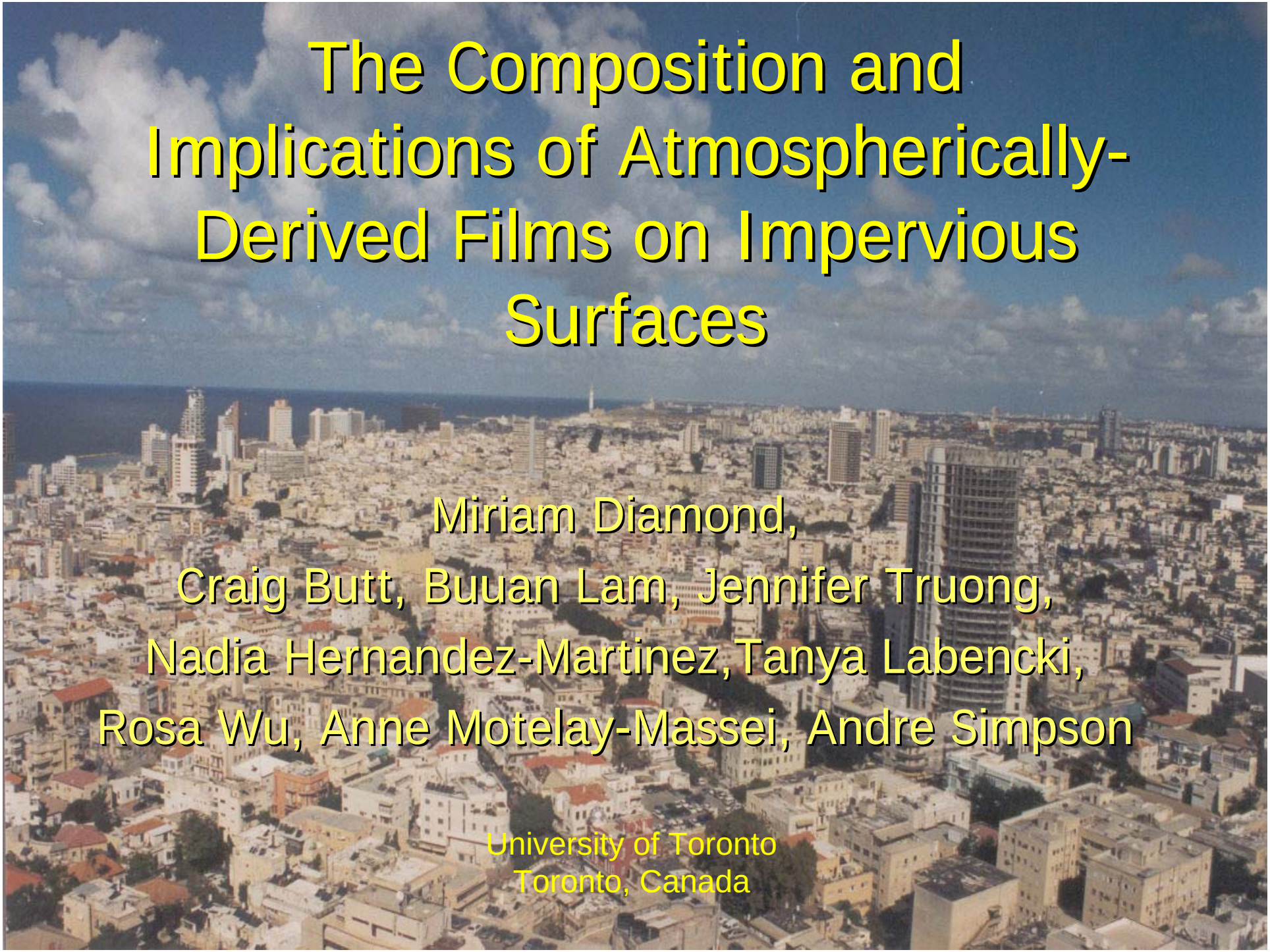

The Composition and Implications of Atmospherically-Derived Films on Impervious Surfaces

Miriam Diamond,
Craig Butt, Buuan Lam, Jennifer Truong,
Nadia Hernandez-Martinez, Tanya Labencki,
Rosa Wu, Anne Motelay-Massei, Andre Simpson

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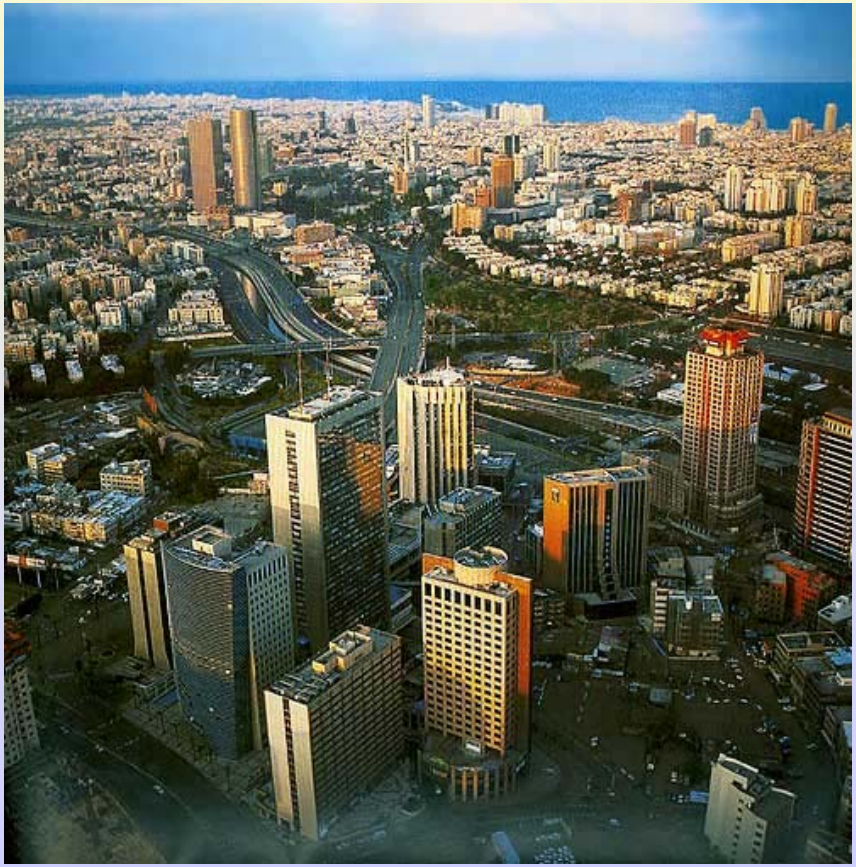
Toronto, Canada

Urban Areas

- Impervious surfaces
- Distorted environment
- Concentration of emission sources
  - Transportation
  - Energy generation
  - Industrial activities
  - Anthropogenic activities
    - Consumer products
    - Bacteria & fungal emissions
    - Cooking



Surface Films

- Ubiquitous
- Composition representative of air quality

  Diamond *et al*. 2000 *Environ Sci Tech* 34:2900-2908

  Gingrich *et al*. 2001 *Environ Sci Tech* 35:4031-4037

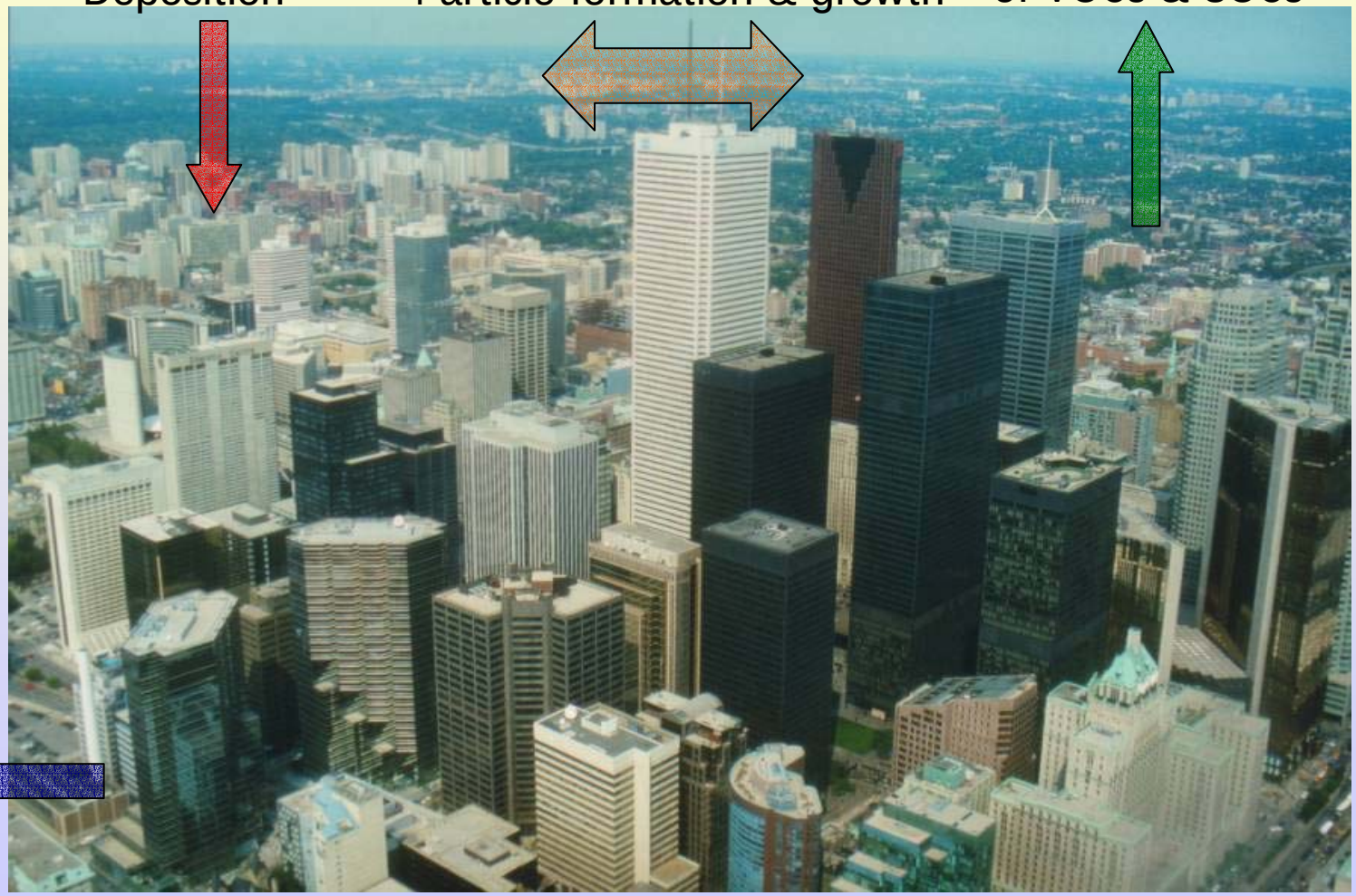
- Formed by:
  - Particulate matter deposition Liu *et al. 2003 Environ Pollut* 122:51-61
  - Gas-phase partitioning
- Significance to Chemical Fate
  - Changed functionality of impervious surfaces Lam et al. Submitted
  - Chemical mobility Priemer & Diamond 2001 *EST* 36:1004-1013

