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SafeCREW

Climate **RE**silient management for **safe** disinfected and non-disinfected **Water** supply systems

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www.safecrew.org



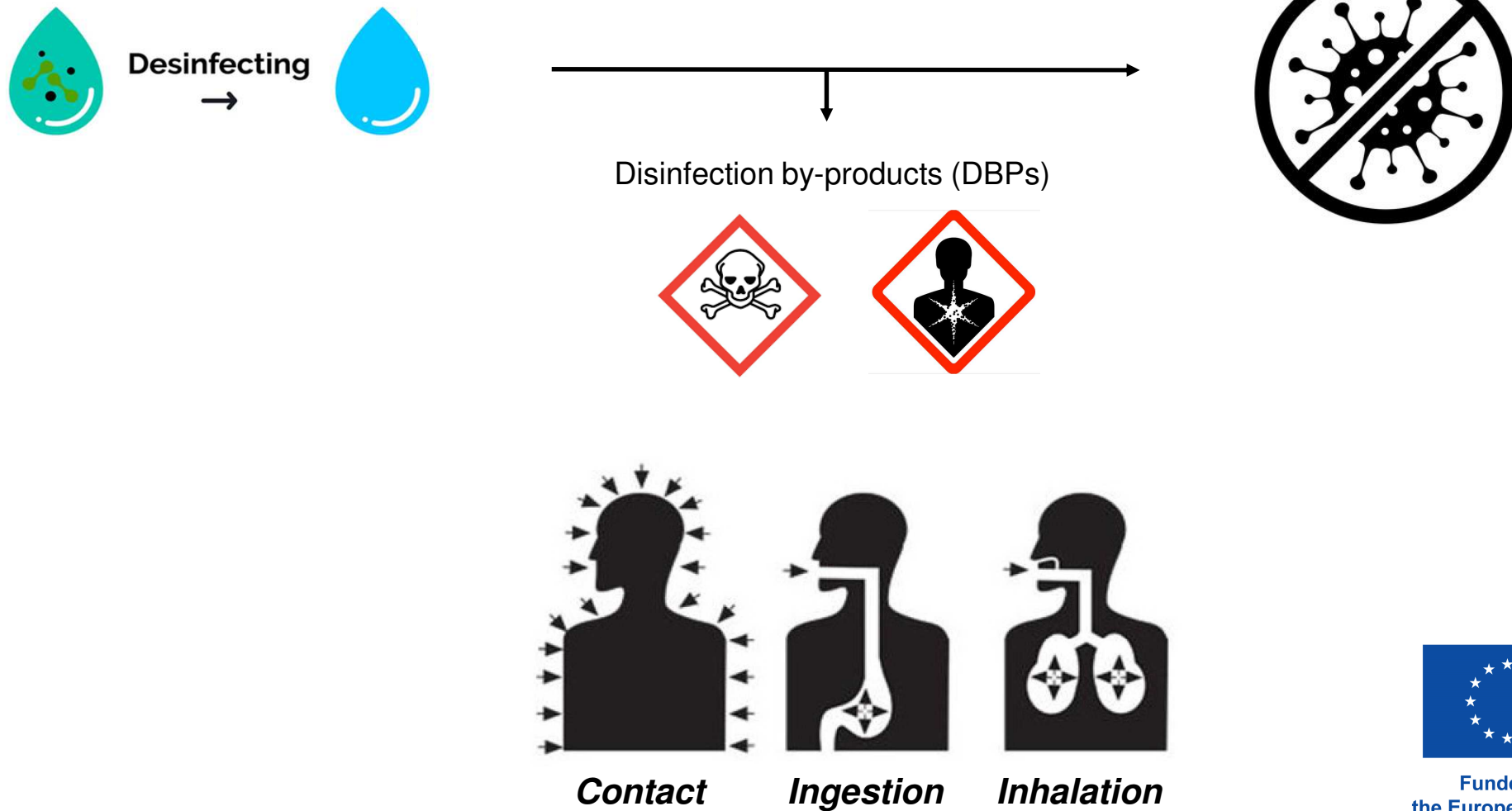
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Estimation models for DBPs in drinking water distribution networks

