Floods in Europe

From Weather Conditions to Insurance

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Topics

Recent flood disasters

Flood types

Loss statistics and trends

Reasons for increasing losses

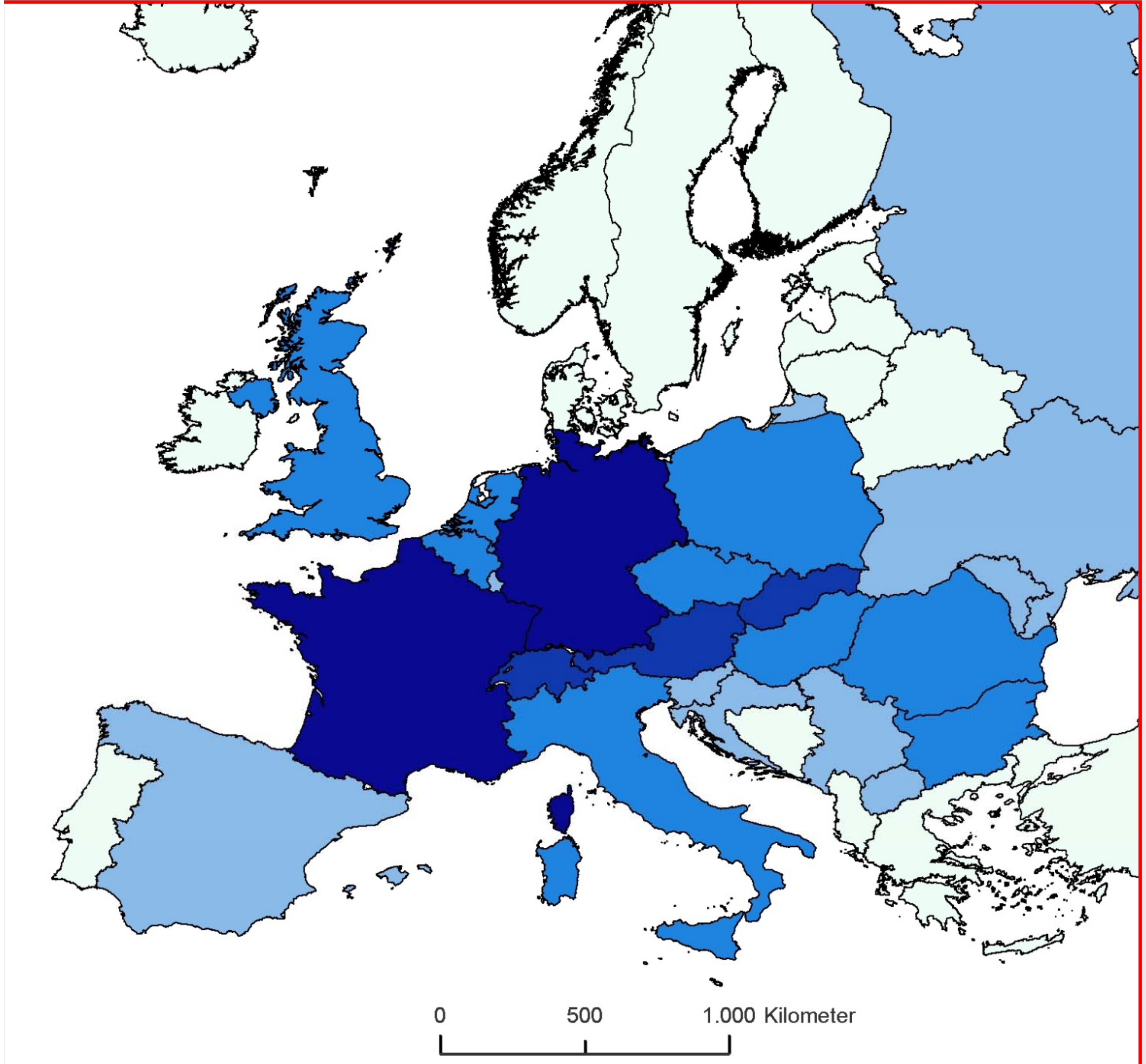
Flood risk reduction

Insurance aspects and flood risk modelling

Recent flood disasters

The costliest floods (> 500m US$) in Europe since 1993

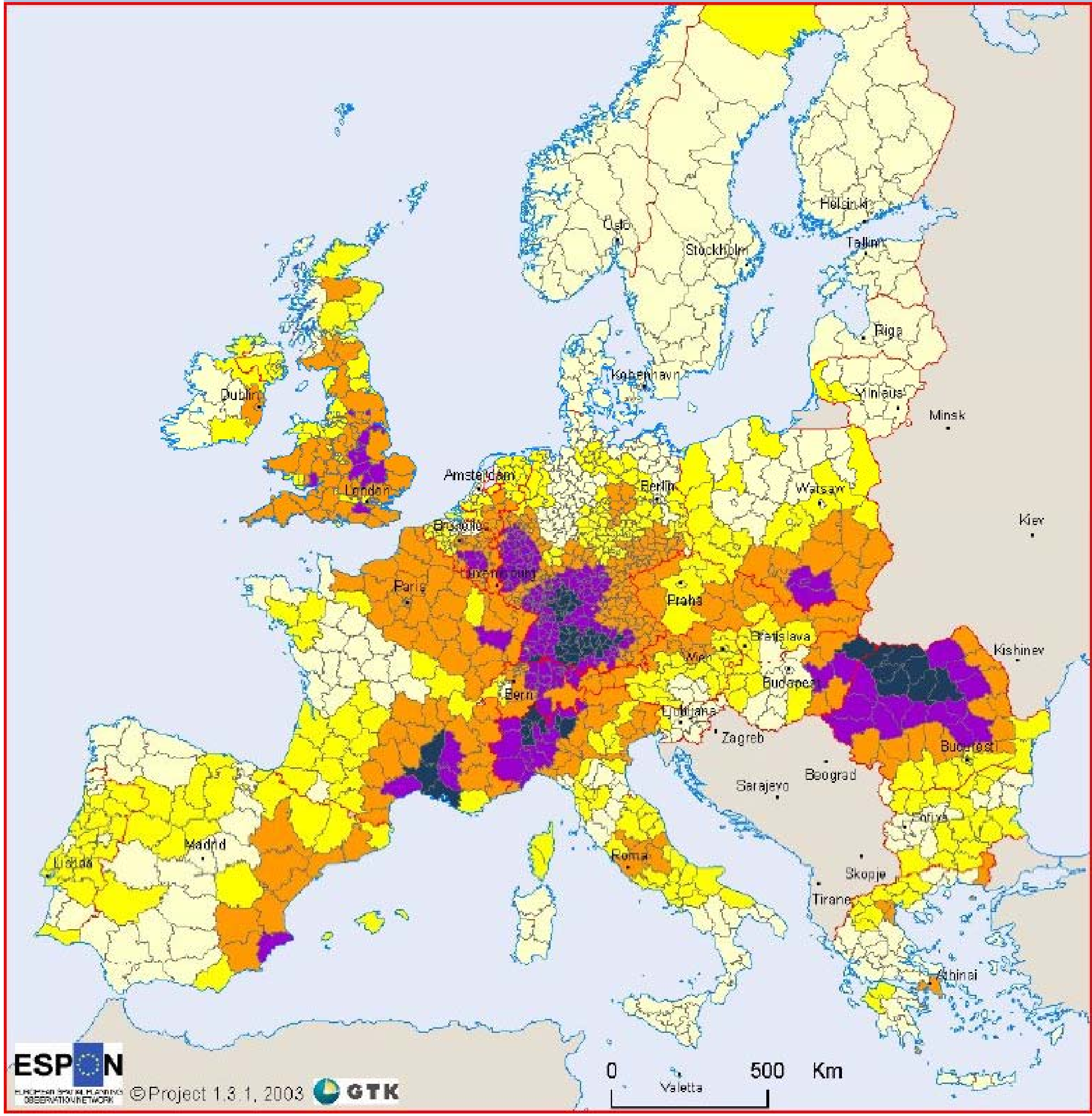
Original values, not adjusted for inflation, in US$ million:		total	insured	% insured
1993	France, Switzerland, N. Italy (W. Alps)	1,500	500	33
1993	Germany, Belgium, Luxembourg (Rhine)	2,000	800	36
1994	Italy (S. Alps)	9,300	65	< 1
1995	Germany, The Netherlands (Rhine)	3,500	910	26
1996	S. Spain, Portugal	1,080	-	-
1997	Czech R., Slovakia, Poland, Germany, Austria (Odra)	5,900	795	13
1998	Belgium, The Netherlands (Meuse)	530	2	< 1
1999	Austria, Czech R., Slovakia, Hungary, Yug., Rom., Poland	600	40	7
2000	Italy, Switzerland (S. Alps, Po)	8,500	470	6
2000	United Kingdom	1,500	1,100	**73**
2001	Poland, Slovakia	700	30	4
2002	Germany, Austria, Italy, Czech R., Hungary, Slovakia, Romania, Bulgaria, Ukraine, Russia (Danube, Elbe)	21,500	3,400	16
2002	France (Rhone)	1,200	700	**58**
2003	France (Rhone)	1,600	900	**56**
2005	Romania, Bulgaria (Danube)	2,440	15	< 1
2005	Switzerland, Austria, Germany, Slovenia (N. Alps)	3,300	1,760	**53**
2006	Central and Eastern Europe (Danube)	500	50	10
2007	United Kingdom (twice)	8,000	6,000	**75**



Countries affected in the 25 costliest floods since 1993

0	times
1 - 2	times
3 - 4	times
5 - 6	times
7 - 9	times

Munich Re NatCatService 2008



Large river flood hazard intensity in Europe

(ESPON 2006 – based on data 1987-2003)

Flood hazard intensity

- Very low
- Low
- Moderate
- High
- Very high
- Non ESPON space

ESPON 2006: European Spatial Planning Observation Network

Flood types

Flood types

Storm surge

Cause:	high water level due to superposition of high tide and wind setup, additionally high waves
Conditions:	strong wind towards the coast for many hours
Exposed areas:	coastal areas
Possibilities of forecast:	good (several hours up to one day)
Duration:	usually < 1 day
Damage factors:	- salt water (corrosive) - wave forces
Losses:	- very low frequency (high standard of coastal protection) - extremely high loss potential

Flood types

River flood

Cause:	long-duration rainfall with high depth over a large area (sometimes snowmelt)
Conditions:	soil naturally sealed by previous rainfall or frost
Exposed areas:	floodplains and valley grounds
Possibilities of forecast:	depending on the characteristics (size, shape) of the catchment area (from several hours to days)
Duration:	days to weeks
Damage factors:	- long-lasting impact of water - contamination of the water (e.g.oil)
Losses:	- low frequency - high loss potential

Flood types

Flash flood

Cause:	intense (often local) precipitation (thunderstorm)
Conditions:	none
Exposed areas:	practically everywhere
Possibilities of forecast:	only via rainfall forecast (uncertain to hardly feasible)
Duration:	hours (minutes)
Damage factors:	- mechanical effects of fast flowing water - sometimes much sediment
Losses:	- high frequency (not at the same location) - mostly relatively small losses from single events

Loss statistics and trends

Munich Re NatCat*SERVICE*

The world‘s greatest data base for losses from natural catastrophes

- **systematic collection of NatCat data since 1980**
- **retrospective findings for events before 1980**
- **information for all GREAT natural catastrophes since 1950**
- **all important natural catastrophes in history since 79 AD (destruction of Pompeii)**

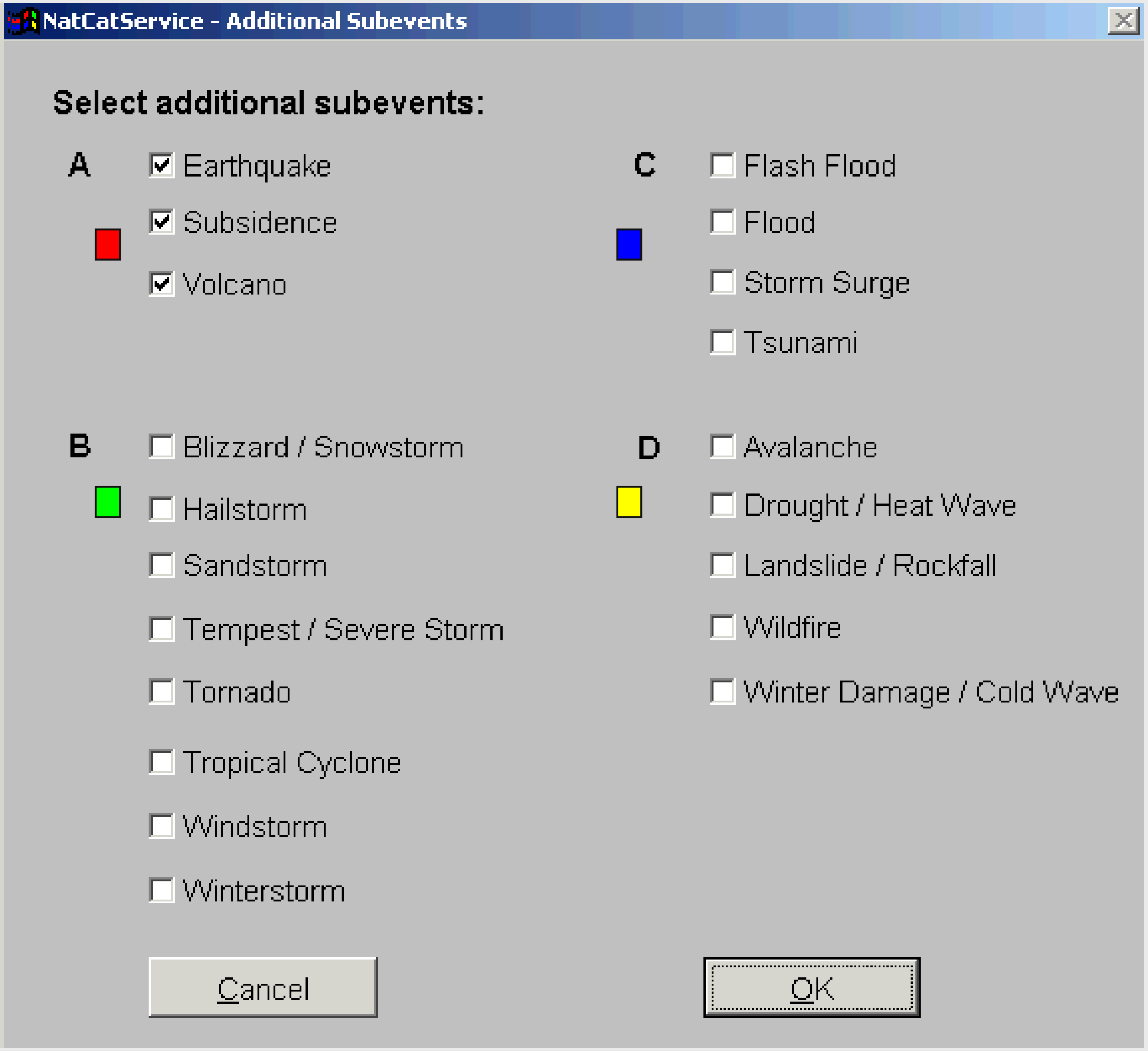
Classification of natural catastrophes in four event groups