Chemical Fate

Sink: Gas- & Particle-phase Deposition

Gas & particle emissions
Particle formation & growth

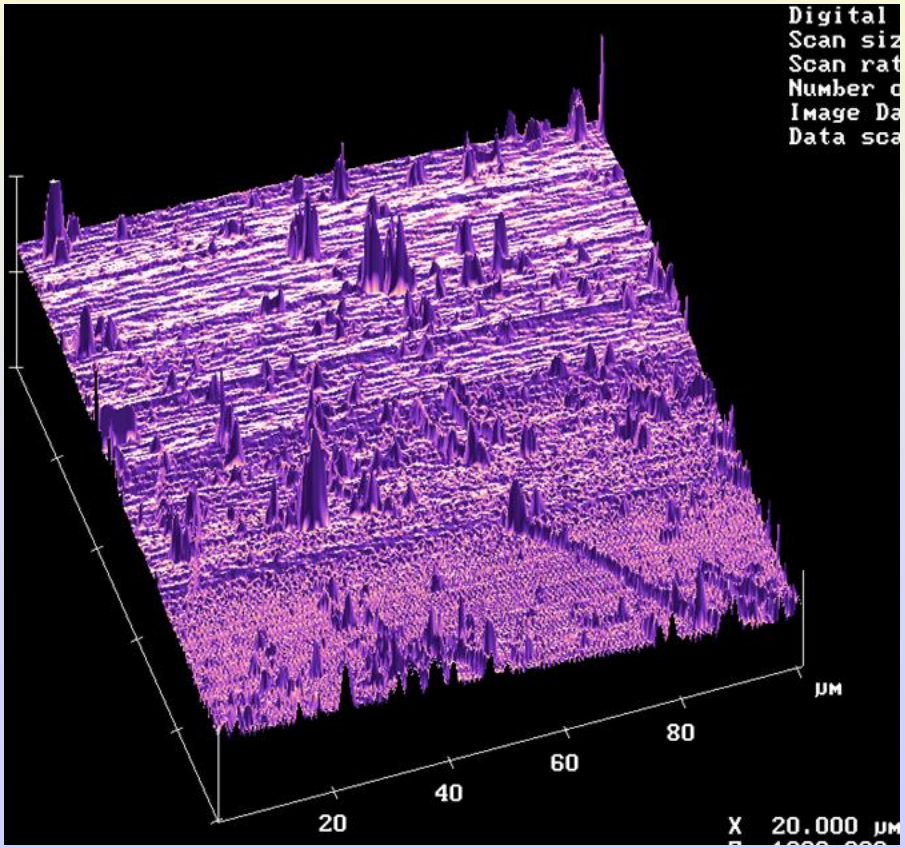
Source: Volatilization of VOCs & SOCs



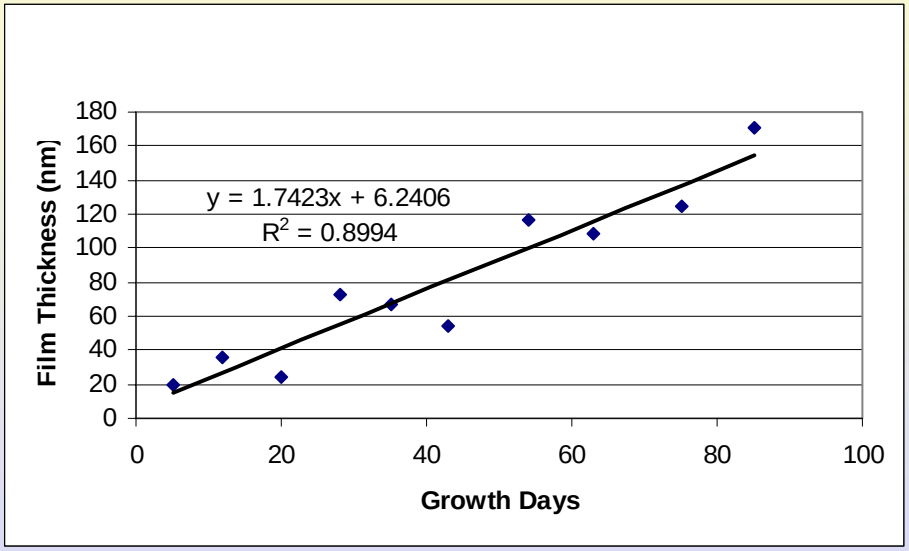
Transfer: Precipitation washoff

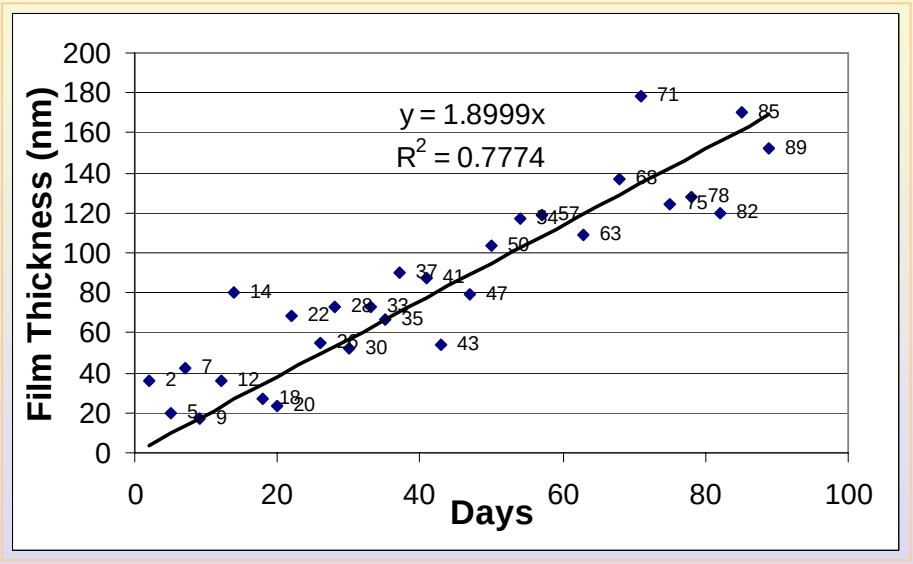
Wu, Harner, et al. 2005

Surface Films



Film Growth

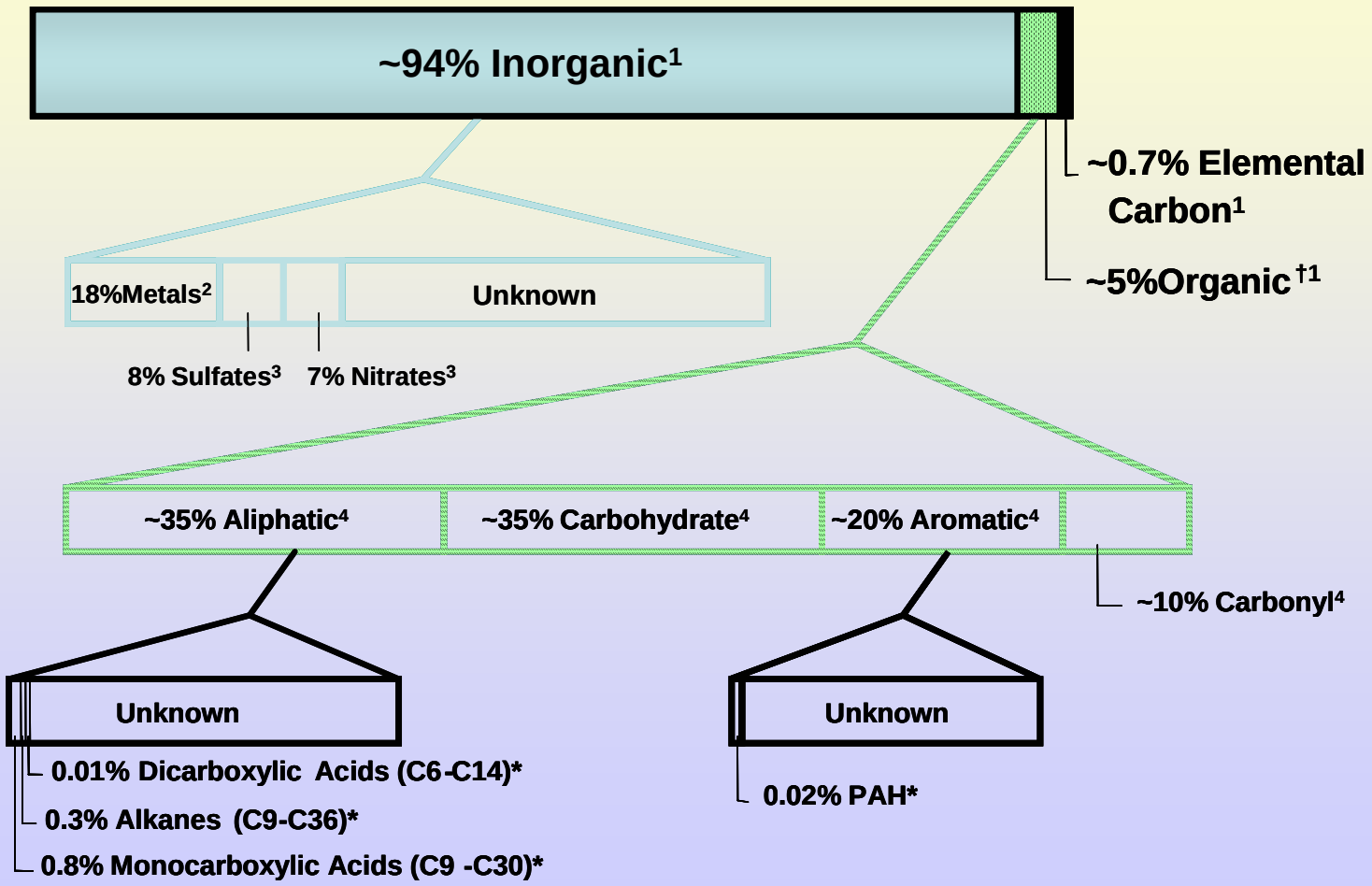




- Film growth rate of ~2 nm/day

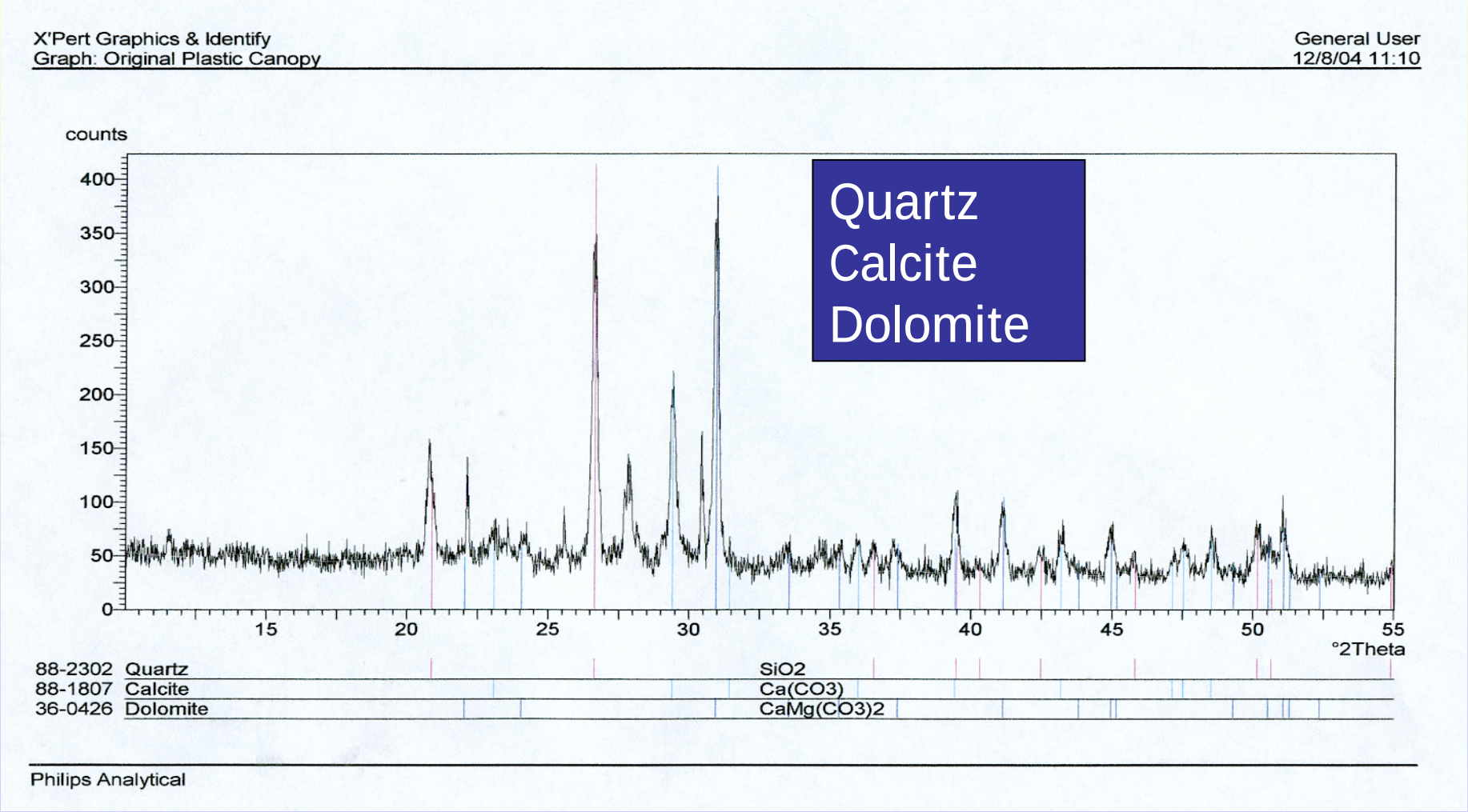
Butt et al. 2004 unpubl. data, Wu, Harner et al. 2005

