Interreg
Danube Transnational Programme

Programme co-funded by European Union funds (ERDF, IPA, ENI)

Newsletter

Danube Hazard m³c

Project progress in the period of July to December 2021

Contents

❖ Preface by Matthias Zessner

Dear readers,

I have the feeling that the Danube Hazard m³c project has just started, but actually we are already at half time. Time passes by so quickly. Yet we have no chance for a half time break. The timetable is challenging. The tasks are ambitious. We know that he (or she) not busy being born is busy dying. And for sure, in this project we are busy being born. For the first time:

- *creating a comprehensive **inventory** of hazardous substances in different environmental compartments in the Danube Basin,*
- ***monitoring** hazardous substances in several environmental compartments with highly sensitive analytical methods to fill in the existing knowledge gaps regarding presence and concentration of those compounds along the basin,*
- *putting together a detailed **review of policies** of hazardous substances management in the Danube countries,*
- *doing detailed **modelling** of selected pilot regions for improvement of system understanding to use it for*
  - *modelling hazardous substances emission along the entire Danube river basin*
  - *supporting the discussion of basin wide management strategies*
- *and on top of that, implementing a series of attractive **capacity building** events to capitalize the knowledge that has been gained during the project.*

In September 2021 we had our 3rd Danube Hazard m³c partner meeting. The first one that took place also in a physical, and not only in an online format! We met in Podersdorf at the Lake

Figure 1: Warm greetings from the participants of the Danube Hazard m³c 3rd partner meeting at lake Neusiedl, Photo: Nikolaus Weber.

Neusiedl. I enjoyed a lot being together (meeting some of the partners for the first time), to discuss the project progress sitting in one room and having some fun together. But not only that. I was really enthusiastic about everything that has already been achieved. Even though we had to face many obstacles and not everything worked out as we had planned, with admirable engagement of the project partners and my colleagues at the institute, who never lost the faith in the project, we made big steps forward.

And if you think something is happening here, but you don't know what it is, this newsletter shall give you some appetizers on current project activities and expected outcomes. We will share impressions gained in the excursion to the Wulka monitoring station during the 3rd partner meeting and will show some interim results from monitoring. We will give you some insights into policy review development, preliminary basin-wide modeling results and draft management recommendations. And finally, we will inform you on the upcoming "capacity building" events, that will be a great opportunity for experts from different countries along the Danube to get to know each other and discuss the outcomes of the Danube Hazard m³c. I hope we were able to awake your interest!

Kind regards

Matthias Zessner

Danube Hazard m3c contest: In this preface there are citations of two Bob Dylan songs included. Whoever is able to find out the related song titles, please write them in an E-mail to mzessner@iwag.tuwien.ac.at. The first two senders will be honored by a Bob Dylan CD of their own choice.

For more information, news and photos from different Project activities, see our Danube Hazard m³c website: http://www.interreg-danube.eu/approved-projects/danube-hazard-m3c.

❖ Preliminary Basin-Wide Modelling Results for Selected Chemicals

In the last months, a comprehensive basin-wide emission modelling has been carried out for selected hazardous substances to identify emission hotspots, evaluate emission sources and pathways, quantify river loads and assess management scenarios. The sub-contractor Deltares applys a material flow type model chain adapted from the former EU project SOLUTIONS (Figure 2).

By summer 2021, the model structure, the parametrization for the 17 target substances and the input database were set up and the preliminary basin-wide emissions were calculated at a sub-catchment level. Target substances were 7 metals, 2 pharmaceuticals, 2 pesticides, PAHs and industrial chemicals (including PFOS and PFOA). Emission sources were as much as possible quantified, in some cases with quite good confidence, in other cases in a very preliminary way. Some sources, in particular those related to abandoned mining sites, could not yet be quantified. The simulation results were compared to the observed concentrations, in order to obtain an impression of the performance of the model. For the 17 analysed hazardous substances, the basin-wide emissions to surface waters were provisionally quantified and distributed over various sources and pathways. The spatial distribution of the long-term area-specific emissions of zinc is shown on Figure 3 as an example.

