



UNIVERSITY OF LJUBLJANA
FACULTY OF CIVIL AND GEODETIC ENGINEERING



CHAIR OF FLUID MECHANICS

Flood Hazard, Flood damage potential, Residual Risk

Univ.Prof. Dr-Ing. Franci **STEINMAN**,
Ass.Prof. Dr.-Ing. Primož **BANOVEC**

Drava River Vision, Maribor 2008

from **HAZARD** to (residual) **RISK MAPS**

HAZARD:

- floods,
- landslides
- debris flows,
- avalanches..

Sensitivity/vulnerability

- inhabitants,
- activities,
- structures...

ENDANGERED:

- inhabitants,
- activities,
- structures..

Undertaken risk, using:

- protective equipment
- protective measures,
- Spatial planning
- Building Code etc.

Residual risk:

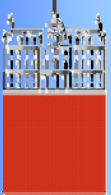
- “Act of God” ---**
- Interventions
 - Rescue Activities...





KMTe

UNIVERSITY OF LJUBLJANA
FACULTY OF CIVIL AND GEODETIC ENGINEERING

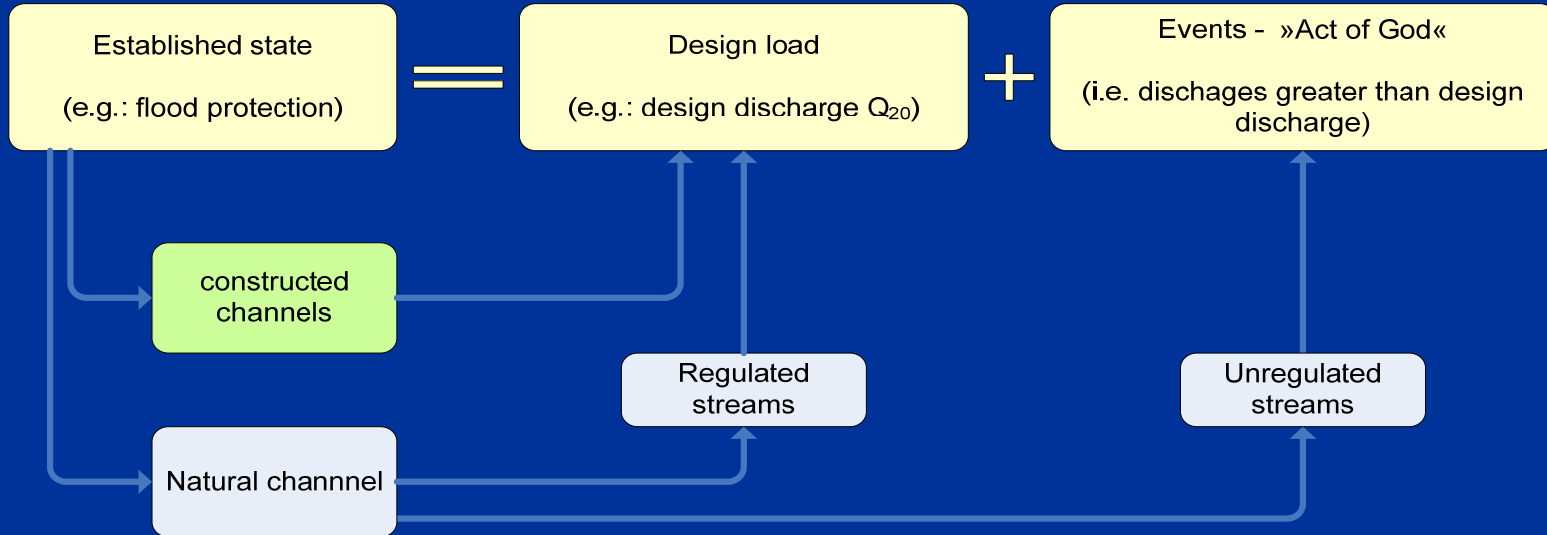


ATTENTION: Human projects have limited capacity!

Design discharge = level of undertaken risk
Exposure of Rescuers – to high risk?



Residual risk could be materialized!



No river training – Every event is »Act of God«!

