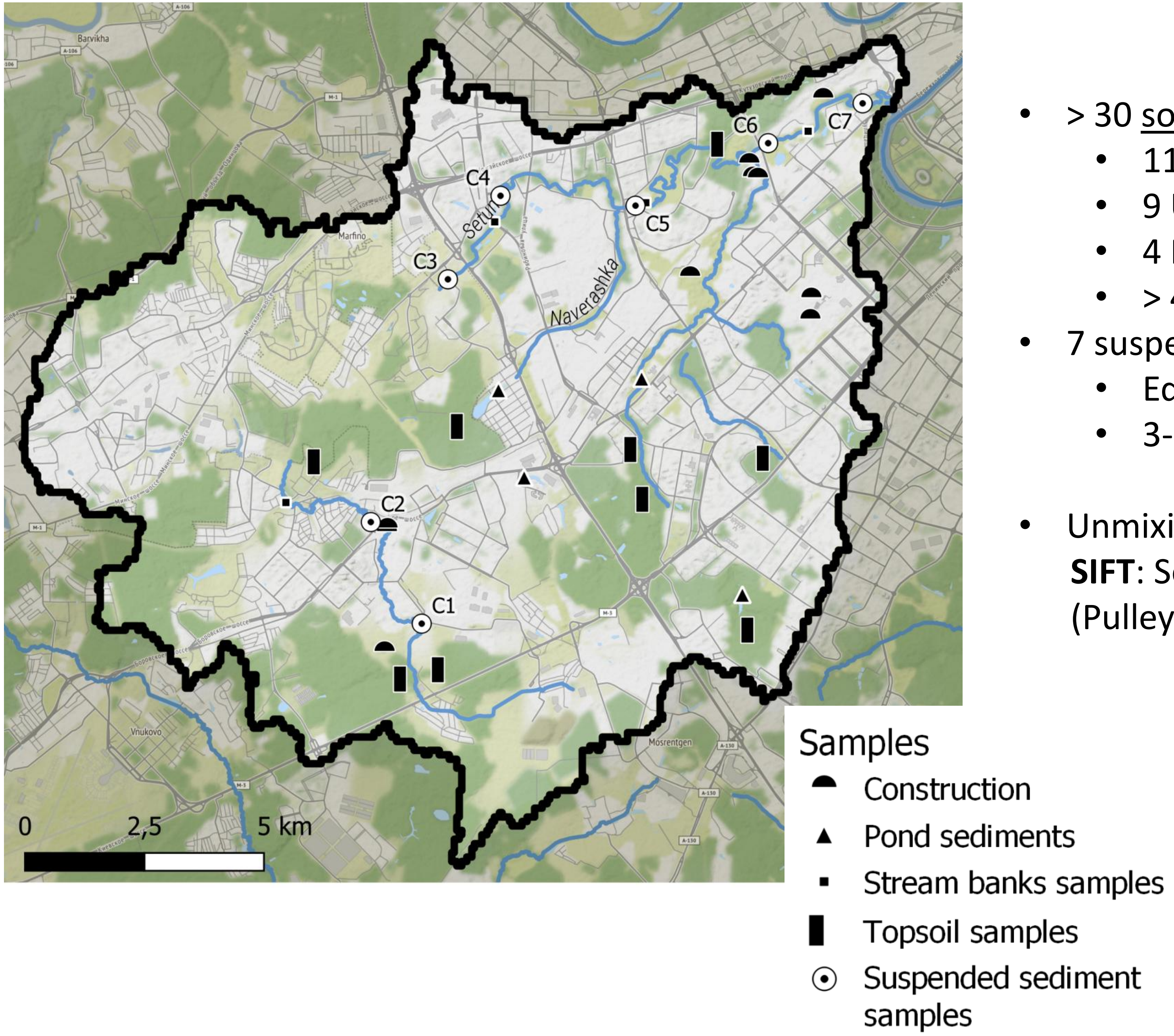
Deliverable 4: contaminants apportionment in Moscow drainage area

