

Extreme events and societal transformation processes: new challenges for risk management and strategic planning

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Scientific Dinner Speech at the Extreme Events and
Environments: from Climate to Society
cross community workshop, Berlin, 15th February 2016

I The Global Perspective

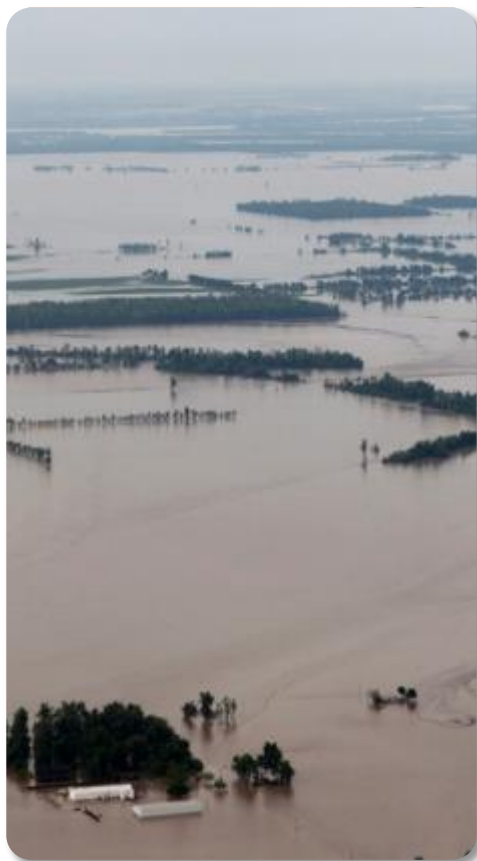
Key Drivers of Global Change and Determinants of Risk

Urbanization

Urban growth between 2014 – 2050 (UN/DESA 2014)

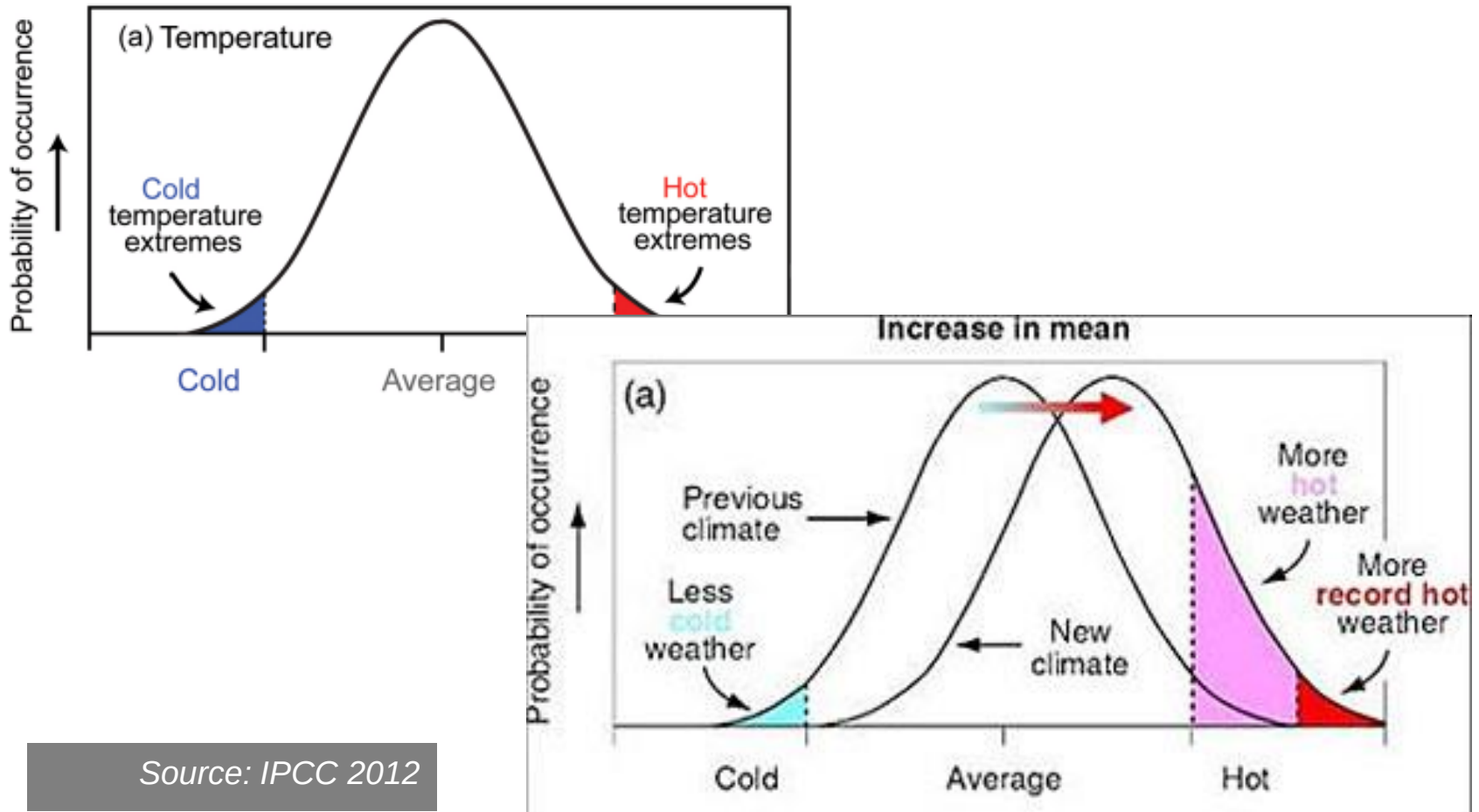


Climate Change leads to changes in extreme events



What are extreme events?