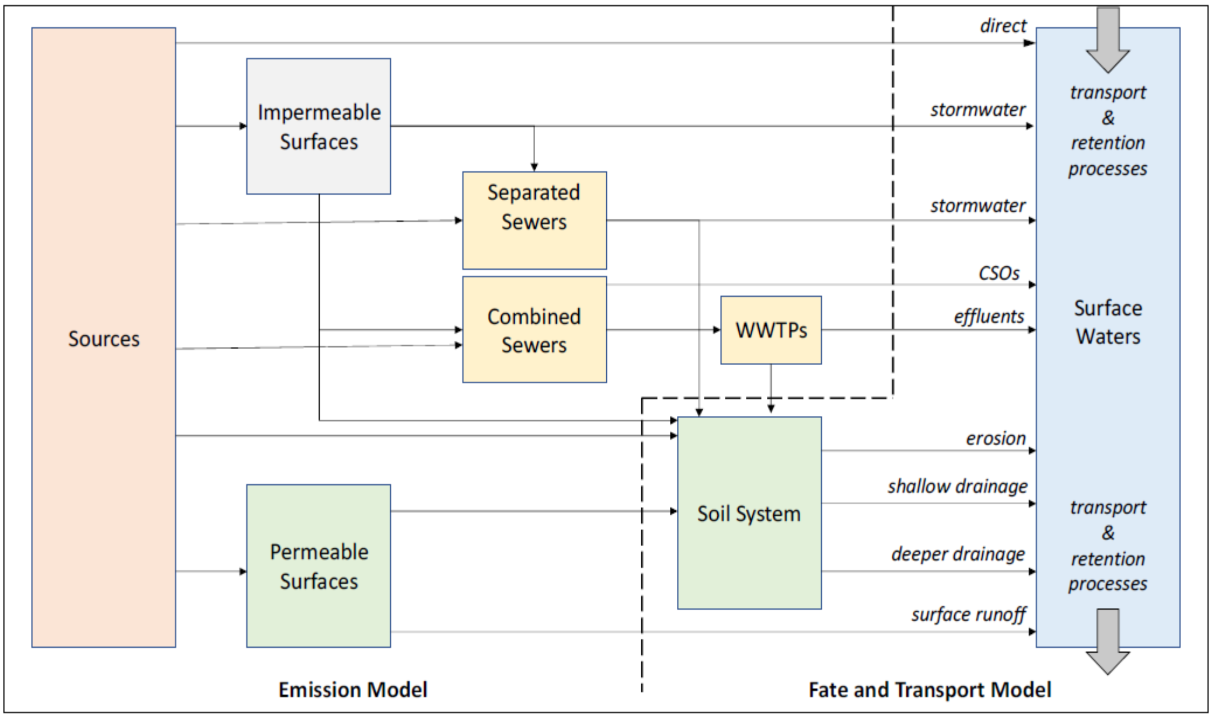

Figure 2: Structure of the Danube Hazard Substances Model.

The preliminary model results could be incorporated into the draft Danube River Basin Management Plan Update 2021, which will be adopted in December 2021, serving the assessments of hazardous substances pollution. The model system and the interim results will be further updated and improved based on the outcomes of pilot catchment investigations and a targeted data collection in the Danube countries. The updated model will be then used to assess the impacts of certain management interventions on water quality.

