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UNDERSTANDING RISK GLOBAL FORUM 2024

TRADITION • INNOVATION • RESILIENCE

強靭性 革新 伝統

Making Urban Flood Protection More Accessible: Decoding Risks and Democratizing Assessment

Speakers:

Ross Eisenberg

Philip Ward

Blair Spendelow

Karel Heijnert

Seyi Makinde


City
Resilience
Program
Deltares
Royal
HaskoningDHV
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Why Are We Here

Growing urban concentration of population and economic activity

Climate change and socioeconomic development exacerbating challenges

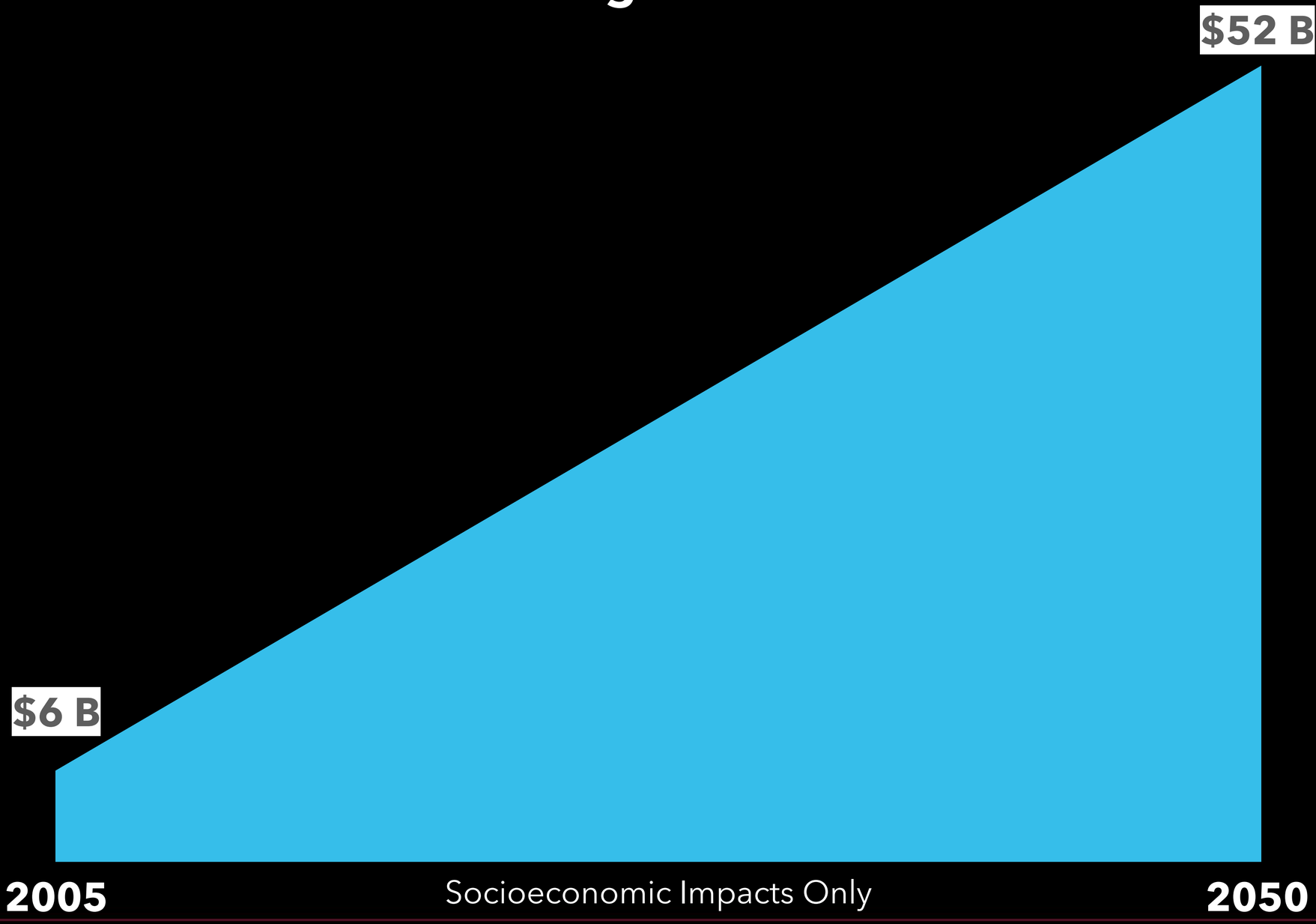
Inadequate planning

Impacts on health, livelihoods, poverty, and more

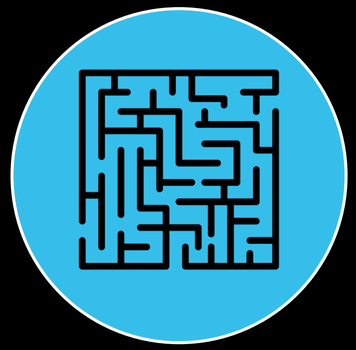
Increased exposure of population, assets, and economic activities

More weather extremes and increased water runoff

Losses due to Flooding in Just 136 Global Cities

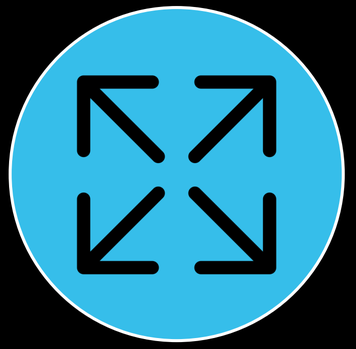


Key Challenges



Urban flood risk is not easy to understand

Urban flood risk is not easy to address



Urban flood risk actions are not easy to scale up

Agenda

Urban Floods: An Increasing Challenge for Urban Sustainability

Ross Eisenberg, World Bank

Innovations in Urban Flood Risk: Insights and Case Studies from the Private Sector

Philip Ward, Deltares

Blair Spendelow, Jeremy Benn Associates

Karel Heijnert, Royal HaskoningDHV

Panel Reflections

Seyi Makinde, Governor, Oyo State, Nigeria

Q&A

Scenario Role-Play and Read-Out

Opening

City Resilience Program

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URBAN FLOODS

AN INCREASING CHALLENGE FOR URBAN SUSTAINABILITY

A handbook for flood risk knowledge and assessment of interventions

City Resilience Program

GFDRR
Global Facility for Disaster Reduction and Recovery

Administered by
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WHY IS IT IMPORTANT TO UNDERSTAND FLOOD RISK?

Flooding is often the most frequent and damaging natural disaster that threatens developing nations.

The importance of accurate, reliable and actionable flood hazard and risk data cannot be underestimated.

It is:

- essential for understanding the scale of flooding and severity of its impacts, and;
- fundamental to planning and decision making of risk mitigation strategies.

LEVELS OF FLOOD RISK ASSESSMENT

LEVELS OF FLOOD RISK ASSESSMENT

LEVEL 1

PRELIMINARY,
typically national or city scale, for "hot spot" mapping and screening

LEVEL 2

STRATEGIC,
typically city (regional or small island state) scale analysis

LEVEL 3

DETAILED
high-resolution analysis focusing on basin, sub-basin, or individual channel scale

INITIAL DISCUSSIONS AND INVESTIGATIONS
Initiaton of dialogue, identification of the scale of hazard or risk, definition of the problem and scope of risk assessment

PROJECT CONCEPT AND PREPARATION
Strategic assessment allowing prefeasibility, outline of cost-benefit analysis, initial scoping of investments

PROJECT PLANNING, APPRAISAL, AND DESIGN
Feasibility, engineering, and design studies, economic analysis, environmental and social impact assessment

IMPLEMENTATION
Procurement, contract negotiation, land acquisition, environmental licensing and permits, construction

COMMISSIONING AND OPERATION
Construction and project monitoring and supervision, O&M of structures, postconstruction review

FLOOD RISK ASSESSMENTS ARE CHALLENGING

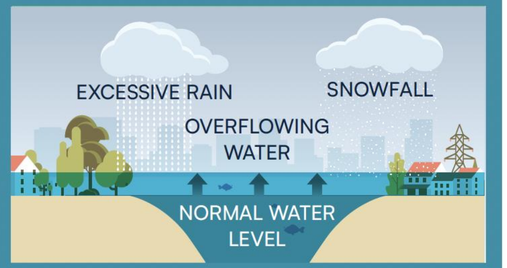
Carrying out flood hazard and risk assessments can be challenging, combining complex technical and non-technical factors, such as:

- Natural variability and different flood mechanisms.
- High-density and rapid changes of population and assets.
- Uncertainties in many of the inputs as well as future climate change and urban growth.

1 RIVER OR FLUVIAL FLOODS

Insufficient capacity and/or protection during high discharge, resulting in overflow into urban areas

Examples:
Bangkok, 2011;
Mississippi River flood, 2019



2 PLUVIAL FLOODS

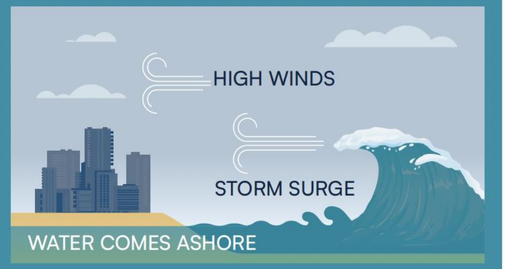
Insufficient capacity of the urban drainage system during rainfall events, resulting in flooded urban areas

Examples:
Houston, 2017;
Paramaribo, Suriname, 2022

3 COASTAL FLOODS

Inundation of low-lying land by tidal water during storms (cyclones, extratropical storms), resulting in flooding in the city

Examples:
New Orleans, 2005;
Beira, Mozambique, 2019

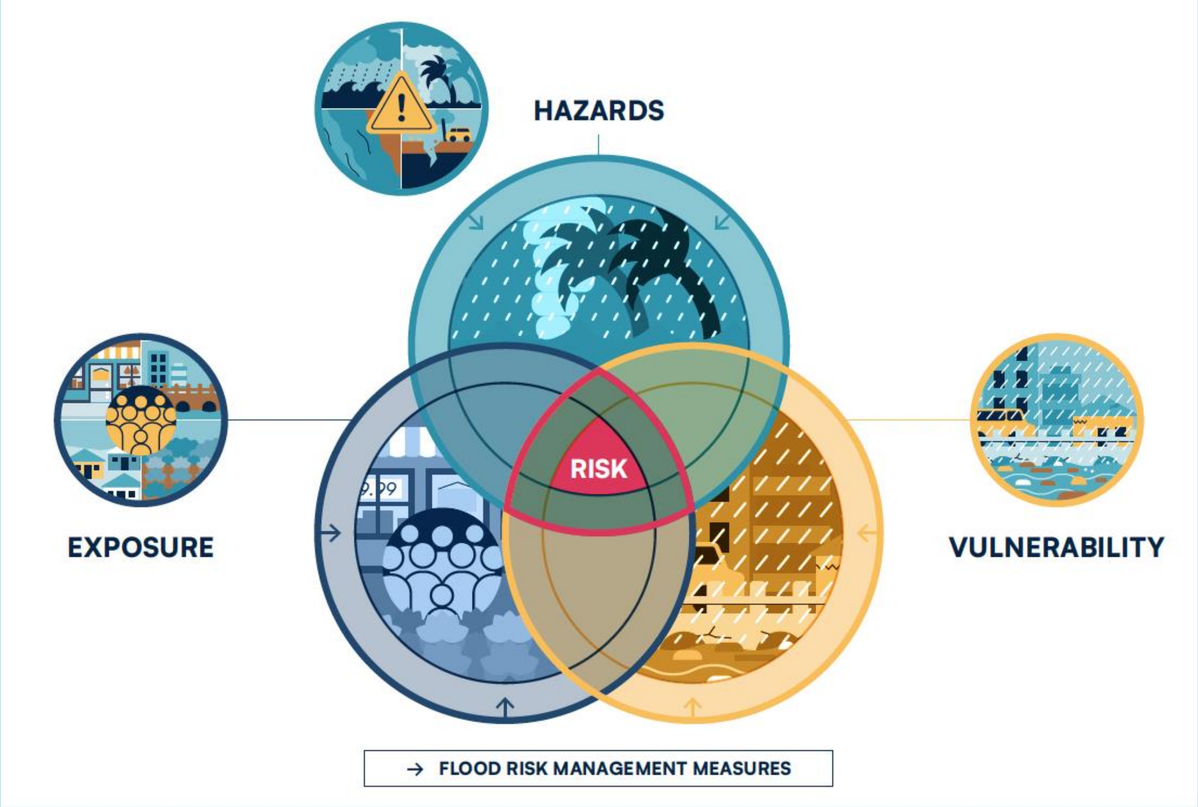


4 FLASH FLOODS

Rapid onset of damaging flooding due to intense rainfall run-off from nearby hilly terrain and/or a dam or dike breach

Examples:
Brumadinho Dam, Brazil, 2019;
Germany, Belgium, and the Netherlands, 2021

FLOOD RISK STUDIES ARE MULTI-DISCIPLINARY IN NATURE



1

Flood hazard assessment:

- Meteorology / Oceanography / Hydrology
- Hydraulics
- GIS Mapping

2

Flood risk assessment:

- Economics and Finance
- Physical and Social Geography
- GIS processing and analysis

INTENDED PURPOSE

Purpose of the guidance is to provide practical advice and information that is easy to adopt, at a complexity appropriate for non-specialists, focused on strategic level assessments. It is hoped this will:

INTENDED PURPOSE

Improve efficiency and cost effectiveness.

