FAKULTÄT FÜR
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UND RESSOURCENMANAGEMENT

Yearly key figures of concentrations and loads of trace contaminants in rivers – which sampling strategies lead to reliable results?

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Trace contaminants

Persistency

Costly monitoring

Variety of substances, variable inputs

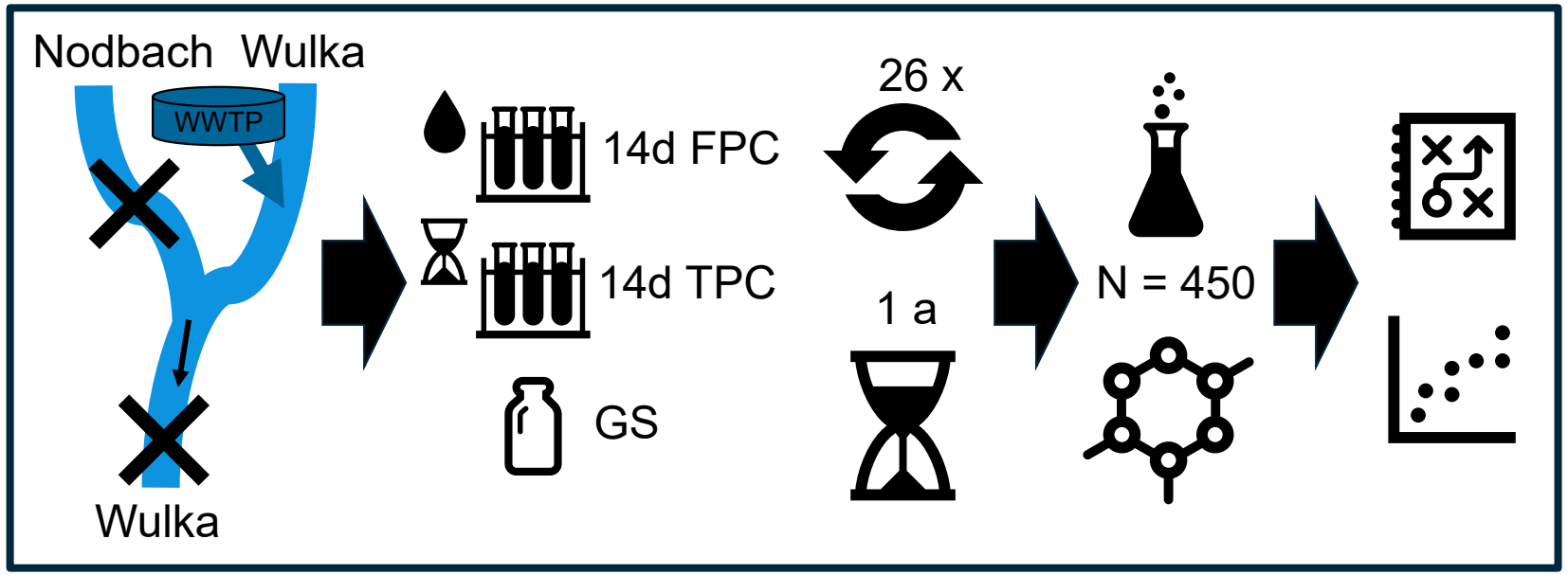
EU Priority substance list

Case study's research question: “How do mean and maximum concentrations and annual loads of trace contaminants differ in water bodies that have been collected using different sampling methods?”

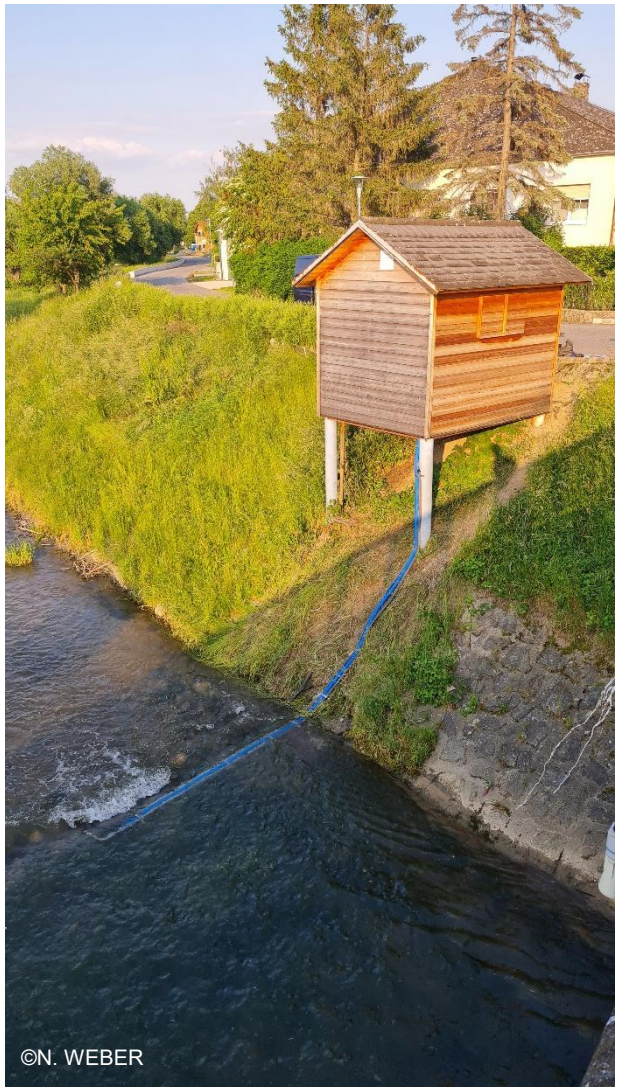
Analyzed trace contaminants:

