Understanding Risk

Balkans Conference

Proceedings from the 2018 UR Balkans Conference

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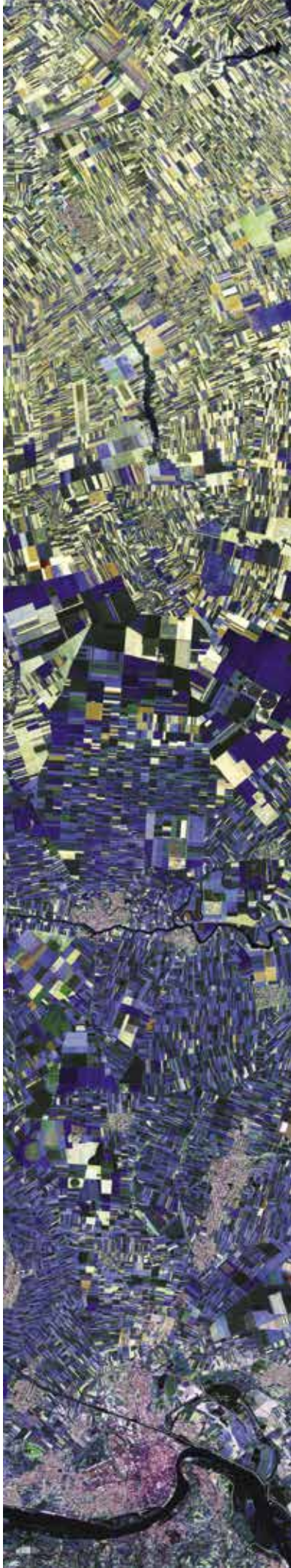

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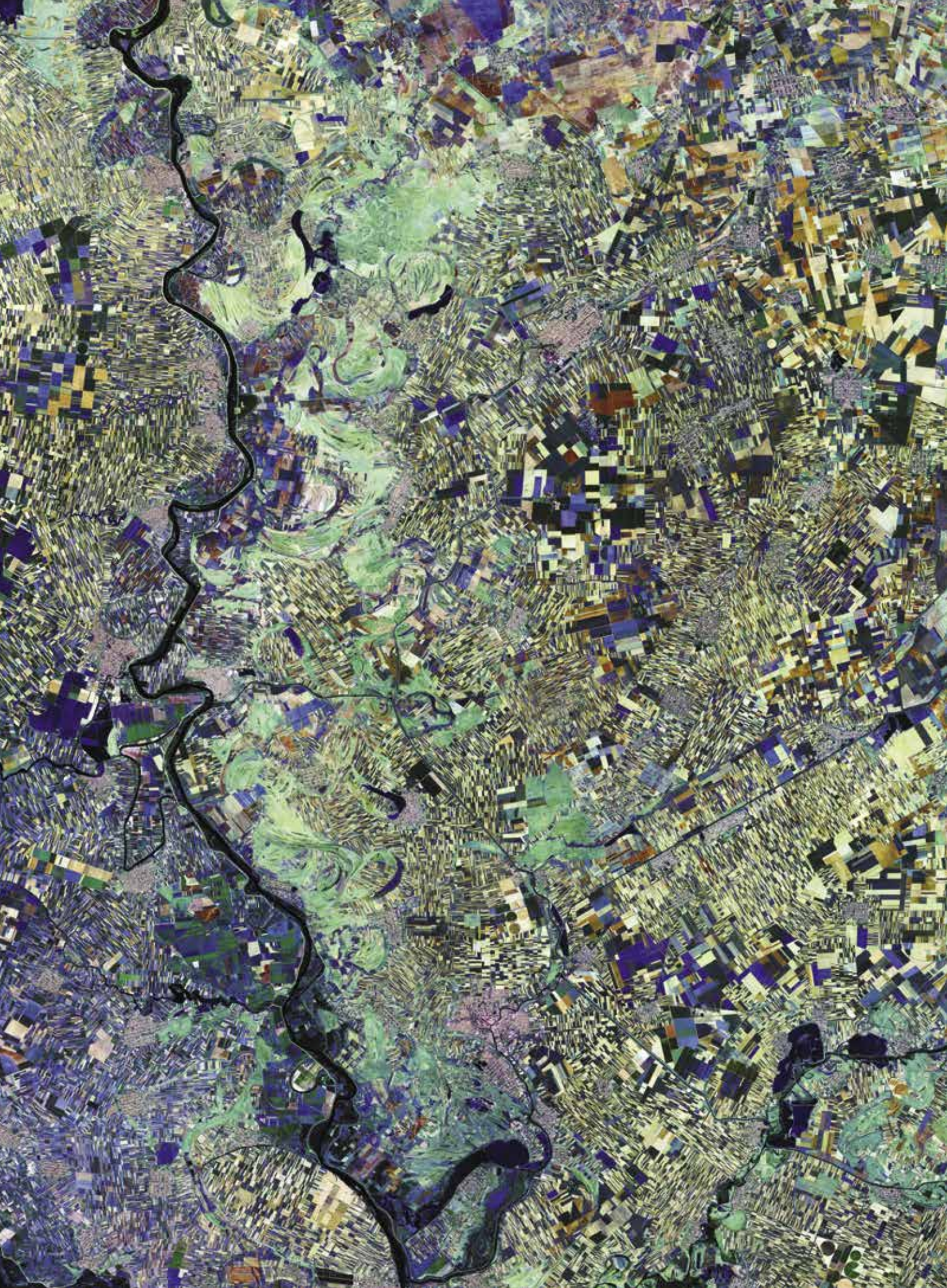

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Contents

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Mateja Norčič Štamcar, Deputy Head of the EU Delegation to the Republic of Serbia, delivers opening remarks.

A platform of collaboration is needed to bring together policy makers and DRM practitioners globally to exchange knowledge and share lessons.

Zoran Radojičić, Mayor of Belgrade, delivers opening remarks.

Foreword

The first edition of the Understanding Risk Balkans Conference was successfully concluded in Serbia on September 19, 2018. The three-day event brought together policy makers, academics, technical experts, and practitioners from both public and private sectors to communicate risk information and share best practices on addressing disaster risk challenges.

Jointly organized by the Government of Serbia, the World Bank, and the Global Facility for Disaster Reduction and Recovery (GFDRR), and with financial support from the European Union (EU) in the frame of the EU-World Bank/ GFDRR Western Balkans Disaster Risk Management Program, the conference was hosted in Belgrade, a charming city that has been torn and ruptured by disasters, yet perpetually strives to recover and rebuild as a resilient community. Against this backdrop, a conference dedicated to disaster risk management (DRM) echoes the region's urgent need for a better understanding of disaster risks and innovative solutions that promote a sustainable future. In 12 technical sessions, 353 attendees from 46 countries in the region and beyond explored different sectoral needs for DRM and engaged in inspiring discussions of experiences and lessons learned in coping with disaster risks.

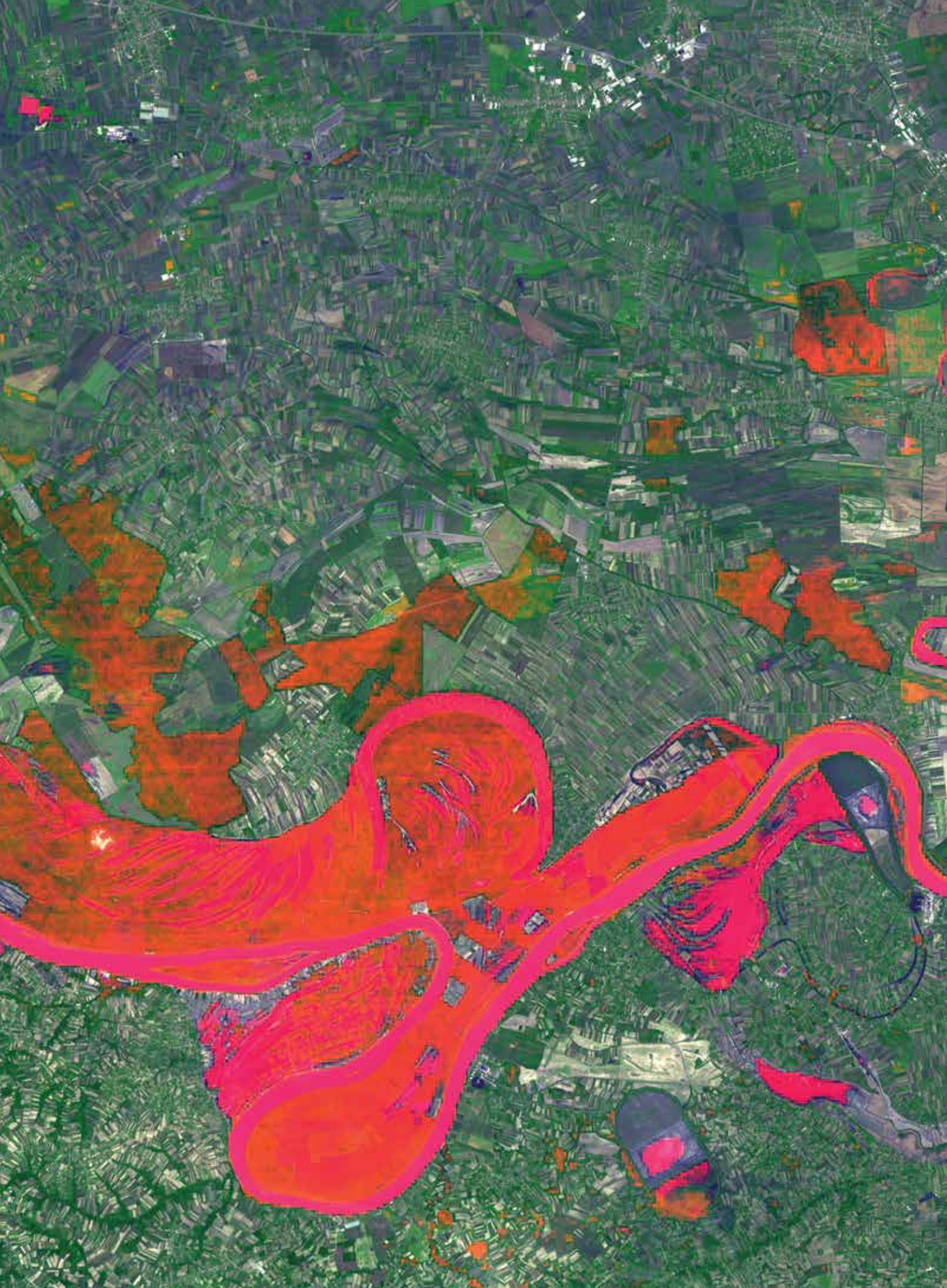
These discussions have revealed some of the most compelling yet disturbing insights into the pressing challenges we face today. For instance, the lack of open and high-quality data has hampered full understanding of disaster risks in the Balkans and hindered the development of effective risk management plans. Serious deterioration of and disinvestments in multifamily buildings in certain countries have compounded seismic risk in the housing sector and warrant urgent attention. Catastrophe insurance programs, which are designed to hedge against economic losses from disasters, have been slow to gain ground due to an absence of incentive policies. These are only a few of the key messages from the conference. More thought-provoking findings are elaborated in the session summaries in the following pages.

Admittedly, earthquakes, floods, droughts, and landslides cannot be eliminated. However, communities have never simply accepted disasters passively. Instead, they have emerged more resilient through developing innovative technologies, strengthening social protection capacity, and investing in infrastructure improvements. By preparing for the inevitable, communities reduce their vulnerabilities to disasters, and learn to appreciate the flawed beauty of nature. In this spirit, we celebrate the conclusion of the Understanding Risk Balkans Conference as the beginning of a new chapter in advancing the DRM agenda in the Balkans region, and hope that the conference outcomes documented in the proceedings will also shed light on DRM practices for disaster risk specialists and practitioners more broadly across the world.

Abbreviations

AFAD	Disaster and Emergency Management Presidency of Turkey
APSFR	Areas with Potential Significant Flood Risk
AYII	area yield index insurance
CHwB	Cultural Heritage without Borders
CRI	City Resilience Index
DASK	Turkish Catastrophe Insurance Pool
DRAS	Disaster Risk Analysis System
DRM	disaster risk management
DRR	disaster risk reduction
DTM	digital terrain model
EU	European Union
GFDRR	Global Facility for Disaster Reduction and Recovery
ha	hectare(s)
INSPIRE	Infrastructure for Spatial Information in the European Community
IPA	Instrument for Pre-Accession Assistance
IPA DRAM	Programme for Disaster Risk Assessment and Mapping
ISRBC	International Sava River Basin Commission
IUCN	International Union for Conservation of Nature
MoEU	Ministry of Environment and Urbanization (Turkey)

NBS	nature-based solutions
NMHSs	National Meteorological and Hydrological Services
OpenDRI	Open Data for Resilience Initiative
PSI	Public Sector Information
Sava FFWS	Flood Forecasting and Warning System in the Sava River Basin
Sava HIS	Hydrological Information System for the Sava River Basin
SAR	special administrative region
SEDESOL	Social Development Secretariat (Mexico)
SEE CRIF	Southeast Europe Catastrophe Risk Insurance Facility
SEE-MHEWS-A	South East Europe Multi-Hazard Early Warning Advisory System
SISI	Integrated Social Information System (Mexico)
SoFPAS1	Study of Flood Prone Areas in Serbia—Phase 1
UNDP	United Nations Development Programme
UR	Understanding Risk
WMO	World Meteorological Organization



Demystifying the Growth Drivers of Catastrophe Insurance Markets

In 2014, more than 1.5 million people in Serbia—or 20 percent of the country's population—were affected by floods. The total cost of devastation wrought by these floods was estimated at 4 percent of gross domestic product (GDP). Damage to the agriculture sector alone amounted to €230 million, with 12,000 hectares (ha) of crop area submerged under the floodwaters (World Bank 2014).

Historic Serbian floods as seen by NASA spacecraft.
Credit: NASA/GSFC/METI/ERSDAC/JAROS, and U.S./Japan ASTER Science Team.

Floods in Brčko, Bosnia and Herzegovina. Photo: https://goo.gl/images/R2UEv9.

Although extreme weather conditions in the Balkans are not new, they are becoming more and more frequent and severe as a result of climate change. High seismic risk adds to the challenges faced by the countries of southeastern Europe. In 1963, a 6.1 magnitude earthquake devastated Skopje, the capital of what is now called the Former Yugoslav Republic of Macedonia. It damaged 80 percent of the building stock, killed more than 1,000 people, and caused economic damage of about US$1 billion, requiring the rebuilding of almost the entire city. The Macedonian Insurance Supervision Agency (2015) estimates that if this earthquake were to occur today, the damage could be three times as large, and that the private housing stock would account for at least one-third of the damage.

Such a scenario raises some key questions. What can be done to ensure that people and governments have the financial resources to quickly recover from natural disasters? And how can the right balance be struck between cultivating citizens' responsibility for the financial consequences of natural disasters and ensuring that governments can support disaster victims?

Today, catastrophe insurance is among the most effective tools available to support a faster post-disaster recovery in a fiscally responsible way. It works by transferring financial responsibility to the insured and thus reduces the public financial resources needed to support the victims of disasters.

In recent years, the volume of catastrophe insurance premium written globally has grown significantly. But the market has also experienced many challenges. The UR Balkans session on catastrophe insurance markets sought to demystify some key drivers of these markets and some of the challenges that markets face. Experts looked at the experience of the Southeast Europe Catastrophe Risk Insurance Facility (SEE CRIF), a World Bank insurance project that aims to make catastrophe insurance affordable and readily available for purchase in Albania, FYR Macedonia, and Serbia. More generally, they explored how to encourage the growth of private catastrophe insurance markets in the Balkans.

SEE CRIF

The SEE CRIF project was launched in 2012 by the governments of Albania, FYR Macedonia, and Serbia with the view of increasing access to catastrophe insurance for homeowners, farmers, and municipalities. To implement this project and provide reinsurance capacity in support of innovative catastrophe insurance products, in 2014 the three governments established Europa Re, a licensed Swiss-based specialty reinsurance company.

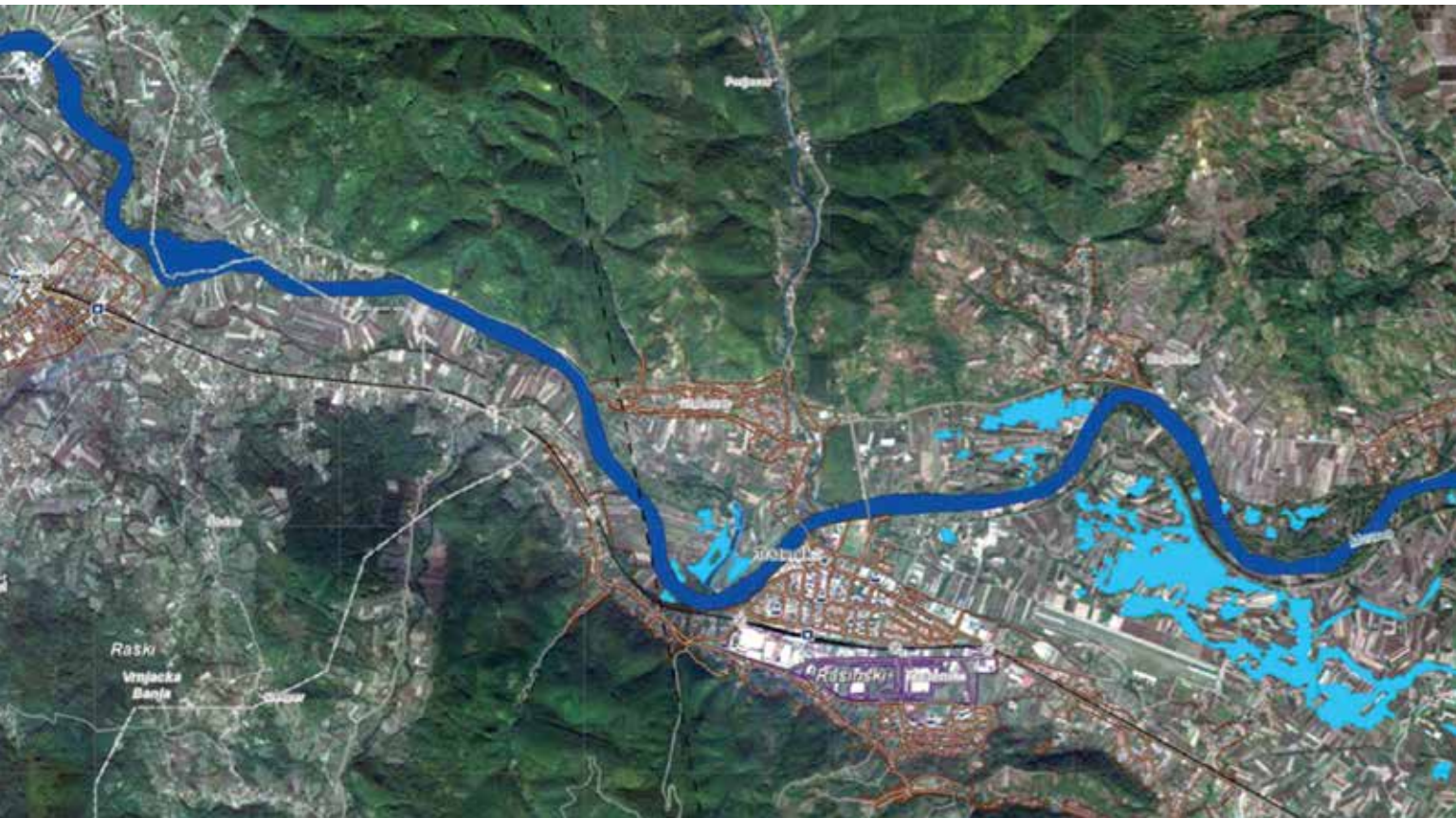
Within its short lifetime, Europa Re has designed numerous catastrophe insurance products for such common perils as earthquake, flood, and drought. These highly affordable Swiss-quality insurance products are now available for purchase through 10 private insurance companies participating in the SEE CRIF program. Europa Re also invests in innovations, market research, and communication campaigns; works to build governments' insurance regulatory capacity; and widely shares its knowledge.

