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# Assessing geographical differences in illicit drug use - A comparison of results from epidemiological and wastewater data

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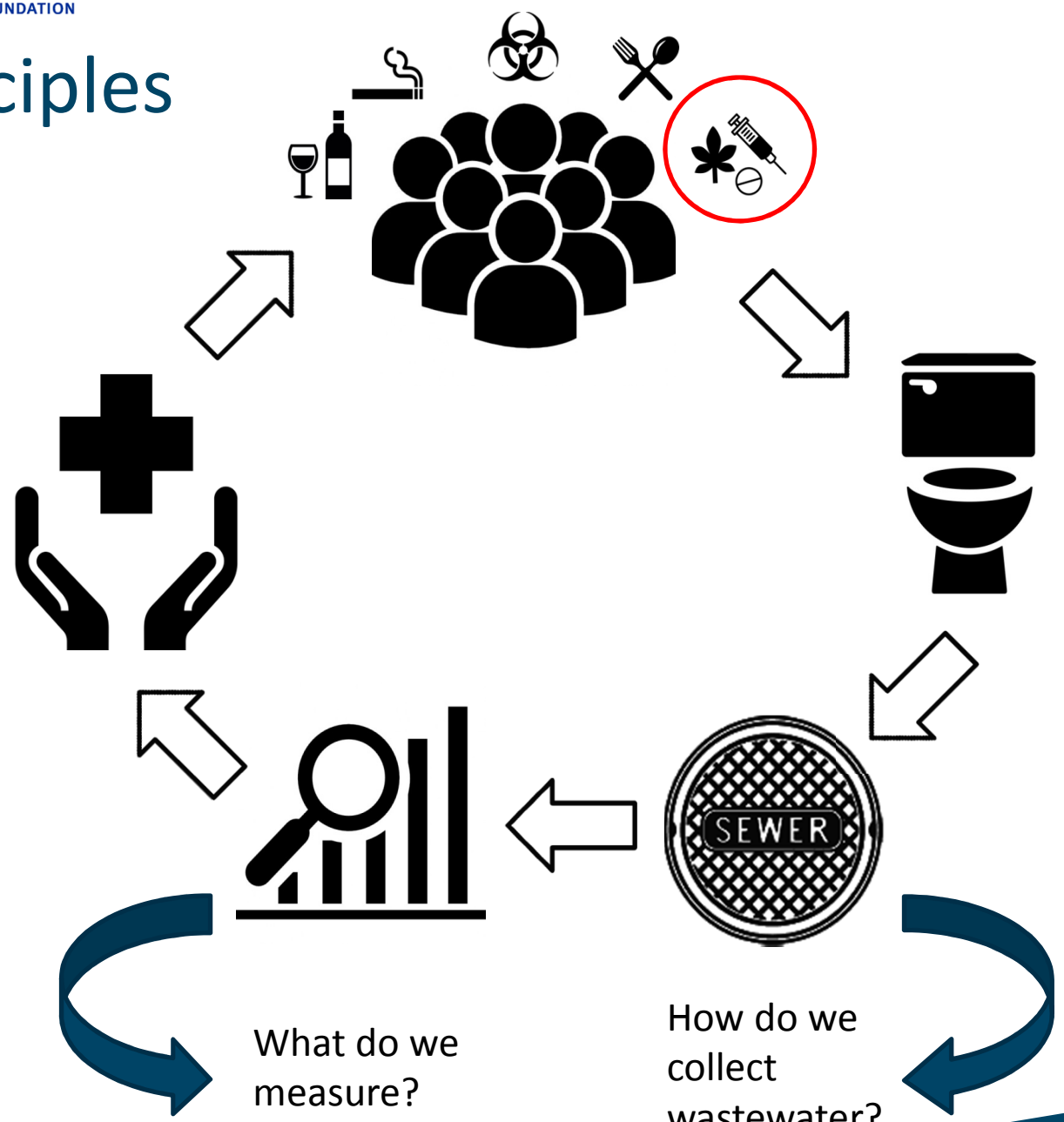
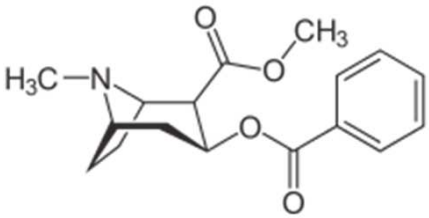
# I. Principles



# I. Principles

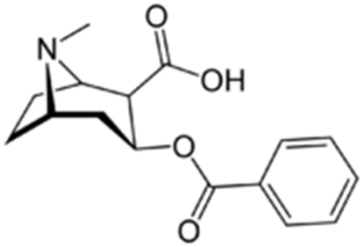
## Parent compound




Cocaine

! Can occur in wastewater for other reasons than consumption!