8 Metals (total & dissolved), 4 Pharmaceuticals, 34 PFAS und 404 Pesticides (screening)

Methodology



Monitoring Station Wulka

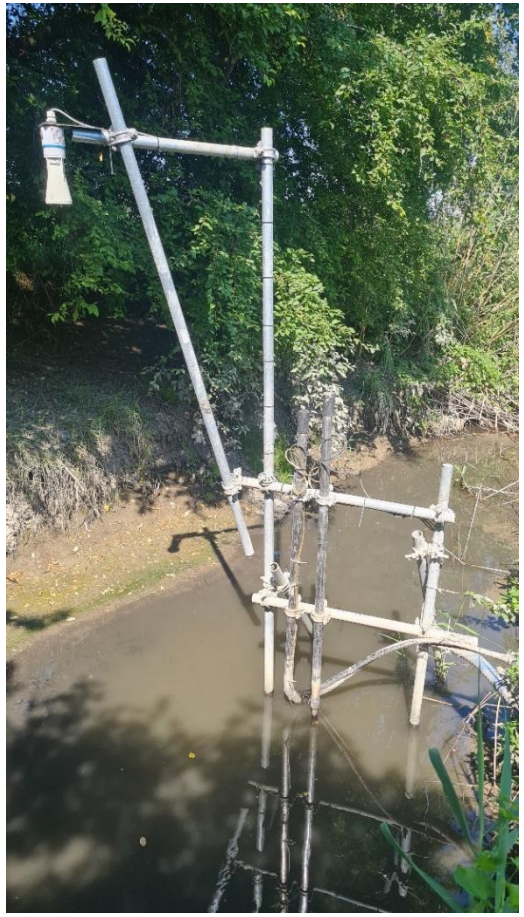


Station setup

The challenge of runoff variability

- Flow-proportional sampling (FPC) challenging due to
  - Very high variability of the runoff on the Nodbach
  - Compliance with minimum and maximum sample volume

Very low water level in summer...

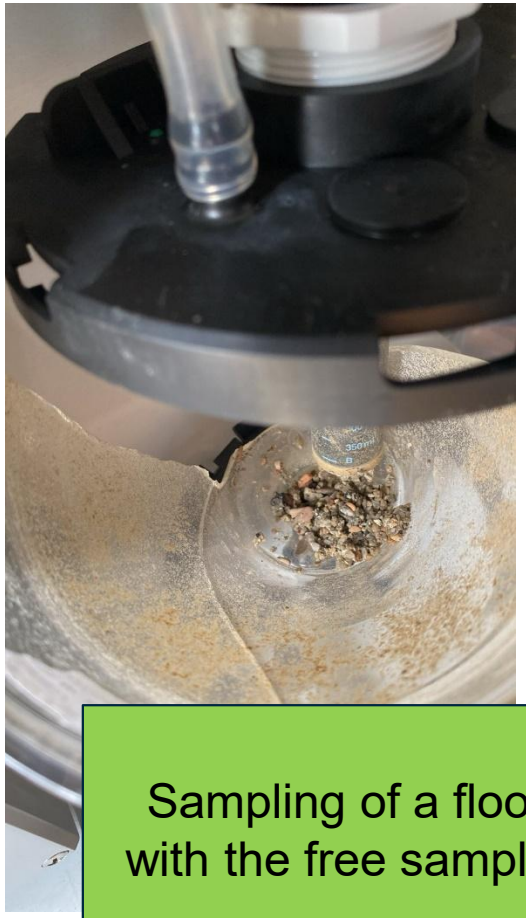


but rapid increase after summer thunderstorms...

