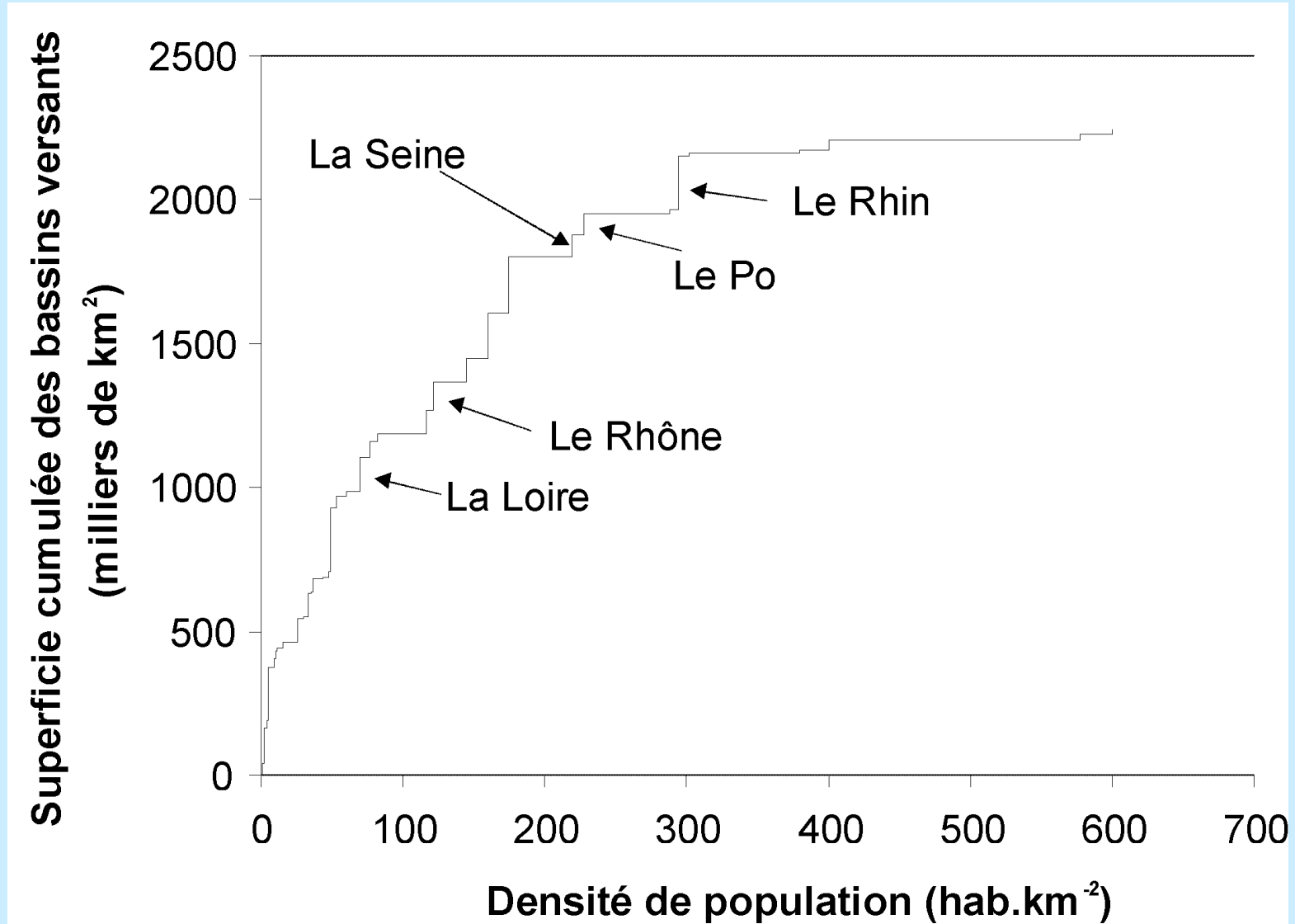


# Urban area(s) in Zone atelier Seine

- $\approx 10^7$  inhabitants in Paris and suburbs
  - central in the Seine river basin
- Large downstream and upstream impacts
- Processes inside the city
  - sources and transport of pollutants
- Downstream impacts