Laura Vinardell Magre, Eurecat



DBPs modelling: Risk approach



Regulated DBPs

DBPs	Threshold	Observations
Trihalomethanes (THMs)	100 ppb	<p>Where possible, without compromising disinfection, Member States shall strive for a lower parametric value. It is the sum of concentrations of the following specified compounds: chloroform, bromoform, dibromochloromethane and bromodichloromethane.</p>
Haloacetic acids (HAAs)	60 ppb	<p>This parameter shall be measured only when disinfection methods that can generate HAAs are used for the disinfection of water intended for human consumption. It is the sum of the following five representative substances: monochloro-, dichloro-, and trichloro-acetic acid, and mono- and dibromo-acetic acid.</p>
Chlorate	250 or 700 ppb	<p>A parametric value of 0,70 mg/l shall be applied where a disinfection method that generates chlorate, in particular chlorine dioxide, is used for disinfection of water intended for human consumption. Where possible, without compromising disinfection, Member States shall strive for a lower value. This parameter shall be measured only if such disinfection methods are used</p>

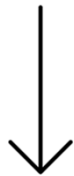
Unregulated DBPs

HANs



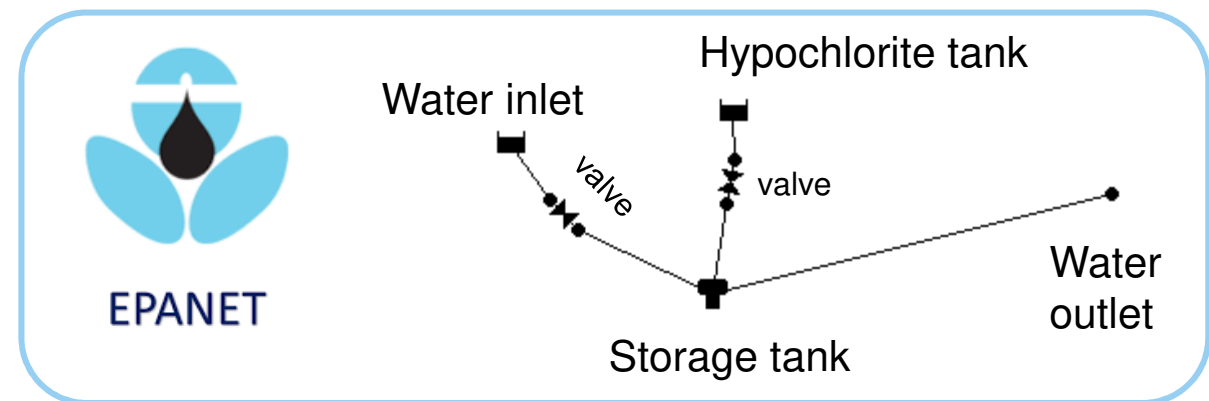
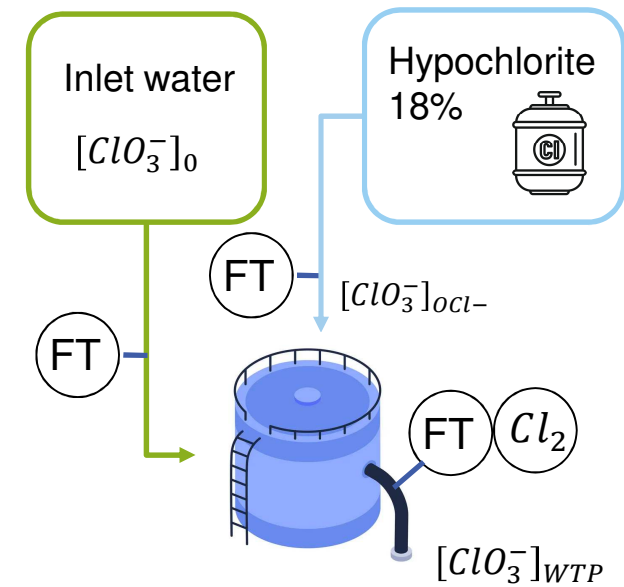
DWDS modeling:

