Estimated Atmospheric Dry Deposition of PCDDs and PCDFs

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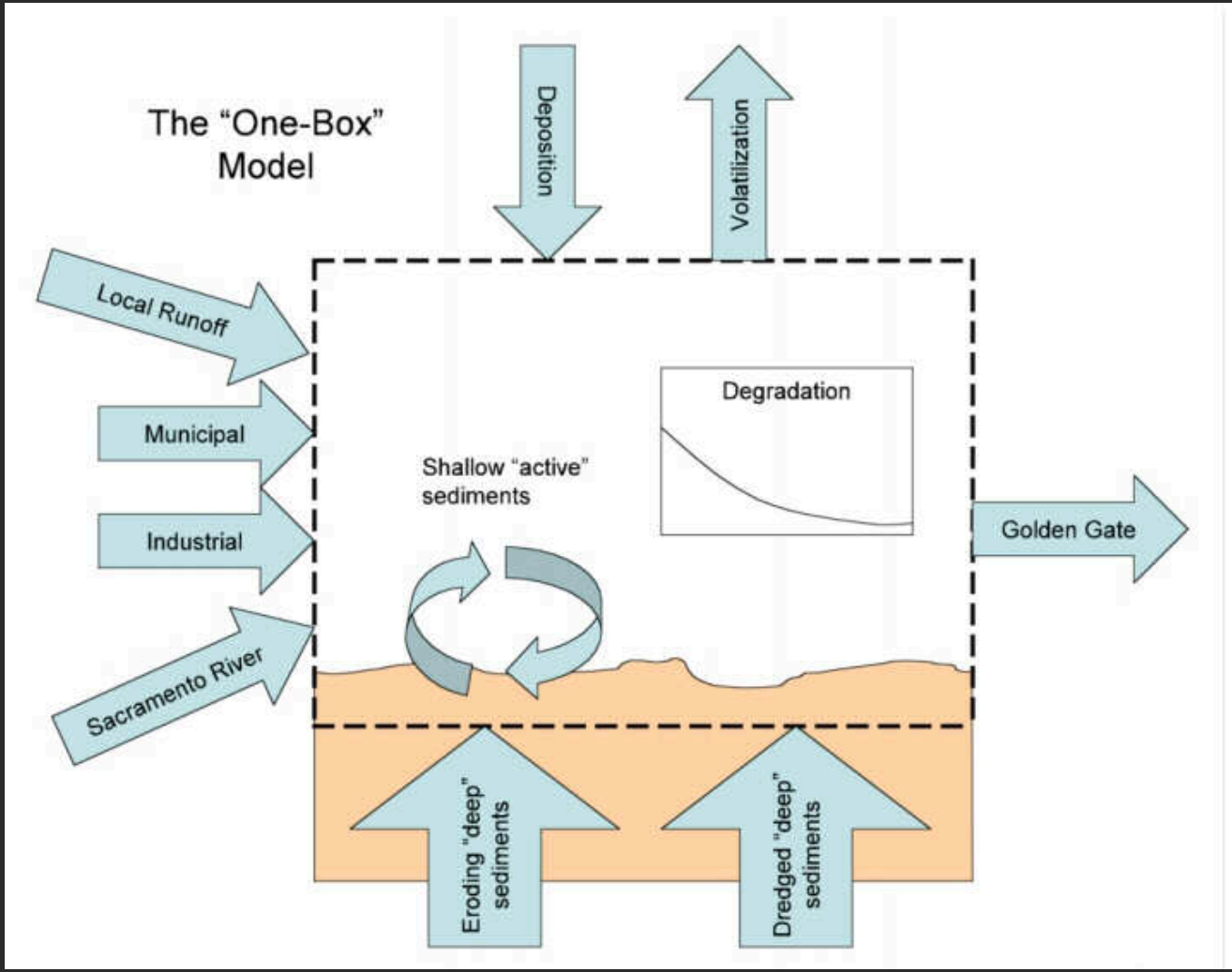
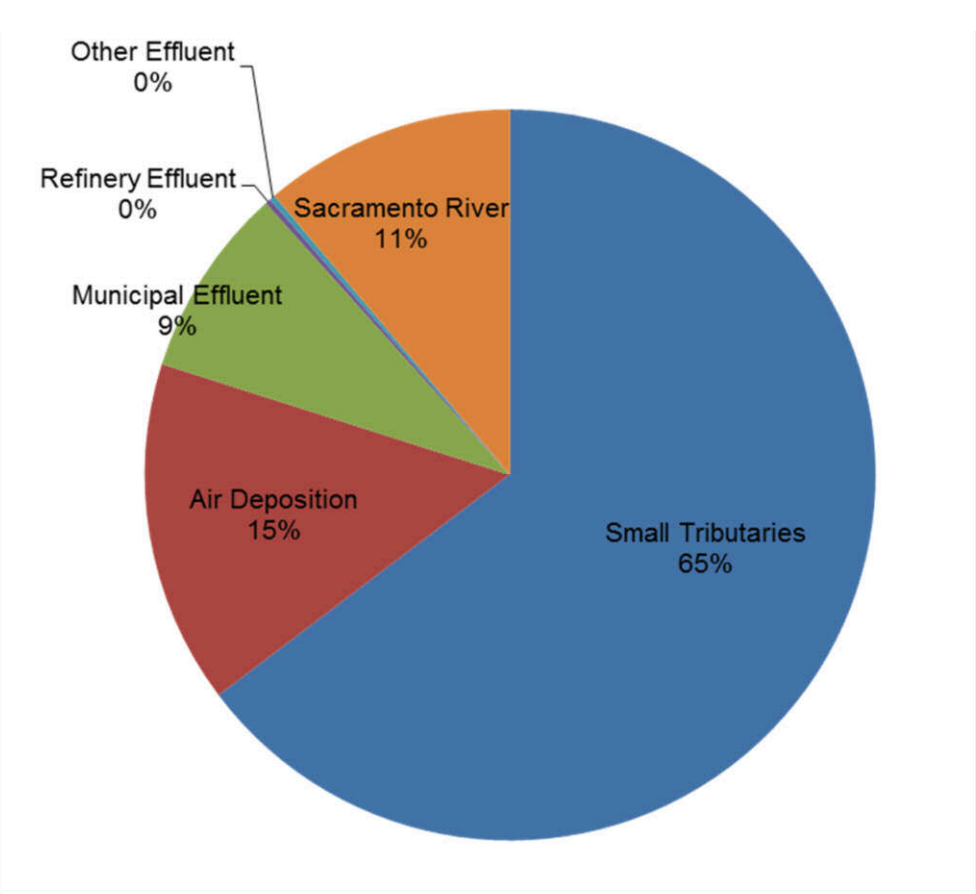
Dioxins in SF Bay

- Conceptual Model/ Impairment Assessment (Connor et al. 2004)



