Flood Risk Management in the Danube River Basin

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Recent major flood events

2002 2005 2006 FD 2010 2013 2014

ICPDR response to floods: Flood Action Programme

Action Programme on Sustainable Flood Protection in the Danube River Basin adopted in 2004

Action plans for sub-basins

17 flood action plans for the sub-basins prepared in 2009;

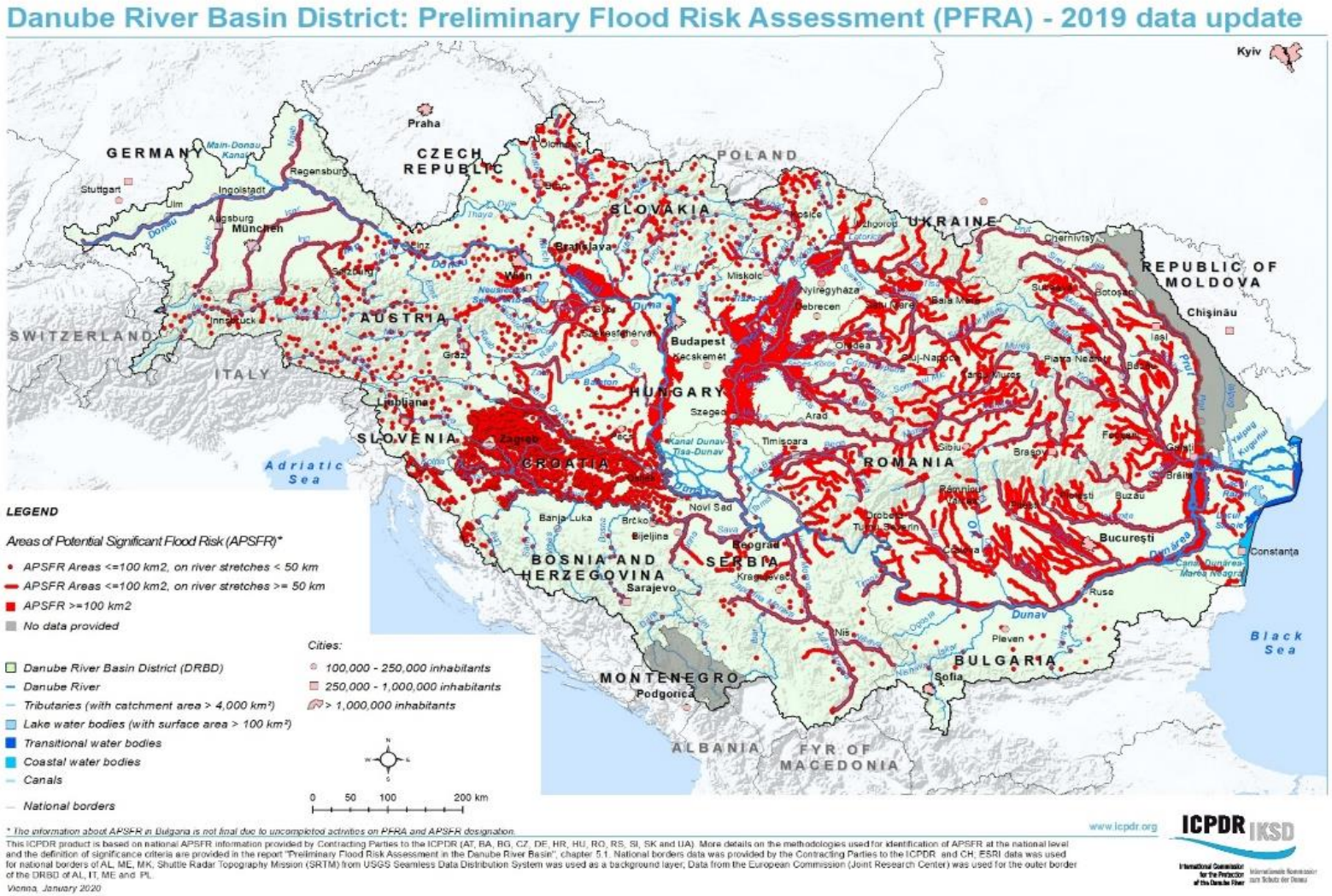
First comprehensive overview of hundreds of measures to reduce flood risks ever prepared in DRB.