- DWDS hydraulic model / metrics
- Flowmeters
- Chlorine sensors

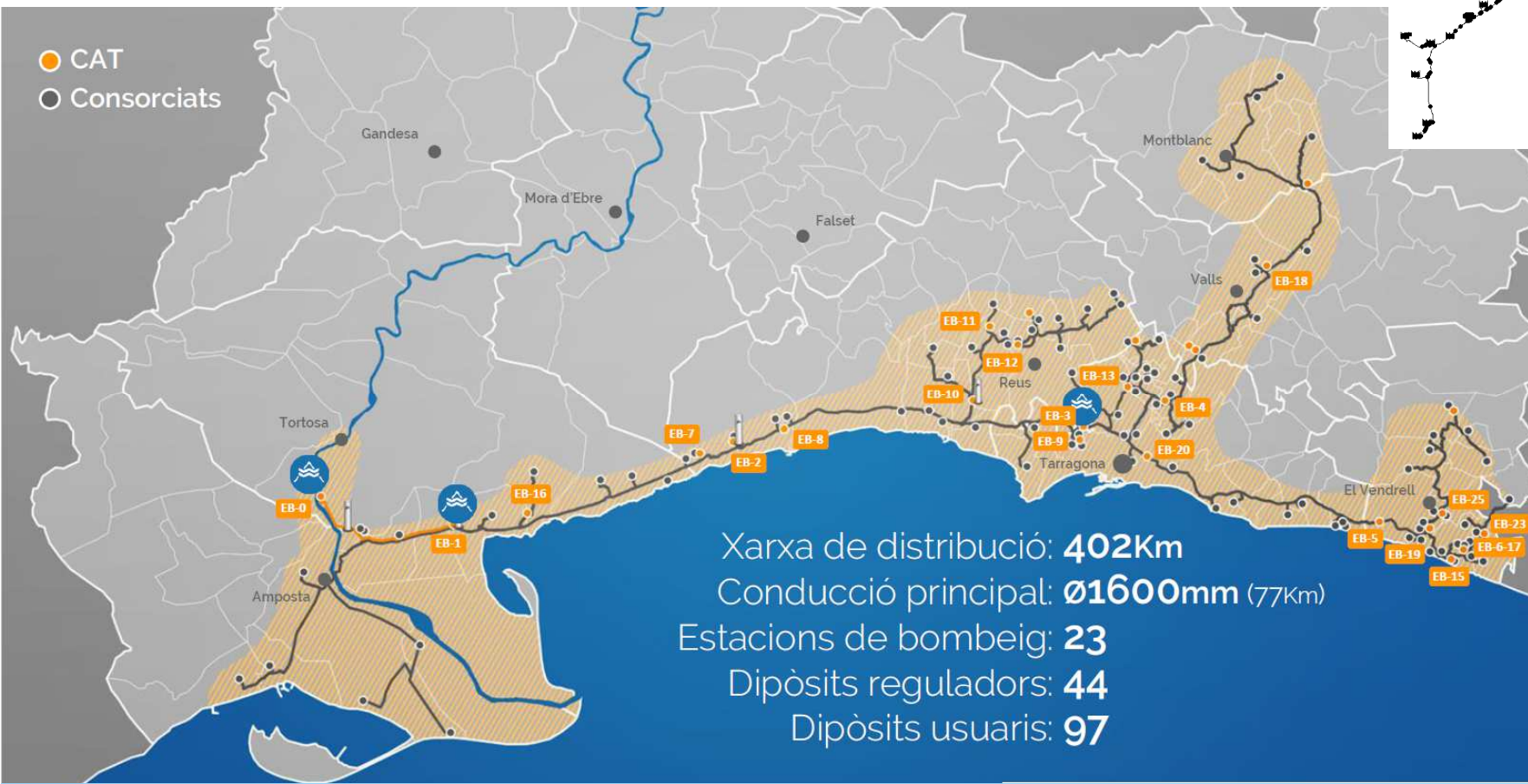
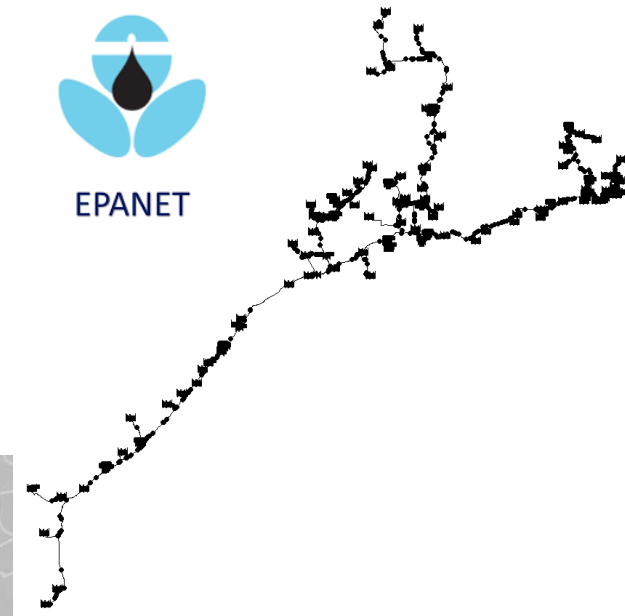