2004 Loading Estimates



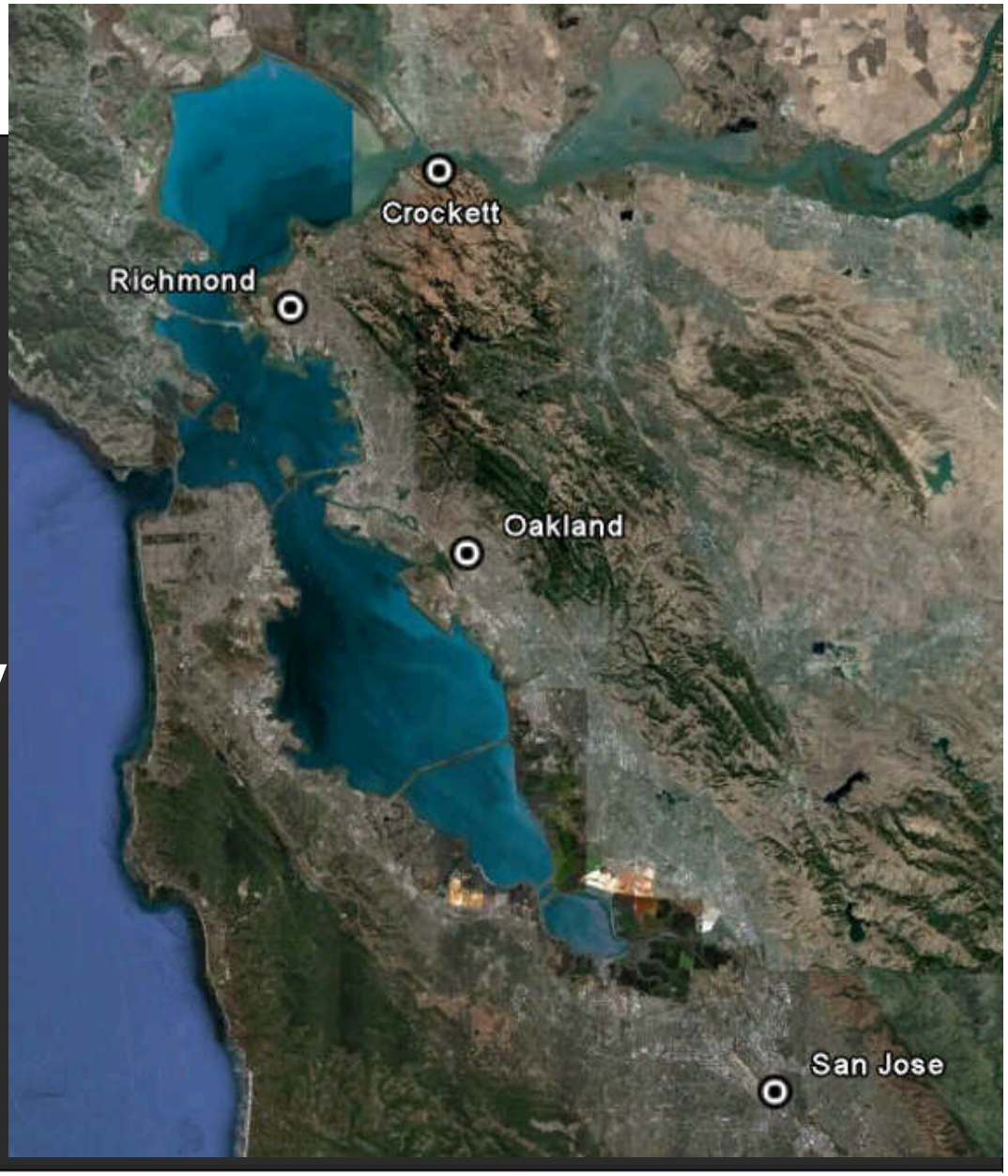
(g TEQ/ year)	Gervason and Tang 1998	Connor et al. 2004
Small Tributaries	5.1	5.1
Air Deposition	1.2	1.2
Municipal Effluent	0.13	0.67
Refinery Effluent	0.004	0.02
Other Effluent	-	0.02
Sacramento River	-	0.88
Total	6.4	7.9

Goal

- Develop an estimate of atmospheric dry deposition of dioxins to the surface of San Francisco Bay
  - Model deposition using existing data
  - Method used previously for PCB and PAH deposition (Tsai et al. 2002)