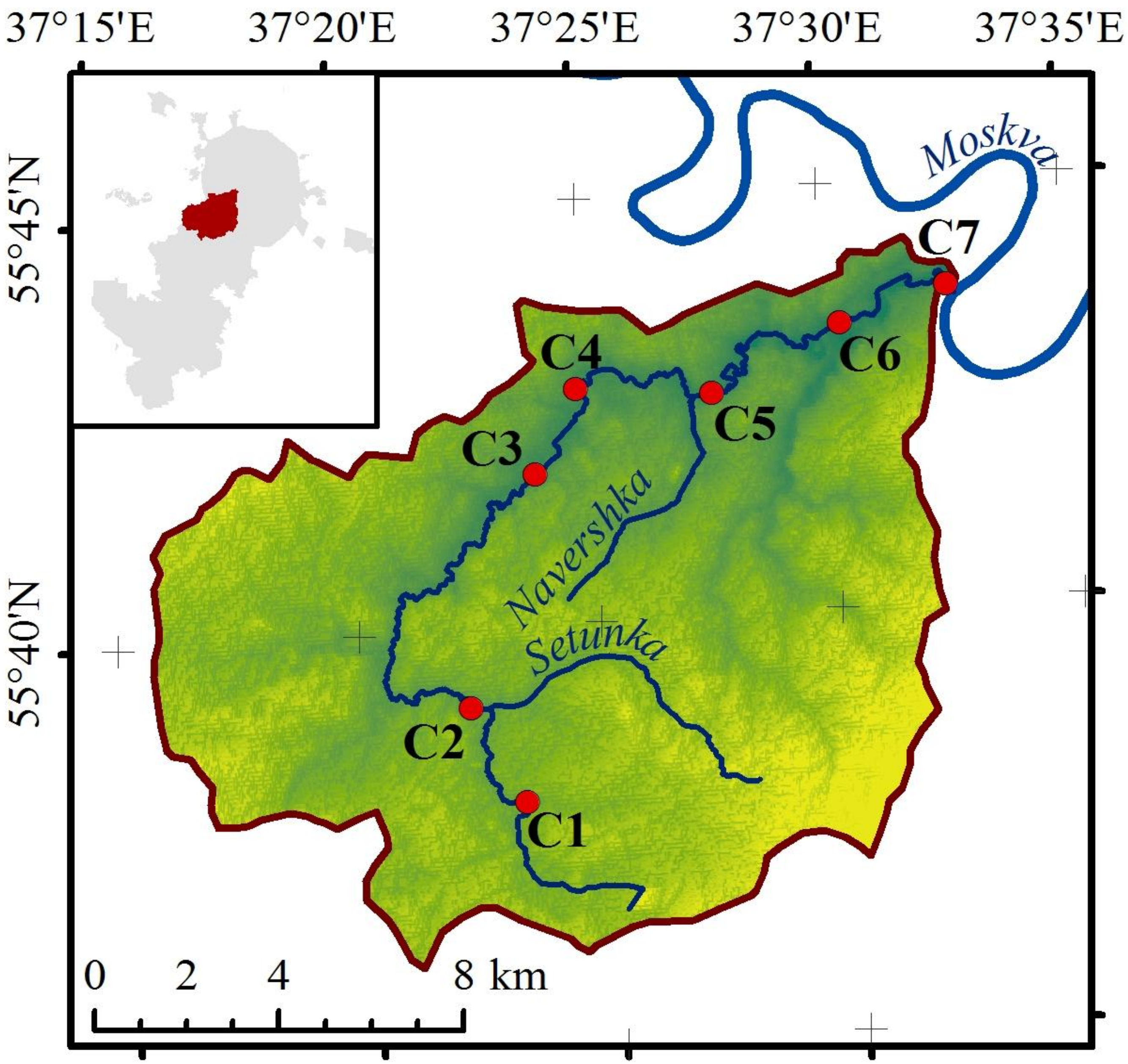
Tracing sediment sources



- > 30 source samples
  - 11 Construction sampling sites
  - 9 Undisturbed topsoil sampling sites
  - 4 Pond bottom sediment sites
  - > 4 stream bank sediment samples
- 7 suspended sediment sampling points (mixture samples)
  - Equipped with Phillips tube integral sampler
  - 3-month sample rotation
- Unmixing sediments samples with **SIFT**: SedIment Fingerprinting Tool (Pulley & Collins, 2018)

ROTHAMSTED RESEARCH

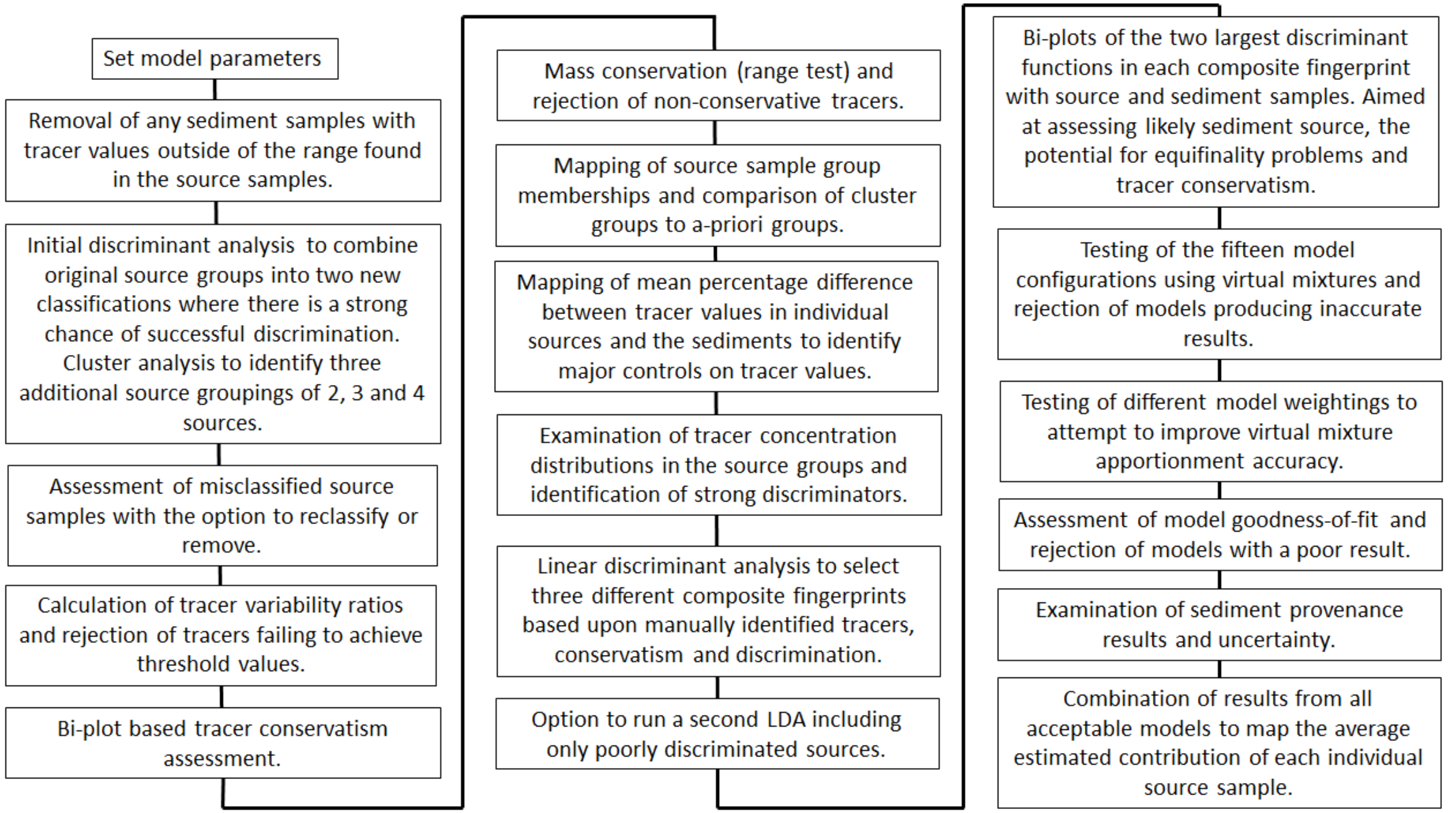
Water and sediment sampling in the Setun watershed



