Occurrence and distribution of contaminants of emerging concern along the Ergene River during dry seasons

SeyedMehdi Emadian | F. Oyku Sefiloglu | Ozgucan Eken | Fulya Cingiroglu | Burcak Kaynak | Isil Balcıoglu
> Ulas Tezel <

The 2nd Water JPI Conference
Emerging pollutants in freshwater ecosystems
6–7th of June, 2018 | Helsinki, Finland

ACADEMY OF FINLAND

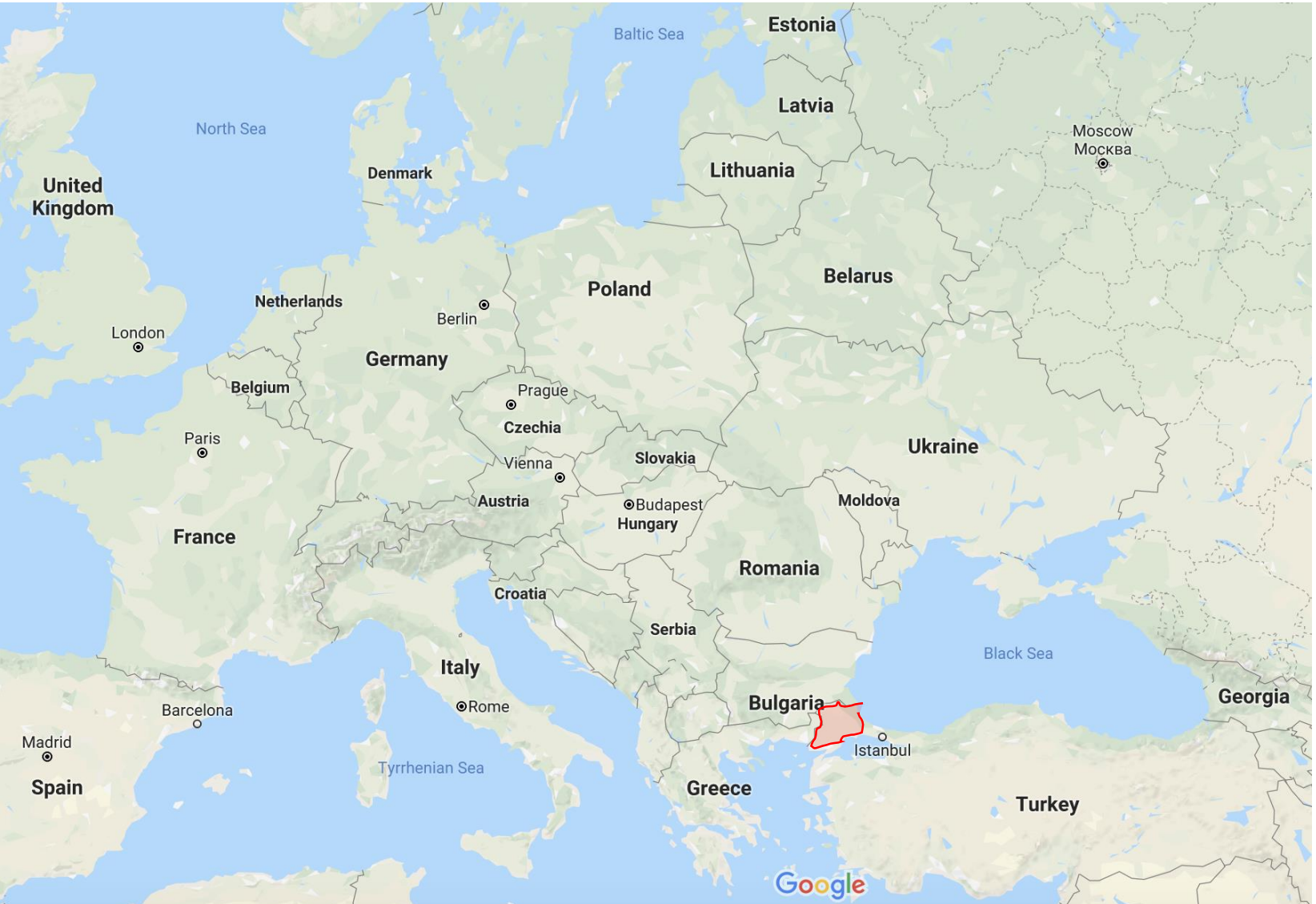
Water JPI

İTÜ
İSTANBUL TEKNİK ÜNİVERSİTESİ 1773
Department of Environmental Engineering

BOĞAZİÇİ ÜNİVERSİTESİ 1863
Institute of Environmental Sciences

Study Area

Ergene Watershed



NorthWestern Turkey
SouthEastern Europe

12,438 km²

2M People

Study Area

Ergene River

289 km long river
Northeast → Sourthwest
Meets **Maritsa River** → **Aegean Sea**