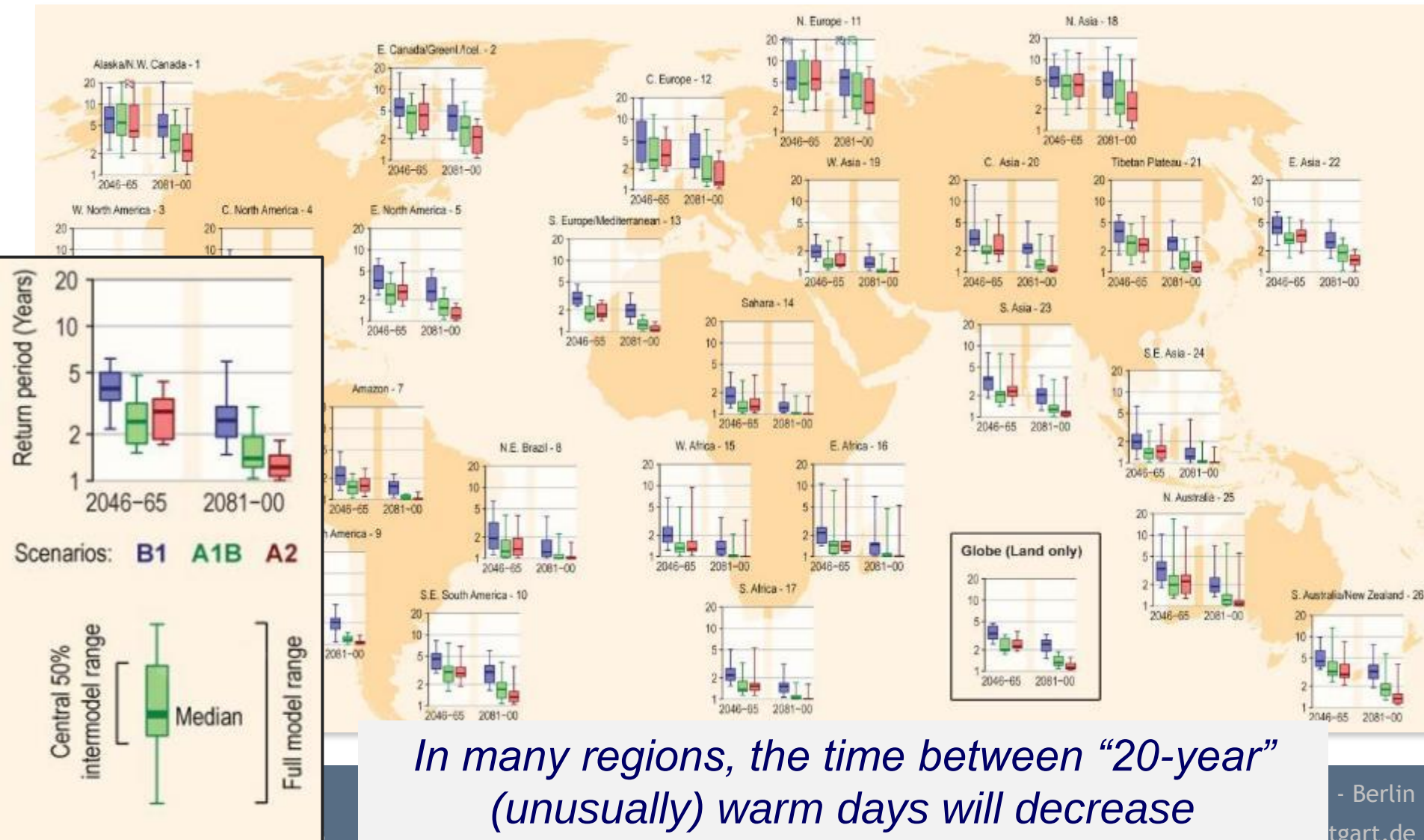
What Is an Extreme?



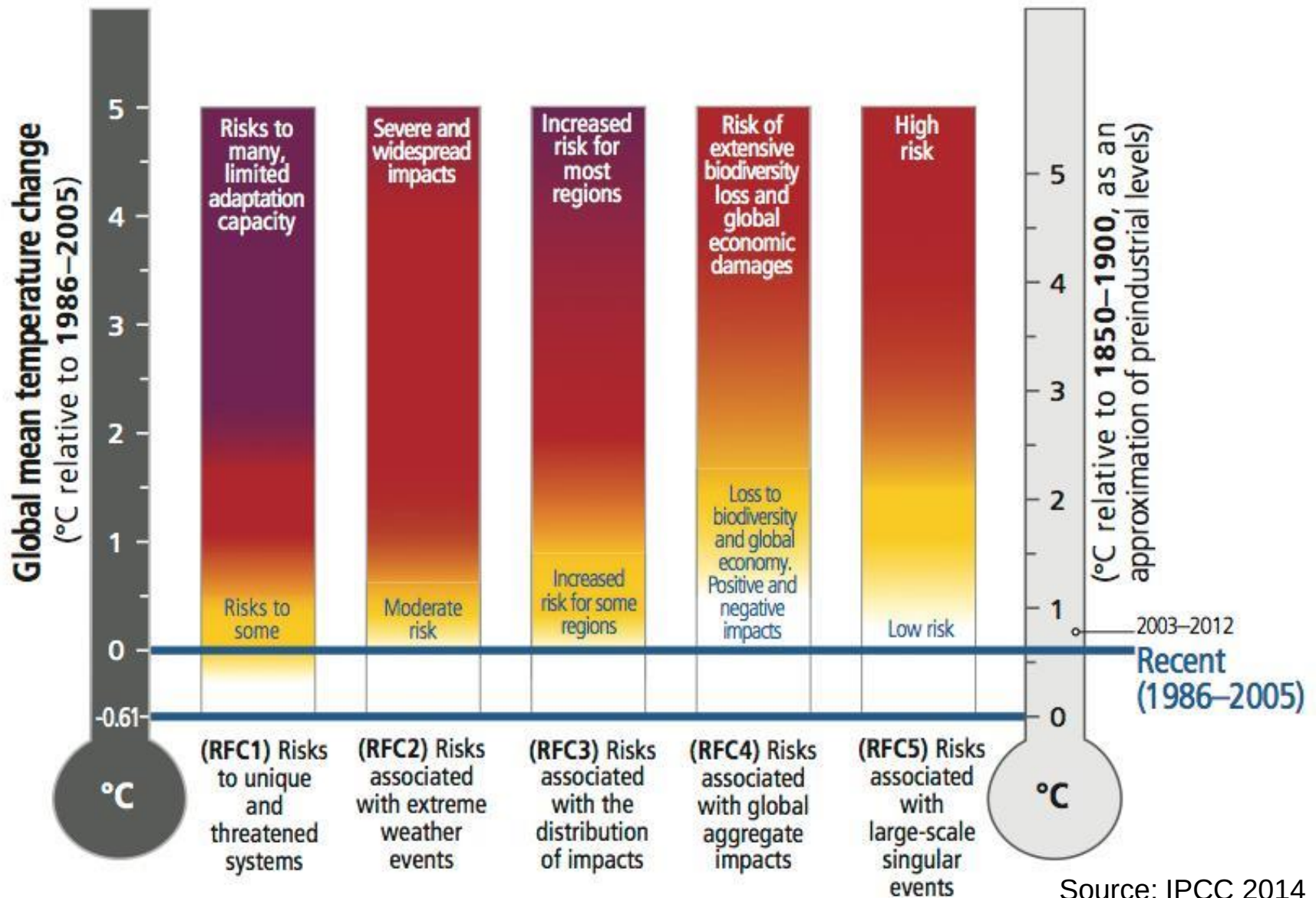
Source: IPCC 2012

Climate models show a higher frequency of hot days in the 21st century

Source: IPCC 2012



Reasons for Concern (RFCs)



Insights into the Reasons for Concern

Level of additional risk due to climate change



at least medium confidence that impacts are both detectable and attributable to climate change; also considering magnitude

increasing magnitude or likelihood of impacts

risk of severe and widespread impacts; "high" on one or more Key-Risk criteria

"high" on all Key-Risk criteria, including limited ability to adapt

Source: O'Neil et al. 2015 (draft)