7 stations on the Setun River, 2 tributaries

- Monthly sampling at 3 stations (the Setun River mouth and 2 tributaties)
- Seasonal sampling (4 times per year) at all 9 stations
- Bottom sediment sampling – once per year

SIFT Model Workflow



BOTH source and mixture

- Samples will be analyzed for 59 geochemical elements including Li, Be, B, Mg, Na, Al, P, S, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, As, Se, Rb, Sr, Y, Zr, Nb, Rh, Pd, Ag, Mo, Cd, Sn, Sb, Cs, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Dy, Ho, Yb, Lu, Hf, Ta, W, Ir, Pt, Hg, Tl, Pb, Bi, Th, and U using magnetic-sector inductively coupled plasma mass spectrometry (ICP-MS)
- The samples will be divided into two particle size fractions, 63–212 μm (fine sand) and < 63 μm (silt and clay)

↓↓↓

Selection of conservative traces

↓↓

Sediment source discrimination

↓

Unmixing model development

UNIVERSAL SOIL LOSS EQUATION
(USLE)

Deliverable 5:
Basin-wide semi-distributed model of the chemical flow

$$A = R \cdot K \cdot C \cdot LS \cdot P$$

Estimated soil loss per year [t ha^{-1} yr^{-1}]

R – rainfall erosivity factor [MJ mm h^{-1} ha^{-1} yr^{-1}]

K – soil erodibility factor [t h MJ^{-1} mm^{-1}]

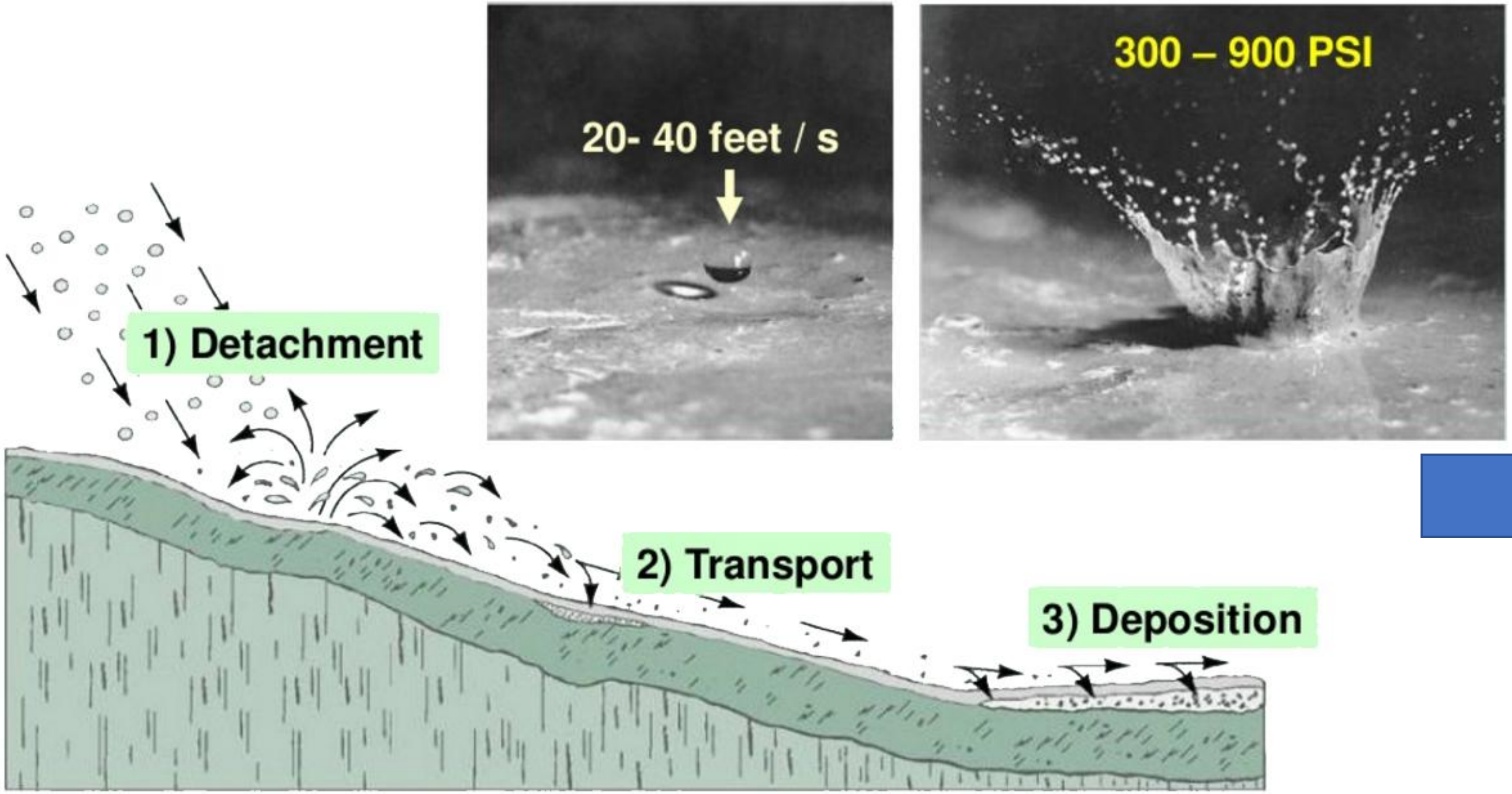
C – crop/cover and management factor [dimensionless]

