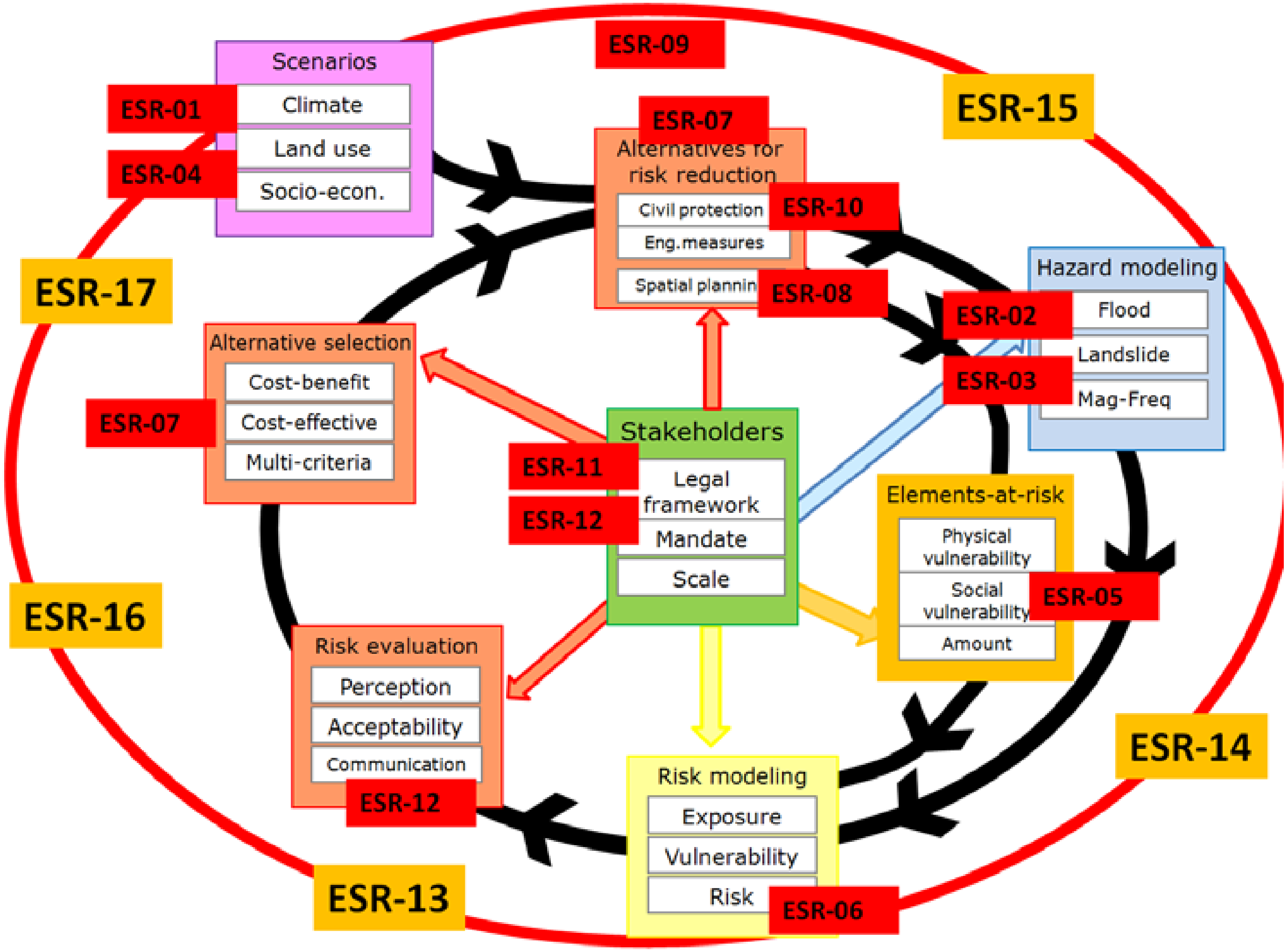
Current status of the web-based platform

CNR-IRPI Perugia, 17 September

Cees van Westen

The initial concept



IncREO
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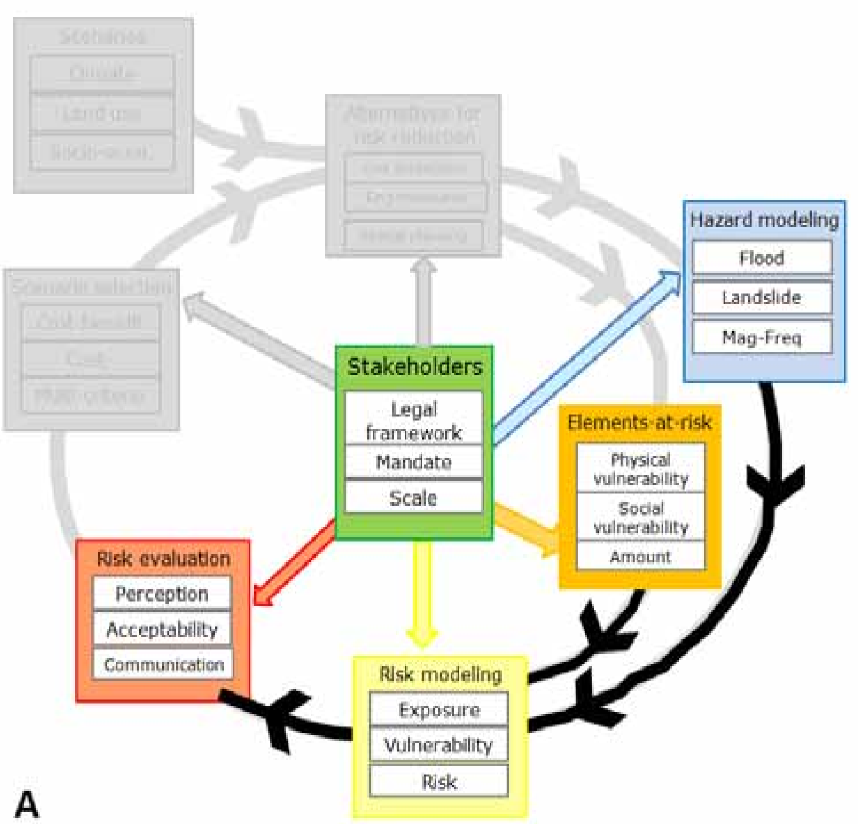
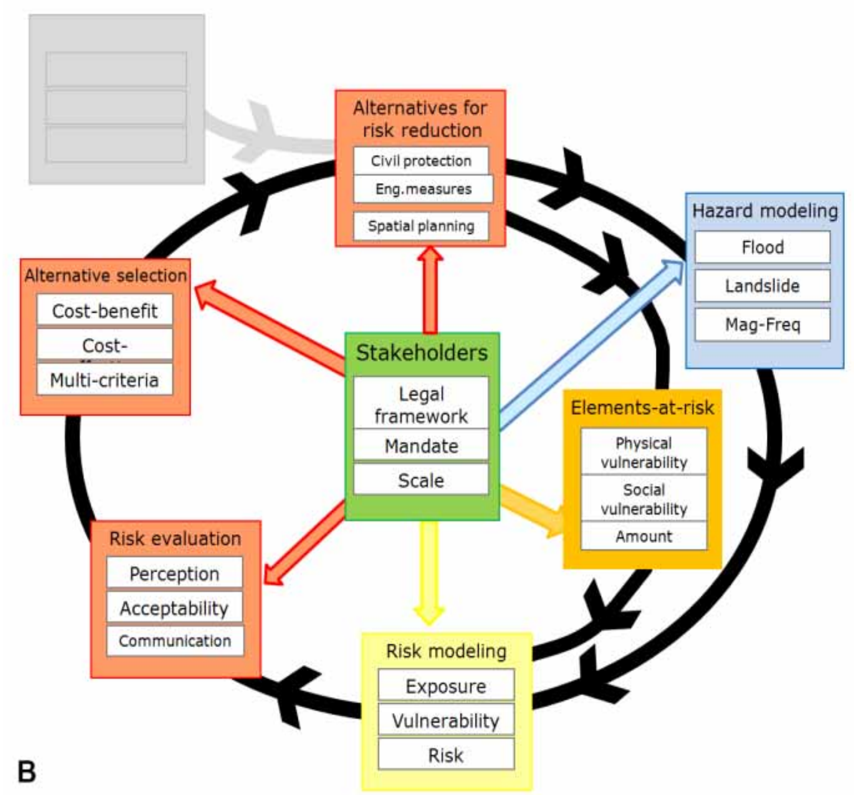
Use of the system (1,2)