require fast exchange of full bottles

The challenge of floods

Equipment failure during HQ1 event

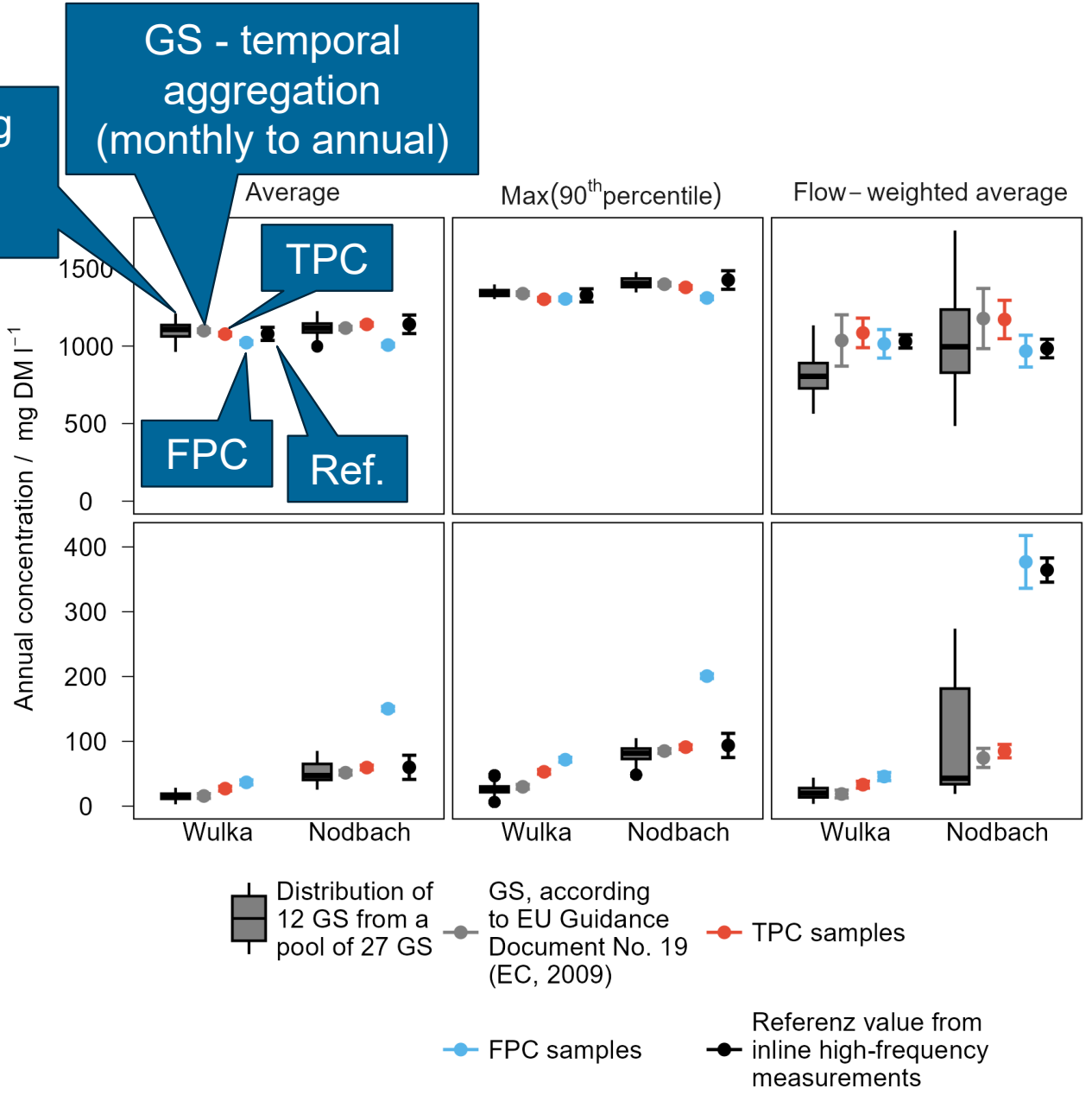


Sampling of a flood with the free samples

Wulka during a ~HQ2 event

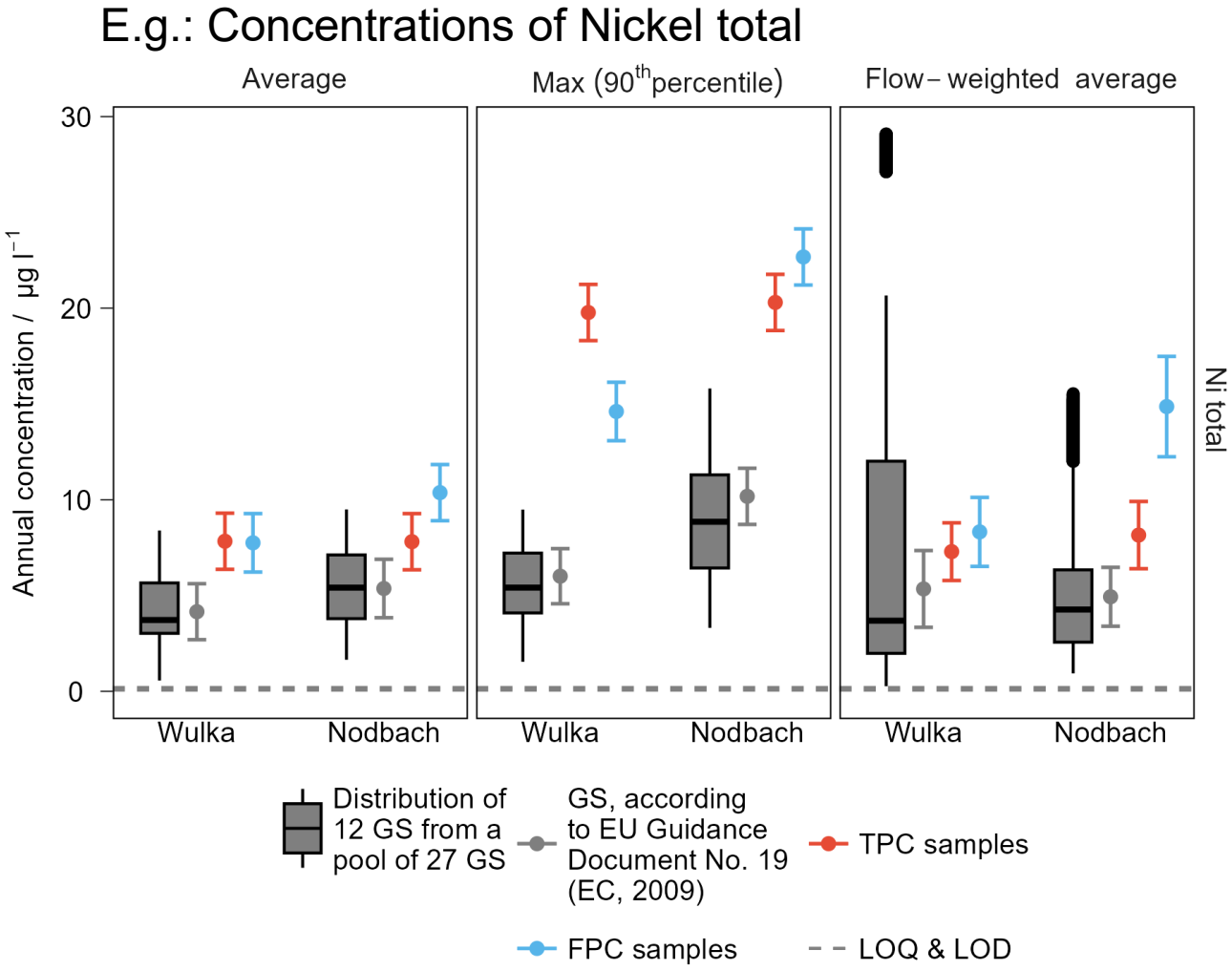
Validation

- Time-proportional samples (TPC) references for AA and Max (P90)
  - Surprising finding for P90 (can be different when P100 is used; e.g. GER)
- Flow-proportional samples (FPC) reference for Load (flow-weighted average)