Film Composition



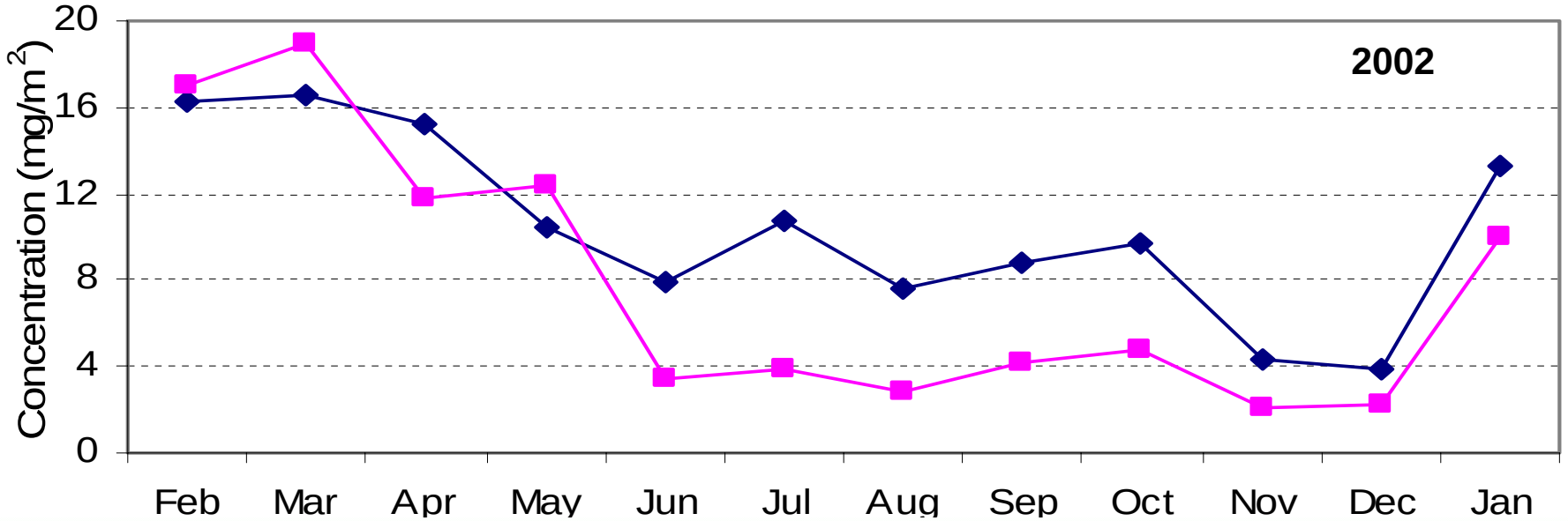
Lam et al. *Atmos Environ* Submitted

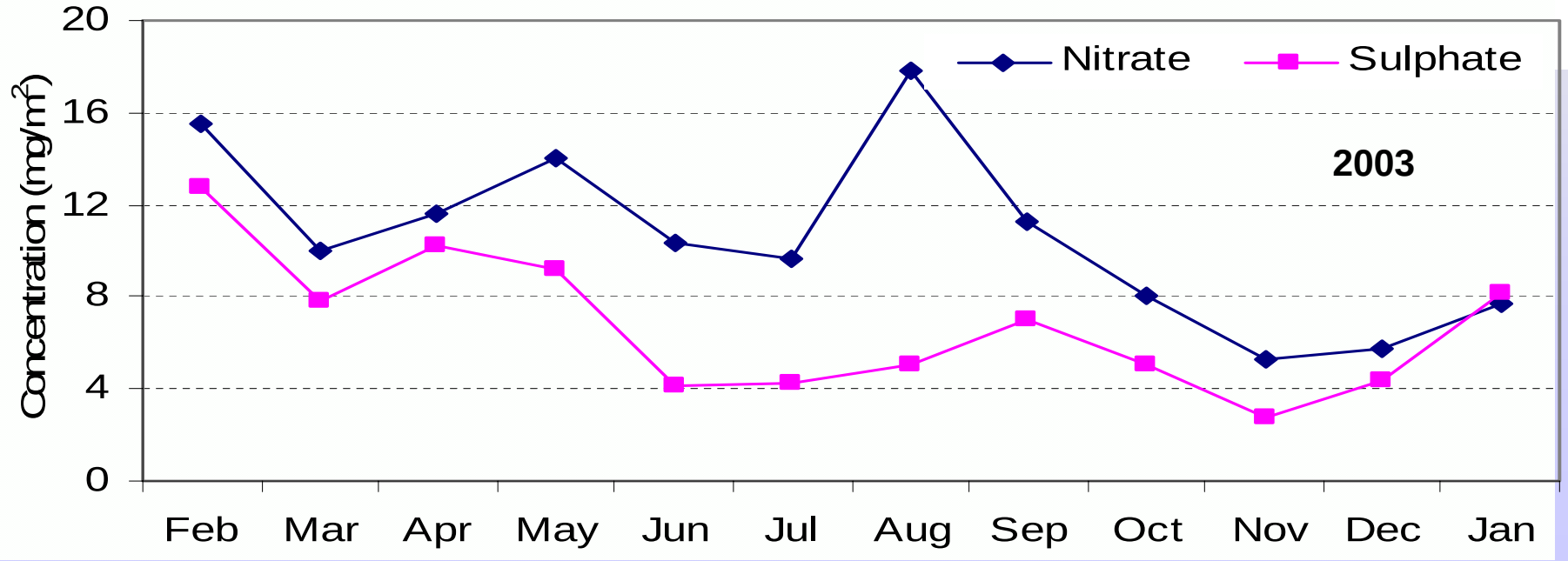
Inorganic Matrix



Cheung 2004

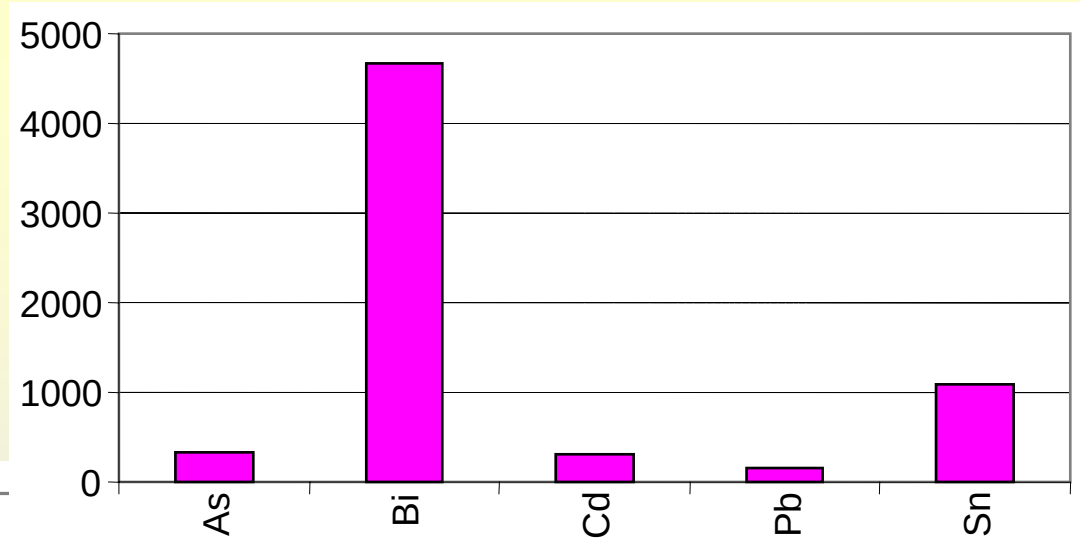
SO_4/NO_3 Concentrations