Analyzing the current level of risk

Analyzing the best alternatives for risk reduction

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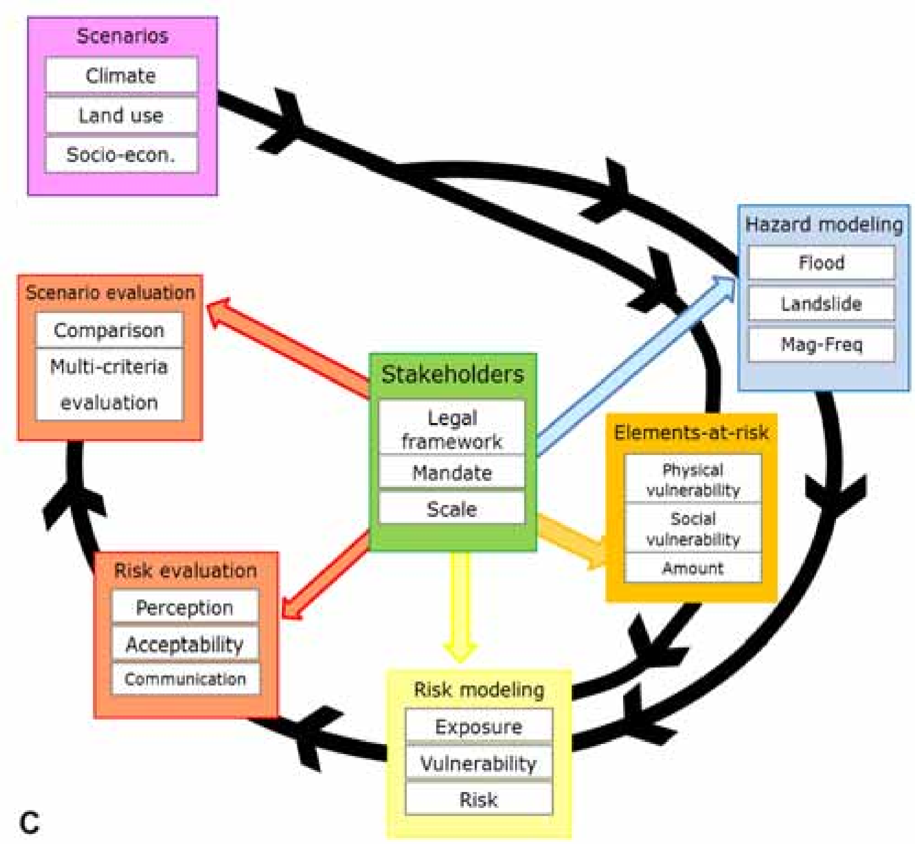
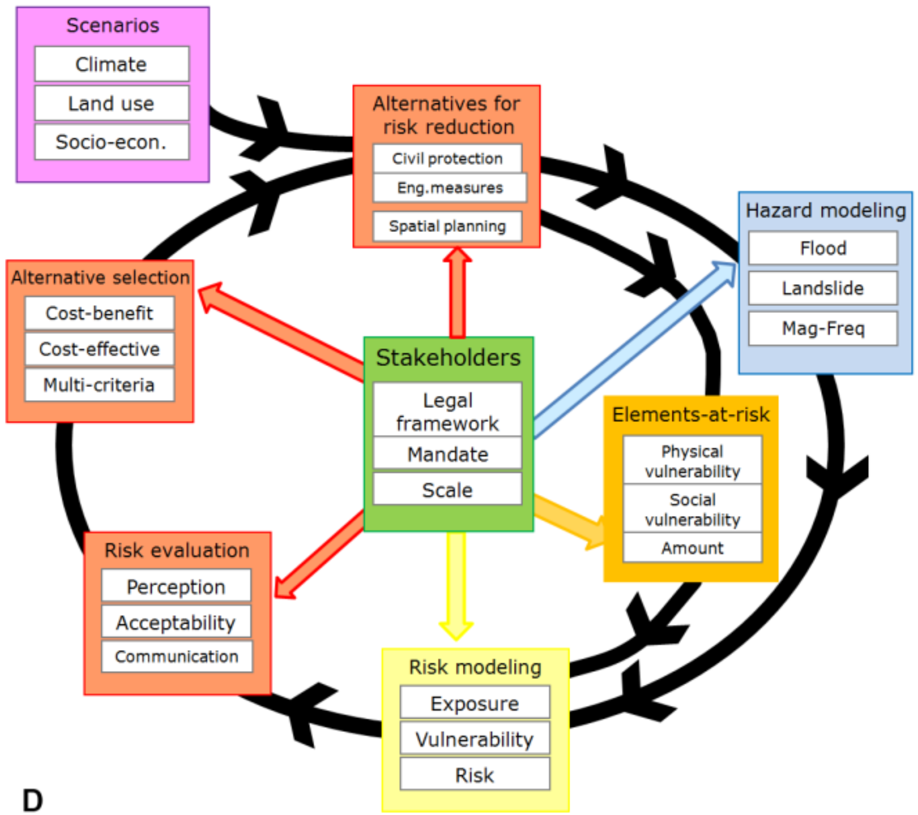
Use of the system (3,4)