RISK = function (HAZARD, VULNERABILITY)

CLASSES OF VULNERABILITY

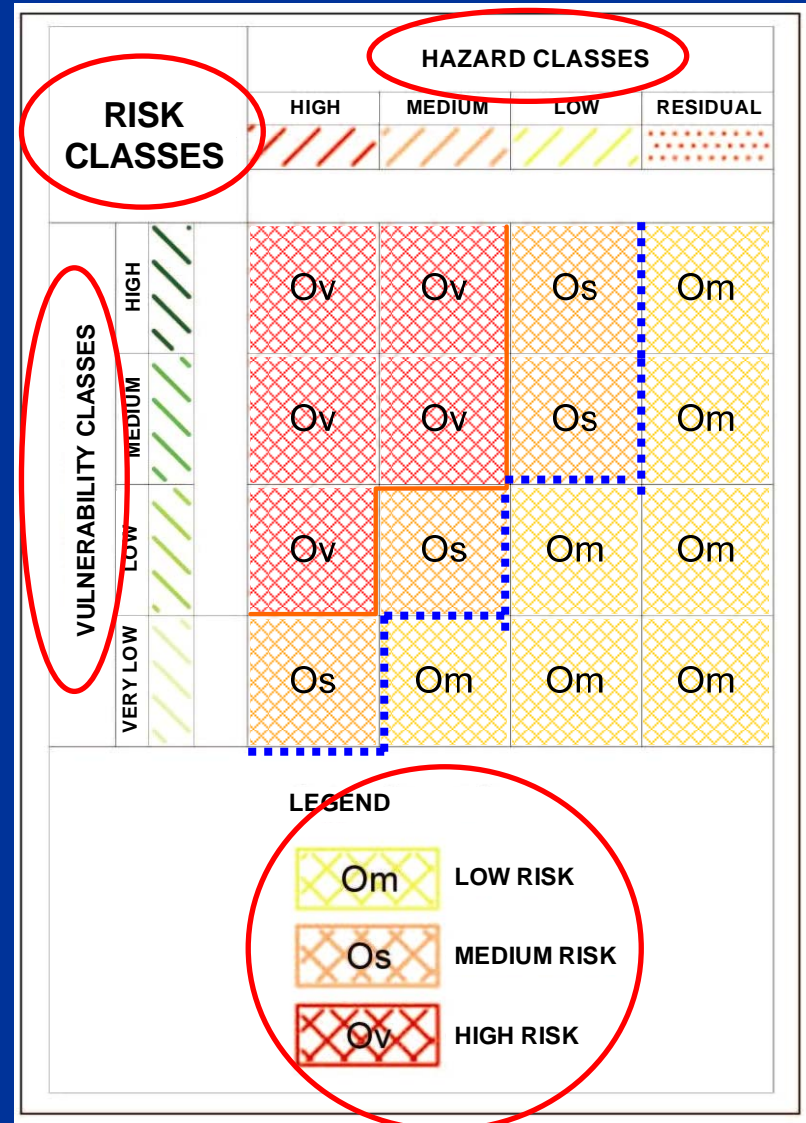
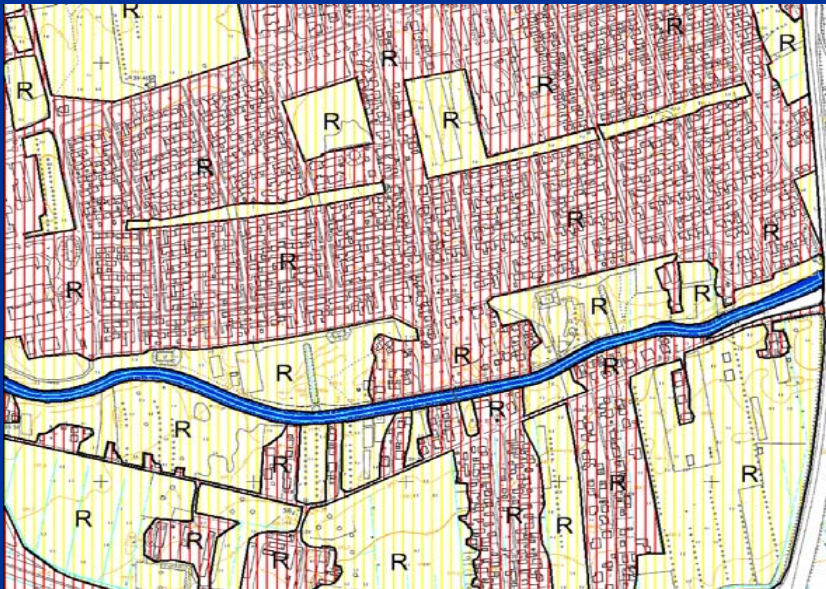


