Management solutions for drinking water distribution networks under climate change

Irene Jubany

Eurecat

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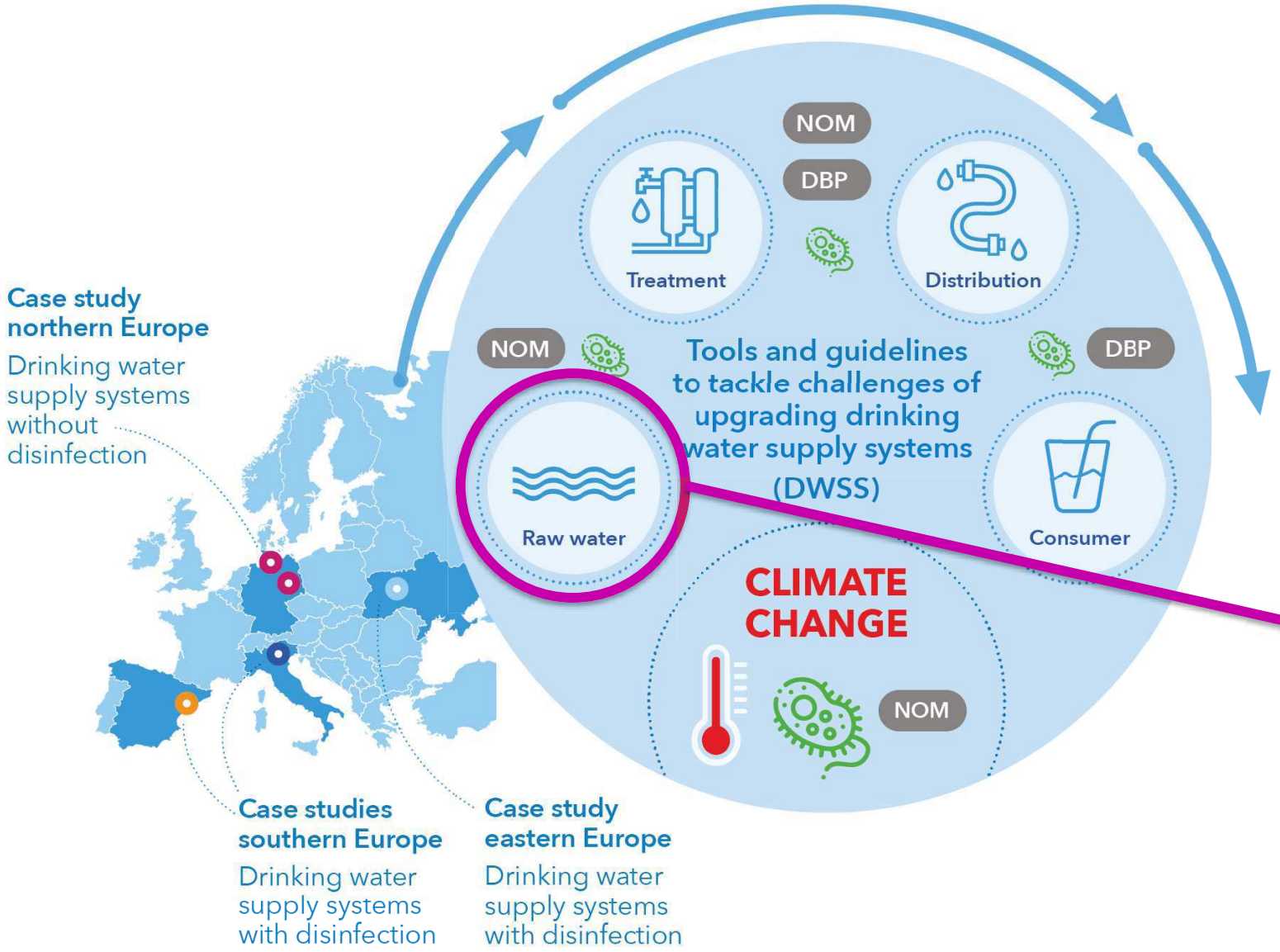
Introduction



Effect of climate change on raw water characteristics

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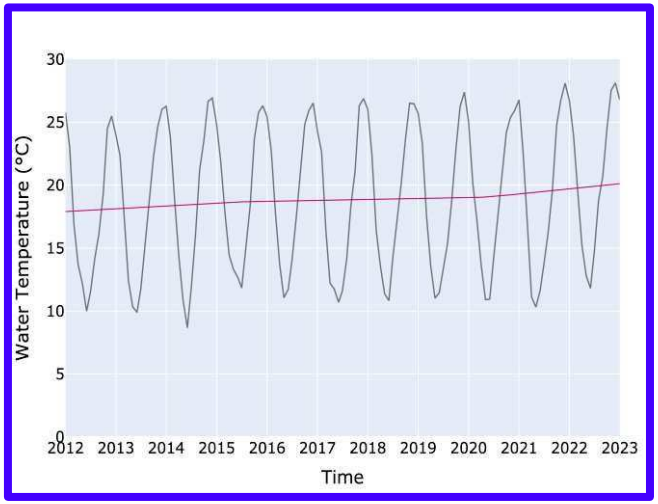
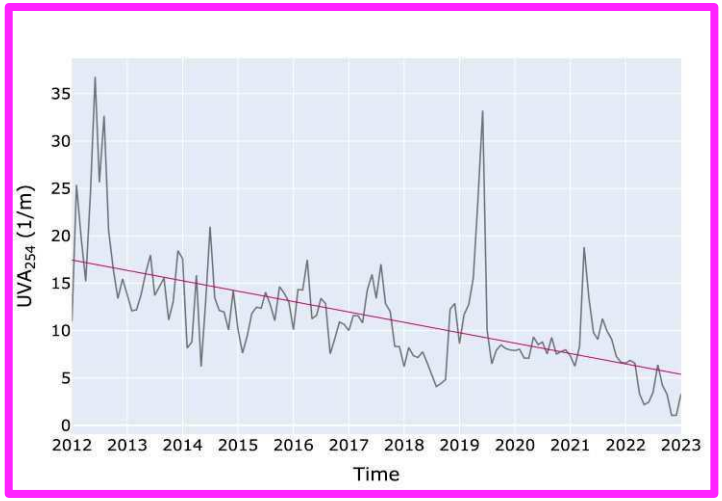
Effect of climate change to source water quality

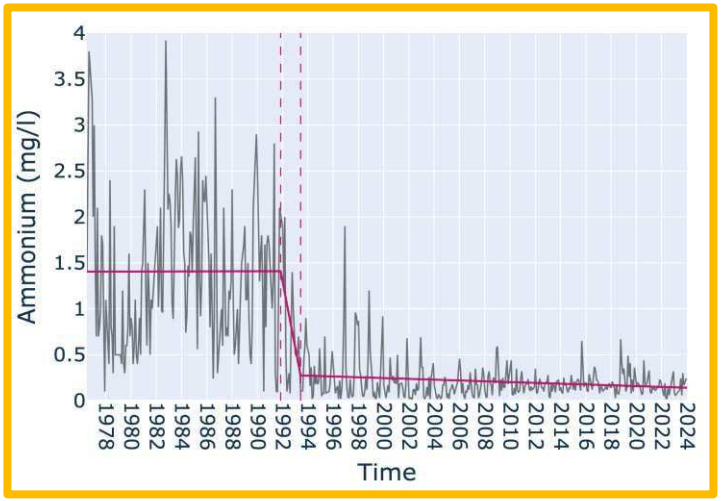
Tarragona (surface water, Ebro River).

Site \ Parameter	Water Temperature (°C)	UVA_{254} (1/m)
Literature on Climate Change	↑	↑
	30/30	23/26
Tarragona	↑	↓





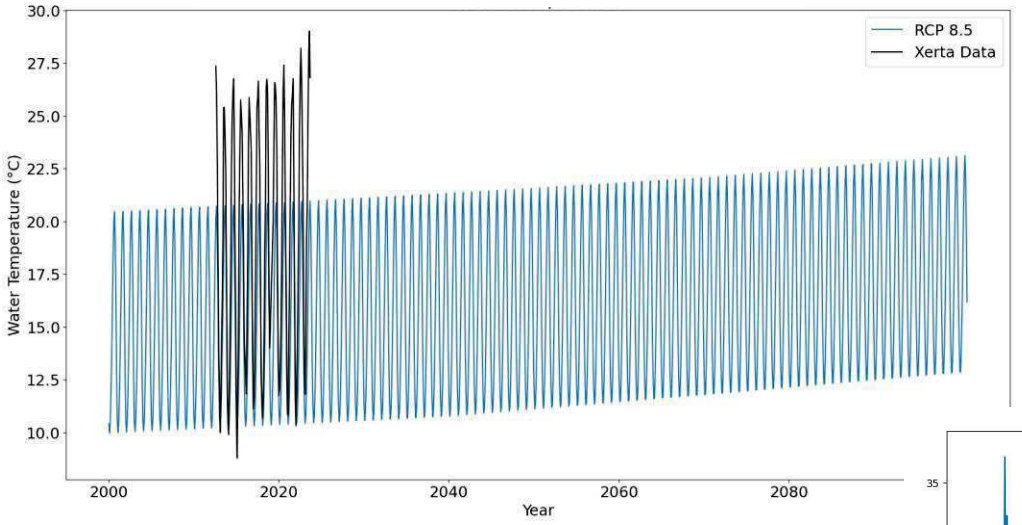
Berlin (induced bank filtration, Spree and Havel rivers)