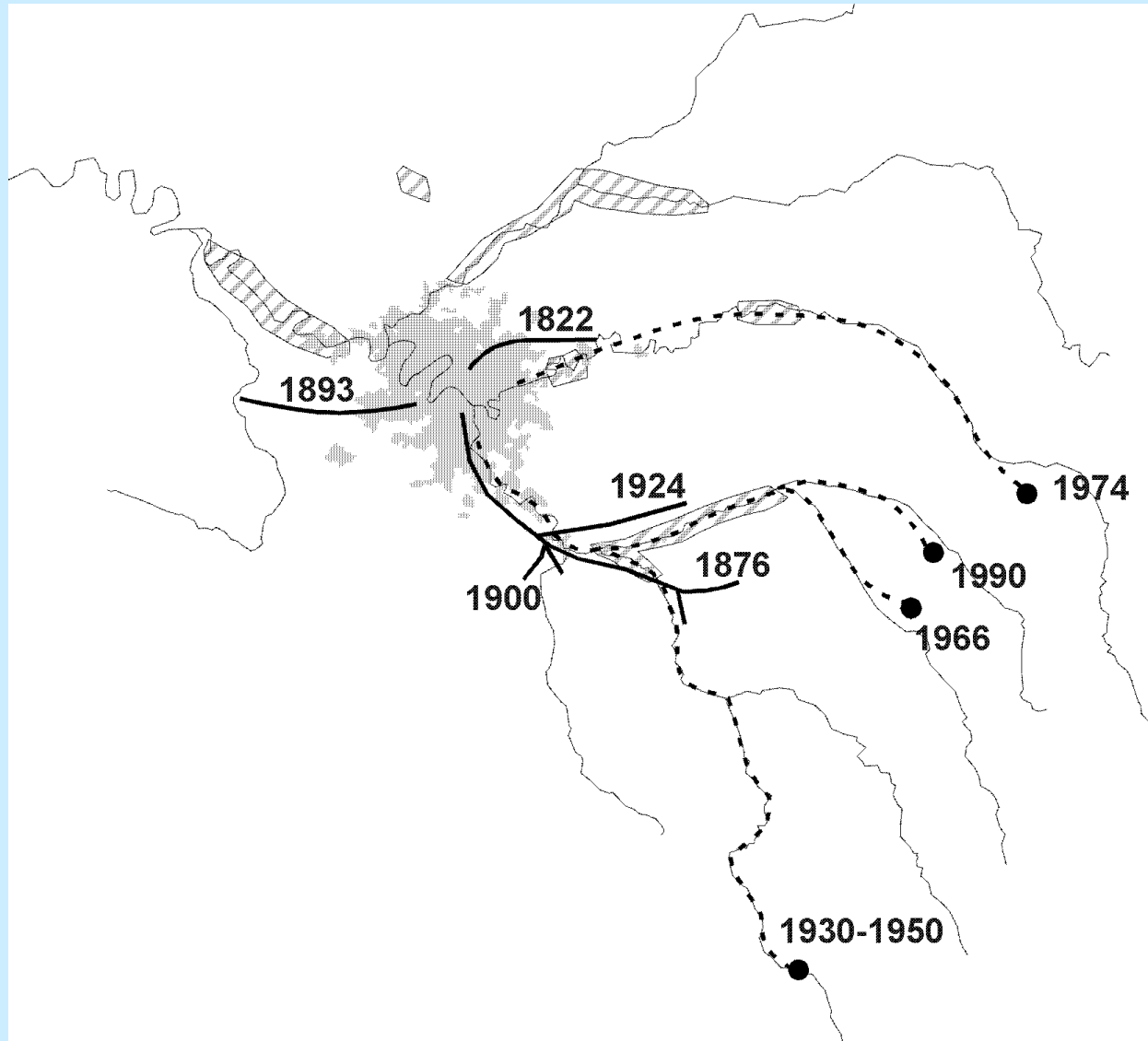
# A dense population on a small stream



# Large upstream and downstream impacts

- Transportation of goods
  - Wood floating, then shipping
- Sand and gravel extraction
  - In alluvial resources in river banks
- Protection against flooding and drinking water production
  - Dikes, upstream reservoirs
- Waste water and urban runoff

# Upstream and downstream impacts



# Work on generic processes

- Common to most human/urban activities
- But concentrated in urban areas
  - Water use and discharge
  - Impervious land use
  - Transportation/construction
  - Heating
  - Housing, Health
- But not specific to urban areas
- Assess production and transfert
  - link to economic activity

# Processes inside the city

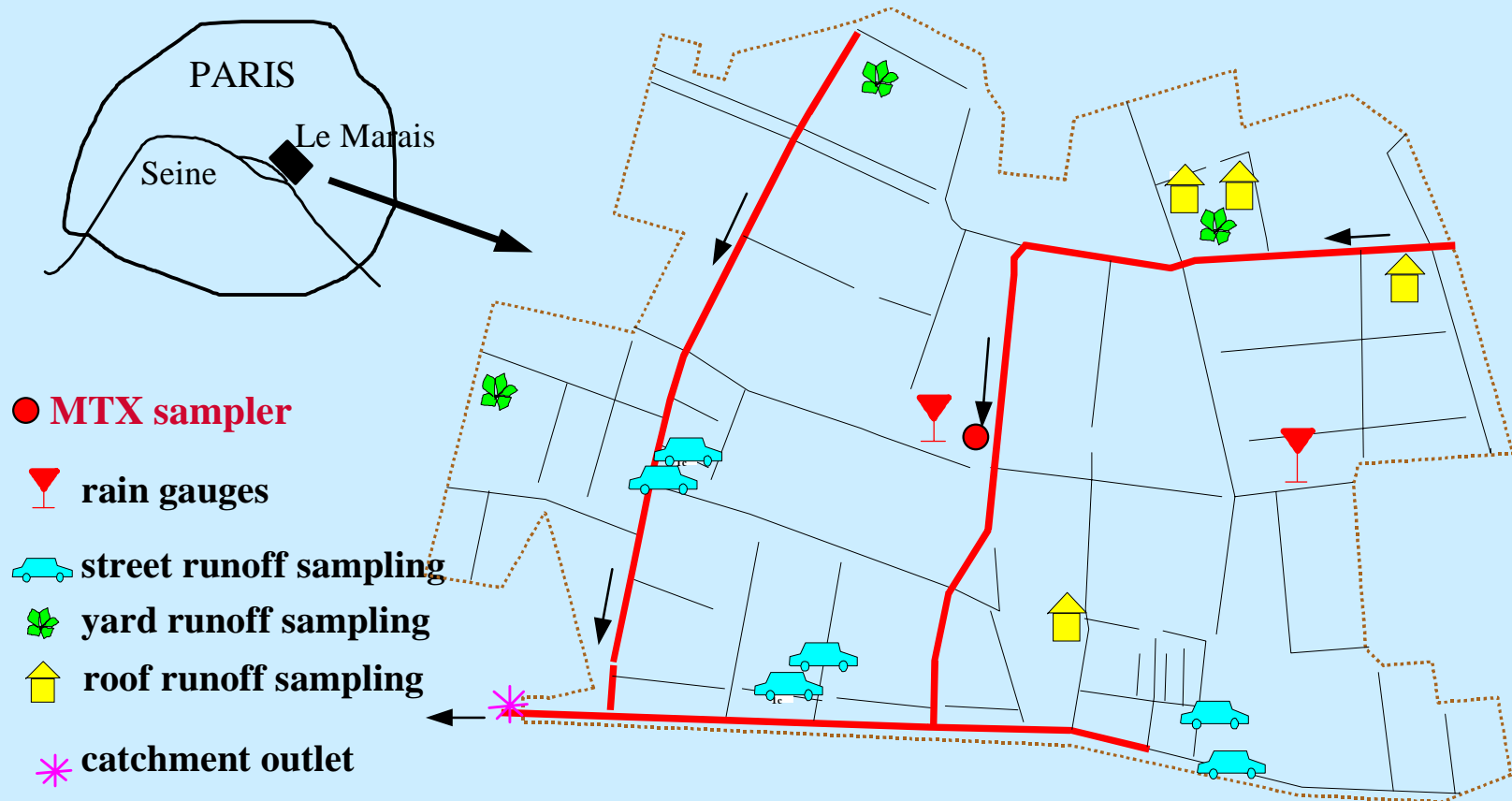


- Pollution generation
  - Corrosion, heating, transportation....
  - Atmospheric pathway may be significant
  - Metals, Persistent Organic Pollutants
  - ... vs domestic, industrial, commercial activities
  - anthropogenic  $\Rightarrow$  social awareness and behavior
- Pollution transport
  - Combined sewer systems
  - Separate systems, which control on runoff pollution ?