Rm Areas of very low vulnerability

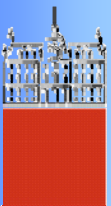
Rs Areas of low vulnerability

Rv Areas of very medium vulnerability

Rs Areas of very high vulnerability



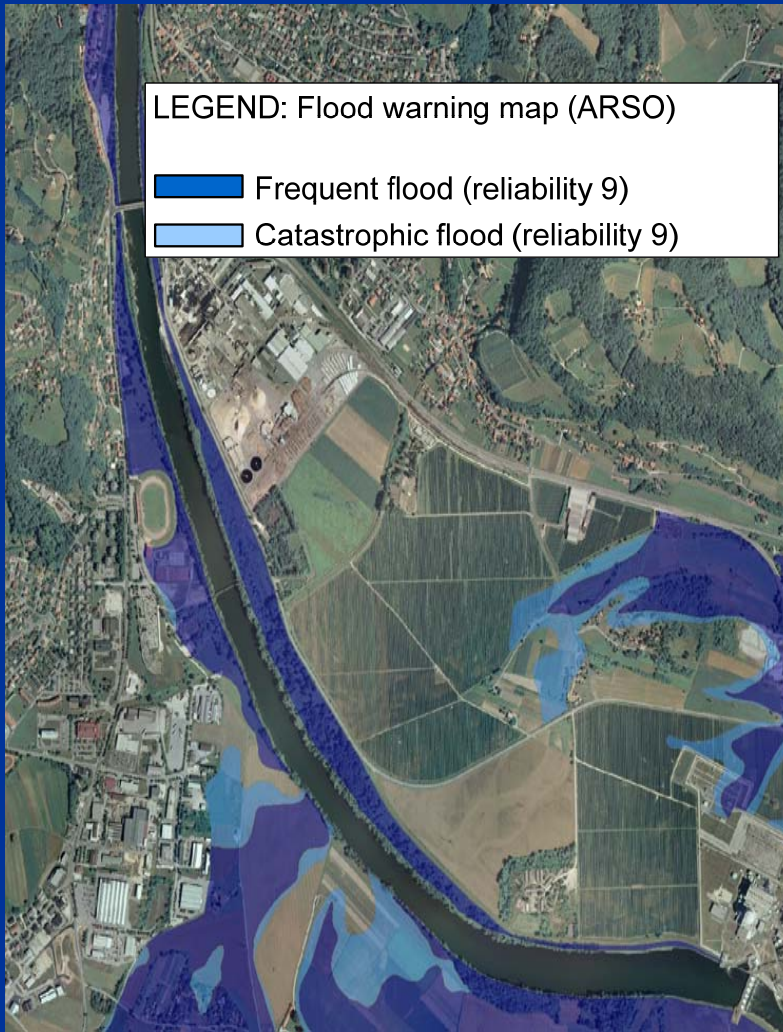
Example: Low and Medium Risk in the Residential Area





