

# Does the perception of extremity change?

## An ongoing case study in the Sure river basin

by H. Hellebrand, G. Drogue, P. Matgen, C. Schmitz, J. Juilleret, E. Vansuypeene, L.  
Hoffmann and L. Pfister



Centre de Recherche Public  
Gabriel Lippmann

# Outline

- Introduction
- Methodology
  - Models, maps, flood hazard and vulnerability assessment
- Preliminary results
  - Maps, flood hazard, security deficit
- Conclusion
- Perspectives

# Introduction

- Why this study?
  - Recent floods in Luxembourg
  - Is there a shift in flood frequency?

- A shift might be explained by:
  - Climate change
  - Land Use change
  - Change in river morphology

MITTWOCH, DEN 14. AUGUST 2002 TEL. 49 931 - E-MAIL: wort@wort.lu - URL: www.wort.lu  
JAHRGANG: 111 NUMMER: 100 FAX: (0)931 10-1111 (0)931 10-1111

für Wahrheit

VERLI  
L-2985

d Regen

Grad. In  
elma würd  
10 Grad. I  
letten die li  
hige Wata  
nien fel a  
en Schaan.

d Mallorca  
ochburg 5:  
ite Strand  
Strandsp  
emmt. Ten  
en Kälte i  
stärkten  
ie Lüzern  
ch der Isse

netriffen. In Ta  
nungen brachen  
ghrbeitungge.  
Luzernjov fiels  
pro Quadrates  
mer bei den U

massen war die Lage im sächsischen  
Landkreis Freiberg, wo zahlreiche  
Orte von der Anflutwelt abgeschnit-

Am Wochenende gab es in Mitteleuropa nicht nur überflutete Häuser und verschlammte Straßen, sondern auch schlechte Stimmung. Strände und Überpromenaden blieben menschenleer, Touristen

Unwetter in Deutschland kosteten ein erstes Todesopfer - ein 31-jähriger Fahrer eines Rot-Kreuz-Wagens kam bei einem Unfall auf einer überfluteten Straße in Niedersachsen ums Leben.

er wurden von den Wassermassen lädem gelegt. An der Adria und an den Küstenorten Liguriens, der Toskana und des Latiums massierten sich viele Urlauber in Sicherheit. Am Sonntag berührte

Sch  
>  
Han  
maß  
Asie  
mas  
Sach  
blieb  
kam  
Folg  
tausende mussten ihre Häuser verlassen.

# Observed changes

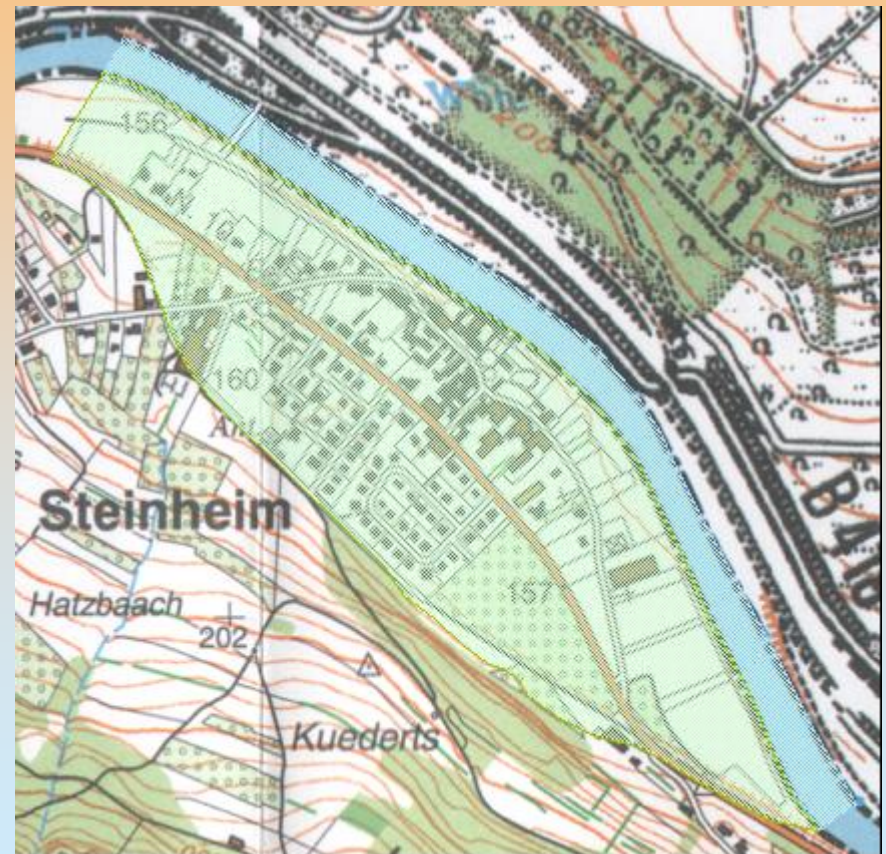
- Climate change (Saar-Lor-Lux region)
  - Increase of winter rainfall in last 50 years
  - Increase of westerly fluxes bringing storm fronts
  - From 19<sup>th</sup> to 20<sup>th</sup> century clear trend towards long lasting and intense westerly rainfall events
- Land Use change (Sure basin)
  - Increase of urban area
  - Increase of drained agricultural lands
  - No observed change in forest area
- Changes in river bed (Alzette basin)
  - 55% loss of floodplain in last 200 years