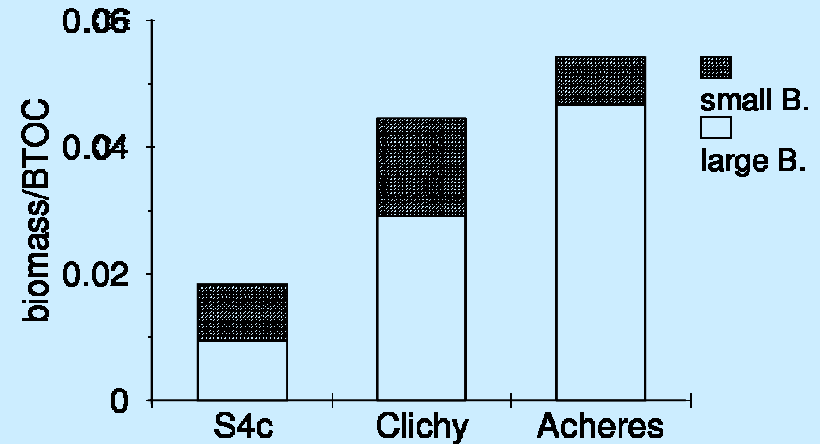
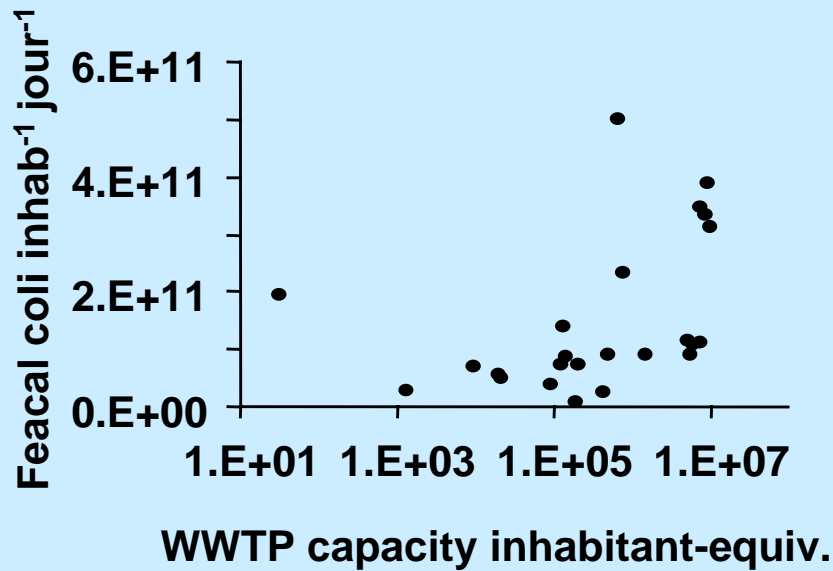
# Sites

- "Le Marais" experimental urban catchment
  - 48, ha, 78% impervious, combined sewer
- Extension to 5 nested catchments
  - up to 12000 ha
- Some other sites in suburbs
  - less perennial for now

# "Le Marais catchment



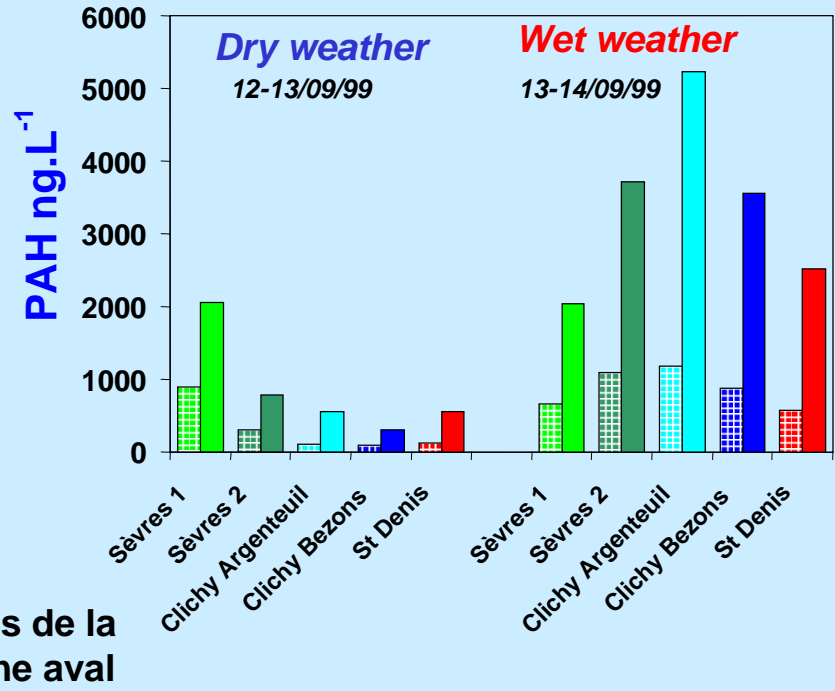
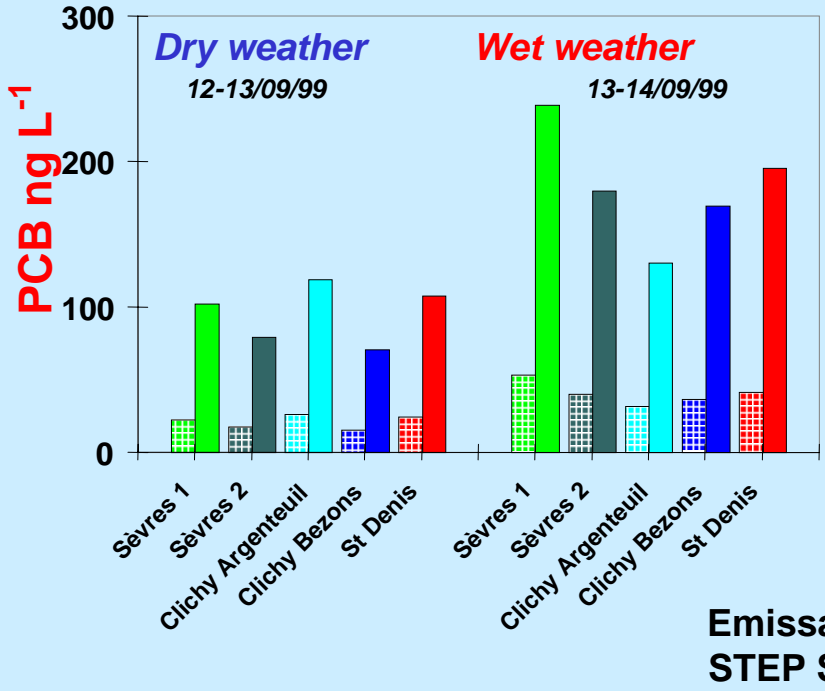
# Bacterial processes inside sewers







