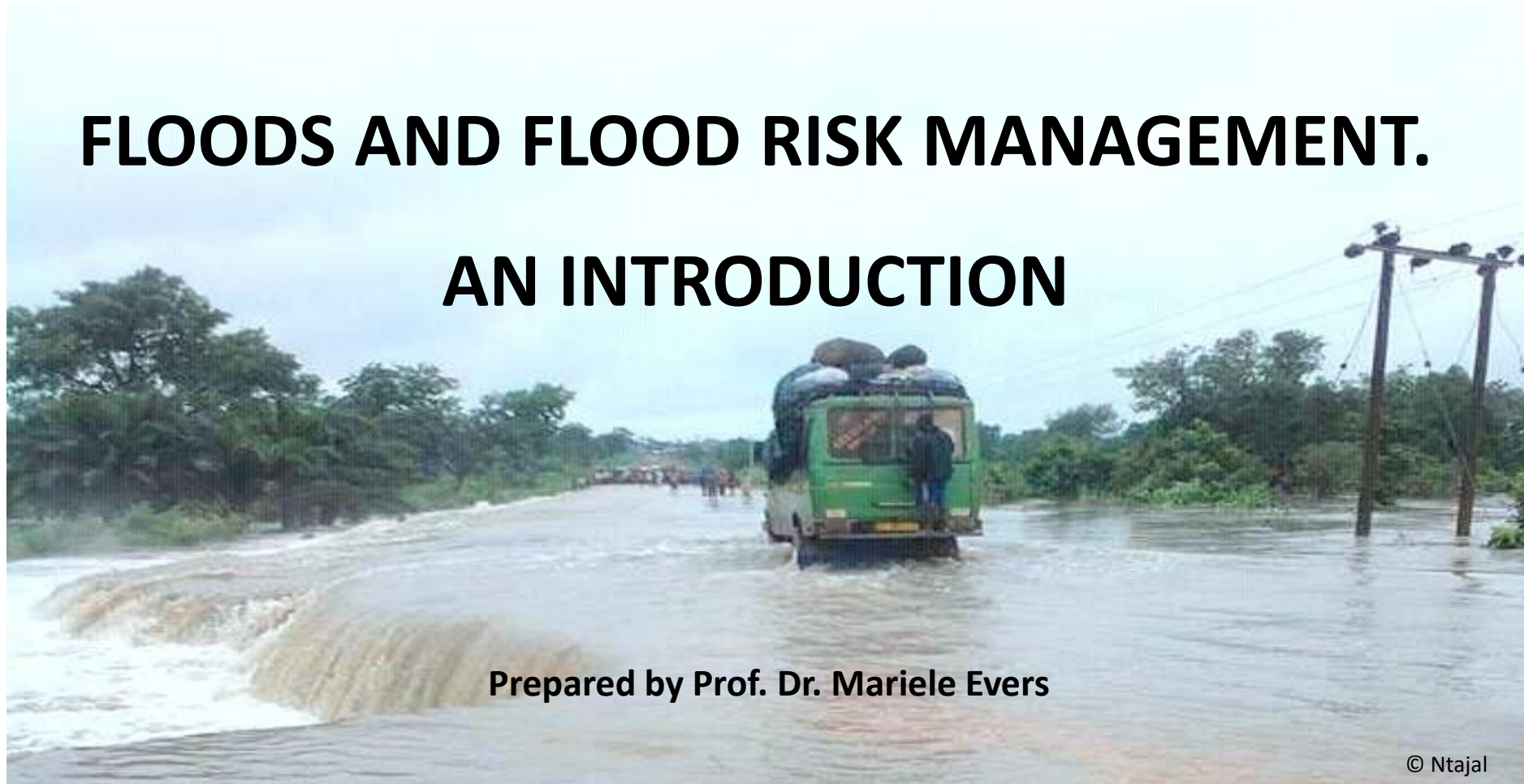


FLOODS AND FLOOD RISK MANAGEMENT. AN INTRODUCTION



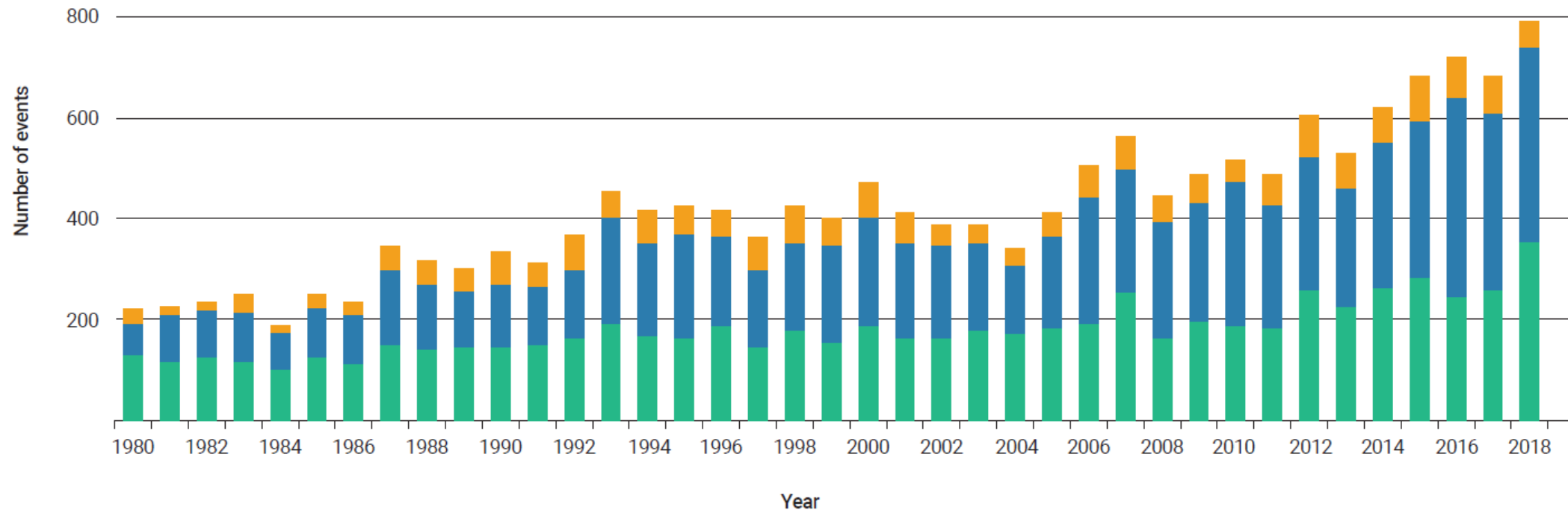
Prepared by Prof. Dr. Mariele Evers

© Ntajal

Contents

- Flood Hazard – definitions, types and influencing factors
- Data bases
- Flood Risk – concepts and factors
- Projected flood risk
- Flood risk management cycle

Weather induced extreme events



- **Meteorological events**
 (Tropical storm, extratropical storm, convective storm, local storm)
- **Hydrological events**
 (Flood, mass movement)
- **Climatological events**
 (Extreme temperature, drought, forest fire)

Note: Accounted events have caused at least one fatality and/or produced normalized losses \geq US\$100K, 300K, 1M, or 3M (depending on the assigned World Bank income group of the affected country).

What is a flood?



A **flood** is the overflowing of the normal confines of a stream or other body of water, or the accumulation of water over areas that are not normally submerged (IPCC Glossary)

If a flood (described by discharge as a flowrate m^3/s or water level) is exceeding a certain threshold above the average values that is calculated statistically.

A **return period**, also known as a **recurrence interval**, is an average time or an estimated average time between events such as river discharge or floods to occur.

Commonly calculated return periods are a 100-year flood, or 30-year flood or extreme flood (e.g., 200y or 500y).

A **100-year flood** is a flood event that has on average a 1 in 100 chance (1% probability) of being equaled or exceeded in any given year.

Regarding the rating curve at a certain gauging station, the flood water level can be mapped as an area of inundation.

What is a flood?

Elbe, km 550



M. Evers

June 2007; approxm. 900 m³/s

What is a flood?



Same river

(same, same but different)