Among the most popular insurance products designed and sold under SEE CRIF is area yield index insurance (AYII). This product offers protection against all natural and biological perils that could reduce crop yields. With this product, a farmer can insure against a drop in the municipality-level crop yield relative to the historic average. After a disaster, the losses are automatically settled based on the government statistical yield data, which means that the farmer does not need to prove the loss. This product typically covers 60–80 percent of the expected yield. In some countries, like FYR Macedonia, the premiums for this insurance are eligible for a 60 percent government subsidy.

Europa Re also offers flood insurance to municipalities in the region. This product was created to compensate local governments for the unforeseen budgetary expenditures incurred in the event of a catastrophic flood within municipal administrative boundaries. The size of the insurance indemnity payment is calculated based on the flooded area as a percentage of the total area of the municipality. The insurance payout is triggered automatically once the footprint of flooded area exceeds the minimum flooded area threshold defined by the contract.

Parametric earthquake insurance is also offered to the municipalities.

Flood footprint derived from remote sensing data. Europa Re uses the flood footprint as the basis for insurance payouts. *Source:* Europa Re.



With this product, the insurance payment is made based on the level of damage, which is defined using both ground observations and remote sensing, including photographs taken from the air.

The technical design and quality of these products is well supported by the latest research and technological innovations, which include the following:

- Big data processing, instant communication, and archiving techniques, including CATMonitor (https://catmonitor.com/), an interactive website to help the public better understand and measure risk
- Advanced risk modeling
- Remote sensing technology using satellites and drones, with in-house processing of collected images

These innovations have allowed Europa Re to evaluate and settle disaster claims quickly and reliably.

Case Studies

Use of catastrophe insurance in the Balkans is gaining pace slowly. On the technical side, Europa Re was already able to demonstrate an innovative damage assessment methodology after the floods in 2014. It completed the damage assessment and shared it with the government in a mere five days after the inception of the floods—a very rapid response. The assessment was done through aerial and on-the-ground data/image collection surveys.

As a very young company, Europa Re has not yet faced many claims. Thus it based the claim payment under the AYII coverage on a hypothetical scenario of a drought affecting the municipality of Sveti Nicole, FYR Macedonia, which currently produces wine grapes. In 2017, this municipality was expecting a grape yield of 5.434 kg/ha and bought AYII insurance against a 20 percent or more drop in expected yield. Assuming the average price of grapes was €0.164/kg, if a disaster reduced the yield to 3.225 kg/ha (a 6 percent drop below the insured yield of 80 percent), then the municipality would receive €184 per hectare in insurance compensation. With the premium subsidy of 60 percent provided by the government, the farmer's cost of coverage would be €60.4 per hectare.

Challenges

As with any other product, the success of catastrophe insurance is driven by supply and demand. Supported by SEE CRIF, Europa Re has been able to offer high-quality, affordable disaster insurance products throughout southeastern Europe through a network of local insurance companies and other distribution channels, such as banks. It has also supported and helped to bring about material improvements in the insurance regulatory framework in the region.

However, the penetration for catastrophe insurance in the Balkans today still remains low. The demand for catastrophe insurance in this region, as elsewhere, is constrained by a number of challenges.

Demand-Side Challenges

Many products offered to municipalities face local budget constraints. Municipalities either opt for low coverage, or they hope for financial assistance from the central government in case of a catastrophe event and decide not to buy any coverage at all.

Further, it is often difficult for potential purchasers of insurance to see the value of a product that insures against remote threats such as earthquake. The last earthquake in Skopje was 50 years ago, which means that two generations have already passed, and that memories of that event are fading away. For events like floods that recur more often, the value of insurance is easier to see.

External Disincentives

One of the main obstacles to the development of the private catastrophe insurance market is the indiscriminate ad hoc post-disaster government subsidies to affected homeowners. For this market to grow, governments would have to make some tough and unpopular decisions that would either eliminate post-disaster aid or limit it to the truly poor population.

Recommendations

A number of steps can be taken to meet the challenges that face the catastrophe insurance market in the Balkans:

- *Make catastrophe insurance everyone's business.* Insurers and governments (and often their international donors and partners) must act together to ensure that affordable and high-quality catastrophe insurance products are available, both to protect people and public budgets and to promote market growth.
- *Choose policies that boost the growth of the catastrophe insurance market without causing political upheaval.* For instance, it is not necessary to completely eliminate government support to the affected population in the aftermath of natural disasters. Instead, a government could ensure that its financial help is always less than the insurance payout or that its help is not taken for granted.
- *Boost demand for catastrophe insurance by making insurance compulsory by law.* This approach has worked in numerous cases. Among the most vivid examples is Turkey, where earthquake insurance has been compulsory since 2000 and is provided by the Turkish Catastrophe Insurance Pool (DASK). When DASK began, there were virtually no earthquake insurance policies in the country, but today DASK provides earthquake insurance coverage to almost 8 million homeowners, or 45 percent of insurable housing stock.

Conclusions

Supply and demand define the prospects for any insurance product in the marketplace. The SEE CRIF project demonstrates that investing in innovative technology, thinking creatively, and designing insurance products well-attuned to local needs can result in excellent catastrophe insurance products. To ensure a wide uptake of coverage by the population, making catastrophe insurance compulsory may be the best alternative. Less comprehensive and politically difficult solutions do exist that can greatly help to boost demand for catastrophe insurance coverage. The main lesson learned is that without government support, catastrophe insurance will remain the choice of the few.

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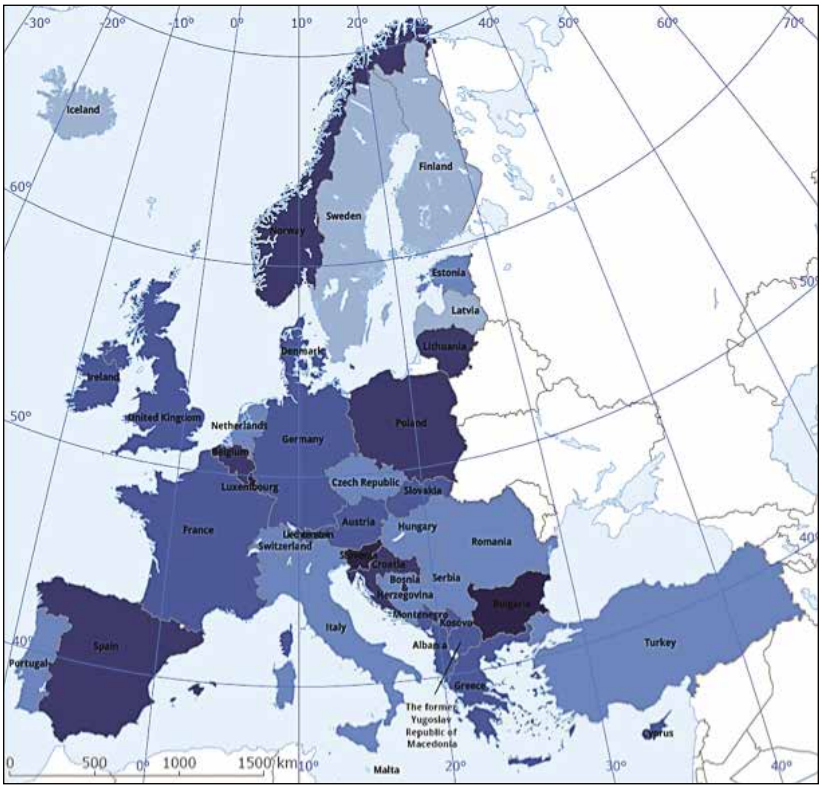
The SEE CRIF project demonstrates that investing in innovative technology, thinking creatively, and designing insurance products well-attuned to local needs can result in excellent catastrophe insurance products.

Flood Risk Mapping within the EU Floods Directive: No Data, No Result?

The European Union (EU) Floods Directive is an instrument to help countries manage the risk of flooding in a continuous and inclusive manner. Over the last decade, this instrument has been implemented after devastating floods in Europe with significant damage and casualties (figure 1). The instrument calls upon countries to assess the risk of flooding, prepare flood risk management plans for flood-prone areas, and inform and proactively engage the public to reduce the risk. The cyclicity of this instrument—its processes are meant to be reviewed every six years—enables countries to continuously improve on models, collect more data, and proactively assess the risks in a changing environment.

Preparing for floods in Belgrade, Serbia, on May 17, 2014. Photo: Baloncici.

Figure 1. Reported flood phenomena in Europe since 1980.



Source: European Environment Agency 2016.

For countries in the Balkans, however, data scarcity is a common challenge. Data on hazard, exposure, and vulnerability within river systems are often not systematically gathered; detailed data sets are often not readily available; and data collection efforts are often costly and time consuming. This UR Balkans session addressed several questions: What challenges do data-poor countries face in carrying out flood risk assessment within the EU Floods Directive framework? What can countries learn from each other about meeting these challenges? Finally, beyond the need for data, what aspects of the flood risk assessment process should countries also focus on to ensure accurate results?

Presenters shared experiences from three countries (Poland, Croatia, and Serbia), which are summarized below.

Case Studies

Poland

The water system in Poland comprises two large river basins: the Odra and the Vistula basins. Floods are Poland's most important natural hazard, causing more than 90 percent of natural hazard-related losses. One of Poland's worst floods occurred in 1997; it claimed 54 lives, caused damage worth €3.5 billion, damaged more than 680,000 houses, and affected 143,000 enterprises as well as 4,000 cultural, health, and education institutions.

The implementation of the EU Floods Directive began by selecting 253 rivers for hazard and risk mapping; this first cycle was finished in 2013. The second cycle, which evaluates 583 rivers, is currently ongoing and should be finished prior to 2021.

The flood risk assessment in Poland offered the following lessons:

- The accuracy of a digital terrain model (DTM) can have a substantial influence on the mapped flood extent, both positively and negatively. In one case, a higher-resolution DTM resulted in a 300 m difference in flood extent (including the resulting difference in exposure status of a critical facility).

- The application of different statistical distributions results in very different estimates of the extreme flood discharges (and thus flood levels). This is of special importance for cross-border situations.
- The assumption in hydraulic modeling of unlimited dike heights results in very conservative (perhaps unrealistic) estimates of the flood levels. It also makes it impossible to analyze risk transfer downstream in case of new passive flood protection investments like levees.
- Information about vulnerability curves is very scarce or absent. The methods applied for estimating damage are based on very simplified models.

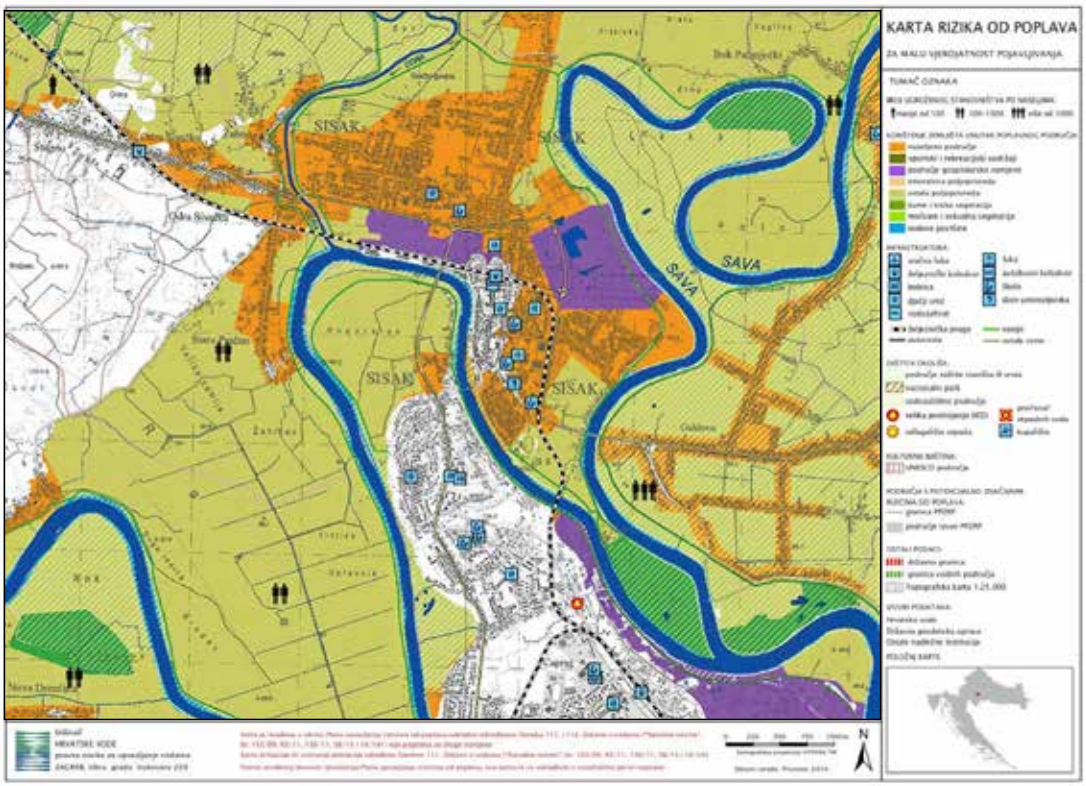
The overarching message from Poland is that even if there is acceptable data quality, the technical assumptions are very important for the end results. Thus it is very important to consider these assumptions carefully during the definition of the methodology.

Croatia

Croatia has several large rivers, including the Danube, the Drava, and the Sava Rivers. Croatia has been working with the EU Floods Directive and carried out flood hazard and risk mapping during the first cycle. Under Croatia's existing framework, the EU Floods Directive and Water Framework Directive are the foundations for planning and mapping. Individual projects to reduce the risk are executed based on the outcomes of these two instruments.

Croatia benefited greatly from international cooperation during the first cycle of the EU Floods Directive. Several recent events confirmed that dike breaches are a relevant flooding scenario in Croatia. Related hazards and risks were therefore included in flood maps, in spite of the associated uncertainties. The Netherlands has developed a sophisticated method to include dike breaches in the flood risk mapping that Croatia could consider using in future hazard assessments. Another item that has received much attention in Croatia is how to create simple but informative flood hazard and risk maps. An example of such a map is shown in figure 2.

Figure 2. Flood risk map for Croatia



Source: Croatian Waters, Croatia.

Flood in 2014 in Serbia along the Sava River, with power plant near the town of Obrenovac. Photo: Republic Directorate of Water, Serbia.

All information generated during the flood hazard and risk mapping process has been made available to the public. Currently, there are several requests per day for this information—an unexpected turn of events that shows the public's interest in this information. The 2015 floods in Trstenik and Kupari were a real-life test of the maps from the first cycle. In general, the flood hazard maps were correct in terms of the observed flood extent. However, in Kupari, local deviations occurred due to the obstruction of a culvert.

The main message from Croatia is that finalizing a flood risk management plan is not the end but rather the beginning of a process involving numerous activities. Improvements in the new planning cycle, additional products (e.g., for emergency management), and improved database design are some of the recommendations for the next mapping cycle.

Serbia

Floods in Serbia are a recurring phenomenon. The most recent large-scale flood disaster in Serbia happened in May 2014 in the Sava River basin, and particularly in its Kolubara tributary catchment. The disaster affected more than 1.6 million people (22 percent of the total population) in 38 municipalities in central and western Serbia. Although Serbia is not yet an EU member state, it decided in the early 2000s to be guided by EU flood control policies. In 2012, the government of Serbia carried out a preliminary assessment according to the EU Floods Directive and identified 99 Areas with Potential Significant Flood Risk (APSFR) in the country. In response, the Study of Flood Prone Areas in Serbia—Phase 1 (SoFPAS1) conducted a detailed flood hazard and risk assessment for approximately 25 percent of the risk areas identified.

Several lessons were learned from SoFPAS1. First, standardizing and preparing spatial planning documents should get more attention as part of mapping. Second, the Serbian government should intensify its efforts to build capacity and internal cooperation

on flood hazard and risk mapping (e.g., on data exchange). Third, flood risk mapping should always have its ultimate use and users in mind, since these maps are not an end goal but an intermediate product.

Currently, Serbia is working on flood hazard and risk mapping of the remaining 74 APSFR. The production of detailed DTMs for the APSFR is carried out using LiDAR remote sensing technology. The mapping will be done according to the rulebook that prescribes the methodology for development of flood hazard maps and flood risk maps, which the Serbian government adopted in 2017. The flood hazard and risk mapping will feed into the generation of flood risk management plans. These should be finished by the end of 2020.

Challenges, Conclusions, and Recommendations

The presentations on Poland, Croatia, and Serbia made clear that these countries share similar challenges in assessing flood risk under the EU Floods Directive—specifically, scare and difficult-to-collect data on exposure and vulnerability. Nevertheless, both Poland and Croatia have significantly improved their understanding of risk through the flood hazard and risk mapping process. Their experience shows the importance of the directive's six-year cycle and the possibility of improving assessments with better data during subsequent rounds of the cycle.

The case of Poland clearly shows the need to have an accurate DTM for flood hazard and risk mapping; the use of an improved DTM for Poland showed much less flooding than originally identified—but more accurate models can also a show greater flood extent. This highlights the importance of the current EU-funded LiDAR data collection effort in Serbia, which should result in more accurate flood risk mapping and flood risk estimates. In Serbia, where the World Bank is implementing the EU-supported flood risk mapping exercise, there might be need for an additional twinning measure—such as has been used in Poland or Croatia—or other forms of cooperation to ensure the full operationalization of the applied EU Floods Directive.

The issue of transboundary river systems was analyzed for the Polish case, which suggested that guidelines to regulate different points of view about the same river would be helpful. Although it seems unlikely that the European Commission would create such guidelines to regulate these differences between involved member states (e.g., define extreme flood discharges or create flood security systems with different parameters for each side of the Oder), the European Commission might facilitate a kind of framework to resolve these situations. The European Union delegation indicated during the session discussion that it will give further attention to this subject.

Finally, dissemination of the risk information to the public is one of the key objectives of the directive. Croatia has put substantial effort into making public-friendly maps and has shared information from the flood risk assessment with the public. The frequent requests to access the data show that there is a need for this information by the public. This example can be inspirational for other countries.

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Community Resilience via Crowdsourcing and Collaborative Mapping

Strong local communities that can effectively respond to and protect themselves from disasters are essential. Studies reveal that in the event of a disaster, up to 90 percent of survivors are assisted and/or rescued by their own neighbors, and this level of engagement often continues through recovery. In recent years, communities have become increasingly involved in crowdsourcing risk information, monitoring potential hot spots, and increasing preparedness efforts in their own neighborhoods. These patterns also show that better-prepared communities recover faster and more effectively. When it comes to identifying forward-looking solutions that can help communities cope with risks and shocks, local leadership and ownership are therefore crucial.

People are seen clearing the debris on Shek O Beach after Typhoon Mangkhut hit Hong Kong SAR, China. Photo: Matt Leung.

Yet how can citizen-led initiatives effectively generate momentum, sustain participation, build trust, and empower communities? What are the opportunities in and limitations of partnering with a variety of actors (municipal authorities, civil protection agencies, academic institutions, local businesses) during pre-disaster phases? This UR Balkans session on community resilience via crowdsourcing and collaborative mapping explored these questions by looking at recent or ongoing bottom-up initiatives in Albania, Romania, and Armenia.