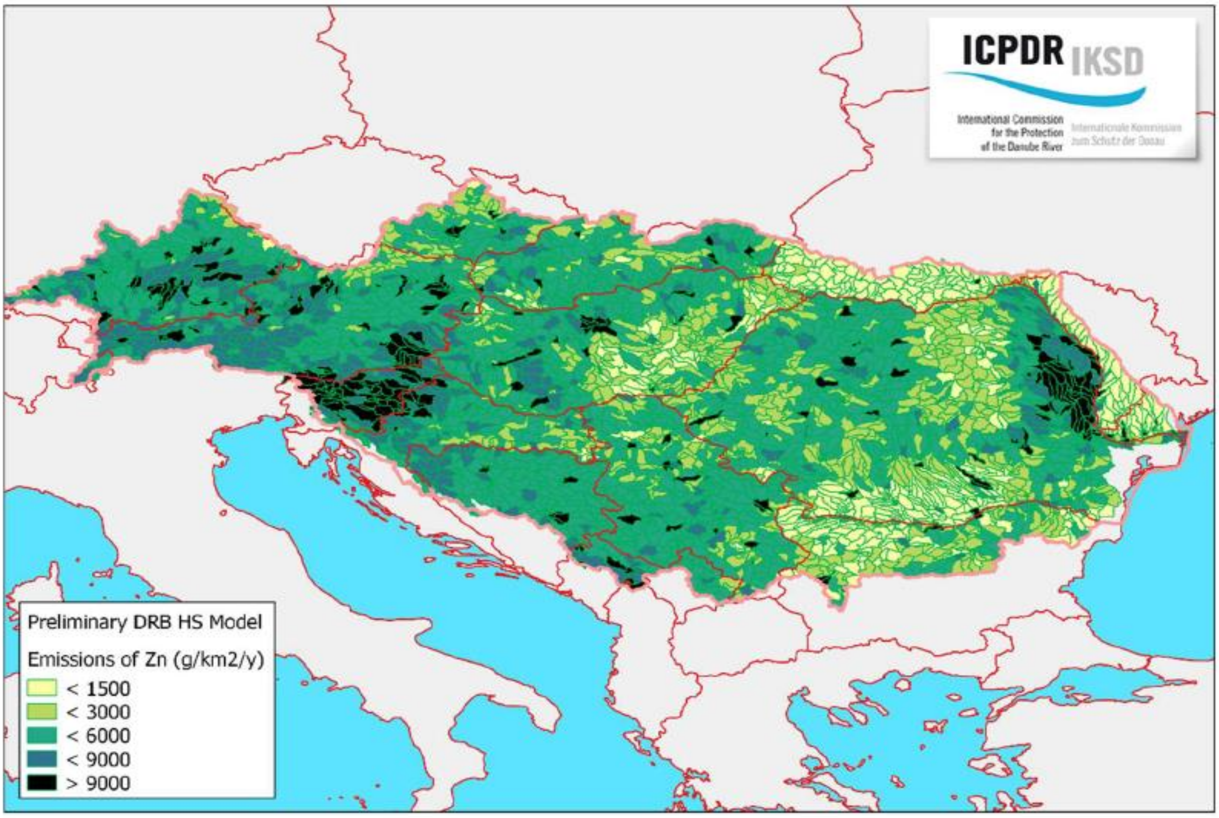

Figure 3: Spatial variability of zinc emissions (preliminary model results).

❖ Preliminary Policy Review and Draft Recommendations for Management Interventions

Besides modelling, work has been performed with the objective of supporting the policy making in the area of water-borne hazardous substance management. Critical review of the existing national policies and regulatory approaches and formulating policy recommendations for adapting these policies as well as choosing appropriate management strategies to achieve a more efficient control of hazardous substances pollution are among the main activities on the agenda.

In autumn 2021, the Project Partner BWA compiled the first policy review for the indirect (connected to public sewer systems) and direct (i.e. into water bodies) industrial discharges by analysing and comparing the respective national policies of 11 Danube countries (Austria, Bulgaria, Croatia, Hungary, Moldova, Montenegro, Romania, Serbia, Slovenia, Slovakia, and Ukraine).

The review shows that all the countries have well developed legislative framework concerning the discharge of hazardous substances through industrial wastewater, as only in Ukraine the regulatory framework for direct industrial discharges is not yet completed. The number of monitored hazardous substances in industrial wastewater vary significantly in the different countries - from 22 to 116, but 4 metals (Cd, Pb, Hg, and Ni) that are monitored in all countries.

The number of monitored priority substances in the industrial wastewater discharges is also rather modest compared to the list in Annex X of the Water Framework Directive, including a limited number of parameters for most of the countries.

The definitions of certain industrial types/processes, the set of monitored substances, the type of sampling and the limit concentrations differ from country to country, which makes it difficult to compare the industrial branches at the level of the Danube River Basin.

The review will be extended to other emitters (i.e. municipal wastewater and diffuse pollution through air and agricultural activities) and policy fields (i.e. the regulatory framework concerning hazardous substances in natural waters) and will underline certain aspects of the current policies where revision, harmonization or improvement might be considered.