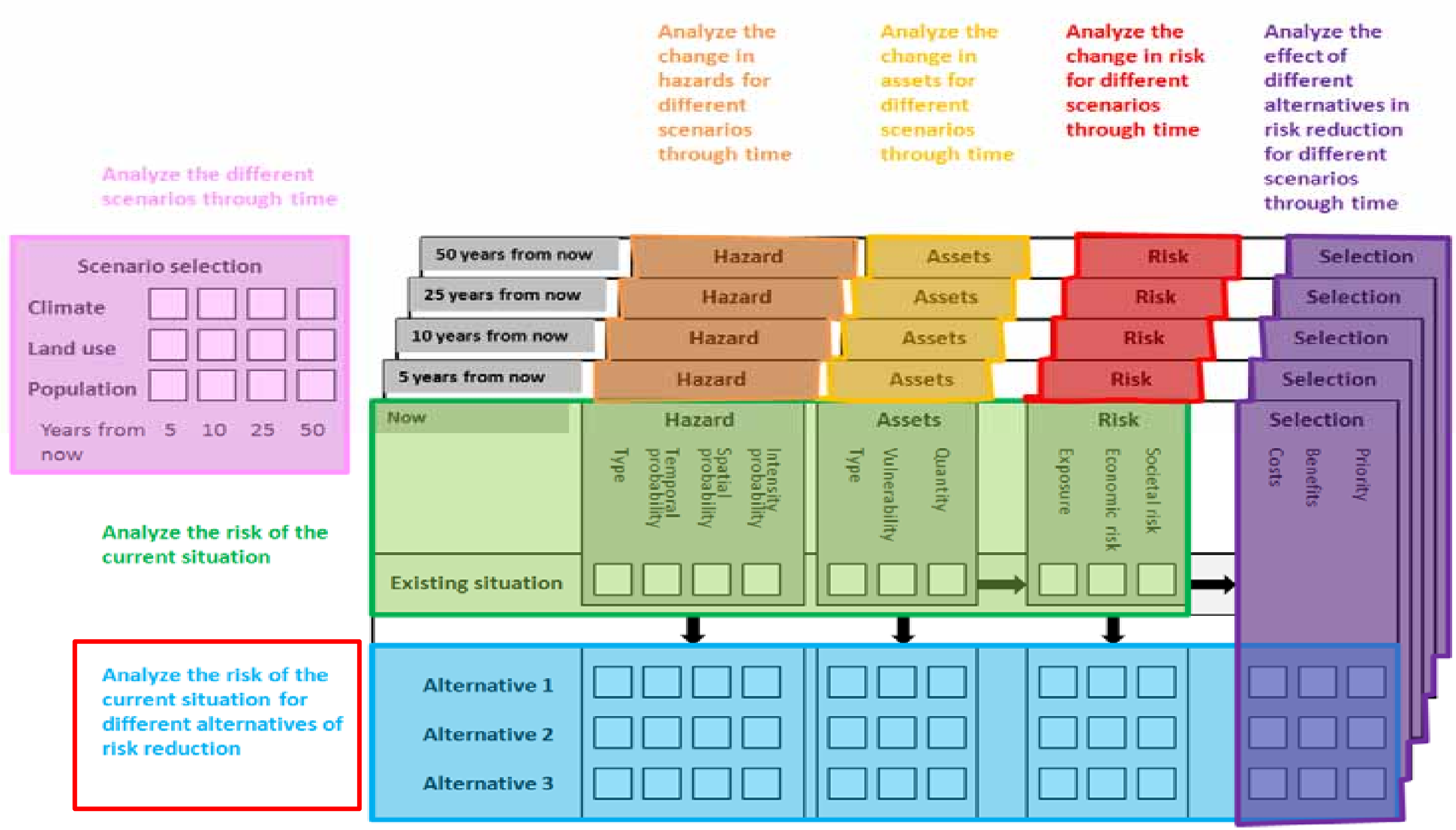




Evaluation of the consequences of scenarios to the risk levels

Evaluation of different risk reduction alternatives under future scenarios

Types of analysis



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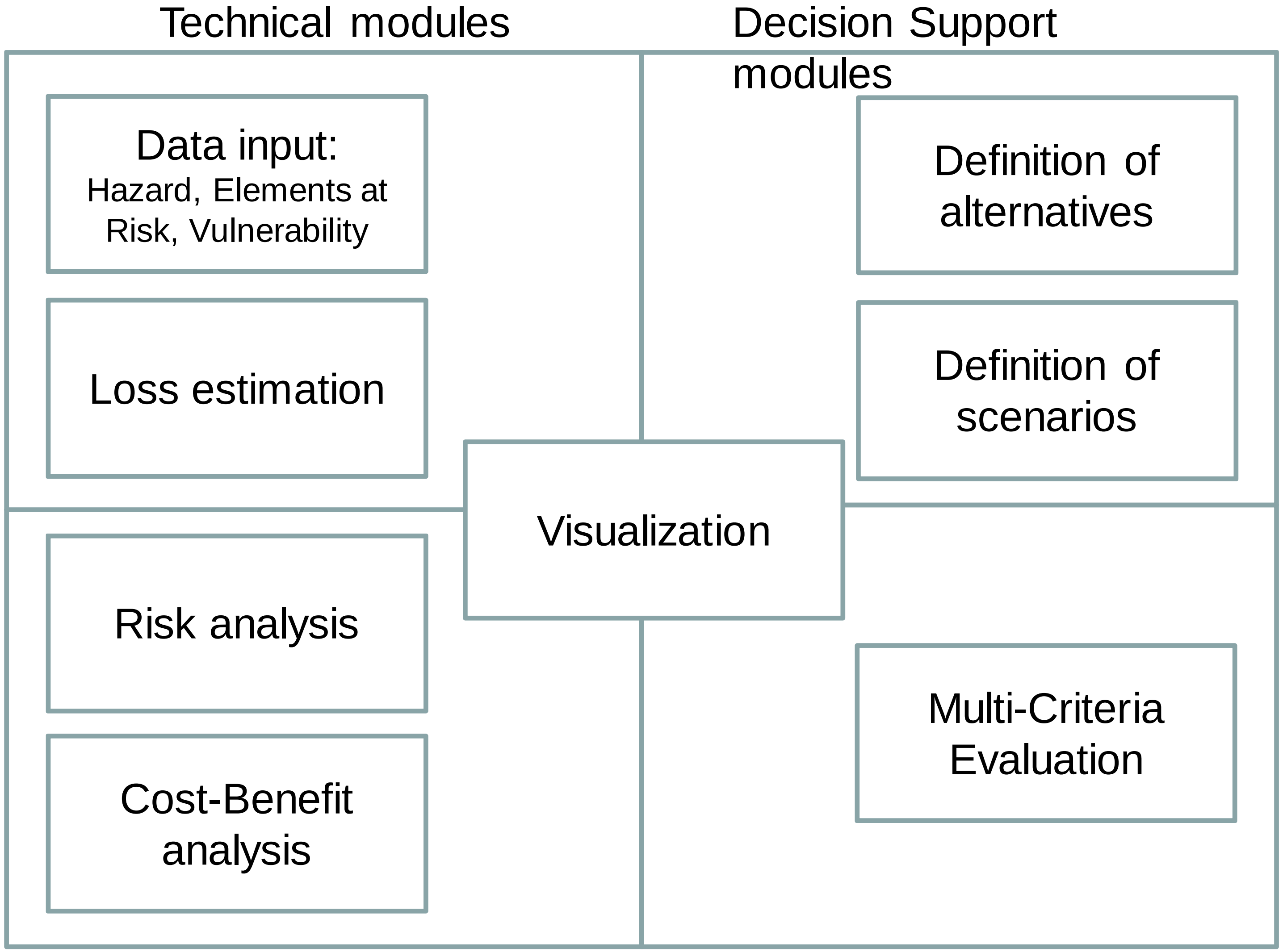
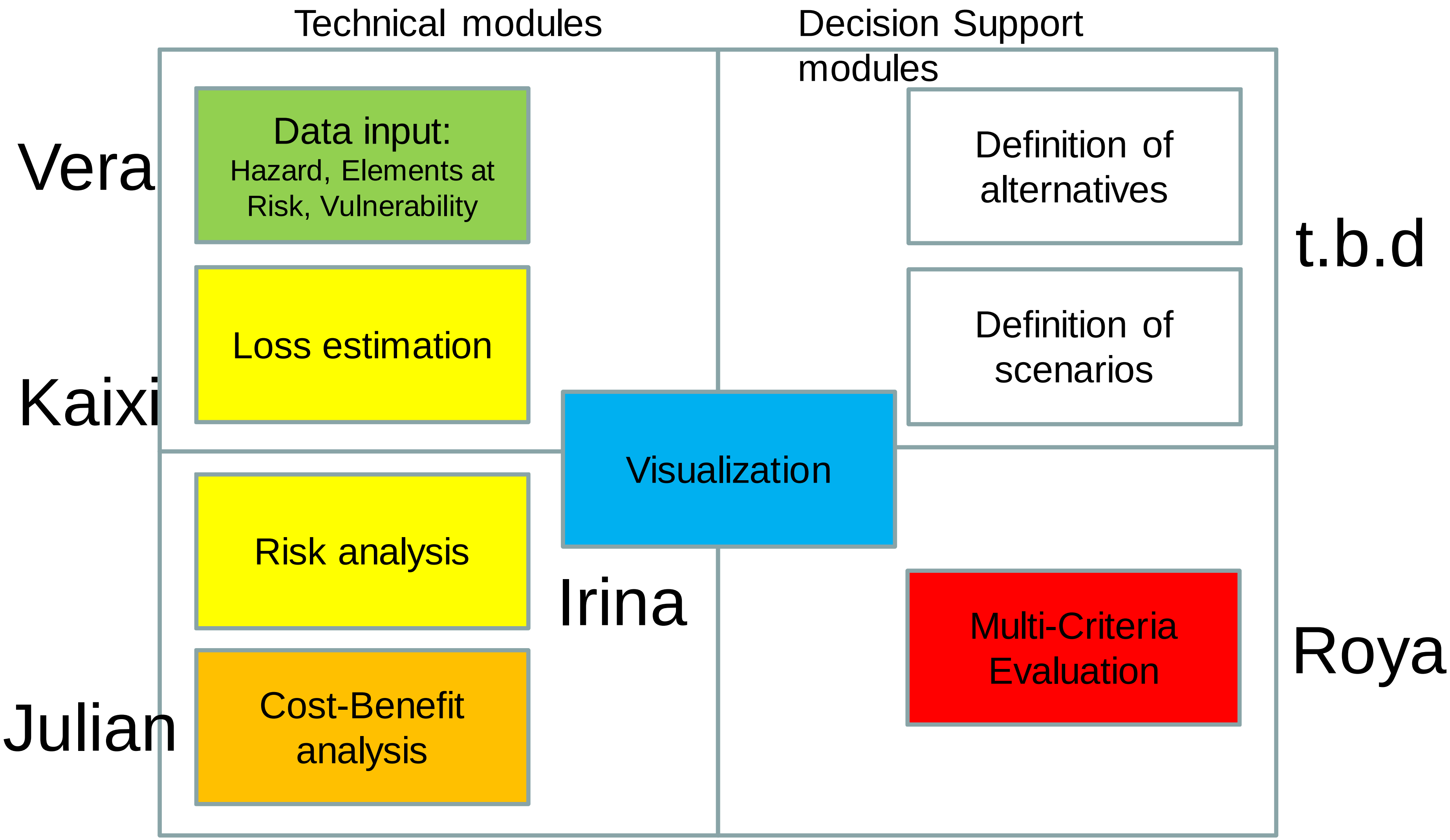
ESRs selected

Nr.	Title of the position - ESRs	Partners and months	
		Main host	Person selected
ESR-13	**Development of the spatial data management of the SDSS and web-GIS component** Background: Informatics ./ Geoinformatics, with expertise in Web-Programming, web-GIS and SDSS	PLUS (18)	**Vera Andrejchenko (Macedonia)**
ESR-14	**Development of the data analysis modules within the SDSS based on Open Source software (ILWIS)** Background: Programmer (e.g. C++)	ITC (18)	**Kaixi Zhang (China)**
ESR-15	**Development of the Spatial Decision Support framework** Background: Informatics / Geoinformatics with programming background and preferably knowledge in Spatial Decision Support Systems	UNIL (18)	**Roya Olyazadeh (Iran)**
ESR-16	**Development of a web-based risk communication and visualization component of the SDSS to embed its suitable visualization methods whenever necessary within the SDSS framework** Background: Informatics / Geoinformatics specialized in visualization. Programming skills required.	TUDO (18)	**Irina Cristal (Moldovan)**
ESR -17	**Development of the cost-Benefit component of the SDSS** Background: Informatics / Economics with programming skills and preferably knowledge of cost-benefit analysis.	TUD (18)	**Julian Berlin (Argentinia)**


Technical modules
Decision Support modules
Data input:
Hazard, Elements at Risk, Vulnerability
Loss estimation
Risk analysis
Cost-Benefit analysis
Visualization
Definition of alternatives
Definition of scenarios
Multi-Criteria Evaluation



