

# Concept of Integral Risk Management

Michael Bründl

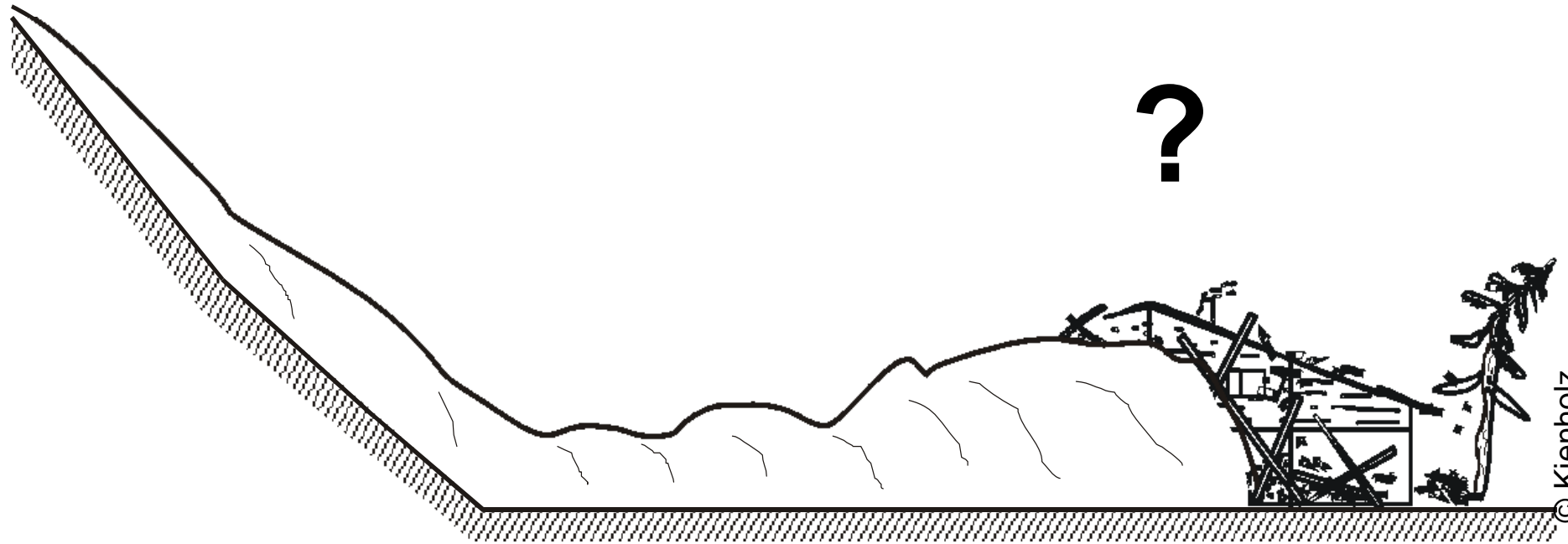
WSL – Swiss Federal Institute for Snow  
and Avalanche Research SLF

**Risk is a construct.**

# Outline

1. How we define risk? Why do we use the construct „risk“?
2. Components of risk-based dealing with natural hazards.
  - a. Risk analysis
  - b. Risk evaluation
  - c. Risk mitigation
3. Chances and Risks in the application.
4. Putting the risk concept into practice.
5. Conclusions and Outlook

# Disaster



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**Dangerous process**  
magnitude  
probability of occurrence

**Loss**  
value  
probability of presence  
vulnerability

# Definition of risk

**Risk** depends on

the **probability of occurrence** of a process, and  
the **expected loss**

$$R_{i,j} = f (p_{Si}, A_{Oj}, v_{Oj, Si}, p_{Oj, Si})$$

$R_{i,j}$  = risk

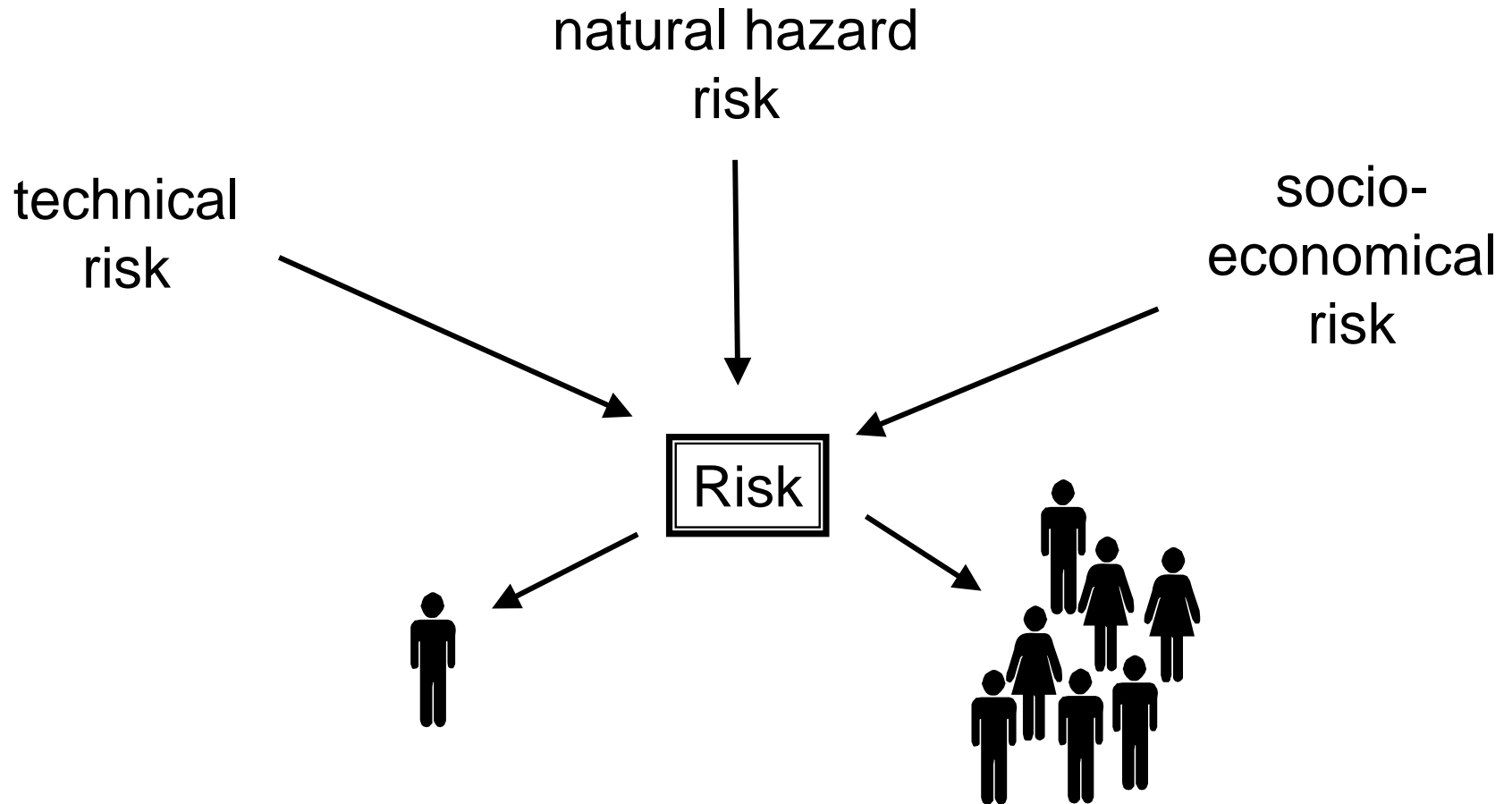
$p_{Si}$  = probability of occurrence of scenario  $i$