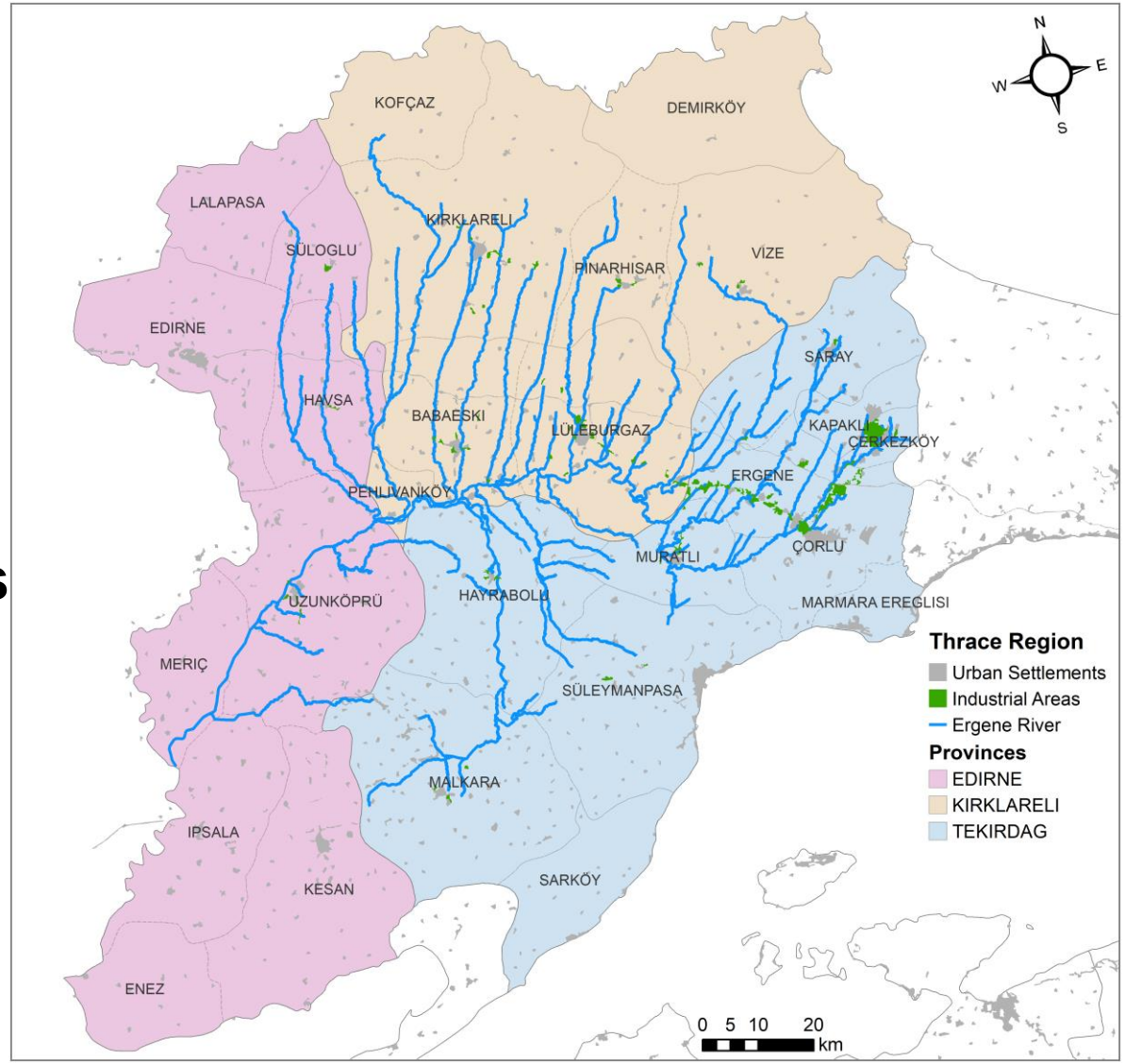
INDUSTRY

URBAN SETTLEMENT

AGRICULTURE

NOVEMBER (Dry) : 0.25 → 12.1 m^3/s

FEBRUARY (Wet) : 3.55 → 254 m^3/s



Problem

Most polluted river in Turkey

Pollution

Point sources

Textile
Metal
Food
Dye
Leather
Pharma

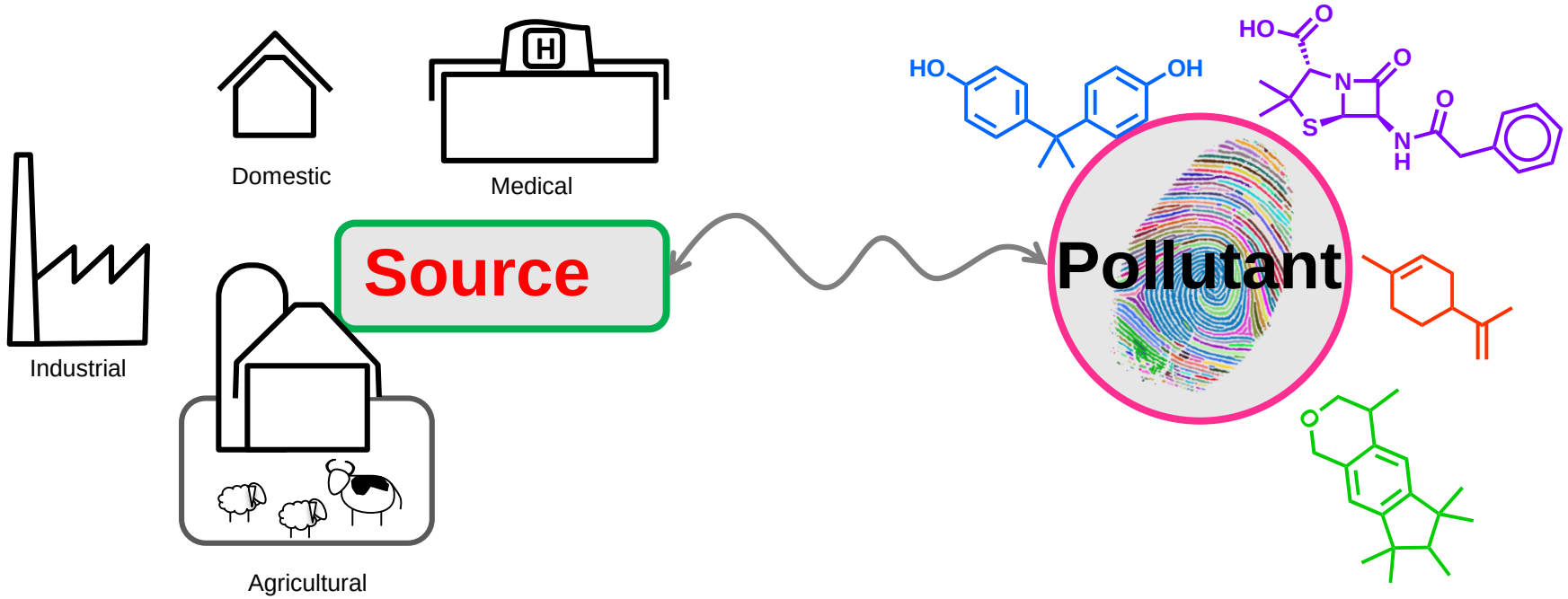
- **Industrial:** Dominant sector, **1303 industrial facilities** (17 OIZs+ 389 singular). Metals and organic micropollutants
- **Domestic: only 2%** of the cities and villages have WWTP

Non-point sources

- **Runoff** from agricultural farms, Source of pesticides (**1,560,825 kg** sold pesticides in 2016)
- **Runoff** from animal farms, source of antibiotics
- **Runoff** from solid waste disposal sites

Wheat, corn, sunflower, canola, barely, rice, vegetables etc.

Objective



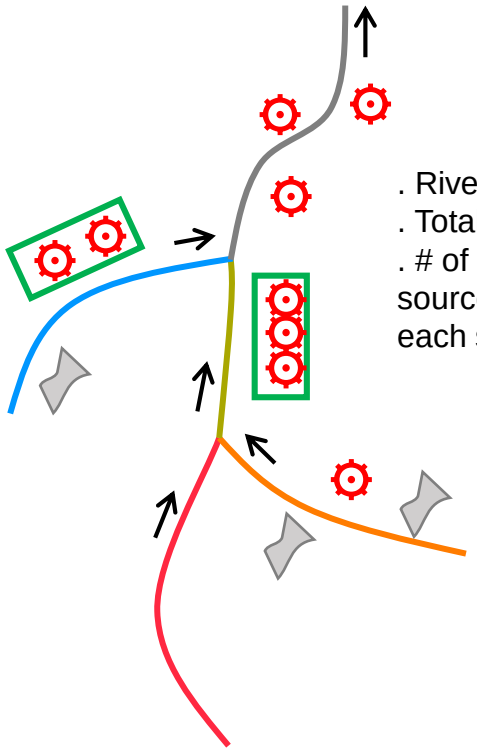
Identify pollution source zone (PSZs) and pollutant relationship
Pollutant Fingerprint

