Long term POCIS measurements of urinary biomarkers in wastewater to determine community health

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Sewage Epidemiology
- No longer a pipe dream...

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What else is down there?
- Unlimitied potential?

ENVIRONMENTAL Science & Technology

VIEWPOINT

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What Else Can the Analysis of Sewage for Urinary Biomarkers Reveal About Communities?

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Measuring overall community health
Potential for systematic use of high res data

- **Lifestyle -** Illegal drugs, abused pharmaceuticals, alcohol, tobacco, steroids,

- **Diet -** Consumption of meat, fruit and vegetables, caffeine

- **Health -** Allergies, pregnancy, prescription compliance

- **Disease –** E.g. cancers

- **Environment -** Reaction to «environmental pressure» or stimuli, exposure to contaminants

- Opportunity to measure, everything we are exposed to, diagnose, treat, even predict!?

- Population level actions *in response to* sensed pollution, lifestyle?

- diagnose, treat, even predict!?

What we did
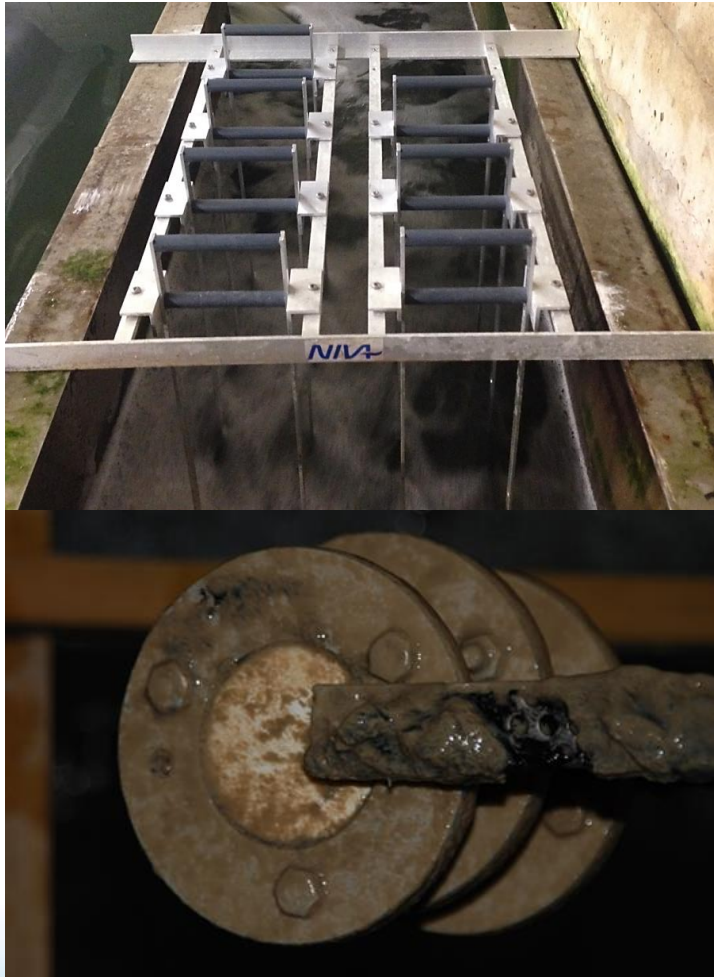
- Suite of in situ calibrations at WWTP
  - Targeted 60 compounds
  - (Non-target >1000)
  - Tried to look at the reproducibility of R_s , competitive uptake, environmental factors
- Long term measurement, nearly 4 years in total
- Knowledge of WWTP
  - Modelling
  - Extra parameters
- Use the Norwegian prescription database
- Baz Lomba et al. 2017. *Wat. Res.*