- Heterotrophic, nitrifying  
⇒ impact of overflows in combined systems

- Sulfate reducing  
⇒ impact on fate of trace metals

# POP in urban runoff



 **Σ 7 congeners**  
 **Aroclor equivalent**

 **Σ 6 HAP**  
 **Σ 16 HAP**

# Wet and dry POP mass balance



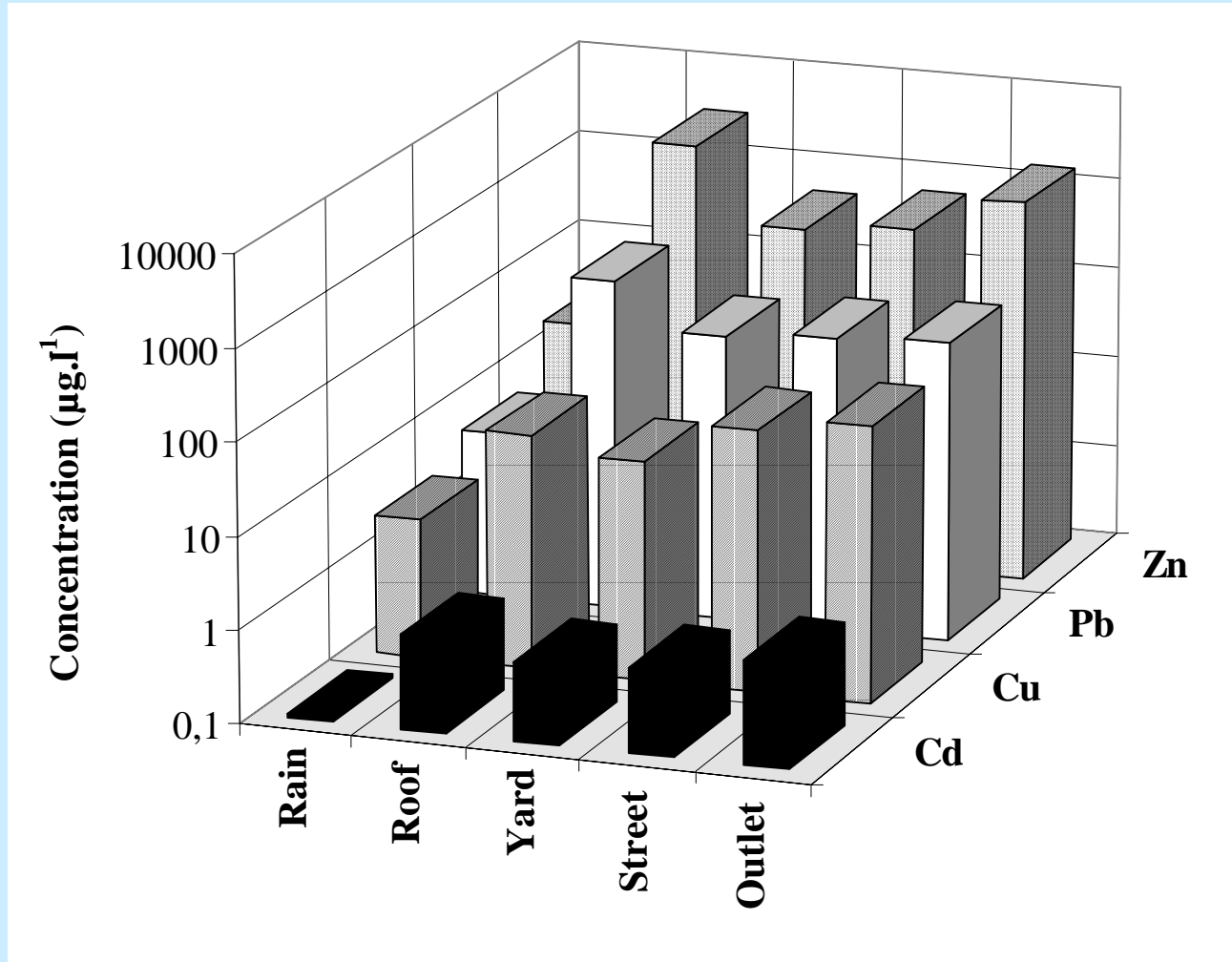
	<b>Dry weather</b>	<b>Wet weather</b>	<b>Atmospheric fallout (wet)</b>
<b>PAH</b> <b>(<math>\Sigma 6</math> components)</b>	470 g d <sup>-1</sup>	2400 g d <sup>-1</sup>	30 g d <sup>-1</sup>
<b>PCB</b> <b>(<math>\Sigma 7</math> congeners)</b>	40 g d <sup>-1</sup>	100 g d <sup>-1</sup>	70 g d <sup>-1</sup>

# Zn/Pb in runoff



runoff	sediment from several ponds, new suburds	0.6 - 1.7°
combined	Montreuil city, old suburds	2.9**
runoff/combined	mixed	1.2-1.6**
combined	Middle aged suburbs	3**
combined	Mixed	1.8 - 5*
combined	Central Paris	6.7*
combined	Central Paris	9.9°
combined	Old suburbs	4.8°
combined	Central Paris	10*
combined	Central Paris	9*
combined	Central Paris	11*
combined	Central Paris	8.4*