In addition, sub-contractor Deltares developed draft recommendations for management interventions that provided valuable inputs for elaborating the Joint Program of Measures of the draft Danube River Basin Management Plan Update 2021. They include the use of indicator substances, and the role such substances can play for a knowledge-based identification and prioritization of measures, in view of the increasing number of chemicals entering the market and reaching aquatic systems. Moreover, an overview has been provided on pollution control measures and developments affecting hazardous substances pollution.

Finally, a semi-quantitative assessment has been provided on how such developments and measures affect the emissions in the Danube River Basin (Table 1). These effects could not yet be diversified for different countries or sub-basins in the basin. The control measures and assessment of their effects will be quantitatively analysed by modelling-based scenario assessment, offering a sound basis for developing the final policy recommendations in 2022.

Development or measure	Pharma-ceuticals	Industrial chemicals	Pesticides	Metals	PAHs
Use regulation	+	++	++	+	+
Construction of sewer systems	--	--	-	--	-
Construction of conventional WWTPs	++	++	+	++	+
Implementation of advanced waste water treatment	++	++	+	o	o
Increased storage in combined sewers	+	+	+	+	+
Retention and filtration of combined sewer overflows	+	+	+	+	+
Decoupling of stormwater collection systems	+	+/-	+/-	+/-	+/-
Retention and filtration in stormwater collection systems	o	+	+	+	+
Green Cities / Sponge Cities	o	+	+	+	+
Industrial discharges control	o	+	o	++	o
Improved solid waste management	+	+	+	+	+
Reduced connectivity between rivers and adjacent soils	+o	o	+	++	++
Reduction of emissions to soil	(+)	(+)	(+)	(+)	(+)
Prevention of accidental discharges and pollution from contaminated sites	o	+	o	+	+
Best pesticide application practices	o	o	++	o	0
Avoidance of tar-based products	o	o	o	o	+

Legend:

++	probably significant positive effect (decreasing emissions)
+	positive effect with small or unknown significance (decreasing emissions)
--	probably significant negative effect (increasing emissions)
-	positive effect with small or unknown significance (increasing emissions)
+/-	positive or negative effect (emissions can decrease or increase)
o	not relevant, or no effect expected
()	indicates a time delay between measure and expected effect

Table 1: Overview of developments and measures effects on hazardous substances emissions to surface waters.

❖ Scenarios Modeling and Assessment in Pilot Regions

Emission modelling performed in the Danube Hazard m3c project in seven representative pilot regions of the Danube catchment with the model MoRE, can provide significant contributions to large parts of the management cycle (see Figure 4).

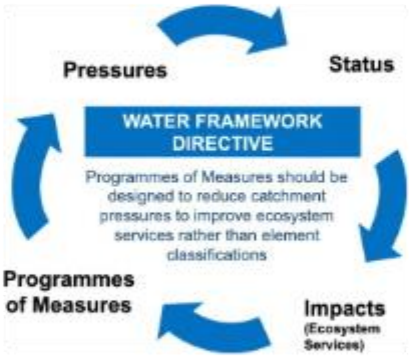

Figure 4: Relevant steps in the WFD manage-ment cycle (T.Giakoumis and N.Voulvoulis, 2019).

The results provide important quantitative information at catchment and sub catchment level (Analytical Unit) on relevant pathways and sources of emission with respect to various substances or groups of substances. They thus can contribute significantly to the designation of existing **pressures** with a clear focus on diffuse pollution, which are generally more difficult to identify than pressures from point sources.

Due to the possibility to estimate mean annual concentration at outlet points of the Analytical Units even a first assessment of the **status** can be prepared. Considering model uncertainties (incl. a typical percentage range of inaccuracy), or even uncertainties in model input parameters (including different variants of input parameters with mean-, max- or min values) mean concentration can be calculated for each Analytical Unit. While certainty of results depends on the quality of the model fit (validated on measured data) and representativeness of data available to perform the validation, in most cases results are suitable to supplement data from the monitoring programs. Specific **Impacts** can be assigned directly to the entry source and/or the entry path.

Accordingly, well-conducted emission modelling is a suitable tool for implementing relevant measures and define promising fields of application. Moreover, model scenarios can provide a preview of possible **measure effectiveness** that depict the reduction of substances also taking the achievement of targets into account.