Example - Response to environmental pressure
## *- Use of antihistamine in relation to pollen count*
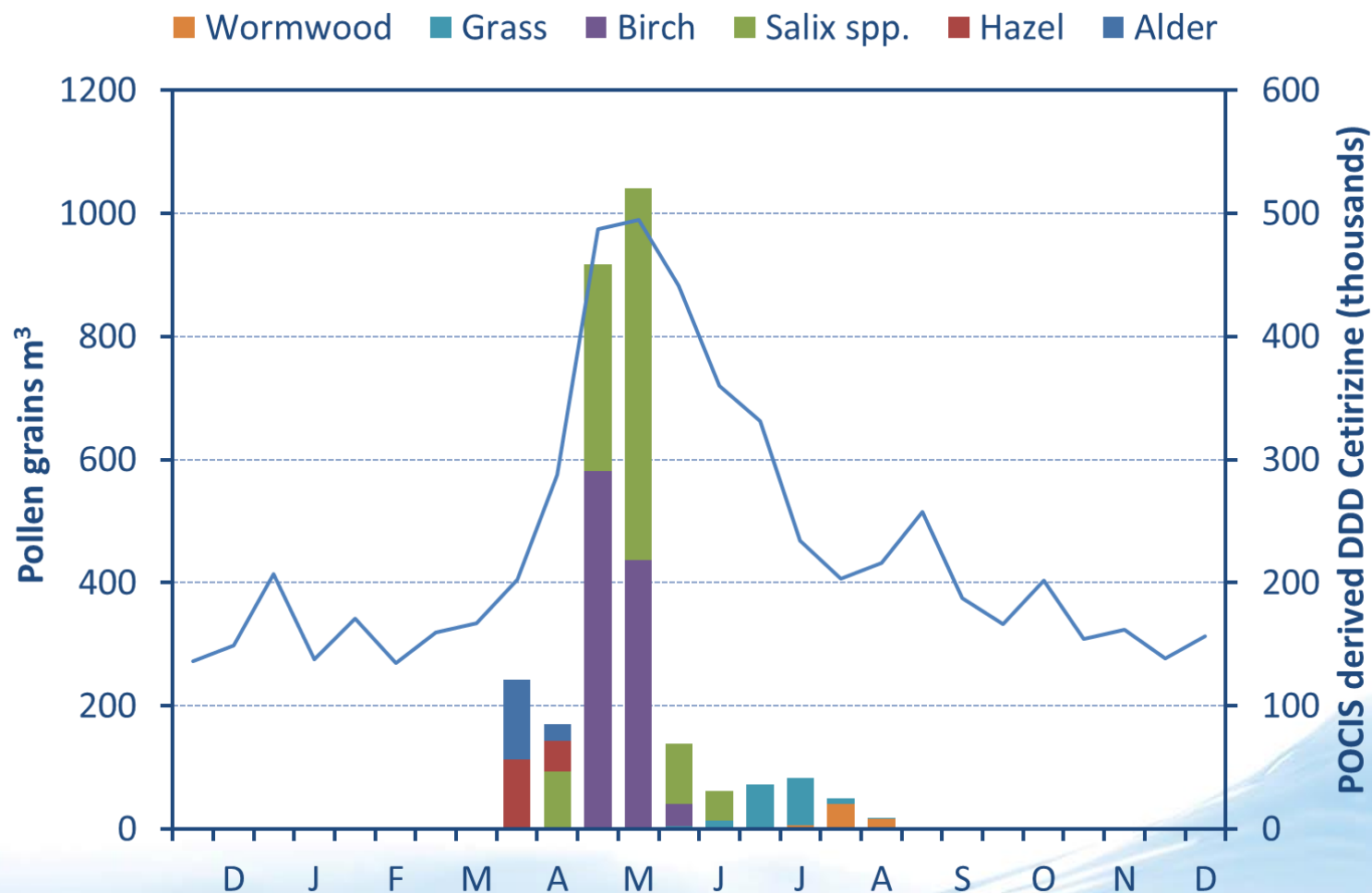
Population response to environmental pressure
- Use of antihistamine in relation to pollen count

- Flux of cetirizine through the STW calculated using POCIS estimated, time integrated water concentrations (after *in situ* calibration)

- Yearly DDD (daily designated dose),10 mg d^{-1}, 50% excreted as parent compound (Pfizer, 2006)

- Public Health Institute registered 5.5 million sold DDD in 2010 (pop. adj.), POCIS derived estimate ca. 6 million

- Gave rise to the idea that it might be possible to use common prescription pharmaceuticals to "validate" the technique

