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Monitoring of hydrological, hydraulic and morphological characteristics of the Danube and inventory of biodiversity components of the Croatian-Serbian common section of the Danube

~Monitoring of parameters important for waterway maintenance~

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Preparing FAIRway2 works in the Rhine Danube Corridor (2019-EU-TM-0262-S and 2019-HR-TMC-0263-S)

1. MONITORING OF PARAMETERS IMPORTANT FOR WATERWAY MAINTENANCE

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1.1 Inventarization of river regulation infrastructure

1.2 Riverbed measurement of cross-sections of Danube river

1.3 Monitoring and analysis of flow, velocity and sediment transport

1.4 Piezometer installation

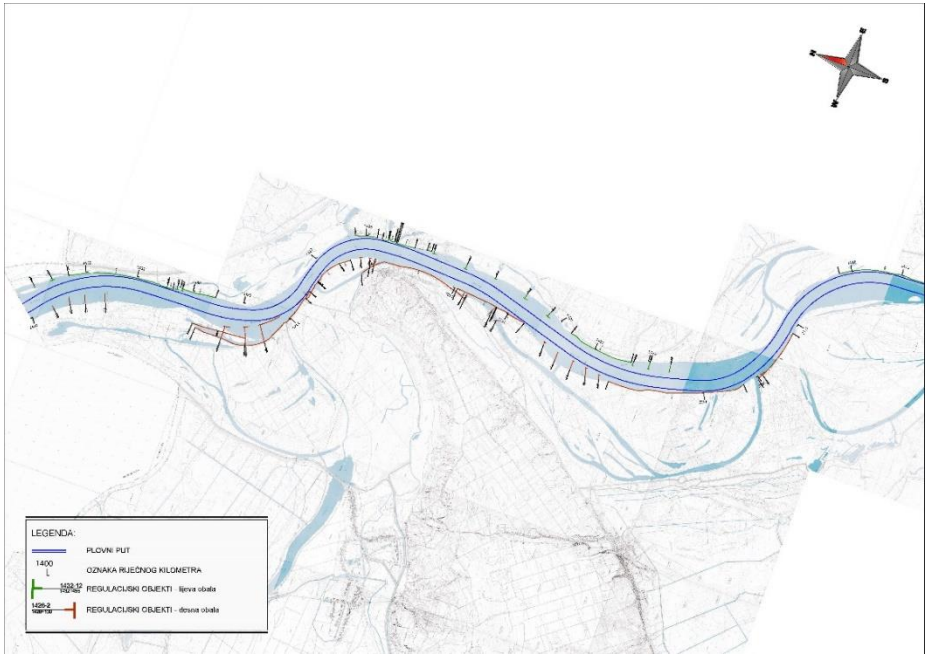
Inventorisation of river regulation infrastructure

Inventorisation of river regulation infrastructure

- Field work of inventorisation and assessment of existing river regulation infrastructure on both sides of the Danube
- Identified 82 existing objects on the right bank; 78 objects on the left bank

Current status (12/2023):

- Inventorisation field work completed, digitalization of data ongoing



Inventorisation of river regulation infrastructure

Inventorisation of river regulation infrastructure

Data gathered:

- Geometry data
- Geodetic survey
- Foto-documentation
- Assessment of the current state/functionality
- Identification of extent of damages (where applicable)

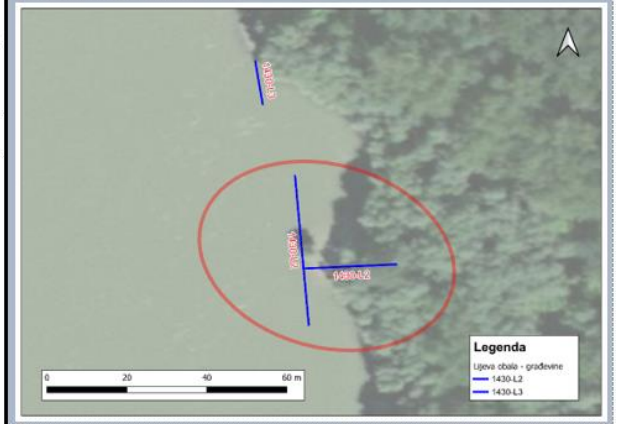
Outputs:

- Detailed table overview
- Graphic representation of each infrastructure
- Graphic database
- Elaborate

