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INTERNATIONAL SAVA RIVER BASIN COMMISSION

Transboundary Training Workshop

Governance and Technology for Flood Risk Reduction: Linking Early Warning to Emergency Management in the Sava River Basin

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Abstract

Over the last 5 years, South-East Europe been severely hit by extreme flooding events. Major floods in 2010, 2013, 2014 and 2015 affected hundreds of thousands of people, causing extensive damage and a high casualty toll. The effects of the May 2014 flood event in the Sava River Basin have been so widespread and evident that in 2014 the European Commission hosted a Donor's Conference in Brussels requesting full mobilisation in support of those countries affected by years of devastating floods. One of the follow-up actions has been a Regional Conference to strengthen policy on flood prevention and flood risk management in the Western Balkans.

Along the same lines, in the fall of 2015 UNESCO supported the Regional Workshop on Flood Risk Management Measures & Links to EU WFD, co-organised with the International Sava River Basin Commission (ISRBC), the World Meteorological Organization (WMO) and the International Commission for the Protection of the Danube River (ICPDR) that explored advances and innovation in flood risk management measures and practices. It provided valuable input for the planning and implementation of activities, in particular of a joint **Flood Forecasting and Warning System in the Sava River Basin** (Sava FFWS), currently under development as per article 9 of the **Protocol on Flood Protection** to the FASRB (**The Framework Agreement on the Sava River Basin**).

This marks an unprecedented attempt to build a shared transboundary regime for floods and drought risk in the entire Sava River Basin through which several numerical weather prediction hydrological and hydraulic models, data and methods are harmonised along with the real-time observed hydrological and meteorological data. Proceeding from the above, the UNESCO Regional Bureau for Science and Culture in Europe, in collaboration with the ISRBC and with the technical support provided by the CIMA Research Foundation and ISMB (Istituto Superiore Mario Boella) from Italy, the Deltares, the Royal HaskoningDHV from the Netherlands, Rescue Directorate from Croatia, as well as by the experts from the Sava River Basin, organised a training workshop titled **Governance and Technology for Flood Risk Reduction: Linking early warning to emergency management in the Sava River Basin** in Zagreb (December 2017).

The training workshop aimed to connect early warning alerts with monitoring, response and flood protection actions performed by all responsible institutions. Representatives of Civil Protection, water management and hydro-meteorological services tested different tools and convened on possible strategies necessary to ensure coordination and that precise and reliable information are shared among all stakeholders during emergencies. The very positive collaboration during the workshop between hydro-meteorological and water agency units, civil protection authorities and professional volunteers was formed the basis for a set of recommendations included in this report.

The workshop and this report were undertaken as a contribution from South-East European (SEE) countries to the eighth phase of the **International Hydrological Programme of UNESCO**, and in particular, its **Focal Area 1.1 dedicated to Risk management as adaptation to global changes**[1].

1 Risk communication and stakeholder participation have emerged in recent years as an integral part of strategies for managing water-related risks. The aim of risk communication is to reduce exposure to risk and build resilience and resistance to hazards by enhancing the public's perceptions of risks, thus influencing behaviour in response to them. Risk communication is both a means to facilitate the adoption of risk reduction/prevention measures and part of the measures themselves (especially early warning, risk mapping and land planning) and brings social benefits such as capacity building and trust. Finally, involving informed stakeholders (with access to key information) in the various stages of participatory planning will also result in more socially robust and accepted mitigation measures.

Foreword

The organizers have decided to publish the proceedings of the workshop to further share the knowledge and practical experiences discussed during the event as well as the insightful recommendations of the participants on a topic of extreme importance both for UNESCO and for the International Sava River Basin Commission: governance and technology for flood management in the Sava River basin.

UNESCO and the International Sava River Basin Commission strongly believe that regional and international cooperation is a key instrument to building more resilient societies in any international river basin. The establishment of transboundary and regional regimes for the creation and implementation of legal frameworks and institutionalised systems for the management of shared resources and common goods, and provision of innovative decision support systems and technological tools cannot function without a strong cooperation framework among the nations and peoples of the region. This is why the proceedings of the December 2017 workshop contained herein are so important: the workshop brought together many key players from the Sava River basin, both technical and political, and it proposed tools, methodologies and recommendations on how to manage floods that have had a real impact in the lives of the population in the Sava River basin, in a sustainable way.

We hope that these proceedings, as the workshop itself, will draw the interest of and be useful to many stakeholders involved in disaster/flood risk management not only in the Sava River basin but also in other international river basins.

Ana Luiza Massot Thompson-Flores, Director
UNESCO Regional Bureau for Science
and Culture in Europe

Dragan Zeljko, Secretary
International Sava River Basin Commission

Acknowledgments

The concept, planning and execution of this workshop and the preparation of these proceedings were achieved by the organising committee composed of Science unit's officers of the UNESCO Regional Bureau for Science and Culture in Europe and the ISRBC Secretariat.
The organisers are grateful for the technical support provided by the CIMA Research Foundation and ISMB (Istituto Superiore Mario Boella) from Italy; Deltares, the Royal HaskoningDHV from the Netherlands; the National Protection and Rescue Directorate from Croatia, as well as by the experts from the Sava River Basin as presenters/speakers and moderators of group discussions
These proceedings also include information presented and discussed during the workshop. In particular, all the slides presented can be viewed at the public webpage:
http://savacommission.org/event_detail/8/22/389.
Finally, a video clip https://youtu.be/jthRr3qbg6s has been produced to summarise the workshop.

Introduction

1.1 Overall goal and specific objectives

The overall goal of the workshop was that of **promoting a multi-stakeholder dialogue, covering "the last mile" gap between early warning and monitoring-response phases in the Flood Risk Disaster Management Cycle**. The divide between emergency managers and flood forecasting operators on how to close the gap between early warning/dissemination of information of hydrological and meteorological relevance and the activation of the remaining phases of the Disaster/ Flood Risk Management Cycle is an issue to further explore and debate. The workshop demonstrated that major benefits are possible for the Sava riparian countries if an integrated forecasting service, as operated by the Sava FFWS, is combined with the uptake of innovative ICT-based solutions, real-time reporting and situational awareness on flood-based hazards. The latter should be at the service of the civil protections in a standardised format and with guiding procedures of activation and use, well embedded in civil protection risk management plans both at the central and municipal level.
Specifically, attention has been paid to the following topics:
Raising the awareness and understanding among relevant stakeholders of the potentialities offered by the common use of integrated systems and tools for monitoring, forecasting, alerting and reporting in the entire Flood Risk Management Cycle;
Identification of major obstacles and possible solutions at the Sava River Basin level to empower national and local governance capacity for disaster/ flood risk reduction in the elaboration of sound governance solution with a sub-regional perspective;
Setting up a background for preparing the proposals of mechanisms of coordination on the basin-wide level and the modes of cooperation of the Sava countries in flood defence emergency situations including the arrangements in the basin for preparedness (forecasting and warning) and the measures for mitigation of transboundary impacts, in line with Article 11 of the Protocol on Flood Protection to the FASRB.

1.2 Setting the stage of the workshop

During this introductory session, the ISRBC and UNESCO Regional Bureau for Science and Culture in Europe introduced the aim and methodology of the workshop.
The workshop was divided into 5 sessions that brought together emergency responders and flood forecasting operators from the Sava River Basin and major stakeholders of the beneficiary countries in consultation with the ISRBC. The participants engaged in a highly participatory environment where role-play exercises and in-field activities permitted them to draft a list of recommendations that will provide guidance for future initiatives in the Sava River Basin. Emphasis was placed on the local/ country-level early warning system, communication flows, preparedness, monitoring and response to flood risk.

Figure 1: UNESCO Regional Bureau for Science and Culture in Europe, SC Unit
Figure 2: Dragan Zeljko: International Sava River Basin Commission Secretary

Session II

Flood risk Governance and Technology for the Sava River Basin

A brief explanation of flood risk management plans in the Sava River Basin was provided by ISRBC PEG FP experts. Practical examples of the utilisation of advanced ICT solutions were given. First, a demo of the Sava River Basin flood forecasting and warning system was shared. Secondly, the I-REACT project and its crowdsourcing solutions were presented with a focus on infield reporting for both professionals and citizens (crowdsourcing) and geo-located real-time warning and alerts.

2.1 Flood risk management planning in the Sava River Basin – National and transboundary flood risk management planning & measures to enhance flood risk prevention

Floods are mostly natural phenomena, which cannot be fully prevented. However, the flood risk can be significantly reduced depending on the human, financial and other resources invested in the flood risk reduction activities and the overall effectiveness of the flood protection measures. In the year 2007, the Directive 2007/60/EC of the European Parliament and the Council of 23 October 2007 on the assessment and management of flood risks (the so-called EU Floods Directive) was adopted with the aim of overall more effective and harmonised flood risk management in all EU Member States. The EU Floods Directive envisages a 6-year flood risk management planning cycle (the first one for years 2010[2009]-2015, the second one for years 2016[2015]-2021 with a special emphasis on transnational flood risk management for international river basins like the Sava (or Danube) River Basin.