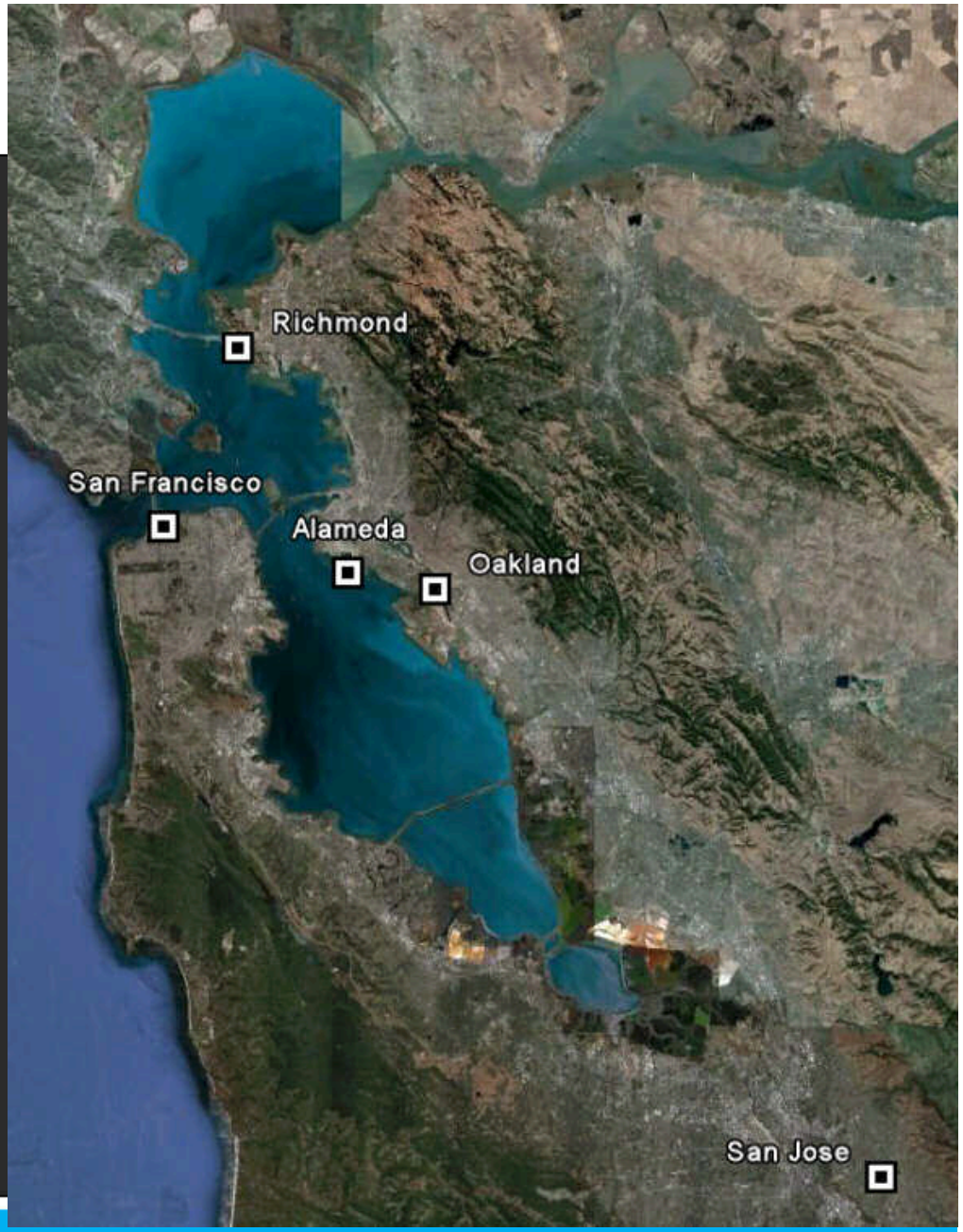
Dioxins in Air

- California Air Resources Board, Bay Area Air Quality Management District, and USEPA
- Total air concentrations collected monthly from December 2001 and May 2006
- Bay Area locations: Oakland, San Jose, Richmond, and Crockett



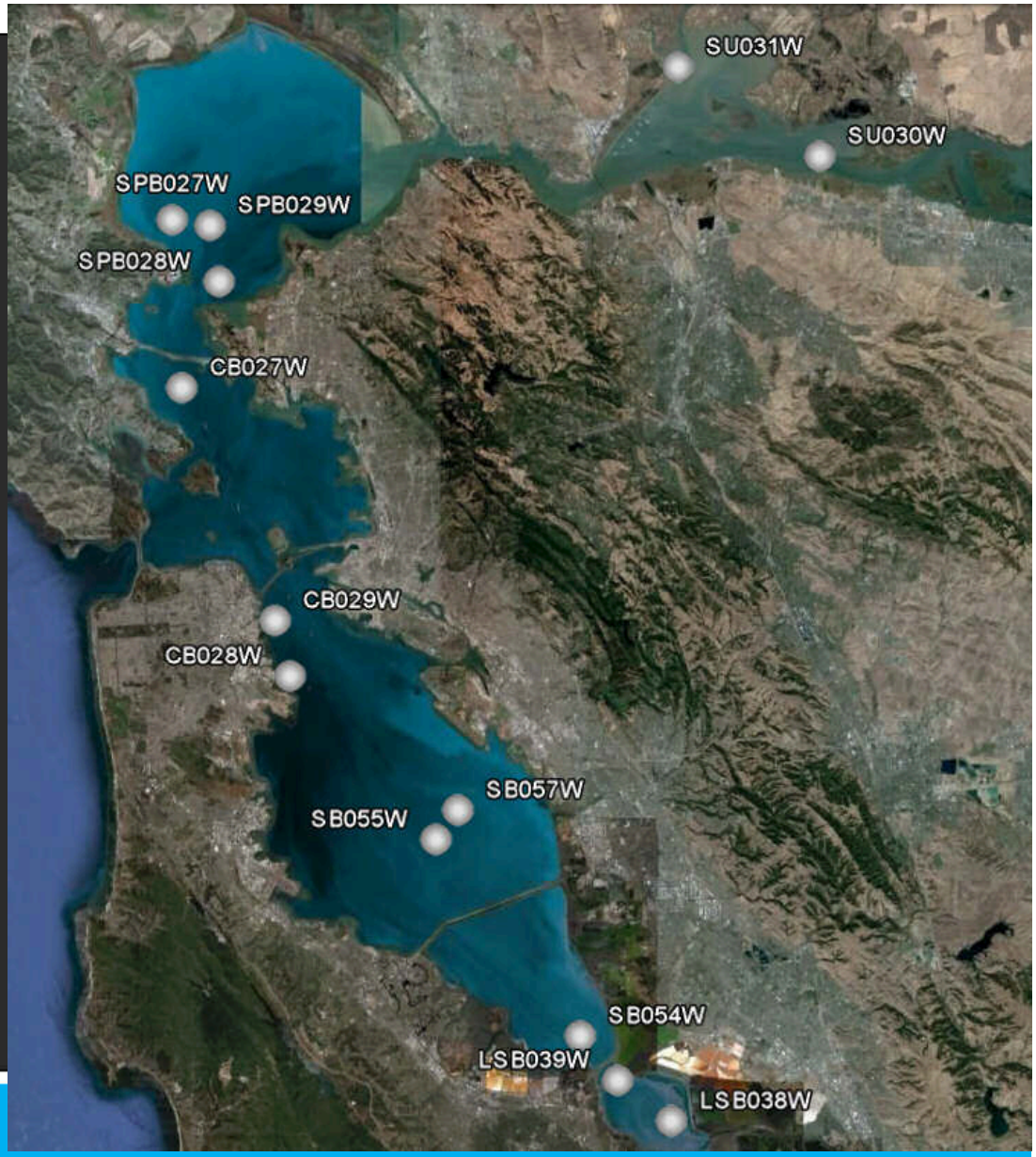
Climate Data

- NOAA National Climatic Data Center
- Wind speed and temperature
- Collected hourly from 2006-2009

