

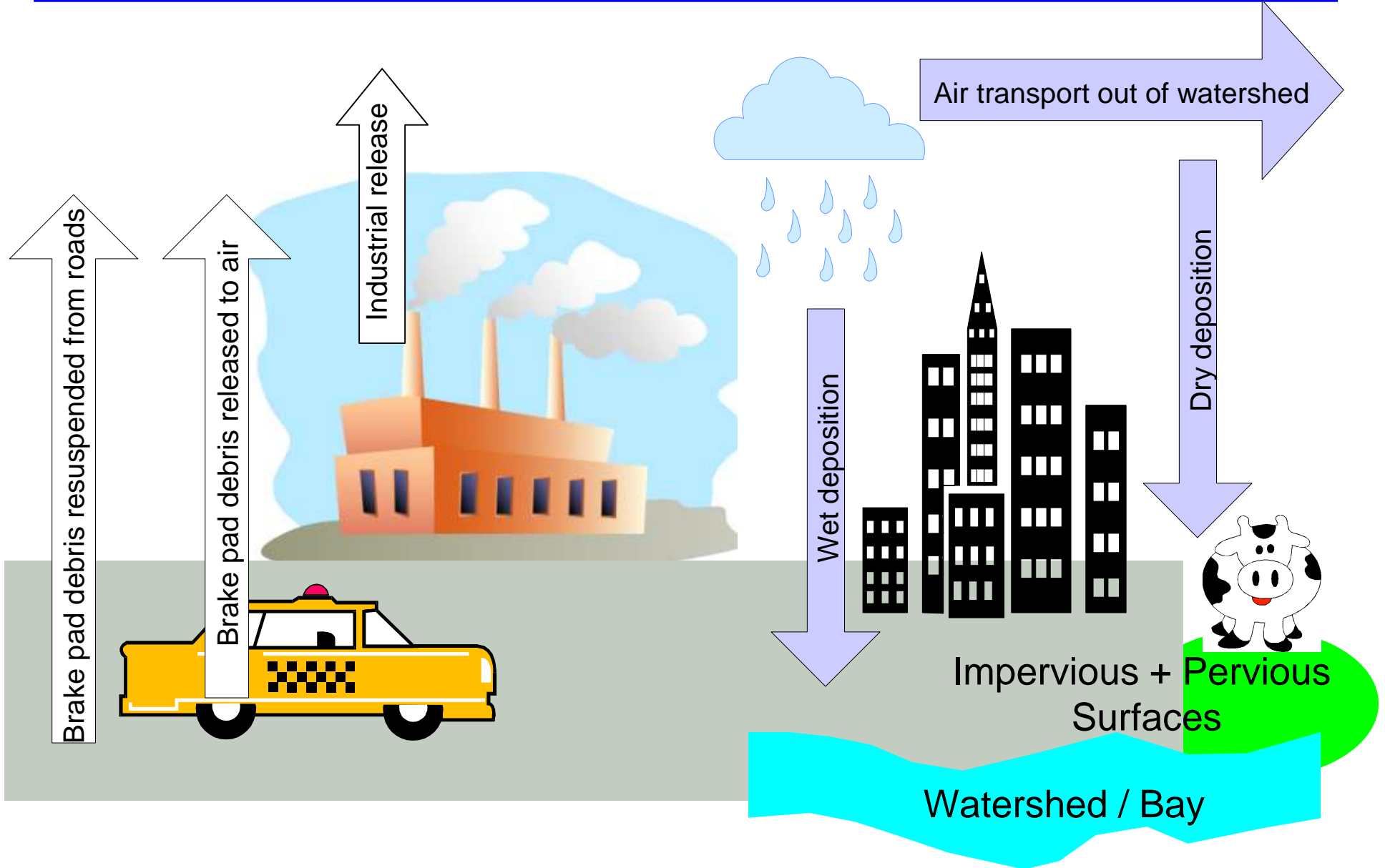
Air Deposition Modeling

Brake Pad Partnership Stakeholder Conference 2007

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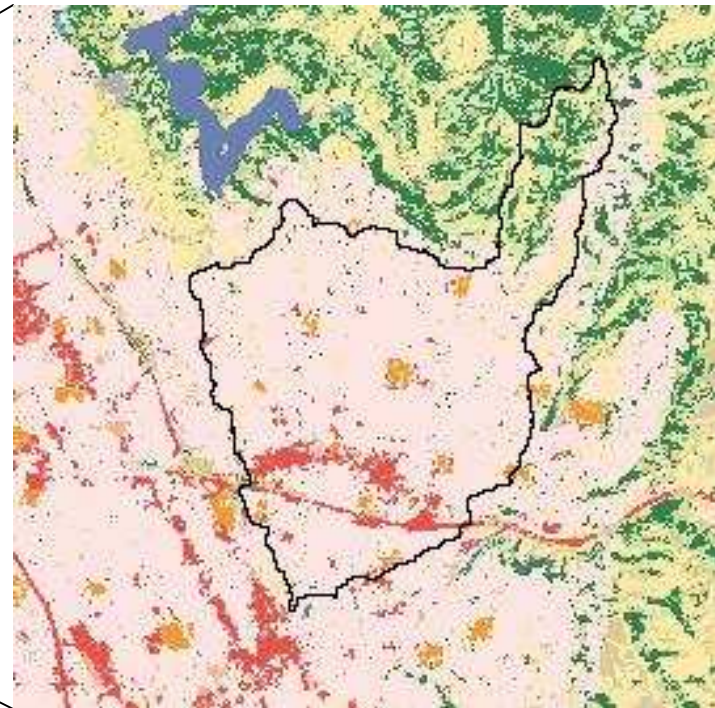
Fate of Copper in the Air Transport & Deposition



Regional and Local Study Domains



San Francisco Bay Area
Well-mixed box model



Castro Valley
Gaussian Plume Model

- I-580: line source
- Streets: area source

- **Source term**
 - Spatially (highway vs. surface streets) and temporally (uniform over time) distributed
 - Particle size distribution
- **Terrain and land use**
