OUTPUT TITLE:

30 EXPERTS TRAINED AT

1. SIMONA TRAINING EVENT

OUTPUT T5.1

PROJECT TITLE:

SEDIMENT-QUALITY INFORMATION, MONITORING AND ASSESSMENT SYSTEM TO SUPPORT TRANSNATIONAL COOPERATION FOR JOINT DANUBE BASIN WATER MANAGEMENT

ACRONYM: SIMONA

PROJECT DURATION:

1ST JUNE 2018 TO 30TH NOV 2021, 42 MONTHS

DATE OF PREPARATION:

20/04/2021

Project co-funded by the European Union (ERDF, IPA and ENI)

SIMONA 1ST TRAINING EVENT

Date: 25th March 2021
Topic: SIMONA Sediment sampling methodology – training
Type: Online

Organizer: dr. Edith Haslinger (AT-AIT)
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Description:
Due to the still ongoing Covid-situation all over the world and the resulting travel restrictions, the first SIMONA training event will be held entirely online. Since the topic of this first training event is sampling, we wished for a physical meeting with live-demonstration of sampling of different media. However, the core group for this training event prepared a demonstration film for sampling methods according to the SIMONA sampling protocol. In addition, we will have a series of lectures and fruitful discussions.

This training event addresses all SIMONA experts involved in sampling as well as interested national target groups outside of SIMONA, who are active or interested in harmonized sampling methods.

AGENDA

08:30 – 09:00	Meeting room will be opened, technical issues, virtual morning coffee
09:00 – 09:10	META DOBNIKAR (LEAD PARTNER COORDINATOR): Welcome by the project coordinator and introduction into the project
09:10 – 09:20	EDITH HASLINGER (LEADER, WP7 TRAINING): Review of the agenda and goals for the day
09:20 – 10:45	FRANKO HUMER (FEDERAL ENVIRONMENT AGENCY, AUSTRIA): Key note lecture: General framework of sampling and sampling requirements (Working title), including 5-minute discussion
09:45 – 10:10	GYOZO JORDAN (SCIENTIFIC COORDINATOR): Preparation of the national sampling campaigns: Detailed sampling instructions ('Cookbook') based on experiences from the Test Areas
10:10 – 10:20	**Coffee break**
10:20 – 12:00	Watching the SIMONA video on sediment sampling methods (sediment sampling of lowland streams)
12:00 – 12:30	Q/A Session on sampling techniques. Moderator: Meta Dobnikar (Lead Partner Coordinator)
12:30 – 13:30	**Lunch break**
13:30 – 14:00	ZOLTÁN VILÁGOSI (BÁLINT ANALITIKA LABS, REFERENCE LABORATORY): Instructions from sample logistics – from field to the lab
14:00 – 14:10	AJKA ŠORŠA (LEADER, WP4 SAMPLING): Sampling protocol
14:10 – 14:40	Q/A Session on logistics and the sampling protocol. Moderator: Meta Dobnikar (Lead Partner Coordinator)
14:40 – 15:40	SIMONA Case Studies from the Test Areas: 1. KATA DUDAS (LEADER, WP5 EVALUATION): Water Framework Directive - Sediment Quality Evaluation (10 min) 2. Case Studies: ZSOFIA KOVÁCS: Drava Test Area (10 min) GHEORGHE DAMIAN: Upper Tisa Test Area (10 min) IRENA PEYTCHEVA: South Danube Test Area (10 min) PRVOSLAV MARJANOVIĆ: Reservoirs (10 min)
15:40 – 16:30	Discussion, virtual coffee break
16:30	Meta Dobnikar (Lead Partner Coordinator): Closing of meeting

Interreg
Danube Transnational Programme
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SIMONA – Sediment quality Information, Monitoring and Assessment System to support transnational cooperation for joint Danube Basin water management

Dr. Meta Dobnikar

SIMONA 1st Training event – online GoToMeeting Webinar, 25th March 2021

Project co-funded by the European Union
http://www.interreg-danube.eu/approved-projects/simona

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SIMONA WP7 presentation

Franko Humer, Environment Agency Austria

Training Event on Sediment Sampling

Online March 22-25, 2021

Project co-funded by the European Union
http://www.interreg-danube.eu/approved-projects/simona

General aspects of sediment sampling

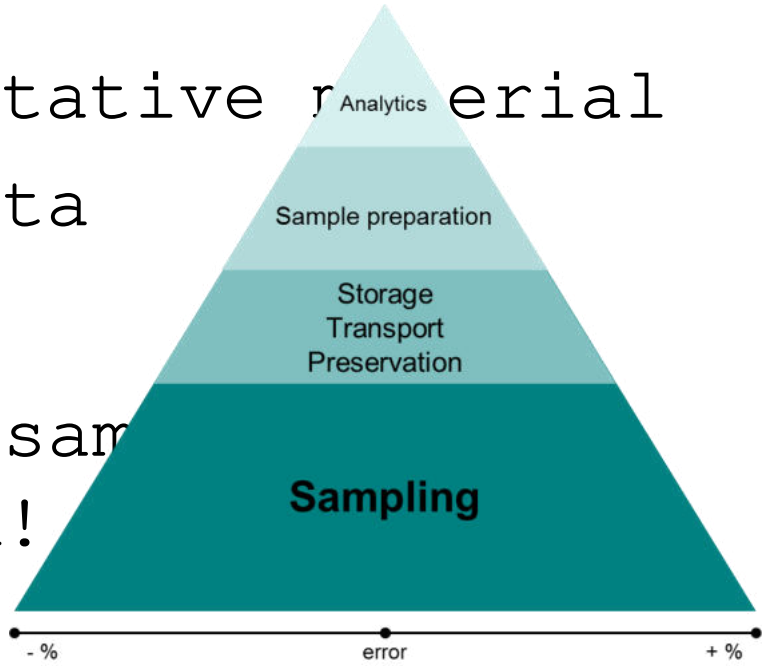
Content

- Importance of sampling
- Work safety
- Responsibilities
- Preparation, planning
- Procedures

General aspects of sediment sampling

ð Why is sampling so important?

- Collecting representative material
- Comparability of data
- Errors made during sampling can not be repaired!



General aspects of sediment sampling

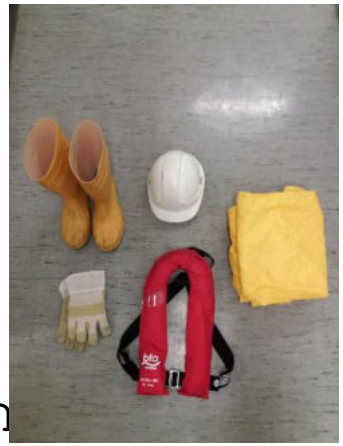
- Relevant international standards and guidance documents
  - ISO 5667-1: Guidance on the design of sampling programmes and sampling techniques
  - ISO 5667-12: Guidance on sampling of bottom sediments from rivers and estuarine areas
  - ISO 5667-15: Guidance on the preservation and handling of sludge and sediment samples
  - ISO 5667-17: Guidance on the sampling of bulk suspended solids
  - CIS Guidance Document No 19: Guidance on surface water chemical monitoring under the Water Framework Directive
  - CIS Guidance Document No 25: Guidance on chemical monitoring of sediment and biota under the Water Framework Directive
  - ISO 5667-3: Preservation and handling of water samples
  - ISO 5667-6: Guidance on sampling of rivers and streams

General aspects of sediment sampling

- Work safety
  - All international sampling guidances make explicit reference to compliance regulations.

General aspects of sediment sampling

- Work safety
  - Particular danger points
    - Location of sampling site
    - Handling with harmful substan
    - Dangerous weather and terrain conditions
  - Specially trained persons
  - Usually a team of at least two people
  - Perhaps special safety equipment requ



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General aspects of sediment sampling

- Responsibility of the sampling team
  - Starting with takeover of the bottles, reagents, containers
  - On-site inspection
  - Measuring of the on-site parameters
    - pH, EC, temperature, redox potential
    - organoleptic (color, smell), turbidity
  - Proper sampling including sieving, filtration, sample stabilization if needed
  - Documentation
  - Handover of the samples
  - Ending with cleaning and maintenance of the sampling equipment

General aspects of sediment sampling

- Preparation, planning
  - Formulation of questions
    Why? Who? What? When? Where? How?
  - Coordination with laboratory
  - Sampling programmes should answer all formulated questions

- Important task before actual field work

General aspects of sediment sampling

ð Sampling site/section selection

- Presence of good sedimentation condition
  ð e.g. reduced flow rate
- Ease of repeated access to the location
- Definition of sampling depth
- Identification of the precise point at t
- At least 5 % fine fraction (< 63 µm)

Δ Preliminary investigations

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General aspects of sediment sampling

- On-Site inspection, observations
  - Weather conditions
  - Discharge conditions
  - Abnormalities, special features
  - New influences and changes compared t documented state
  - Surroundings and sampling site!

General aspects of sediment sampling

- Composite samples
  - Sample representativeness at large si
  - Sediment beds should be geomorphically comparable
  - Equivalent penetration depths
  - From at least two or more single samp
  - The individual single sample should b homogenized
  - Equal volumes of each sample should b

General aspects of sediment sampling

- On-Site parameters
  - Calibration and maintenance

- Electrical conductivity
- Temperature
- pH-value
- Redox potential

© M.Kralik

General aspects of sediment sampling

- Sediment fraction analysed
  - The smaller the particle, the larger the area
  - The greater part of many hazardous subst contained in the finer sediment fraction
  - Analyses of (< 63 µm) fraction as a compromise
  - Tendency to manipulate as less as possib
    - No sieving or sieving over 2 mm mesh in the f
    - Collection and transport of larger quantities
    - Sieving to < 63 µm in the laboratory under co conditions as soon as possible

General aspects of sediment sampling

- Important!
  - Rinse the equipment before sampling
  - During sampling
    - Do not eat and drink!
    - Do not wear jewellery!
    - Do not smoke!
    - Avoid creams or sprays!
    - Do not phone!
    - Work clean and concentrated!
      - Assume you are in a laboratory
  - Avoid cross contamination

General aspects of sediment sampling

- Labeling
  - Water resistant adhesive labels
  - Waterproof marker
  - Clear identification of sample
    - Name, number of sampling site
    - Date and time
  - Same information as in the sampling p

General aspects of sediment sampling

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- Documentation
  - Sampling protocol
  - Information about sampling site
  - Information about sampling performed
  - Information on site c[…]ns
  - Information about sam[…]
  - To be filled on-site

© ISO 5667-12:2017(E)

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SIMONA

Sediment-quality Information, Monitoring and Assessment System to support transnational cooperation for joint Danube Basin water

Sample handling and storage

Zoltán Világosi, Bálint Analitika Ltd.
Head of Sampling Department

Sample handling

choose sample container

identification

transport

storage

Sample container

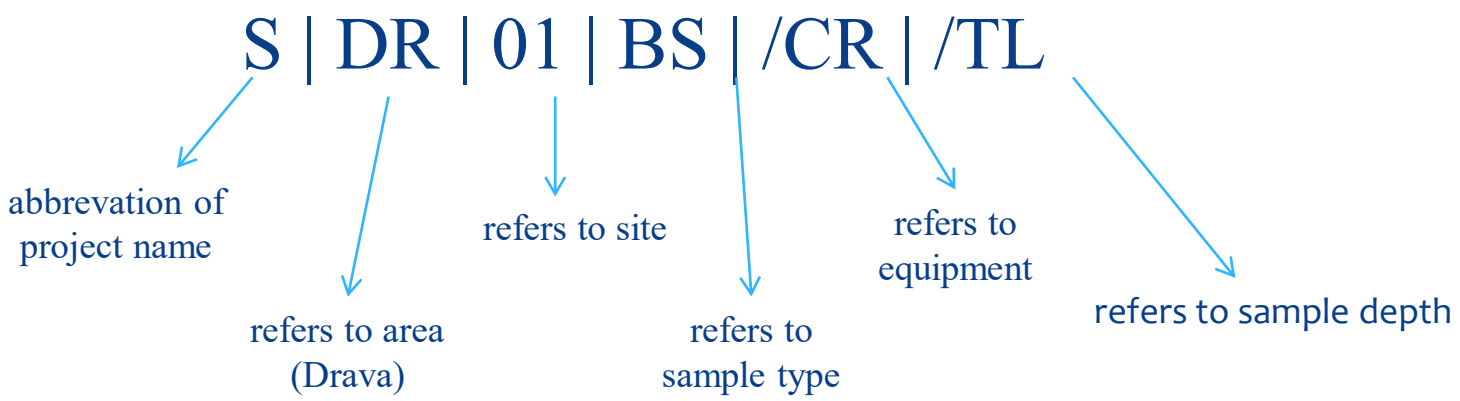
* material and volume depends on contaminant(s)
* volume shall be sufficient to: repeat the analysis, requirements of duplicate samples (QC), etc.
* glass containers are appropriate for most cases
* dimensions of container shall be suitable to sampling equipment to ensure unnecessary disturbance of sample
* choose the proper sample container, according to **ISO 5667-15:2009** (Tables 1, 2 and 3)

Analyte to be studied	Type of container [a]	Minimum sample size [b] g	Preservation and storage conditions	Maximum storage duration [c]	Comments
Mineral oil (hydrocarbons C10-C40)	G	100	1 °C to 5 °C, dark and airtight	1 month	
	P		< –18 °C	6 months	
	G		Add sodium sulfate (4.2): 25 g on 50 g of sample	6 months	

Identification

- labeling the sample on the field prior to sampling or in the lab/office/headquarter
- waterproof labels are recommended
- write the identifier directly on sample container also (waterproof pen)
- label provides information at least about:
  - Sample ID (refer to sampling site, water body, sample type, etc.)
  - date and time of sampling
- further informations (recommended):
  - type of sample
  - name of sampler
  - preservation applied

Example of sample ID



Transportation of samples

from field to office and from office to lab

* during transportation to the laboratory/headquarter, samples to be stored in cooling devices capable maintain temperature between 2°C and 8°C
* electric cooling box operating from 12V socket of a car or battery
* usual cooling box with thermometer inside
* temperature shall record in the laboratory
* core samples has to be (if) transported vertically due to avoid disturbance (cooling is not possible)

Transportation of samples

* good examples from Romania, Serbia and Bulgaria
* try to separate bottles (ice battery, sponge, bubbles, textile)
* transport by car or a delivery company
* avoid of freezing full containers

Storage

* long-term storage before/after analyses in electric cooling boxes or refrigerator (dark, temperature set to 4℃)
* put back the remaining of samples after analyses

Thank you for your attention!

Watching the SIMONA video on sediment sampling methods

(sediment sampling of lowland streams)

Gyozo Jordan (Scientific Coordinator)

Project co-funded by the European Union
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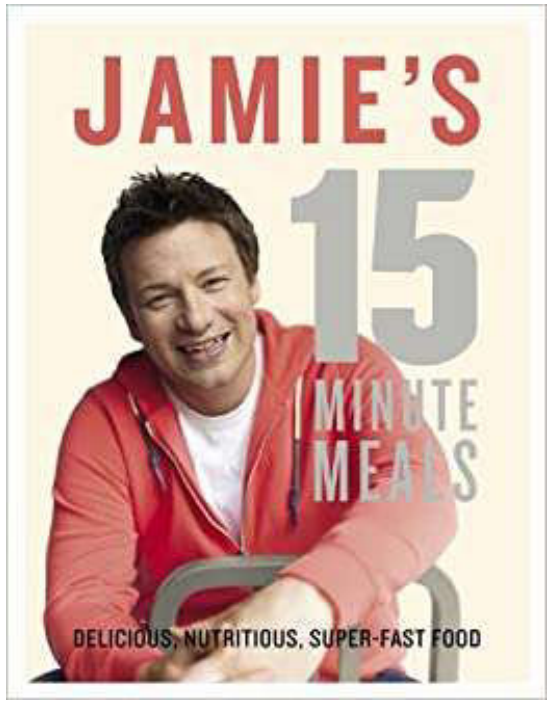
SIMONA Sediment Sampling:

The COOKBOOK Approach



COOKBOOK
Sampling PROTOCOL

RECIPES

Bottom Sediment

Suspended Sediment

rrel with underwater pump

Floodplain Sediment

Figure 6.5. Profiling floodplain sediment

MOVIE
Sampling VIDEO

How does a recipe look like?

let’s have a look at the sampling methods

2ND SCENE: SUSPENDED SEDIMENT SAMPLING – BARREL SYSTEM

Figure 1.3. Suspended sediment collected into a 30 L barrel with underwater pump

ACTION:

- prep: on ground: fix pump on rod, fix pump on battery, fix barrel
- label barrel, photo sample code
- in water: sample from active stream current
- in water: measure depth, messure distance from bank
- merge pump to the upper 1/3 of water depth
- pump is uptream of sampler in water
- turn on pump
- rinsing: pumping 3x pipe volume (10 sec)
- rinsing the barrel and lid
- fill the barrel with water **UNDERWATER**
- lock barrel;
- complete field sheet
- clean the tools, rinse pump with DW

CAMERA, UNDERWATER

Figure 18: Suspended sediment collected into a 30 L barrel with underwater pump

PHASE 01 - PREPARATION:

- Prepare **equipment of sampling system** at the sampling site: 1. sample container (plastic tank), 2. electric pump attached to plastic pipe, 3. pump-holding stick, 4. batteries, 5. digital camera, 6. two trained sampling personnel
- **Fix the pump** connected to plastic pipe on the pump-holding stick so its heights can be adjusted
- Prepare the equipment for horizontal distance and vertical water depth **measurement**: 1. laser distance measure or tape measure, 2. scaled stick
- Prepare the equipment for field sampling **documentation**: 1. fieldsheet, 2. pen/pencil for notes, 3. marker pen (permanent ink), 4. sample label (stick-on label), 5. GPS device (<5m precision), 4. digital camera.

NOTE: It is assumed that all your equipment is clean and is in good condtion to collect representative and reproducible sample.

MISTAKE: Equipment, tools are not clean (REPRODUCIBILITY, REPRESENTATIVITY).

PHASE 02 – SAMPLING DOCUMENTATION:

- **Label** the sample container (plastic tank) 1. with permanent ink marker on the sample container and 2. with stick-on label
- Complete the field sheet for **SAMPLING site identification** (site code, location ID, water boday ID, surface water name, coordinates, etc.)
- Take **GPS** field measurement at the SAMPLING site on the river bank: X,Y coordinates, Z altutide, E measurement error (preferably <5m), use WGS84 coordinates in degrees form (NOT decimals)

NOTE - Alternatve: Take GPS measurement in the water at the actual SAMPLING point.

- Take **length measurements**: 1. measure the distance-from-bank to the sampling point with laser distance measure and 2. measure the water depth with scaled stick

NOTE - Alternatve: Use tape-measure for distance measurement.

Take SAMPLING site and SAMPLING point **photos** (6 photos) on: 1. the sample code, 2. SAMPLING site: the landscape showing the stream and its surroundings in the 4 principal directions (4 pictures), 3. SAMPLING point: location of sample collection in the water (showing the sampling action)

- **Complete fieldsheet for sampling**

MISTAKE: Sampling site ID, including GPS coordinates are incorrect (REPRESENTATIVITY).