A Geophysical events

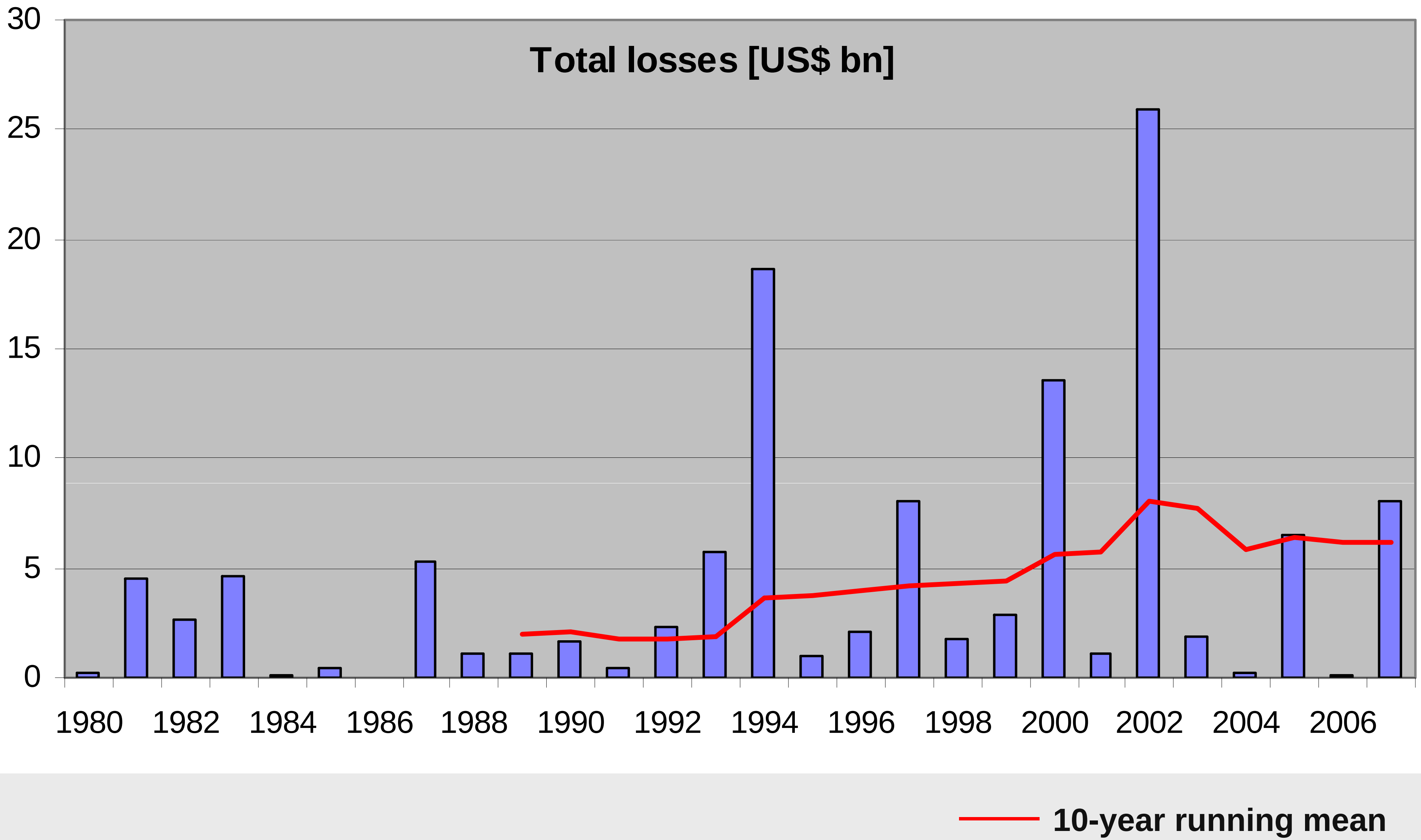
B Windstorms

C Floods

D others

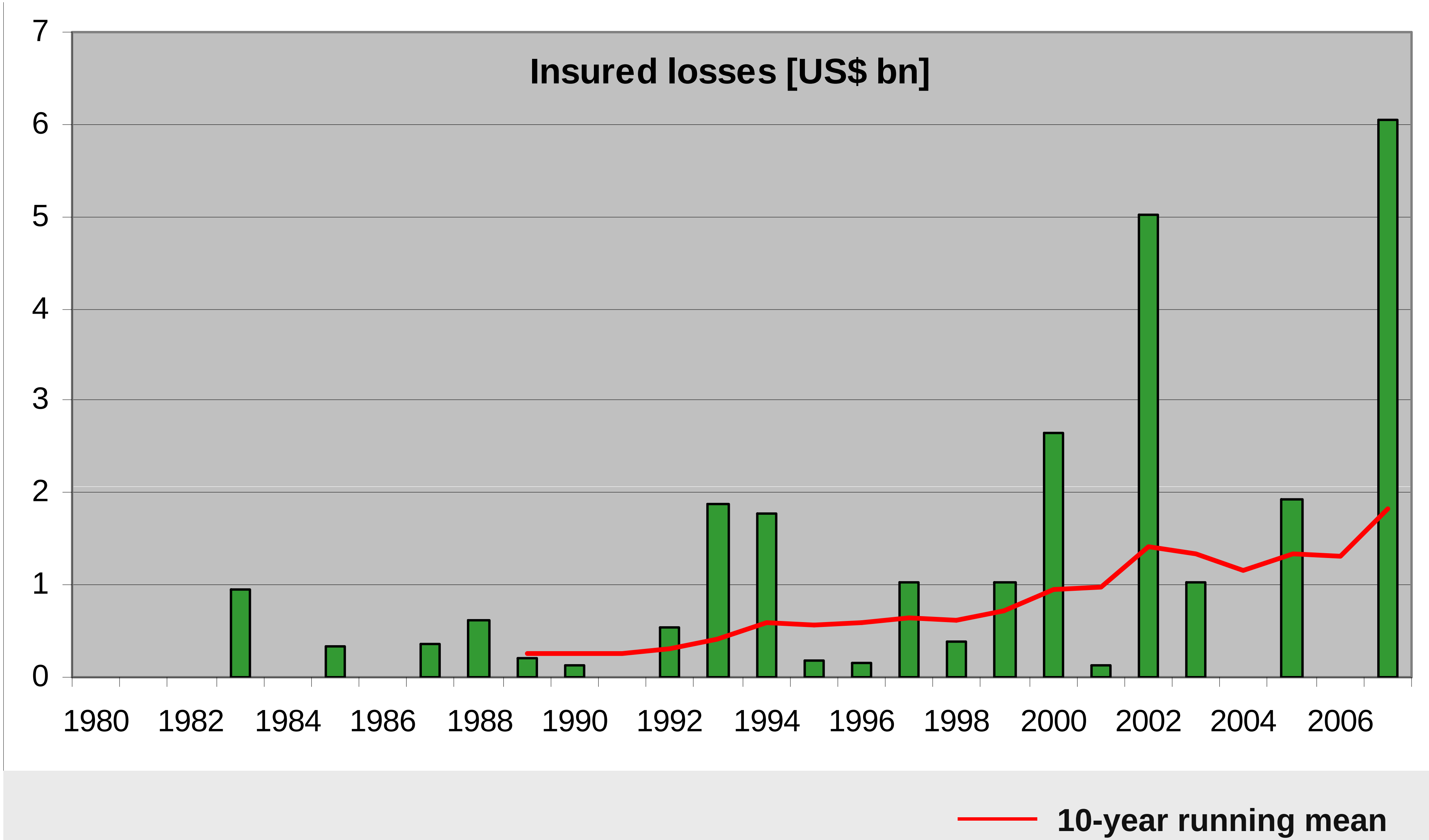


Flood losses in Europe



As at: February 2008

Flood losses in Europe



As at: February 2008

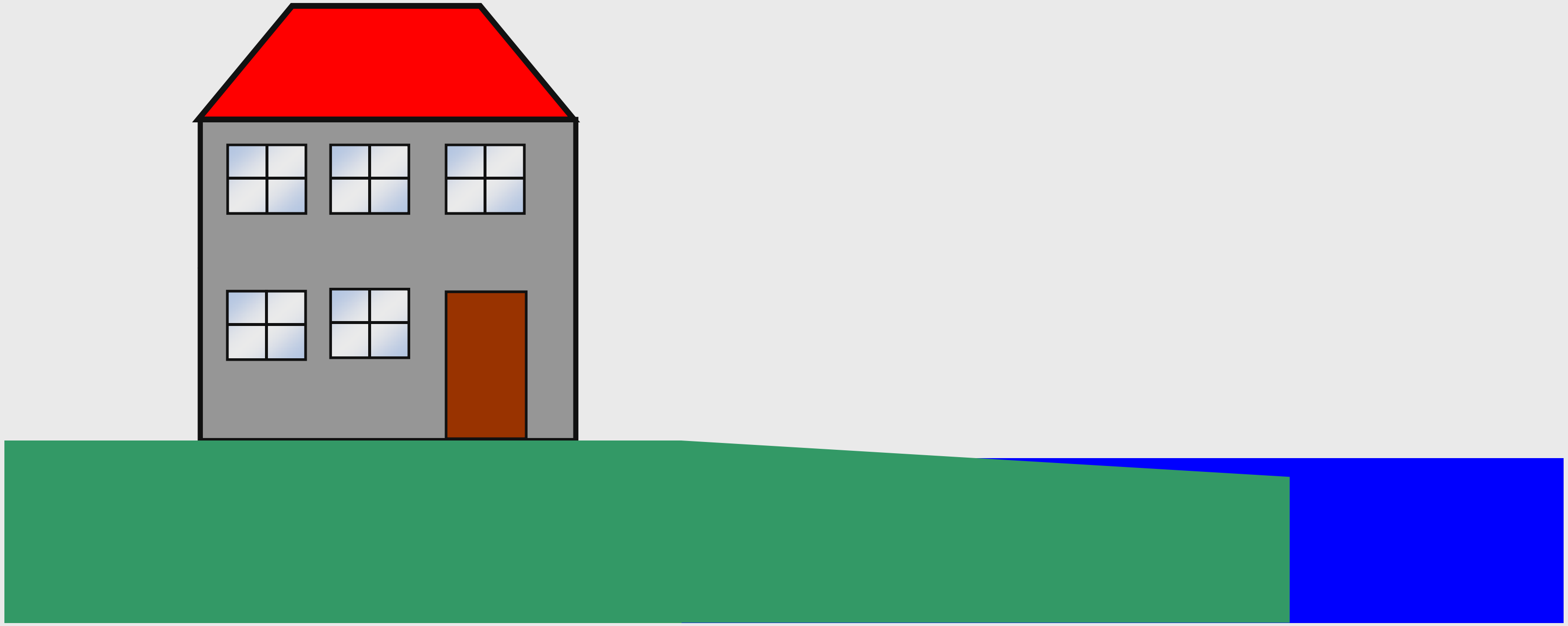
Reasons for increasing losses

- **Population trends**
- **Change in environmental conditions** (deforestation, conversion of natural areas to cropland, etc.)
- **Land-use changes** (loss of retention, “anthropogenic sealing“)
- **Settling on flood-plains** (inexpensive, attractive, easy to develop)
- **Access to water** (processing, cooling, shipping)
- **High accumulation of values**
- **More values in the lower parts of buildings**
- **Higher vulnerability of values**
- **Less risk awareness and risk perception** („the feeling of safety behind the dyke“)
- **Climate change** (more extremes, more loss events)