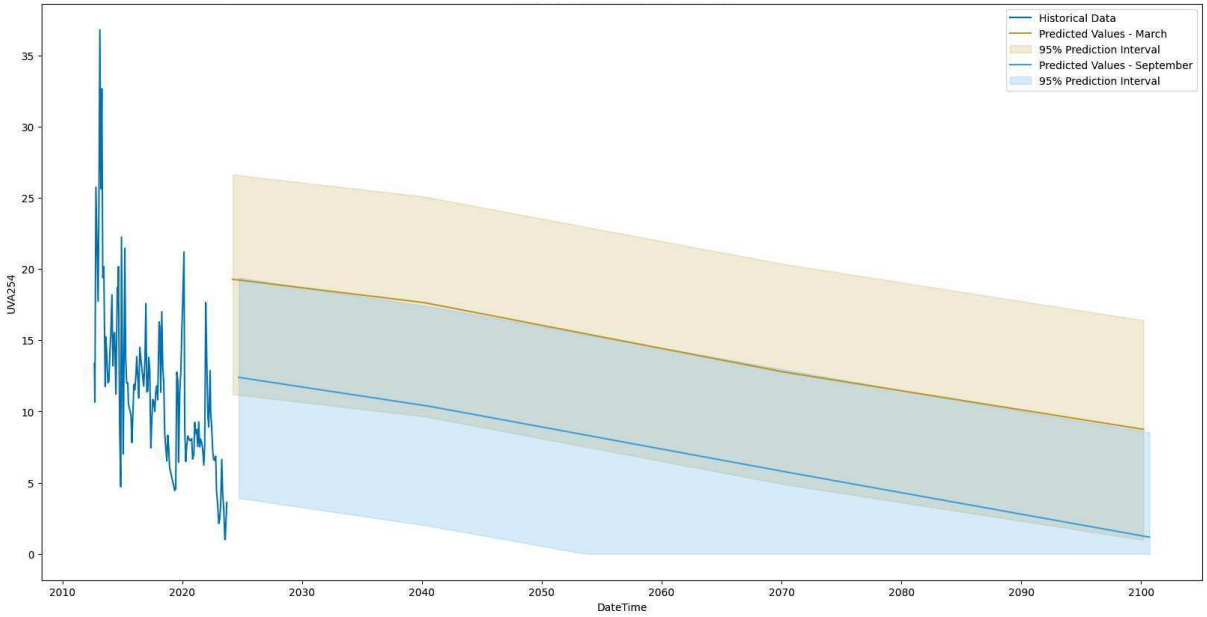
Effect of climate change to source water quality

Case study: Tarragona (surface water, Ebro River). Projections based on climate change scenarios

Water temperature



UVA254 monthly Min/Max – RCP8.5



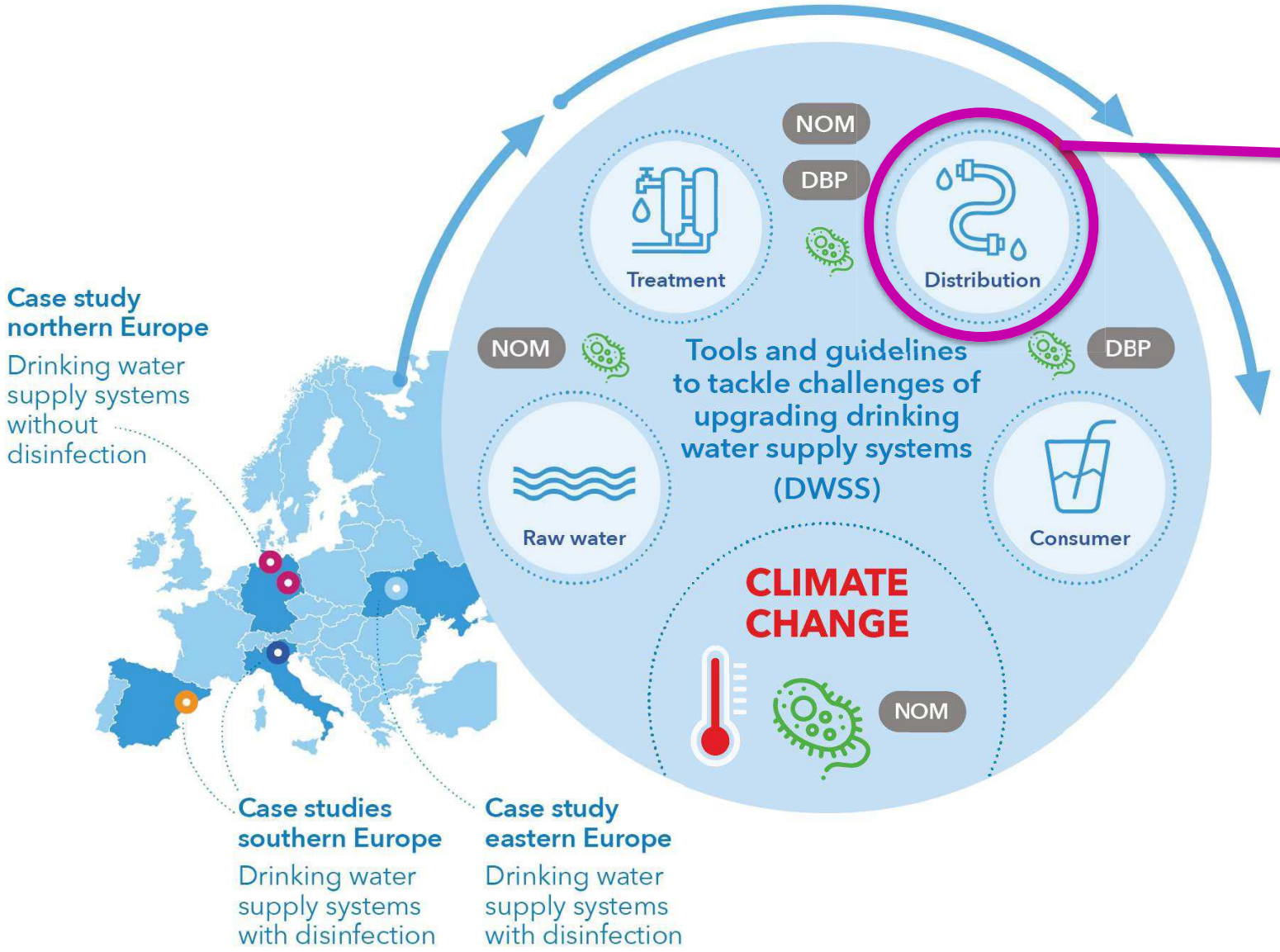
Effect of climate change to source water quality

- Human interventions can be as important as climate factors in shaping water quality, with activities such as land use changes, wastewater discharges, agricultural runoff, and industrial pollution significantly influencing outcomes.

- Case studies in Tarragona and Berlin show that local anthropic actions can alter expected climate-driven trends, highlighting the need to include both climatic and human drivers in predictive models for drinking water quality.

- Not only do long-term climatic trends have to be considered in water management, but also short-term and intense episodes.

Introduction



Management solutions under climate change.

- Temperature
- Bacteria regrowth
- Disinfection

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Management of non-disinfected water distribution in case of transition to disinfection (CS #1)

Berlin

Berliner Wasserbetriebe have developed a concept for "**as-needed disinfection**":

- *D*W pumping stations Bln-Lindenberg & Bln- Lichtenberg are fully equipped with **UV**-disinfection.
- Waterwork Bln-Kladow is fully equipped with **UV**-disinfection.
- All other Bln-waterworks are currently equipped with **chlorine** stations and will be equipped with **UV** disinfection as part of coming retrofitting.

Hamburg

Hamburg Wasser has not developed a comprehensive transition concept for "as-needed disinfection", as the source waters consist of protected deep-well groundwater. However, the following measures have been implemented:

- In one water work, an "as-needed disinfection" chlorination station was converted into a **chlorine dioxide** application.
- Several **mobile disinfection units** (hypochlorite) are available for emergency needs.