EU-Floods Directive

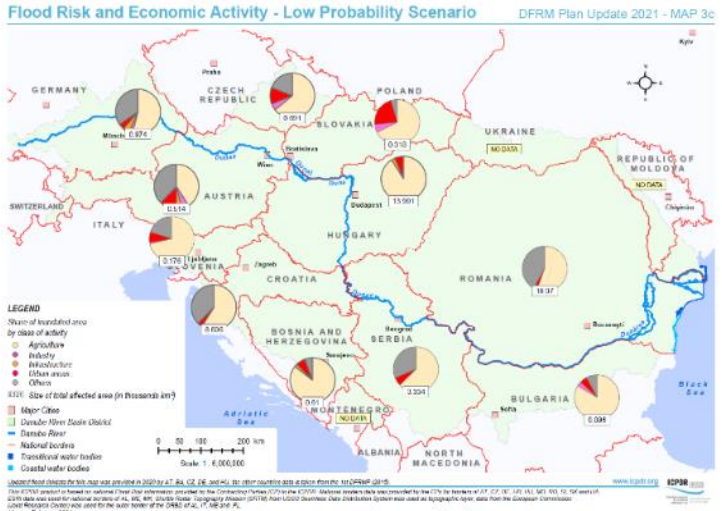
Three steps of implementation:

1. Preliminary flood risk assessment (2011/2018)
2. Flood risk and flood hazard maps (2013/2019)
3. Flood risk management plans (2015/2021)

Risk assessment



Hazard and Risk Maps



Danube Flood Risk Management Plan – Update 2021

1. Introduction
2. Conclusions of the preliminary flood risk assessment
3. Conclusions on flood hazard maps and flood risk maps
4. Objectives
5. Measures and their prioritisation
6. Water retention
7. Coordination with WFD
8. Cost-benefit analysis
9. Impacts of climate change
10. International coordination
11. Promoting the solidarity principle
12. Public information and consultation
13. Conclusions and next steps.

Appropriate objectives

Basin-wide objectives of DFRMP - they are linked to the respective measures and reconfirmed for 2021:

- ✓ Avoidance of new risks
- ✓ Reduction of existing risks
- ✓ Strengthening resilience
- ✓ Raising awareness
- ✓ Solidarity principle

Annex 2: Measures & projects supporting DFRMP 2021

Strategic level measures: Measures with downstream effect and measures applicable in more countries of the basin

- natural water retention,
- warning systems,
- awareness rising,
- reduction of risk from contaminated sites in floodplain areas.

Projects & project ideas identified by FP EG:

- Reflect the objectives and priorities set in DFRMP
- Basin-wide / transboundary character

Best practice examples

ICPDR IKSD

AUSTRIA — Status: Revisions Ongoing

Target area: Austria

Project: National Hazard Overview & Risk Assessment Austria

In Austria a Private Public Partnership of the insurance industry together with the federal ministry was set up as an output of the 2002 flood analysis. It aims at communicating flood risk to the citizens as well as supporting insurers to define their premiums. Starting with floods the tool (www.hora.gv.at) was enriched by information of other natural hazards leading to the tool of the so called "risk passport" where it is possible to assess his or her own risk against different natural hazards. The HORA tool is currently in a phase of revision where additional tools and visualisation options will be implemented to further increase the flood awareness of Austrian citizens.

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CZECH REPUBLIC — Status: Implemented

