

Scientific Issues Related to Atmospheric Deposition and Receiving Water Quality

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Overview

- Atmospheric deposition certainly contributes to (causes?) water quality impairment
- Need additional study on toxicity and impacts
- Ability to use science, data to prioritize control efforts

Atmospheric deposition fluxes of metals are high

Atmospheric Deposition to Los Angeles Basin Watersheds

	Chromium	Copper	Nickel	Lead	Zinc
<u>Atmospheric Deposition (MT/Year)</u>					
Los Angeles River	3.0 (2.1-3.9)	16 (10-22)	3.7 (2.4-5.1)	12 (6-18)	80 (54-110)
Ballona Creek	0.56 (0.37-0.75)	3.5 (2.0-5.0)	0.59 (0.39-0.79)	2.1 (1.1-2.8)	13 (12-15)
Dominguez Channel	0.9 (0.24-1.6)	2.1 (1.6-2.6)	0.9 (0.33-1.5)	1.6 (-0.1-3.3)	9.4 (3.8-15)
Lower Santa Ana River	0.78 (0.47-1.1)	3.8 (3.0-4.6)	0.9 (0.6-1.2)	1.6 (1.0-2.3)	37 (11-64)
Malibu Creek	0.10 (0.09-0.1)	0.35 (0.32-0.38)	0.13 (0.10-0.15)	0.14 (<DL-0.14)	1.4 (1.3-1.5)
<u>Stormwater Runoff (2)</u>					
Los Angeles River	0.68	3.11	0.86	1.04	17.30
Ballona Creek	0.17	0.72	0.21	0.23	3.72
Dominguez Channel	0.13	0.65	0.17	0.23	4.00
<u>Watershed Transmission Efficiency (3)</u>					
Los Angeles River	23%	19%	23%	9%	22%
Ballona Creek	30%	21%	35%	11%	29%
Dominguez Channel	13%	31%	18%	14%	43%

Source: Sabin, L. D., Schiff, K. C., Lim, J. H., Stolzenbach, K. D., "Atmospheric dry deposition of trace metals in the Los Angeles coastal region," Southern California Coastal Water Research Project Biennial Report 2003-2004, Dec. 2004, p.50-60.

Fires release significant quantities of metals, dioxins, PAHs

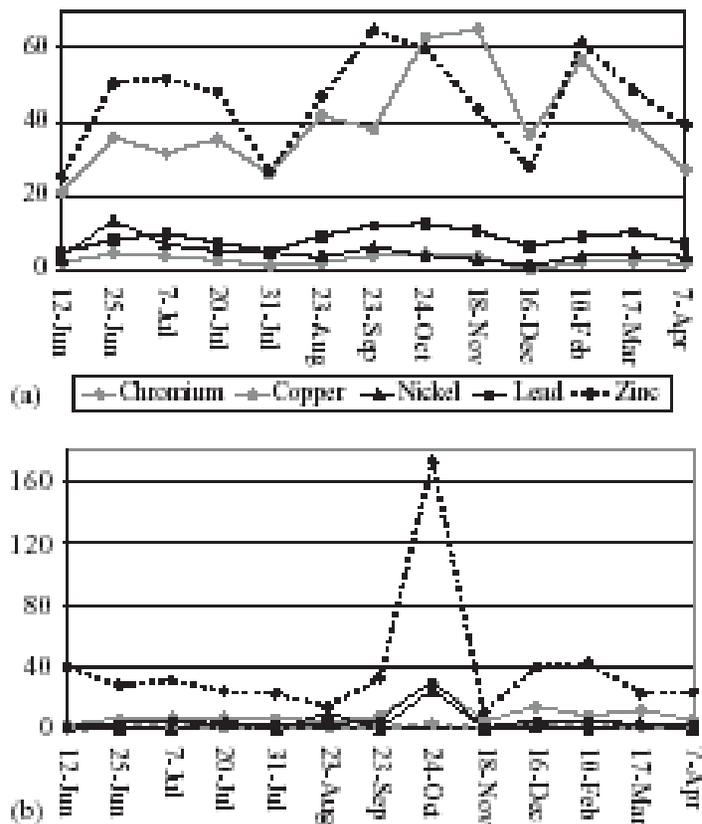


Fig. 2. Time series of (a) dry deposition flux in $\mu\text{g}/\text{m}^2/\text{day}$ (MDL = 0.01) and (b) atmospheric concentration in ng/m^3 (MDL = 0.03) based on sampling times/air volumes collected.