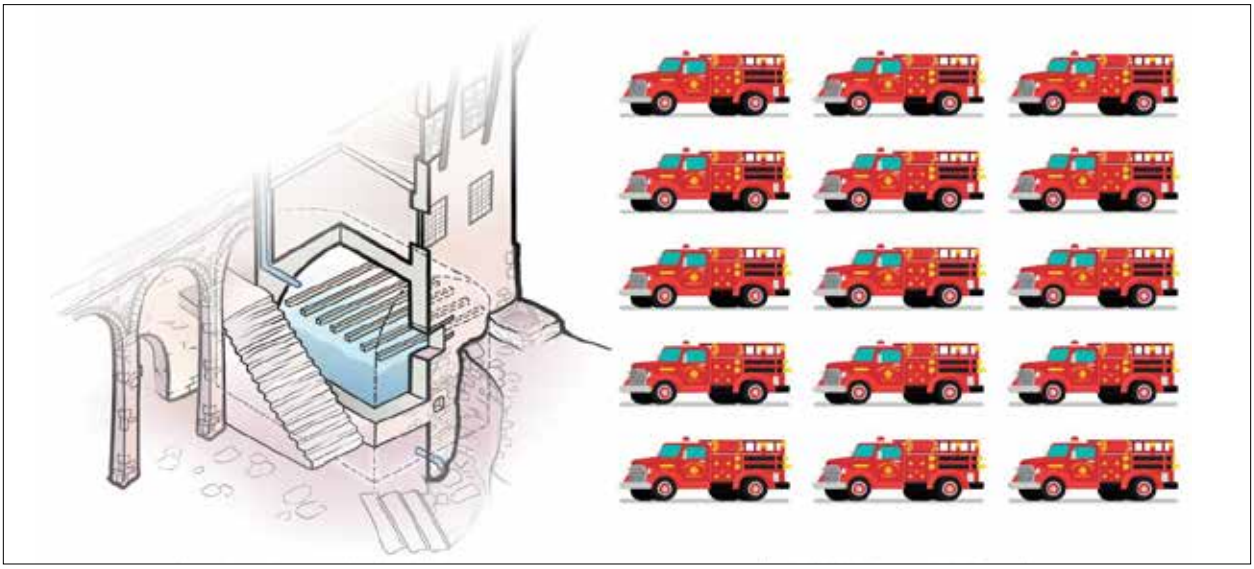
Built Heritage Risk Assessment and Preparedness Strategies for Albania's Historic Centers

In Albania, the most recurrent hazards are floods, fires, and earthquakes. The country's poverty, combined with limited infrastructure maintenance, unsafe construction regulation, and land use practices driven by rapid urbanization and climate change effects, tends to exacerbate disaster impacts. Albania's cultural heritage buildings are particularly vulnerable to disasters, and Cultural Heritage without Borders (CHwB) has been leading efforts to strengthen at-risk cultural heritage sites and more broadly to reduce the impact of natural hazards on local communities.

At the *neighborhood level,* CHwB is piloting a solution to reduce fire risks in the historic centers of Gjirokastra and Berat—which together form a UNESCO World Heritage Site—by revitalizing traditional water cisterns as firefighting assets. With their limited supply of water (particularly during summer months) and their steep, narrow cobblestone streets lined with houses, the historic centers in both cities are especially vulnerable to fire. To provide a needed water source for firefighting, CHwB has developed a plan to use the large cisterns still present on the ground floor of many historic homes. These cisterns can collect 50 m^3 to 120 m^3 of rainwater, equivalent to 15 times more than the capacity of a single fire truck (see figure 1). CHwB has worked with municipal firefighters and local residents to ensure the best results for this firefighting system.

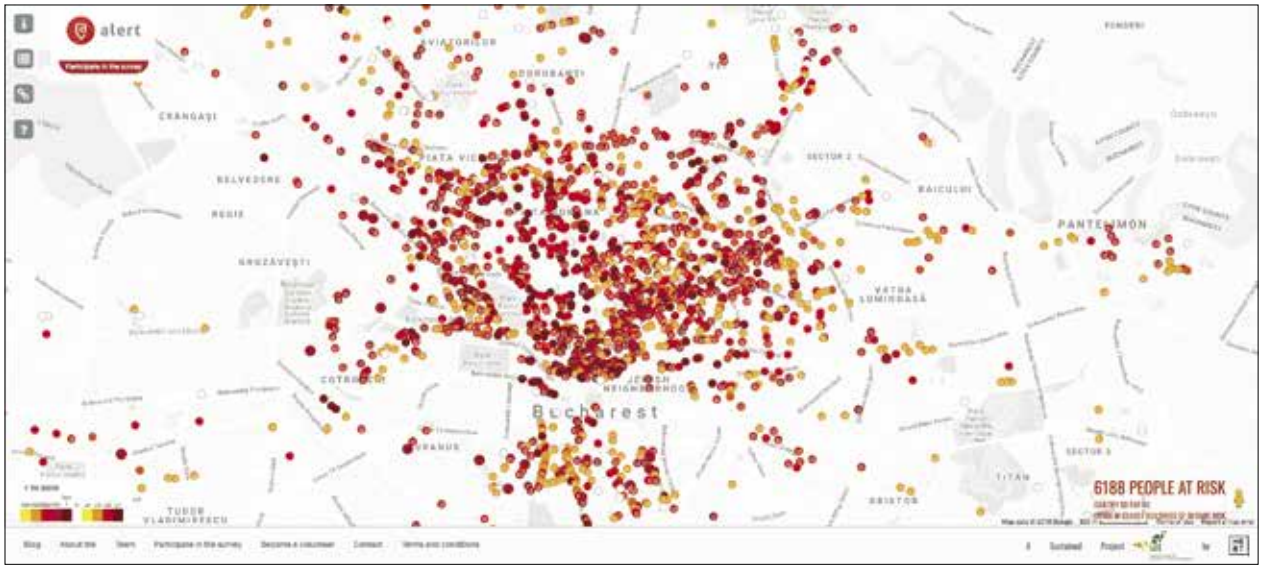
At the *municipal level,* CHwB has worked with local authorities to leverage participatory mapping techniques for risk assessment in 655 buildings within the historical core of Gjirokastra. Georeferenced survey results were compiled to alert the government about the critical situation facing the built heritage of the city, to provide guidance in defining wider conservation strategies, and in some cases to prioritize in

Figure 1. In Albania, CHwB is piloting a solution to reduce fire risks in old historic centers by revitalizing water cisterns as firefighting assets. Some of these cisterns can hold 15 times more water than the capacity of a single fire truck.



Source: CHwB 2017. Cistern illustration created by Gjergj Zhuka. Fire truck illustration created by Freepik.

Figure 2. Seismic Alert is one of Romania's first disaster prevention web apps. The online Seismic Alert Platform continues to collect data.



Source: ALERT, www.seismic-alert.ro, using Google Maps. © 2018 Google.

situ interventions to strengthen structures.

Finally, at the *regional level,* Balkan Cultural Aid Response for Emergencies (B+CARE)—a joint initiative of CHwB and Urban Development Center-Belgrade—strives to harmonize cultural emergency response efforts jointly led by national disaster response institutions and cultural institutions. B+CARE trains and deploys a network of volunteers across the Balkans to conduct "first aid" for cultural heritage threatened by natural disasters.

Seismic Alert Platform and Disaster Relief Apps Ecosystem in Bucharest

Situated only 170 km from the Vrancea seismic zone, and hosting a population of almost 1.8 million, Bucharest, Romania, has the highest seismic risk of any European Union capital. Bucharest's aging building stock, much of which is unsafe for housing and commercial purposes, contributes to the city's vulnerability. Many public buildings are in danger of collapse in case of a major earthquake, including hospitals and other buildings performing essential administrative functions.

The public is relatively aware of the city's seismic risk, especially because the city has marked several hundred of the most dangerous buildings with a bright red dot. In recent years, however, there has been little effort to effect further change, either by government or civil society. This situation has slightly altered following the Colectiv Club fire (October 2015) in which 64 people died. That event has renewed public interest in the safety of homes and public spaces. MKBT: Make Better, a start-up that provides technical support for local development and urban regeneration projects in Romania, worked with volunteers in the aftermath of the fire to create the first inventory of the most at-risk buildings in Bucharest. Developed through an online data crowdsourcing platform, the registry can be easily visualized through an interactive web map (figure 2) hosted on the Seismic Alert platform.[1]

Results indicate that of 2,365 buildings evaluated in Bucharest, only 82 buildings have been retrofitted in the last 25 years to withstand seismic tremors. Results also indicate that over 8,000 people currently live in

[1] The Seismic Alert online platform is part of a wider project dedicated to seismic risk awareness in Bucharest that builds on technology solutions to meet the challenges of local communities. For more information, see the project website at http://seismic-alert.ro/.

Figure 3. In Armenia, the "Super David" educational e-game was officially launched in 2017 by Dasaran in collaboration with Armenia's Ministry of Emergency Situations.

Source: Panorama.am 2017.

295 buildings with seismic risk categorized as Class I—the so-called "red dot buildings"—that are in danger of collapsing in the event of a strong earthquake.

Recently, Code for Romania[2] partnered with MKBT to upgrade and expand the Seismic Alert platform to other Romanian cities. This effort draws on proven relief and preparedness tech solutions developed in Mexico and elsewhere (including a disaster relief ecosystem of apps) and imports them to the Romanian context. For instance, one idea that is being tested is to convert the Seismic Alert platform into a disaster relief app; in the event of a major earthquake, it would centralize information on shelters, food banks, and other forms of immediate assistance available. In parallel, together with MKBT and other partners, including government authorities, Code for Romania is set to begin a process of mapping and building dedicated disaster risk management tools in Romania by the end of 2018.

Innovative Education in Disaster Risk Reduction in Armenia

In Armenia, events such as the 1988 Spitak earthquake illustrate the devastation, economic disruption, and loss of human life that can result from a large disaster. Due to aging infrastructure, the country remains highly vulnerable, and another large-scale disaster would likely significantly damage public and private assets and generate a high number of causalities.

The education sector is especially vulnerable to natural hazards, with 90 percent of schools built before the country adopted its first seismic building code in 1994. Several other factors also make it hard to reduce disaster risk in the education sector, such as a low awareness of correct behavior during disasters, outdated and passive learning methods, and a significant education gap between urban and rural populations. Recognizing this issue, Armenia has made seismic safety of schools a national priority and is currently leveraging existing information technology platforms to highlight disaster vulnerabilities across society.

Through the World Bank National Disaster Risk Management Program, and supported by the Japan-World Bank Program for Mainstreaming Disaster Risk

[2] Inspired by the Code for America movement and a member of the Code for All network, Code for Romania is a civic technology nongovernmental organization that develops IT solutions to address societal issues. For more information, see the group's website at https://code4.ro/en/.

Sandbags piled for flood defense near the banks of the Sava River in Šabac, Serbia, May 2014. Photo: nemar74.

Management in Developing Countries (administered by the Global Facility for Disaster Reduction and Recovery), the education company Dasaran has developed an educational e-learning module that strives to strengthen disaster preparedness, particularly among children, through innovative experiential learning. Most popular among middle schoolers while also accessible to teachers and parents, the Super David e-game (figure 3) developed by Dasaran consists of a range of questions and challenges relating to eight types of natural disasters. "Super David" can be seen traveling all over Armenia and sharing his experience on how to behave in various emergency situations. The creators have launched an official webpage on Dasaran.am to help students learn more about disaster risk management measures. Dasaran has also partnered with Armenia's Ministry of Emergency Situations to conduct school-based drills, first aid lessons, and related awareness-raising sessions.

Launched in October 2017, the Super David e-game already has more than 1 million registered users across Armenia—representing one-third of the country's population—and is available to all 1,500 schools across the country. In May 2018, the mobile version was launched on both iOS and Android platforms and is accessible to English and Russian speakers worldwide.

Challenges Facing Crowd-Based Solutions and Collaborative Mapping Techniques

For similar community resilience initiatives in the future, a couple of key challenges are worth considering.

Information Accuracy and Data Quality

Information or data directly gathered by participating citizens (or by other community members) can sometimes be less reliable

Volunteers sweep the boardwalk in Brooklyn, NY, after Hurricane Sandy in 2012. Photo: Jim Henderson. Licensed under Creative Commons CC0 1.0 Universal Public Domain Dedication (CC0 1.0).

than that gathered by hardware sensors and other technological means. Risk information quickly becomes an issue when there are concerns about data quality, or when the data source or data verification processes are unclear.

Sustainability and Long-Term Incentives for Participation

The technology aspect of community resilience initiatives is often considered to be the easy part. Given that most crowdsourcing efforts depend on voluntary networks and contributions, the issue of volunteer sustainability can emerge at any time, simply because volunteers and participating communities have responsibilities outside of their crowdsourcing/collaborative mapping/risk identification efforts. An important challenge is to ensure that volunteers (or local communities) remain motivated in the long term and can be mobilized on a timely basis.

Conclusions and Recommendations for Future Community Resilience Initiatives

Turning to the crowd for solutions—through social media, crowd sensing, or collaborative mapping—offers some of the most promising tools that can be deployed for streamlining relief and post-disaster recovery efforts. These participatory approaches are also increasingly used for scaling up ex ante disaster risk mitigation measures. To build community resilience prior to a disaster, particularly in areas with low levels of risk awareness, these approaches should have a couple of key characteristics:

They should have an inherently bottom-up design; this helps ensure that communities can develop significant ownership and leadership.

They should be flexible and dynamic (especially during pilot phases); this helps ensure that lessons learned can be easily reflected and that scaling-up possibilities can be envisaged in the long term.

Another key component of effective approaches is the awareness that communication goes in both directions. In other words, it is as important to

genuinely listen to communities as it is to communicate to them. To understand what channel works best for creating awareness ahead of disasters, and for communicating with communities in times of crisis, it is important for local authorities, disaster risk management agencies, and civil protection agencies to listen to and learn from the community. Awareness campaigns must be well-targeted and disseminated in a way that is inclusive and accessible. To build communities' trust, it is critical that communication remains a flexible, ongoing process, not one that kicks in only when an event occurs. Finally, given the complexity of urban settings, it is crucial that local communities are made aware of these constraints in times when there are no crises to respond to.

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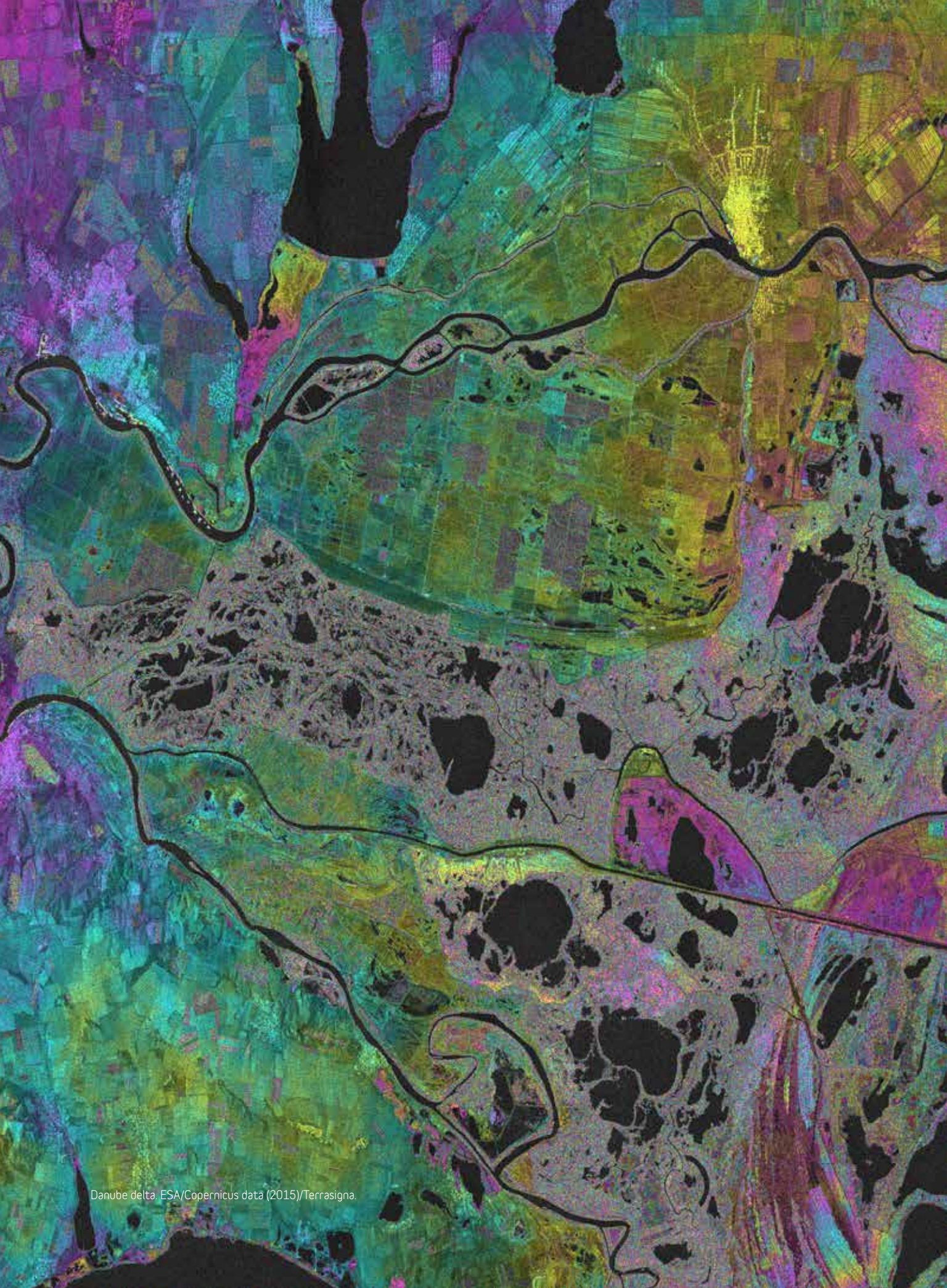
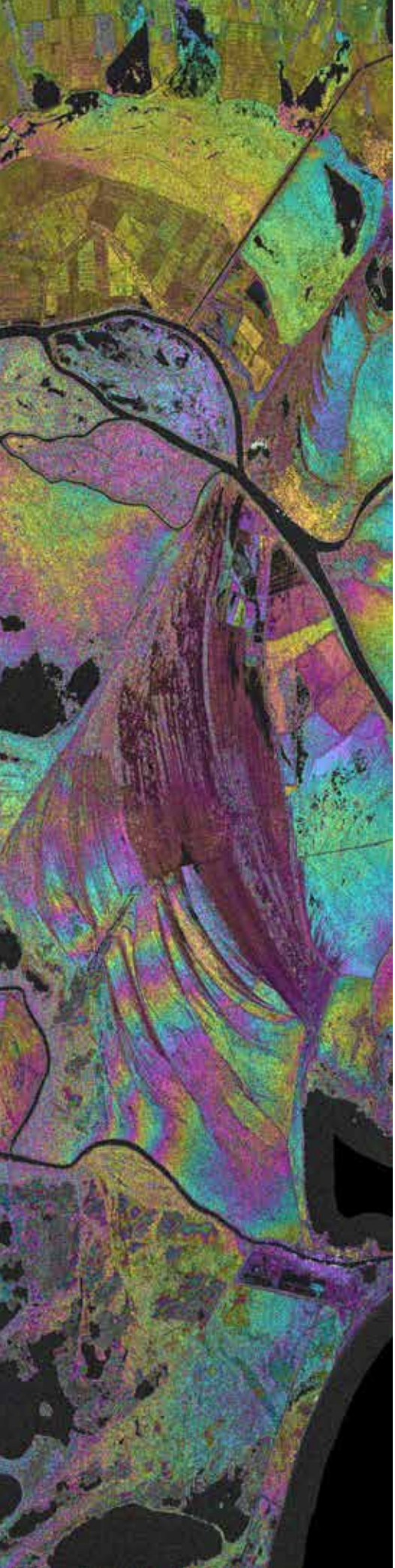


Danube delta. ESA/Copernicus data (2015)/Terrasigna.



Flood Protection Is Everyone's Responsibility

For decades, flood events have been a recurrent phenomenon, and climate change projections indicate an expected increase in the frequency and intensity of flooding.

Severe events, such as the one occurring in May 2014 in the Balkan region, can take years to recover from. In order to decrease the predicted adverse effects of floods, countries need to increase risk awareness and build the prevention capacities of local communities, citizens, and (in particular) vulnerable populations.

Understanding people's vulnerability and their capacity is at the core of preventing risks from turning into disasters. People must understand why and how to develop societies that are resilient to disasters. Experiences from the 2014 Balkan floods have shown the power of unity and solidarity, but also suggest that in an emergency, empowered and informed communities can make better choices than others.