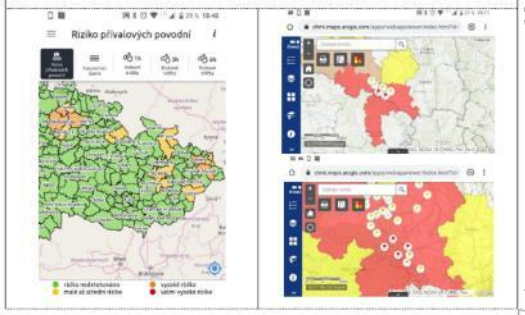
Target area: Czech Republic

Project: Flash flood indicator

Flash flood indicator project deals with the calculation of the probability of occurrence of flash floods resulting from torrential rainfall events. This approach highlights the requirement of more accurate prediction of torrential rainfall along with its location to improve the accuracy of flash flood forecasting. However, it is possible to identify areas where the occurrence of intense rainfall, due to the physical-geographical characteristics, has possibly occurred leading to saturated soil conditions, resulting in an increased probability of flash floods to occur. Estimates of rainfall using weather radar adjusted data of ground observations and nowcasting methods can be used to detect (calculate) the current probability of flash floods to occur over the forecast lead time. For this purpose, it is possible to use established and simple methods for rainfall-runoff modelling, such as the USA Soil Conservation Service (SCS) Curve Number (CN) method and the unit hydrograph, and to use the data of antecedent soil moisture conditions together with the physical-geographical and soil characteristics of the watershed.

Within this project, a system of procedures, termed the "Flash flood indicator (FFI)", was developed. This approach tries to solve the issues outlined above using GIS tools. Its main outputs are the current soil moisture conditions, the potential risk precipitation of a given duration and the real-time estimation of the flash floods occurrence hazard within a given territory. The FFI has been operated since 2010 at the Central Forecasting Office of the Czech Hydrometeorological Institute (CHMI), but until 2016 was in experimental operation only, and in 2016 was tuned. Its results during 2017–2019 were evaluated in detail and since 2020 the FFI has been one of the important parts of forecasting system at the CHMI.

Outputs of Flash flood indicator are published via web and mobile application available for IOS and Android.



HUNGARY — Status: Implemented

Target area: Hungary

Project: Restoration of flood protection capacity on main flood protection dykes

The nationwide project mostly ensures the reinforcement of the sections of the Danube, Tisza and Körös protection lines that need to be confirmed during the 2016 surveys. The implementation of the project has increased the flood safety of nearly forty settlements. Within the framework of the project, the protection line sections with the exceptionally low protection capacity were strengthened, because the flood protection embankment is low or weak due to the cross-section and the poor nature of the subsoil, which is prone to slipping and washing. The primary goal of the project was to make the line of defence effective on these sections as well, and to minimize unpredictable flood phenomena (sand boils, pipes, slope slip, dike collapse). In addition, the aim was to increase the height deficit on sections where it is risky to raise the flood defense embankment temporarily (with sandbags) at least to the point of protection. The Hungarian General Directorate for Water implemented the developments on the first-level state main defence lines managed by the Water Directorates under its professional management. The extent of the investment is characterized by the fact that 10 of the 12 regional water directorates in Hungary are territorially involved in the implementation of the project. As part of the local flood defence development, sheet piles and gap walls were built into the embankment.

Information about the project: http://vedelempesep.ovf.hu/

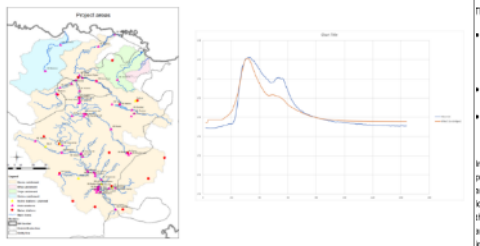
BOSNIA AND HERZEGOVINA — Status: Ongoing

Target area: Bosna River

Project: Development of Hydrological Flood Forecasting System for Sava River Basin (Bosna River)

Overall objective of the Project is to support the development of integrated flood risk management in BiH in line with the EU Floods Directive. Project purpose is to support weather and hydrological data collection, systematization, indexing and improvement of acquisition services, as well as establishment of consistent HFFS on a common IT platform accessible to the appropriate institutions, primarily to the project beneficiaries – water agencies and hydrometeorology institutes. The Project will support the implementation of measures of the Flood Action Plan for flood protection and river management, through consistent and coordinated development and implementation of cutting-edge tools and technologies for flood forecasting and strengthening capacities of Hydrometeorological Services and Water Agencies in BiH.

The main purpose of the Project is to integrate information and communication infrastructure and observation systems in BiH to enable automatic, accurate, reliable, timely and consistent hydrometeorological data acquisition services data collections store and improve access to databases and information on weather and hydrological conditions; as well as to Establish consistent hydrological flood forecasting system (HFFS) on a common IT platform to provide synoptic meteorological and hydrological services, hourly forecasts and informing on potential hazardous flood events to the responsible government bodies at the state and entity levels, institution in charge for flood and civil protection, and thus increase social, economic and environmental safety. The Project will be implemented until end of March 2021.