M. Evers



Types and causes of floods



Type of flooding	Causes of flooding	Effect of flooding	Relevant parameters
River flooding in flood plains	<ul style="list-style-type: none"> Intensive rainfall and/or snowmelt Ice jam, clogging Collapse of dikes or other protective structures 	<ul style="list-style-type: none"> Stagnant or flowing water outside the channel 	<ul style="list-style-type: none"> Extent (according to probability) Water depth Water velocity Propagation of flood
Sea water flooding	<ul style="list-style-type: none"> Storm surge Tsunami High tide 	<ul style="list-style-type: none"> Stagnant or flowing water behind the shore line Salinisation of agricultural land 	<ul style="list-style-type: none"> Same as above
Mountain torrent activity or rapid run-off from hills	<ul style="list-style-type: none"> Cloud burst Lake outburst Slope instability in watershed Debris flow 	<ul style="list-style-type: none"> Water and sediments outside the channel on alluvial fan; erosion along channel 	<ul style="list-style-type: none"> Same as above; Sediment deposition
Flash floods in Mediterranean ephemeral water courses	<ul style="list-style-type: none"> Cloud burst 	<ul style="list-style-type: none"> Water and sediments outside the channel on alluvial fan Erosion along channel 	<ul style="list-style-type: none"> Same as above
Groundwater flooding	<ul style="list-style-type: none"> High water level in adjacent water bodies 	<ul style="list-style-type: none"> Stagnant water in flood plain (long period of flooding) 	<ul style="list-style-type: none"> Extent (according to probability) water depth
Lake flooding	<ul style="list-style-type: none"> Water level rise trough inflow or wind induced set up 	<ul style="list-style-type: none"> Stagnant water behind the shore line 	<ul style="list-style-type: none"> Same as above