Background

Scientists from the Vienna University of Technology have studied the complex interplay between flood events and society. Their research shows that informed, active, and responsible citizens are a country's best assets.

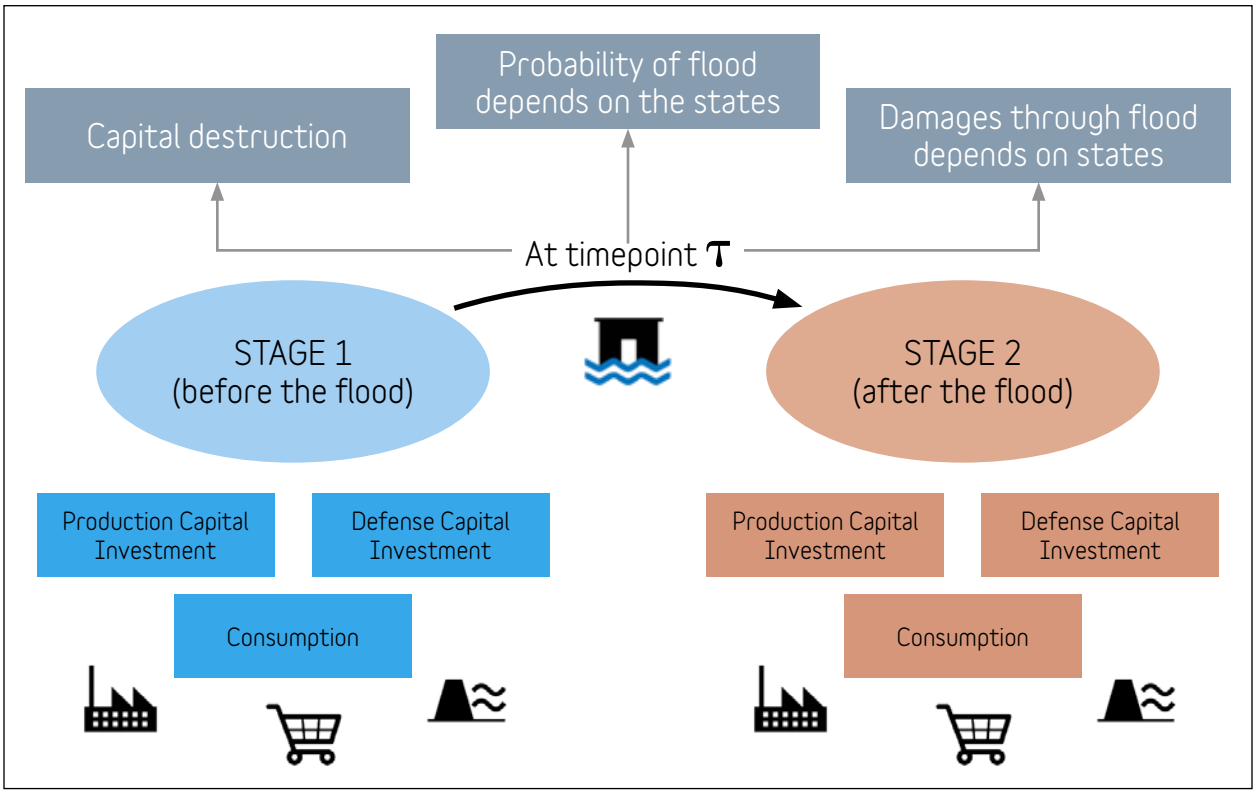
The field of hydrology has been investigating the impact of agriculture and built environment on the risk of flooding for decades, but research on the two-way interactions between water systems and society—that is, socio-hydrology—is an extremely young field of research. Socio-hydrology analyzes the two-way coupled feedback between water systems and human behavior. Taking these interactions into consideration is an important advancement in making the right decisions for long-term flood prevention strategies.

In economic models, stochastic environmental shocks and their economic impacts are formulated in a fairly general way. In contrast, socio-hydrological flood risk models (figure 1) define flood impacts more precisely. These models lack the element of economic decision making, however, as they use a priori defined decision rules. Recent literature has managed to account for this discrepancy by introducing a hydrological system into an economic growth model, but the combination of stochastic flood events and optimal decisions was still missing.

Challenges in the Field of Socio-hydrology

To incorporate economic elements as well as the stochastic properties of floods into a socio-hydrological model, researchers

Figure 1. Basic structure of a socio-hydrological model.



Source: © Freiberger and Prskawetz 2018.

applied a new technique that offered new insights from an analytical and numerical point of view. These mathematical and economic analyses have shown that both the public and the private sector have an important role to play in flood protection. More specifically, the calculations show that government investment in infrastructure is better than direct subsidies to companies. Direct subsidies are not invested in flood protection but are often invested in measures that merely maximize profit in the short term. On the other hand, if the government invests in flood protection instead of subsidies, firms will produce more and consequently earn higher profits in the long term. Flood protection allows for higher economic growth than direct subsidies to firms in flood risk areas.

However, the best investment strategy may not be the same for every country. Interestingly, from a macroeconomic point of view, there are two investment scenarios, each with a different optimal solution. In rich economies, substantial investments in flood protection are best to both reduce flood risk and enable economic growth. The existing technology and capital allow a significant reduction of flood risk. In poorer areas, where there is very little capital available, it may make more economic sense for countries to boost their economic performance and accept a degree of flood risk, instead of pouring resources into flood protection measures likely to have very little success anyway.

Communities can make the right decisions only if they have all the important facts at their disposal. It's not that the Balkan region lacks solid scientific data on hazards, exposure, and vulnerabilities. The main problems are instead that data are not systematically collected, information is not exchanged among public institutions, and the available data are not translated into action. Even where adequate information is available, it is rarely used by decision makers and rarely translated into an effective response. Complicated reporting and governance structures among different levels of government often leave local authorities and citizens disconnected from changes and progress happening at higher levels. This situation represents a lost opportunity, as municipalities have the greatest power to make tangible changes on the ground.

We need transparency, clarity, and education so that all parties involved can make rational, well-informed decisions—and this goal can be met only with interdisciplinary cooperation. Thus a lot of research remains to be done in socio-hydrology in the future.

Case Studies

With the availability of social media and the Internet, the general public nowadays demands a transparent government that takes action; at the same time, people are more proactive themselves and do not wait for solutions from the government. This trend, in combination with the increase in disaster risk due to urbanization and climate change, suggests that there is a greater need than ever for actionable information in the lead-up to or during an extreme weather event. Impact-based forecasting is internationally recognized as an important tool for increasing the resilience and coping strategies of vulnerable communities. A pilot project in the city of Kraljevo, Serbia, has shown the potential of providing actionable risk information to crisis managers, decision makers, and first responders. This project, conducted by Deltares, underlines how a better use of risk information can reduce the impact of disasters—but also how use of real-time information versus scenario-based information produces different results. The 2014 floods also raised the issue of urban water management. Identification and assessment of risk, along with comprehensive contingency planning for the supply network and a clear understanding of vulnerability, are of great importance.

The United Nations Development Programme (UNDP) in Bosnia and Herzegovina used the momentum after the May 2014 floods to develop the Disaster Risk Analysis System (DRAS).[1] DRAS is an online tool that provides free access to scientific hazard data, not just to

[1] For more information see the DRAS website at https://dras.undp.ba/index.php.

municipalities but to all citizens. It projects existing hazard maps onto publicly available Google Maps. The application connects existing data on precipitation and water levels. In this way, any citizens in a municipality with a DRAS application can easily access scientific data and learn whether their homes are under threat of floods, landslides, or earthquakes. They can also check current rainfall or water levels in their vicinity. With DRAS, municipalities can for the first time see an overview of vulnerable categories of the population on spatial maps (Google Maps). The ability to overlay spatial data with hazard data makes it easy for municipalities to include vulnerable categories in prevention and response planning. DRAS enables fast computer analysis and creation of spatial risk assessments for municipalities that combine scientific hazard data with detailed land-use and vulnerability data. Because it enables objective and precise calculations of risks using scientific data already available at higher levels of government, DRAS allows municipalities to conduct evidence-based decision making in accordance with the European Union Floods Directive methodology. After successful piloting, UNDP is currently institutionalizing DRAS with local governments and the general public via civil protection units in 12 municipalities covering 13 percent of the population in Bosnia and Herzegovina.

Recommendations and Conclusions

We are living in very exciting times, when advancements in research, along with technological innovations and new tools, are providing us with better and better formulas for resilience. As the best opportunity for decreasing disaster risk lies in empowered citizens, we must make a greater effort to meet this goal and bring new knowledge to citizens.

Specifically, we should do the following:

- Cooperate and collectively find ways to inform people about disaster risks, and about solutions that minimize these risks through one-stop shops.
- Ensure that any valuable research finds its way to becoming an integral part of practices and concrete actions.
- Coordinate research efforts and share lessons learned.

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Daisy Leitch addresses the 5x15 session where five outstanding individuals have 15 minutes to tell stories about risk.

Scientific progress and technological innovation can empower communities through access to new tools that strengthen resilience to natural disasters.

Participants network during the reception.


BRASIL

The Role of Social Protection Systems in Preparing for and Responding to Disasters

Disaster-responsive social protection is an emerging concept among countries in the Western Balkans region. While some elements of disaster response are integrated in these countries' social protection legislation, systematic crisis response remains underspecified and underdeveloped. However, the social protection systems in the region have demonstrated considerable crisis response capacities in the past. In the aftermath of the 2008 financial crisis, for example, some countries expanded social assistance coverage to include newly targeted groups; some expanded social protection through the institutional support provided during the devastating 2014 floods and more recently to address the arrival of a large number of refugees. These and similar responses signal that countries' social safety nets have the potential to adapt to crises, mitigate the adverse impacts of natural disasters ex ante, and build resilience among the population. At the same time, there are clear challenges facing countries that seek to adapt their social protection programs in the event of disaster or other shock.

Sremska Mitrovica, Serbia, May 17 2014: The army, police, and citizens together erect a wall of sandbags. Photo: nemar74.

Background

Social protection systems help the poor and vulnerable cope with crises and shocks, find jobs, and invest in the health and education of their children, as well as protect the aging population. If properly designed and implemented, social protection systems can efficiently protect the most vulnerable, both in good times and in the event of a disaster. Moreover, disaster-responsive social protection can go beyond supporting the poor and vulnerable and protect the living standard of a larger share of the population.

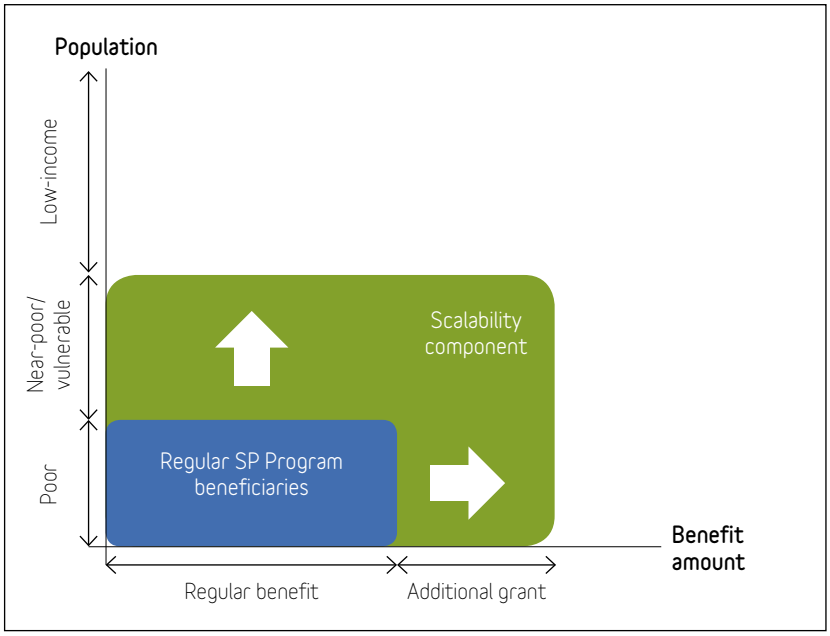
Disaster-responsive social protection may respond to different types of shocks by various means:

- Increase in the benefit value or duration for existing beneficiaries (vertical expansion)
- Addition of new beneficiaries to an existing program (horizontal expansion)
- Use of social protection administrative mechanisms to deliver assistance for a separately run shock-response program ("piggybacking")
- Operation of a parallel but aligned humanitarian program
- Adaptation of a social protection program to refocus assistance on groups within the caseload that are most vulnerable to the disaster

Figure 1 shows vertical and horizontal expansion of social protection.

These approaches require that the main social protection program has incorporated some flexibility ex ante and that it has developed a comprehensive mechanism for its benefit and service delivery system. They further require appropriate and credible information flows that are capable of identifying the vulnerable population, determining the right responses, preparing adequately for scale-up, and influencing timely decision making. Finally, they require institutional coordination and capacity that allow for effective communication with different social protection (and other) programs in place.

Figure 1. Post-disaster scale-up of existing social protection programs.



Source: Arulpragasam 2015. *Note:* SP = social protection.

Case Studies

The case studies presented here showcase both the important role that a core social inclusion program can play in disaster response, and the crucial need for an integrated data system in adapting social protection programs following a disaster or other shock.

Mexico

PROSPERA is a conditional cash transfer program originally aimed at improving education, health, and nutrition for poor families in highly marginalized contexts in Mexico. PROSPERA's aims and actions have expanded over time to promote beneficiaries' access to higher education and formal employment. PROSPERA has also started facilitating access to financial services, thereby ensuring increased social inclusion of the country's poorest citizens. On the social protection delivery side, the government has developed an integrated social information system to better identify who the poor are, where they live, and what they need.

Until recently, each social protection program in Mexico administered a separate socioeconomic and

demographic data collection on potential and existing beneficiaries. Information was managed independently through isolated information systems for targeting, delivery, and monitoring purposes. To reduce these inefficiencies and promote complementarities, the Social Development Secretariat (SEDESOL) developed SISI (Integrated Social Information System), a technological platform that integrates, manages, and exploits three types of information: (1) sociodemographic characteristics of potential and actual beneficiaries of social programs; (2) administrative data on the supply of social programs; and (3) geospatial information on the location of both the demand for and the supply of social programs and services.

SISI includes socioeconomic information for 40 million people (approximately 66.7 percent of Mexico's poor), benefits from 267 federal and state programs (identifying approximately 80 million beneficiaries), and 450 layers of geostatistical information. It is thus able to provide more transparent and accurate mechanisms for planning, targeting, and coordination of social policy, as well as to increase support in emergency situations. SISI can be employed at different points in the disaster risk management cycle and in particular when the focus is on a disaster's socioeconomic effects. Recently, the government has begun testing the use of small-area estimation methodologies to adjust poverty estimates at the municipal level based on the information gathered by different programs. Hence, in the case of a disaster or other exogenous shock, a representative sample can be surveyed quickly.

When two earthquakes struck southern and central Mexico in September 2017, PROSPERA was tasked with carrying out a census of housing damage in six municipalities and developing a database for the purposes of future reconstruction. It was also responsible for canceling cash benefit suspensions and reactivating suspended benefits, processing new benefit applications, and placing program conditionalities on stand-by. The program also extended its activities to the general population for supply delivery and information sharing. Currently, the program covers 28 million beneficiaries, which is more than one-fifth of the total population of Mexico.

Serbia

Serbia builds some elements of disaster response into the national social protection legislation, which recognizes one-off assistance as an emergency response tool. It has upgraded its approach to disaster risk management in recent years, but systematic crisis response is still underdeveloped. The disaster risk management framework has principally evolved as a byproduct of the response to crisis situations. The original regulation aimed at ensuring general safety and protection of people and resources. It did not have a special focus on the social protection system and did not specify in detail how social protection should respond to a crisis.

Serbia's efforts to automate data collection on vulnerable populations pre- and post-disaster are hampered by the lack of an integrated social protection information system such as Mexico's SISI. The question then arises: how are vulnerable groups to be identified and protected in the absence of such a system? The approach taken by the city of Kraljevo was to initiate data collection on the poor and vulnerable from the social welfare center, while at the same time mobilizing citizens to fill in the knowledge gaps about the vulnerable population. The example of Kraljevo demonstrates the importance of local initiatives in such circumstances. Coordinated activities, field work, and broader civic participation are part of possible information-gathering approaches that could be quickly deployed if properly planned and developed ahead of time.

Challenges

There are several important challenges in strengthening disaster-responsive social protection systems:

- *Access to data needed to identify risks and vulnerabilities.* Facts and figures are only bits of information; they are not information itself. Having some data on the vulnerable population does not necessarily mean having the right data when it is needed most. The challenge of accessing needed data is faced not only by less developed systems but also by the sophisticated information systems containing a wealth of data.

- *Coordination.* Social protection systems offer a range of benefits and services, which are often delivered in a fragmented way. There are also challenges of horizontal and vertical coordination, including among multiple layers of government.
- *Inclusion.* Enabling dynamic inclusion, reaching specific vulnerable groups (such as those living in remote areas or the disabled), and ensuring flexibility and adaptability (i.e., the capacity to scale up in case of disaster) are typical challenges still faced by many modern systems.

Recommendations

Countries can support the development of disaster-responsive social protection systems in several ways:

- Increase knowledge about the role of social protection systems in disaster response and build stronger disaster-responsive elements in their social protection systems. This step may include investing in additional analytical work and identification of options for adapting the existing social protection programs and ensuring scalability.
- Invest in integrated information systems that can tackle the challenges of identification, coordination, and inclusion. With integrated information systems, countries can learn what type of support is needed, and which programs exist or should exist to serve the needs of the population. The development of these integrated social information systems is also key to better targeting government interventions, supporting more efficient government spending, and avoiding benefit duplication.
- Build societal awareness of risk, engage communities in data collection when needed, and continuously build communities' capacity to identify risks and vulnerabilities in a timely manner.

On a broader scale, a community of practice on disaster-responsive social protection is needed to bring together policy makers and practitioners globally to exchange knowledge and share lessons.

Conclusion

Disaster-responsive social protection systems aim to build the resilience of the poorest and most vulnerable people by combining elements of social protection and disaster risk management. The impact of social protection programs could be enlarged by ensuring that the right information is obtained and by aiming for greater coordination and social inclusion. Response capacity must not only be built into relevant institutions, but must also be developed among individuals and agencies that are outside of traditional social protection interventions. To this end, various partnerships and knowledge-sharing activities among national and local agencies, public and private service providers, and development partners should be implemented.

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Session leads deliver their Ignite presentations.

In response to growing exposure to disaster risks in the Western Balkans, the DRM community has supported the conference as a means of increasing international cooperation and resilience investment.

Participants attend technical sessions.

Transboundary Sava River Cruise with Views on Successful Multi-Hazard Early Warning Advisory Systems

Early warning is a major element of disaster risk management, preventing loss of life and potentially reducing the economic and material impacts of hazardous events. To be effective, early warning systems need to actively involve the people and communities at risk from a range of hazards, facilitate public education and awareness of risks, disseminate messages and warnings efficiently, ensure a constant state of preparedness, and enable early action (WMO 2018).

Recognizing that the countries of the Balkans and greater Eastern Europe are affected by the same weather systems and share many transboundary rivers, governments have been working together to support regional approaches that foster the sharing of early warning information, forecasts, and expertise, thereby strengthening decision support at the national level.

The Ada Bridge, Belgrade. Photo: Imre Cikajlo.

Background and Concepts

Multi-hazard early warning systems address several hazards and/or impacts in contexts where hazard events may occur alone, simultaneously, or cumulatively over time, or may cascade from one another. A multi-hazard early warning system—one with the ability to warn of more than one hazard—increases the efficiency and consistency of warnings through coordinated and compatible mechanisms and capacities. Such systems draw on multiple disciplines for up-to-date and accurate hazard and risk identification and monitoring (WMO 2018).

