

Supplementary Material

Chronic exposure to drinking water in the French CONSTANCES cohort: trihalomethanes and nitrate concentrations.

Antoine Lafontaine, Sewon Lee, Bénédicte Jacquemin, Philippe Glorennec, Barbara Le Bot, Dominique Verry, Marcel Goldberg, Marie Zins, Emeline Lequy-Flahault, Cristina M Villanueva

Supplementary Table S1. Median annual value of chloroform limit of detection (\square g/l) over the study years in the four departments of Brittany region.

Year	Côtes d'Armor	Finistère	Ile-et-Vilaine	Morbihan
2000	1	1	0.5	1
2001	1	1	0.5	1
2002	1	1	0.5	2
2003	1	1	0.5	2
2004	1	1	0.5	2
2005	1	1	0.5	2
2006	1	1	0.5	2
2007	1	1	0.5	2
2008	1	1	0.5	2
2009	1	1	0.5	2
2010	1	1	0.5	1
2011	1	1	0.5	1
2012	1	1	0.5	1
2013	1	1	0.5	0.2
2014	1	1	0.5	0.2
2015	0.5	1	0.5	0.2
2016	0.5	1	0.5	0.2
2017	1	1	0.5	0.2
2018	1	1	0.5	0.2
2019	1	1	0.5	0.2
2020	0.8	0.8	0.5	0.2

Supplementary Table S2. WHO drinking water guideline values for parameters included in the present study, used in water treatment or materials in contact with drinking-water that are of health significance in drinking water.

Parameter	Guideline value
Chloroform	300 µg/l
Bromodichloromethane	60 µg/l
Dibromochloromethane	100 µg/l
Bromoform	100 µg/l
Free chlorine	5,000 µg/l
Nitrate	50 mg/l

Reference:

WHO. Guidelines for drinking-water quality, Fourth edition incorporating the first and second addenda. World Health Organization, Geneva 2022.

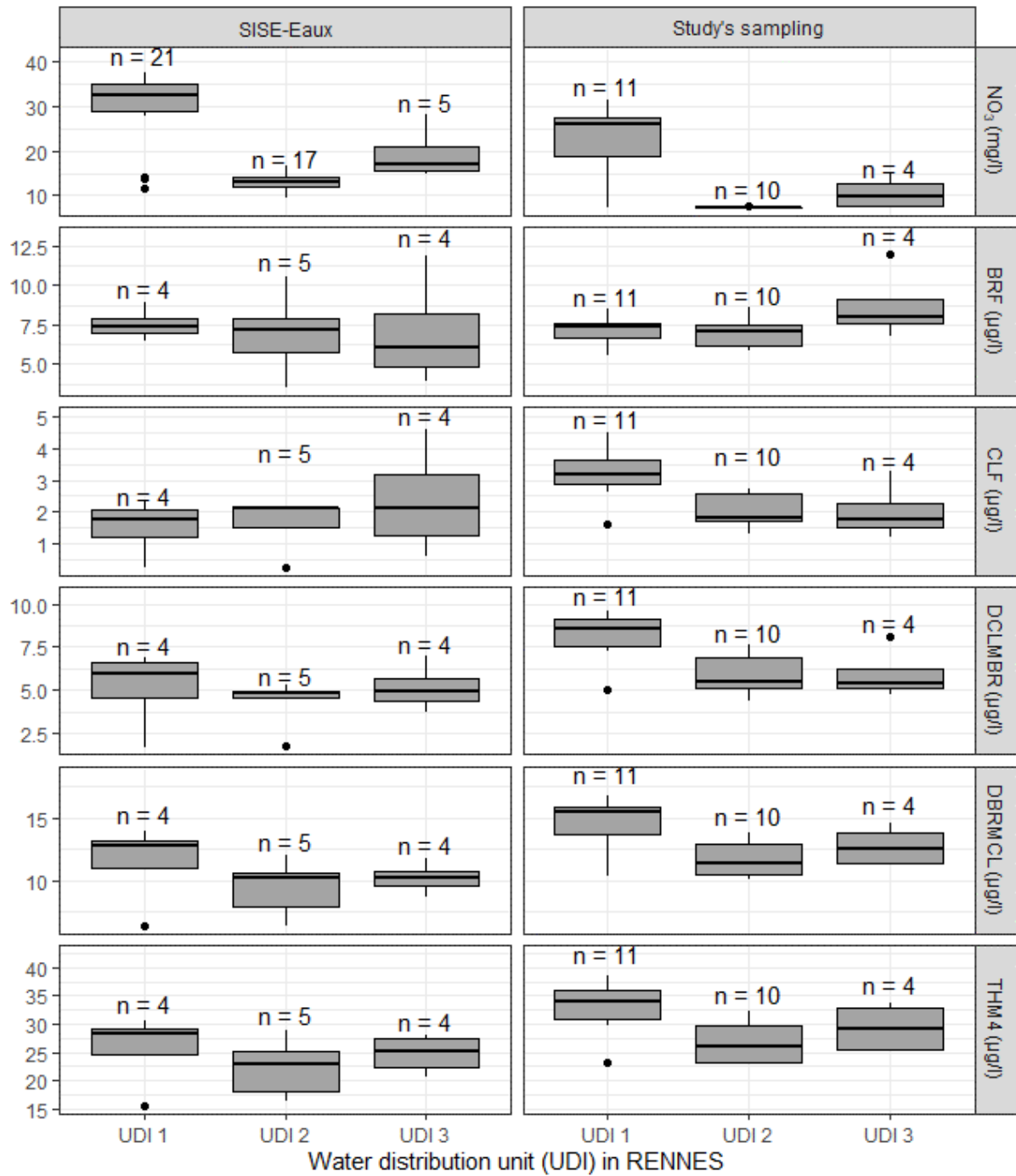
Supplementary Table S3. Description of the aggregated database per year and surveillance areas among treatment plant (TTP) and distribution system (NTTP) measurements.