# However

- Effects of climate change are strongly influenced by topography
- Effects of urbanisation only strong in headwaters
- Interaction between the effects make it difficult to predict changes in flood frequency

# Study area

Stretch of the Sure river at Steinheim (Luxembourg)



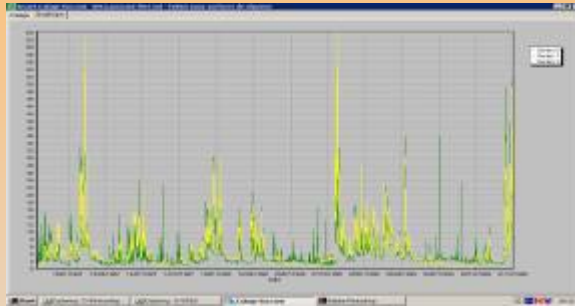
# Methodology

## outline

- Use of hydro-climatological data sets as input for models
  - Peak discharges from 1870-1920 (Steinheim)
  - Daily rainfall from 1966-1996 (Sure basin)
  - Hourly rainfall (Sure basin) + discharge (Steinheim) 1996-2003
- Calculation of flood maps
  - Flood frequency
  - Flood hazard
- Assessment of urbanisation & security deficit

# Methodology

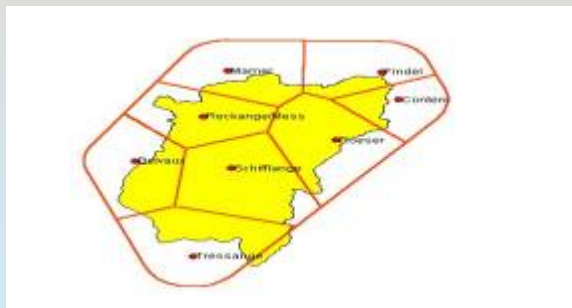
## modelling



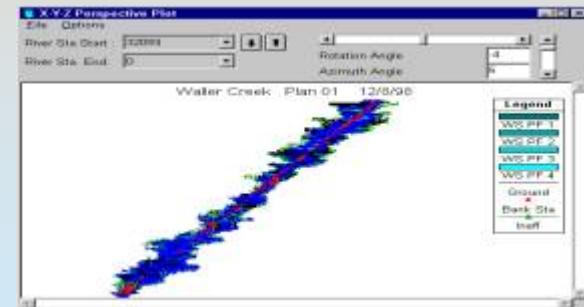
19/01/1873	870	13/12/1966	718
28/01/1877	514	21/02/1977	565
22/11/1878	510	04/02/1980	483
27/12/1879	582	06/01/1982	454
30/12/1880	749	27/05/1983	495
12/12/1881	1014	07/02/1984	689
27/11/1882	521	03/02/1988	464
04/11/1883	760	04/01/1991	461