5. Left bank	Type:	Chainage (r.km)	Length (m)	Crown elevation (m asl)
1430-L2	T-groyne	1430+280	53,36	53,36

Existing documentation
- Cadastre mark **1430/00**
- Cadastre page **2/1**

Location of the infrastructure



Picture of the infrastructure

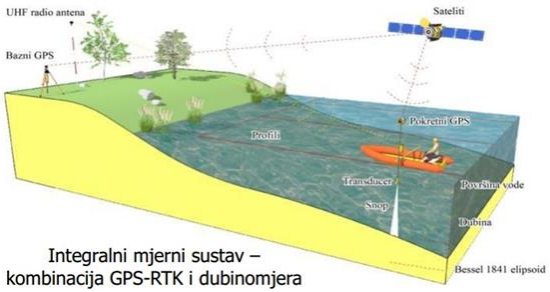
Analysis
- Infrastructure in good condition
- Effect of material deposition ongoing (upstream, downstream)
- Material of the infrastructure visible, vegetation present on the beginning of the infrastructure

Riverbed measurement of cross-sections of Danube river

- Field work of hydrographic riverbed measurements of cross-sections
- Overall length of ~ 140 rkm; 1375 (Danube)+6 (Drava) control profiles (equidistance of 100 m); 2 sets of measurements (yearly)

Current status (12/2023):

- First set of measurements conducted in 05-08/2023
- Data processing



Integralni mjerni sustav – kombinacija GPS-RTK i dubinomjera

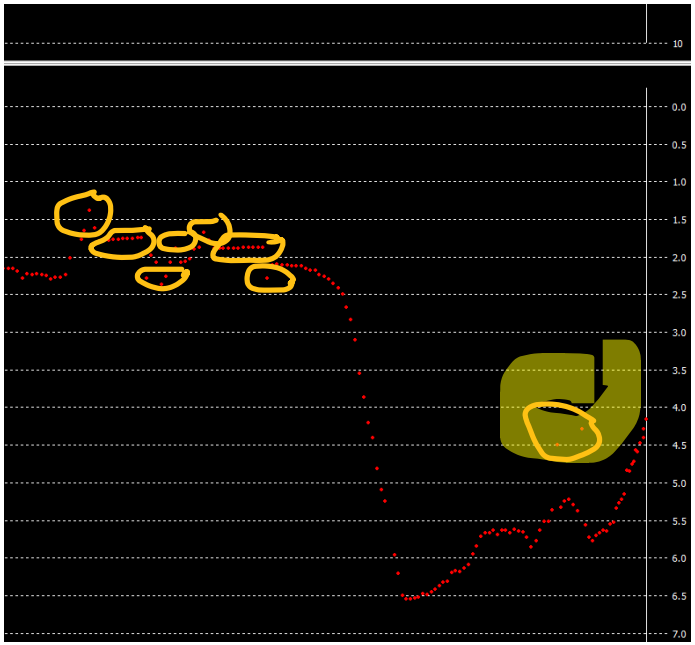
Processing data

Cross-section data processing

- Cleaning data
- Projecting data on cross-section lines
- Creating 3d model
- Data processing