The activities of the International Sava River Basin Commission definitely are an important added value in the form of winning additional (financial and other) resources for better, more effective and transnational coordinated flood risk management in the Sava River Basin.

Two such activities in the framework of overall flood risk management in the Sava River Basin are the Sava Flood Risk Management Plan (**Sava FRMP**) and the Sava Flood Forecasting and Warning System (**Sava FFWS**).

The **Sava FRMP** focuses its flood reduction activities on the areas of common interest in the Sava River Basin like the borderline rivers (for example Kolpa/Kupa or Sotla/Sutla Rivers if we focus on Slovenia and Croatia's common interest) or the (administrative) border areas around the Sava River's main watercourse. The Sava FRMP also includes a wide range of non-structural flood risk reduction measures and consensually prepared studies and analyses, which would lead to easier and better coordinated, harmonised and commonly agreed upon solutions among all the countries sharing the international Sava River Basin.

One such commonly agreed practice the river basin level is the common **Sava FFWS**, which is already in the final stages of development and will be primarily hosted by Slovenia.

The Sava FRMP will serve as a complementary addition to the already established national flood risk management plans and help the countries to win additional financial resources for the purposes of implementing the flood risk reduction measures in the Sava River Basin. It would include real, easy to implement, cost-effective, sustainable and transnational (and at the level of the Sava River Basin) harmonised flood reduction measures and projects for the areas of common interest. Unfortunately, the non-implemented flood protection measures, which look good on paper but remain solely that, are not actually reducing the flood risks or helping anyone.

Some other important aspects when considering what to perform in the framework of national and transboundary flood risk management (and planning) are:

In some cases, transboundary flood risk management (for example - flood forecasting in the Sava River Basin) is not only important but also mandatory/crucial;

Overlapping or duplicated flood risk reduction measures should be avoided or reduced to a minimum;

A good (flood risk management) plan, national or transboundary and without implementation, is of NO USE for the people and other subjects (economy, cultural heritage, etc.) if located in the flood risk areas;
After the plan is adopted, most of the (financial, human and other) resources must be focused on the implementation of the plan.

2.2 Flood forecasting system establishment in Slovenia

The national hydro-meteorological service at the Slovenian Environment Agency, which was initiated by the extensive European project BOBER, has been in continuous development in the past years, followed by participation in several national and multinational projects. Through various development phases, the aim was to advance all associated fields of work in order to increase its services for the public, civil protection and other end users.
The foundation of improving models and products was the construction of a hydro-meteorological monitoring network comprising 147 hydrological stations, 92 meteorological stations and an additional meteorological radar, which now enables real-time access to a substantial amount of environmental data. Investment also was made in the modernisation of the computer infrastructure for operational use, as well as research and improvement of the complex meteorological models. Secondly, newly acquired data and infrastructure provide, with the use of the MIKE by DHI software, the backbone of the national hydrological forecasting system. It provides the hydrological forecasting service, which currently consists of eight forecasters, a vital operational tool for monitoring and forecasting the state of Slovenian rivers.

The forecasting system covers hydrological and hydrodynamic models divided into 4 spatial domains: one each for the major river basins in Slovenia, i.e. Sava, Soča and Mura River Basin and the full Slovenia model that consists of 227 sub-catchments. The latter is considered as a semi-distributed model with an average catchment size of 90 km^2 and is as such primarily designed for forecasting smaller scale flash floods. As meteorological input data, point measurements and processed radar estimates are used in the analysis period of the model simulations, a forecasting period continues that is run by deterministic and ensemble ALADIN models as well as ECMWF results. The system is updated hourly with discharge and water level forecasts monitored for up to 6 days. Additionally, for the purpose of "nowcasting" even the sub-scale local flash floods, catchment

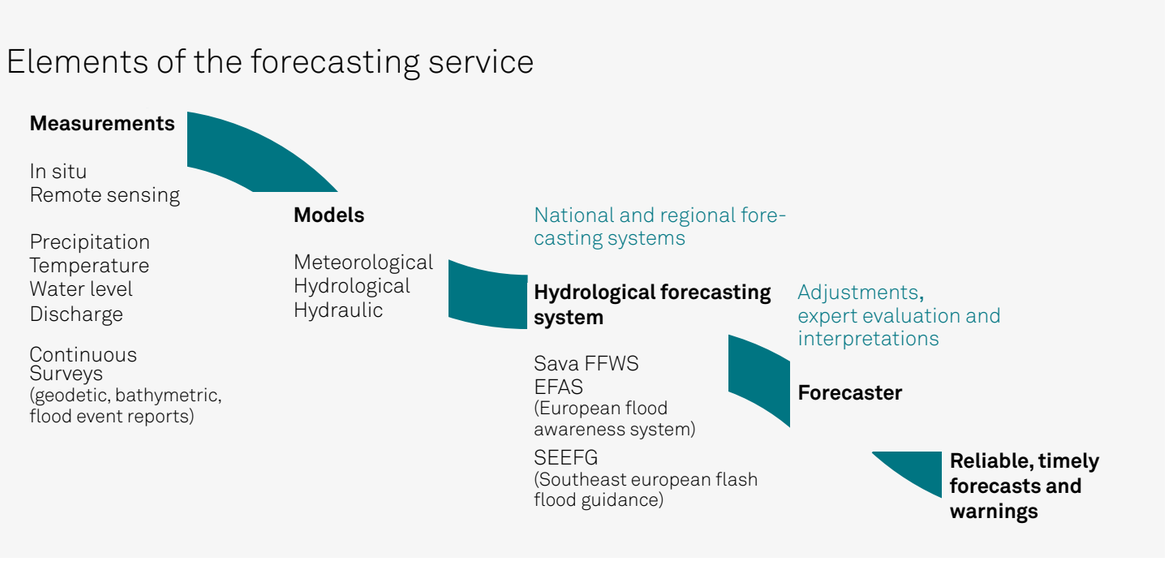


Figure 3: Main elements of the hydrological forecasting service and its data flow. The forecaster's role of aggregating information is a key role in the process

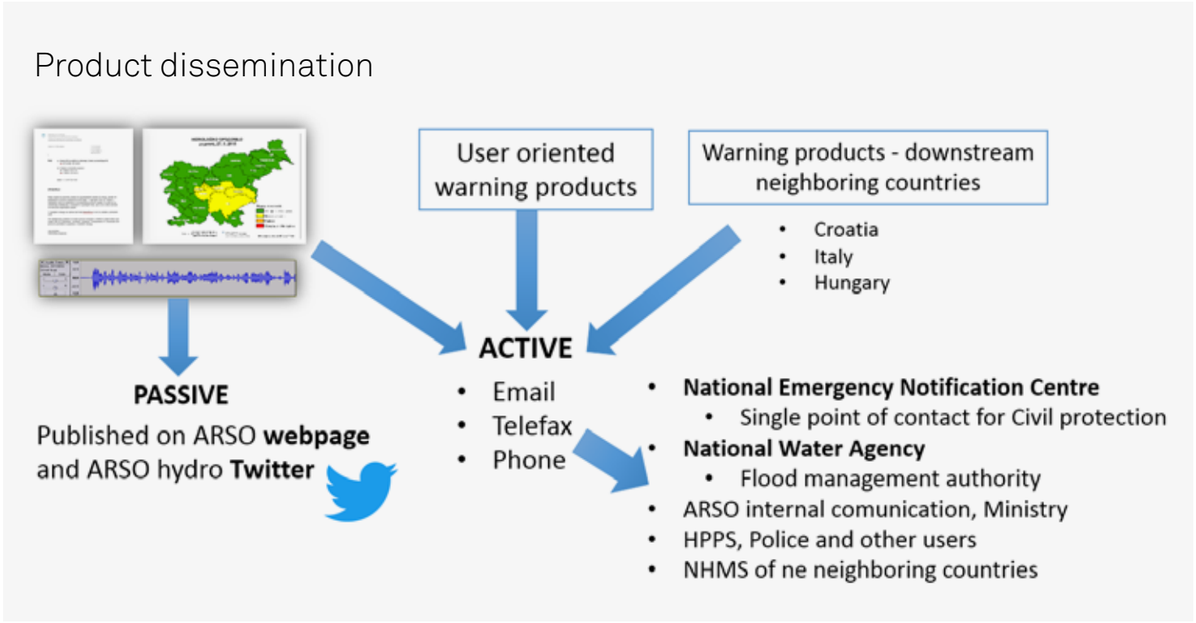


Figure 4: Dissemination process of the official hydrological warning and other user-oriented warning products

average rainfall and specific runoff data are analysed to assist the forecaster.
In the consideration of the above, the Slovenian Environment Agency recognised a benefit in the organisational aspect of having the meteo and hydro offices working side by side. It enables daily or more frequent consultations that provide helpful information especially regarding uncertainty in numerical weather predictions (NWP). Both offices issue forecasts and warnings in text, audio and graphical formats that are composed in accordance with the Meteoalarm colour-coded warning levels based on potential impact (Figure 4). In addition, the dissemination of information through the social media channel Twitter was introduced with the goal of improving the usability of services from the end-users.