Effect of flood control measures

without flood control

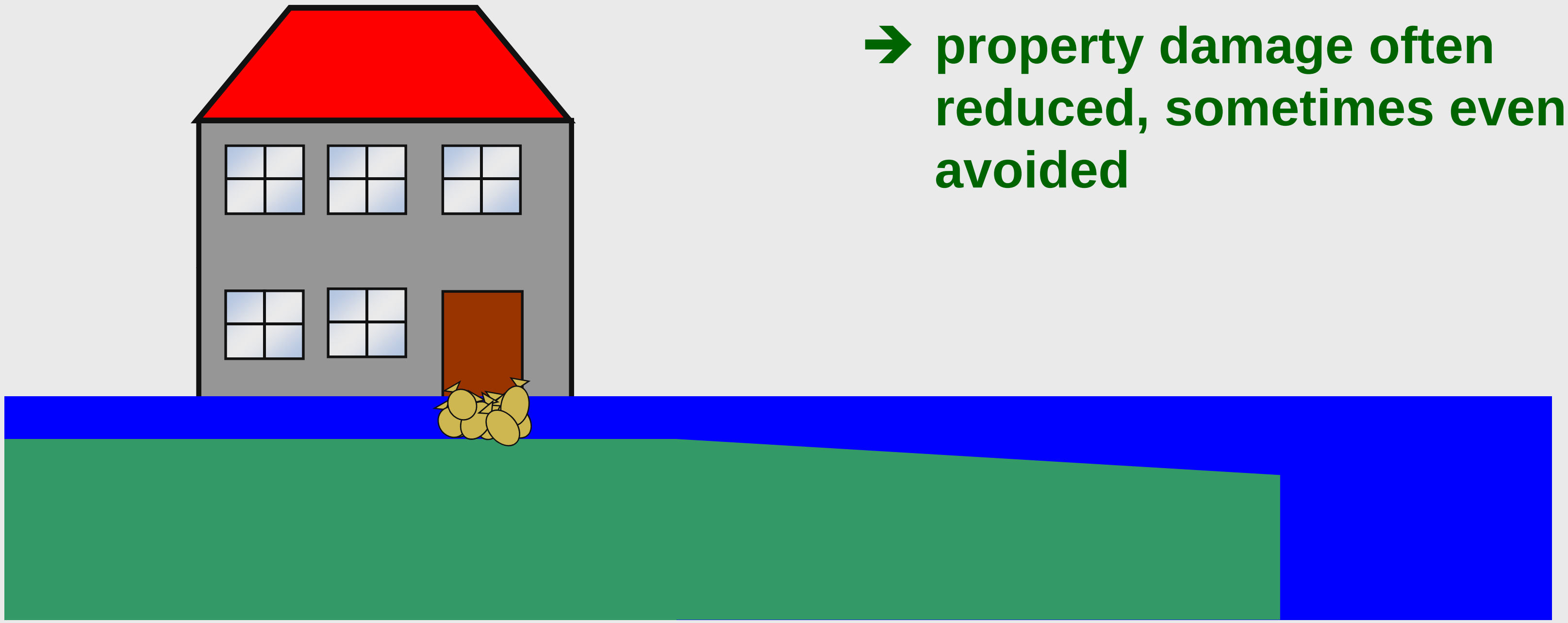
T = 4 h



Effect of flood control measures

without flood control

T = 8 h



➔ surface flooding

➔ property damage often reduced, sometimes even avoided

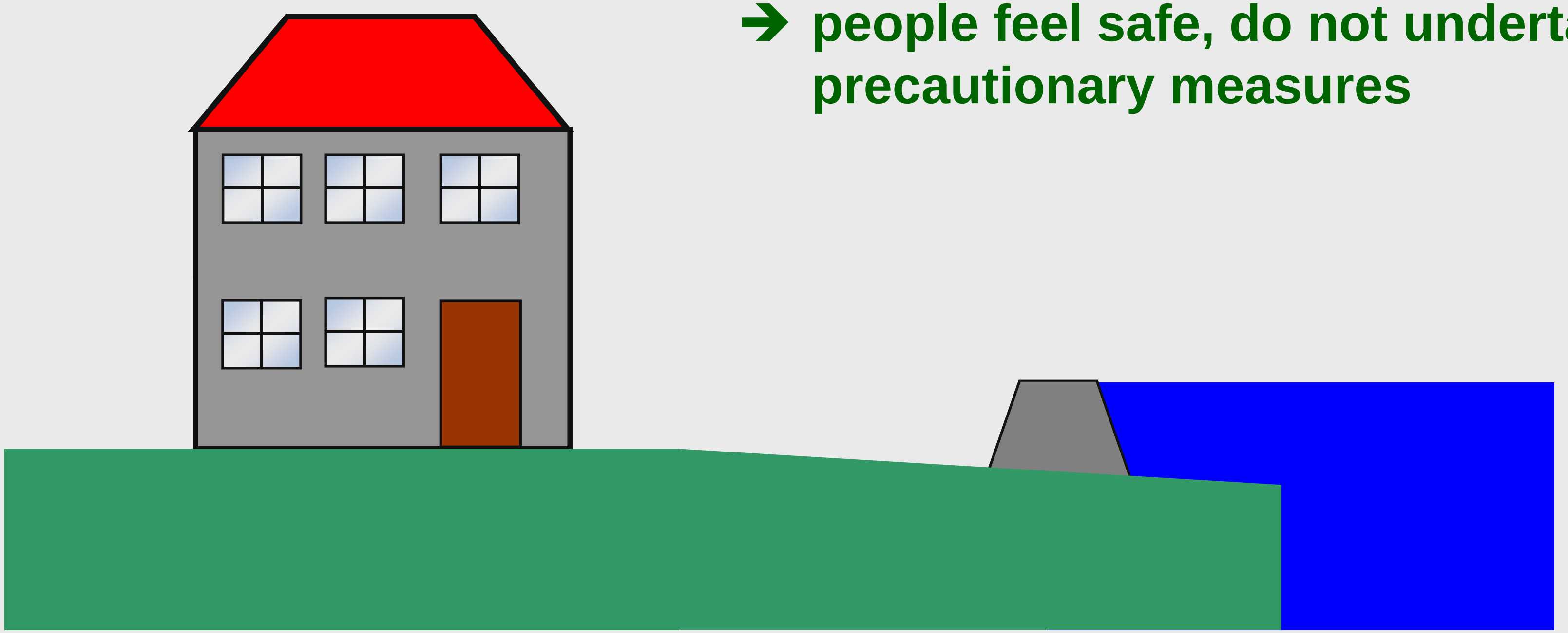
Effect of flood control measures

with flood control

T = 4 h

➔ no surface flooding

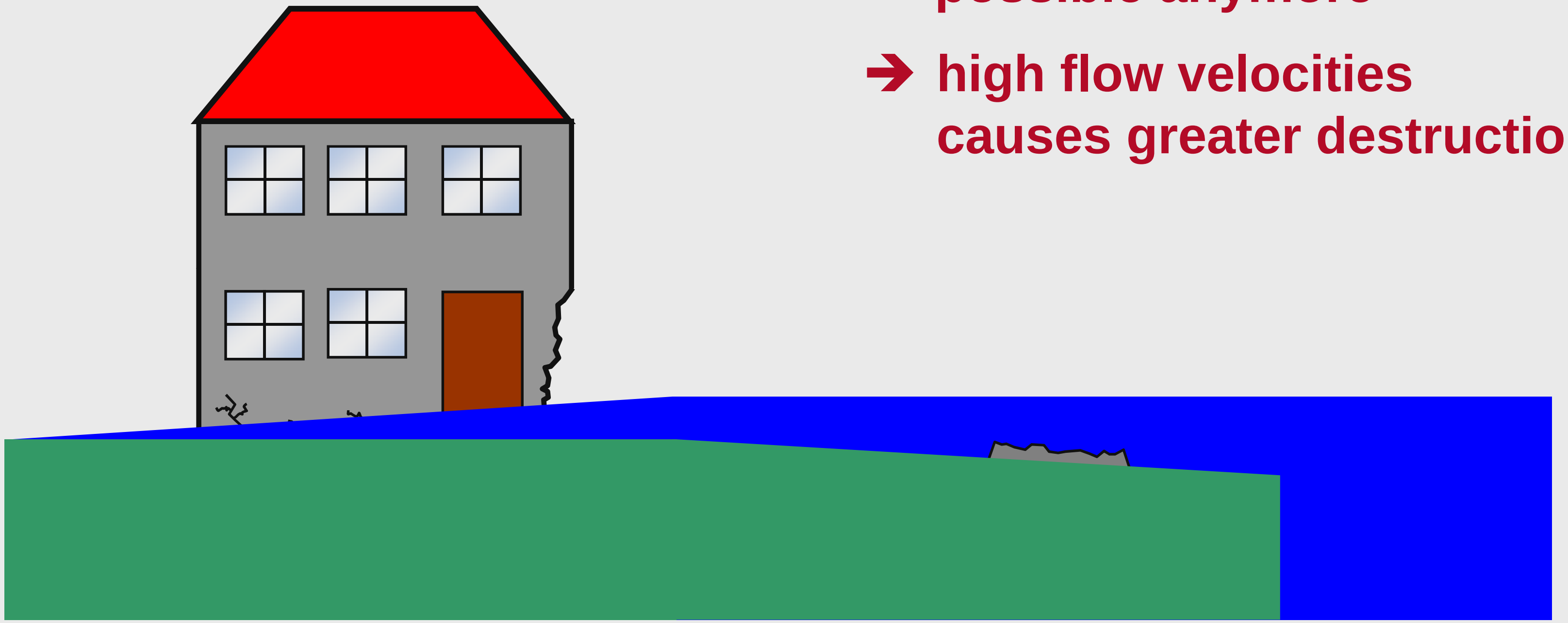
➔ people feel safe, do not undertake precautionary measures



Effect of flood control measures

with flood control

T = 8 h



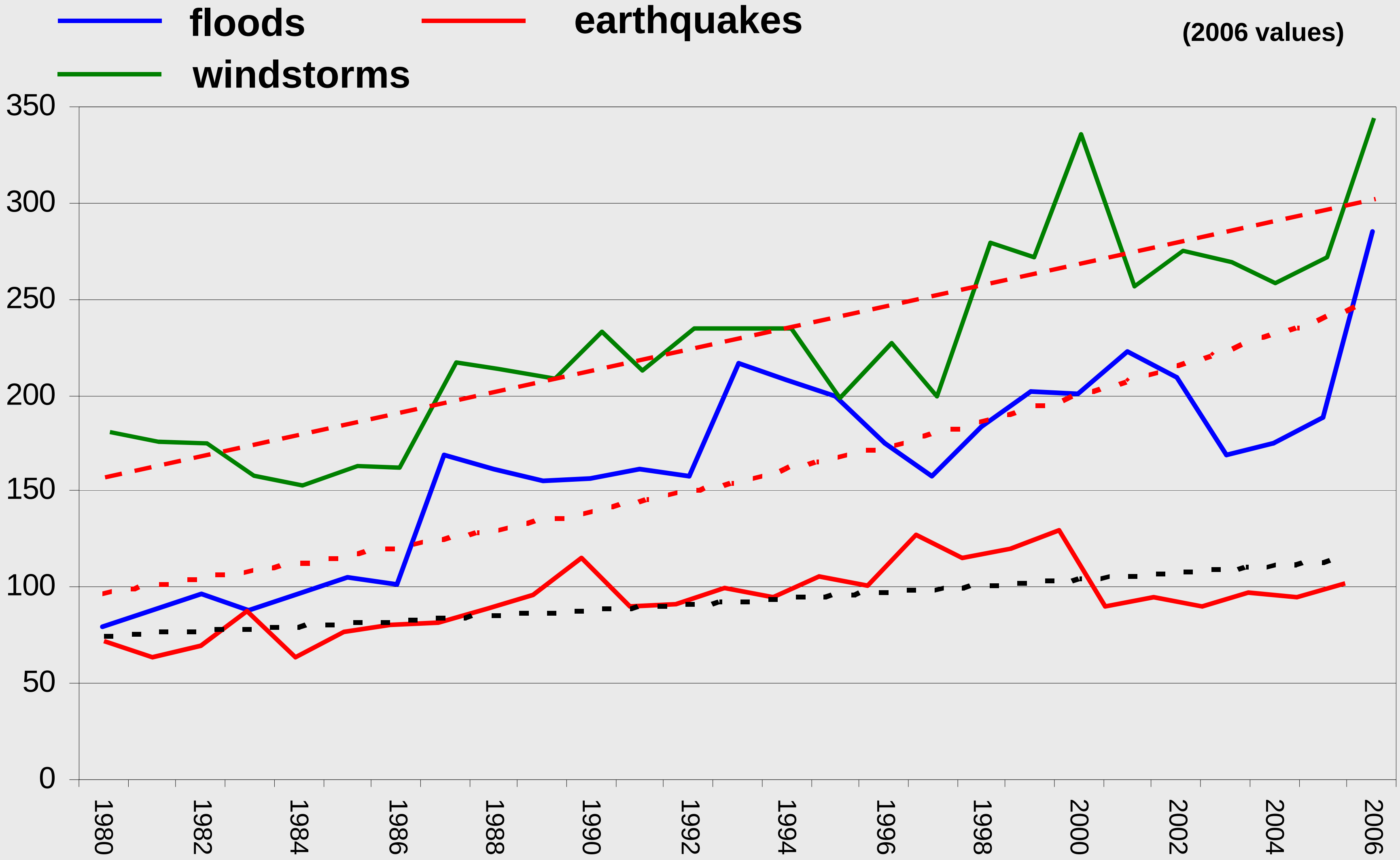
- ➔ when the dyke fails, no measures are possible anymore
- ➔ high flow velocities causes greater destruction

Effect of flood control measures

without flood protection

with flood protection
design: 100 year flood

Number of loss events 1980 – 2006 (worldwide)



Climate Change

The hottest years since 1856 (152 years)

**All 7 years since 2001
rank among the 8 hottest years ever.**

1. 1998
2. 2005
3. 2002
4. 2003
5. 2004
6. 2006
7. 2001
8. 2007
9. 1997
10. 1995

* Global mean temperature near the ground (source: WMO)

