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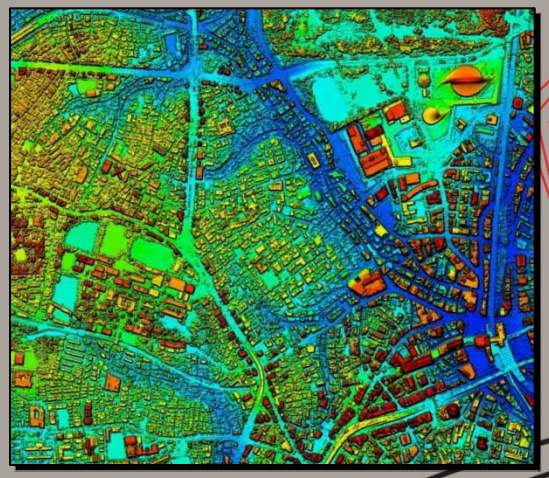
Methodological approaches to urban hazard *and risk assessment*



Victor Jetten

Cees van Westen, Richard Sliuzas, Norman Kerle, Anne van Veen

Dept. of Earth Systems Analysis, ITC

UN-GGIM – Chengduforum15-17 Oct 013

ITC FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

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URBAN HAZARD ANALYSIS

Hazards and Risk

- Simple hazard analysis
- Multiple Hazards and chain effects
- Complex physical processes

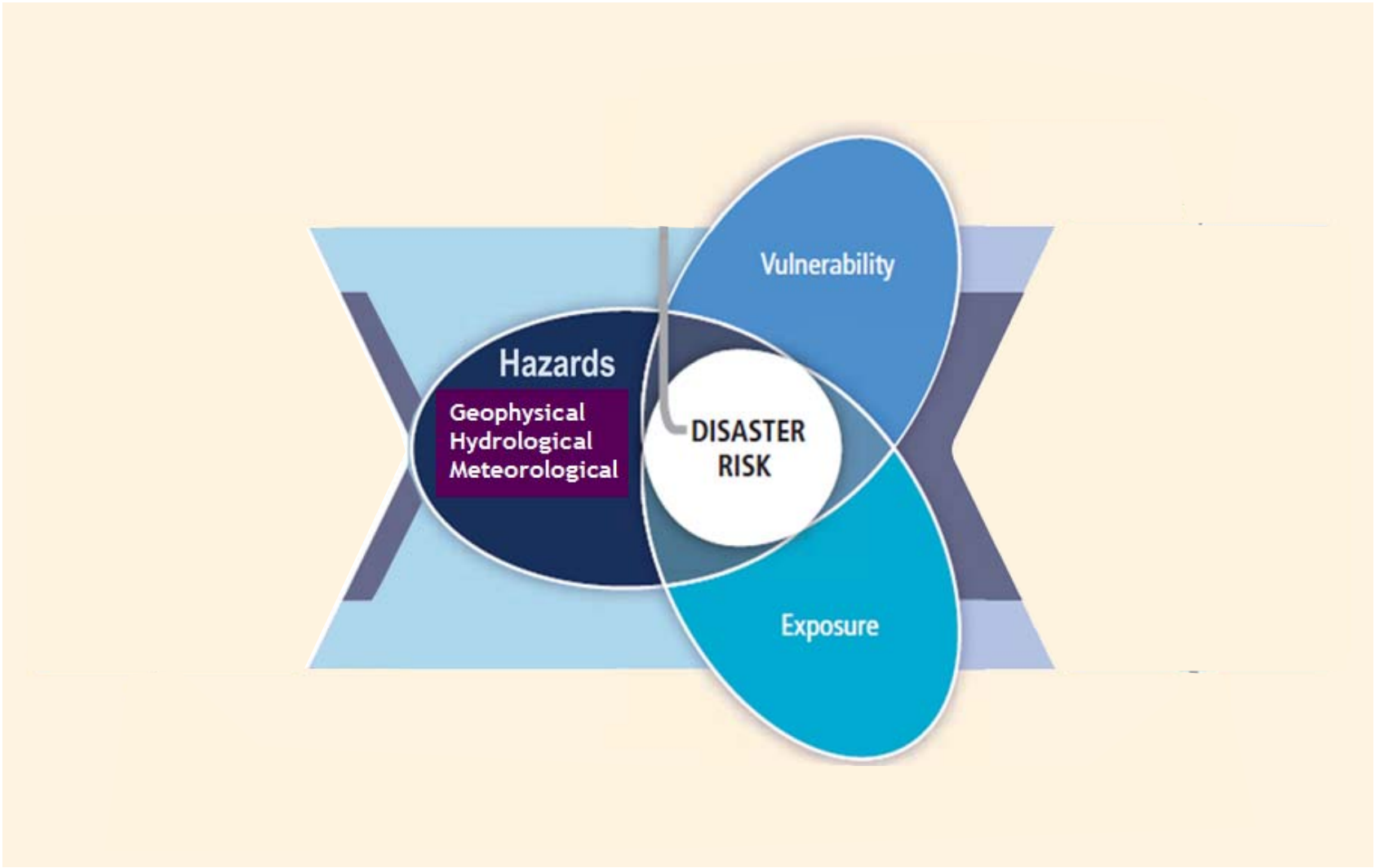
Vulnerability analysis

- Simple risk mapping
- Social vulnerability and potential casualties
- Economic risk