However, next to dissemination of warnings, the notification or understanding of its information is of crucial importance in the early warning process. For that objective, a joint working group was established. The Slovenian Environment Agency, along with the National Administration for Civil Protection on Flood Warning and River Threshold Analysis, detailed warning levels and expected flood impacts.

An important role is played by main national media channels, which notify the public of official warnings as well as explanations of the uncertainties and expected scenarios.

As an active regional and European partner, the Slovenian Environment Agency collaborates with 3 hydrological forecasting systems: European Flood Awareness System (EFAS), European Flash Flood Guidance System developed with support of the WMO and our common Sava River Basin Flood Forecasting and Warning System that is at the time in its development phase and based on the Delft-FEWS system by Deltares.

2.3 Establishment of Flood Forecasting and Warning System in the Sava River Basin

In May 2014, disastrous floods in the Sava basin resulted in 79 casualties and substantial economic damage in Croatia, Bosnia and Herzegovina and Serbia. Assessments of the total damage in the area range up to 3.8 billion Euros. The events led to a major international aid campaign, with numerous countries, organisations and individuals sending humanitarian, material and monetary support to the affected areas. This disastrous event again indicated the need for a transboundary flood early warning system.
Deltares along with Royal HaskoningDHV, Eptisa, the Hydro-Engineering Institute of Sarajevo and Mihailo

Andjelic have joined forces to help riparian countries in the Sava River Basin located in Eastern Europe to establish a Flood Forecasting and Warning System (Sava FFWS). This consortium, led by Deltares, combines international expertise in flood and drought forecasting and early warning with strong local expertise and good working relationships with national and regional authorities. The efforts of the consortium focus on 3 aspects: how to establish an effective organisational structure; delivering the right information at the right time and to the right place; and, training for the relevant stakeholders.

During the workshop, the consultant presented to the participants the objectives of the Sava FFWS project and demonstrated a snapshot of the pre-release. In response to floods and droughts, the consortium developed a joint, operational flood forecasting and early warning system for the riparian countries in the Sava River Basin (97,700 km2). Better information will lead to better decisions and the resulting system will enable the five countries involved to take the right management decisions and implement operational measures to prevent and mitigate severe flood and drought situations on the basis of accurate forecasts of flows and discharges with a long lead time.

The Sava FFWS allows each country to continue working on its own models, monitoring systems, forecasting systems, water authorities and interests while providing a common platform. An effective FFWS has to bridge differences and supporting collaboration in the field of water management. The Sava FFWS project started in June 2016 and currently is being implemented. The project is intended to be completely finished after the summer of 2018. Currently, the Sava FFWS is almost complete from a technical point of view. During the workshop, an unmet need to bridge the gap between expert users (the target group of the Sava FFWS) and the civil protection service (those responsible for the actions taken on the ground) emerged.

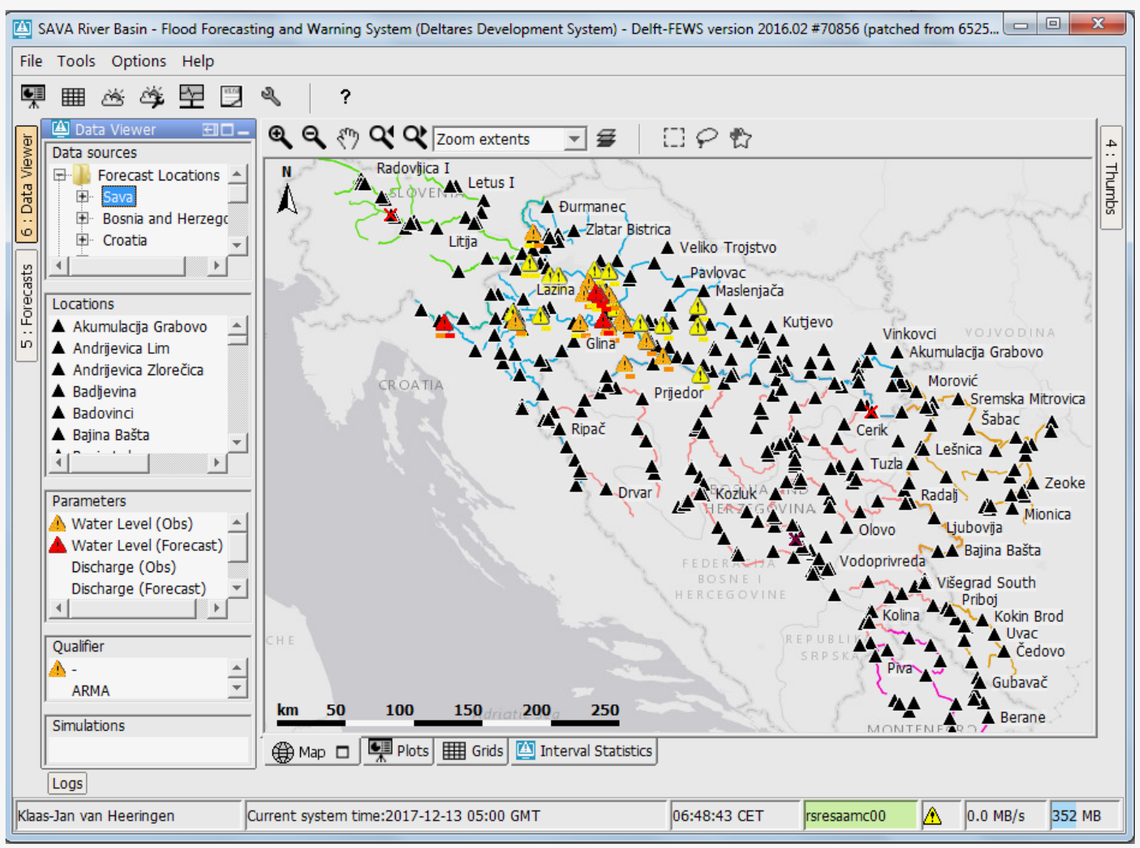


Figure 5: Main overview map of the Sava FFWS, showing the status at December 13th, 2017, while in Croatia and Slovenia some flooding is expected and as a result of that, the corresponding forecasting locations have warning icons displayed up to a red warning

Information technology plays a key role in bridging this gap, but also the information need for civil protection services is different from the information need of expert users.

In addition to the presentation of the Sava FFWS and a live demonstration, a questionnaire was organised. The following statements are a synthesis of the results:

The workshop was attended by a good mixture of professionals, operational forecasters and emergency managers;

There is a frequent need for information regarding hydro-meteorological forecasts;

There is an unmet need for a so-called 'push' service (direct phone call, mobile alerting);

The majority stated that it is unknown whether making forecasts publically available will lead to a more effective response;

Communicating the uncertainty of the warning and the contextual information explaining the warning are indicated as the two most important aspects when communicating with end-users;

The two biggest challenges currently are transboundary communication and communication between forecasters and civil protection.

Follow-up actions

Further development of the Sava FFWS in terms of linking its results with multi-stakeholder application would even more signify the importance of the systems itself and the position of the national hydrological services. However, the implementation of such complex national and international cooperation would require a similarly structured project organisation as the one of Sava FFWS, which could enable a systematic implementation phase both on the technical and organisational aspect. Only such committed participation can then result in incorporating a new tool into established procedures.

2.4 Bridging the gap between early warning forecasts and emergency response through a real-time communication system

Society as a whole is increasingly exposed and vulnerable to natural disasters because extreme weather events, exacerbated by climate change, are becoming more frequent and longer. In this context, the access to an integrated system providing the main emergency management information and data coming from multiple sources is even more critical to successful disaster risk management. Despite this, current systems for risk management are still limited in their effectiveness. Even if technological processes are registered and large amounts of data are available, there is no platform that integrates and analyses all the useful data to improve the prediction and management of natural disasters in real time. On the other hand, the need for systematic data for disaster mitigation and prevention is an increasing concern for both development and response agencies. In the past, data needs were addressed on an ad hoc basis, which included collecting the information at the time of the emergency. However, there is a growing understanding that data collection, analysis and management can help both short and long-term development goals and support to identify and address disaster risks. The I-REACT project has been conceived in this context, considering that "*you cannot manage what you cannot measure*", as stated Margareta Wahlström, United Nations Special Representative of the Secretary-General for Disaster Risk Reduction.

The project: I-REACT in brief

I-REACT (Improving Resilience to Emergencies through Advanced Cyber Technologies) is a Horizon 2020 3-year project (2016-2019) funded by the European Commission under the Secure Society Work Programme (DRS-1-2015).

I-REACT integrates existing services, both local and European, into a platform that supports the entire Emergency Management Cycle. In particular, I-REACT implements a multi-hazard system with a focus on floods, fires and extreme weather events, as they are the most impacting natural hazard affected by climate change.

To reach this objective, **I-REACT brings together a multidisciplinary team of 20 European partners. From researchers and technologists to industry leaders, UN officials, consultants and communicators, these partners are working collaboratively on the different tasks of the project providing their experience and expertise to generate the best solution against disasters.** The project is coordinated by the Istituto Superiore Mario Boella of Turin. Consortium partners include: Geoville, Eoxplore, Terranea, Alpha Consult, UNESCO (Regional Bureau for Science and Culture in Europe, Venice), Politecnico di Torino, Celi, JoinPad, Fondazione Bruno Kessler, Finnish Meteorological Institute, Meteosim, Bitgear, Ansur Technologies, Technical University of Vienna, Scienseed, CSI Piemonte, Aquobex, Answaretech and the Joint Research Centre (JRC) of the European Commission. I-REACT align the key phases of the emergency management, i.e. prevention, preparedness and response phases.