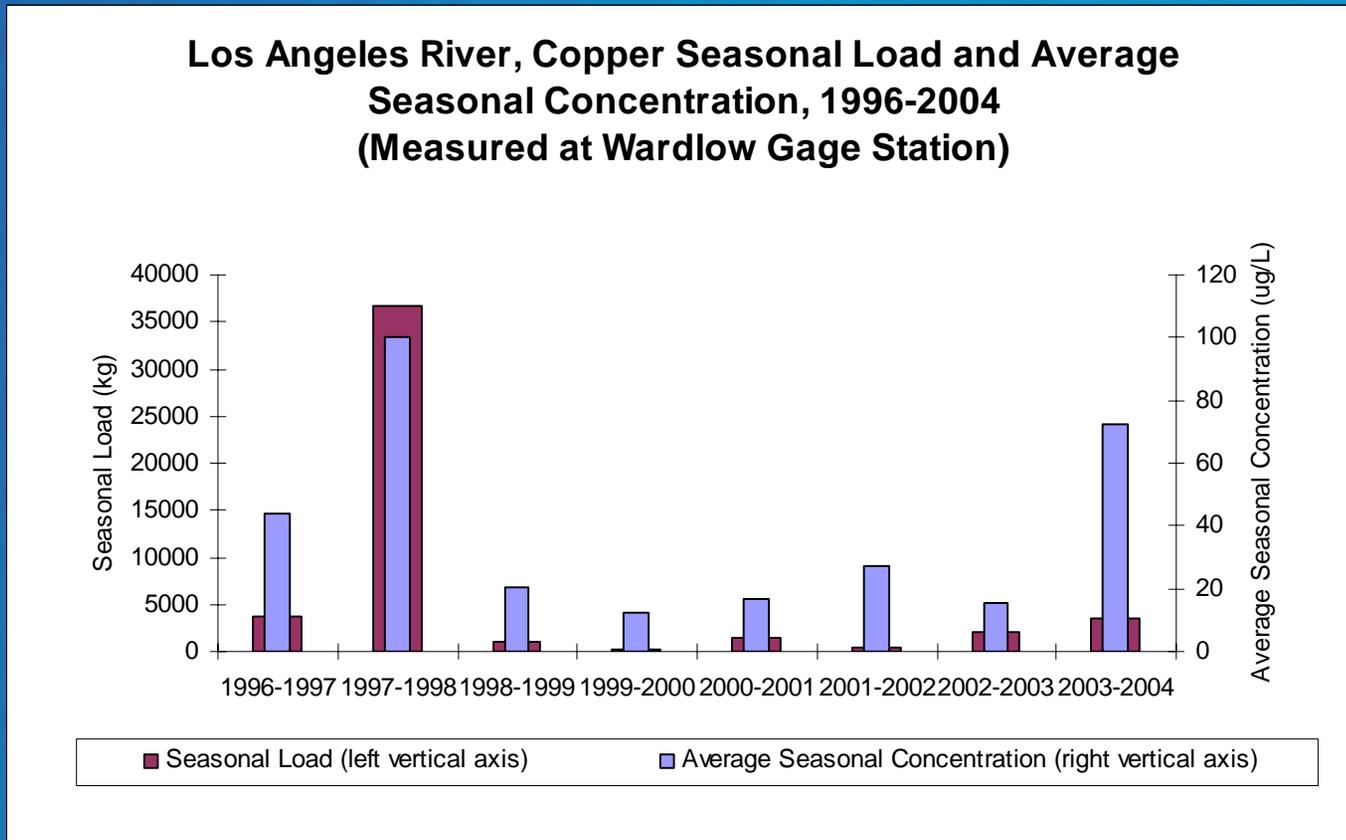
NASA Satellite Picture of Southern California Bight, October 27, 2003

Source: Sabin, L.D., Lim, J.H., Stolzenbach, K. D., Schiff, K. C., "Contribution of trace metals from atmospheric deposition to stormwater runoff in a small impervious urban catchment." *Water Research*, (39), 2005, p.3929-3937, 2005.

Dioxins in storm flows likely from atmospheric deposition

- Storm water dioxin concentrations in Santa Monica Bay catchment range from 7×10^{-7} ($\mu\text{g/L}$) TEQ to 5.3×10^{-5} ($\mu\text{g/L}$) TEQ [Fisher et al. (1999)]
- Surface water dioxin concentrations between 1.68×10^{-8} ($\mu\text{g/L}$) TEQ and 1.29×10^{-3} ($\mu\text{g/L}$) TEQ [LARWQCB database]
- CTR limit is 1.4×10^{-8} ($\mu\text{g/L}$)
- Largest source is combustion processes, including waste incineration, motor vehicle exhaust, domestic heating fires, and forest fires
- Atmospheric deposition is widespread

“Transmission efficiency” and mass flux are variable



Source: LACDPW Integrated Receiving Waters Impact Reports 1994-2000, 1994-2005, and Annual Storm Water Reports 2000-01, 2001-02, 2002-03, 2003-04. On line at http://ladpw.org/wmd/NPDES/report_directory.cfm