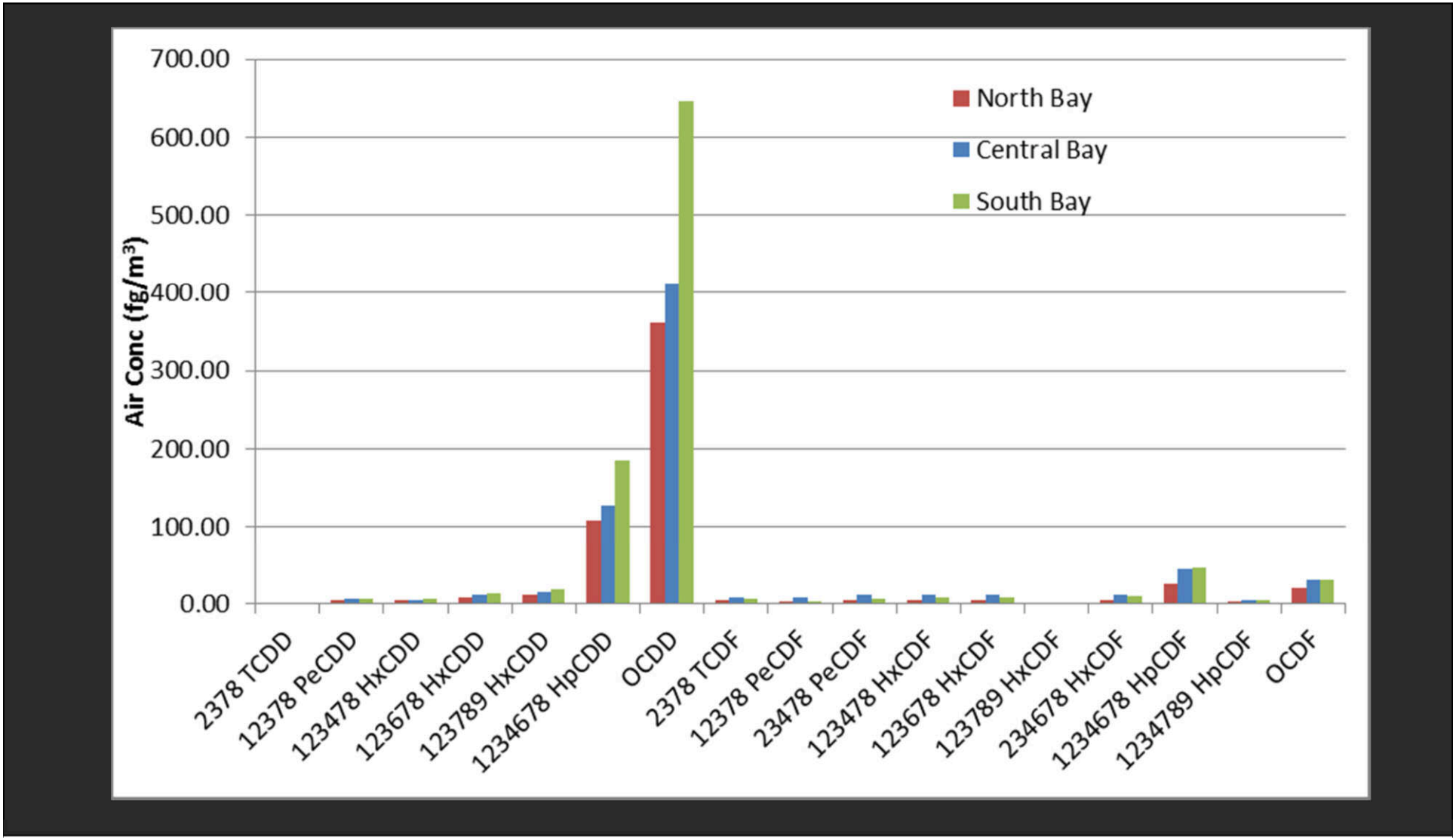


Dioxins in Water

- RMP 2009 Water Cruise
- Total Water concentrations (11 stations)
- Dissolved/ Particulate partitioning (2 stations)



Congener Profiles - Air Data



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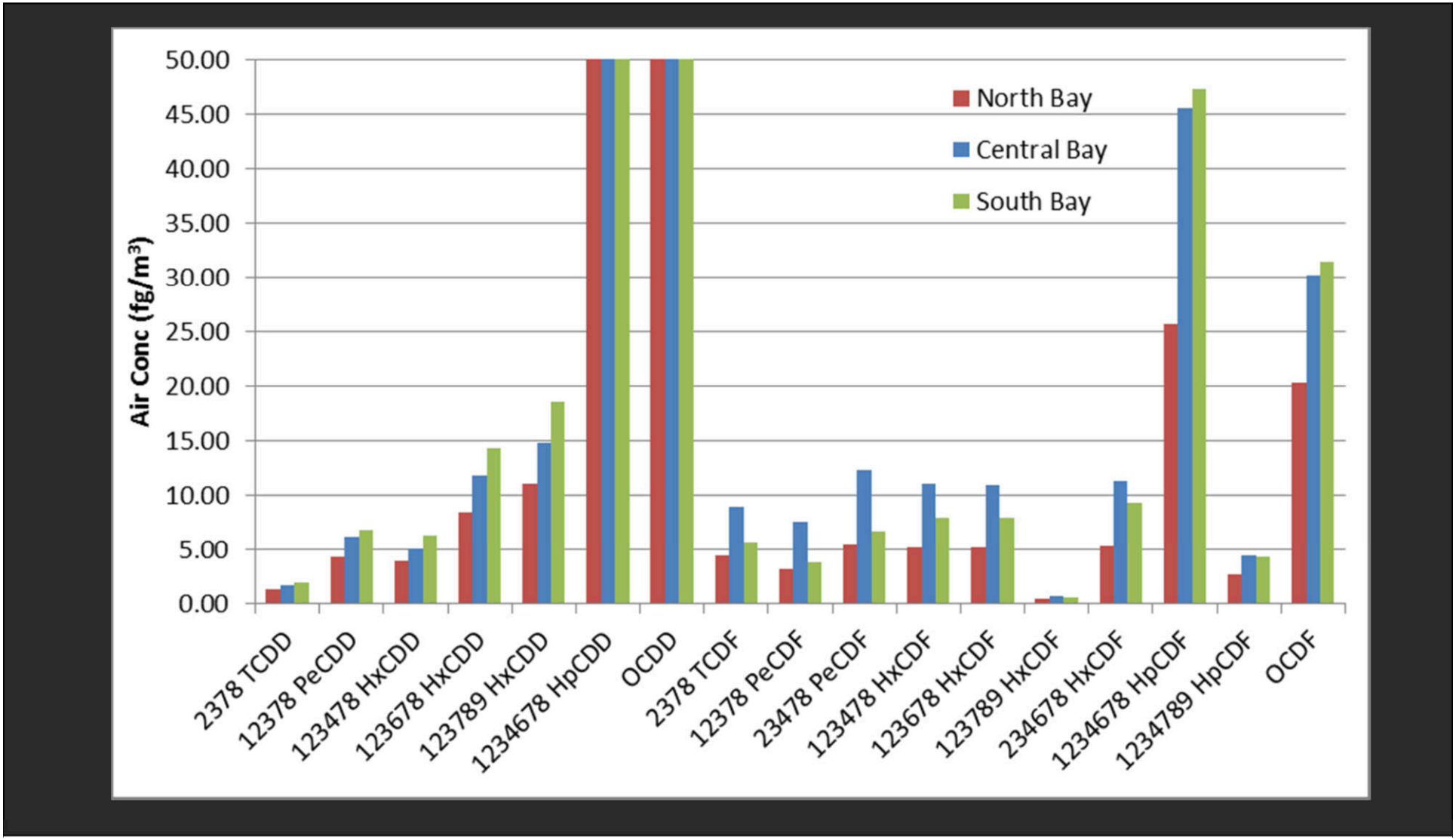
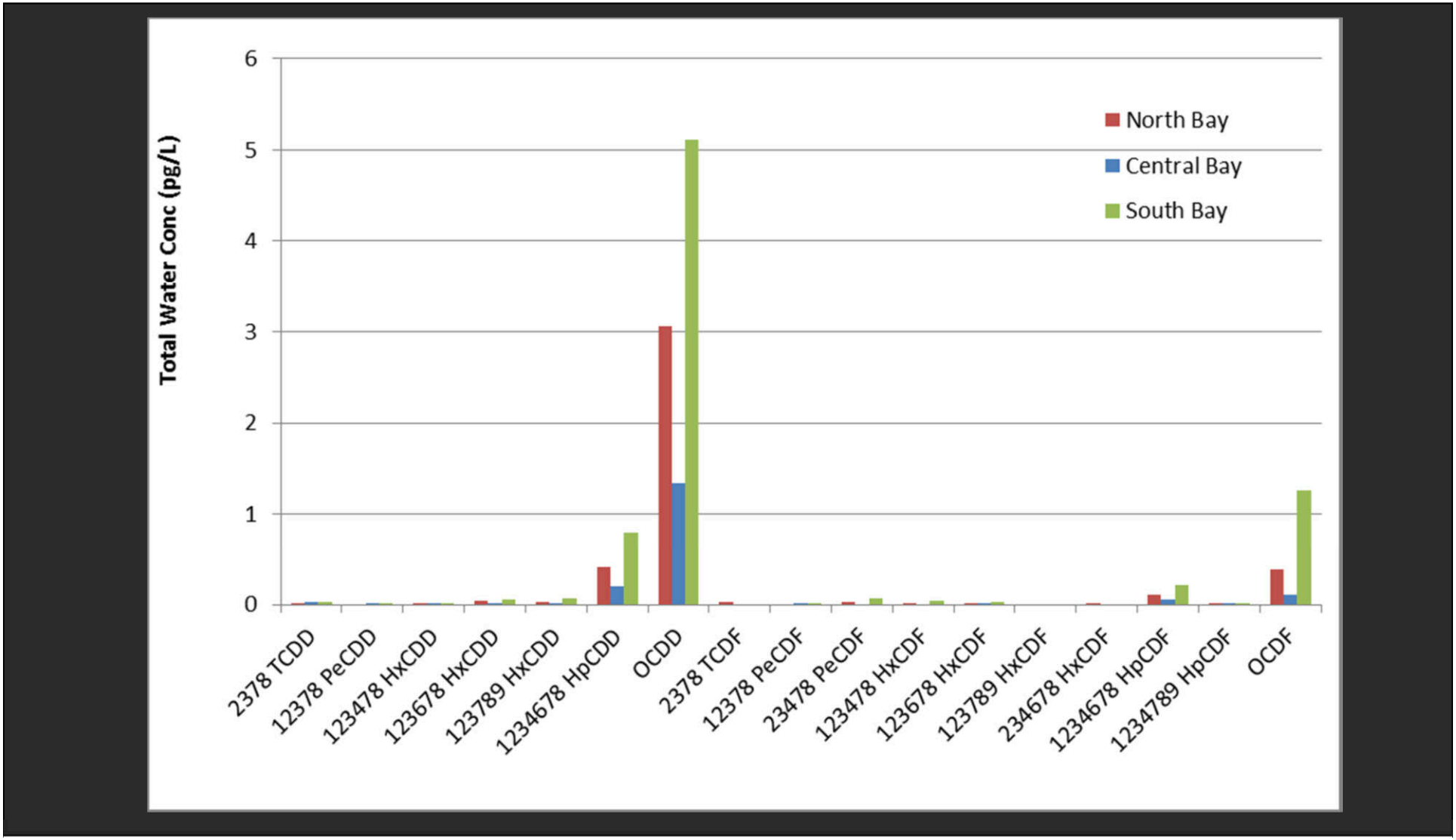