KMTe

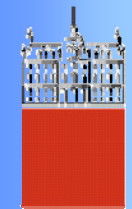
1st step: FLOOD WARNING MAPS

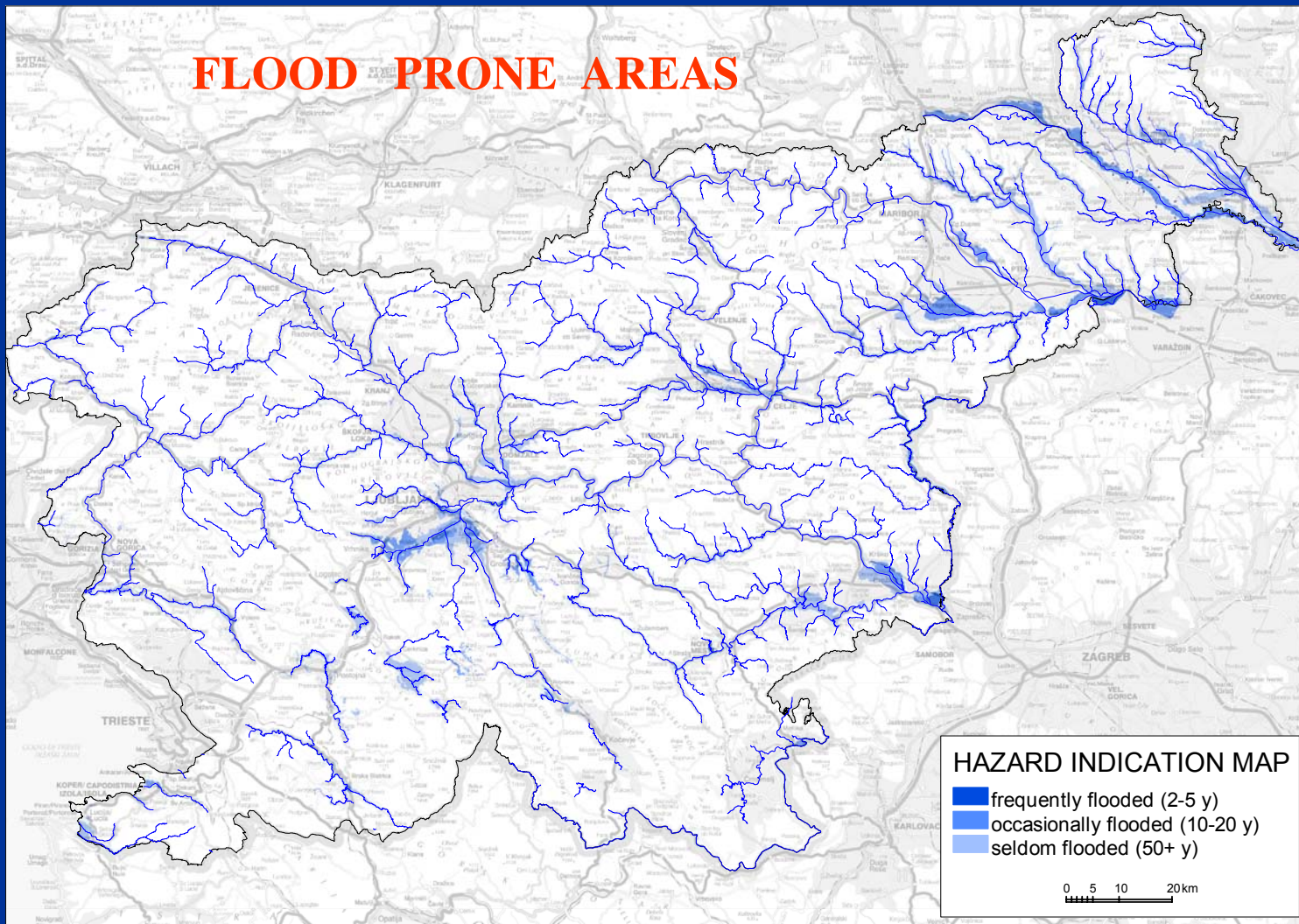


Concept:

- Flood extent & frequency based on various sources
(hydrologic/hydraulic research, field measures, eyewitness..)
- Floodplains categorized within 3 classes of flood occurrences → frequent, rare, catastrophic.
- Event probability is often not known → so information are ranged with a reliability (scale from 1 to 10)
- Local community can prepare more **detailed map** → for development, spatial planning, zoning of industrial areas, etc.

2nd step: FLOOD HAZARD MAPS





40% of SLO territory related to water hazards (floods, landslides, avalanches etc.)

7% of population lives in areas often reached by floods

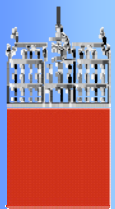
24% of population lives in areas of extreme floods...

VULNERABILITY ANALYSIS – basic approach



KMTe

UNIVERSITY OF LJUBLJANA
FACULTY OF CIVIL AND GEODETIC ENGINEERING

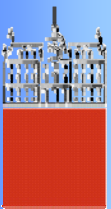


CLASS	RISK ELEMENTS
very low vulnerability	population density: to 10 inhabitants per km ²
	small economic and non-economic plant local interest
	vulnerable buildings
low vulnerability	population density: from 11 to 100 inhabitants per km ²
	economic and non-economic plant local interest
	vulnerable buildings
	cultural heritage of local interest
medium vulnerability	areas with special demands according to regulations, which define method of preparing plans of water management
	population density: from 101 to 300 inhabitants per km ²
	economic and non-economic buildings, significant for entire community
	vulnerable buildings
	plants and devices, owing to them could come to pollution
	areas with special demands according to regulations, which define method of preparing plans of water management
high vulnerability	cultural heritage of regional interest
	population density: more than 500 inhabitants per km ²
	economic and non-economic buildings of national interest
	plants and devices, owing to them could come to pollution of great extend, specially in areas with population density from 101 to 500 inhabitants per km ² or in areas with special demands according to regulations, which define method of preparing plans of water management
	cultural heritage of national or world interest
vulnerable buildings	