EXCIMAP 2007

Flash flood



- Flash floods are caused by heavy rain events = large amount of rain in a short time (definition according to intensity and duration)
- usually falls spatially limited
- very large amounts of rainfall can cause water levels in small rivers and streams to rise rapidly
- flash floods occur even without bodies of water due to the enormous amount of rain, especially on slopes
- rain masses running off the surface collect in topographically low areas and can cause flooding and damage to infrastructure
- heavy rainfall and the resulting flooding are intensified by waterlogged soils, lack of retention areas, sealing and backwater in the sewage system
- due to a high degree of building and sealing, the damage potential of flash floods is high, especially in urban areas

(Klimanavigator)

Search Results for: ghana



Ghana – Deadly Floods Strike in Southern Regions

25 JUNE, 2023

At least 8 people have died as a result of flooding in several regions of Ghana over the last few days. Flooding affected parts of Greater Accra, Western and Ashanti...

[Read Full Article](#)



Ghana – Accra Floods Cause Damage and Fatalities

8 MARCH, 2023

A heavy downpour lasting several hours caused flooding in parts of Accra, the capital of Ghana, on 07 March 2023. Ghana Meteorological Agency wanted that, "Southeastern Ghana has been engulfed..."

[Read Full Article](#)









Ghana – Hundreds of Homes Flooded in Greater Accra Region After Weija Dam Releases

5 OCTOBER, 2022

ECMWF



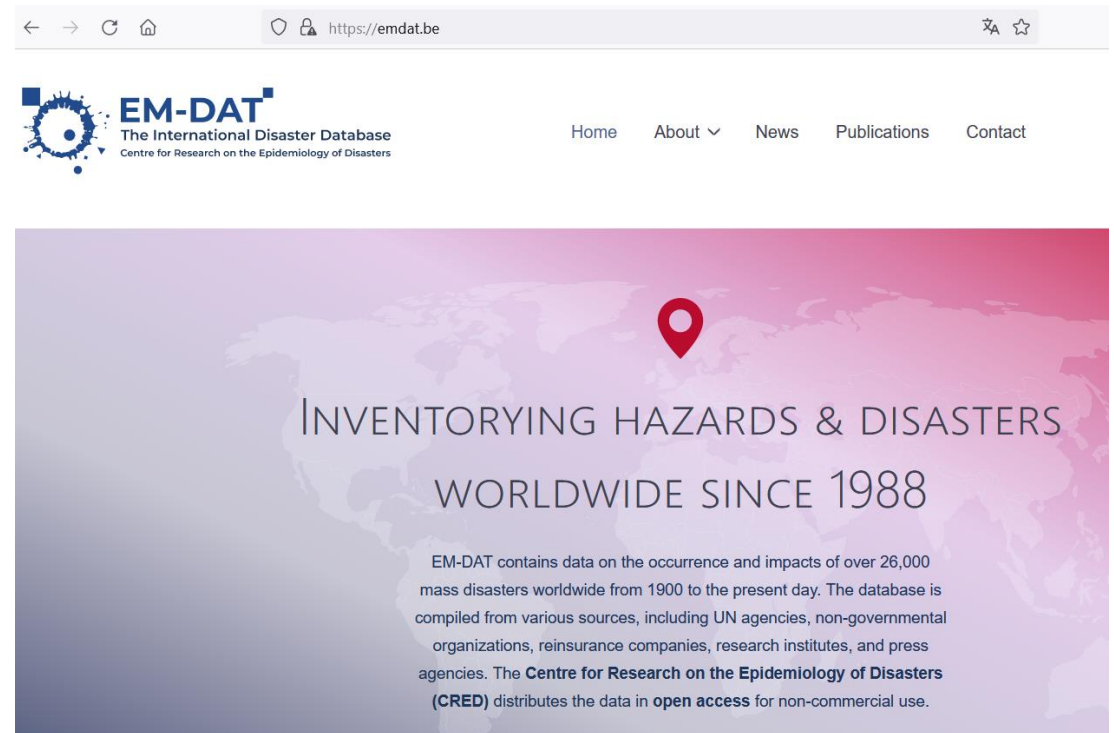
FloodList is funded by European Centre for Medium-Range Weather Forecasts