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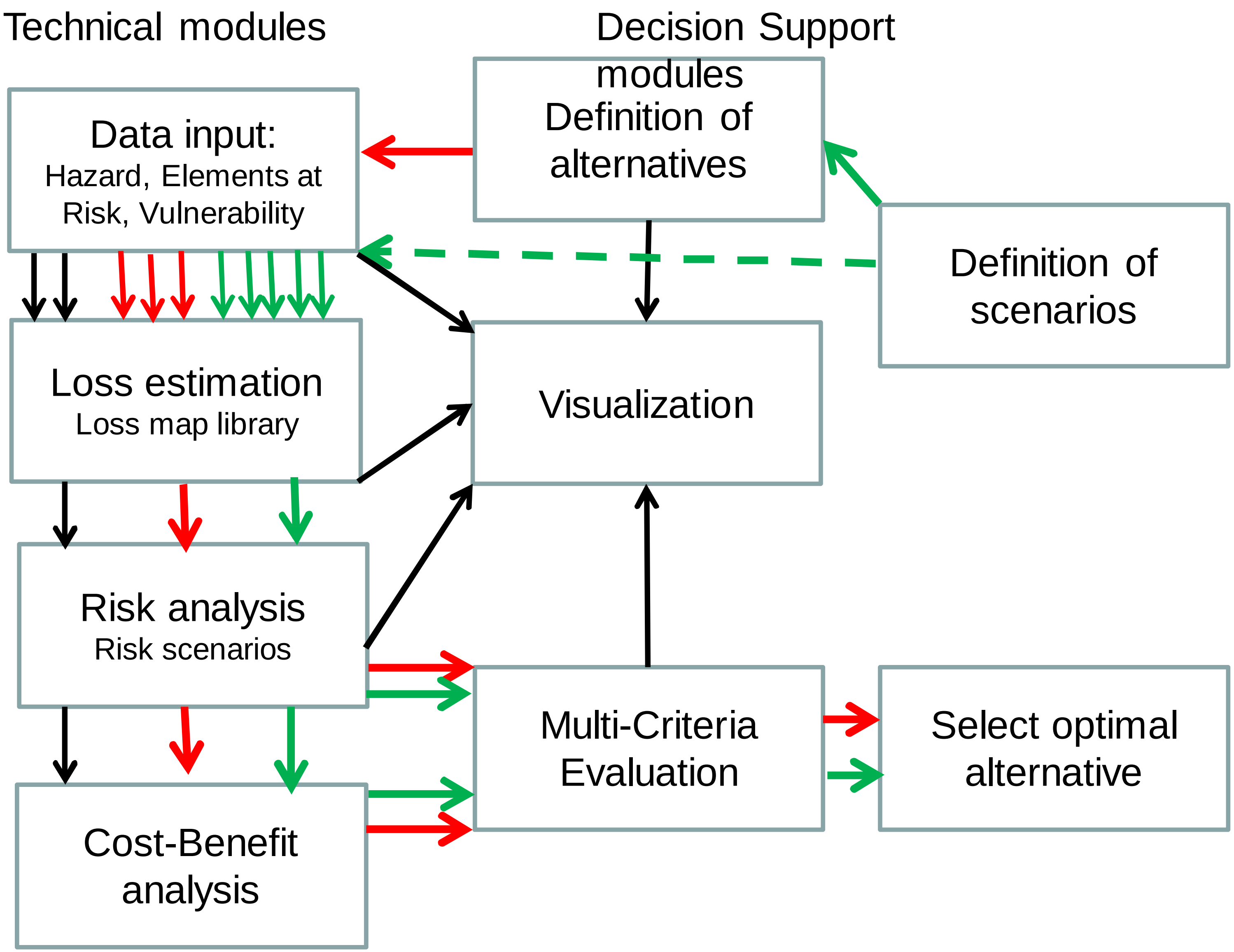
Technical modules
Decision Support modules
Data input:
Hazard, Elements at Risk, Vulnerability
Definition of alternatives
Definition of scenarios
Loss estimation
Loss map library
Visualization
Risk analysis
Risk scenarios
Multi-Criteria Evaluation
Select optimal alternative
Cost-Benefit analysis

Technical modules

Decision Support modules

Hazard experts
Elements at Risk
Vulnerability experts
experts
Technical representative of EUO
Technical GIS / risk expert

Data input:
Hazard, Elements at Risk, Vulnerability

Definition of alternatives

Technical representative of EUO

Technical GIS / risk expert

Loss estimation

Definition of scenarios

Hazard expert
Elements at Risk expert
Vulnerability expert
Climate change expert
Socioeconomic expert
Planning expert
Technical representative of EUO

Visualization

All users

Technical representative of EUO
Technical GIS / risk expert

Risk analysis

Multi-Criteria Evaluation

Representatives of EUO
Local authorities,
Community representatives
Government organizations
Non-Governmental organizations
Local pressure groups
Local authorities

Economist
Technical representative of EUO
Technical GIS / risk expert

Cost-Benefit analysis

Local population

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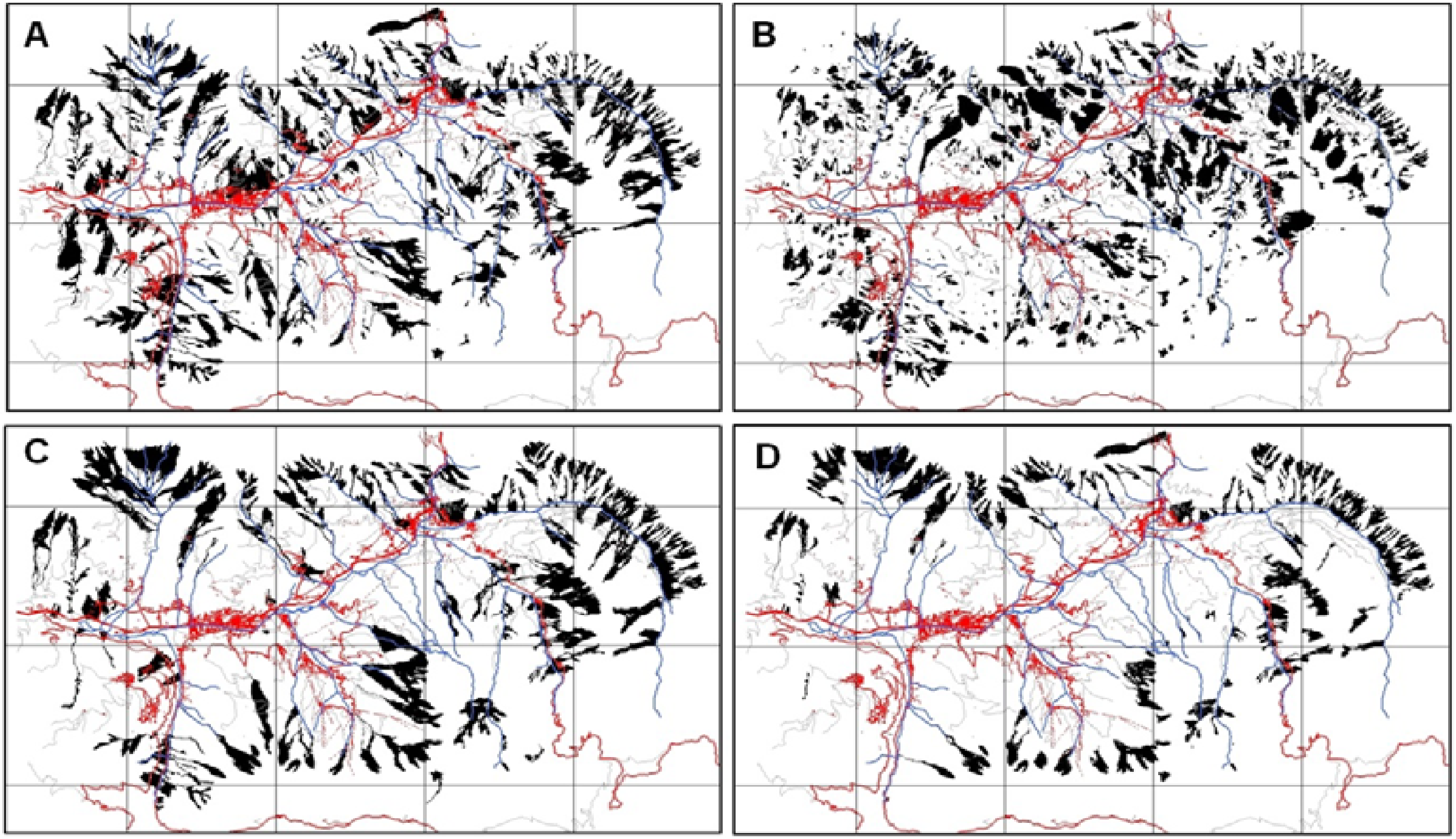
Hazard maps

- **Hazard type.** Users should indicate the type of hazard (e.g. river flood). The names are user defined. Users can also make scenarios of combinations of hazards.
- **Intensity**. Users should indicate the intensity measurement used (e.g. water height) as well as the units of measurement (e.g. centimeters). The best is to use classified intensity maps, where the class boundaries are the same as the class boundaries used for the vulnerability tables.
- **Return Periods**. Users can define how many return periods should be used. In order to be able to calculate risk curves at least 3 return periods should be used)
- **Spatial Probability**. A user should define the chance that a pixel that has been modeled also will experience the event, given the return period. In most cases this spatial probability will be 1.
- **Alternative**. A user should define the risk reduction alternative for which the hazard map is valid. By default it is ALT000 which is the current situation
- **Scenario.** A user should define the scenario for which the hazard map is valid. By default it is SCE001. Also the reference year should be indicated (the future year for which the effect of the scenario is calculated).
- **User defined keywords.** These are used later in the querying part of the system, for retrieving specific hazard maps.