It is generally accepted that successful early systems include four interlinked elements (WMO 2018):

1. Disaster risk knowledge
2. Detection, monitoring, analysis, and forecasting of hazards and possible consequences
3. Warning dissemination and communication
4. Preparedness and response capabilities

This UR Balkans session focused on elements 2 and 3. Specifically, it explored how countries can take advantage of modern technology and engineering innovations to work together in monitoring and forecasting of hydrometeorological hazards. It also explored approaches for creating more easily understood and consistent early warnings across countries.

Case Studies

South East Europe Multi-Hazard Early Warning Advisory System (SEE-MHEWS-A)

Initiated in 2016 under the auspices of the World Meteorological Organization (WMO), SEE-MHEWS-A aims to support participating National Meteorological and Hydrological Services (NMHSs) in providing timely and accurate warnings of hydrometeorological events. It seeks to provide operational forecasters with tools for forecasting events and their possible impacts. The system functions as a cooperative platform that allows forecasters from different countries to work together, especially when impending weather hazards may affect several countries.

SEE-MHEWS-A began with a successful preparation phase that attained the commitment of more than 15 countries and an agreed-upon implementation plan. Now, with support from the World Bank and Global Facility for Disaster Reduction and Recovery, SEE-MHEWS-A Phase 2 is developing a pilot operational hydrological modeling system as the basis for development of the comprehensive regional advisory system. This phase includes setting up an operational database and archiving software on an ICT platform, running existing operational limited area numerical weather prediction models in quasi-operational mode, and connecting high-resolution numerical model outputs to hydrological models at the basin level to provide strengthened flood forecasting capacities.

Flood Forecasting and Warning System in the Sava River Basin (Sava FFWS)

In 2003, the members of the International Sava River Basin Commission (ISRBC)—Bosnia and Herzegovina, Croatia, Serbia, and Slovenia—along with Montenegro, began efforts to establish a system for forecasting floods in the Sava River basin. Partly in response to the major floods of 2014, the proposed Sava FFWS was approved under the Improvement of Joint Actions in Flood Management in the Sava River Basin project, funded by the European Union (EU) Western Balkans Investment Framework and implemented by the World Bank.

In cooperation with relevant national institutions, ISRBC developed a hydrological model for the entire basin (Sava HMS model) and a hydraulic model for the Sava River (Sava RAS model). It has also established a

A multi-hazard early warning system—one with the ability to warn of more than one hazard—increases the efficiency and consistency of warnings through coordinated and compatible mechanisms and capacities.

joint platform that allows ISRBC countries to exchange and use hydrometeorological information and data (the Hydrological Information System for the Sava River Basin, or Sava HIS). Sava HIS was established based on the Policy on the Exchange of Hydrological and Meteorological Data and Information in the Sava River Basin, which the ISRBC prepared in close cooperation with WMO. Already operational as an open shell platform for managing the data handling and forecasting process, Sava FFWS allows a wide range of external data and models to be integrated.

Flood Foresight

Developed to meet the need for flood forecasts and real-time flood information, the Flood Foresight framework is an innovative operational system that provides maps of flood inundation, depth, and impact at all phases of major fluvial flood events (i.e., before, during, and after). These data enable rapid forecast and real-time impact and loss estimation for a variety of sectors and users.

In Flood Foresight, a library of pre-computed flood hazard maps and associated annual exceedance probabilities is coupled with current and forecast streamflow conditions to create an estimation of flood inundation extents and depths. Data are updated every three hours and are provided as 30 m resolution maps for both the current state (from telemetered streamflow gauges) and daily forecast states (using rainfall-runoff models) up to 10 days ahead. The Flood Foresight framework is flexible, allowing integration of national or local-scale flood hazard maps, rainfall-runoff models, or river gauges, where available. The mapping routines can be integrated into several forecasting systems to allow translation of point-based streamflows into flood inundation extents and depths. These forecast flood maps allow users to understand where flooding may impact assets, thus providing decision support to operational forecasting teams or to a range of public or private end-users. This high-level flood mapping can help target additional hydrodynamic modeling, further data capture (including from satellite or aerial sensors), and mitigation or communication activities aimed at reducing overall losses.

MeteoAlarm

In support of regional integration and resilience, EUMETNET (a cooperative group of 37 European NMHSs) established MeteoAlarm to provide pan-European alert information online for a variety of hazards. MeteoAlarm aims to deliver impact-based multi-hazard warnings in multiple languages and to indicate warning levels with a common, logical, and easy-to-understand color scale (figure 1).

Impact-based warnings issued by MeteoAlarm are generated by the NMHSs and take into consideration local forecasted hydrometeorological parameters, climatology, exposure, and vulnerability. In addition to indicating potential impacts, warnings provide instructions on appropriate behavior. Leveraging modern communication technologies, MeteoAlarm is made freely available for reproduction through all kinds of media, thereby ensuring the official warnings it delivers reach as many people as possible.

Challenges

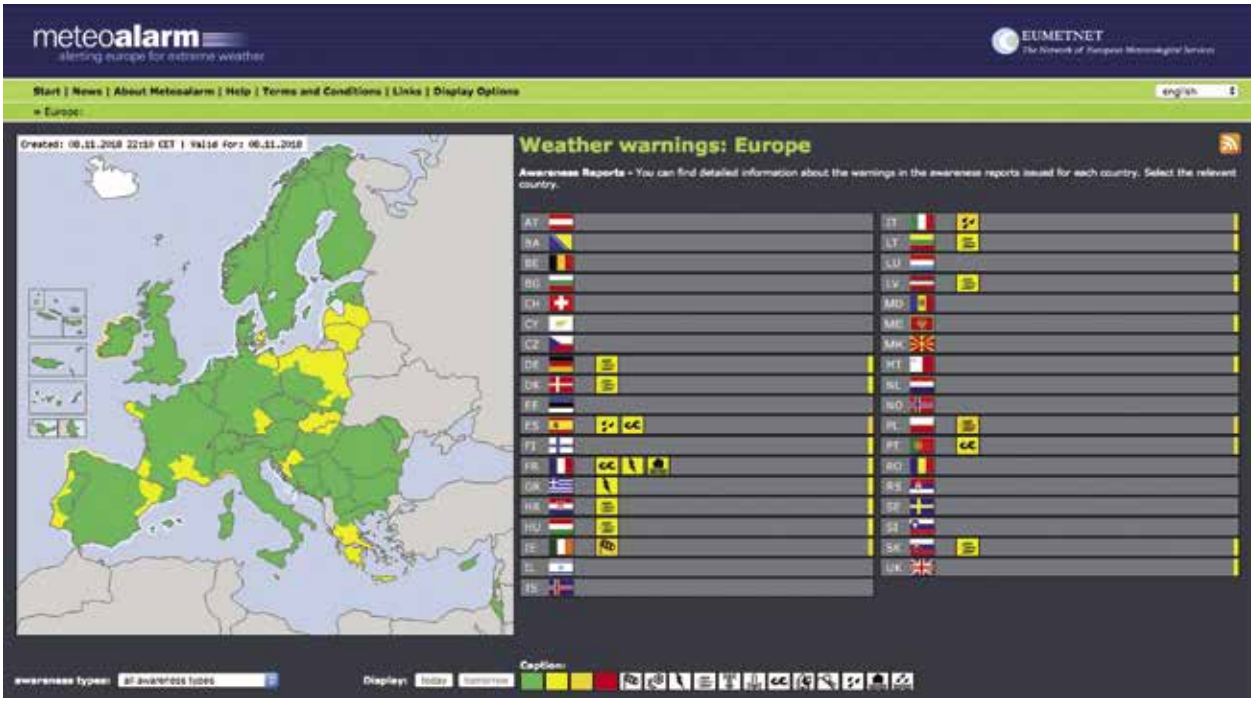
There are several challenges entailed in developing systems that detect, monitor, analyze, and forecast hazards and their possible impacts, and that disseminate and communicate warnings in a way that meets user needs. Many of these challenges are exacerbated when there are transboundary hydrometeorological hazards involved, since these may involve the following:

- Need for rapid/real-time production of robust and reliable hazard and potential impact forecasts
- Political and technical obstacles to data and information sharing
- Depending on the context, insufficient resources (technical, human, and financial)
- Overlapping or unclear institutional mandates
- National systems and approaches that are not consistent between countries and/or institutions

Recommendations

The case studies above highlight several lessons learned that are

Figure 1. MeteoAlarm homepage. MeteoAlarm provides a one-stop shop for hydrometeorological hazard warning across Europe.



Source: © EUMETNET - MeteoAlarm, www.meteoalarm.eu.

here translated into good practice:

- *Foster an enabling environment.* In transboundary settings, countries need to agree on a shared vision and commit to long-term collaboration at the highest possible institutional and political levels. This commitment needs to be codified through formal agreements that respect sovereign responsibilities and mandates.
- *Define partnership roles.* Clear definitions of roles and responsibilities are needed to support equal partnerships that build trust between partners. Partnerships should also aim to follow current development trends such as open data policies.
- *Share limited resources.* Sharing of resources (pooling of expertise, etc.) makes it possible to achieve more with less cost and facilitates wider access to better technologies and products.
- *Increase computational speed.* Effective disaster management requires forecasts and related information in real time. By harnessing modern computational resources such as the cloud and developing libraries of relevant information for quick access, computational speed can be accelerated.
- *Support national systems.* Any regional system must support national systems and approaches; otherwise it will not be fully leveraged.
- *Create understandable and harmonized warnings.* Public hazard warnings should focus on potential impacts rather than technical metrics and be color-coded across multiple hazards to support ease of understanding. In an increasingly interconnected world, where governments are responsible for both their own citizens and visitors, harmonization is needed across national warning systems.
- *Demonstrate benefits to users.* The wider benefits of transboundary forecasting systems and use of linked decision support tools should be demonstrated to encourage broader understanding of, adoption of, innovation in, and

data sharing for these tools and systems. Demonstrating the benefits of transboundary collaboration will encourage public agency involvement in initiatives and wider sharing of data for use in these systems, which will mutually benefit stakeholders.

Conclusions

With political will and accelerating technologies, multi-hazard early warning systems can be made more effective and efficient. By pooling data and other resources, regional advisory systems can also support improved national early warning services.

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Seismic Risk in Multifamily Apartment Buildings: Engineering, Social, Financial, and Policy Implications

Between 1960 and 1990, many countries across Europe, the Caucasus, and Central Asia responded to shortages in housing by mass-producing prefabricated large-panel buildings, among other building types. Today, many of these buildings have outlived their design life span and suffer from deterioration and poor maintenance. In addition, the buildings are not designed to modern seismic code standards, and their seismic vulnerability is not well understood. An added complexity is the absence of information on the extent to which these apartments may have been reconfigured by the owners (e.g., by removal of load-bearing walls).

The UR Balkans session on seismic risk in multifamily apartment buildings highlighted recent work in this area. Focusing on the Balkan region, participants discussed advances in the understanding of seismic risk of pre-1990s multifamily buildings, addressed the social and financial challenges associated with risk reduction in these buildings, and explored potential intervention strategies.

Sofia, Bulgaria, skyline as seen from the Vitosha Mountains. Photo: Alexander Farnsworth.

Case Studies

Housing Sector Diagnostics

Ashna Mathema of the World Bank gave an overview of the findings from recent housing sector diagnostics in Azerbaijan, Bulgaria, Georgia, and Romania—countries with similar infrastructure, challenges, and opportunities. All four countries are characterized by a lack of affordability and housing choice, population shifts that create demand and supply imbalances, and inadequate building management and maintenance. These countries also exhibit a lingering culture of dependency—a remnant of the former Soviet/Communist regimes—in which residents tend to expect that the government will provide and maintain housing. This tendency is exacerbated by extremely weak homeowners' associations. It also became evident that the seismic risk of multifamily apartment buildings is largely unknown, and homeowners have only limited risk awareness. As a result, risk mitigation initiatives, such as retrofitting programs and earthquake/disaster insurance, are largely absent. More information on the findings and web links to the World Bank housing studies can be found in a recent blogpost, "On Shaky Ground" (Mathema and Simpson 2018).

Large-Panel Buildings in Bulgaria

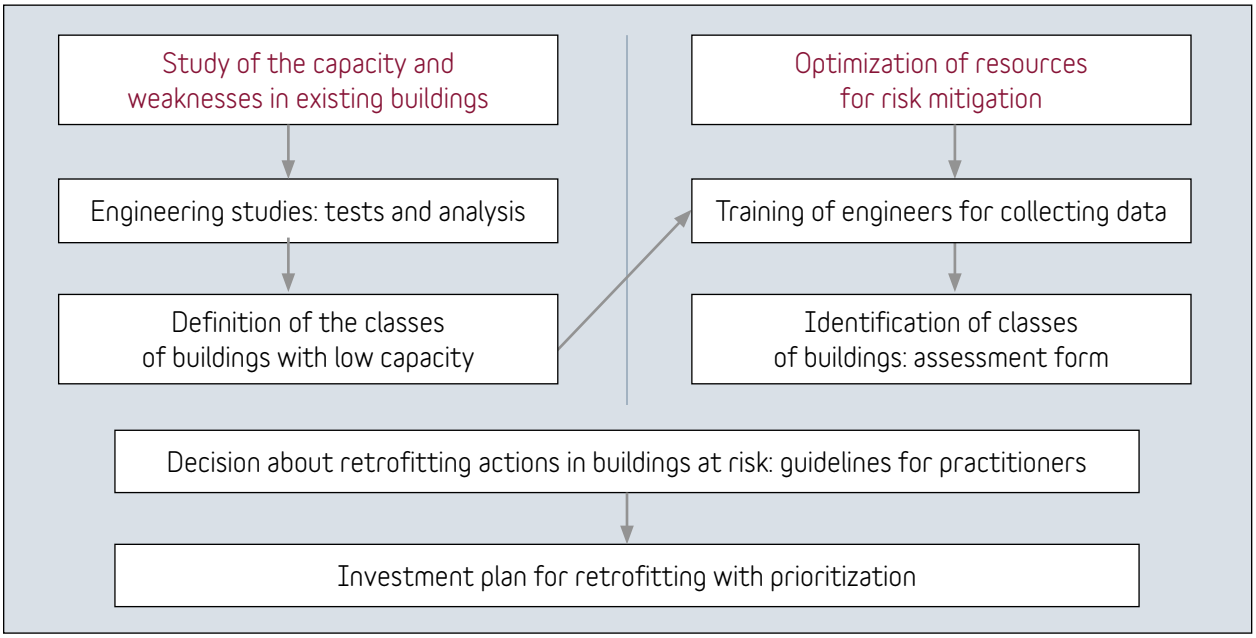
Anton Andonov of Mott MacDonald shared some insights from an ongoing World Bank study on large-panel buildings in Bulgaria. This study is the first ever to perform full-scale 3D nonlinear numerical modeling of large-panel buildings to assess their seismic capacity. Using region-specific damage-to-loss models, the team produced the first analytical fragility and vulnerability functions for large-panel buildings. Once the study is complete, the results will contribute to global knowledge on seismic risk in these buildings and will inform risk assessments and intervention strategies throughout Europe and Central Asia. In Bulgaria, close to 25 percent of the population lives in large-panel buildings. Since these buildings are between 30 and 50 years old, deterioration and lack of maintenance are a concern, especially given their likely effect on structural safety. Another concern is the evidence that some unit owners removed load-bearing walls to create more space or achieve more desirable apartment layouts, which could further compromise structural stability.

Preliminary study results show that while in a large earthquake, the probability of full structural collapse of large-panel buildings is relatively low, the risk of out-of-plane failure of facades (non-load-bearing in most cases) is not negligible, in particular when there is accelerated deterioration of the facade connection details. Furthermore, since all internal walls are structural, post-earthquake structural repair of light and moderate damage of such buildings is rather costly. As a result, large-panel buildings are prone to large financial losses in the event of a major earthquake, with repair costs likely equivalent to several years of the average household's annual income. Preliminary recommendations on possible risk reduction strategies in these buildings include (1) development of a robust, risk-based rapid visual assessment methodology, (2) introduction of rapid and cost-effective interventions that can piggyback on the large ongoing investments in energy efficiency improvements, and (3) development of the insurance market to help mitigate financial losses.

Earthquake Vulnerability in Romania

In Romania, earthquakes pose a large risk to the housing sector. In 1977, a moment magnitude 7.4 Vrancea earthquake claimed over 1,500 lives, destroyed 33,000 housing units, and caused losses in excess of 6 percent of gross domestic product. Professor Radu Vacareanu's research group performed extensive studies to understand the consequences of a large earthquake in Romania today. The findings show that 60 percent of the existing building stock was built prior to the Vrancea earthquake with low seismic design standards, making it vulnerable to earthquakes. Older high-rise concrete buildings are of particular concern, as they are structurally vulnerable and house a large portion of the population. In September 2016, Professor Vacareanu's research group also conducted a survey on risk awareness and preparedness among the general population of Bucharest. According to the results, most of the population believed that there was a risk of a major earthquake in Bucharest—but

Figure 1. Proposed approach for risk mitigation in the Balkans.



Source: Marianna Ercolino.

the majority did not have a family emergency plan and believed that their home would sustain minor to no damage. Interestingly enough, people also believed that buildings built between 1978 and 1992 would sustain less damage than those being built today, revealing a misconception about seismic safety of aging infrastructure.

Lessons from Italy on Precast Industrial Buildings

The failure of precast industrial buildings in Italy offers lesson to the housing sector in the Balkans. Dr. Marianna Ercolino explained that industrial precast buildings proved to be highly vulnerable during several earthquakes in Italy and Turkey, especially buildings with weak connections between panels and the structure—a characteristic of some large-panel buildings across the Balkans. The first step in Italy to reducing the risk to precast buildings was to develop and implement a rapid capacity assessment. The assessment was done by surveyors who filled out a relatively simple survey form, one based on previous building vulnerability studies, which were much like those being conducted in Bulgaria. The survey collected information on building use and on condition of connections and panels. Once the information was collected, predefined recommendations/guidelines for the retrofitting of structures were provided in order to define uniform actions for risk reduction in precast buildings in the country. Balkan countries could adopt an approach similar to Italy's to mitigate risk in buildings; see figure 1.

Conclusion

All the speakers agreed that seismic risk in the housing sector is a very urgent issue, and one that is worthy of more attention, more analytics, and certainly a lot more financing.

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Getting Informed: Disaster and Climate Risk Tools for Improved Decision Making

To make policy and planning decisions that reduce future risk, present and future risk must be quantified and visualized with and without the effect of disaster risk management (DRM) policies, and the results compared. Decision makers can then evaluate how policy actions taken now and in the near future could affect the risk environment in the medium to long term. But to ensure reliable risk and DRM scenarios that provide a degree of certainty, decision makers require up-to-date and accessible scientific information that is complemented by knowledge from the community and other stakeholders—including existing and upcoming land-use planning decisions. Risk assessments must also account for the specific needs of decision makers and communities to support their analysis, decision making, and communication processes.

Expedition 31, International Space Station (ISS). Credit: NASA.