The first phase mainly deals with the preparation of a community to eliminate or reduce the impact of future disasters. For this, the I-REACT platform integrates historical data, weather data and satellite observations to derive detailed statistics and trends. These data, coupled with a decision support system, allows decision makers effectively to plan prevention measures aimed at increasing resilience to future disasters.

The second is the preparedness phase. During this phase, coordination between governments, civil organisations and citizens is promoted through the integration of different early warning services and real-time alerting system. To reach this objective, I-REACT integrates extreme weather forecasts; data from both local and European early warning systems, such as the European Flood Awareness System (EFAS) and the European Forest Fire Information (EFFIS); and warnings extracted through social media analysis or received through crowdsourced reports from authorities and citizens, who can use the I-REACT mobile application.

The third is the emergency response phase, in which effective reaction, first aid and evacuation are crucial. To help on-site operators, I-REACT allows getting a quick and complete operational picture thanks to the ingestion of different data sources, such as real-time reporting (from mobile phones or wearable devices) and “nowcast”/forecast maps. To improve self-protection behaviour and reduce exposure, I-REACT allows public authorities and responders immediately to warn citizens with real-time information and instructions. Moreover, I-REACT offers a command and control module to manage missions and tasks, and it can be linked with local operational procedures in order to automate alerting processes.

Therefore, I-REACT solutions can be used to complement local monitoring and forecasting systems in a view of closing the gaps between early warning/dissemination of information of hydrological and meteorological relevance and the activation of the remaining phases of the Disaster/ Flood Risk Management Cycle.

Session III
Team work and gap analysis

In session 3, a table top exercise was organised, attempting to demonstrate that weak communication flows, especially in a fluvial transboundary region, can be detrimental to the correct management of the Disaster Management Cycle. Emphasis was placed on the determination by participants of critical issues within the communication of information both at national and regional levels.

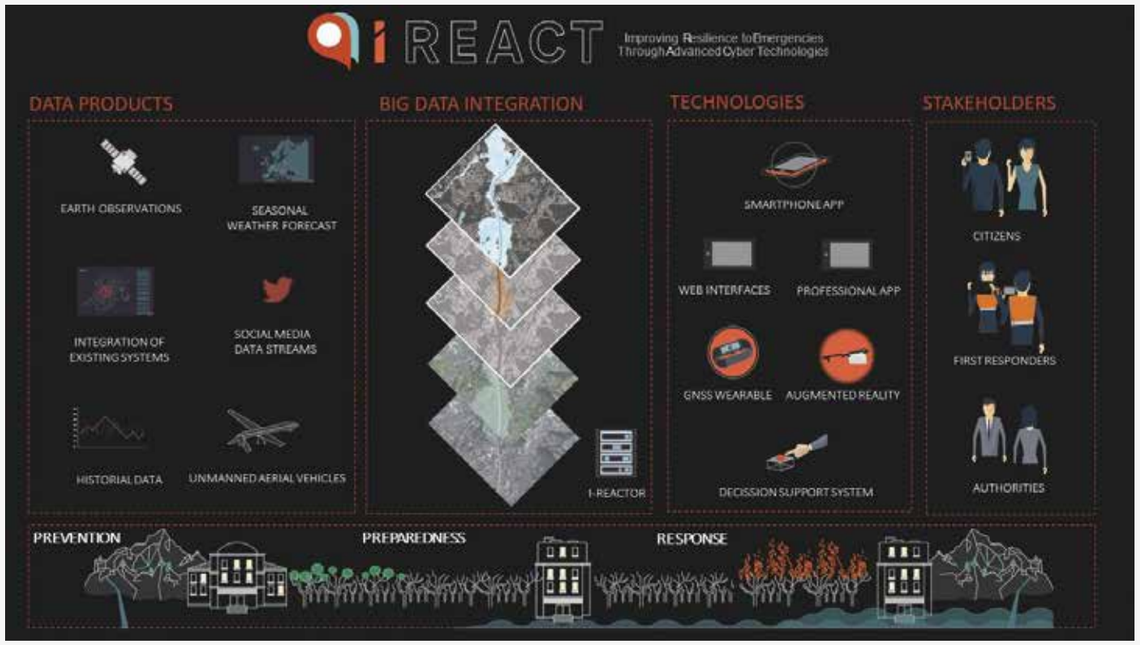
May 2014 will be remembered by devastating floods in Sava River Basin countries (Bosnia and Herzegovina, Croatia and Serbia). The breaking of embankments in several places resulted in a spill of the Sava River from the riverbed and fast flooding. Intensive rainfall in May 2014, especially in the week of May 12-17, in the Sava River Basin States resulted in the rise of the left and mainly of the right Sava tributaries: the Una, Bosna and Vrbas Rivers and consequently the Sava River. In some areas, their volume surpassed all records since the taking of measurements began, and, in many places in those few days, more than the maximum monthly rainfall for the whole month of May occurred.

The peak water level of the Sava River during the 2014 flood was monitored from Slavonski Brod to Županja and the Bosna, Vrbas and Drina Rivers. In addition to intensive rain in the first half of May, the situation further was aggravated by the fact that the soil was already saturated with water from extreme precipitation from April to the first half of May. Many landslides were triggered, especially in Bosnia and Herzegovina.

Unfortunately, those events had a devastating impact. From information obtained from the ICPDR & ISRBC’s “Brief Overview of Key Events and Lessons Learned” from 2015, 79 casualties were reported in Bosnia and Herzegovina, Croatia and Serbia and 2,638,000 people were affected.

All available local and national capacities (emergency services, civil protection, Red Cross, armed forces, citizens’ associations, etc.) were activated to support rescue operations and the sheltering of the affected population. A large number of citizens volunteered to assist. For the first time, the Croatian Government declared a state of disaster for the

Figure 6: I-REACT project overview



area of Vukovarsko-Srijemska County. A state of emergency was declared in Bosnia and Herzegovina and Serbia as well.
That situation also triggered requests for international assistance from Bosnia and Herzegovina and Serbia. Requests were sent on a bilateral basis and also toward the European Commission, activating the Union Civil Protection Mechanism.
In addition to flood defence activities in its own territory, Croatia urged rescue assistance in rescue teams and material-technical resources to Bosnia and Herzegovina and Serbia. At the operational level, information was shared with partners in neighbouring countries. Institutions of Croatia provided assistance to Bosnia and Herzegovina and Serbia and assisted in facilitating the transition of 96 humanitarian convoys of foreign operational teams across the Croatian territory and smooth border crossings procedures.
After the breaking of dams on 17 May in Croatia and intensive activities carried out by the county-level protection and rescue system, the Government of Croatia declared a state of disaster on 20 May for Vukovarsko-srijemska County. It was decided on the strategic level that the base of operations was to be established in the city of Zupanja, which would serve as the Command and Communication Centre from where all activities will be coordinated to support operations in the affected areas. The National Protection and Rescue Headquarters held regular meetings there, and all national level agencies (civil protection, fire fighters, Red Cross, police, mountain rescue, health, military, agriculture, environment, foreign affairs) were represented in Command and Communication Centre.
Working in field conditions was very demanding and only trained and equipped experts were able to maintain operational continuity in the floods response operation for both operational and tactical levels. Existing plans were used to carry out civil protection measures, and it was noted that plans needed to be updated, and a familiarisation of plans with all stakeholders needed to be improved.
Logistics support is always challenging in emergency situations. It is based on the assessment of the situation and the requirements of emergency services in the upcoming period and therefore very relevant for successful operation. Coordination and communication are among the most important processes for fast and efficient decision making that is very much related to information management in order to collect, process, analyse and disseminate operational information. All these activities have been identified as ones to be improved for future operations and much more emphasis is needed to be placed on them in training activities (courses, table top and field exercises).
Consequently, floods in the lower part of the Sava River Basin certainly were worsened by the above-mentioned high precipitation, especially in the area of eastern Croatia, northern Bosnia and Herzegovina and Serbia. Given that floods do not know borders, neighbouring countries' cooperation is needed to exchange meteorological and hydrological information so that such events can be predicted as precisely as possible and thus mitigate possible negative consequences.