## Metabolite




Benzoylecgonine

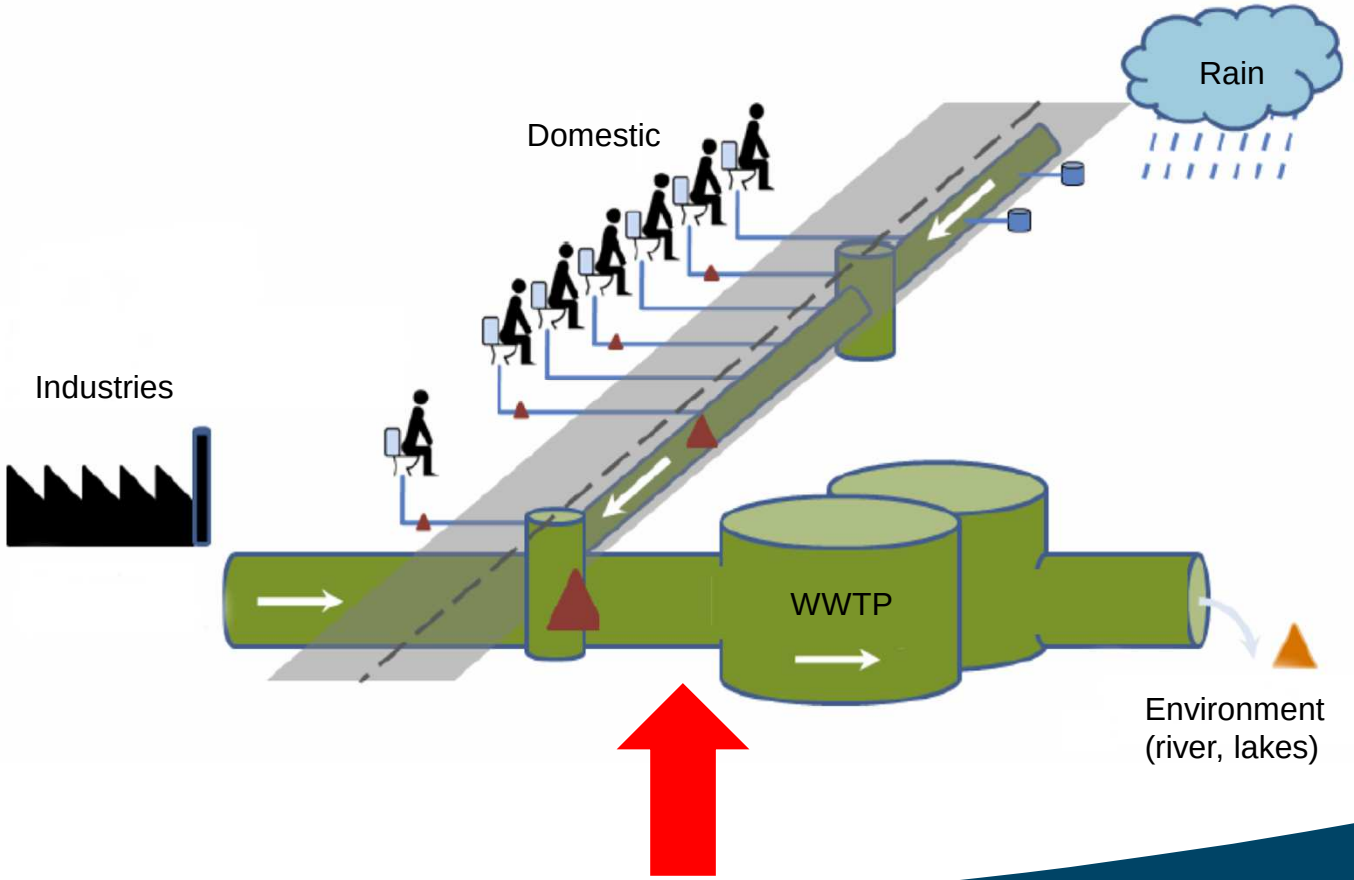
Are (generally) produced by the human body after intake