Metals total

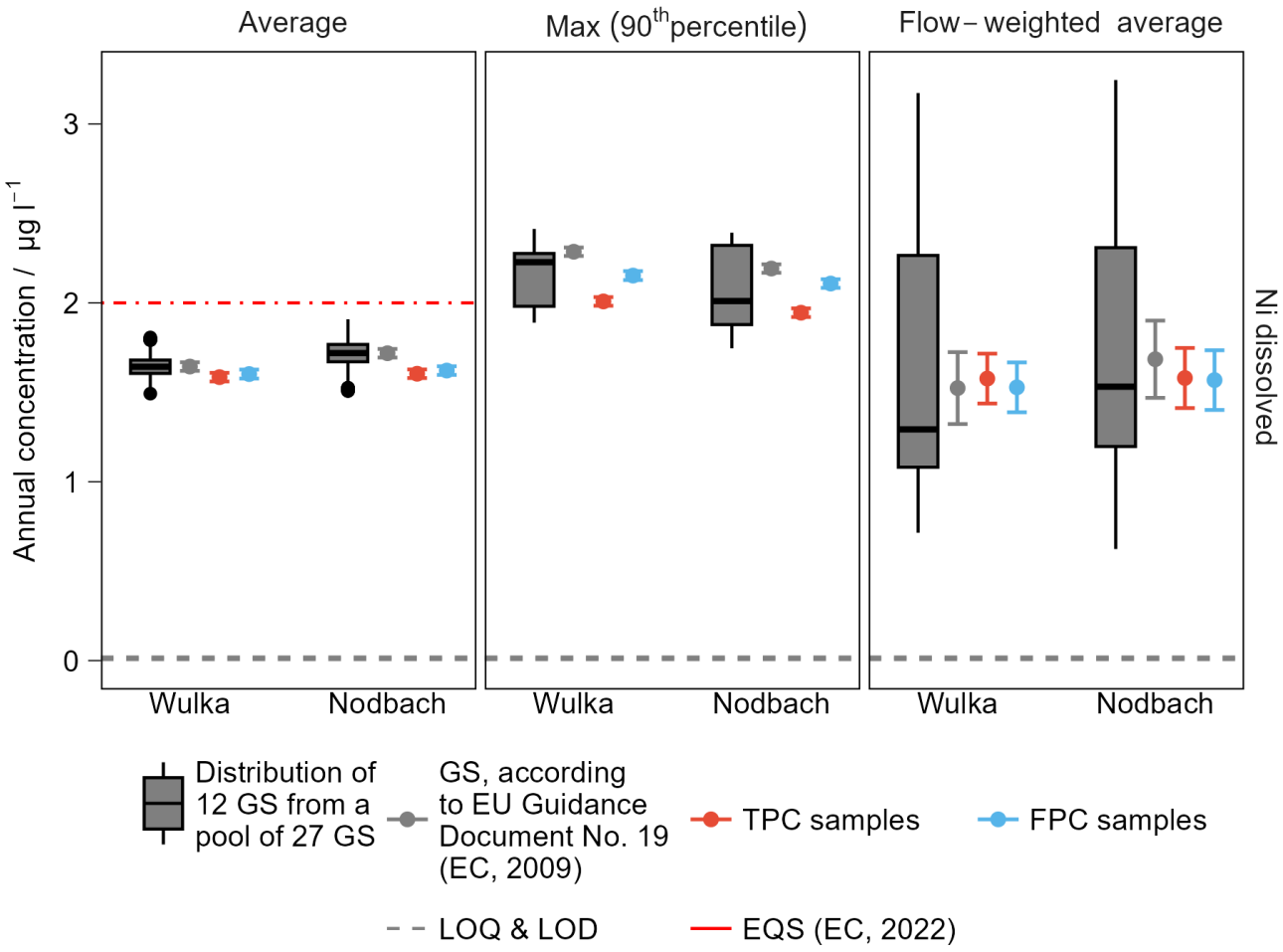
- Predominantly particulate transports during runoff events
- Quantitatively evaluable: As, Cd, Cr, Cu, Ni, Pb & Zn (Cd rare but more common in TPC/FPC than in GS, Ag never >LOD)
- Poor suitability of 12 grab samples (GS) due to poor mapping of short-term runoff events
- Composite samples, especially drawn in a volume-proportional manner, have great advantages here