Consequently, it can also contribute to a well-adopted **Programs of Measures** and be used as a sound Management tool to plan and optimize these measures.

One important task of the project will be a series of workshops in different Danube countries to give a sound overview on the above-mentioned areas of application of emission modelling, but also to provide some aspects on its technical background.

Literature:

T.Giakoumis and N.Voulvoulis (2019): Water Framework Directive programmes of measures: Lessons from the 1st planning cycle of a catchment in England. Science of The Total Environment. Volume 668, 10 June 2019, Pages 903-916. https://doi.org/10.1016/j.scitotenv.2019.01.405

❖ Monitoring in Pilot Regions

The main objective of our own monitoring performed in the Danube Hazard m3c project is to present a resources-effective yet representative approach capable of providing a detailed description of the occurrence of hazardous substances in the environment. The quantification of the pollutants supports the emission modelling on subcatchment level, as well as the creation of an inventory for the river basin. The joined monitoring program was implemented in 7 pilot catchments in 4 countries.

The implementation has provided many useful lessons. Although sample collection, storage and analysis requirements are well-defined in European and international norms, for the special circumstances determined by the composite sampling, several undefined issues were faced which might have a substantial influence on the concentrations measured. First results from atmospheric deposition, waste water and river monitoring show interesting patterns and give first indications about emission pathways. Distinguishing between the characteristic river flow conditions as well as particulate and dissolved forms of most determinants enables us to set up preferably accurate mass fluxes from each relevant source or pathway (see Figure 5). These further enables the calibration and validation of mass balance based fate and transport models to simulate possible environmental, economic and policy scenarios along with their evaluation.

The monitoring will be continued until spring 2022.

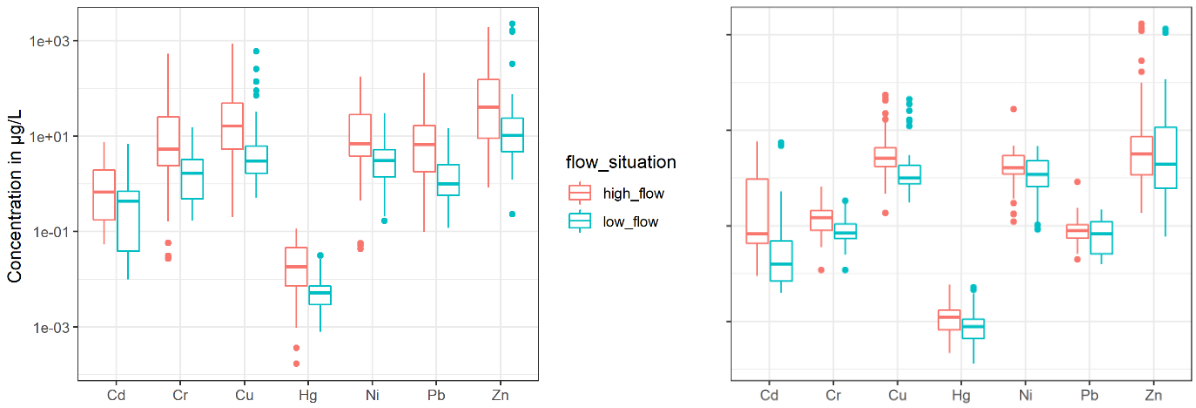

Figure 5. Range of measured total (left) and dissolved (right) heavy metals concentration for high flow and low- to midflow conditions

❖ Danube Hazard m³c Helps to Transfer Knowledge

Within the frame of the Erasmus+ student exchange program, Katarina Marković, a PhD student at the Jožef Stefan International Postgraduate School, and co-worker of the Department of Environmental Sciences at the Jožef Stefan Institute (JSI), visited the TU Wien, Institute for Water Quality and Resource Management. Working visit was led by Dr. techn. Ernis Saracevic and Univ. Prof. Dipl.-Ing. Dr. techn. Matthias Zessner.

It lasted for two months, from September to November 2021 and was focused on the optimization of the analytical method for the determination of per- and polyfluorinated alkyl substances (PFAS) by liquid chromatography tandem mass spectrometry (LC-MS/MS) technique in river water, and influent and effluent wastewater samples (see Figure 6).