$A_{Oj}$  = value of object  $j$

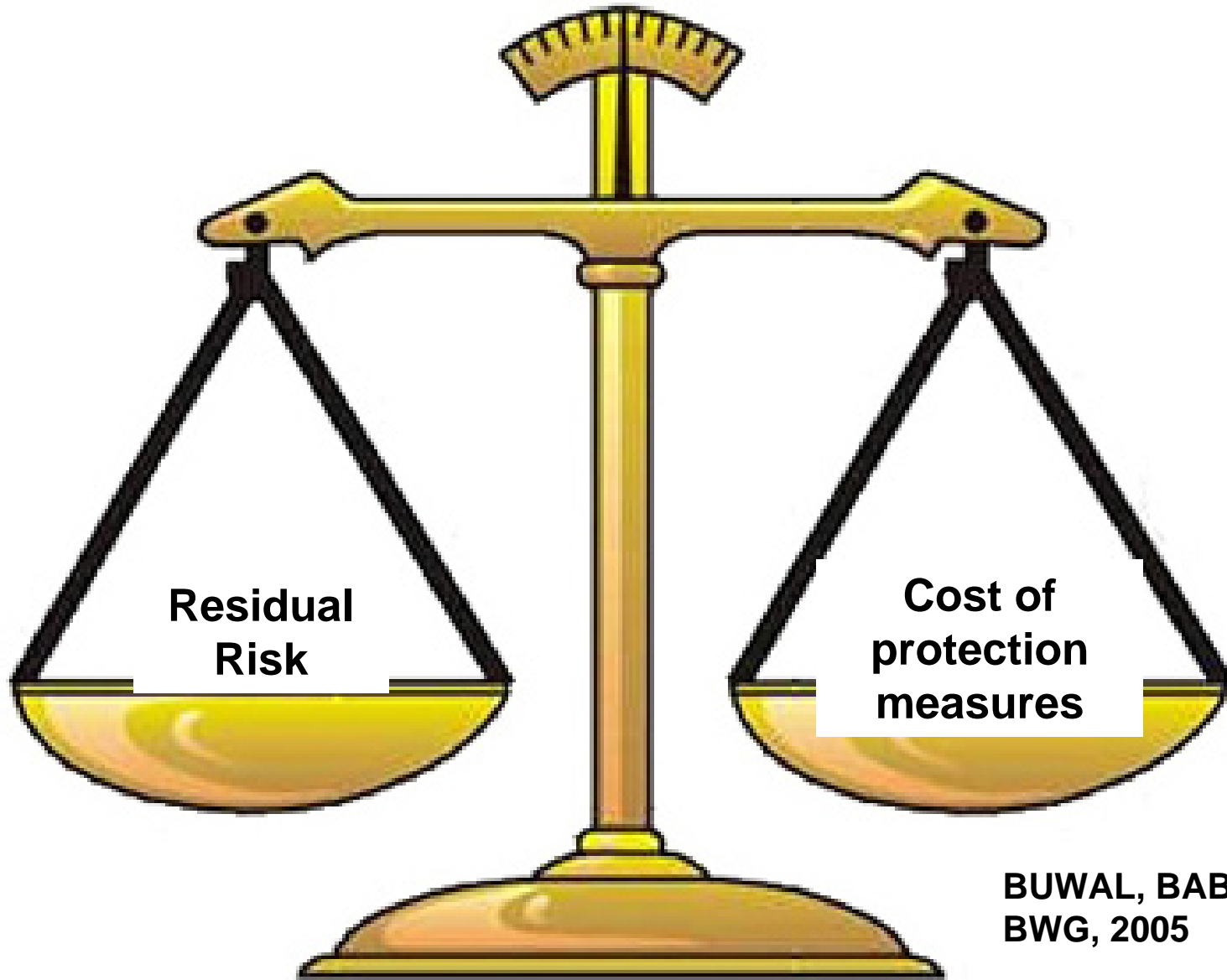
$v_{Oj, Si}$  = vulnerability of object  $j$  responding to scenario  $i$

$p_{Oj, Si}$  = probability of presence of object  $j$  responding to scenario  $i$