PHASE 03 – SAMPLING – GETTING READY:

- Sampler 2: Hold the free end of the plastic pipe on the river bank, standing near the sample container (plastic tank) and the baterries.
- Sampler 1: **Walk** into the water to the **SAMPLING point** with the pump fixed on the pump-holding stick, and pump attached to plastic pipe.
- Sampler 1: First, **merge the pump** with the stick to the upper 1/3 of water depth, adjust pump depth as needed, DOWNSTREAM of the sampling point for rinsing the sampling system,

NOTE: Sampling point is located in the active flowing streamline.

MISTAKE: 1. Pump is not merged deep enough; 2. pump is merged too deep so it may pick up loose bottom sediment (REPRESENTATIVITY).

PHASE 04 – SAMPLING – COLLECTION:

- Sampler 1 signals 'Ready!' and Sampler 2 turns on the pump (practically by connecting the wires to the batteries)
- Sampler 2 **equilibrate** the sampling system with the stream water: 1. rinse the pump and the plastic pipe: let the pumped stream water flow on the ground for minimum 10 seconds; 3 times of the pump and pipe volume), 2. rinse the sample container (plastic tank) with the pumped stream water 3x times, 3. rinse the cover of the sample container (plastic tank) with the pumped stream water **3x times**.
- Sampler 1: Second, merge the pump with the stick to the upper 1/3 of water depth, adjust pump depth as needed, UPSTREAM of the sampling point for sample collection
- Sampler 2: **Fill the sample container** (plastic tank) to the top with pumped stream water carrying the suspended sediment
- Stop the pump (practically by disconnecting the wires to the batteries)
- Close the sample container (plastic tank) with the cover
- SAMPLE COLLECTION IS COMPLETED, Sampler 2 signals 'Sampling completed!'

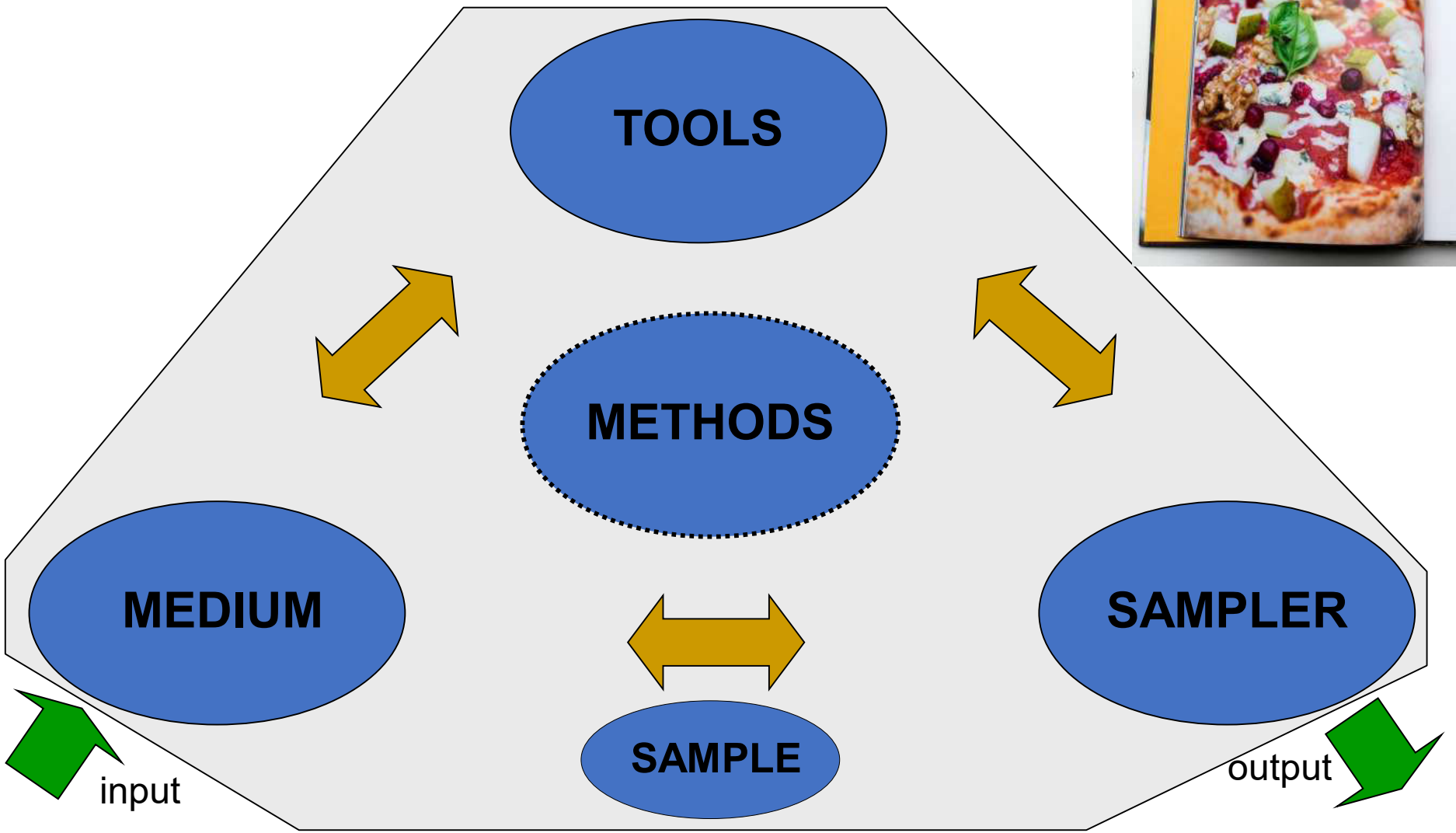
MISTAKE: Sampling system is not thoroughly equilibrated with the stream water by rinsing (REPRODUCIBILITY, REPRESENTATIVITY).

PHASE 05 – SAMPLING CLOSING

- Sampler 1: Walk out off the water
- Clean the tools with water and disposable paper towel, rinse pump with DW
- Put tools into tool holder rake and box
- Check field documentation and complete it by corrections as necessary

MISTAKE: Equipment, tools are not cleaned well (REPRODUCIBILITY, REPRESENTATIVITY).

THE SAMPLING SYSTEM



How to evaluate the sampling system's performance?

CRITERIA FOR SAMPLING METHOD – EVALUATION

- ✓ **SCIENTIFIC (Reproducibility, Representativity)**
- ✓ **LEGISLATIVE (WFD: Surveilance/**Regular **Monitoring; EQS)**
- ✓ **EFFICIENT (simple, fast, cheap, ready-to-deploy)**

1.2.1 Romanian grab sampler

1.2.1 Romanian grab sampler

EVALUATION

ADVANTAGE

- fully closed containment
- relatively undisturbed sampling
- fully closed containment (no loss of sample)
- easy to operate by hand
- large sample volume
- easy to control depths
- the blockage of closing lips is easy to identify and control during the sampling
- good visibility of the sample
- easy to push the sampler into the sediment (unlike the mechanical grab systems which are gravitationally controlled)
- easy and fast to clean
- fast sampling: easy for replicate sample collection
- easy to empty the sample into the glass jar container
- easy to take the sample out from the upper part of the container using a scoop

DISADVANTAGE

- limited usage in deep water (applicable only in shallow water, not applicable from bridge and boat)
- the lips do not close perfectly (losing the sample, especially fine fraction; ; the grab shall be redesigned with perfectly closing lips) *(reproducibility problem)*
- presence of paint (sample contamination problem; the grab shall be redesigned without paint)

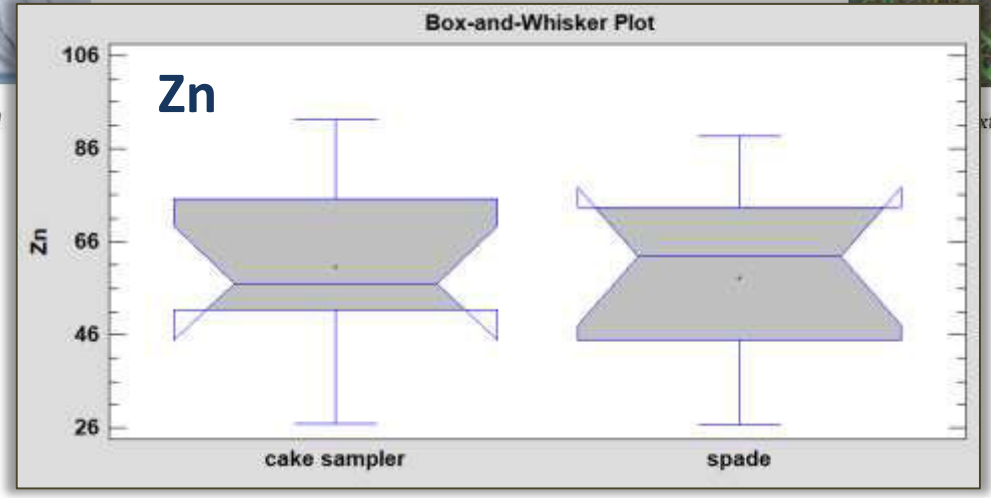
3.1 Spade system

versus

3.2 Top soil sampler – Austrian soil cake sampler

Figure 4.5. Loading jar with floodplain sediment (bottom layer)

xtracting top soil from floodplain sediment using the cake sampler

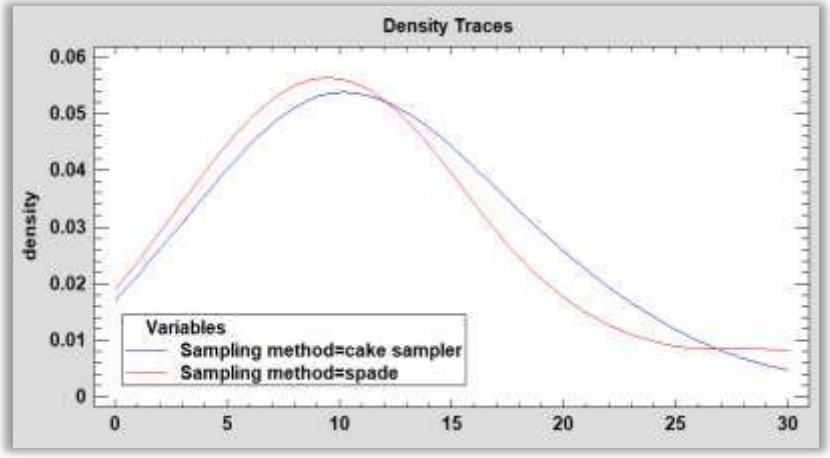


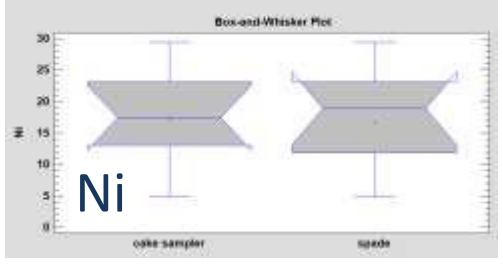
Comparison of Medians for Zn
Median of sample 1: 57.1
Median of sample 2: 62.8

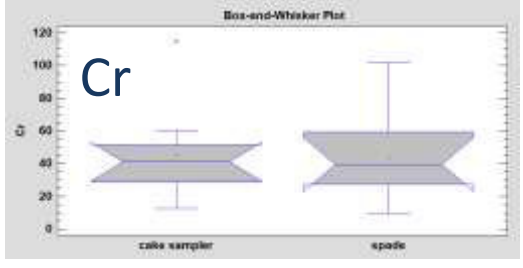
Mann-Whitney (Wilcoxon) W-test to compare medians
Null hypothesis: median1 = median2
Alt. hypothesis: median1 NE median2

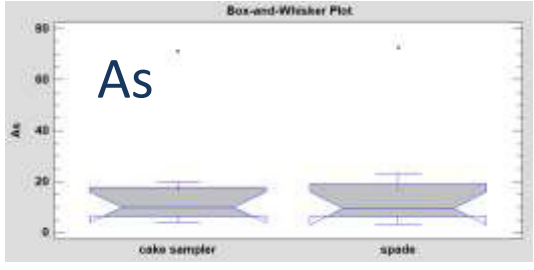
Average rank of sample 1: 9.88889
Average rank of sample 2: 9.11111

W = 37.0 P-value = 0.791077
Do not reject the null hypothesis for alpha = 0.05.









The COOKBOOK

VIDEO SHOW – RECIPES:

SUSPENDED SEDIMENT

1. Barrel system

BOTTOM SEDIMENT

2. Vacuum core system - top 5cm
3. Scoop system
4. Romanian grab system
5. Sediment pH measurement

FLOODPLAIN SEDIMENT

6. Spade system
7. Cake system
8. Floodplain core system – sediment layers

MISCELLENAOUS

9. Laser distance measurement
10. Field XRF measurrement
11. Basic field safety

The COOKBOOK Approach

VIDEO MOVIES IMPROVEMENT

1. **Native English** narrative
2. Text slides inserted (between: major steps, lists of tools, etc.)
3. **Text** in picture
4. **Slowdown** or standstill pictures to allow narrative to explain the main points
5. Divided screens for showing the 'typical mistakes', '**how-not-to-do**' examples
6. Anything that makes them more useful as cookbook-style videos for practitioners who want to make the same good PIZZA

The COOKBOOK Approach

VIDEO MOVIES PLANNED

SAMPLING METHODS DEVELOPED

1. Floodplain coring
2. Alpine rivers
3. Large rivers (from boat)
4. Other methods (e.g. Bavarian-Elbe River mobile centrifuge, Austrian passive alpine SS sampler)

SAMPLING METHODS STILL UNDER DEVELOPMENT

5. Passive membrane sampler
6. Suspended sediment box (JDS4) in river & on floodpain
7. In-situ filtering
8. In-situ pore water collection

SEDIMENT SAMPLING SYSTEM

9. Development of your sampling system
10. Operation (storage, maintenance, QA/QC)
11. Good practice (NOT-TO-DO LIST, typical mistakes)

MONITORING SITE & SAMPLING POINT DESIGN

Interreg
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Danube Transnational Programme
SIMONA

Water Framework Directive (WFD) Sediment Quality Evaluation

SIMONA 1st training event, online meeting, 25th Marc. 2021

Katalin Mária DUDÁS, HU-MATE

Facts

- Hydrophobic and lipophilic substances are **deposited/accumulated** in sediment.
- Sediment is a **sink** and a **source** of hazardous materials.
- Sediment is **not a waste**, part of the ecosystem.
- Sediment contamination can have many negative effects on an ecosystem.
  - **Benthic** invertebrate communities can be **degraded,** totally **lost** or **converted** from sensitive **to pollution-tolerant species.**
  - **Biodegradation is the dominant** transformation **pathway to remove** the environmental concentration significantly.

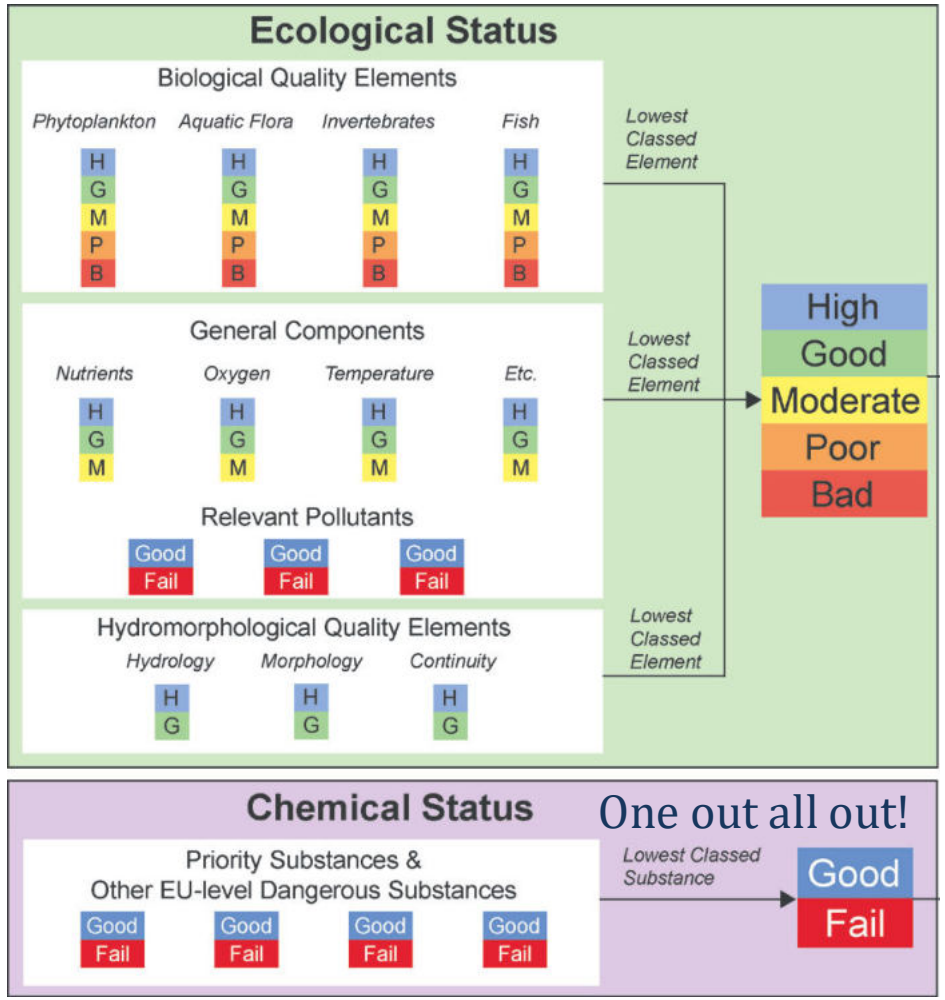
Photo: Bird's-eye view of Danube-Ipoly National Park
Photo credits: Ádám Selmeczi Kovács, Danube-Ipoly National Park, 2019

Relevant substances in sediment: log Koc >3 or log Kow >3

Koc = Organic carbon – water partition coefficient; Kow = Octanol-water partition coefficient

Interreg Danube Transnational Programme SIMONA

WFD Surface water status assessment process



Water Framework Directive, 2000/60/EC Annex X listing the **Priority Substances**:

Alachlor, Atrazine, Benzene, Chlorpyrifos, 1,2-dichloroethane, Dichloromethane, Diuron, Fluoranthene, Isoproturon, Lead and its compounds, Naphthalene, Nickel and its compounds, Octylphenols, Pentachlorophenol, Simazine, Trichlorobenzenes, Trichloromethane, Aclonifen, Bifenox, Cybutryne, Cypermethrin, Dichlorvos, Terbutryn

and **Priority Hazardous Substances**:

Anthracene, Brominated diphenylethers, Cadmium and its compounds, C10-13 chloroalkanes, Chlorfenvinphos, Di(2-ethylhexyl)phthalate (DEHP), Endosulfan, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclohexane, Mercury and its compounds, Nonylphenols, Pentachlorobenzene, Polyaromatic hydrocarbons (PAH), Tributyltin-cation, Trifluralin, Dicofol, Perfluorooctane sulfonic acid and its derivatives (PFOS), Quinoxyfen, Dioxins and dioxin-like compounds, Hexabromocyclododecanes (HBCDD), Heptachlor and heptachlor epoxide

- Optional for sediment monitoring, Kow>3
- Preferred for sediment monitoring and compliance evaluation, Kow>5

EU regulation status - Sediment Quality

- **Water Framework Directive** (WFD) 2000/60/EC
  + related directives and CIS guidances
  - One of the aims: progressively reducing pollution from priority substances
  - Need to measure for trend assesment (2008/105/EC and 2013/39/EU)
  - No existing EU EQSs for sediment; sediment ecotoxicological data was missing in 2005 and 2011

EQS = Environmental Quality Standard = limit values

- **Intensive research period** (~2009-2019)
  - Many ecotoxicological test for benthic communities
  - How contaminated sed. effects an ecosystem? Which are evident, invisible or unknown?
  - How contaminant properties, temperature, pH, microbial population density etc. can influence the rate and extent of toxicity?
- **Need for harmonized sediment guidances & step-by-step 'how to evaluate' tools:**
  - New drafted EU CIS guidance document on Sediment (2021) with EU Water Directors statements, best practices, good existing national/regional regulations, eg. Elbe RBMP
  - Danube SIMONA Evaluation Protocol (2021) fully compatible with Sediment EU CIS guidance document
- 2008/105/EC **EQS directive is** again **under revision** (new PS list and EQSs are expected)
  - Matter of discussion if the new EQS directive will regulate sediment quality too?!