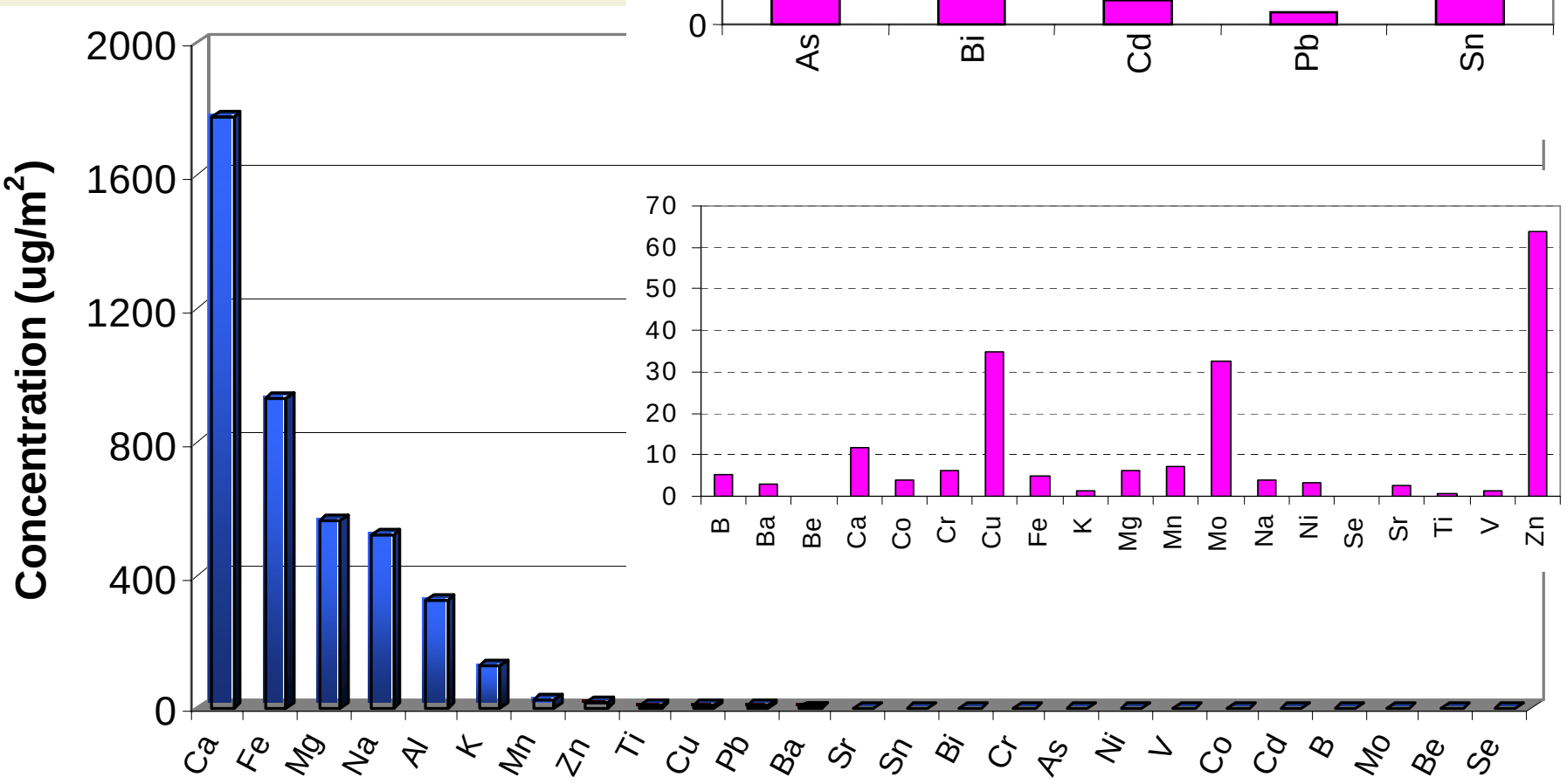




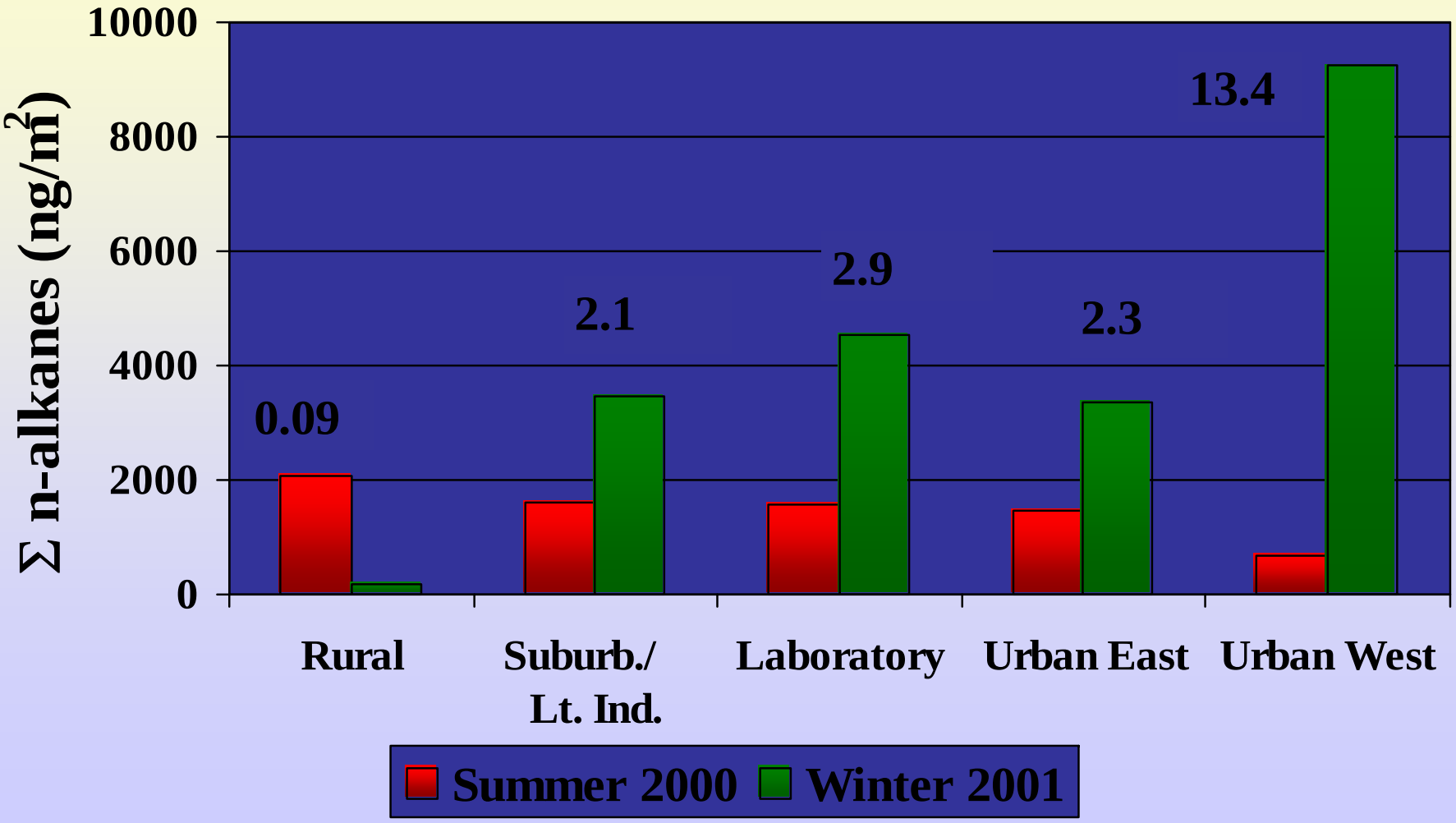
Metals

Enrichment Factors

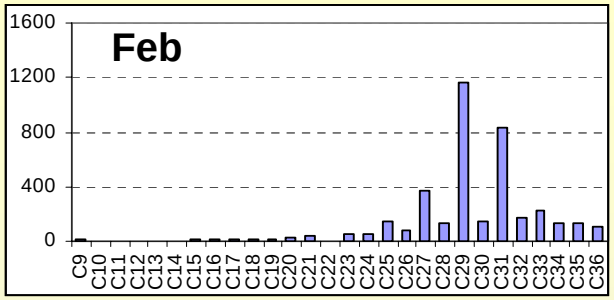


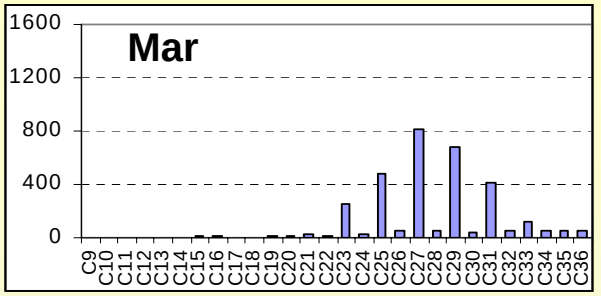


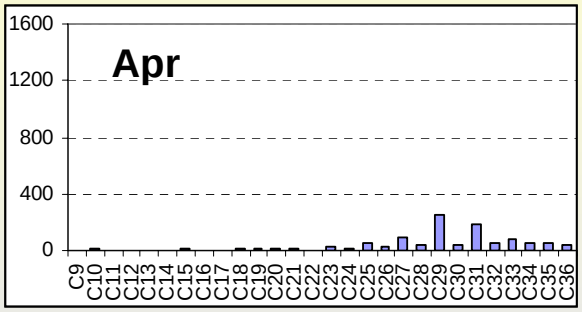
Total Alkanes (ng/m²)