# Comparison of risk from different sources

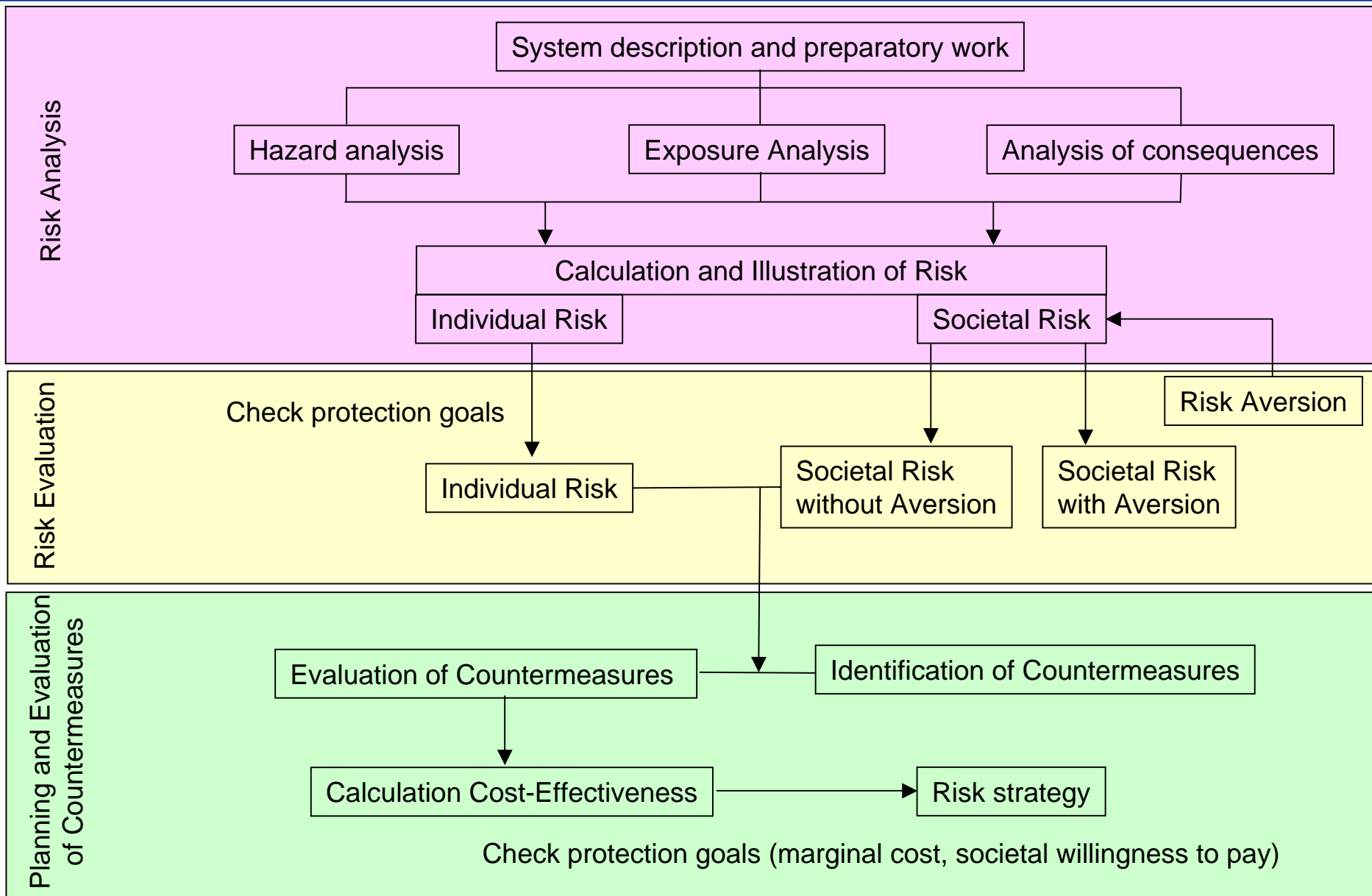


# Risk assessment as decision tool



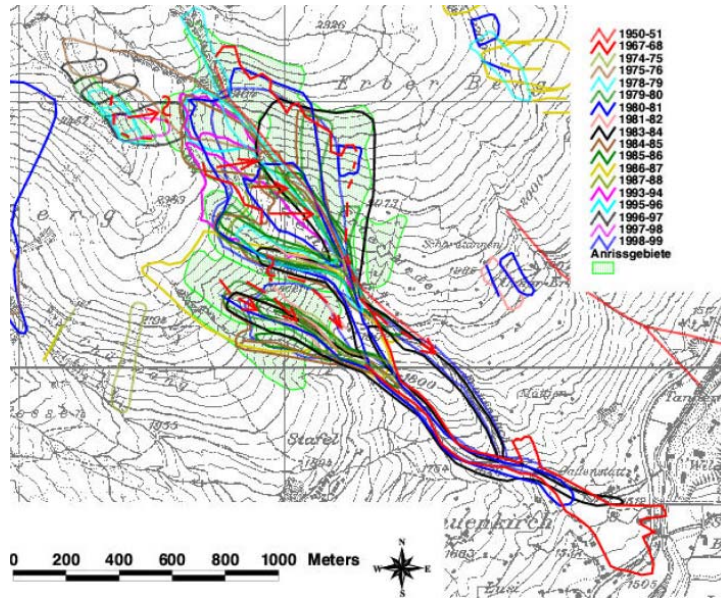
BUWAL, BABS und  
BWG, 2005

# Risk concept



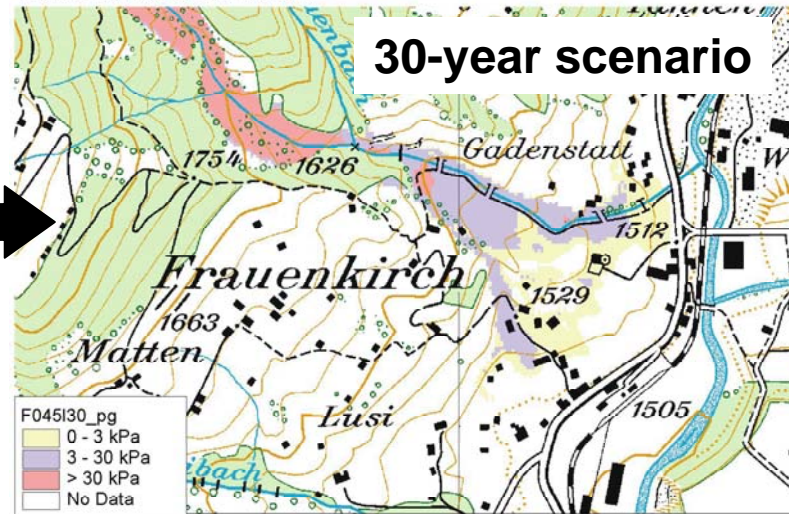


# Risk Analysis: Hazard analysis



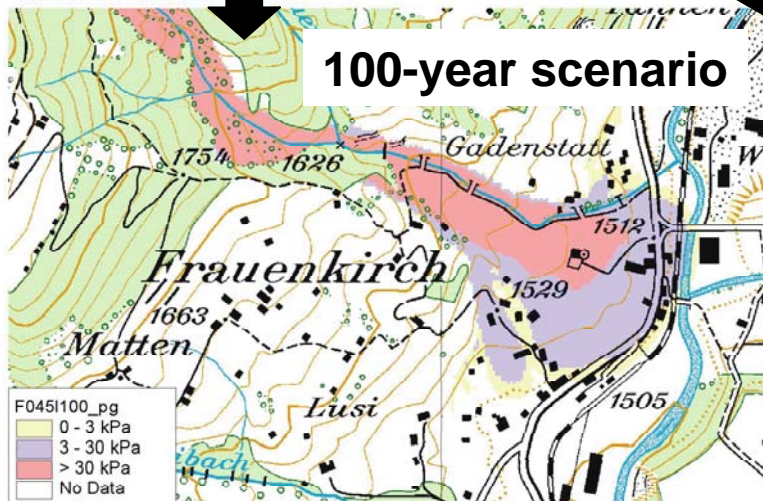
Druckzonen 30 jähriges Ereignis (Anriss A und B)

## 30-year scenario



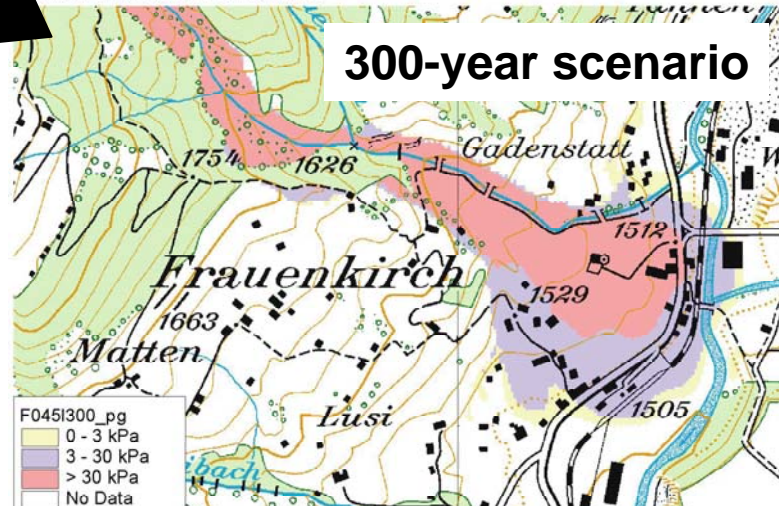
Druckzonen 100 jähriges Ereignis (Anriss A und B)

## 100-year scenario



Druckzonen 300 jähriges Ereignis (Anriss A und B)

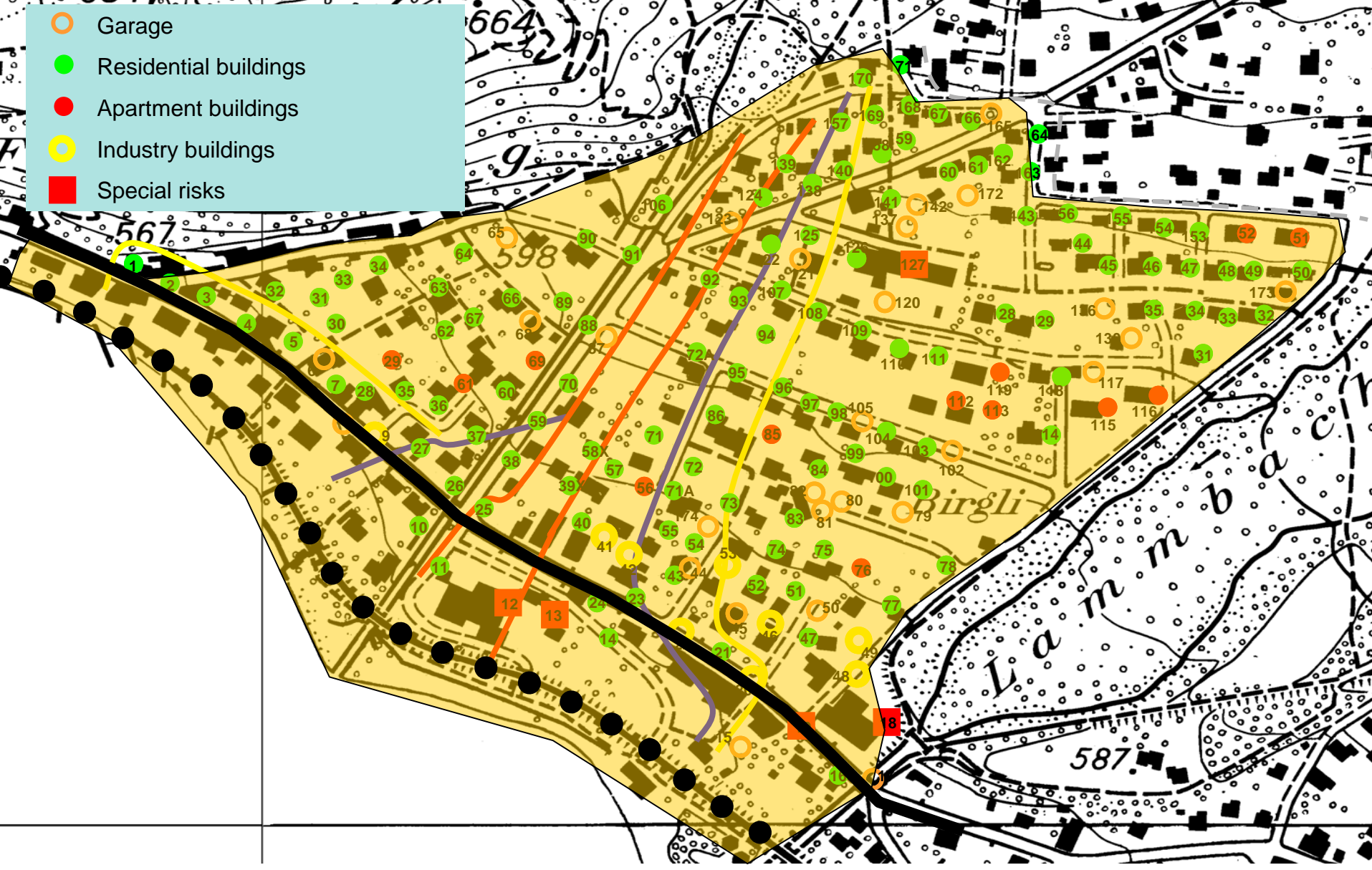
## 300-year scenario





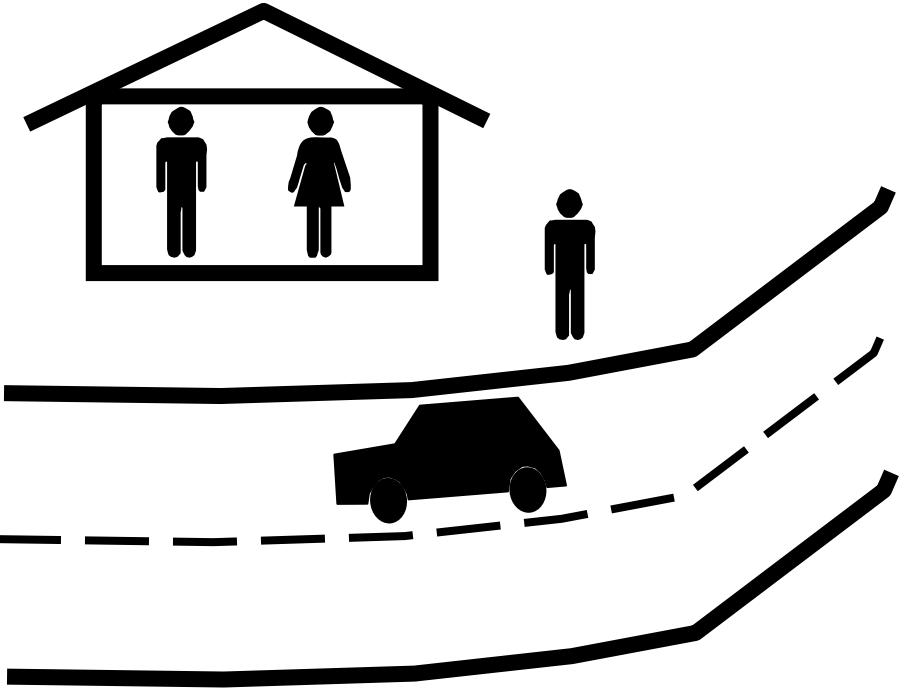
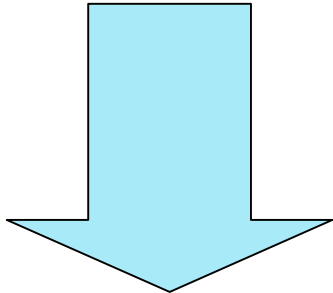
# Risk Analysis: Exposure analysis