How sediment associated contaminants may **affect the achievement of the WFD goals;** and the **classification status** of the water body?

Statements from New EU CIS guidance document on Sediment Contamination (draft):

- Sediment associated contaminants may have an impact on both the ecological and the chemical status.
- However, there are also many factors that limit this impact:
  - the contaminated sediment may have been covered with a cleaner fraction,
  - the contaminants may not be bioavailable,
  - the contaminants may not bioaccumulate in pelagic species, etc.

Need to deliver EQSs for sediment using CIS g. no. 27.

- Related to **chemical status assessment compliance monitoring**:
  - Sediment is a recommended matrix for the assessment of chemical status for some metals and hydrophobic compounds in marine and lentic water bodies.
  - In dynamic lotic water bodies, sediments do not often provide an appropriate matrix for compliance checking because of high variability.
- For the **purpose of trend monitoring**, **sediment-** or alternatively SPM and biota- are the **most suitable matrices for many substances** because:
  - integrates in time and space the pollution in a specific water body;
  - changes of pollution in these compartments are not as fast as in the water column;
  - long term comparisons can be made.

How to deliver EQSs for sediment?

Statements from WFD and EQS CIS guidance document No. 27.:

- Environmental quality standards (EQS) need to be effect-based according to CIS guidance no 27. (the derived values are related to effects on biota).
- The WFD defines EQS as "*the concentration of a particular pollutant or group of pollutants in water, sediment or biota which should not be exceeded in order to protect human health and the environment.*"
  This means that exceedance of the EQS indicates a risk and thus, potential impact on human health and the environment.

How to deliver EQSs for sediment based on CIS G. No. 27.

1. Deliver from ecotoxicological test for benthics to protect benthic communities

2. Deliver form EQSwater (or $QS_{fw,eco}$)

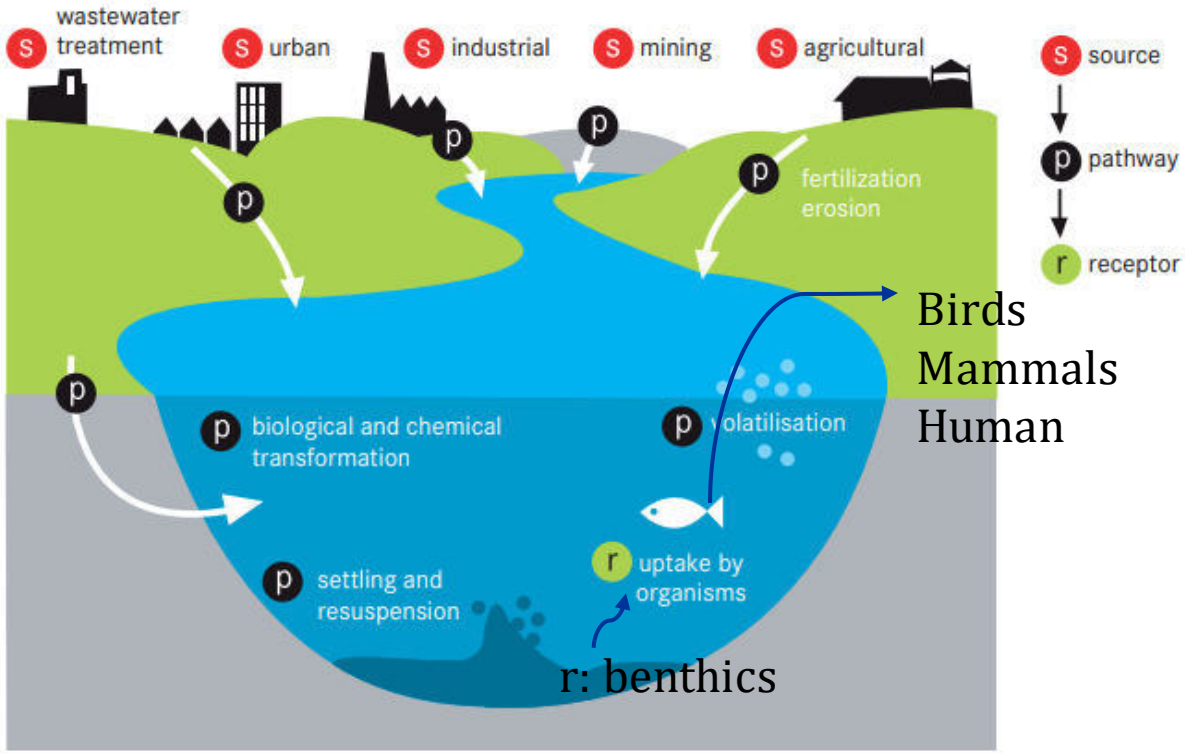
$$QS_{sediment,EqP,ww} = \frac{K_{sed-water}}{RHOsed} \times QS_{fw,eco} \times 1000$$

$K_{sed-water}$ [m^3 pore water/m^3 wet sediment]: partition coefficient between sediment and water
RHOsed [kg/m^3 ww]: bulk density of wet sediment
$QS_{fw,eco}$ [µg/l] : Quality standard for freshwater, based on ecotoxicological tests

$$K_{sed-water} = \frac{Ctotalsed}{Cporewater} \text{ by definition.}$$

$$K_{sed-water} = F_{airsed} \times K_{air-water} + F_{watersed} + F_{solidsed} \times Kp_{sed} \times RHO_{solid}$$

Kpsed: partition coefficient solid-water in sediment



Risk 'sources (S)-pathways (P)-receptors (R)' model [Brils et al., 2014].

Look out for more details in CIS Guidance 27 and SIMONA Evaluation Protocol

Evaluation method

More site-specific information is needed

Global

EQSs delivered by EU are generics. Goal is to protect the 90% of the EU waters.

- Used supporting factors (eg. Ksed-water and RHOsed) are selected via worst-case scenario.

Pass
Good status

Fail

Regional / QS for group

EQSs delivered for region or waterbody group. Goal is to protect the 90% of the grouped waterbodies.

- Used supporting factors (eg. Ksed-water and RHOsed) are selected for representing the waterbody group.

SIMONA Evaluation Protocol will help with it.

Pass
Good status

Fail

Local

EQSs delivered for local conditions. Goal is to protect the selected waterbody.

- Used supporting factors (eg. Ksed-water and RHOsed) are selected for representing the waterbody.

Pass
Good status

What to measure as supporting parameter?

Local site-specific information:

- Contaminant concentration in sediment
- Contaminant concentration in pore water
- Wet weight of sediment sample
- Volume of wet sediment sample
- Dry matter content of sediment sample
- Weight fraction of organic carbon in sediment
- Density of the solid phase of sediment or type of the sediment
- Other physical-chemical parameters may be helpful: pH, temperature, type, smell, color

Why measure sediment?

Sediment-quality monitoring is able to help

1. to **protect benthic** community
2. to **supplement the conventional water monitoring** in cost-effective way
3. to contribute to **answer why ecological status is not good** or excellent

Results of chemical status assessment

4. to find the **pollution sources**
5. to **locate the most risky** / polluted areas
6. to help to **optimize the monitoring programs** (eg. where should be measured next time)

Helping for the sampling design. Which parameters are relevant in the catchment?

Why measure sediment?

Sediment-quality monitoring by trend monitoring can be helpful

6. concentrations of substances are below detection limits, declining or stable and **there is no obvious risk of increase** *(eg. Persistence substances)*
7. to assess **long-term changes in natural conditions**
8. to assess **long-term changes** from widespread **anthropogenic** activity
9. **to monitor the** progressive **reduction** in the concentrations

Thank you for your attention!

contact: Katalin Mária DUDÁS; kata.9.dudas@gmail.com

Please join:

SIMONA Training event 3. for 'How to Evaluate' in October!

Further information please subscribe to the SIMONA newsletter:

http://www.interreg-danube.eu/approved-projects/simona/campaigns

SIMONA Case Studies from the Test Areas

DRAVA Test Area (DTA)

à ↕ XIь ₲ Ц Y &XD↓⊞Ы↕ v (Scientific Coordinator)

25 March 2021

Project co-funded by the European Union
http://www.interreg-danube.eu/approved-projects/simona

0. BACKGROUND – RIVER DRAVA

DRAVA RIVER BASIN

The **River Drava** is one of the largest and most significant rivers in Central Europe

- The whole length of the river is approximately 749 km, it is running 140 km long, along the **border** between Hungary and Croatia
- These countries are **downstream regions** of the river with meandering character, different biogeographical properties and sedimentation.
- There is a regional **historical pollution**, originating mainly from **mining and smelting industry** in the Alps can be found in the sediments and in the soils in the floodplain.
- Moreover, **industrial areas, water power plants**, water reservoirs, agricultural areas, forests and numerous settlements can be found all along the river.

1. AIM OF THE CASE STUDY

Testing of chosen samplers and evaluating the sediment samples

The testing of chosen samplers according to the following major criteria:

- Selection of monitoring sites based on preliminary survey
- Testing of different sampling methods
- Feedback of the results.

2. SITES – INITIAL PLAN

Nr.	Code	Name of the river	Name of the site	WGS Long	WGS Lat	Owner of water monitoring data	Owner of sediment monitoring data	Responsible for sampling	Existent archive water, sediment monitoring data	Comments
1.	AEP543	' Ł θ ā ó stream	+ ¯ ī Γ ù	⚀ ✓ す ⚄ ⚀	⚄ ⚅ す ⚅ ×	OVF	SIMONA Prj	HU-SZIE	Only water	**Relocated, modified water body**
2.	AEP852	Okor- " Ж ú ú θ IJ Z Ł	3 Ł ð ā ī í	⚀ ✓ す ⚅ ⚅	⚄ ⚅ す ⚅ ×	OVF	SIMONA Prj	HU-SZIE	Only water	-
3.	AEP875	0 ¯ ì-IJ ħ Z ø	: ε ú	⚀ × す ⚀ ⚅	⚄ √ す ⚀ ⚀	OVF	SIMONA Prj	HU-SZIE	Only water	**Relocated**
4.	AEP361	" Ж ú ú θ ł Ħ é ē é	' ø ü IJ ł	1 ✓ す ⚅ ✓ ⚅	⚄ ⚅ す ⚅ ⚄	OVF	SIMONA Prj	HU-SZIE	Only water	-
5.	AEP571	(ð ó Ł -é stream	Hegyszent þ ł Ħ ī đ	⚀ × す ⚀ ⚅	⚄ ⚅ す ⚅ ⚄	OVF	SIMONA Prj	HU-SZIE	Only water	**Replaced**
6.	AEP453	Egerszegi csatorna	+ đ IJ ł ì ħ	⚀ × す ⚀ ⚀	⚄ ⚅ す ⚅ ⚀	OVF	SIMONA Prj	HU-SZIE	Only water	-
7.	AEP478	Fekete-IJ Z	# Γ ā	⚀ × す ⚀ ⚄	⚄ ⚅ す ⚄ ×	OVF	SIMONA Prj	HU-SZIE	Only water	**Relocated, modified water body**
8.	AEP438	$ Ħ ł IJ	$ Ħ ł IJ é ħ ł	⚀ × す ⚀ ⚀	⚄ ⚅ す ⚄ √	OVF	SIMONA Prj	HU-SZIE	Only water	**Relocated**
9.	CROATIA (HR5)	Drava	Donji Miholjac	⚀ × す ⚀ ⚀	⚄ ⚅ す ⚄ √	OVF	SIMONA Prj	HU-SZIE	Only water	**Replaced**
10.	SIMONA CODE	$ Ħ ł IJ	before the Fekete-IJ Z Ł - ary	⚀ × す ⚀ ×	⚄ ⚅ す ⚄ √	OVF	SIMONA Prj	HU-SZIE	new site	**Replaced**

List of the originally planned sampling sites

The selection of monitoring sites is based on the following major criteria:

- Monitoring sites that have been monitored in the past and therefore suitable for long term trend analyses
- Transnational character
- The catchment area is characterized by small watercourses
- Existing authority water monitoring sites and moderate water quality (polluted area)
- Different typology and hydromorphology
- Diverse pollution points and diffuse sources
- Good infrastructure (accessibility, depth of water, parking place etc.)

2. SITES DETAILED PRELIMINARY SURVEY

1/ Relocation of the sampling sites due to inadequate site conditions

Two sites (à XI5Å↑ Ш↑↓Ц↕) had to be replaced with new sites (Y ϕ I, Barcs).

WHY?

a) t ϕ д↑⇓≠6⇑ XI Å

The site was not suitable for sediment sampling due to dense vegetation cover inhibiting access to sampling points.

b) 5 ↑ Ц,I5↓↑Ц Ш↑↓Ц↕ ⇑ Ц г IX⅓ д ↕

The large river Drava bottom sediment at sampling site Barcs will be collected from boat by the Water Management Directorate. This location will be the Training Event venue, too.

Landscape photo of the sampling site ϕ д↑⇓≠6⇑ XI Å
Dense vegetation inhibit sediment sampling.

Interreg
Danube Transnational Programme
SIMONA

SIMONA Training Event on Sediment Sampling

25 March 2021

SIMONA Case Studies from the Test Areas

South Danube Test Area (SDTA)

Irena Peytcheva & Atanas Hikov (GI-BAS)

With contribution from:
Bulgaria: Petyo Filipov, Zlatka Milakovska (GIBAS)
Romania: Anca-Marina Vijdea, Albert Baltres (RO-IGR)
Serbia: Prvoslav Marjanovic, Dragica Vulic, Dragan Aleksic, Marko Marjanovic (RS-JCI), Kristina Saric, Vladica Cvetkovic (RS-UB-FMG)

Project co-funded by the European Union
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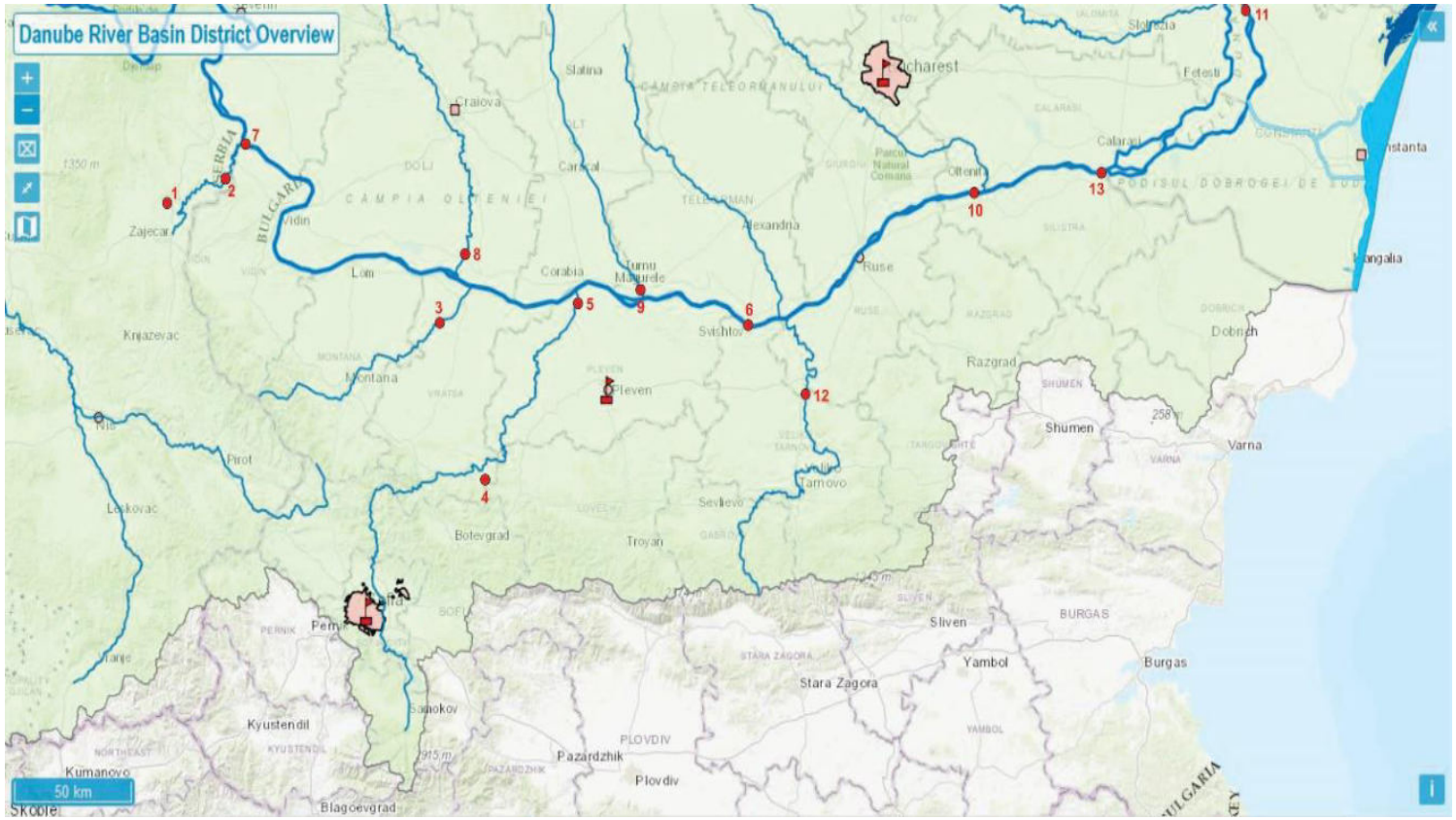
SIMONA Training Event on Sediment Sampling: SDTA case studies



The South Danube test area comprises part of the Lower Danube River, including a number of large and small tributaries.

The area is characterized by present and past mining activities and industrial and agricultural activities, which could contribute to the overall sediment pollution.

