

DanubeSediment

Danube Sediment Management – Restoration of the Sediment Balance in the Danube River

DanubeSediment – an EU project aiming to the restoration of the sediment balance in the Danube River

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- Short info about the project status
- Role of sediments for a sustainable river basin management





- To propose a transnational **sediment monitoring network**
- To establish for the first time the **sediment budget** for the Danube River considering the input of the most important tributaries as well,
- To identify reaches with surplus and deficit, river bed aggradation and degradation, sediment-related problems in flood risk management, hydropower generation, navigation, ecology
- To gain **knowledge and** better **understanding** of sediment transport and morphodynamic processes
- To develop a Danube Sediment Management Guidance (DSMG) and a related Sediment Manual for Stakeholders (SMS)



Longitudinal variation of mean annual SS load (1986-2016) vs. preHPP



→ Reduction of sediment input to Black Sea by about 60 %



Change of the river channel length





reach	country	from rkm	to rkm	confineme	river type	type_no	length change (km)
upper	DE	2585	2498	auc	single-thread meand	14	-42,4
upper	DE	2498	2471	auc	transitional	11	-3,8
upper	DE	2471	2433	auc	m 94 N. KM vergy	10	-7,6
upper	DE	2433	2420	auc	e^{-Ca}	11	-1,3
upper	DE	2420	2415	, Danu	bei za. 8 ki	6	-0,3
upper	DE	2415	IPA	per Dan	meandering	14	-8,4
upper	DE	2315	2.	ddle nar	e-thread sinous	13	-0,5
upper	DE	2281	22t	werd	single-thread meandering	14	-2,0
upper	AT	2258	2195	apc	single-thread sinous	13	-0,1
upper	AT	2195	2160	ac	single-thread plane bed	6	-0,2
upper	AT	2160	2144	auc	multi-thread anabranching (high energy)	10	0,2
upper	AT	2144	2135	арс	single-thread sinuous	13	-0,6
upper	AT	2135	2082	auc	multi-thread anabranching (high energy)	10	-7,1

Final project results to follow

Average Danube width change																					
river km 2588-2225	section DE	reference conditions: average historical channel width in section (m) 195	average present channel width in section (m) 157	referen conditio avera island width	nce ons: ge ds (m) 1	e e t s s e channel width change in section (%) -20%	e averag island width change in sectio -99%	100% 80% 60%	Avera	erage Danube channel and islan change in sections (%)					nds	ds width Danube channe Islands					
2225-2202	DE/AT	285	278	17	0	-2%	-100%	40%										1			
2202-1880	AT	488	318	237	1	-35%	-100%	20%													
1880-1872	SK/AT	511	287	219	0	-44%	-100%	0%		-							-		-		
1872-1850	SK	613	313	344	0	-49%	-100%	-20%		-					•		-		-	1	
1850-1708	SK/HU	744	404	288	8 8	-46%	-97%	-40%		-	-					-	-			+	
1708-1433	HU	614	485	79	4	- 21%	-95%	-60%		-	-	-				-	-				
1433-1295	RS/HR	622	465	149	12	-25%	-92%	-80%		-	-	-				-					
1295-1075	RS	782	763	175	87	- 2%	-51%	-100%	, –												
1075-845	RO/RS	779	989	20	25	27%	28%		ш	H	F	F	×	\supset		œ	S	S	5	0	
845-375	RO/BG	1005	977	190	115	-3%	-39%			4	4	4p	01	H	Т	H		H/)/B	8	
375-0	RO	738	636	328	8 72	-14%	- 78%			Ō		SI		SK		R		R	RO		
Sec	tion	reference conditions: average historical channel width in section (m)			average present channel width in section (m)			average islands (reference conditions)		average present islands		average channel width change in section (%)			e I n	average island width change (%)					
Upper		382			236			171			2			-38%				-99,0%			
Middle 680				639			111			32			-6%				-71,5%				
Lower		895			851			220			88			-5%				-60,0%			

24.92

Sediment disbalance - river bed change





modified after Batuca et al., 2002



- Ioss of gravel bed / change of sand bed in a few decades
- reversion of river morphological processes takes a very long time, so measures have to be undertaken now to guarantee a sustainable development

- danger of dislocation in case of floods
- danger of tremendously fast incision of the river bed river bed breakthrough
- Iowering of the groundwater level
- ➢ no / reduced morphodynamics (gravel / sand bars → loss of spawning-grounds)...