 - Road surface to estimate resuspension (12 % in CV)
- **Meteorological data: NCDC hourly data**
 - Surface and upper air
 - Temperature, pressure, relative humidity, precipitation, wind speed, wind direction, stability category
- **Ambient deposition measurements**
- **Estimates of uncertainties used to investigate sensitivities of model results**

Brake Pad Source Term

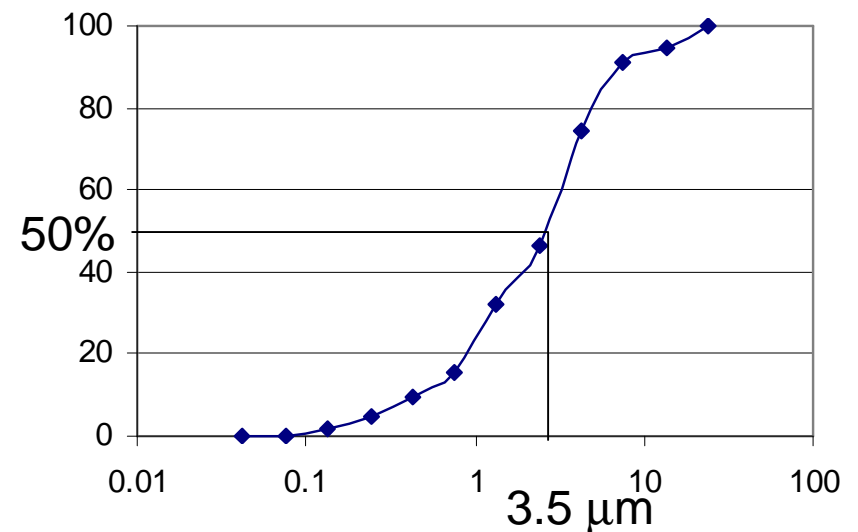
- Direct source = Emission factor \times Traffic activity
(Rosselot, 2005)

grams of brake wear
debris emitted to air
per vehicle mile
traveled
- classes of vehicles

