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new tools for water quality monitoring

# New tools for monitoring the chemical status in transitional and coastal waters under the Water Framework Directive

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# MONITOOL 8 Full Partners

itc INSTITUTO TECNOLÓGICO DE CANARIAS

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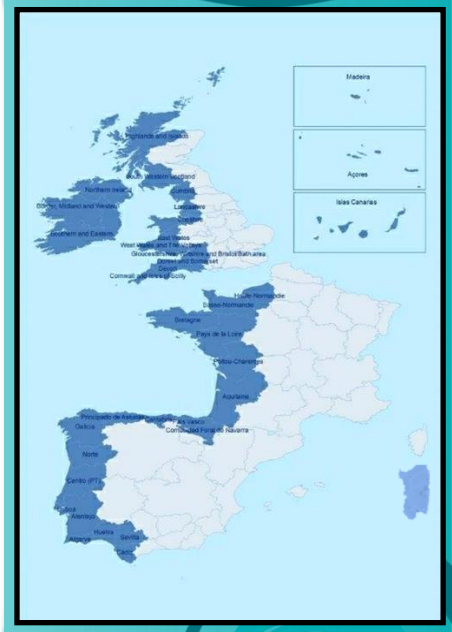

# MONITOOL 10 Associated Partners (stakeholders & end users)

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marinescotland science

Marine Institute
Foras na Mara

CONSEJO INSULAR DE AGUAS DE GRAN CANARIA

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Scottish Environment Protection Agency
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The largest European consortium working on DGTs

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# Introduction

**European Water Framework Directive** (WFD;2000/60/EC)

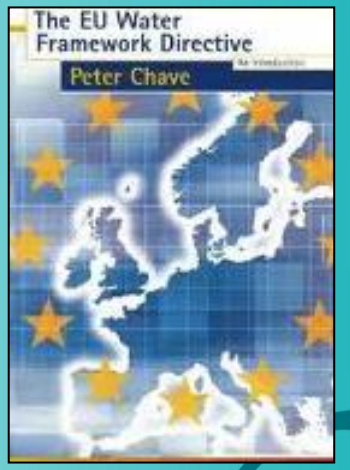
Aim: to achieve a "Good Ecological and Chemical Status" for all European Union waters (including transitional/estuarine and coastal waters)

**Ecological status**

- Biological
- Hydromorphological
- Physico-chemical (main pollutants)

**Chemical status**

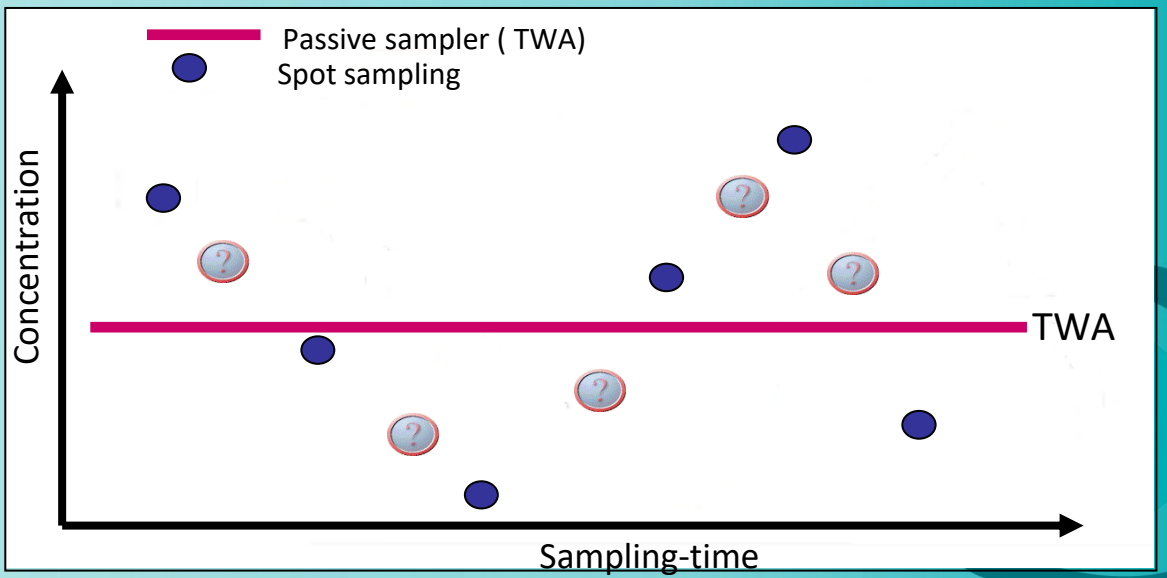
- Priority substances




- WFD (2013/39/EU)→ 45 priority substances
  - Four toxic metals (Cd, Pb, Ni, Hg)
- Good chemical status (*sensu* WFD)
  - [priority substances] < Environmental Quality Standards (EQS)
  - 'Compliance Checking'

# Introduction

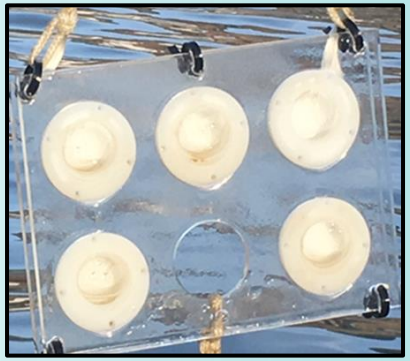
- Shortcomings of traditional monitoring
  - Spot sampling→ represents metal concentration at the exact sampling time (over/sub estimation the contamination of the system)
  - Missing of episodic contamination and/or decisions taken based on transient peak of contaminants
  - Toxicological relevance of dissolved concentrations ???
  - Metal concentrations below the detection limits