Determinants of Risk



Intensity and frequency of hazards



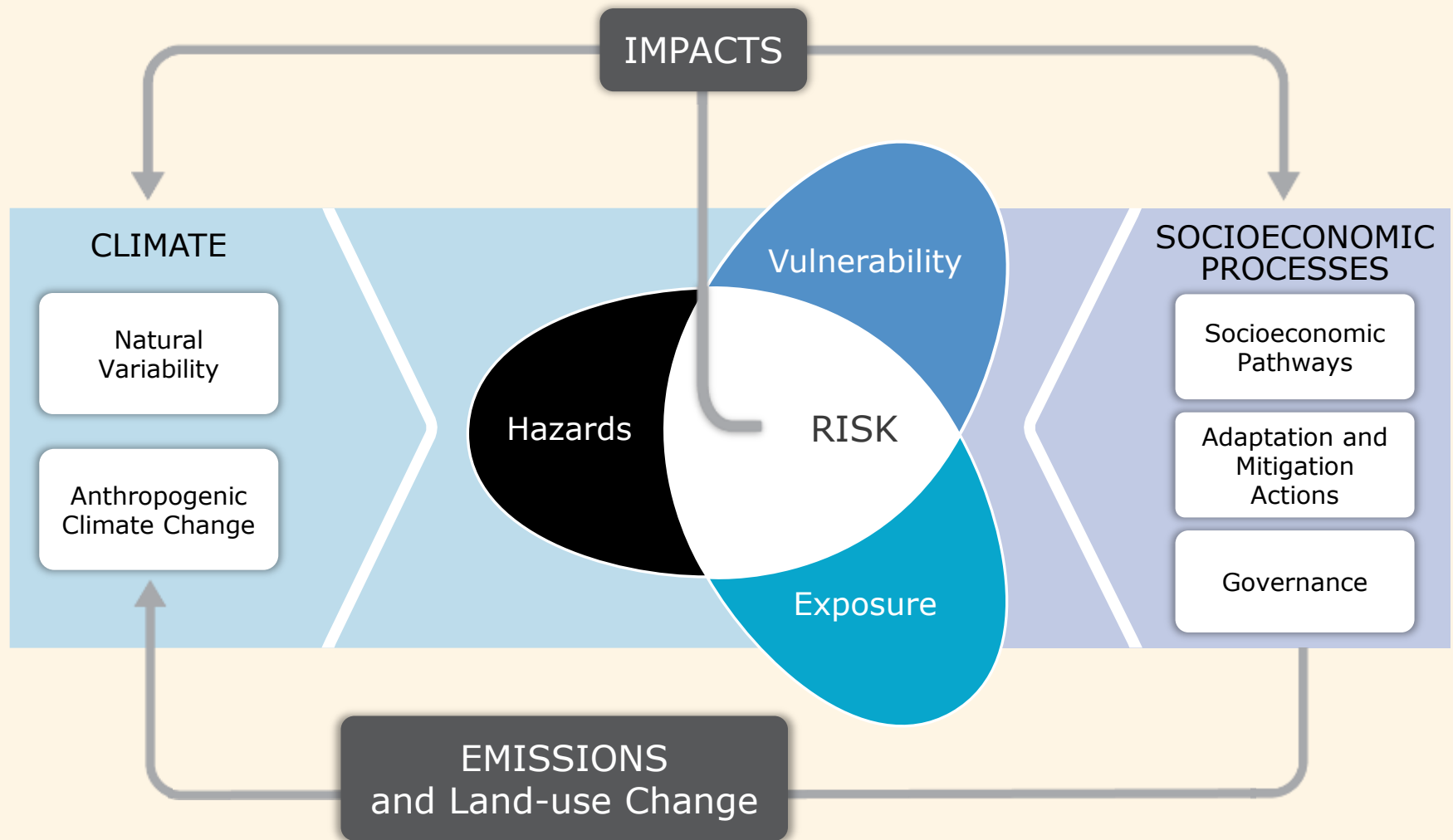
vulnerability



exposure

Source: IPCC 2012

The new framework



Source: IPCC 2014

WorldRiskIndex

– Linking natural and societal data

1. Exposure

EXPOSED POPULATION WITH REGARD TO

- A) Cyclones
- B) Floods
- C) Droughts
- D) Sea level rise

2. Susceptibility

NUTRITION

- A) Percentage of undernourished population

PUBLIC INFRASTRUCTURE

- B) Population without access to improved sanitation
- C) Population without access to clean water

HOUSING CONDITIONS

Proportion of population in slums;
proportion of semi-solid and fragile houses

→ limited data availability

POVERTY AND DEPENDENCIES

- D) Dependency ratio (proportion of under 15 – and above 65-year-olds in relation to the working population)
- E) Extreme poverty (population living on less than 1.25 USD (live PPPs) per day)

ECONOMIC CAPACITY AND INCOME

- F) Gross Domestic Product per capita (Purchasing Power Parity)
- G) Gini-Index

3. Coping Capacity

GOVERNMENT AND AUTHORITIES

- A) Corruption Perception Index
- B) Failed States Index

DISASTER PREPAREDNESS AND EARLY WARNING

National disaster risk management policy according to the report of UN / ISDR

MEDICAL SERVICES

- C) Number of physicians per 10,000 population
- D) The number of hospital beds per 10,000 population

SOCIAL NETWORKS: NEIGHBORHOOD, FAMILY AND SELF-HELP

→ No data available

ECONOMIC COVERAGE

- E) Insurance (except life insurance)

4. Adaptive Capacity

EDUCATION AND RESEARCH

- A) Adult literacy rate
- B) Combined gross school enrolment (rate of school-aged children in primary, secondary and tertiary educational institutions)

GENDER EQUITY

- C) Gender parity in education (in primary, secondary and tertiary educational institutions)
- D) Percentage of female representatives in the National Parliament

ENVIRONMENTAL STATUS / ECOSYSTEM

PROTECTION

- E) Water resources
- F) Protection of biodiversity and habitats
- G) Forest management
- H) Agricultural Management

ADAPTATION STRATEGIES

Volume of National Adaptation Programmes of Action to Climate Change, Climate Change Convention (available for 45 of the least developed countries)

INVESTMENTS

- I) Life expectancy at birth
- J) Private health expenditure
- K) Public health expenditure

$$\text{Exposure (E)}_{\text{annually per country}} = \frac{A + B + (0.5 * C + D)}{\text{population number}}$$

$$\text{Susceptibility (S)} = (2/7 * (0.5 * (A + B))) + (1/7 * C) + (2/7 * (0.5 * (D + E))) + (2/7 * (0.5 * (F + G)))$$

$$\text{Coping Capacity (CC)} = (0.45 * (0.5 * (A + B))) + (0.45 * (0.5 * (C + D))) + (0.1 * E)$$

$$\text{Lack of Coping Capacity (LoCC)} = 1 - CC$$

$$\text{Adaptive Capacity (AC)}$$

$$= (0.25 * (0.5 * (A + B))) + (0.25 * (0.5 * (C + D))) + (0.25 * (0.25 * (E + F + G + H))) + (0.25 * (1/3 * (I + J + K)))$$