- Garage
- Residential buildings
- Apartment buildings
- Industry buildings
- Special risks

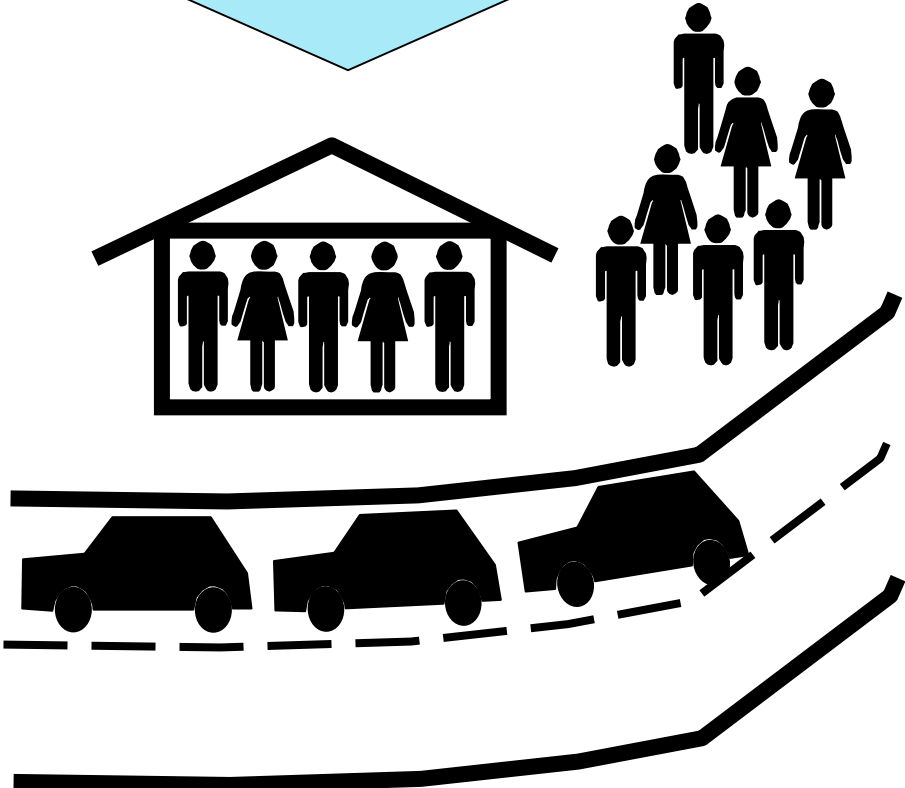
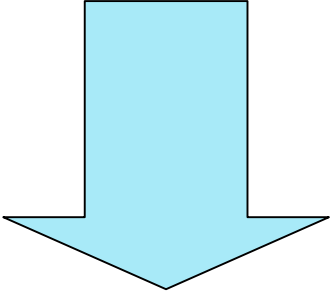


# Exposure analysis: varying number of persons

Situation 1



Situation 2



# Consequence analysis: calculation of damage

## Damage (scenario $i$ , object $j$ )

### Damage persons $Ap_{i,j}$

- residential buildings
- special buildings
- road traffic
- rail traffic
- cable cars
  
- persons outdoor

low  
intensity

medium  
intensity

high  
intensity

scenario (1, ..., n)

### Damage assets $As_{i,j}$

- residential buildings
- special buildings
- road traffic
- rail traffic
- cable cars
  
- power and comm. lines
- agriculture, parks, forest

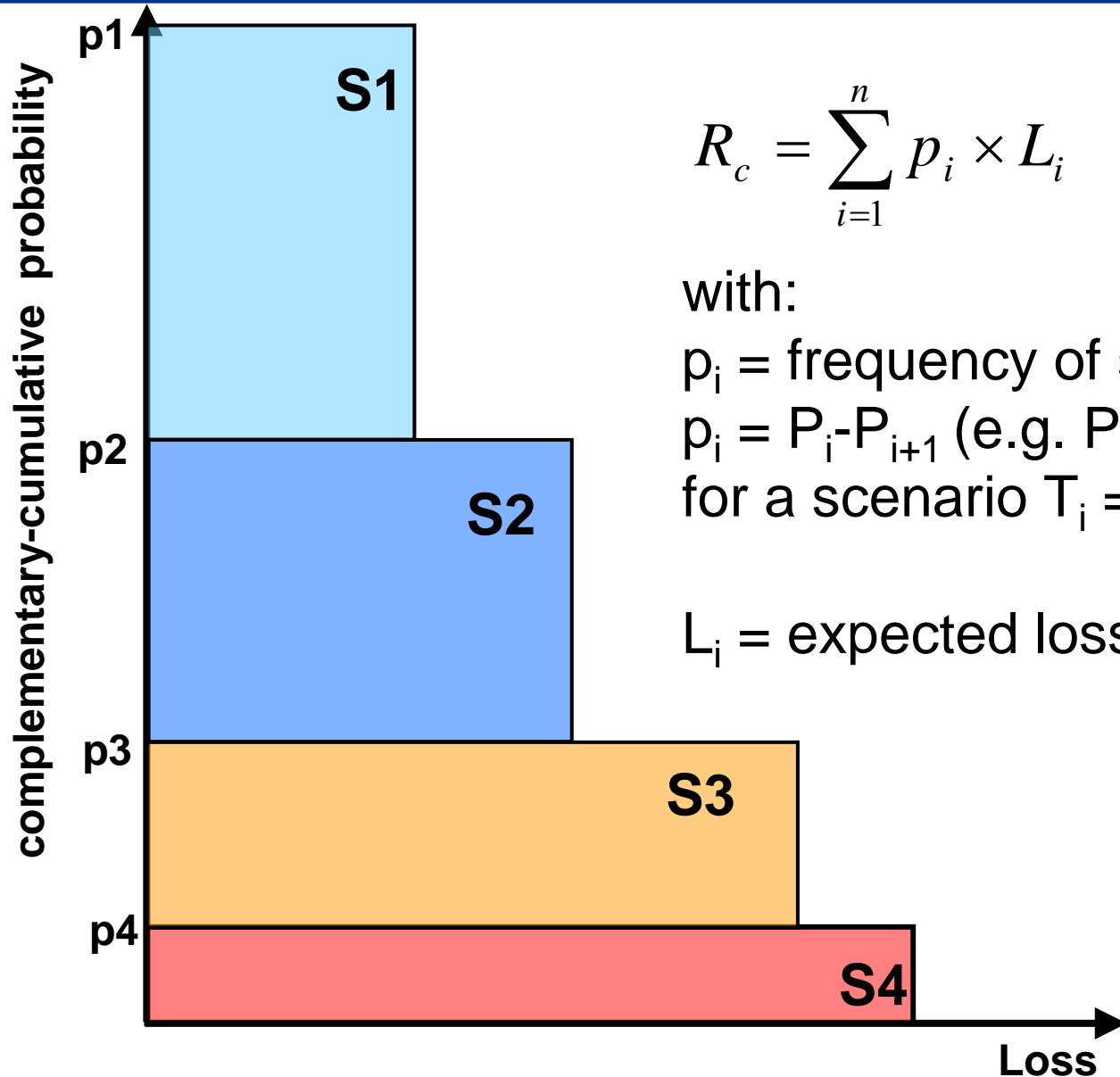
low  
intensity

medium  
intensity

high  
intensity

scenario (1, ..., n)

# Calculation of societal risk



$$R_c = \sum_{i=1}^n p_i \times L_i \quad \begin{array}{l} \text{[# fatalities/a]} \\ \text{[Euro/a]} \end{array}$$

with:

$p_i$  = frequency of scenario  $i$

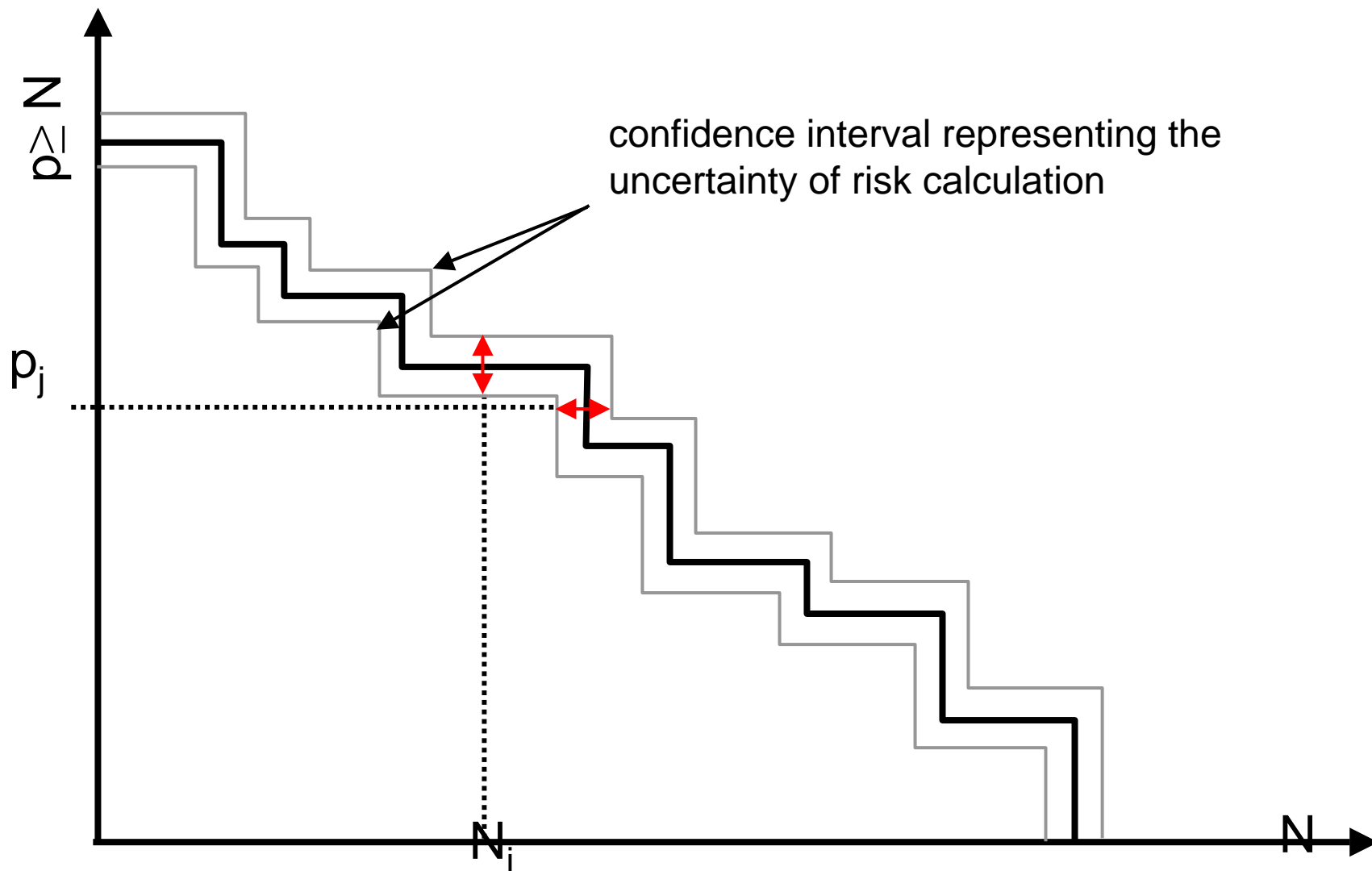
$p_i = P_i - P_{i+1}$  (e.g.  $P_i = 0.1$ ;  $P_{i+1} = 0.033$ ,  
for a scenario  $T_i = 10$  years)

$L_i$  = expected loss of scenario  $i$

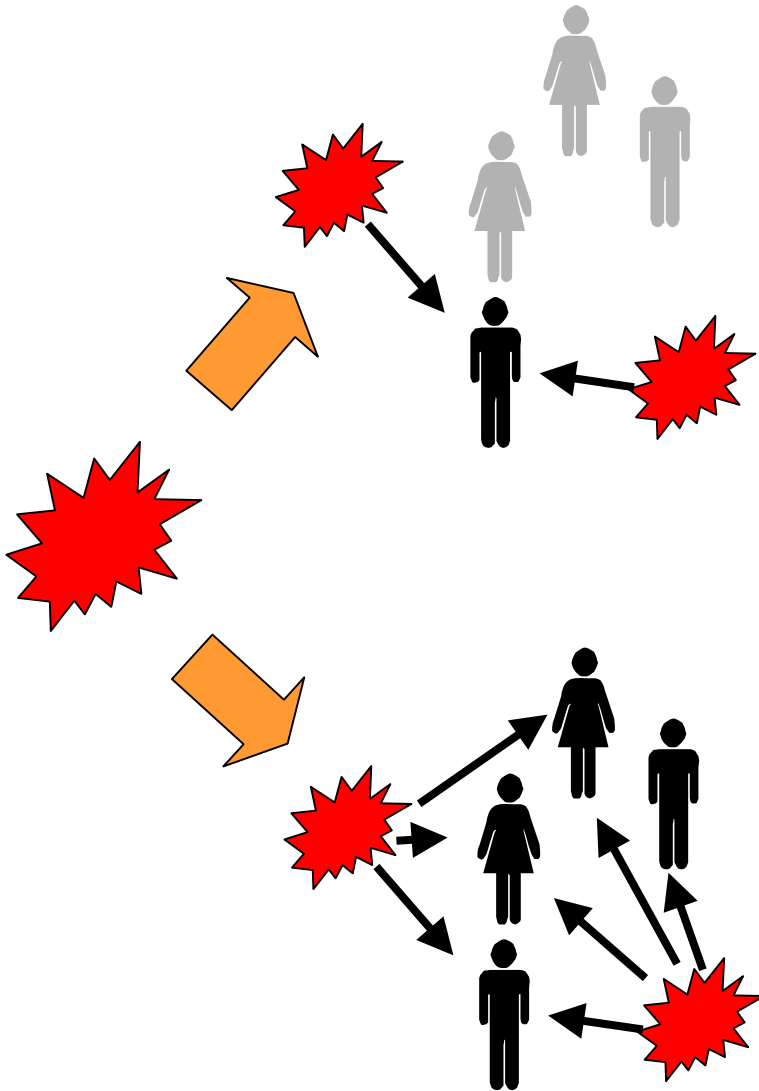
# Risk analysis: presentation of societal risk

*„A single number is not a big enough concept to communicate the idea of risk. It takes a whole curve.“ (Kaplan and Garrick, 1981)*

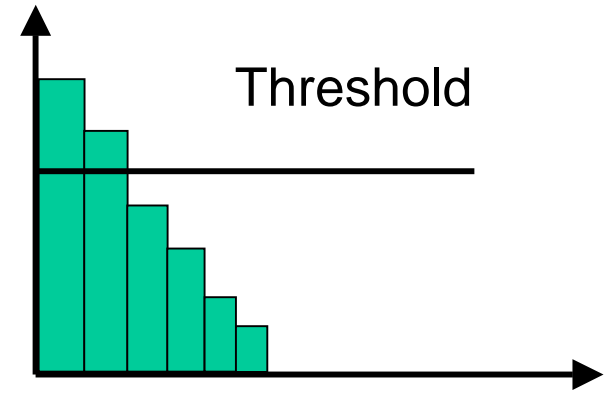
# Risk analysis: presentation of societal risk