Evaluate **Pollutant Transport** from source thru the river

Calculate **Pollutant Loads** from PSZs

Sampling

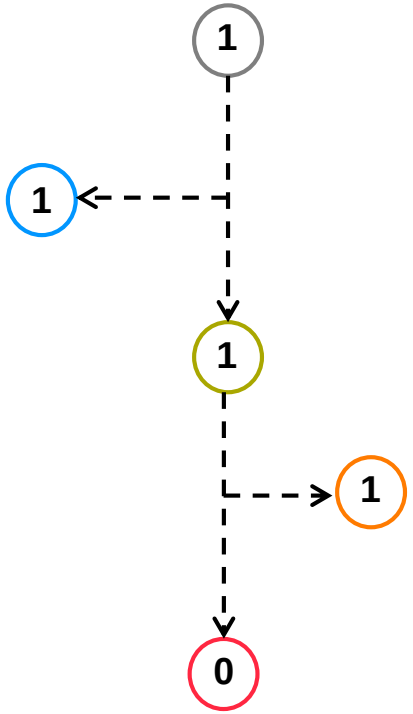
Input



. River network
. Total # of sampling points
. # of individual pollution sources or discharges on each segment

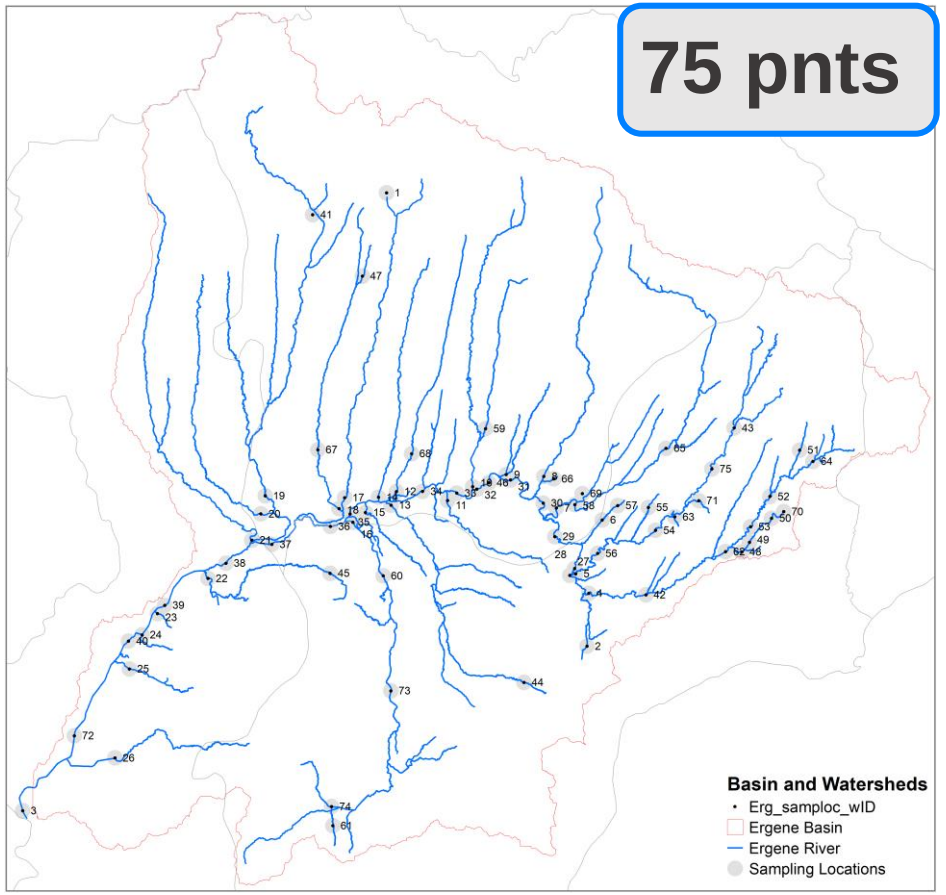
industrial zone
urban settlement
industrial facility
river segment
river segment

Model Framework



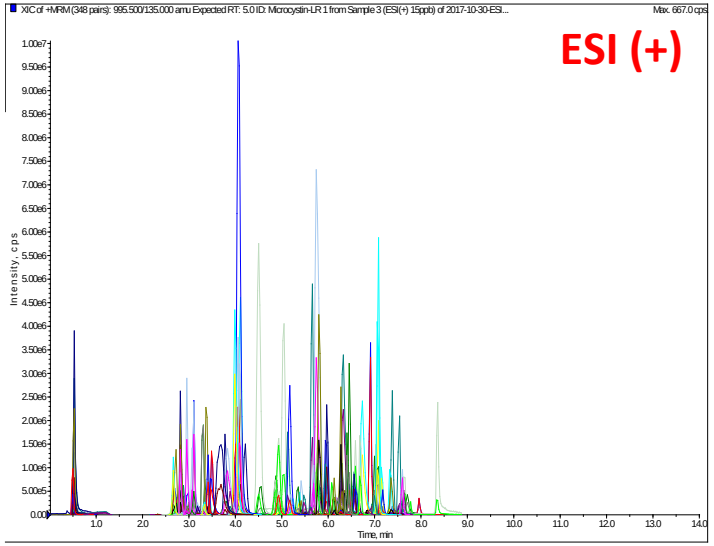
Binary tree node corresponding to a river segment

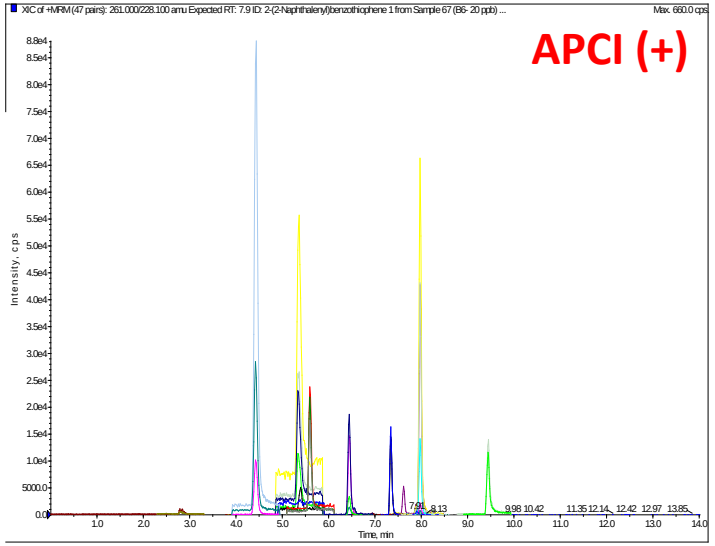
Objective function: *pollution sources, profile for pollutant transport modeling*