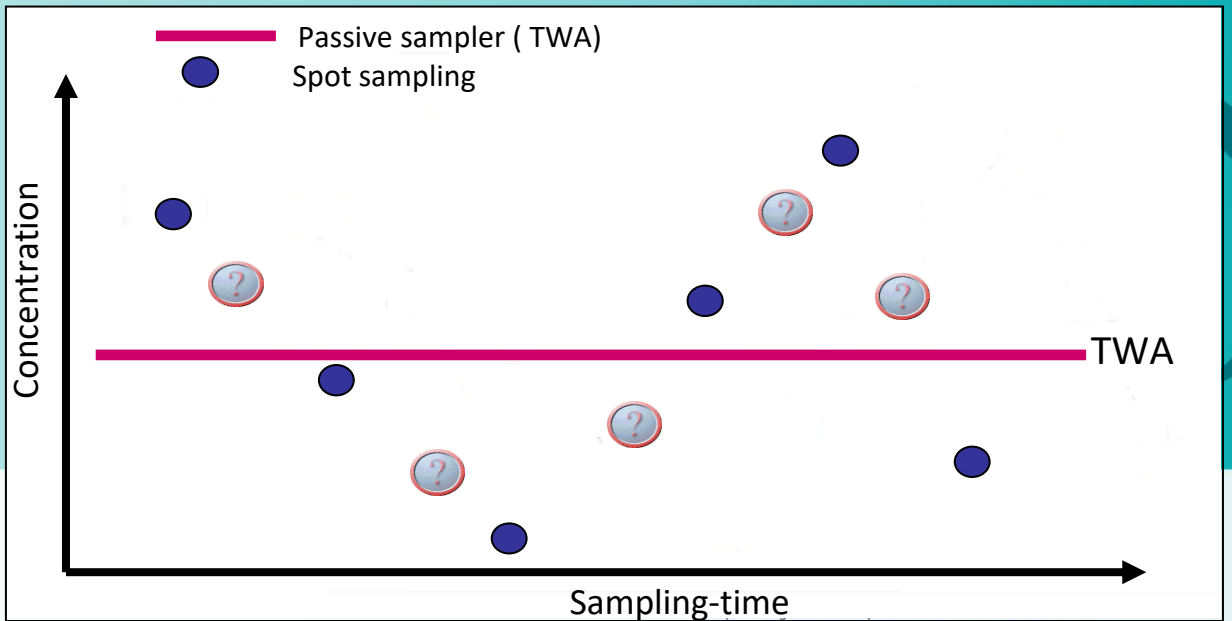


# Introduction

- New methodologies to comply with the WFD requirements (especially in estuaries)
  - ❖ Attain lower limits of detection
  - ❖ Integrate temporal variability of contaminants → permits to provide more reliable metal concentration measurements
  - ❖ Provide information on the labile concentration → toxicologically relevant

- Passive samples as a good alternative widely used in investigative monitoring
- Main barrier: the lack of specific EQS for DGTs





# MONITOOL Project EAPA_565/2016

Interreg Atlantic Area Transnational Cooperation Programme
3 years (2017-2020)
Total cost: 1.92 M€
ERDF 75 %: 1,5 M€

## Main objectives:

- To define Environmental Quality Standards and protocols for the use of DGTs in chemical monitoring within the European Water Framework Directive
- To develop a network of laboratories focused on the use of DGTs within the European Water Framework Directive

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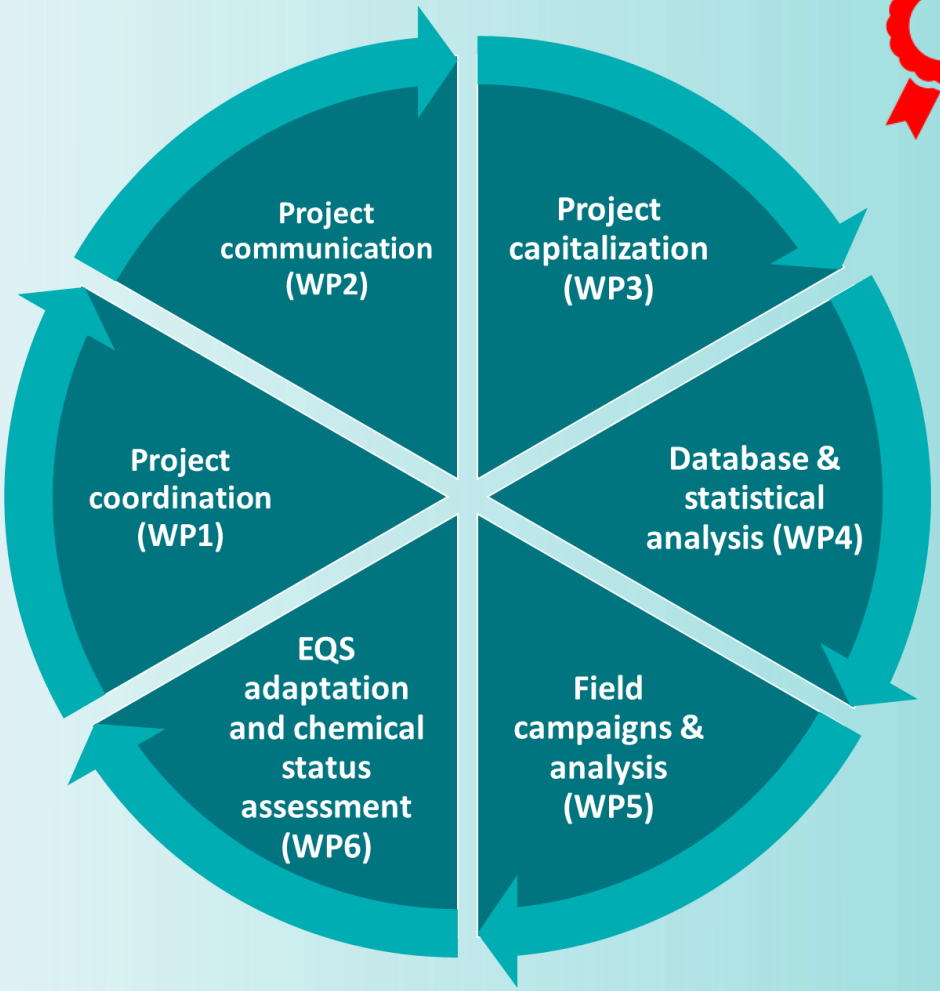
# Monitool Work Packages




Common protocols for sampling and analysis:
ALL partners followed the same protocol in the different regions

All samples were analyzed within the Consortium:
3 different labs for:
Metals in Waters by ICPMS.
Metals in Waters by voltametry
Metals in DGT resins by ICPMS