Improve the output quality and robustness.

Ensure technical compliance with industry standards.

Contribute to better decision making and planning processes.

Result in consistency, compatibility & comparability in outputs.

Support more effective and efficient project delivery for urban flood risk management programs and investments.

FOCUS ON URBAN FLOODING

The geographical scope of the handbook is focussed on urban environments and urban floods around the world.

- Rate of urbanisation in developing countries
- Concentration of GDP, people, assets, infrastructure etc,
- Complexity of analysis (social, physical, hydrometeorological, economic, etc)
- Importance to understand the complexity of the problem in order to develop potential solutions.

The concept of this handbook is to provide comprehensive guidance that would build upon:

- Academic and standard textbooks on urban flooding
- Lessons learned and experience gained from past flood hazard and risk assessments
- Survey and feedback amongst potential users
- Inputs from many individual interviews/discussions with

STRUCTURE OF THE HANDBOOK

FIVE PHASES OF A LEVEL 2 URBAN FLOOD RISK ASSESSMENT

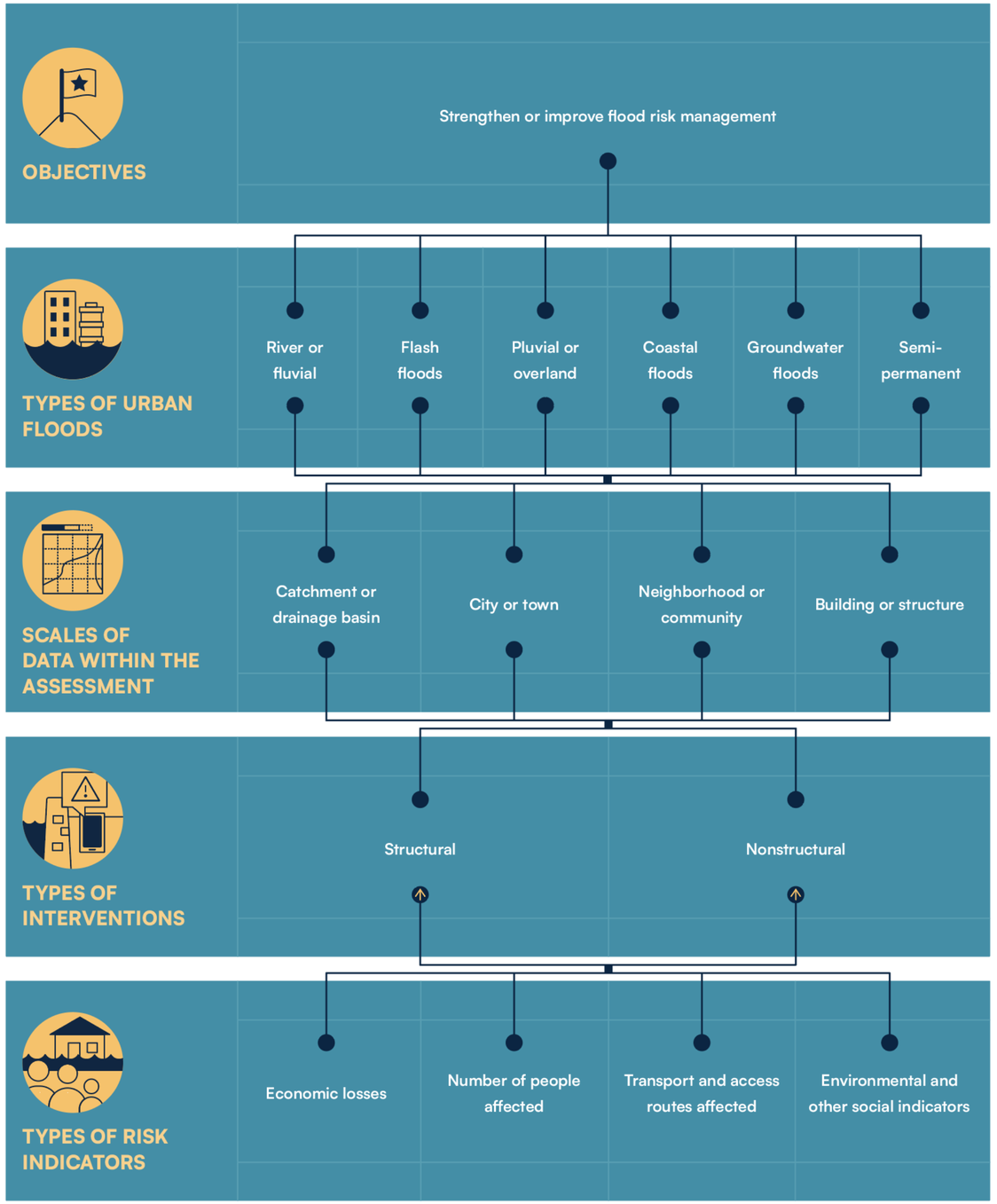
KEY ASPECTS OF THE GUIDANCE

1

DEFINITION OF AIM AND SCOPE

Prior to the start of an urban flood risk assessment, the scope of the assessment must be properly defined by covering the following:

1. Specific aims
2. Relevant types of flood hazards and consequences
3. Key stakeholders and institutional setting
4. Existing data/models/analyses and data/model gaps
5. Spatial scale of the analysis and type of interventions
6. Analysis methodologies required

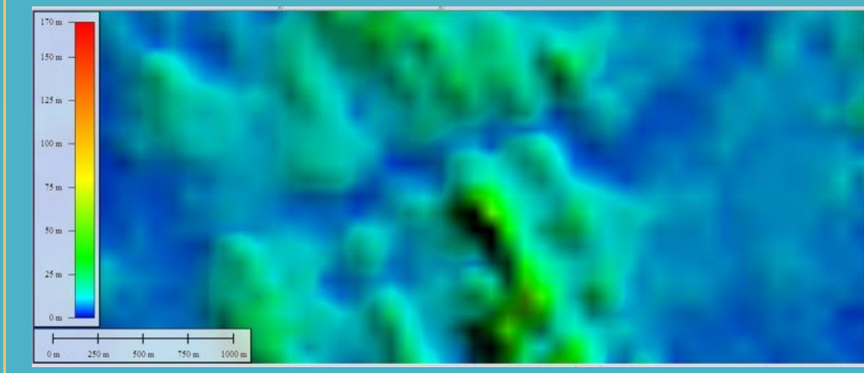


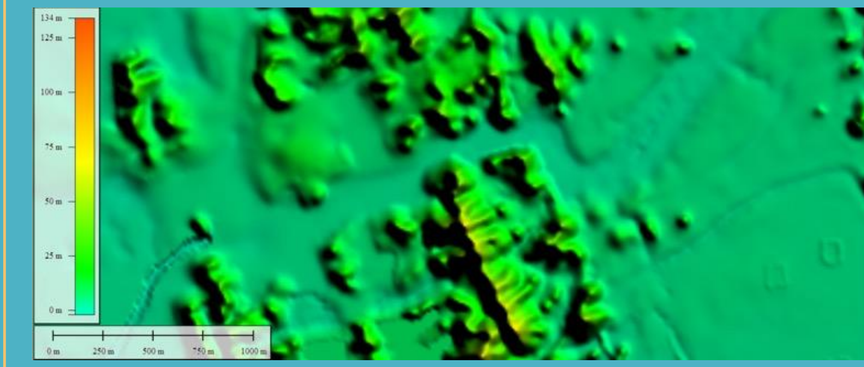
2

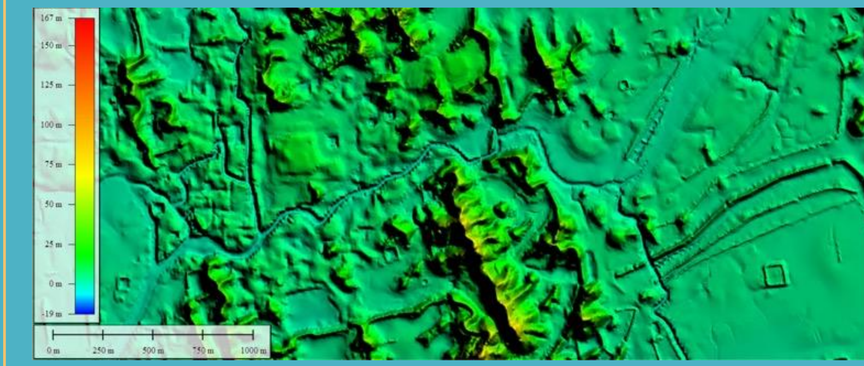
FLOOD HAZARD ASSESSMENT

Mapping the flood characteristics (e.g. extent, depth, speed) are key to understand the flood hazard an urban environment. Relevant aspects are:

1. Criticality of topography data (DTM)
2. Relevant man-made and natural waterways and infrastructure
3. Suitable modelling approach (1D, 2D, 1D2D)
4. Statistical approach (‘deterministic’ or ‘probabilistic’)
5. Boundary conditions
6. Calibration and validation
7. Flood simulations and scenarios
8. Mapping and visualizations







3

FLOOD RISK ASSESSMENT

Quantification the potential consequences of flooding is an essential part of a flood risk assessment. The following questions are relevant for this part of the assessment:

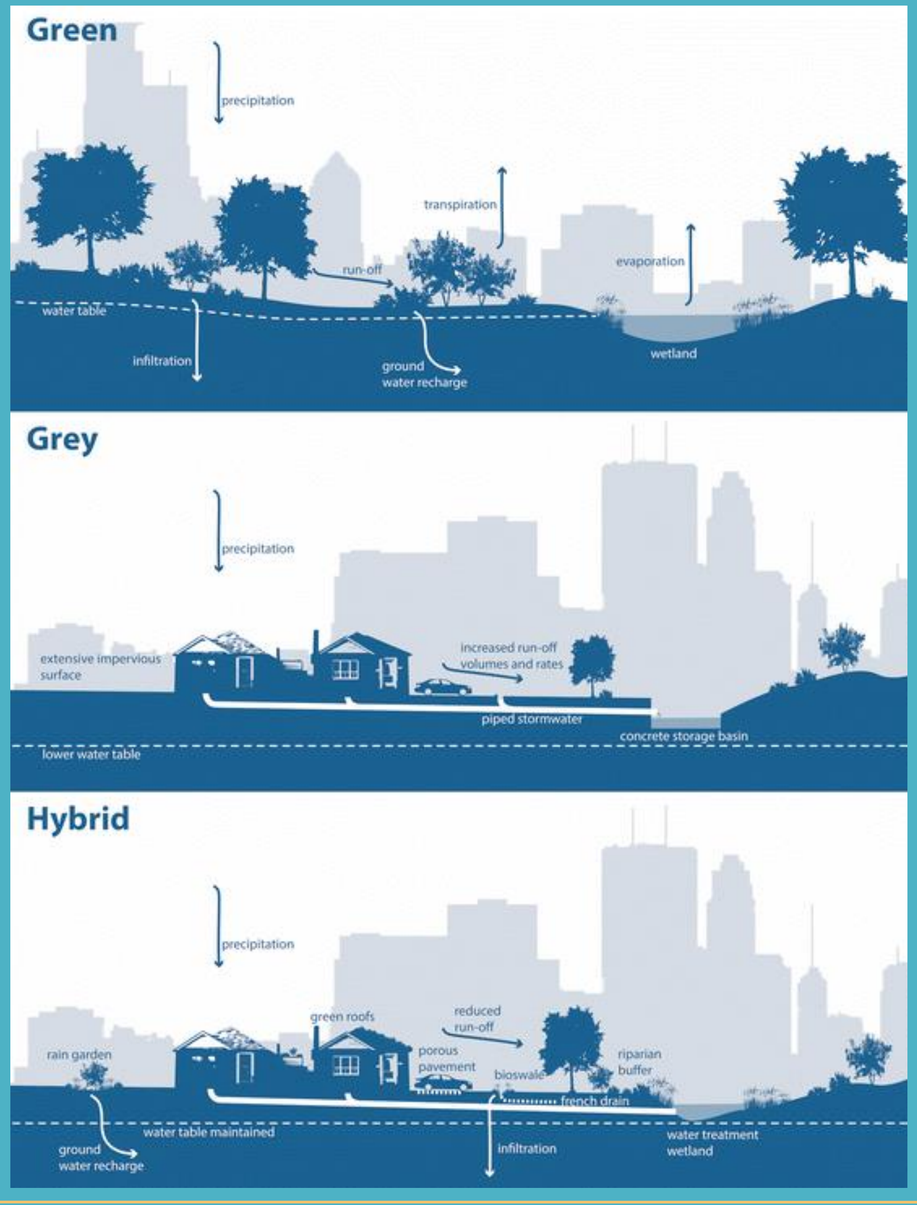
1. What data sources are suitable to assess the exposed population, assets, etc.?
2. What information is available on vulnerability of the risk receptors?
3. What is the appropriate risk modelling approach given the available hazard, exposure and vulnerability data?
4. How to calibrate/validate risk models?