Management of disinfected water distribution networks (CS#2 and CS#3)

Testing protocols for reaction between disinfectants and materials

Monitoring tools for network and treatment processes

Soft-sensors

Management tools based on DBPs prediction models

Risk assessment framework

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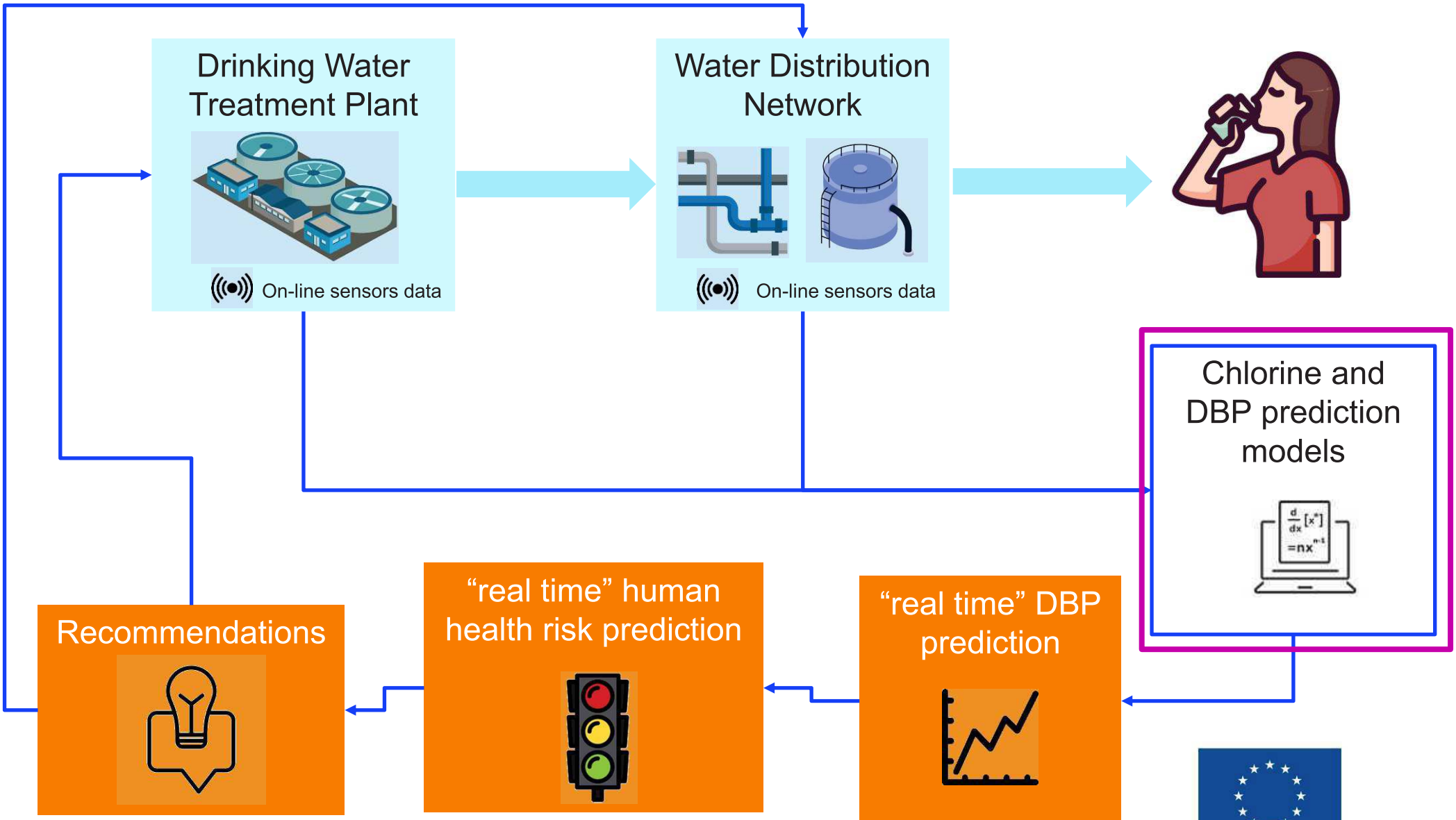
Management tools based on DBPs prediction models



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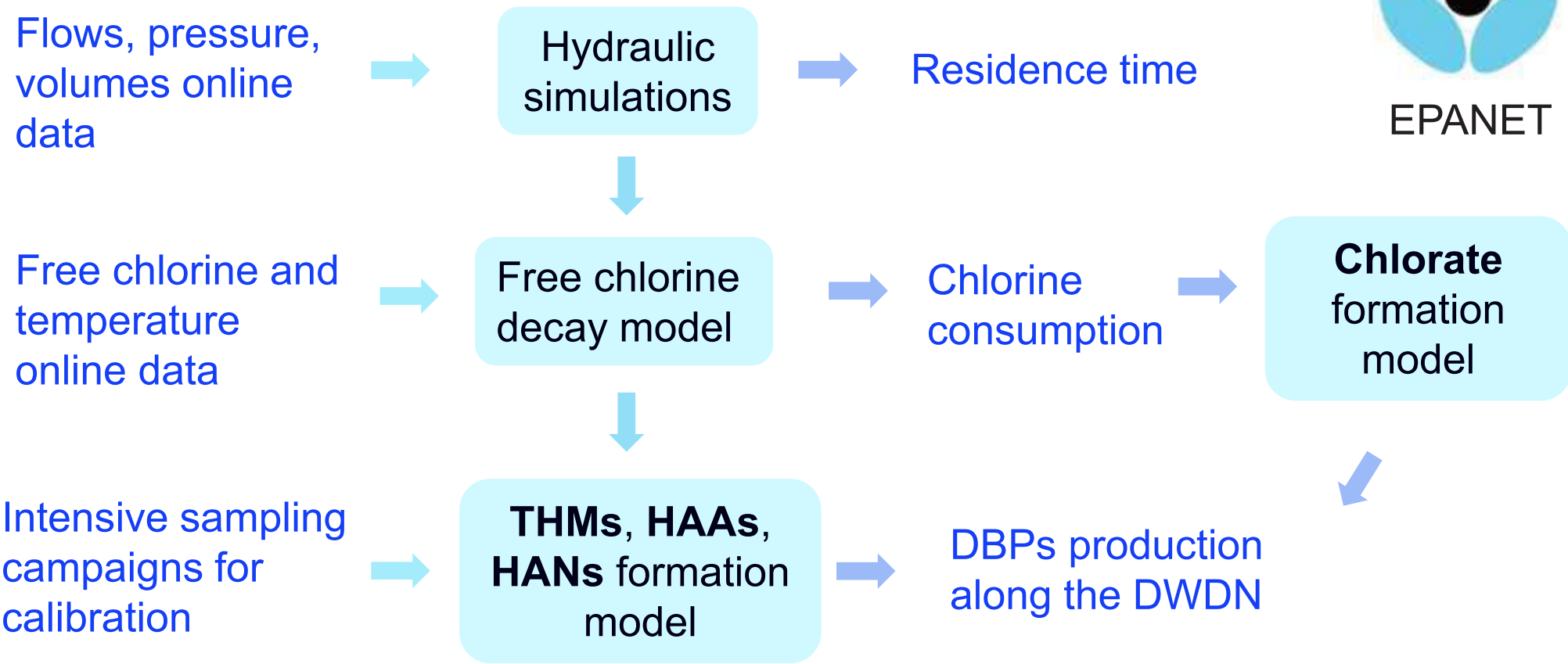
Management tools based on DBPs prediction models