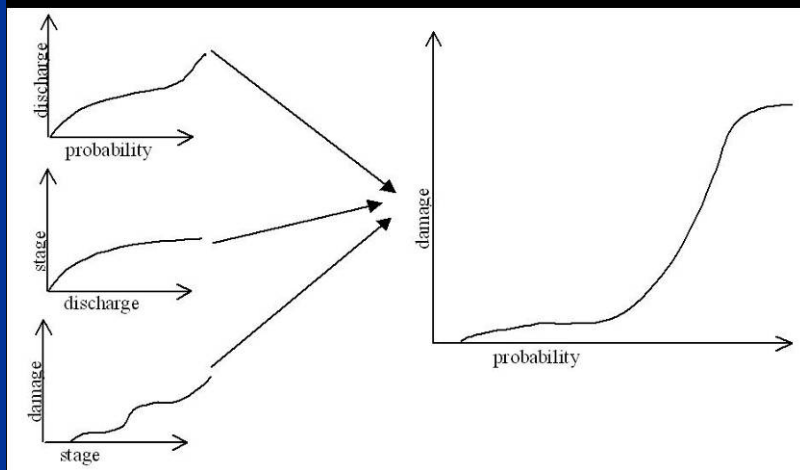
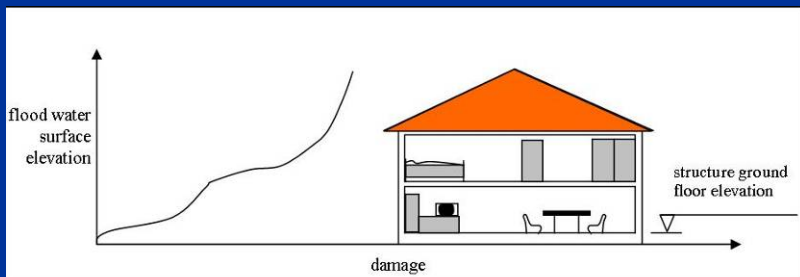
KMTe