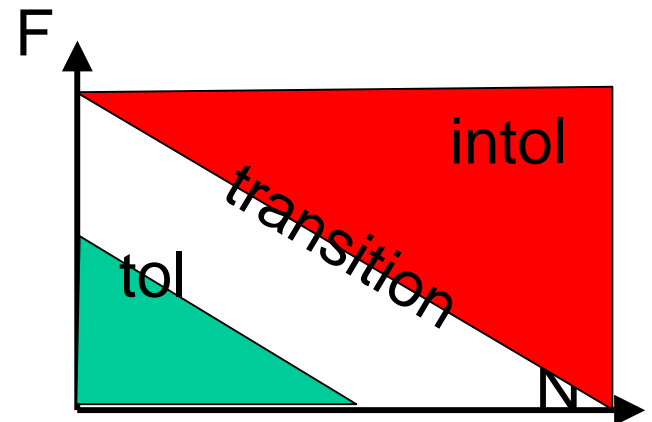
# Risk Evaluation



## Individual risk



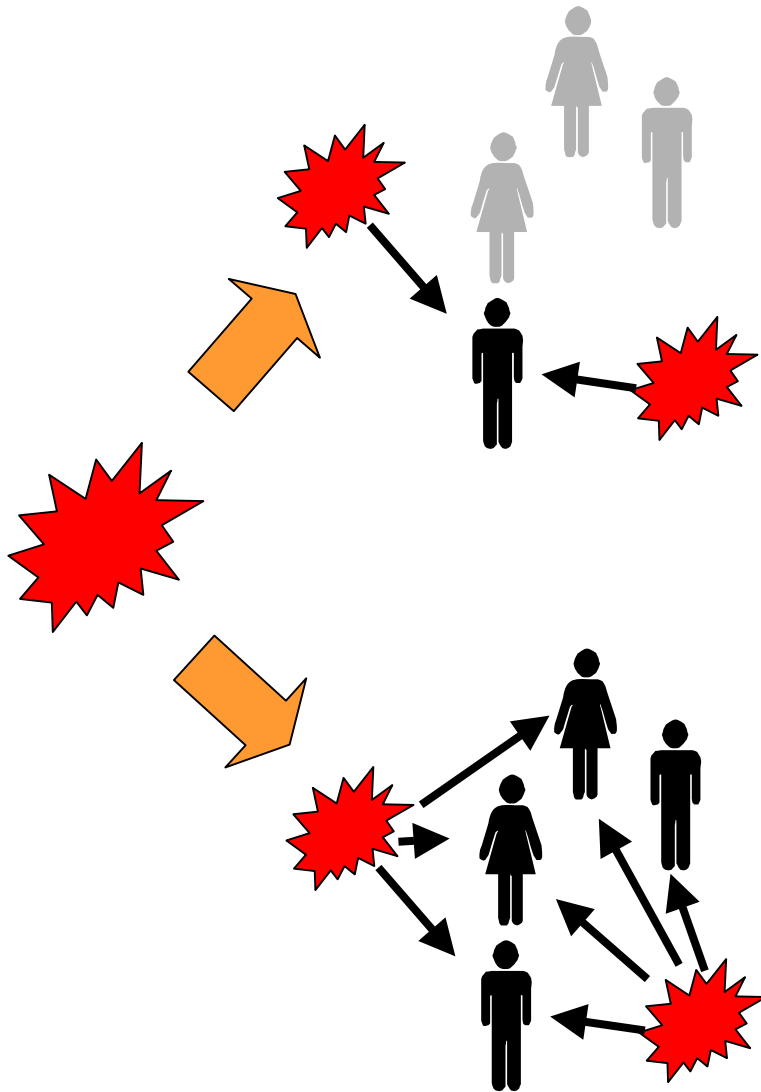
## Societal risk



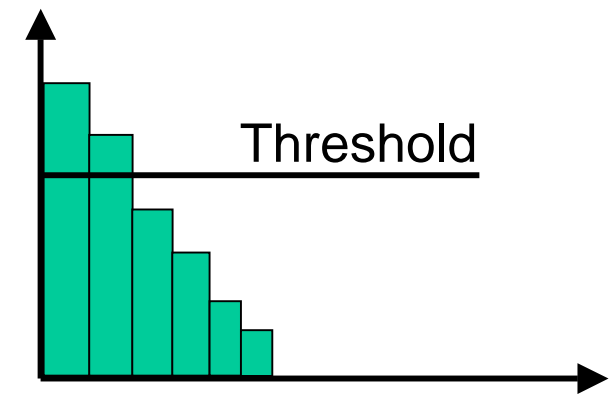
based on Schneider, 1984



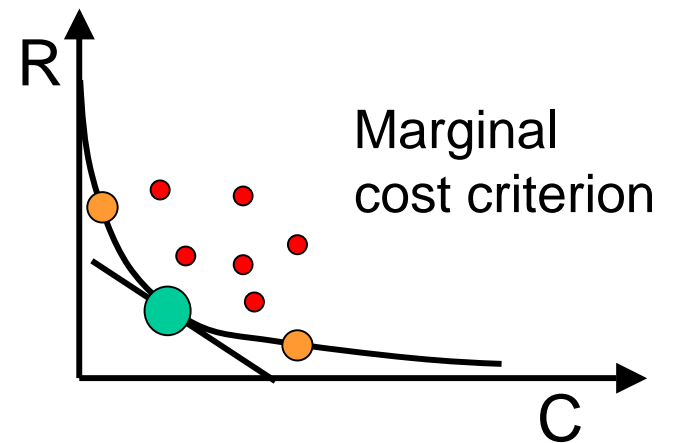