Metals dissolved

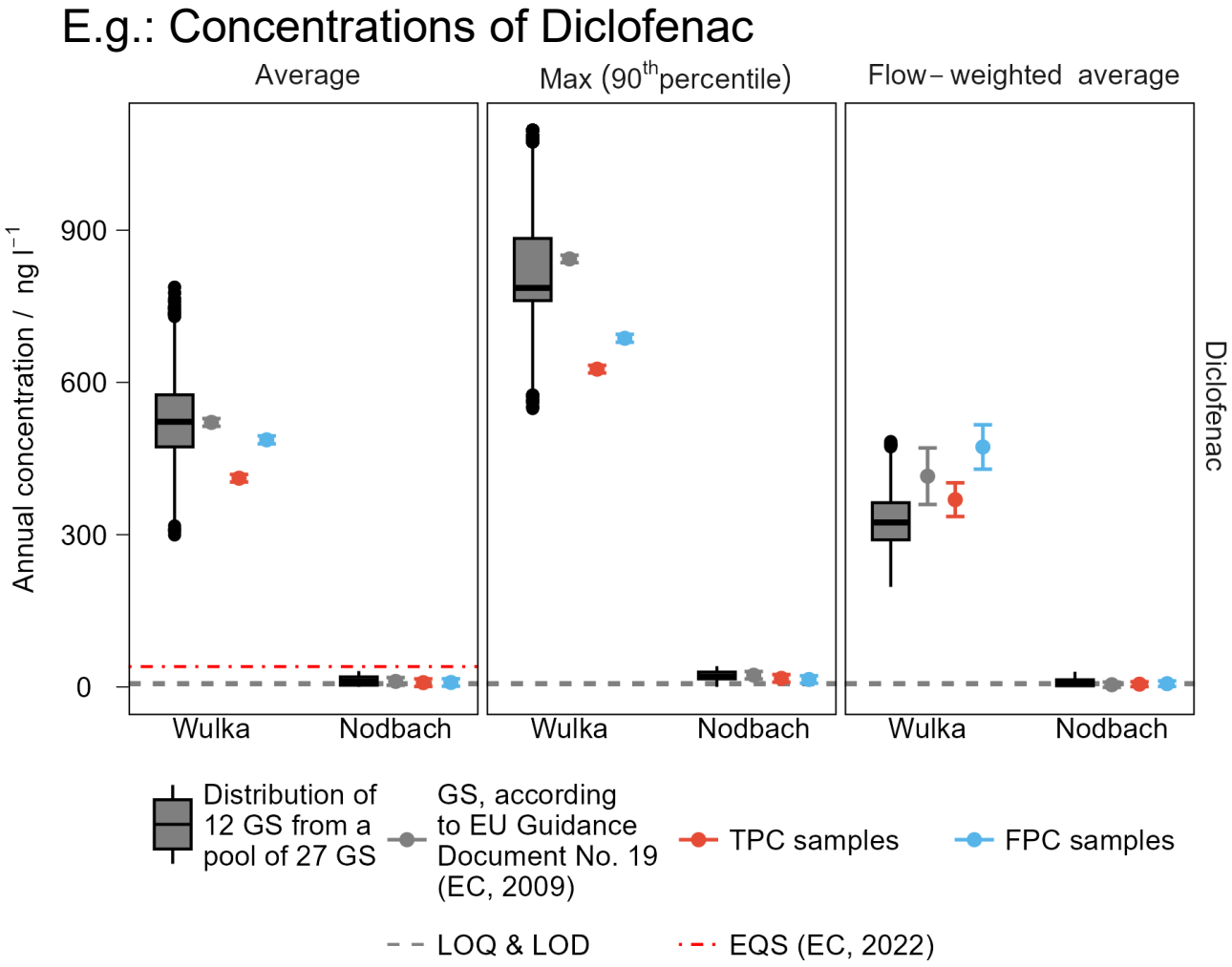
- Largely continuous input via variable pathways (e.g. groundwater, WWTP effluent)
- Quantitatively evaluable: As, Cd, Cr, Cu, Ni, Pb & Zn (Cd rarely, Pb sometimes, Ag never >LOD)
- Low systematic deviation of the AA-conc. from 12 GS compared to TPC/FPC
  - Random errors can be big (e.g.: Pb, Cr)