P – conservation/support practice factor [dimensionless]

LS – the slope length and steepness factor (also known as topographic factor)

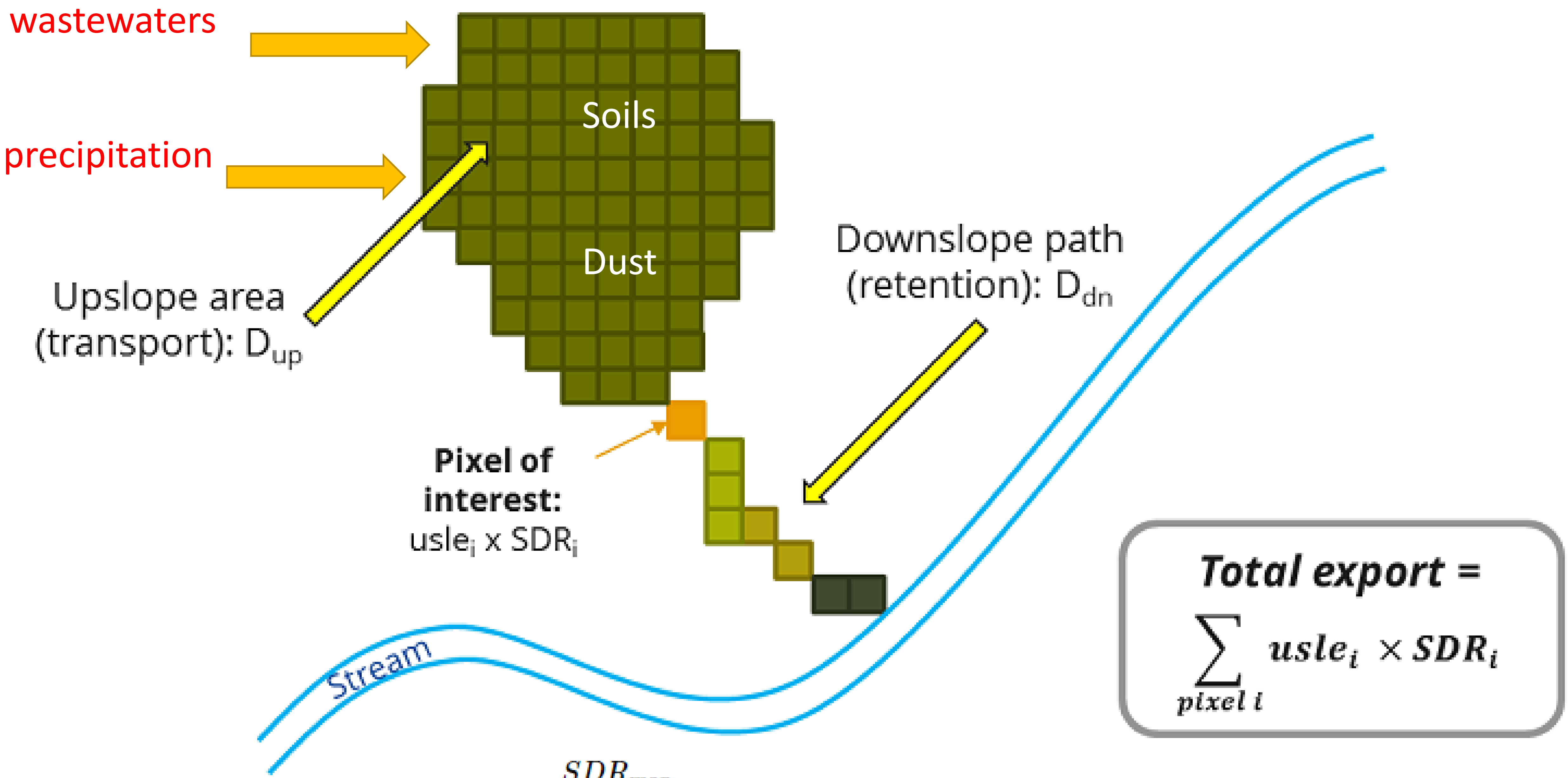
[dimensionless]

How USLE works?