Water residence time

Compound mixture



CASE STUDY: DWDN Tarragona



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Data driven models

WATER QUALITY:
pH, CE, Temperature, Free
chlorine

HYDRAULIC VARIABLES:
residence time, chlorine
dose

$$THM_i = \sum_{i=1}^i \alpha_i \cdot X_i$$

Mechanistic models

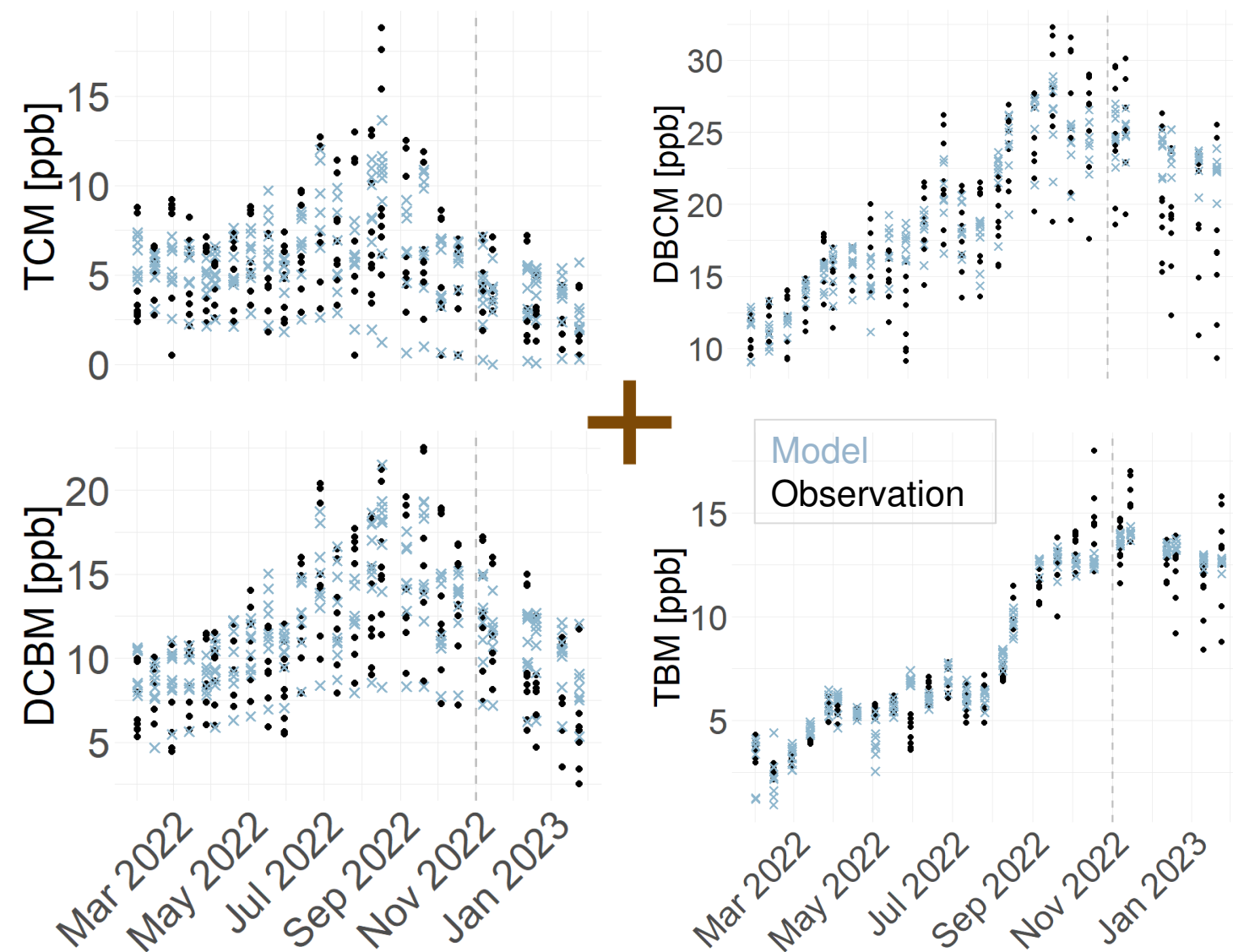
Chlorine decay dependent

$$Cl_f = Cl_0 e^{-kt}$$

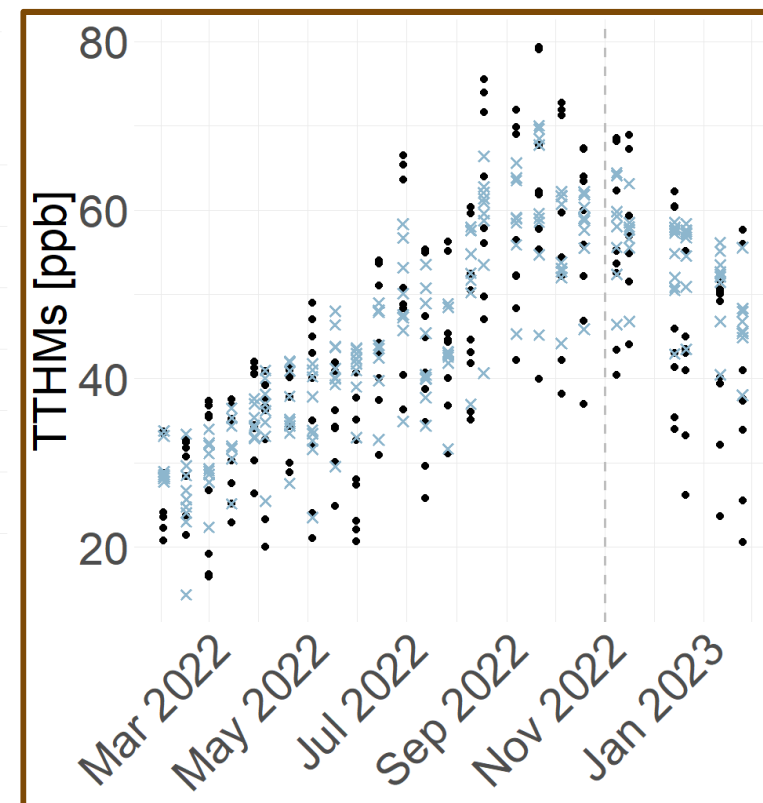
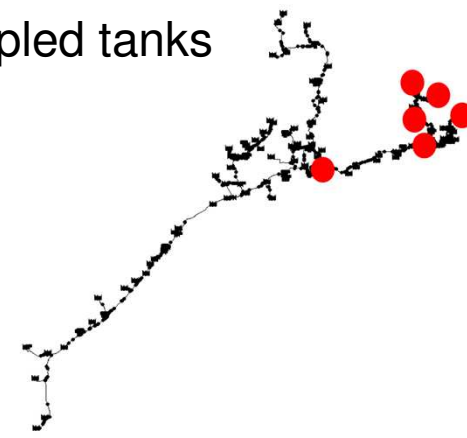
$$\Delta THMs = \alpha \cdot \Delta Cl$$