Kampala flash flood project

- City growth versus climate change

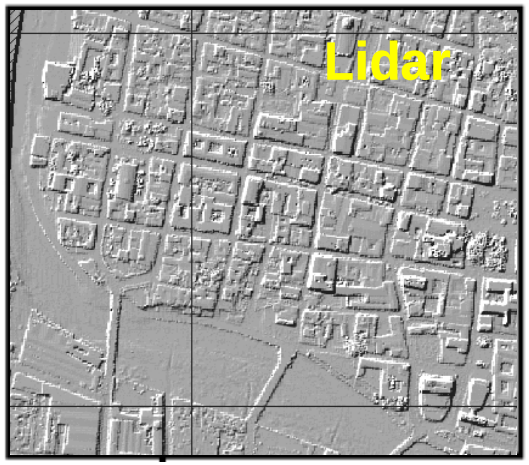
HAZARDS AND RISK



Based on: IPCC SREX report, 2012

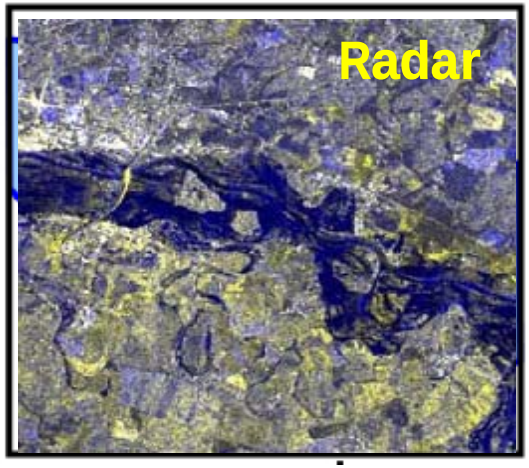
SIMPLE RISK MAPPING AS A SPATIAL EXERCISE

Elements at risk:
Building footprint

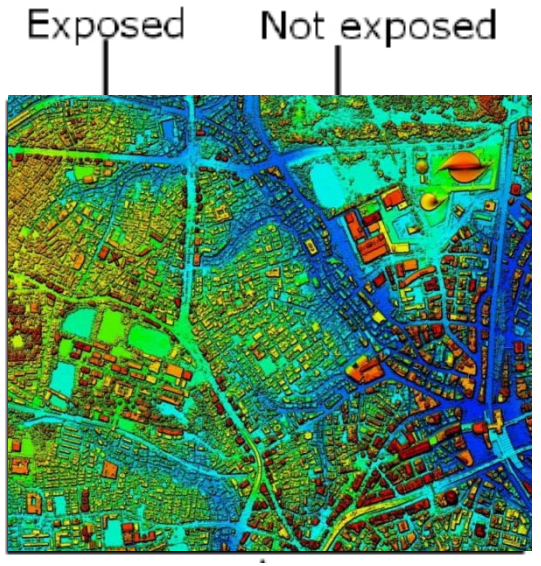


- High res imagery
- LIDAR
- UAV
- open street map
- Cadaster

Hazard:
Hazard footprint

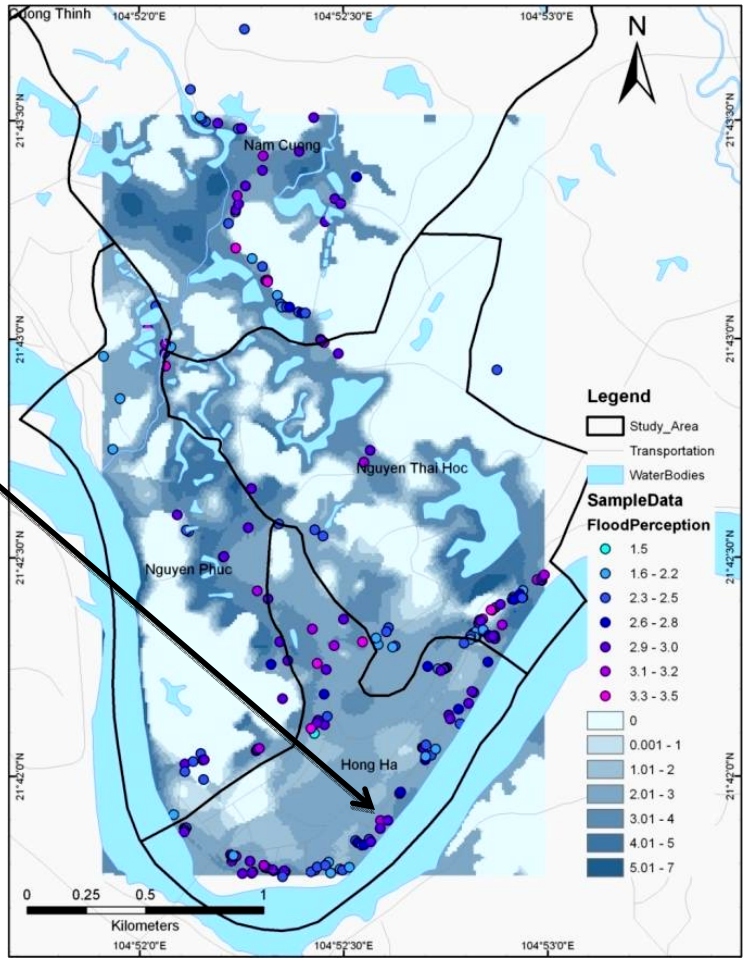


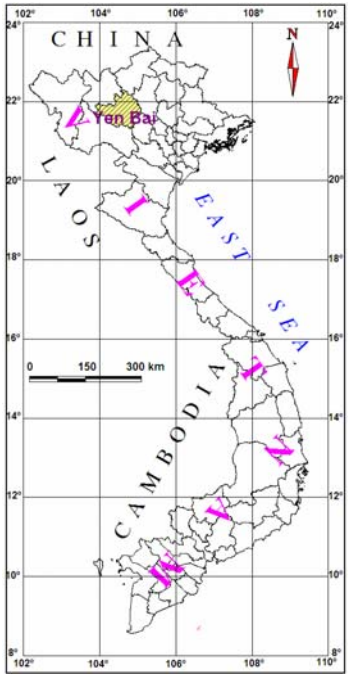
- GIS/DEM operations
- Radar images
- Community based mapping
- Spatial Modelling



Vulnerability
oStructure info (damage curves)
oCommunity based (questionnaires and focus group discussions)
oSpatial multicriteria analysis

HAZARDS: STAKEHOLDER BASED FLOOD LEVEL MAPPING IN YEN BAI (VIETNAM)





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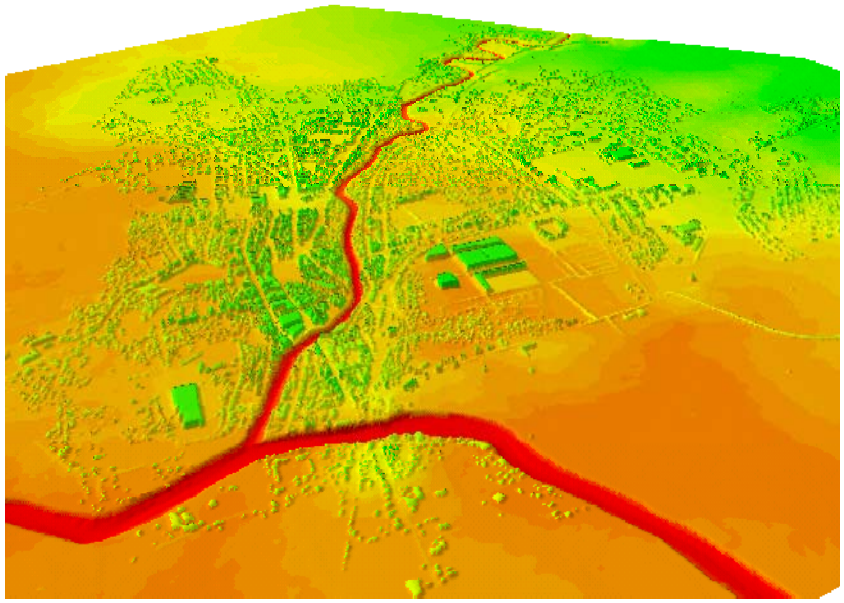
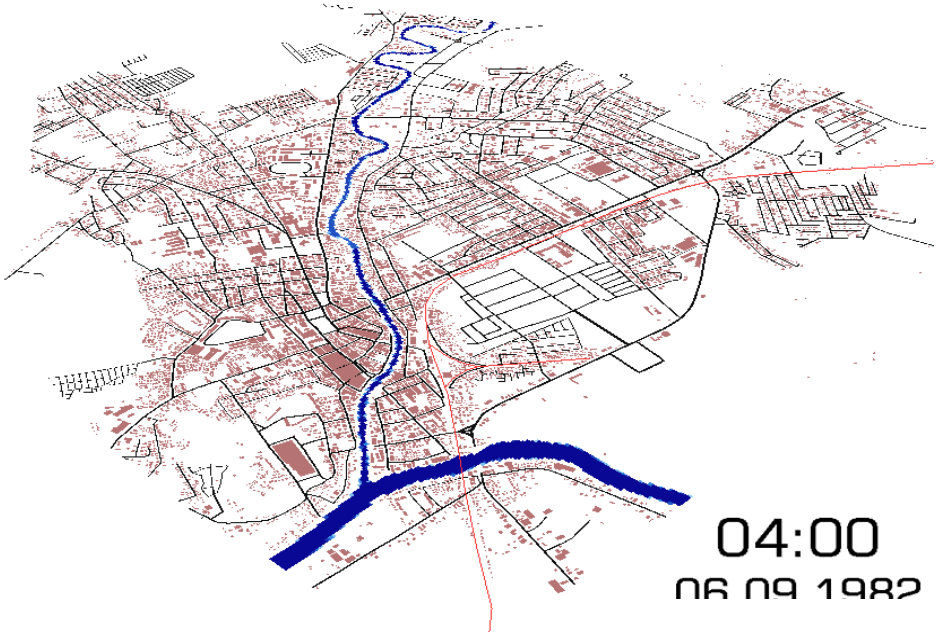
Trang & Niranga, 2008