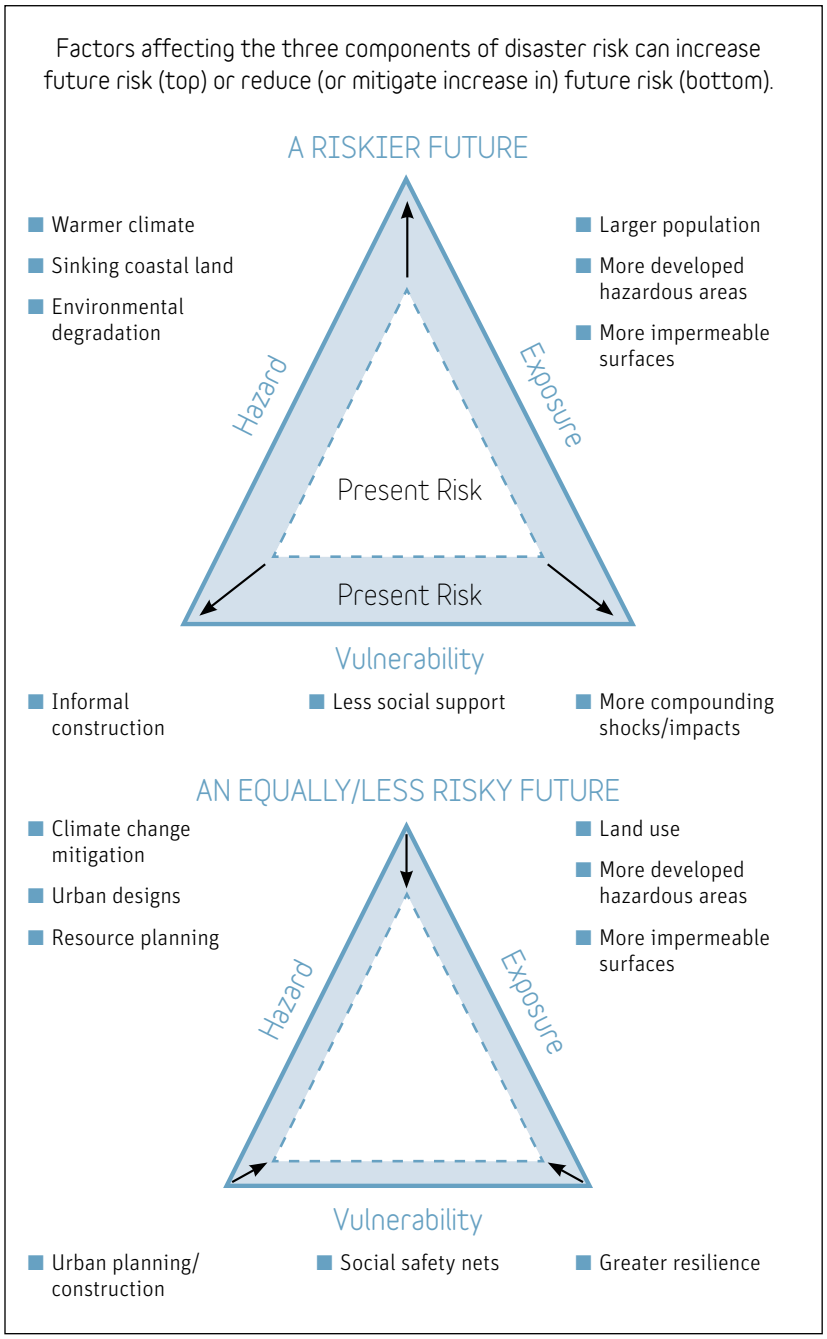
This UR Balkans session explored how risk assessments and tools can best inform DRM decisions. It laid out the basics of disaster risk assessment, described exciting new assessment tools, and discussed the importance of utilizing real-time data and of effectively communicating risk to decision makers and the community.

Background: Basics of Risk Assessment

Risk occurs at the intersection of exposure, hazard, and vulnerability. Factors affecting these components can increase future risk, or they can reduce (or mitigate increases in) future risk. Policy makers, society, and individuals can exert some control over these components (figure 1).

Disaster risk assessments vary in complexity. They can be as simple as producing an order-of-magnitude loss estimate by overlaying exposure on a hazard scenario and assuming a damage ratio for each unit of exposure. Risk assessments can also be based on expert judgment to assess the likelihood of different risk components, or of overall loss. One structured method of collecting expert judgment is the Delphi method (Elmer et al. 2010), a weighted ranking approach based on expert judgment that ranks events or scenarios with a high degree of uncertainty to estimate risks in the future. The most complex approaches to assessing risk comprise statistical distributions to represent probability of hazard intensity and damage, and they compute uncertainty at each step of the modeling. In these models, the hazard component provides the georeferenced event severity (e.g., maximum wind speed, flow depth, or ground-shaking intensity) and frequency (how often the event is expected to occur) at each modeled location. Georeferenced exposure data provide population, asset characteristics, and value at each location. The vulnerability component relates an event's intensity to its impact based

Figure 1. Choosing a riskier or less risky future.



Source: GFDRR 2016.

on the statistical relationship between intensity and probability of damage, number of fatalities, or impact on coping capacity and poverty.

Risk assessments can be deterministic or probabilistic. Deterministic modeling uses event scenarios to provide the hazard data. Probabilistic modeling combines many thousands of different events of varying frequency (annual occurrence probability) and severity. The loss from each event in a probabilistic event catalog can be used to establish a loss exceedance probability and average annual loss, whether in terms of monetary value, population, or asset units (e.g., number of buildings).

Challenges

Despite huge advances in risk assessment methodology, decision makers continue to engage risk assessments that are static in nature, focused only on understanding current and singular risks. Further, by their nature there is uncertainty in all risk assessments, whether they are assessing present risk or projecting future risk, due to natural variability in Earth's systems, data availability, and limitations in modeling methods. This can reduce the appeal for decision makers or property owners who value certainty before making decisions. Risk assessment products can also be highly technical and not user-friendly, and the results can often be poorly communicated to the key audience—governments and the affected community.

The Needs of Decision Makers: Addressing Underlying Drivers and Compounding Factors

Risk assessment and communication should account for the evolving nature of the underlying drivers of—and compounding factors that exacerbate—natural hazard risks, including projected risks, a changing climate, population increase, rapid urbanization, cascading risks, and future environmental and societal conditions and vulnerabilities. Risk assessments should provide clarity on the expected impacts of risks on communities and infrastructure (expected damages and losses). For example, risk analysis offers an opportunity to quantify the decrease in future risk that arises from better enforcement of building codes—and hence to demonstrate the benefit of spending additional funds on building code enforcement.

Innovations in Risk Assessment

Real-Time and Smarter Data

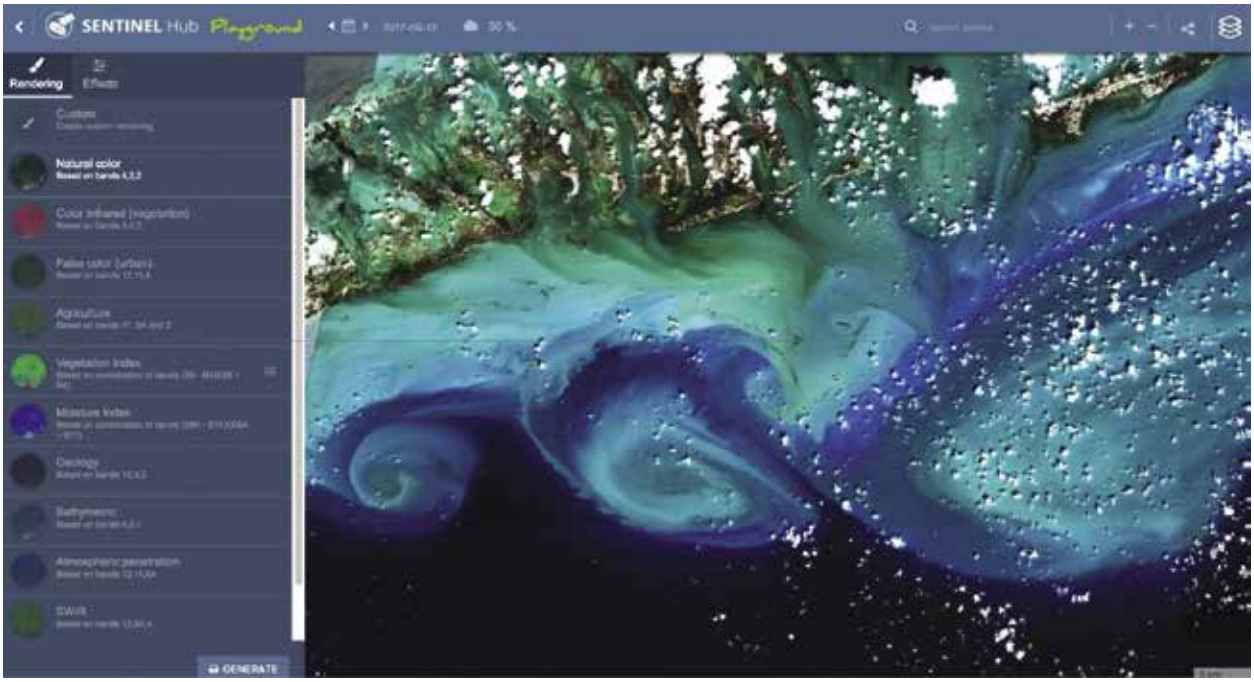
Risk assessments can be made smarter by augmenting models with data representing current and future conditions (e.g., higher sea level, increased population density, or changing climatic conditions). Although such approaches were once expensive, there are now low- to no-cost ways of accessing real-time data through satellite imagery (to evaluate cyclone, flood, drought, landslide, and volcano risks). This information can provide accurate, actionable, and end-user-friendly information on the scope, extent, and potential impact of risk. Such information—like that supported by Sinergise's Sentinel Hub, a Copernicus award-winning service of open source satellite imagery—reduces the time and cost of analyzing satellite images of Earth. Figure 2 shows how the Sentinel Hub tool highlighted the impact of Hurricane Irma on the Florida Keys.

3D Visualization

Visualization or simulation of future risk with and without the effect of DRM actions can help decision makers and communities understand the risks to their property and assets, and can clarify the investments in DRM that could be made. For example, RIOCOM has produced a new 2D hydrodynamic simulation model called Visdom, which encompasses dynamic 3D visualization, risk analysis, measurement planning, and data optimization (figure 3).

Communicating risk through 3D visualization is becoming more popular, particularly for communicating immediate threats. During Hurricane Florence, the Weather Channel used this approach to show in real time the danger of rising flood waters in parts of the Carolinas. The National Hurricane Center predicted

Figure 2. Demonstration of Sentinel Hub showing Florida Keys after Hurricane Irma.



Source: Sinergise, Sentinel Hub, https://www.sentinel-hub.com/; https://www.sinergise.com/. Produced from ESA remote sensing data.

Figure 3. Sample Visdom simulation.

Source: RIOCOM, https://riocom.at/en/disaster-reduction/; https://riocom.at/en/simulation/.

storm surges of 2 feet to more than 11 feet and illustrated this with a cartoon graphic showing rainbow-colored water rising over the heads of a family in a house.

The Weather Channel took the visuals a step further and used mixed reality to show waters rising around the on-screen meteorologist. The mixed reality graphics, created in partnership with augmented reality company The Future Group, harnessed the Unreal Engine, a popular video game development platform

Figure 4. At-risk Turkish cities.

Source: Ministry of Environment and Urbanization, Government of Turkey.

that builds effects in real time (Weather Channel 2018).

Case Study: Turkey

Too often risk assessment information is not communicated to affected communities or used to inform DRM processes. The case of Turkey, which is highly vulnerable to earthquakes and other hazards, makes clear that the benefits of a risk assessment depend on the assessment results being integrated into a risk management process.

The Ministry of Environment and Urbanization (MoEU) has been compiling and managing data on property, geological features, land use, and spatial plans to identify areas and buildings at risk; the data are collected via 81 provincial directorates. MoEU has identified 52 cities—containing 35,000 buildings and 1.8 million inhabitants—that face risks (figure 4). By utilizing this information, Turkey is aiming to inform citizens of the risks faced, manage earthquake risk, and minimize consequences for human lives and the Turkish economy.

Within these 52 cities, MoEU has initiated a process to disclose relevant data to inform decisions by both policy makers and citizens. This process considers average annual losses (both human and capital losses) and structural vulnerabilities, and uses an approach to yield an optimum return on lives saved and urban regeneration. MoEU has also aimed to minimize social disturbance and create durable solutions for citizens. Toward that end, the General Directorate of Infrastructure and Urban Transformation Services of the MoEU developed the ARAAD system.[1]

ARAAD is an automated, open source, real-time, GIS-interfaced software program under the E-State mechanism that collects and manages risk data on areas and buildings across Turkey, with the goal of facilitating evidence-based decision making. The program processes data by using 42 different modules through NexusDB database engines, with the GIS interface directly linked to Google Maps. The data collected are divided into project data, parcel/lot data, and building data. The project data cover time, budget, actors, legislation, and the monitoring committee. The parcel/lot data cover address, area, property, and litigation issues. The building data cover name, address, co-ordinates, parcel, building code number (from

[1] For more information on the ARAAD system, see https://www.kentseldonusum.gov.tr/?AspxAutoDetectCookieSupport=1 (in Turkish).

the national database of addresses), building measurement, construction details, earthquake hazard zone information, and the level of life safety. Other data incorporated into the program include administrative units, addresses, cadastral parcels, hydrography, land cover and geology, statistical units, land use, utility and governmental services, and natural hazard zones.

The program allows various users—public institutions, enterprises, and individuals—to request a seismic risk assessment for their building or apartment. It guides users through the necessary steps, such as consulting with other building residents, determining the proper compensation scheme for residents if they are required to leave the building, and deploying citizen mediation where disputes arise. The Director General of Land Registry and Cadastre then informs all property owners in the potentially risky building of the need to evacuate. If the assessment confirms the building's risk, the building is demolished and the process to develop a new building begins. Eventually this is finalized with the consensus of two-thirds of the property owners. MoEU provides rental subsidies and user-friendly loans to the unit owners in risky buildings to support temporary accommodations during this process.

The system is not without its shortcomings, but MoEU is working towards strengthening the system. For example, the ARAAD system includes mainly nongraphic data. MoEU is aiming to improve the software program to include graphic and nongraphic data in order to fulfill the INSPIRE (Infrastructure for Spatial Information in the European Community) standards of the European Union.[2]

Conclusions

The session presentations and discussion suggested some key conclusions about how risk assessments and their tools can best inform DRM decisions. Specifically, they should

- Utilize real-time data and data representing future conditions (e.g., higher sea level, increased population density, or changing climatic conditions)
- Account for the evolving nature of the underlying drivers and compounding factors that exacerbate natural hazard risks and undermine resilience of communities and assets
- Account for the specific needs of decision makers and their communities—for example, by taking into consideration draft land-use plans, key strategies (such as water management plans), refugee influx expectations, climate change, and poverty levels
- Be used cyclically to reevaluate risk
- Provide a visual/simulated approach to communicate the risks faced or the impacts of DRM investments
- Lend themselves to use as an open source data platform to inform affected individuals and communities of the risks their property faces.

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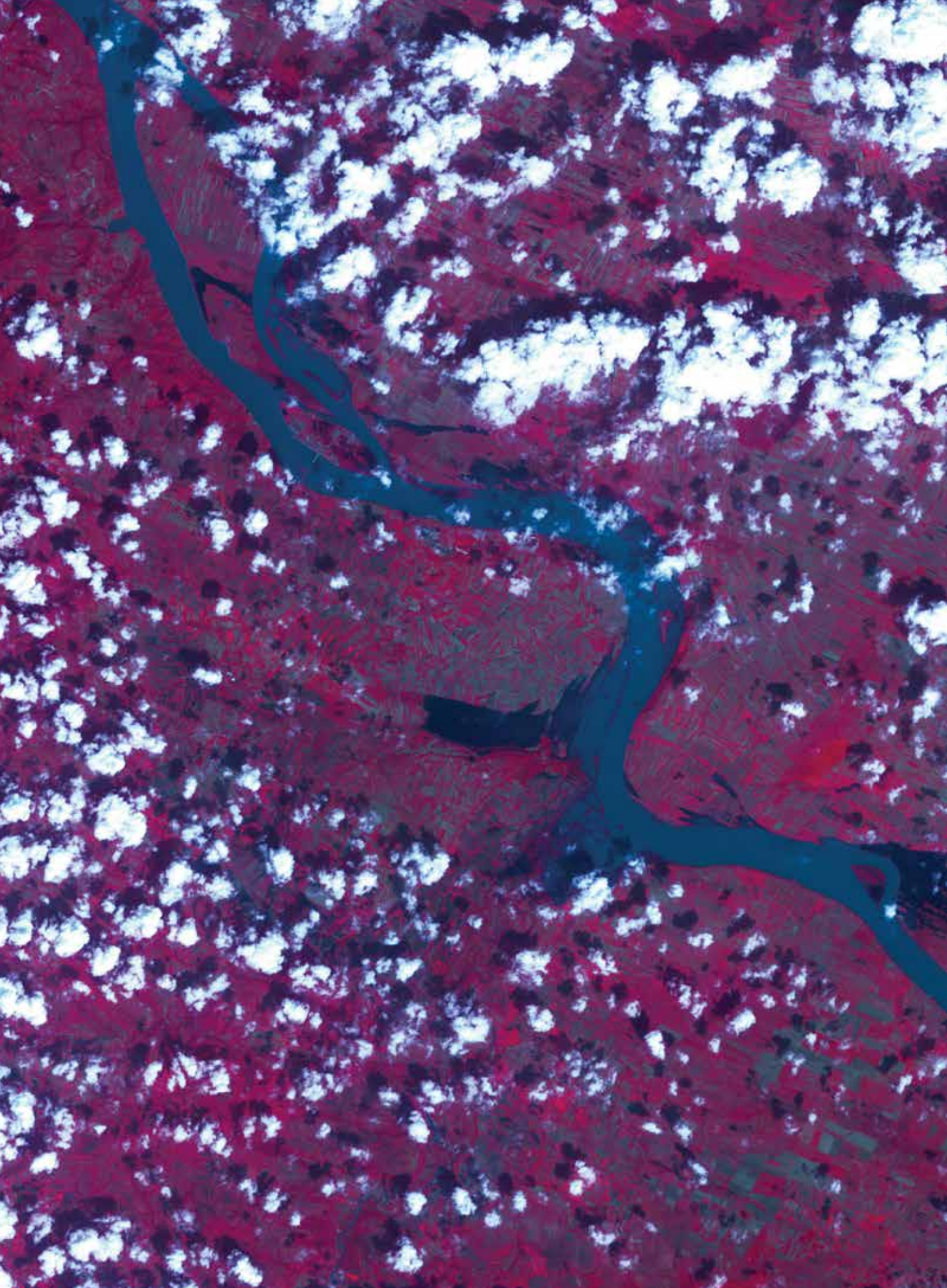
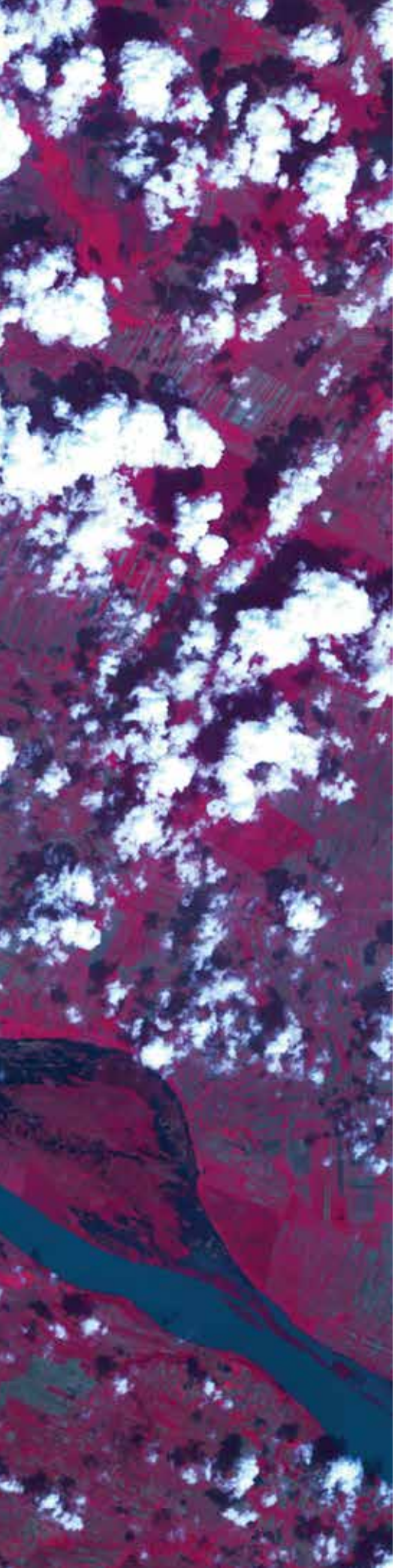
[2] For more information on the INSPIRE Directive, see the directive's website at https://inspire.ec.europa.eu/.