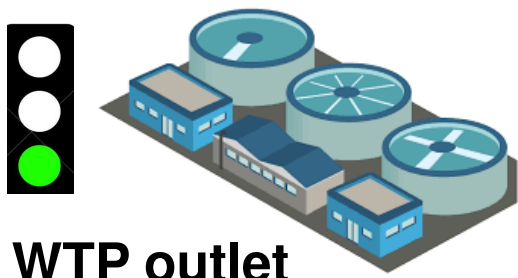
Data driven models: MLR*



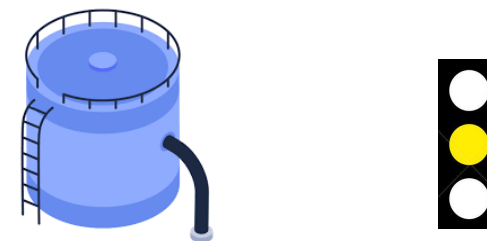
● Sampled tanks



*Manuscript under preparation

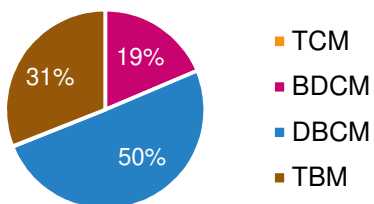


WTP outlet

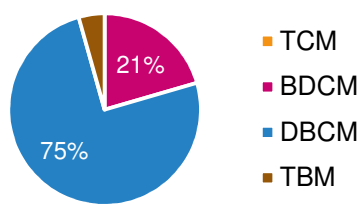