1. Rainfall runoff model (HBV)
  - Calibration with hourly 1996-2003 discharge data

3. Two peak discharge data series:
  - 1870-1920
  - 1966-2003



2. Rainfall data
  - 1966-1996 daily rainfall as input



4. Hydraulic model (HEC-RAS)
  - Calculation of flood extension maps

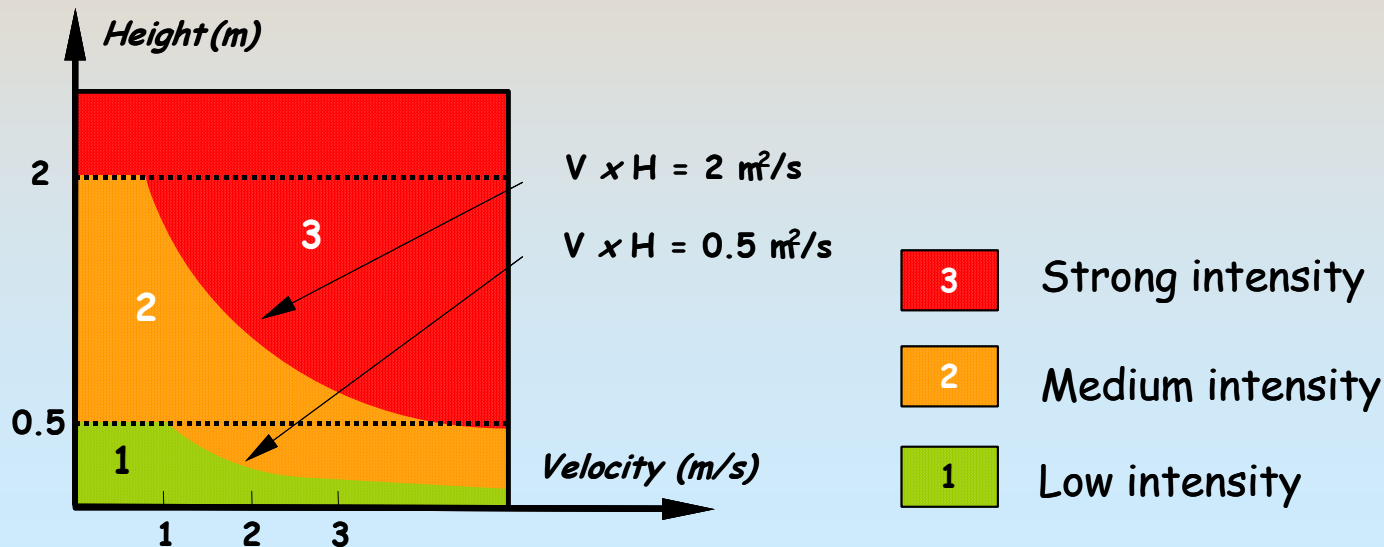


# Methodology

## calculation of flood hazard

According to a Swiss methodology (developed by OFEE, 1997), a flood hazard should be expressed in terms of flood intensity. The **flood depth** [m] and the **flood velocity** [m/s] have to be considered to assess the flood intensity of a given flood event.

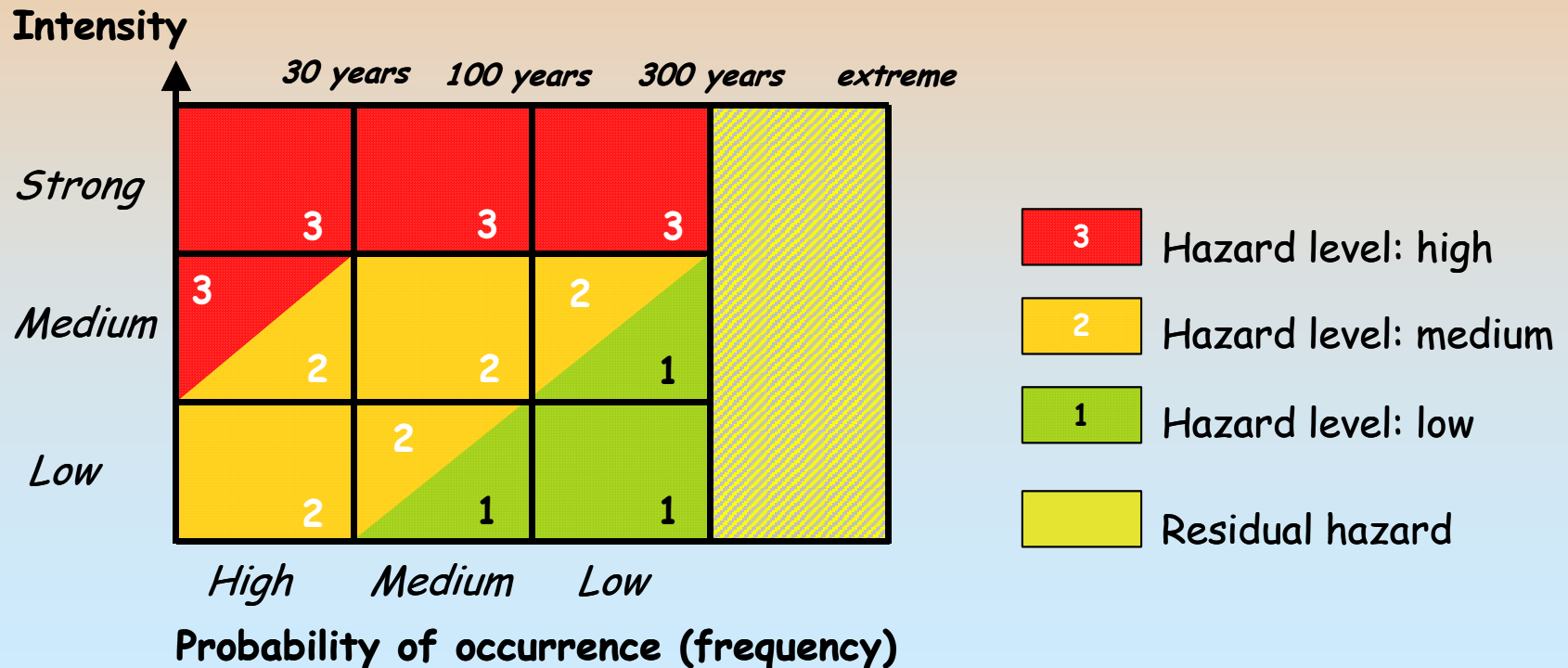
Flood intensity	Level	If $V < 1$ m/s	If $V > 1$ m/s
<b>Strong</b>	3	$2.0 \text{ m} < H$	$2.0 \text{ m}^2/\text{s} < H \times V$
<b>Medium</b>	2	$0.5 \text{ m} < H < 2.0 \text{ m}$	$0.5 \text{ m}^2/\text{s} > H \times V < 2.0 \text{ m}^2/\text{s}$
<b>Weak</b>	1	$0.0 \text{ m} < H < 0.5 \text{ m}$	$0.0 \text{ m}^2/\text{s} < H \times V < 0.5 \text{ m}^2/\text{s}$