Specific markers of consumption

# I. Principles

## Wastewater sampling

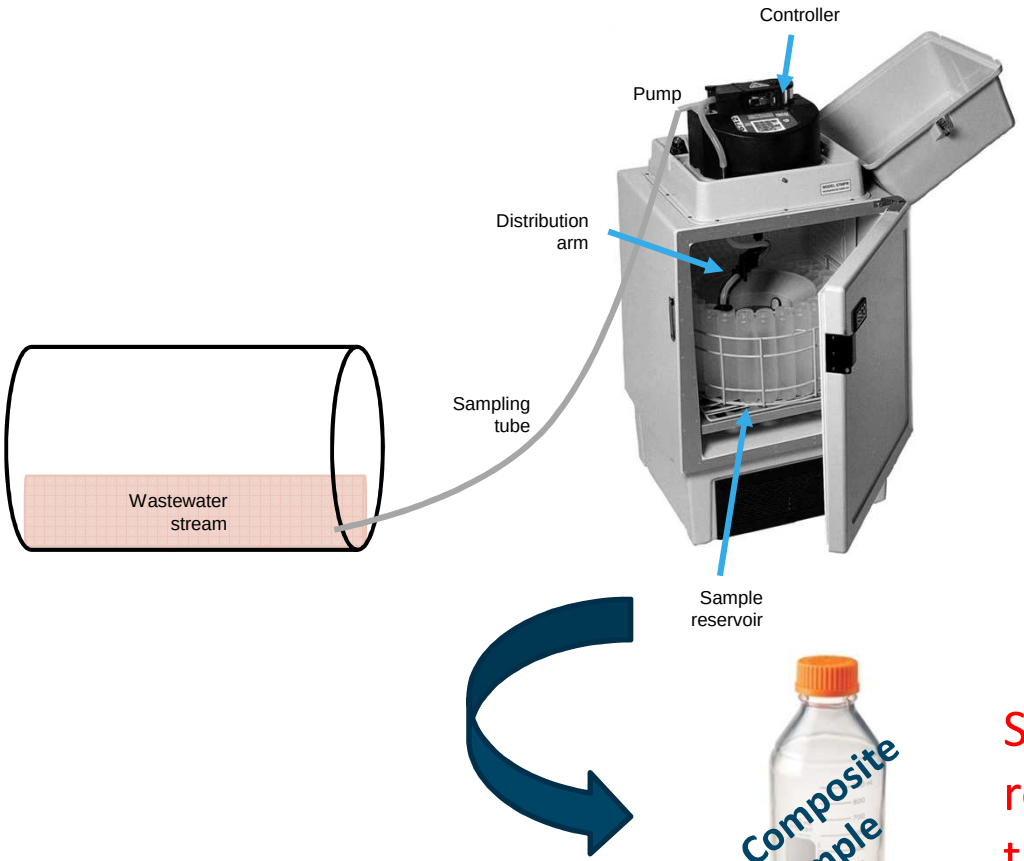
### Where?



# I. Principles

## Wastewater sampling

### How?




Collects a certain volume (fixed or variable) of wastewater every *n* minutes during 24h

Sample representative of the whole day

# I. Principles

1. Concentrations
   Amount of metabolite and/or parent compound in the collected wastewater sample


→ Nanograms per litre

part per billion of a gram

# I. Principles

## 2. Population normalised loads

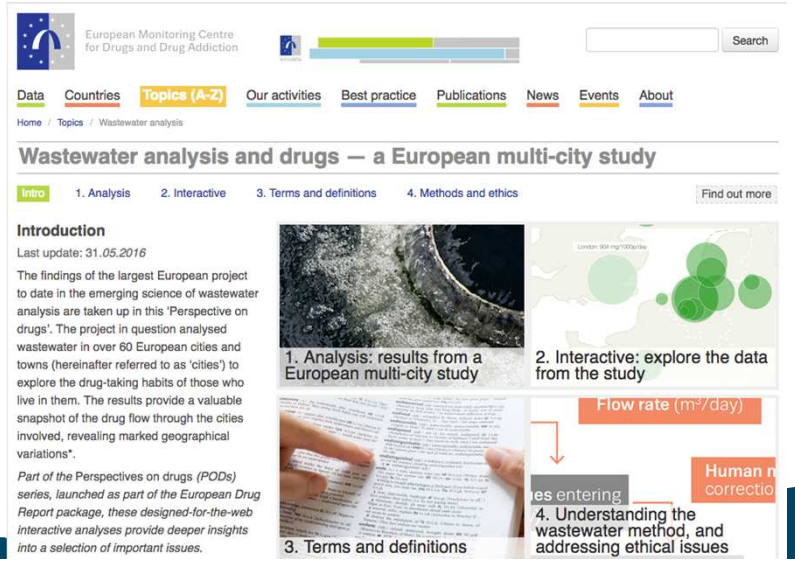
- Absolute loads divided by the size of the population served by the WWTP

$$Pop.Loads[\frac{mg}{day.1000inhab}] = \frac{Concentration\left[\frac{ng}{L}\right] * Flow[\frac{L}{day}]}{10^{-6}} / Population$$