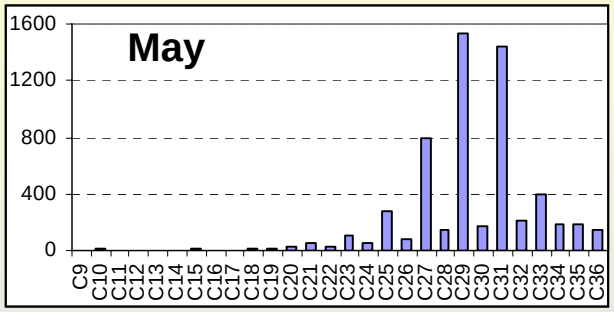


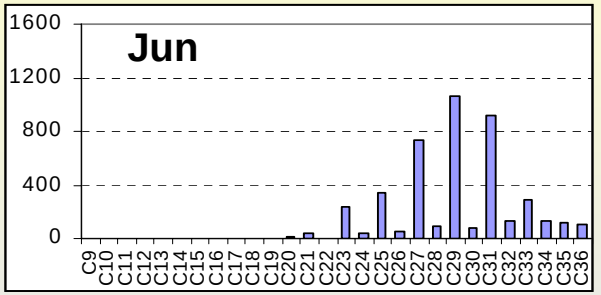
n-Alkanes in Film (ng/m^2) 2002

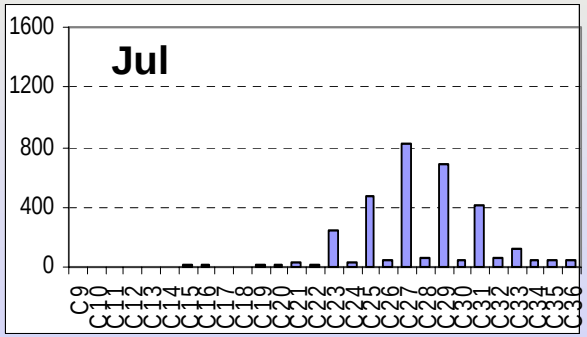


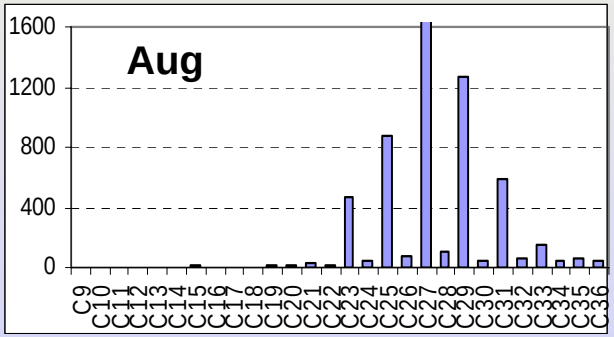


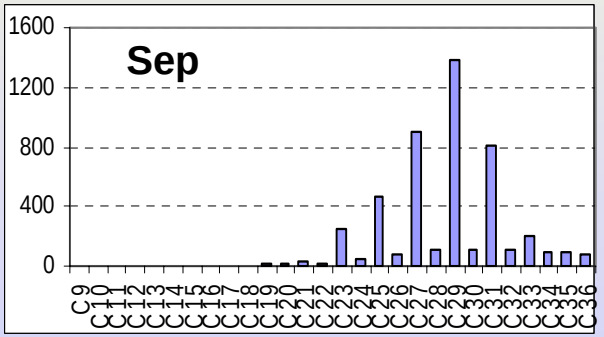


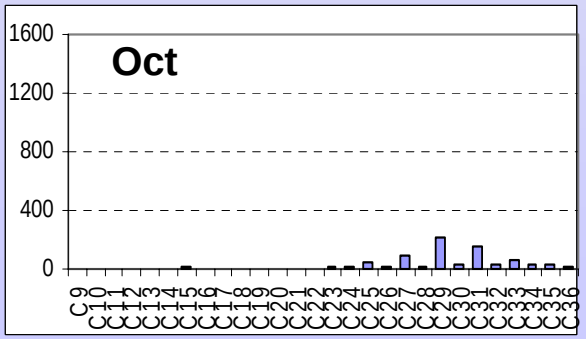


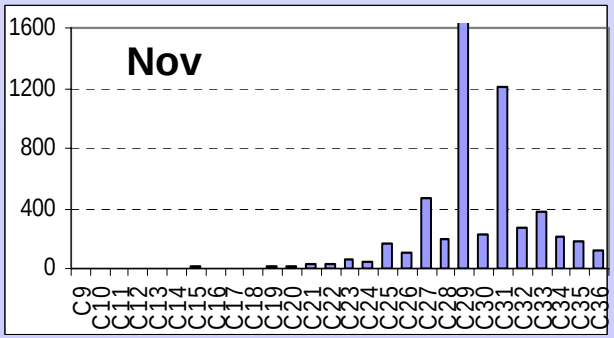


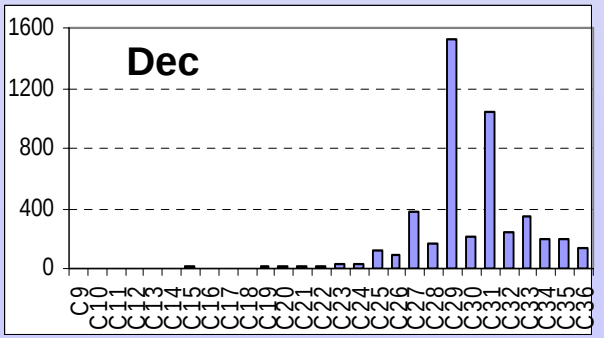






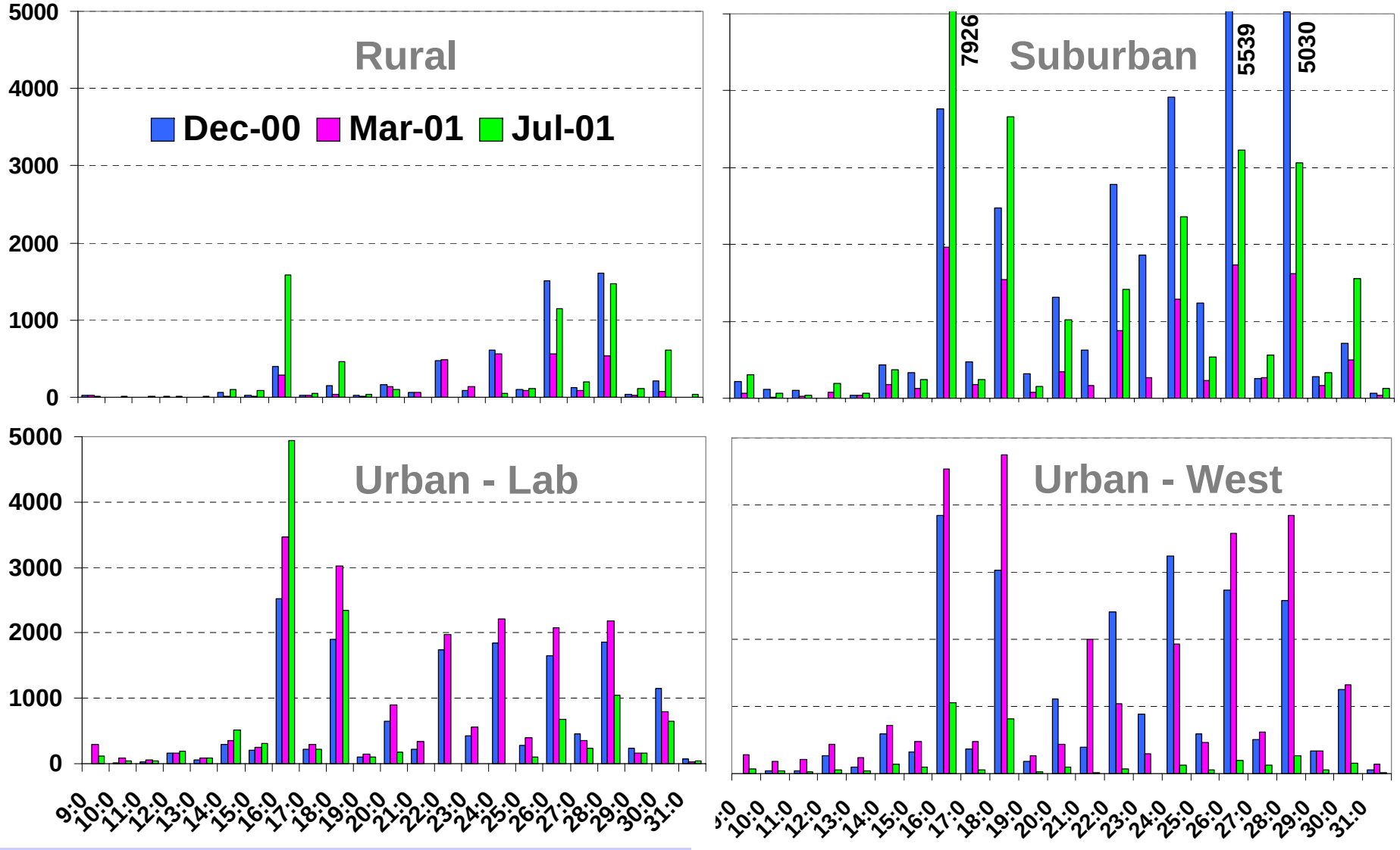






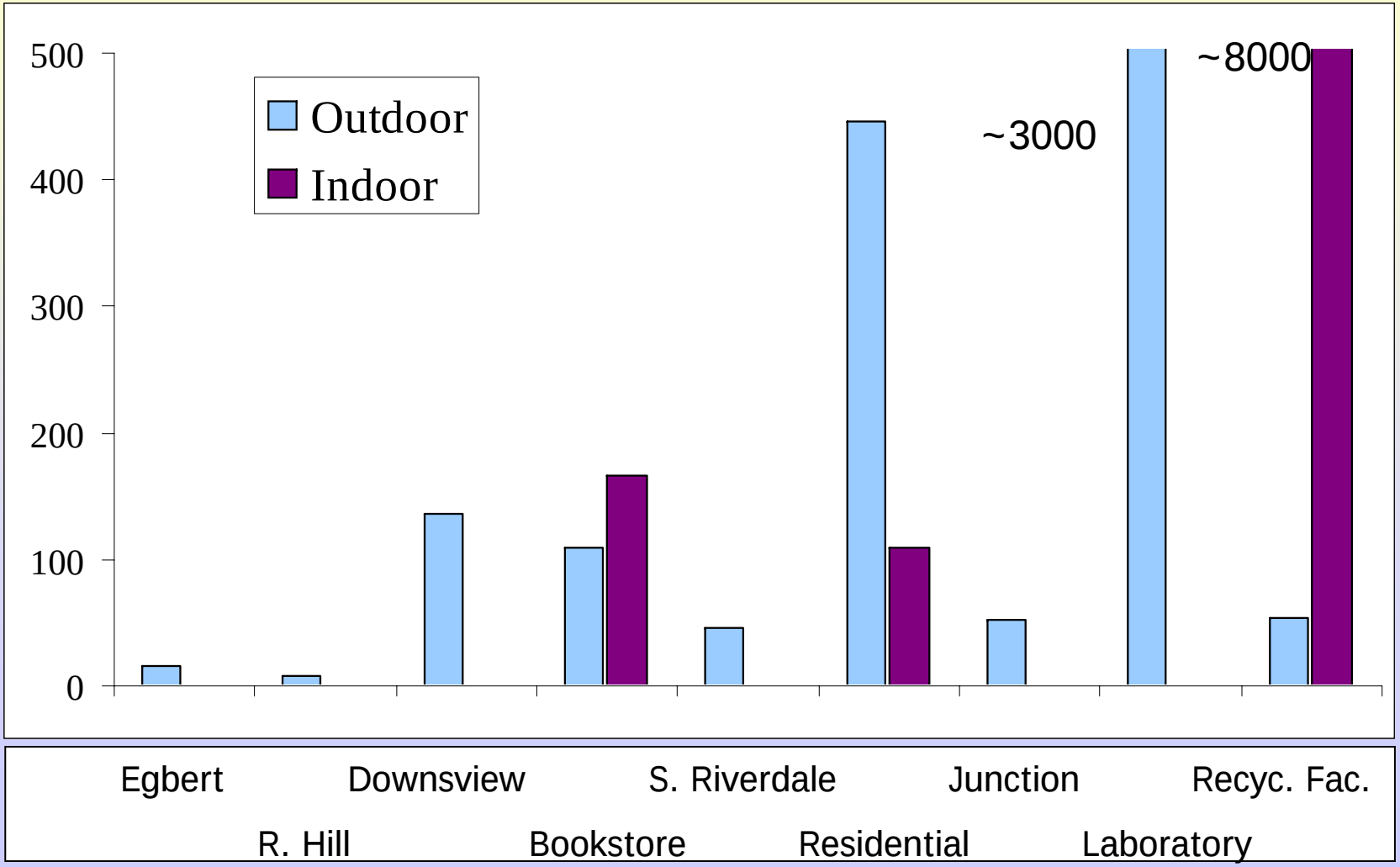
Monoacids – Seasonal Pattern

(ng m^{-2})



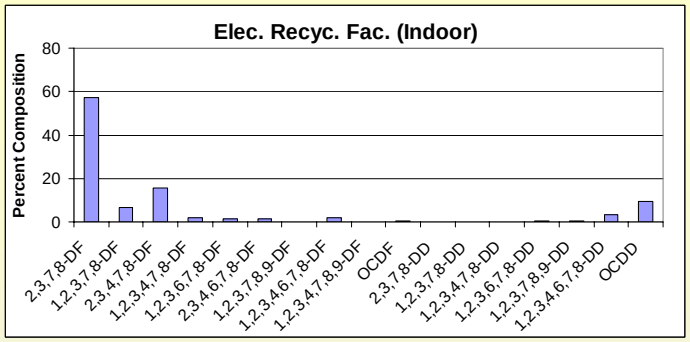
Urban-Rural: PCDD/F in Films

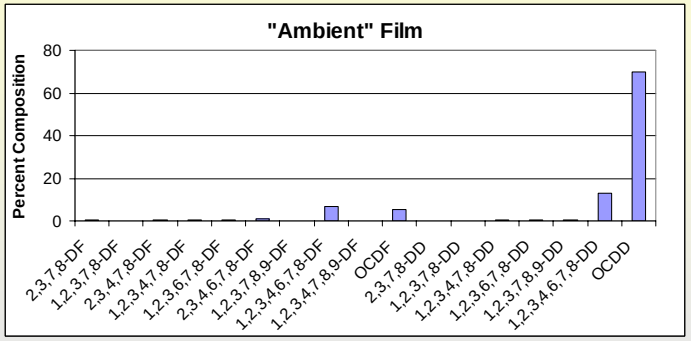
(pg/m^2)