3.1 Simulation of a real emergency case – Floods 2014

The overall goal of TTX-Sava 17 (the name given to the tabletop exercise) has been that of promoting a multi-stakeholder dialogue, covering the gap between actors operating in the early warning stages and monitoring-response institutions within the Flood Risk Disaster Management Cycle.
In this context, particular attention has been paid to the divide between emergency managers and flood forecasting operators on how to close the gap between early warning/dissemination of hydrological and meteorological information and the activation of disaster/flood risk management phases.
The TTX-Sava 17 revolved around a flood scenario where Sava riparian countries had to operate in an integrated way. Areas of primary importance were:
→ quality and responsiveness of the communication flow
→ planning capabilities
→ national dissemination of messages
→ cooperation at Sava River Basin level between Member States of the International Sava River Commission
Specific aims of the exercise have been the following:
→ Test and identify vulnerability and opportunities
→ Monitoring of weather conditions
→ Communication between stakeholders (water, meteorological, emergency managers)
→ Regional communication protocols
→ Decision-making and decision makers
The results of the exercise were discussed in a round table. The gap between the institutional stakeholders involved in all phases of emergency and hydro-meteorological services are not fully established, and there is a diffused fragmentation of knowledge that impedes the establishment of a fully coordinated Civil Protection mechanism.
The results of the exercise, along with discussion emerging from the other sessions, allowed the drafting of recommendations contained in this report.

Follow-up actions
It should be noted that when the consequences of flooding cannot be completely prevented, it is necessary to continue to intensify the readiness for joint action in rescue activities, rapid crossing of the state border and mutual assistance between neighbouring countries. The lessons learned need to be implemented in new regulations, focusing on strengthening prevention, risk management and preparedness. It is necessary to continue to train operational forces and educate the public through raising awareness of flood risks and also how effectively to reduce the unwanted consequences of flooding on human lives and protecting property.

Figure 7: International team work session

Session IV

Emergency response - Operationalising solutions

In session 4, a practical demonstration of the functionalities of I-REACT platform was performed by staging a flood risk scenario considering a transboundary area: the border between Slovenia and Croatia, near the city of Bregana that is prone to floods. The alert level started from yellow (minor floods are expected) and grew to red (extensive, severe floods expected) when the flood was actually simulated.

The alerts were created according to the colour codes used in Slovenia (Figure 8). This choice was made because colour-coded alerts are used in the majority of European Member States. The scenario entailed a group of in-field responders, who were sent by the Civil Protection to monitor the status of the water level, river banks and a group of citizens living near the river.

Within citizens, two sub-groups were identified: “good” citizens, who act in good faith and provide correct information and “bad” citizens, who generate wrong reports. This was done to test the validation mechanisms. Figure 9 summarises the simulated scenario (left) and the real in-field exercise deployment (right).

While participants were in the field for 1 hour, a small group of 10 participants stayed at the workshop premises in order to operate the I-REACT software for the control room, through which the warnings were generated and all data were collected and visualised in real-time.

Additionally, the pre-alpha version I-REACT smart glasses also were tested. The smart glass application (App) allowed users to see nearby reports and generate reports. As the version of this App was very preliminary, it was not evaluated.

In order to allow people to access and evaluate the main features of the App, a set of tasks (T) has been prepared:

→ T1: Download and access to the App

→ T2: Reporting, consisting of some sub-tasks

→ T2a: Spontaneous report creation

→ T2b: On-demand report creation after the reception of a report request

→ T2c: Report during ongoing emergency

→ T3: Receive and read alerts

→ T4: Validate reports from citizens

To collect feedback on the usability of the App, a questionnaire was distributed to all persons that took part in the in-field trial and used the beta version of the I-REACT mobile App to receive real-time warnings, report requests and provide reports.

20 questionnaires were compiled by both experts and professionals from Public Administrations (65%) and emergency and environmental organizations of the Sava River Basin.

The appreciation of the I-REACT mobile App was high for all evaluated aspects: appearance (GUI), worthiness and novelty.

The App is considered not yet mature enough to be recommended. This result is coherent with the intermediate phase of the development in which the evaluation has been held.

	Description Slovenian	Description English
0	Običajne vodne razmere	Regular water conditions
1	Razlivanja	Minor floods
2	Poplave	Floods
3	Obsežne, silozite poplave	Extensive, severe floods

Figure 8: Alerting standard used in Slovenia

Scenario

We are in a transboundary area (border between Slovenia and Croatia, near the city of Bregana) that historically has been prone to floodings

Pro

Good Citizen

Bad Citizen

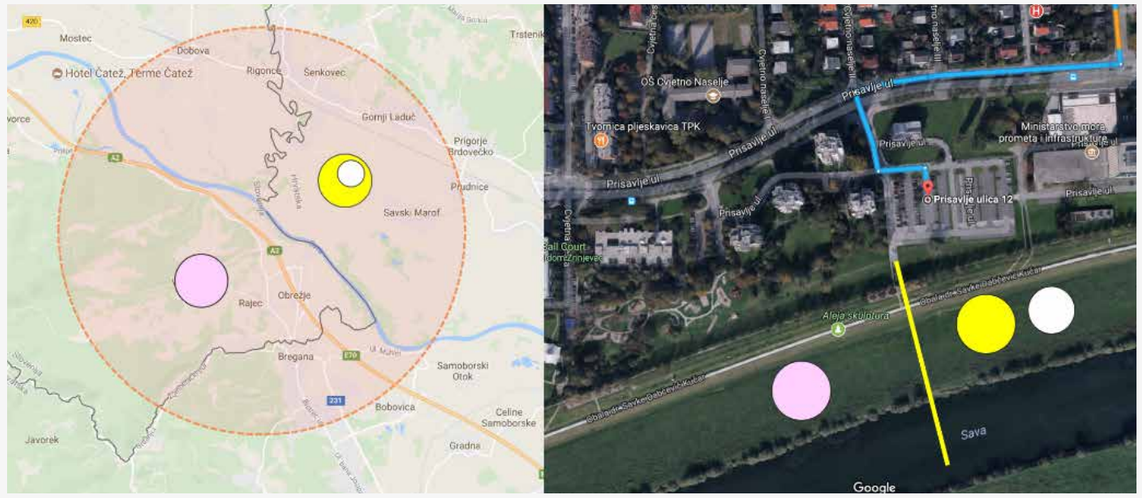


Figure 9: Simulated scenario (left) and real deployment in the field in the city of Zagreb (right).

The comments of participants confirmed the novelty and good design of the App. It additionally was stated that, though it gives rich and informative results, it was too complex to be used by citizens. In addition, participants suggested that the use of the system needs to be better introduced with more a complete training session and test run.

The test allowed the core functionalities of the App to be evaluated in depth. The key outcomes are:

Reporting has been extensively tested in order to evaluate the core functionality of the App. It resulted to be easy to use; although, a training phase is recommended to familiarise users with the process and understand the functionalities completely. The comments raised suggested that the report creation should be simplified in order to be effectively used by the general public.

The I-REACT App supports 2-levels of **validation**: the first one is based on citizens’ feedback on reports, while the second one is the confirmation from professionals (first responders, authorities, etc.), which can be either in-field agents or decision makers operating in control rooms. This mechanism proved to be very valuable because it makes the system trustable for all target users. The validation task was perceived as very easy. Nevertheless, some details of the GUI should be refined in order

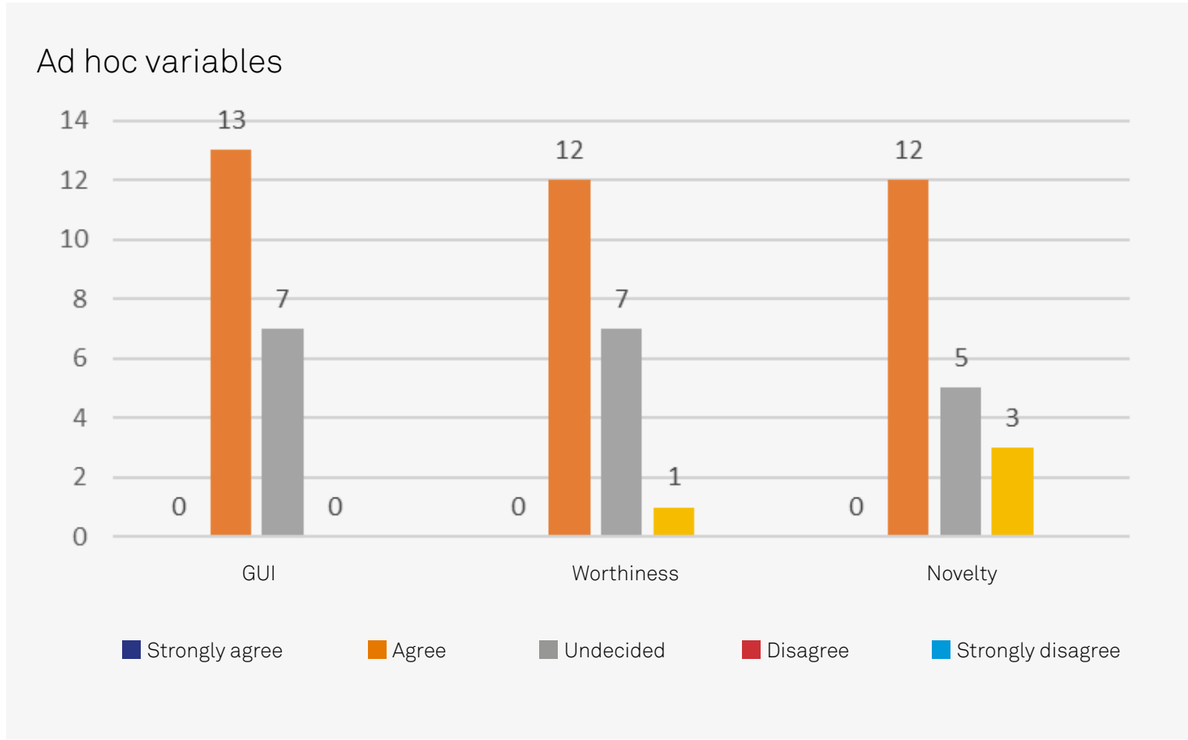


Figure 10-11: Flood expert using the I-REACT smart glasses

Figure 12: Overall appreciation of the I-REACT App

to make the procedure clearer. In particular, the used icons, designed to recall commonly known symbols, do not perfectly represent the specific types of actions available and their consequences.