E.g.: Concentrations of Nickel dissolved



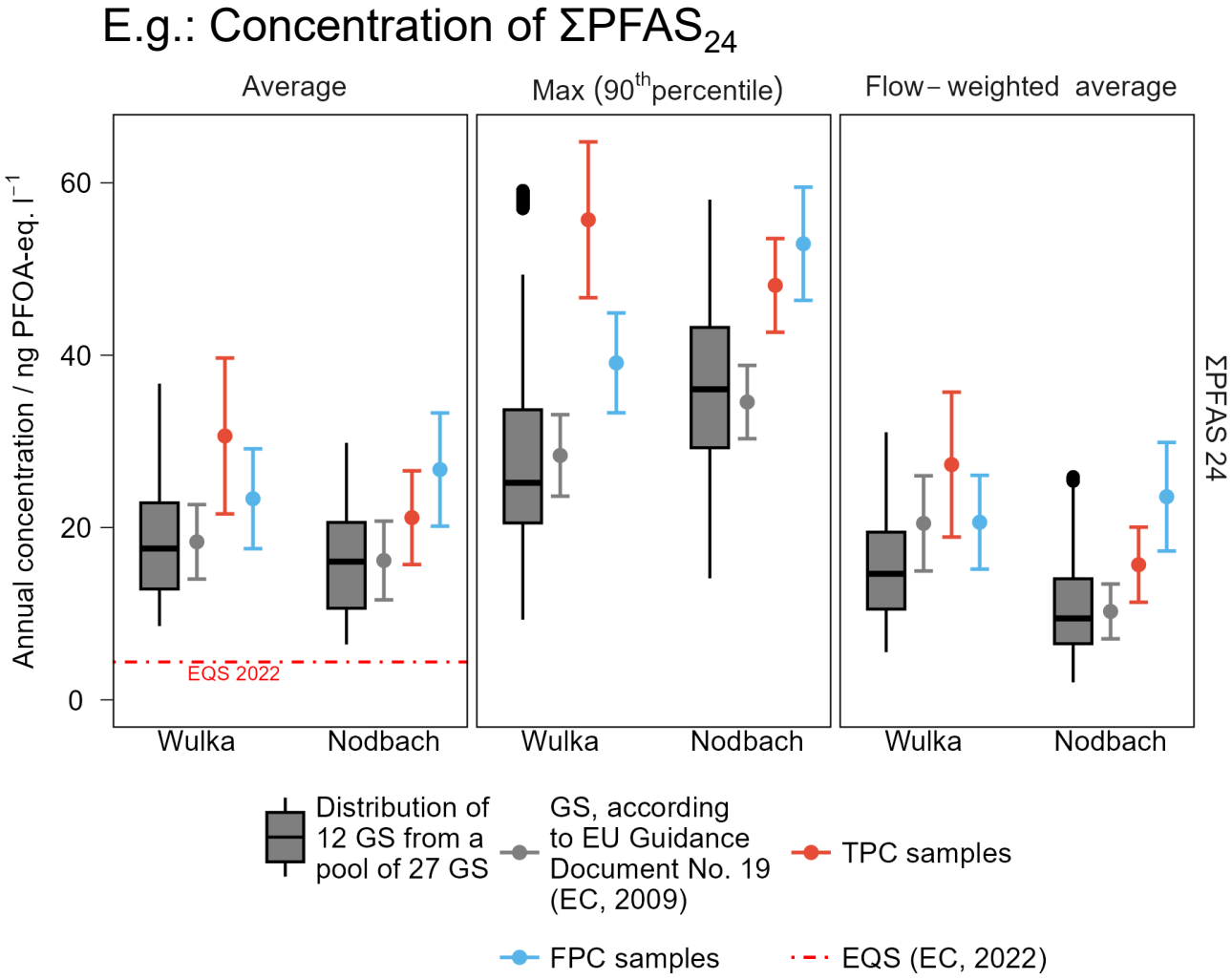
Pharmaceuticals

- Largely continuous inputs mainly via WWTP effluent
- Influence of wastewater treatment plants clearly recognizable (Exceeding the proposal AA-EQS for Diclofenac in Wulka, but not in Nodbach)
- Low systematic deviation of the AA-conc. from 12 GS compared to TPC/FPC but
  - Overestimation of AA and MAC with 12 GS
  - Underestimation of loads with 12 GS
- Random errors can be big
  - Factor 2-3 at Ibuprofen, Diclofenac, Sulfamethoxazole, Carbamazepine



PFAS

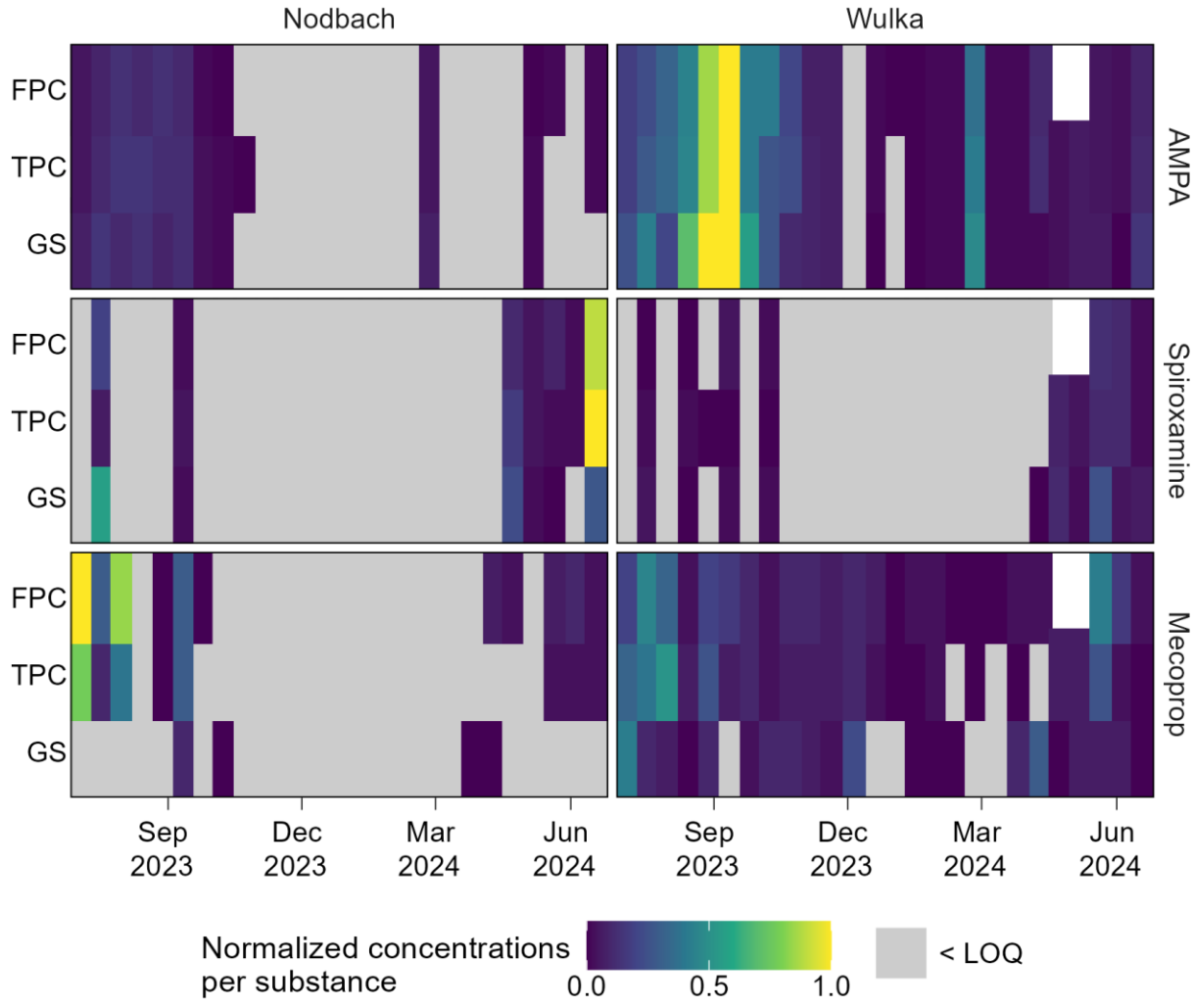
- Diverse pathways, time-variable emissions – often event-driven
- Exceeding the AA-EQS for PFOS and the proposal for $\Sigma PFAS_{24}$ in both rivers
- Some individual substances show a systematic underdetermination of AA-conc. over 12 GS compared to TPC/FPC
  - PFNA, PFOA, PFOS and 6:2 FTS
- Loads are poorly recorded via 12 randomly taken GS