Congener Profiles - RMP Data



Net Loading

- Net loading = particulate loading + gaseous loading - volatilization

$$L(net) = L(p) + L(g) - V(g)$$

- Calculated for
  - Each congener
  - Each month
  - Each segment of the Bay (North, Central and South)

Particulate Dry Deposition

- Particulate loading = Area *
  air concentration partitioned to particles *
  particle deposition velocity

$$L(p) = \left(A * C(a,p) * V_d\right)/1000$$

- Sensitive to deposition velocity

Gas Absorption

- Gaseous loading = Area *
  air-water mass transfer coefficient *
  air concentration in gaseous form

$$L(g) = A * k_{OL} * C(a,g) * \frac{R * T}{H * 1000}$$

- Dependent on temperature and Henry's Law Coefficient for each congener

Volatilization

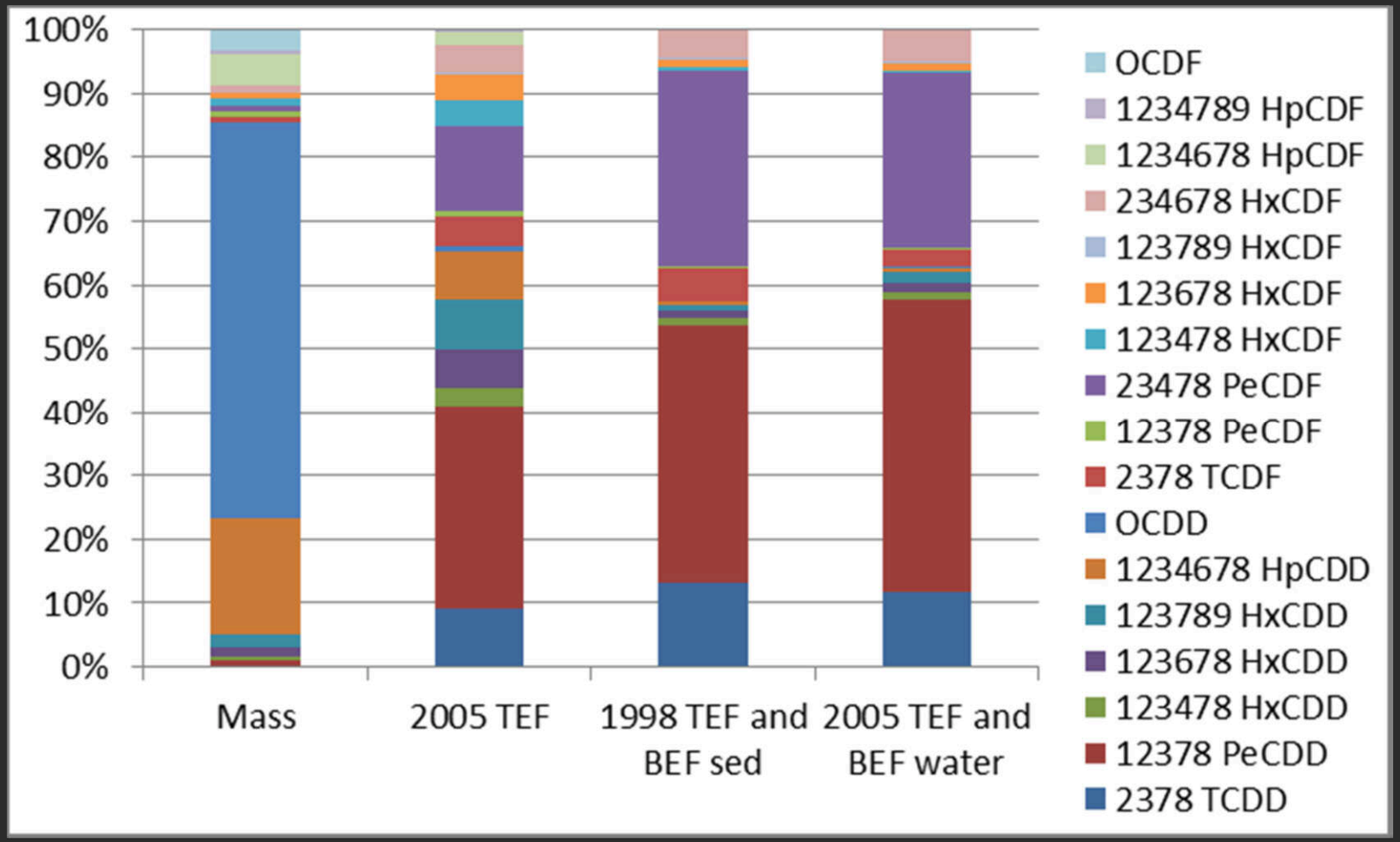
- Loss due to volatilization = Area * air-water mass transfer coefficient * dissolved concentration in water