4

EVALUATION OF INTERVENTIONS

The aim of the evaluation of interventions is to analyse the appropriateness of specific interventions to reduce the risk of flooding. Many options must be screened in an efficient but also robust way.

1. What types of interventions are possible and how to select relevant ones for the assessment?
2. What are possible future scenarios?
3. What is the performance of the interventions under a range of possible future scenarios (climate, socio-economic situation)?
4. What are the (co-)benefits and costs of these interventions?
5. How to assess (critical) environmental & social impacts?



Source: Depietri & McPhearson, 2017. Integrating the Grey, Green, and Blue in Cities: Nature-Based Solutions for Climate Change Adaptation and Risk Reduction

5

PROJECT MANAGEMENT

The management of an urban flood risk assessment has resulted in various lessons learned for the key phases of the project:

1. Bidding and selection (e.g. roles, ToR examples)
2. Executing the project (e.g. progress meetings, reviews)
3. Closing the project (e.g. archiving data and models)

CONTEXT:

- What is the country context, what are the existing and potential future challenges of urban flood risk, and who are the main stakeholders?

PURPOSE:

- What is the objective of the assessment, and who will use the output?

SCOPE:

- What is the geographical (scale) and temporal (existing, future) scope?
- What flood hazards (pluvial, coastal, fluvial) and risks (affected population, casualities, direct or indirect damages, and critical infrastructure) are included?
- Who are the stakeholders, and when and how should they be engaged in the assignment?
- What outputs, such as flood hazard maps and risk metrics, are expected?
- What types of interventions (gray-green-blue infrastructure solutions, nonstructural solutions) shall be considered?
- What level of detail is required for the hazard and risk assessment—horizontal resolution, type of modeling to use, quality of the digital terrain model to use, number of small-scale features included in models, and number of events, among others?
- What level of detail is required regarding the design, costing, and assessment of potential impacts of structural interventions?
- What are the needs for capacity building within the agencies or among other stakeholders?
- What is the level of engagement and interaction with government counterparts and other relevant stakeholders in the country?

DELIVERABLES:

- Which reports, datasets, prefeasibility drawings, visualizations, and the like should be developed, and what do the acceptance processes (reviews) of these products look like?

TIMELINE:

- What are the deadlines for reporting, feedback, and meetings with stakeholders?

CONSULTANT'S TEAM REQUIREMENTS:

- Which staff competencies and skills are required to cover relevant disciplines as well as local or global experience requirements?

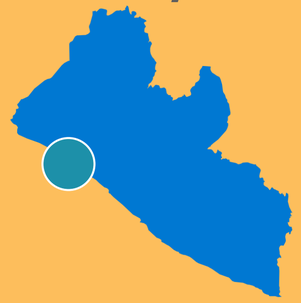
IMPLEMENTATION ARRANGEMENTS:

- What is the contracting agency, what is the role and organization of stakeholders, and what is the country's safety and security situation?

HANDBOOK APPROACH IN PRACTICE

- Flood hazard and risk modelling in an urban setting is not an exact science
- The overall quality and usefulness of the modeling results is dependent on the weakest link in that chain
- Costs and time can escalate exponentially by attempting to achieve high accuracy levels

Monrovia, Liberia

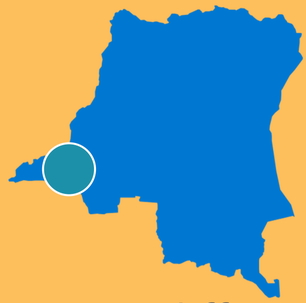


profiling multiple flood hazards

Paramaribo, Suriname

selecting modeling approaches

Kinshasa, DRC



testing different interventions

Dar es Salaam & Zanibar City, Tanzania

assessing flood risk probabalistically

Bima, Manado, & Pontianak, Indonesia

engaging stakeholders

Dhaka, Bangladesh

investing to address adaptation deficits

Panel Presentations

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Making urban flood protection more accessible: decoding risks and democratizing assessment

Speakers:

Philip J. Ward

Dirk Eilander

Hessel Winsemius

Hans Gehrels

Deltares

Rapid assessment of urban flood risk

RESILIENT CITIES NETWORK

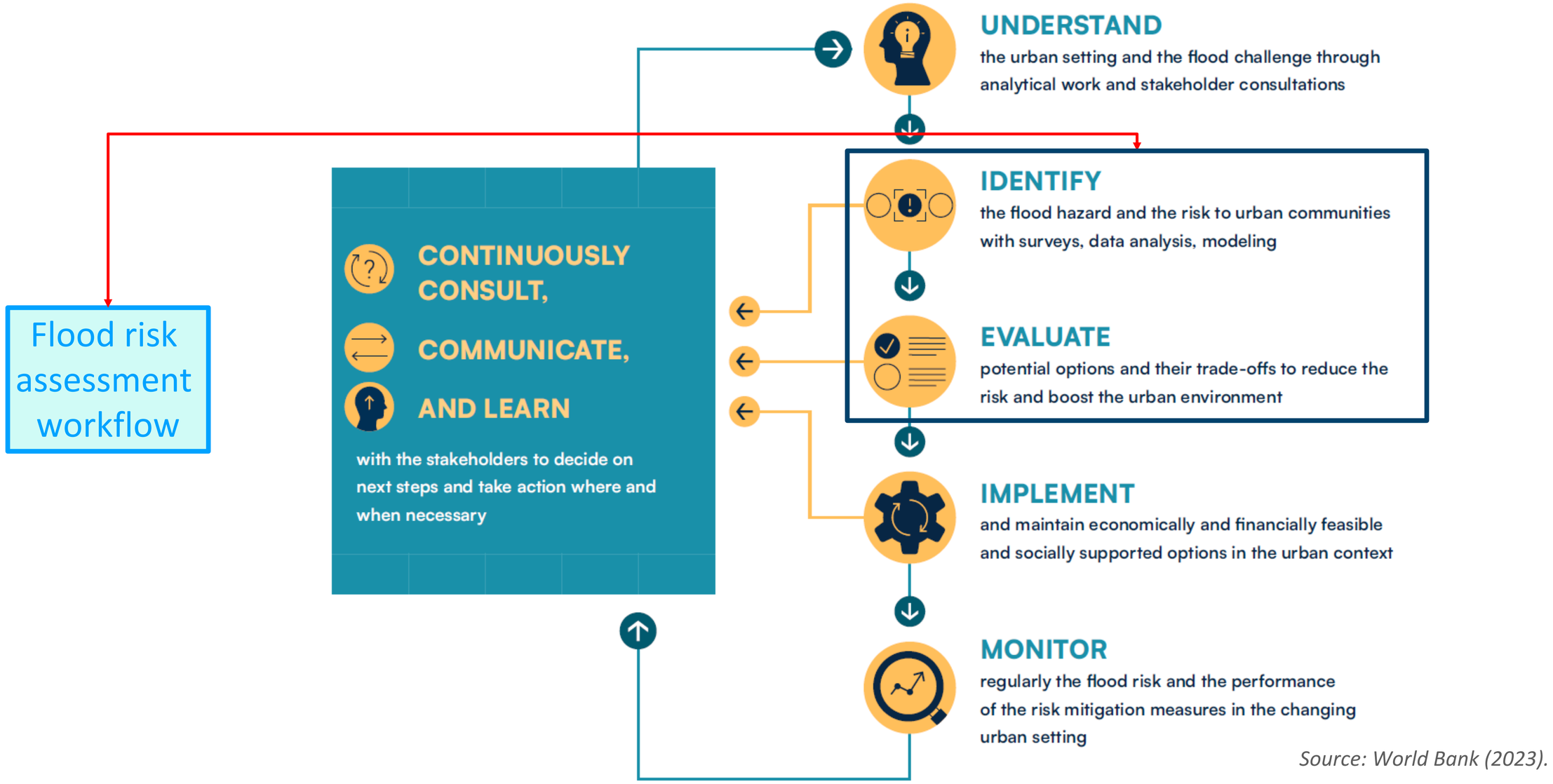
49% of cities cite **water insecurity** as a chronic stress

4 out of 5 of 97 Network member cities cite water as a key risk

81% of cities cite **rainfall flooding** as an acute shock

Without a determined effort to adapt to climate change, the **economic toll and human costs** in cities will inevitably climb.

Local flood risk management project cycle



Source: World Bank (2023).

Traditional risk modelling approach

Classical approach

1) Collect local data
2) Collect more local data
3) Collect even more local data
4) Analyse data
5) Build a model
6) Throw away 80% of the collected data
7) Do some stakeholder handover (TOR)

Time

1) *Month 1-3*
2) *Month 3-6*
3) *Month 6*
4) *Month 7*
5) *Month 8-12*
6) *Month 12+*

Proposing a new approach

Classical approach

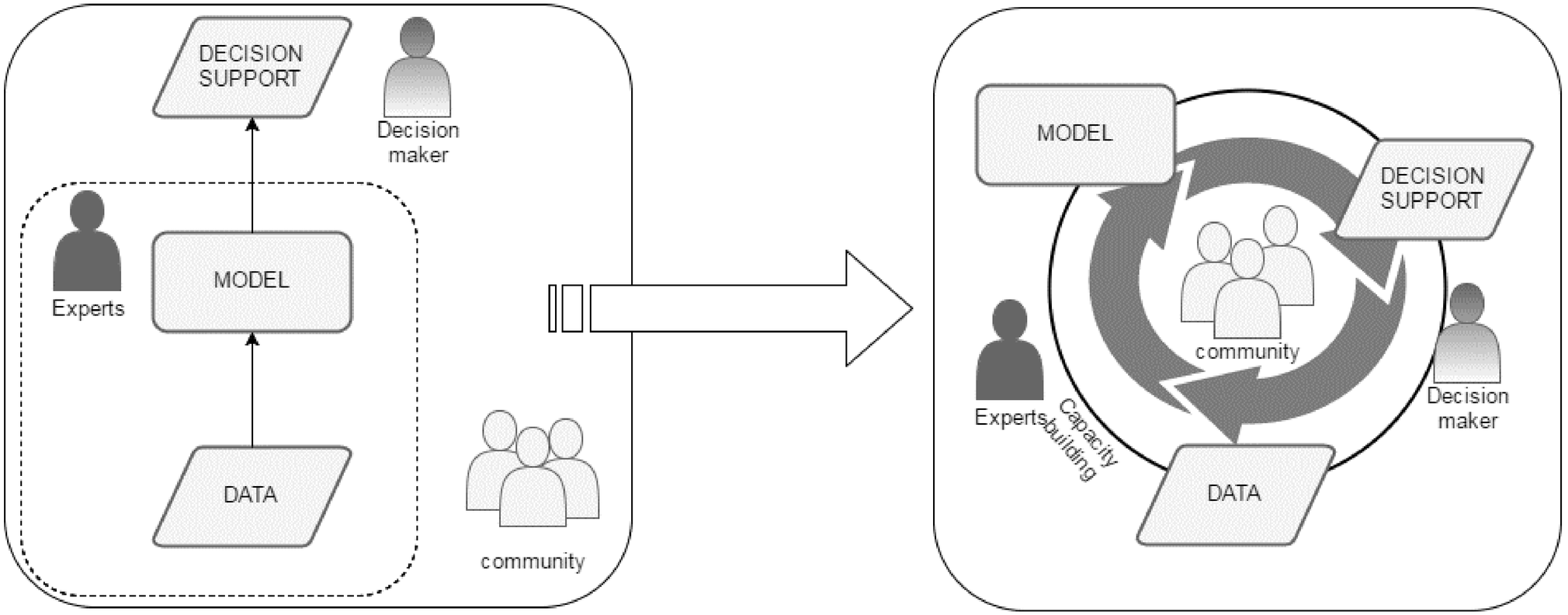
1) Collect local data
2) Collect more local data
3) Collect even more local data
4) Analyse data
5) Build a model
6) Throw away 80% of the collected data
7) Do some stakeholder handover (TOR)