$$\text{Lack of Adaptive Capacity (LoAC)} = 1 - AC$$

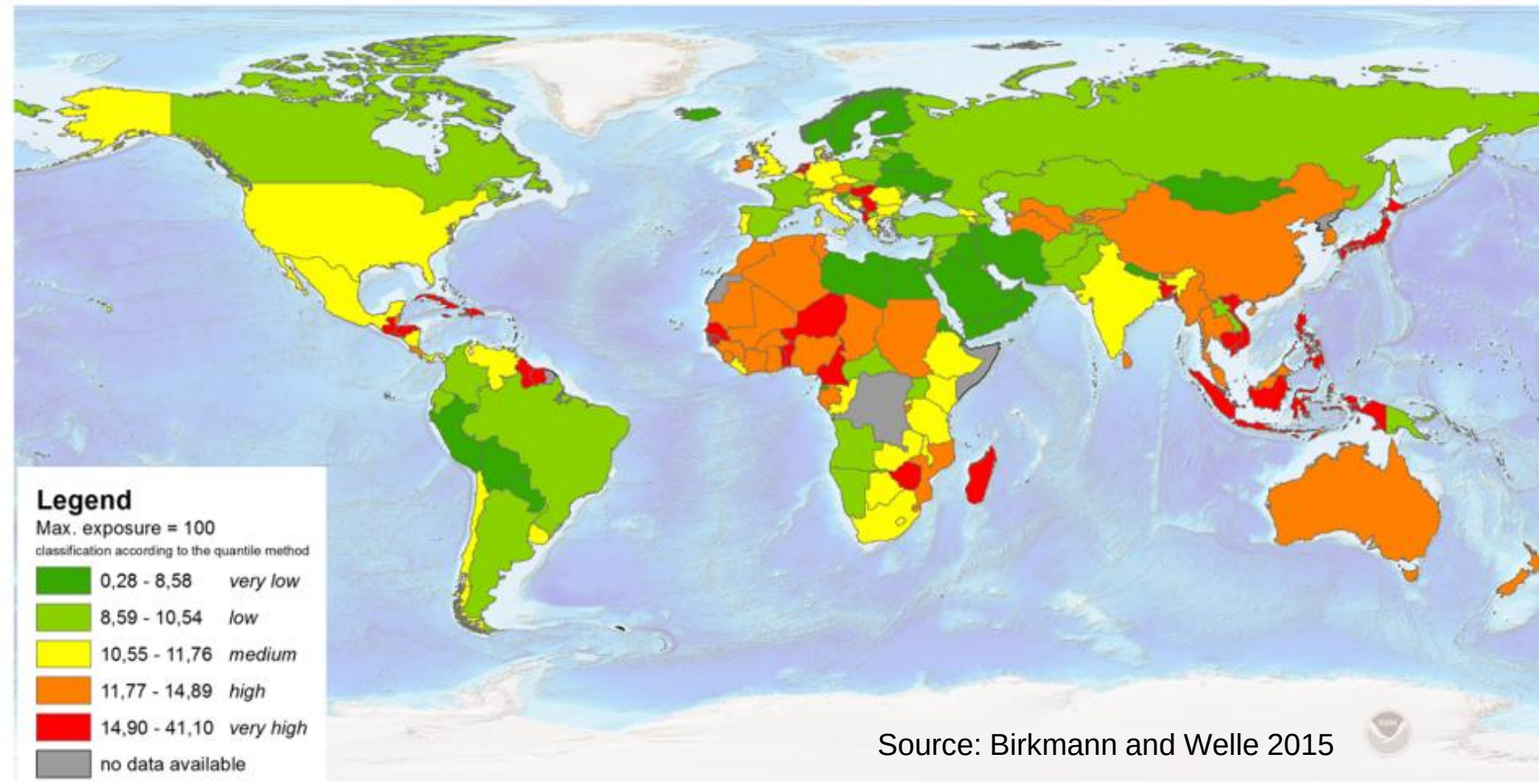
$$\text{WorldRiskIndex} = E * (1/3 * (S + LoCC + LoAC))$$

Source: Birkmann and Welle 2015

Exposure of People

Exposure

Exposure of the population to climate related natural hazards (storms, floods, droughts and sea level rise)



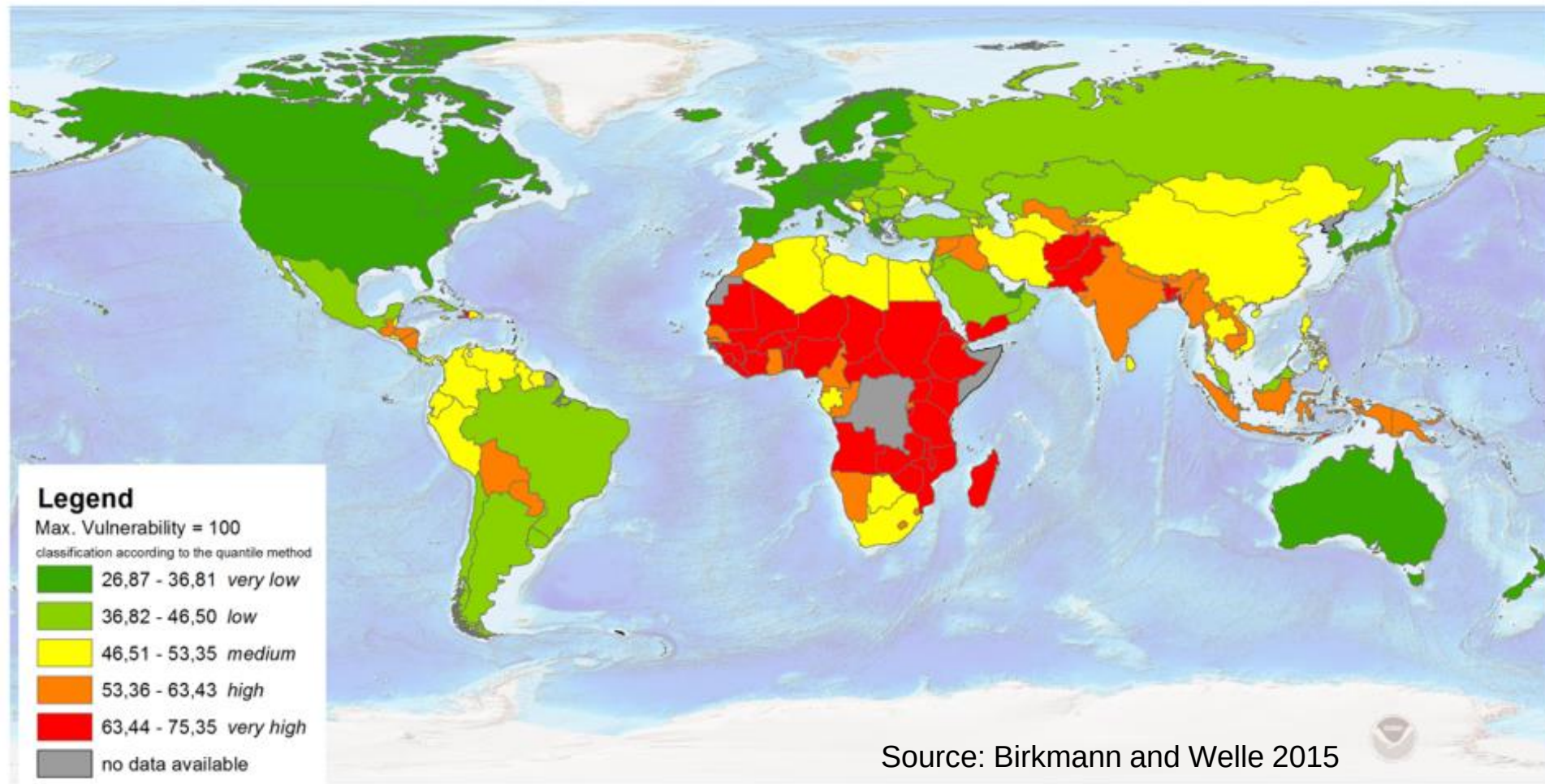
Source: Birkmann and Welle 2015



Vulnerability

Vulnerability

Vulnerability of society as the sum of susceptibility, lack of coping capacities and lack of adaptive capacities