WWTP personnel

Census, registered inhabitants

Used to compare results from different sampling locations



# I. Principles

## 3. Back-calculation

- Amounts of (pure) substance initially consumed

$$Consumption\left[\frac{g}{day}\right] = Loads\left[\frac{g}{day}\right] * \underbrace{\frac{1}{Excretion[\%]}} * \underbrace{\frac{Mwc}{Mwm}}$$

**Proportion of the initial dose** that will be excreted as parent compound and/or metabolite(s).
Example of cocaine (urine):

- Metabolised to **benzoylecgonine 32.5%**

Ratio between the (molecular) mass of the parent compound (cocaine) and the metabolite (benzoylecgonine)

# I. Principles

## What we measure (generally)

| Parent | Metabolite |
|---|---|
| Cocaine | Benzoylecgonine |
| Amphetamine | - |
| Methamphetamine | - |
| MDMA | (HMMA) |
| Heroin | Morphine, 6-MAM, Codeine |
| Cannabis | THC-COOH, (THC-OH) |
| Ketamine | |
| Methadone | EDDP |
| Cathinone | - |
| Mephedrone | - |
| NPS (Cannabinoids, cathinones,…) | |
| Alcohol | Ethyl sulfate |
| Tobacco | Nicotine, cotinine,… |
| Benzodiazepines | |
| and other pharmaceuticals | |

# II. Advantages

- No human-related biases
- Quantitative
- Costs
  - Few samples (14-28 per WWTP) for an annual estimate (uncertainty ≤ 20%)
  - 100-150€/sample (~ 3-4 substances)
- Geographical dimension
  - Atlas of drug use
  - Data granularity
- Temporal dimension
  - Routine sampling allows follow-up
- Retrospective

# II. Limitations

- Uncertainties
  - Pharmacokinetics (back-calculation)
  - Degradation (in-sewer transformation) and adsorption (suspended solids)
- Population estimates (commuters, holidays)
- Patterns of drug use
  - Quantity
  - Frequency
  - Risk behaviours
  - Poly drug use
- Screening
  - NPS

# III. Geographical differences

Objectives

- Investigate **geographical features** with regard to different indicators
  - Wastewater analysis
  - GPS
  - Crime statistics
- **How well do they overlap?**
- **Specific regional features?**

Been F., Bijlsma L., Benaglia L., Berset J-D., Botero-Coy A. M., Castiglioni S., Kraus L., Zobel L., Schaub M., Bücheli A., Hernández F., Delémont O., Esseiva P., Ort C., *Assessing geographical differences in illicit drug consumption – A comparison of results from epidemiological and wastewater data in Germany and Switzerland,* Drug and Alcohol Dependence, 2016, 161, 189-199.

# III. Geographical differences

Wastewater

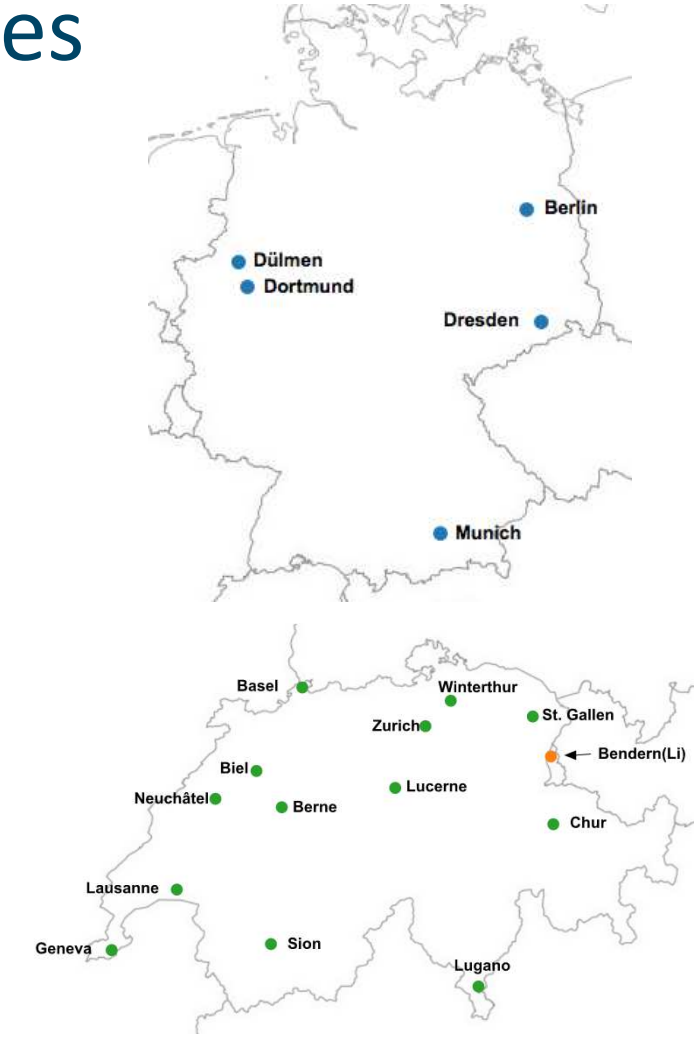
- Germany
  - 5 cities (8 WWTP)
  - 5.8 mio inhabitants
- Switzerland & Liechtenstein
  - 14 cities (14 WWTP)
  - 2.3 mio inhabitants