2-year trend Atenolol

PDB
43702g

POCIS
95%

PDB
39535g
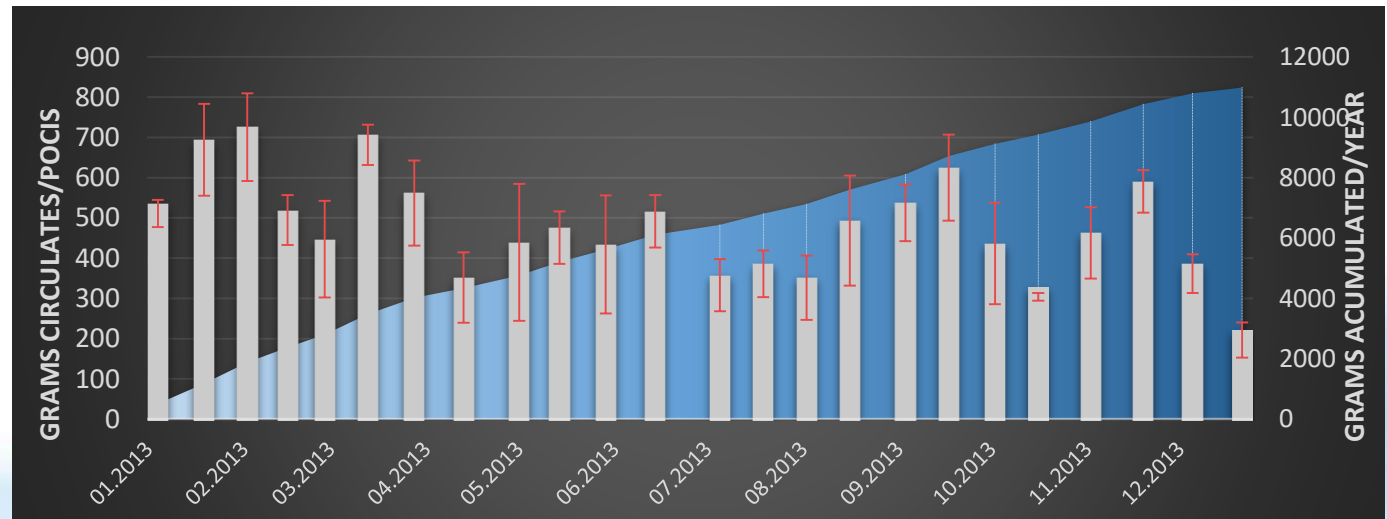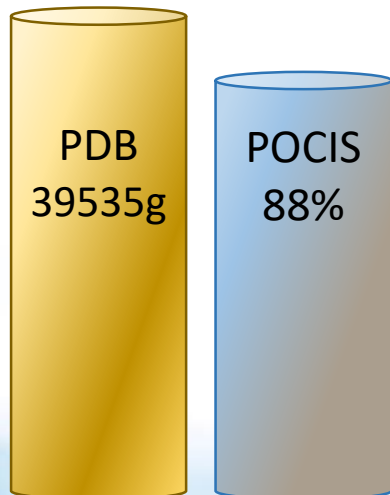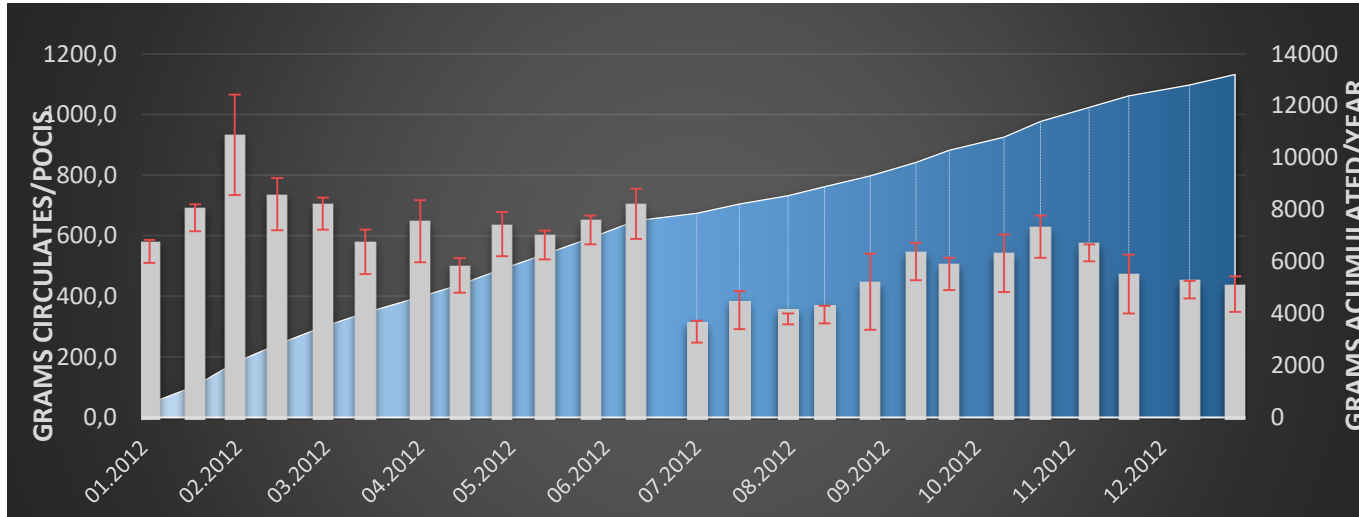
POCIS
88%