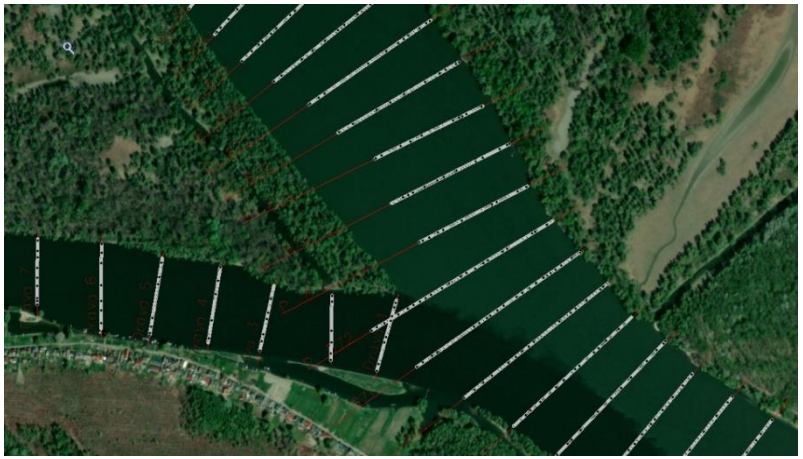
To do

- Data processing
- Second set of measurements 03/2024-06/2024

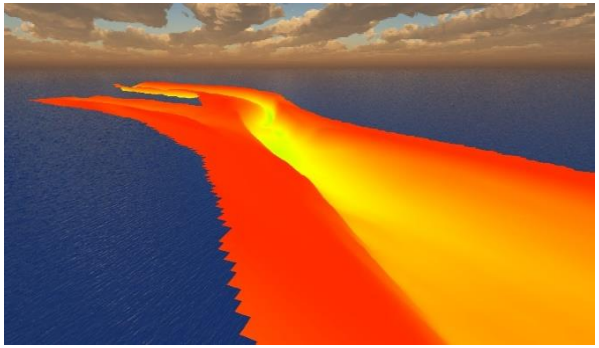


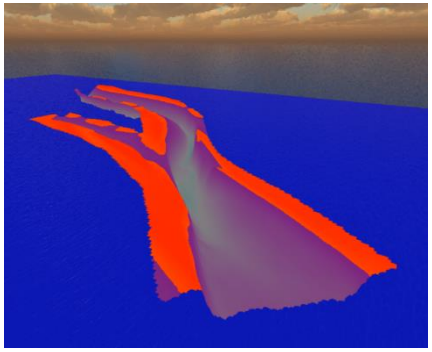
Results

- Projecting data on cross-section lines; surveyed daTa are projected on crosslines as a preparation for creating 3d model of riverbed.



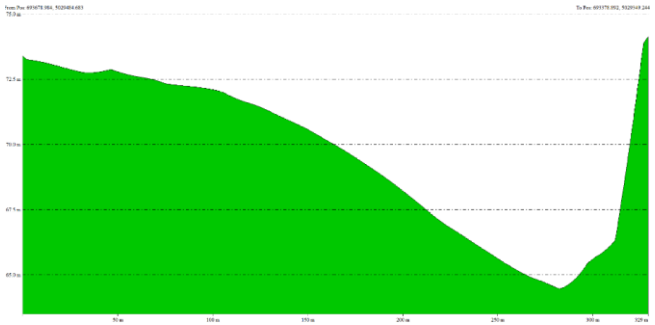
- 3D model; After cleaning and projecting, 3D model of terrain of riverbed was created.

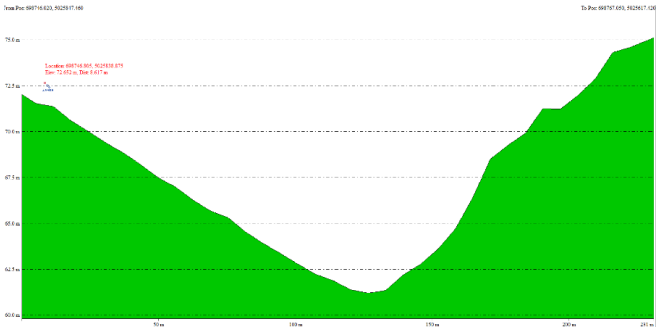


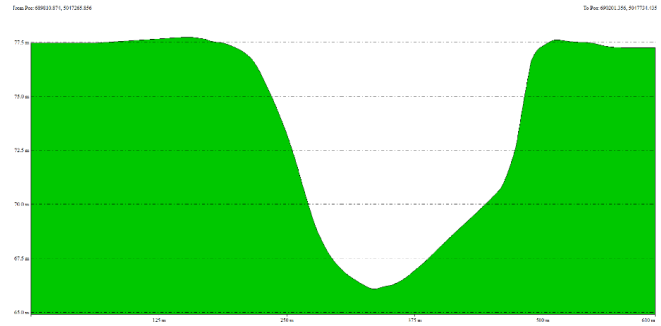


Results

- Projections; results are delivered as a textual file in 3 projections:
  - HTRS96/TM (HVRS71),
  - HDKS (GK) 6 zone (HVRSTRST) and
  - UTM 34 (N) (HVRSTRST)