VMT

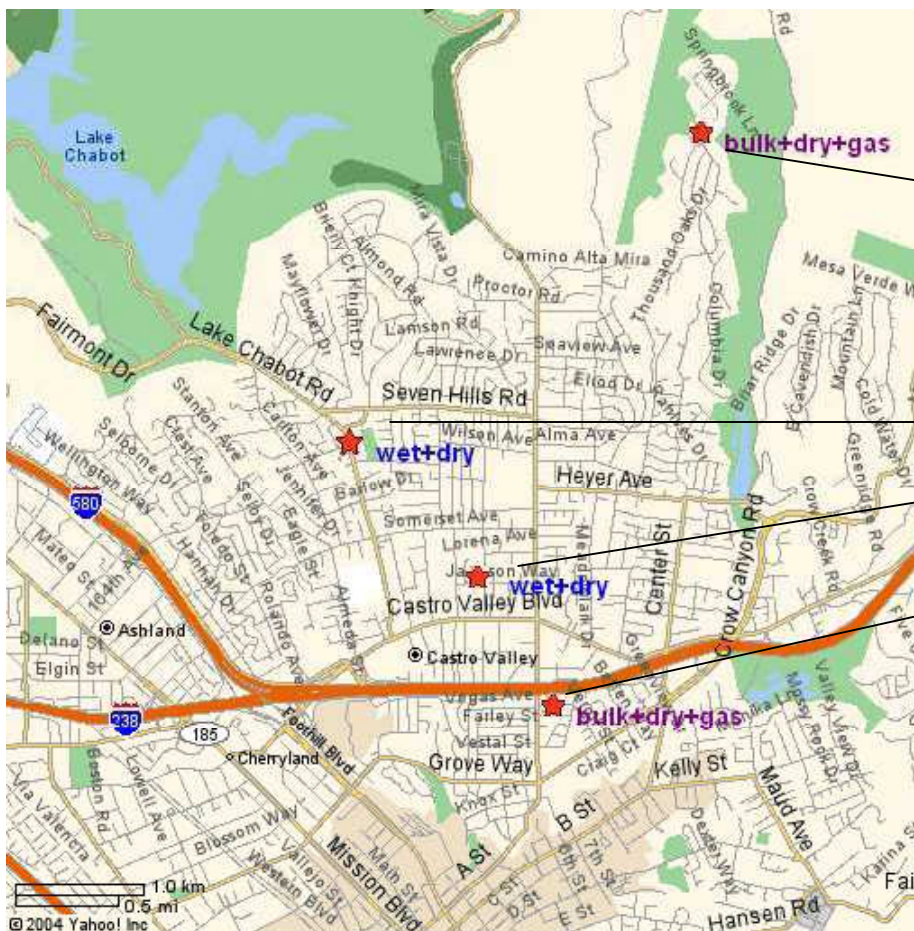
- surface vs. highway
- classes of vehicles
- weekdays vs. weekends
(sensitivity)

- Particle size distribution
(Haselden et al, 2004)

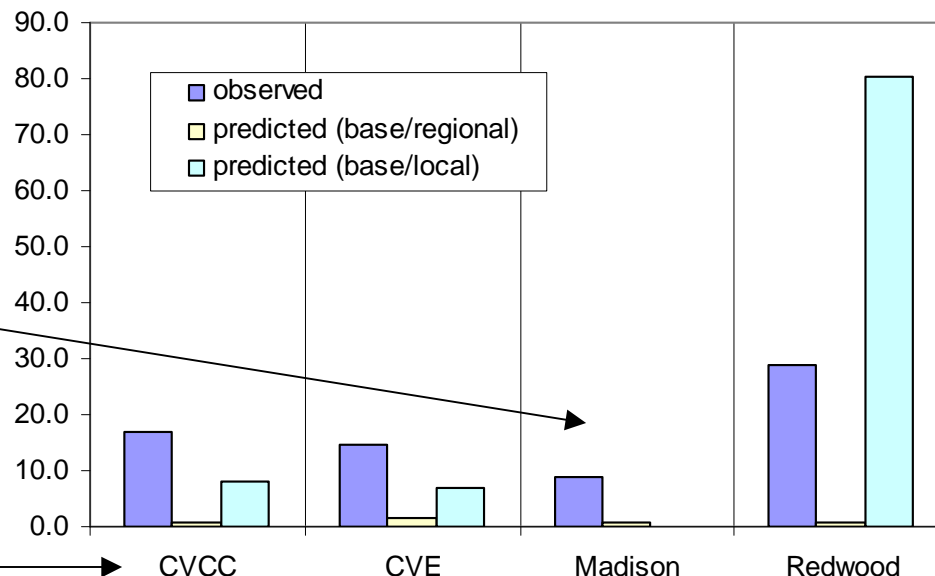


Comparison of Simulation Results with Dry Deposition Measurements (SFEI)

Dry deposition monitors



Average dry deposition (microgram/m²)

