Cross **BO**rder **RIS**k assessment for increased prevention and preparedness in Europe

Exportability of project results- seismic/multi-risk

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BORIS Final conference

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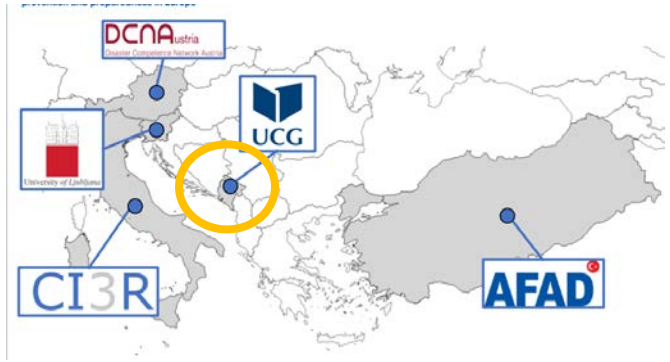
Cross BOrder RISk assessment for increased prevention and preparedness in Europe

Activities taken to evaluate exportability



- Evaluate and compare MNE national practice to practice in partner countries
- Identify MNE stakeholder needs
- Checking availability of data
- Test exportability of Project results to MNE

→

- ✓ Comparison of National Risk Assessments
- ✓ Data availability and needs for large scale and cross-border risk assessment, obstacles and solutions
- ✓ Shared framework for single and multi-risk assessment at cross-border sites
- ✓ Consolidated version of the guidelines for cross-border risk assessment

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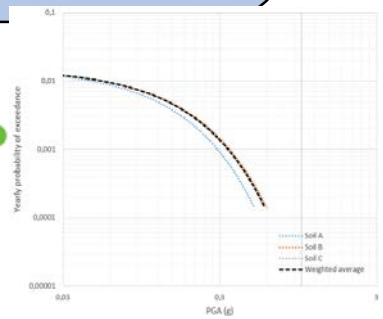
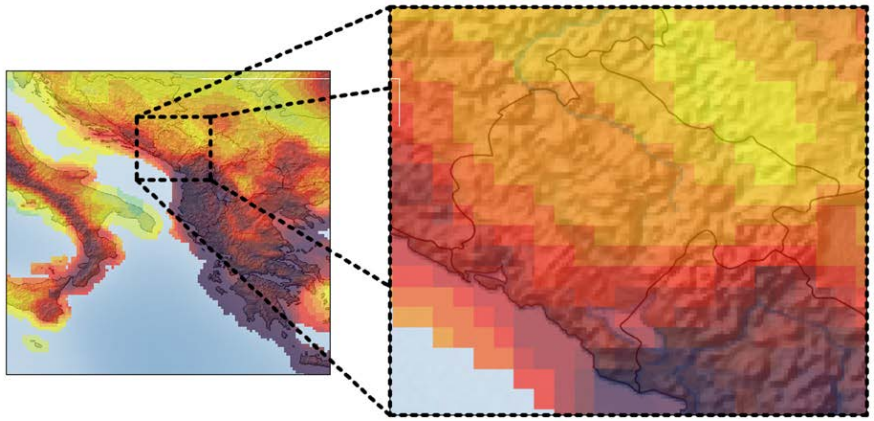
- **Deliverable 2.1**
- **Deliverable 2.2**
- **Deliverable 4.1**
- **Deliverable 5.2**

Shared framework: seismic hazard

- ✓ Seismic hazard assessment data: data is available on-demand.
- ✓ The return period-based hazard exist in Montenegro, PGA is in use, however EMS-98 intensity measure is used in NRA.
- ✓ Vs 30 values exists for some locations in Montenegro, not publicly available.

European hazard model (ESHM2020)
Global Vs30 map proposed by Worden and Heath (2019).