Atmospheric deposition may be predominant storm water source

- SCCWRP estimates of transmission efficiency of metals:
 - 10-40% in LA area in 2003 storm season
 - 57-100% from impervious, small area in 2004
- Mass loadings are greater in wet years, and likely contain mass accumulated over multiple years
- Both urban and natural sources (such as wild fires) contribute

Ability to control pollutants in storm water is limited

- BMPs generally remove coarse particles but not dissolved pollutants
- Source control is often more efficient
- Removing very low concentrations in water is very difficult
 - High flows and volumes over very short periods of time
 - Difficult to remove dissolved phase
- If atmospheric deposition to natural areas is a significant source of pollutants in storm flows, compliance may be impossible

Toxicity is likely dependent upon particle size

- Most pollutant mass is associated with fine particles
- Most toxicity and availability is associated with fine particles
- Indications are that CTR limits (aquatic life protection) are overly protective

Most information on atmospheric deposition is for the fine fraction

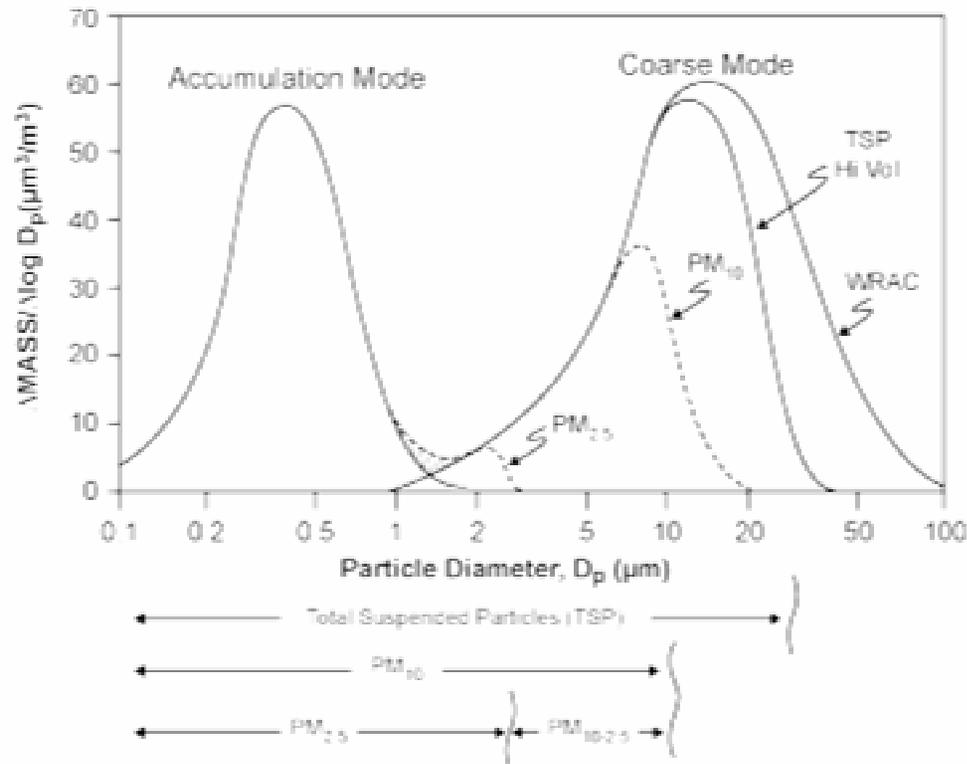


Figure 2-2. An idealized distribution of ambient PM showing fine and coarse particles and the fractions collected by size-selective samplers. (WRAC is the Wide Range Aerosol Classifier which collects the entire coarse mode).

Source: Adapted from Wilson and Suh (1997) and Whitby (1978); CD page 2-18

Preliminary draft WERs (dry weather) indicate that CTR limits for metals are likely overly protective

Location	Cu Water Effect Ratio	
	Low	High
Tillman WRP	4.4	5.0
Burbank WRP	4.2	5.0
LA Glendale WRP	4.6	5.1
LA River at Rosecrans	6.5	10.2
LA River at Willow	8.4	14.2

Dissolved v. total metals also determines toxicity

- CTR assumes most metals are present in dissolved phase
- Data indicate that CTR conversion factors (CFs) are overly conservative
- If most metals deposited from the atmosphere are present in storm flows in particulate form, impacts are likely smaller than predicted by CTR

Suggested scientific approach

- Evaluate atmospheric deposition fluxes and pollutant mass fluxes as a function of particle size
- Evaluate transmission efficiencies, including from natural areas
- Evaluate relationship between toxicity (impact) and particle size
- Evaluate sources of pollutants

How can we improve water quality most efficiently?

- Use scientific information to target control strategies
- Employ a combination of air and water controls
- Target controls that will have greatest impact on toxicity (actual impairment)