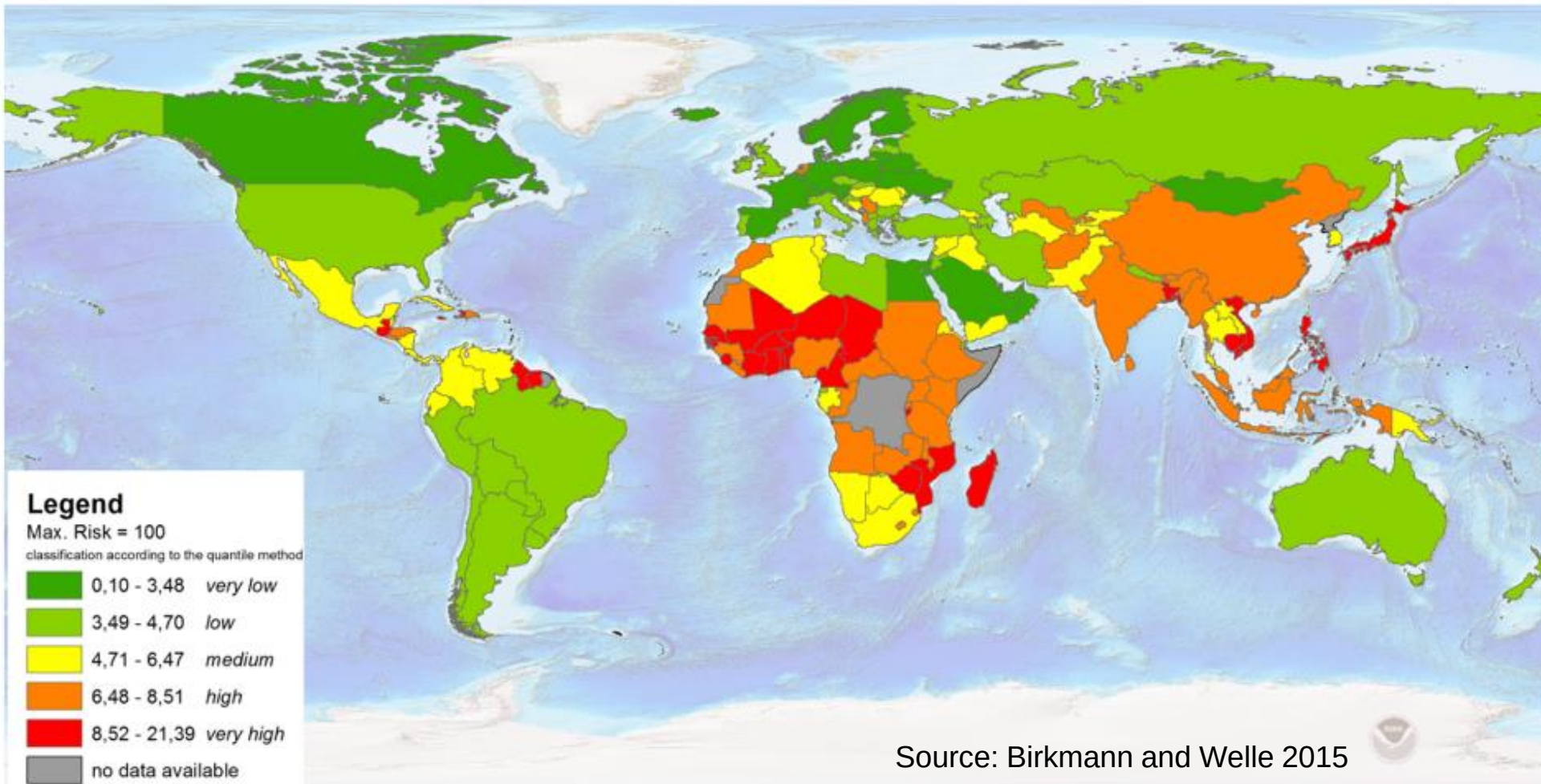


Source: Birkmann and Welle 2015



WorldRiskIndex (climate related hazards)

WorldRiskIndex as a result of exposure and vulnerability

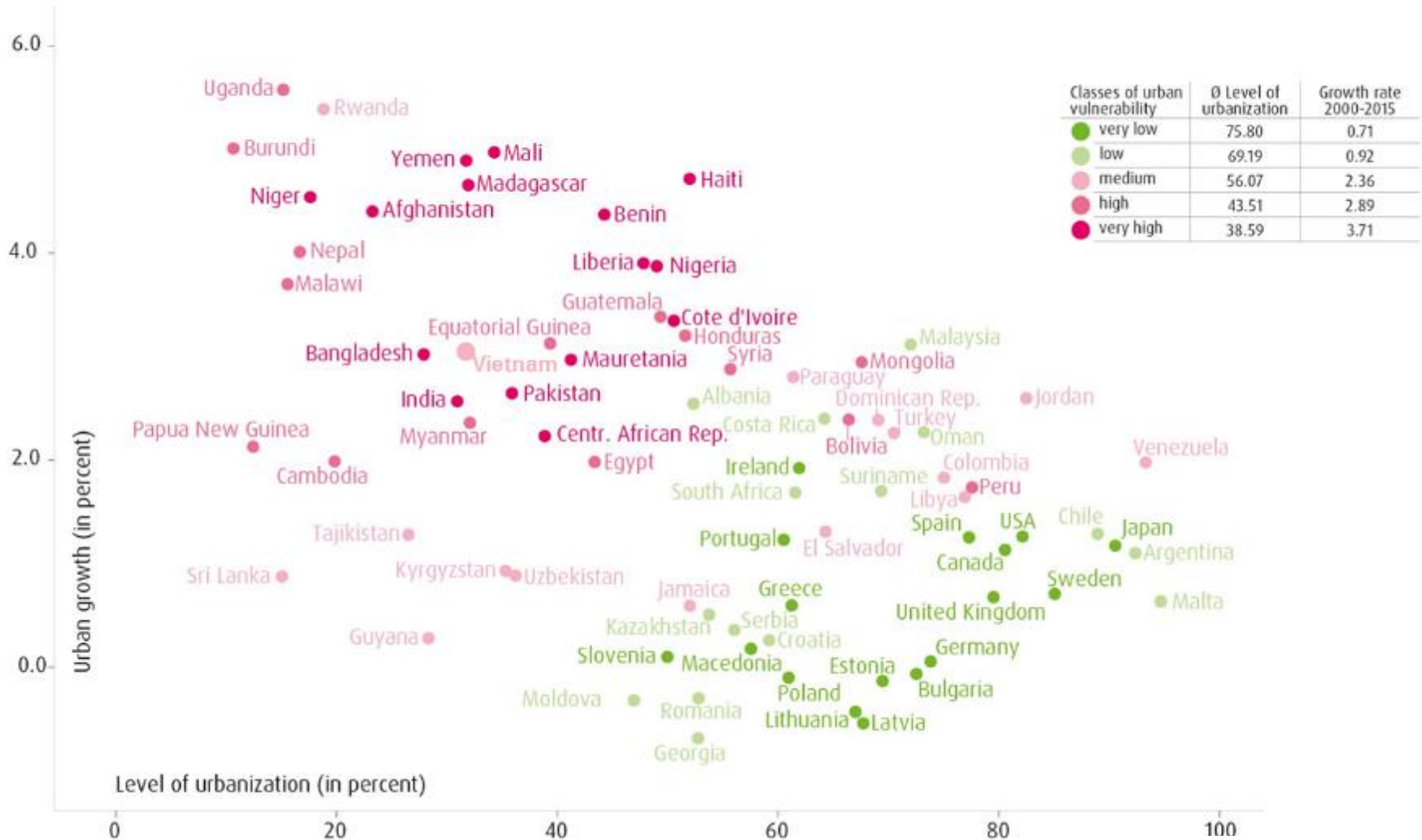


Source: Birkmann and Welle 2015



Urbanization and Vulnerability

Where rapid growth faces high vulnerability



Data: Source UNU-EHS based on UN DESA (2012)

Source: Welle, et al. 2014

- **Rapid urbanization** is particularly evident in countries that are highly vulnerable. Planning tools have to be adapted to these new challenges.
- Reasons for Concern (RFCs) have to be interpreted carefully, since also exposure and vulnerability are changing. The WorldRiskIndex shows that exposure and vulnerability to climate related hazards differ significantly in its spatial dimension.
- For future planning and management approaches, it is essential to better understand the **temporal dimension** of likely changes.