PFAS are highly persistent organofluorine compounds monitored within the European project Danube Hazard m³c in which TU Wien and JSI are involved.

Figure 5: Katarina Markovič and Ernis Saracevic in the laboratory at the Insitute for Water Quality and Resources Management (TU Wien).

Due to their unique chemical characteristics, PFAS are widely used for numerous industrial purposes (surfactants, sprays, lubricants, adhesives, additives, coatings, paints etc.), making them one of the most prevalent emerging contaminants.

Establishment of reliable analytical method for PFAS determination is challenging due to their abundance (more than 4700 compounds) and diversity of chemical properties. Another issue lies in their widespread use, which may contribute to the risk of extraneous contamination and consequently to the high limits of detection and quantification (LODs and LOQs). During her stay in Vienna, Katarina joined the group and worked on overcoming the above-mentioned problems. First, LC-MS/MS procedure was optimized applying three different quantification methods i.e. external calibration, internal calibration and standard addition calibration. Katarina had also the opportunity to join sampling and to work on further optimization and validation of the analytical procedure. The joint work resulted in the establishment of the reliable analytical procedure for PFAS determination.

The experience and new knowledge that Katarina gained in TU Wien laboratory will be of great benefit in her further career. Katarina's visit strengthened collaboration between Danube Hazard m3c partners (TU Wien and JSI) and contributed to the knowledge transfer.

Figure 6: Schematic steps of sample preparation for analyses of PFAS.

❖ Impressions from the Wulka Monitoring Stations

After the Partner Meeting TU Wien organized an excursion to the monitoring stations in Oslip on Eisbach and Sankt Margarethen im Burgenland on Nodbach. Steffen Kittlaus and Nikolaus Weber explained in depth explanation the technical set-up of monitoring stations, parameters and measuring instruments taking data directly on site including on-line set up and the function of automated sampling instruments taking water samples when triggered by high flow events. The design and assembly of stations was done by TU Wien.

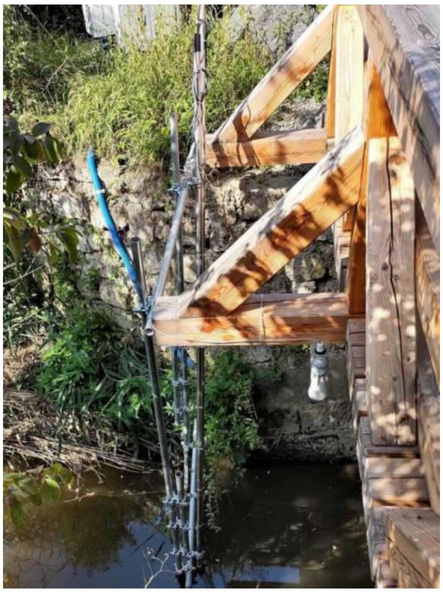

Figure 7: Construction, sensors and sampling hose mounted on bridge at the Oslip station.

Figure 8: Control and sampling box of the monitoring station, Steffen Kittlaus showing the autosampler part.

Figure 9: Nikolaus Weber presenting atmospheric precipitation sampling station in Sankt Margarethen im Burgenland.

Figure 10: Steffen Kittlaus presenting assembly and maintenance of sensors immersed in monitored water, Sankt Margarethen im Burgenland.

❖ Invitation to Capacity Building Activities of Danube Hazard m3c

Capacity building is another activity developed withing the frame of the project. It has started in July 2021. Within its frame it is planned to develop multiple knowledge transfer activities that will ensure the long-lasting capitalization of the project outcomes on Hazardous Substances management pollution. The goal will be achieved through a dedicated program of capacity building events on both, the national and transnational level.

At national level we will organize workshops dealing with monitoring and inventorying of hazardous substances pollution. Each Project Partner will organize one national event, so workshops will take place in Austria, Bulgaria, Croatia, Hungary, Moldova, Romania, Slovenia, Slovakia. ICPDR and CETI will collaborate at the organization of an event for participants from Montenegro and Serbia. For each event the maximal capacity is expected to be 30 participants.

Each national event, which will last 2 days, will be carried out in national language and local project partner organizing the event will have option to modify the content of the training to better fit national needs.