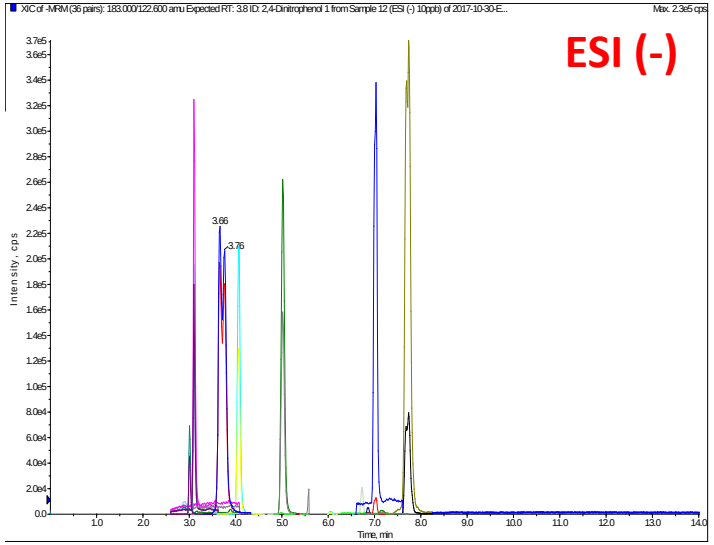


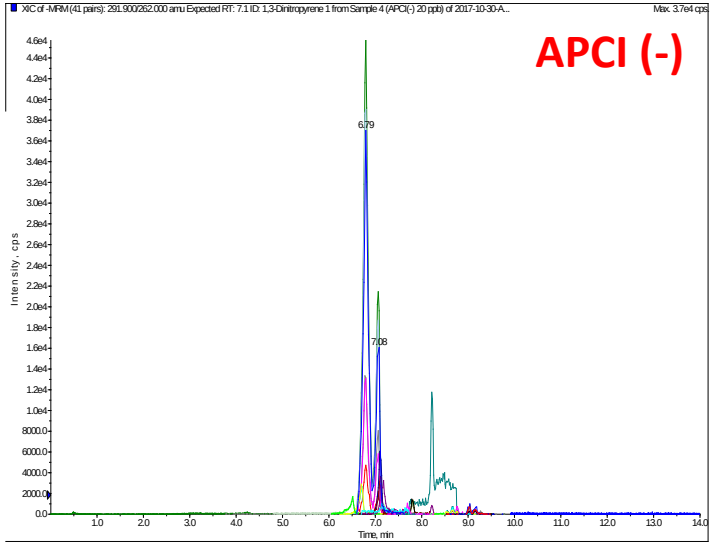
Micropollutant Analysis

ESI and APCI ionization

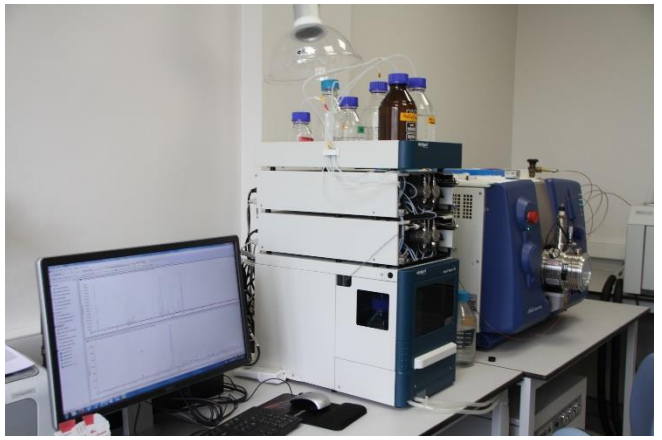








AB SCIEX Qtrap 4500



240 Micropollutants

Emerging pollutants
(CEC List of Norman Network)

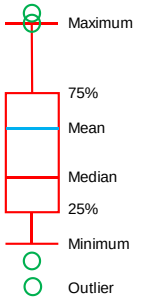
Priority pollutants
(EU Water Framework Directive)

Micropollutants in Ergene River

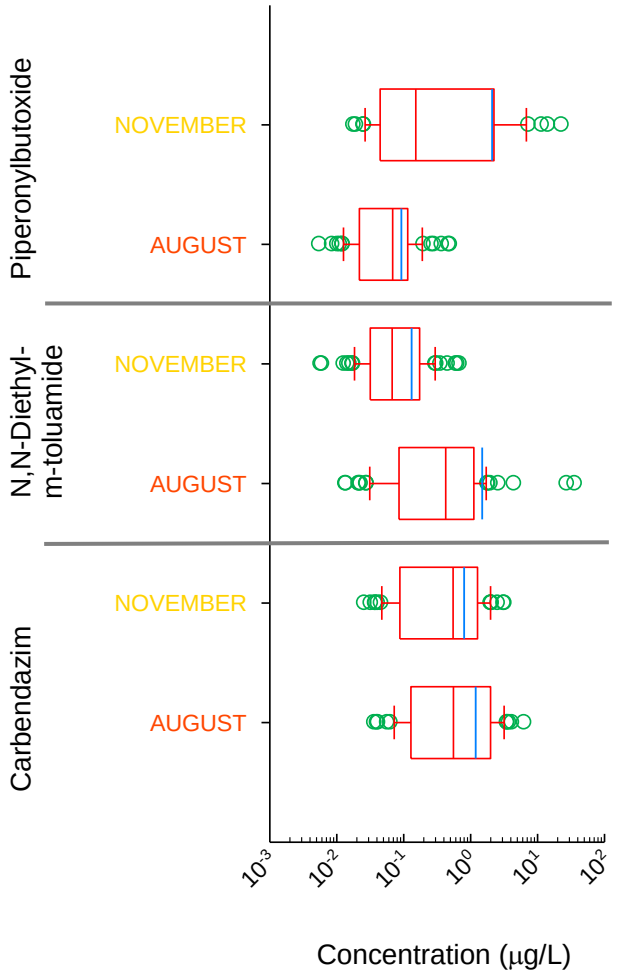
August and November 2017

Pollutants	August	November
Organic pollutants		
Pharmaceuticals	16	16
Agricultural (pesticides)	54	57
Flame retardants	4	5
Fragrances	10	12
Manufacturing of other chemicals (dyes, paints, rubber, pesticides, etc.)	11	10
Surfactants	5	5
Combustion byproducts	12	12
Sunscreening agents	5	4
Other chemicals	14	14
Total organic pollutants	**131**	**135**
Inorganic pollutants		
Heavy metals	16	16
Total	147	151