Pesticides

- Multiple diffuse emission pathways, during episodes such as application periods and runoff events -> challenging to sample
- Occurrence during application episodes clearly visible
- Rivers with sewage influence (Wulka) have a significantly higher or longer load than rivers without sewage influence (Nodbach).

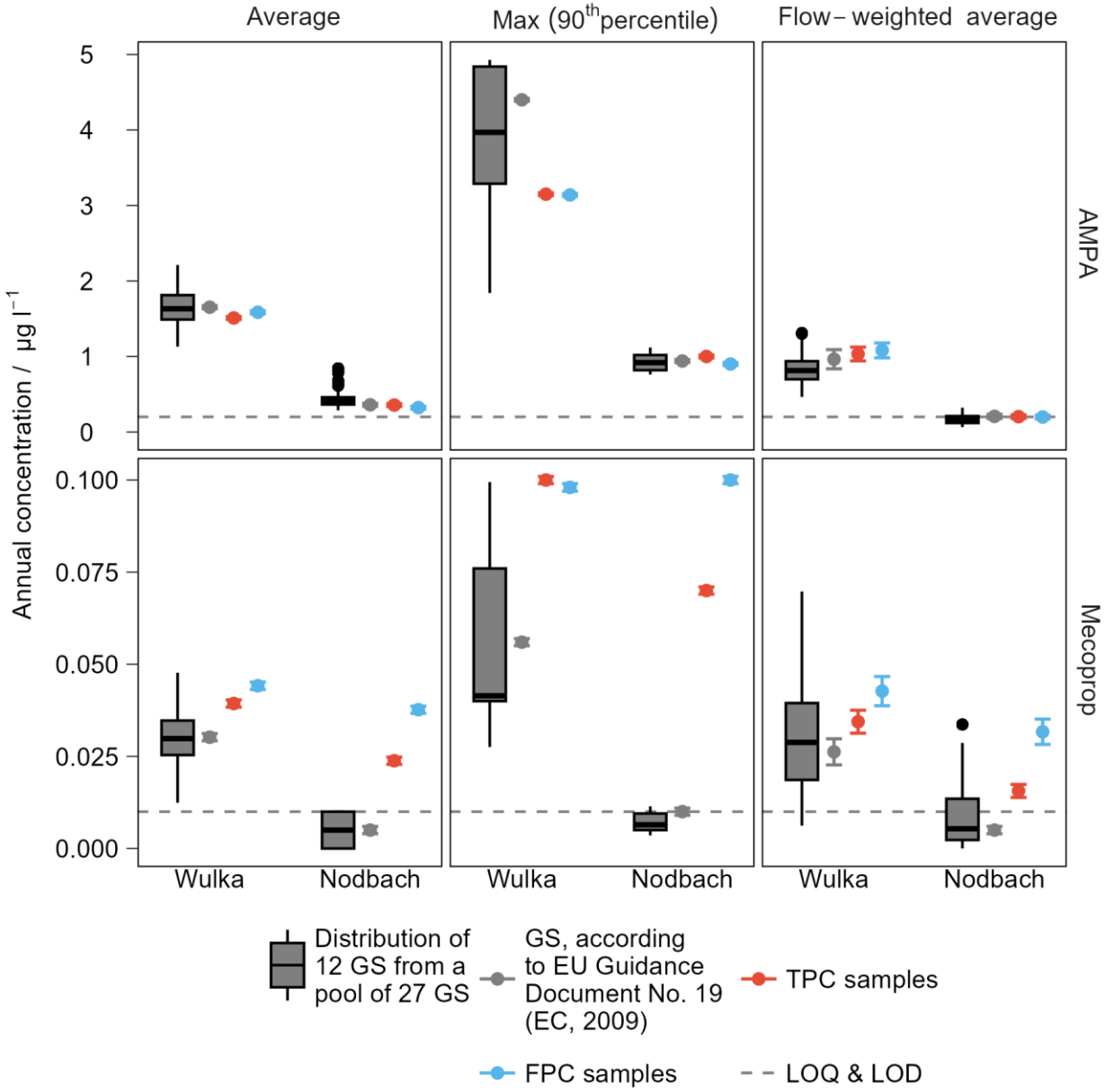
E.g.: Normalized concentrations of AMPA, Mecoprop und Spiroxamine