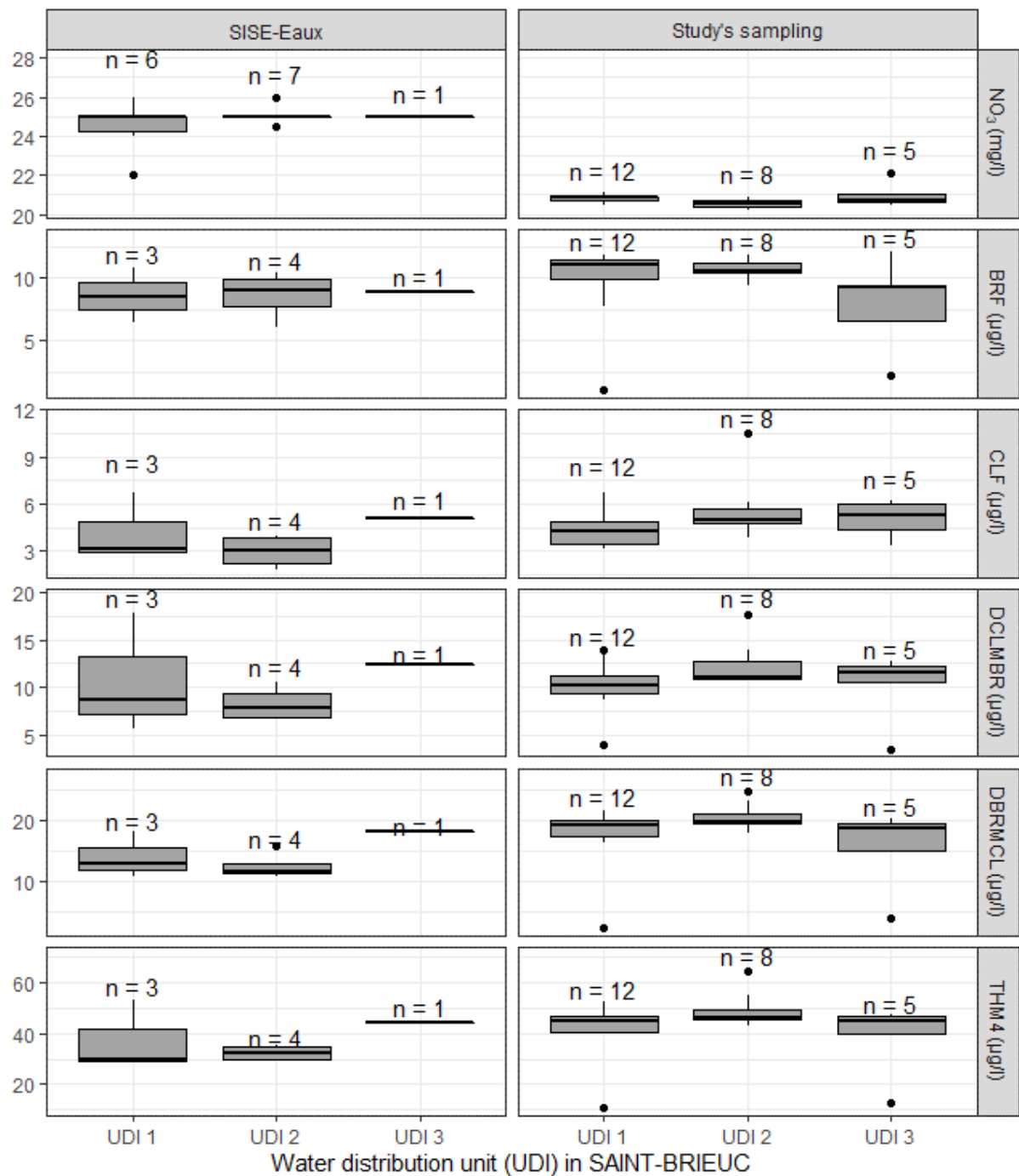
	NTTP (N=1,275,711)	TTP (N=386,661)
Water source		
Mixed	111,579 (8.7%)	11,230 (2.9%)
Ground	989,647 (77.6%)	355,384 (91.9%)
Surface	173,858 (13.6%)	20,024 (5.2%)
Sea	23 (0.0%)	22 (0.0%)
Missing	604 (0.0%)	1 (0.0%)
Quality of geocoding		
Municipality centroid	346,500 (27.2%)	187,298 (48.4%)
Real geocode	929,211 (72.8%)	199,363 (51.6%)
Missing annual concentrations		
Conductivity ($\mu\text{S}/\text{cm}$)	1,008,464 (79.1%)	318,173 (82.3%)
Conductivity 25°C ($\mu\text{S}/\text{cm}$)	174,335 (13.7%)	38,718 (10.0%)
Free chlorine (mg/l)	197,999 (15.5%)	83,837 (21.7%)
Total chlorine (mg/l)	298,190 (23.4%)	107,069 (27.7%)
Chlorate ($\mu\text{g}/\text{l}$)	1,275,289 (99.9%)	386,244 (99.9%)
Chlorite (mg/l)	1,250,159 (98.0%)	378,033 (97.8%)
Total organic carbon (mg/l)	1,225,139 (96.0%)	69,951 (18.1%)
Permanganate index ¹ (mg O ₂ /l)	1,258,790 (98.7%)	333,489 (86.2%)
pH	9,675 (0.8%)	3,084 (0.8%)
Alcalinity ² (°f)	1,188,946 (93.2%)	35,759 (9.2%)
Chloroform ($\mu\text{g}/\text{l}$)	1,152,035 (90.3%)	220,802 (57.1%)
Bromodichloromethane ($\mu\text{g}/\text{l}$)	1,152,079 (90.3%)	221,240 (57.2%)
Dibromochloromethane ($\mu\text{g}/\text{l}$)	1,153,179 (90.4%)	222,565 (57.6%)
Bromoform ($\mu\text{g}/\text{l}$)	1,153,123 (90.4%)	221,512 (57.3%)
Total THM ($\mu\text{g}/\text{l}$)	1,153,385 (90.4%)	223,231 (57.7%)
Nitrate (mg/l)	847,669 (66.4%)	7,933 (2.1%)