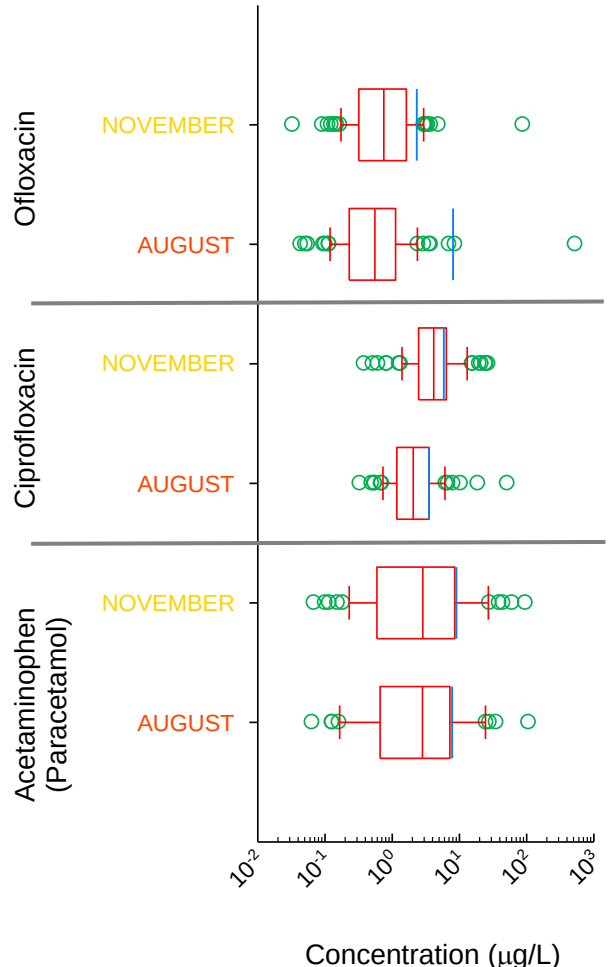
Most frequent detected micropollutants



Agricultural Chemicals

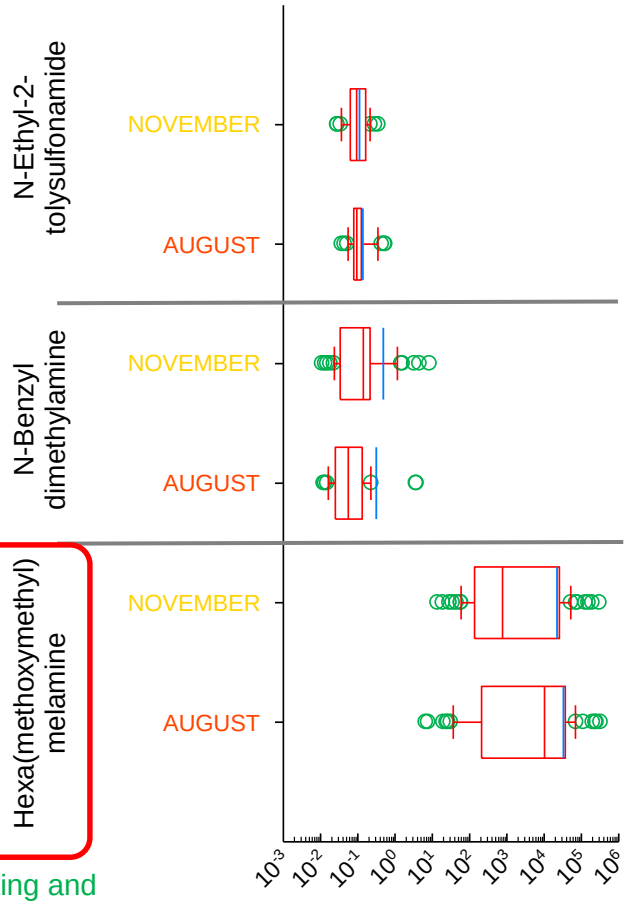


Pharmaceuticals



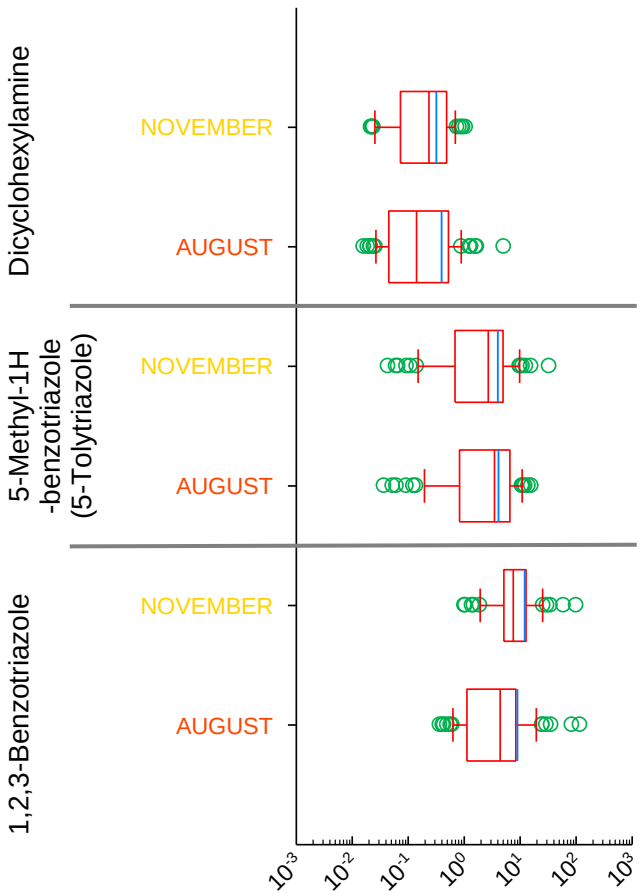
Micropollutants in Ergene River

Manufacturing of Chemicals

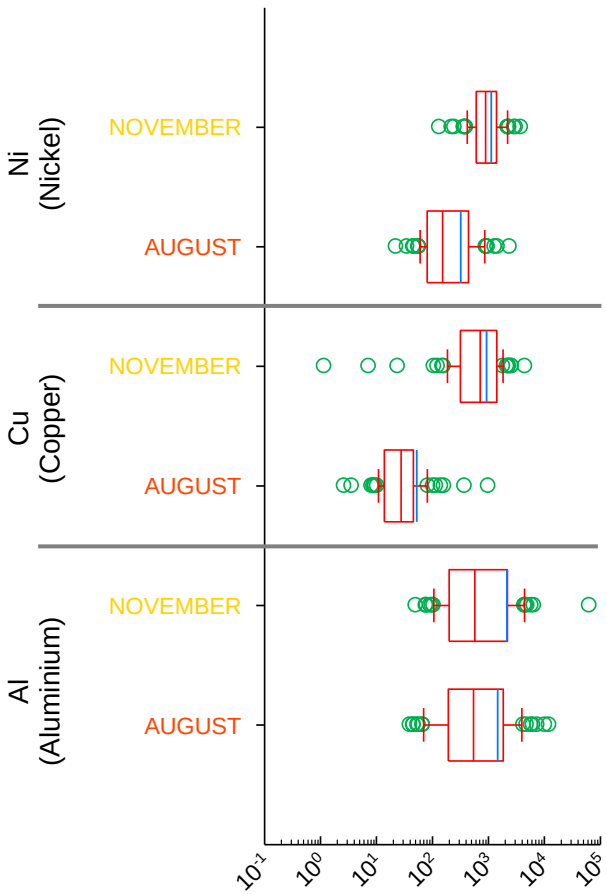


Coating and painting additives (textile, leather, paints, rubber, etc

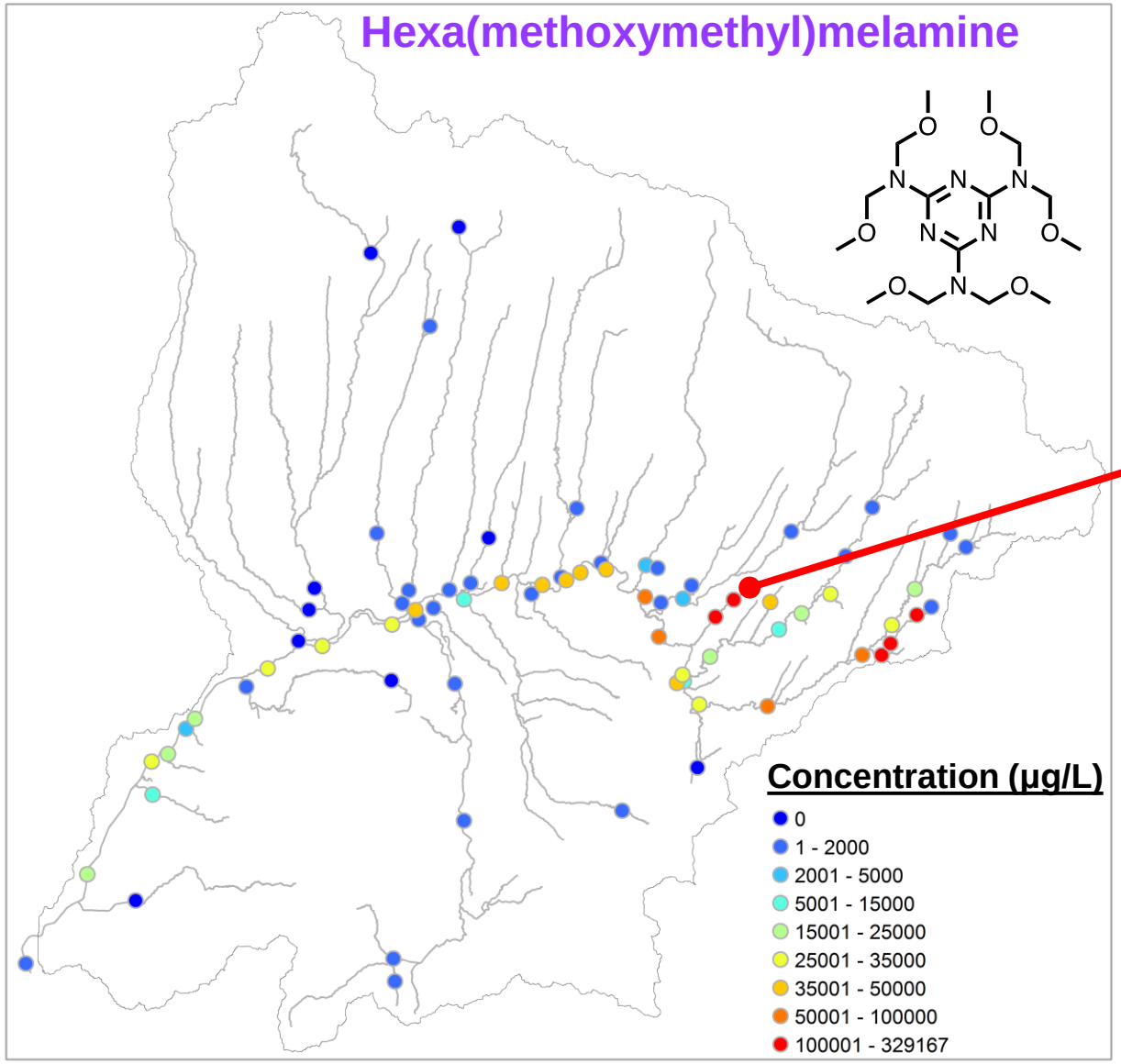
Corrosion Inhibitors



Heavy Metals

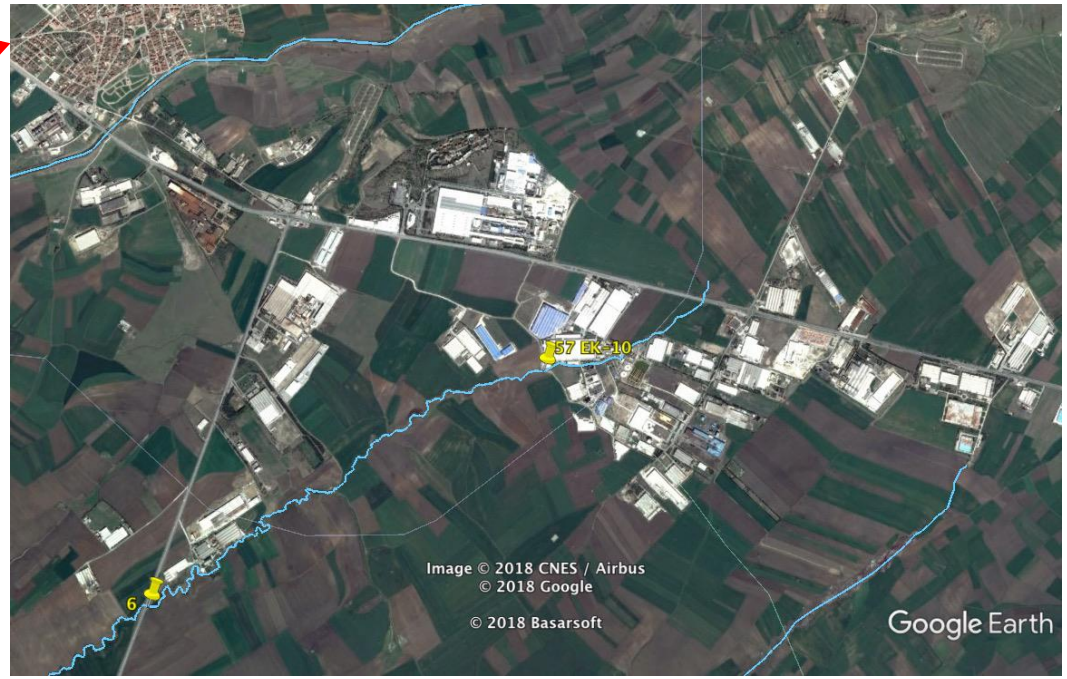


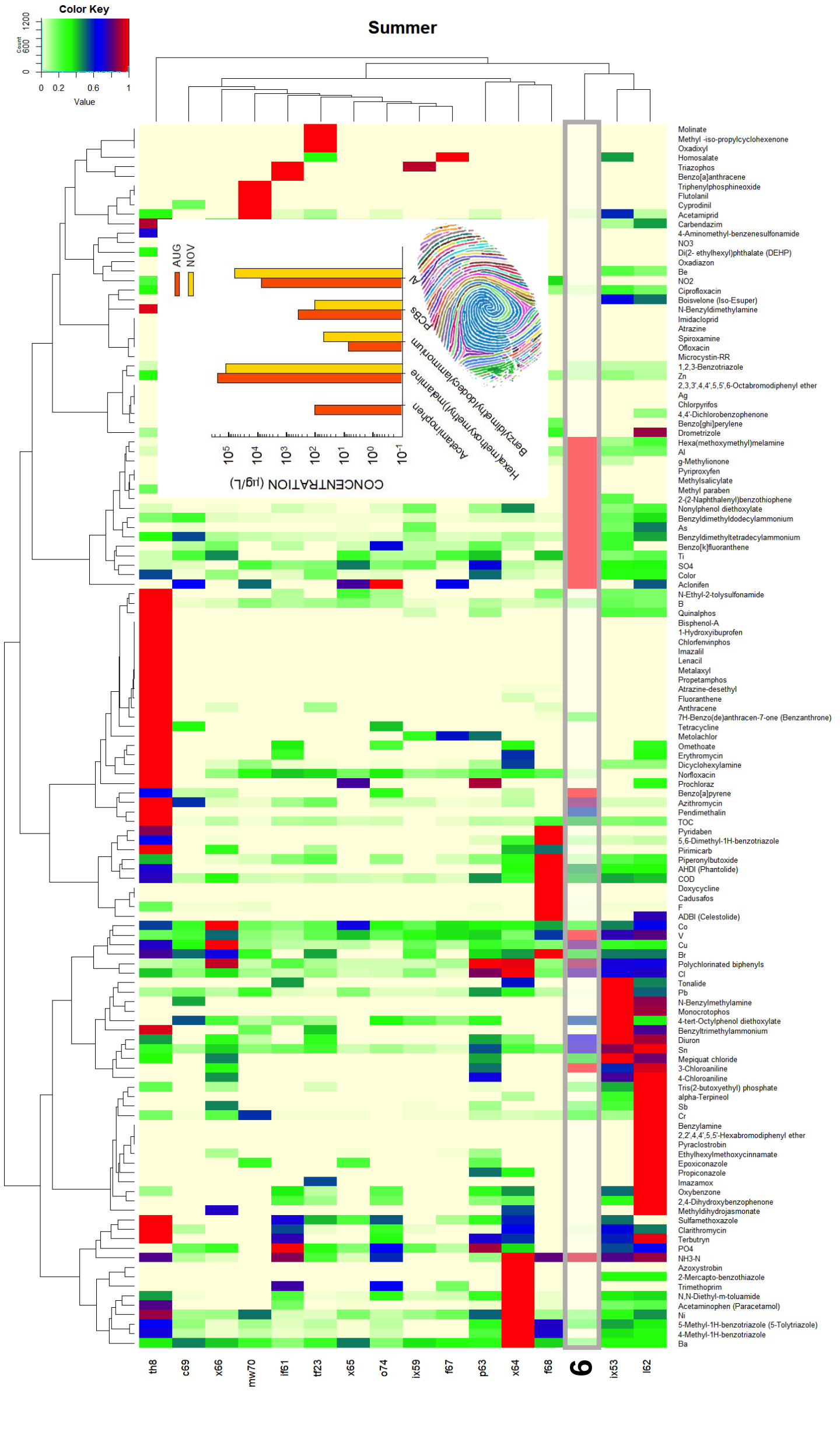
Micropollutants in Ergene River



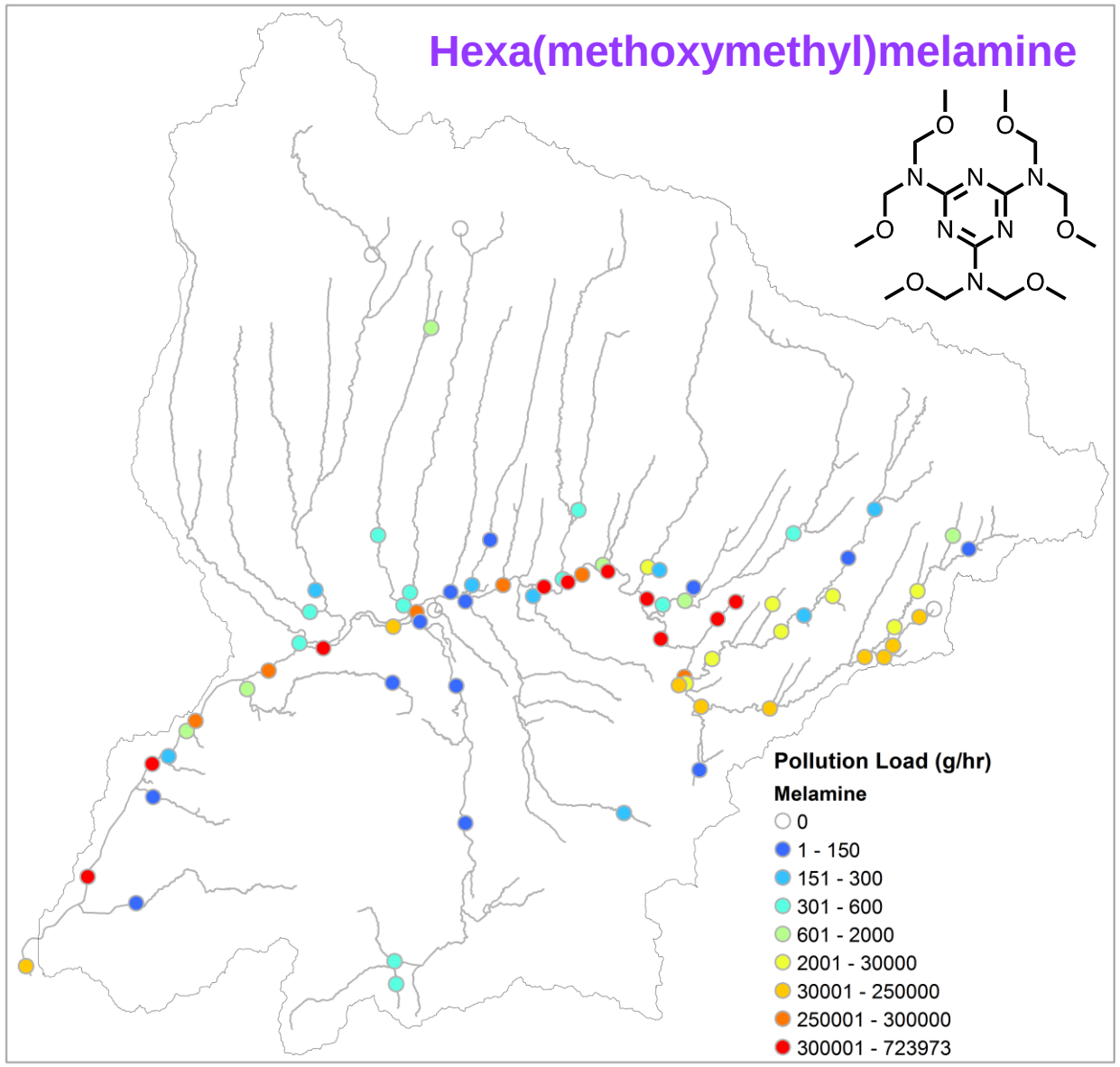
Industrial Zone

Textiles
Leather
Pharma
Dye
Aluminum
Electronics

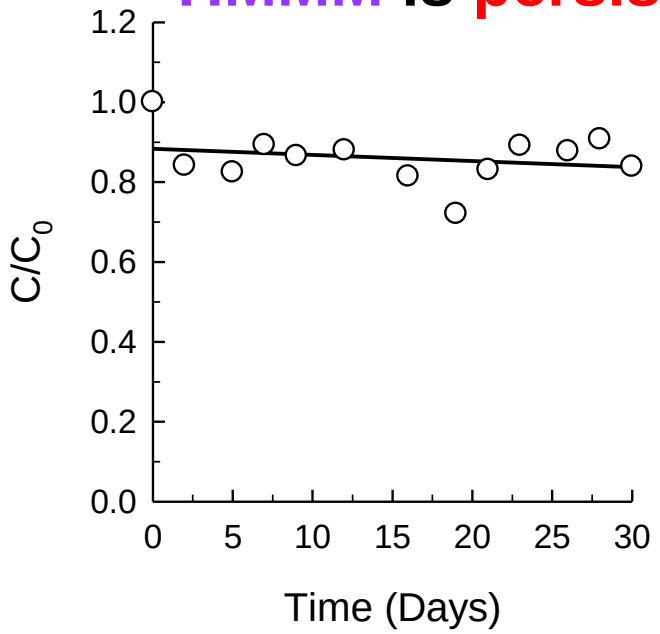



Color Key
Count
1200
600
0
0
0.2
0.6
1
Value
Summer
AUG
NOV
Al
PCBs
Ammonium
Hexa(methoxymethyl)melamine
Benzyldimethyldodecylammonium
Acetamiprid
CONCENTRATION (µg/L)
10^5
10^4
10^3
10^2
10^1