Brady and Weil (2002)

Linking with geochemical soil (dust) mapping will allow to count chemical delivery



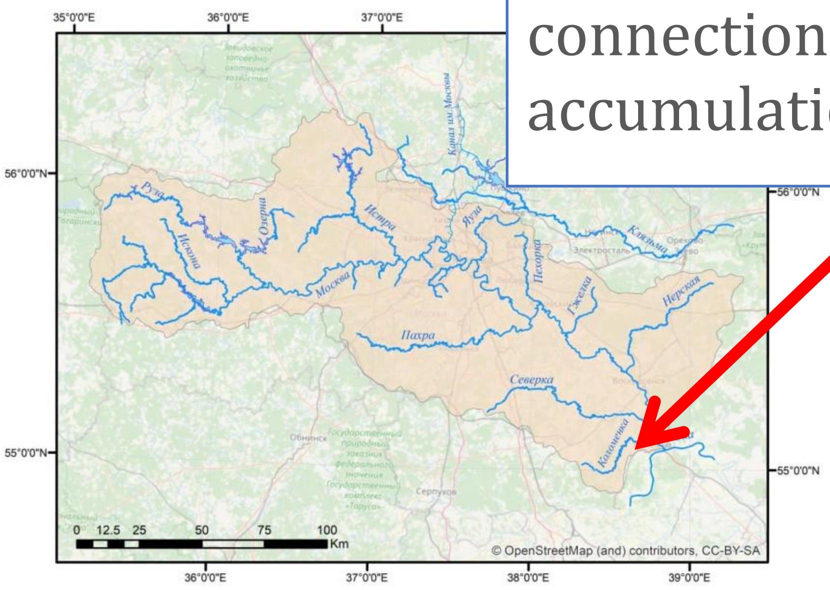
$$SDR_i = \frac{SDR_{max}}{1 + \exp\left(\frac{IC_0 - IC_i}{k}\right)}$$

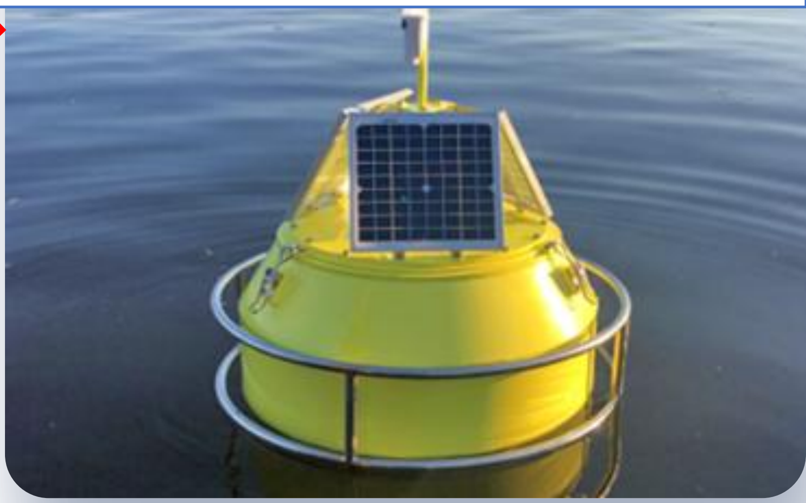
Deliverable 6. pollutants delivery at the outlet of the Moscow River and connection with atmospheric accumulation

-Allows to closely monitor water pollution - one of the most pressing environmental problems of the Moscow megacity

- Very important in relation to Science Diplomacy
(combined with air pollution)

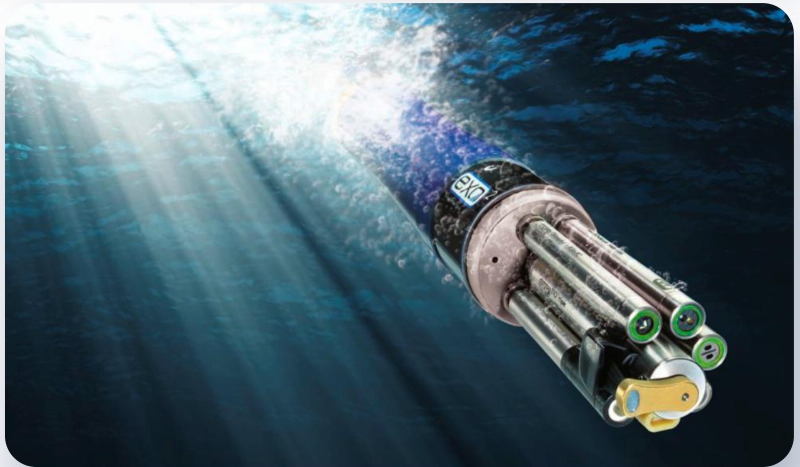
- Over 50% of the Moskva River runoff at mouth is composed of treated and untreated wastewater





Measured parameters:
TSS, ph, level-water discharge, TDS + ammonia, PAH, petroleum products