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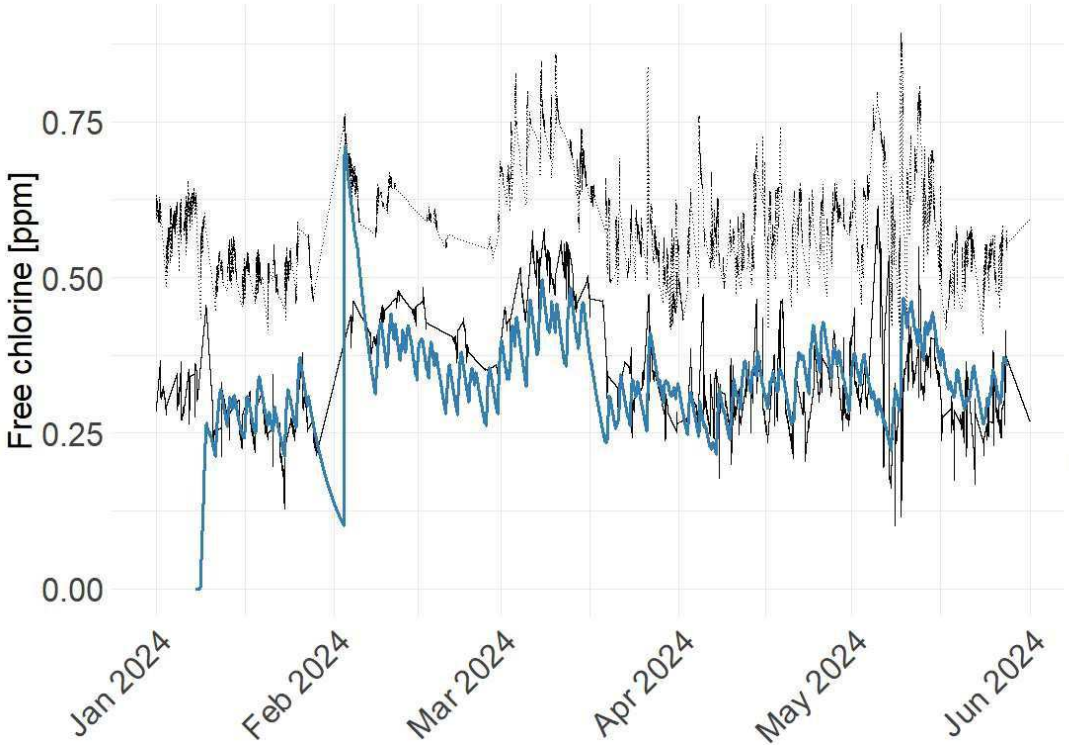
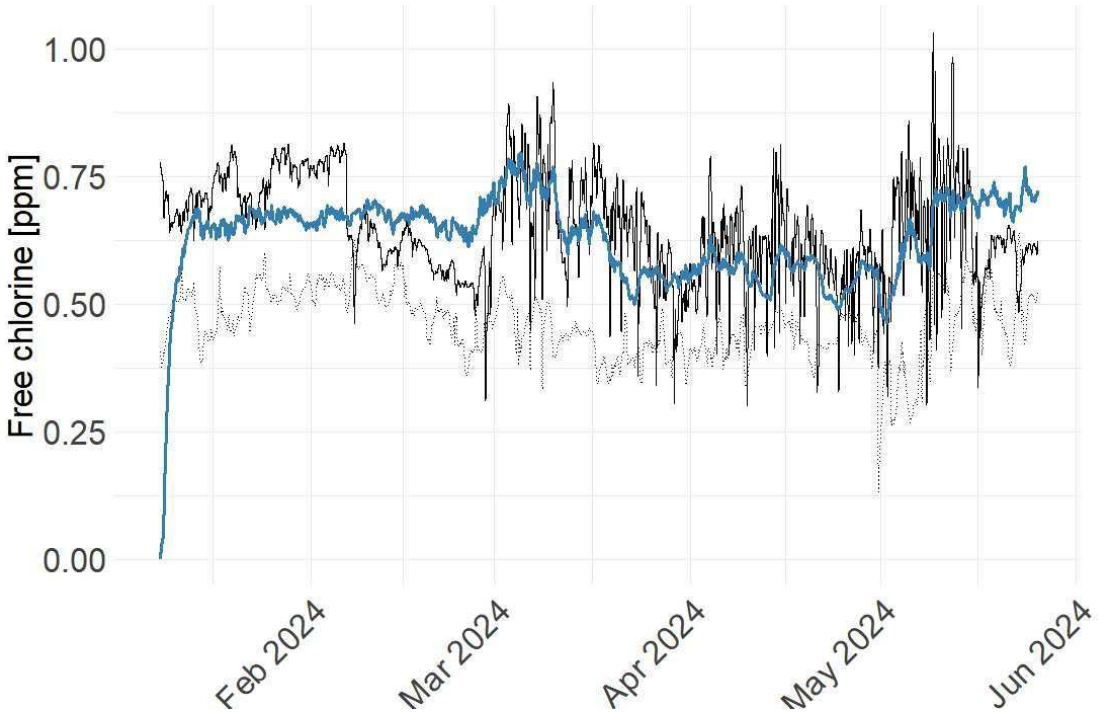
Management tools based on DBPs prediction models

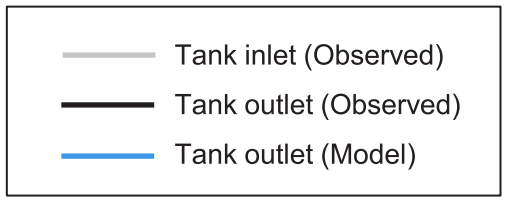
Free chlorine

Storage tank



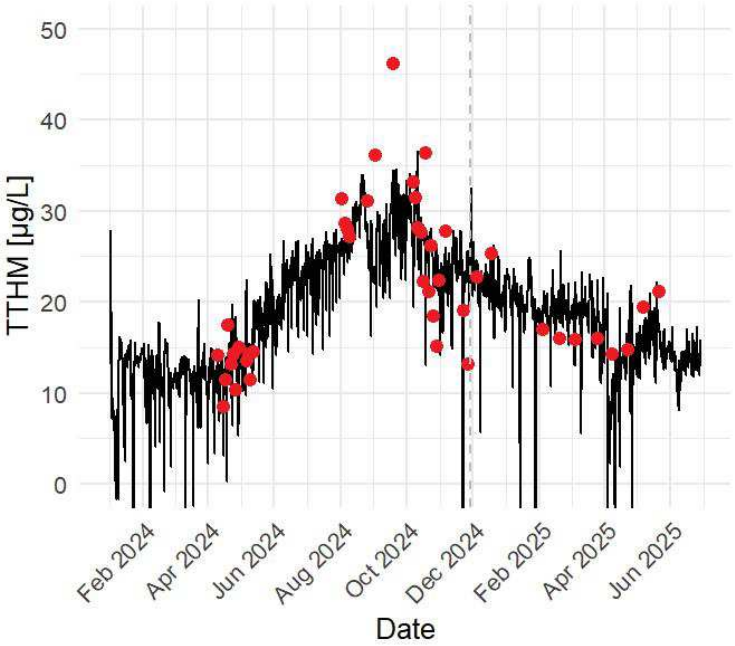
Chlorine booster station

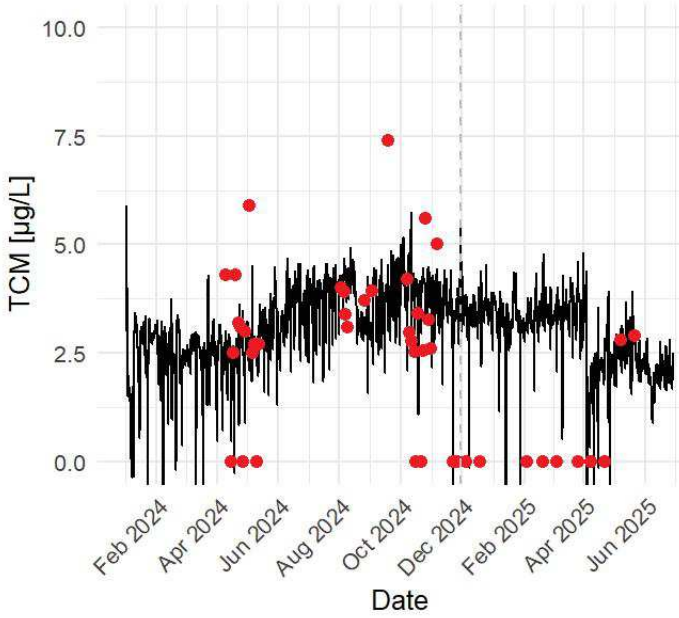


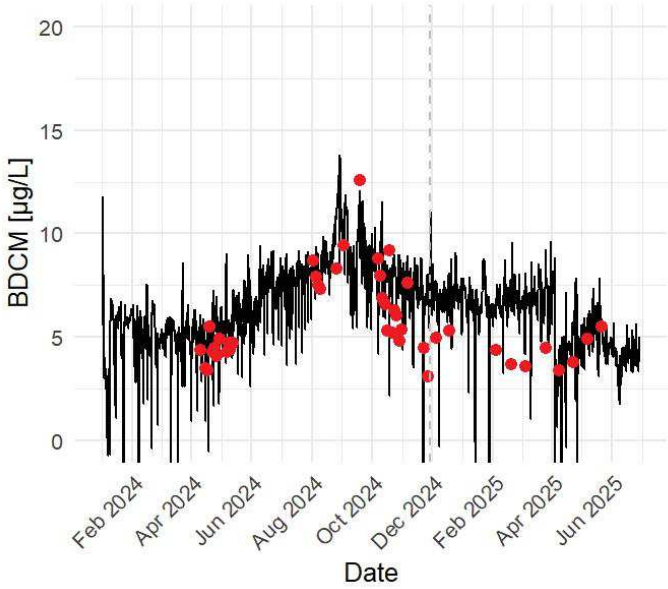


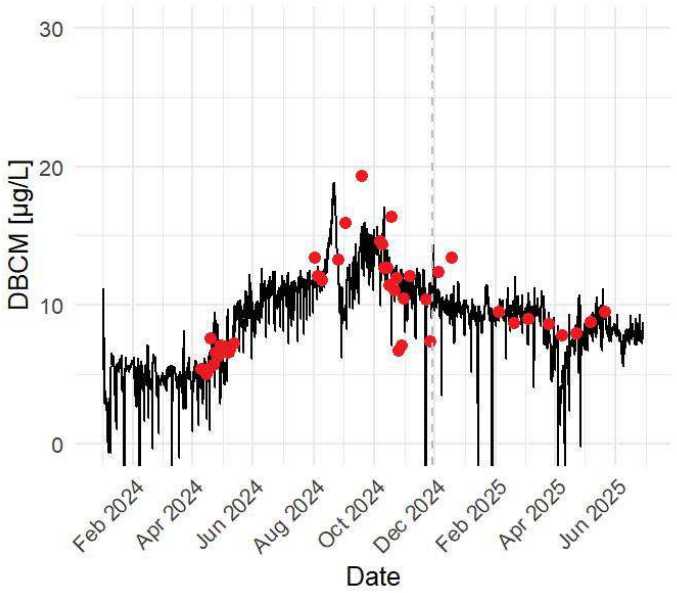
Management tools based on DBPs prediction models