Pesticides

- Substances with minor systematic deviations between GS and TPC/FPC
  - Glyphosate, AMPA, Diuron, Terbutryn
- Substances with high systematic deviations between GS and TPC/FPC
  - MCPA, Mecoprop, Metolachlor or Benalaxyl
  - Extreme case Lindane (γ-HCH) only recorded with TPC/FPC (Exceeding the AA-EQS (Proposal for HCH))
    -> pulse-like emissions, origin?

E.g.: Concentrations of AMPA & Mecoprop



Summary

- Substances with continuous emissions: represented well with GS
  - Pharmaceuticals, continuously discharged pesticides und dissolved metals
- Substances with seasonal emissions: targeted sampling necessary
  - Majority of pesticides
- Substances with event-driven emissions: poor capture with GS, TPC/FPC advantageous
  - Some pesticides, some PFAS, total metals
  - FPC are advantageous for runoff-driven emissions
- Substances with pulse-like emissions: not detectable with GS, TPC/FPC necessary
  - Insecticide Lindane

Outlook

- A nationwide switch from grab samples to composite samples is currently hardly feasible in Austria due to the effort involved
- Targeted expansion of the current monitoring network with
  - Monitoring for selected, critical trace contaminants for load estimation via volume-proportional composite samples at larger (cross-border) rivers and above vulnerable lakes
  - Additional monitoring of selected, critical trace contaminants via time-proportional composite samples on small flowing waters with a critical pollution situation (agriculture, urban water sector)

Federal Ministry
Republic of Austria
Agriculture, Forestry, Regions
and Water Management

DaFNE

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Open Access Article

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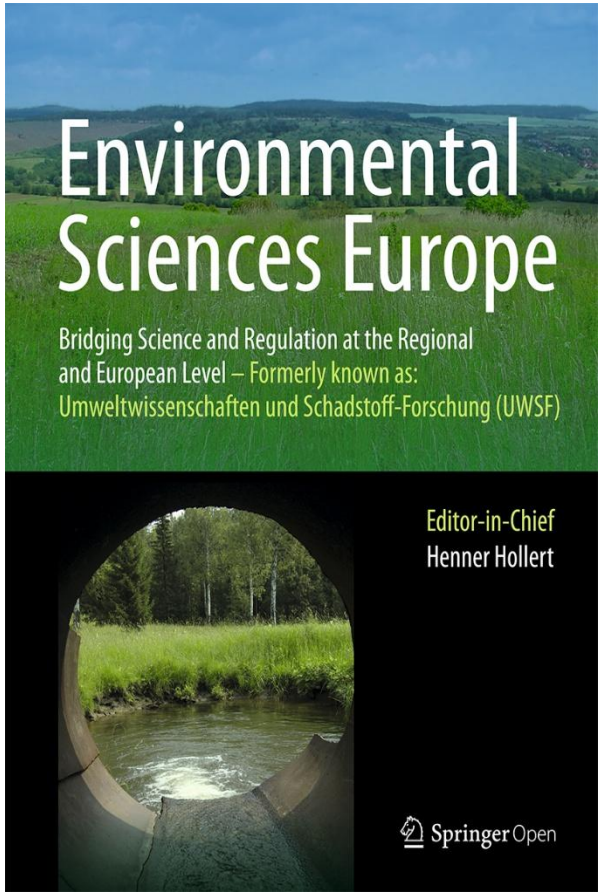

Diffuse Pollution Conference 2026 in Vienna

DIPCON2026

Main themes

- Diffuse emissions of legacy and **emerging trace contaminants**: monitoring, modelling and management
- Diffuse emissions of **nutrients**: monitoring, modelling and management
- Diffuse contaminant emissions from **urban areas**: control and management
- **Agriculture** and water quality interactions: innovative approaches and solutions
- **Eutrophication** in freshwater and marine environments
- **Nature-based solutions** to tackle diffuse water pollution
- Tackling water quality problems at the scale of large **river basins** and impacted coastal areas
- Quality dimension in **water scarcity** assessment
- **Pollution – biodiversity – climate change** nexus: interconnections and innovative approaches

Open call for abstracts
April 15, 2026

Deadline for abstract submission
June 05, 2026

Abstract submission OPEN & extended to June 30

registration
Sep. 30, 2026

Deadline for regular registration
Nov. 8, 2026

Conference
Nov. 24 - 27, 2026

DIPCON2026

Highlights

- YWP networking event, Nov. 24
- Two technical tours, Nov. 27
- Gala dinner at the Vienna City Hall, Nov. 25
- Take a stroll through Vienna's magical Christmas markets

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