Example

Flood hazard		**Debris flow hazard**		**Landslide hazard**	
Depth of flooding, 50 year RP	Spatial Probability =1 (no maps)	Average Impact pressure, 20 year RP Standard deviation of impact pressure, 20 year RP	Spatial probability, 20 year RP	Hazard intensity unknown. No maps	Spatial probability, major event, assumed to occur between 80 and 100 years
Depth of flooding, 100 year RP		Average Impact pressure, 50 year RP Standard deviation of impact pressure, 50 year RP	Spatial probability, 50 year RP		Spatial probability, moderate event, assumed every 40-60 years
Depth of flooding, 200 year RP					Spatial probability, minor event, assumed every 10-15 year
Depth of flooding, 200 year RP					

Hazard maps



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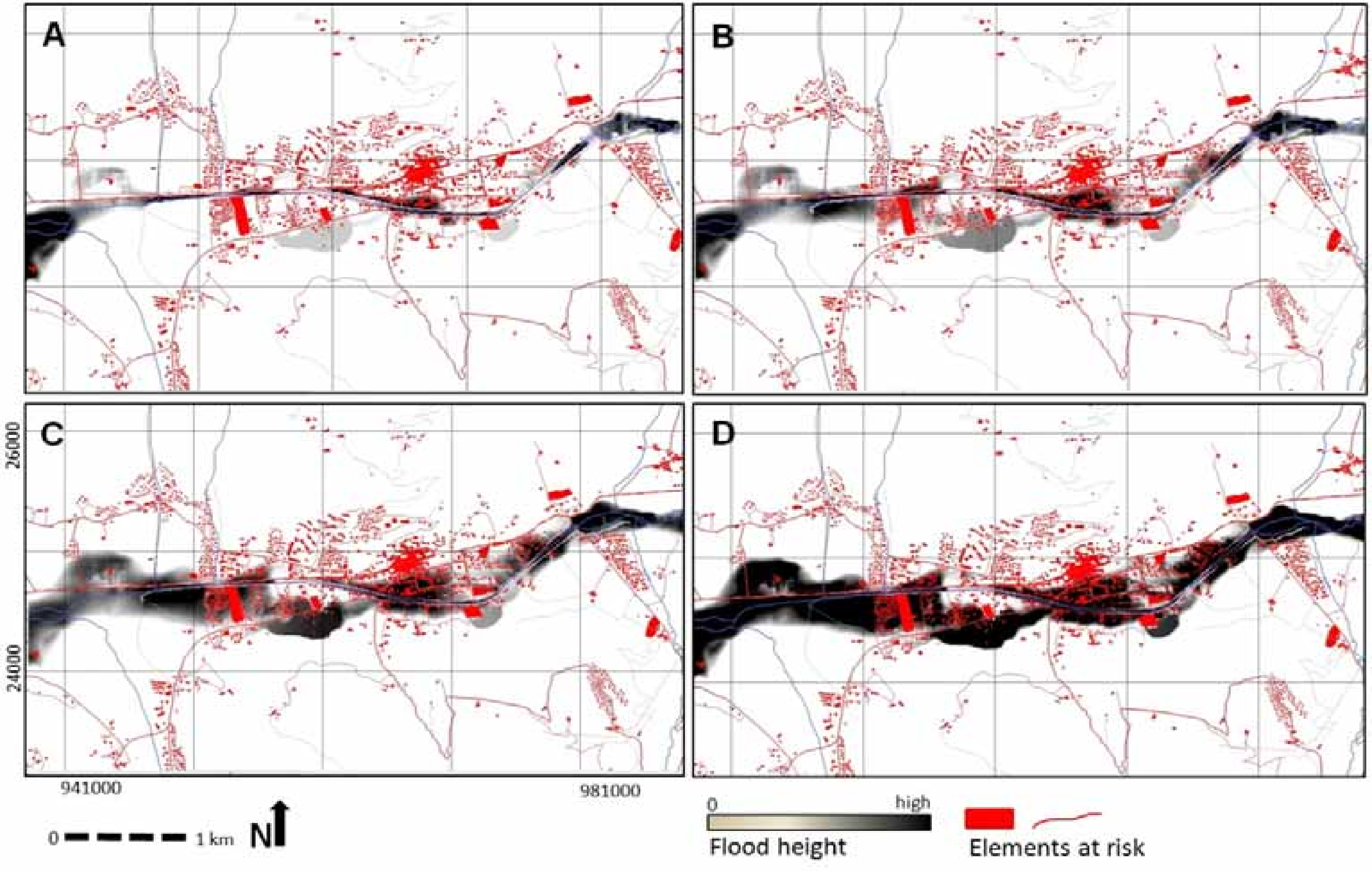
Hazard maps



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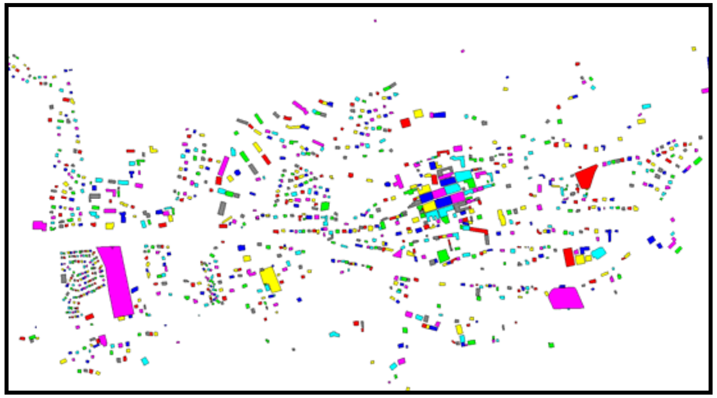
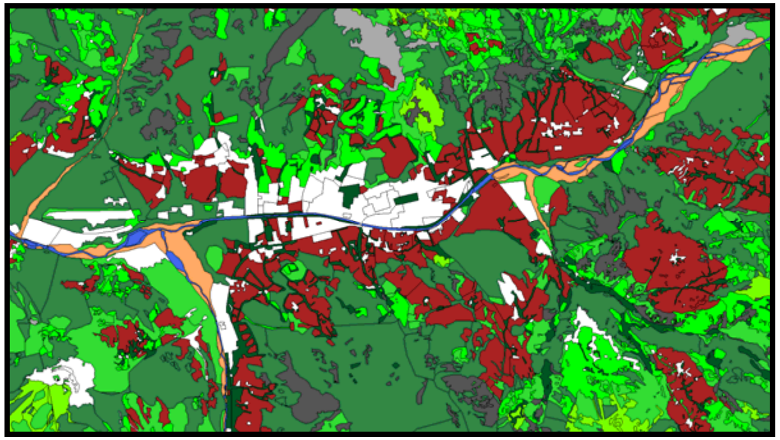
Elements at risk

- Building footprints
- Land parcels
- Linear features





Vulnerability

Intensity		Vulnerability		
From	To	average	minimum	maximum
The class boundaries should ideally be the same as the classes in the hazard intensity maps			Optional	Optional

For example if we have a number of building types

Code	Building type	Hazard
WF1_FLO	Wooden building, 1 floor	Flooding
WF2_FLO	Wooden building, 2 floors	Flooding
MA1_FLO	Masonry building, 1 floor	Flooding
MA2_FLO	Masonry building, 2 floors	Flooding
RC1_FLO	Reinforced concrete building, 1 floor	Flooding
RC2_FLO	Reinforced concrete building, 2 floors	Flooding
Etc..		

For example for flooding, with I (Intensity) showing the water height the following vulnerability tables could be made:

WF1_FLO

I	V
0-1	0.1
1-2	0.3
2-3	0.8
3-4	1.0

WF2_FLO

I	V
0-1	0.05
1-2	0.1
2-3	0.4
3-4	0.5

MA1_FLO

I	V
0-1	0.07
1-2	0.09
2-3	0.23
3-4	0.35

MA2_FLO

I	V
0-1	0.02
1-2	0.06
2-3	0.12
3-4	0.25

RC1_FLO

I	V
0-1	0.01
1-2	0.03
2-3	0.08
3-4	0.15

RC2_FLO

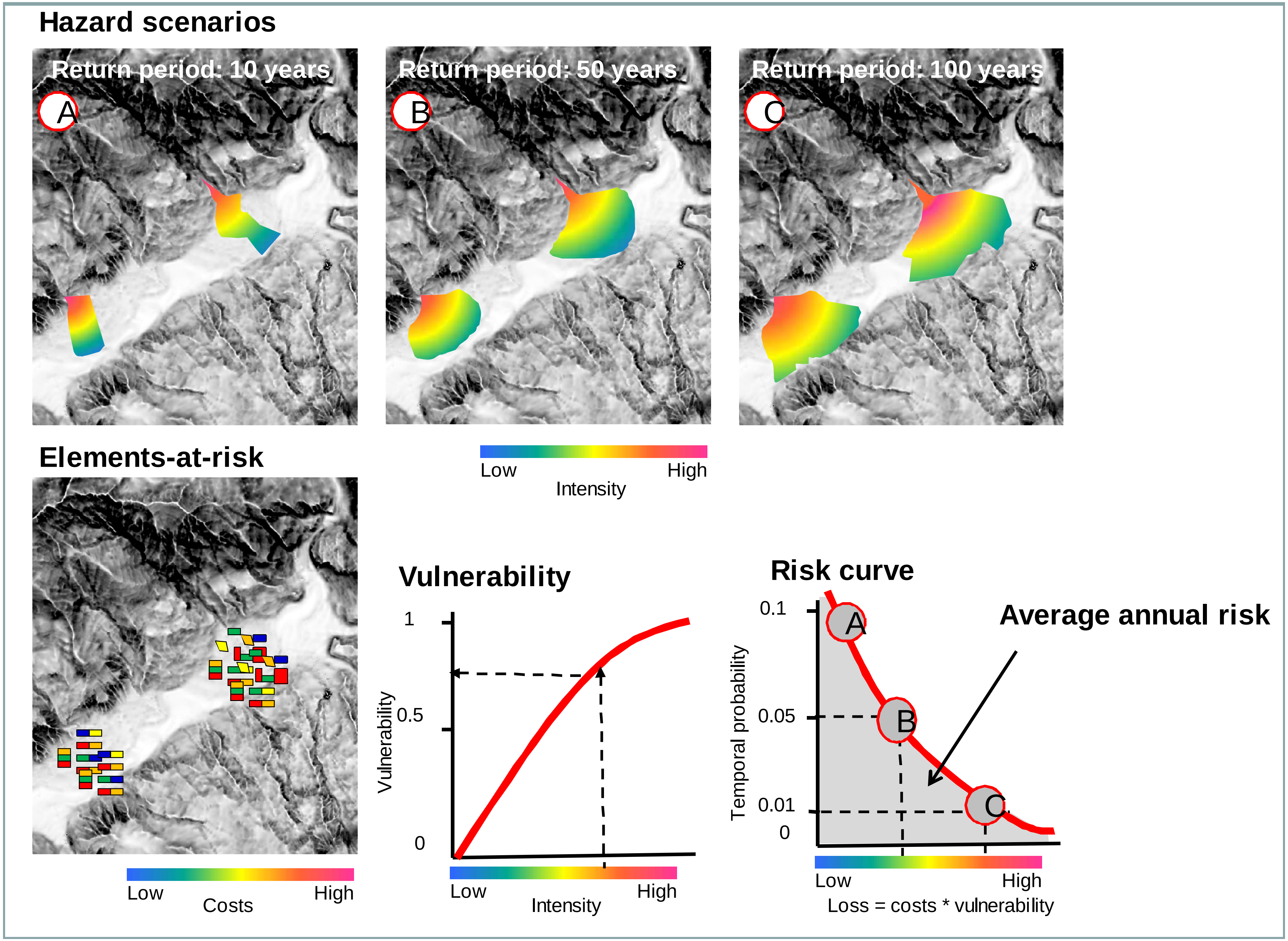
I	V
0-1	0.00
1-2	0.01
2-3	0.05
3-4	0.08

Data input module

Upload hazard and elements at risk maps into the system

Hazard data

Map Name	Hazard Type	Return period (years)			Intensity					Spatial probability		Alternative	Scenario
		Average	Minimum	maximum	Scale	metric	Classes	AVG	STD	Value	Map		
Map1	flood	50			depth	m	table	map	-	1	-	00	00
Map2	flood	100			depth	m	table	map	-	1	-	00	00
Map3	flood	200			depth	m	table	map	-	1	-	00	00
Map4	slide	50	20	40	-	-	-	-	-		map	00	00
Map5	Debris	70	50	80	impact	Kpa	table	map	map		map	01	01_Y20



Hazard scenarios
Return period: 10 years
A
Return period: 50 years
B
Return period: 100 years
C
Low
High
Intensity
Elements-at-risk
Low
Costs
High
Vulnerability
1
0.5
0
Vulnerability
Low
Intensity
High
Risk curve
0.1
0.05
0.01
0
Temporal probability
A
B
C
Average annual risk
Low
High
Loss = costs * vulnerability

Loss estimation procedure

Vulnerability tables

WF1_FLO

I	V
0-1	0.1
1-2	0.3
2-3	0.8
3-4	1.0

WF2_FLO

I	V
0-1	0.05
1-2	0.1
2-3	0.4
3-4	0.5

MA1_FLO

I	V
0-1	0.07
1-2	0.09
2-3	0.23
3-4	0.35

MA2_FLO

I	V
0-1	0.02
1-2	0.06
2-3	0.12
3-4	0.25

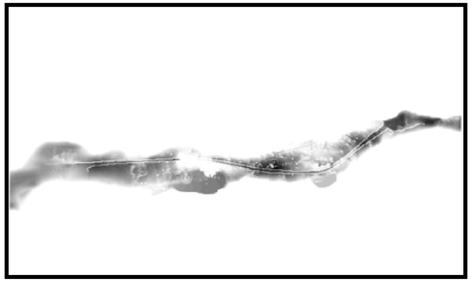
RC1_FLO

I	V
0-1	0.01
1-2	0.03
2-3	0.08
3-4	0.15

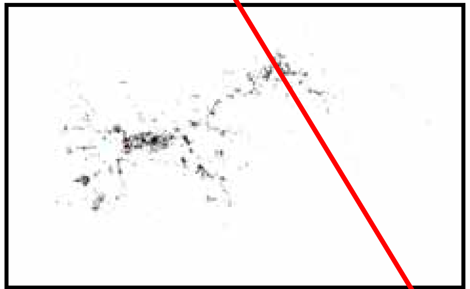
RC2_FLO

I	V
0-1	0.00
1-2	0.01
2-3	0.05
3-4	0.08

Hazard intensity



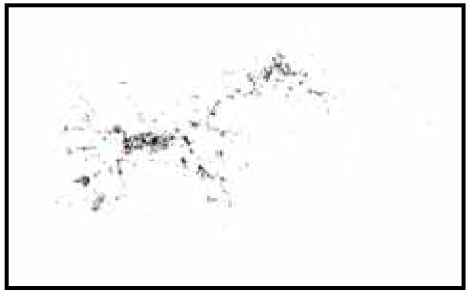
Building footprints



Attribute table

ID	Use	Type	Value object	Nr of persons
001	RES	WF1_FLO	120000	15
002	COM	WF2_FLO	180000	35
003	IND	MA1_FLO	220000	9
004	RES	MA2_FLO	300000	25
005	EDU	RC1_FLO	400000	18
006	RES	RC2_FLO	460000	56
etc				