- #### LATEST ARTICLES
-  Kenya – 46 Dead and 58,000 Displaced as Floods Worsen
 -  East Africa – Heavy Rains and Floods Take Their Toll in Somalia, Ethiopia, Kenya, Burundi and Malawi
 -  Italy – State of Emergency After Storm Triggers Deadly Floods in Tuscany
 -  Yemen – Thousands Displaced by Floods After Cyclone Tej Dumps 400mm of Rain
 -  UK – Over 1,000 Homes Damaged, Hundreds Evacuated as Storm Babet Triggers Major Floods
 -  Brazil – Rains and Floods Wreak Havoc in Santa Catarina as Emergency Declarations Escalate

https://floodlist.com/?s=ghana&submit=

CRED – EM-DAT

- Centre for Research on the Epidemiology of Disasters
- Located in Belgium
- Database EM-DAT
- Criteria:
 - 10 or more people reported killed
 - 100 people reported affected
 - declaration of a state of emergency
 - call for international assistance



Spatial aspects



- Size and shape of the catchment matters
- Upstream-downstream relations
- Geographical borders (e.g. administrative), transnational rivers
- Multi-risk
 - Other natural risks (landslides, erosion, ...)
 - Industrial risks
 - Drinking water supply
 - Water related diseases
- Cascading risk → esp. relevance for critical infrastructure

Temporal aspects

- Rapid local events – flash floods
- Small and medium-sized catchments
- Slow events – large lakes/reservoirs
- Historical floods

Key concepts

(definitions from UN Internat. Strategy for Disaster Reduction)



- **Natural hazard:** " Natural processes or phenomena occurring in the biosphere that may constitute a damaging event.

Hazardous events can vary in magnitude or intensity, frequency, duration, area of extent, speed of onset, spatial dispersion and temporal spacing."

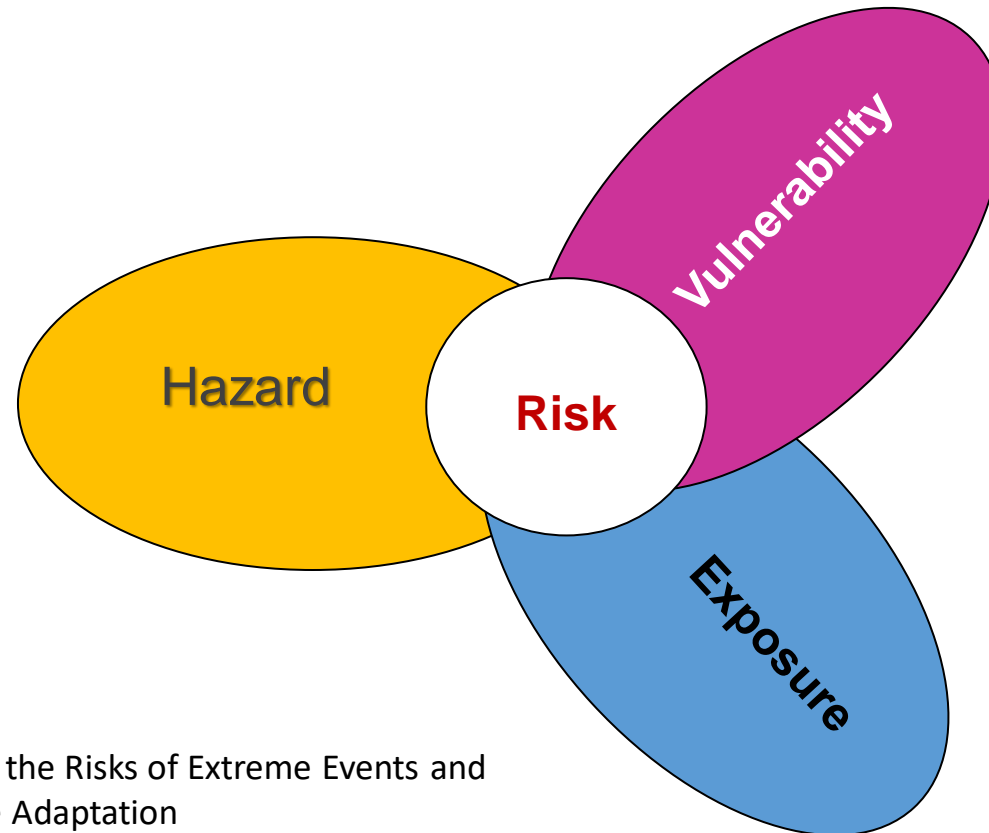
- **Disaster:** "A serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources"

Flood risk



- Flood risk means the combination of the probability of a flood event and of the potential adverse consequences for human health, the environment, cultural heritage and economic activity associated with a flood event.
- There different concepts / definitions of flood risk integrating different parameters