2-year trend Citalopram
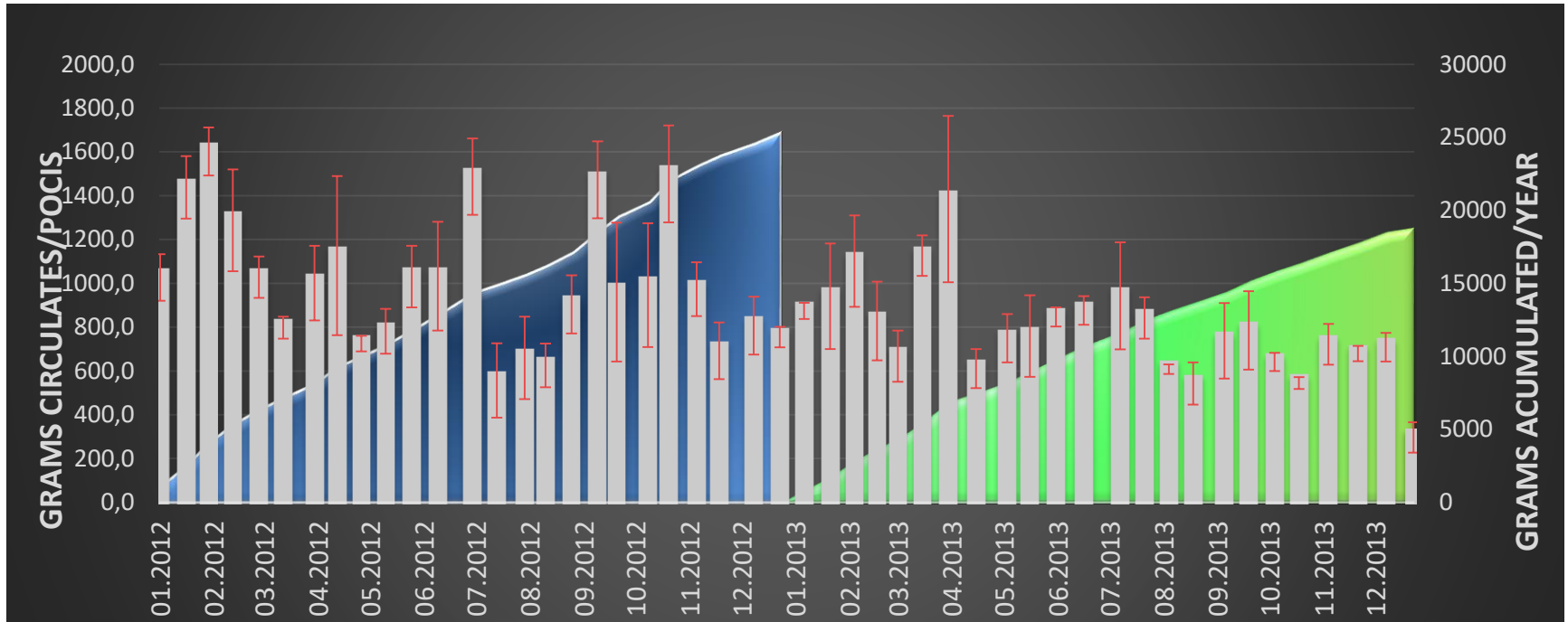
Prescription -10%, POCIS -25%