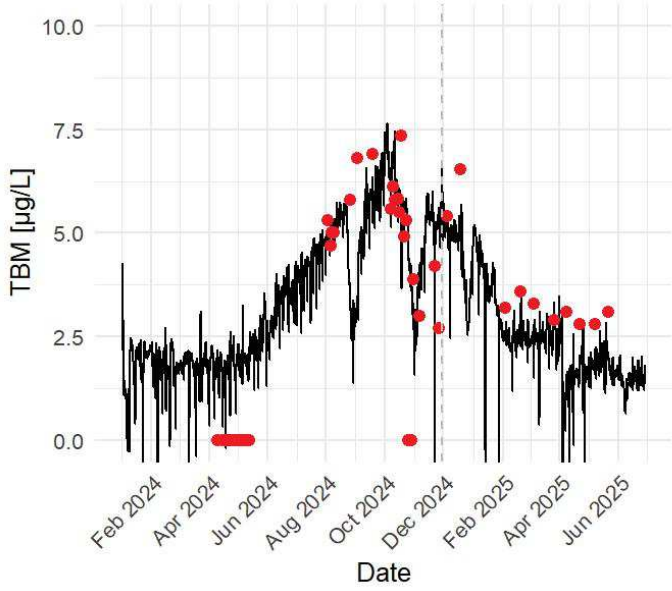
THMs

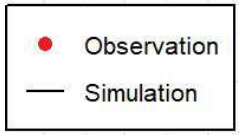






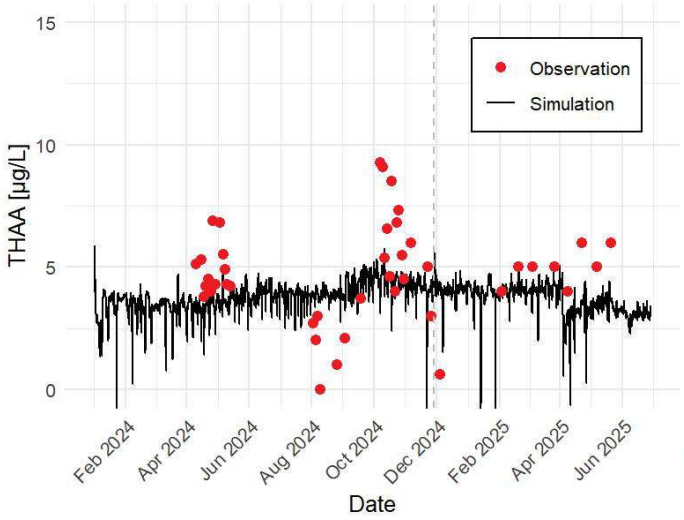


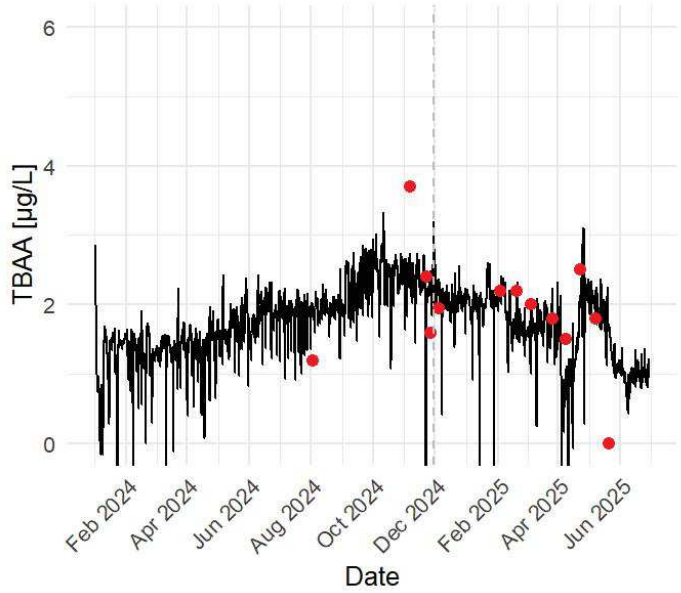


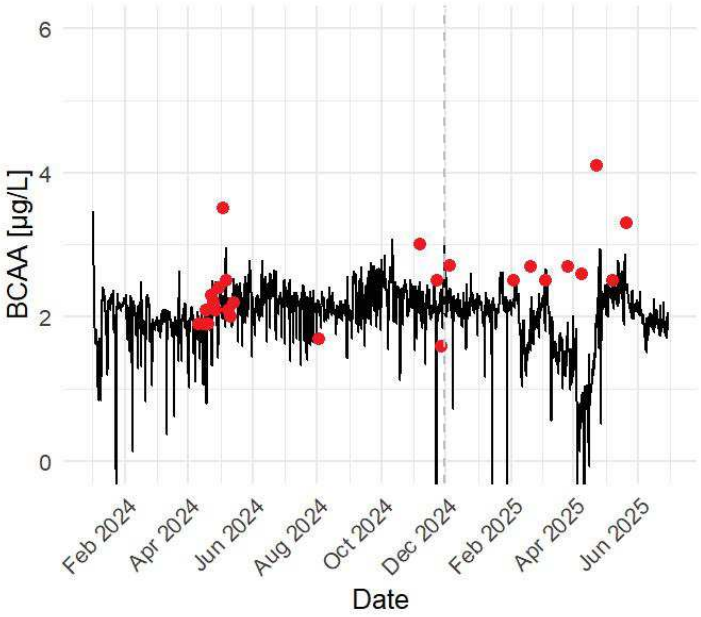


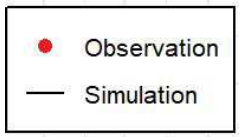
Management tools based on DBPs prediction models

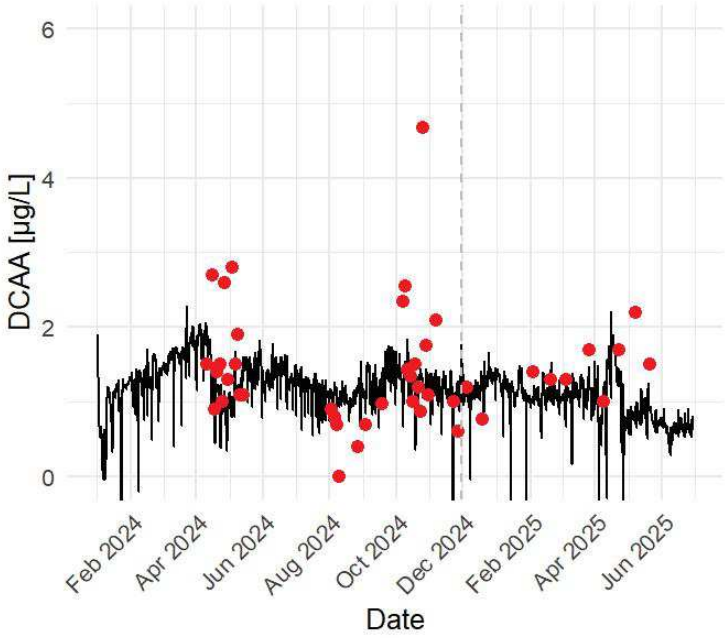
HAAs

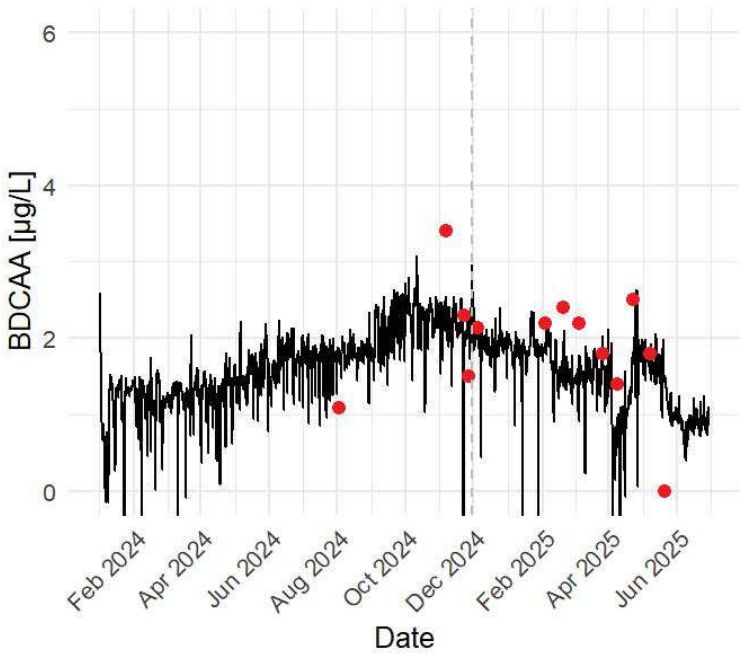












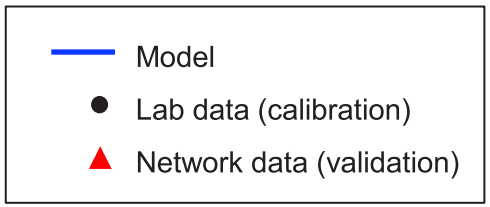
Management tools based on DBPs prediction models