Slovakia — Status: Implemented

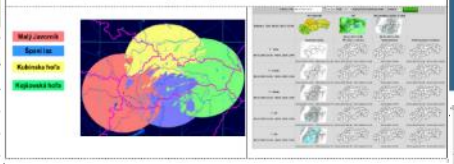
Target area: Slovak Republic

Project: POVAPSYS Flood Warning and Forecasting System

The key purpose of the POVAPSYS Flood Warning and Forecasting System system built in 2015 was production of early and high-quality forecasts of the meteorological and hydrological situation, including warnings of extreme flood events and the online dissemination of this information to the flood protection authorities. The hydrometeorological network feeding the system contains 137 automatic rain gauge stations, 78 automatic meteorological stations, 216 snow scales and cylinders, 19 weather cameras, 12 off-road vehicles, leveling and GPS devices and ADCP devices for discharge measuring. Within the building of remote sensing methods, a system of receiving data from circumpolar satellites was completed. Two new observation spots were built - radar towers on Kubinska hola and Spani laz including the installation of new radars. New radar network should ensure reliable monitoring of a long-term intensive precipitation connected with stratiform cloudiness as well as the short-time storm floods usually interfering with small limited areas. New radars were delivered and installed also on two existing radar towers Maly Javornik and Kojsovska hola. The measurements by new radars are submitted to the Composite Radar Information System. Radar horizon composite map for Maly Javornik, Kojsovska hola, Spani laz and Kubinska hola shows which of radars provide minimum visible height at the given point.

HYDOS systems (data collection control, visualization, control of model running, etc.), HelpDesk (issues tracking system), Electronic tool for manual - water level forecasting, Hydrological data management line (processing and storage of discharge measurements, discharge rating curves), Meteorological data management line (processing and storage of meteorological data), Delivery and Visualization Service of products (export of outputs to users) and other smaller systems have been developed.

A part of the POVAPSYS is a sub-module for flash-flood forecasting. It supports decision making process of hydrologists during convective precipitation season. The system is based on the WMO Flash-Flood Guidance System (FFGS). In its Slovak adaptation, INCA system is used as a combined information for precipitation analysis and soil saturation is computed by model of antecedent precipitation index (API). The system works in 5-minute time step and spatial resolution of a 1 km grid. Outputs from INCA analysis are summed up to different time intervals (5 min, 15 min, 30 min, 1 hour and 2 hours) and results are compared with values of a so-called FFG potential. The latter is defined as vulnerability of a territory to flash-floods, determined on basis of selected geographical and climatological features. If the sum of precipitation for certain time interval is higher than FFG potential, the district with high probability of flash-flood occurrence is marked in colour. New comprehensive flood forecasting system allows to ensure and improve the collection of input data not only from Slovakia but also from neighboring countries and to provide numerical forecasts for more than 100 new water gauge stations. In the framework of international data exchange, output of the POVAPSYS can be a valuable input for flood forecasting and warning system for the downstream countries.



ROMANIA — Status: Implemented

Target area: Romanian Black Sea Coast

Project: Protection and rehabilitation of the southern part of the Romanian Black Sea coast in the area c Constanța and Eforie Nord"

The phenomenon of erosion of the Romanian Black Sea Coast became visible after the '60s, the causes being multi They can be mainly associated with climate change, complex port development and changes in the Danube flow regi which over time have affected the natural morphological balance of the coastal zone. The coastal area between the Ch arm to the north and Vama Veche to the south was analyzed, studies, hydraulic modeling and diagnostic analysis erosions and their effects on the environment were carried out, and a coastal zone management strategy was dra up, the Coastal Master Plan, over a time horizon of 30 years.

The specific objectives of the Master Plan are:

- development of a programme of measures for the protection of the coastal zone against erosion, rehabilitation and protection of the shoreline, adjacent areas and land and marine ecosystems;
- protection of economic infrastructure and social objectives endangered by marine erosion processes;
- implementation of an integrated coastal and medium-term coastal zone monitoring programme, to support maintenance operations.