Sampling

- 1 week, 18-24 March 2014

Measurement

- Population normalised loads
  - Cocaine, amphetamine, methamphetamine and MDMA (THC-COOH and 6-MAM)



# III. Geographical differences

## Prevalence data

- Results from *General Population Surveys*
  - Switzerland: specific for investigated areas (CoRolAR)
  - Germany: Federal States (Bundesländer) only, except Berlin

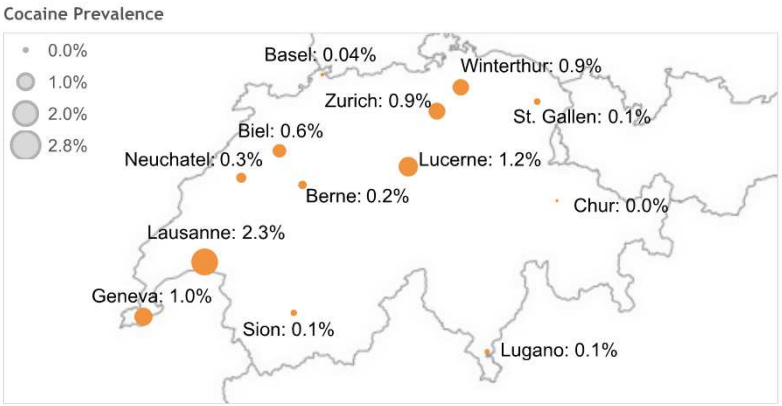
## Crime statistics

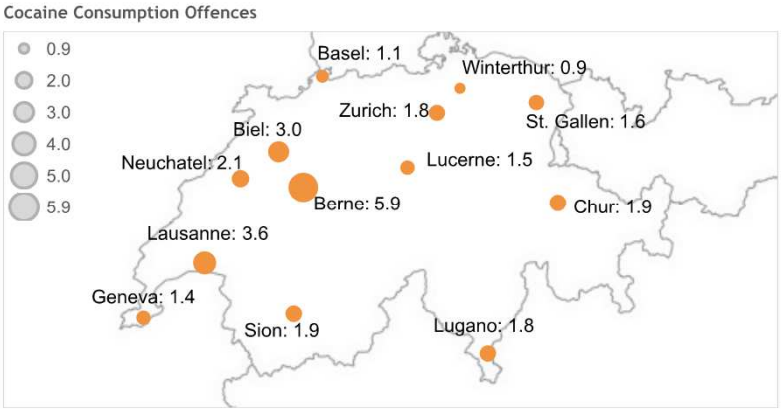
- Number of *reported offences for consumption*
  - Specific for investigated areas

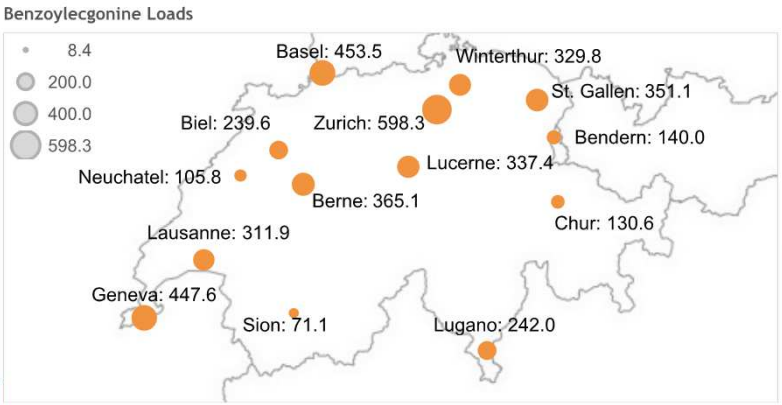
# III. Cocaine – CH & FL

## Cocaine – CH & FL

- Prevalence and offences: heterogeneous
  - Reporting bias?
  - Concealment?
  - Availability?
  - Law enforcement strategies?
- WW suggest homogeneous consumption within cities of similar size

