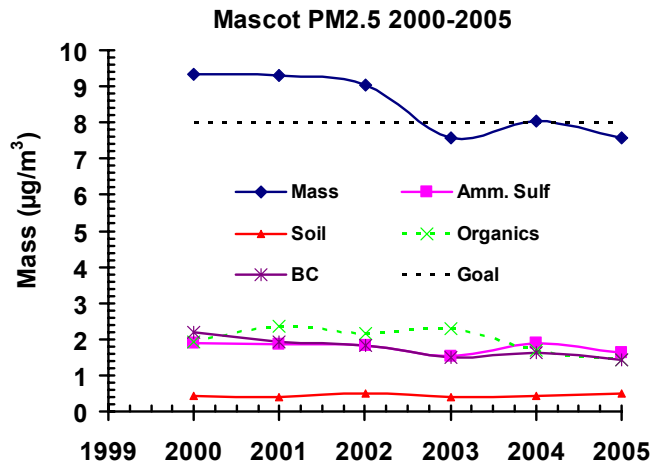


Fig. 2. PM_{2.5} ambient aerosol data for Mascot 2000- 2005

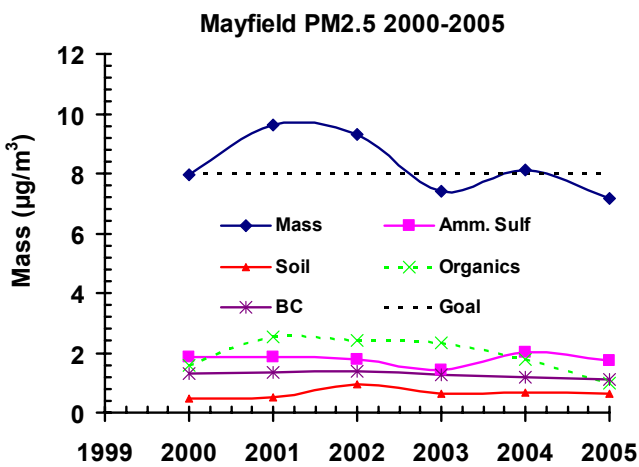


Fig. 3. PM_{2.5} ambient aerosol data for Mayfield 2000- 2005

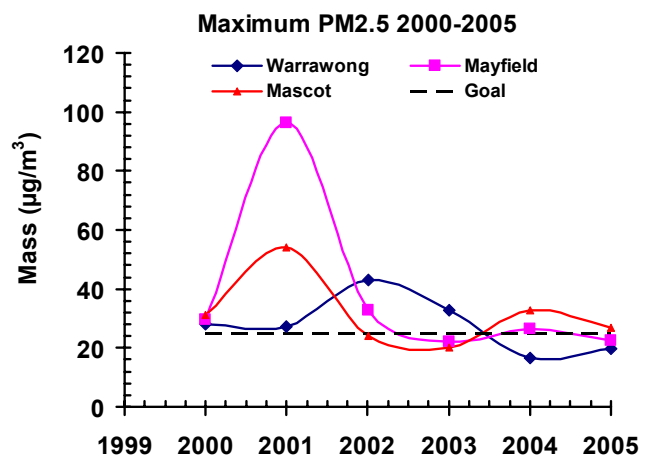


Fig. 4. Max PM_{2.5} ambient aerosol data for 3 sites 2000- 2005

The Ion Beam Analysis (IBA) techniques measure sufficient number of elements for us to be able to determine the average chemical composition of the ambient fine particle mass. Table 2 below shows the 5 year average composition for the major aerosol components for the three sites. The missing mass is mainly composed of nitrates which are not measured by our IBA methods, trace elements such as Zn, K, Cu, Cr, Mn, Pb etc... and water vapour. The composition at the three coastal sites was very similar with sea spray, windblown soil, black carbon or soot, ammonium sulfate and organics making up more than 80% of the fine aerosol.

Table 2. 5-year average composition of PM_{2.5} ambient aerosols

PM _{2.5} – 5yr Average	Warrawong	Mascot	Mayfield
Mass (µg/m ³)	6.8±0.6	8.5±0.8	8.3±1
Sea Salt (NaCl)	(16±4)%	(14±4)%	(13±6)%
Black Carbon (BC)	(13±1)%	(21±2)%	(15±2)%
Soil	(11±1)%	(5.3±0.8)%	(7.8±2)%
Ammonium Sulfate	(30±3)%	(21±2)%	(22±3)%
Organics	(13±5)%	(23±4)%	(23±6)%

Short Term US EPA NAAQS Standards for Airborne Particulate Matter

Index (NAAQS)	TSP (µg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/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_{2.5}
8 µg/m³ annual and 25 µg/m³ 24-hr average



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

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sto.gov.au/ansto/environment1/iba/index.html

Further information can be obtained at the addresses given in the header or ad in this ASP Newsletter.