Climate Change

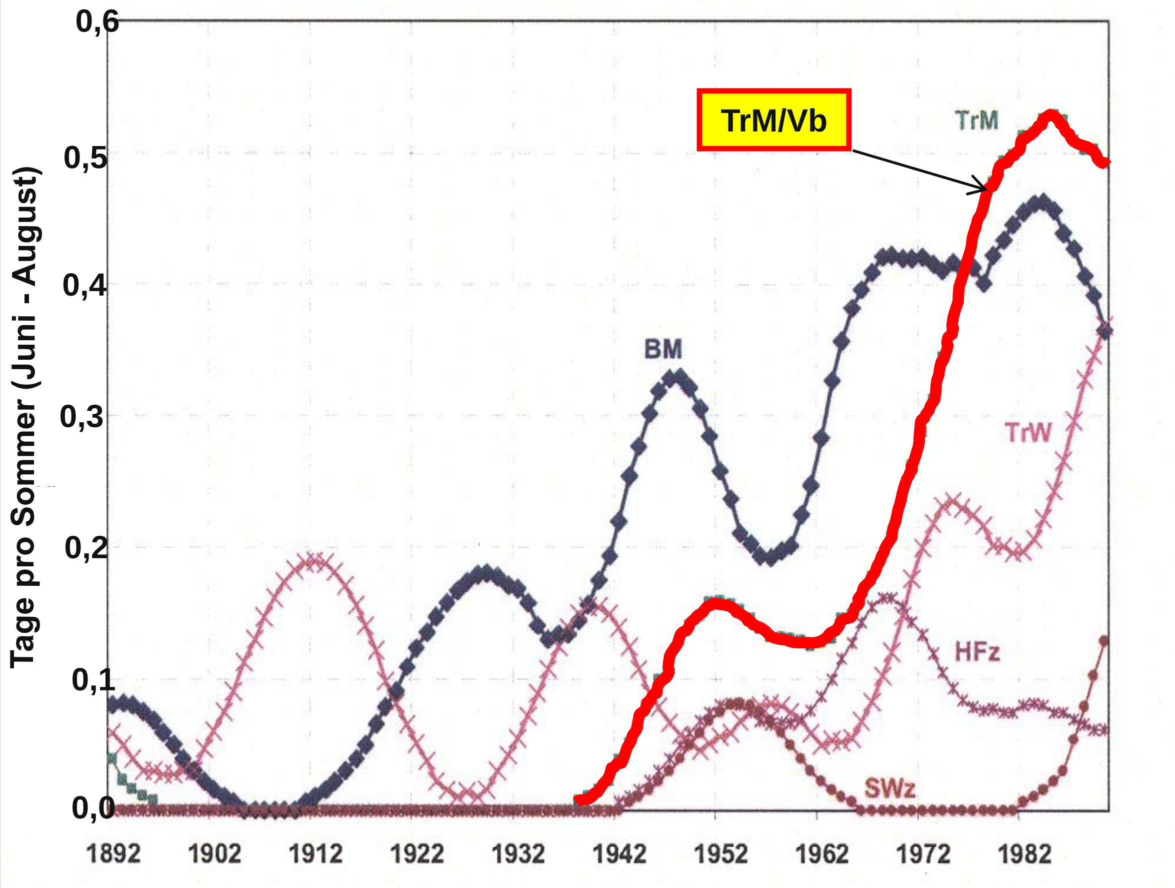
Effects of Global Warming on Extreme Weather Events

Phenomenon (increase in)	observed trend	human contribution	future trend
Warmer and fewer cold days and nights over most land areas	*Very likely*[c]	*Likely*[d]	*Virtually certain*[d]
Warmer and more frequent hot days and nights over most land areas	*Very likely*[e]	*Likely (nights)*[d]	*Virtually certain*[d]
heat waves	*Likely*	*More likely than not*[f]	**very likely**
heavy precipitation	*Likely*	*More likely than not*[f]	**very likely**
Area affected by droughts increases	*Likely* in many regions since 1970s	*More likely than not*	*Likely*
Intense tropical cyclone activity increases	*Likely* in some regions since 1970	*More likely than not*[f]	*Likely*
Increased incidence of extreme high sea level (excludes tsunamis)[g]	*Likely*	*More likely than not*[f,h]	*Likely*[i]

very likely: > 90% **likely: >66%** **more likely than not: > 50%** **IPCC 2007**

Change in weather patterns

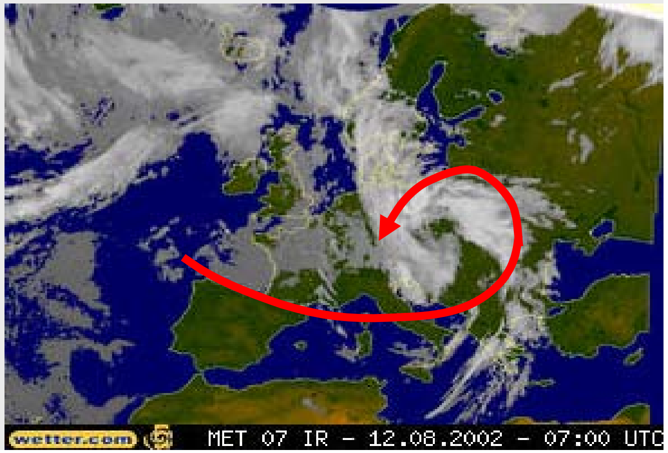
Observation in Southern Bavaria
(Hohenpeissenberg station):



Source: Fricke/Kaminski (Sept 2002), GAW 12

1.Trough Central Europe pattern (TrM/Vb situation)

Significant increase in days with rainfall depth > 30 mm in summer (Jun-Aug) during weather pattern Trough Central Europe (Vb pattern) (1891 - 2001).

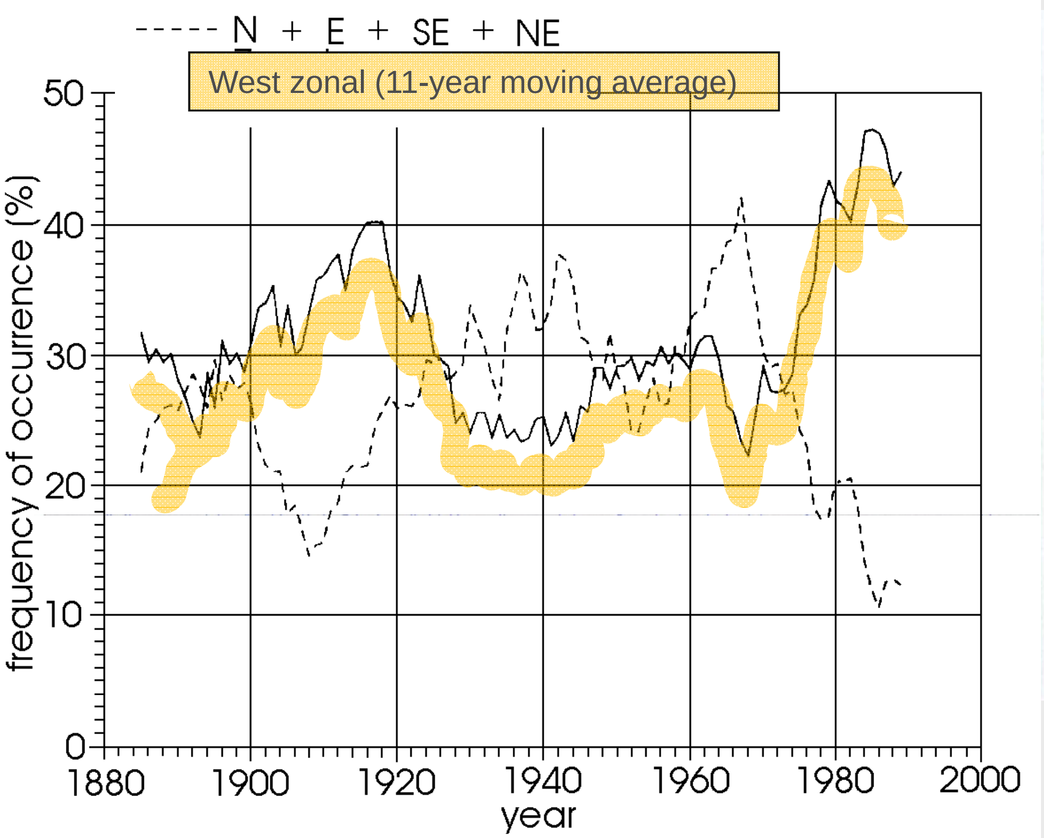


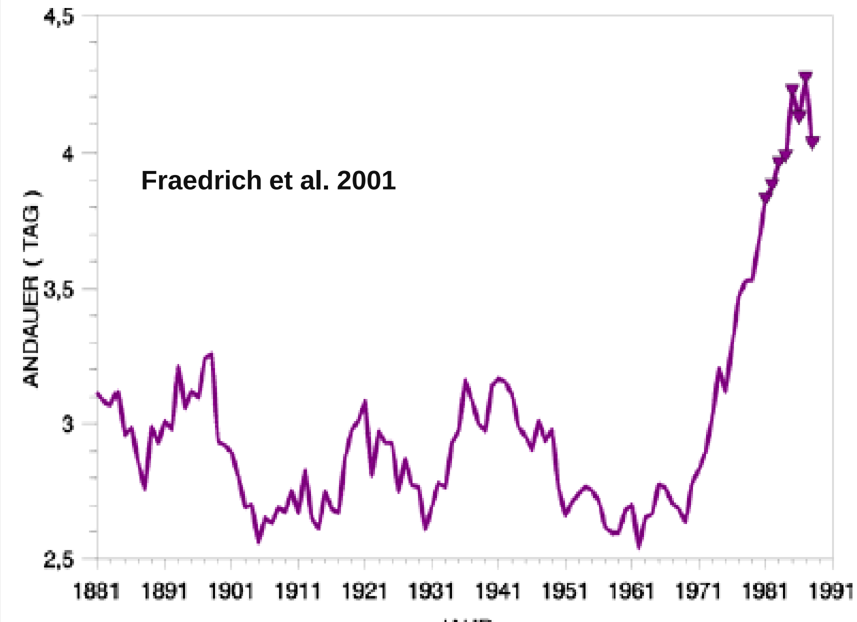
Change in weather patterns

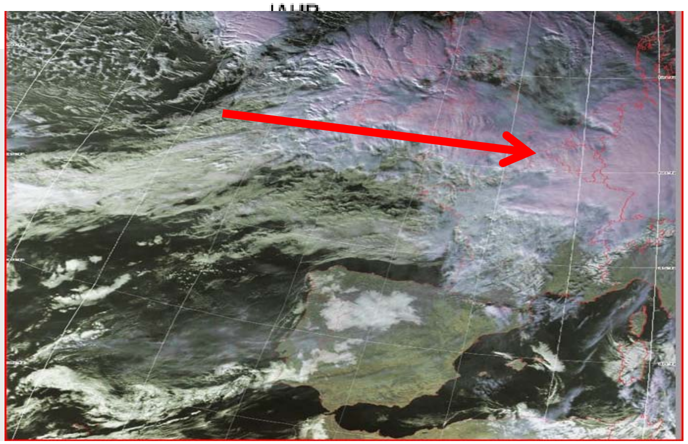
Number of days with westerly patterns Dec - Feb

2. West zonal pattern (Wz)

Persistence (duration) of westerly patterns





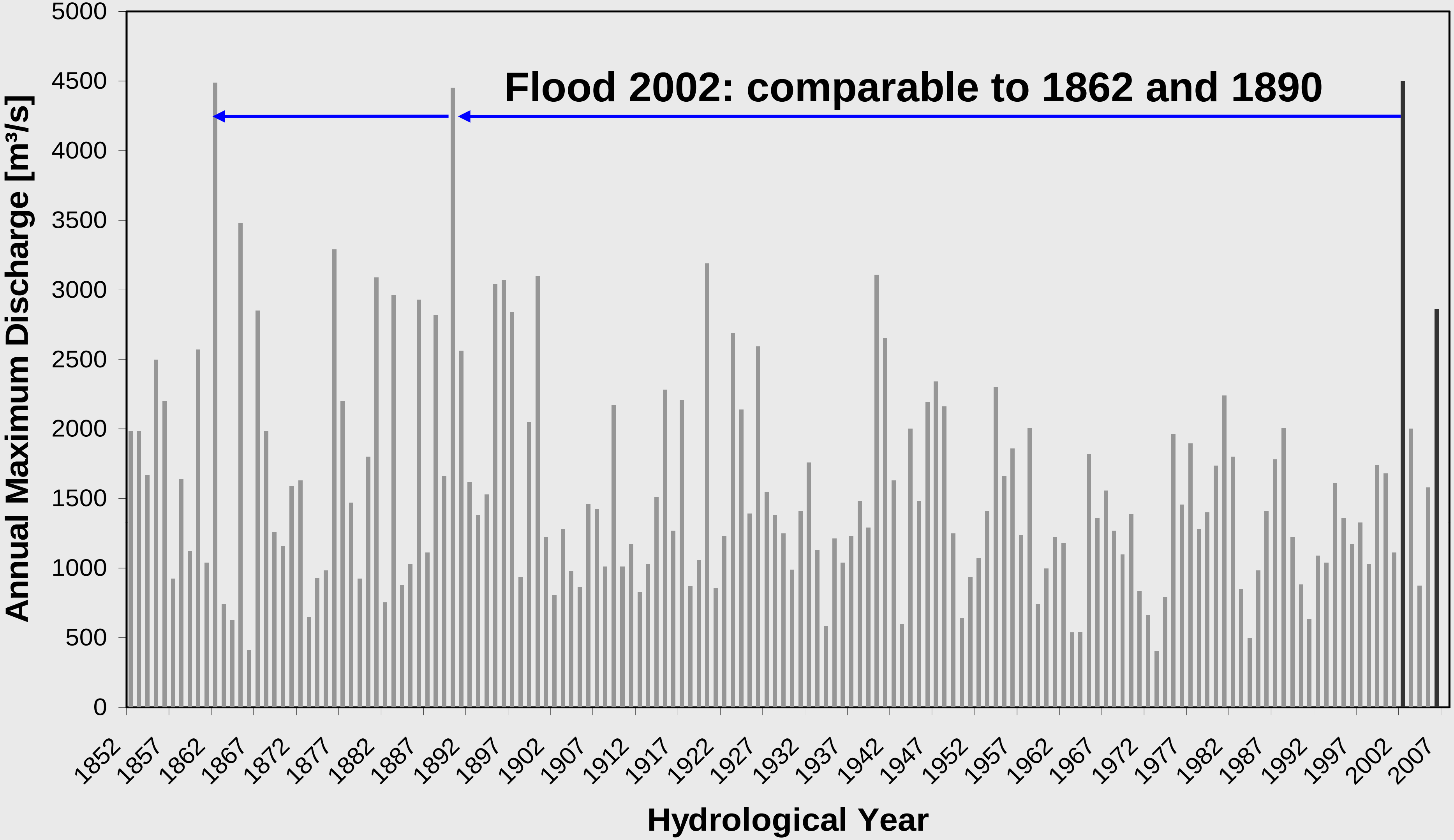


Climate Change

What must we expect?