10^0
10^{-1}
Molinate
Methyl -iso-propylcyclohexenone
Oxadixyl
Homosalate
Triazophos
Benzo[a]anthracene
Triphenylphosphineoxide
Flutolanil
Cyprodinil
Acetamiprid
Carbendazim
4-Aminomethyl-benzenesulfonamide
NO3
Di(2- ethylhexyl)phthalate (DEHP)
Oxadiazon
Be
NO2
Ciprofloxacin
Boisvelone (Iso-Esuper)
N-Benzyldimethylamine
Imidacloprid
Atrazine
Spiroxamine
Ofloxacin
Microcystin-RR
1,2,3-Benzotriazole
Zn
2,3,3',4,4',5,5',6-Octabromodiphenyl ether
Ag
Chlorpyrifos
4,4'-Dichlorobenzophenone
Benzo[ghi]perylene
Drometrizole
Hexa(methoxymethyl)melamine
Al
g-Methylionone
Pyriproxyfen
Methylsalicylate
Methyl paraben
2-(2-Naphthalenyl)benzothiophene
Nonylphenol diethoxylate
Benzyldimethyldodecylammonium
As
Benzyldimethyltetradecylammonium
Benzo[k]fluoranthene
Ti
SO4
Color
Aclonifen
N-Ethyl-2-tolysulfonamide
B
Quinalphos
Bisphenol-A
1-Hydroxyibuprofen
Chlorfenvinphos
Imazalil
Lenacil
Metalaxyl
Propetamphos
Atrazine-desethyl