DWDN end-tank

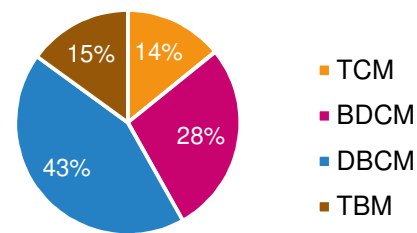
THMs distribution



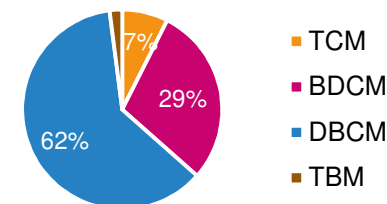
Risk distribution

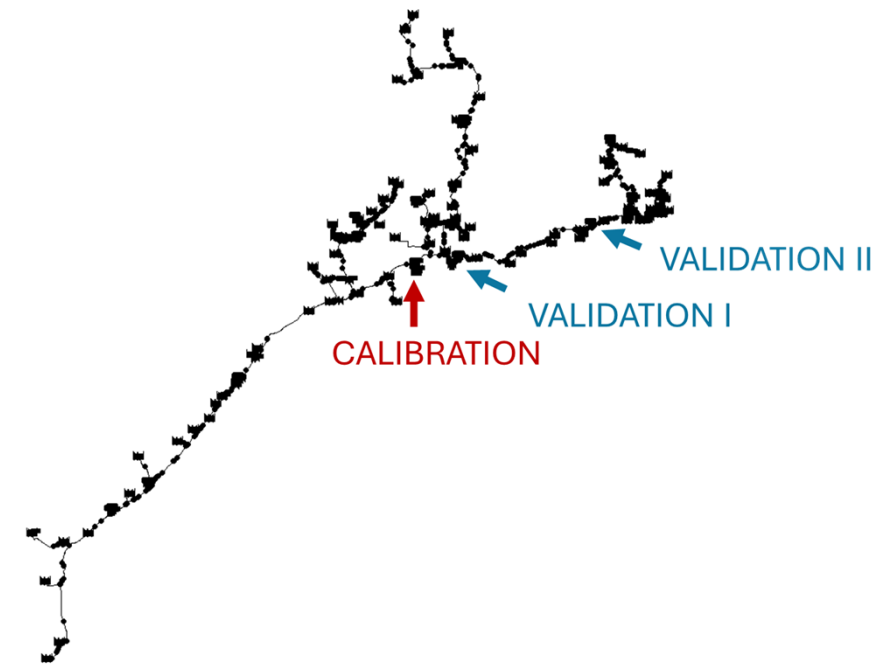
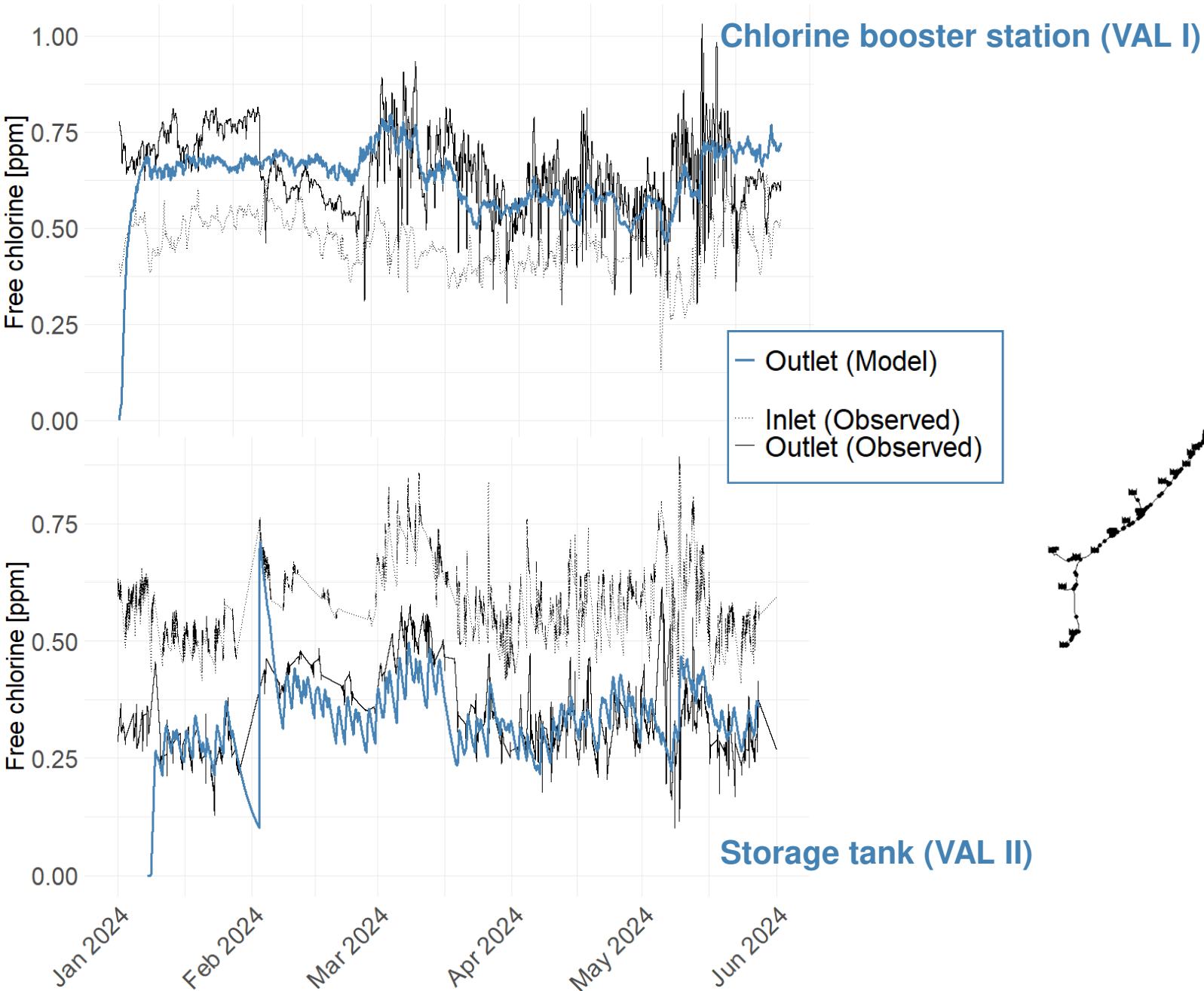