II

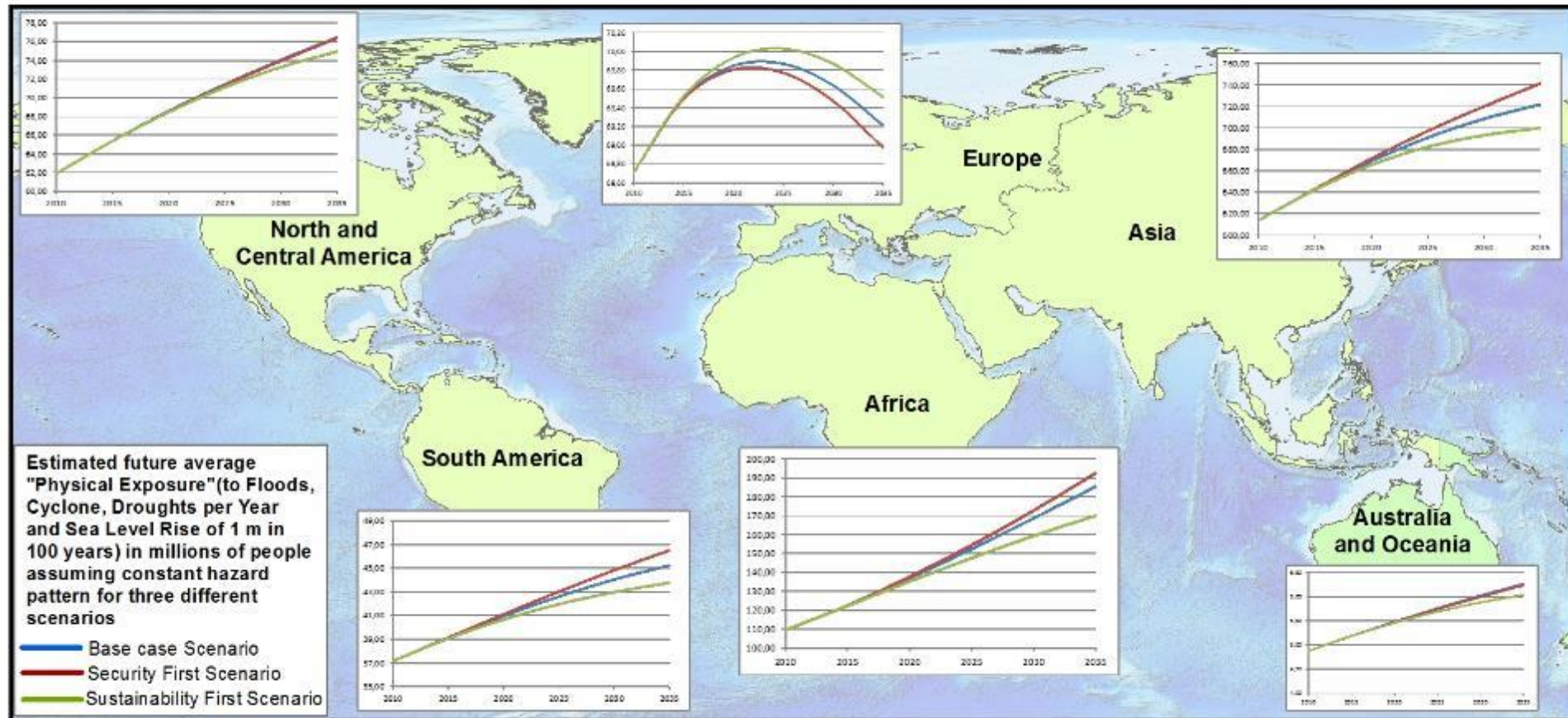
The Regional and Local Perspective



**Increasing exposure of people and
assets has been the major cause of
changes in disaster losses
(IPCC 2012)**

Exposure Scenarios until 2035

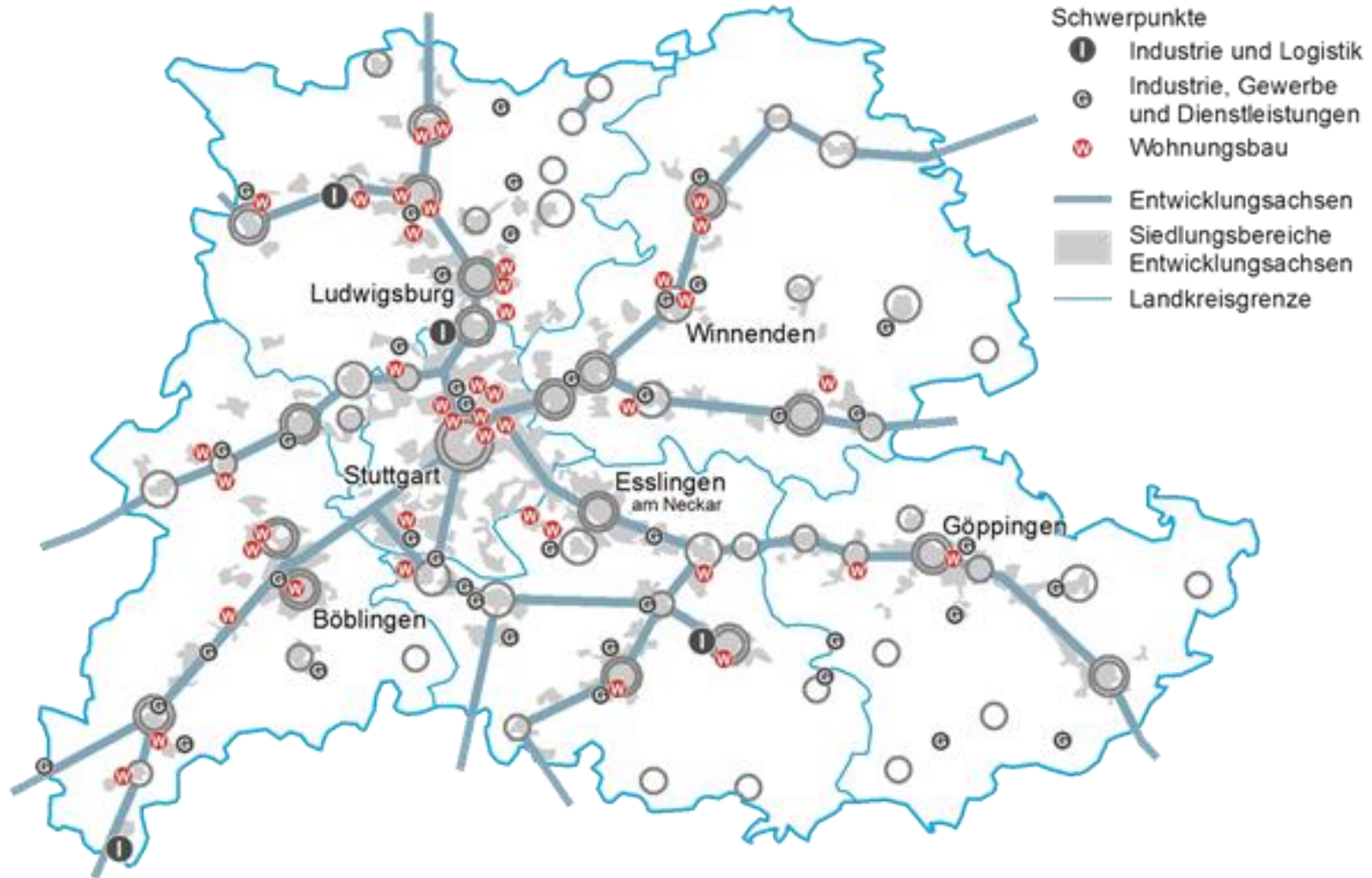
Estimated future physical exposure for three scenarios



