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CEE 697z

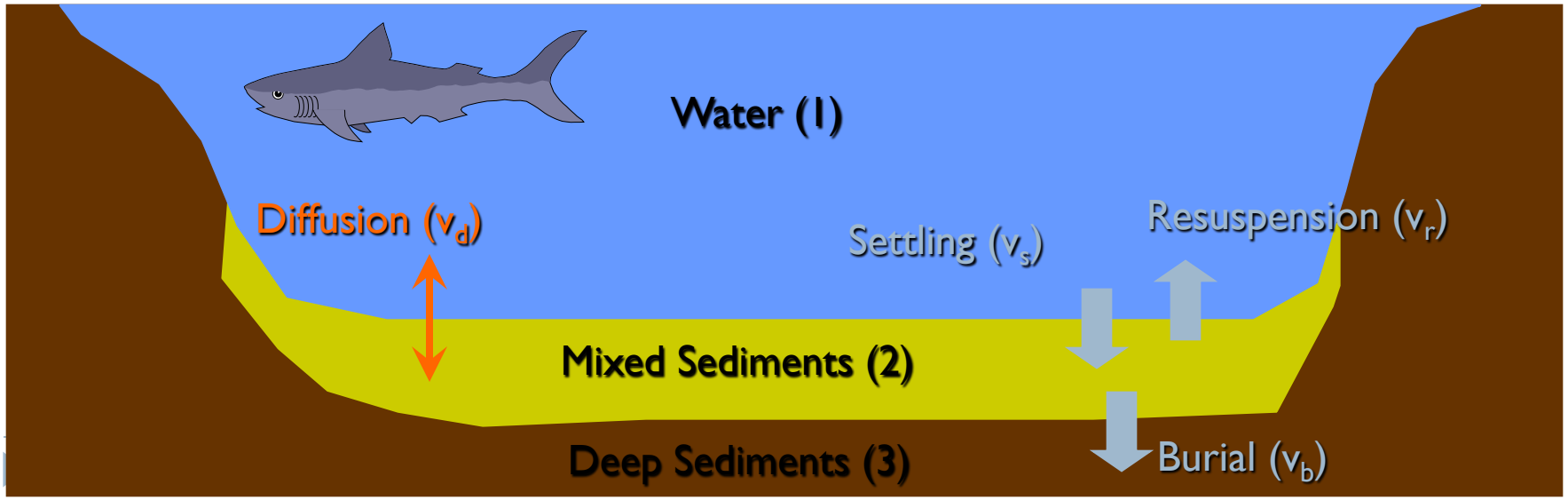
Organic Compounds in Water and Wastewater