Marko Blagojevic, the director of the Serbian government's Public Investment Management Office, is interviewed by local media.

The wide range of DRM topics explored at the conference were relevant to various sectors and informed the audience of both best practices and lessons learned in different countries.

Technical Session.





The State of Open Data for DRM in the Balkans

There has been a surge in the volume of available climate and disaster risk data for the Balkans, but critical data gaps remain, making it difficult to get a full understanding of the risks faced by Balkan countries.

The UR Balkans session on the state of open data for disaster risk management (DRM) focused on addressing this issue. It looked at what DRM data are—and are not—available for the Balkans, and explored how the data situation could be improved, country by country.

The Danube River spills over into farm fields in the northeastern corner of Serbia.
Credit: NASA.

Background

The session started with an introduction to the Open Data for Resilience Index, a website developed by the Global Facility for Disaster Reduction and Recovery (GFDRR) Open Data for Resilience Initiative (OpenDRI) to track and evaluate the state of open data related to DRM. The index enables anyone to submit data on exposure, hazard, and vulnerability, as well as baseline data, for a given country. Each data set is then assessed against a set of 10 open data criteria to determine how easily it can be downloaded and reused. The platform aims to become a common resource for DRM practitioners, governments, and other stakeholders seeking to reduce data gaps for territories exposed to natural hazards. Figure 1 shows Balkan countries ranked on the Open Data for Resilience Index.

According to Stella Karafagka, a risk assessment specialist at the Aristotle University of Thessaloniki who has conducted an inventory of data sets for Balkan countries, most of the essential data for DRM still has restricted access or does not exist. Slovenia stands out from this general trend as the only country in the region that has published most of its key data sets as open data. For instance, it is possible to download and reuse Slovenian building data, a must-have for DRM, without any restriction,[1] as shown in figure 2. The index also revealed that most of the countries do not release meteorological data as open data, despite floods and extreme weather causing increasing damage in the region. Traditional funding mechanisms, which require hydrometeorological agencies to fund themselves and sell their data, may be one of the explanations for this data lock. Concerning online data availability, results from the index show that

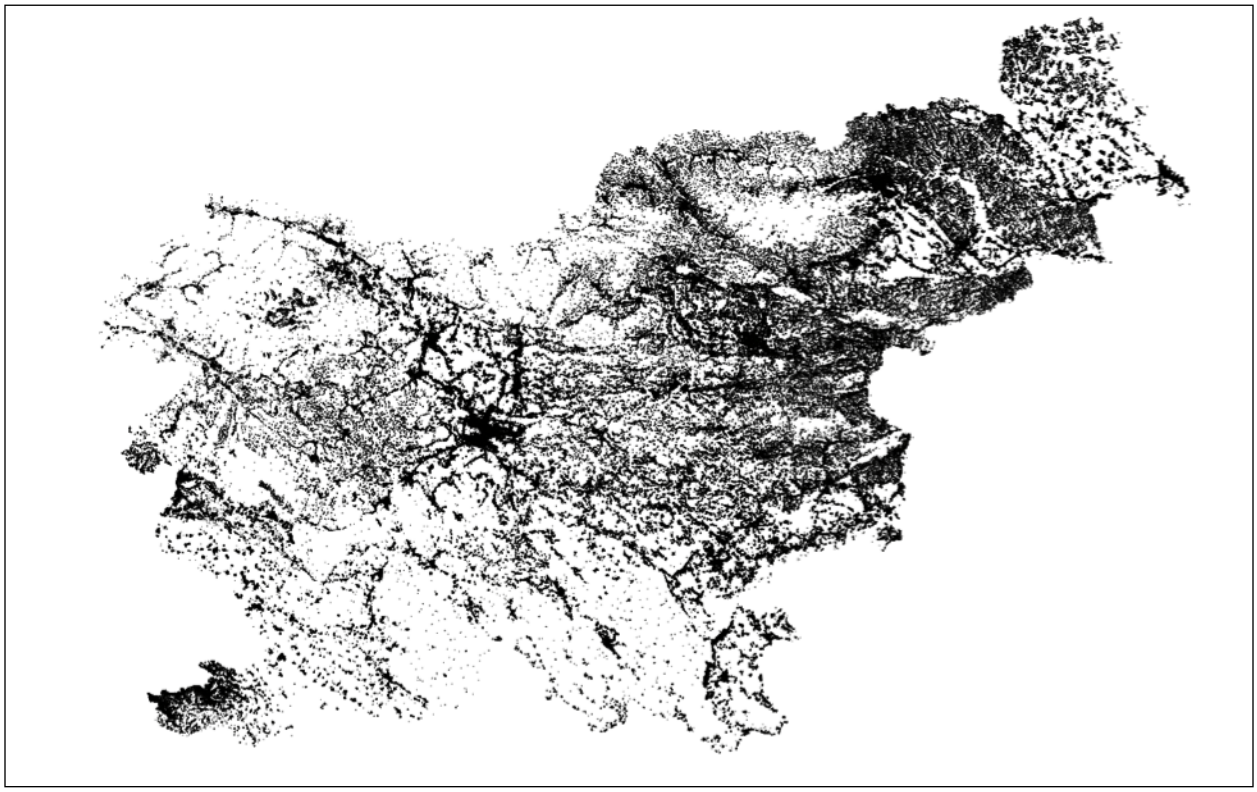
Figure 1. Balkan countries ranked on the Open Data for Resilience Index by level of open data for DRM.

Location	Score	Data sets submitted	Open data
Slovenia	46.0%	24	14
Greece	41.7%	28	5
Serbia	41.7%	24	3
Bulgaria	39.2%	25	4
Italy	39.0%	19	10
Albania	37.2%	25	2
Romania	33.9%	20	4
Croatia	31.1%	20	2
Macedonia	25.7%	18	2
Bosnia and Herzegovina	21.7%	18	2
Montenegro	21.5%	17	2
Turkey	20.0%	15	2

Source: Open Data for Resilience Index, https://index.opendri.org/.

[2] See Open Data for Resilience Index, "Slovenia—Buildings," https://index.opendri.org/dataset_details.html?keyds=414.

Figure 2. Map of building footprints in Slovenia processed on QGIS software.



Credit: Surveying and Mapping Authority of the Republic of Slovenia.

restricted terms of use, lack of open licenses, and difficulty associated with downloading raw data were among the main issues preventing data reuse.

Tracking disaster data through the index is an ongoing, crowdsourced process, where any contribution from the community is welcome.

Case Studies

The session provided an opportunity to explore initiatives and projects addressing risk data gaps in the Balkans.

IPA DRAM

The European Union (EU)-funded Programme for Disaster Risk Assessment and Mapping (IPA DRAM), a partnership between national civil protection agencies, supports Balkan countries in collecting and making better use of disaster loss data. One of the main deliverables of IPA DRAM will be a global disaster loss database, one that leverages EU and Sendai disaster risk reduction frameworks to foster data harmonization among countries. The program also provides support for risk assessment and risk mapping. As stressed by Stefania Traverso, a GIS specialist from the CIMA Research Foundation and an IPA DRAM expert, there is a need to raise awareness at all levels about the issue of data availability and interoperability. Civil protection agencies need to cooperate on this issue, work together toward common data frameworks, and where possible use common resources.

Journalism

The role of journalists in addressing disasters, and the way that data gaps can hamper their work, were described by Georgiana Ilie, a reporter and senior editor at the Romanian magazine *DoR*. Her investigation of what would happen if an earthquake hit Bucharest took several months, mainly because of the lack of public access to information in her country. But her resulting story, "Earthquake in the Vulnerable City" (Ilie 2017), shows that journalism can both entertain and educate citizens about disaster risk management. The data she used


Orasul vulnerabil

Un cutremur de 7,5 magnitudine va lovi cu siguranță Bucureștiul. Poate să se întâmple oricând și n-avem cum să-l prevenim. Dar nici nu facem tot ce-am putea ca să-i atenuăm urmările.

De Georgiana Ilie

Georgiana Ilie's original article, "Earthquake in the Vulnerable City," published in *DoR* issue #28 (June 2017). *Credit:* © DoR, http://shop.decatorevista.ro/product/DoR28.

for the publication included an incomplete list of buildings at risk provided by the city, hazard data from the National Institute of Earth Physics (INFP), and various reports from the World Bank and other international organizations. But her research could not locate a comprehensive database of all buildings. Similarly missing was information related to safety and emergency measures such as shelter locations, safe open places, and evacuation plans—all of which journalists could share and publicize in the case of an earthquake.

Challenges

Access to open disaster and climate data for Balkan countries is challenging for a number of reasons:

- Despite a favorable environment—including national open data initiatives, the EU directive on open government data (PSI [Public Sector Information] Directive), and the directive on environmental and geospatial data (INSPIRE [Infrastructure for Spatial Information in the European Community] Directive)—most key data sets for disaster risk management in Balkan countries are still under restricted access.
- Closed or restricted access is worryingly high for building data, one of the most important types of information when it comes to disaster risk management.
- Availability of geospatial data through web services is increasing, but the lack of access to raw data through direct download remains an important constraint on conducting risk analysis.
- Lack of interoperability and standardization between data sets impedes regional collaboration and regional scale-up of DRM projects.

Recommendations

The session participants had a number of recommendations for improving the state of open data for DRM in the Balkans:

- Taking preliminary results from the Open Data for Resilience Index as a useful baseline, organizations and projects involved in the collection and use of data for DRM in the Balkans should share their findings online through the index in an ongoing and collective process. Efforts should concentrate on key data bottlenecks, such as building data.
- There are more and more open data activities in the Balkans, both at the government level (in Bulgaria, Croatia, Serbia, and Slovenia)[2] and led by civil society organizations.[3] These initiatives should focus on data for resilience and ensure that key data sets in the sector are

[2] Open data portals exist for Bulgaria (https://opendata.government.bg/), Croatia (http://data.gov.hr/), Serbia (https://data.gov.rs/sr/), and Slovenia (https://podatki.gov.si/).
[3] See for example Blina Meta, "Measuring the Openness of Government Data in the Balkans," Open Knowledge International Blog, May 24, 2017, https://blog.okfn.org/2017/05/24/measuring-the-openness-of-government-data-in-the-balkans/.

released as open data. It is also recommended that teams reach out to and work more closely with DRM stakeholders such as national civil protection agencies.

- As extreme weather events are going to intensify and become more frequent in the Balkan region, journalists should investigate what type of data are needed to cover natural hazards and climate change stories. Journalists can also play a role in advocating for greater access to public sector information in the area.
- The EU and international organizations such as the World Bank offer frameworks, guidelines, and support related to open data and disaster risk management. These should be used by Balkan countries to identify financial resources, peer-to-peer knowledge exchange opportunities, and common resources and tools.
- Data publishers should go beyond restricted or limited access such as through web services and provide full open data with direct download access to raw data sets.

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Most of the essential data for DRM still has restricted access or not does not exist. Slovenia stands out from this general trend as the only country in the region that has published most of its key data sets as open data.

Photo: Goja1

Integrating Risk Assessment into Road Asset Management

Transport infrastructure is key for economic and social growth. It is a precondition for people's mobility and access to schools, hospitals, and jobs, as well as for economic activities and trade. Roads typically represent one of the biggest capital assets in a country and attract significant investment for maintenance and extension. Countries must have systems in place for regular and sufficient maintenance of this important asset. These systems use network and traffic data to assess the operating, maintenance, and upgrade needs of the network, and in turn ensure better resource allocation and priority planning.

Climate change and natural hazards pose a particular challenge to roads; their impacts could completely disrupt transportation systems and consequently affect the livelihoods of communities and normal functioning of societies. The challenge for road authorities is how to estimate the potential effects of climate change and natural hazards on the road network and develop engineering standards, maintenance practices, and road network plans that take these effects into account for greater resilience.

Following recent extreme weather events in the Western Balkans, road authorities across the region are recognizing the value of developing proactive and risk-informed approaches to road asset management. New technologies and risk assessment methodologies applied in the European Union, New Zealand, and the United States have the potential to facilitate this process. However, these methodologies generally require a plethora of data and financial and human resources. Authorities in the Balkans are eager to leverage risk assessments as tools for decision making on maintenance priorities and practices. But the extent to which risk assessments will be mainstreamed into road asset management in the region remains to be seen, given the remaining gaps in the availability and quality of road data, as well as limitations in human and financial resources.

This UR Balkans session looked at climate risk assessment approaches developed in the Western Balkans for road networks. It discussed bottlenecks in the current environment, explored how road asset management systems could be enhanced to include risk assessments, and showcased key elements of the ongoing technical assistance in Albania, Bosnia and Herzegovina, and Serbia for integrating risk assessment in road asset management.

Case Studies in the Western Balkans

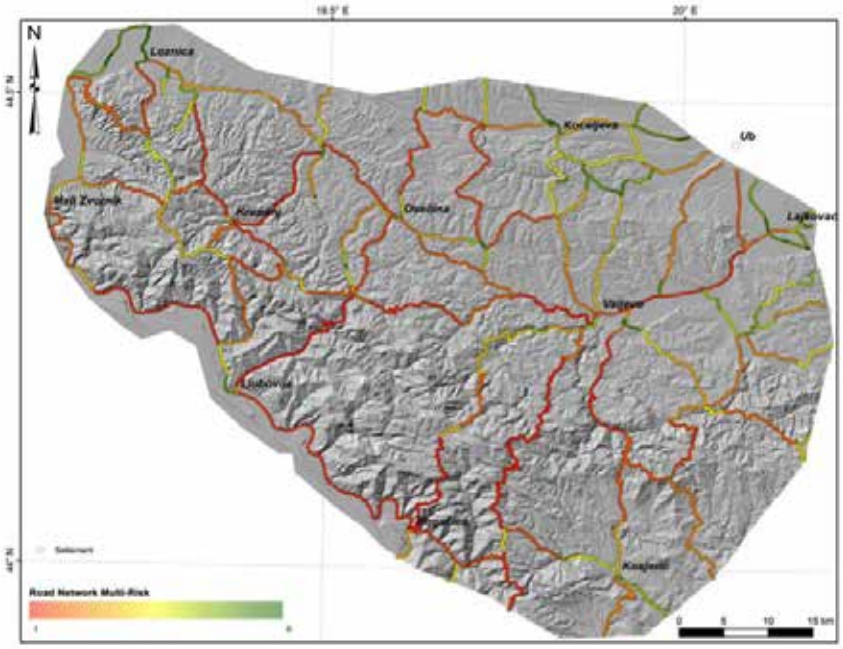
With the support of the Global Facility for Disaster Reduction and Recovery and in collaboration with disaster risk management colleagues, the World Bank transport team working in the Western Balkans is leading technical assistance to help road authorities understand risk and integrate this information in their road management decisions.

In Serbia, where the collaboration includes the University of Belgrade and the private sector company IMC, partners have worked to mainstream climate resilience in road transport management. They tested their method for climate-resilient road asset management on 200 km of roadway around Valjevo with the use of geospatial information systems. Figure 1 shows the risk map for the pilot area.

In Bosnia and Herzegovina, the World Bank team is collaborating with TRL, the University of Birmingham, and the University of Sarajevo to support the Public Enterprise Roads of Federation of Bosnia and Herzegovina in identifying an adequate risk assessment methodology that considers the availability of data and existing budget constraints. The team is also trying to identify how network-wide risk assessment results could be added as input in the road asset management system.

Road damages in Serbia after flood of 2014. Photo: Baloncici.

Figure 1. Risk index map for the road network in the pilot area of Vlajevo, Serbia.



Source: World Bank 2018.

In Albania, the collaboration with Deltares, SEED Consulting, and the Polytechnic University of Tirana aims to test a climate and seismic vulnerability assessment of the national road network. This partnership has proposed mitigation measures designed to inform the improvement of climate- and seismic-resilient design as well as construction and maintenance standards for national and local roads.

A regional risk assessment activity is also under way that aims at supporting all Western Balkan countries in developing road network resilience plans and identifying interventions for resilience. This regional approach, a response to the Transport and Trade Facilitation Joint Action Plan developed by countries in 2015, aims to improve the climate resilience of key European transport corridors throughout the region.

Challenges: Data, Resources, Collaboration, and Transferability

In addition to resource limitations, road authorities throughout the Balkans are challenged by limitations in data availability, georeferenced road network information, and data collection and sharing protocols. Through discussions with stakeholders, a number of questions have emerged that highlight current challenges:

How can regional governments and transport authorities benefit from risk assessment methodologies developed in the European Union, New Zealand, and the United States, which require a plethora of data and capacity? What kind of risk assessment methodologies can the Western Balkans develop to make sure they are implementable in their country-specific context?

Furthermore, can existing risk assessment methodologies be simplified without undermining the relevance of the proposed assessment? Which capacities do countries need to develop or improve to ensure that risk assessments will be carried out at regular intervals and become a regular element of road asset management?

Finally, as these countries develop their road asset management systems, how can they efficiently include recommendations from risk assessments, considering the existing limitations in resources? How will adaptation prioritization be conducted?

A comment from Artan Tapia, a project engineer with the Albania Roads Authority, makes clear that in some countries there is basic work to be done before risk assessments get under way: "As a first step, in Albania, we need data to highlight the areas where the problems are, so as road engineers we would be more aware of the problems the roads face. The present condition of the road is the first step; then we can categorize the climate risk."

In the countries that have begun developing a road asset management system, risk assessment findings are having an effect on planning and budgets. According to Senad Smajlovic, an engineer with the Public

Enterprise Roads of Federation of Bosnia and Herzegovina, "We are developing the Road Asset Management System that will be linked to the meteorological and hydrological center and agencies, so we can be more efficient in planning. As well, we are tendering new maintenance contracts with increased budget as a result of climate assessment."

Conclusions and Recommendations

The case studies and ensuing discussion highlight the importance of—and remaining challenges in—managing climate and natural hazard risks affecting the road infrastructure in the Western Balkans. Such risks are highly unpredictable and have severely impacted large portions of the transport networks in the region. The findings from the case studies suggest a series of recommendations to improve the climate resilience of transport networks in the Western Balkan region:

- *Consider new technologies.* To enhance the efficiency of both data collection and asset monitoring, consider the application of new technologies, such as the use of drones to collect data, map roads, study and analyze landslides, and inspect the condition of bridges and roads. In addition, up-to-date early warning systems can reduce transport networks' vulnerability.
- *Use available data.* Crowdsourcing could be helpful in collecting data on road conditions and damage. Machine learning could be useful for analyzing satellite imaginary (to detect landslides) and road failure mechanisms. However, open data, global data, or crowdsourced data may need to be combined with field inspections by local experts to detect anomalies in the data.
- *Share data.* To ensure the long-term sustainability of assessment tools, countries should consider establishing data-sharing protocols between their respective transport agencies. Countries will also need to consider the evolution of future protocols and regulations.
- *Raise awareness of decision makers.* To ensure the sustainability of road monitoring systems and the resilience of road agencies, agency leadership and federal politicians must be made aware of the importance of these systems. This enhanced awareness is critical to ensuring that appropriate funding and effort are allocated in this area. Events that disseminate information, such as the Understanding Risk conferences, along with enhanced methods of risk communication, are critical to helping road agencies mainstream climate risk transport assessments in their organizations.
- *Provide training.* To train the next generation of road agency and transport administrators, training on transport risk assessment and disaster risk management should be integrated in university courses for students.

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Session leads deliver their Ignite presentations.

As the first UR event in the Western Balkans, the conference boosts the region's efforts to enhance resilience capacity and fosters a stronger commitment to addressing disaster challenges in the future.

Local artists perform traditional dance at the opening ceremony.


City Resilience Index
The Resilience Shift:
A Value Chain Approach
Corridor X
Urban Rail Development
Handbook

Enhancing Resilience: From Asset to City Scale

From floods in the Balkans to tsunamis in Indonesia, recent hazard events have caused disruption at various scales, ranging from individual assets to whole cities to entire regions. In the coming decades, individuals, communities, and systems will be exposed to unprecedented threats in an increasingly volatile, uncertain, and complex world.