Investments were needed to help reducing the impact of climate change on the southern Black Sea coast, as well as protect human communities and the environment in these areas. The investment has a positive impact on the sal and quality of life of the inhabitants, by restoring the beaches and protection structures in the vicinity of which located housing and socio-economic objectives. The works consisted of new constructions for dissipating the energy the waves that affect the shoreline, artificial sanding of the beaches and constructions for the protection of the shorel and the retention of sand on the beach (extension on a length of 7.3 km of beaches in the coastal area of the Black S increasing by 33 ha the surface of the beaches of the Romanian coast in 5 areas, construction of 11 emerged dikes a 5 submerged dikes).

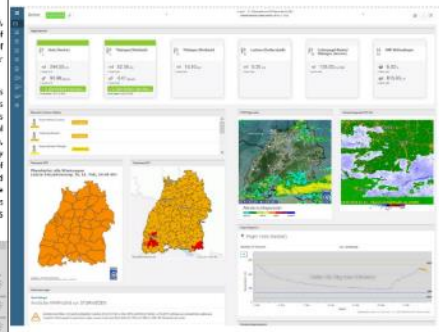
GERMANY — Status: Implemented

Target area: Federal State of Baden Wuerttemberg

Project: Flood Information and Warning System FLIWAS 3.0

The Flood Information and Warning System FLIWAS 3.0 is a web-based application for providing and exchanging information on flood crisis management for the federal state of Baden Wuerttemberg. It is intended for use by public authorities and emergency services. The project was launched in 2015 and finished in 2019. Currently, FLIWAS is used in Baden Wuerttemberg by 1,100 people.

FLIWAS is suitable for desktop computers and mobile devices. It provides a wide range of flood-related data and information, such as current and predicted rainfall, current and predicted water levels, fill levels of flood retention basins and status of critical infrastructures. Users can include emergency plans and share additional information, for example situation reports and maps. Add user defined threshold values such as predefined water levels, FLIWAS will automatically send messages to the user. The user interface of FLIWAS is highly configurable and can be adapted to the individual needs of any administration. Last but not least, FLIWAS enables authorities to operate their flood retention basins in a coordinated way. This helps to reduce water levels in the upper reaches of the Danube River and to mitigate damages in the middle and lower reaches of the Danube River.



SERBIA — Status: Implemented

Target area: Velika Morava River basin

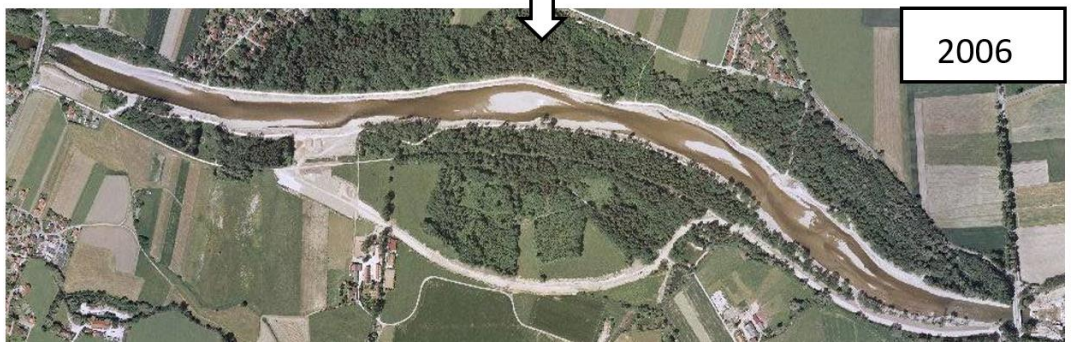
Project: Development of the Flood Forecasting and Warning System for the Velika Morava river basin