PCBs:
Introduction and Properties

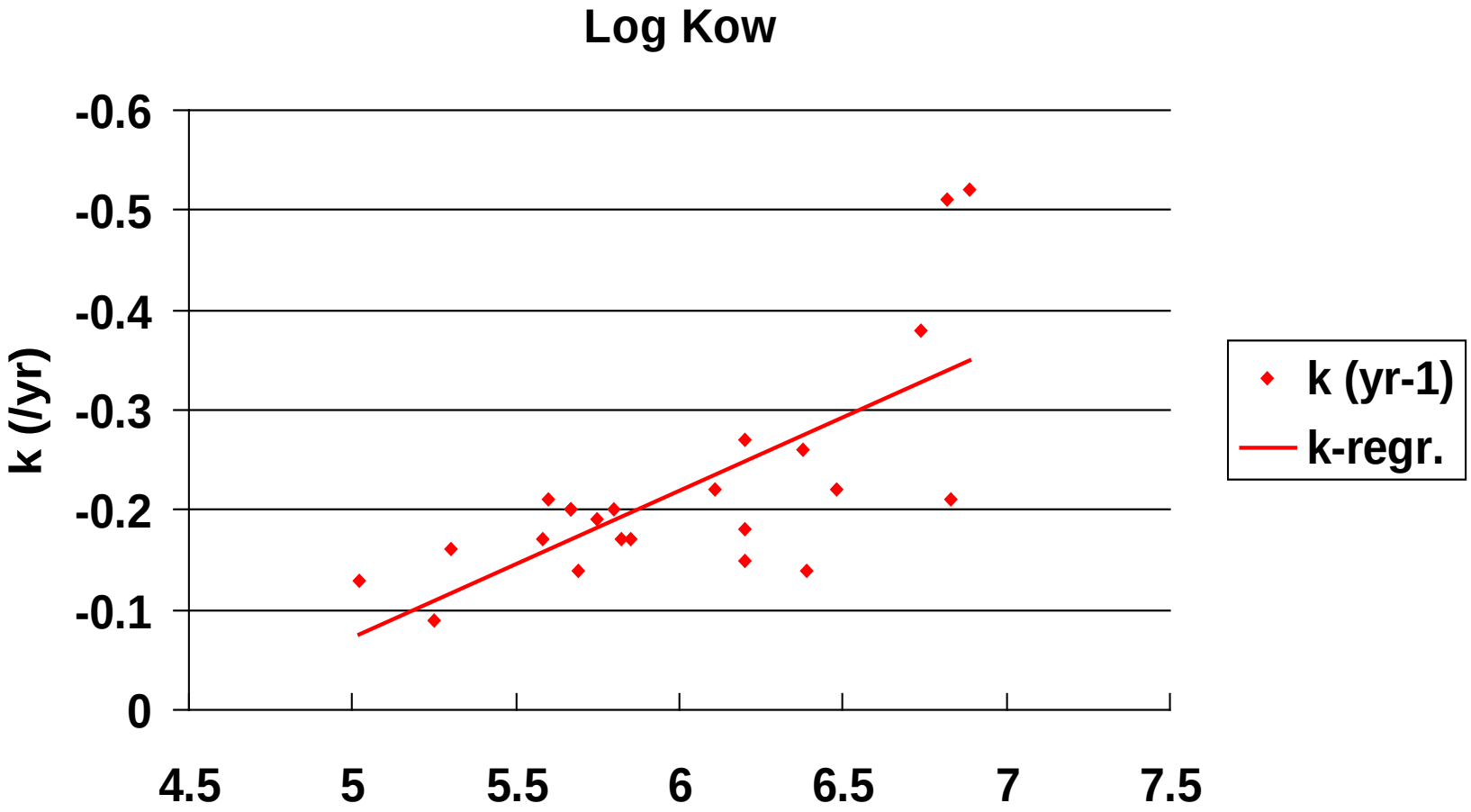
Lecture #35

Toxics Model: CSTR with sediments

- Internal Transport Processes (between compartments)
  - dissolved: diffusion
  - particulate: settling, resuspension & burial
- Expressed as velocities (e.g., m/yr)



Loss rate and K_{ow}'s



Areal Sediment Burden (mass)

- Estimated at 4900 kg in 1986
  - using data from sediment cores
  - relatively small compared to total lost from water column (26,500 kg from '80 to '92)

$$\sum PCB_{areal} = \sum PCB_i (1-\phi_i)\rho_s z_i$$

PCB conc. (ng/g-dry sediment) in depth increment "i"

Porosity of increment "i"

Thickness of depth increment "i"

Inputs

- Riverine
  - Known Q
  - Estimate c from analysis of pristi

$$W = Qc$$
$$= 5.4x10^{13}\, L/yr\left(2ng/L\right)$$
$$= 110kg/yr$$

- Other
  - estimates from industrial, municipal, (urban) runoff and storm sewer flows gives a combined total of about 40 kg/yr

Inputs (cont.)

- Direct Atmospheric deposition
  - wet deposition

precipitation

Surface Area

$$F_{wet} = \sum PCB_{T,rain} P(SA)$$
$$= 2ng/L(76cm)8.21x10^{10} m^2$$
$$= 125kg/yr$$

  - dry deposition
    - calculated for 4 seasons, then averaged

Dry particle deposition velocity (0.2 cm/s)

$$F_{dry} = \sum PCB_{T,air} V_d \phi(SA) f_d$$
$$= 32kg/yr$$

Fraction of year when it is not precipitating (0.9)

Fraction of PCBs associated with particles

Outputs

- Outflow
  - St. Mary's River

$$W_{outflow} = 7.1x10^{13}\, L/yr(0.84ng/L) = 60kg/yr$$

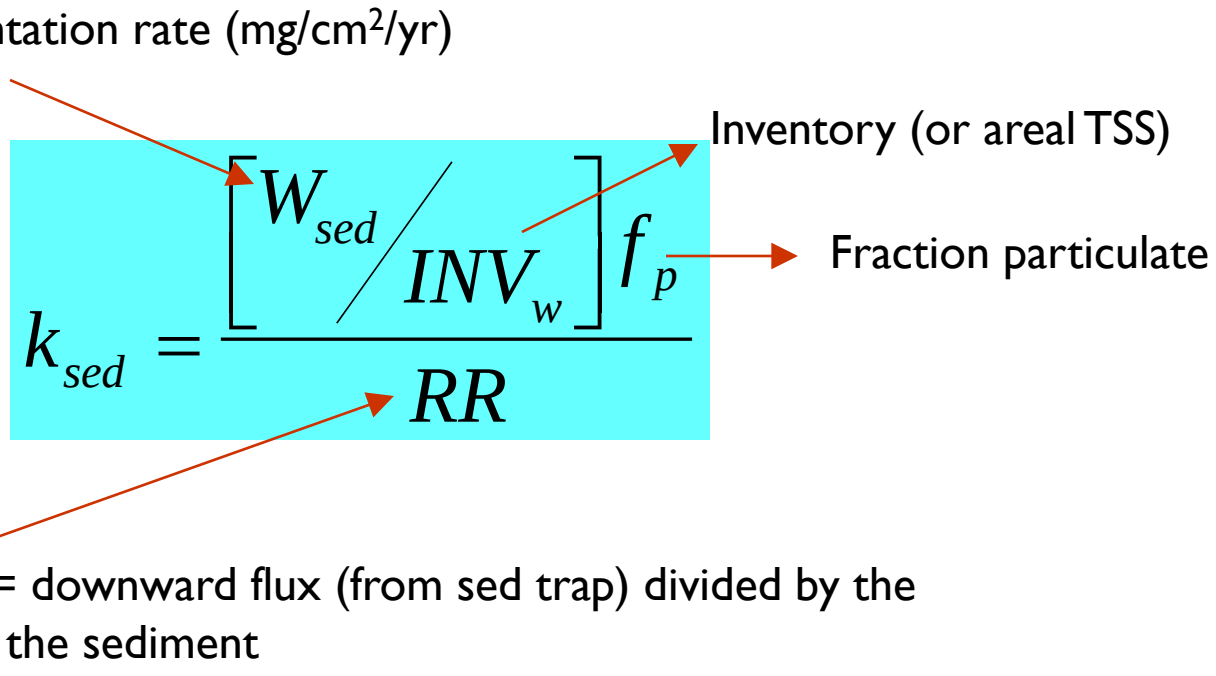
- Burial (net loss to sedimentation)
  - estimated at 110 kg/yr from sediment cores collected in 1986 and 1990
- Net Volatilization
  - true volatilization minus gas absorption
  - assumed to account for missing flux