New approach

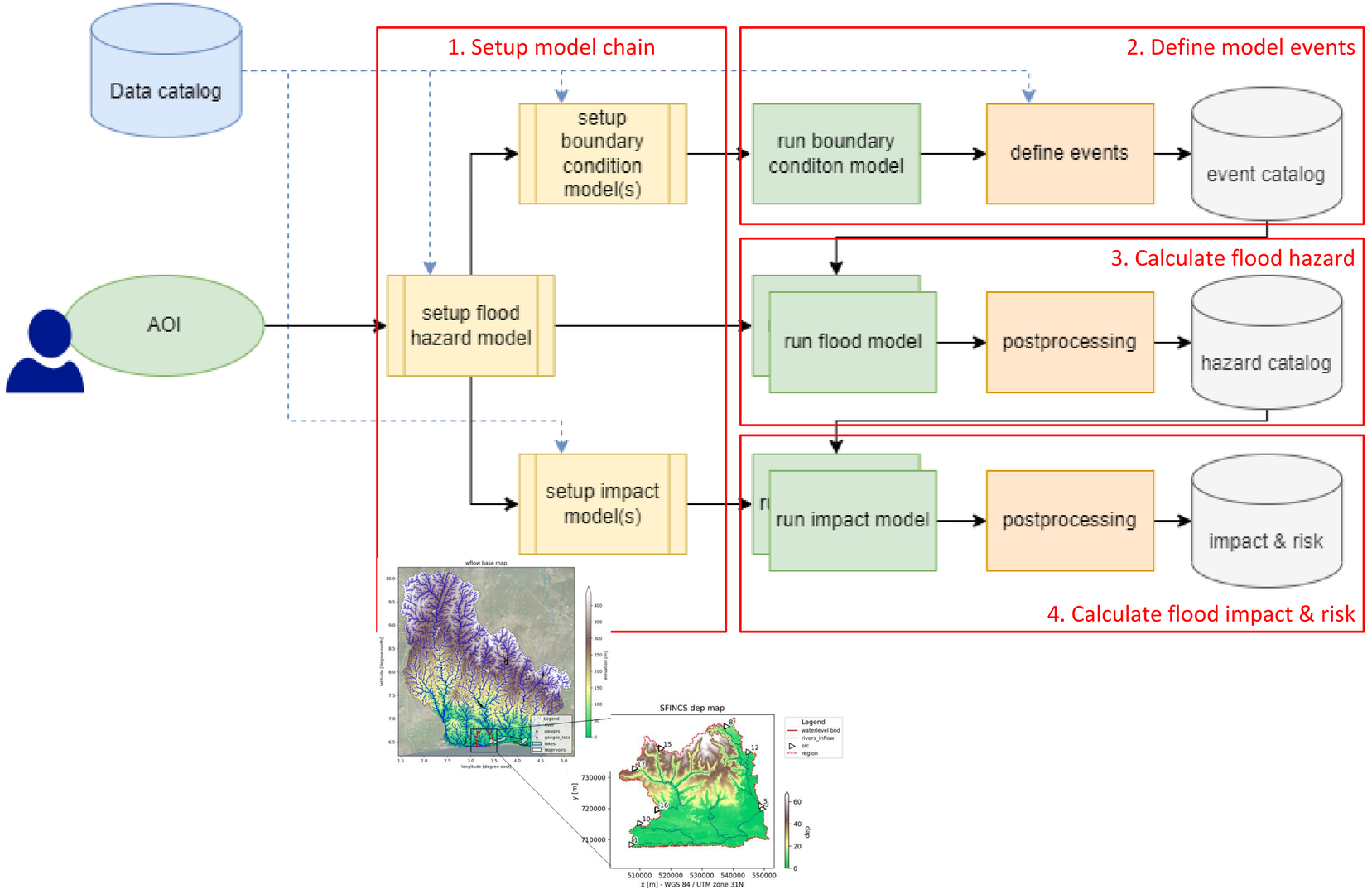
1) Build an initial model base on available (global) data
2) Train local stakeholders (e.g. a capable project/programme partner)
3) Discuss where improvements are required and which data is missing
4) Local partner to find/analyze local data
5) Local partner improves the model with the new data

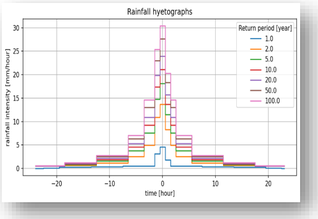
Stakeholder-driven modelling + decision support

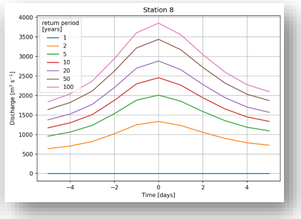
moving from a linear, top-down, modelling process to an interactive, iterative stakeholder-driven decision support process.