$$V(g) = A * k_{OL} * C(w) * 1000$$

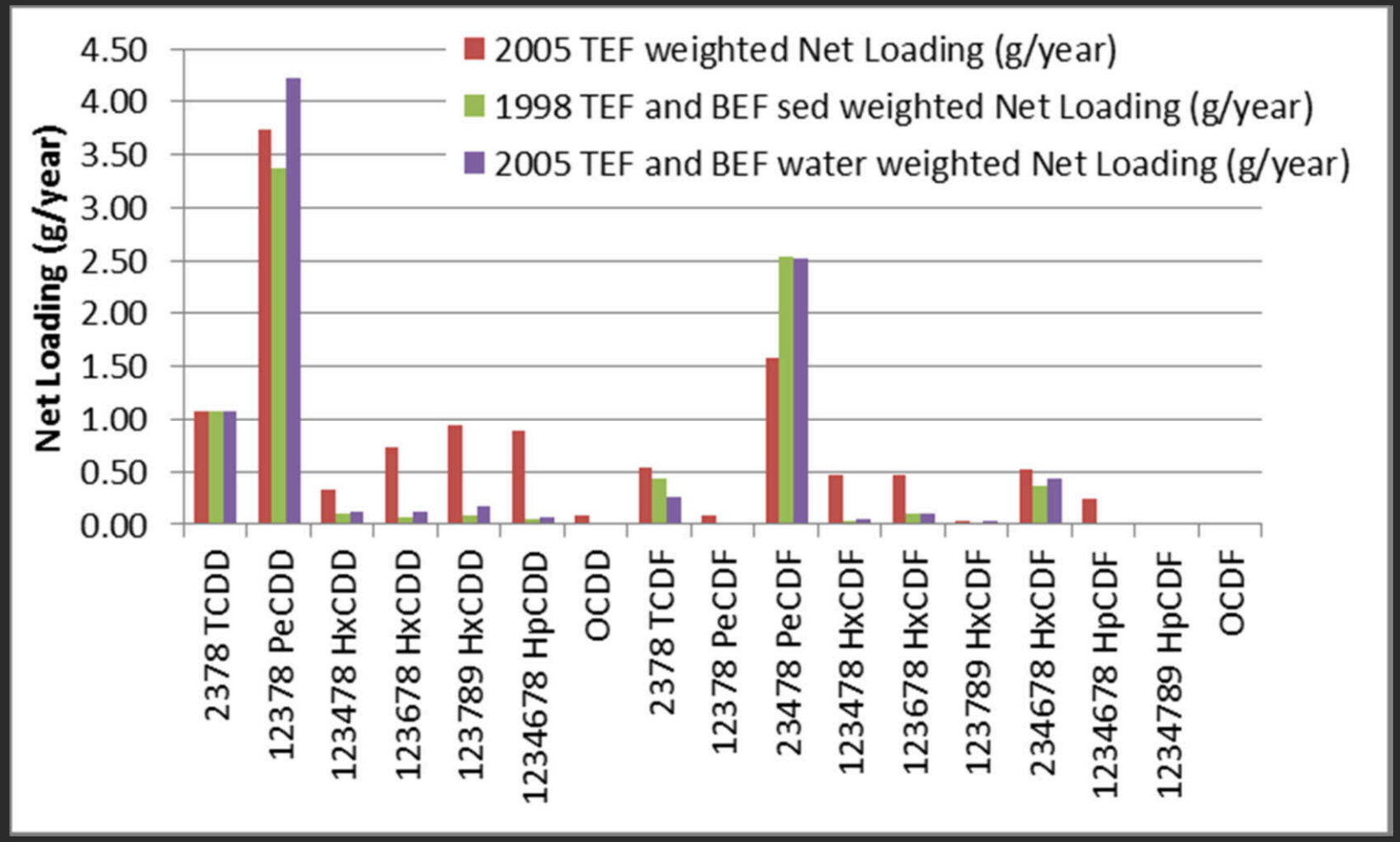
Net Loading

Congener	Net Loading (g/year)	2005 TEF weighted Net Loading (g/year)	1998 TEF and BEF sed weighted Net Loading (g/year)	2005 TEF and BEF water weighted Net Loading (g/year)
2378 TCDD	1.08	1.08	1.08	1.08
12378 PeCDD	3.74	3.74	3.37	4.23
123478 HxCDD	3.23	0.32	0.10	0.13
123678 HxCDD	7.23	0.72	0.07	0.12
123789 HxCDD	9.32	0.93	0.09	0.17
1234678 HpCDD	88.65	0.89	0.04	0.06
OCDD	303.29	0.09	0.00	0.00
2378 TCDF	5.43	0.54	0.43	0.26
12378 PeCDF	3.12	0.09	0.02	0.02
23478 PeCDF	5.29	1.59	2.54	2.52
123478 HxCDF	4.69	0.47	0.04	0.04
123678 HxCDF	4.76	0.48	0.10	0.11
123789 HxCDF	0.37	0.04	0.02	0.03
234678 HxCDF	5.15	0.51	0.36	0.43
1234678 HpCDF	23.86	0.24	0.00	0.00
1234789 HpCDF	2.31	0.02	0.01	0.01
OCDF	16.58	0.00	0.00	0.00
TEQ		**11.77**	**8.28**	**9.23**