Map overlay & table operations

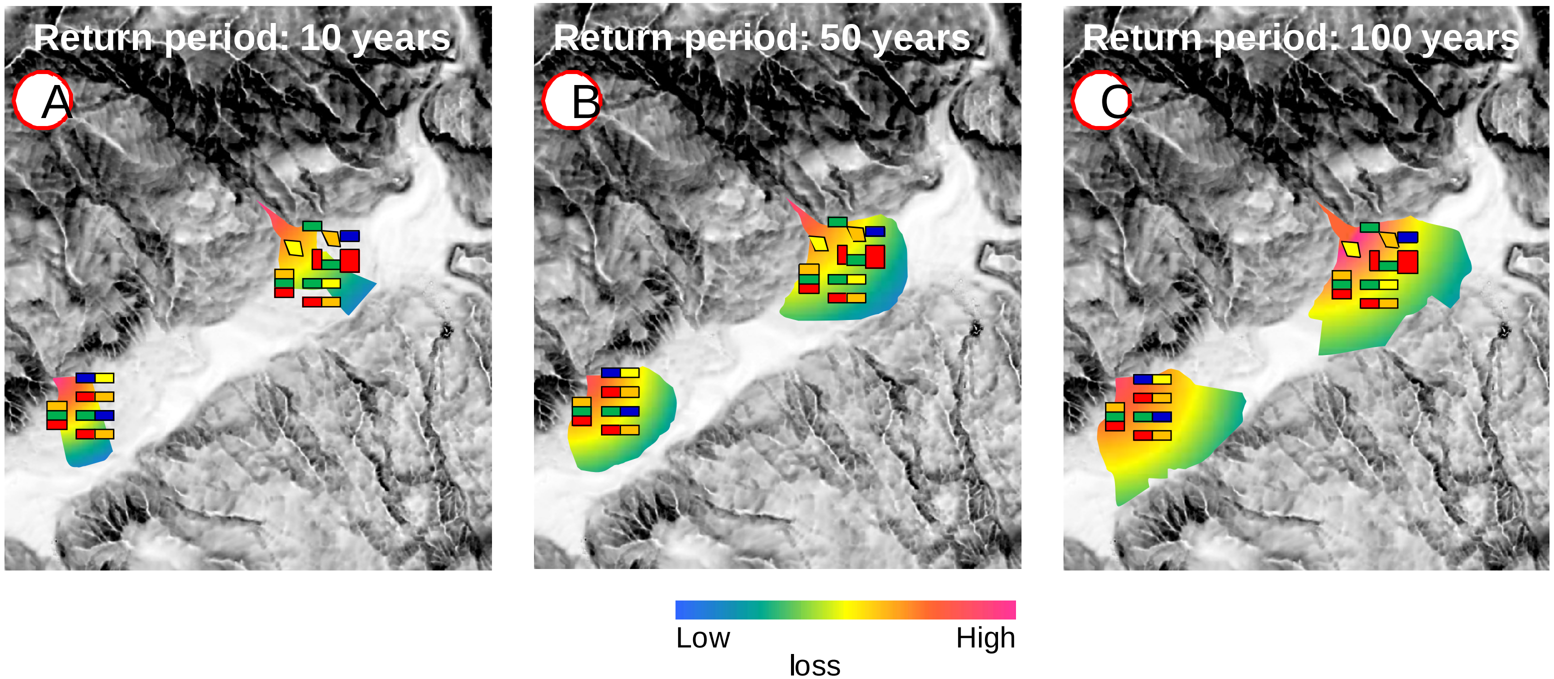


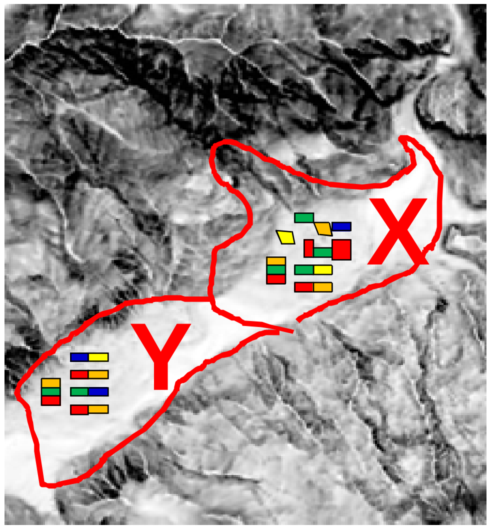
Attribute table

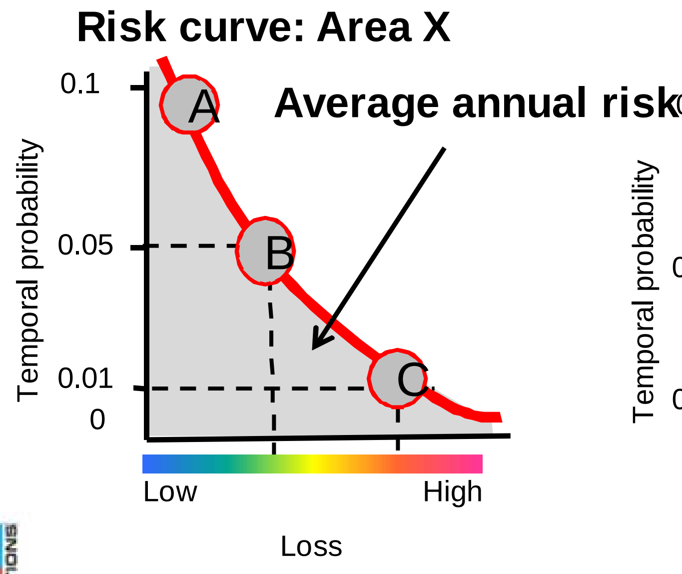
New_ID	ID	Hazard intensity	Spatial Probability	Value	Vulnerability	Loss
0001	001	1-2	1	60000	0.3	18000
0002	001	0-1	1	60000	0.1	6000
0003	002	2-3	1	180000	0.4	72000
0004	003	1-2	1	220000	0.09	19800
0005	004	2-3	1	200000	0.12	24000
0006	004	1-2	1	100000	0.06	6000
0007	005	0-1	1	400000	0.01	4000
0008	006	2-3	1	460000	0.05	23000
etc						

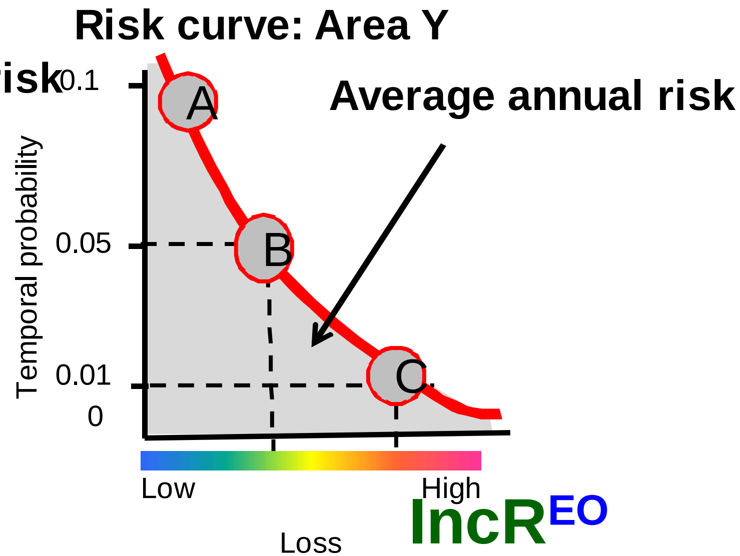
Loss= Spatial probability *value * vulnerability

Loss maps









CHANGES Risk-HVA

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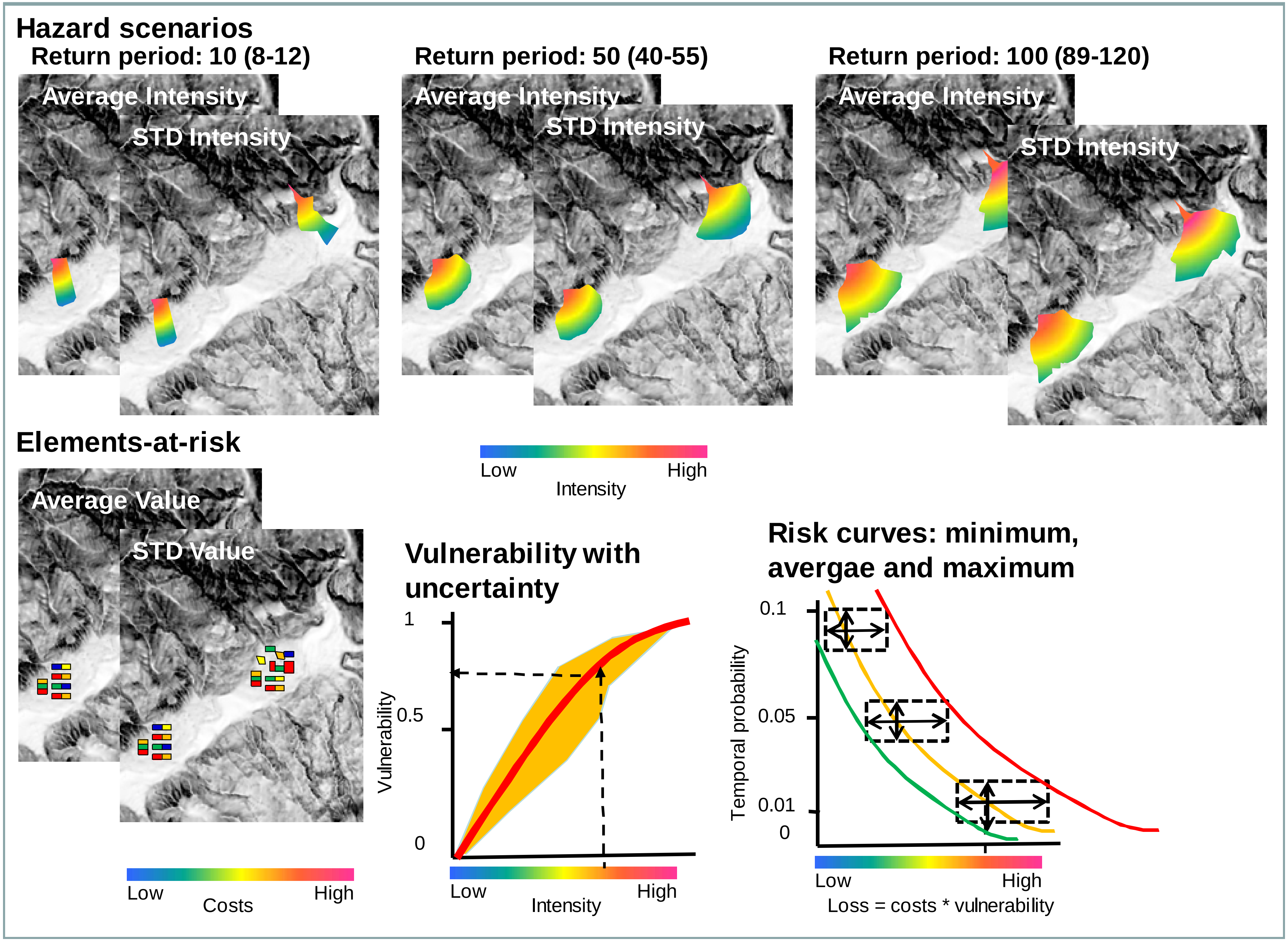


Hazard scenarios
Return period: 10 (8-12)
Return period: 50 (40-55)
Return period: 100 (89-120)
Average Intensity
STD Intensity
Low
High
Intensity
Elements-at-risk
Average Value
STD Value
Low
Costs
High
Vulnerability with uncertainty
1
0.5
0
Vulnerability
Low
Intensity
High
Risk curves: minimum, avergae and maximum
0.1
0.05
0.01
0
Temporal probability
Low
High
Loss = costs * vulnerability

Tools to evaluate best risk reduction alternatives

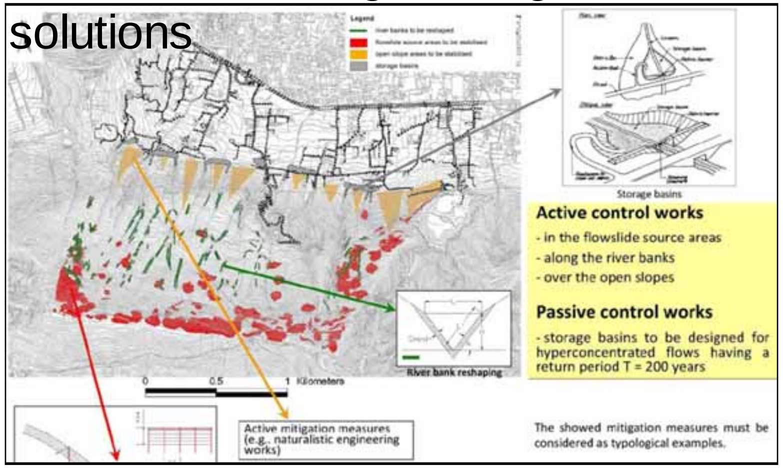
- Cost Benefit Analysis (CBA) is used to compare costs and benefits of a one specific measures or a set of alternative measures over a period of time for a. CBA assesses the measure(s) mainly on the basis of the efficiency criterion. It requires the monetization of all the effects. The effects that cannot be expressed in monetary terms will be usually described in their original unit of measurement.
- Cost Effectiveness Analysis: (CEA) has most of the features of CBA, but does not require the monetization of either the benefits or the costs (usually the benefits). CEA does not show whether the benefits outweigh the costs, but shows which alternative has the lowest costs (with the same level of benefits). CEA is often applied when the norm for a certain level of safety has been set. CEA analyzes which types of solution is the 'cheapest' given a certain level of safety standard.
- Multi Criteria Analysis (MCE) is a tool that allows comparing alternative measures on multiple criteria. In contrast to CBA, MCE allows the treatment of more than one criterion and does not require the monetization of all the impacts. MCE results in a ranking of alternatives.