Sediments – Floods – Hydropower







Habersack et al., 2015

Remobilisation in a HPP reservoir





Abschnitt Aschach Strom-km 2162,900 - 2203,200 (100m) Summe der Stromschlenänderungen zwischen August 1963 und Oktober 2013

Habersack et al., 2015

Source: viadonau, Verbund



Sediments: Deposition in floodplains



Sediments and Navigation





Sediments and Ecosystem



Sediments – Functions – Ecosystem Services



Ecosystem Services



- The Danube River features a totally disturbed system (sediment continuum interruption, sediment disbalance).
- Sediments are essential for hydromorphology, thus for ecology, but also an essential aspect for hydropower, navigation, flood risk management etc.
- Cumulative effects on sediments arise not only from upstream to downstream but also backwards.
- It has to be considered that sediment processes differ between each river section (Upper ⇔ Middle ⇔Lower Danube ⇔ Danube Delta).

Recommendations (examples)



C. tributaries)

- In Upper and Middle Danube improve sediment balance by river restoration and stop of riverbed erosion in free flo sections.
- At the Lower Danube preservation of ma stop of further riverbed degradatic clude
- Improvement of the sedime
- hould be a ill col Develop/implement measures for navigation. Jagement. hydropower
 - aredged material. Defin
- 23e, reduce sediment outputs from agriculture. prinent of a catchment-wide sediment management concept.
- Sediment quality needs to be included.



Alteration of sediment balance

The aspect of **sediment quantity** in the Danube River Basin was already mentioned in the 1st DRBMP 2009 and considered as **potential Significant Water Management Issue in 2013**. Based on key findings of the DanubeSediment project (Danube Sediment Management - Restoration of the Sediment Balance in the Danube River) the alteration of the sediment balance is **now** identified as new **sub-item of the Significant Water Management Issue "Hydromorphological alterations"**. First results of the project are used for the description of the issue and the preliminary identification of actions and coordination requirements for the basin-wide level. The results of the project will be further discussed by the ICPDR with the aim to fully integrate them into the development of the 3rd DRBMP Update 2021.



The issue

The sediment balance is disturbed in particular by interruption of sediment transport caused by transversal structures (such as weirs or dams) due to hydropower use, water supply and flood protection. The sediment balance is furthermore impacted by river regulation works for flood protection and navigation, as well as commercial dredging, land use/agriculture and other infrastructure projects. These measures reduce the river width, increase the riverbed slope and bank protection measures prohibit side erosion. This leads to a sediment deficit and increased sediment transport capacity in the free flowing sections as well as to **coastal erosion**. In **impounded sections**, floodplains and groin fields a surplus of sediments is dominating. Consequently, the morphodynamics are negatively affected, causing a deterioration of type-specific habitats and lowering of groundwater levels. This leads to severe impacts on the type-specific aquatic communities and water dependent terrestrial ecosystems and thus on the water status.



Vision

The ICPDR's basin-wide vision is a **balanced sediment regime** by an **undisturbed sediment continuity.** Type-specific **natural bed forms and bed material** as well as a **dynamic equilibrium** between **sedimentation and erosion** is provided. The balanced sediment regime enables the **long term provision of appropriate habitats** for the type-specific aquatic communities and water dependent terrestrial ecosystems



Preliminary identification of actions and coordination requirements for the basin-wide level (1)

- The objective of the EU funded DanubeSediment project (2017-2019) is to improve water and sediment management as well as the morphology of the Danube River. Following the DPSIR approach the key drivers and pressures in the Danube River Basin that act on the sediment regime were identified and their impacts were described.
- The DanubeSediment project identified a sediment imbalance for the Danube River, revealing areas with erosion and sedimentation being a risk for achieving the environmental objectives of the WFD.
- To gain deeper understanding of sediment quantity related problems, the establishment of a harmonized sediment quantity monitoring network will be discussed in the frame of the TNMN and under the supervision of the HYMO TG.



Preliminary identification of actions and coordination requirements for the basin-wide level (2)

- The Danube Sediment Management Guidance will provide recommendations towards the 3rd DRBM Plan Update 2021 for an improved sediment regime.
- The Manual for Stakeholders will offer assistance for sediment related actions in the Danube River Basin and future programmes of measures.
- A catalogue of measures in order to mitigate the impacts is available to support targeting measures to improve the sediment regime and continuity; the catalogue will need to be updated in the future.



Element	High Status
Hydrological regime	The quantity and dynamics of flow, and the resultant connection to groundwaters, reflect totally, or nearly totally, undisturbed conditions.
River continuity	The continuity of the river is not disturbed by anthropogenic activities and allows undisturbed migration of aquatic organisms and sediment transport .
Morphological conditions	Channel patterns, width and depth variations, flow velocities, substrate conditions and both the structure and condition of the riparian zones correspond totally or nearly totally to undisturbed conditions.