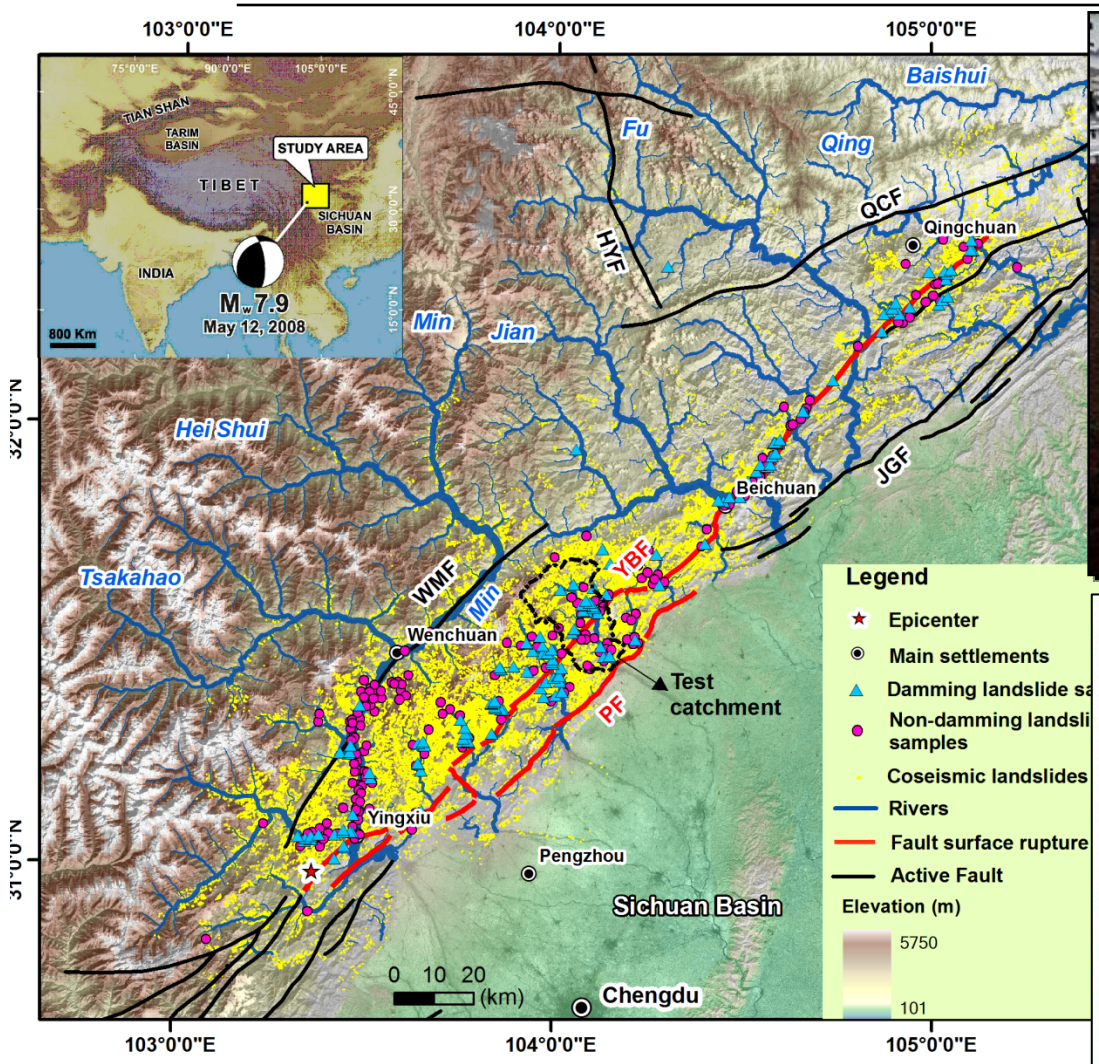
YEN BAI 2008 RED RIVER FLOOD SIMULATION





- Not only depth, but duration/response time, flow energy
- Scenario modelling, e.g. urban planning strategies
- Calibration and validation issues
  (compare with community maps and images)

MULTIPLE HAZARDS: WENCHUAN EARTHQUAKE 2008



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Xuanmei Fan, 2013

DEBRIS FLOWS: HAZARD DETERMINED BY MOVEMENT

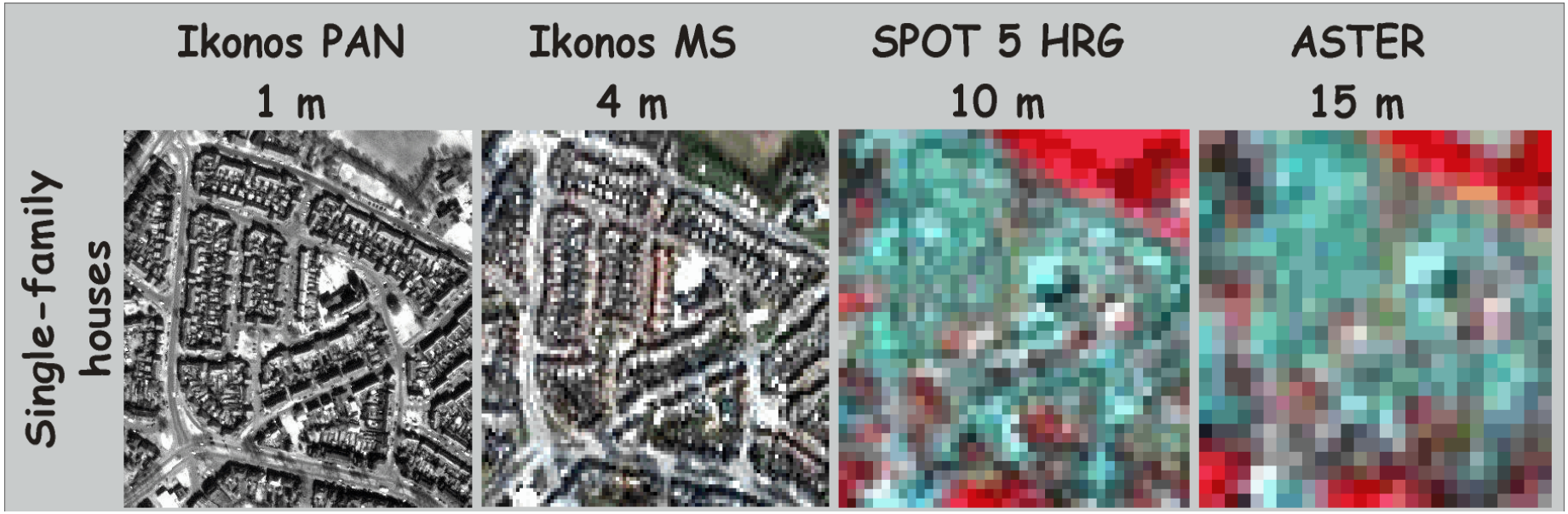
- Long reach, beyond trigger area
- High velocities and mass, devastating
- Interaction with obstacles
- Damage curves are not known

EXAMPLE MULTIPLE HAZARDS

- Earth quake has a direct effect
- Earth quake weakens the hillslopes in the area (ground shaking)
- Every major rainfall causes new landslides and debris flows until long after the earth quake
- Debirs flows can dam rivers
- Dam breaks cause flood waves

- Long after people re-settle, effects can manifest

Elements at risk mapping



Object Information

Spectral information

Object oriented analysis
Combined with LIDAR gives
3D information

ADVANTAGES OF OBJECT ORIENTED ANALYSIS

- Before and after a disaster, rapid damage assessment (make a database)
- Depends on how recognizable objects are (slums)
- Use of UAVs for 3D object damage analysis