Efforts to combat or avoid this disruption need to consider resilience as well as risk; resilience can enrich the understanding of risk by introducing a systems perspective that takes a comparatively long view. However, it is not enough to deem resilience important in theory; the practice of resilience is also crucial. To make resilience a fundamental guiding principle in the planning, design, construction, and operation of critical infrastructure, practical approaches and tools are needed by designers, engineers, asset owners, investors, regulators, and decision makers. These tools and approaches will empower them to make better decisions about enhancing resilience at different scales.

This UR Balkans session explored some of the tools and approaches used to enhance disaster resilience at several scales—specifically city scale, infrastructure system scale, and asset/project scale. It included presentations on four projects that seek to enhance resilience:

- *The City Resilience Index (CRI).* This is the first comprehensive tool allowing cities to understand and assess their resilience, thus enhancing their ability to build sound strategies and plans for a strong future.
- *The World Bank Urban Rail Design Guidebook.* This work offers practical guidance on embedding resilience to climate and natural hazards in urban rail projects.
- *The Corridor X Highway project.* This road construction project being carried out in Serbia includes measures to strengthen the roadway's environmental and social performance.
- *The Resilience Shift.* This project takes a value chain–based approach in order to deliver more resilient infrastructure.

Each is described in more detail below.

Case Studies

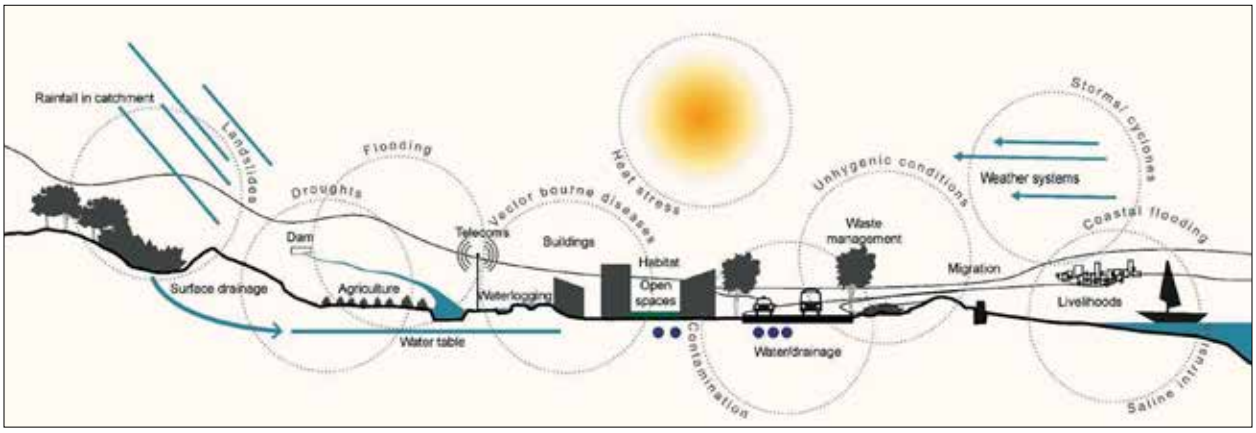
City Resilience Index

The majority of people in the world—55 percent—live in cities, and this share is projected to increase to 68 percent by 2050 (UN DESA 2018). Cities rely on a complex web of infrastructure, institutions, and information systems to perform essential functions every day. City systems are constantly under stress from internal and external factors (figure 1).

Working at city scale requires working with complexity and appreciating how risks manifest within and between city systems. Shocked city systems display cascading failure; for example, in the case of the 2010 earthquake in Haiti, more casualties occurred due to failures in health care and crime prevention in the aftermath of the earthquake than due to falling buildings during the earthquake itself.

For the creators of the City Resilience Index, the challenge was to make resilience practical (so cities can use the knowledge), tangible (so cities can understand what contributes to resilience), and globally applicable (so cities can share the knowledge between them). CRI is the result

Figure 1. Stressors affecting urban systems.



Source: © Arup.

of significant research carried out over five years that looked at over 150 publications and 45 frameworks, and that learned from 27 diverse cities, including Lima, Cape Town, and Hong Kong SAR, China.

The research showed that the factors contributing to city resilience are the same worldwide, although how these play out in each city may vary. In order to observe, measure, and share findings, the index was organized around four dimensions: health and well-being; economy and society; infrastructure and environment; and leadership and strategy.

The validity of the framework was tested in partnership with 100 Resilient Cities.[1] Feedback from the cities that have used the CRI has illustrated two types of value derived from working holistically at the city scale to promote resilience: (1) the approach helps inform integrated planning and investment decisions; and (2) the process itself enables monitoring, builds credibility in decision making, and guides a stakeholder engagement process. The CRI is now being used in 120 cities worldwide.[2]

Urban Rail Development Handbook

The World Bank's recently published *Urban Rail Development Handbook* (Pulido et al. 2018) presents high-level practical guidance for the consideration of climate and natural hazard resilience in urban rail projects, covering both the implementation of new urban rail infrastructure and the management of existing urban rail systems.

The guidance recognizes that infrastructure resilience both contributes to overall city resilience and depends on it. Each infrastructure system has interdependencies with other systems, but also needs to consider its own resilience—both its ability to anticipate, absorb, and recover from an event and its ability to adapt after an event based on lessons learned.

The handbook addresses the possible impacts of climate and natural hazards on an urban rail system, including safety impacts (physical harm to system components that could lead to a train accident or cause damage to infrastructure) and service impacts (short-term service disruptions). It outlines mitigation measures that can enhance the resilience of the system, including structural measures (e.g., placing rolling stock on higher ground or providing an independent backup power supply) and nonstructural measures (e.g., early warning systems or response plans, including evacuation).

To embed resilience in the system, a holistic approach that takes account of multiple hazards is required. Resilience must be considered early in project development and be a continuous focus throughout operations. The handbook makes clear that the resilience of rail systems cannot be achieved simply through robustness and that it depends as much on institutional and stakeholder coordination as on the resilience of the physical infrastructure.

Corridor X

The Corridor X Highway is the key axis in the Serbian road network and is recognized as a project of national importance. It is also part of the Pan-European Road Network; it connects nine countries in central and southeastern Europe and affects traffic across a significant part of the continent. This highway represents the difference between isolation and connectivity to global economics and social development.

The Corridor X construction project is located in southeast Serbia and has two branches. By the end of the project, 160 km of new highway from central Serbia to FYR Macedonia and Bulgaria will be built. The highway passes very close to many settlements, river systems, and environmentally and historically sensitive areas; it is classified as Category A for environmental impact by the World Bank.

Partners involved in the project recognize the need to preserve ecosystems and ecosystem services as imperative for the resilience of human societies. A disregard for ecosystem

[1] 100 Resilient Cities was pioneered by the Rockefeller Foundation and seeks to increase cities' resilience to physical, social, and economic shocks; for more information, see the organization's website at https://www.100resilientcities.org/.

[2] Arup, "Facing Up to the Future: The City Resilience Index," https://www.arup.com/perspectives/city-resilience-index.

services could lead to ecosystem fragmentation and biodiversity loss and in the long run create conflict over resources.

Several lessons have emerged through the Corridor X project. One concerns the importance of resilience even during the construction of infrastructure. Flooding in May 2014 and December 2017 occurred on site, interrupting the works and services and affecting the local communities.

Another lesson, one stemming from the fact that resilience strategies involve multiple institutions and agencies, is that roles and responsibilities at different levels must be understood in order to effectively implement projects. In cases where jurisdictions overlap, the lack of clarity could delay responses and undermine resilience. For instance, local decisions on emergency flood management could get delayed where regional management authorities have significant influence. Similarly, local decisions to evacuate due to flooding could be constrained by warning systems operating at national and international scales.

The Resilience Shift: A Value Chain Approach

A value chain approach[3] recognizes that there are multiple stakeholders involved in critical infrastructure—for example, those delivering new infrastructure, those operating and maintaining an existing system, and those planning for how communities can function when infrastructure is affected by a hazard event. Each of these stakeholders has its own value chain, but there should be a benefit (value) to all stakeholders in enhancing resilience, as well as the ultimate benefit to society.

For example, value for private sector investors may be a straightforward return on investment, which means that it must be possible to articulate clearly the resilience return on investment. Value for regional government, however, could be the contribution toward economic growth and productivity that resilient infrastructure can make.

All actors must be shown and understand how enhancing resilience creates value for them. The actions and decision of all those along the value chain have an impact on, and ultimately contribute to, overall value delivery, which benefits everyone. Once the value of resilience is clear to all those involved, making decisions to enhance resilience will be more obvious. Resilience value is the golden thread that joins stakeholders together.

Conclusions and Recommendations

In an increasingly uncertain world, resilient approaches help ensure that societal needs are supported in ordinary as well as extraordinary circumstances. There are several scales and dimensions of resilience. This UR Balkans session looked at examples of how resilience can be implemented and embedded at different scales.

A value chain–based approach could be helpful as a framework showing the value of resilience across stakeholders and encouraging them to work toward enhancing resilience, regardless of scales and definitions.

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Speaker shares experiences at the technical session.

The technical sessions offered profound insights into a variety of topics that are highly relevant to the DRM agenda in the Balkan region, and thus captured the audience's attention.

Participants attend technical sessions.

Credit: retrorocket

From Assessing Risk to Managing Risk: The Science-Policy Interface

Natural, technological, and man-made disasters have harmful impacts around the world, including loss of life and loss of social assets. As a result of climate change, those impacts are expected to increase.

Prevention or reduction of disaster risks relies on a robust knowledge base and efficient sharing of knowledge, best practices, and information. A strong science-based understanding of disaster risks is important for countries seeking to undertake risk assessments, assess their risk management capabilities, and prepare their risk management plans. With a focus on the European Union (EU), this UR Balkans session explored the integration of disaster risk data into policy making; the importance of implementing regional policies at the local level; and the challenges countries face in ensuring that disaster data are used effectively in policy making. It also generated some recommendations for countries seeking to strengthen their disaster risk management (DRM) approaches.

Background

Disaster risk reduction (DRR) and climate change adaptation both contribute to reducing vulnerabilities to climate-related hazards. Both rely on the availability of robust knowledge and data at all levels. Knowledge and data are key in defining the scenarios and making the projections that adaptation measures are based on; they are likewise important in monitoring progress of implementation and in developing innovative instruments and tools to increase resilience.

According to the Sendai Framework for Disaster Risk Reduction 2015–2030 (UNISDR 2015), each state has the primary responsibility to prevent and reduce disaster risk, including through international, regional, subregional, transboundary, and bilateral cooperation. Similarly, Decision No. 1313/2013/EU on a European Union civil protection mechanism (European Parliament and Council of the European Union 2013) aims to promote a culture of prevention and preparedness, with an emphasis on development of capacities to deal with risk.

While the drivers of disaster risk may be local, national, regional, or global, disaster risks have local and specific characteristics that must be understood in order to devise measures to reduce risk. The local level is also crucial in implementing agreements and policies drafted at higher levels. The Sendai Framework, for example, highlights the need to tackle underlying disaster risk drivers, which are mainly defined by their context. The validity of this approach has been proved in the projects developed at municipality level as part of the Covenant of Mayors;[1] the projects are based on national and international strategies, but the implementation is done at the lowest level.

In addition, the evidence that supports DRR actions mainly comes from the local level. When EU member states began drafting flood management plans under the EU Floods Directive,[2] their first step was the collection of local data for producing flood risk maps.

An increasing number of European Commission services are collaborating to reinforce the links between the different DRR- and DRM-related policies. Doing so helps optimize use of the resources, makes implementation of DRR and DRM policies more coherent, and thus maximizes policies' impact.

All these policies depend on disaster damage and loss data as an evidence base. Damage and loss data are also needed to develop, implement, and monitor adequate risk management plans, and to track trends and monitor progress under the Sendai Framework, Paris Agreement, and Sustainable Development Goals.[3]

In addition to the need for data, there is also a need for models to forecast future losses and develop and implement suitable plans for disaster risk prevention, mitigation, and/or adaptation, along with plans for disaster preparedness, response, recovery, and reconstruction phases—with the ultimate goal of improving resilience. Lack of data actually hinders most of the processes for analyzing and planning for disaster risk. Involving the scientific community is essential for the

[1] For more on the Covenant of Mayors, see the organization's website at https://www.covenantofmayors.eu/.
[2] European Commission, "EU Floods Directive," http://ec.europa.eu/environment/water/flood_risk/index.htm.
[3] For the Paris Agreement, see United Nations Climate Change, "Paris Agreement, https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement. For the Sustainable Development Goals, see United Nations, "Sustainable Development Goals," https://www.un.org/sustainabledevelopment/sustainable-development-goals/.

development of sound DRM actions.

Case Study: 1999 Marmara Earthquake

More than 17,000 people died and many were injured in the 1999 Marmara, Turkey, earthquake. Thousands of residences and workplaces were damaged, and approximately 15 million people were adversely affected.

After the earthquake, the Turkish government took significant steps to strengthen its legal and institutional framework for DRM. It established the Disaster and Emergency Management Presidency of Turkey (AFAD),[4] an authority for disaster and emergency situations that has prioritized Turkey's transition from crisis management to risk management. This integrated disaster management system has moved Turkey away from traditional DRM toward three-stage DRM, which plans for national disaster risk reduction, national disaster response, and national disaster recovery.

In addition, Turkey has created a DRM national platform as a multi-sectoral structure. Its DRM system combines top-down and bottom-up approaches. DRR activities have been encouraged at the local level through legal regulations and sufficient resources; as a result, these activities have increased.

Turkey has also implemented strategic plans, produced integrated hazard and risk maps, developed a new building code, strengthened its insurance system, and conducted the public awareness project Disaster-Ready Turkey.

Efforts should be made to explain DRM to all segments of society using appropriate communication channels, and to ensure that DRM correctly addresses the risks each segment of society faces, as well as the risks faced by each sector.

Challenges

Challenges remain in ensuring that disaster data are used effectively in policy making.

The biggest challenge is ensuring wide acceptance of integrated disaster risk management by all sectors of society. Efforts should be made to explain DRM to all segments of society using appropriate communication channels, and to ensure that DRM correctly addresses the risks each segment of society faces, as well as the risks faced by each sector.

The second challenge is addressing the overlapping roles and responsibilities created by such complicated planning systems. The establishment of a proper governance system with clear mandates and responsibilities can help coordinate DRM across all sectors.

Another challenge is the fact that quantitative risk assessment approaches, including probabilistic assessments, require a large amount of data on hazard, exposure, vulnerabilities, coping capacities, and historical losses. Though more and more data are available to national and international stakeholders, data accessibility remains challenging. Partnership among international, national, and subnational institutions, authorities, research organizations, academic institutions, and civil society groups can foster data accessibility; this can in turn enable the broader application of more advanced risk assessment methods, resulting in an improved understanding of disaster risk in all its complex dimensions.

A further challenge is improving the process to systematically integrate nature-based solutions (NBS) into DRM plans. NBS are defined by the International Union for Conservation of Nature (IUCN) as "actions to protect, sustainably manage and restore natural or modified ecosystems, which address societal challenges (e.g. climate change, food and water security or natural disasters) effectively and adaptively, while simultaneously providing human well-being and biodiversity

[4] For more on AFAD, see its website at https://www.afad.gov.tr/en/.

benefits."[5] While still an emerging concept, NBS have demonstrated their value in providing multiple benefits to societies, e.g., in mitigating and fostering adaption to climate change impacts, improving community resilience and livelihoods, and safeguarding ecosystems and biodiversity. There is growing evidence on the value and importance of NBS, and steady progress has been made in documenting and communicating NBS as well as mainstreaming NBS into climate and sustainable development policies and activities on the ground.

Recommendations

Share knowledge. In order to minimize disasters loss, each country should create a disaster risk management system according to its requirements. But countries should work to share knowledge and technologies with one another in order to improve DRM processes and become more resilient. Regional level projects such as the European Commission peer review program[6] are also beneficial and help create new networks.

Conduct probabilistic risk assessments. Most national risk assessments currently use scenario-based approaches, which are easy to apply, require less information than more sophisticated approaches, and can be very detailed for a single scenario or event (e.g., worst case or most probable). But probabilistic risk assessment—which considers a very large number of possible scenarios, including their likelihood and associated impacts, and which incorporates scientific information on hazard, exposure, and vulnerabilities, as well as insights from historical loss and damage data—offers a more complete description and understanding of risks.

Use nature-based solutions. Despite various efforts to mainstream and implement NBS principles and approaches, the integration and application of NBS at regional, national, and local levels remains fragmented. In order to address growing societal and environmental challenges linked with climate change, there is a need to protect and restore ecosystems by means of coordinated and tailored approaches. NBS can both ensure economic benefits and provide an economically efficient way to adapt to climate change impacts.

Conclusions

DRM policies at local, national, and international levels should be well aligned in order to exploit synergies. A governance framework that provides the basis for coordinated action can help achieve this alignment by establishing stakeholders and sectors to be engaged and stating the responsibilities of each.

Tackling the dynamism of risks, particularly at the local level, requires a focus on innovation. To enhance the different capacities of the various actors, it is necessary to be creative and to learn from the many communities and sectors dealing with risk. There are also opportunities offered by reuse of existing research through testing and adaption to new contexts.

Linking research to existing EU projects,[7] and establishing networks that facilitate the sharing of information while optimizing countries' ability to develop risk management plans, are crucial in light of the changing landscape of hazards that EU countries face.

The systematic collection of data on potential and real losses, both pre- and post-event, is needed to quantitatively evaluate the progress made to reduce risk.[8]

Financial capacities need to be considered over the long term. Risks are expected to increase in the future, so early investments in prevention, mitigation, and adaptation are advantageous in the long run given how their costs compare to those of preparedness, response, recovery,

[5] ICUN, "Nature-Based Solutions," https://www.iucn.org/commissions/commission-ecosystem-management/our-work/nature-based-solutions.
[6] See European Commission, "Peer Review," https://ec.europa.eu/echo/what-we-do/civil-protection/peer-review_en.
[7] See the Disaster Risk Management Knowledge Centre website at https://drmkc.jrc.ec.europa.eu/knowledge/Projects-Explorer#project-explorer/631/projects/map.
[8] See the European Commission Risk Data Hub at https://drmkc.jrc.ec.europa.eu/risk-data-hub; and the Disaster Risk Management Knowledge Centre's Disaster Loss and Damage Working Group web page at https://drmkc.jrc.ec.europa.eu/partnership/Science-Policy-Interface/Disaster-Loss-and-Damage-Working-Group.

and rehabilitation. When planning disaster risk measures, institutions should seek funding from EU mechanisms and other external sources.[9]

A well-informed society will contribute to a more resilient future, and well-informed citizens will have a more rational risk perception. Policy priorities can be influenced by political or public perception of where risks are highest, but a more objective analysis, with data demonstrating where the real weaknesses exist and what the priorities should be, could facilitate the political decisions taken at national, regional, and global level. It is vital to engage citizens and to keep them informed. For that reason, risk awareness should be included as part of risk management plans.

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[9] Multiple EU funding mechanisms—such as Structural Funds-REGIO, H2020, Preparedness and Prevention-ECHO, CCA Strategies-CLIMA, and Copernicus—are listed on the Welcome Europe website at https://www.welcomeurope.com/list-european-funds.html.

In order to minimize disasters loss, each country should create a disaster risk management system according to its requirements. But countries should work to share knowledge and technologies with one another in order to improve DRM processes and become more resilient.

Full house attendance marks the beginning of the UR Balkans Conference

What is Understanding Risk?

Understanding Risk (UR) is an open and global community of over 8,000 experts and practitioners interested and active in the creation, communication, and use of disaster risk information. This vibrant community—a diverse group of people from the private, public, nonprofit, technology, and financial sectors—meets at the UR global forum every two years. Each iteration of the UR Forum has produced new ideas and partnerships that have improved risk information and helped to integrate evidence into policy making and development planning.

This publication captures the experiences, lessons, and best practices in the field discussed at the Understanding Risk Balkans Conference, held in Belgrade, Serbia, from September 17 to September19, 2018.

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