Heavy rainfall event in Žilina region, Slovakia, in 2014 and its impacts on infrastructure and society

RAIN Workshop

Critical Infrastructure Safety in the Context of Climate Change

Delft

4th April 2016

Michal Titko

University of Žilina (UNIZA)

michal.titko@fbi.uniza.sk

www.rain-project.eu

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 608166. The contents of this presentation are the author's views. The European Union is not liable for any use that may be made of the information contained therein.

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Introduction

- In general, nature is more powerful than man.
- Natural disasters (or extreme weather events) are unintentional and they are not motivated
- Underestimation of natural hazards and their impacts on society led almost always, sooner or later, to disasters or incidencts with lesser or greater extent.
- Historical events and their analysis should lead to addoption of appropriate prevention or mitigation strategies and measures.

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What happened?

Widespread thunderstorm activity was observed on 21st July 2014 across central Europe with many reports of excessive precipitation (rainfall) arriving from the Czech Republic, Slovakia and Austria.

Blue circles correspond to the heavy rain reports and yellow squares to the severe wind gust reports (European Severe Weather Database report)

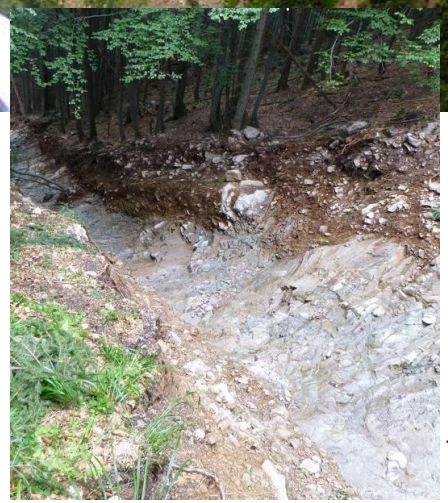
Extreme climatological phenomena

Heavy rainfall – flash flood

Žilina

Heavy rainfall – landslides

Vrátna Valley



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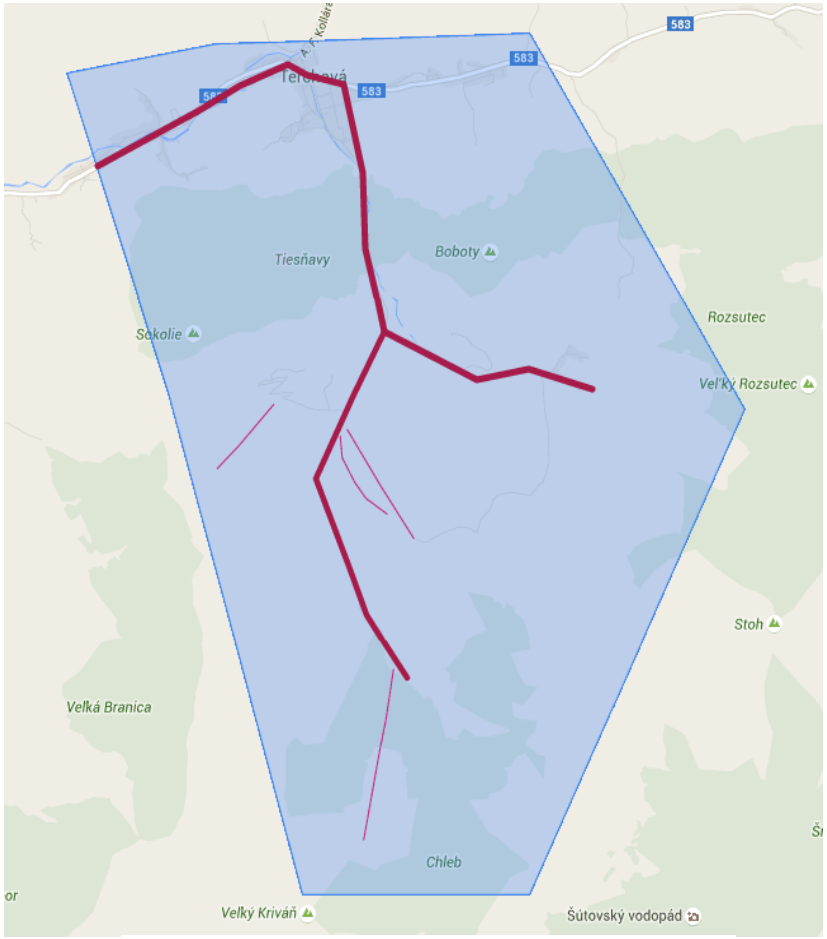
Heavy rainfall – flash flood Žilina City

Another 5 villages were affected

Landslides/Rock-clay flood flow

Vrátna Valley – Terchová



More than 100 mm/h

Landslides/Rock-clay flow

- The worst situation was in the glacier peaks Chleb, Steny a Hromové.
- At a height of 1500-1600 m.a.s.l. was floated **moraine sediments and stone rubble**, which, together with the vegetation formed flows with a thickness of 1-2 m.
- The numerous "plates" of rock-clay material was tear off (each part about 100m^2) – with **landslide/avalanche** speed from 10 to 20 m/sec.
- In one point these flows began **blur together**.
- Main flow continued to narrow stream valley, gathering additional bottom sediment, stones, earth, and trees.
- Flow reach an adjacent **infrastructure, buildings and villages** with destructive impacts.