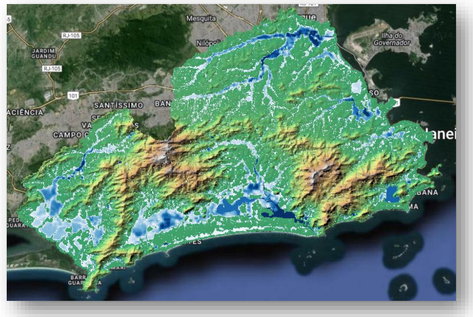


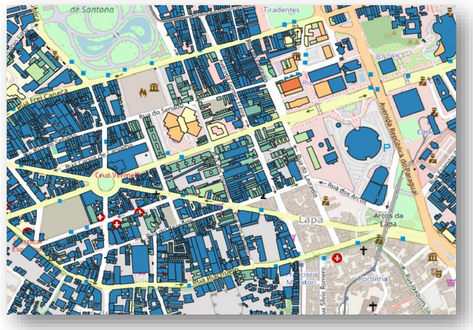
Models + entire workflows to run them



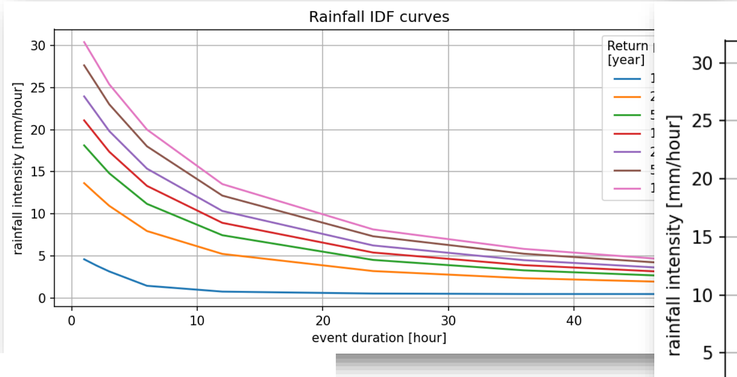


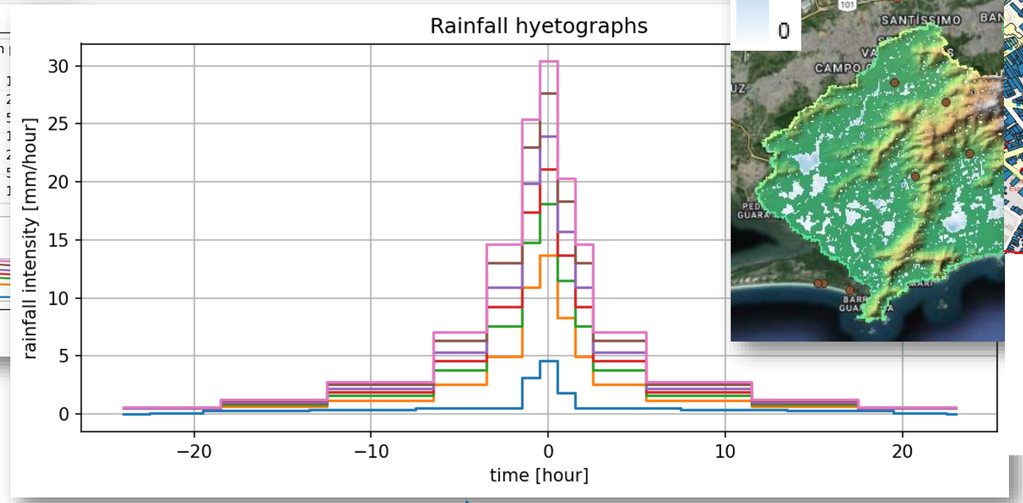


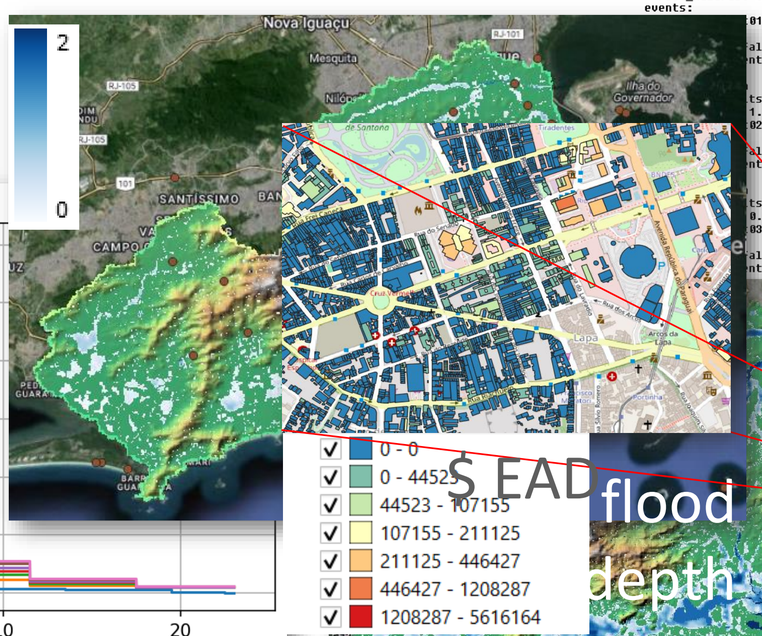




Case study: rio – pluvial flood risk

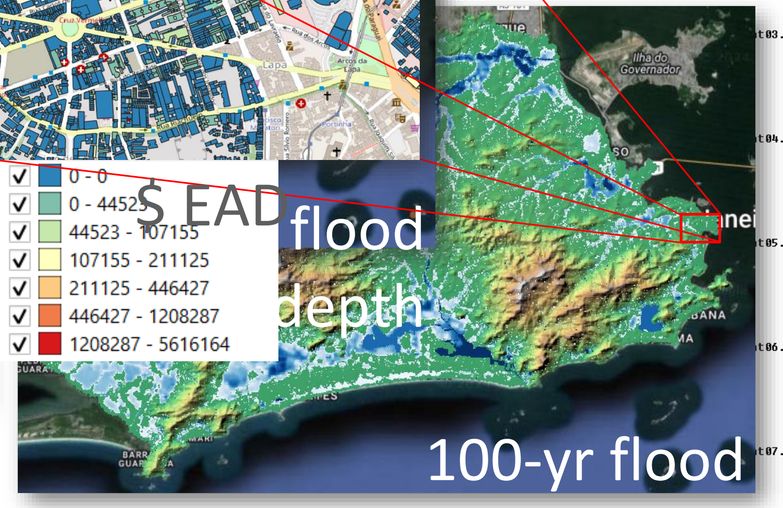


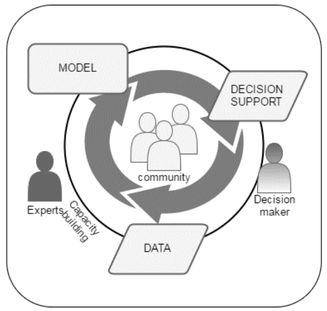




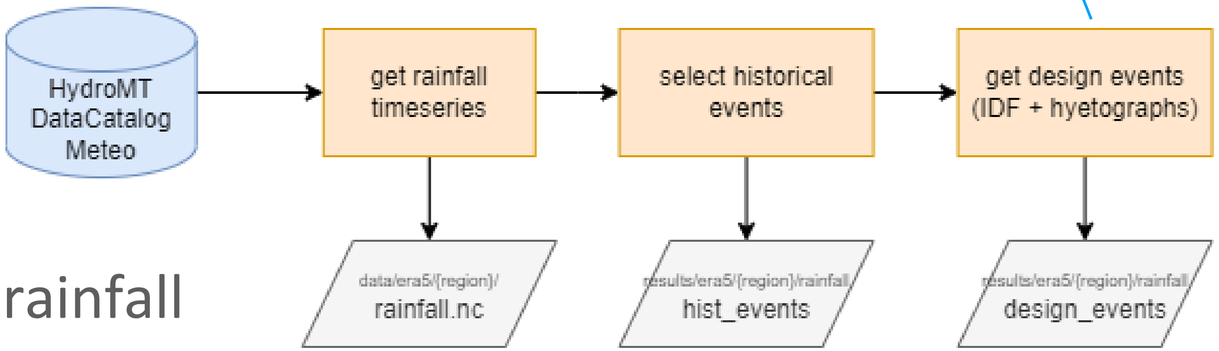
$ EAD

flood depth

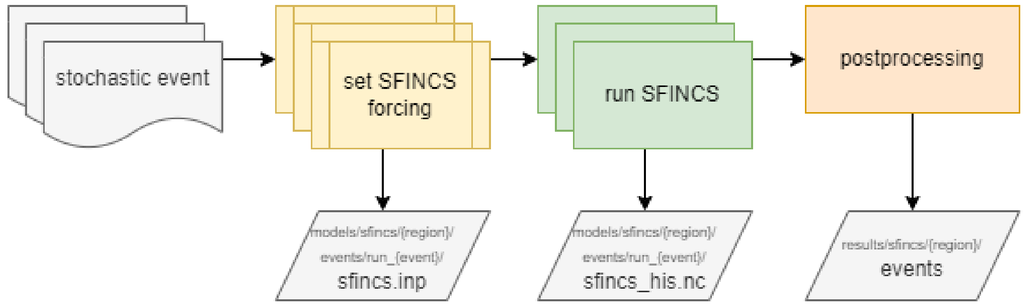




Event based simulations

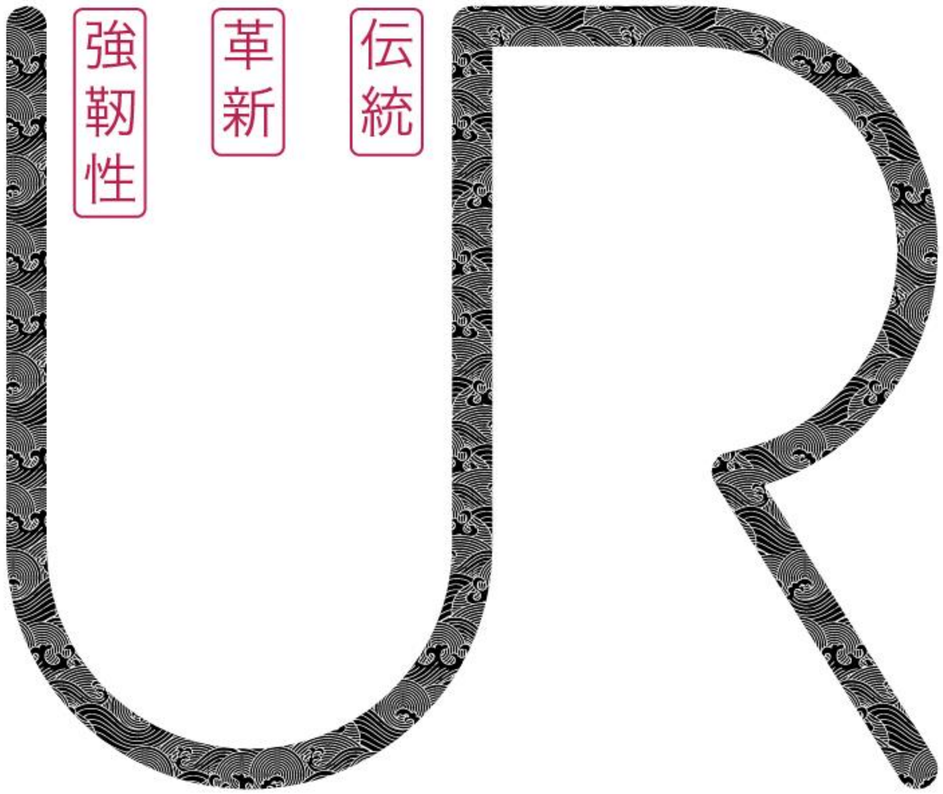


rainfall



Take home messages

- We are automating workflow setups with global data.
- Not as a panacea, but as a starting point for *local capacity, local data driven* assessments by *local people*.
- Democratizing assessment → moving knowledge to local people.



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Thank you !

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Making urban flood protection more accessible: decoding risks and democratizing assessment

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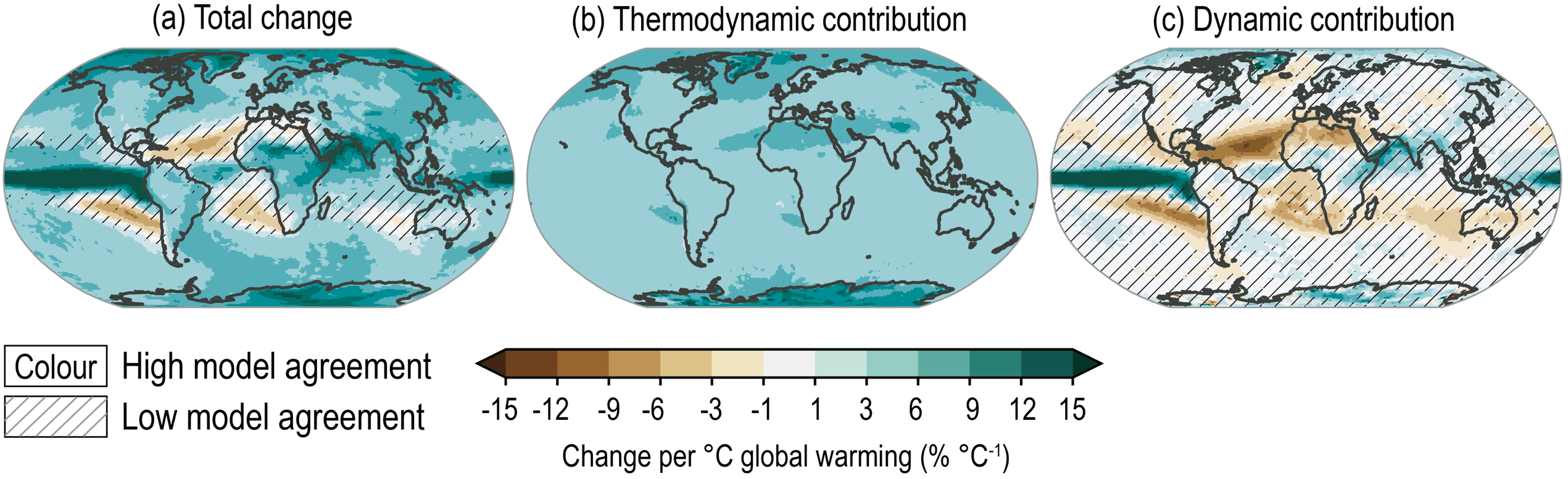
CLIMATE CHANGE AND RAIN
THE BIGGER PICTURE