Reactions

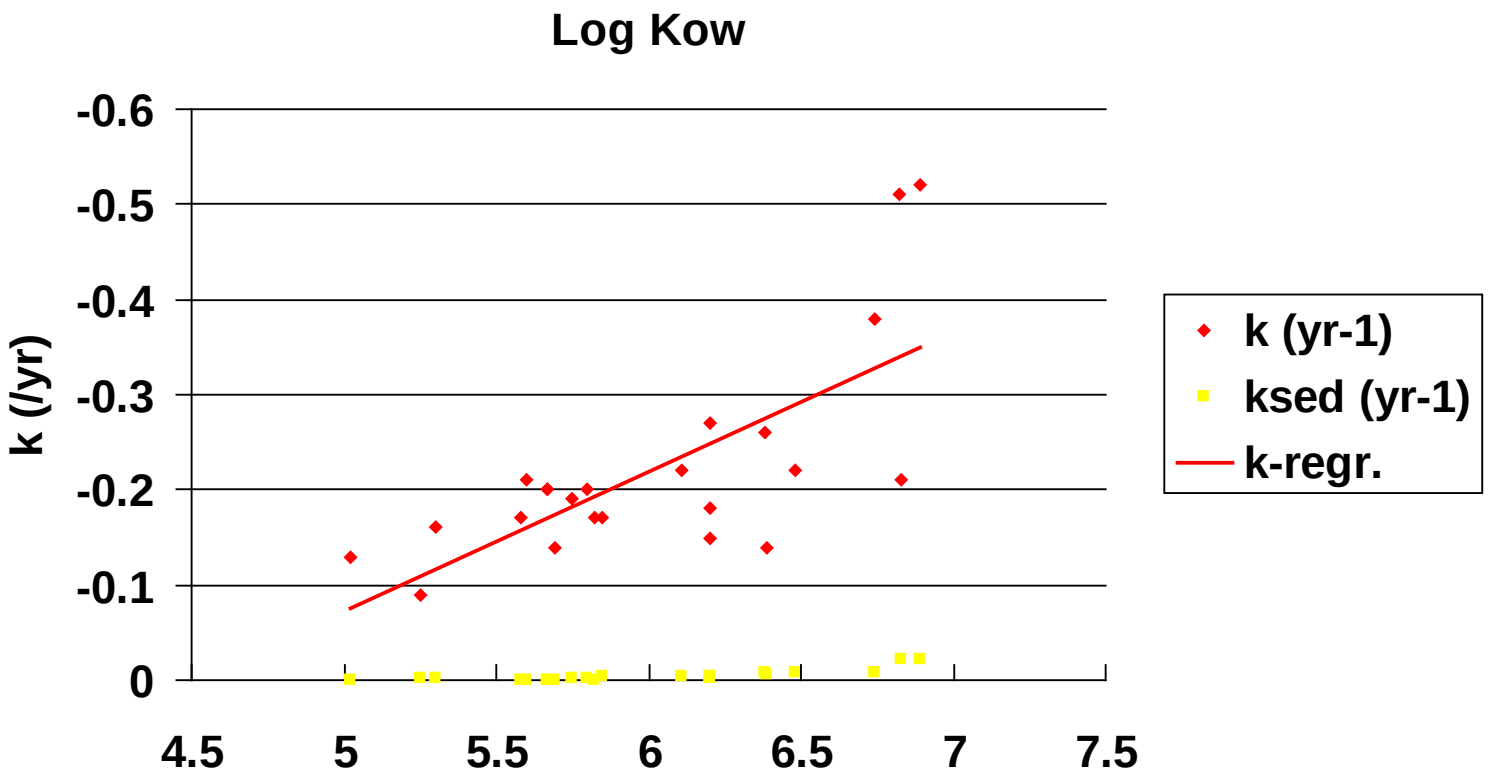
- NONE!
  - "evidence does not exist to support PCB degradation in Lake Superior or any other oligotrophic, aerobic system exhibiting low ambient concentrations"

Congener-specific sedimentation

- Calculation of first-order net sedimentation rate



Sedimentation vs overall loss rate



- To next lecture