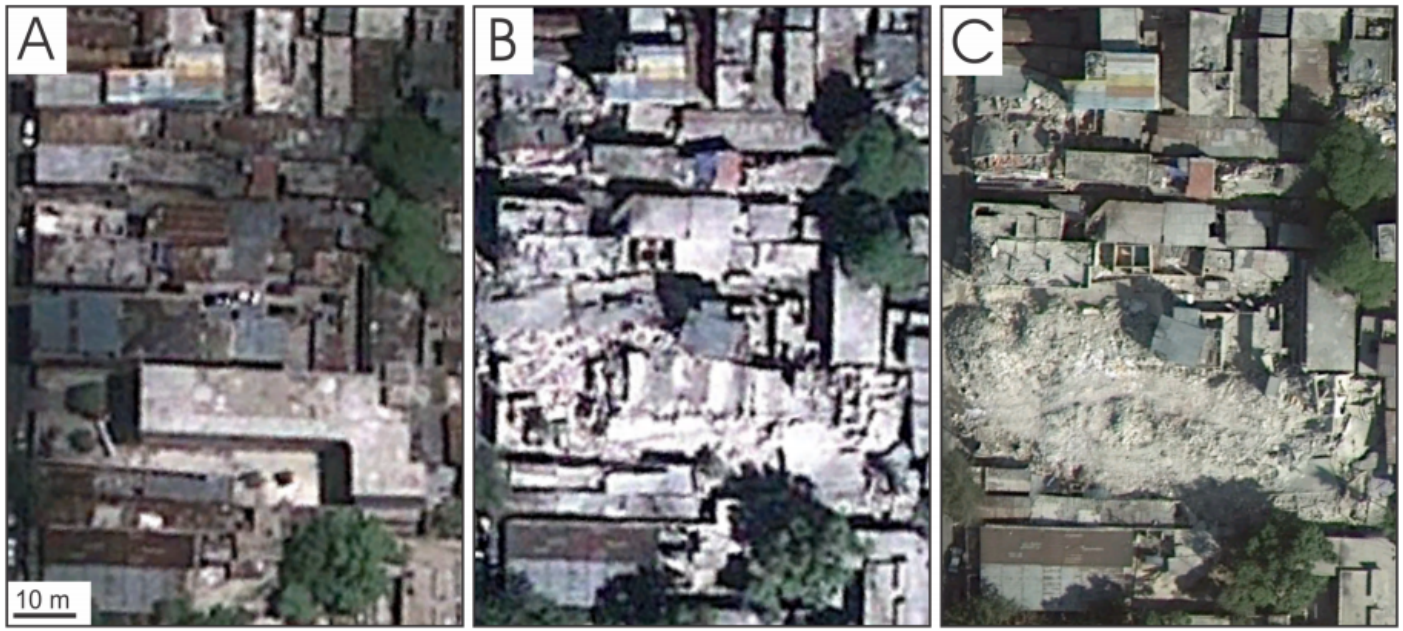
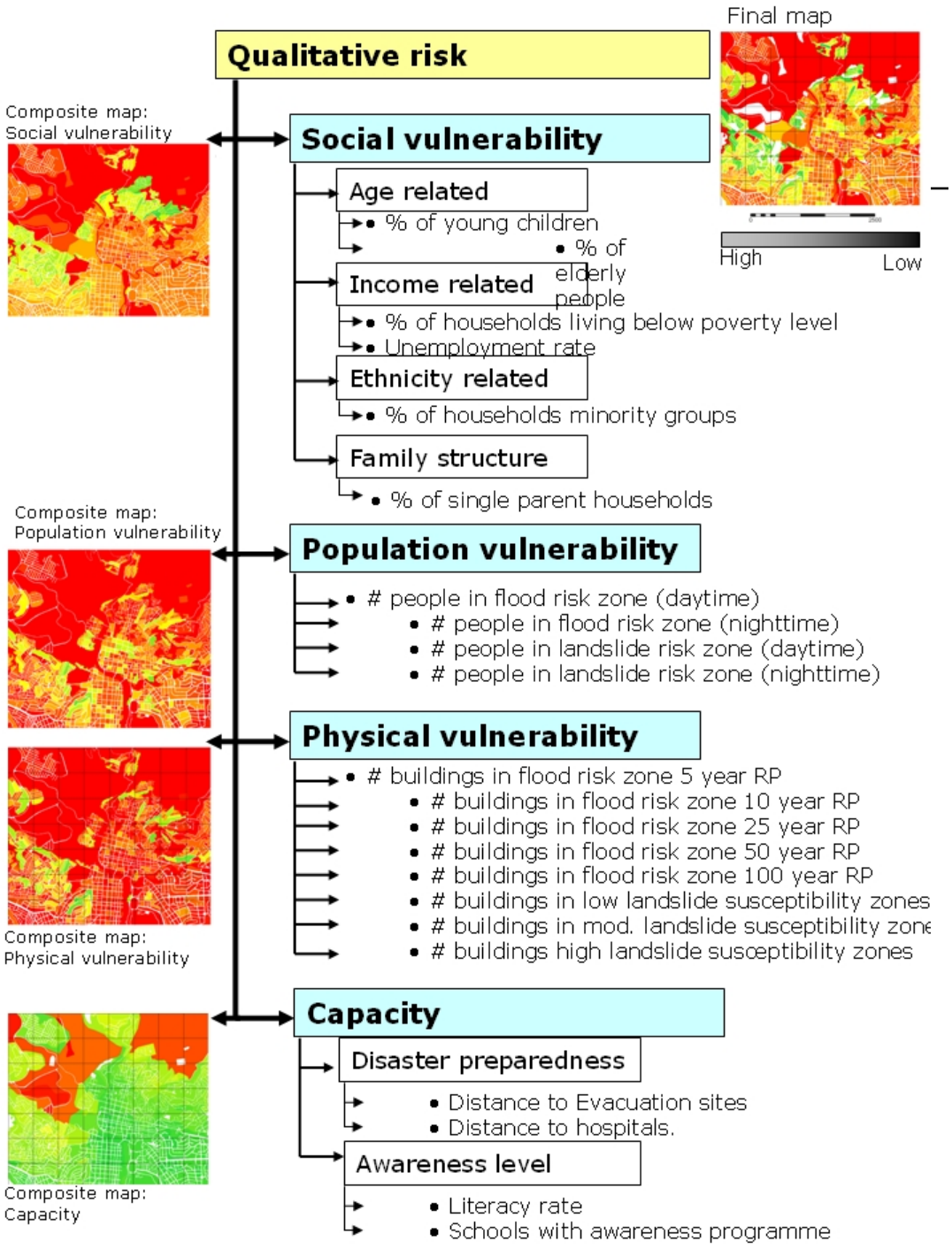