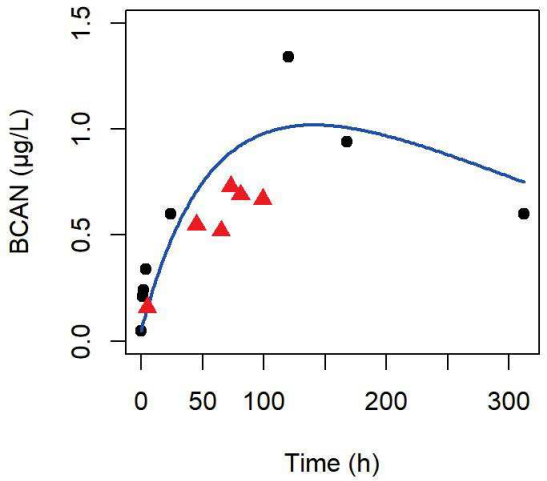
		TTHMs	TCM	BDCM	DBCM	TBM	Free chlorine
CAL	MAE [ppb]	4.89	1.56	1.80	2.00	1.09	0.10 mg/L
	MAE [%]	23%	67%	31%	20%	23%	18%
VAL	MAE [ppb]	2.46	2.50	1.85	0.75	0.82	0.08 mg/L
	MAE [%]	12%	107%	32%	8%	18%	14%

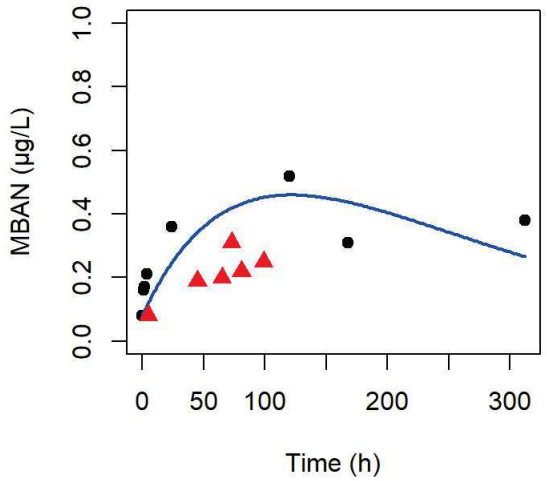
		THAAs	TBAA	DCAA	BCAA	BDCAA
CAL	MAE [ppb]	1.47	0.82	0.68	0.39	0.76
	MAE [%]	31%	43%	47%	16%	40%
VAL	MAE [ppb]	1.58	0.48	0.43	0.88	0.55
	MAE [%]	33%	25%	30%	36%	29%

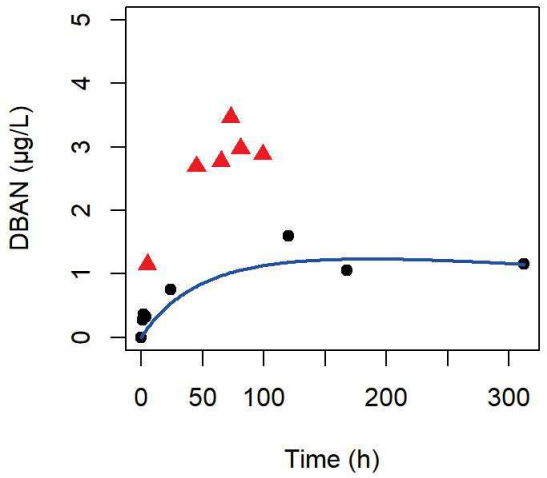
Management tools based on DBPs prediction models