2-year trend Oxazepam

Prescription -1.5%, POCIS +8%

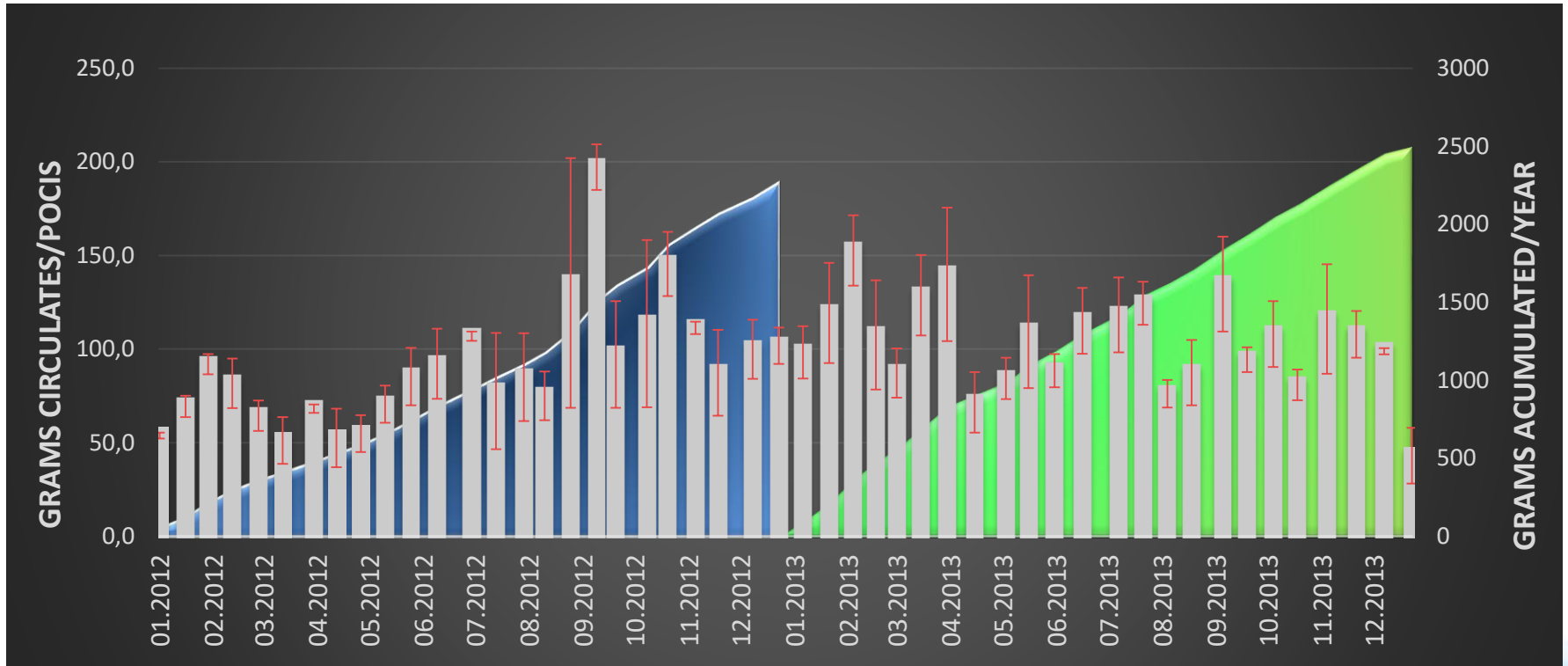# 2-year trend Carbamazepine
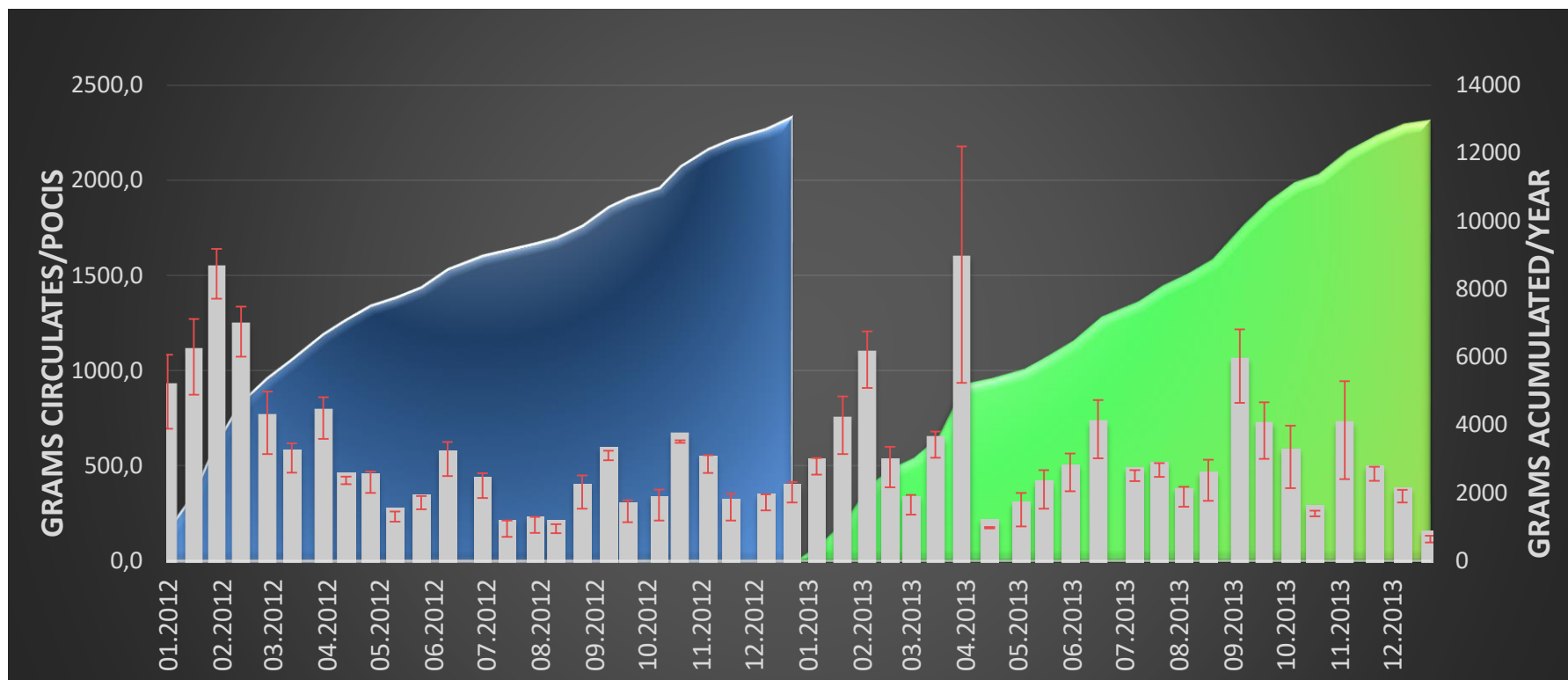
Prescription -5%, POCIS -2%