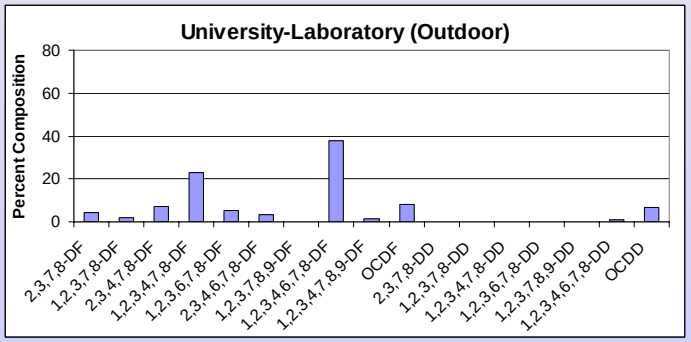


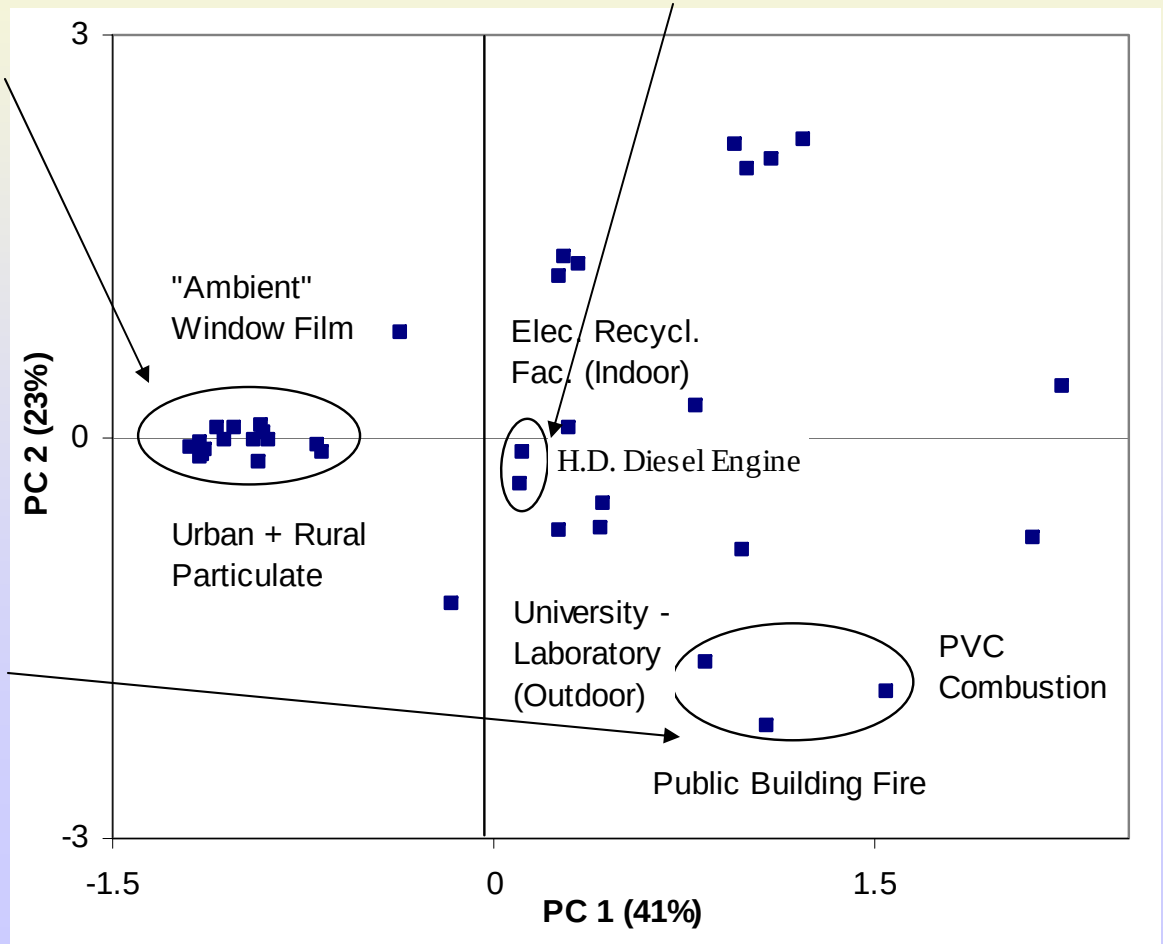
Butt et al. 2003 Organohalogen Comp

Source Fingerprinting









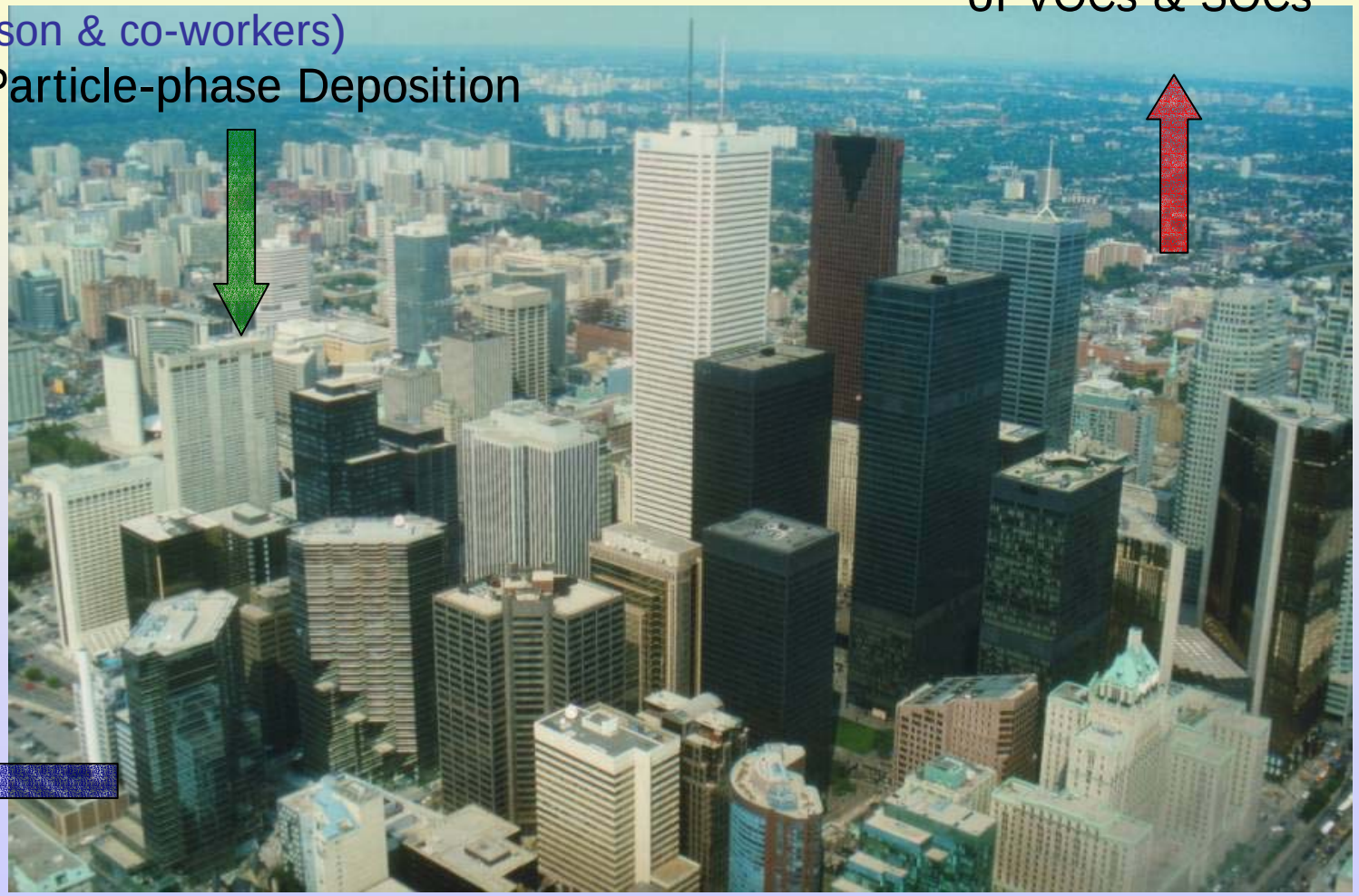
Diamond et al. in prep

Chemical Fate

Sink: Gas-phase Deposition
(Rudich & co-workers, Dubowski et al., Donaldson & co-workers)

Particle-phase Deposition

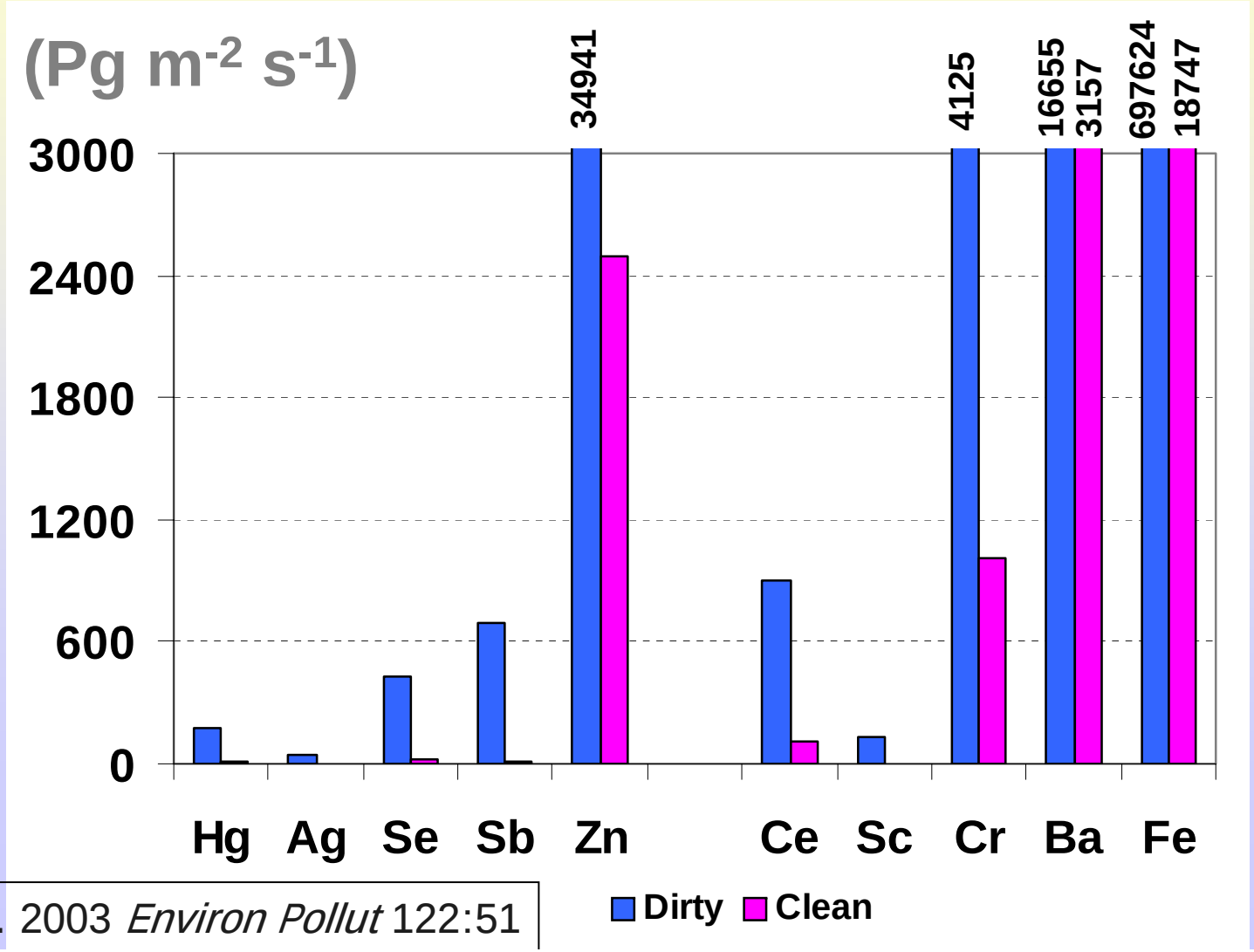
Source: Volatilization of VOCs & SOCs



Transfer: Precipitation washoff

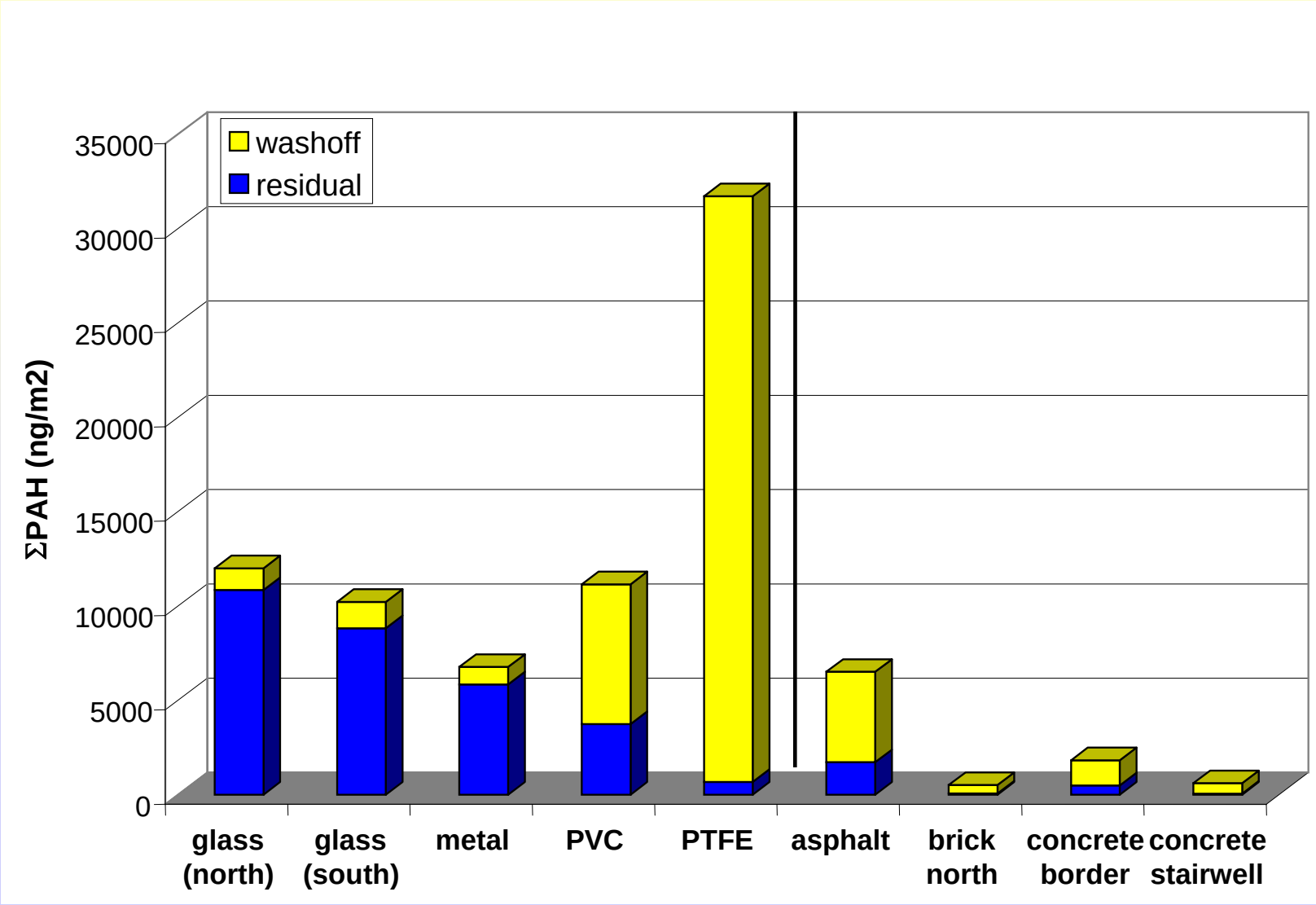
Wu, Harner, et al. 2005

Metal Deposition:
with (dirty) and without (clean)