UNIVERSITY OF LJUBLJANA
FACULTY OF CIVIL AND GEODETIC ENGINEERING

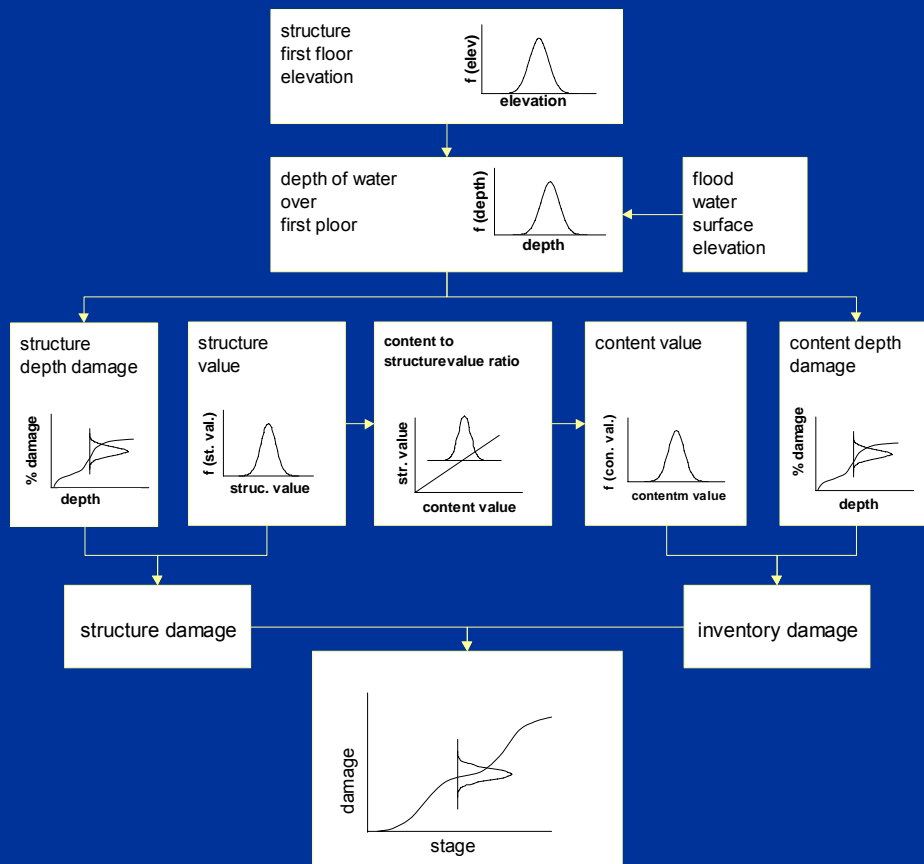


VULNERABILITY ANALYSIS – advanced approach

→ FLOOD DAMAGE ASSESSMENT (FDA)