Transnational capacity building events will be focused to disseminate results and knowledge gained from work packages of the Danube Hazard m3c project. Main topics will include concepts of modelling of hazardous substances emissions, illustration of state-of-the-art approaches to develop and define scenarios and their interpretation and assessment.

Organization of events should enable not only the dissemination of the project results but also support discussions of national experts working in the area of hazardous substances management in surface waters. There will be in total 3 transnational events organized in Romania, Hungary and Austria. All events will have identical content and will be held in English.

All these events will be free of charge for participants. Dates, venues and final programme and lecturers/trainers will be announced in the coming months. We would like to warmly invite you to participate in these events. If you wish to receive more information or if you have specific comments, please send an email to danubehazard@tuwien.ac.at.

❖ Brief Information on the Danube Transnational Programme

The Danube Transnational Programme is a financing instrument of the European Territorial Cooperation (ETC), better known as Interreg. ETC is one of the goals of the European Union cohesion policy and provides a framework for the implementation of joint actions and policy exchanges between national, regional and local actors from different Member States.

The Danube Transnational Programme[1] (DTP) promotes economic, social and territorial cohesion in the Danube Region through policy integration in selected fields. In order to achieve a higher degree of territorial integration of the very heterogeneous Danube region, the transnational cooperation programme acts as a policy driver and pioneer to tackle common challenges and needs in specific policy fields where transnational cooperation is expected to deliver tangible results. Considering its geographical coverage, this highly complex programme provides a political dimension to transnational cooperation which is unique in Europe, successfully facing challenges such as ensuring good mechanisms to contract partners who receive funding from different EU instruments.

The Danube Transnational Programme finances projects for the development and practical implementation of policy frameworks, tools and services and concrete small-scale pilot investments. Strong complementarities with the broader EU Strategy for the Danube Region (EUSDR) are sought. The Danube Transnational Programme defines itself as a "financing instrument with a specific scope and an independent decision-making body. It supports the policy integration in the Danube area ... below the EU-level ... and above the national level in specific fields of action."[2]

The DTP cooperation is structured across four priority axes:

- Innovative and socially responsible Danube region
- Environment and culture responsible Danube region – the priority axis that includes the DanubeSediment and Danube Hazard m3c projects
- Better connected and energy responsible Danube region and
- Well-governed Danube region.

For more information on the European Territorial Cooperation (ETC):
http://ec.europa.eu/regional_policy/de/policy/cooperation/european-territorial/

For more information on the Danube Transnational Programme:
http://www.interreg-danube.eu/

[1] The programme area covers nine Member States (Austria, Bulgaria, Croatia, Czech Republic, Hungary, the states of Baden-Württemberg and Bayern in Germany, Romania, Slovakia and Slovenia) and five non-EU Member States (Bosnia and Herzegovina, Moldova, Montenegro, Serbia and 4 provinces of Ukraine).

[2] See the DTP cooperation programme, pg. 4: http://www.interreg-danube.eu/uploads/media/default/0001/08/81e933247b2bb1449c467f4cd1bd55cf0e734948.pdf

❖ Events

PROJECT EVENTS DURING PERIOD #3 (01.07.2021 – 31.12.2021):

- 3rd Project Partner Meeting, hyrbid, 23rd – 24thd September
- 3rd Steering Committee Meeting, hyrbid, 23rd September
- 3rd Advisory Board Meeting, hyrbid, 23rd September
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UPCOMING EVENTS

- 4th Project Partner Meeting, tbd
- 4th Steering Committee Meeting, tbd

❖ Interesting links

- Download our project Poster and our initial leaflet (in 8 national project languages)
- Find photos from projects events and meetings in the Gallery
- Guidance documents and technical reports that assist stakeholders in implementing the WFD can be found on the EU Commission website
- You may also check out the sites of our partner project: "The SOLUTIONS EU FP7 project about emerging chemicals in water resources management: lessons learnt and questions remaining"

THIS NEWSLETTER WAS COORDINATED BY (based on PPs contributions):

Water Research Institute, Bratislava, Slovakia, http://www.vuvh.sk/.

For questions or comments, please send us an e-mail at: danubehazard@tuwien.ac.at