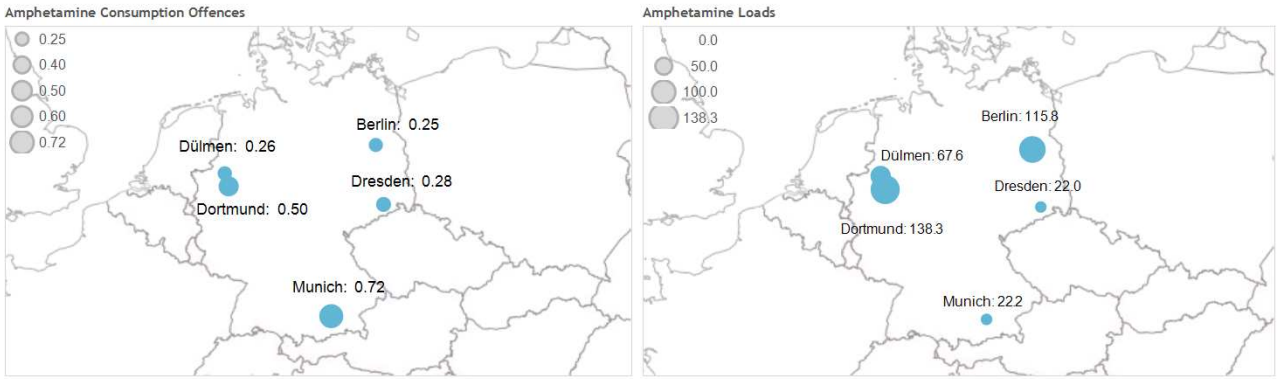


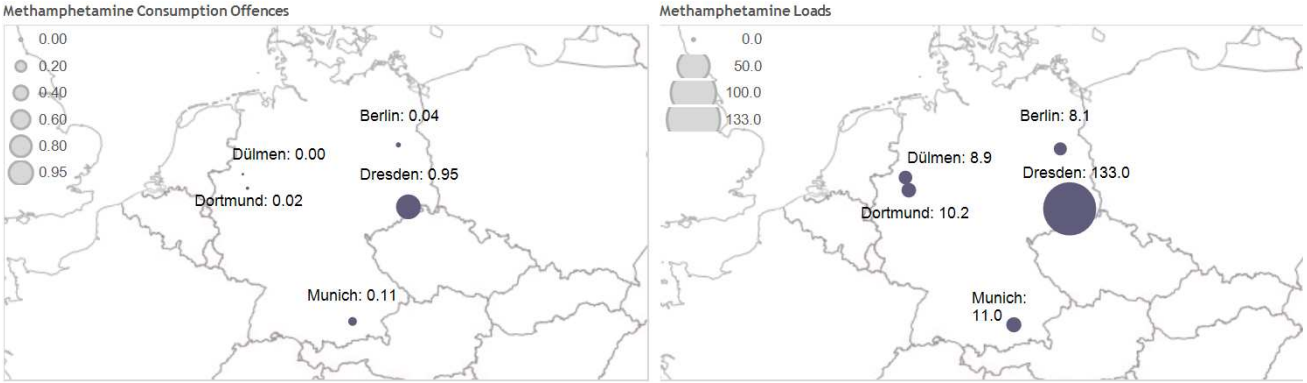
# III. Amphetamine & Meth - Germany

## Amphetamine




- Offences *vs* Wastewater → Opposing picture

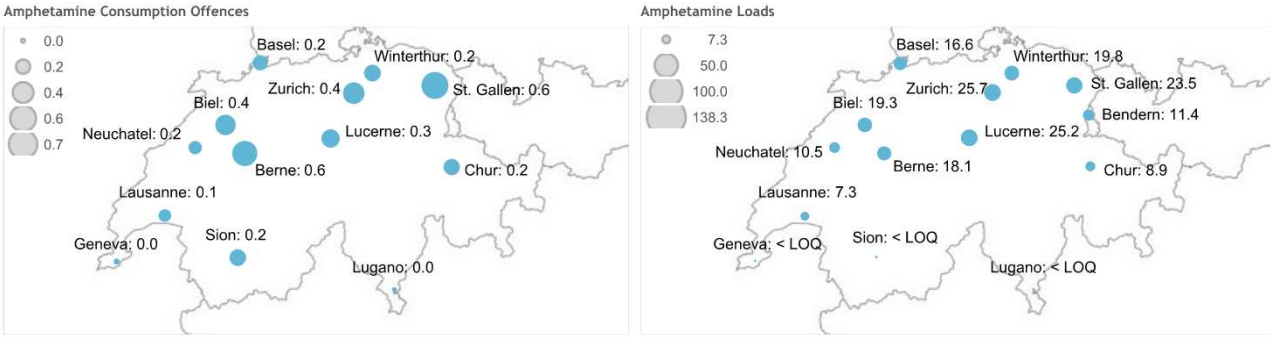
## Methamphetamine




- Consistent results, consumption limited to Dresden ✔
  - Major stimulant

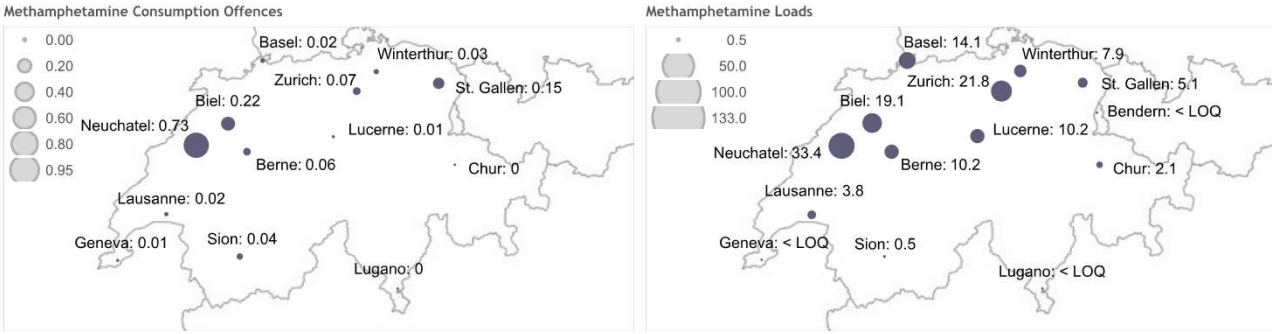
# III. Amphetamine & Meth – CH & FL

## Amphetamine




- Increased consumption in north-eastern part (german speaking?) ✔