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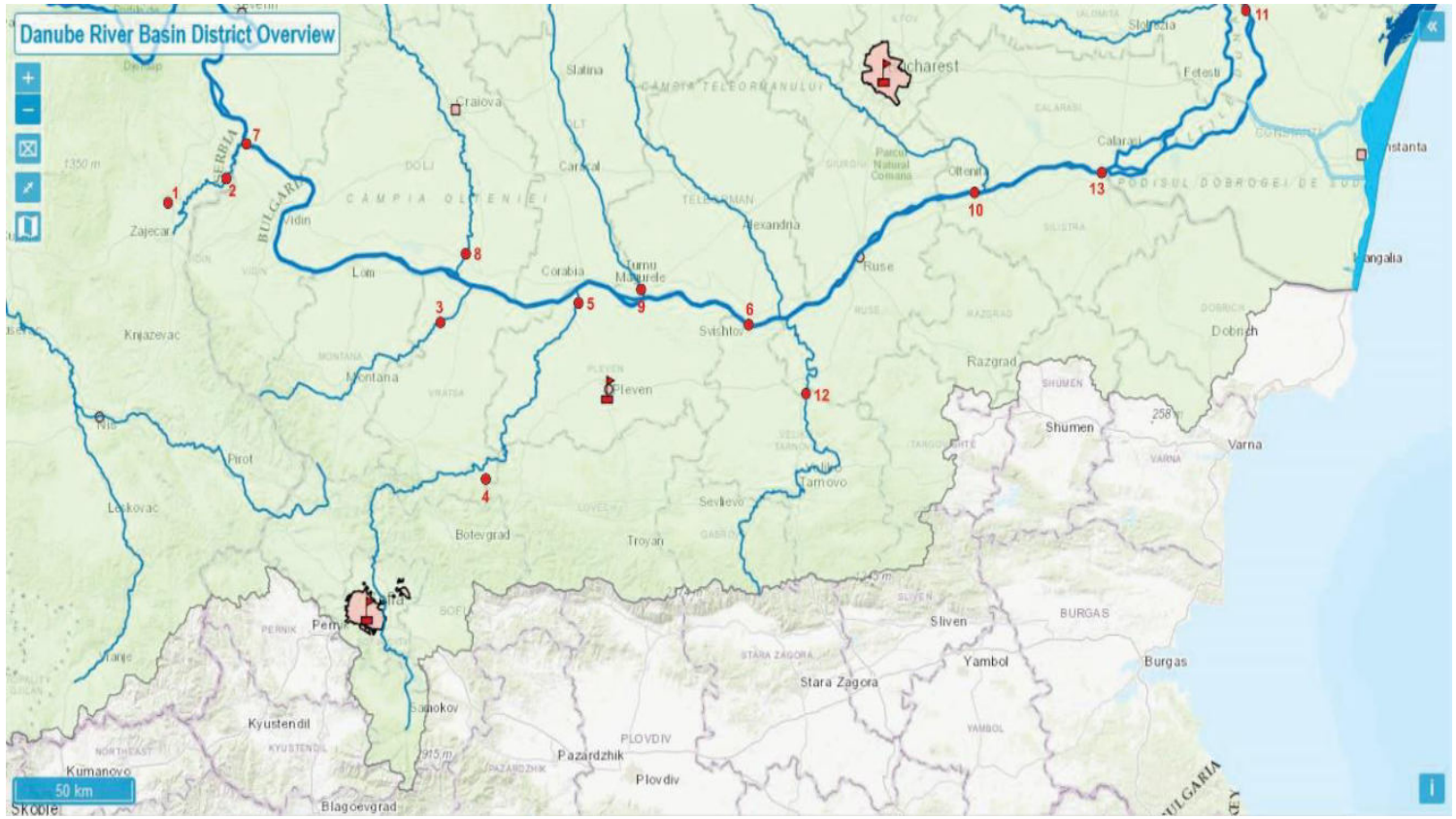

Sampling sites in the South Danube test area were selected based on the following major criteria:

- Trans-national character;
- Covering rivers of different size (small, medium, and large), including the Danube River;
- Existing sediment/water monitoring sites;
- Different geology;
- Diverse pollution sources;
- Good infrastructure.

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Nr.	Name of the river	Name of the site	WGS Long	WGS Lat	Suspended sediment	Bottom sediment	Floodplain sediment	Responsible for sampling	Comment
1.	Borska Reka	Rgotina	44º01'49,78"	22º12'39,18"	no	yes	yes	UB/ GI-BAS	Site moved upstreem
2.	Timok	Timok at Bregovo	44º06'14,3"	22º34'13,5"	no	yes	yes	UB/ GI-BAS	Site moved upstreem
3.	Ogosta	Ogosta before Danube at Mizia	43.691609	23.826234	no	yes	yes	GI-BAS	Site moved slightly upstreem
4.	Malak Iskar	Malak Iskar near Roman	43.135981	23.926079	no	yes	yes	GI-BAS	New coordinates
5.	Iskar	Iskar before Danube at Baykal	43.703047	24.456328	no	yes	yes	GI-BAS	Site moved downstreem
6.	Danube	Danube at Svishtov-Zimnicea	43.620321	25.360049	In contracting stage-Ro	In contracting stage-Ro	yes	GI-BAS/ IGR	New coordinates
7.	Danube	Danube at Pristol	44.2132	22.682069	In contracting stage	In contracting stage	yes	IGR/ GI-BAS	
8.	Jiu	Zaval, downstream of bridge	43.841761	23.844953	In contracting stage	In contracting stage	yes	IGR	
9.	Olt	Islaz, upstream Danube confluence	43.717558	24.792675	In contracting stage	In contracting stage	yes	IGR	
10.	Danube	Oltenița (upstream confluence Argeș)	44.054251	26.605097	In contracting stage	In contracting stage	yes	IGR/ GI-BAS	
11.	Danube	Hârșova	44.68058	27.95259	In contracting stage	In contracting stage	yes	IGR	Additional station

Serbian, Romanian, and Bulgarian Project Partners (PPs) from the South Danube Catchment area countries agreed upon the following sites:

- 1 sampling point at the Borska Reka tributary (SRB);
- 1 sampling point at the Timok River in its transboundary part (BG/SRB);
- 1 sampling point at the Ogosta River (BG);
- 2 points in the Iskar River basin (BG) – one above the confluence with the Danube and one at its tributary Malak Iskar River;
- 1 sampling point at the lower Jiu River (RO);
- 1 sampling point at the Lower Olt River (RO);
- 3 transnational sampling points/transects (RO/BG) at the Danube River: near Pristol (Romania), near Svishtov (Bulgaria) and near Oltenita (Romania).

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SIMONA Training Event on Sediment Sampling: SDTA case studies

Detailed preliminary survey of the sampling sites is required (according to the accepted ISO standards and WFD Guidance Documents) following the minimum criteria:

a. Logistic issues;

b. Accessibility of the sampling location under different environmental conditions;

c. Characteristics of the river/stream section to be sampled;

d. Possible local influences on the sampling site;

e. Security of sampling staff;

f. Need for special equipment to access the sampling site;

g. Heterogeneity of the sediment at the sampling site;

h. Bottom sediment, floodplain sediments and suspended sediment issues.

The right bank of Iskar R., view from the bridge near Orehovitsa village

- local contamination with waste from quartz-kaolinite mine

New sampling site of Iskar R. at Baykal village

SIMONA Training Event on Sediment Sampling: SDTA case studies

Detailed preliminary survey of the sampling sites

- The pre-sampling survey of the Bulgarian part at Ogosta River Oryhovo site revealed potential danger to the sampling staff, bad environment for floodplain sampling and possible contamination from the next motel, so the site was moved upstream to the Miziya town.
- The pre-sampling survey of the Serbian part of the SDTA found out that the Borska Reka site at Rgotina is contaminated and compromised, so the site was moved upstream. The Timok at Bregovo sampling site is on the border between Serbia and Bulgaria, which complicates the sampling procedure and the site was moved upstream.

The right bank of Ogosta R. at Oryahovo with the rusty ladder

The new sampling site of Ogosta R. at Miziya

Contaminated site at Rgotina, Borska R.

New sampling site of Borska R.

SIMONA Training Event on Sediment Sampling: SDTA case studies

SEDIMENT SAMPLING

After the virtual Sampling Harmonization training event (Harkany, July, 2020) and practical training event in Serbia during the sampling campaign at the Serbian SDTA sites (09.2020).

Equipment

The important rules of the protocol were followed strictly:
Use of gloves! All hand jewellery removed!
Smoking is not permitted! All tools and containers cleaned of contaminants!

- ***Metal tools for samples for organic compounds analyses and plastic tools for inorganic compounds***

Setting up the workspace

SIMONA Training Event on Sediment Sampling: SDTA case studies

SEDIMENT SAMPLING

Bottom/stream sediments

Depth: 5 (to 10) cm
Scoop and corer sampler
Separate metal and plastic tools
Composite samples (5 sub-samples)
Homogenization on site

Collection of bottom sediment with scoop at Borska R. site

Collection of bottom sediment with corer sampler at Malak Iskar site

Taking separate samples from undisturbed bottom sediment core sample

Collection of bottom sediment with corer sampler at Timok site

SIMONA Training Event on Sediment Sampling: SDTA case studies

SEDIMENT SAMPLING
Floodplain sediments

Depth: 20 cm – active layer
Auger sampler (metal)
Separate metal and plastic tools
Composite samples (5 sub-samples)
Homogenization on site

Collection of floodplain sediment with Auger sampler at Iskar R. site

Transfer of composite floodplain sample for heavy/hazardous metals in the brown glass jar

Floodplain sediment collection with Auger sampler at Timok site

Collection of floodplain sediment with Auger sampler at Svishtov site

Sieving the composite sample of floodplain sediments to <2 mm

SIMONA Training Event on Sediment Sampling: SDTA case studies

SEDIMENT SAMPLING

Floodplain sediments

(4 Romanian sites)

Depth: 50 cm – top soil (5 cm) and bottom soil (5-50 cm)

Shovel (metal)

Composite samples

ANAR's sediment monitoring station at Zimnicea (left); Profile on Cheson beach at Zimnicea for floodplain sediment sampling (right)

One of the 5 holes dug for bottom soil sediments, showing an alternation of sand and clay layers at Zaval on Jiu River

Topsoil of the floodplain sediments at Pristol (sampling depth: 0-5 cm)(left); Hole dug for bottom soil sampling at 40-50 cm depth (right)

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SEDIMENT SAMPLING

SUSPENDED SEDIMENTS

It was only-possible in high turbidity rivers (measured with Secci disk).
20 l plastic can; the sediment settled for 2 days, the water was decanted and the rest of 2 litres + SS sent to Balint Analiticals

In-situ measurements

temperature, electrical conductivity, pH, transparency (according to the standard ISO 7027:2001)
Field observation sheets - printed or using the SIMONA IT tool (tablet)

Collection of suspended sediment with plastic can at Svishtov site

Measurement of turbidity with Secci disk at Silistra site

Taking in situ measurements in the floodplain sediments at Borska reka

Taking in situ measurements in the Iskar River

SIMONA Training Event on Sediment Sampling: SDTA case studies

SEDIMENT SAMPLING

Coding, storage and transport

Uniform codes

Storage and transport in cooling boxes

RO-SDTA

Test Area ID	sample site	Sample type	Sample number	Sample depth	Duplicate
	MI (Malak Iskar)	BS	1	0-10 cm	D
SDTA	IS (Iskar)		2	10-25 cm	
	OG (Ogosta)	FS	1		
	SV (Svishtov)				
	BR (Borska Reka)	SS	1		
	TI (Timok)				

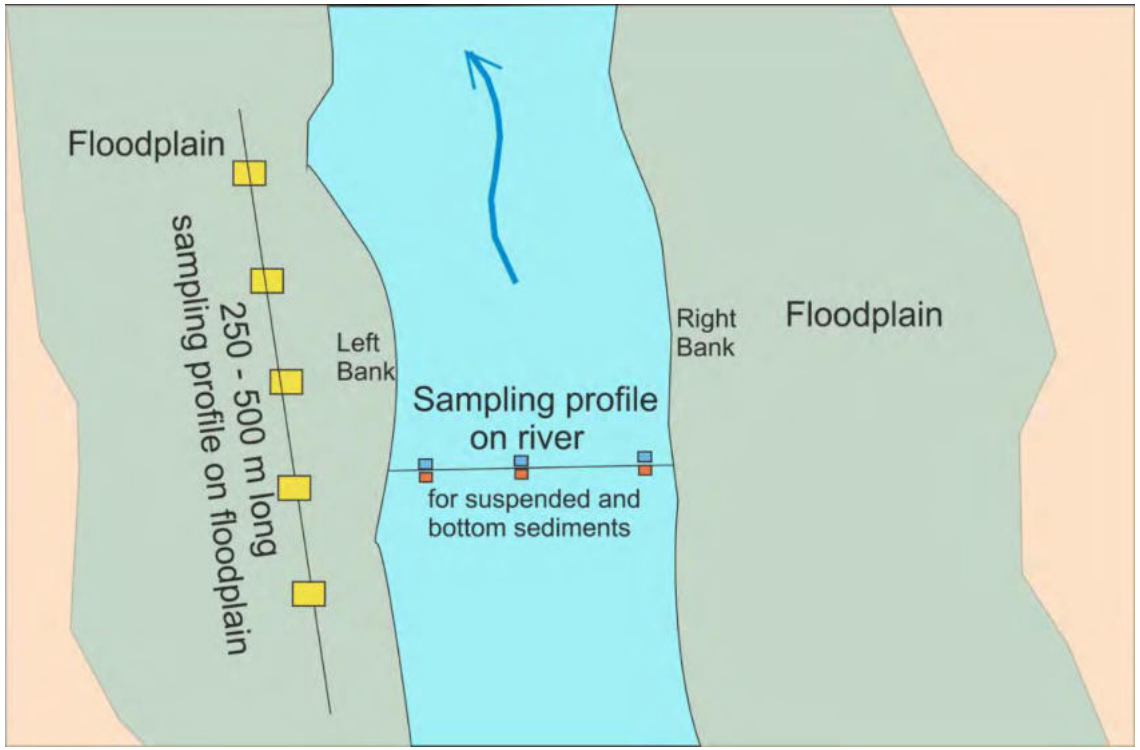
SEDIMENT SAMPLING Coding, storage and transport Uniform codes, comments

Sample ID	Sampling method	Sampling date	Sample type	Package	NOTES	NOTES	NOTES	Depth
SDTA-MIBS-01	vakuum corer	15.09.2020	bottom sediment	1 white jar	composite of 5 samples	for organic components		0-5/10 cm
SDTA-MIBS-01	vakuum corer	15.09.2020	bottom sediment	1 brown jar	composite of 5 samples	for metals		
SDTA-MIBS-01	vakuum corer	15.09.2020	bottom sediment	1 plastic bag	composite of 5 samples	for granulometry		
SDTA-MIFS-01	auger sampler	15.09.2020	floodplain sediment	1 white jar	composite of 5 samples	for organic components	dry sieved to -2 mm	0-20 cm
SDTA-MIFS-01	auger sampler	15.09.2020	floodplain sediment	1 brown jar	composite of 5 samples	for metals	dry sieved to -2 mm	
SDTA-MIFS-01	auger sampler	15.09.2020	floodplain sediment	1 plastic bag	composite of 5 samples	for granulometry		
SDTA-ISBS-01	scoop	16.09.2020	bottom sediment	1 white jar	composite of 5 samples	for organic components		0-5/10 cm
SDTA-ISBS-01	scoop	16.09.2020	bottom sediment	1 brown jar	composite of 5 samples	for metals		
SDTA-ISBS-01	scoop	16.09.2020	bottom sediment	1 plastic bag	composite of 5 samples	for granulometry		
SDTA-ISFS-01	auger sampler	16.09.2020	floodplain sediment	1 white jar	composite of 5 samples	for organic components		0-20 cm
SDTA-ISFS-01	auger sampler	16.09.2020	floodplain sediment	1 brown jar	composite of 5 samples	for metals		
SDTA-ISFS-01	auger sampler	16.09.2020	floodplain sediment	1 plastic bag	composite of 5 samples	for granulometry		
SDTA-OGBS-01	scoop	17.09.2020	bottom sediment	1 white jar	composite of 5 samples	for organic components	wet sieved to -2 mm	0-5/10 cm
SDTA-OGBS-01	scoop	17.09.2020	bottom sediment	1 brown jar	composite of 5 samples	for metals	wet sieved to -2 mm	
SDTA-OGBS-01	scoop	17.09.2020	bottom sediment	1 plastic bag	composite of 5 samples	for granulometry		
SDTA-OGFS-01	auger sampler	17.09.2020	floodplain sediment	1 white jar	composite of 5 samples	for organic components		0-20 cm
SDTA-OGFS-01	auger sampler	17.09.2020	floodplain sediment	1 brown jar	composite of 5 samples	for metals		
SDTA-OGFS-01	auger sampler	17.09.2020	floodplain sediment	1 plastic bag	composite of 5 samples	for granulometry		
SDTA-SVBS-01	scoop	06.10.2020	bottom sediment	1 white jar	composite of 5 samples	for organic components		0-5/10 cm
SDTA-SVBS-01	scoop	06.10.2020	bottom sediment	1 brown jar	composite of 5 samples	for metals		
SDTA-SVBS-01	scoop	06.10.2020	bottom sediment	1 plastic bag	composite of 5 samples	for granulometry		
SDTA-SVFS-01	auger sampler	06.10.2020	floodplain sediment	1 white jar	composite of 5 samples	for organic components		0-20 cm
SDTA-SVFS-01	auger sampler	06.10.2020	floodplain sediment	1 brown jar	composite of 5 samples	for metals		
SDTA-SVFS-01	auger sampler	06.10.2020	floodplain sediment	1 plastic bag	composite of 5 samples	for granulometry		
SDTA-SVSS-01	barrel	06.10.2020	suspending sediment	2 bottles	decanted water from 20 l			

MAIN CONCLUSIONS AND EXPERIENCE GAINED

- the sampling exercise has confirmed the ISO recommendation, which is also reiterated by the WFD Guidance Documents, that prior to any sediment monitoring a detailed **preliminary monitoring site investigation** is required

- **Bottom sediment sampling issues**
  - possible to use different sampling methods and equipment to achieve similar results as prescribed by the SIMONA protocol (scoop for small rivers; corer sampler for large rivers)
  - Separate collection of samples for analyses of organic and inorganic substances



General scheme of sampling sediments in big rivers (e.g. Danube). Sampling from boat: to be performed at Pristol, Svishtov and Silistra TN sites during the BN campaign

MAIN CONCLUSIONS AND EXPERIENCE GAINED

- **Floodplain sediment sampling issues**
  - In the SEDIMENT QUALITY SAMPLING PROTOCOL FOR HSS there are only RECOMMENDATIONS for the MONITORING of ACTIVE FLOODPLAIN sediments. "The floodplain sediments suitable for monitoring are deposits of suspended material onto active, regularly flooded floodplains and levees along rivers." The prescribed sampling depth for floodplain sediments in the FOREGS Atlas 0 – 25 cm was used for all points of SDTA.
  - "the separate sampling of individual flood events (e.g. the pre-industrial level (once) and the latest flood event (occasionally) is preferable and the results are more meaningful" ⇒ **BN sampling**

It has been demonstrated that it is possible to collect floodplain sediment samples using different kind of equipment.