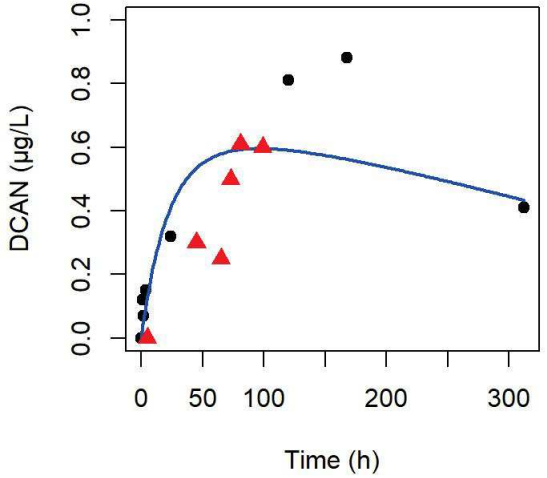
HANs





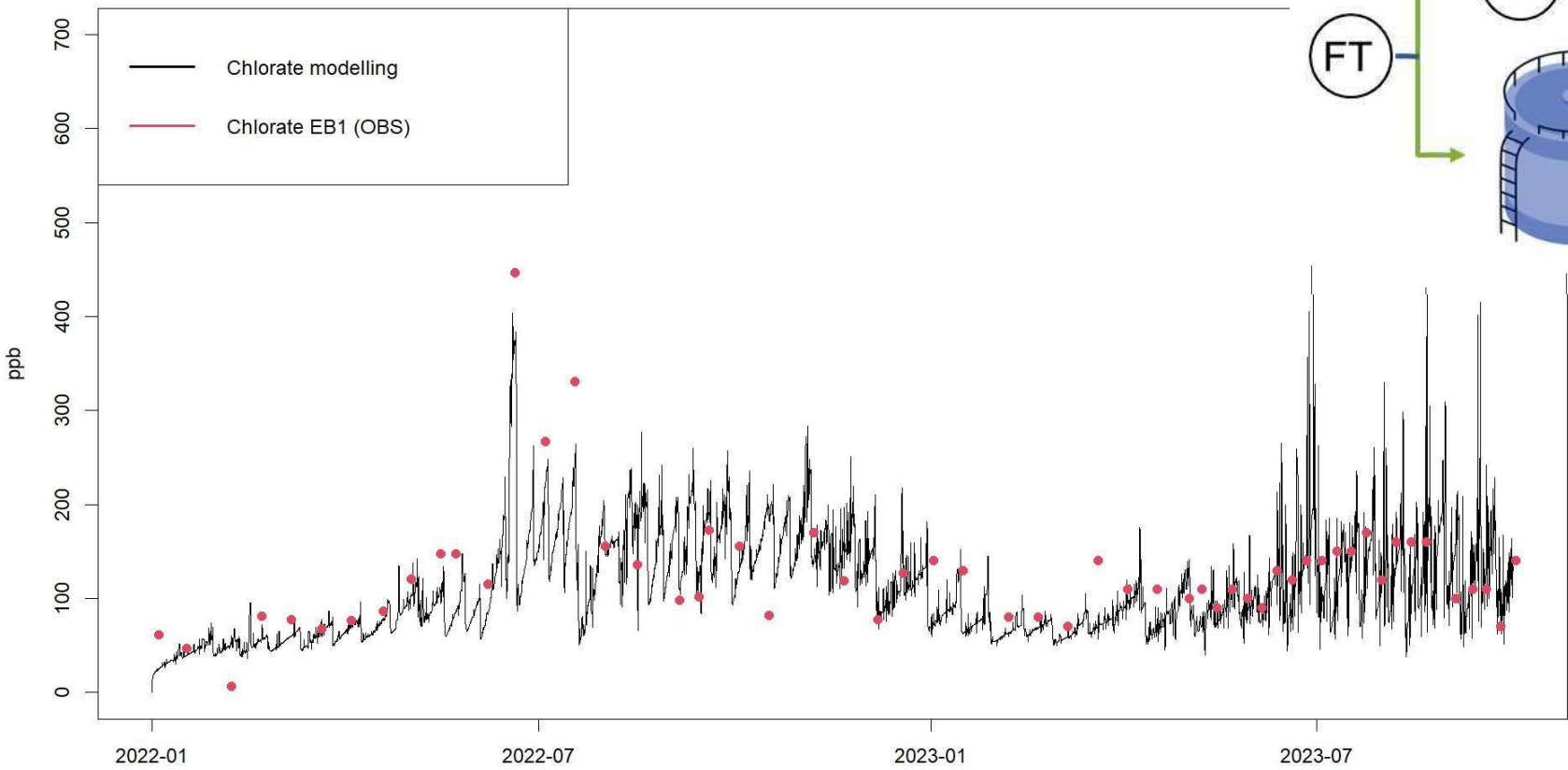


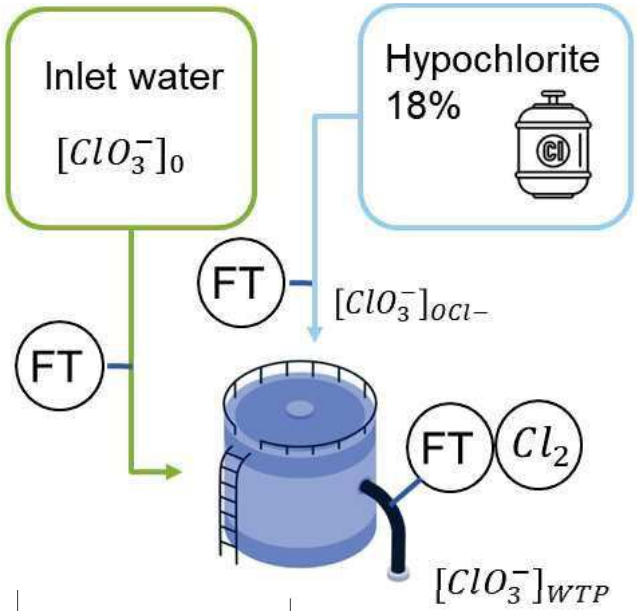




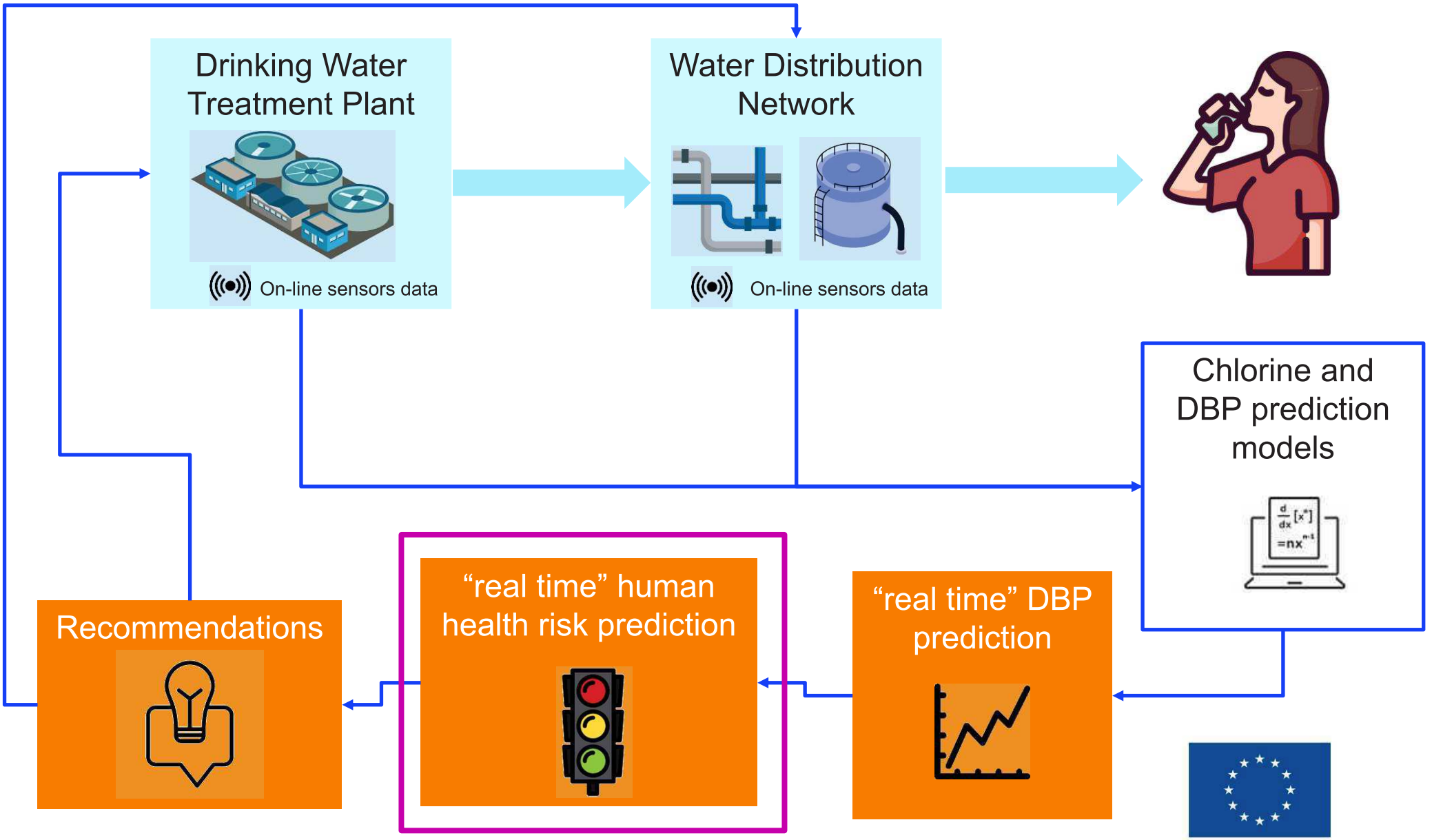
Management tools based on DBPs prediction models

Chlorate





Management tools based on DBPs prediction models



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Management tools based on DBPs prediction models

WATER EXPOSURE

DBP concentration
+
Scenario (ingestion, inhalation & frequency)

+

TOXICITY ASSESSMENT

Carcinogenic toxicity
- Oral : daily ingestion
- Inhalation : shower

RISK

$> 10^{-5}$: Unacceptable risk

$< 10^{-5}$: Acceptable risk

$RISK_{THMs} < 1$: Acceptable risk
$RISK_{HAAs} < 1$: Acceptable risk

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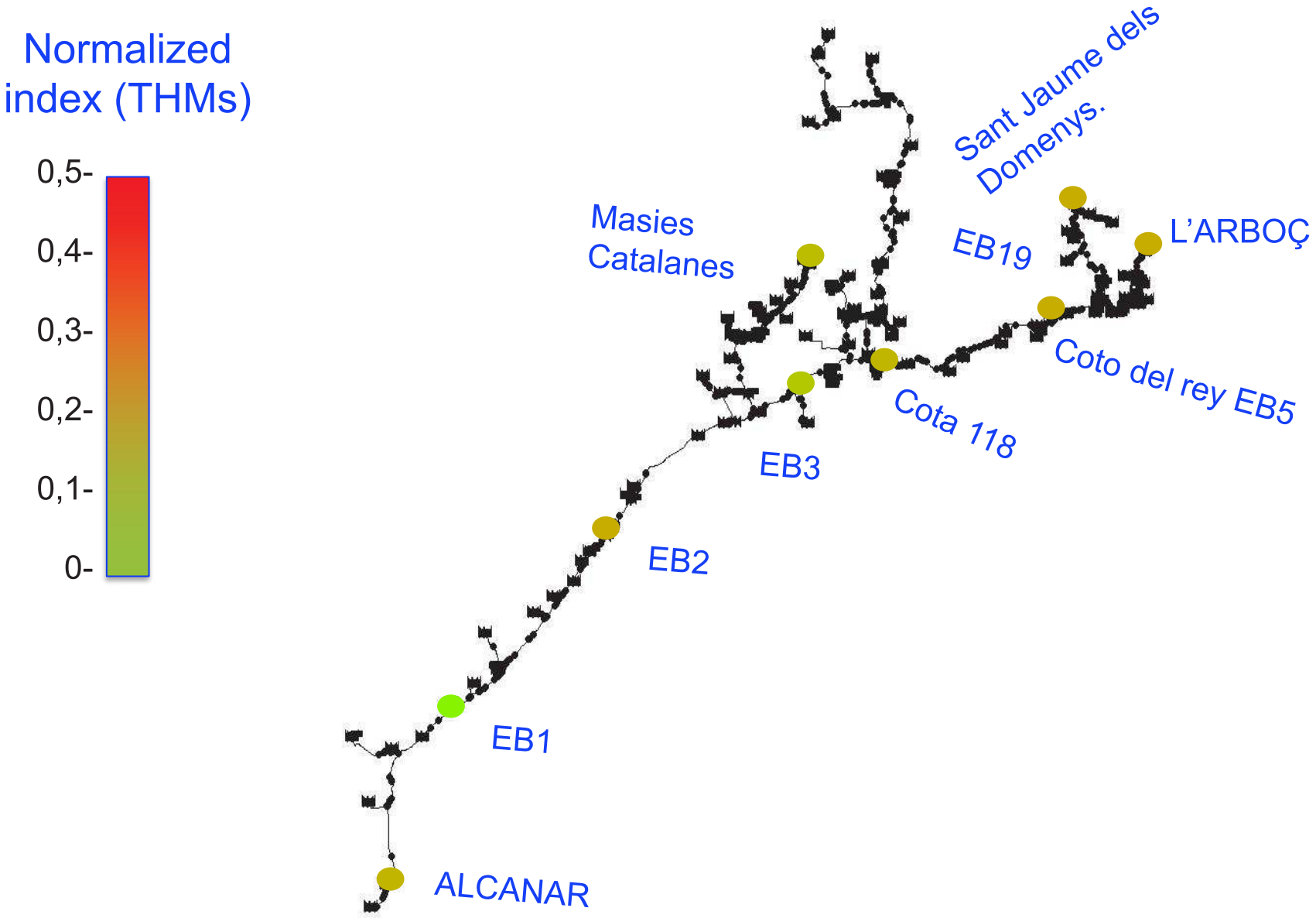
Management tools based on DBPs prediction models