All results from the different regions are recorded in a common database

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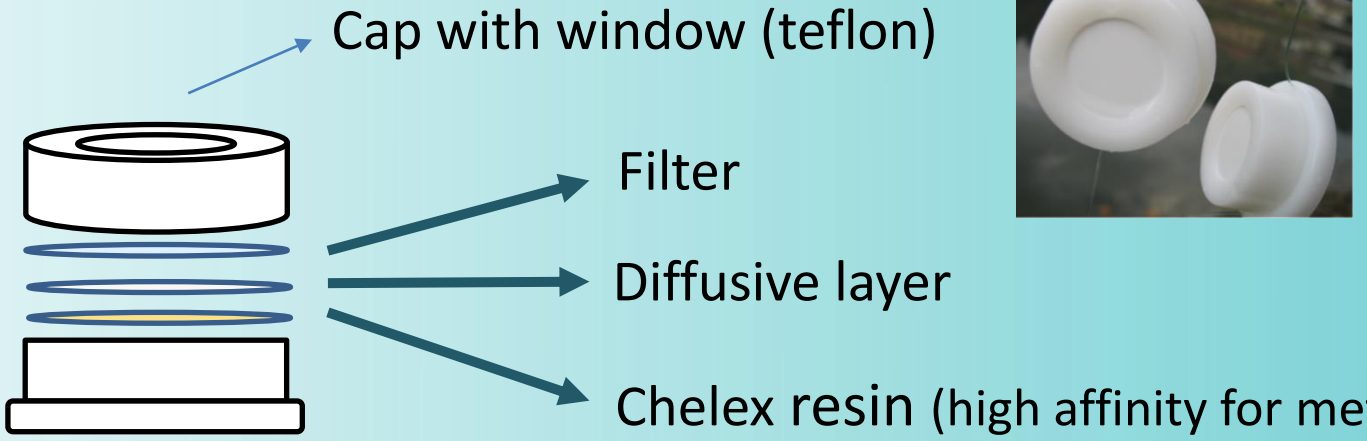
# Passive samplers for metals DGT type

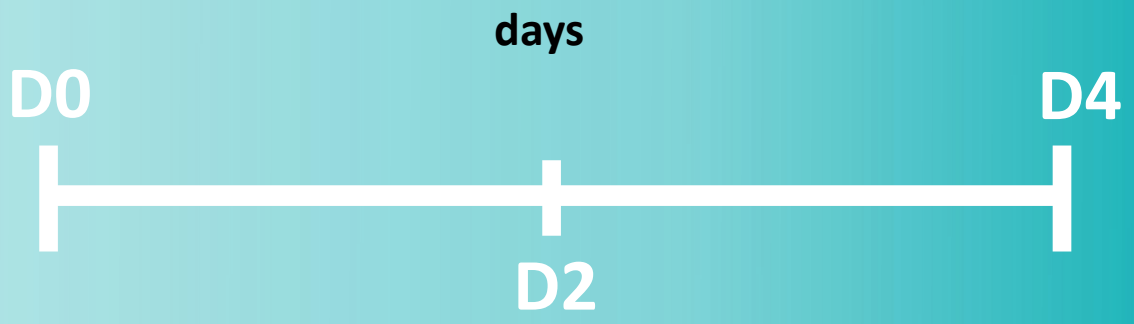
- DGT: Diffussive Gradient in Thin Films
- Disc of ± 4 cm of diameter and 2.0 cm of diameter of the exposition window
- Filled by three membranes:
  - Polysulfone filter (0.45 µm Ø; avoid particle abrasion)
  - Diffusive layer of hydrogel (0.8 mm thickness; **Polyacrylamide**)
  - **Chelex-100** resin immersed in polyacrylamide (0.4 mm thickness; cations exchange)



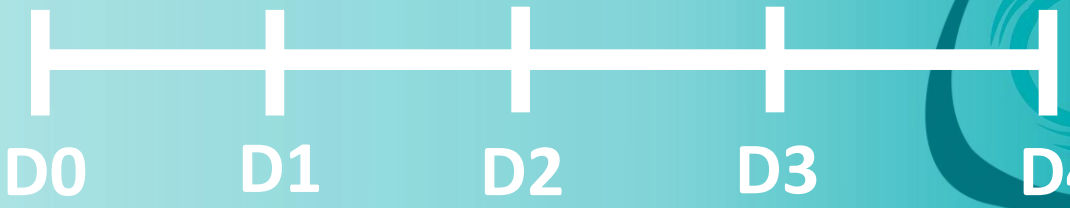



# WP5: Monitool sampling strategy

- 8 European regions
- 4 sampling sites per region (estuary or coast)
- In 2018: 2 sampling campaigns (wet and dry seasons)




**Coast: 3 days (1 sampling per day)**
**Estuary: 5 days and 2 sampling per day (at high and low tide)**

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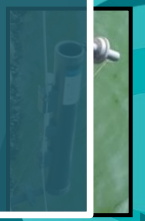
# WP4: Database and statistical analysis

**Published/ unpublished data** + **MONITOOL data** → **Environmental quality standard (EQS) adaptation for DGT**

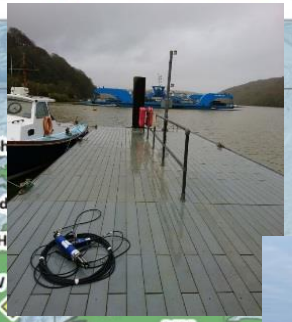
- Concentration of metal (DGT)
- Concentration of metal (water)
- Physicochemical parameters of water (DOC, turbidity, SPM, temperature, salinity, dissolved oxygen, biofouling)

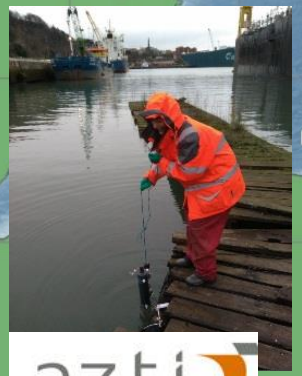
**The application of DGT to respond to the demands of the WFD in relation with the evaluation of the chemical status in the marine environment**



Concentration of metal (ng $L^{-1}$)

# WP5: Monitool Sampling Sites





TOTAL nº of sites:
21 coastal sites
13 estuarine sites

Over 250 DGTs and over 500 seawater samples from wet and dry campaign

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# WP5: Monitool sampling strategy