The options that can be considered include:

i. Manual soil corers of different types

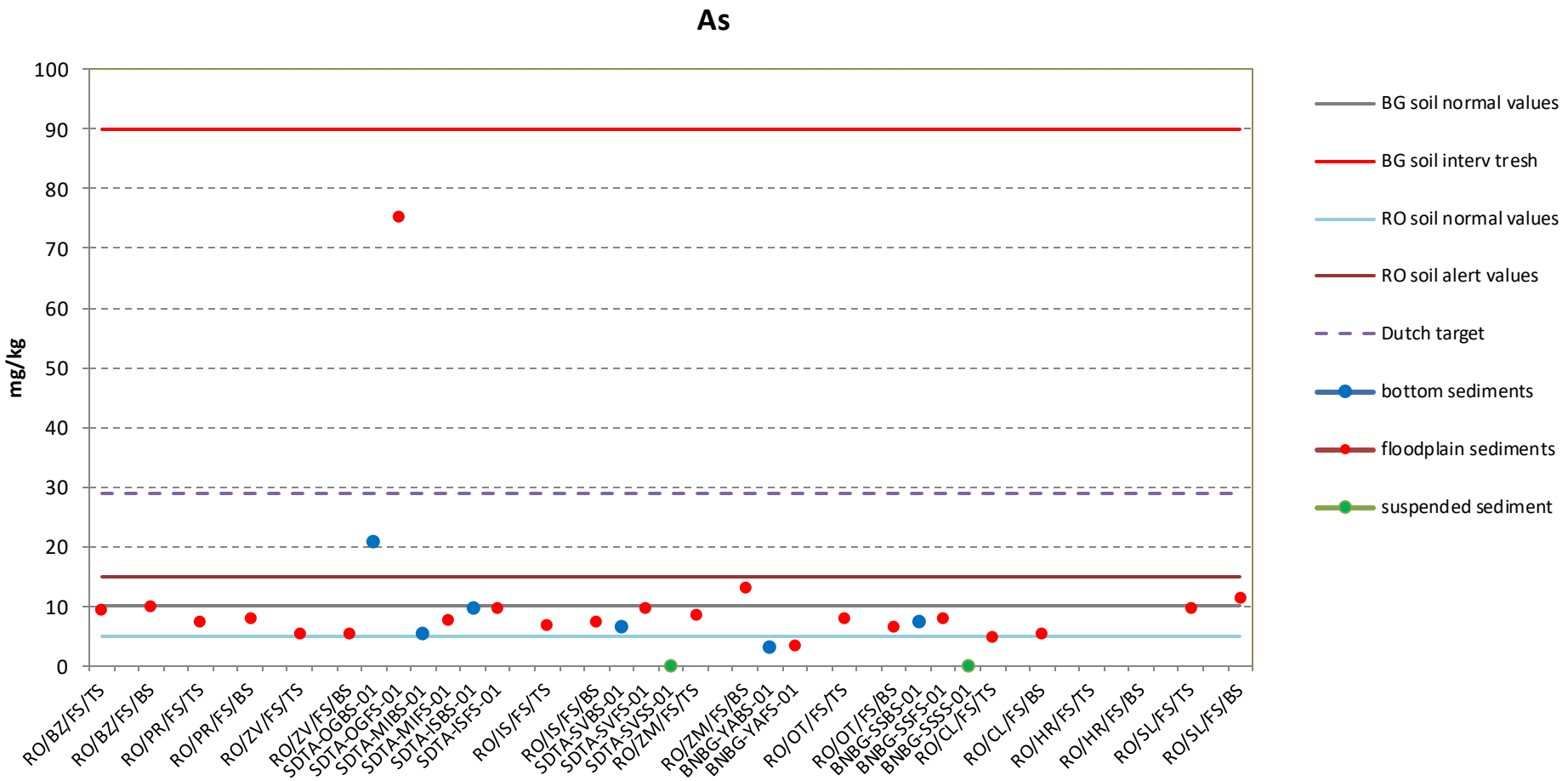
ii. Scoop and shovel/spade

MAIN CONCLUSIONS AND EXPERIENCE GAINED

- **Suspended sediment sampling issues**
  - Specialized equipment is needed for collection of adequate volume of the samples in the field; sampling with a plastic can is possible but may face transport problems in a case of rivers with low turbidity;
  - Suspended sediments in rivers and streams can be extremely varying both in quantity and quality, and often governed by weather events;
  - To collect the sufficient amount of suspended sediments (100-300 g) for the sediment quality analysis, a large volume of water - 200 l (?) might be needed.
  - The quantity of water should be measured (?) to involve a normalization coefficient during laboratory analyses for HSs concentrations;
  - The suspended sediment sampling faces additional scientific problems such as what is the meaning of the gained information, because it would be representing the moment situation at the site and would leave open questions for the sediment source;
  - Which information cannot be obtained by other means and sampling techniques (BS, passive samplers, etc)?
  - ***Need for developing of harmonized techniques for suspended sediment sampling.***

SIMONA Training Event on Sediment Sampling: SDTA case studies

Results and possible sources of contamination



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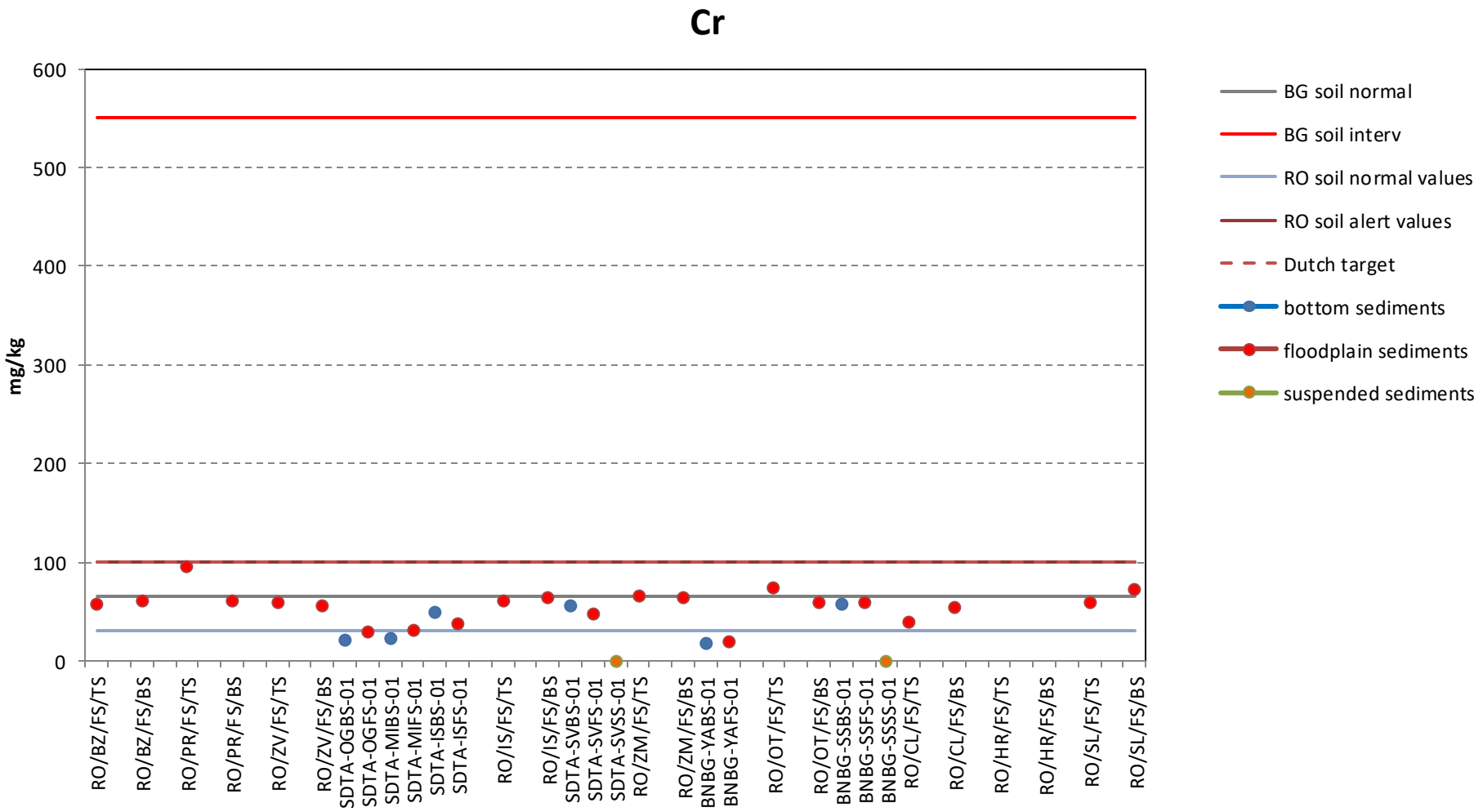
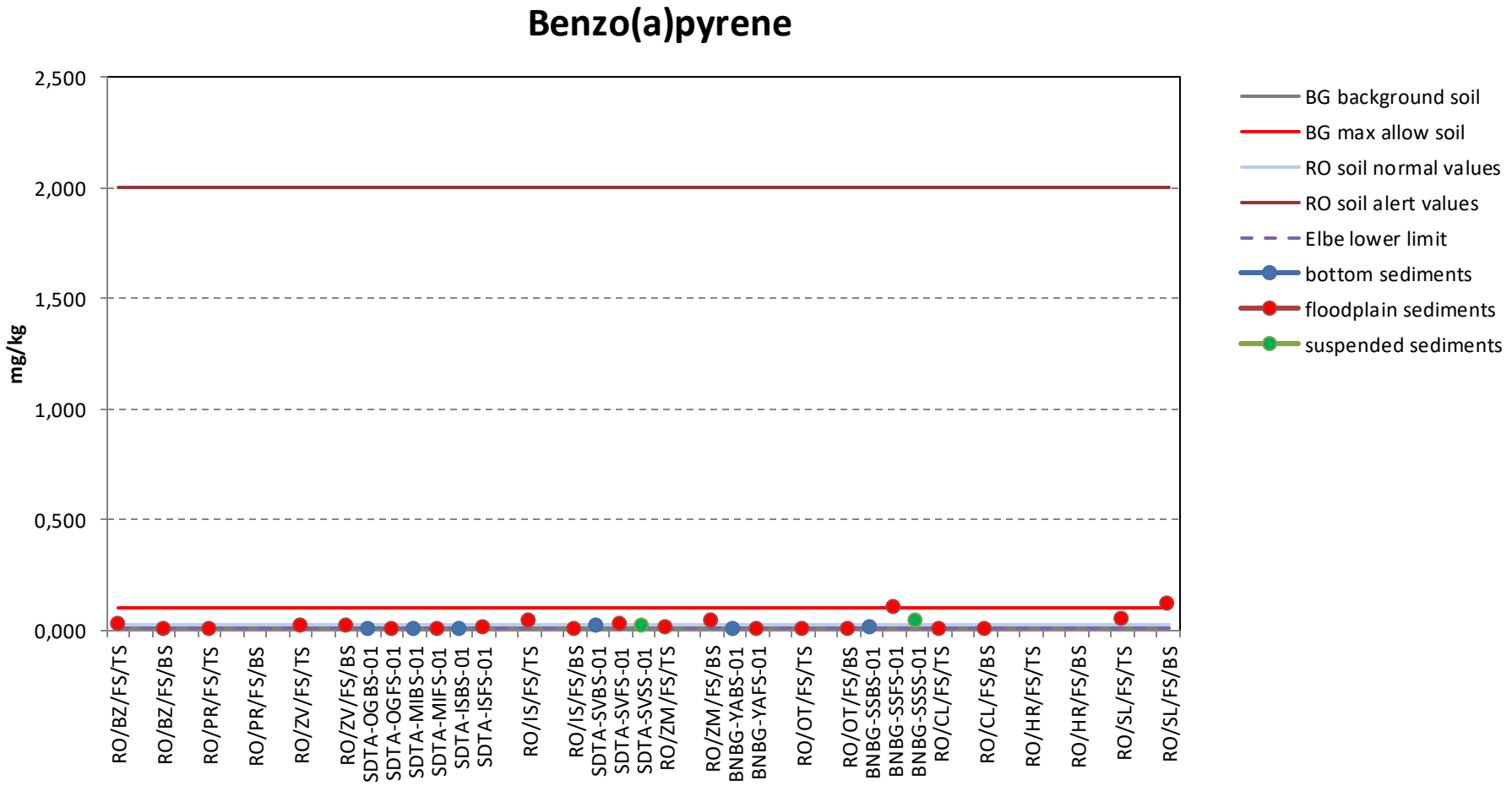
Results and possible sources of contamination



SIMONA Training Event on Sediment Sampling: SDTA case studies

Results and possible sources of contamination



Results and possible sources of contamination

PRELIMINARY CONCLUSIONS FOR POSSIBLE SOURCES OF CONTAMINATION

1. The elevated Zn, Cu, Pb, and As values in some catchments (Ogosta R., Iskar River, Borska Reka) result from current or past mining activity. The Cd values are normal, whereas Cr values are slightly elevated in some floodplain samples (Pristol, Bazias, Sulina) but not exceeding the soil alert values. The lowest values of monitored metals are measured in the suspended sediment samples of the SDTA sites, however further data are needed.

3. The identified organic compounds exceeding the normal EQS values are assumed to be generated during incomplete or low temperature combustion processes occurring in households (mainly in rural areas) or during road and river transportation. These organic components are found mainly in the Danube river sites and reveal values in the normal range in the catchments (Ogosta, Yantra and Iskar Rivers).

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SIMONA

SIMONA Training Event on Sediment Sampling

25 March 2021

SIMONA Case Studies from the Test Areas

South Danube Test Area (SDTA)

Irena Peytcheva & Atanas Hikov (GI-BAS)

With contribution from:
Bulgaria: Petyo Filipov, Zlatka Milakovska (GIBAS)
Romania: Anca-Marina Vijdea, Albert Baltres (RO-IGR)
Serbia: Prvoslav Marjanovic, Dragica Vulic, Dragan Aleksic, Marko Marjanovic (RS-JCI), Kristina Saric, Vladica Cvetkovic (RS-UB-FMG)

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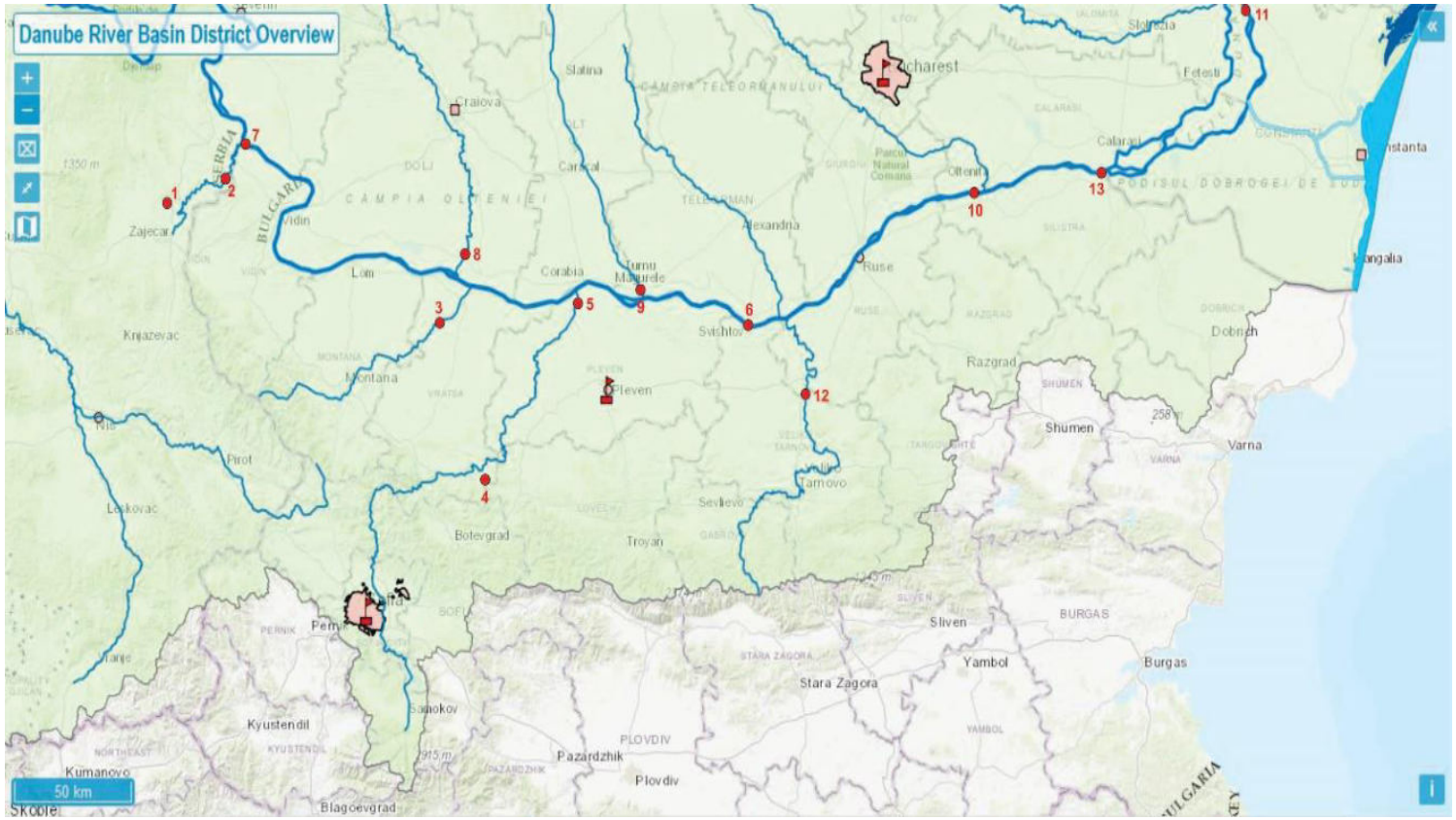
SIMONA Training Event on Sediment Sampling: SDTA case studies



The South Danube test area comprises part of the Lower Danube River, including a number of large and small tributaries.

The area is characterized by present and past mining activities and industrial and agricultural activities, which could contribute to the overall sediment pollution.