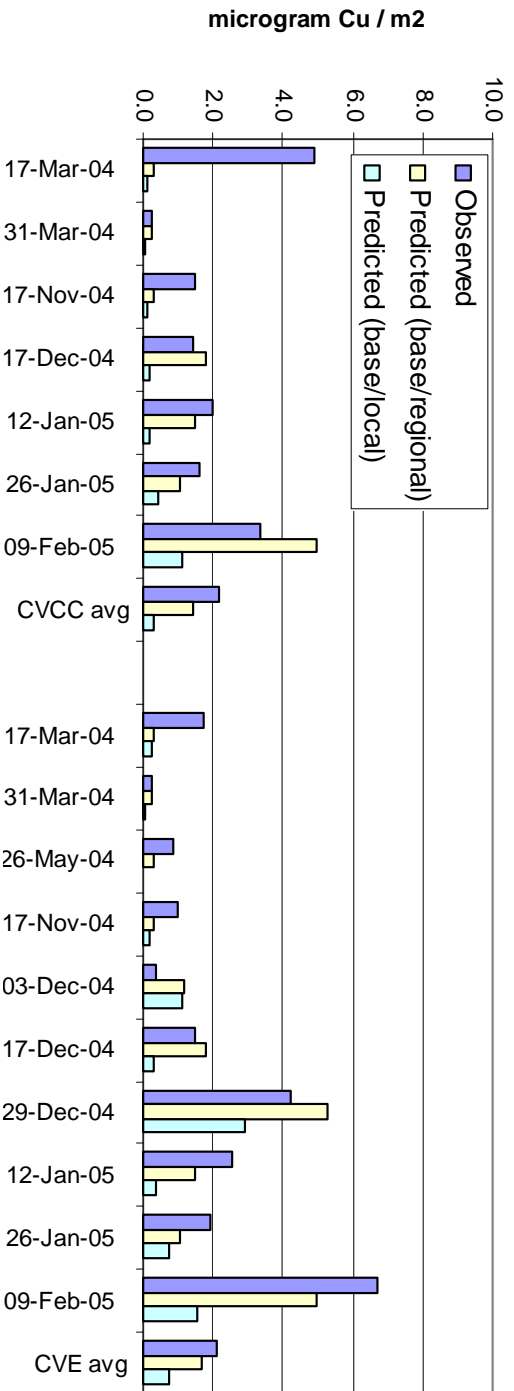
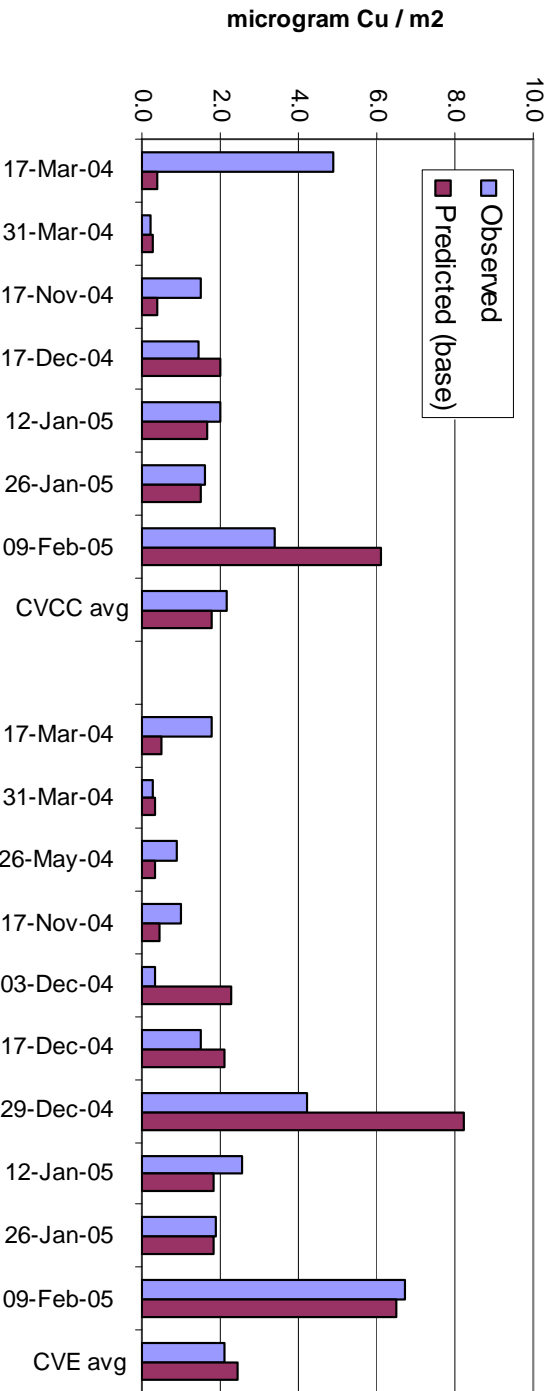