-Combined with manual WQ sampling on monthly basis

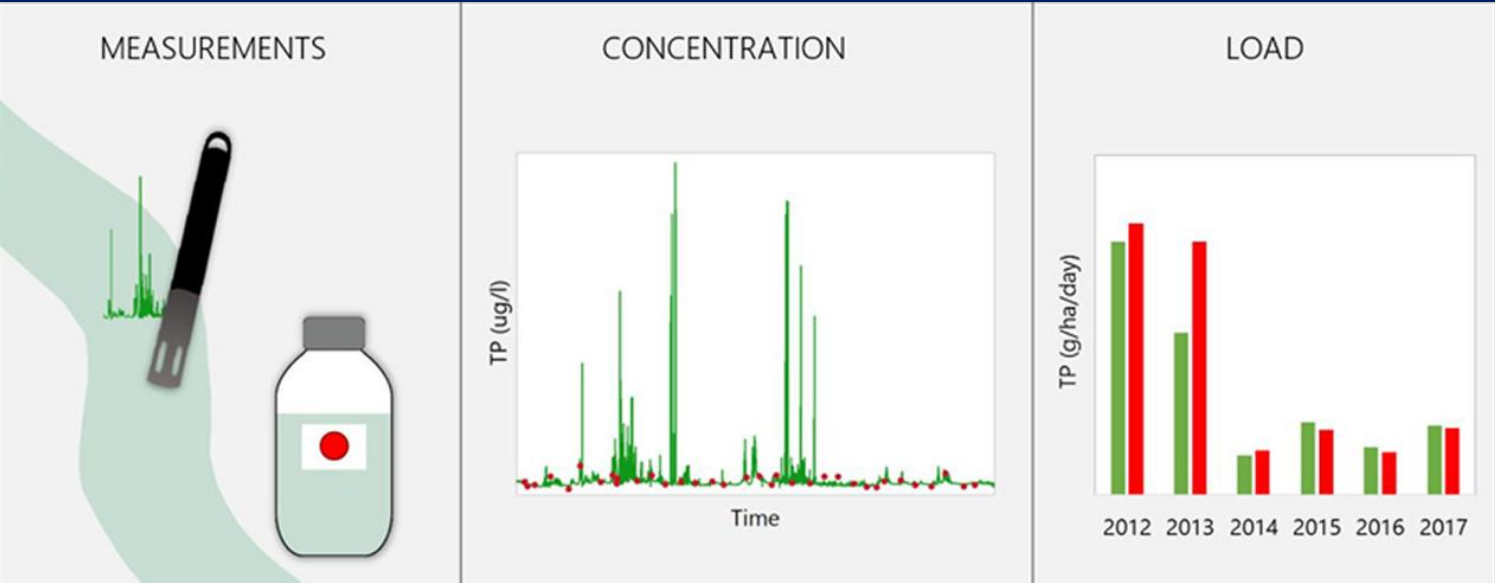


Potential of utilizing high-resolution monitoring data in assessment and forecasting of water quality

- Quantitative estimation of chemical loads and fluxes to the Oka River based on high-frequency monitoring combined with manual sampling

- Detection of short-term pollution surges, assessment of their frequency and variation

- Evaluation of actual seasonal variability of parameters in an anthropogenically altered stream