Transport Infrastructure Impacts

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Tourism Impacts

- Tourist resort (summer and winter),
- cableway.

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Safety Impacts

- Police and rescue sercives immediately took the necessary measures to protect the life, health and property but during the storm **158 hotline for calling police stopped to work**. The inhabitants had to use emergency number 112 until its repair – **links were overloaded**.
- **120 tourists** were trapped in Vrátna Valley (including children, infants and a pregnant woman).

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Heavy Rainfall Impacts - Numbers

Heavy Rainfall Impacts (region Zilina)		Unit	Quantity/Amount
Affected population	evacuated people	number	190
	fatalities	number	0
Flooded residential buildings	total	number	73
Damaged infrastructure	railway, cableway	number	4
	roads (1. class, 2. class)	[m]	5001
	local and tertiary roads	[m]	9153
	forest transport routes	[m]	4250
	sidewalks	[m]	1201
	bridges	number	22
	local gas distribution network	[m]	7
	water supply distribution network	[m]	3315
	electricity distribution network	[m]	3000
Flooded vehicles	total	number	52

Economic Impacts

Damaged subjects	Type of flood damage			Flood damage total [€]
	Movable property	Immovable property	Lands	
Individuals (Residents)	17 540	25 860	1 650	45 050
Legal entities, operators,...	650 000	2 403 000	300 000	3 353 000
Local government	-	392 000	2 000	394 000
Total	667 540	2 820 860	303 650	**3 792 050**

ALMOST ALL FLOOD EXPENSES WERE REFUNDED FROM STATE BUDGET

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Stakeholders

- National government,
- **Crisis Staff of Zilina – District Office Department of Crisis Management**
- the Slovak water management enterprise,
- the Slovak water supply and sewerage,
- Operators of engineering networks,
- **Operators of transport network (Road Administration Zilina)**,
- Firefighters,
- Municipal and state police,
- Firefighter volunteers,
- Local citizens and individual volunteers.

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Activities of responsible authorities – 1. phase

- Evacuation of 190 people (120 from Vrátna Valley)
- Searching for injured or missing people in affected area
- Pumping water from subways/underpasses, station, basements and removal of debris and trees from the roads (mainly in Zilina city) in order to restore road network and help to people in crisis

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Activities of responsible authorities – 2. phase

- Accessing cut ends of the villages
- Setting of 2 provisional bridges
  (national government in coordination with the armed forces of the Slovak Republic)
- Construction and reconstruction of 6 footbridges

The pontoon bridge setting by armed forces of the Slovak Republic

- Protection of drinking water

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Activities of responsible authorities – 3. phase

- Roads and bridges cleaning (with heavy construction machinery)
- Identifying of the destroyed movable property (mainly vehicles) and transfer to their owners
- Removal of flood debris and other barriers (road parts, stones, clay, etc.)

Activities of responsible authorities – 4. phase

- Regulation of the river flow with the heavy construction machinery
- Roads and bridges reconstruction (also cableway)
- Construction of new retaining walls

RESILIENCE ENHANCED!

Problems

- Communication network was overlaodad
- Response of the local authorities – necessary coordination with higher government level
- Bureaucratic issues slowing down the process of disaster solution – delayed reconstruction activities (however in this case the reconstruction was also a priority for the national government so many actions were conduced smoothly)
- Deficit of the heavy machinery at the beginning of the rescue works – the number is limited due to allocation along country
- Parts of the adjacent forest were private property – there were some delay circumstances within reconstruction process and refundation of the recovery costs

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Lessons for other Human Activities and Crisis Management

To predict similar phenomena is necessary to carry out a risk analysis based on expert assessments (in this case - meteorological, hydrological and geological).

State Geological Institute recommend to update the geological map to scale 1:10000 in the area of interest. Such a map is essential for drawing up maps of hazard.

State Geological Institute also recommend implemented in the affected area air photogrammetry or laser scanning.

In Slovakia there are hundreds of similar risk areas - it would be necessary to carry out their new risk analysis and take effective preventive measures to reduce the potential consequences of similar disasters.

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Lessons for other Human Activities and Crisis Management

Based on the risk analysis - in case of an identified potential natural disaster and their consequences, the construction activity in that area should not be allowed.

For this is necessary to enhanced the role of crisis management in the building and planning process.

Task of the crisis management should be to highlight the risks associated with the implementation and operation of buildings and infrastructure.

The government education at all levels should be strengthened – mainly in the areas of risk analysis and disasters solving.

Rescue units should have an appropriate technical equipment created and also heavy machinery prepared for such an event.

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Conclusion

According to several experts as immediate trigger of the event we consider extreme weather conditions – heavy rainfall. Such a natural disaster could not be prevented and was not directly related to human activities.

Described extreme weather event and its consequences are a great **lesson** and a memento to human activities and the building of transport, tourist and industrial infrastructure, not only in the Slovakia but also for other coutries.

It also explain/predicate the necessity of creating **professional rescue teams and their specific equipment**.

A **detailed and specific risk analysis** may serve in building planning in risk areas, or on the implementation of preventive measures in existing infrastructures.

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