Influencing factors for Flood Risk

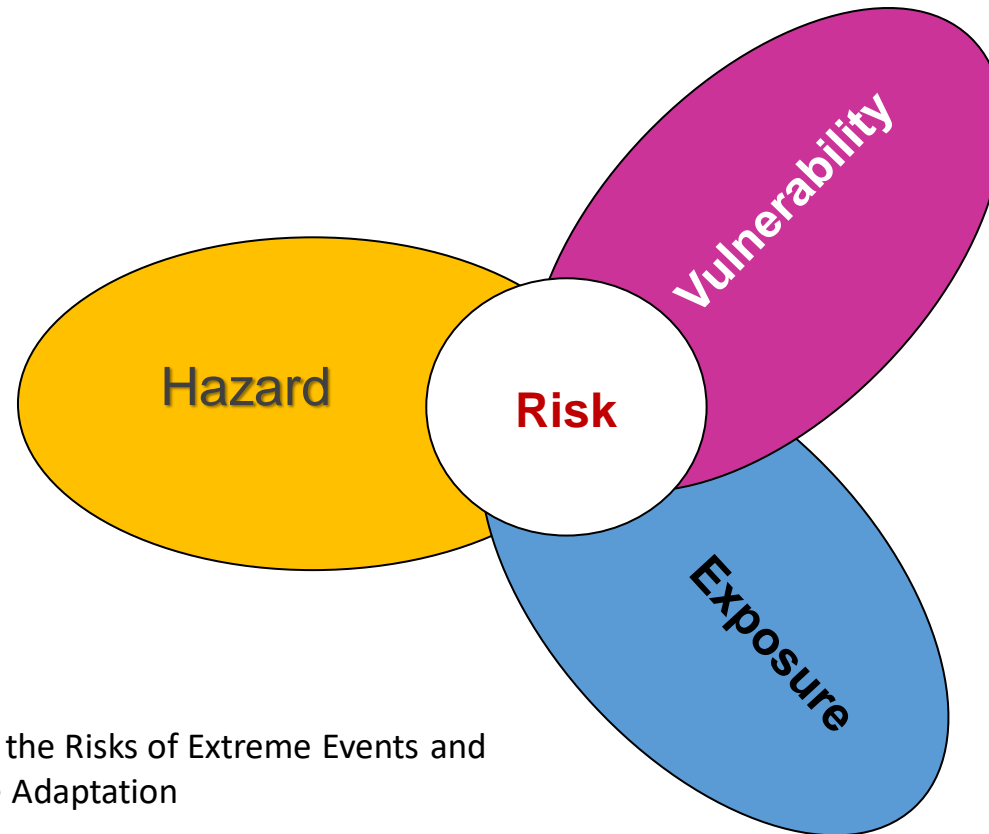


Changed after IPCC, 2012: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation

Influencing factors for Flood Risk



- Natural hazards
- Human induced hazards



- Awareness
- Information
- Preparedness
- Income
- Adaptation
- Coping Capacity
- ...

Changed after IPCC, 2012: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation

Increase of percentage of global population prone to floods between 2000 and 2015 grew by 20 to 24 % (NASA 2020)

Flood risks factors



- Risk is a function of hazards, vulnerabilities and exposure
- The hazard is assessed with probabilistic approach and different scenarios of return periods are used (e.g. 30 years, 100 years or 500years flood)
- The exposure is increasing in many parts of the world as also in Ghana
- The vulnerability refers to the physical, social, economic and environmental conditions, which increase the susceptibility of the exposed elements to the impact of hazards (UNISDR, 2016)

Key concepts



- **Exposure:** “People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses.

Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest.

- **Risk assessment:** “A methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend.

https://www.preventionweb.net/files/7817_UNISDRTerminologyEnglish.pdf?_gl=1*_temd20*_ga*MTg5NjlwOTQ0MC4xNjl2ODcwNTI5*_ga_D8G5WXP6YM*MTcwMDE1Mjc3MS42LjAuMTcwMDE1Mjc3MS4wLjAuMA..

Exposure to floods

Africa has the highest increase in proportion of population exposed to flooding (2000-2015)