JBA consulting

Change in annual maximum daily precipitation

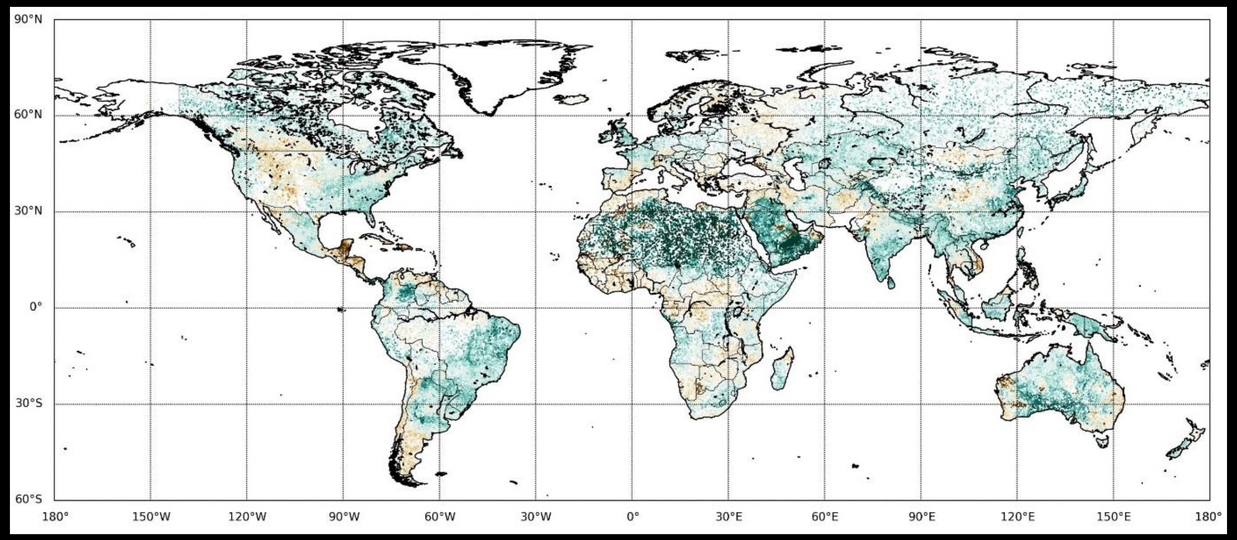


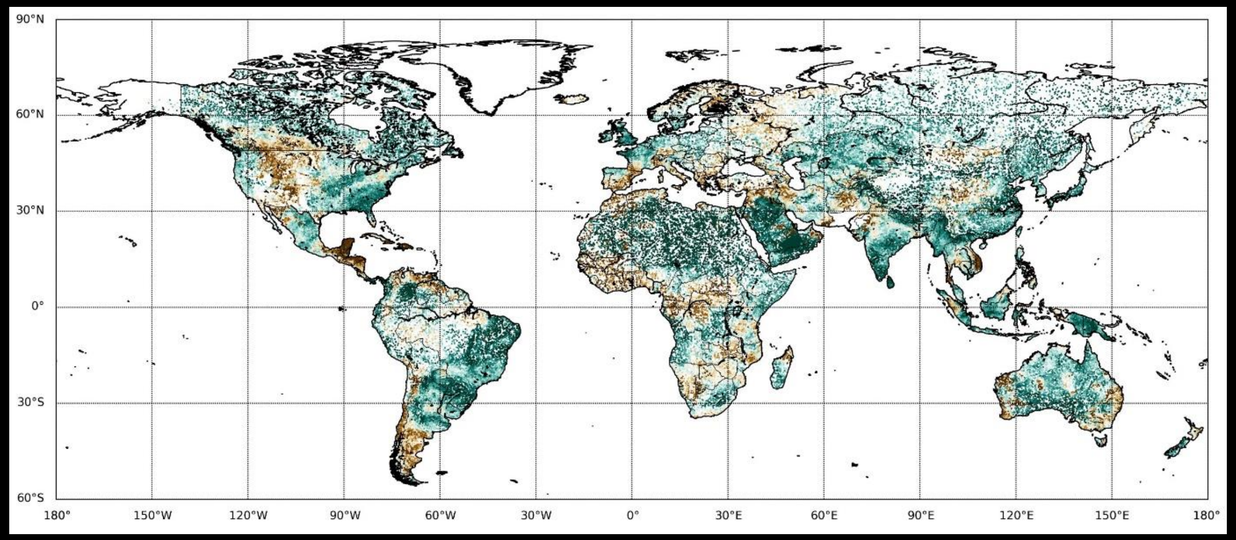
IPCC AR6 WG1 (2021) Box 11.1, Figure 1

EXAMPLE CHANGE FACTORS
RIVER

JBA consulting

‘RCP’ 7.0





Future less than baseline

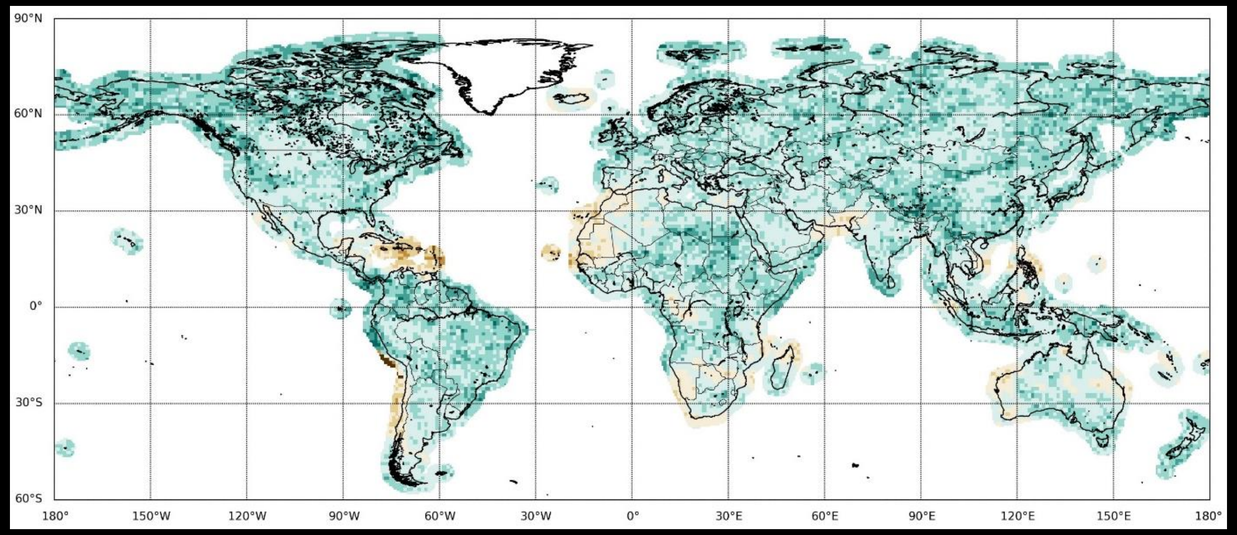
Future greater than baseline

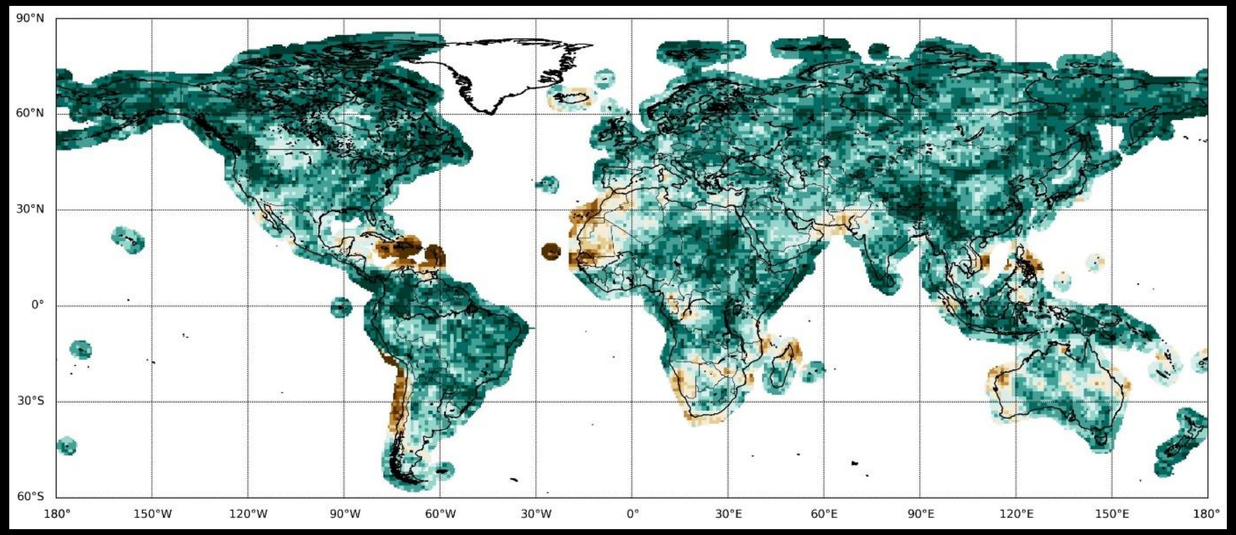
Return period

EXAMPLE CHANGE FACTORS
SURFACE WATER

JBA consulting

‘RCP’ 7.0



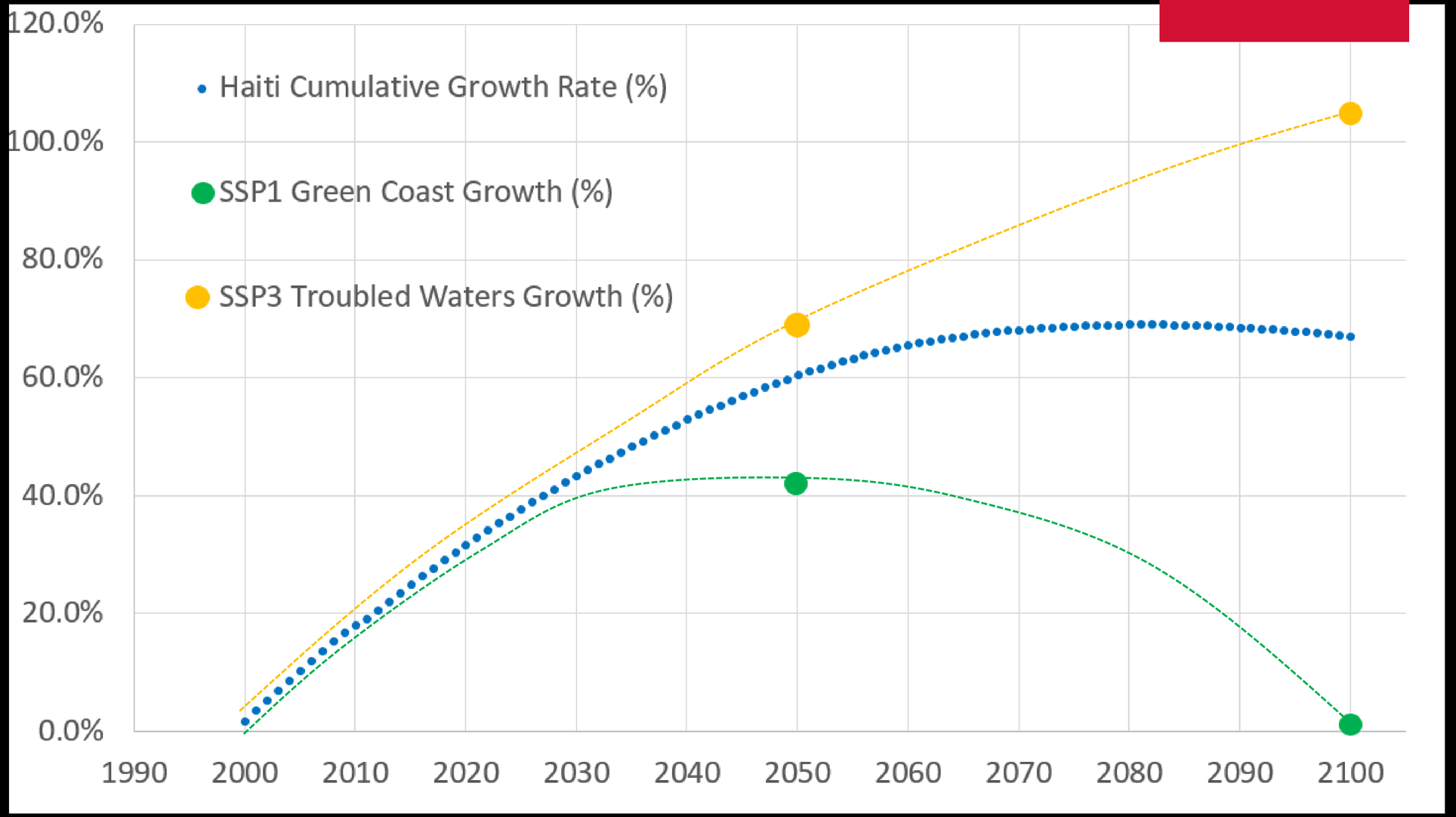


Future less than baseline

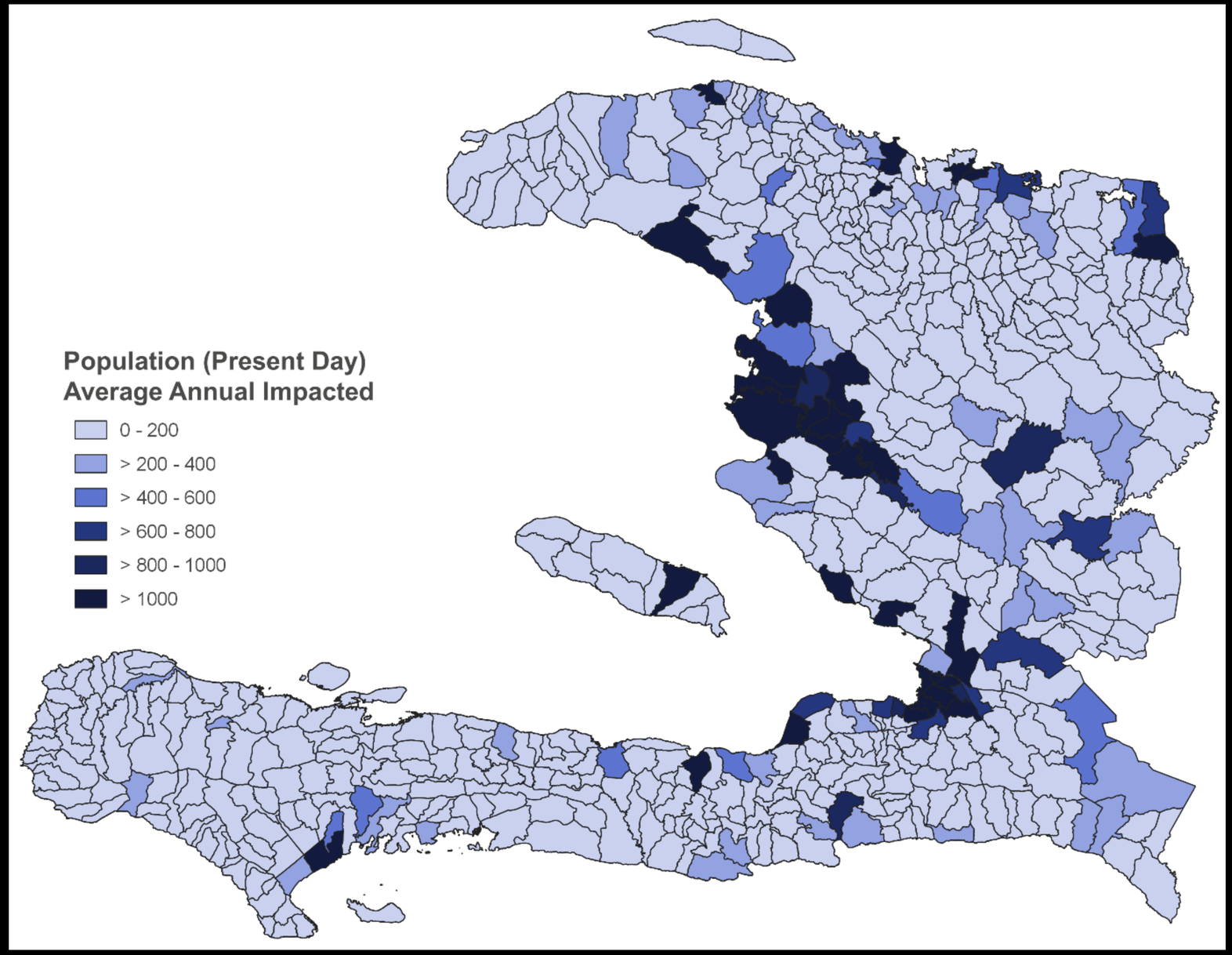
Future greater than baseline

Return period

HAITI
GROWTH RATE PROJECTIONS



Merkens et al., (2016)