2-year trend for methamphetamine
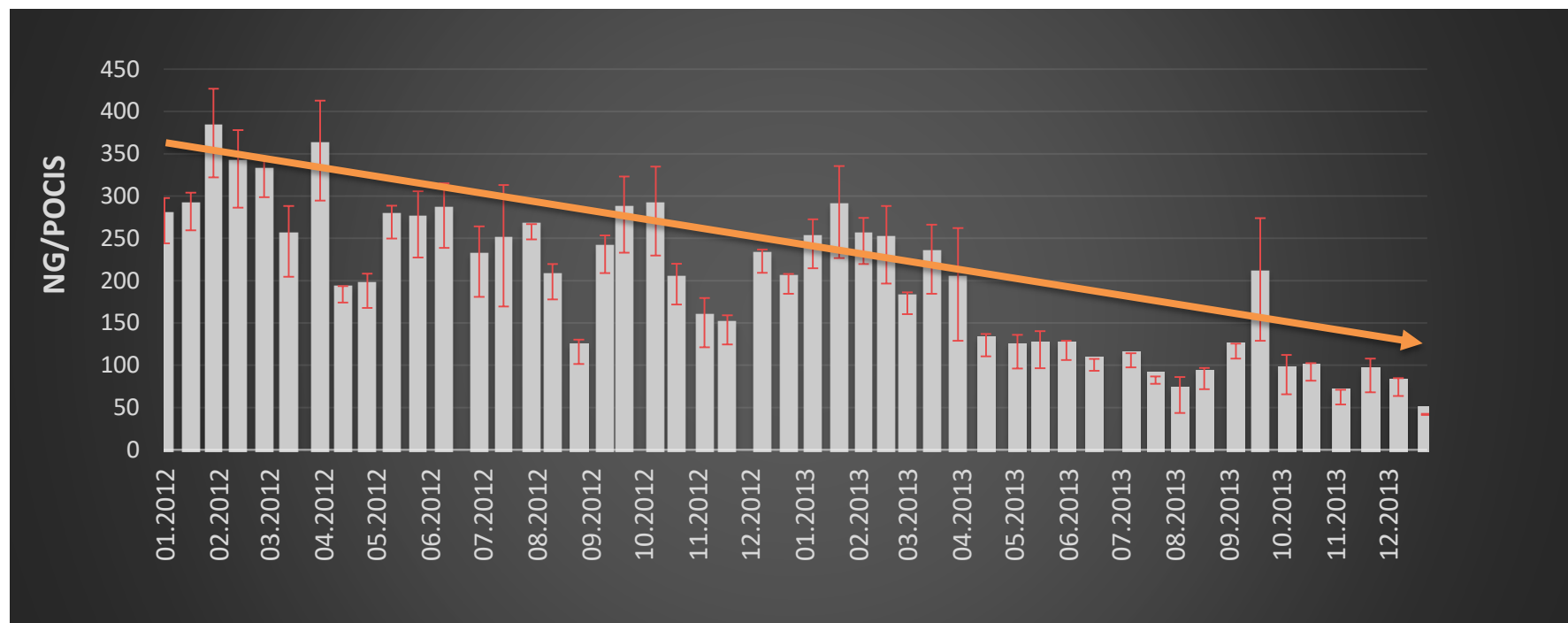
Good correlation between prescription data and POCIS measurements give confidence to POCIS results for illegal drugs (other things being equal, for "easy" compounds)