¹ Oxidation by potassium permanganate in acid medium under hot conditions.

² Measured as “titre alcalimétrique complet, TAC”

Supplementary Figure S1. Comparison of nitrate (NO₃), bromoform (BRF), chloroform (CLF), dichlorobromomethane (DCBM), dibromochloromethane (DBRM), and total trihalomethane (THM4) concentrations in Rennes and Saint-Brieuc by distribution unit (UDI).





Supplementary Table S4. Description of the aggregated database per region among distribution system (NTTP) measurements after prediction and imputation.

A. Nitrate

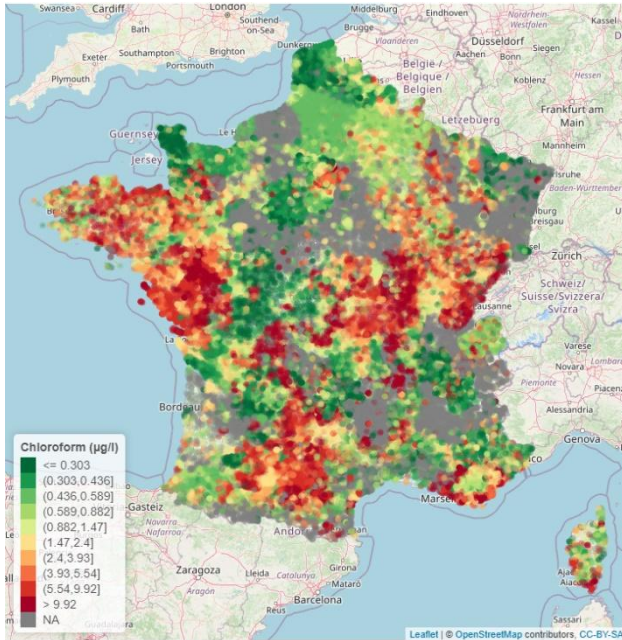
region	N	Real values (%)	Predicted Values (%)	Values imputed by the median of the UDI	Missing values	R2c
Auvergne Rhône Alpes	296,982	12.68	35.81	20.81	30.70	0.904
Bourgogne Franche Comté	142,443	16.69	37.05	20.91	25.36	0.845
Brittany	61,362	69.35	26.07	4.35	0.24	0.804
Centre Val de Loire	97,209	47.21	36.25	7.71	8.84	0.871
Corse	21,861	7.71	45.22	20.94	26.13	0.806
Grand Est	211,155	21.23	27.08	17.02	34.67	0.893
Hauts de France	144,291	30.94	46.26	22.21	0.60	0.913
Île de France	285,600	6.85	39.67	29.82	23.66	0.705
Normandy	110,565	48.78	29.57	7.75	13.90	0.872
Nouvelle Aquitaine	192,024	26.06	28.34	23.99	21.61	0.835
Occitanie	315,546	8.69	36.71	27.34	27.26	0.851
Pays de la Loire	124,257	16.36	31.15	37.62	14.87	0.813
Provence Alpes Côte d'Azur	160,482	9.80	32.36	38.25	19.59	0.871

B. Total THMs

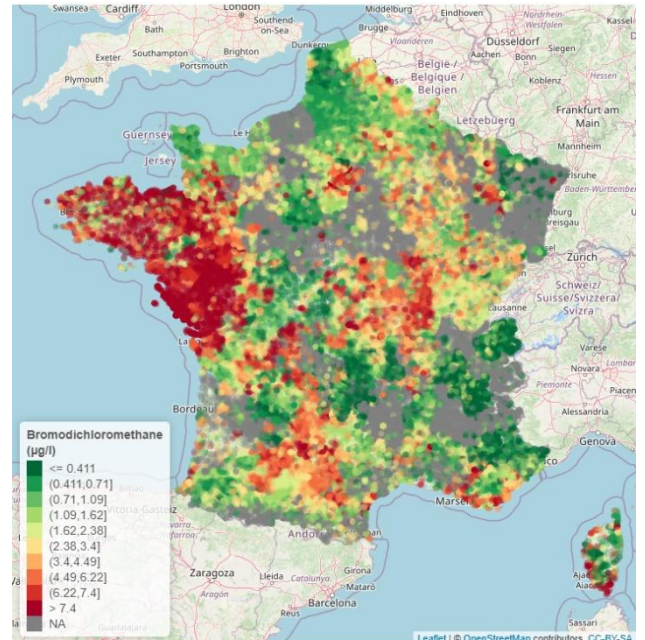
region	N	Real values (%)	Predicted Values (%)	Values imputed by the median of the UDI	Missing values	R2c
Auvergne Rhône Alpes	296,982	5.14	33.05	27.93	33.88	0.801
Bourgogne Franche Comté	142,443	7.26	39.75	28.76	24.22	0.635
Brittany	61,362	17.58	63.05	18.38	0.99	0.533
Centre Val de Loire	97,209	7.15	33.03	30.19	29.63	0.651
Corse	21,861	10.72	44.26	22.31	22.71	0.633
Grand Est	211,155	3.02	24.47	25.77	46.74	0.748
Hauts de France	144,291	8.49	46.77	42.50	2.24	0.650
Île de France	285,600	2.28	16.95	71.85	8.93	0.478
Normandy	110,565	7.28	30.87	28.82	33.03	0.680
Nouvelle Aquitaine	192,024	8.29	34.90	30.61	26.19	0.708
Occitanie	315,546	4.15	29.10	32.41	34.34	0.679
Pays de la Loire	124,257	5.90	27.49	48.94	17.66	0.703
Provence Alpes Côte d'Azur	160,482	4.43	27.70	36.94	30.93	0.760