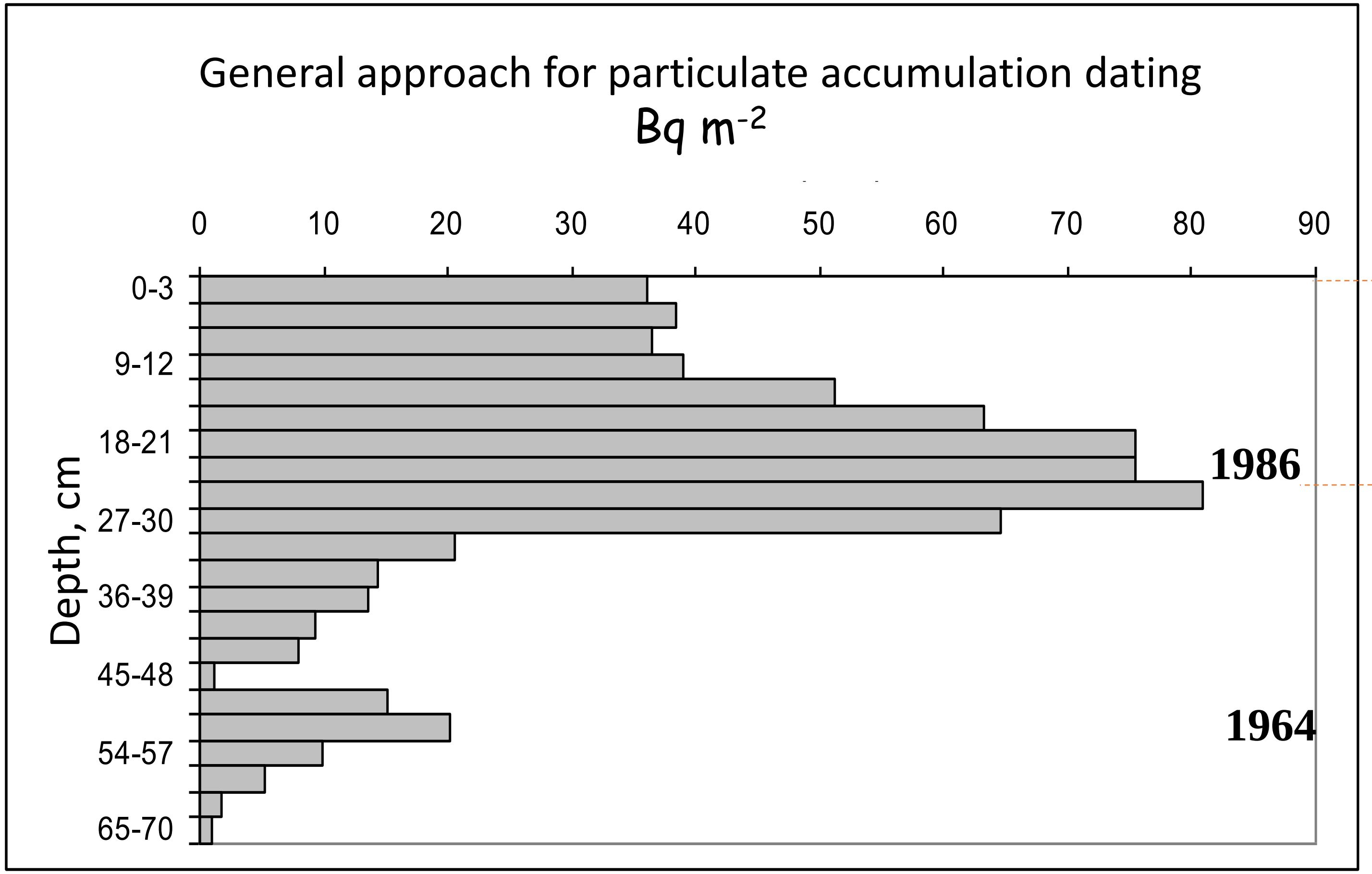


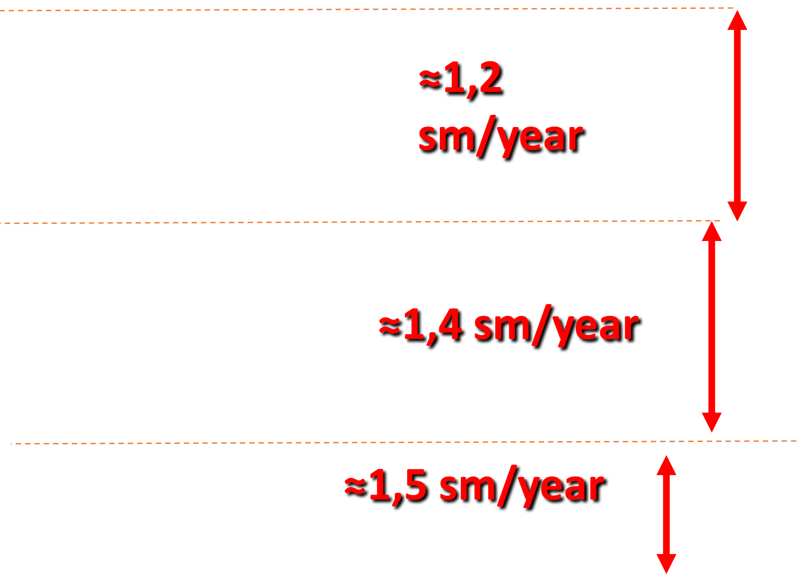
Random Forests Regression → **Pollutant concentrations**