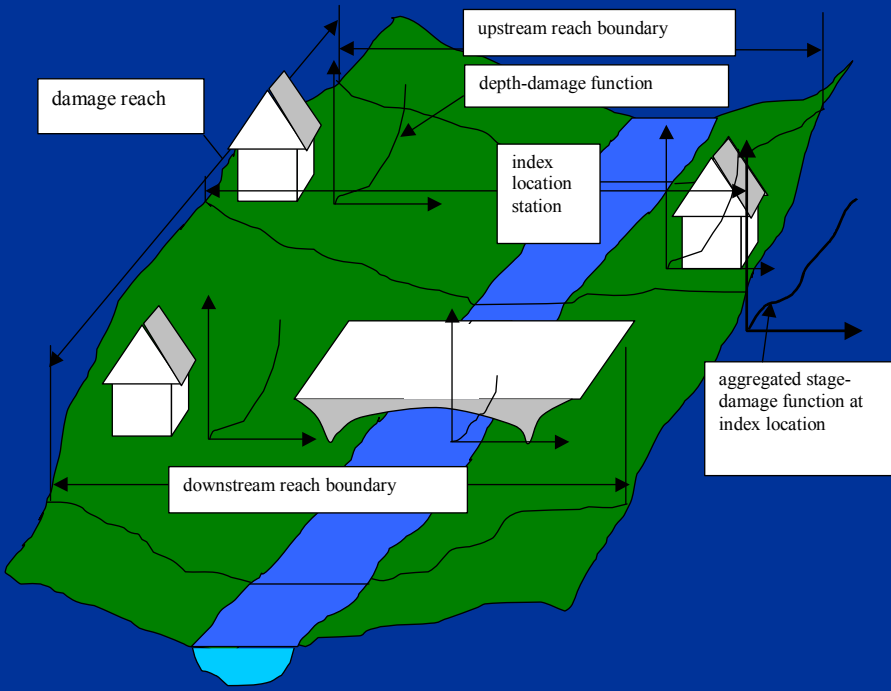


**Stage-damage curve –
based on Damage Reports**

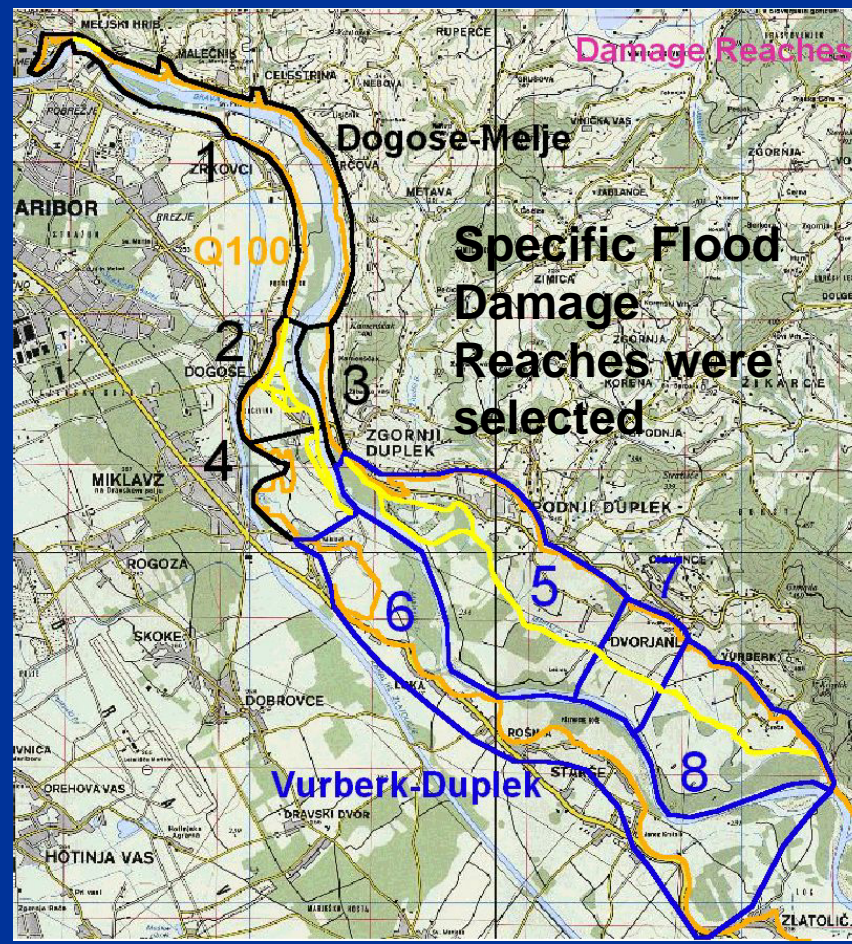


Stochastic characteristics of parameters!