Supplementary Figure S2. Map of the median concentrations of chloroform, bromodichloromethane, dibromochloromethane, bromoform by surveillance area in 2020 in mainland France (SISE-Eaux) after prediction and imputation. Source: French Health Ministry – Regional Health Agency (ARS)-SISE-Eaux.

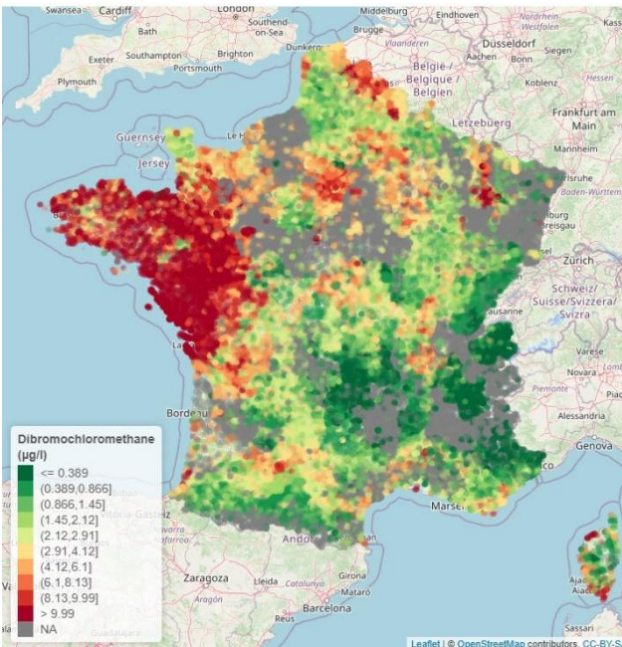
a) Chloroform



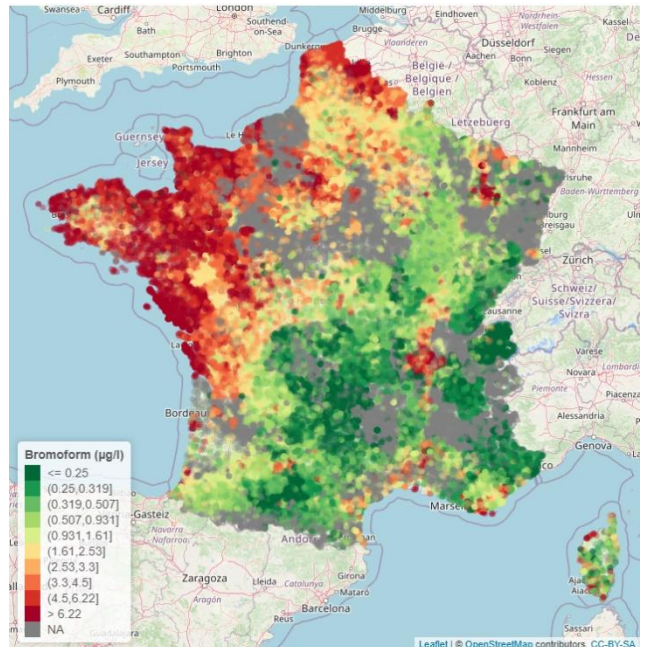
b) Bromodichloromethane



c) Dibromochloromethane



d) Bromoform



Supplementary Figure S3. Regions of France. Source: Wikimedia