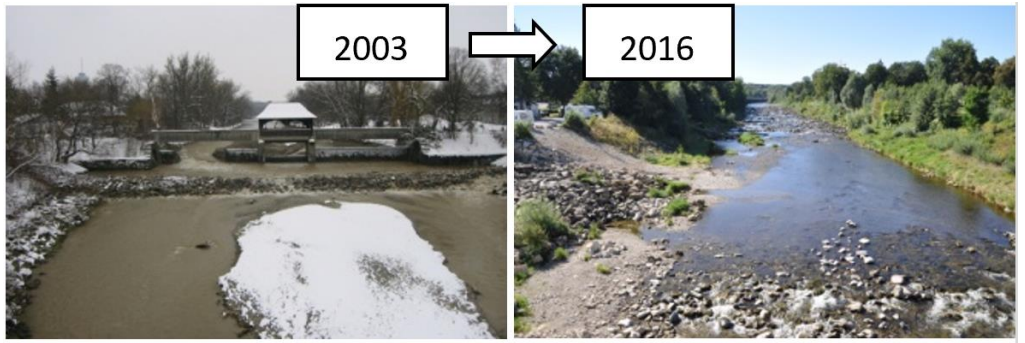
The project was initiated at the project kick-off meeting, held on August 26, 2019, at the Republic Hydrometeorological Service of Serbia (RHMSS) in Belgrade. This forecasting system has been implemented for the Republic Hydrometeorological Service of Serbia (RHMSS) during the period of August 2019 till March 2020 by Deltares, along with the Centar Građevinskog fakulteta d.o.o. Zagreb and Mihailo Anđelić as subcontractors. During the project implementation, all partners have maintained fruitful and mutually beneficial cooperation with the RHMSS, the Water Directorate of the Ministry of Agriculture, Forestry and Water Management, the World Bank and the independent advisor - Prof. Dr. Jasna Plavšić. The project is part of the larger Serbia National Disaster Risk Management Program, which is financed by the Trust Fund provided by the European Commission on behalf of the European Union and administered by the World Bank.

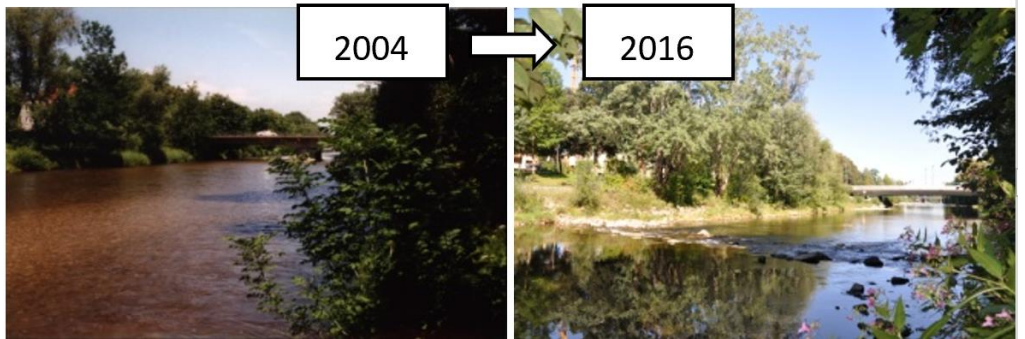
In accordance with the Terms of Reference (ToR), the principal objective of the project was to build a hydrological model that supports flood forecasting embedded in a real-time operational platform, without inclusion of a hydraulic model and training components. The Consultant has developed, calibrated and verified two hydrological models for the Velika Morava catchment - a semi-distributed HEC-HMS and a fully distributed Wflow model. These models are integrated in an independent Delft-FEWS client-server application hosted at the RHMSS in a Test and Production environment, fed with real-time observations from the RHMSS WISKI database, csv files and deterministic and ensemble Numerical Weather Prediction models. The forecasting results contain forecasted river flows and water levels derived from rating curves for 16 hydrological stations on Zapadna, Južna and Velika Morava. These results are checked with crossing of warning levels, which may result in additional alerts to be sent out by the RHMSS.