The **report request** mechanism, through which professionals can request information from in-field agents or citizens in a defined spatio-temporal range, worked well and it resulted to be very useful.

The possibility to receive **real-time alerts** was perceived as very important and critical to safety. The feature might be improved to enhance the provided content, for example adding attachments or instructions that can inform citizens about the correct behaviour to be taken.

The App key functionalities are dependent on the availability of an Internet connection (cellular, Wi-Fi), which may be disrupted during a big emergency event. This is the weakest point of the I-REACT App according to participants. To mitigate this problem, the App stores the reports until the connectivity is available again.

2 Verbatim are presented in Italic and rated with ★ when concerning UI aspects and marked with ▾ when describing errors or technical issues and improvements.

Table 1
Open comments received [sic]

★★★★★ Very informative

★★★★★ Very good app, with lots of useful options, very well organized

★★★★★ Good design and easy to use

★★★★★ Intuitive, easy to use at first sight

★★★★★ Good for making data collection of previous hazard events

★★★ It is good for expert people but too complex for e.g. my family. Simplify the system for the use for normal citizens

★★★ It needs to be introduced and trained also for specialist

★★ Very structured but there are many features, so one need assistance/training to use the app

★★ There are a lot of options, information. You have to be very careful to not make it difficult to use. I don't know how many citizens will use it while they will be during a real hazard and panic situation

▾ It would be great if it could work without internet connection. Offline mode can be useful to make report and upload it when get internet connection

▾ It would good to have also video filming, not only picture, approx. 30 sec/per video

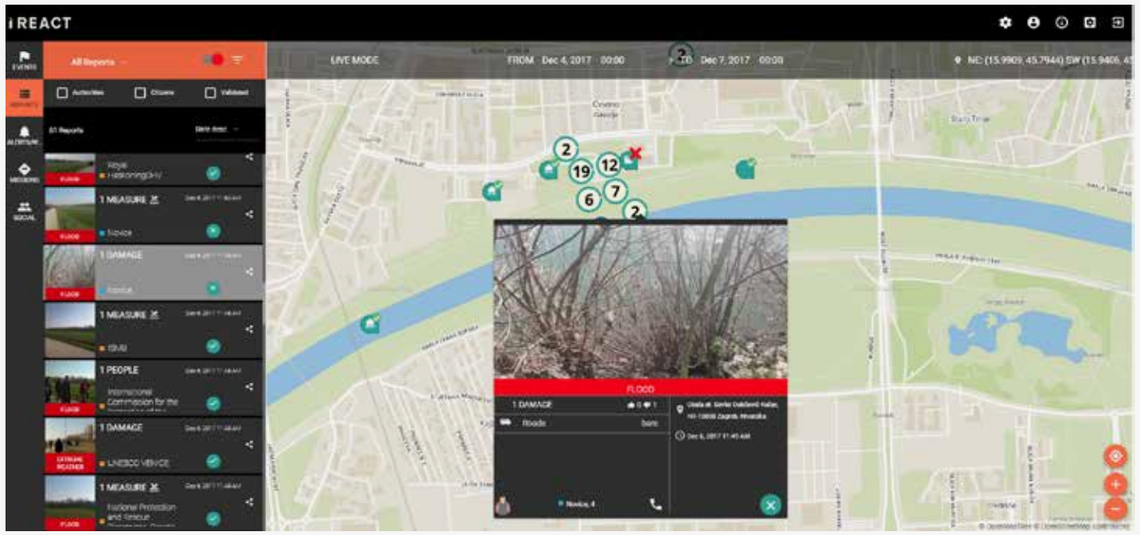


Figure 13: Screenshot of the I-REACT software for control rooms with all reports collected from the field.

The questionnaire included open questions, a summary of which is reported in Table 1[2]. The App was judged as very informative and well designed and, at the same time, too complex for some users. The concern about the availability of Internet connectivity was raised multiple times.

Figure 13 shows a screenshot of the I-REACT software for the control room with the collected reports.

To summarise, the test of the I-REACT mobile App was very successful as participants were able to complete the assigned task and understand the potential of the I-REACT App. The overall feedback was positive and provided valuable insight into the weaknesses of the system at the same time. The App was perceived as a very useful tool for getting information from the field, especially in the early warning phase. This system could be used in parallel with the Sava River Basin forecasting system to get the real view from the field and help authorities in determining the appropriate warning level. Additionally, the I-REACT platform effectively can be used to disseminate alerts and warnings, and it could be linked to a sensor threshold overpass to automate the warning procedures toward the population.

Figure 14: I-REACT in action on the Sava river

Session V
Debriefing and conclusions

During session 5, all the activities carried on in the previous days were discussed among participants. Moreover, a specific session dedicated to some preliminary economic topics relevant for future I-REACT use were explored among the workshop participants.
Stemming from the conclusions of the session, a set of recommendations were drafted by the expert team encompassing the main issues and setbacks that need to be addressed to ensure the strengthening of the entire Disaster Management Cycle, thus creating solid grounds upon which communities can greatly improve their resilience.

5.1 Preparation of the session

The aim of the business session was to gather feedback on some key topics relevant for the commercialisation of I-REACT, i.e. a preliminary market assessment and cost benefits analysis (CBA). To collect this feedback, an interview guide was drafted. It was formed by the following sections:

Section	
User information	Section 1 presents a set of questions related to the user and stakeholder organisations.
Preliminary Market Assessment	Section 2 is focused on industry structure and characteristics and aimed at defining how companies compete/interact/ partner within it.
Costs-Benefits Analysis	Section 3 foresees some questions to identify key inputs for the CBA. In particular, the idea behind this analysis was to consider the 2014 flood (as for the other workshop sessions) as the main event and case used. For this flood, the CBA presents the main costs (as assessed in the official report "Floods in May 2014 in the Sava River Basin" prepared by the ISRBC, ICPDR and IKSD[3] and reported also in previous chapters). Together with costs, potential benefits and savings that I-REACT could have brought during this event have been analysed and preliminary estimated (%).
Other Information	Section 4 asks for other useful information.

A paper-based and an online survey (using Google forms) was prepared for the session, together with the support of UNESCO and the ISRBC. Finally, an orientation slideshow was compiled to provide guidelines for the participants during the business session.

5.2 The business session

The business session (~1hour) was conducted by ALPHA Consult. After a presentation (~15 minutes) explaining the guidelines for and goals of the survey, the participants were kindly asked to provide the organisers with their feedback. Then, the questionnaire or the link to the online survey was circulated, and the invited stakeholders had the possibility to express their opinion on some preliminary business topics (~45 minutes). The I-REACT team assisted the stakeholders to clarify some details.

5.3 Results and outcomes of the business session

The feedback of 23 participants were received[4]. Results and outcomes are presented following the questionnaire structure.
Looking at the sample of interviewees (user information), most come from the public sector and actively are involved within the emergency management domain.
Out of the 23, 17 participants (74%) come from a governmental organisation, while the rest (26%) represent international organisations, hydrometeorological services, private companies or SMEs. Regarding the field of the sending organisation's activities, the majority of the interviewees work in the field of water management (48%) and emergency management (26%), while the others (26%) work for organisations active in the field of R&D, meteo/forecasting services, flood

3 Internationale Kommission zum Schutz der Donau

4 Some interviewees come from the same organisations; however, their answers are analysed separately (as interviewee and not as organisation), considering their individual point of view.