# Methodology

## calculation of flood hazard

- By comparing flood intensity maps with the return period of peak discharges the flood hazard can be assessed

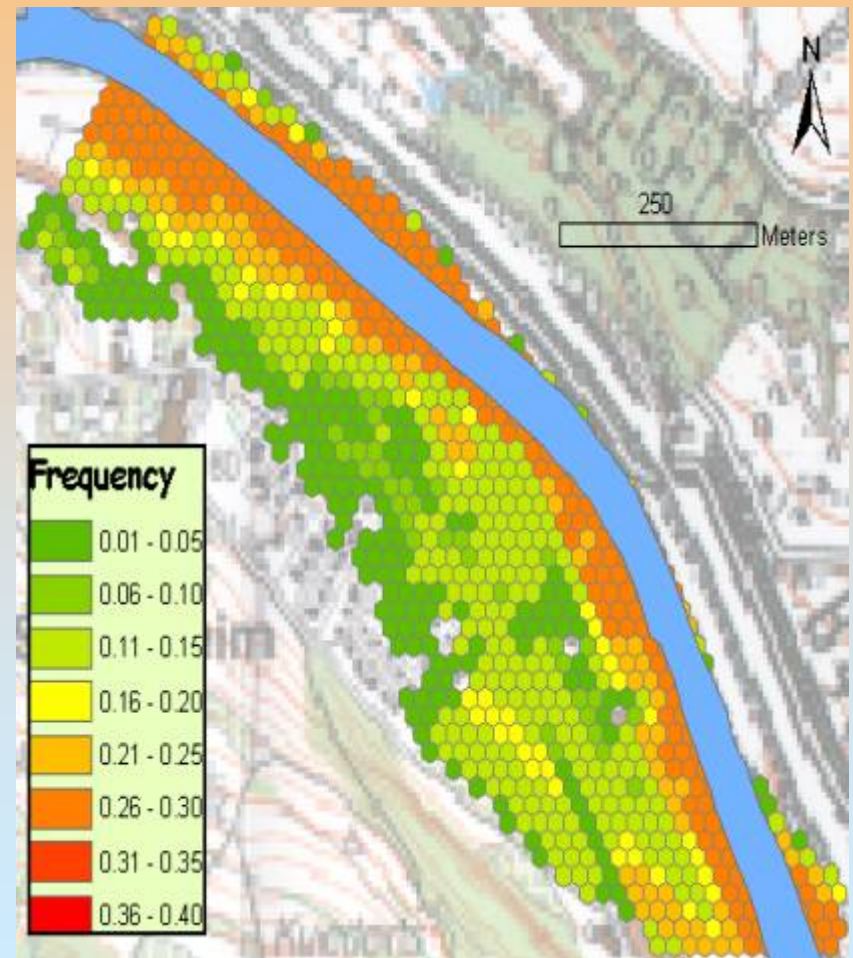
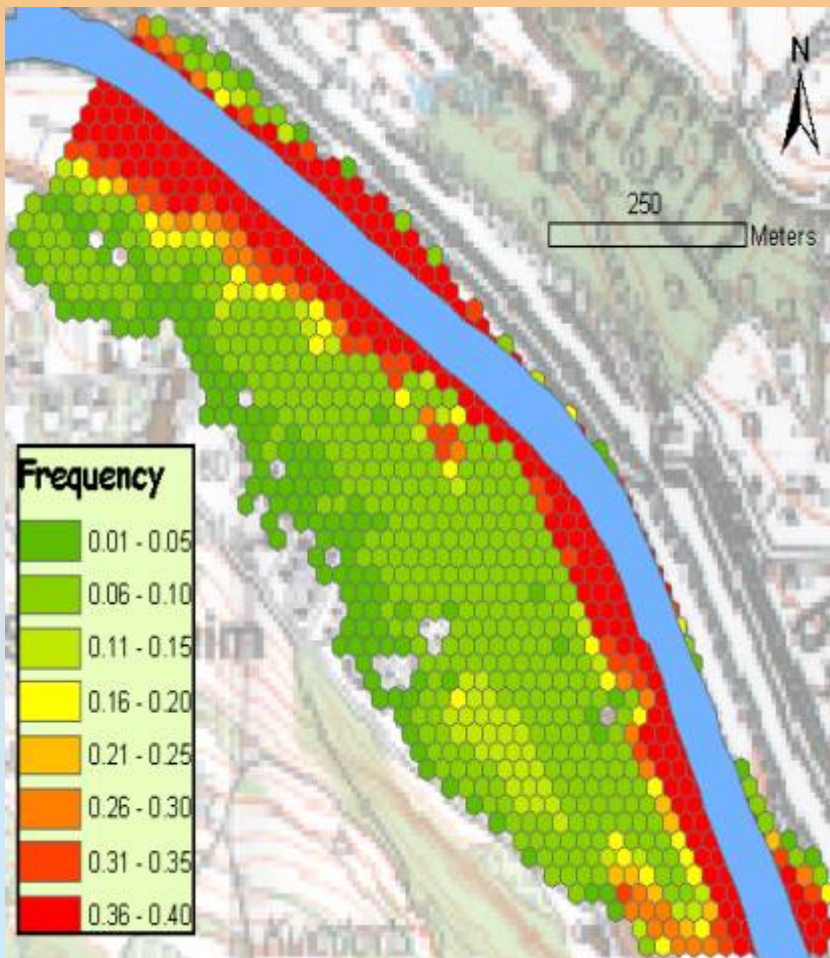