***IN SITU* PHYSICO-CHEMICAL PARAMETERS (at DGTs Depth)**

**Temperature, salinity, DO (mg/L and %), pH, turbidity, depth, specific conductivity, biofouling**

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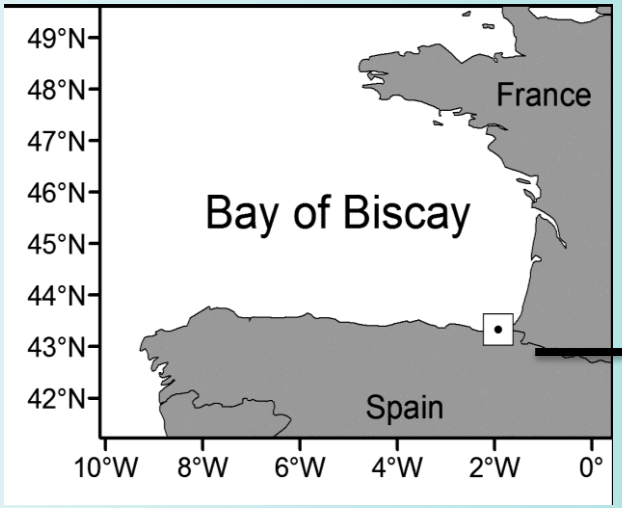
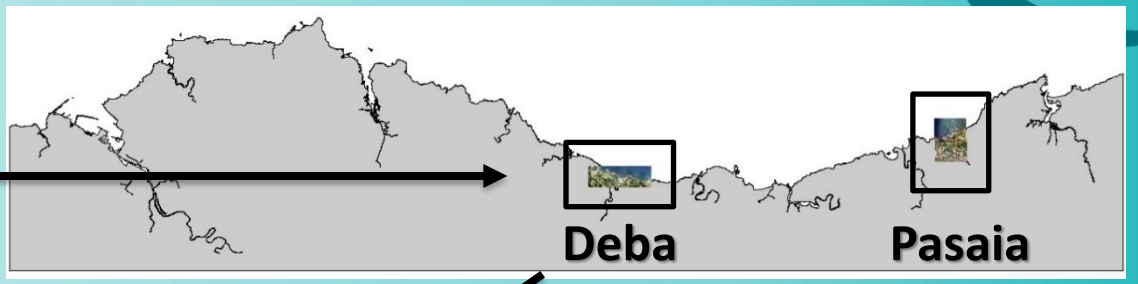
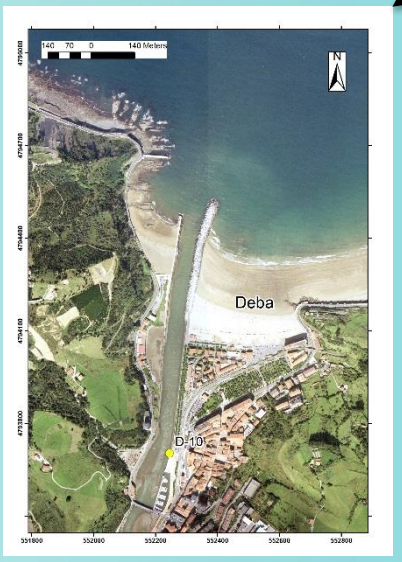
# Sampling campaigns in the Basque Coast

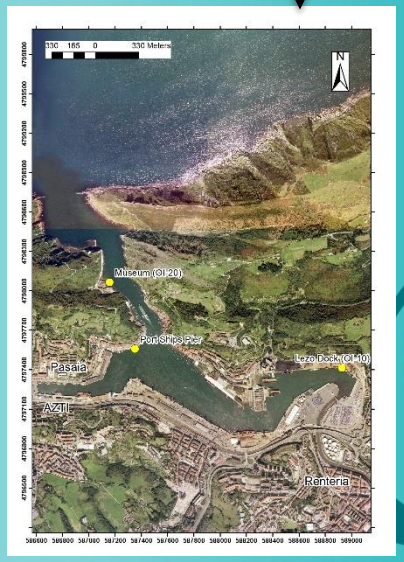



## Basque coast




2 estuaries with different riverine/marine influence; different contamination sources.
4 stations
2 campaigns:
Wet season (February-March 2018)
Dry season (September 2018)

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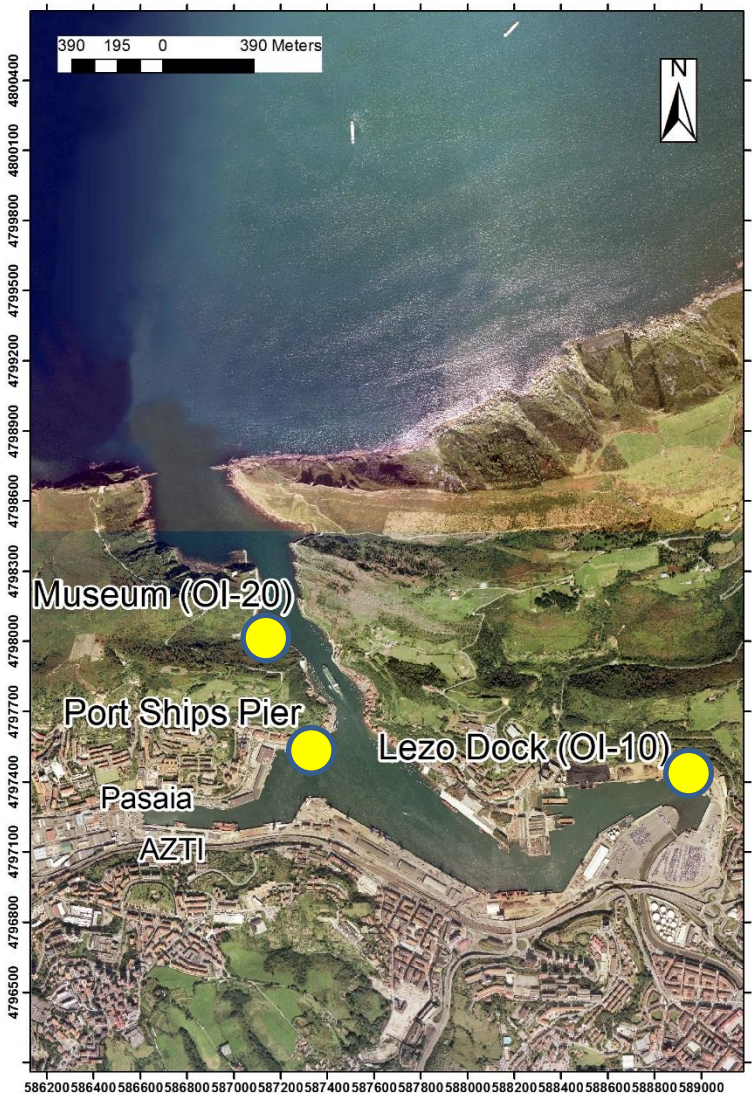
# Sampling sites in the Basque Coast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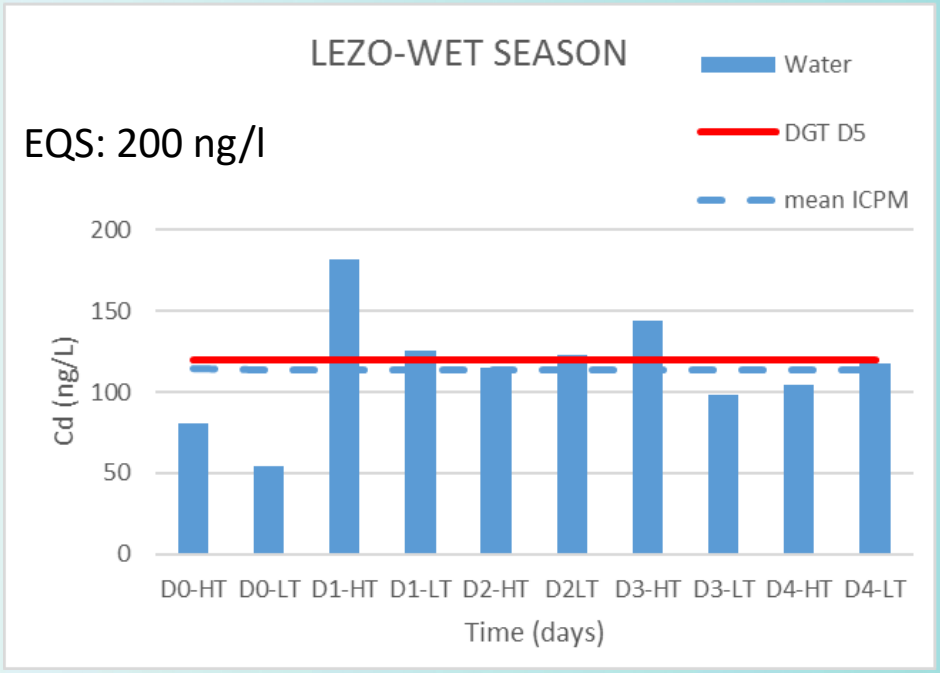
# Results