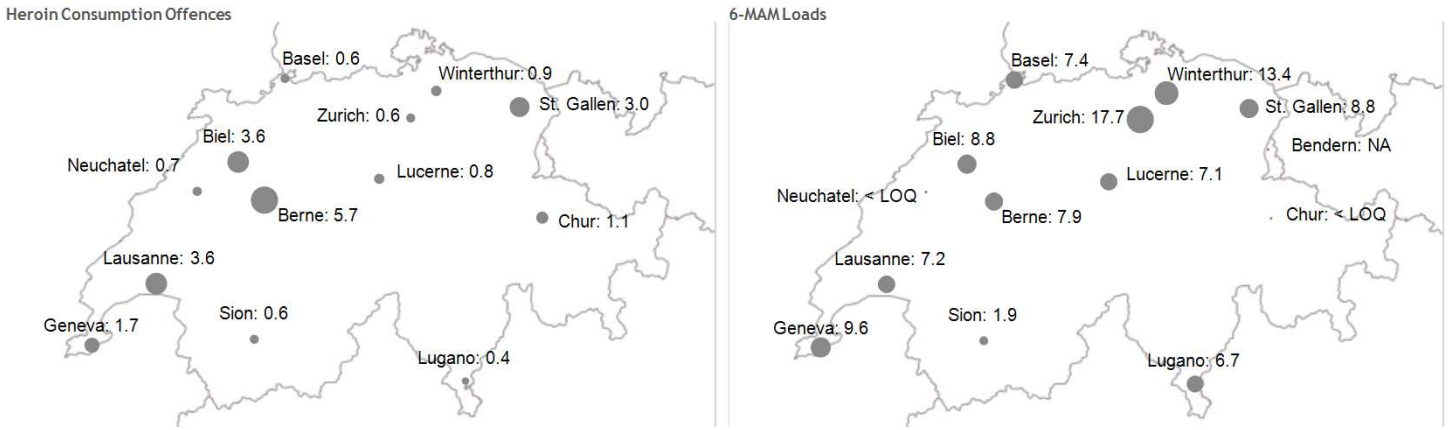
## Methamphetamine




- Significant consumption in “golden triangle” ✔
- Yet, wastewater suggests that consumpion touches also other areas

# III. Heroin – CH & FL

- Offences vs Wastewater




- Strong dissimilarities
  - Visibility?
  - Strategies?
- Wastewater suggest “homogeneous” use
  - Except smallest catchments

# IV. Conclusions

Geographical features – Indicators overlap?