# Risk Evaluation



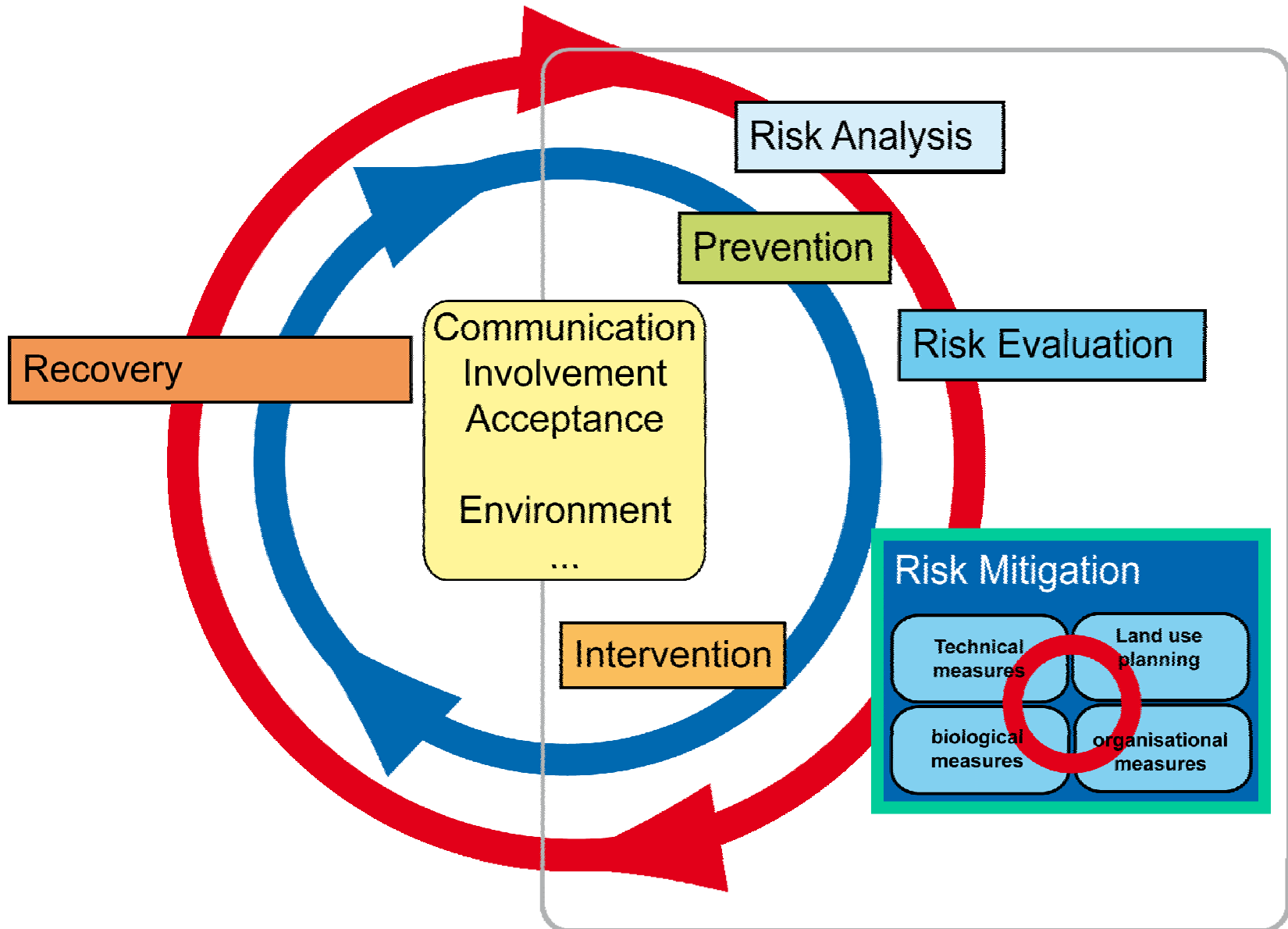
Individual risk



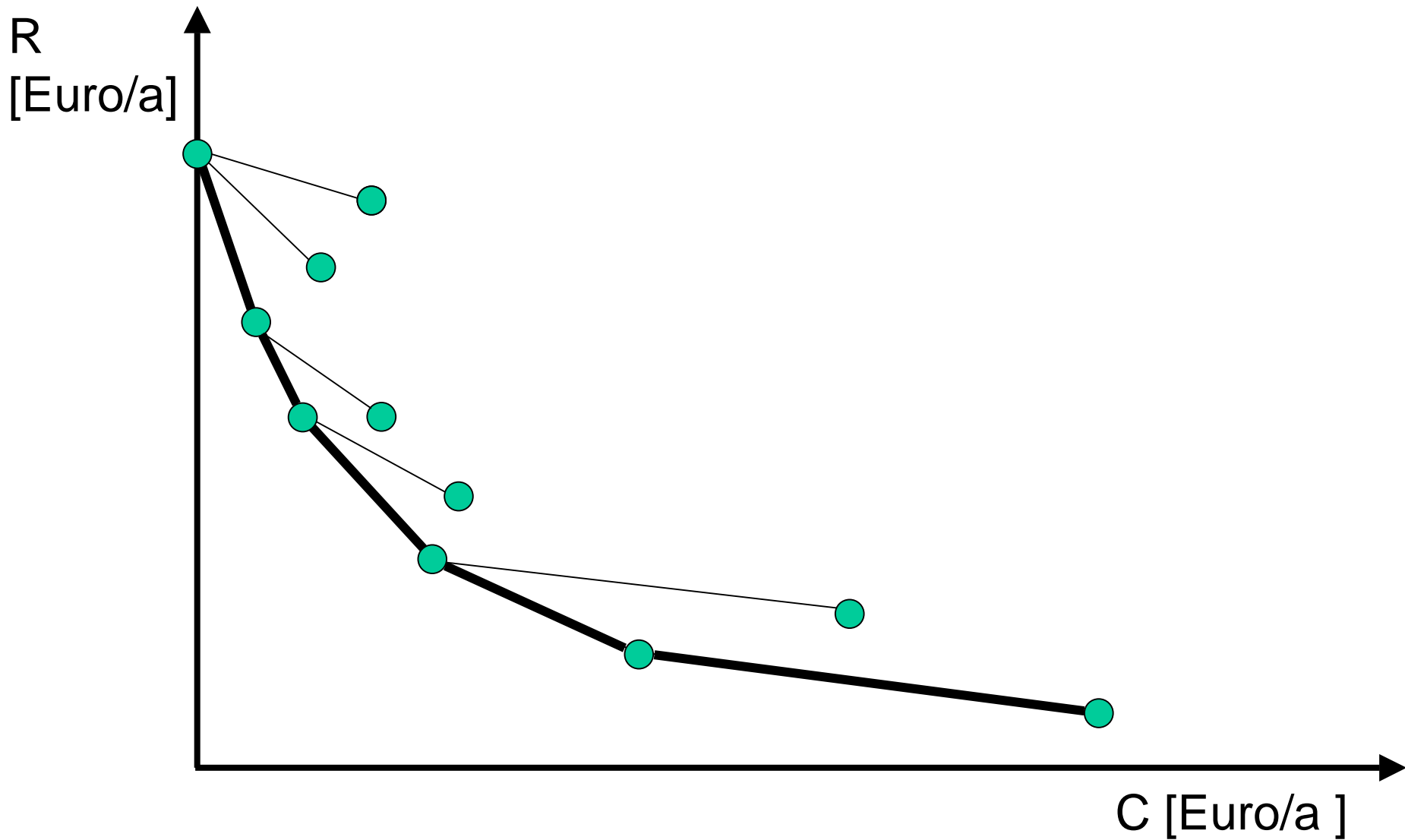
Societal risk



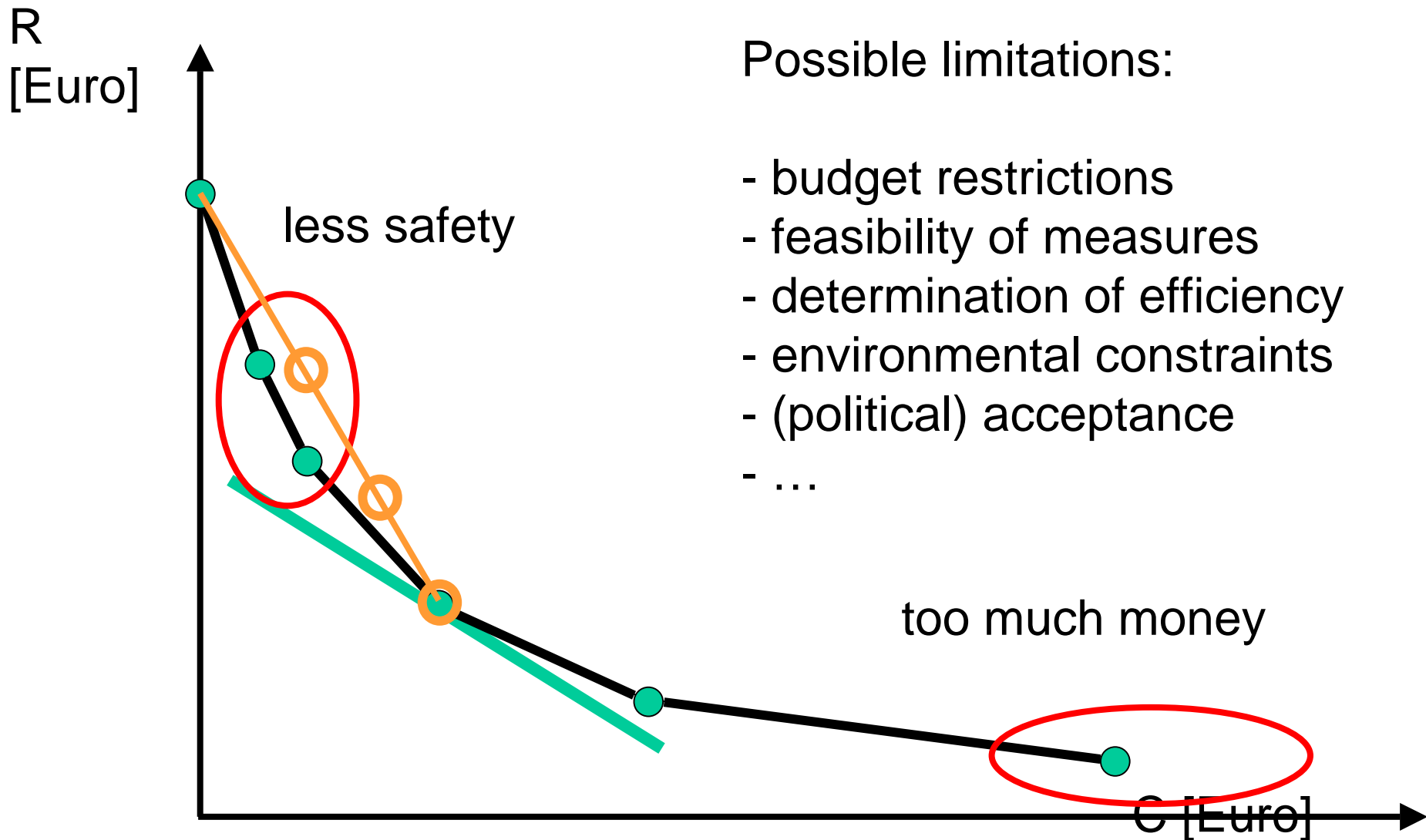
# Risk Mitigation as part of an integral approach