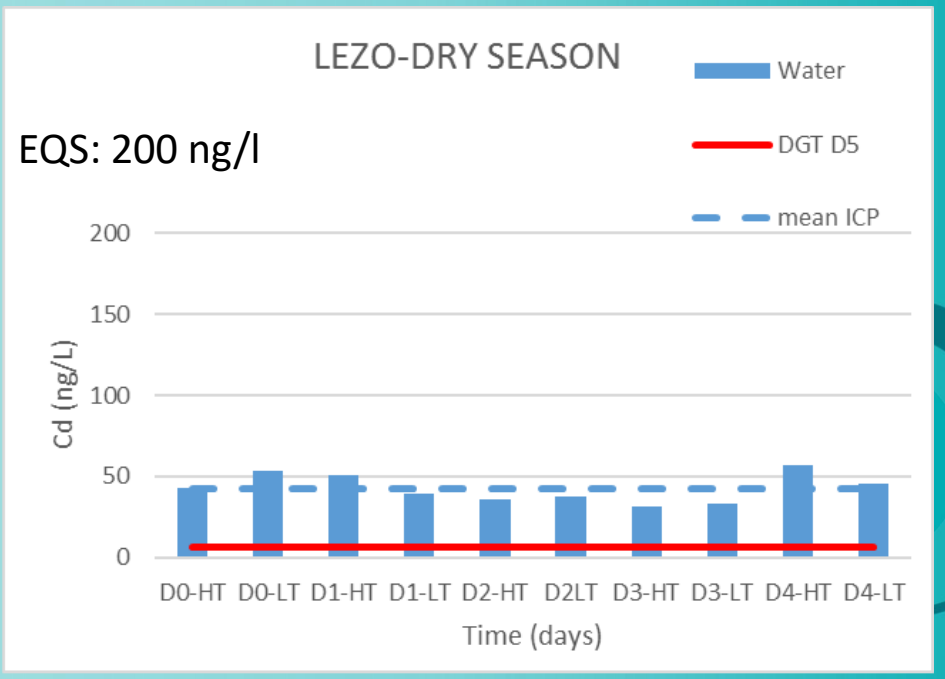
**Cd**, **Ni**, **Pb**, Co, Cr, Cu, Fe, Mn, Zn

Results show differences with seasonality and between estuaries (different salinity ranges, DOC, spm, turbidity, different contamination sources….)

Salinity range: 3-28 psu




Salinity range: 24-34 psu

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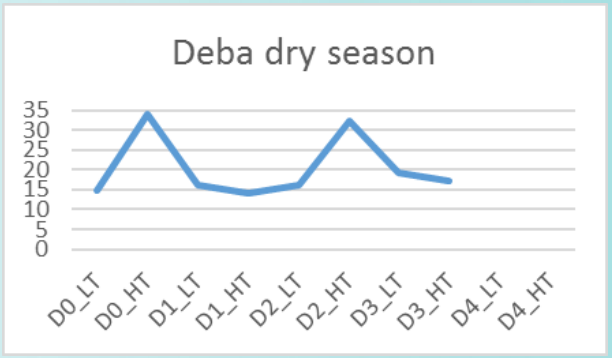