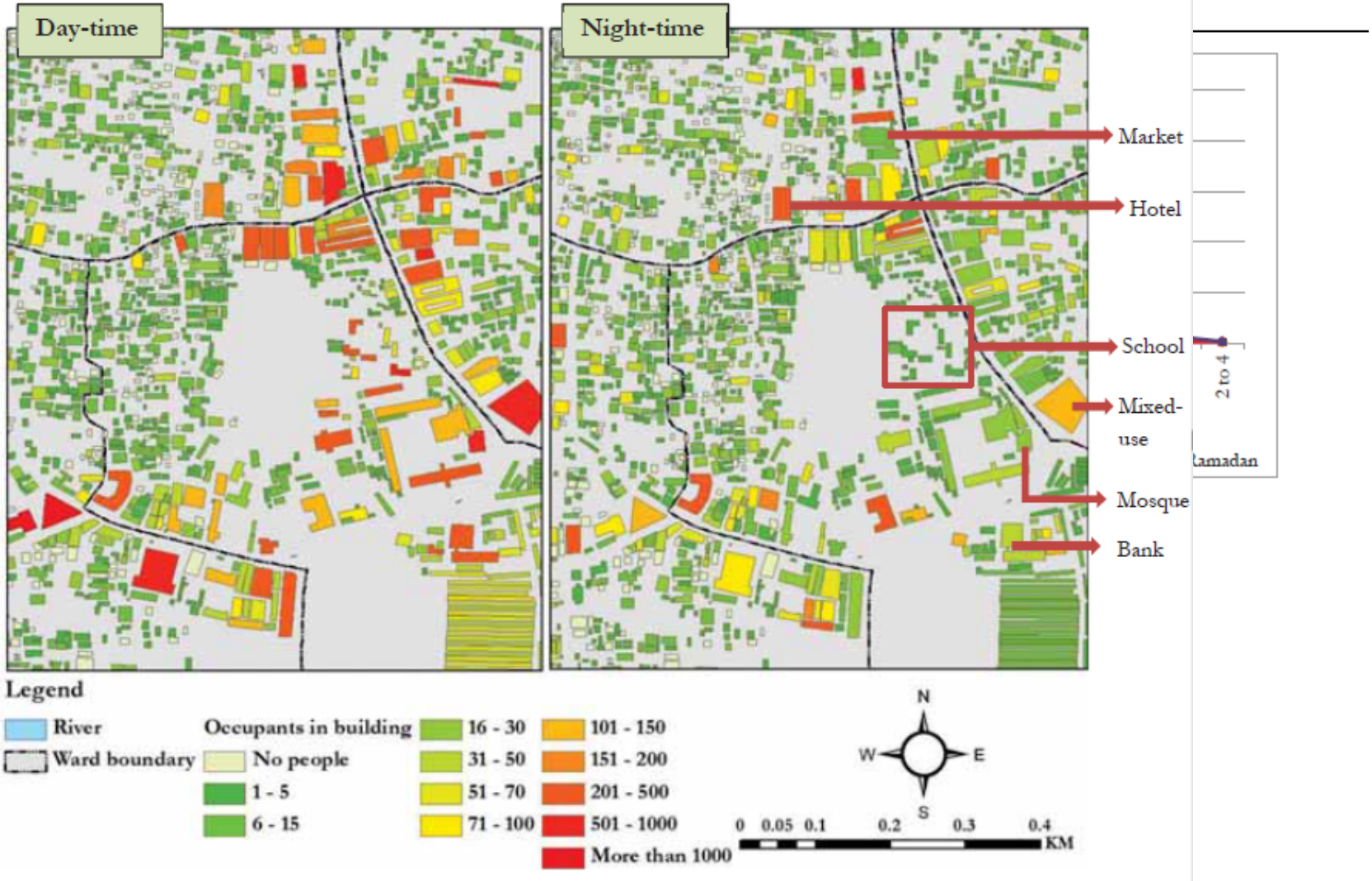
Fig. 2. Neighborhood in Port-au-Prince (Haiti) severely affected by the 12 January 2010 earthquake. Pre-event Geoeye-1 satellite image (26 August 2009; **A**), first post-event satellite scene (Geoeye-1, 13 January 2010; **B**), and airborne image acquired on 25 January 2010 **(C)**. ©Google Earth.

SPATIAL MULTI CRITERIA SOCIAL VULNERABILITY

- Independent on choice of social indicators
- Link to poverty indicators
- Weighing is important and subjective
- Information is not always available on the same scale as the hazard
- Result can be very abstract



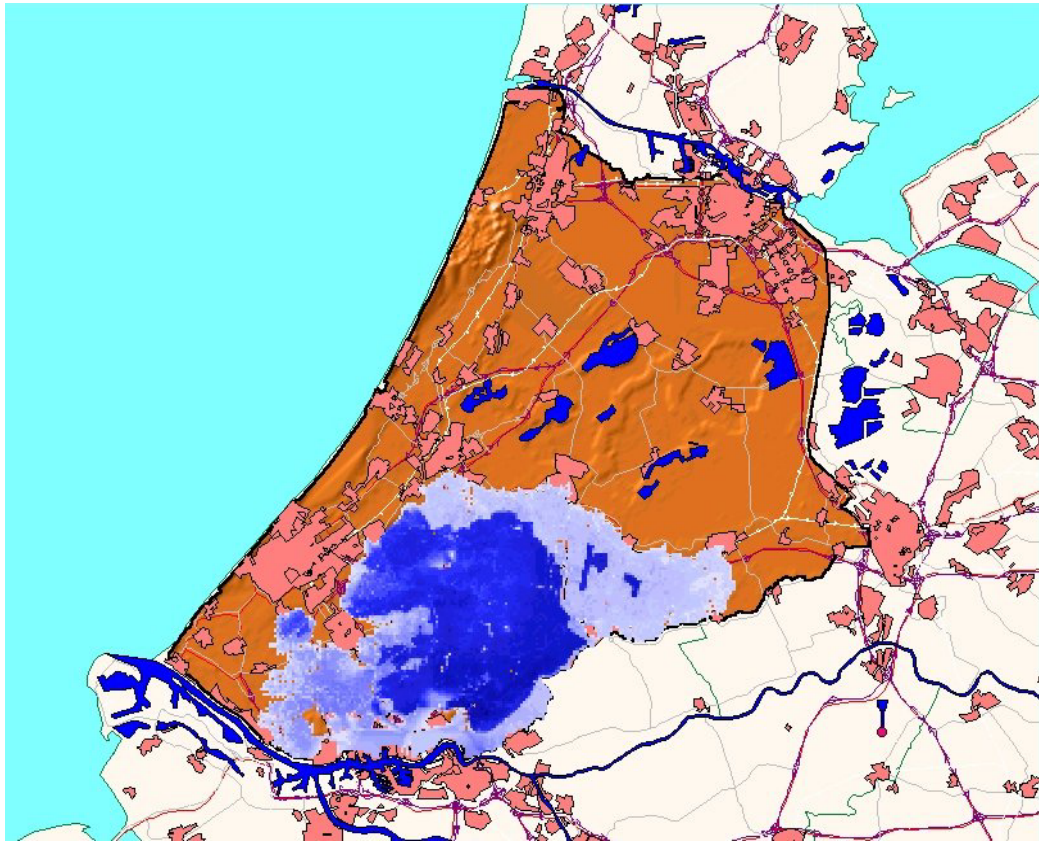
AND PEOPLE ARE MOBILE ...