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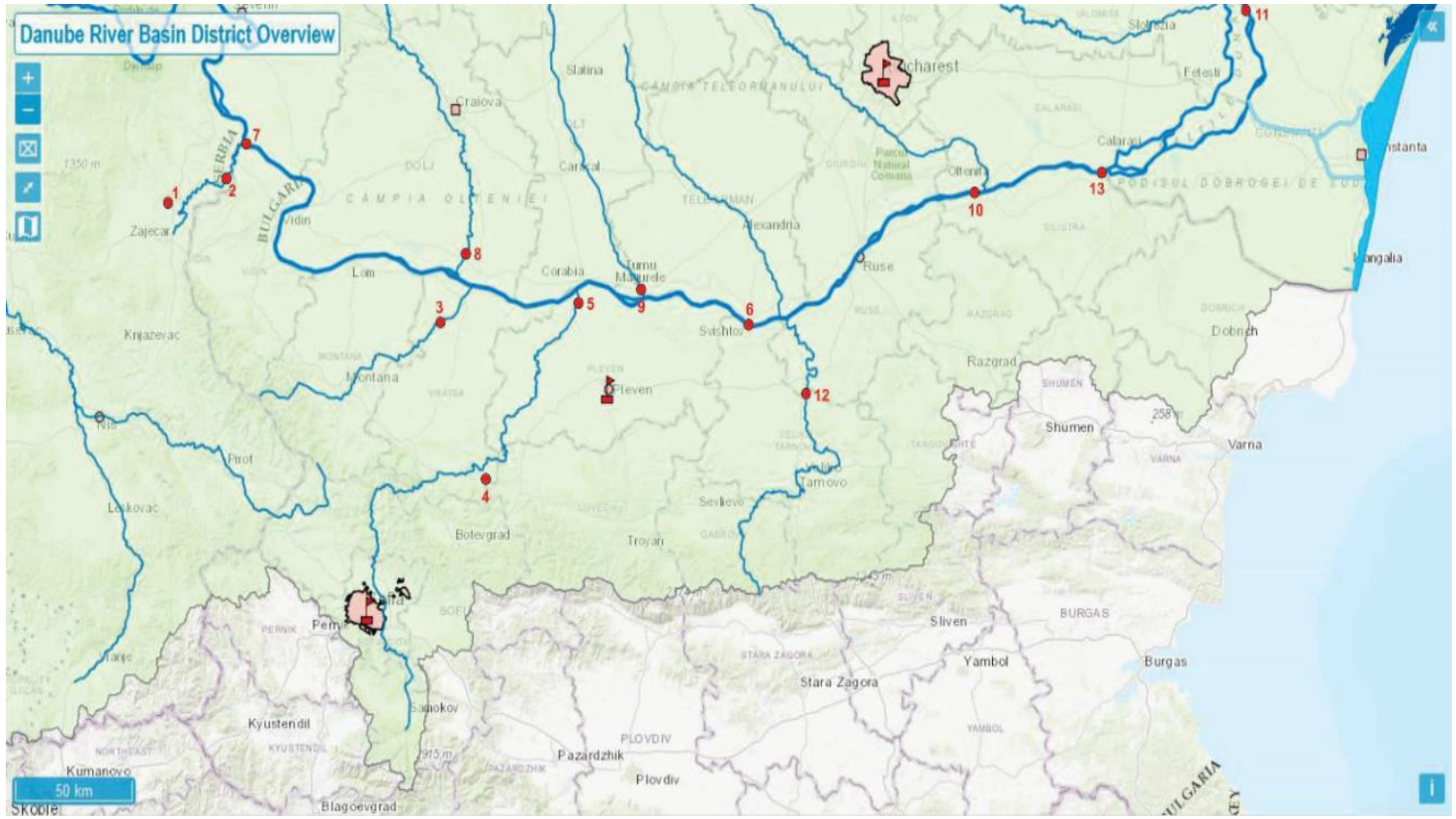

Sampling sites in the South Danube test area were selected based on the following major criteria:

- Trans-national character;
- Covering rivers of different size (small, medium, and large), including the Danube River;
- Existing sediment/water monitoring sites;
- Different geology;
- Diverse pollution sources;
- Good infrastructure.

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Nr.	Name of the river	Name of the site	WGS Long	WGS Lat	Suspended sediment	Bottom sediment	Floodplain sediment	Responsible for sampling	Comment
1.	Borska Reka	Rgotina	44º01'49,78"	22º12'39,18"	no	yes	yes	UB/ GI-BAS	Site moved upstreem
2.	Timok	Timok at Bregovo	44º06'14,3"	22º34'13,5"	no	yes	yes	UB/ GI-BAS	Site moved upstreem
3.	Ogosta	Ogosta before Danube at Mizia	43.691609	23.826234	no	yes	yes	GI-BAS	Site moved slightly upstreem
4.	Malak Iskar	Malak Iskar near Roman	43.135981	23.926079	no	yes	yes	GI-BAS	New coordinates
5.	Iskar	Iskar before Danube at Baykal	43.703047	24.456328	no	yes	yes	GI-BAS	Site moved downstreem
6.	Danube	Danube at Svishtov-Zimnicea	43.620321	25.360049	In contracting stage-Ro	In contracting stage-Ro	yes	GI-BAS/ IGR	New coordinates
7.	Danube	Danube at Pristol	44.2132	22.682069	In contracting stage	In contracting stage	yes	IGR/ GI-BAS	
8.	Jiu	Zaval, downstream of bridge	43.841761	23.844953	In contracting stage	In contracting stage	yes	IGR	
9.	Olt	Islaz, upstream Danube confluence	43.717558	24.792675	In contracting stage	In contracting stage	yes	IGR	
10.	Danube	Oltenița (upstream confluence Argeș)	44.054251	26.605097	In contracting stage	In contracting stage	yes	IGR/ GI-BAS	
11.	Danube	Hârșova	44.68058	27.95259	In contracting stage	In contracting stage	yes	IGR	Additional station

Serbian, Romanian, and Bulgarian Project Partners (PPs) from the South Danube Catchment area countries agreed upon the following sites:

- 1 sampling point at the Borska Reka tributary (SRB);
- 1 sampling point at the Timok River in its transboundary part (BG/SRB);
- 1 sampling point at the Ogosta River (BG);
- 2 points in the Iskar River basin (BG) – one above the confluence with the Danube and one at its tributary Malak Iskar River;
- 1 sampling point at the lower Jiu River (RO);
- 1 sampling point at the Lower Olt River (RO);
- 3 transnational sampling points/transects (RO/BG) at the Danube River: near Pristol (Romania), near Svishtov (Bulgaria) and near Oltenita (Romania).

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Detailed preliminary survey of the sampling sites is required (according to the accepted ISO standards and WFD Guidance Documents) following the minimum criteria:

a. Logistic issues;

b. Accessibility of the sampling location under different environmental conditions;

c. Characteristics of the river/stream section to be sampled;

d. Possible local influences on the sampling site;

e. Security of sampling staff;

f. Need for special equipment to access the sampling site;

g. Heterogeneity of the sediment at the sampling site;

h. Bottom sediment, floodplain sediments and suspended sediment issues.

The right bank of Iskar R., view from the bridge near Orehovitsa village

- local contamination with waste from quartz-kaolinite mine

New sampling site of Iskar R. at Baykal village

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Detailed preliminary survey of the sampling sites

- The pre-sampling survey of the Bulgarian part at Ogosta River Oryhovo site revealed potential danger to the sampling staff, bad environment for floodplain sampling and possible contamination from the next motel, so the site was moved upstream to the Miziya town.
- The pre-sampling survey of the Serbian part of the SDTA found out that the Borska Reka site at Rgotina is contaminated and compromised, so the site was moved upstream. The Timok at Bregovo sampling site is on the border between Serbia and Bulgaria, which complicates the sampling procedure and the site was moved upstream.

The right bank of Ogosta R. at Oryahovo with the rusty ladder

The new sampling site of Ogosta R. at Miziya

Contaminated site at Rgotina, Borska R.

New sampling site of Borska R.

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SEDIMENT SAMPLING

After the virtual Sampling Harmonization training event (Harkany, July, 2020) and practical training event in Serbia during the sampling campaign at the Serbian SDTA sites (09.2020).

Equipment

The important rules of the protocol were followed strictly:
Use of gloves! All hand jewellery removed!
Smoking is not permitted! All tools and containers cleaned of contaminants!

- ***Metal tools for samples for organic compounds analyses and plastic tools for inorganic compounds***

Setting up the workspace

SIMONA Training Event on Sediment Sampling: SDTA case studies

SEDIMENT SAMPLING

Bottom/stream sediments

Depth: 5 (to 10) cm
Scoop and corer sampler
Separate metal and plastic tools
Composite samples (5 sub-samples)
Homogenization on site

Collection of bottom sediment with scoop at Borska R. site

Collection of bottom sediment with corer sampler at Malak Iskar site

Taking separate samples from undisturbed bottom sediment core sample

Collection of bottom sediment with corer sampler at Timok site

SIMONA Training Event on Sediment Sampling: SDTA case studies

SEDIMENT SAMPLING
Floodplain sediments

Depth: 20 cm – active layer
Auger sampler (metal)
Separate metal and plastic tools
Composite samples (5 sub-samples)
Homogenization on site

Collection of floodplain sediment with Auger sampler at Iskar R. site

Transfer of composite floodplain sample for heavy/hazardous metals in the brown glass jar

Floodplain sediment collection with Auger sampler at Timok site

Collection of floodplain sediment with Auger sampler at Svishtov site

Sieving the composite sample of floodplain sediments to <2 mm

SIMONA Training Event on Sediment Sampling: SDTA case studies

SEDIMENT SAMPLING

Floodplain sediments

(4 Romanian sites)

Depth: 50 cm – top soil (5 cm) and bottom soil (5-50 cm)

Shovel (metal)

Composite samples

ANAR's sediment monitoring station at Zimnicea (left); Profile on Cheson beach at Zimnicea for floodplain sediment sampling (right)

One of the 5 holes dug for bottom soil sediments, showing an alternation of sand and clay layers at Zaval on Jiu River

Topsoil of the floodplain sediments at Pristol (sampling depth: 0-5 cm)(left); Hole dug for bottom soil sampling at 40-50 cm depth (right)

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SEDIMENT SAMPLING

SUSPENDED SEDIMENTS

It was only-possible in high turbidity rivers (measured with Secci disk).
20 l plastic can; the sediment settled for 2 days, the water was decanted and the rest of 2 litres + SS sent to Balint Analiticals

In-situ measurements

temperature, electrical conductivity, pH, transparency (according to the standard ISO 7027:2001)
Field observation sheets - printed or using the SIMONA IT tool (tablet)

Collection of suspended sediment with plastic can at Svishtov site

Measurement of turbidity with Secci disk at Silistra site

Taking in situ measurements in the floodplain sediments at Borska reka

Taking in situ measurements in the Iskar River

SIMONA Training Event on Sediment Sampling: SDTA case studies

SEDIMENT SAMPLING

Coding, storage and transport

Uniform codes

Storage and transport in cooling boxes

RO-SDTA

Test Area ID	sample site	Sample type	Sample number	Sample depth	Duplicate
	MI (Malak Iskar)	BS	1	0-10 cm	D
SDTA	IS (Iskar)		2	10-25 cm	
	OG (Ogosta)	FS	1		
	SV (Svishtov)				
	BR (Borska Reka)	SS	1		
	TI (Timok)				

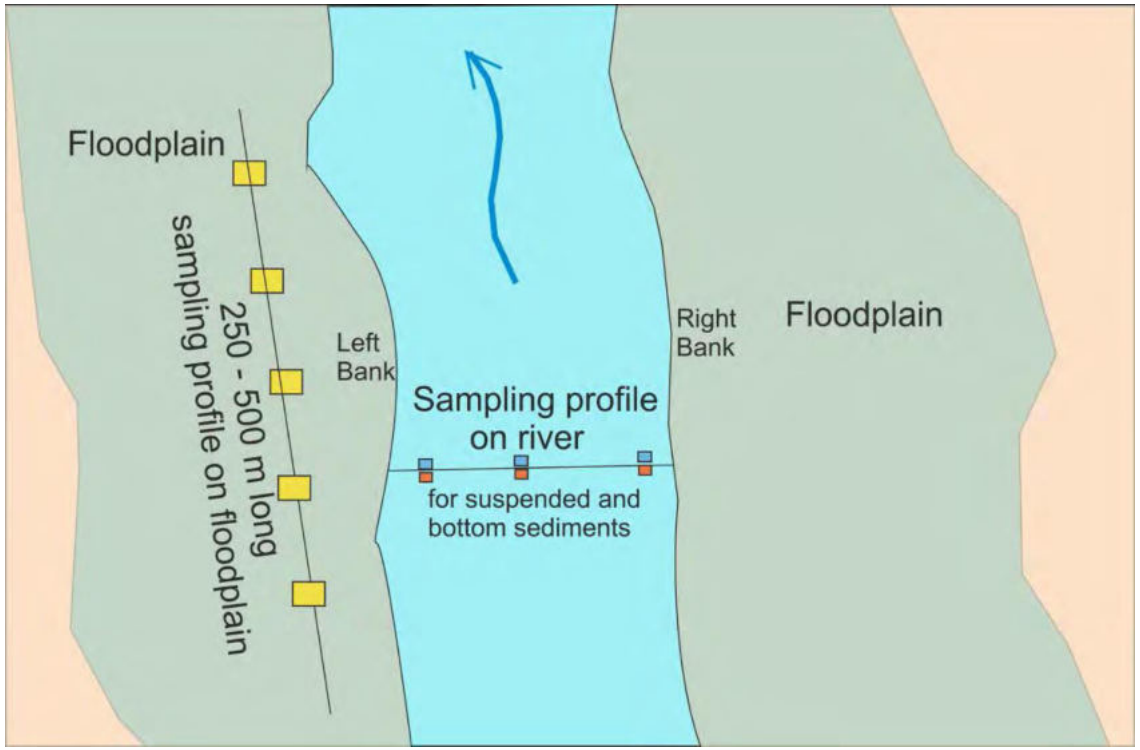
SEDIMENT SAMPLING Coding, storage and transport Uniform codes, comments

Sample ID	Sampling method	Sampling date	Sample type	Package	NOTES	NOTES	NOTES	Depth
SDTA-MIBS-01	vakuum corer	15.09.2020	bottom sediment	1 white jar	composite of 5 samples	for organic components		0-5/10 cm
SDTA-MIBS-01	vakuum corer	15.09.2020	bottom sediment	1 brown jar	composite of 5 samples	for metals		
SDTA-MIBS-01	vakuum corer	15.09.2020	bottom sediment	1 plastic bag	composite of 5 samples	for granulometry		
SDTA-MIFS-01	auger sampler	15.09.2020	floodplain sediment	1 white jar	composite of 5 samples	for organic components	dry sieved to -2 mm	0-20 cm
SDTA-MIFS-01	auger sampler	15.09.2020	floodplain sediment	1 brown jar	composite of 5 samples	for metals	dry sieved to -2 mm	
SDTA-MIFS-01	auger sampler	15.09.2020	floodplain sediment	1 plastic bag	composite of 5 samples	for granulometry		
SDTA-ISBS-01	scoop	16.09.2020	bottom sediment	1 white jar	composite of 5 samples	for organic components		0-5/10 cm
SDTA-ISBS-01	scoop	16.09.2020	bottom sediment	1 brown jar	composite of 5 samples	for metals		
SDTA-ISBS-01	scoop	16.09.2020	bottom sediment	1 plastic bag	composite of 5 samples	for granulometry		
SDTA-ISFS-01	auger sampler	16.09.2020	floodplain sediment	1 white jar	composite of 5 samples	for organic components		0-20 cm
SDTA-ISFS-01	auger sampler	16.09.2020	floodplain sediment	1 brown jar	composite of 5 samples	for metals		
SDTA-ISFS-01	auger sampler	16.09.2020	floodplain sediment	1 plastic bag	composite of 5 samples	for granulometry		
SDTA-OGBS-01	scoop	17.09.2020	bottom sediment	1 white jar	composite of 5 samples	for organic components	wet sieved to -2 mm	0-5/10 cm
SDTA-OGBS-01	scoop	17.09.2020	bottom sediment	1 brown jar	composite of 5 samples	for metals	wet sieved to -2 mm	
SDTA-OGBS-01	scoop	17.09.2020	bottom sediment	1 plastic bag	composite of 5 samples	for granulometry		
SDTA-OGFS-01	auger sampler	17.09.2020	floodplain sediment	1 white jar	composite of 5 samples	for organic components		0-20 cm
SDTA-OGFS-01	auger sampler	17.09.2020	floodplain sediment	1 brown jar	composite of 5 samples	for metals		
SDTA-OGFS-01	auger sampler	17.09.2020	floodplain sediment	1 plastic bag	composite of 5 samples	for granulometry		
SDTA-SVBS-01	scoop	06.10.2020	bottom sediment	1 white jar	composite of 5 samples	for organic components		0-5/10 cm
SDTA-SVBS-01	scoop	06.10.2020	bottom sediment	1 brown jar	composite of 5 samples	for metals		
SDTA-SVBS-01	scoop	06.10.2020	bottom sediment	1 plastic bag	composite of 5 samples	for granulometry		
SDTA-SVFS-01	auger sampler	06.10.2020	floodplain sediment	1 white jar	composite of 5 samples	for organic components		0-20 cm
SDTA-SVFS-01	auger sampler	06.10.2020	floodplain sediment	1 brown jar	composite of 5 samples	for metals		
SDTA-SVFS-01	auger sampler	06.10.2020	floodplain sediment	1 plastic bag	composite of 5 samples	for granulometry		
SDTA-SVSS-01	barrel	06.10.2020	suspending sediment	2 bottles	decanted water from 20 l			

MAIN CONCLUSIONS AND EXPERIENCE GAINED

- the sampling exercise has confirmed the ISO recommendation, which is also reiterated by the WFD Guidance Documents, that prior to any sediment monitoring a detailed **preliminary monitoring site investigation** is required

- **Bottom sediment sampling issues**
  - possible to use different sampling methods and equipment to achieve similar results as prescribed by the SIMONA protocol (scoop for small rivers; corer sampler for large rivers)
  - Separate collection of samples for analyses of organic and inorganic substances



General scheme of sampling sediments in big rivers (e.g. Danube). Sampling from boat: to be performed at Pristol, Svishtov and Silistra TN sites during the BN campaign

MAIN CONCLUSIONS AND EXPERIENCE GAINED

- **Floodplain sediment sampling issues**
  - In the SEDIMENT QUALITY SAMPLING PROTOCOL FOR HSS there are only RECOMMENDATIONS for the MONITORING of ACTIVE FLOODPLAIN sediments. "The floodplain sediments suitable for monitoring are deposits of suspended material onto active, regularly flooded floodplains and levees along rivers." The prescribed sampling depth for floodplain sediments in the FOREGS Atlas 0 – 25 cm was used for all points of SDTA.
  - "the separate sampling of individual flood events (e.g. the pre-industrial level (once) and the latest flood event (occasionally) is preferable and the results are more meaningful" ⇒ **BN sampling**

It has been demonstrated that it is possible to collect floodplain sediment samples using different kind of equipment.