Fluoranthene
Anthracene
7H-Benzo(de)anthracen-7-one (Benzanthrone)
Tetracycline
Metolachlor
Omethoate
Erythromycin
Dicyclohexylamine
Norfloxacin
Prochloraz
Benzo[a]pyrene
Azithromycin
Pendimethalin
TOC
Pyridaben
5,6-Dimethyl-1H-benzotriazole
Pirimicarb
Piperonylbutoxide
AHDI (Phantolide)
COD
Doxycycline
Cadusafos
F
ADBI (Celestolide)
Co
V
Cu
Br
Polychlorinated biphenyls
Cl
Tonalide
Pb
N-Benzylmethylamine
Monocrotophos
4-tert-Octylphenol diethoxylate
Benzyltrimethylammonium
Diuron
Sn
Mepiquat chloride
3-Chloroaniline
4-Chloroaniline
Tris(2-butoxyethyl) phosphate
alpha-Terpineol
Sb
Cr
Benzylamine
2,2',4,4',5,5'-Hexabromodiphenyl ether
Pyraclostrobin
Ethylhexylmethoxycinnamate
Epoxiconazole
Propiconazole
Imazamox
Oxybenzone
2,4-Dihydroxybenzophenone
Methyldihydrojasmonate
Sulfamethoxazole
Clarithromycin
Terbutryn
PO4
NH3-N
Azoxystrobin
2-Mercapto-benzothiazole
Trimethoprim
N,N-Diethyl-m-toluamide
Acetaminophen (Paracetamol)