Source:

Birkmann, J.; Cutter, S.; Rothman, D.; Welle, T.; Garschagen, M.; van Ruijven, B.; O'Neill, B.; Preston, B.; Kienberger, S.; Cardona, O.; Siagian, T.; Hidayati, D.; Setiadi, N.; Binder, C.; Hughes, B.; Pulwarty, R. (2015) Scenarios for vulnerability: opportunities and constraints in the context of climate change and disaster risk. IN: *Climatic Change* (online first)

Region of Stuttgart



Source: Regional Planning Authority Stuttgart 2014

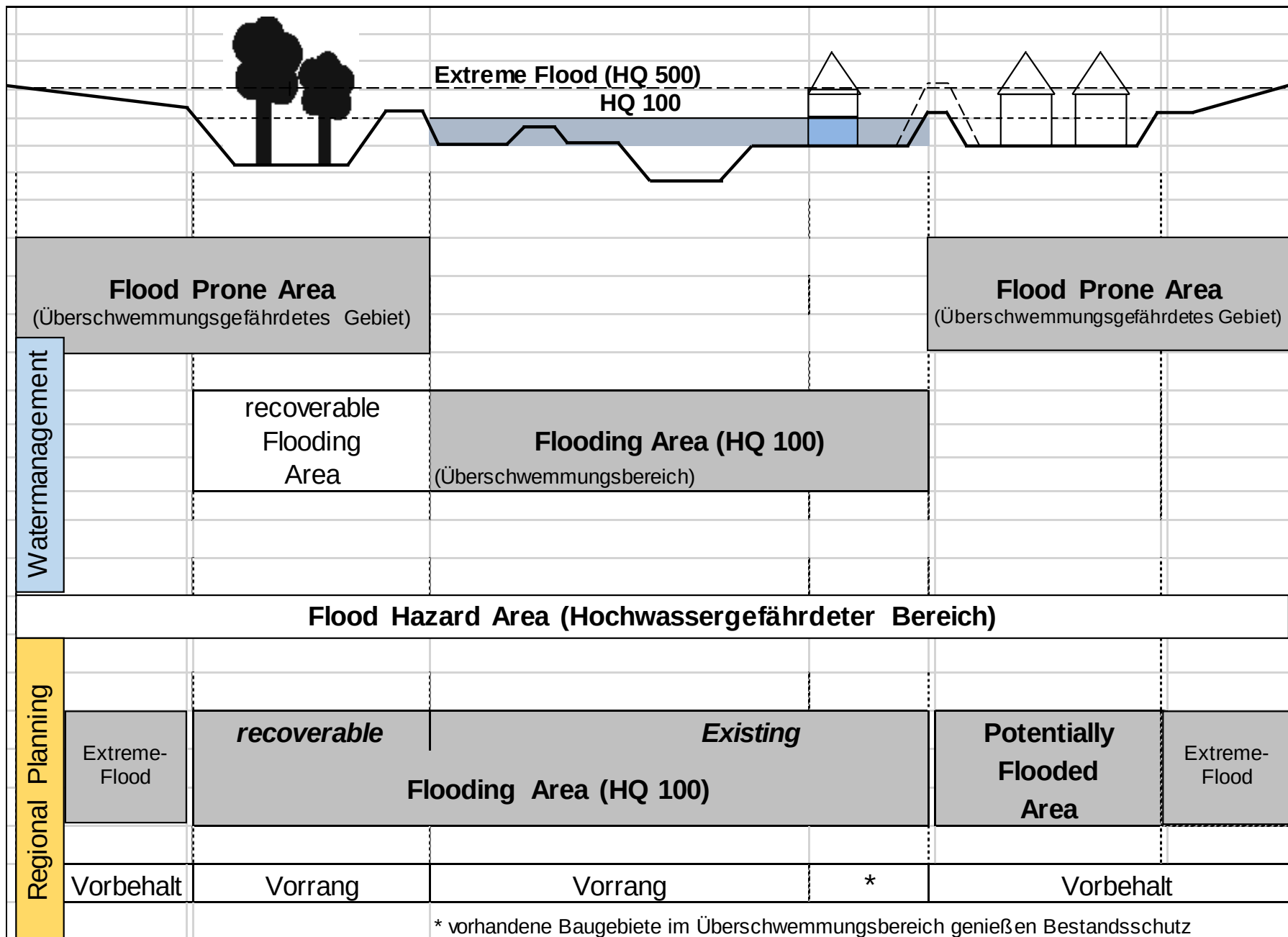
Revealed Exposure



Source: Flooding Rems Murr 2013

The Case of Winterbach

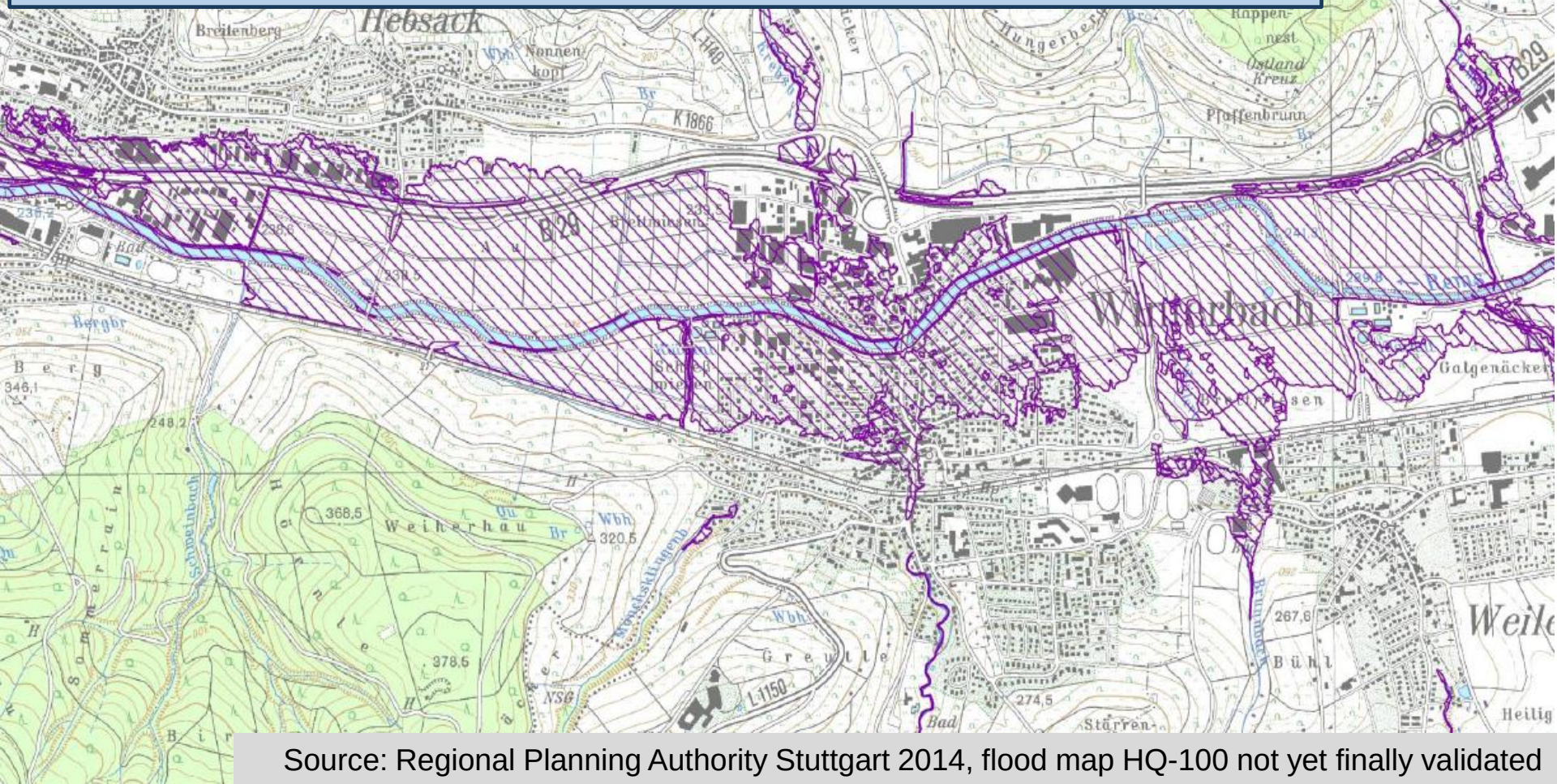




Flood Hazard Map – HQ 100

Future development options?

Does exposure also mean high vulnerability?



Source: Regional Planning Authority Stuttgart 2014, flood map HQ-100 not yet finally validated

- Environmental change and extreme events are important issues for planning and risk management in Germany and the region of Stuttgart. Various approaches, however, focus primarily on exposure.
- Various planning and risk management approaches as well as EU guidelines are based on a deterministic view and a pre-defined “when-if” relationship.
- Risk based approaches and the consideration of extreme events is still a challenge for formal planning tools.

Cần Thơ and Mekong Delta



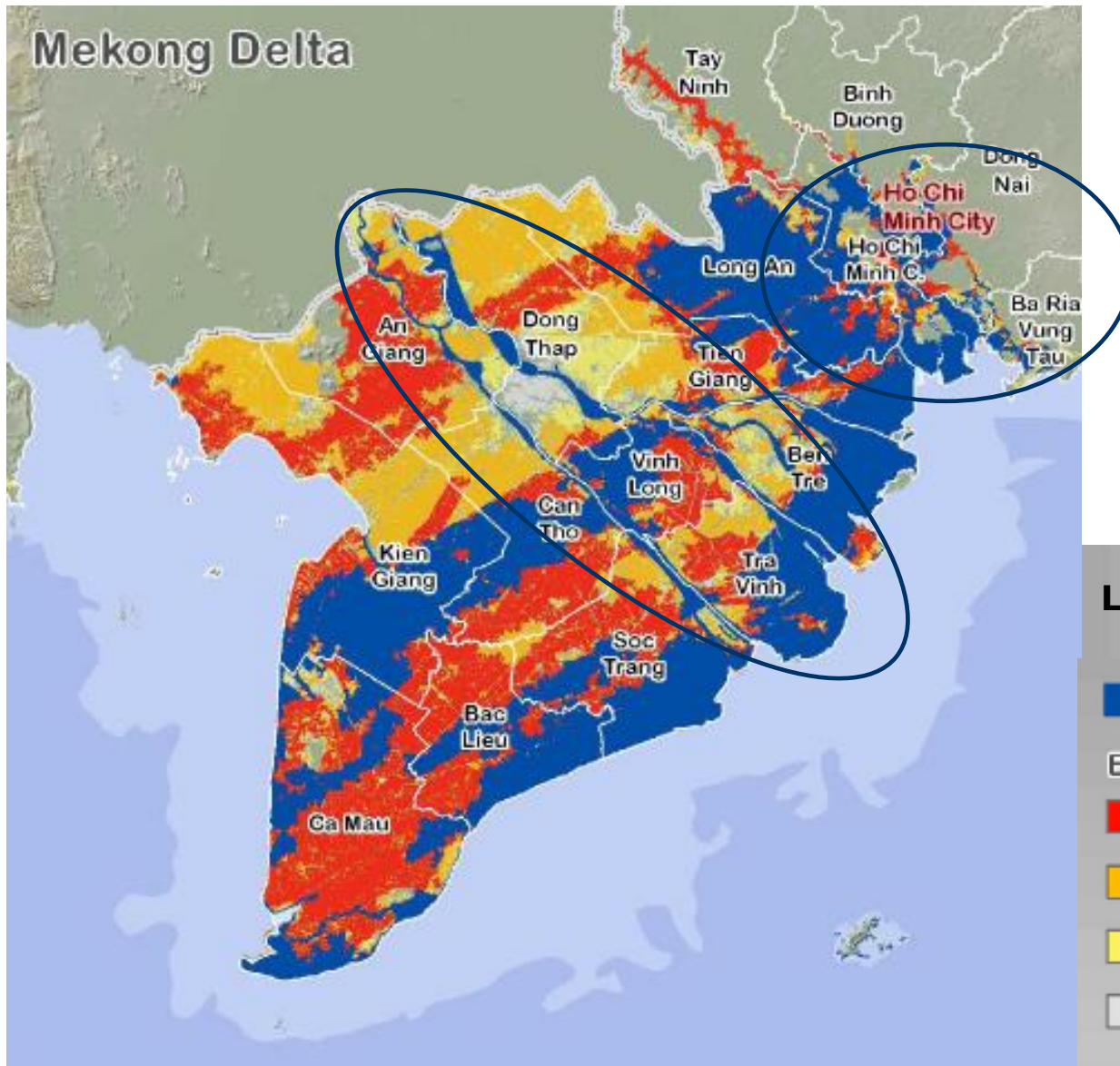
Vietnam

- Urbanization 30,4%
- Urban Growth 3,2%

Mekong Delta

- 39,000 km²;
- 18 m. inhabitants
- National importance:
  - 50% of the rice production
  - over 50% of the fish production
  - 60% of the fruit production

Climate Change: Sea Level Rise



Source: Carew-Reid, 2008 -
Rapid Assessment of the
Extent and Impact of Sea
Level Rise in Viet Nam. ICEM

Legend:

1m SLR inundation

Elevation 2-5m asl

2m

3m

4m

5m

Vietnam: Mekong Delta – Cần Thơ



Changing hazards and changing extremes - past and future adaptation needs -



Typhoon Linda; 100km/h on 2nd November 1997,
approx. 500-3000 fatalities and large economic losses.

Storms are very rare so far in the VN Mekong Delta

Local Perspective II

- Extreme events under the conditions of climate change is often not sufficiently considered in planning tools. The increase in exposure and vulnerability is not yet discussed.
- The top-down planning system is still dominated by a rather technocratic approach.
- Past adaptation strategies have in part lead to risk accumulation.



III

Conclusions

Overall Conclusions

- Climate change and societal transformation require more **adaptive planning approaches**.
- Various norms in planning and in individual decision making processes are based on **experiences in the past**.
- **New methods are needed that combine scenarios of climate change and extreme events with scenarios of exposure and vulnerability for specific planning tools. These scenarios and tools need to focus on different spatial and temporal scales.**

Thanks

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