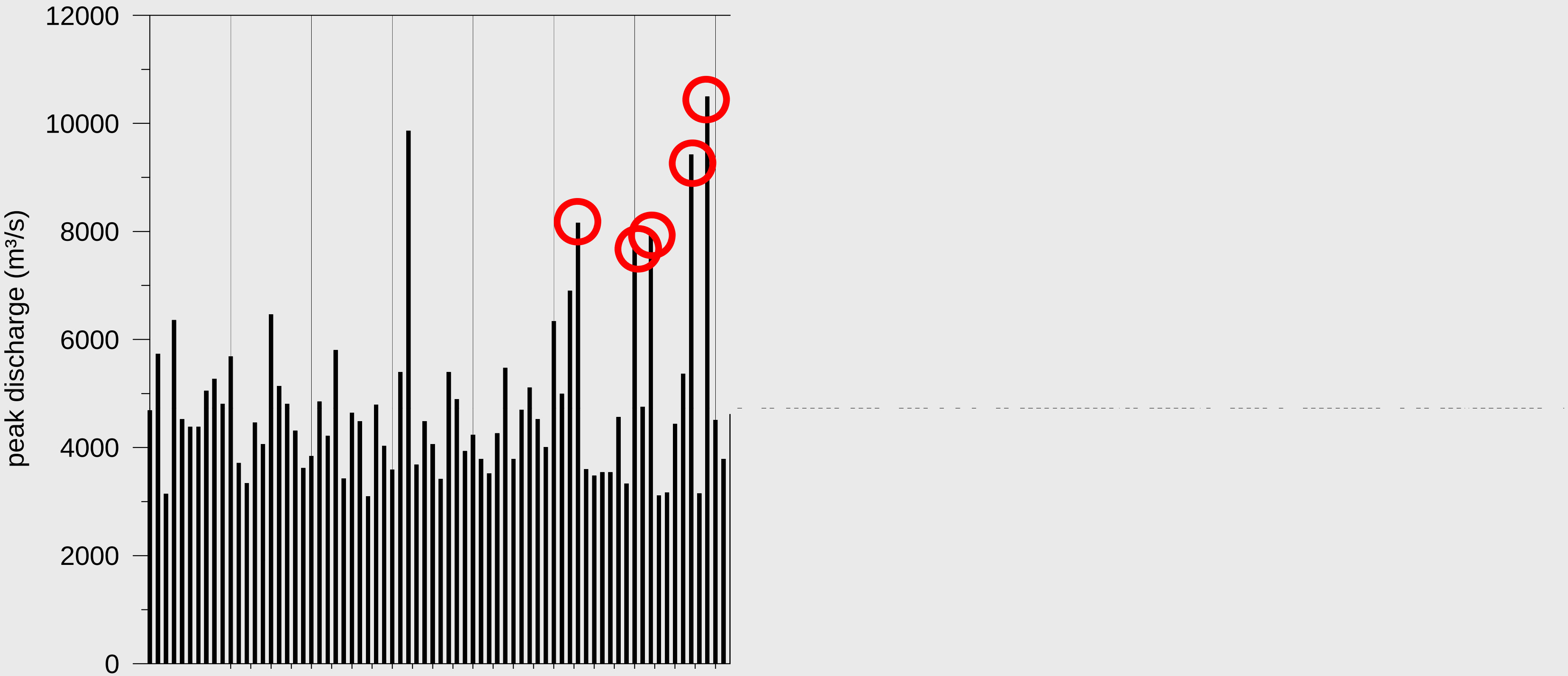
- increase in sea level
- higher weather variability
- more frequent events
- stronger events
- more loss events
- higher losses

Elbe, Dresden



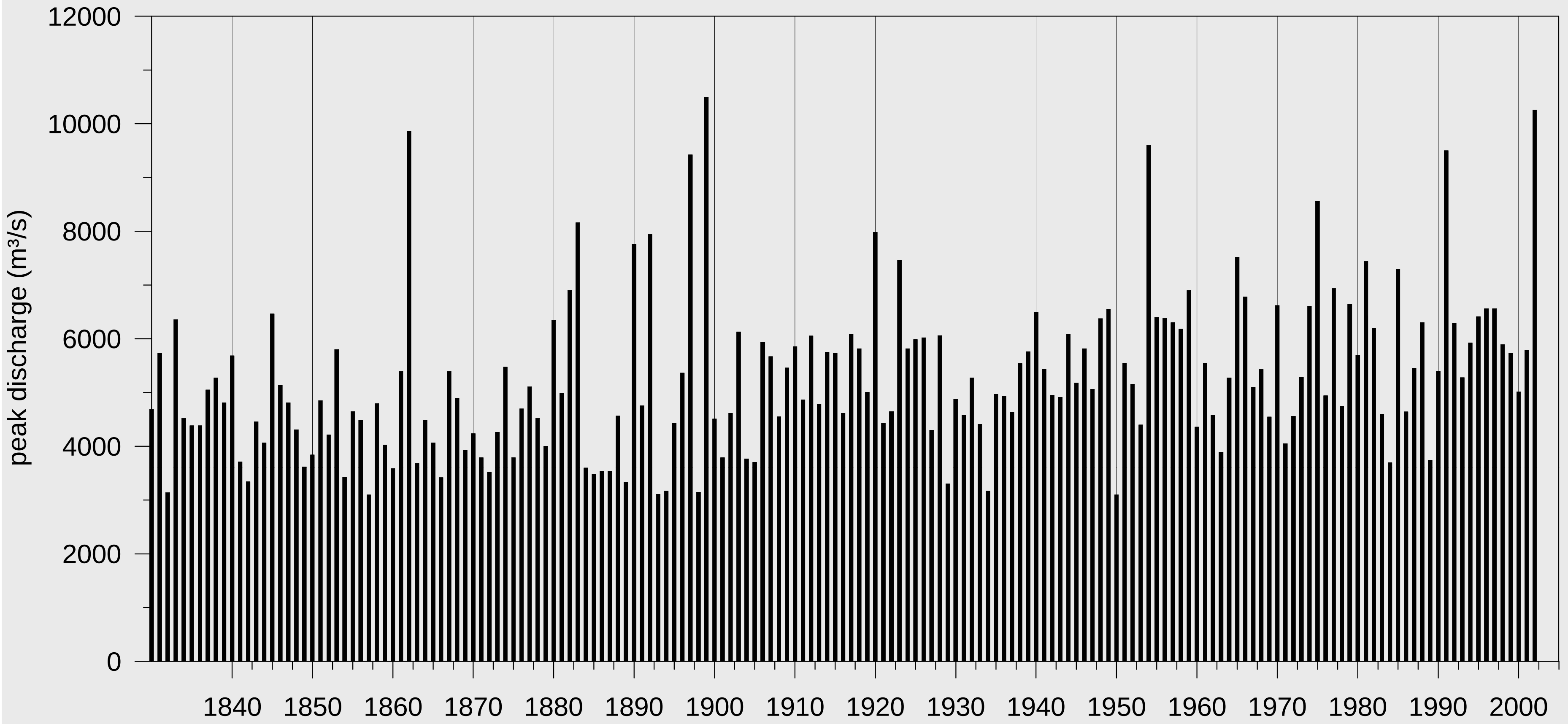
Danube, Vienna

5 out of the 6 largest floods in past two decades!



Merz, 2007, TU Vienna

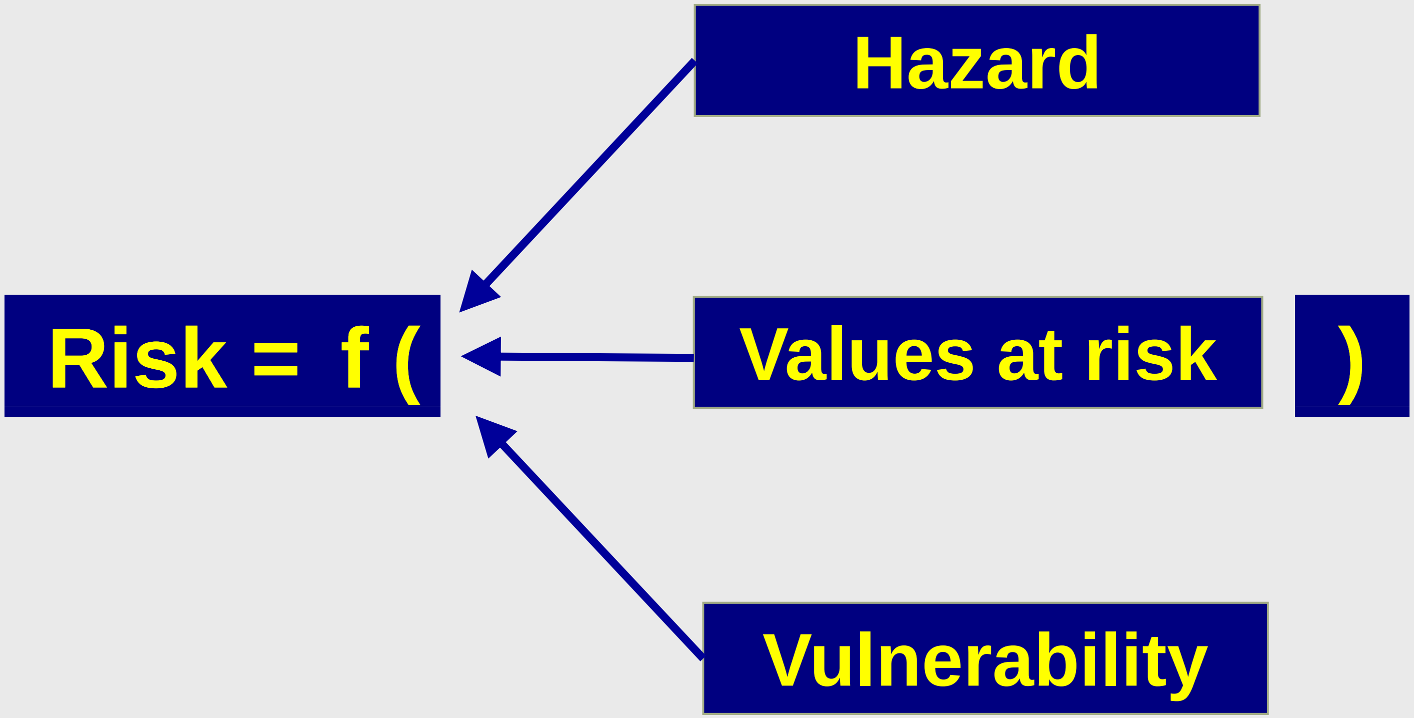
Danube, Vienna



Merz, 2007, TU Vienna

Climate changes cannot be blamed for everything!

Flood risk reduction



How can we reduce the risk?

by reducing one or more of these influencing factors

Flood risk reduction

Hazard: **natural event (storm, rainfall, flood, ...)**

→ cannot be influenced

(at least almost not; exception: via anthropogenic climate change; but this is only possible in the long run)

Values at risk **and**

Vulnerability **→ are man-made**

Strategies against the flood risk

1. **Preparing for floods**
   Avoiding high flood peaks

2. **Preparing for flooding**
   Preventing high-value areas from flooding

3. **Preparing for losses**
   Limiting and reducing damage

4. **Preparing for risk**
   Preparing (financially) against ruin

Risk reduction

requires a risk partnership between

Public authorities
(state, community, NGOs)

People concerned
(private persons, companies)

Finance industry
(insurance and capital market)

Main tasks of the partners

Public authorities/organisations

→ basic prevention measures :
- avoiding frequent losses
- mitigation during rare events

- land-use regulations
- technical flood control
- observation networks
- forecasting and warning
- flood retention
- providing information

EU Flood Directive

Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks

FLOOD HAZARD MAPS AND FLOOD RISK MAPS

CHAPTER III, Article 6

1. Member States shall … prepare flood hazard maps and flood risk maps…

…

3. Flood hazard maps shall cover … floods with a low … medium … high probability …
4. For each scenario … shall be shown ... the flood extent ... water depths or water level … flow velocity …
5. Flood risk maps shall show … the indicative number of inhabitants potentially affected … the type of economic activity of the area potentially affected;

FLOOD RISK MANAGEMENT PLANS

CHAPTER IV, Article 7

1. On the basis of the maps … Member States shall establish flood risk management plans ….
2. Member States shall establish … objectives for the management of flood risks … focusing on the reduction of potential adverse consequences of flooding …

...