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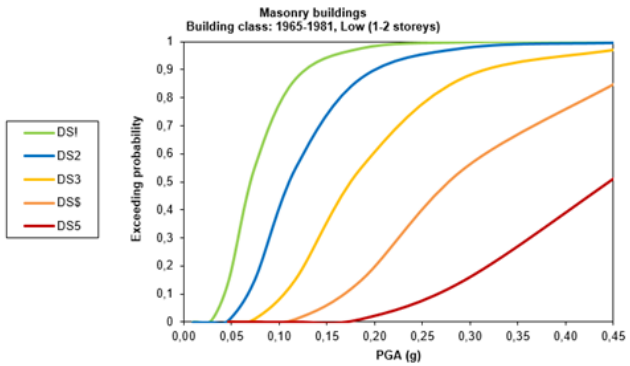
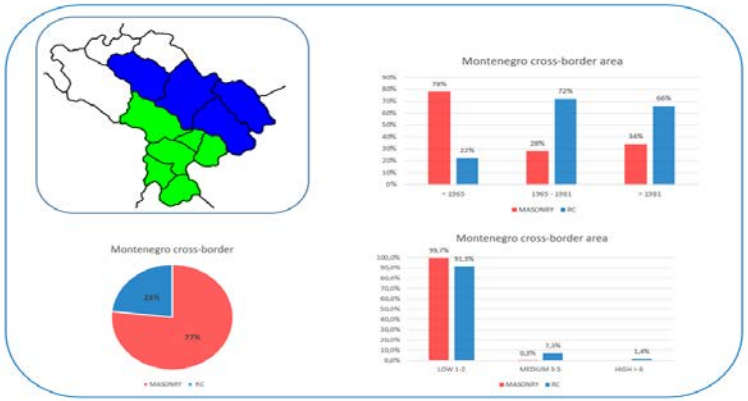
Shared framework: exposure, fragility and damage scale

- ✓ Exposure data: number of people and dwellings are available at municipality level in Montenegro.
- ✓ Exposure model: building classification according load-bearing structure, number of stories and period of construction.
- ✓ The building typologies are grouped into vulnerability classes, and the fragility curves are defined.
- ✓ The five-grade EMS-98 damage scale (slight, moderate, heavy, very heavy, destruction) is in use.

Shared methodology: Fragility curves defined at the same level for countries at the border (building typology level or vulnerability class level) and for the same intensity measure, and at the same time allowing the differences in the fragility curves of buildings with same basic characteristics.

Material	masonry
	reinforced concrete
Stories	1 - 2, 3 - 5, >=6
Period	< 1964
	1965-1981
	> 1981

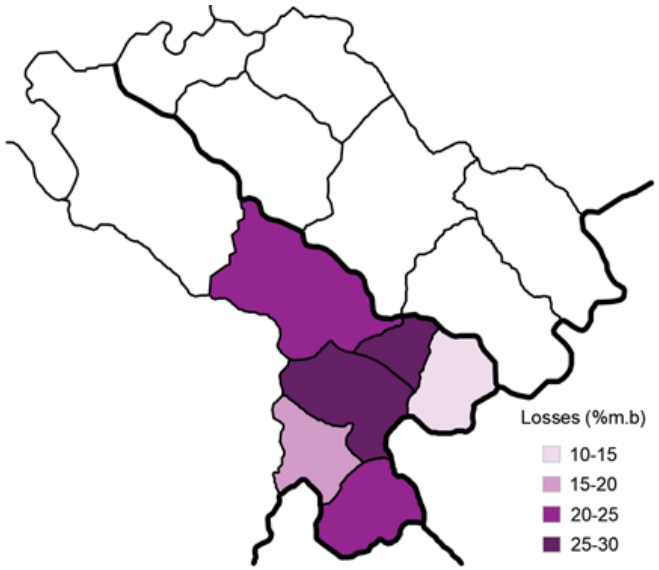


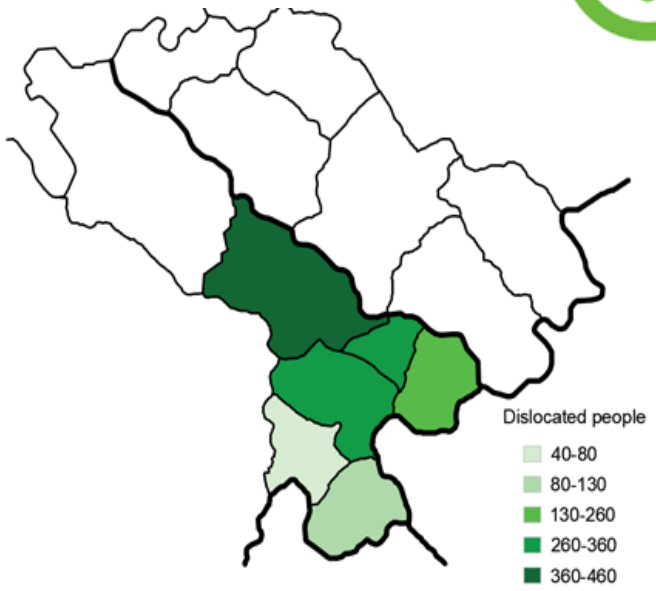


Shared framework: consequences

- ✓ In Montenegro consequences are calculated as: number of fatalities, number of injured people, direct economic losses calculated for residential buildings and road infrastructure and social consequences. Model in use matches the models used in Italy.