# Preliminary results

## flood frequency maps

1870-1920

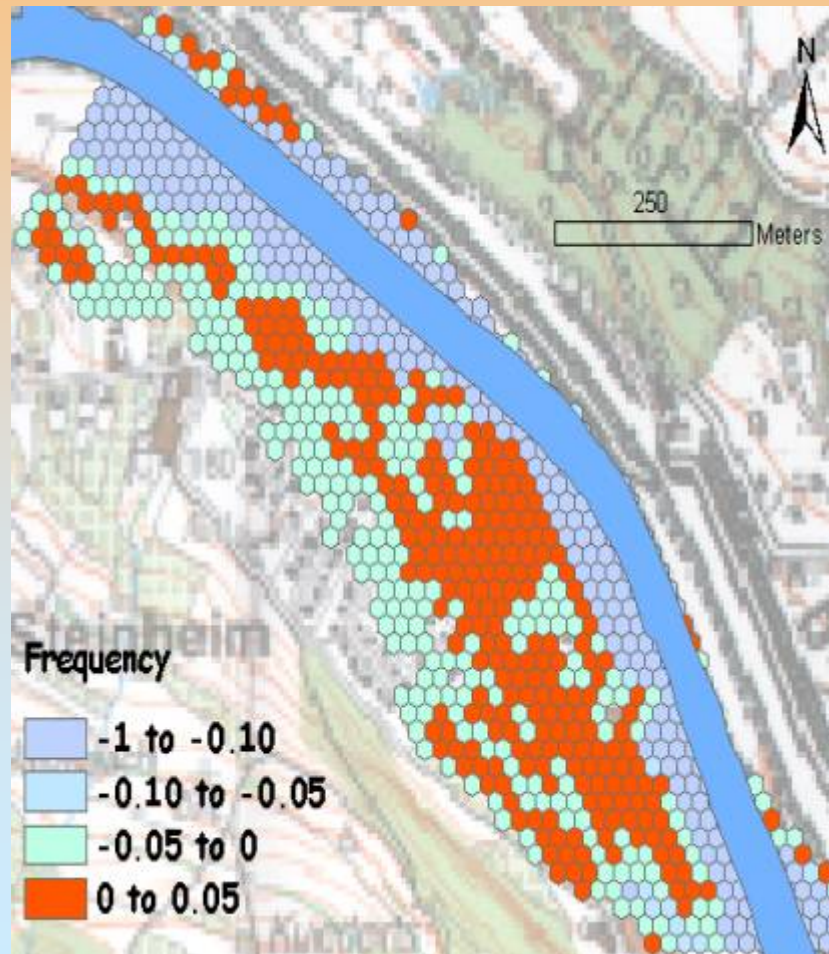
1966-2003



