Fine particle aerosol and black carbon in Suva, Fiji

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Road vehicles and the widespread burning of wastes are major air pollution sources implicated in Suva, Fiji's capital and the largest city in the South Pacific Islands. This study is the first to investigate the levels and sources of fine particulate matter ($PM_{2.5}$) in Suva. Elemental concentration has been determined using ion beam analysis and black carbon (BC) was estimated by the transmission of [He/Ne] laser light (633 nm wavelength). Results will be interpreted by Positive matrix factorisation (PMF) to identify the contribution of receptor source groups.

Suva is located on a peninsula, in the southeast of Viti Levu, the largest of the Fiji Islands. Suva city centre is on the west side of the peninsula. Prevailing winds are from the east-southeast. Continuous monitoring of fine aerosol ($PM_{2.5}$) levels has occurred over a 12-month period, from October 2014, at three locations across Suva (Figure 1); city, residential (Kinoya) and background (University of the South Pacific - USP); using Turnkey Osiris samplers. Wind speed and direction have also been monitored at each site, allowing comparison of meteorology with periods of elevated $PM_{2.5}$. $PM_{2.5}$ samples have been collected at the city site, using an ANSTO Aerosol Sampling Program (ASP) sampler, for 24-hours each Wednesday and Sunday. Intermittent samples have been collected at the Kinoya and USP sites using an Ecotech Microvol (Mvol) sampler.

USP is located on the east of the peninsula and is mainly characterised by winds from the ocean. Kinoya is a more densely populated residential area, west of diesel-fuelled power plants. Kinoya displays less windy conditions than the other sites, impeding the dispersal of air pollutants. The Suva bus terminal, city markets, an industrial area and shipping port activities all lie within 1 km of the City site.

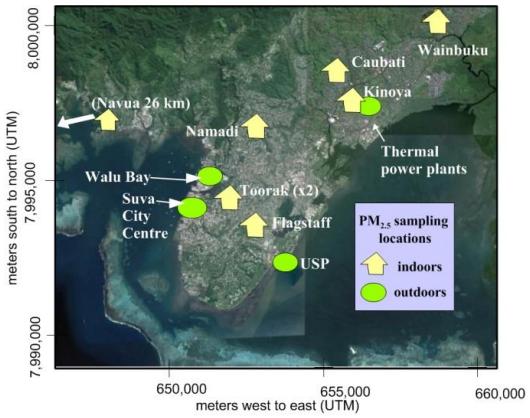

Figure 1. Sampling locations

ASP samples collected at the City site indicate ambient weekday $PM_{2.5}$ concentrations of 8.6 ± 0.4 μg/m^3 (Table 1). Weekend concentrations were lower, at 6.0 ± 0.3 μg/m^3. Continuous monitoring indicates that World Health Organisation (WHO) guidelines (10 μg/m^3 as an annual mean) and Australian guidelines (8 μg/m^3 as an annual mean) may be exceeded in some areas of Suva. $PM_{2.5}$ and BC concentrations for eight indoor locations (Figure 1, using Microvol) have also been determined.

Table 1. Fine aerosol and black carbon concentration

Site	Sampler	$PM_{2.5}$ (μg/m^3)	BC (μg/m^3)	n sample (BC)
City	ASP			
	weekday	8.6 ± 0.4	2.6 ± 0.2	66
	weekend	6.0 ± 0.3	1.8 ± 0.1	54
City	Osiris	10.1 ± 0.5	3.2 ± 0.5	4 (Mvol)
Kinoya	Osiris	11.9 ± 0.5	2.6 ± 0.3	6 (Mvol)
USP	Osiris	5.1 ± 0.2	0.5 ± 0.2	6 (Mvol)

Black carbon constitutes around 30 % of $PM_{2.5}$ mass for Suva City samples, indicating combustion sources as major contributors to Suva's fine aerosol. Household emission surveys report that waste burning is practiced by around 53% of Suva households and that 41% of households cook with kerosene or wood; whilst Campbell (2004) reports 40 % of cars and over 90% of other vehicles in Suva to emit visible smoke. This prevalence of human-influenced emission sources means there is significant potential for emission reduction.

Observed levels of BC and $PM_{2.5}$ concentrations are unexpected for a city of only 200,000 people; that is also geographically isolated from other centres. PMF determination of receptor source contributions to Suva's fine aerosol provides information necessary to implement more effectively targeted emissions controls.

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Campbell, A. (2004) *Road safety reform and safety improvement*, TA No. 2850-FIJ Department of Environment and Ministry of Transport and Civil Aviation.