<https://earthobservatory.nasa.gov>

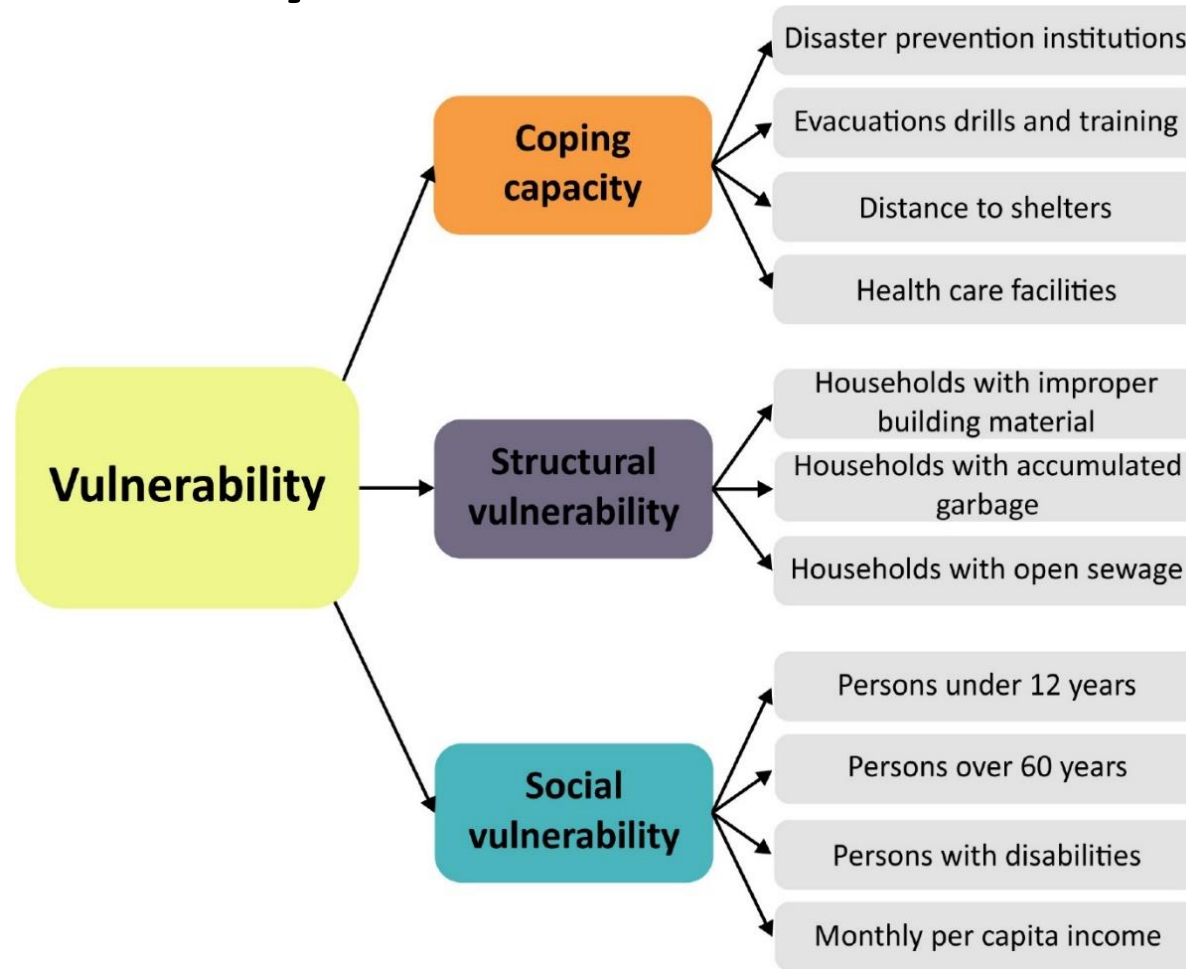
Key concepts

(definitions from UN Internat. Strategy for Disaster Reduction)



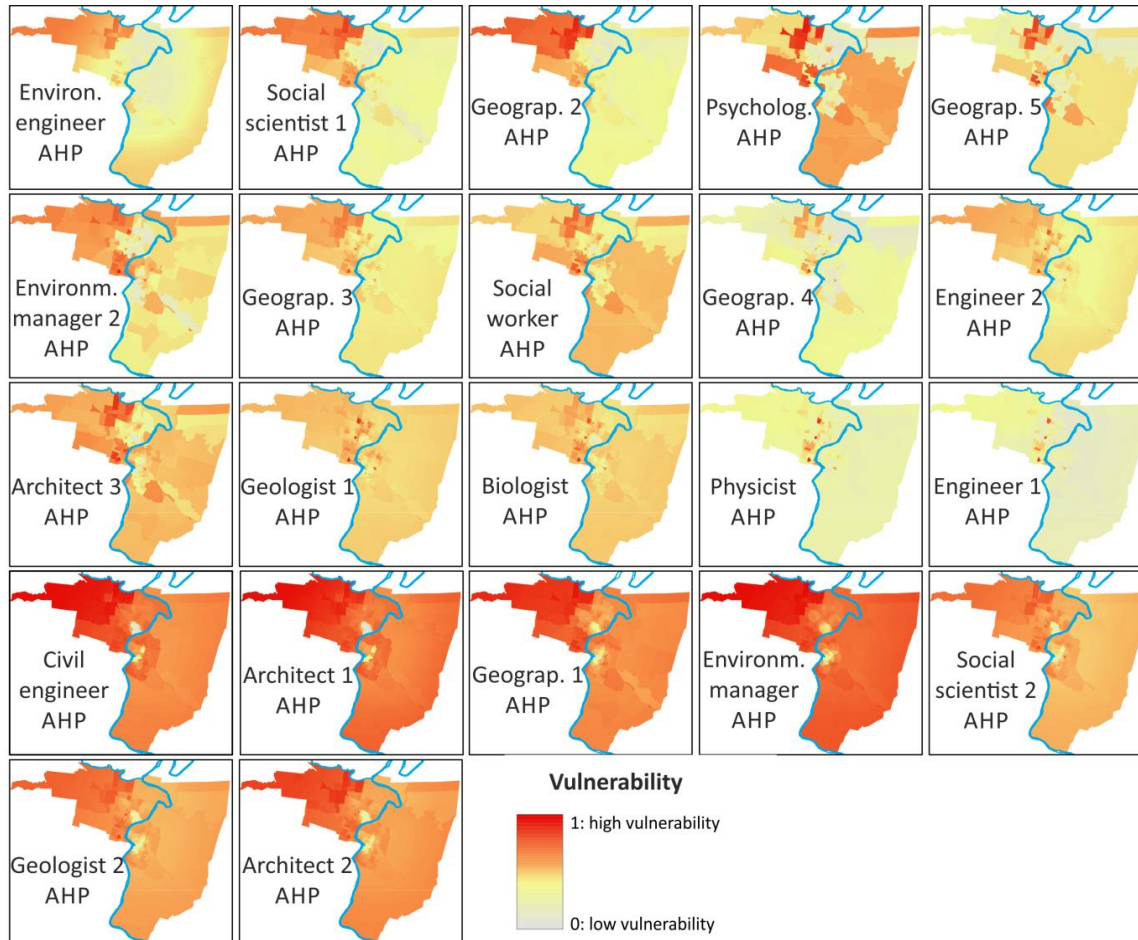
- **Vulnerability:** "The conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards."