Shared methodology: direct economic losses (EAL), number of fatalities, dislocated people.





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Exportability of project results – flood risk

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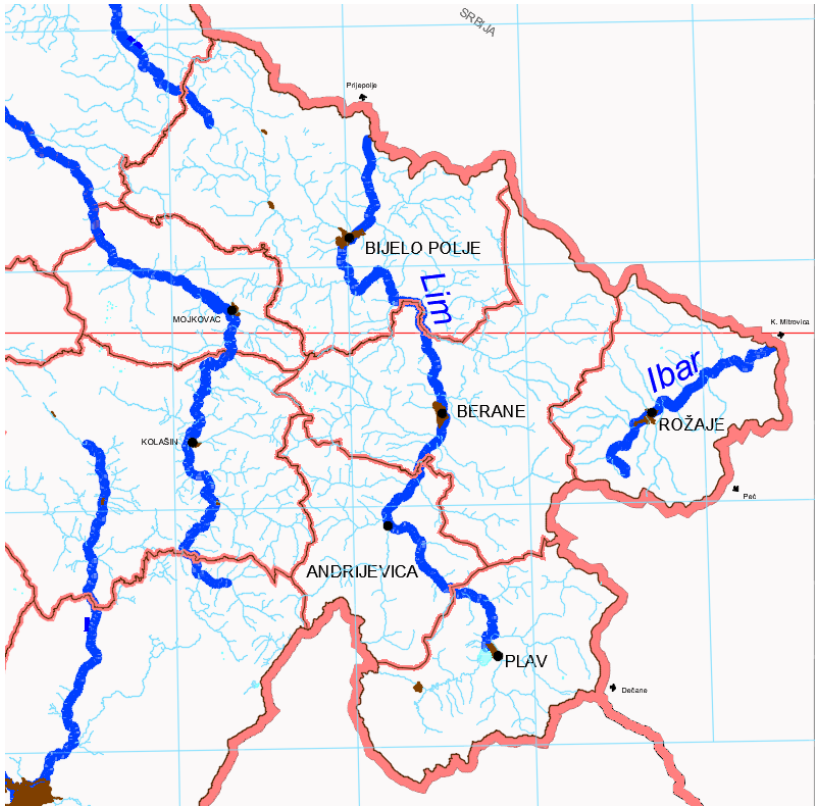
Montenegro pilot site

- Cross border area includes 5 municipalities : Bijelo Polje, Berane, Andrijevica, Plav and Rozaje
- Neighbour countries: Serbia, Kosovo, Albania
- Hydrographic network of two major watercourses: Lim and Ibar – Danube water basin