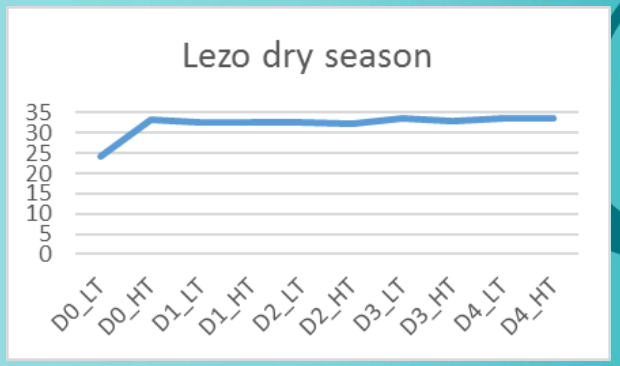


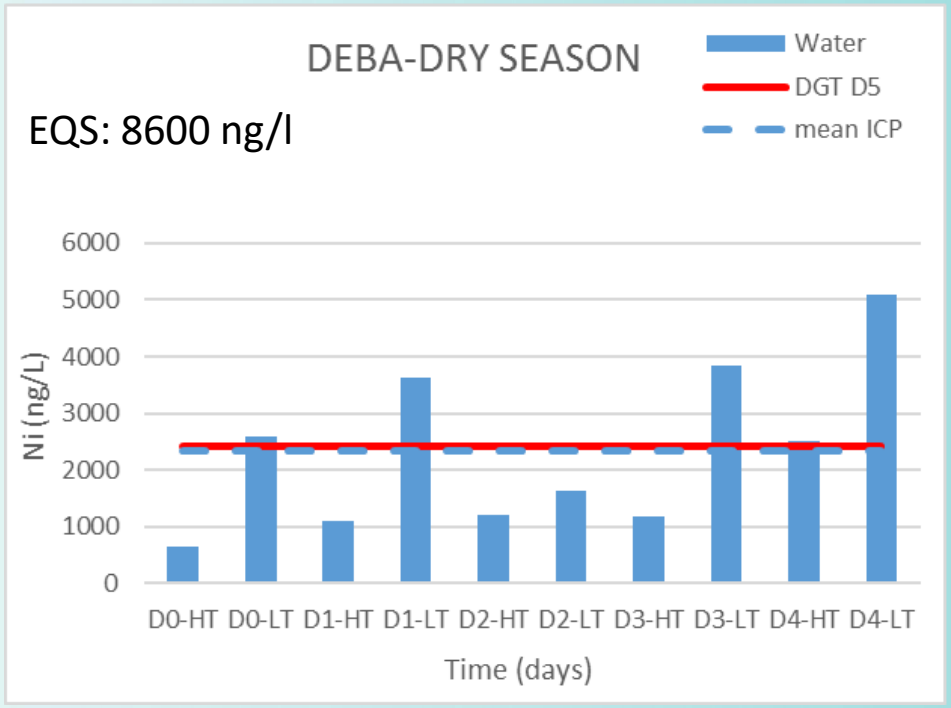


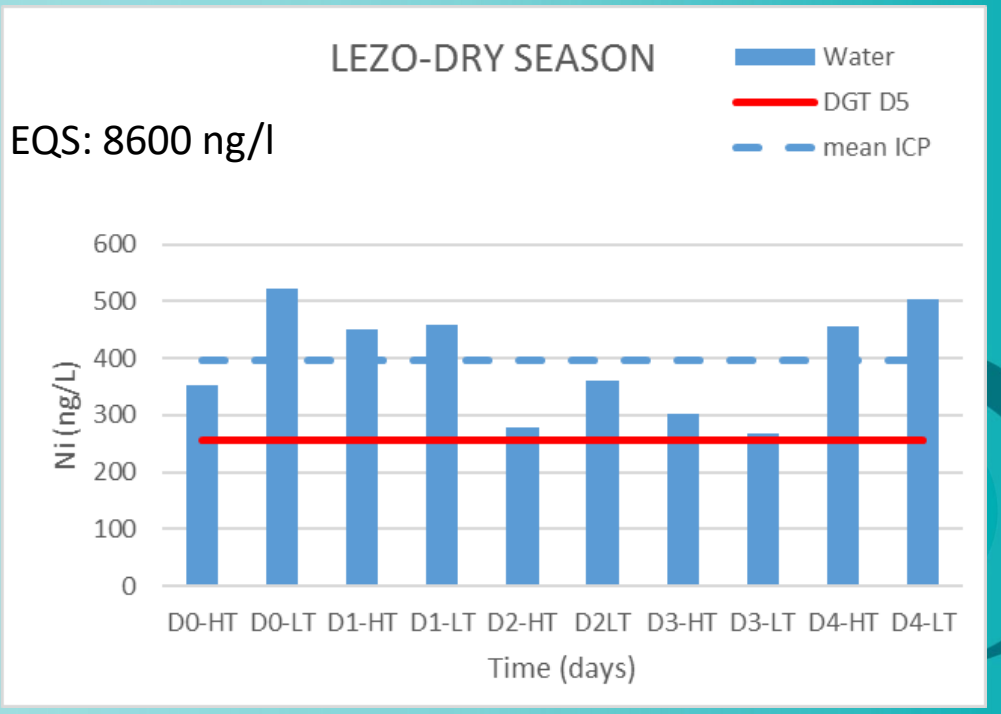


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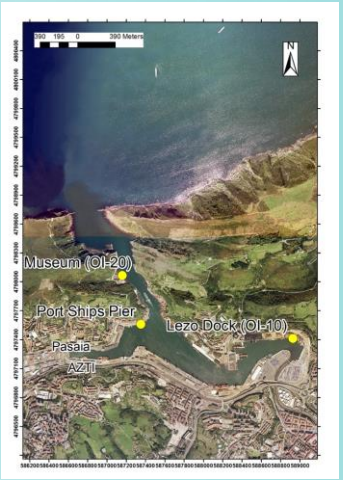