5. Member States shall ensure that flood risk management plans are completed and published by 22 December 2015.

Main tasks of the partners

People concerned/affected

→ actions during rare events: loss prevention/reduction/limitation

- proper construction
- spot protection
- appropriate behaviour (alarm plan, checklist)
- seeking/receiving information
- maintaining risk awareness

Main tasks of the partners

Insurance industry

→ securing existence, prevention of ruinous consequences for personal/business property

- assuming part of the risk
- proper risk assessment
- adequate contracts
- providing information
- accumulation control

→ Make sure that the commitments towards the insureds can be fulfilled.

Insurance aspects and flood risk modelling

General problems

- large loss potential
- linear rather than area impacts
- high variation of exposure within short distance
- high influence of local factors
- flood control structures (e.g. dykes) make floods rare, but have almost no effect during extreme events
- loss of awareness and feeling of security
- anti- or adverse selection

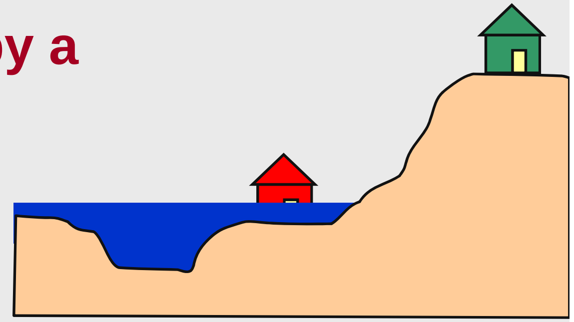
Flood insurance

Principle of the insurance

sum of premiums from all clients (+ yields)	=	sum of payments to the affected clients (+ administrative costs + profits)

Adverse selection

A Only those, who subjectively feel threatened by a flood, have interest in insurance cover; a large portion of them is in fact exposed to a high risk and experiences losses more or less regularly.



B The others feel safe and do not want to get insured.

If the portfolio mainly consists of members of group A, the spatial and temporal risk compensation is not guaranteed anymore.

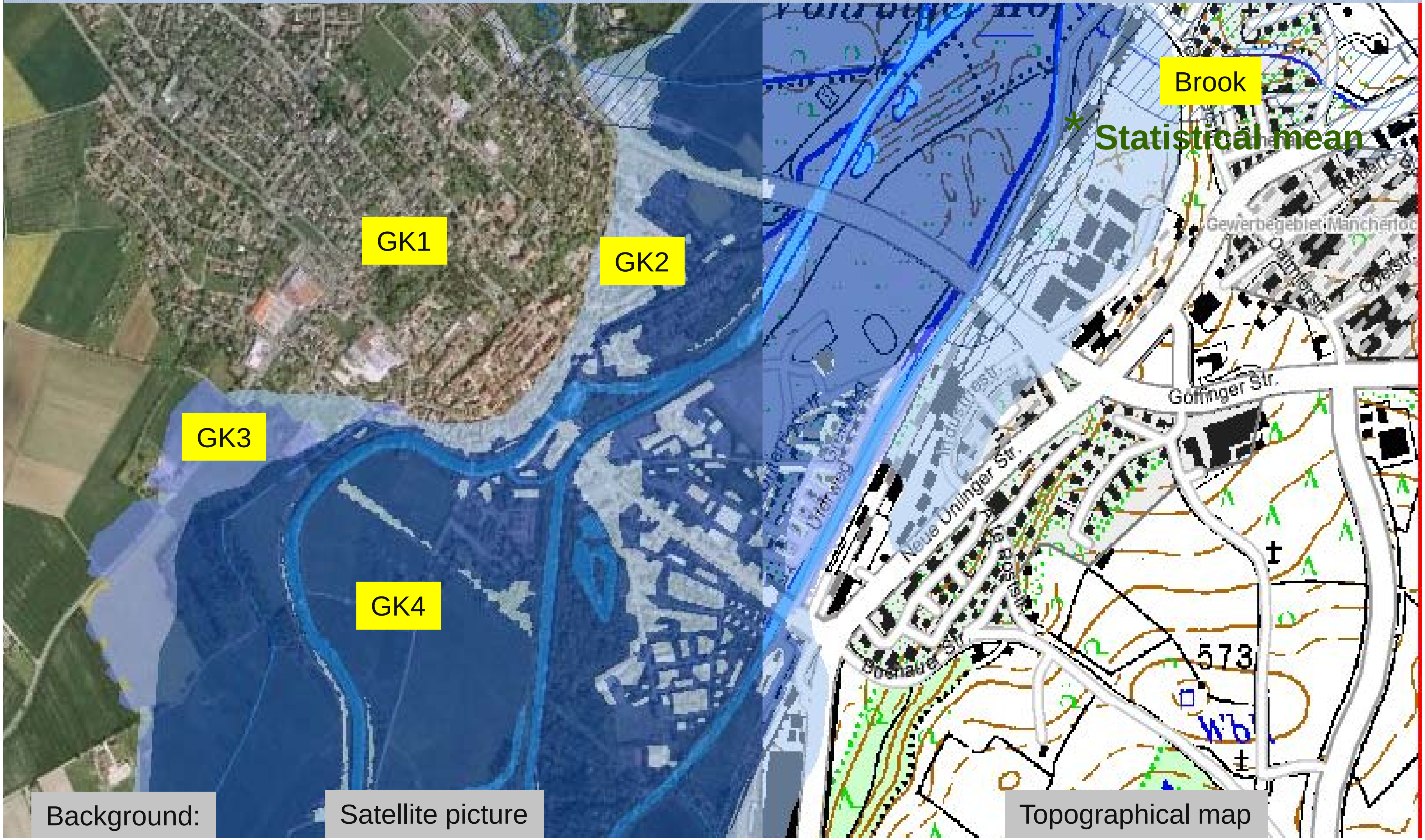
Flood insurance

Approaches to a solution

- information about the individual exposure
- definition of zones according to exposure level (country-wide for all areas)
- exclusion of particularly exposed areas

Flood insurance

Hazard zonation: Flood hazard classes in the German system ZÜRS



Flood insurance

Hazard zonation: Flood hazard classes in the German system ZÜRS

GK 4, high hazard:

Flooded at least once in 10 years*

* Statistical mean

GK 3, medium hazard:

Flooded at least once in 10 to 50 years*

GK 2, low hazard

Flooded at least once in 50 to 200 years*
(≈ area protected by dykes)

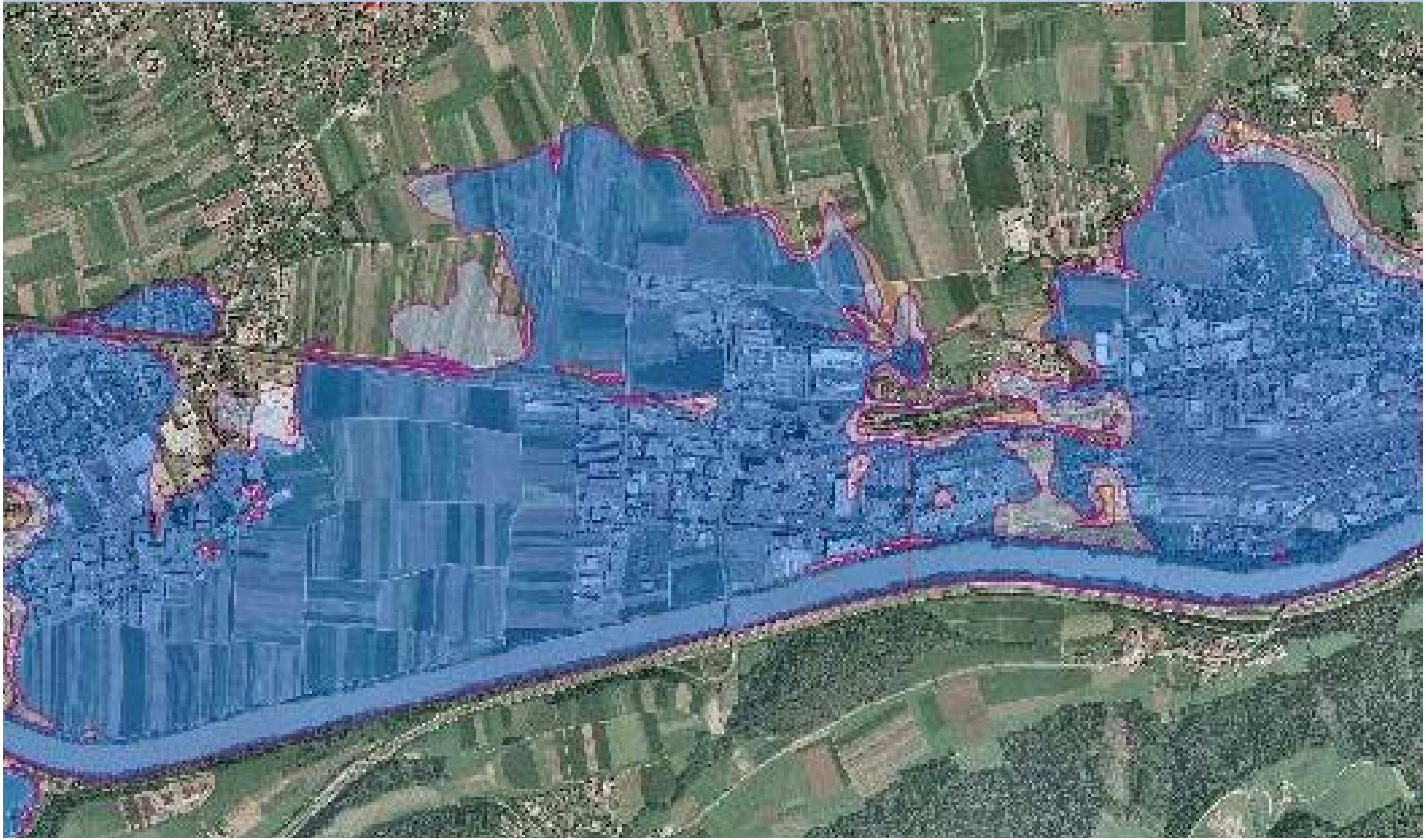
GK 1, very low hazard:

Flooded less than once in 200 years*

Brook: 200 m wide corridor along brooks indicating flash flood hazard

Flood insurance

Hazard zonation: Flood hazard classes in the Austrian system HORA



Flood insurance

Hazard zonation: Flood hazard classes in the Austrian system HORA

high hazard:

Zone 1 Flooded at least once in 30 years

medium hazard:

Zone 2 Flooded at least once in 30 to 100 years

low hazard:

Zone 3 Flooded at least once in 100 to 200 years

very low hazard:

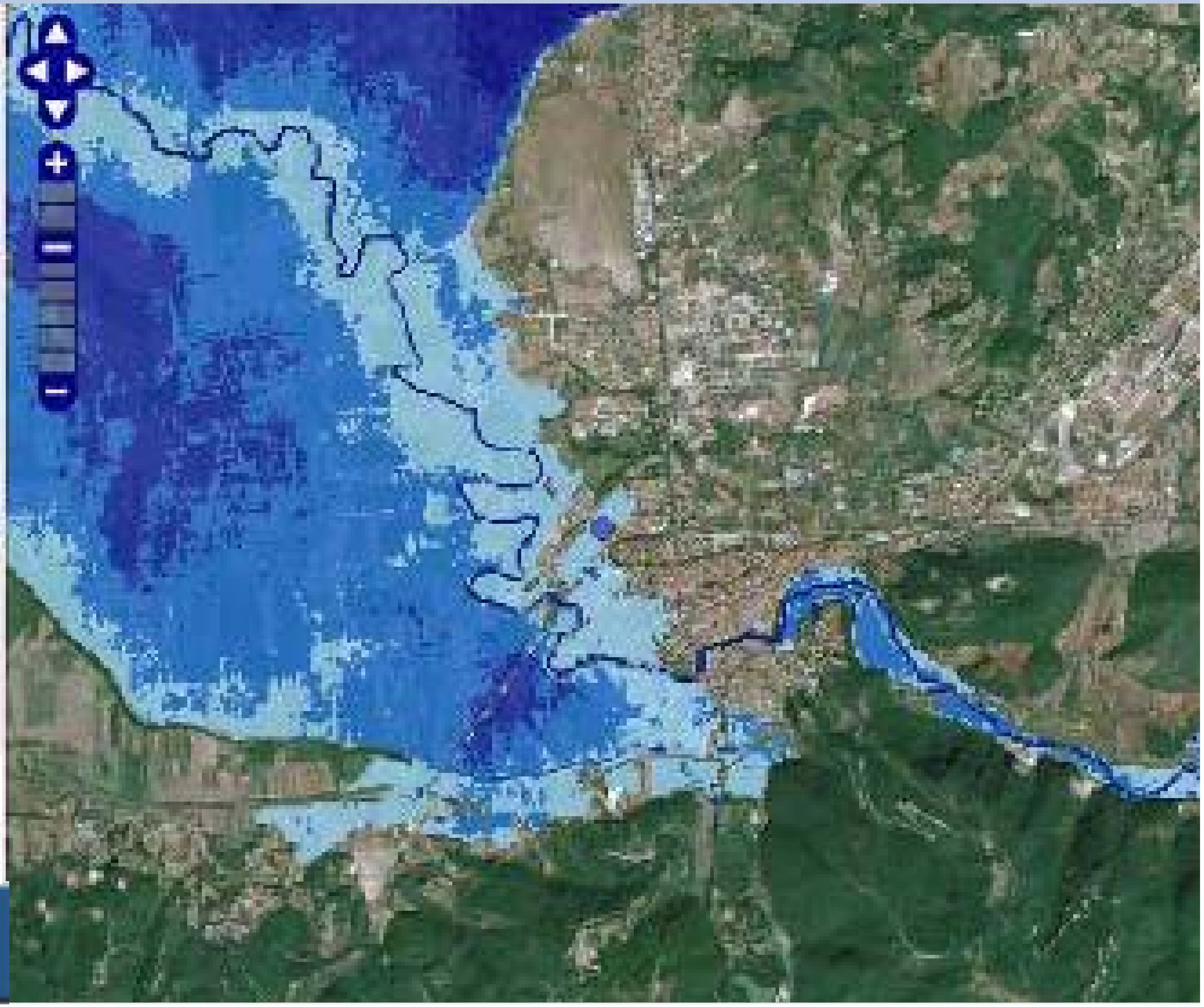
remaining area Flooded less than once in 200 years