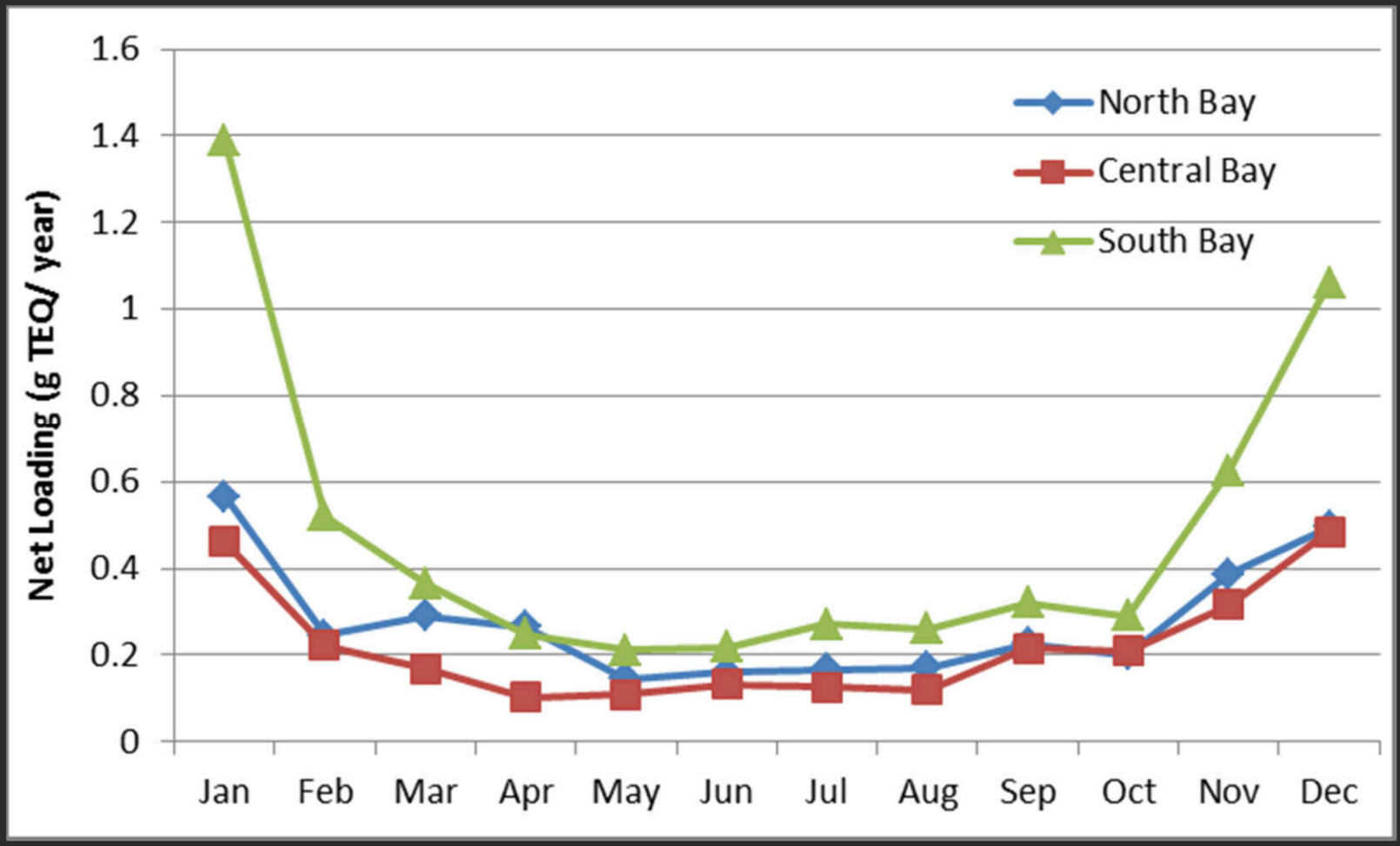
TEQ weighting



TEQ weighting



Seasonal and Spatial Variations



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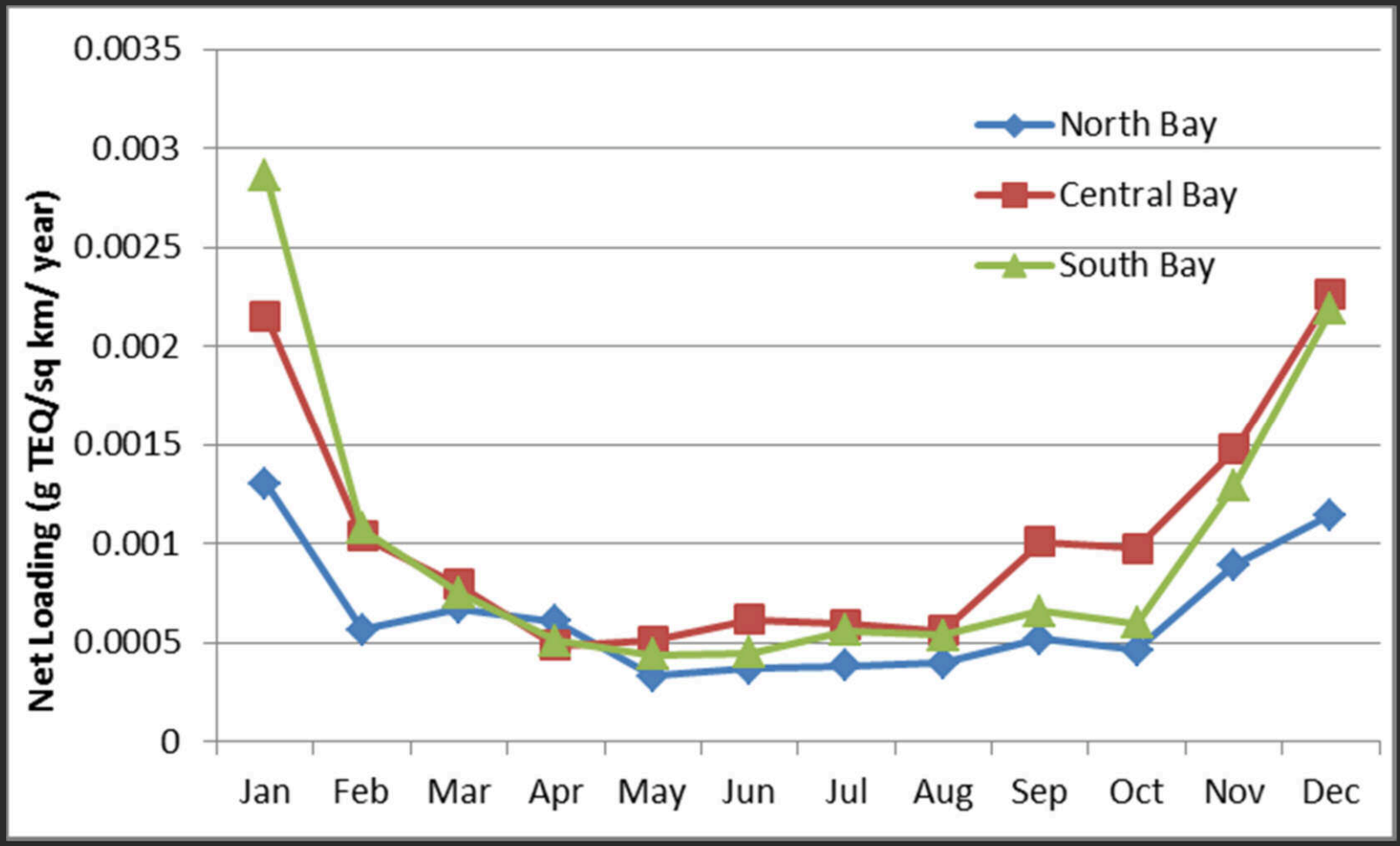
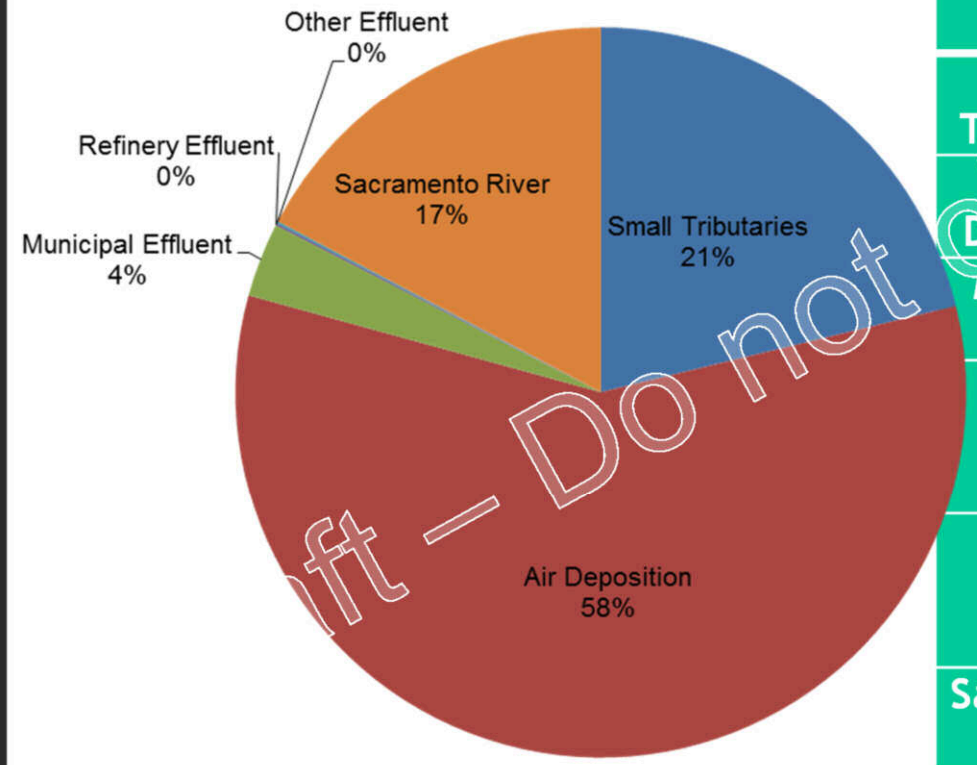