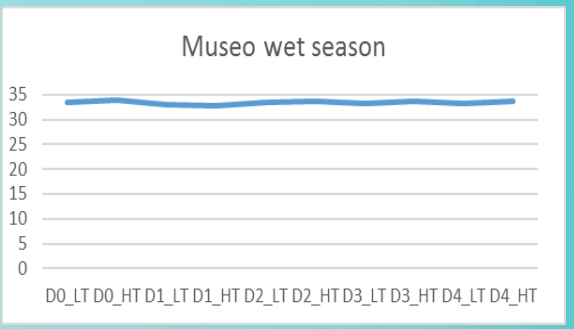


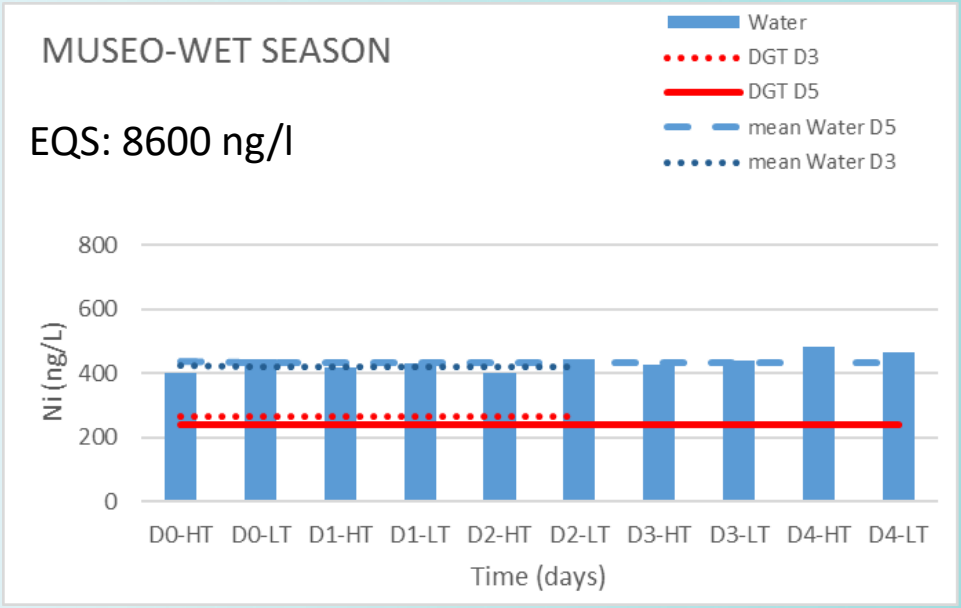


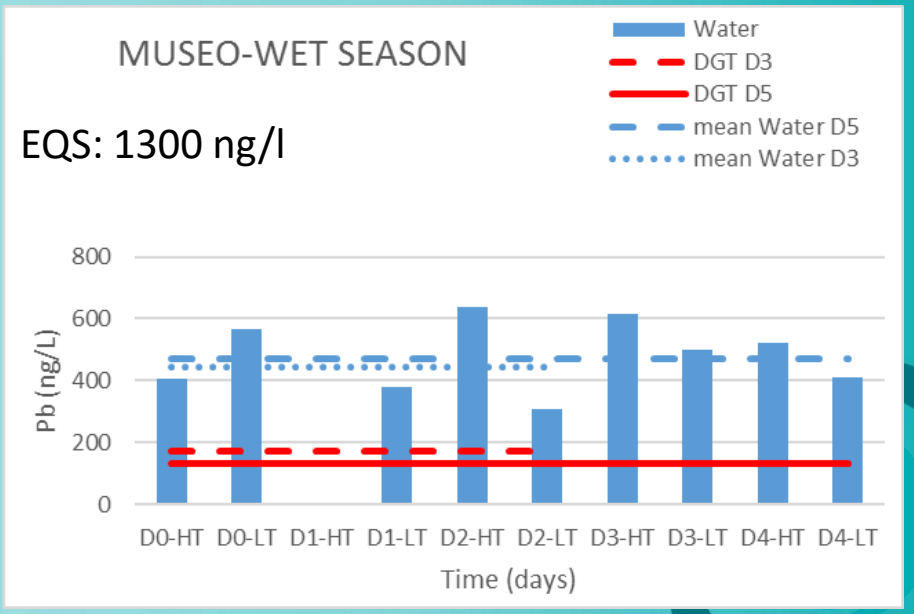


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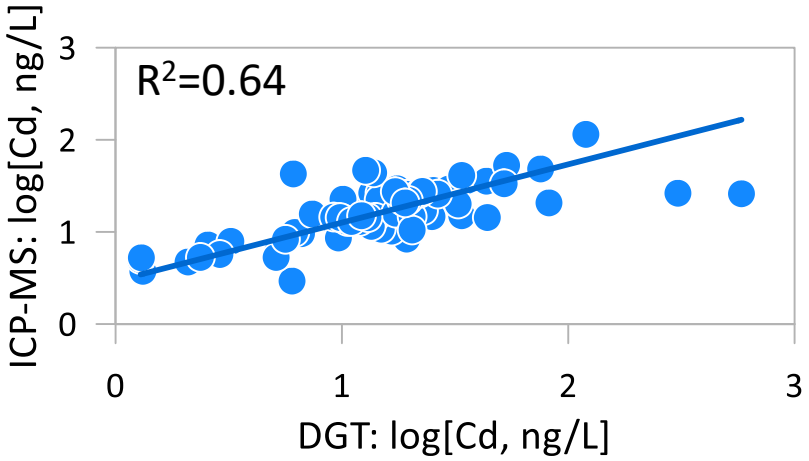
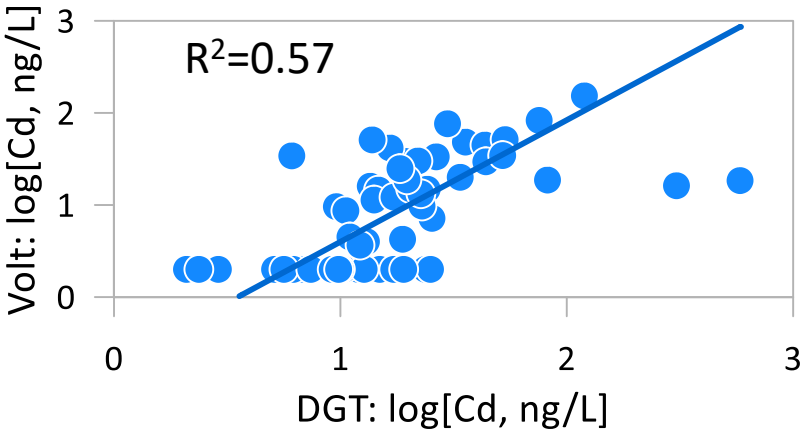
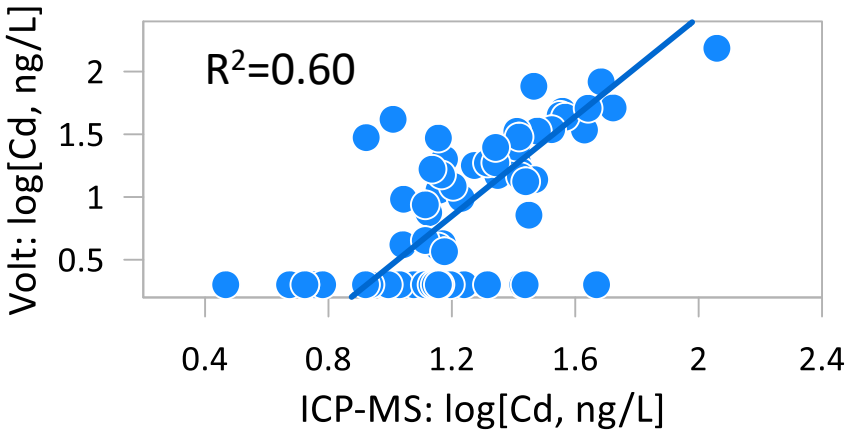
# Results: correlations

Cd, EQS = 200 ng/L (2,30 ng/L in log)