Flood insurance

Hazard zonation: Flood hazard classes in the Italian system SIGRA

Water depth for return period 200 years (medium)

- 0 <= h < 50 (cm)
- 50 <= h < 100 (cm)
- 100 <= h < 150 (cm)
- 150 <= h < 200 (cm)
- 200 <= h < 250 (cm)
- 250 <= h < 300 (cm)
- 300 <= h < 350 (cm)
- 350 <= h < 400 (cm)
- h >= 400 (cm)



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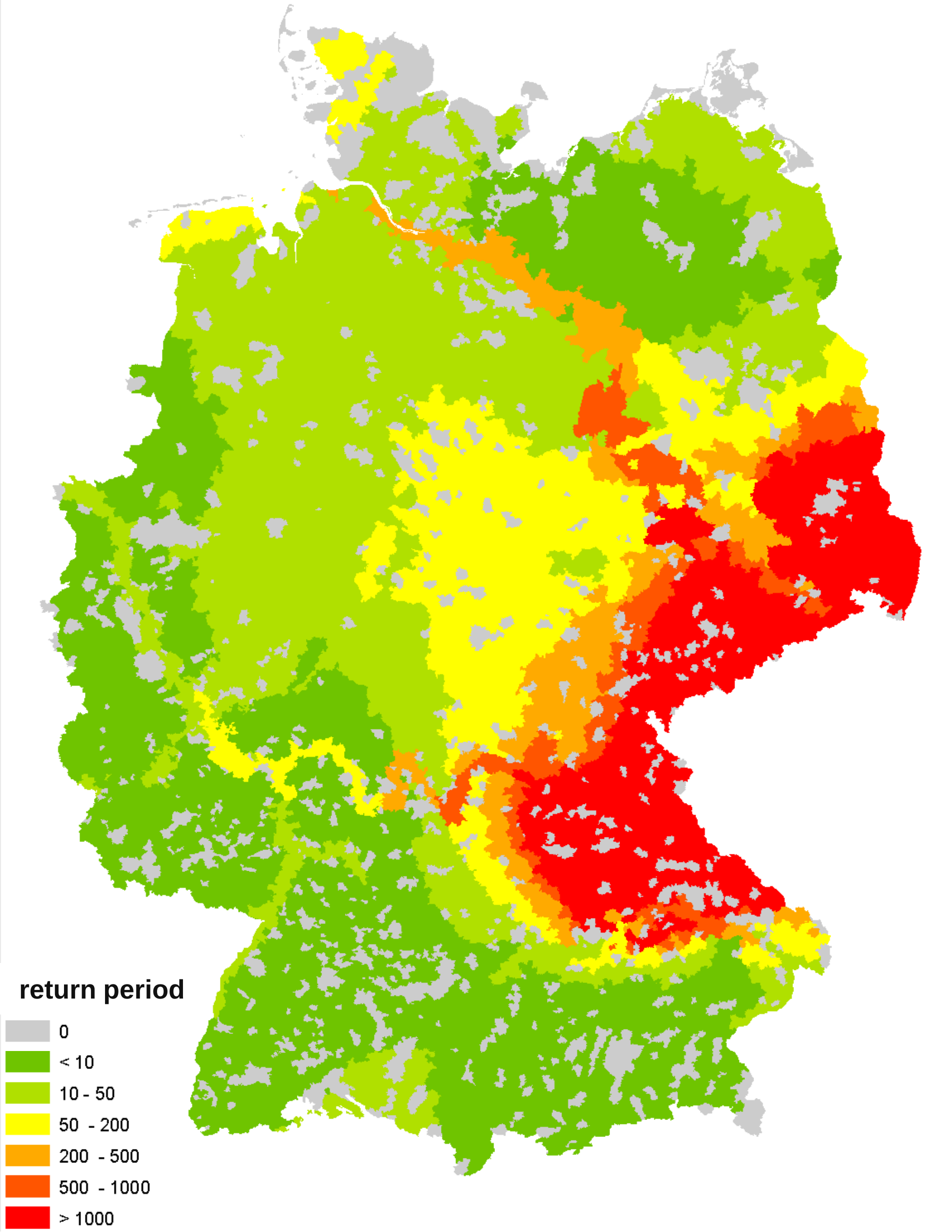
ANIA Associazione Nazionale fra le Imprese Assicuratrici

Flood insurance: Accumulation control

WANTED:

The Probable* Maximum Losses (PML)
that a portfolio, i.e. a company may face

* "Probable" depends on the company's risk policy, but also on legal requirements (e.g. Solvency II)



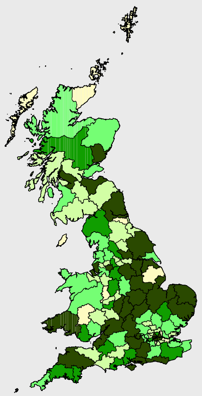
Flood insurance

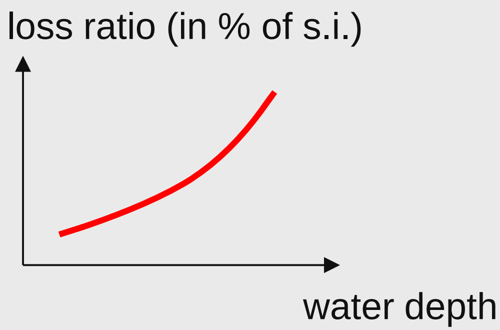
Accumulation control - Calculation of the PML curve

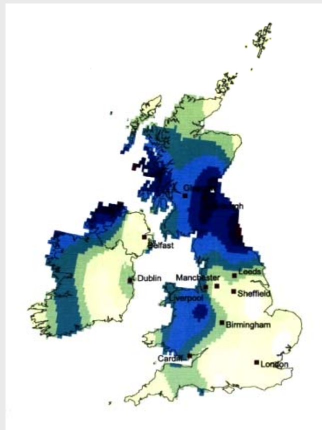
To obtain (estimate) the loss of a single event, we have to combine:

Values at risk	Vulnerability	Hazard

liability distribution + **vulnerability** + **event scenario**

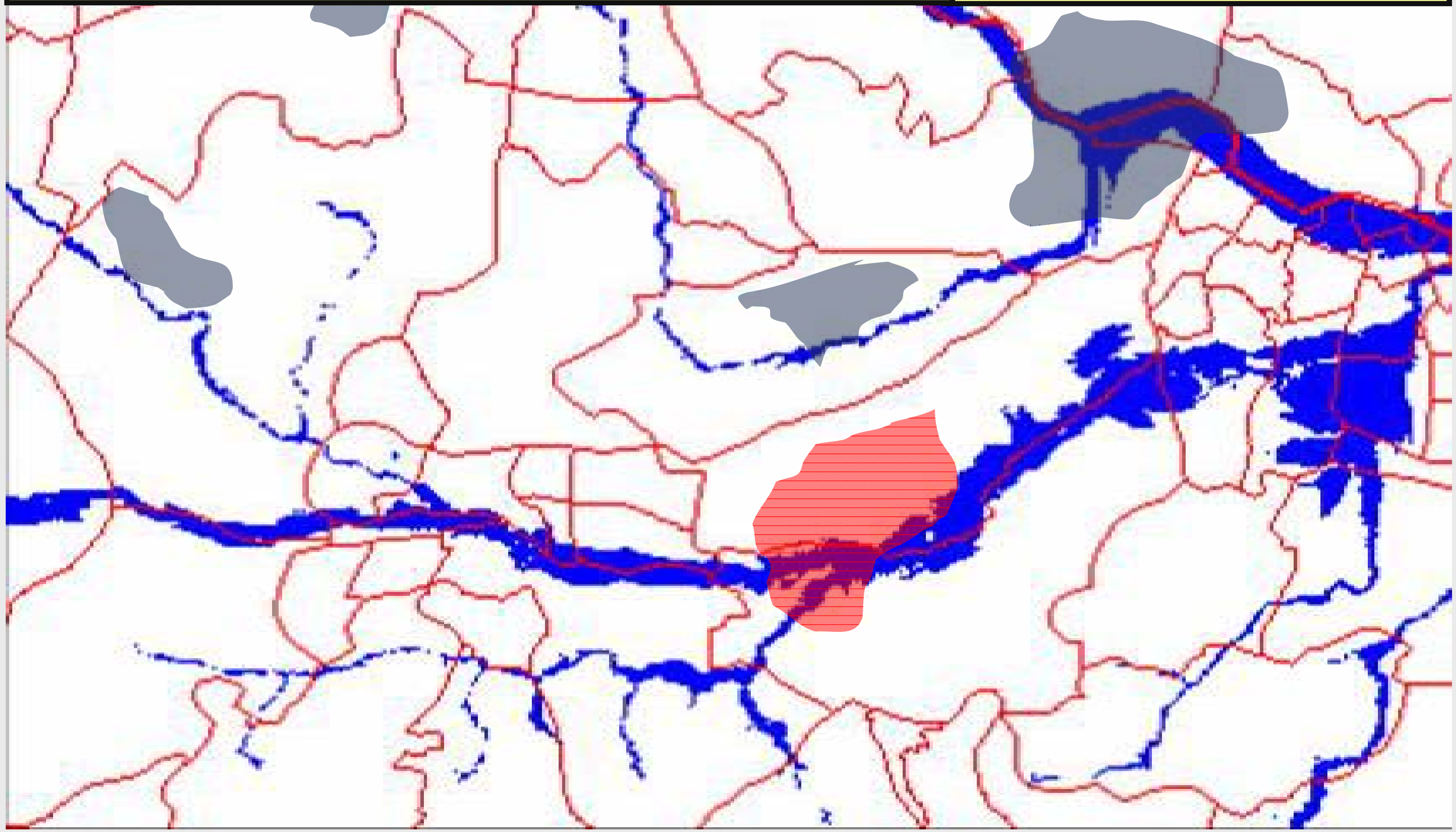






Flood insurance

Identification of areas hit by flood waters → Superposition of flooded areas with built-up areas



Flood insurance

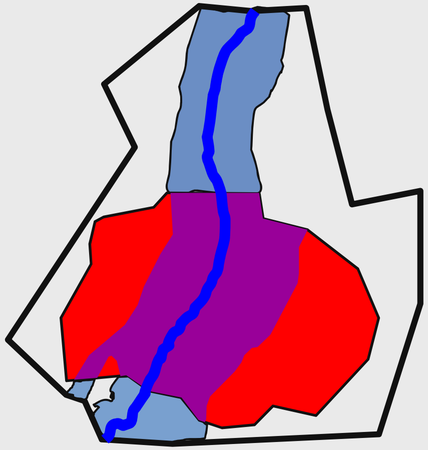
Loss analysis per postcode-sector

SI = sum insured

A_s = total settled area

A_f = flooded part of settled area

R_D = damage ratio



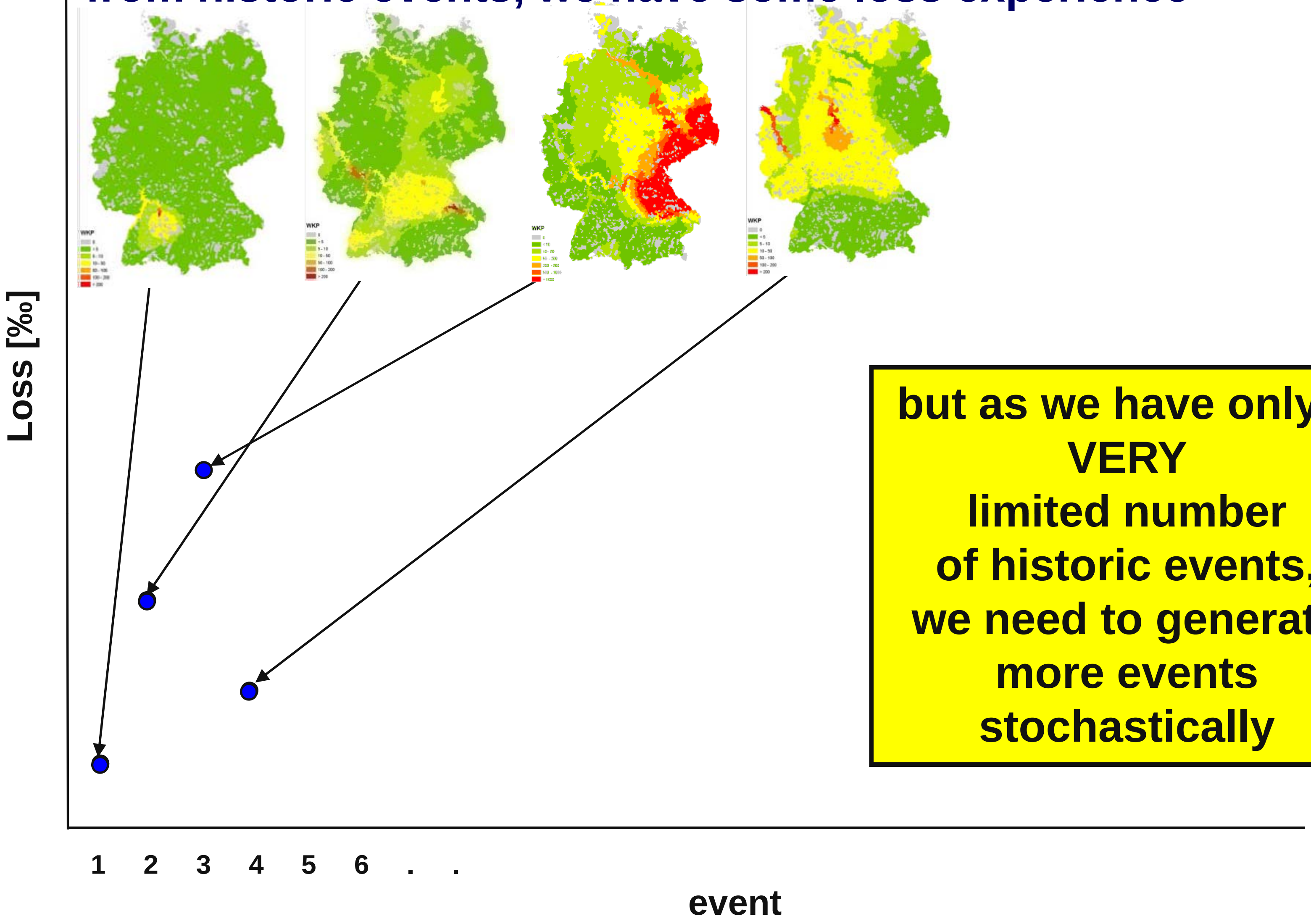
Loss: $L = SI \times A_f / A_s \times R_D$