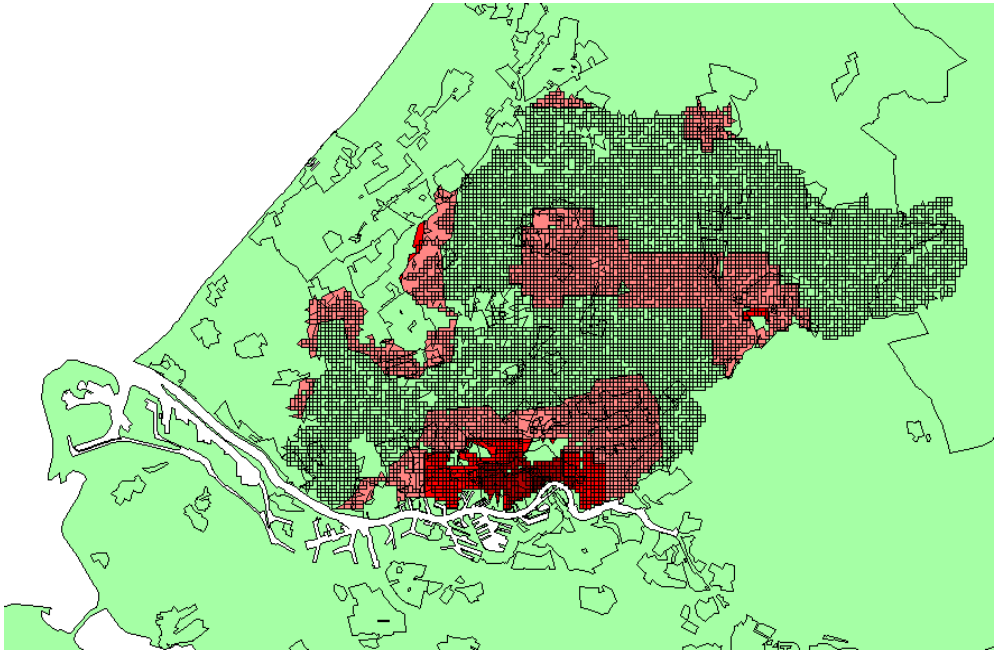
There is not one risk map

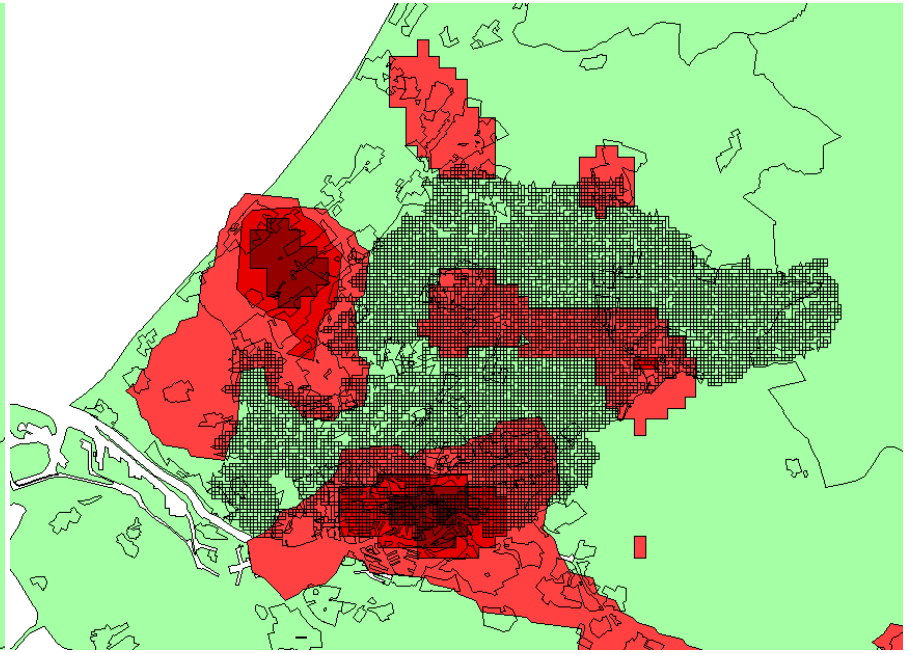
ECONOMIC RISK – AN EXAMPLE FROM HOLLAND

- Simulated dike breach north of the Rotterdam harbour
- Affected area: large industry, horticulture, cities (part of the Hague)
- Economic risk including supply demand chains, input-output modelling



ESTIMATED DAMAGES





Direct: 22 billion

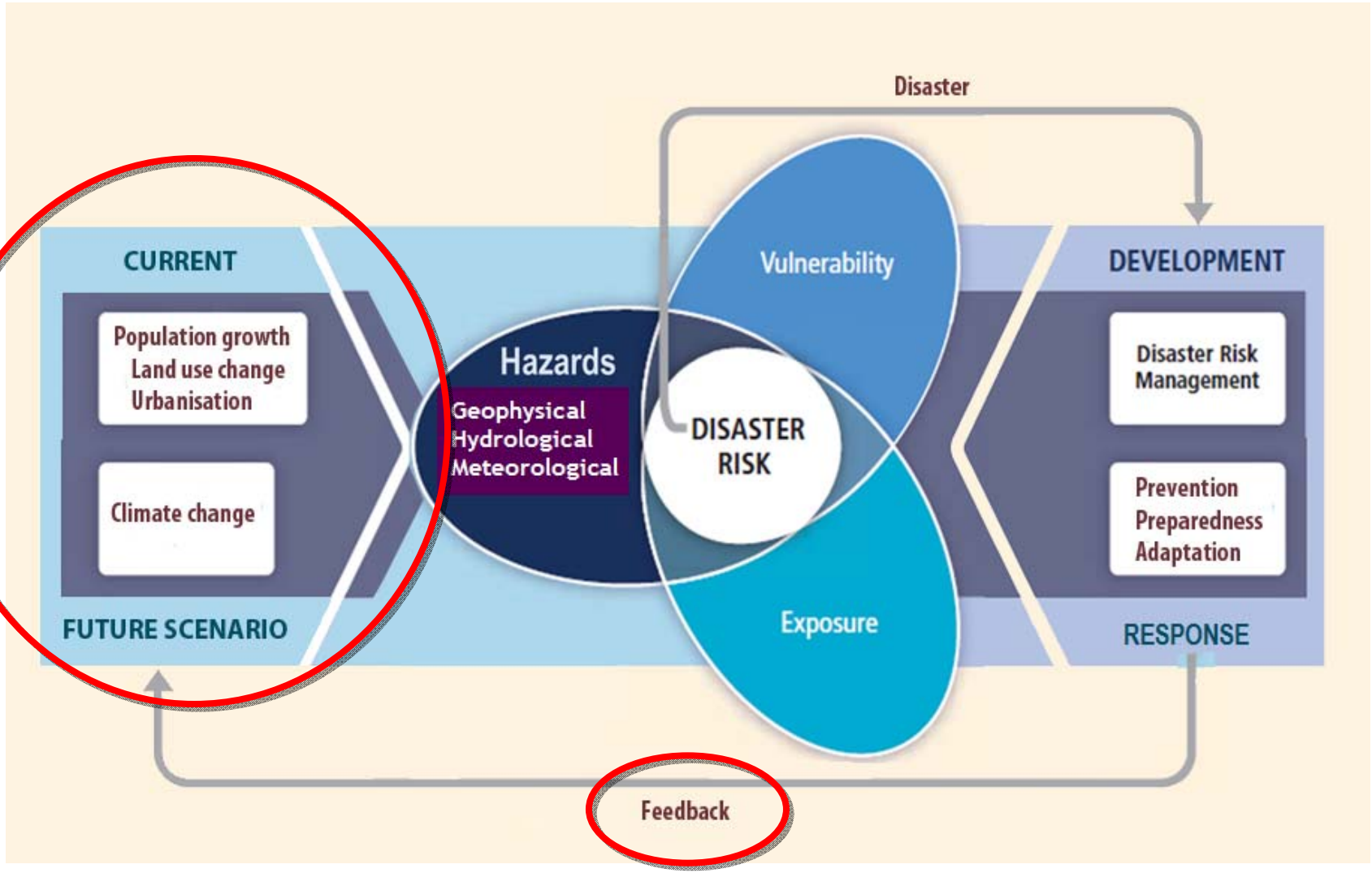
incl.indirect: 30 billion euro

Area affected is far outside flood zone

If supply-demand is taken over by another factory, indirect damages decrease.

Damages depend also on the duration of restoration period

WHAT ARE THE REAL DRIVERS?



Based on: IPCC SREX report, 2012

INTEGRATED FLOOD MANAGEMENT KAMPALA

1. City-wide assessment of flood risks & climate change impacts
2. Detailed flood risk assessment in flood ‘hotspot’
3. Develop a strategy and action plan for improved and integrated flood management.

Partners:

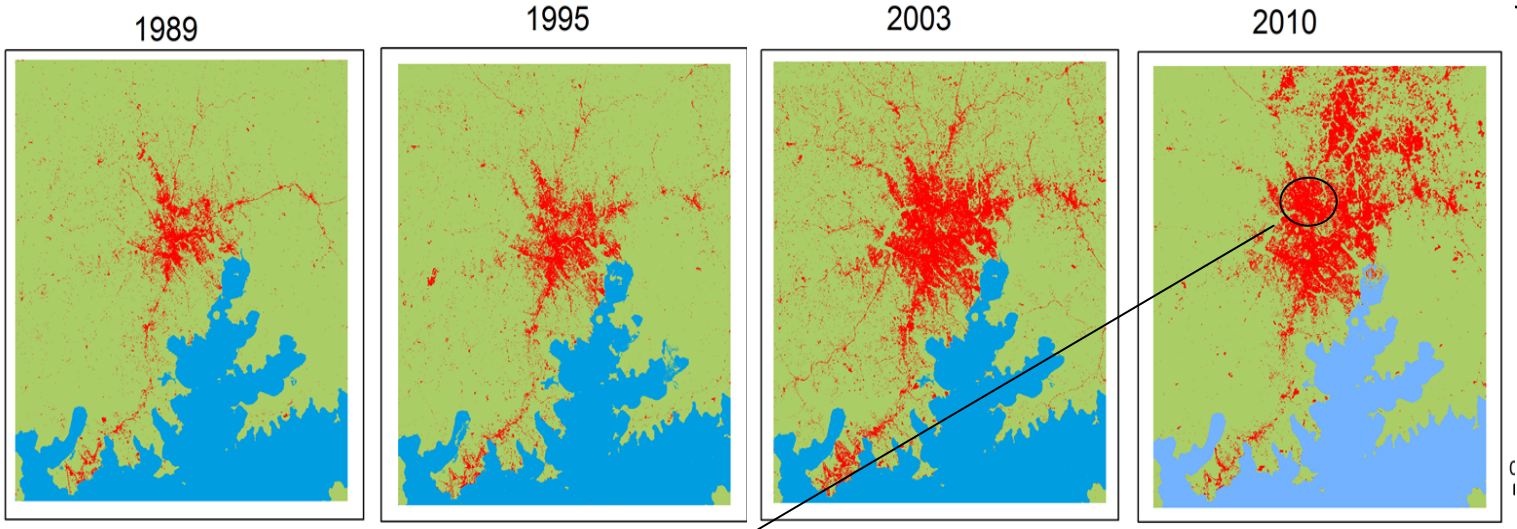
UN-HABITAT Cities and Climate Change Initiative (CCCI)