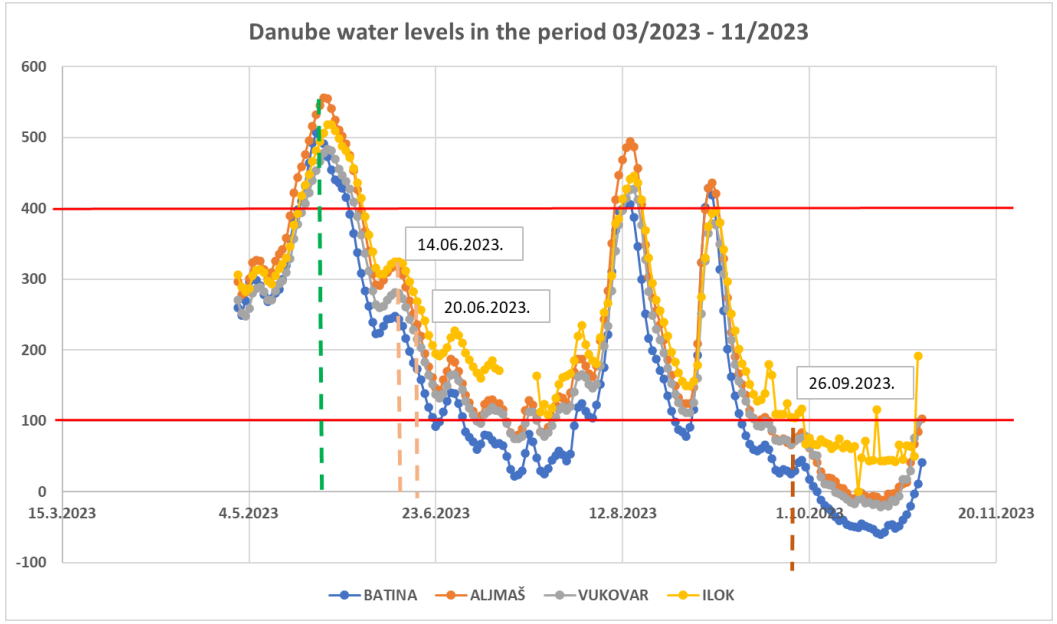
Monitoring and analysis of flow, velocity and sediment transport

Monitoring and analysis of flow, velocity and sediment transport

- 3 sets of measurement campaign (lower, medium and higher water levels) on 3 locations
- Locations: Batina/Vukovar/Ilok for flow and velocity measurements; Batina/Drava confluence/Ilok for sediment transport

Current status (12/2023):

- Measurement campaign completed, laboratory analysis undertaken
- Elaborate completed
- Raw data delivered



Monitoring and analysis of flow, velocity and sediment transport

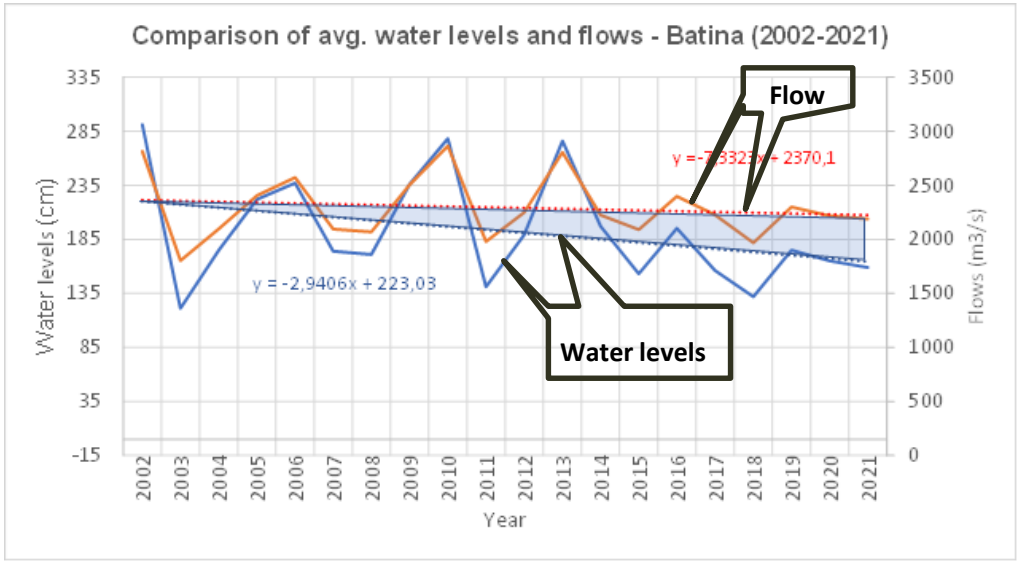
Monitoring and analysis of flow, velocity and sediment transport