# Zn in "Le Marais" catchment



# Downstream impacts

- Oxygen depletion
  - Coupling heterotrophic, nitrifying and phytoplanktonic activity
- Fecal contamination indicators
- Suspended solids and particulate pollutants residence time
  - long during summer periods
- Toxicity of runoff

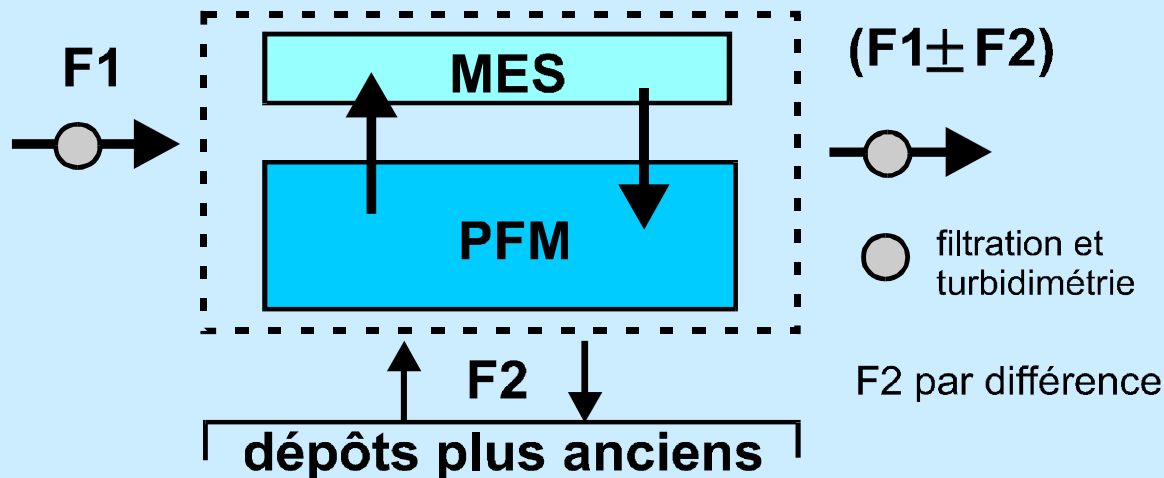
# Sites

- Mainly the river Seine, through Paris and downstream, including estuary (Seine-Aval program)
- Few smaller rivers