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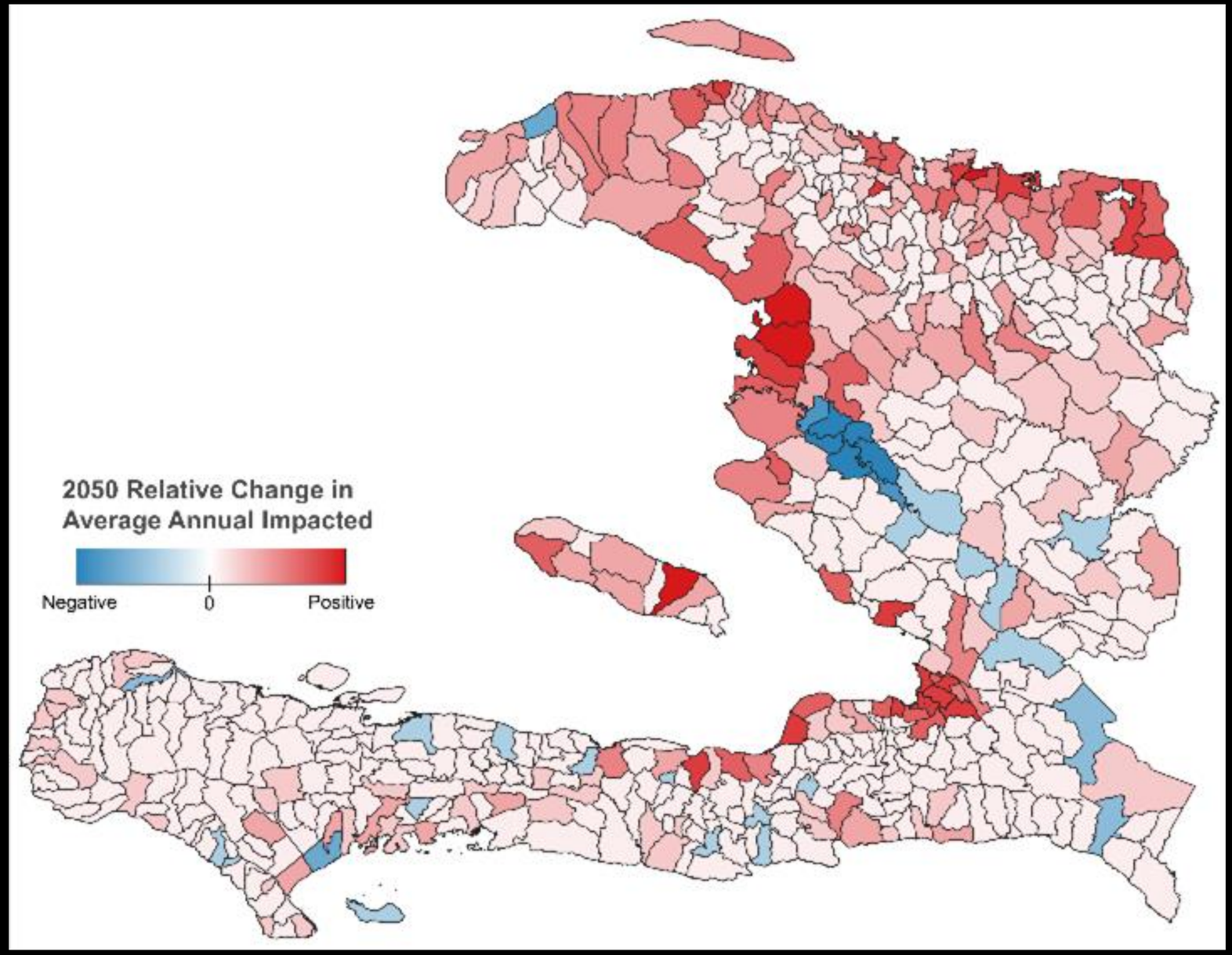

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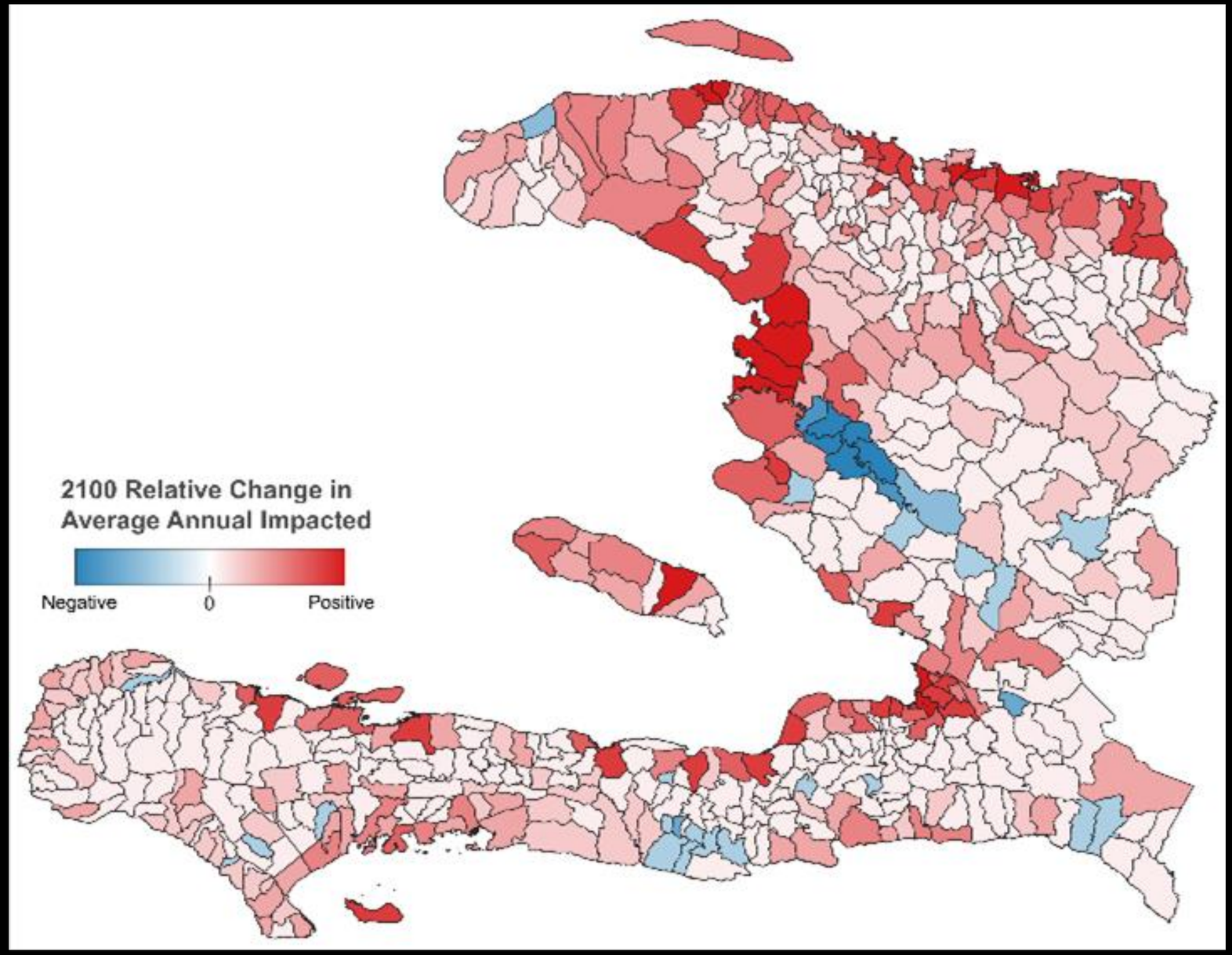

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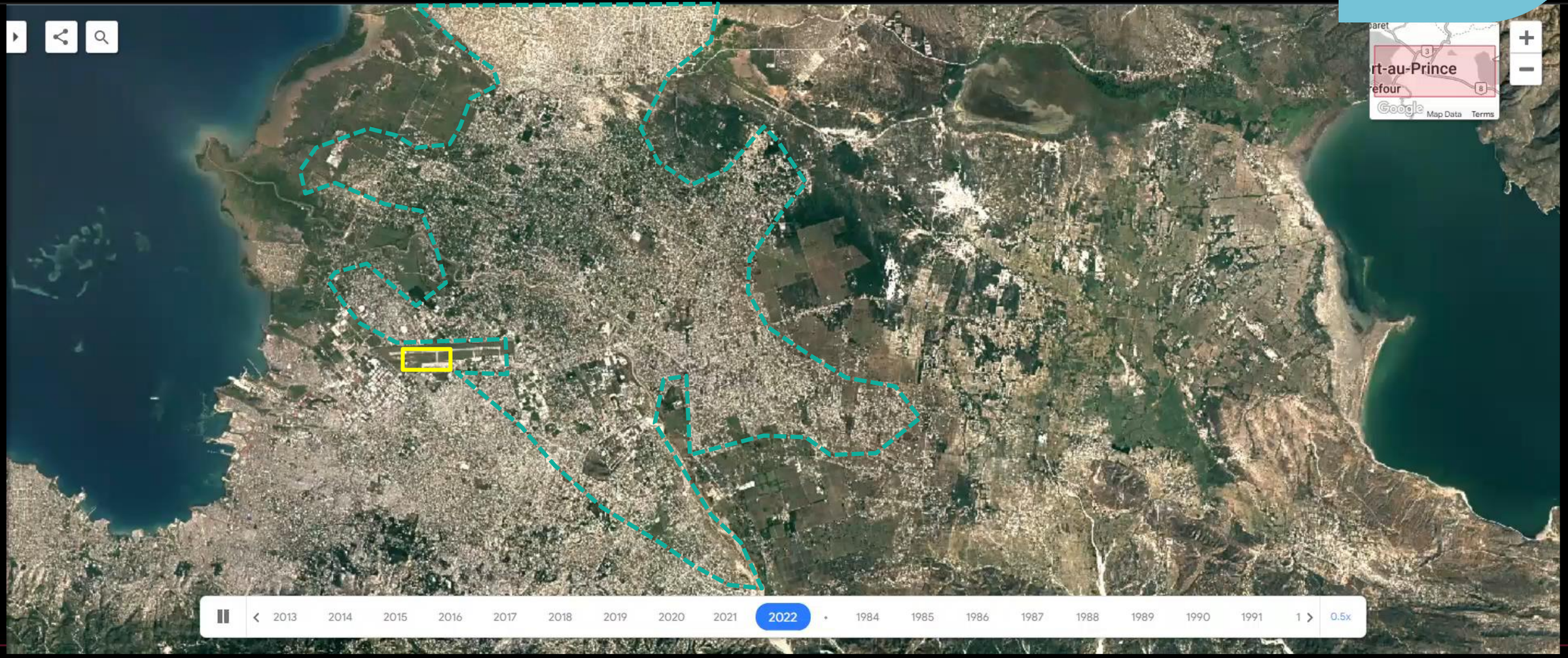
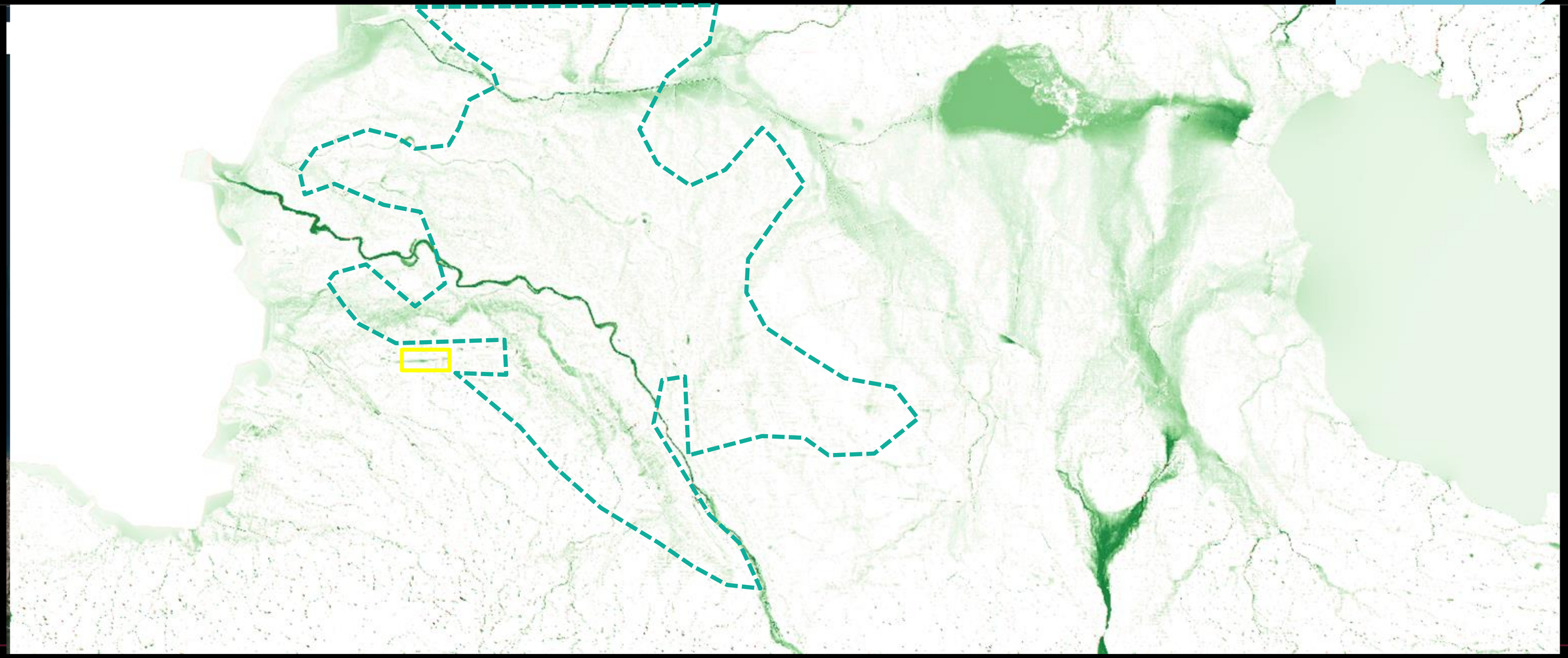
PORT-AU-PRINCE
1984 - 2022