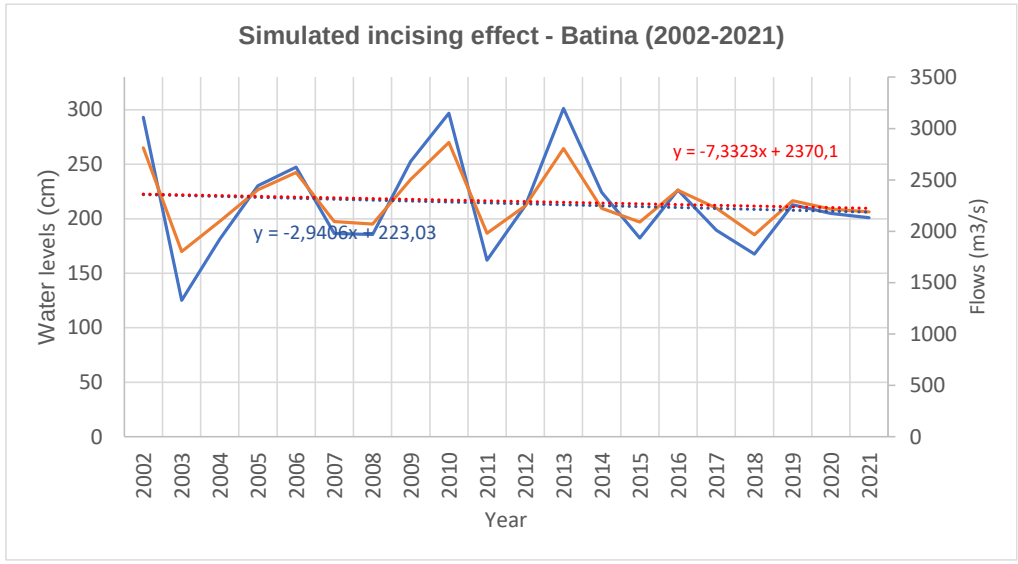
- Flow and velocity data distribution fairly consistent, bearing in mind cross section geometry (~ 1 m/s of integrated velocity, >1,5 m/s in main current)
- Measured flows in the 1.350-5.400 m3/s, taking into account different hydrological events and location
- Bedload sediment 5-7% of total sediment
- Granulometric curve fairly consistent, reducing in size downstream

Element / Location	*Measuring unit*	*Batina/Bezdan*	*The confluence of Drava*	*Vukovar*	*Ilok*
The position of the upstream profile	*rkm*	rkm 1429+000	1383+000	1332+000	1302+000
		rkm 142+5000	1381+600	1325+000	1300+000
		Measured velocities			
		0,91-1,02		0,99-1,18	1,17-1,05
		0,72-0,72		0,88-0,91	1,01-0,85
		0,66-0,67		0,76-0,67	0,82-0,88
		~ 1,5		~ 2,0	~ 1,5
		Measured flows			
		3.862-3.916	4.009-5.373	5.439-5.082	5389-5301
		1.833-1.839	1.963-2.797	3.484-3.112	3559-3232
		1.367-1.393	1.348-1.863	1.736-1.691	1956-1876
		Transport of bedload sediment			
		5,9-9,5	10,5-5,1		7,8-18,0
		12,6-3,6	8,5-5,0		11,3-15,0
		14,3-3,0	5,0-3,4		7,9-9,5
		Transport of suspended sediment			
m01 (high water level)	*kg/s*	128-130	135-189		198-184
m02 (medium water level)	*kg/s*	55	61-90		118-109
m03 (low water level)	*kg/s*	43,-44	42-63		62-63
Granulometric curve		D50 ~ 0,3 mm	D50 ~ 0,25 mm		D50 ~ 0,2 mm

Monitoring and analysis of flow, velocity and sediment transport

- Hydrological analysis undertaken prior to measurement campaign
- Comparison of water levels and flow data in analyzed timeline
  - Batina WM example
- General decline in values, sharper decline for water levels – incising effect
- Simulation of incising effect – **2,1** cm/ann for Batina WM station





Piezometer installation

Piezometer installation

- Piezometer installation adjacent to Danube (<100 m), 15m of depth for continuous monitoring of water levels and temperature
- Locations: Batina, Aljmas and Ilok
- Goals: continuous data which shall enable correlation for any future hydrographic surveying and measurements

Current status (12/2023):

- Installed piezometers, measurement equipment to be installed 01/2024