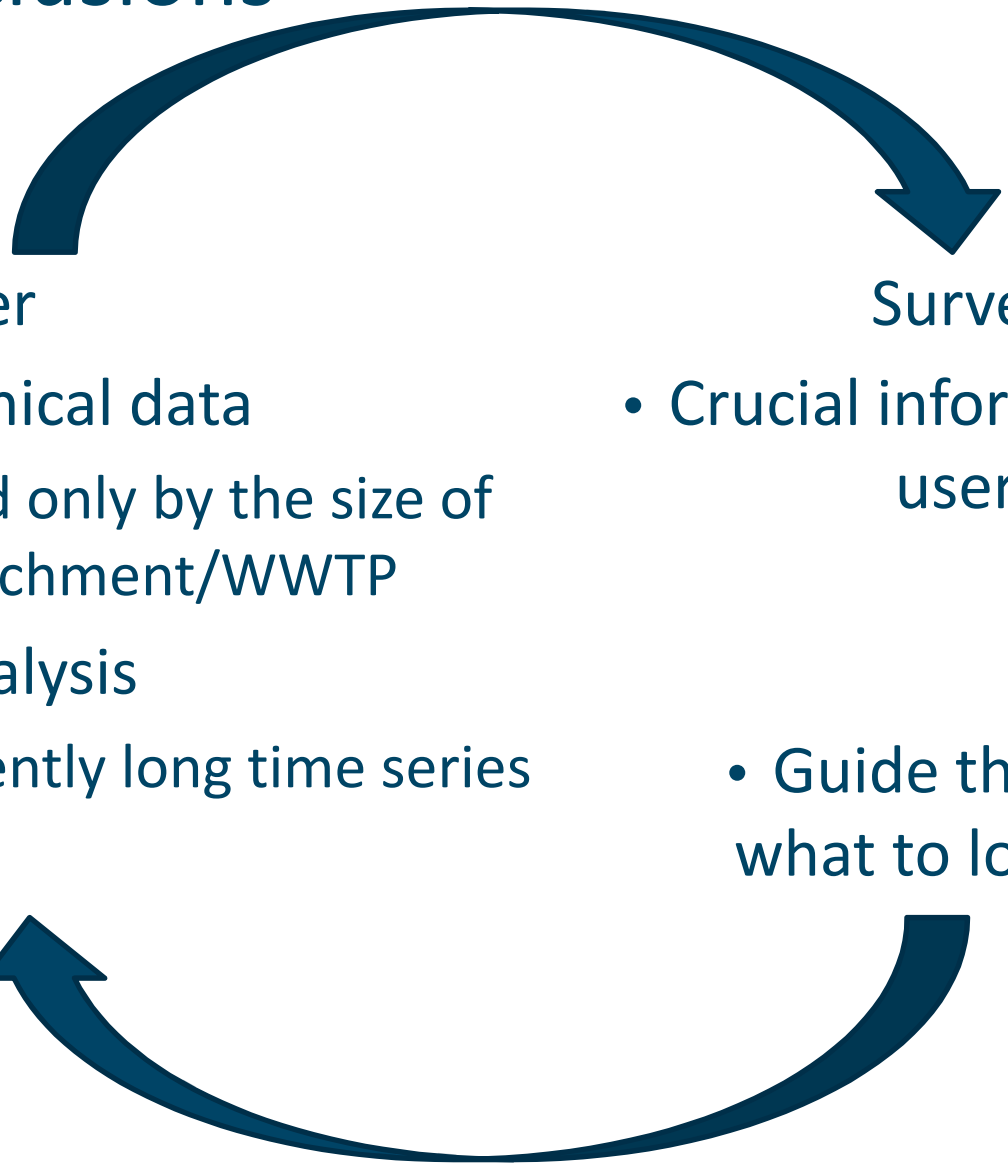
✗ Cocaine & Heroin

- Stigmatised?
- Visibility & repression?

✔ Amphetamine, methamphetamine (MDMA and cannabis)

- Overall good overlap
- Less stigmatised/repressed?

# IV. Conclusions



## Wastewater

- Geographical data
  - Limited only by the size of the catchment/WWTP
- Trend analysis
  - Sufficiently long time series

## Surveys/Indicators

- Crucial information about users background
  - Habits
  - Frequency
- Guide the selection of what to look for in WW
  - NPS?

# IV. Conclusions

Refine current estimates

- Prevalence
- Number of users per category
- Quantities

# Acknowledgments

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# Thank you!

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