STAGE – DAMAGE CURVES: **Case study**



Case study: **DRAVA** downstream of Maribor



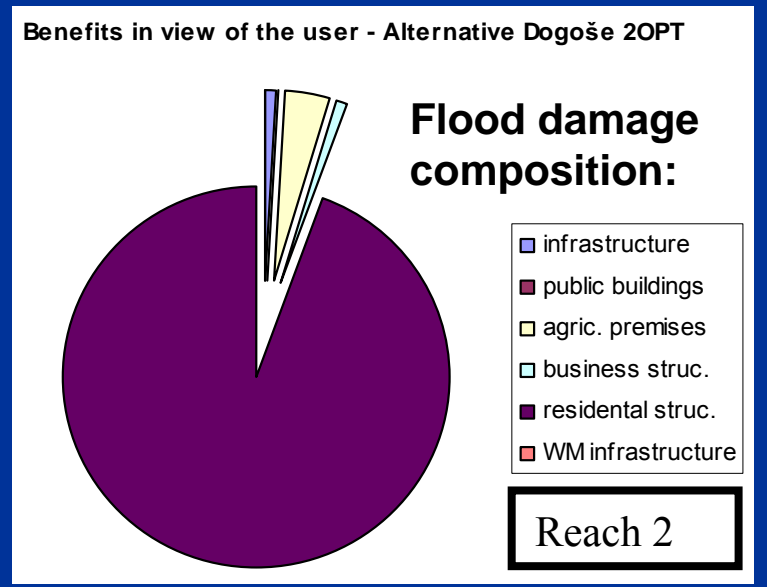
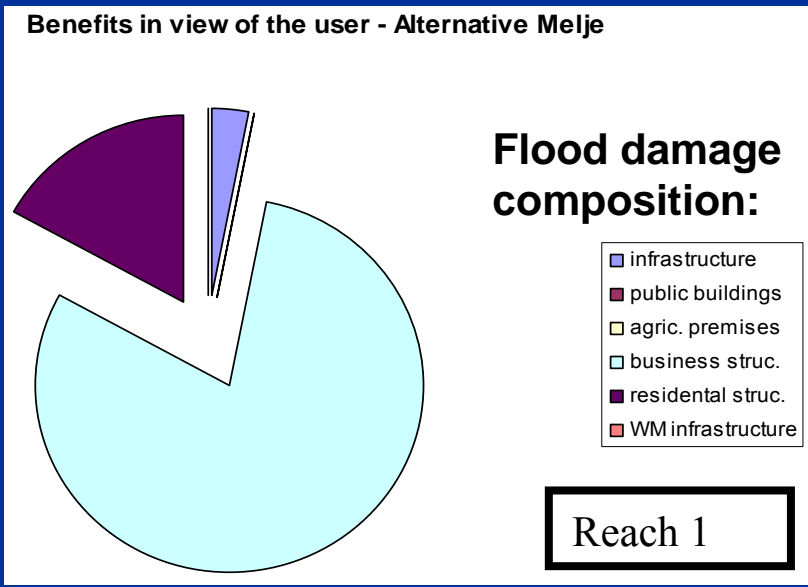
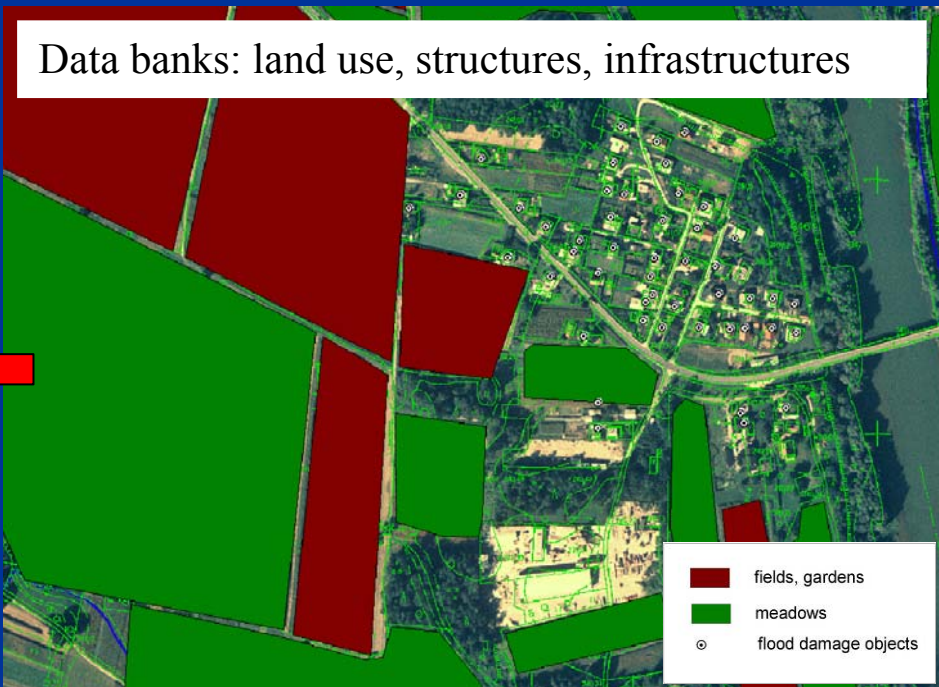
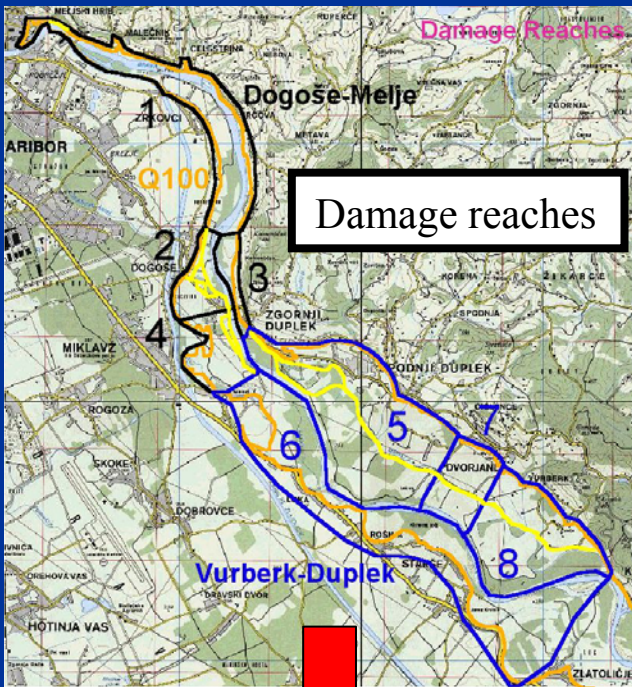
Cost – Benefit Analysis
(Benefits = Reduced Flood damages)





KMTe

UNIVERSITY OF LJUBLJANA
FACULTY OF CIVIL AND GEODETIC ENGINEERING



Common Methodologies or Comparing Studies for Drava River Basin ?

Flood Hazard Mapping,

Flood Damage Potential Assessment

Residual Risk Assessment and Mapping

needed for:

Transboundary Impact Assessment ?

Common policy on improving Retention Capacity ?

Adoption of Flood management Vision?

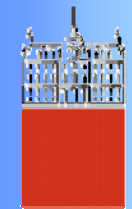
etc.: there are several challenges!





KMTe

UNIVERSITY OF LJUBLJANA
FACULTY OF CIVIL AND GEODETIC ENGINEERING



And,

because many stakeholders are not trained to understand Engineers' schemes, diagrams, calculations:

**Visualization of flood processes
could be very useful:**

short presentation of Drava River is given.