Ni
5-Methyl-1H-benzotriazole (5-Tolytriazole)
4-Methyl-1H-benzotriazole
Ba
th8
c69
x66
mw70
if61
tf23
x65
o74
ix59
f67
p63
x64
f68
6
ix53
l62

Concentration vs. Load



HMMM is persistent!



LOAD sustains thru the river

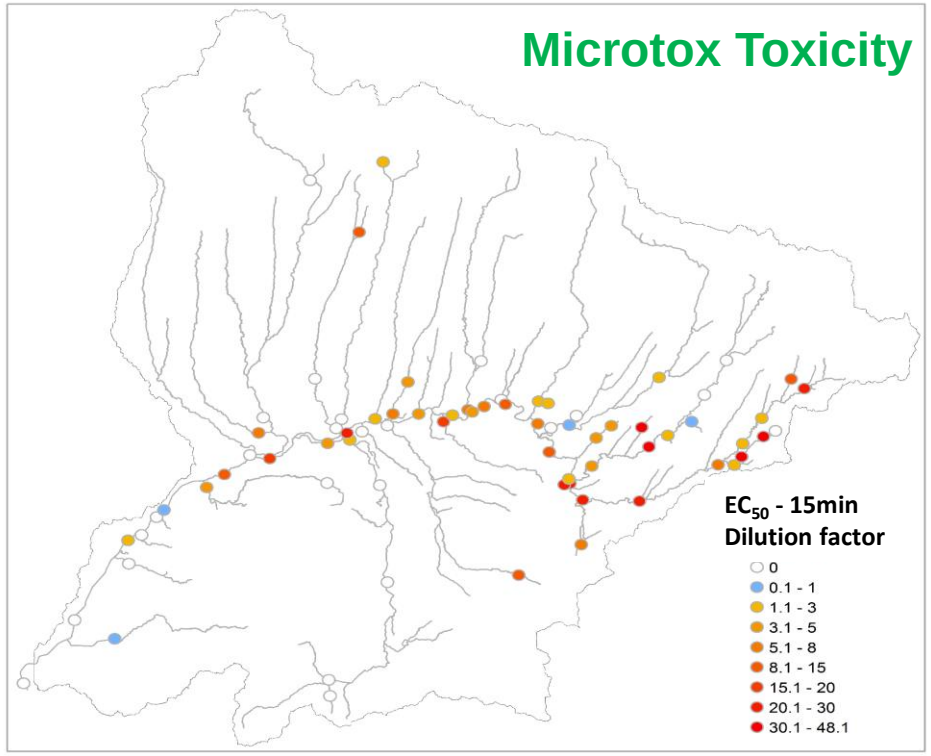
HMMM may be used to detect discharges and pollutant loads from a particular pollution zone

Future Research

Identify **signature persistent pollutants** to track discharges from pollution sources

Couple micropollutant **measurements and toxicity** to set PNECs OR **PNEdf:** Predicted No-Effect Dilution Factor

Based on PNEdf's identify risk zones and set **Maximum Daily Pollutant Loads** (**MDPLs**)



Integrated Watershed Management System

GIS

Measurements → Transport Model → PNEdf → MDPLs → Regulations

THANK YOU

Acknowledgement

The Scientific and Technological Research Council of Turkey (**TUBITAK**) under the grant number of **115Y064**.