# Economic optimisation of protection strategy



# Economic optimisation of protection strategy



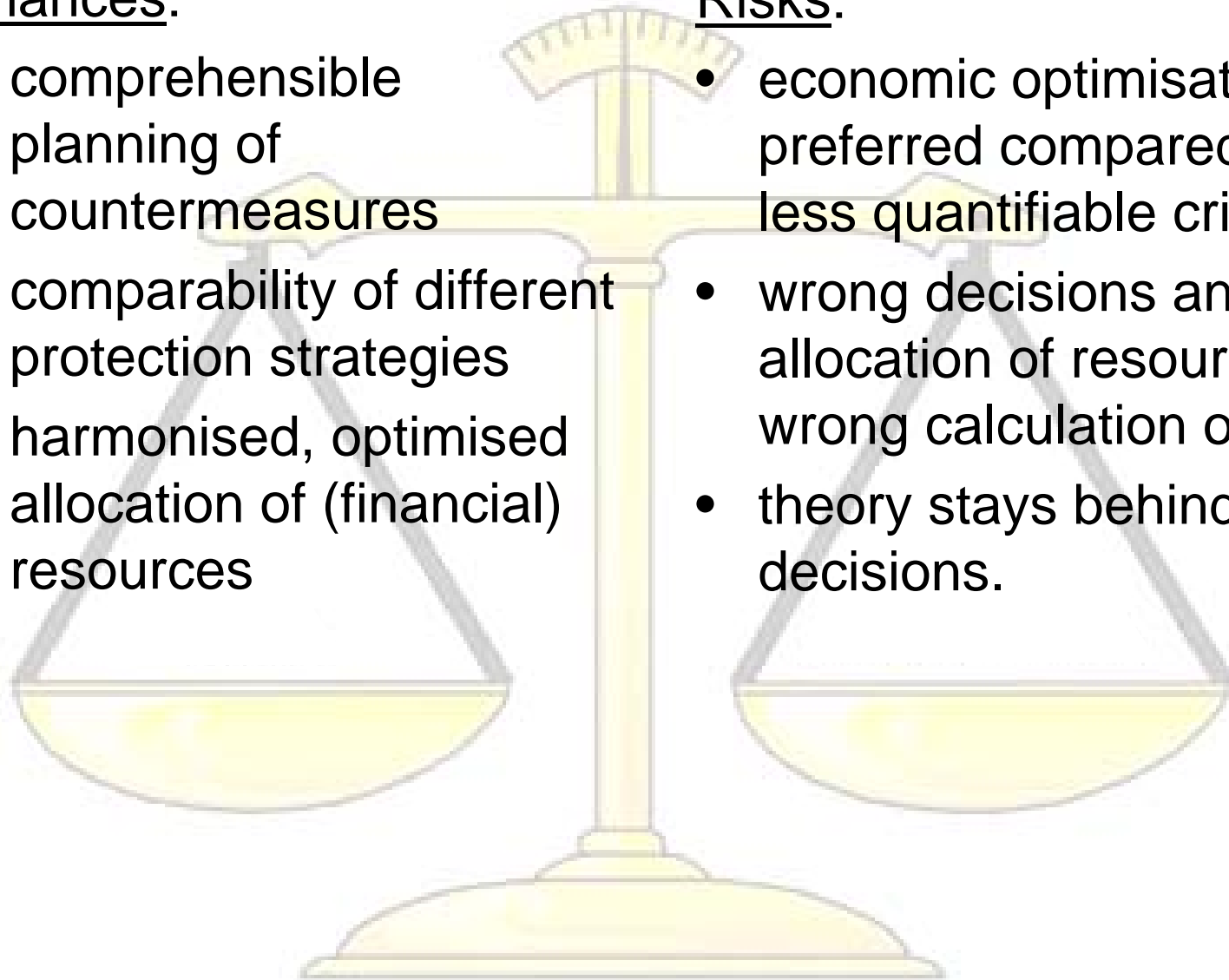
# Chances and risks

## Chances:

- comprehensible planning of countermeasures
- comparability of different protection strategies
- harmonised, optimised allocation of (financial) resources




























## Risks:

- economic optimisation is preferred compared to other less quantifiable criteria
- wrong decisions and allocation of resources by wrong calculation of risks
- theory stays behind political decisions.





Putting the risk concept into  
practice and education.

# RiskPlan as a tool for overview and sensitisation

Systemdefinition		Risikobeurteilung		Übersichten	
Cockpit Risikobeurteilung					
Istzustand		Schutzmauer am Weinberg		Stabilisierungsbau	
<input type="checkbox"/> Risikobeurteilung mit Gewichtung (Aversion)					
Istzustand	Risiken/Gefahrenprozesse		Risiken Region/Objektraum		
Regionen/Objekträume	Erdbeben im Hohenzollern Graben	Hagel	Risiko/Region bzw. Objektraum		
<b>Region Plüderhausen</b>	<b>Risiko Region/Jahr</b> Personen: 0 CHF Sachwerte: 0 CHF Gesamt: 0 CHF   	<b>Risiko Region/Jahr</b> Personen: 0 CHF Sachwerte: 0 CHF Gesamt: 0 CHF   	<b>Risiko Region gesamt/Jahr</b> Personen: 0 CHF Sachwerte: 0 CHF Gesamt: 0 CHF 		
<b>Wohngelände Plüderhausen Süd</b>	<b>Risiko Objektraum/Jahr</b> Personen: 0 CHF Sachwerte: 0 CHF Gesamt: 0 CHF 	<b>Risiko Objektraum/Jahr</b> Personen: 0 CHF Sachwerte: 0 CHF Gesamt: 0 CHF      	<b>Risiko Objektraum gesamt/Jahr</b> Personen: 0 CHF Sachwerte: 0 CHF Gesamt: 0 CHF 		
<b>Region Schorndorf</b>	<b>Risiko Region/Jahr</b> Personen: 2 905 000 CHF Sachwerte: 101 543 CHF Gesamt: 3 006 543 CHF   	<b>Risiko Region/Jahr</b> Personen: 2 250 000 CHF Sachwerte: 24 750 CHF Gesamt: 2 274 750 CHF   	<b>Risiko Region gesamt/Jahr</b> Personen: 5 155 000 CHF Sachwerte: 126 293 CHF Gesamt: 5 281 293 CHF 		
<b>Industriegebiet Schorndorf Rems-Ost</b>	Gesamt: 250 750 CHF	Gesamt: 2 274 750 CHF	Gesamt: 2 525 500 CHF		
<b>Wohngelände Schorndorf Nord</b>	Gesamt: 354 693 CHF	Gesamt: 0 CHF	Gesamt: 354 693 CHF		
<b>Erlensiedlung Schorndorf</b>	Gesamt: 1 016 600 CHF	Gesamt: 0 CHF	Gesamt: 1 016 600 CHF		
<b>Stadtzentrum</b>	Gesamt: 1 384 500 CHF	Gesamt: 0 CHF	Gesamt: 1 384 500 CHF		
<b>Risiko/Gefahrenprozess</b>	<b>Risiko Gefahrenprozess/Jahr</b> Personen: 2 905 000 CHF Sachwerte: 101 543 CHF Gesamt: 3 006 543 CHF  	<b>Risiko Gefahrenprozess/Jahr</b> Personen: 2 250 000 CHF Sachwerte: 24 750 CHF Gesamt: 2 274 750 CHF  	<b>Risiko Gesamt/Jahr</b> Personen: 5 155 000 CHF Sachwerte: 126 293 CHF Gesamt: 5 281 293 CHF 		

# EconoMe as tool for the practice

 Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra

 Schweizerische Eidgenossenschaft  
Confédération suisse  
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**Projektantrag** | **Dokumen**

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**Projektantrag** | **Dokumentation** | **Über EconoMe 1.0** | **EconoMe intern**

**EconoMe intern**

**Projekt Manager**

**Projektbearbeitung**

Benutzerverwaltung

Datei Manager

 **Log out**

**EconoMe intern**

**Projekt Manager**

**Projektbearbeitung**

Kostenwirksamkeit

 **Log out**

Bundesverwaltung admin.ch

Department für Umwelt, Verkehr, Energie und Kommunikation


Bundesverwaltung admin.ch

Department für Umwelt, Verkehr, Energie und Kommunikation

Bundesamt für Umwelt BAFU

Wirtschaftlichkeit von Schutzmassnahmen gegen Naturgefahren

[Deutsch](#) | [Français](#) | [Italiano](#)

<b>Projekt:</b>	 Bern - Brienz - Glyssibach - Glyssibach
<b>Bearbeiter:</b>	Bründl, Michael - Administrator BAFU - WSL-Eidg. Institut für Schnee- und Lawinenforschung SLF
<b>Bearbeitungsdatum:</b>	10.04.08, 14:47:46

## Schritt 10: Übersicht Risiken und Kosten

### Übersicht Schadenpotenzial

Schadenpotenzial Anzahl Personen	1098.23
Schadenpotenzial Personen (monetarisiert)	5 491 171 429 CHF
Schadenpotenzial Sachwerte	345 157 300 CHF
Schadenpotenzial Gesamt	5 836 328 729 CHF

### Risiken und Kosten der Massnahme Glyssibach

Risiko CHF/a	Risikobeitrag Szenario 30 in CHF/a	Risikobeitrag Szenario 100 in CHF/a	Risikobeitrag Szenario 300 in CHF/a	Gesamt
Vor Massnahme	103 879	660 739	436 677	1 201 294
Nach Massnahme	0	25 055	34 629	59 684
Risikoreduktion (Nutzen) CHF/a	103 879	635 684	402 048	1 141 611
			Massnahmekosten CHF/a	1 070 000
			<b>Nutzen/Kosten - Verhältnis</b>	<b>1,1</b>

11. Projektabschluss





# Conclusions and outlook

- The risk concept is a reasonable basis for decision making.
- Better knowledge on processes and behaviour of buildings and infrastructure will help to reduce uncertainties.
- Communication, education and the development of modern tools will help to make risk-based decision making an integrating part of dealing with natural hazards.
- Practical application of the risk concept demands software that enable the consultants a quick calculation.
- Integral risk management means not only to consider several natural hazard processes but to take all sources of risk into consideration.
- Integrated multi-risk management will become an important issue in future.

Thank you for your attention!

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