resilience or hydrological forecasting services.
Different sizes of organisations were represented within the sample with great diversity. The majority employs more than 50 workers (61% of interviewees work for an organisation with 50-250 employees or with more than 250 employees). However, stakeholders coming from smaller entities (with 10-50 employees or fewer than 10 employees) constituted about the 39% of the sample. All in all, the involved experts came from 7 countries (Albania, Bosnia and Herzegovina, Croatia, Montenegro, Serbia, Slovenia and the UK).
The overwhelming majority of the contacted participants (87%) confirmed that their organisations are involved in projects focused on the improvement of resilience to emergencies through ICT and/or already use ICT for emergency management services. In particular, among other projects and systems mentioned, the FRISCO 1[5] project, the Sava GIS, Sava HIS[6], Sava FFWS, Sava FRMP and Sava EWSS were named. The Next Generation Incident Command System[7] (NICS) seems also widely used in the South-East European countries. In addition to these, internal systems (e.g. early warning systems) autonomously developed by the organisations or Internet of Things (IoT) sensors were listed. In summary, the role of ICT to improve resilience to emergencies is widely known, and their usage is growing within the involved organisations.
Moving to the preliminary market assessment, a deep understanding in terms of current technologies and systems used (especially at country level) emerged. At the same time, more information on I-REACT seems to be needed before providing an overall economic feedback on it.
Starting from the beginning, the stakeholders have been asked about the most advanced systems (using ICT) of which they are aware of and currently use to predict and manage emergencies. In this context, very different examples have been mentioned. Apart for the Sava systems listed above, other technologies have been highlighted, such as Copernicus applications (in particular EFAS), damage assessment software, hydrological monitoring systems or hydrological and hydraulic models for forecasting, water information and level monitoring systems, GIS-based applications, natural hazard monitoring systems and forecasting tools.
In general terms, the main strengths of these systems are the "one stop shop" approach (i.e. multiple services/information offered through one system), with easy access provided to real-time data that supports decision makers to get a broader picture about emergency situations. Moreover, the possibility to integrate the main lessons learned and past experiences is seen as a very positive characteristic. However, the impression of the participants was that these novel systems would overwhelm the users with too much data. This aspect would consequently entail some processing uncertainties that would raise the issue of data validation. Some of the data also are considered too complex, vulnerable, not developed enough or not allowing an adequate level of engagement of end-users. Furthermore, the direction of the future ICT developments for these systems was considered unclear.
Among the listed technologies, some of them are perceived as comparable/similar to I-REACT, at least for some specific functionalities (e.g. web App for water level, forecasting, etc.). The solutions that were named (such as Cisco's CONSERVE) were put in the range of €100-200K in terms of price with very few examples of a cheaper solution. However, the majority of the responders could not mention an overall decision support system in the domain of emergency management that can boast all the functionalities of I-REACT. Therefore, it appears quite uniquely in the market.
When asked about the main strengths of the proposed I-REACT solution, the responders praised its one stop shop approach; easy access; the informative, robust database that encompasses different data sources (social media, historical data, etc.); and the

5 Frisco 1, i.e. Cross-Border Harmonised Slovenian-Croatian Flood Risk Reduction, is a strategic project aimed at reducing flood risk in the river basins of Dragonja, Kolpa, Sotla and Bregana, as well as in parts of the Drava and Mura river basins. For more information, see also frisco-project.eu/en/.

6 Hydrological Information System.

7 NICS is developed by MIT Lincoln Laboratory in partnership with the California Department of Forestry and Fire Protection (CAL FIRE) and sponsored by the U.S. Department of Homeland Security (DHS) Science and Technology Directorate. For more information, see also https://www.dhs.gov/publication/next-generation-incident-command-system

communicational capabilities to support reporting. Moreover, it has been perceived as a convenient tool for developing disaster awareness. Additionally, other key characteristics are the use of crowdsourced and in-field data products that can be integrated into existing systems, the App for public use and "gamification" products that could add value to existing systems and procedures and the possibility to add value in localised incident command and resource management across multiple agencies. On the other hand, participants also pointed out that some users might find it difficult to use because of its complexity. Furthermore, a major obstacle that could hinder I-REACT's penetration into the market is represented by the maintenance requirements of the system. A high price could also discourage potential end-users. This aspect also was confirmed by questions related to the selection and purchasing criteria of emergency systems. The key finding of the survey was that (on average) the majority of stakeholders attributed greater importance to the price than to quality when asked about selection main criterion. Among the other interviewees, they mainly see price and quality at the same level. Very few interviewees rated quality as more important than price. The I-REACT commercial strategy will carefully consider all these concerns to design a final roadmap for the adoption.
Despite these weaknesses, the positive features of the proposed system prevailed over the negative aspects in the interviewees' feedback. In fact, they rated the attitude towards the I-REACT solution and functionalities of end-users (identified mainly as Civil Protections) between 3 and 4 (an average of 3.5 on a 1-5 scale where 1 designates negative attitude and 5 represents very positive attitude). It means a positive attitude especially considering the conservativeness of the "emergency" market when new solutions are proposed.
This positive attitude is strengthened by the product features that could provide additional capabilities for the end-users, as stated by interviewees, and can support their day-to-day activities, such as in terms of data collection (especially from the field), damage reporting, forecasting and communication with end-users and citizens.
For the CBA, a simulation exercise has been undertaken with the interviewees, trying to identify costs related to the 2014 flood and benefits brought hypothetically by I-REACT if it was in place during this event.
Starting with damages, all the responders confirmed the data presented in terms of main costs (i.e. affected people, deaths/casualties and total economic impact), coming from the official report "Floods in May 2014 in the Sava River Basin". Moreover, thanks to the support of multiple stakeholders, it was easier to identify and assess the overall economic impact in terms of structural and socio-economical loss or damage, including natural and cultural assets.
Moving to the benefits, the role of preparedness in the overall emergency management process is perceived as fundamental by all the involved actors. Almost all in conjunction with the project agree with the U.S. Federal Emergency Management Agency's assumption "for every euro invested in preparing against disaster, on average four euros are saved". Some experts went even further and put the return at €5-7.
In this context, the expected benefits brought by I-REACT have been assessed. In particular, potential savings that I-REACT could have brought during the 2014 flood preliminarily have been presented with still few validations or updates from the interviewees. Generally speaking, interviewees do not think that they have enough information on I-REACT for this kind of feedback at this stage of the project. However, a few of them confirmed the presented projections. The foreshadowed reductions can vary between 2%-8% of related costs. Therefore, if confirmed, these benefits could have represented a significant reduction of the overall economic and social impact for the Sava River Basin during the considered event, even considering the marginal costs related to the I-REACT adoption (both Opex and Capex).

Recommendations

The international team of experts involved in the transboundary training workshop has agreed on a set of recommendations aimed at strengthening the existing regime for the transboundary management of flood risk in the Sava River Basin. In particular, the team recognises the importance of adopting an integrated approach, which may secure, on one hand, the interoperability of innovative disaster risk reduction and management systems and, on the other, to embed any suitable technological solution to the rising standard operational and regulatory framework. The inherent potential of this operation lies in the formation of an exemplary regime of cooperation for disaster risk management in the Sava River Basin with extensible application also for the Drin River Basin.

This process has already taken shape since initiatives on strengthening the cooperation of the Sava countries for flood defence and response during emergencies, including arrangements for flood forecasting and warning, are in progress through the development of a common Flood Risk Management Plan for the Sava River Basin. This normative process is in line with the Protocol on Flood Protection to the Framework Agreement on Sava River Basin, the EU Floods Directive as well as with the Sendai Framework for Disaster Risk Reduction.

In particular, the development and adoption of the Flood Risk Management Plan for the basin as a whole includes the establishment of a set of arrangements for flood awareness and preparedness (i.e. warning dissemination) as well as measures related to flood defence and response during emergencies. As to the former, ISRBC Member States are the first beneficiaries of the Sava FFWS initiative, which establishes a suitable technological solution and sound protocols for the sharing of information amongst co-riparian states in fostering a coordinated effort towards the mitigation of transboundary impacts of floods. A similar cooperative approach is also required in the reactive monitoring and response phases generally undertaken by Civil Protections along with professional volunteers in compliance with domestic provisions and regulations. In this particular context, integrated and modular solutions with a high density of resilient technology, such as those developed by the EU project I-REACT, may serve the purpose well. Along with the current national inter-sectoral revision of the procedures between the flood forecasters and emergency responders, the planning activity should continue as a quintessential effort for the creation of resilient communities.

The following recommendations that were discussed during the Workshop identify areas that need urgent attention and well-focused action:

1. Comprehensive dissemination of hydro-meteorological information amidst Civil Protection stakeholders and technical services

The sharing of tailored information from the Sava FFWS (Delft-FEWS system) should be performed according to the requirements of each institutional user without a self-confining approach. Data exchange protocols should rely on web-based services to ensure end-users' access and facilitate their dissemination to any competent institution having a role in disaster risk management from preparedness to response.

2. Ensure interoperability among platforms

In order to avoid duplication of efforts and, at the same time, increase the buy-in of users to such innovative platforms, it is recommended to utilise their inter-operationalisation. For instance, the interface between early warning services performed by the Sava FFWS with the reactive monitoring and response, such as those operated by I-REACT for instance, could couple flood warnings with additional relevant data: in-field reports, social media, satellite and unmanned vehicles derived images, etc. This link will strongly support the capacity of decision makers, improving the situational awareness at all stages of the emergency cycle by enhancing monitoring and the communication flow across borders and organisations while involving citizens.

3. Codify alerting and warning protocols

The conversion from scientifically robust data into understandable and easy to use codified information requires a well-organised planning process. To this end, the development of standard operative procedure (SPOs) that allow the use and dissemination of data, received from the Sava FFWS, is of paramount importance. The production of regular bulletins coupled with the creation of a standardised alerting protocol, and its communication to the population through all available channels, would bring great societal benefits to the countries of the Sava River Basin.

4. Introduce Common Alerting Protocol (CAP) in the dissemination of warnings

Standardise the procedure of dissemination of warnings via the CAP allowing a warning message to be broadcasted simultaneously over the most relevant media channels, including social media and mobile devices through a dedicated application.