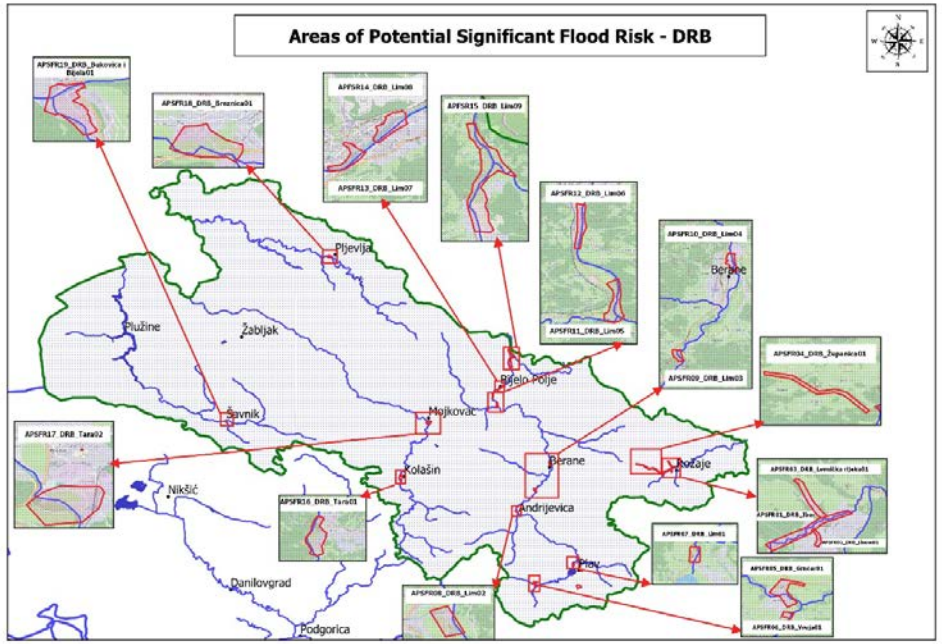
Pilot cross border area in Montenegro



Hydrographic network of cross-border watercourses

Hazard definition

- For Areas of Potential Significant Flood Risk in Montenegro – hazard is defined through flood probability (return period) and flood intensity (flood depth)
- Three return periods are considered for each APSFR: T=10years, T=100years and T=500 years



Areas of Potential Significant Flood Risk – Danube river basin

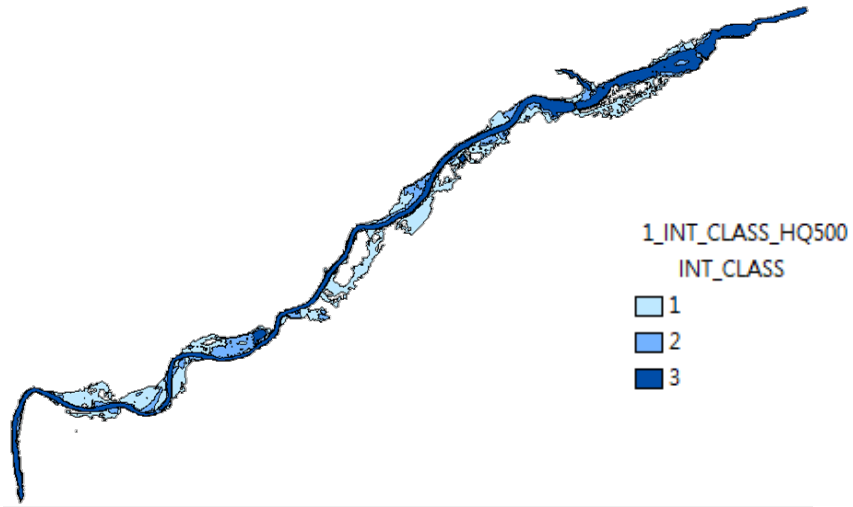
Hazard definition

- Hazard data – intensity classes for three return periods are defined based on inundation depth
- Example of river Ibar (Rozaje municipality)

River Ibar located in municipality of Rozaje

Flood intensity classification

Water depth	Class
< 0.5 m	1
0.5-1 m	2
1-5 m	3
> 5 m	4



Hazard layer with assigned intensity classes for river Ibar (HQ500)

Exposure data

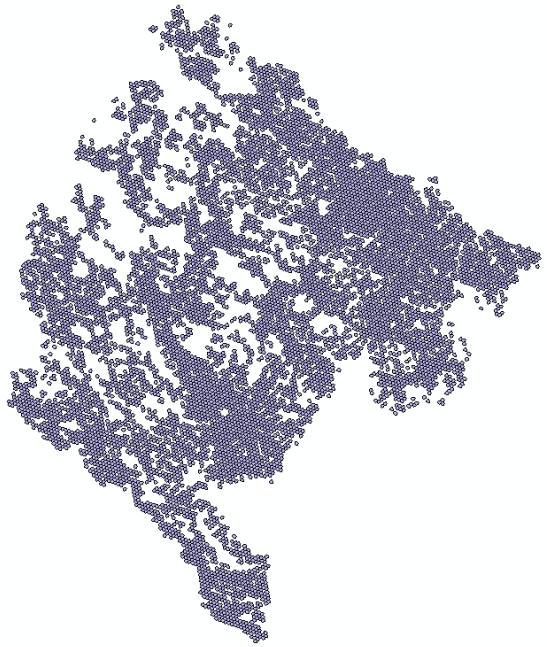
- Population data sources: census data (for settlements in Montenegro) – tabular format, available global datasets such as WorldPop, High-resolution Population Density Maps