# Preliminary results

flood frequency maps

frequency change

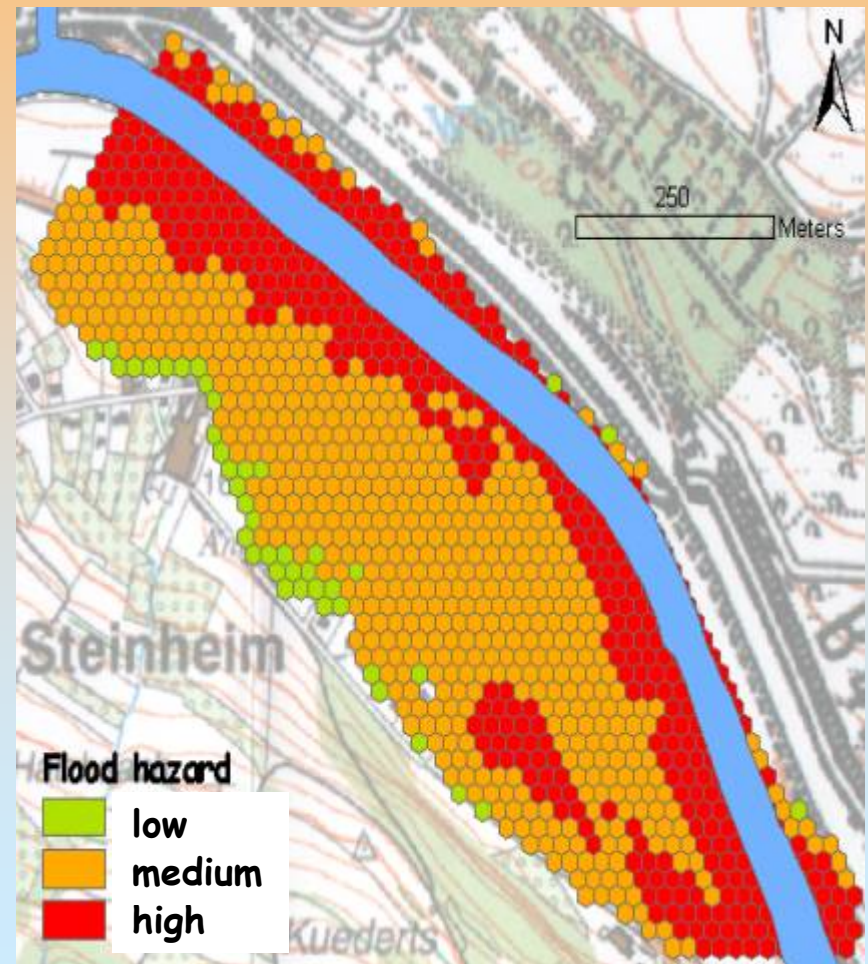
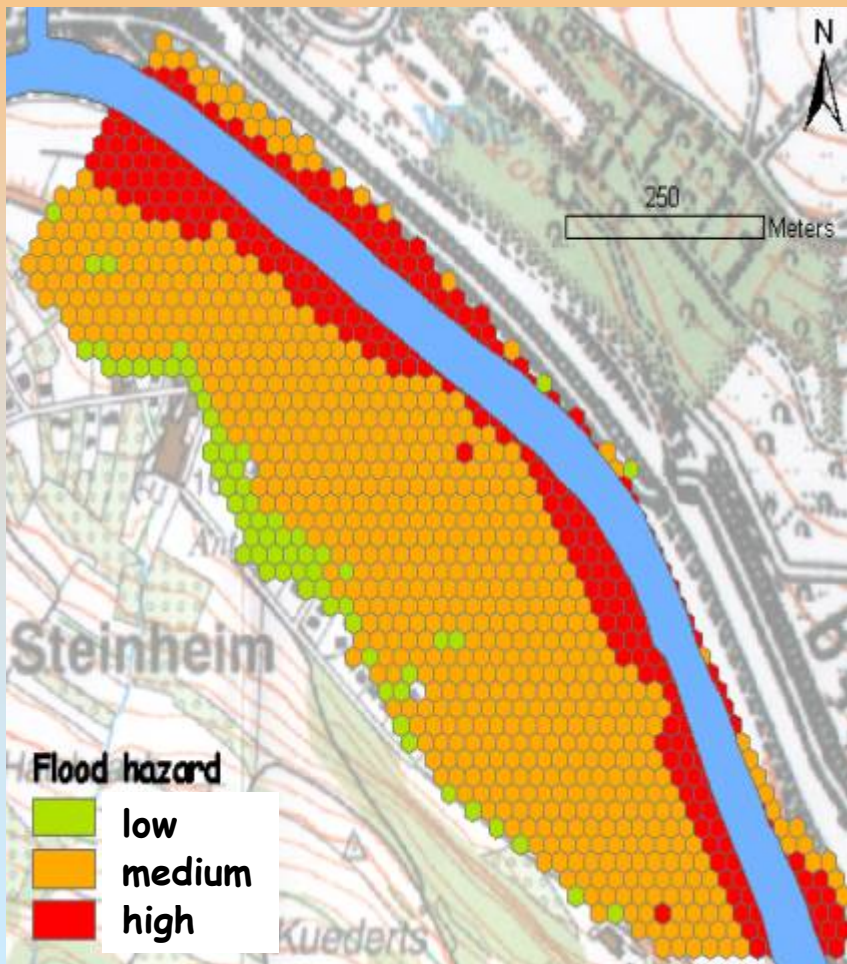