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Comparison of Simulation Results with Wet Deposition Measurements (SFEI)

Community Center (CVCC) Elementary School (CVE)



Parametric Sensitivity Studies

Tests

- **Copper content 6%±4%**
- Alternative rainfall/scaled wet deposition
- Spatial allocation, including more of I580
- Weekday/weekend allocation
- Reduce particle size
- Increase particle density
- Increase total emissions

Results

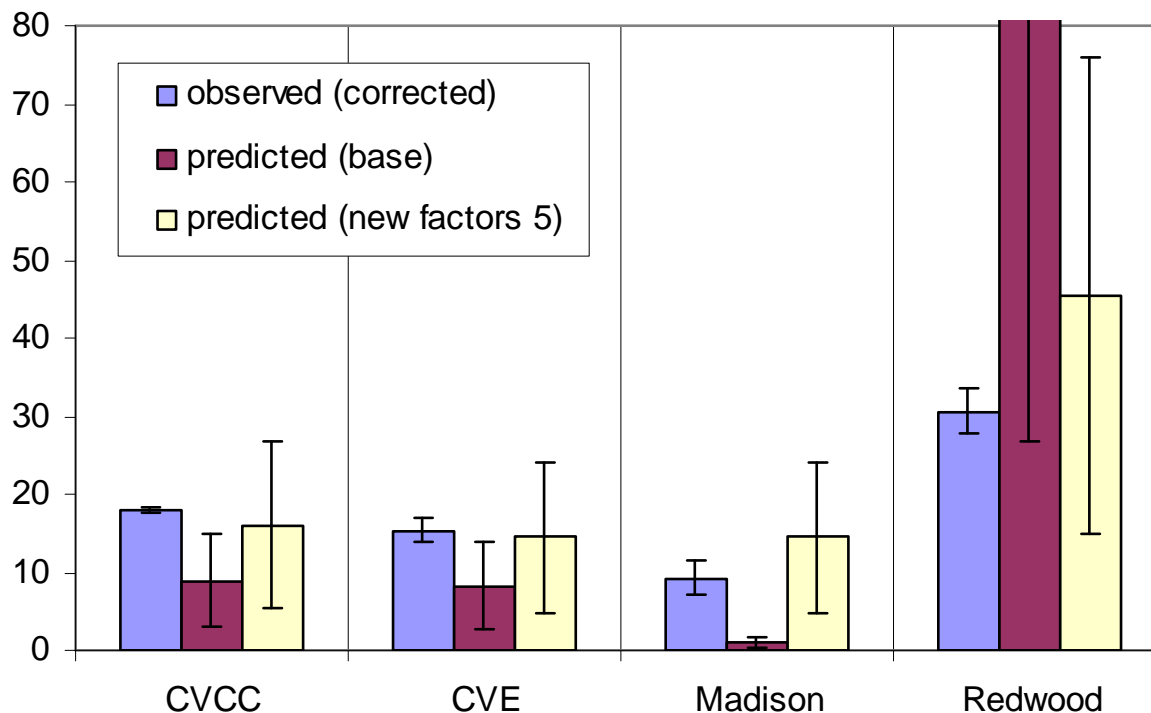
- **67% error bars on estimates**
- improvement during some periods; did not explain wet deposition variability
- small ↑ wet (CVCC > CVE) and dry deposition (Redwood > CVCC, CVE > Madison)
- negligible
- ↑ wet deposition; ↓ dry deposition
- ↓ wet deposition; ↑ dry deposition
- ↑ wet deposition; ↑ dry deposition

Known uncertainties change overall magnitude in the same direction at all sites, rather than to reduce site-to-site differences

Redistributing Brake Pad Emissions to Surface Streets

- Highway emission factor is assumed to be a factor of 5 less than that on surface streets (per VMT)

Average dry deposition (microgram/m²)



- Average air deposition fluxes ($\mu\text{g}/\text{m}^2/\text{day}$) in Castro Valley:

	<u>Wet deposition</u>	<u>Dry Deposition</u>
Regional	0.85	0.80
Local	0.30	16.5

- Average air deposition fluxes ($\mu\text{g}/\text{m}^2/\text{day}$) in SF Bay watersheds:

	<u>Wet deposition</u>	<u>Dry Deposition</u>
Max.	1.2	24.4
Min.	0.87	1.2

- Average air deposition fluxes ($\mu\text{g}/\text{m}^2/\text{day}$) to SF Bay

	<u>Wet deposition</u>	<u>Dry Deposition</u>
Regional	0.85	0.81