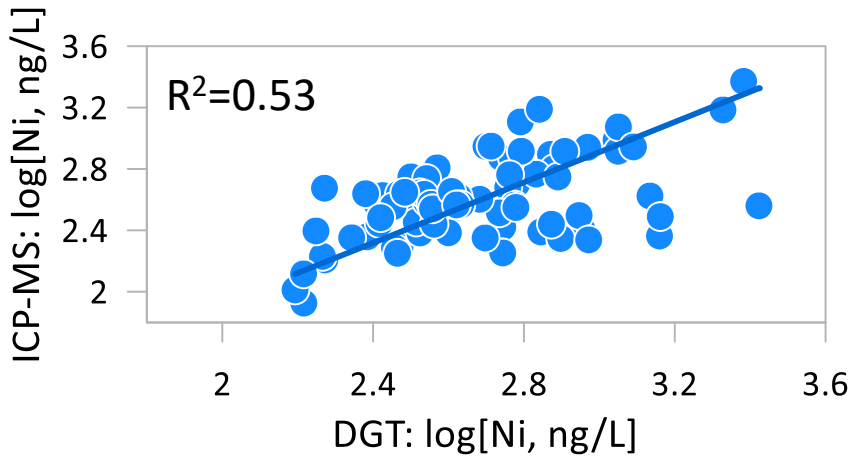


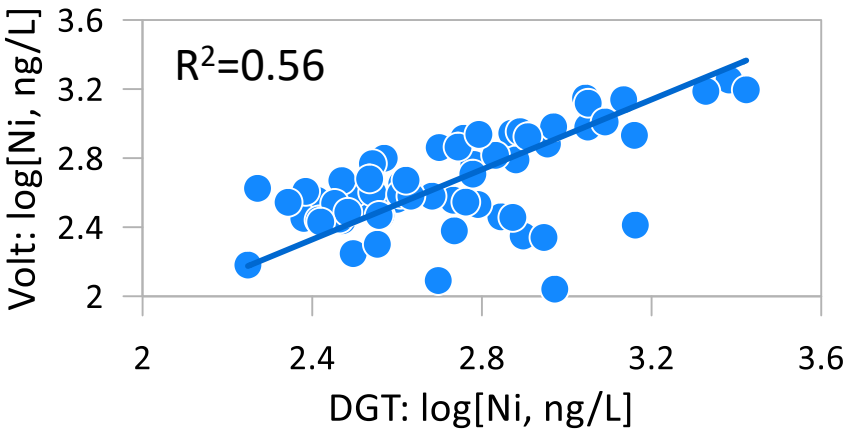



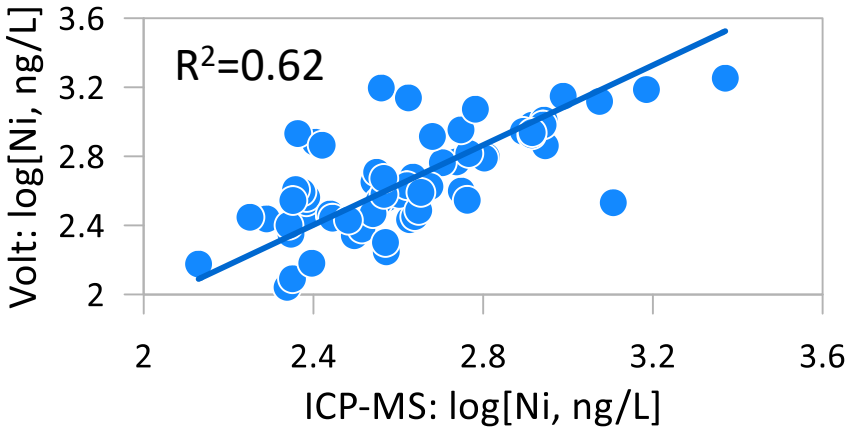



# Results: correlations

Ni, EQS = 8600 ng/L (3,93 ng/L in log)

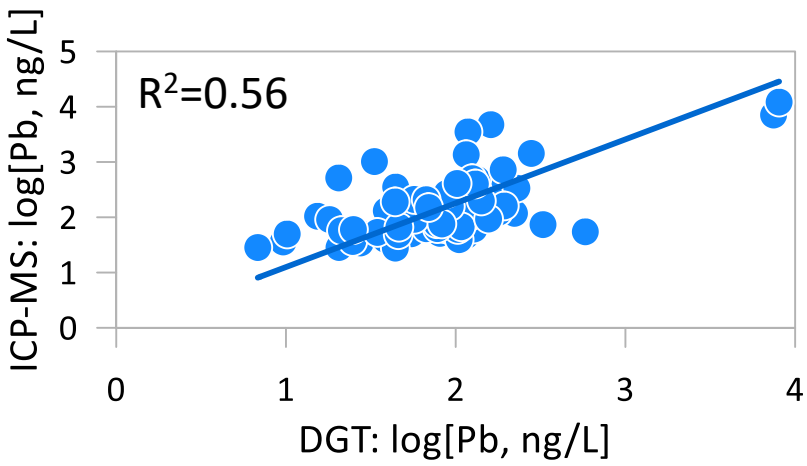


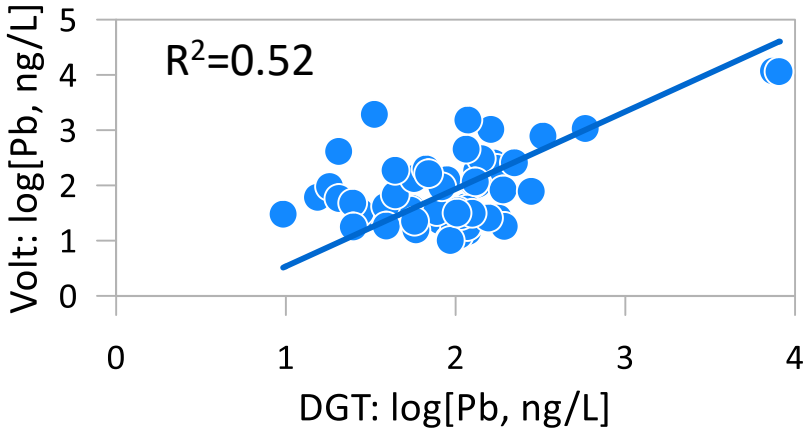



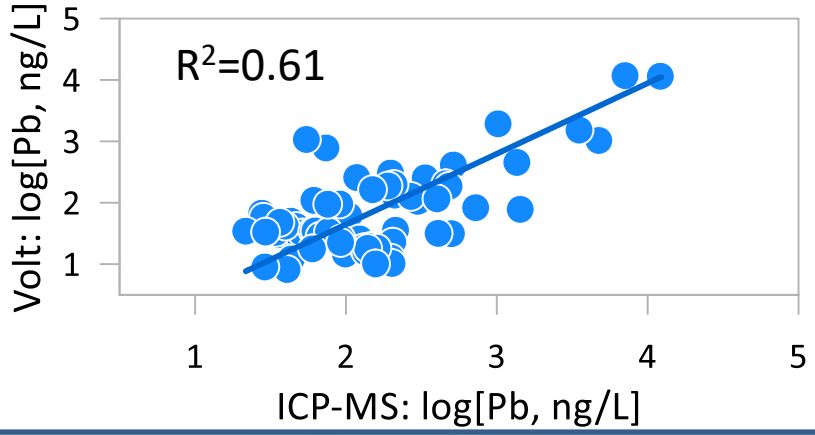



# Results: correlations

## Pb, EQS = 1300 ng/L (3,11 ng/L in log)



# Next steps:

- Correlation analysis of metal concentrations with environmental parameters.

- Statistical analysis with all data from 8 regions.

- To derive the EQS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