Population estimates re-visited
Using mobile phone data
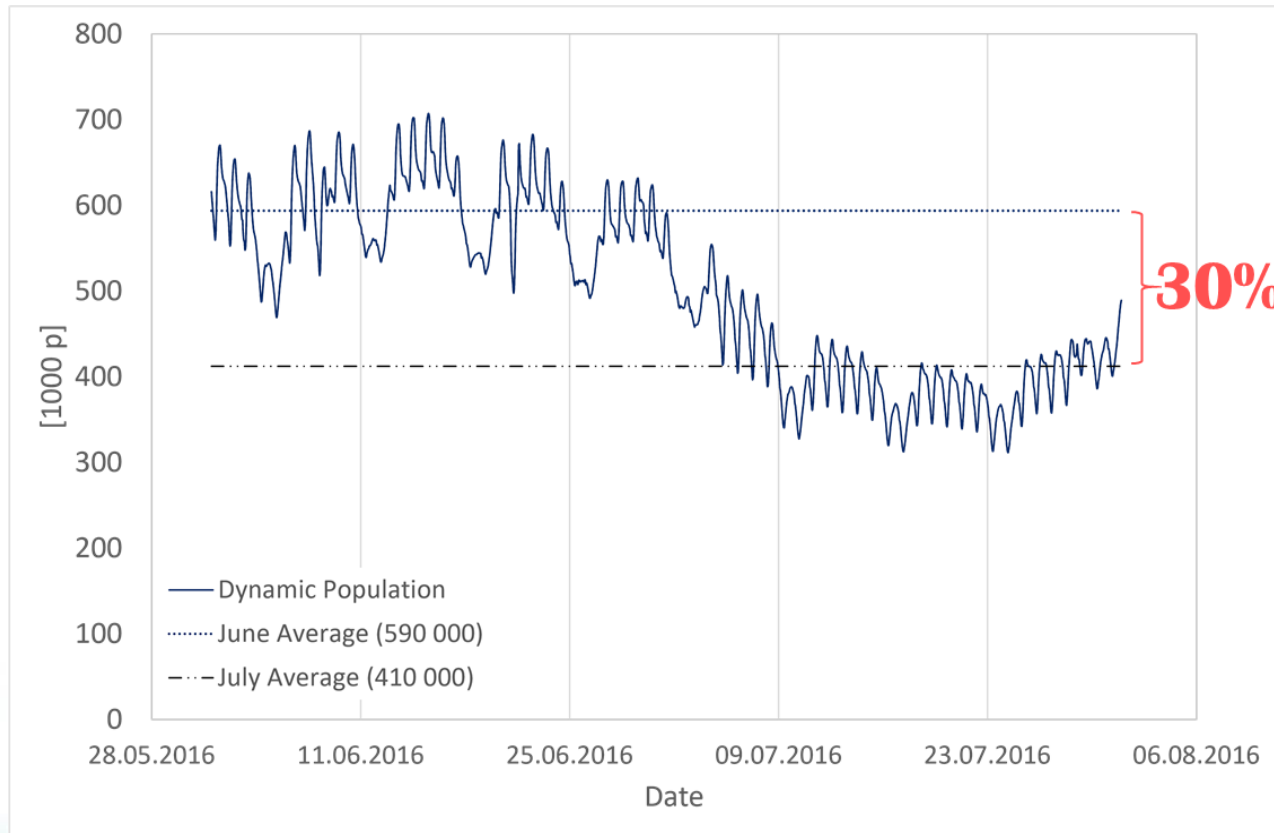
Dynamic population of the treatment works "catchment"