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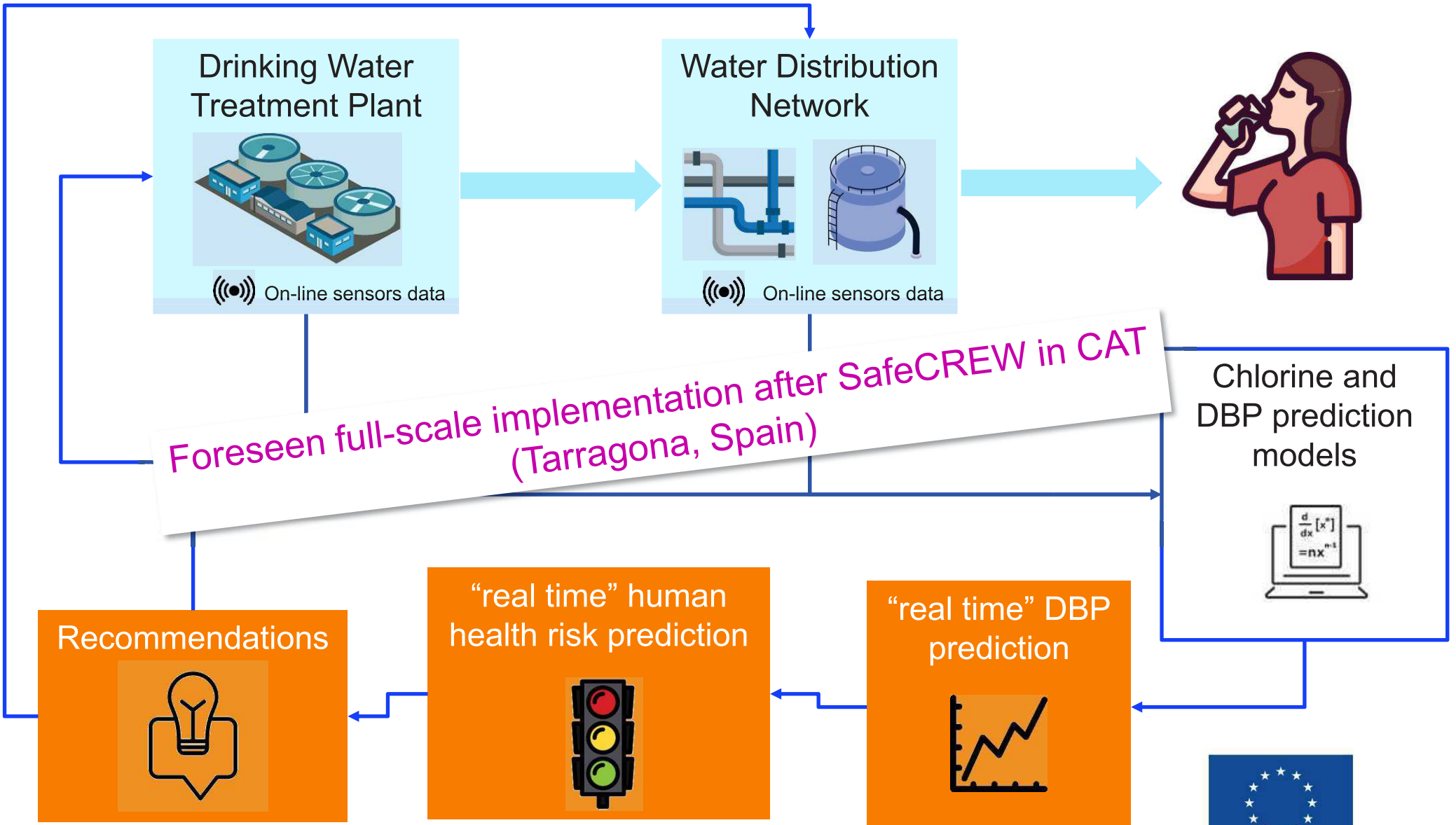
Management tools based on DBPs prediction models



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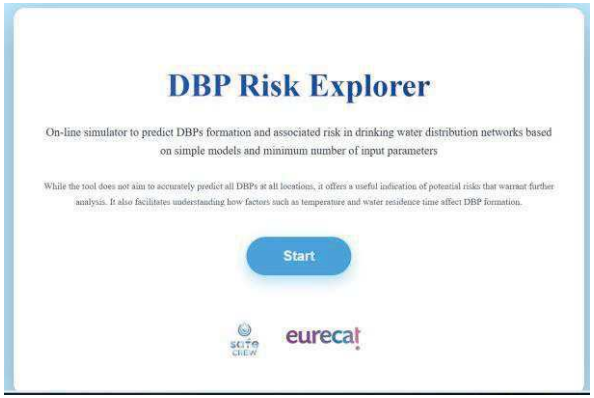
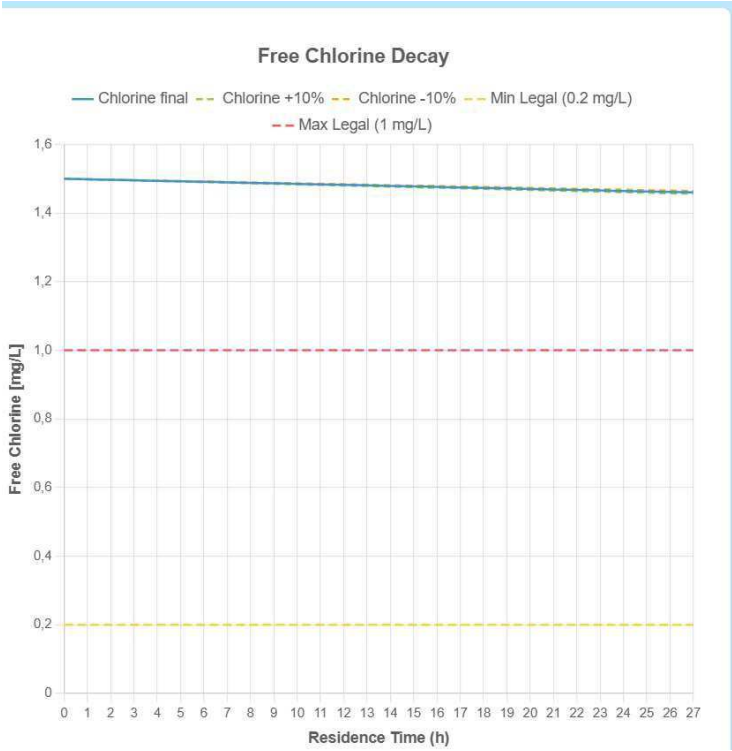
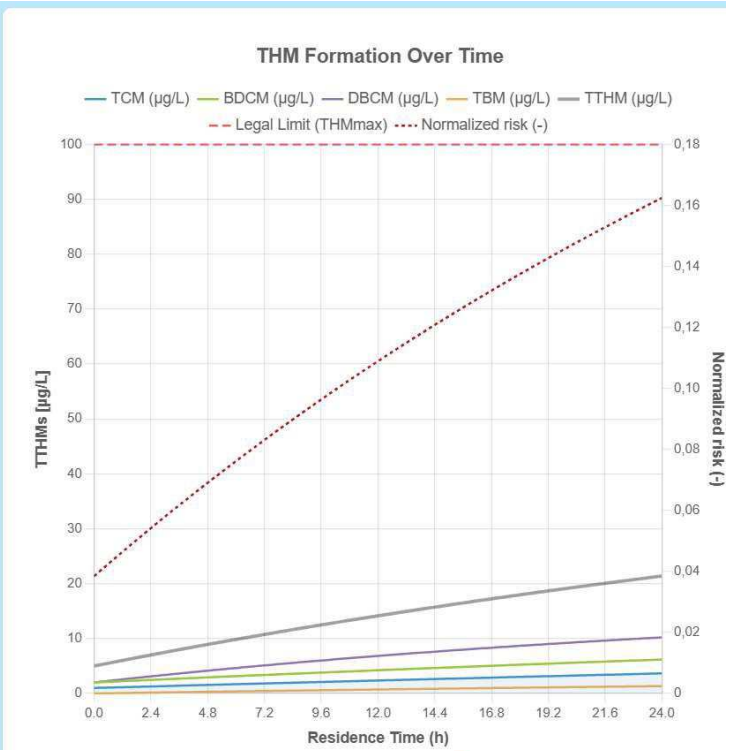
Management tools based on DBPs prediction models

On-line simulator to predict DBPs formation based on SafeCREW results



Available in April





safe CREW

Coordinated by

DVGW

Participants

POLITECNICO DI MILANO

KWB Kompetenzzentrum Wasser Berlin

BDS BioDetection Systems

eurecat Centre Tecnològic de Catalunya

Umwelt Bundesamt

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