# Preliminary results

## flood hazard maps

1870-1920

1966-2003



# Preliminary results

## urbanisation of Steinheim



1775



1910



1952



1993



2002

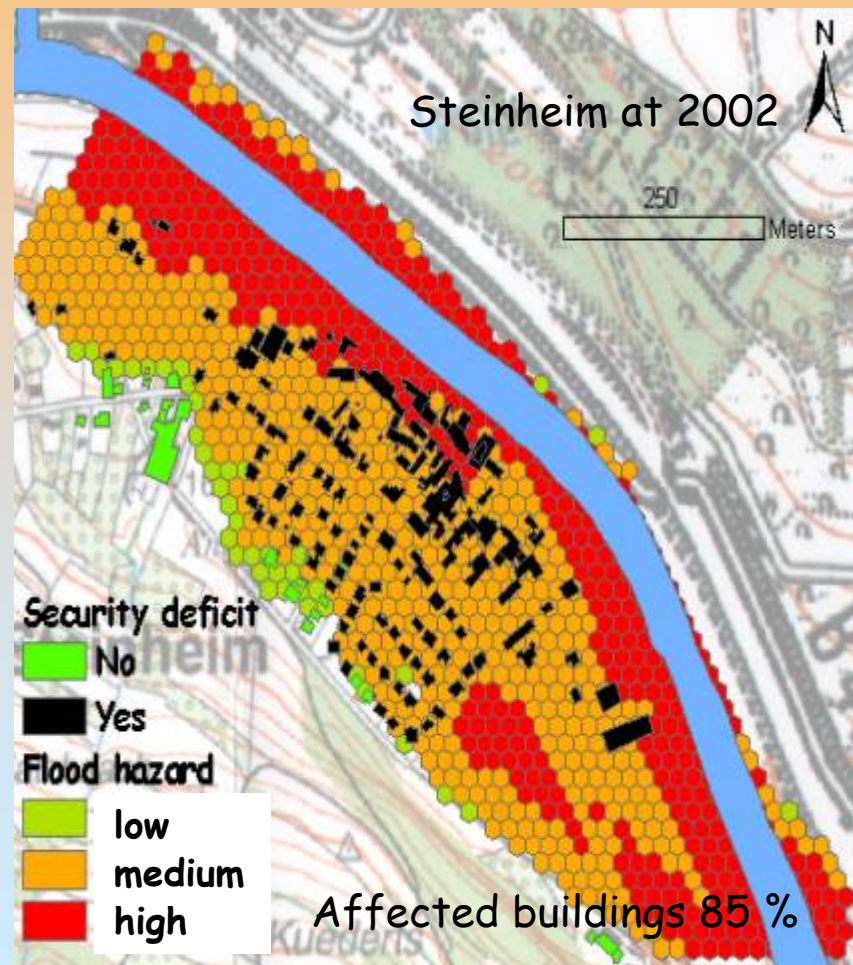
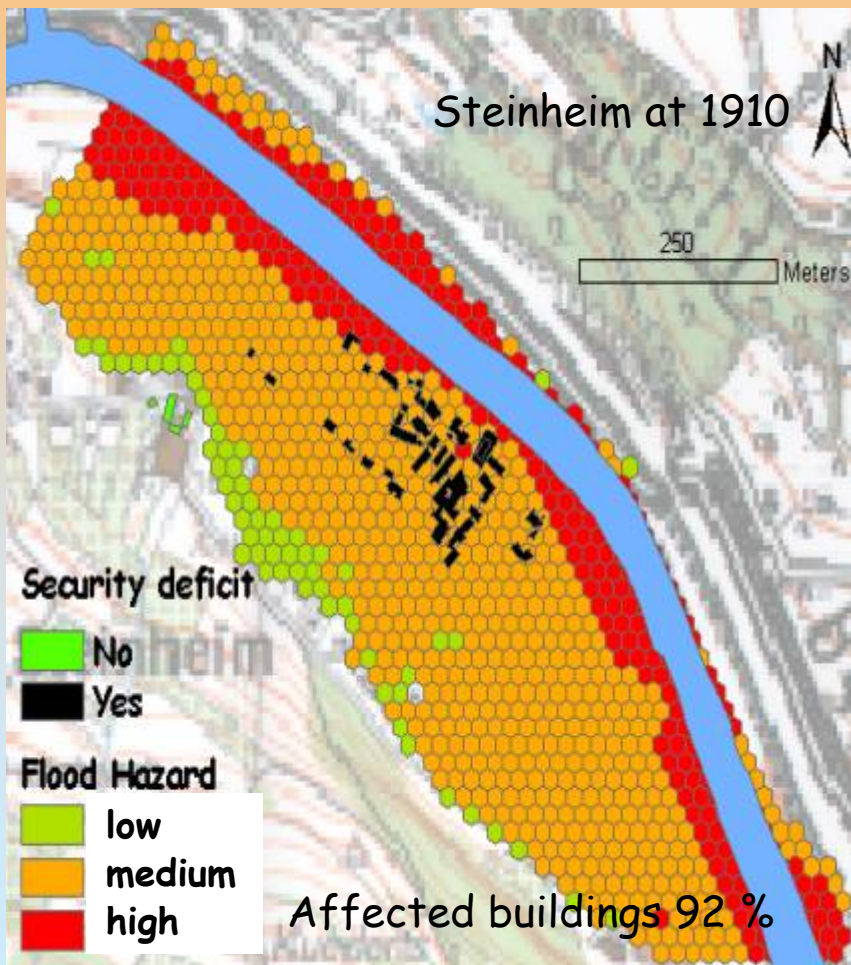
From 1775 to 2002  
the urbanised area  
increased almost  
six fold