Vulnerability



De Brito and Evers 2017

Vulnerability (experts view)

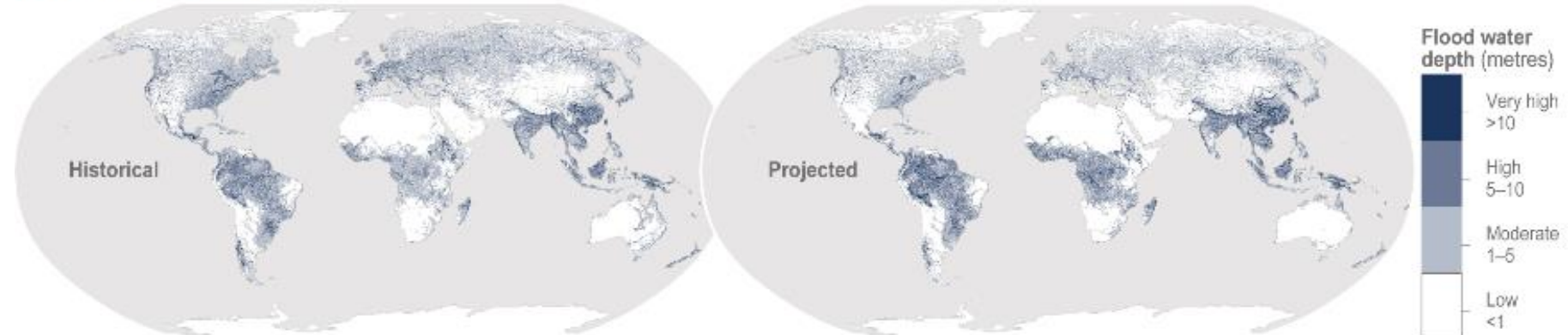


Individual vulnerability maps generated for each one of the 22 expert stakeholders that attended the workshops (de Brito et al., 2018).

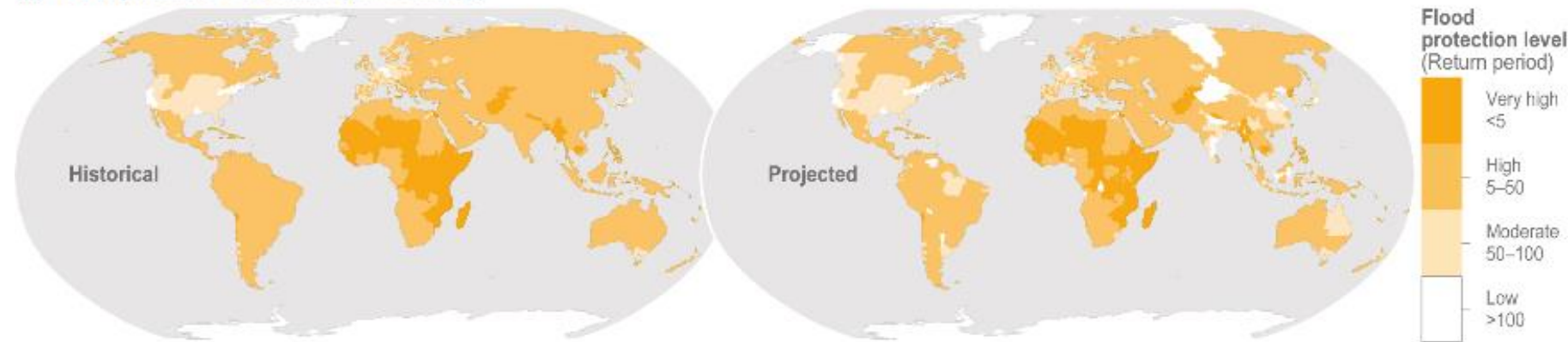
Projected flood risk

Risk of historical (1961–2005) and projected (2051–2070) river flooding

(a) Flood water (hazard)



