NAWQA – National Water Quality Assessment Program

- STATUS – characterize water quality nationally
- TRENDS – describe trends, or lack of trends
- UNDERSTANDING – identify and explain major factors controlling water quality
Paleolimnology
Some good news...

Total DDT (ppb)

1900 1920 1940 1960 1980 2000

Van Metre et al., 1998, Environmental Sci. & Tech.
And some bad news

Patterns that repeat

ΣDDT

ΣPAH

ΣPCBs

Van Metre and Mahler, 2005, Environmental Sci. & Tech.
PAH sources to 40 United States lakes

- Quantified PAH, post-1990, to 40 lakes using EPA CMB* receptor model
- Analyzed trends in PAH sources in eight urban lakes
- First such study at national scale and first to include CT sealcoat
- Paper is approved by USGS, in journal review

*Contaminant Mass Balance
How CMB works

- Uses proportional PAH profiles (12 PAH) in many sources
- Adds source contributions to get best match of receptor profile (lake sediment) by minimizing Chi-squared ($\chi^2$)
- Provides estimated mass loading and uncertainty for each source
PAH sources considered

- Vehicle/traffic related:
  Gasoline and diesel soot and exhaust, tunnel air, used oil, tires
- Asphalt
- Coal combustion:
  Residential, power plant, and coking
- Fuel oil combustion
- Wood burning
- Coal-tar based sealcoat
Modeling Process

- Over 200 modeling scenarios run
- Many combinations of sources, PAHs, and lakes tried
- Identified the 4 best performing models
- Summarized results by five general source types: vehicles, coal, fuel oil, CT sealcoat, and wood
Results of 4 best models

- Total PAH concentration
- Coal-tar-based sealcoat 50%
- Vehicle-related sources 23%
- Coal combustion 18%
- Fuel-oil combustion 5%
- Wood burning 5%
Dust from sealed and unsealed pavement shows a very strong regional gradient

Van Metre et al., 2009, Environmental Sci. & Tech.
Source-Receptor Regionally
Does CT source affect concentrations?

Five lakes with <20% CT sealcoat

Continental Divide

Mean total PAH

6.9–81 mg/kg

0.09–1.4 mg/kg

Five lakes with <20% CT sealcoat
Ten lakes with >70% CT sealcoat
PAH vs CT loading – 40 lakes

![Graph showing the relationship between PAH mass loading from CT sealcoat (mg/kg) and total PAH concentration (mg/kg). The graph includes data points and a trend line with an R² value of 0.9432.](image-url)
CT sealcoat role in PAH trends
All urban is not equal.

**Sealed Pavement Dust PAH (mg/kg)**

- **Palmer Lake**: 939 people/km, $\Sigma$PAH 34.1 mg/kg
- **Tanasbrook Pond**: 844 people/km, $\Sigma$PAH 1.34 mg/kg
- **Lake Anne**: 2,095 people/km, $\Sigma$PAH 17.0 mg/kg
- **Decker Lake**: 2,090 people/km, $\Sigma$PAH 0.76 mg/kg
PAHs in sources

How do they stack up?

- Tire wear particles
  - 175 (mean of 3 studies)
- Road dust
  - 59
- Brake lining particles
  - 9
- Air particles, major roadway
  - 104
- Fresh asphalt
  - 2
- Weathered asphalt
  - 9
- Fresh motor oil
  - 7
- Used motor oil
  - 726
- Diesel engine
  - 304 (mean of 2 studies)
- Gasoline engine
  - 35
- Coal-tar-based pavement sealcoat
  - 92,000 (mean of 6 products)

All concentrations in mg/kg