Coordination with WFD

- Emphasis on integrated approaches
- Focus on natural water retention measures
- Discussion paper







Danube
Flood Risk Management Plan

Public consultation 04-09/2021

http://icpdr.org/main/public-consultation-draft-river-basin-and-flood-risk-management-plans-2021

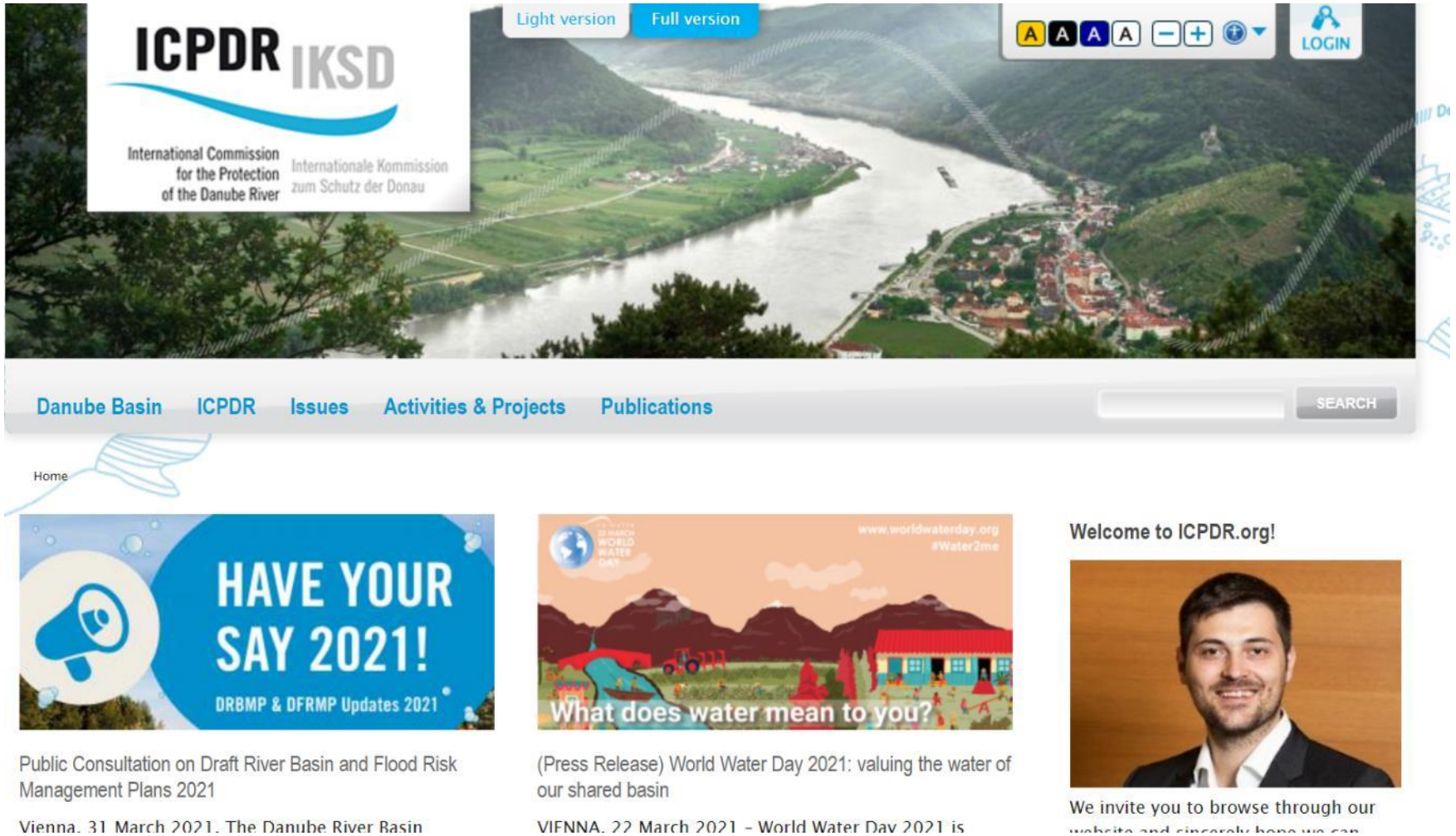
Implementation progress

- Progress in achieving objectives is addressed primarily through the implementation of the best practices projects;
- Progress in implementing measures demonstrated through achievements of international projects;
- Giving priority to measures with positive up/downstream effects such as natural water retention, warning systems, reduction of risk from contaminated sites in floodplain areas or exchange of information;

Key messages

- Implementation of flood risk management measures during the first cycle of FD implementation contributed to a significant reduction of flood risks in the whole river basin;
- Joint implementation of the FD by EU Member States together with non-EU Member States strengthened the common view on a holistic flood risk management approach in the whole Danube River Basin.

Further information



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