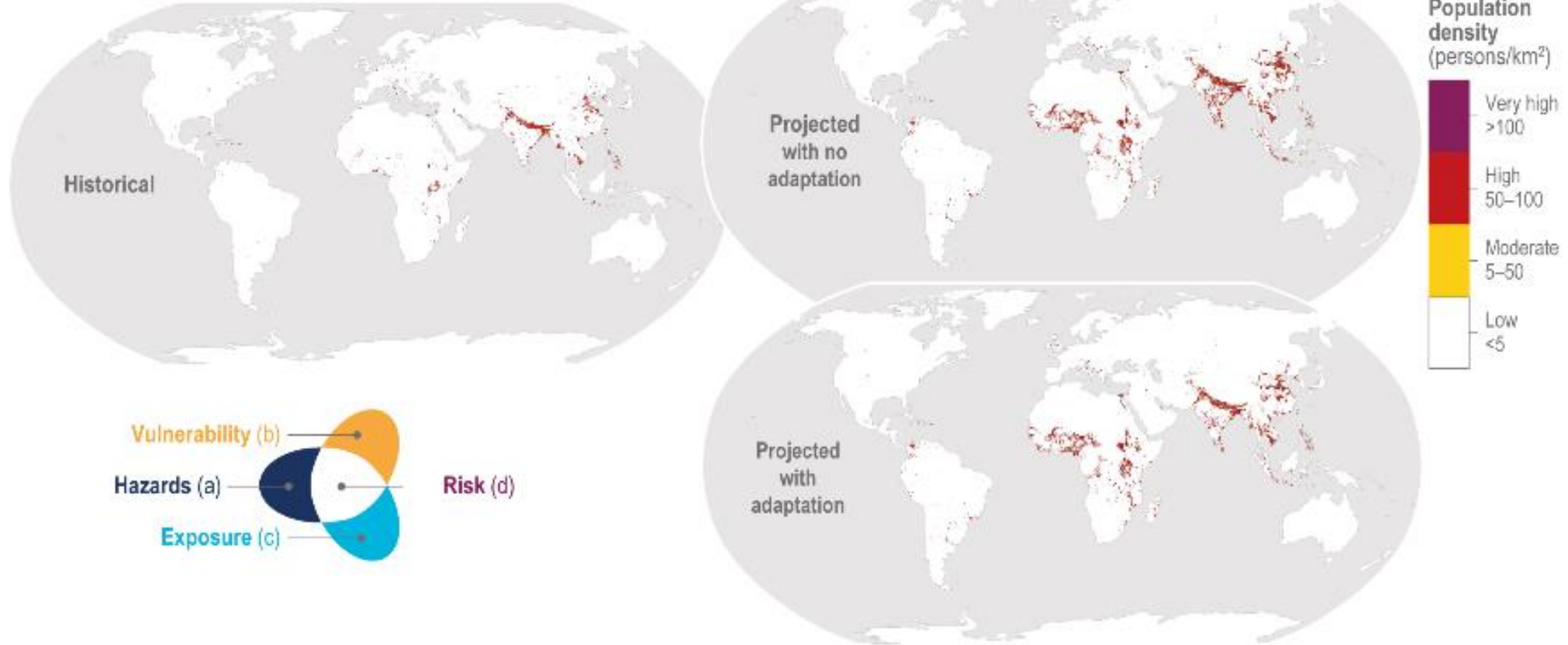
(b) Flood protection standard (vulnerability)



Caretta et al. (2022)

Projected flood risk

(d) Population exposed to river flooding (risk)



Caretta et al. (2022)

Key concepts

(definitions from UN Internat. Strategy for Disaster Reduction)



- **Resilience:** "The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures."

FR Management Cycle



<https://un-spider.org/risks-and-disasters>

Risk-reducing measures



	Structural measures	Non-structural measures
Before	ex. dikes	ex. physical planning
During	ex. temporary barriers	ex. crisis communication
After	ex. reconstruction	ex. event analysis

After Lars Nyberg (2016)

References



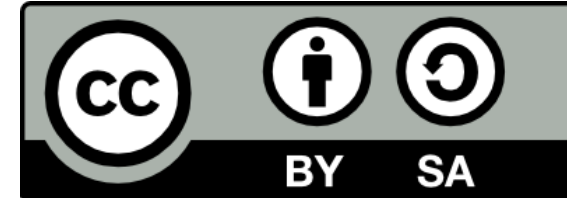
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