Division of Rozaje municipality into settlements

Population data for settlements within the flooded area in Rozaje

Municipality	Settlement	Total number of inhabitants
Rožaje	Rožaje	9422
Rožaje	Ibarac	3135

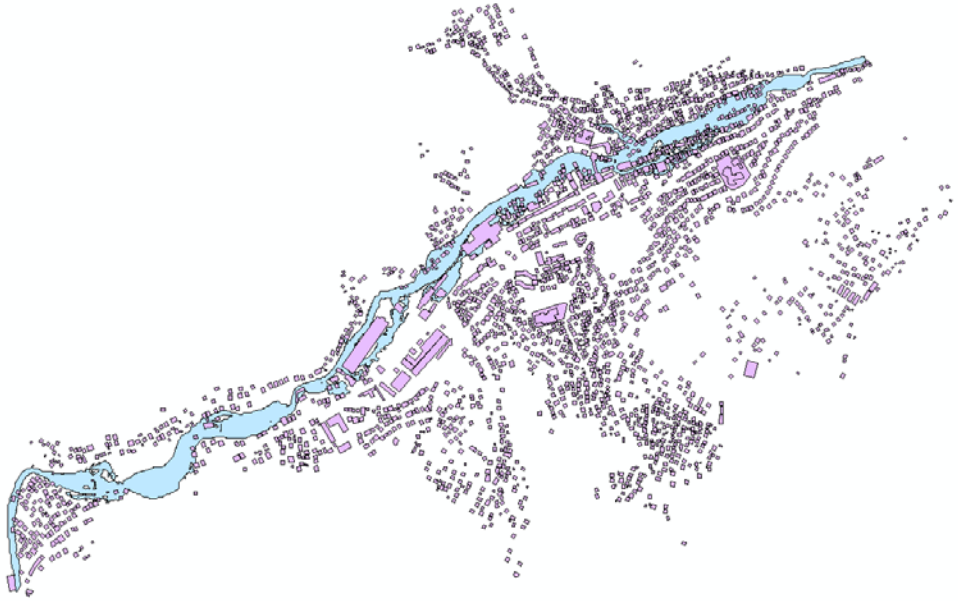
World Population dataset (raster layer)



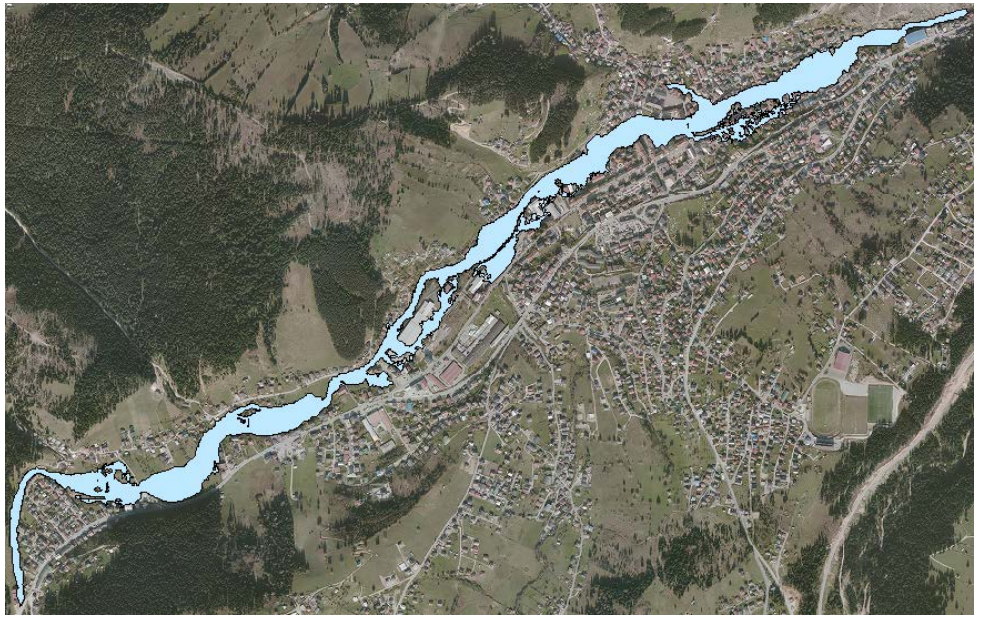
Montenegro population density for 400m H3 hexagons. Built from Kontur Population: Global Population Density for 400m H3 Hexagons