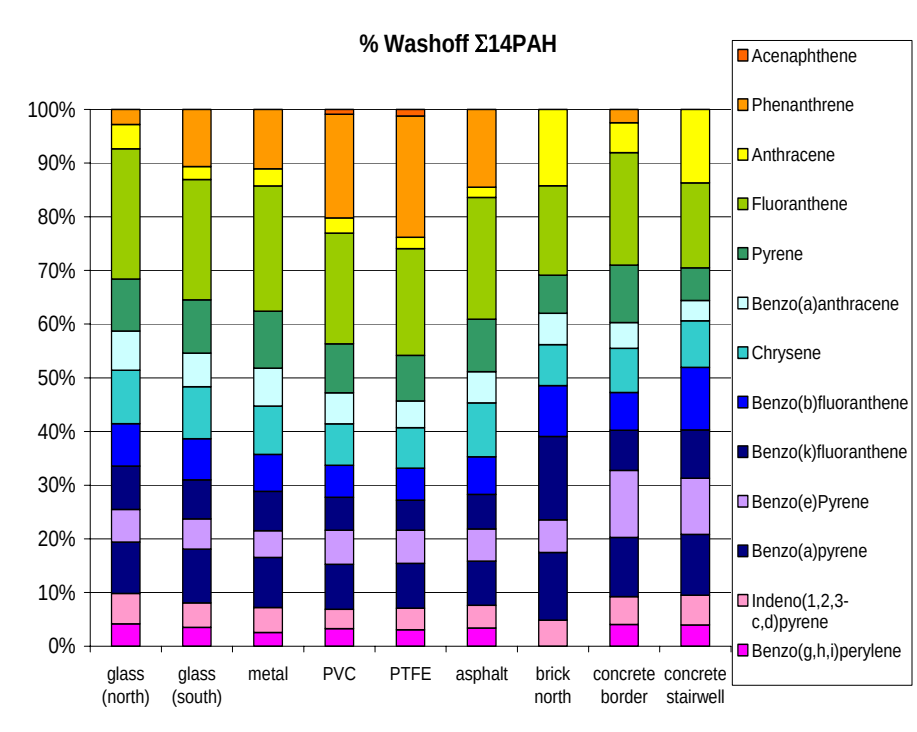
Liu et al. 2003 *Environ Pollut* 122:51

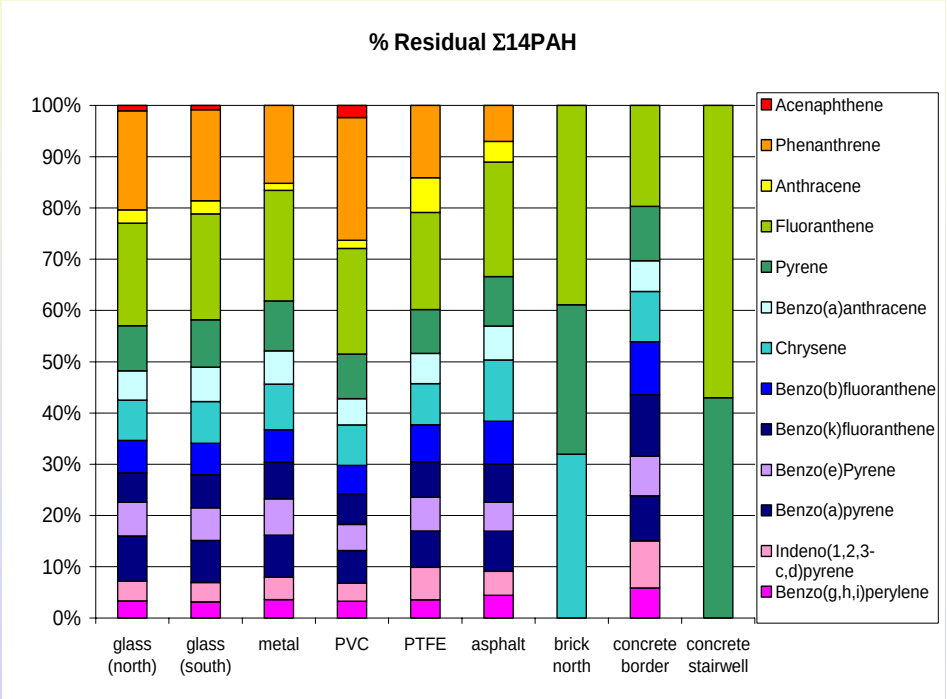
Accumulation & Removal



Labencki et al. *Chemosphere* Submitted

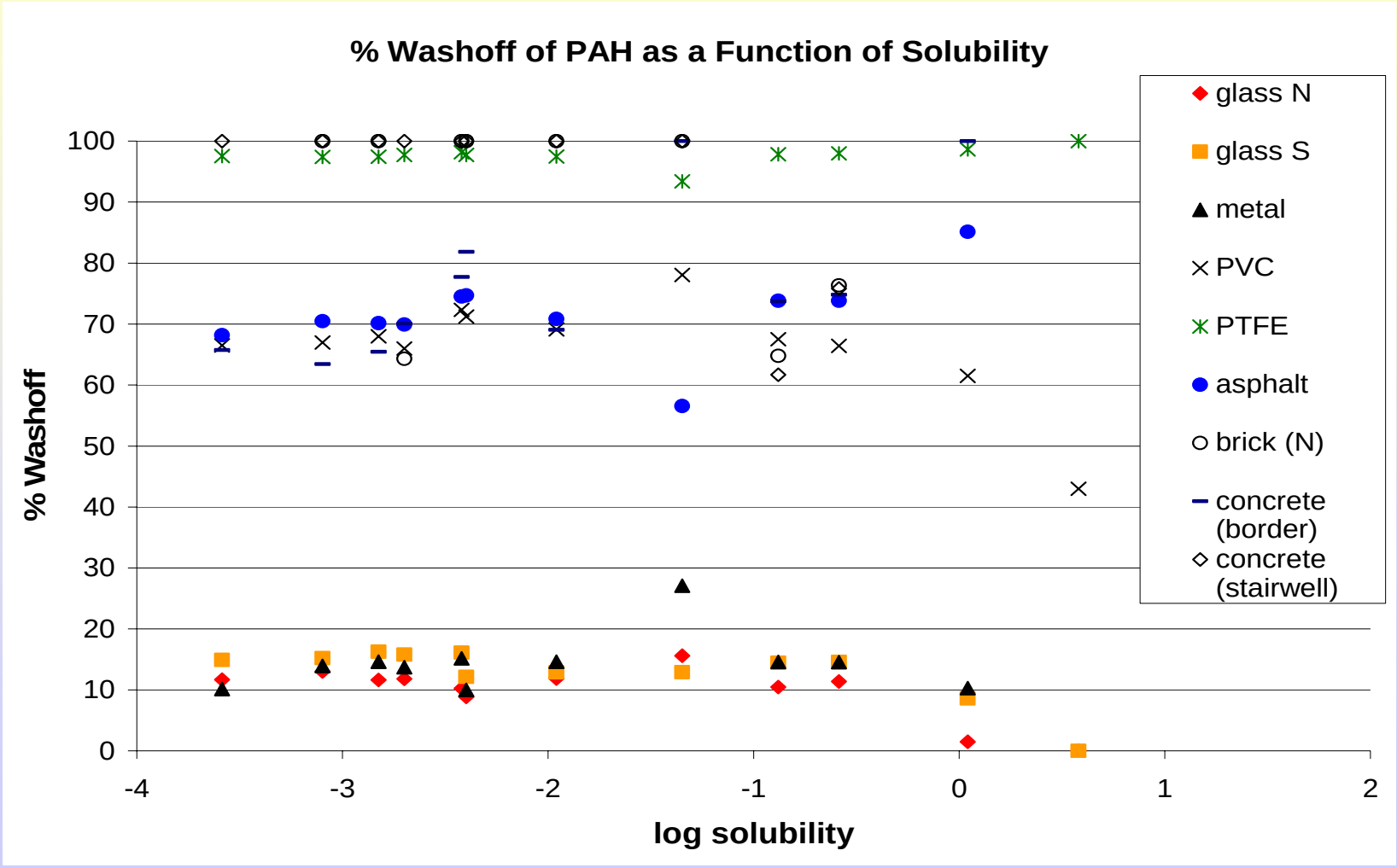
PAH Composition & Removal





Labencki et al. *Chemosphere* Submitted

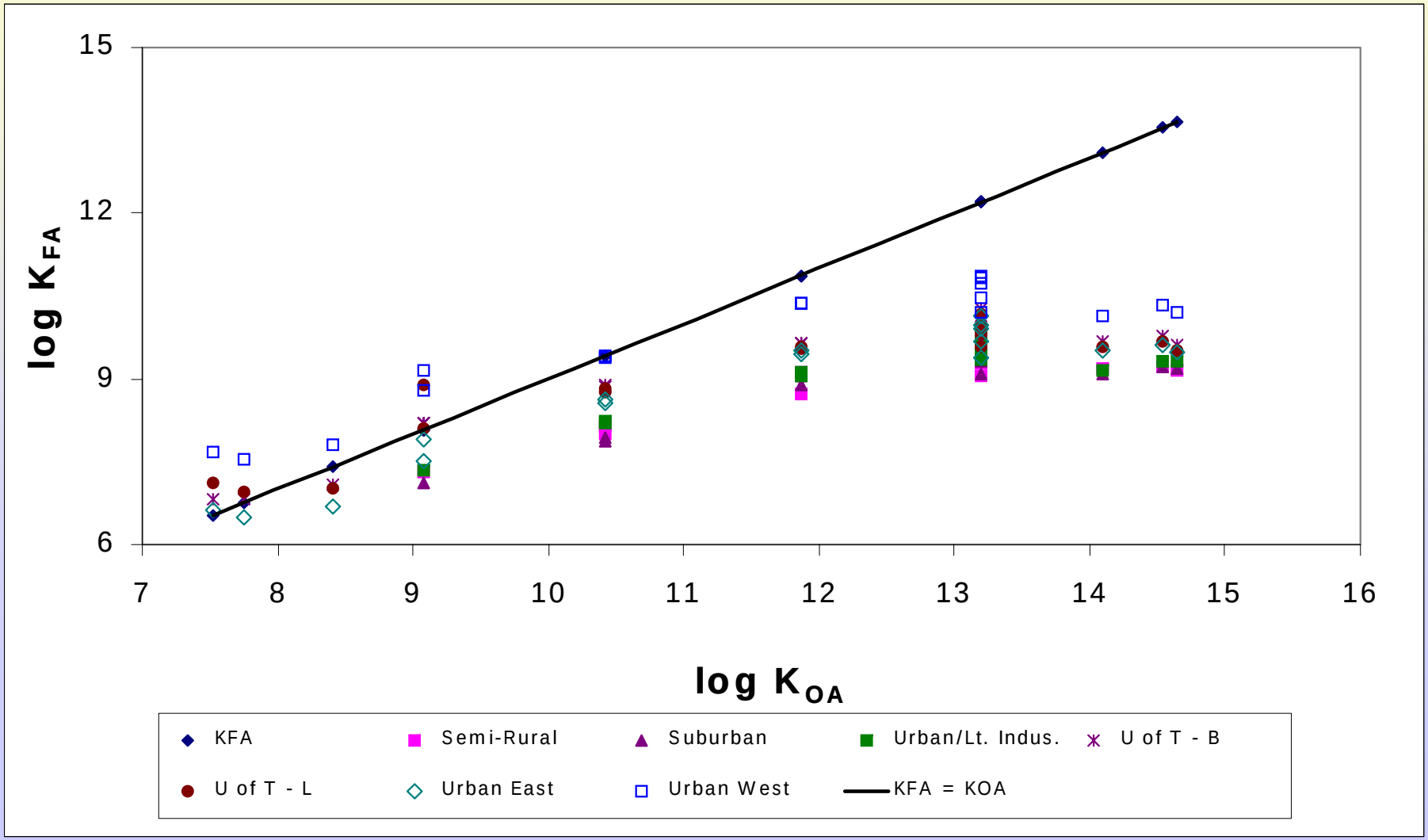
Wash-off & Solubility



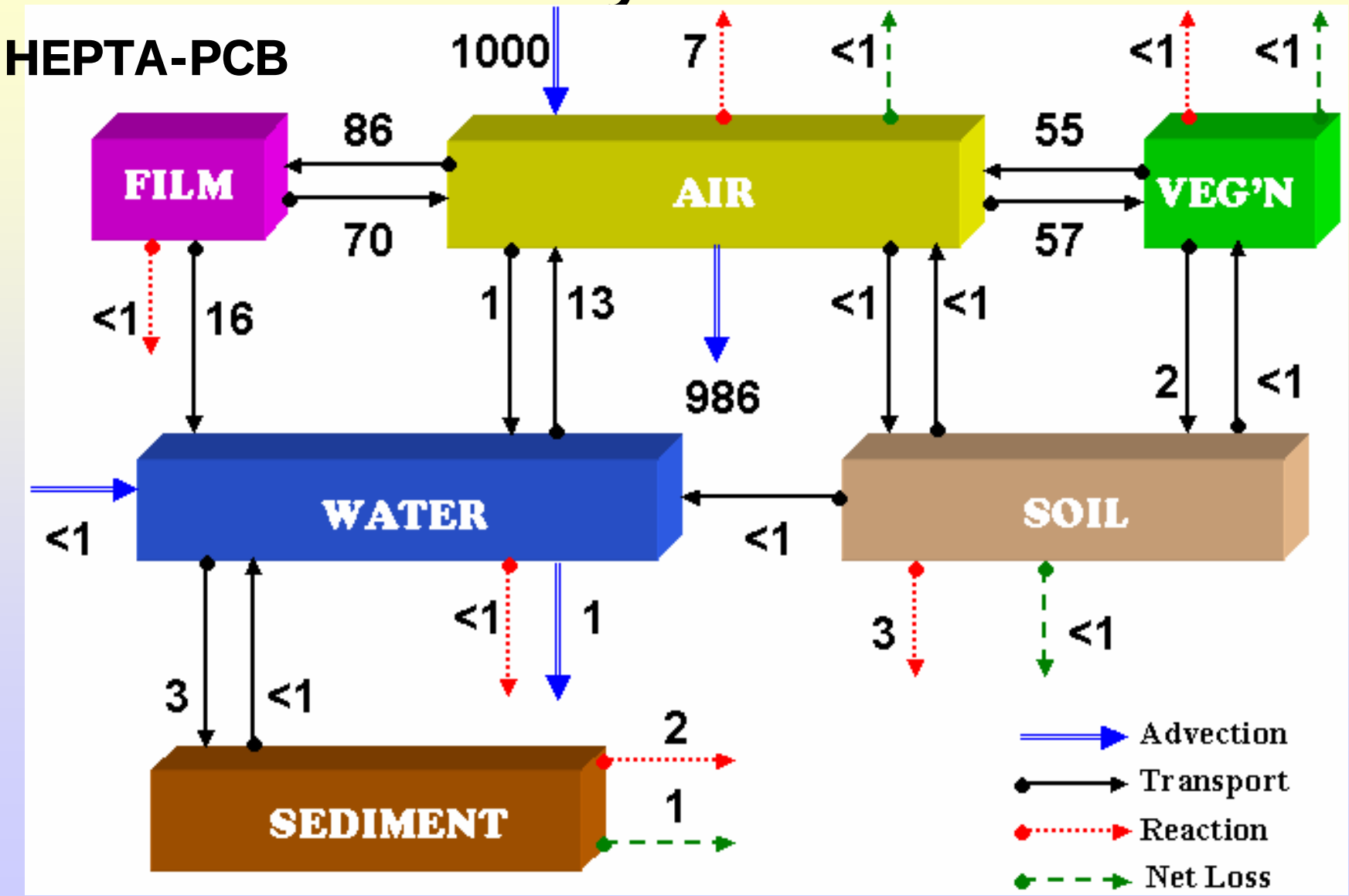
Labencki et al. *Chemosphere* Submitted

Gas-Phase Partitioning

$K_{FA} = f_{oc} * K_{OA}$

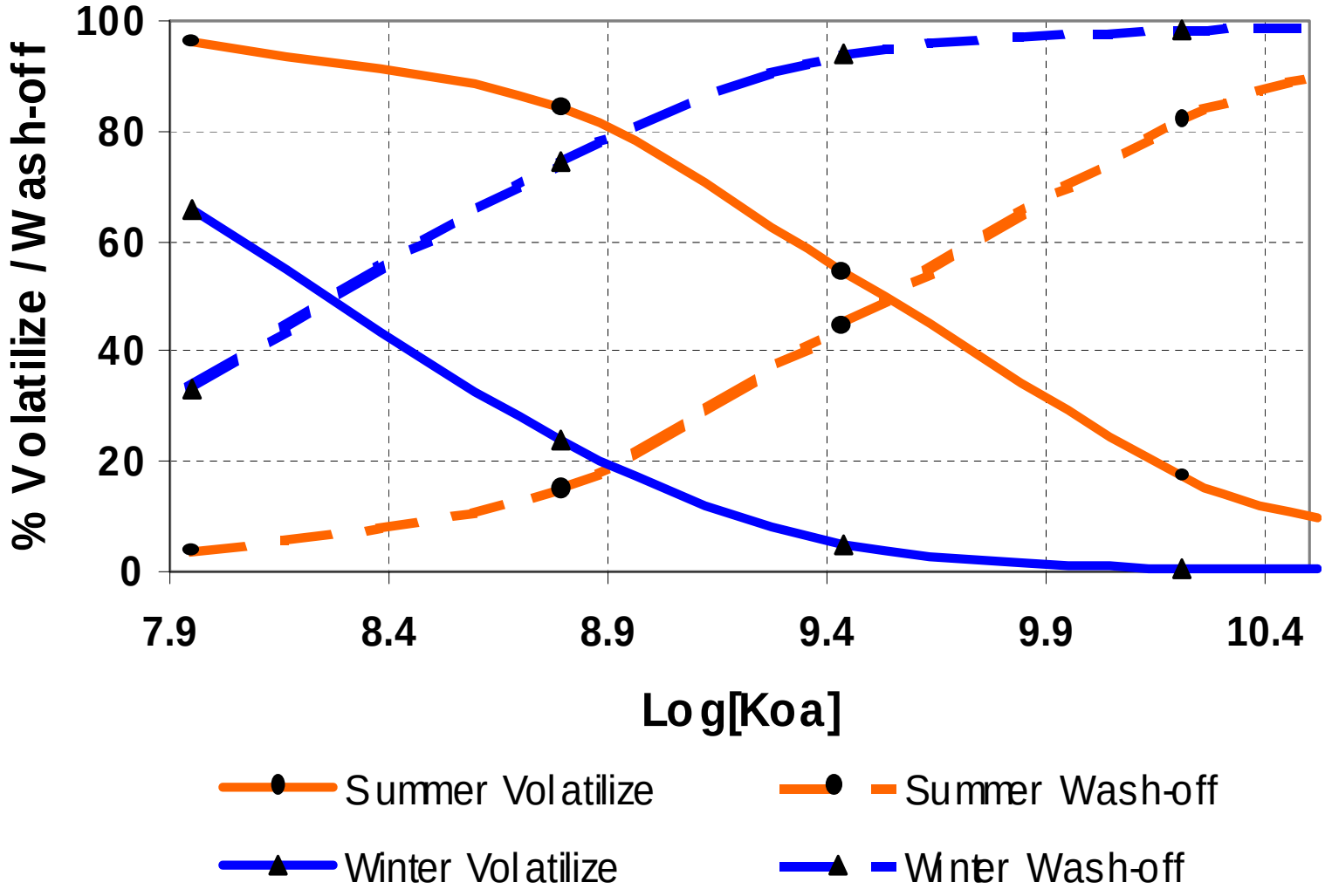


Chemical Dynamics: Urban

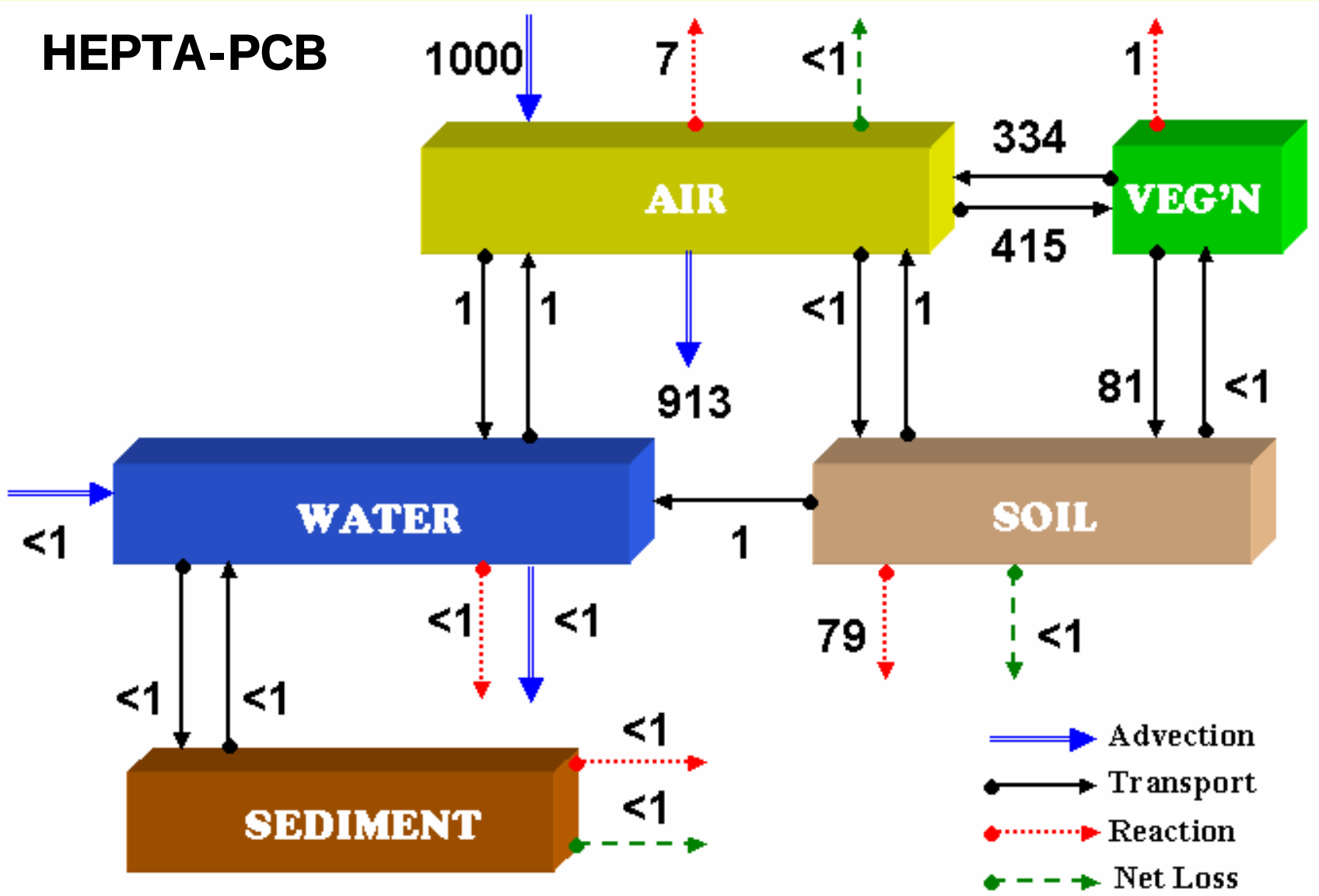


Diamond et al. 2001 Chemosphere