The options that can be considered include:

i. Manual soil corers of different types

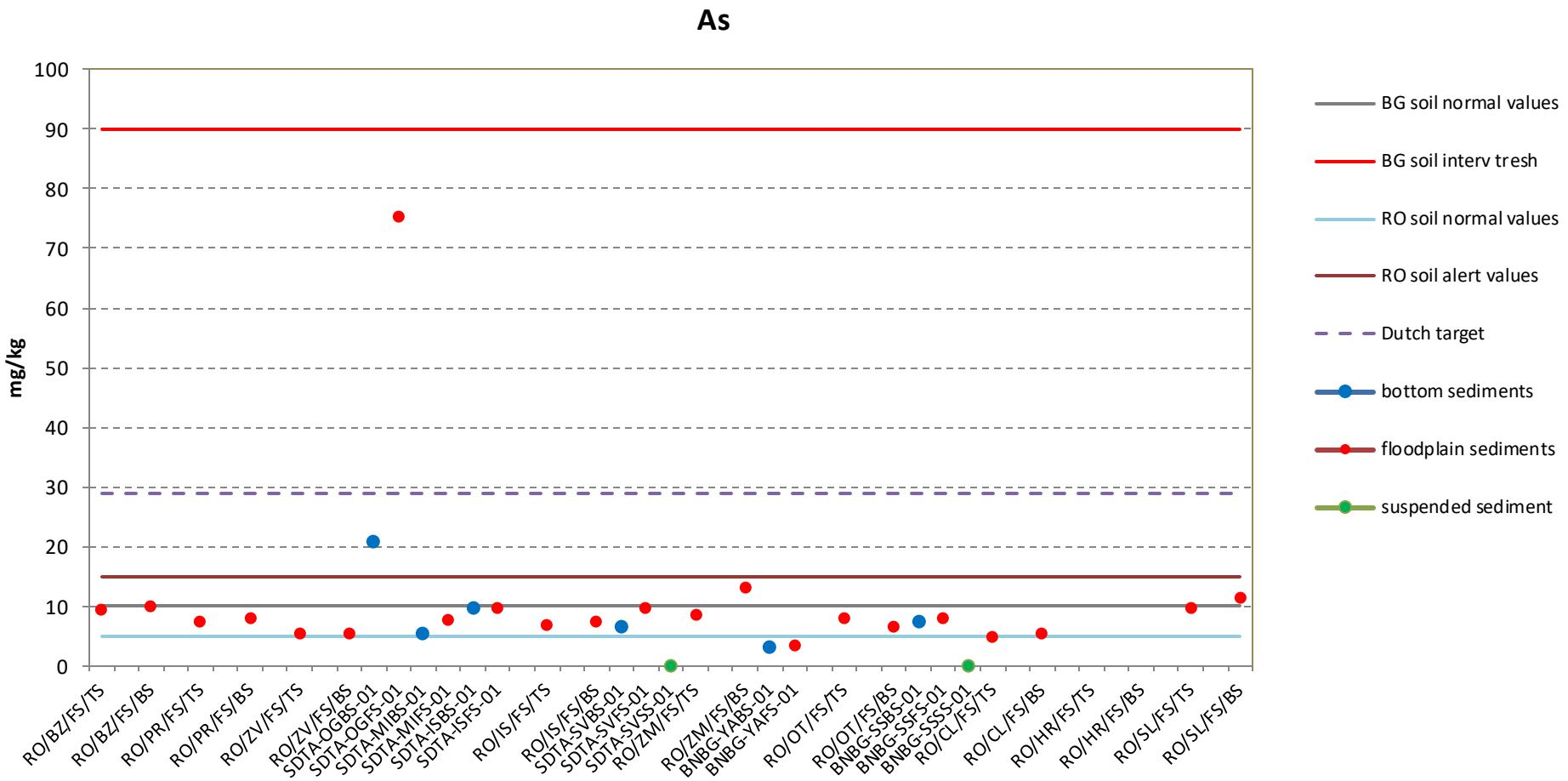
ii. Scoop and shovel/spade

MAIN CONCLUSIONS AND EXPERIENCE GAINED

- **Suspended sediment sampling issues**
  - Specialized equipment is needed for collection of adequate volume of the samples in the field; sampling with a plastic can is possible but may face transport problems in a case of rivers with low turbidity;
  - Suspended sediments in rivers and streams can be extremely varying both in quantity and quality, and often governed by weather events;
  - To collect the sufficient amount of suspended sediments (100-300 g) for the sediment quality analysis, a large volume of water - 200 l (?) might be needed.
  - The quantity of water should be measured (?) to involve a normalization coefficient during laboratory analyses for HSs concentrations;
  - The suspended sediment sampling faces additional scientific problems such as what is the meaning of the gained information, because it would be representing the moment situation at the site and would leave open questions for the sediment source;
  - Which information cannot be obtained by other means and sampling techniques (BS, passive samplers, etc)?
  - ***Need for developing of harmonized techniques for suspended sediment sampling.***

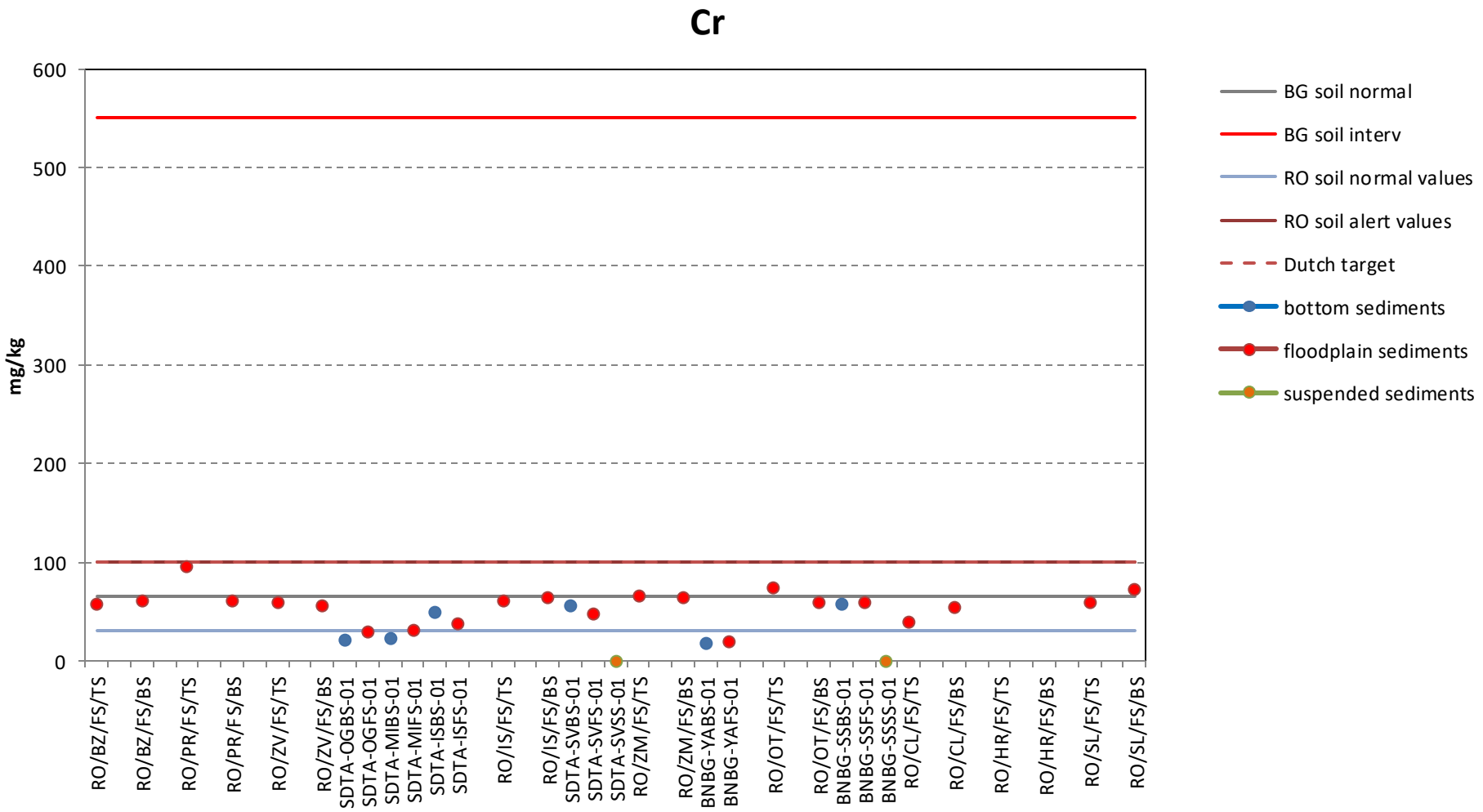
SIMONA Training Event on Sediment Sampling: SDTA case studies

Results and possible sources of contamination



SIMONA Training Event on Sediment Sampling: SDTA case studies

Results and possible sources of contamination



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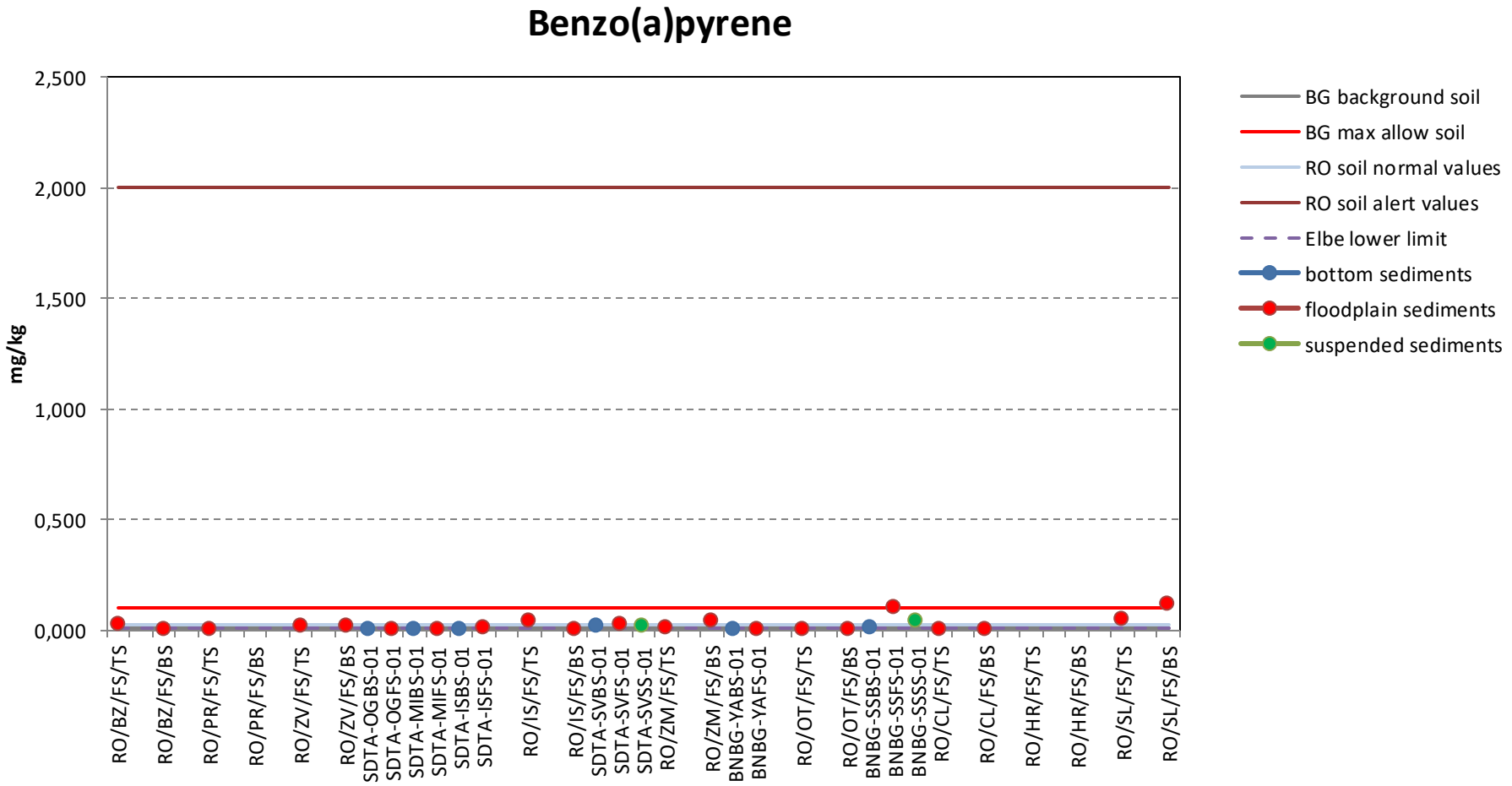

Results and possible sources of contamination

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SIMONA – SAMPLING

SEDIMENT SAMPLING IN LARGE LAKES AND RESERVOIRS

SIMONA PROJECT TRAINNING

1st Trainning Event - **25th March 2021**

Online

Prof. Dr. Prvoslav Marjanović, Marko Marjanović, Dragica Vulić

14:40 – 15:40 , **via video link**

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TODAYS PRESENTATION

01 WFD and Sediment - Reminders

02 The role of sampling

03 Sampling Plan and Mobilization

04 Actuall sampling

05 Post sampling activities

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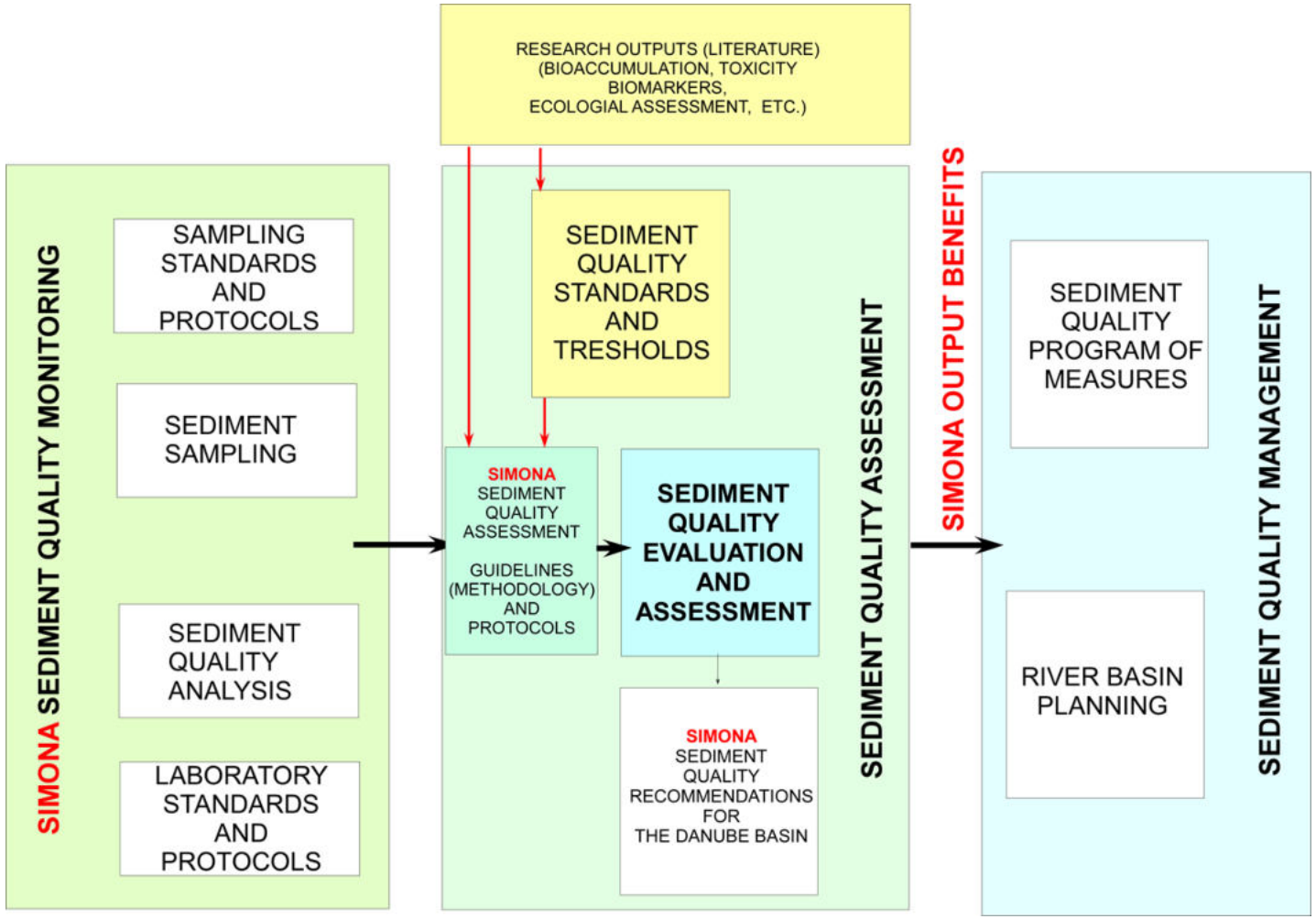
WFD and Sediment - Reminders



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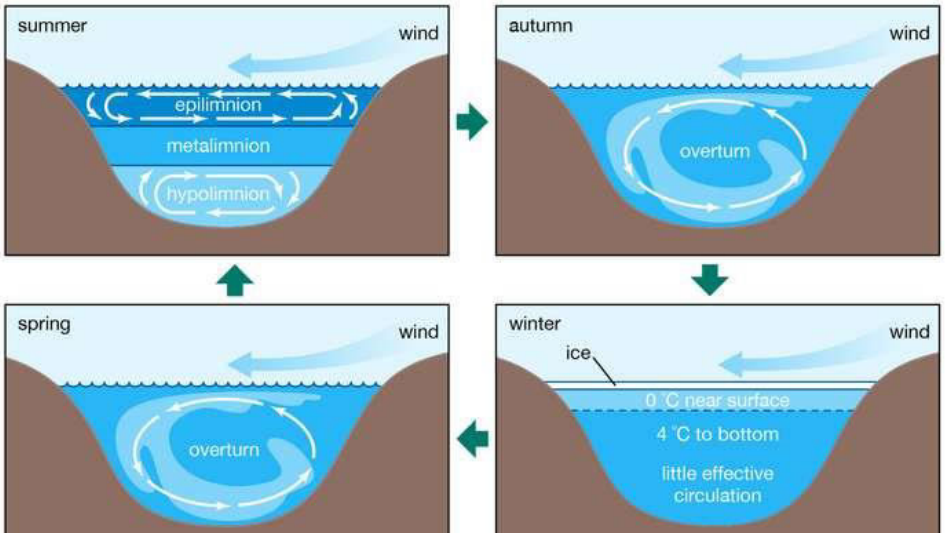
DIFFERENCES BETWEEN LAKES AND RESERVOIRS AND RIVERS AND STREAMS

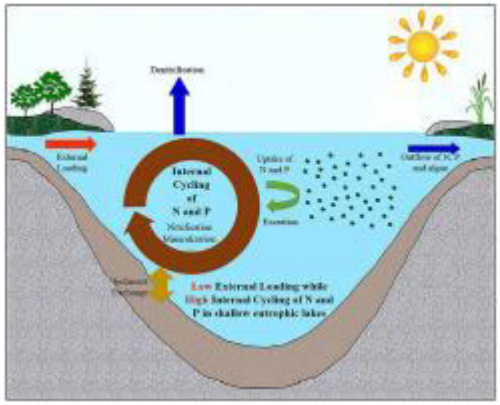
1 STRATIFIED – NOT STRATIFIED

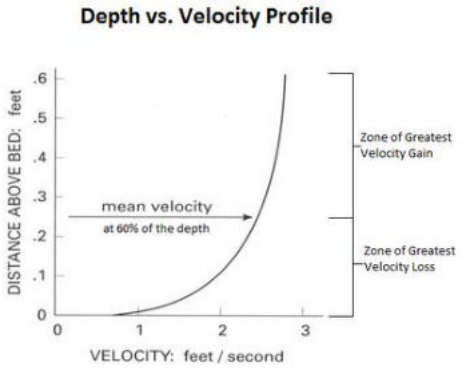
2 FLOW VELOCITY AND TRANSPORT (HORIZONTAL vs VERTICAL

3 BOTTOM AND SUSPENDED

4 IMPRTANCE OF INTERNAL AND EXTERNAL LOADING IN LIGHT OF WFD REQUIREMENTS







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03

Sampling Plan and Mobilization

MOBILIZATION PLAN

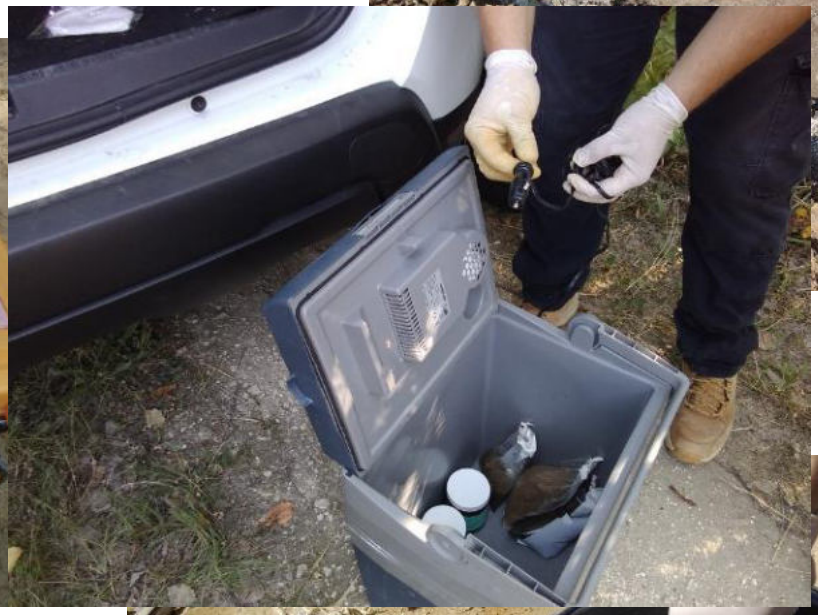
SAMPLING OF SEDIMENTS AND SURFACE WATER

EXAMPLE

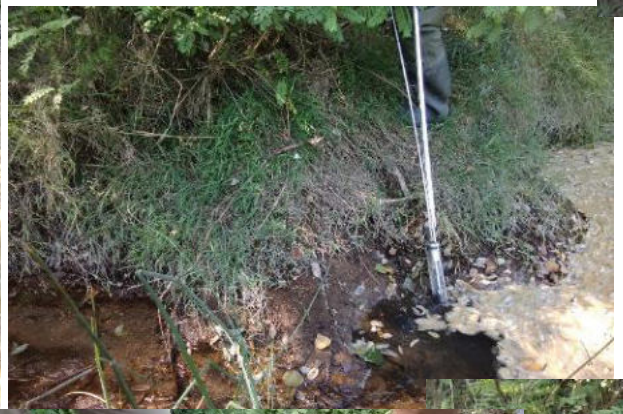
Date xxxxx

THE CONTENT
INTRODUCTION (PURPOSE AND OBJECTIVE, CONTRACT DETAILS ETC.)
FIELD SAMPLING AND MEASUREMENTS SPECIFICATION
EQUIPMENT
SCHEDULE
RESPONSIBILITIES
RECORD KEEPING
FIELD MEASUREMENTS
SAMPLING
ENGAGING FIELD TEAMS
ACTIVITY PLAN
RISK ASSESSMENT
SAFETY AT WORK
MONITORING MAPS
TRANSPORT
SAMPLE DELIVERY AND CHAIN OF CUSTODY

TRIBUTARIES – BOTTOM SEDIMENTS







EXAMINE THE SAMPLE CAREFULLY AND CRITICALLY

WHY IS THIS ??