Description of alternatives

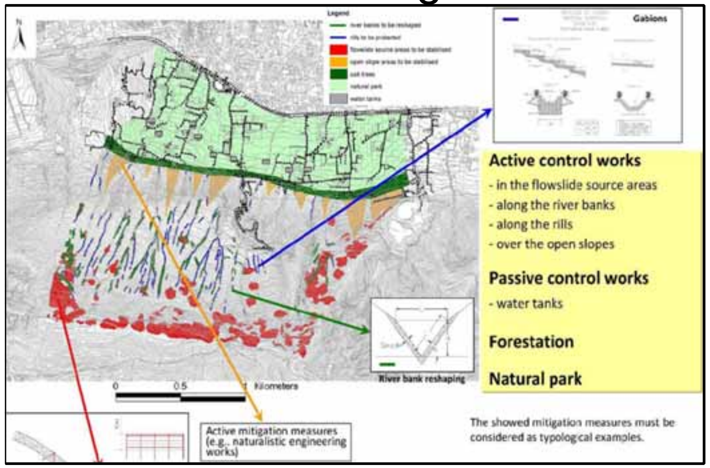
- A name
- A description text
- A map that illustrates the alternative. It is optional to use drawing tools to sketch the alternative first and then make a final one.
- Indicate whether hazard maps should be updated:
  - Which hazard will change?
  - Will return period change?
  - Will intensity change?
- Indicate whether elements at risk maps should be updated?
  - Which Elements at risk
  - Type, Use, Value, Vulnerability
- Status of the updating of the maps should be indicated.
- A report should be generated.

Alternative selection

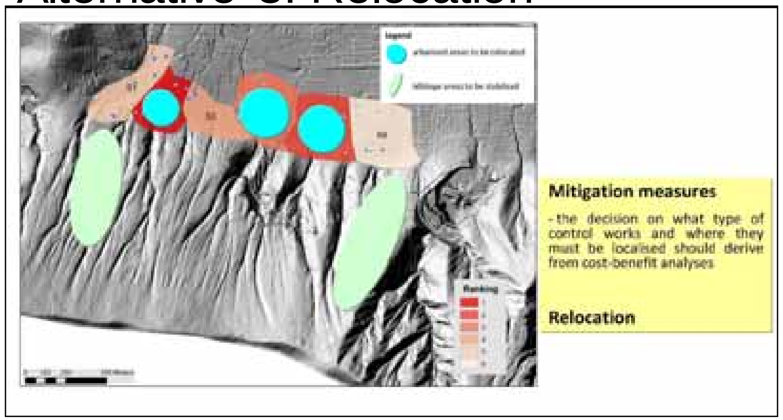
Alternative 1: Engineering solutions



Alternative 2: Ecological solutions



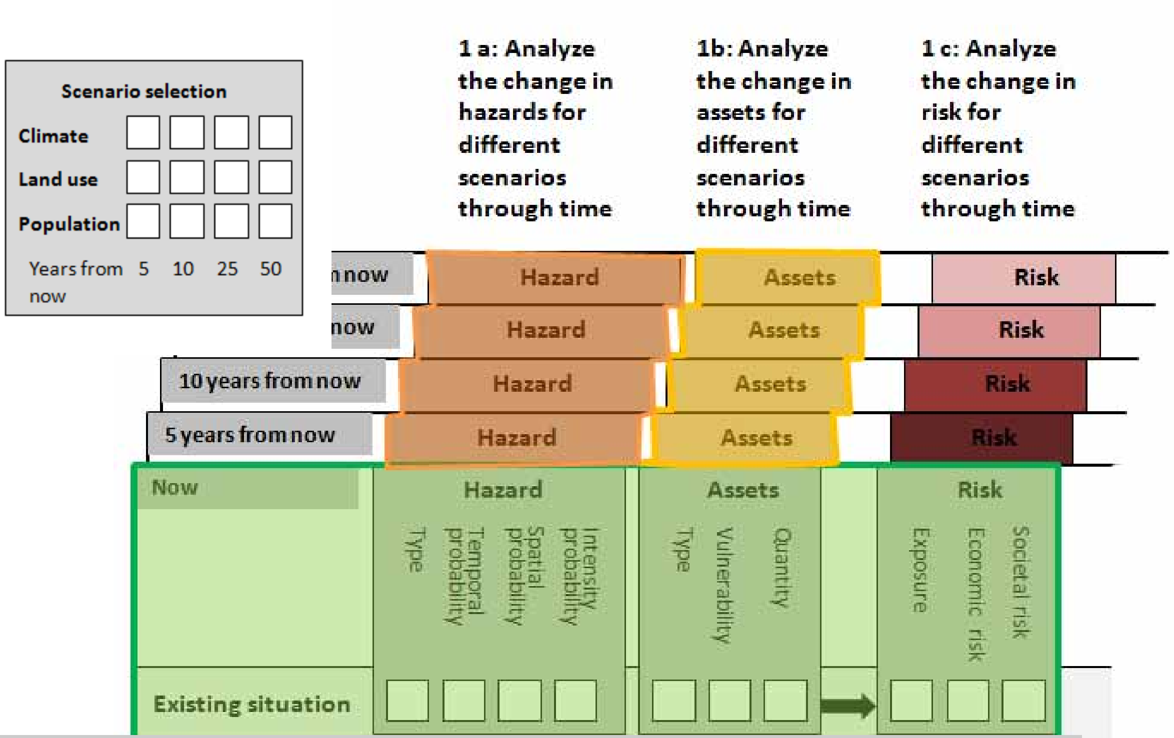
Alternative 3: Relocation

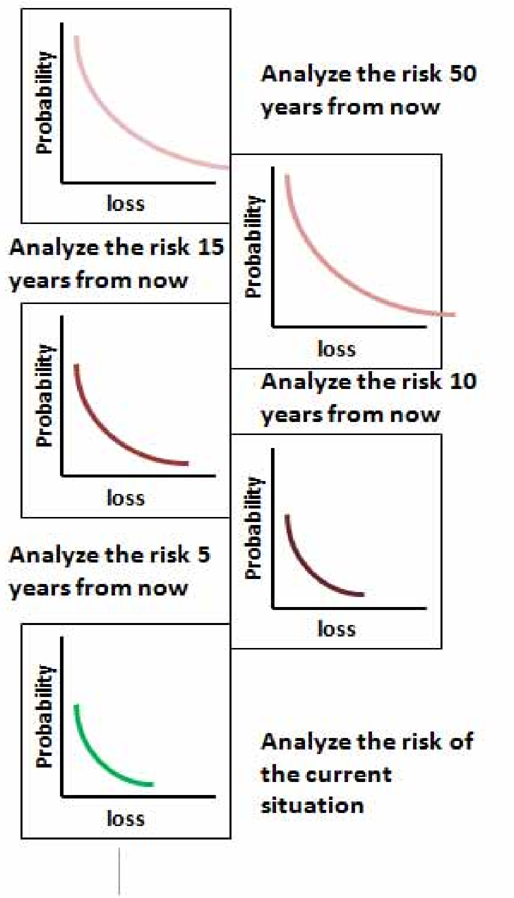


Multi-criteria evaluation

		Indicators		Alternatives		
		Indicators	Weight	1 (click to view)	2(click to view)	3(click to view)
Costs disadvantages	Factual	Construction cost in monetary values		3000000	5000000	10000000
		Maintenance costs, yearly		30000	50000	150000
		Implementation time		5	2	8
	Perception	Resistance by population		low	mod	high
		Political support		high	mod	low
		……				
		……				
		……				
Benefits Advantages	Factual	Risk reduction in monetary value		100000	400000	600000
		Risk reduction : in people killed		150	300	250
		Risk reduction : in people injured		600	800	900
		Internal Rate of Return		+	++	-
		Remaining number of exposed buildings				
		Remaining number of exposed people				
	Perception	Safety		mod	high	high
		Environmental effects		mod	low	high
		Economic opportunities		mod	mod	high
		…….				
			Final score			
			Priority	3	1	2

Scenario evaluation component





Scenario Guidance and Translation:
Each of the scenarios should have a "narrative" explaining the scenario in words and in figures (e.g. percentage change of certain features)