5. Promote the creation of national and regional multi-stakeholder technical roundtables for Civil Protection emergency planning

To allow the clarification of roles, procedures, responsibilities and assets of each relevant institution (public and private), their representatives must be consistently involved in an inclusive planning approach. This includes the creation of technical and thematic roundtables and the development of participatory approaches aiming at the inclusion of both institutional players and the population with differentiated responsibilities.

6. Development of flood emergency plans at the basin level

A coordinated approach at the basin-wide scale will allow the sharing of best practices, information and data. Plans are needed to codify and structure all actions that the Civil Protection system ought to enact while increasing its responsiveness.

7. Integrate existing emergency management volunteer organisations in the National Civil Protection system at every level (national to local)

Volunteerism represents a great added value to the Civil Protection system by simultaneously providing experienced human power and creating channels of communication between and towards populations. Volunteers, in fact, are one of the most efficient means of bridging the gap between national authorities and communities.

8. Renewed stakeholder engagement

In the case of implementation of advanced disaster management systems such as I-REACT, additional user-oriented efforts should be undertaken to collect relevant feedback from major stakeholders to elaborate further a customised strategy for the Sava River Basin. Dedicated sessions (e.g. conference calls, workshops and one-to-one meetings) are recommended to better understand the added value of the proposed solutions for the Sava River Basin countries.

Appendix A
Workshop Agenda

Arrival of participants: 4 December 2017

Accommodation at ARCOTEL Allegra Zagreb Hotel, Ulica kneza Branimira 29, Zagreb

Workshop Day 1: 5 December 2017
Venue: Sheraton Zagreb Hotel,
Ulica kneza Borne 2, Zagreb

09 30 Registration

Session 1 - Setting the stage
Chaired by UNESCO

10 00 Welcome address
UNESCO Regional Bureau for Science and Culture in Europe
ISRBC Secretariat
10:30 Introduction to the workshop: programme, participants, methodology

Session 2 - Flood risk Governance and Technology for the Sava River Basin
Chaired by ISRBC

10 45 Flood Risk Management Planning in the Sava River Basin – An introduction
National and transboundary flood risk management planning & measures to enhance flood risk prevention and preparedness – ISRBC PEG FP Experts
11 15 **Break**
11 30 Managing flood risk through forecasting and early warning system
Drawing insight from an international perspective
Establishment of flood forecasting and warning system in the Sava River Basin (Sava FFWS Live DEMO) – Sava FFWS Experts
National perspective of flood forecasting system establishment
Advanced ICT solutions at the service of an integrated DRM: the case of I-REACT project (I-REACT crowdsourcing solution overview) - I-REACT Experts
12 45 Questions & Answer session
13 00 **Lunch**

Session 3 - Team Work and gap analysis
Chaired by CIMA

14 00 Setting the stage of complexity and emergency scenarios
Introduction: explanation of the considered scenario
14 30 Simulation of a real emergency case
Simulated exercise: bonding early warning to operational phases in the Sava River Basin from a national and international perspective
16 15 **Break**
16 30 Team work on gap analysis in Disaster/Flood Risk Management (DRM)
Bonding early warning to operational phases in the Sava River Basin from a national and international/transboundary concept
18 00 **End of Day 1**

Workshop Day 2: 6 December 2017
Venue: Sheraton Zagreb Hotel,
Ulica kneza Borne 2, Zagreb

09 00 Recap and introduction to the second day

Session 4 - Emergency response Operationalising solutions
Chaired by CIMA and UNESCO

09 15 Bonding local governance to geo-localised crowdsourcing solution for flood risk in the Sava: a narrative from the Drin based case of FLOODIS-DEWETRA interface
Presentation
09 45 Beginning of exercise
Briefing and explanation
10:00 I-REACT - integrating ICT solutions at the service of decision makers in DRM
Training
11 00 **Break**
11.30 Flood risk scenario, use of tools and functionalities of I-REACT
Field session – part 1
13 00 **Lunch**
14.30 Flood risk scenario, use of tools and functionalities of I-REACT
Field session – part 2
16 30 **Break** - End of drill

Session 5 - Debriefing and Conclusions
Chaired by ISMB and UNESCO

16 45 Debriefing on the field demonstration and presentation of the questionnaire for CBA submitted by Alpha Consult, filled through an open discussion with stakeholders
Exchanges on a collective resource mobilisation strategy to interface Sava FFWS with cyber-derived technology from early warning to response phase in the Sava River Basin
18 00 **Workshop closure** - Departure of participants
18 00—18 30 Internal Debriefing of the Expert team and priorities for future action

Appendix B
List of attendees

Albania

Alfred Kristuli
Ministry of Interior of Albania
General Director of Fire and Rescue Service

Saimir Skura
Technical Secretariat of the National Water Council
Hydrotechnical engineer

Bosnia and Herzegovina

Almir Bajramlić
Sava River Watershed Agency, Sarajevo
Senior Associate

Milan Blagojević
Republic Hydrometeorological Service of the Republic of Srpska, Banja Luka
Engineer of Department for Hydrology

Miroslav Čvrgić
Public Institution "Vode Srpske" Bijeljina
Head of Department

Ozren Đurić
Public Institution "Vode Srpske" Bijeljina
Engineer

Amer Kavazović
Sava River Watershed Agency, Sarajevo
Head of Water Protection Department

Marko Krneta
Ministry of Agriculture, Forestry and Water Management of the Republic of Srpska
Senior Associate in Water Management Department

Aleksandar Mandić
Ministry of Security of Bosnia and Herzegovina
Head of Operational and Communication Centre BH-112

Ivan Matković
Agency for Adriatic Sea Watershed, Mostar
Head of Water Information System Department

Hajrudin Mičivoda
Sava River Watershed Agency, Sarajevo
Head of Water Information System Department

Damir Mrđen
Agency for Adriatic Sea Watershed, Mostar
Director

Nino Rimac
Federal Hydrometeorological Institute, Sarajevo
Chief of Department for the Forecast and Water Balance

Strahinja Rogić
Republic Administration of Civil Protection of the Republic of Srpska
Head of Regional Office for Civil Protection Banja Luka

Mirnesa Softić
Ministry of Security of Bosnia and Herzegovina
Expert Advisor

Fahrudin Solak
Federal Civil Protection Administration
Director

Adnan Topalovi
Sava River Watershed Agency, Sarajevo
Senior Associate

Croatia

Tomislav Dujmović
National Protection and Rescue Directorate
Independent Supervisor for Critical Infrastructure and Risk Management

Krešimir Ložnjak
Croatian Waters
Engineer

Tomislav Marević
National Protection and Rescue Directorate
Independent Supervisor for Operational Forces

Igor Milić
National Protection and Rescue Directorate
Head of Department for Operations

Tomislav Novosel
Croatian Waters
Engineer

Luka Vukmanić
Croatian Waters
Engineer

Montenegro

Dragana Đukić
Ministry of Agriculture and Rural Development - Water Directorate
Senior Adviser

Milo Radović
Ministry of Agriculture and Rural Development - Water Administration
Adviser

Serbia

Božidar Beloš
Public Water Management Company "Vode Vojvodine"
Head of Department for Flood Protection

Samir Ćatović
Republic Hydrometeorological Service
Head of the Division for Hydrological Analysis

Rade Marčetić
Public Water Management Company "Vode Vojvodine"
Chief Engineer for Flood Protection

Aleksandar Milićević
Public Water Management Company "Srbijavode"
Independent Engineer

Aleksandar Vujanović
Republic Hydrometeorological Service
Hydrological Forecaster

Slovenia

Andrej Golob
Slovenian Environment Agency
Hydrologist

Klemen Gorše
Administration of the Republic of Slovenia for Civil Protection and Disaster Relief
Information Center

Tomaž Grilj
Ministry of the Environment and Spatial Planning
Senior Adviser of Water Management Division

Maja Jelen
Ministry of the Environment and Spatial Planning
Adviser of Water Management Division

Maja Kregar
Slovenian Water Agency
Senior Advisor in Informatics, GIS and Archive

Stanislav Lotrič
Administration of the Republic of Slovenia for Civil Protection and Disaster Relief
Operations Sector Head

Jože Papež
HIDROTEHNIK Water Management & PLANALP Platform
Head of R&D Department

Mateja Ribnikar
Ministry of the Environment and Spatial Planning
Intern-advisor

Luka Štravs
Ministry of the Environment and Spatial Planning
Head of Water Management Division

International organizations

Karoly Gombas
International Commission for the Protection of the Danube River
ICPDR FP EG Chair; EU SDR PA5 HU coordinator

Samo Grošelj
International Sava River Basin Commission
Deputy Secretary for Protection of Waters and Aquatic Ecosystem

Lorenzo Stefano Massucchielli
Italian Red Cross
European Affairs Officer

Dragana Milovanović
International Sava River Basin Commission
Deputy Secretary for Integrated River Basin Management and Water Planning

Igor Palandžić
World Bank
Water Resources Specialist

Davide Poletto
United Nations Educational, Scientific and Cultural Organization
Project Officer in Science Unit UNESCO Regional Bureau for Science and Culture in Europe

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