# Preliminary results

## security deficit maps

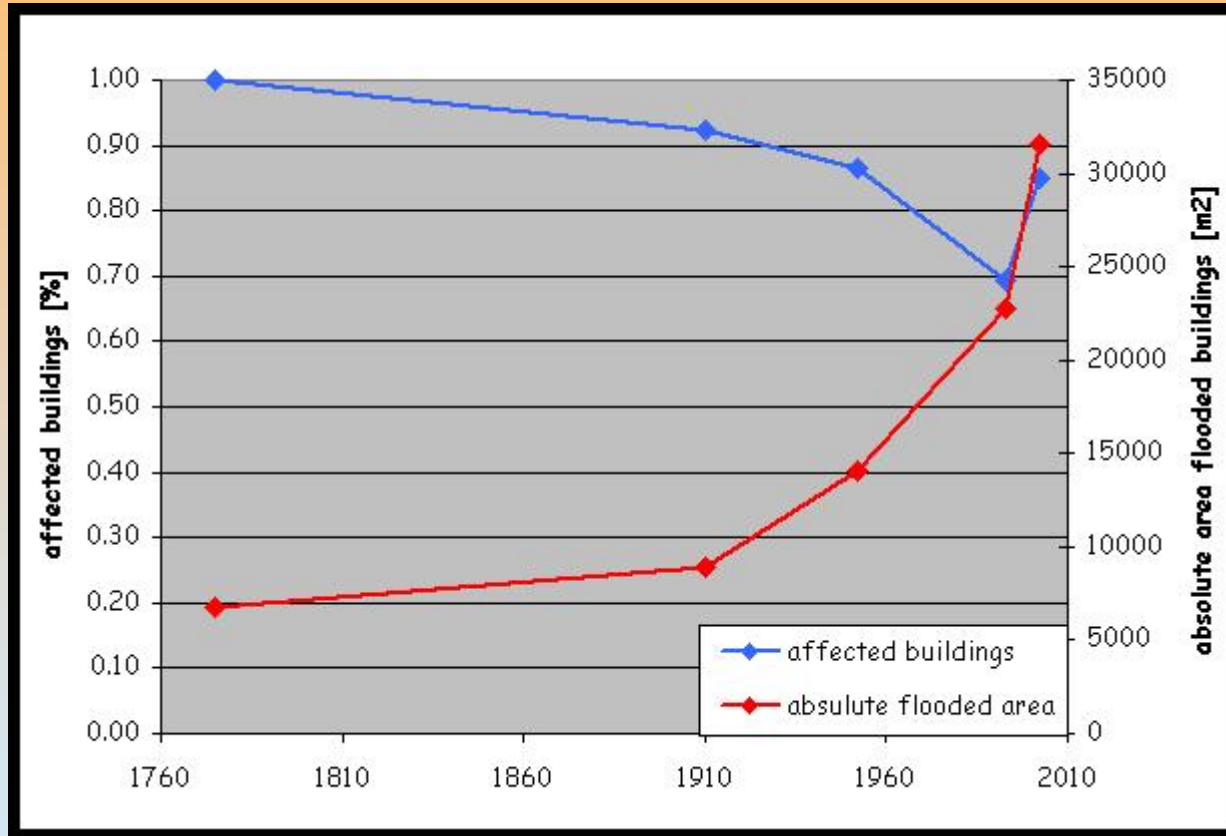
1870-1920

1966-2003



# Preliminary results

## Affected buildings



Decrease of percentage of affected buildings till 1993

Increase of vulnerability



# Conclusion

- Change of flood frequency:
  - Less medium floods
  - Slight increase of major floods
- No major change in flood hazard
- Decrease of percentage of affected buildings
- Increase of total vulnerable area

# Perspectives

- Difficult to assess a change in flood frequency with respect to climate-, land use- and river morphology change
- Perception has changed
  - From small village (nobody cared) to large village (more people involved)
  - Change from flood awareness to no flood awareness to flood awareness

# Questions