recommendations for stakeholders

Lake coring for dating and pollutants accumulation in surface waters

(1) Dating using Cs-137 → (2) Identification of pollutants accumulation rates

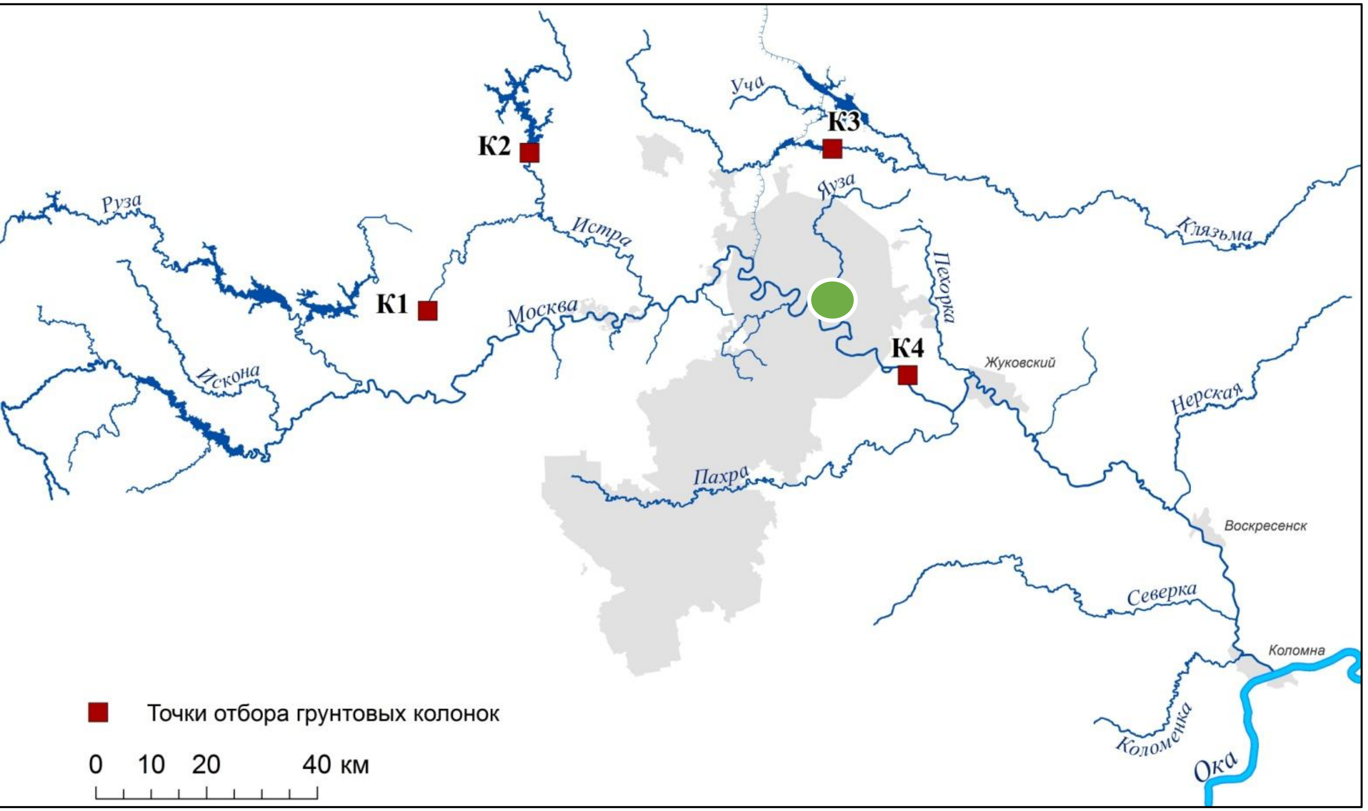




Lake coring for dating and pollutants accumulation in surface waters

■ “Clear” natural lakes and reservours

● Urban lake without recent dredging or reclamation works



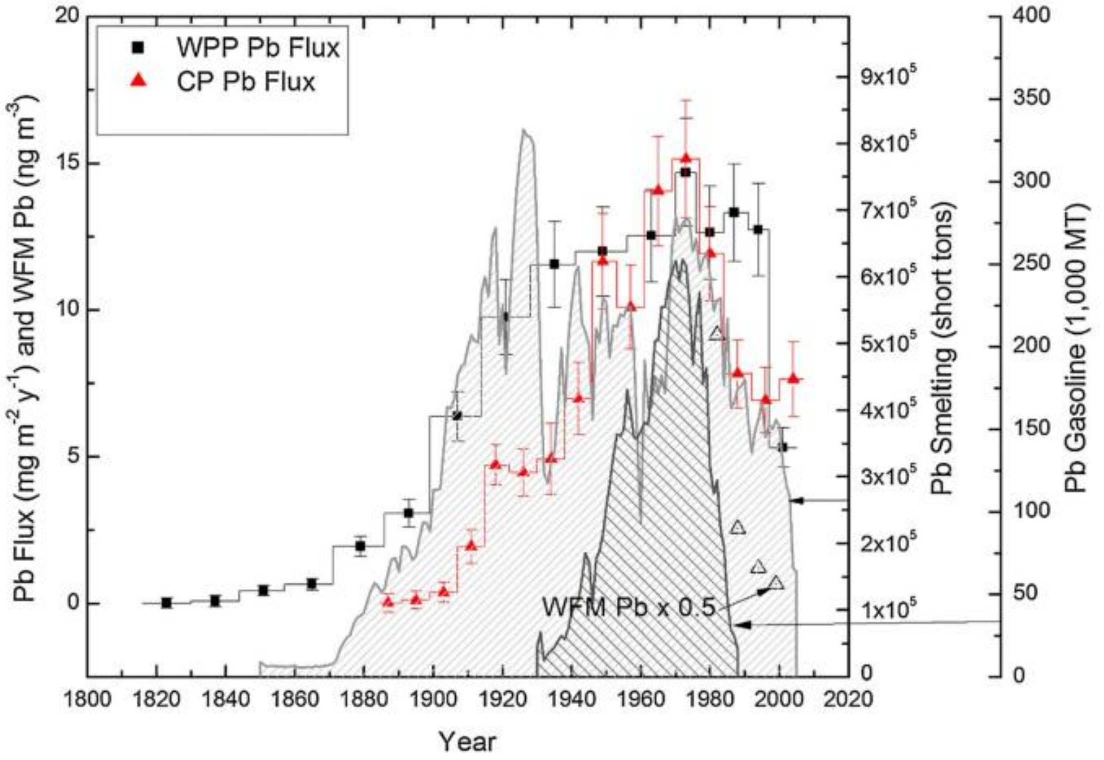


Figure 4. Flux of Pb (mg m^{-2} yr^{-1}) at WPP and CP as functions of chronology. The vertical bars show the propagated 1 sigma uncertainty in the flux. Also shown are primary (smelting) production data (short tons) for Pb between 1850 and 2005 (from “Historical Statistics of the United States 1789–1945” for the period of 1840–1899 and U.S. Geological Survey statistics for 1900–2005), leaded gasoline consumption data (000 t) between 1930 and 1988 [*Nriagu*, 1989b], and atmospheric Pb data (6 yearly average) (ng m^{-3}) at Whiteface Mountain from 1979 to 2001 [*Husain et al.*, 2004].

From Sarkar et al., 2015

THANK
YOU
FOR
YOUR
ATTENTION

OPEN QUESTIONS AND TASKS:

1. Collaborators in Helsinki?
2. Joint conceptual work with other WP → Crucial for WP 6!

Interrelations and chemical (microparticles) transfer between urban atmosphere, soils and surface water

6.1 Supradisciplinary (i.e. simultaneous multi-, inter- and transdisciplinary) and multidisciplinary (physics, chemistry, biology, meteorology, etc.) scientific framework

- Task 6.2 Conceptual and integrated analysis of urban atmospheric and environmental pollution formation, effects and feedback

Holistic concept which can integrate knowledge on various processes and phenomena in urban atmosphere and environment, their interactions and feedbacks