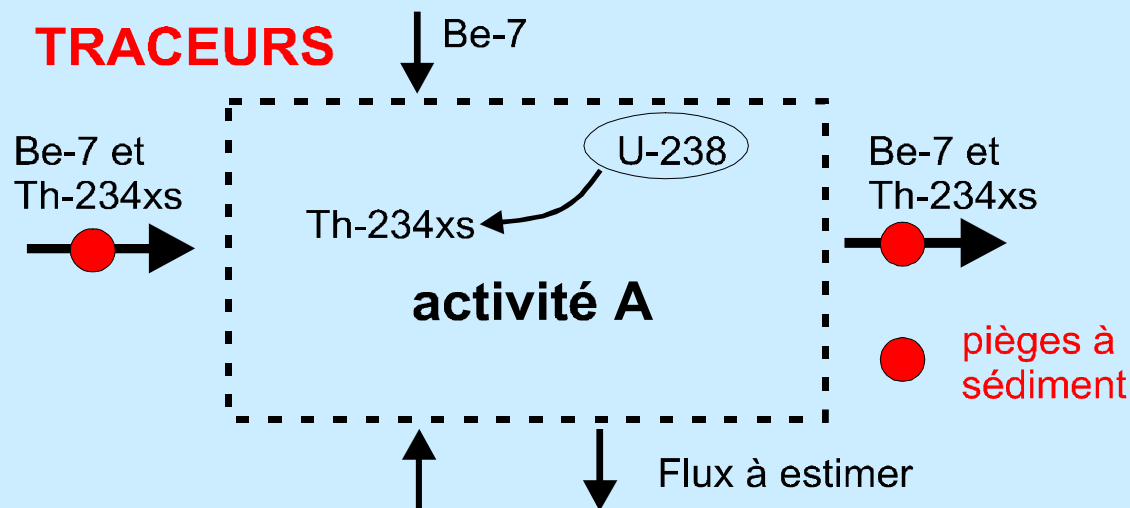
# Measuring residence time of particles



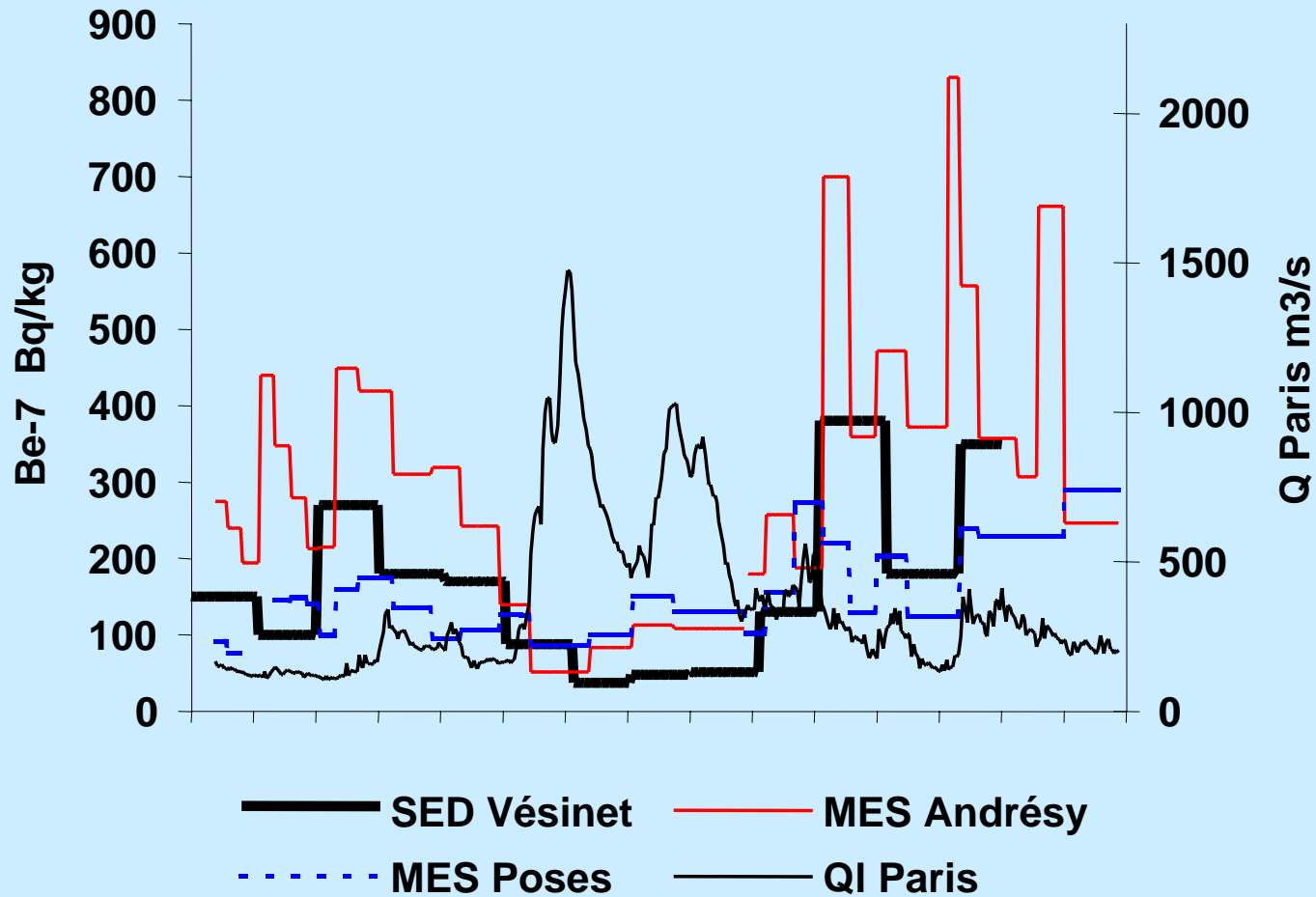
## PARTICULES



## TRACEURS

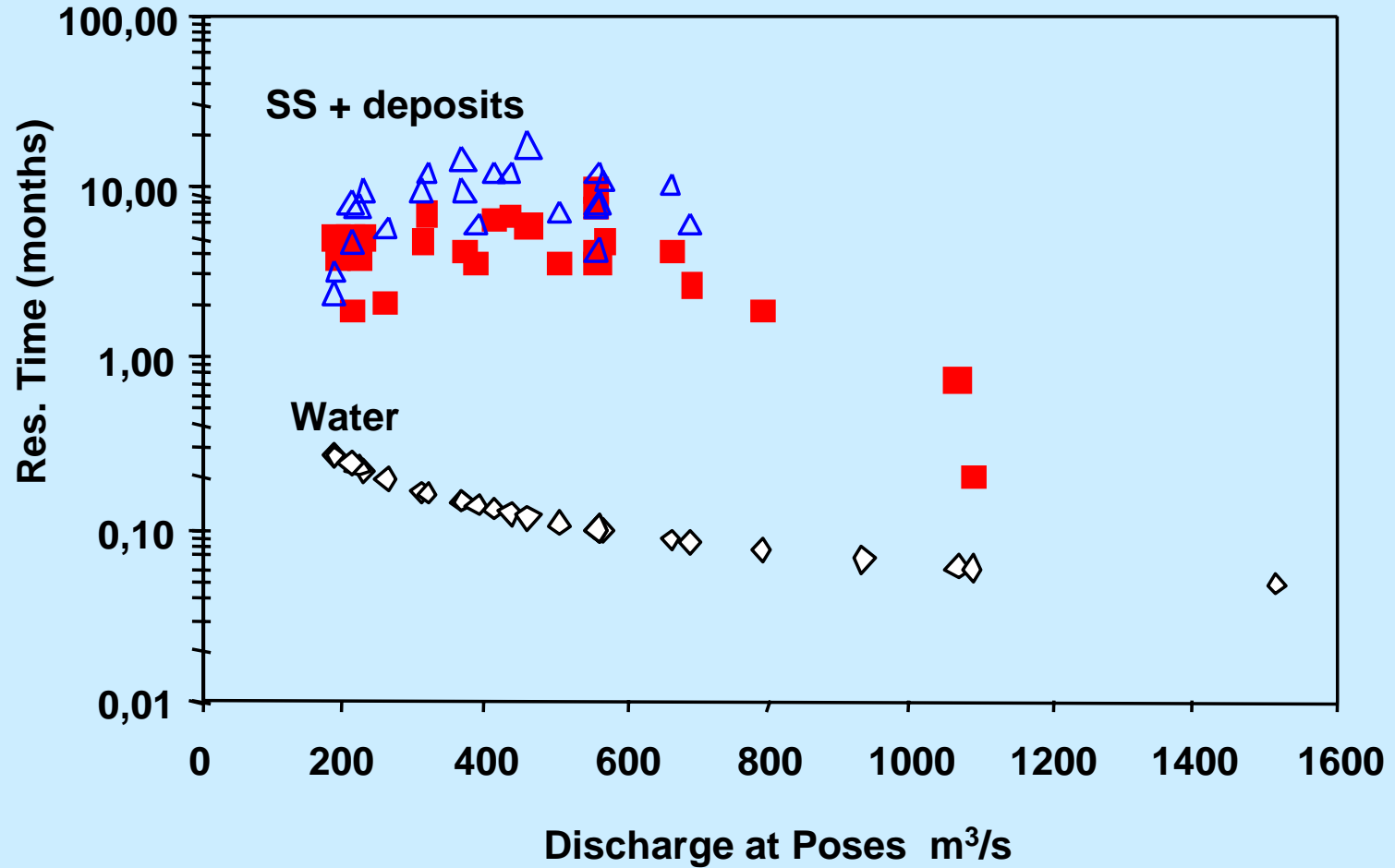


# $^7\text{Be}$ signal

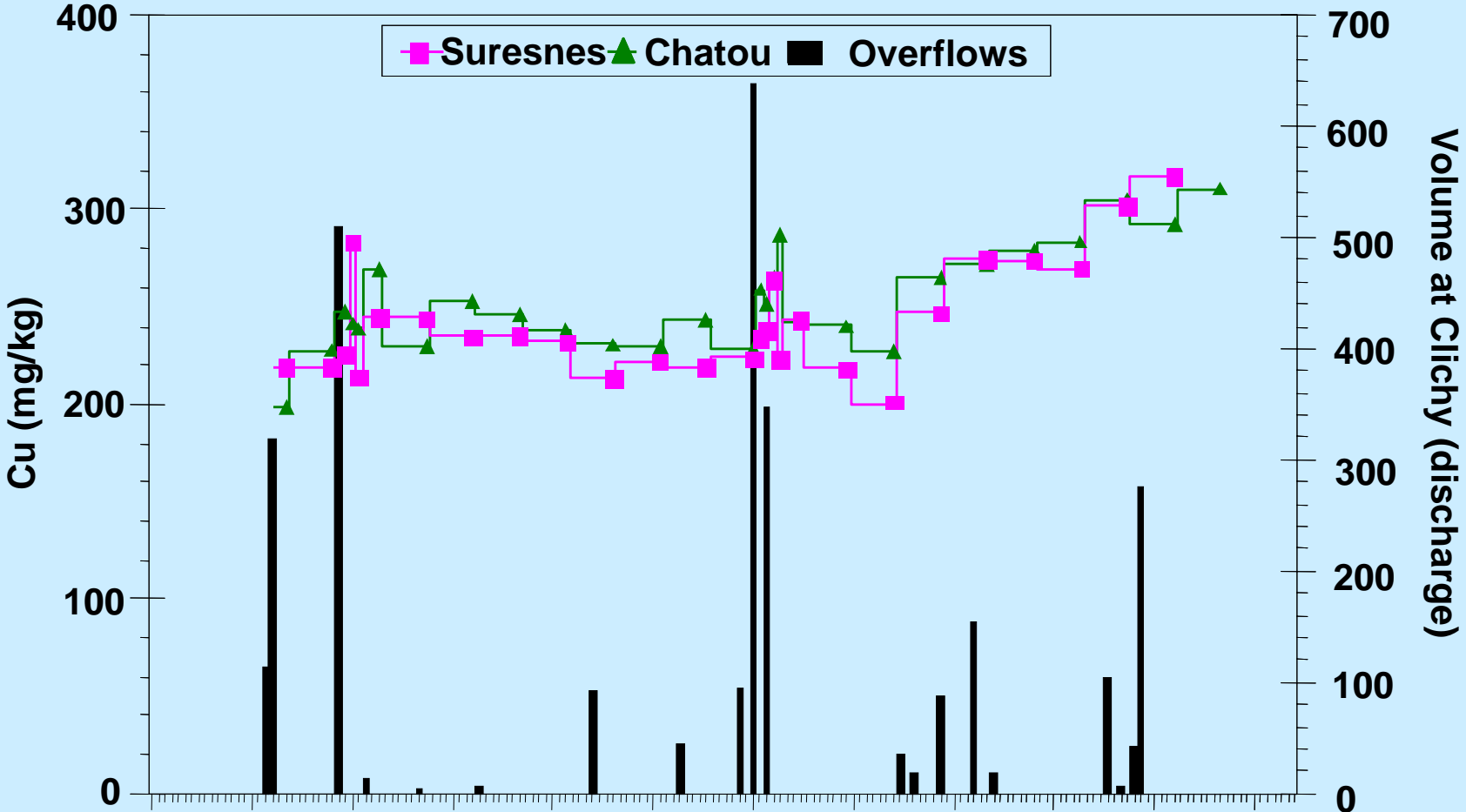


1999-2000

# Res. Time of water and particles



# Impact of rain events



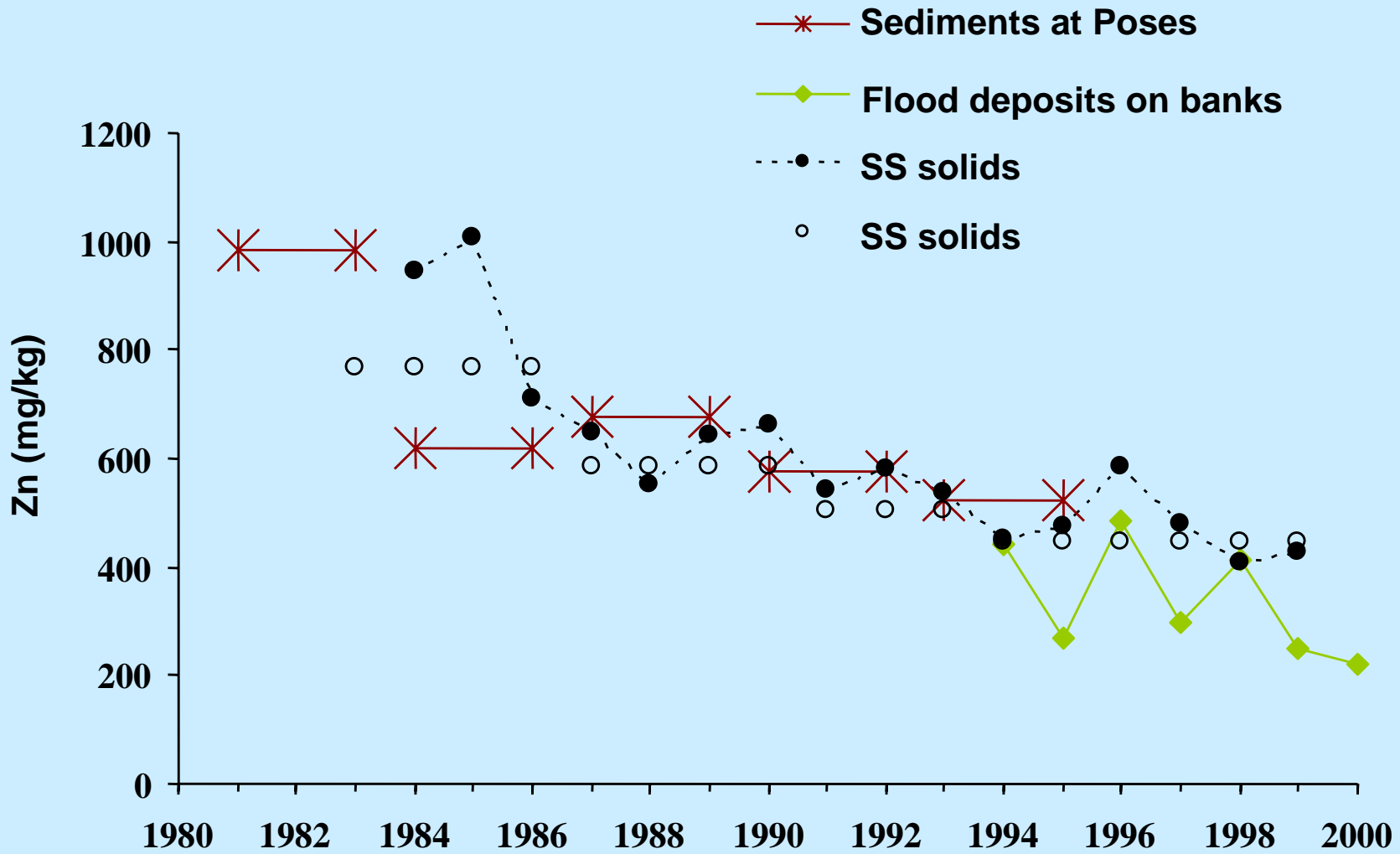