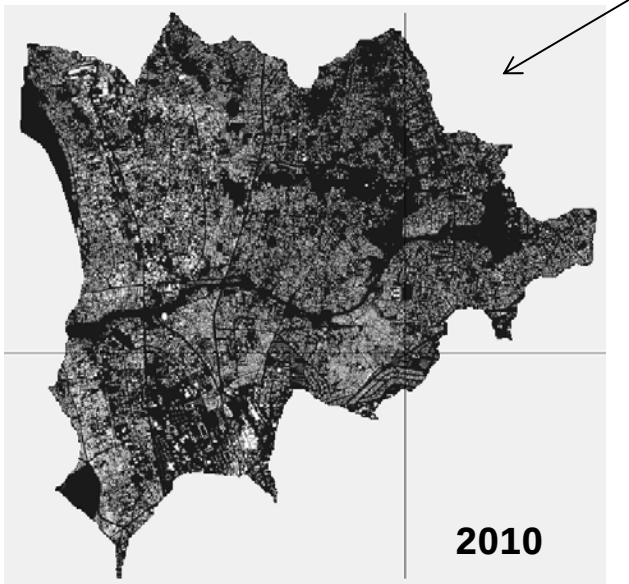
Counterpart: KCCA – Kampala Capital City Authorities

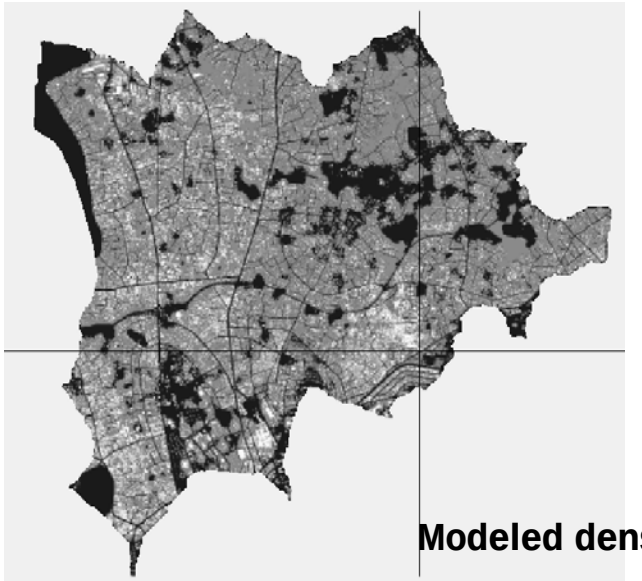
Makerere University, Hydroc Consultants, Local NGO’s