1500 Base stations

Hourly measurements over 3 months

Cells overlapping Uncertainty = 2%

Thomas et al., 2017, *ES&T*

Summary –
Can we use PS for Sewage Epidemiology?

Quantitative analysis of 'health biomarkers' in sewage has the potential to provide evidence based, estimates of community health. Passive sampling may allow for achieving widespread application of the technique

Advantages

- Simple unattended sampling
- Time integration
- Lower detection limits
- Ideal for screening
- Long term measurements (1yr - 30-70 analyses)
- Cheaper (lower sampling burden)

Challenges

- Not fully developed
- High resolution lost
- No one sampler for all targets
- Some quick kinetics
- Integration of peaks?
- Calibration needed?
- No exposure correction method

NIVA

General reflections about polar PS 1
- 12 years of going round in <u>POCIS</u> circles

- PS is not the solution for every measurement problem
  - But you can cause a problem to you measurement using PS, the question was?
  - Rapid technology development
- Start in the lab, but not with a calibration
  - Think about your compounds, can guestimate the R_s
  - Start with standard SPE method development (+ membrane)
- Add something
  - What does the PS/POCIS community learn from *your* study?
- Other samplers?
  - Be flexible about rubber, SR might be the answer (medium polars)
  - Consider other polar samplers (?)

General reflections about polar PS 2
- 12 years of going round in <u>POCIS</u> circles

- Be realistic about the accuracy, say something about uncertainty

  - R_s and C_w in the literature to 4 SF!? (<u>including my own</u>)

- Hydrophobic PS theory and modelling not always appropriate

  - PRC's?, but hydrophobic interaction still dominating?

- POCIS R_s data is fairly ambiguous – why? Treat it as such

- POCIS (or any PS) + Non target analysis = true

Passiv prøvetaking…

- …sier mer om eksponeringen enn om nivåer i biota
- …krever en solid porsjon «Abrakadabra» for tilbakeregning til total vannkonsentrasjon
- …fanger ikke opp transport av partikkelbundet forurensning
- …fanger ikke opp konsentrasjonstopper (jmf MAQ-EQS) som er aktuelt for industriovervåking
- … er ikke ferdigutviklet for mange stoffer vi jobber med å regulere
- …kan innebære økt prosjektrisiko (utstyr tapt i felt el utsatt for hærverk)
- …mangler norsk standard for gjennomføring

MILJØ-DIREKTORATET