# Mass-balance for metals



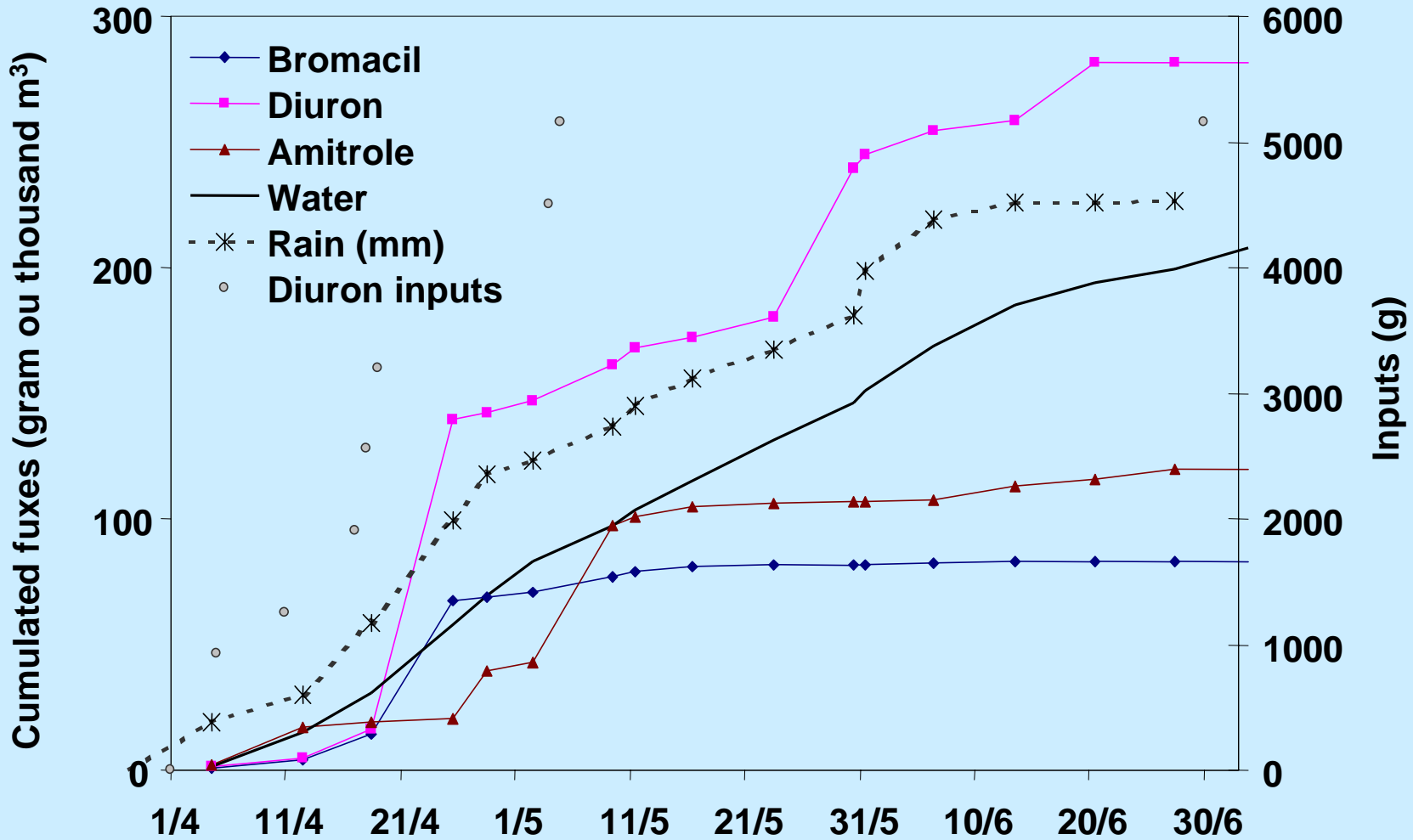
	<b>Urban Runoff</b>	<b>WWTP</b>	<b>Total urban</b>	<b>dredged</b>	<b>Poses</b>
<b>Cd</b>	<b>0.1</b>	<b>0.5</b>	<b>0.6</b>	<b>0.2</b>	<b>1.2</b>
<b>Cu</b>	<b>7</b>	<b>20</b>	<b>27</b>	<b>9</b>	<b>54</b>
<b>Pb</b>	<b>8</b>	<b>9</b>	<b>17</b>	<b>17</b>	<b>45</b>
<b>Zn</b>	<b>75</b>	<b>75</b>	<b>150</b>	<b>31</b>	<b>230</b>

Tonnes per year, 1990-1992

# Significant evolution



# Pesticides in suburban catchment



# Some ideas about the future

- Industrial ecology
  - reconstruct 150 last years, economics, link to signatures of the past
  - global risk management (ecotox. and health)
- Aquatic landscape in cities and suburbs
  - EWFD (acceptable/expectable standards)
  - runoff source control
- Antibiotic, drugs, endocrine disrupters