FLASH FLOODS : ALL CITIZENS ARE STAKEHOLDERS

ONE OF THE FASTEST GROWING CITIES IN AFRICA

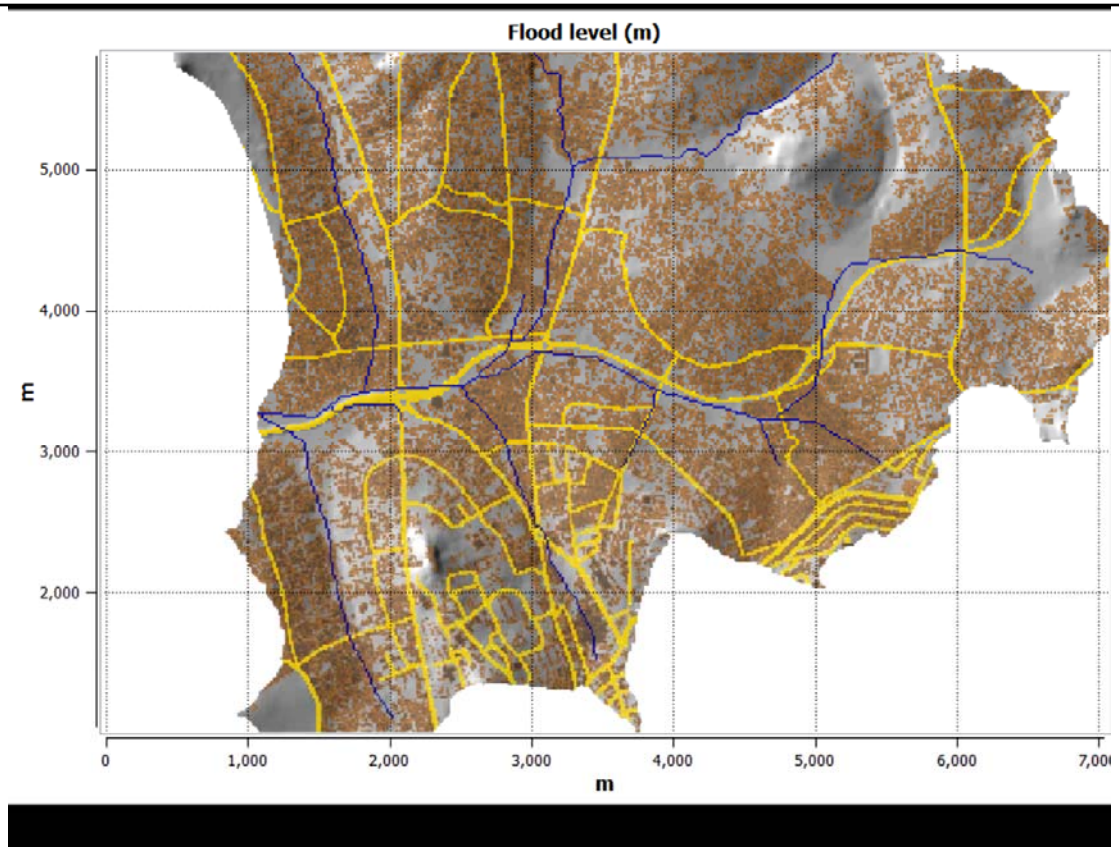



2010

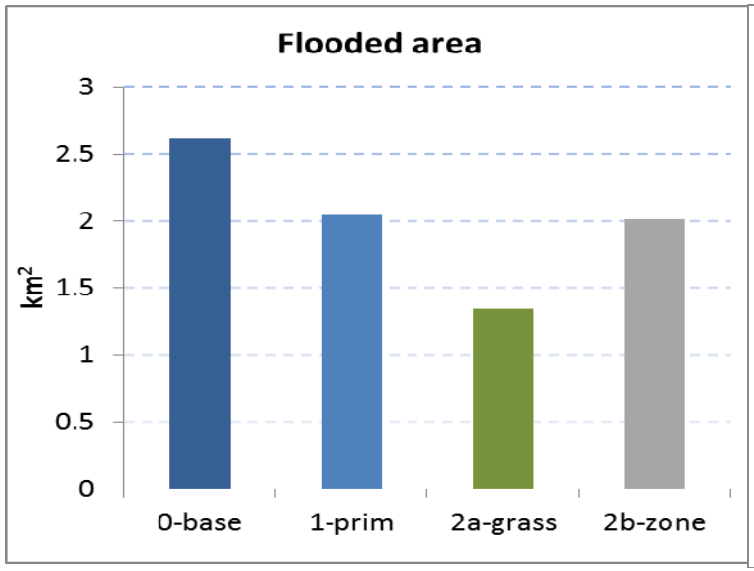

Modeled density 2020

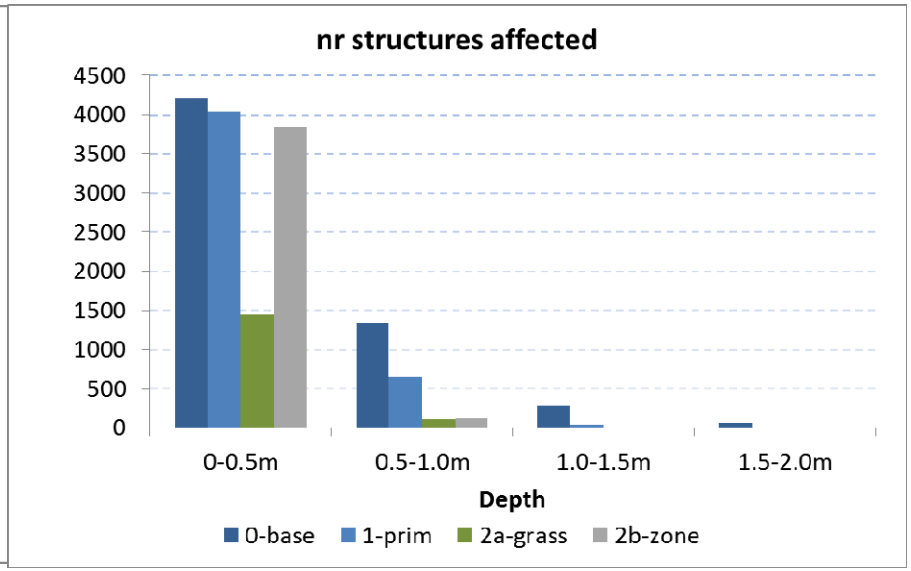
WITH ITS CURRENT HOUSING DENSITY 50% RUNOFF

- Floods 2x per month in the wet season
- Many drainage bottlenecks
- Water has nowhere to go downstream (flat wetlands)
- Flooding in all valleys and former wetlands
- Wetlands are now informal settlements (slums)



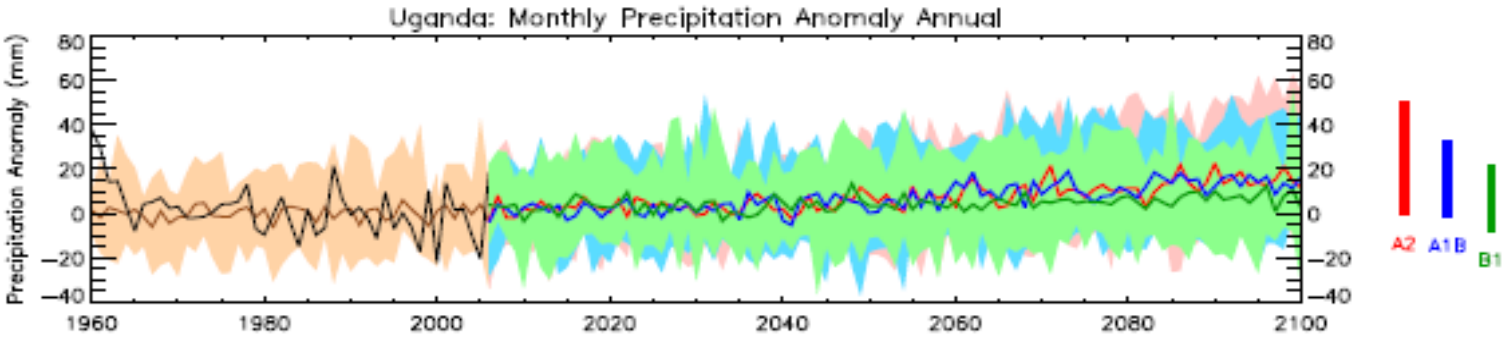
SUSTAINABLE URBAN DRAINAGE SYSTEMS



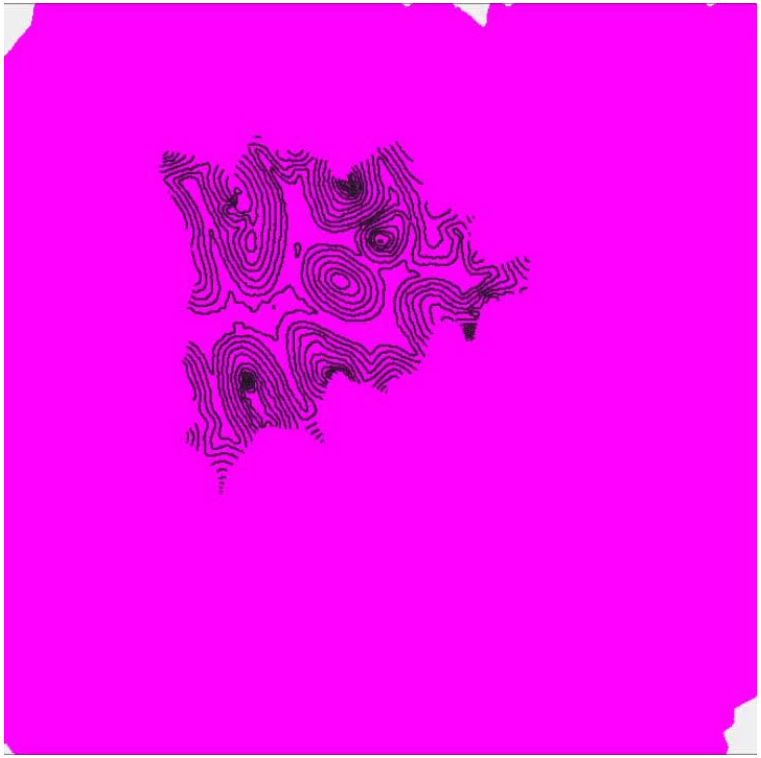


- Keep green open space: infiltration captures 50-60% of the flood water
- Replace drains with grassed waterways
- Flooded decreases by 50% and the nr. houses flooded decrease from 6000 to 1600.
- City PLANNING is most important

LIKE MANY CITIES, KAMPALA CLAIMS CLIMATE CHANGE!



- But according to the IPCC: extreme rainfall does not change significantly
- However, heavy rainfall is caused locally by heat island effect
- So we <u>don't know yet</u> what climate change will do to extremes



CONCLUSIONS – RISK ASSESSMENT

- **Hazards**
  - Advanced spatial modelling of multiple hazards is improving, supported by
  - Community based hazard mapping and image analysis
- **Vulnerability**
  - Structural vulnerability and damage curves: more and more data available (for floods, landslides and earthquakes)
  - Social vulnerability: SMCA but abstract result
  - Potential casualties: time factor is important, (suggests smart phone GPS tracking?)
  - Rapid damage assessment: best when before-after images, and on-the-ground data, advances with UAV
- **Economic damages**
  - Local economic damages doable, supply-demand chains and national effects methodology is being developed

CONCLUSIONS – KAMPALA CASE STUDY

- Urban planning does not take disaster management into account
- Planning is based on optimizing traffic and services: leads to further densification
- Plan for open spaces for flash floods:
  - soils are the largest store
  - SUDS
- It was not necessary to do a risk analysis: the flood simulations triggered a lot of discussion!
- The inconvenient truth is: we really like climate change, but don't know much yet about future extreme weather

THANK YOU


IPCC
NCDP
IRDR
UN-ISDR
GAR
UN-GGIM
UN-HABITAT
PDC
ADPC
USGS
GEOSS
USAID
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