Exposure data

- Building footprint data – Open Street Map
- Orthophoto



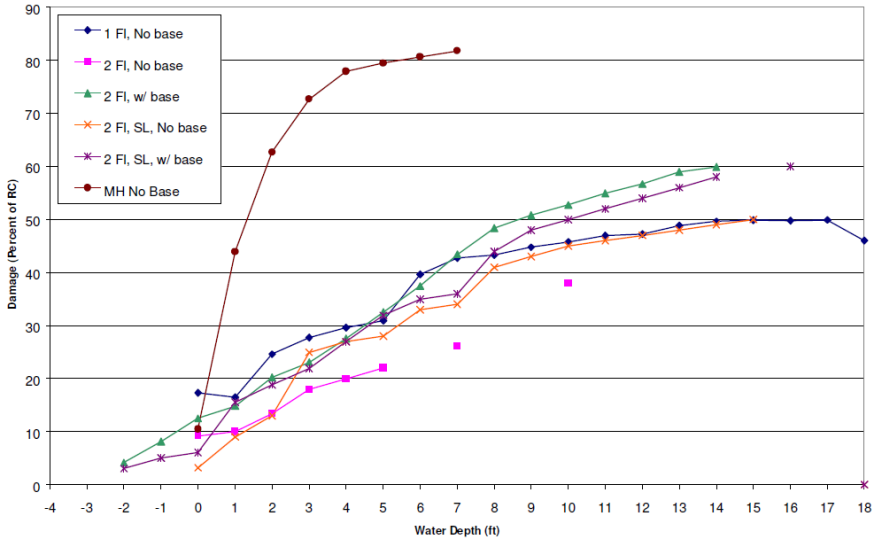
Building footprint data in the flooded zone (river Ibar)



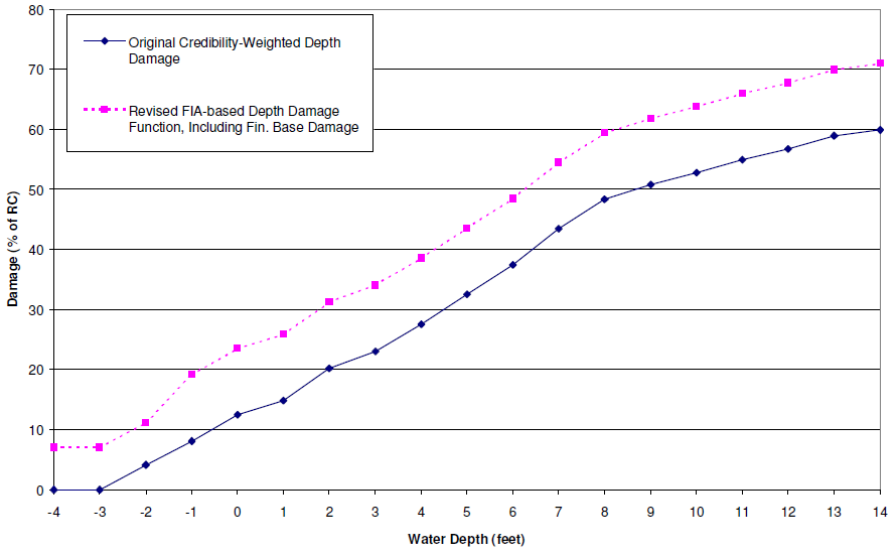
Orthophoto of the flooded zone (river Ibar)

Vulnerability data

- No local depth-damage functions available for Montenegro
- HAZUS (FEMA) depth – damage curves



Building Depth-Damage Curves (HAZUS)



Depth-Damage Curve 2 or More Stories, Basement-Modified (HAZUS)

Consequence assessment

- Number of affected people (based on hazard and exposure data)

- Economic losses

  Damage [€] = Damage [%] x Economic value [€]
  Economic value: expert opinion on replacement/recovery cost of buildings per m^2 – National Institute for Statistic (MONSTAT)

Thank you for your attention!