Result: probable losses per postcode sector

Sum of the losses from all postcode sectors = accumulated event loss

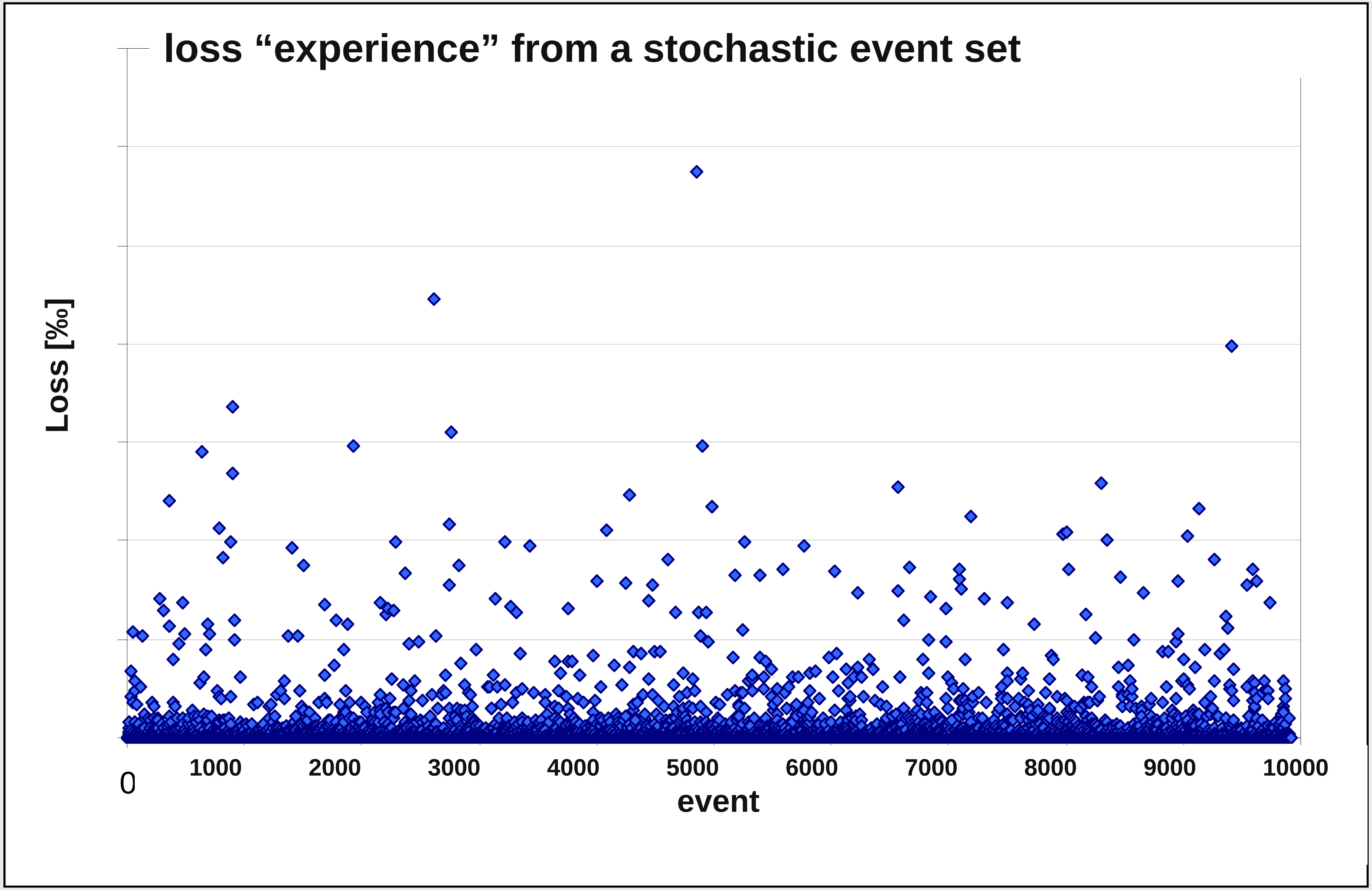
Flood insurance

from historic events, we have some loss experience

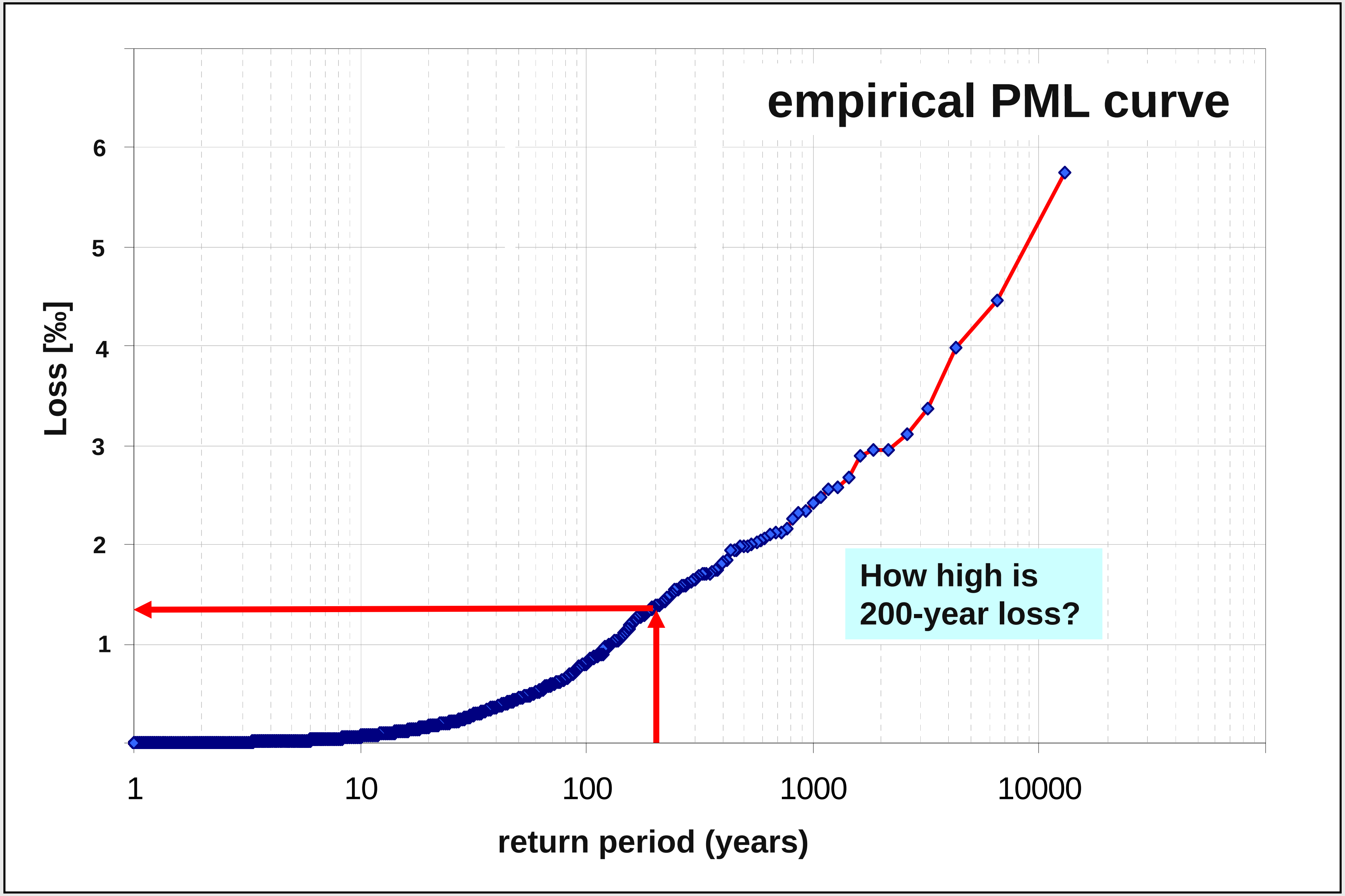


but as we have only a VERY limited number of historic events, we need to generate more events stochastically

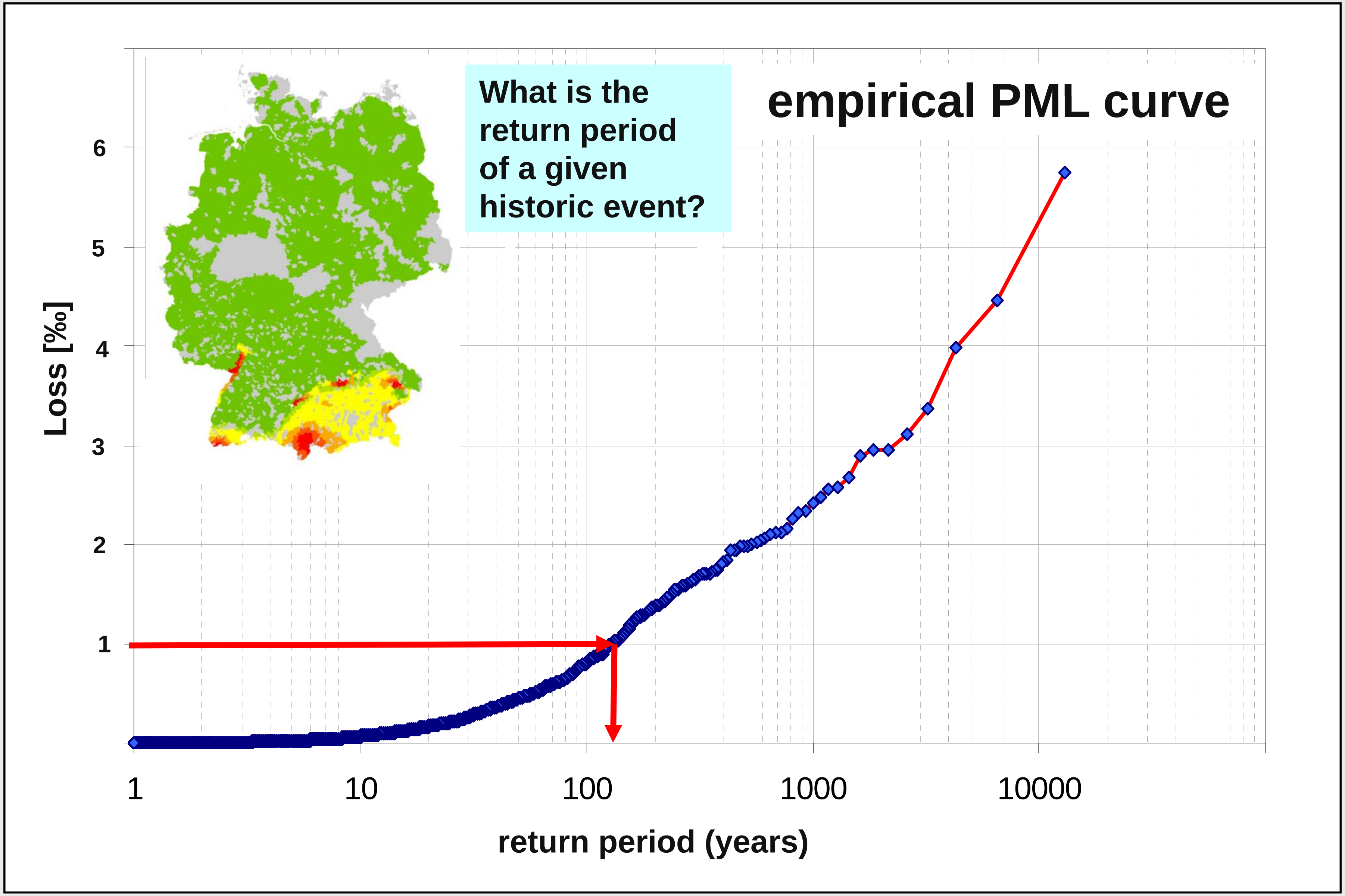
Flood insurance



Flood insurance



Flood insurance



Final remarks

Flood losses are increasing. Loss potentials have reached new dimensions.

The main driving factors are:

- **settling in flood-prone areas,**
- **higher and more vulnerable values,**
- **climatic and environmental changes,**
- **low risk awareness, short memory.**

Risk reduction is necessary (and possible).

The key is proper land-use policy.

Adaptation to the increasing weather hazards is vital.

Efficient risk reduction requires a partnership between the authorities, the people concerned and the insurance industry.

Insurance is a central hub of risk reduction.

Premiums reflecting the individual risk adequately must be determined on the basis of zoning models.

The insurance industry and societies as a whole must prepare for extreme losses.

We must learn to live with floods.

At the same time, we must establish a culture of coping with the resulting risk.

Thank you