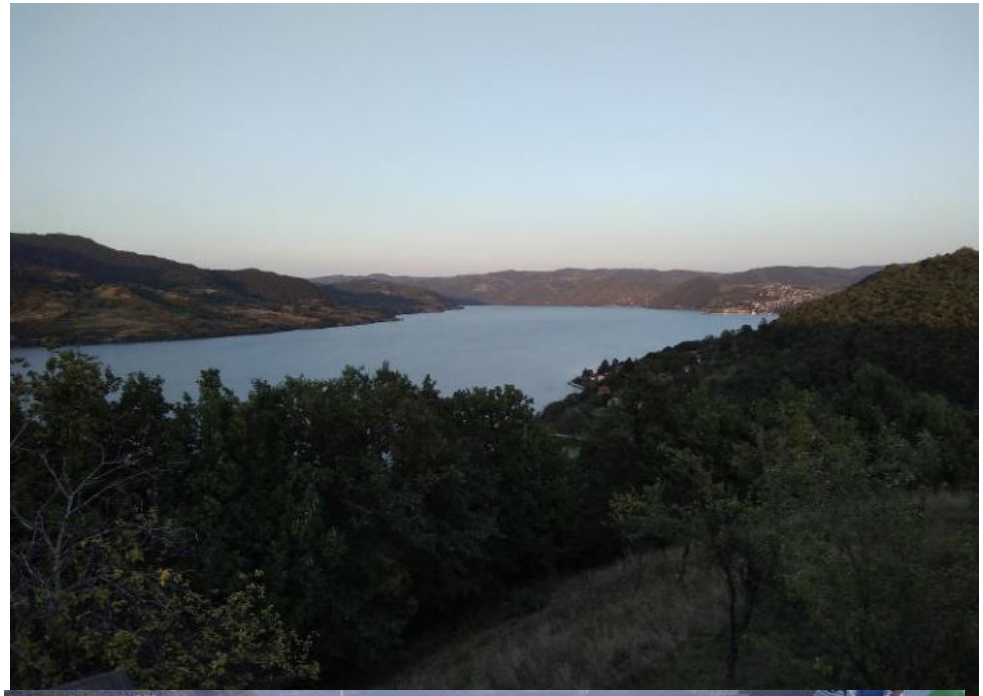
CAN YOU EXPLAIN IT LOGICAL

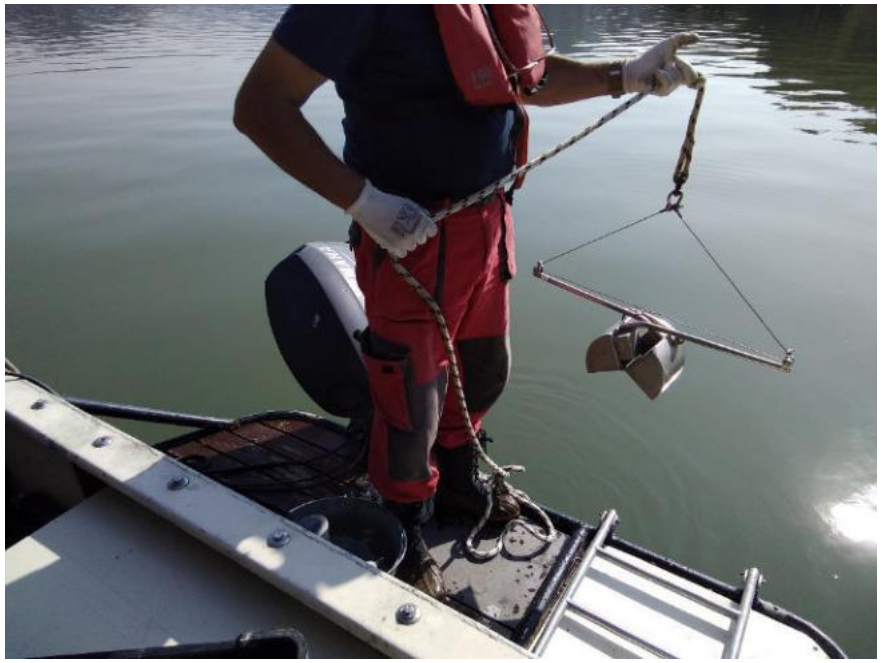
CASE
IN POINT

SOMETIMES SMOKING AND A DRINK IN THE FIELD GIVES UNEXPECTED RESULTS AND INSIGHTS!

TRY TO CAPTURE ALL ADDITIONAL INFORMATION – IT IS VERY IMPORTANAT RECORD THIS IN YOUR FIELDRPORT

DOCUMENTING EFFORT





SUSPENDED SEDIMENT

IMPORTANT

VELOCITY PROFILE

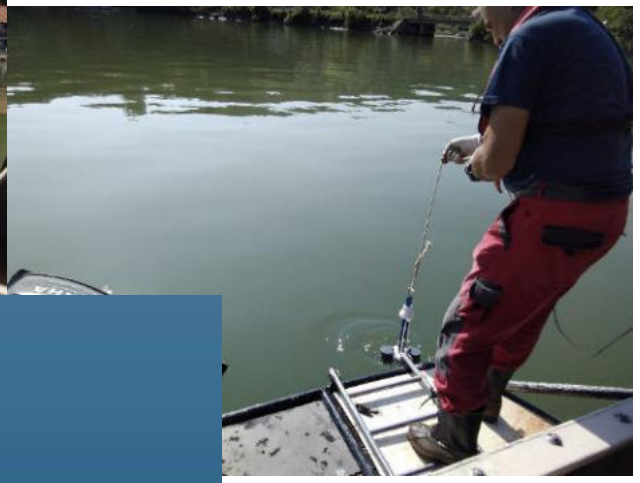
FLOW PROPORTIONAL VOLUME

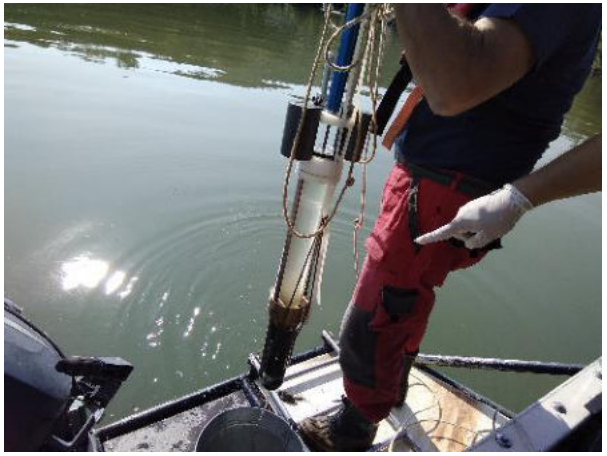
LARGE VOLUME SAMPLE

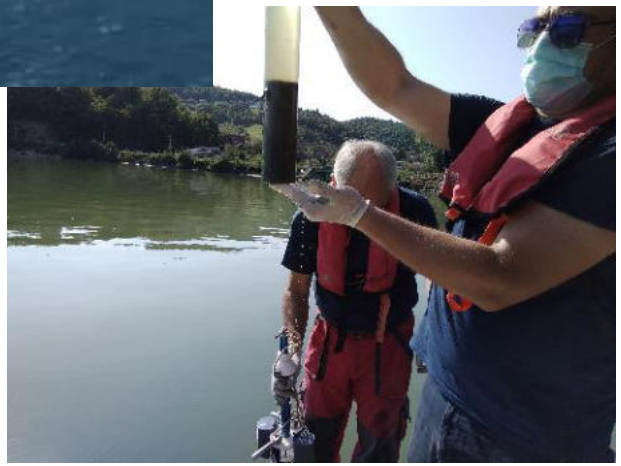
Video 1

BOTTOM SEDIMENT

UNDISTURBED CORE

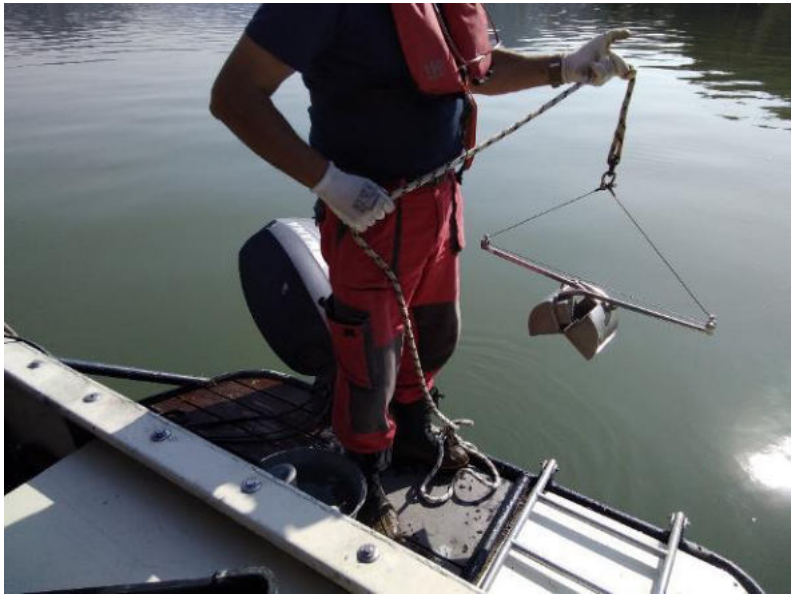






BOTTOM SEDIMENT

DISTURBED SAMPLE



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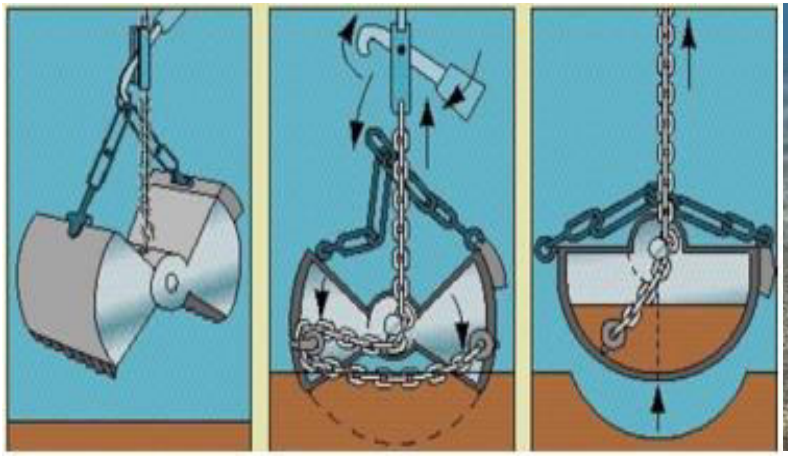
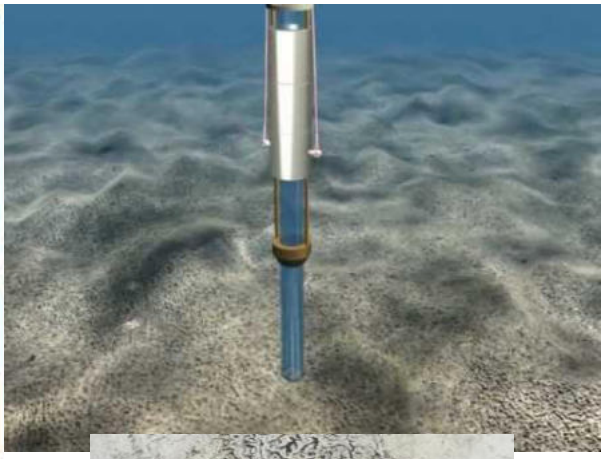
Grab sampling vs. Core sampling





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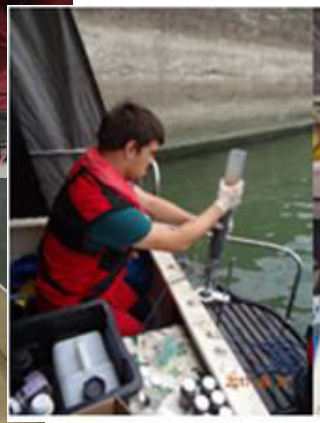
POSIBLE PARTIAL PROCESSING IN THE FIELD



05

Post sampling activities

- SAMPLING REPORT
- 1. FIELD DATA SHEETS WITH SAMPLES TO LABORATORY
- 2. DETAILED REPORT FROM THE FIELD
  - SAME STRUCTURE AS MOBILIZATION PLAN
  - REPORTING ON ACTIVITIES AND PROLEMS ENCOUNTERED

FIELD DATA SHEETS

Interreg Danube Transnational Programme SIMONA

For further information on the **SIMONA Sampling, Laboratory and Evaluation protocols;** on the project, partnership and the Danube Transnational Programme: **www.interreg-danube.eu/simona**

FIELD OBSERVATION SHEET FOR SEDIMENT SAMPLING

APPENDIX 3 OF THE SIMONA SEDIMENT QUALITY SAMPLING PROTOCOL

MONITORING PROGRAMME/ SAMPLING PROJECT INFORMATION:

Project name: SIMONA | Sample identifier (ID): SDTA-BRBS_01

Collection date (DD/MM/YYYY): 08/09/2020 | Collection time (HH:MM):

Sampling matrix: ☐ stream/bottom sediment; ☐ suspended sediment; ☐ other (floodplain sediment, ...):

Sampling: ☑ accredited; ☐ not accredited | Sampling standard: ISO 5667-12:2019

MONITORING SITE IDENTIFICATION:

Monitoring Site ID (WISE-SoE): N/A | Monitoring Site ID (national): 42906

Name of the Monitoring Site (e.g. name of the surface water and the city): Borska Reka midway between Rgotina and Slatina

Sample location description with specific information (bridge, high power electric lines, railway line, major road, natural park, ...) (provide map on opposite side): Borska reka under bridge near natural road R165

Type of the monitoring site (can be different from representing waterbody): ☑ river; ☐ lake; ☐ wetland; ☐ other (floodplain, ...):

Aim of sampling: ☐ general status; ☐ reference site (without/small anthropogenic sources); ☐ investigation site – find contamination source; ☑ investigation site for other: South Danube Test Area sampling program of the SIMONA DTP project.

WGS84	Latitude: 44° 01' 49,75"	National Coordinate system	Latitude:
	Longitude: 22° 12' 39,18"		Longitude:

MONITORING SITE REPRESENTING THE FOLLOWING WATERBODY AND ITS BASIN:

Is it the same waterbody as the Monitoring Site has? ☑ YES or ☐ NO

If no, describe the connection between waterbody and monitoring site (tributary, recipient, ...):

Waterbody ID (WISE-SoE): | Waterbody ID (national): BOR_01(30)

Name of the Waterbody: Borska reka

Type of the Waterbody: ☑ river; ☐ lake; ☐ wetland; ☐ coastal; ☐ transitional

MONITORING SITE CONDITIONS (PART I):

River width [m]: 3 m ☑ estimated; ☐ measured value	Depth of water estimated average depth [m]: 0,5 m	Flow rate [m/s]: ☐ estimated; ☐ measured value
Water temperature [°C]: 24,7°	Water electrical conductivity [µs/cm]: 1704 mS/cm	
Water pH: 4,89	Water transparency (Secchi disk method) [cm]: 70,5m	

Geology and background value of parent material/lithology in the area:

MONITORING SITE CONDITIONS (PART II):

Extreme conditions: ☑ none; ☐ flooding status; ☐ ice; ☐ pollution plume; ☐ contaminated coast/bank; ☐ other:

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Weather conditions: ☐ hot; ☑ sunny; ☐ cloudy; ☐ changeable; ☐ rainy; ☐ frosty

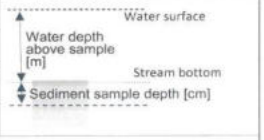
SEDIMENT COLLECTION INFORMATION:

Water depth above sample [m]: 0,5m

Sediment sample depth [cm]: 10cm

Collection device: ☑ stainless steel scoop; ☐ corer; ☐ sampler for suspended sediment; ☐ other:

Sample type: ☑ composite – number of subsamples: 5



Distance between the first and last sampling site? [m]: 25m

Sample replicate collected? ☐ YES or ☑ NO | Replicate ID/name:

Sample is duplicated? ☐ YES or ☑ NO

SAMPLE INFORMATION:

Sampling volume estimated, wet weight [liter]: 300 gr

Temperature of sample (field observation, right after sampling) [°C]: 24,5°

Sediment pH (undisturbed): | Sediment pH (post-homogenization):

Colour (Munsell soil colour chart number):

Texture (particle size description):

Odour: ☑ none; ☐ light; ☐ strong; ☐ earthy; ☐ mildewed; ☐ putrid; ☐ farm slurry; ☐ fishy; ☐ aromatic; ☐ sewage; ☐ fuel/oil

Information on sediment components (seashells, animals, peat, wood, tar, stones, waste, plastics, etc.):

A few small pebbles are visible.

Sample photograph identification:

Additional comments (e.g. map of the sampling site):

Sampler name (readable): M Maganović | Signature:

REPORT FROM THE FIELD

FIELD REPORT

SAMPLING OF SEDIMENTS AND SURFACE WATER

EXAMPLE

Date xxxxx

THE CONTENT

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Thank you for your attention.

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