THMs distribution

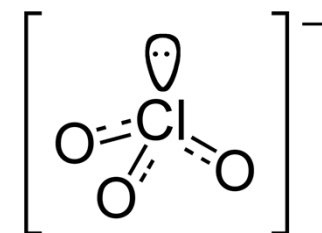


Risk distribution





- Inorganic DBP from:
chlorine dioxide
→ sodium hypochlorite ←



- Toxic by ingestion and inhalation

Hypochlorite degradation → chlorate formation

- DWDN conditions: negligible

temperature
pH
hypochlorite concentration
storage time

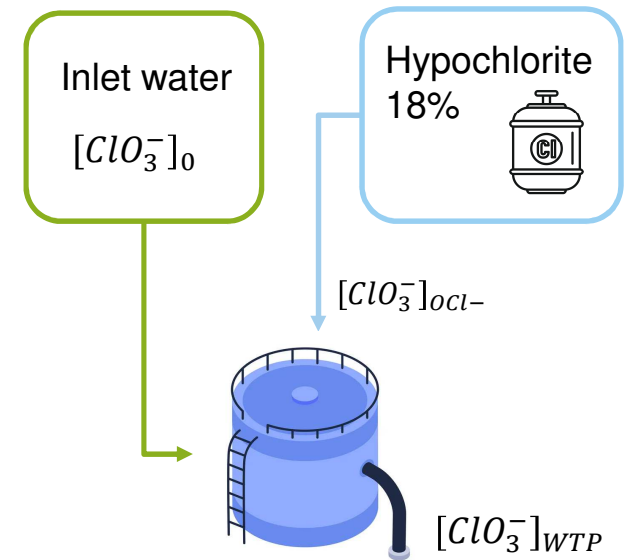
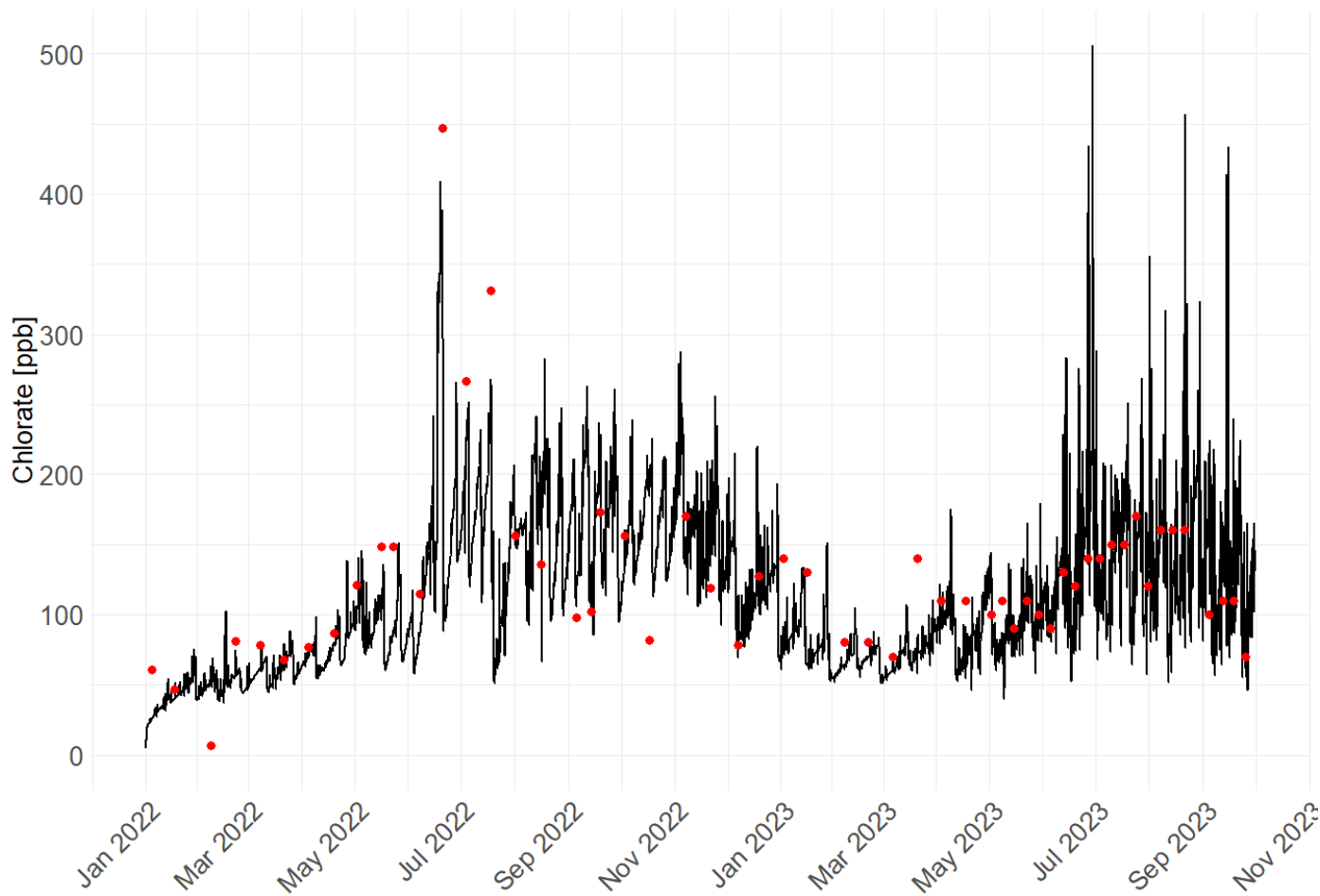
Mechanistic model



Chlorate at WTP outlet*

• Observed
— Model

$R^2 = 0.63$
 $RMSE = 38 \text{ ppb}$



*Manuscript under preparation



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Water utilities

- Modeling for control and improve water quality
- Chlorine model:
 - Chlorine dose more efficient
 - Less DBPs formation
- Risk approach



Thank you for your attention!





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