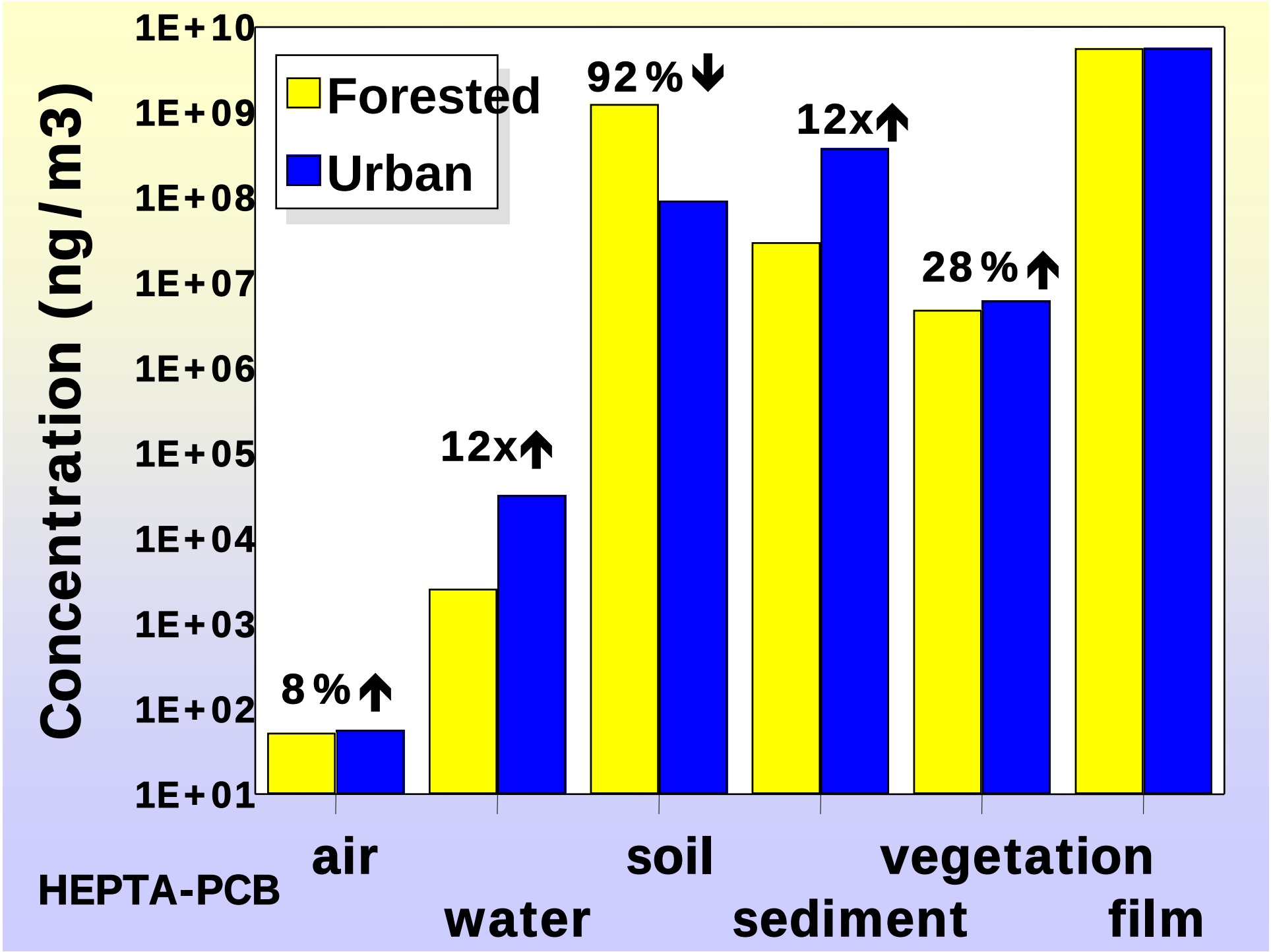
Chemical Transport from Film



Chemical Dynamics: Forested



Priemer and Diamond 2002 Environ Sci Technol


Concentration (ng/m3)
1E+10
1E+09
1E+08
1E+07
1E+06
1E+05
1E+04
1E+03
1E+02
1E+01
Forested
Urban
8%
12x
92%
12x
28%
air
water
soil
sediment
vegetation
film
HEPTA-PCB

Acknowledgements

People

- G. Stern, M. Ikonomou; Fisheries & Oceans Canada
- P. Makar, T. Harner, Environment Canada
- P. Van Metre, USGS
- B. Branfireun, Uof Toronto; B. Fryer, U of Windsor

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- CRESTech
- Toxic Substances Research Initiative
- CFCAS
- Environment Canada