2011 Loading Estimates



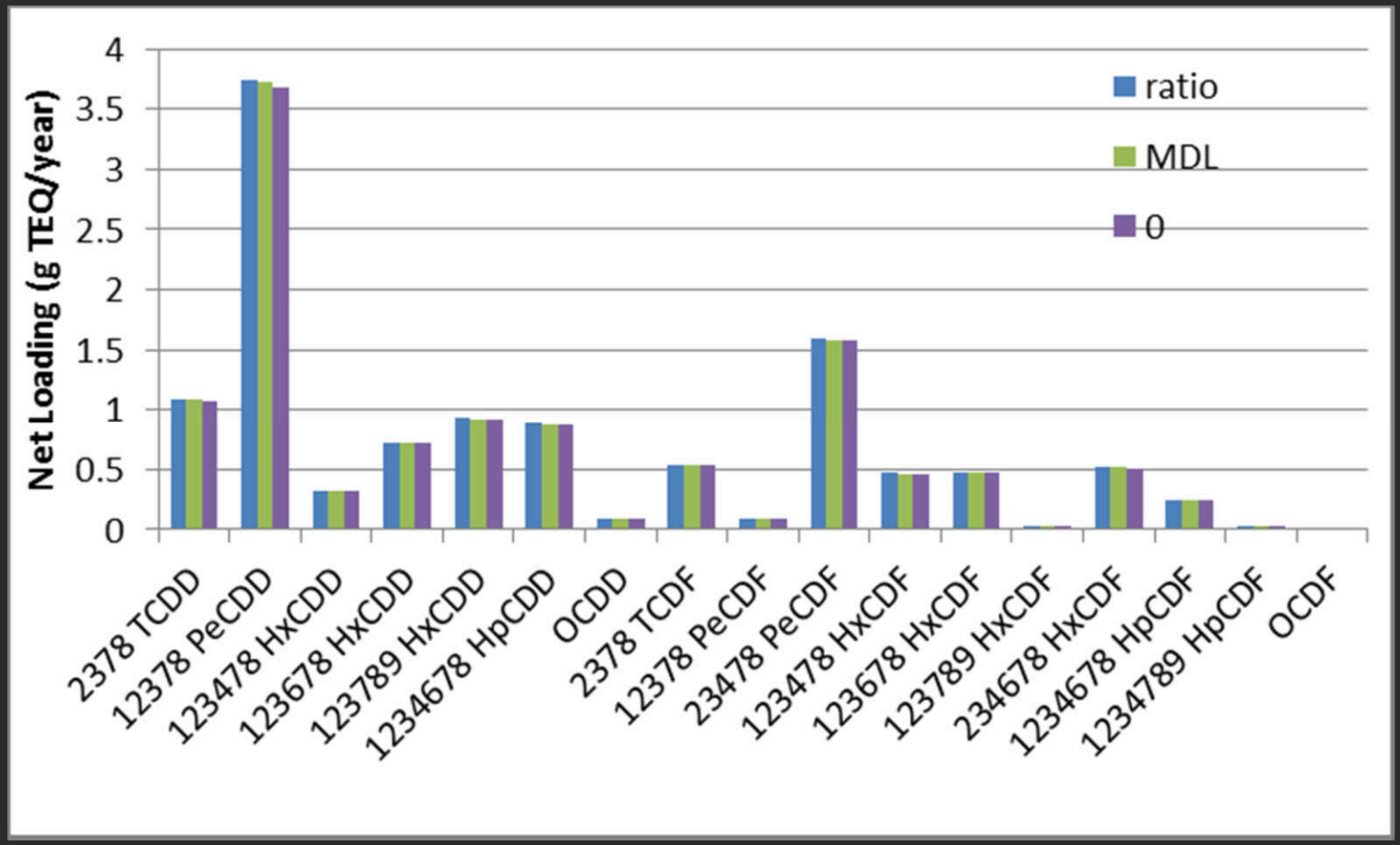
	Gervason and Tang 1998	Connor et al. 2004	Current Best Estimate
Small Tributaries	5.1	5.1	3.7 - 4.3
Air Deposition	1.2	1.2	**11.8 (4.73-43)**
Municipal Effluent	0.13	0.67	0.67 (0.03-13)
Refinery Effluent	0.004	0.019	0.019 (0.0033-0.11)
Other Effluent	-	0.019	0.019 (0.0073-0.051)
Sacramento River	-	0.88	3.5
Total	6.4	7.9	20 (12-63)

Treatment of Non-Detects

- "Ratio substitution"
  - For each congener, calculated the ratio at each site of the congener to OCDD (always detected)
  - Averaged across each congener
  - Ratio applied to OCDD concentration to substitute for non-detects

Sensitivity

- Non-Detect substitution method



Sensitivity

- Choice of particle deposition velocity