PORT-AU-PRINCE

HAZARD – PRESENT DAY OVER RCP370 2100



PORT-AU-PRINCE

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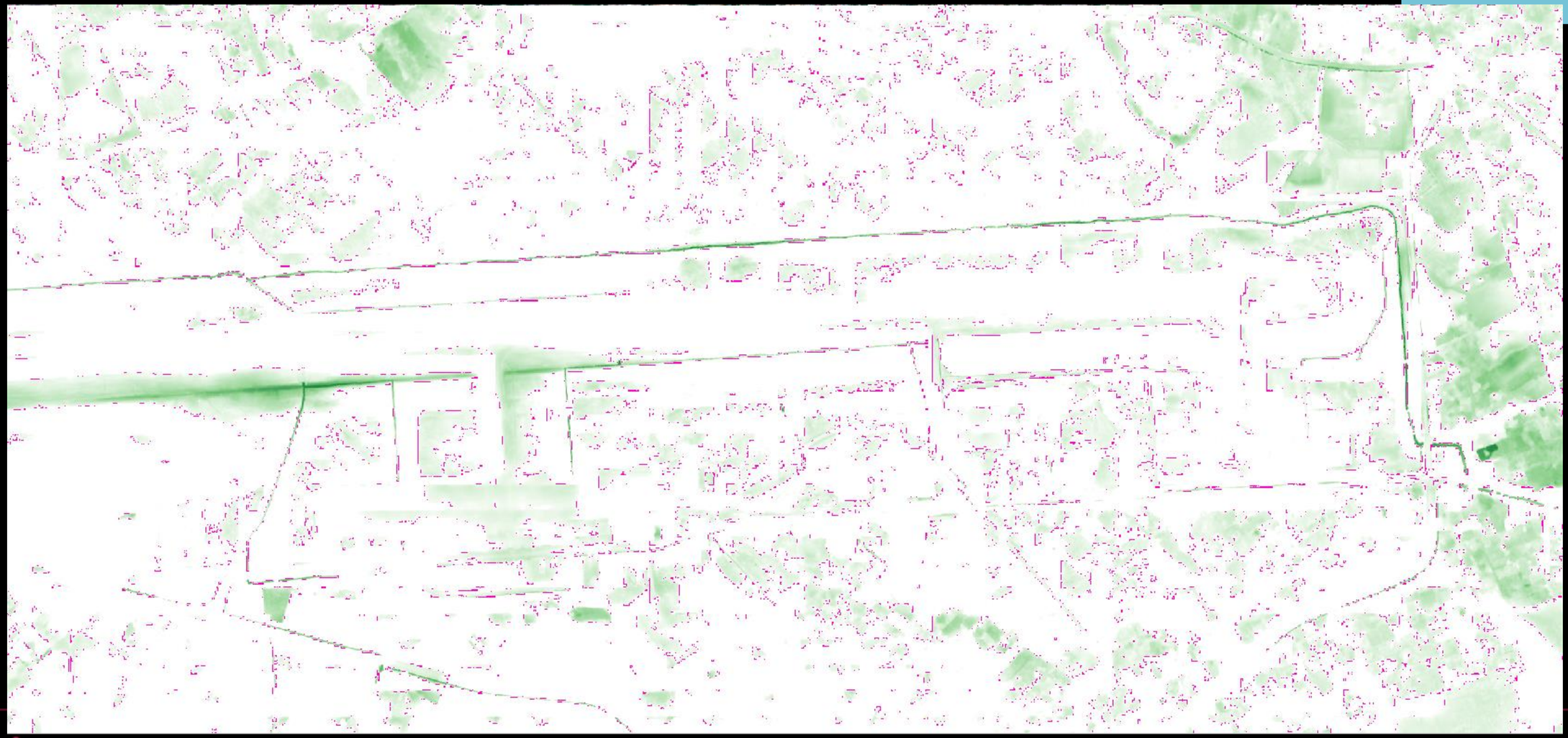

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Thank you !

Acknowledgements to the world bank and its team leader, Naraya Carrasco for our project (assessments on climate risk knowledge and impacts in Haiti).

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UR Himeji+

UNDERSTANDING RISK GLOBAL FORUM 2024

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強靭性 革新 伝統

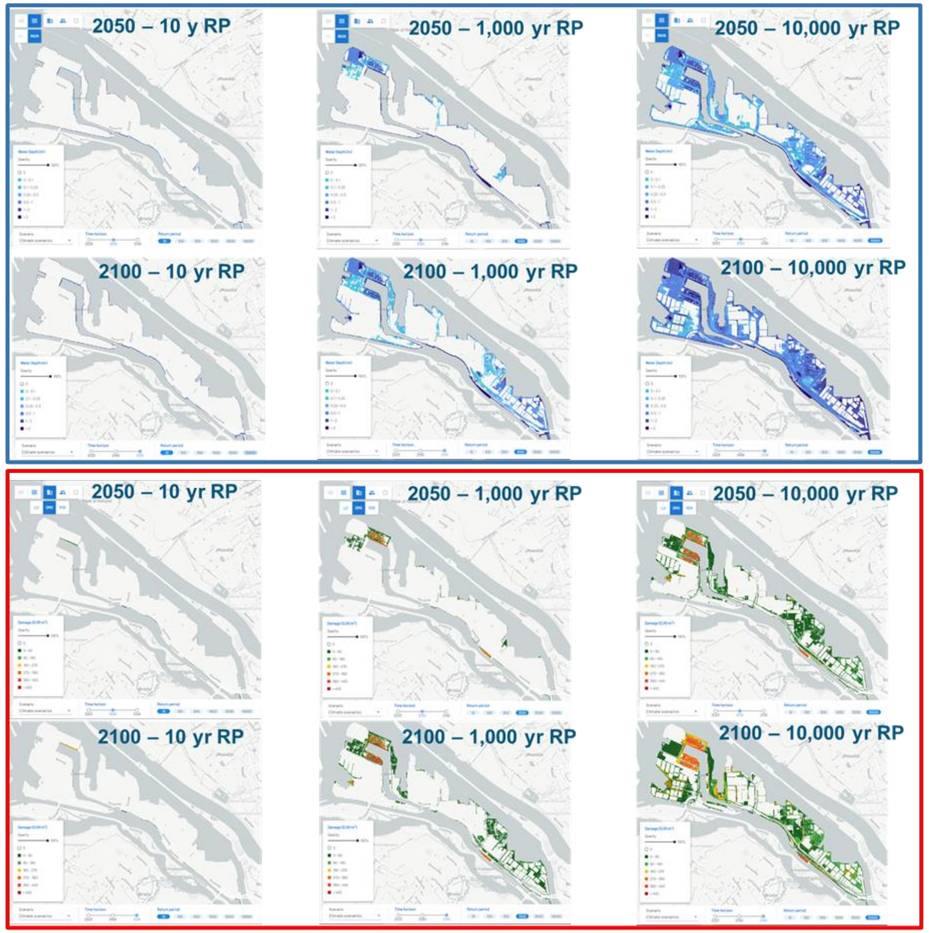
Making urban flood protection more accessible: decoding risks and democratizing assessment

Karel Heijnert

Royal HaskoningDHV
Enhancing Society Together

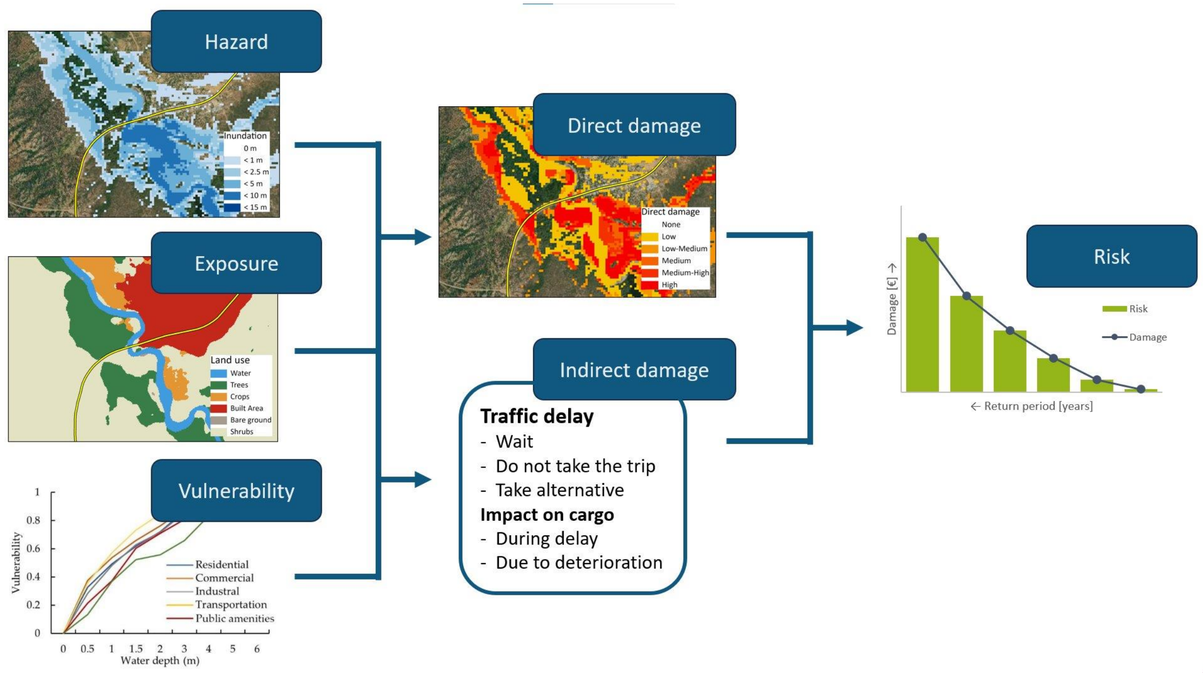
Introduction

- Mitigating impacts of natural hazards
- Identification of measures to reduce risk and impacts
- Communicating flood hazard & risk - Global Flood Risk Tool
- Impact of society → indirect damage
- *Example:* outage of road infrastructure due to various natural hazards



Damage and risk

- **Climate hazard, exposure, vulnerability** → Damage and risk
- **Direct damage**
- **Indirect damage**
  - Currently taken as percentage of direct damage
  - Towards framework for quantifying actual impacts: e.g., for road network
  - Support to identification and prioritisation of of mitigating measures

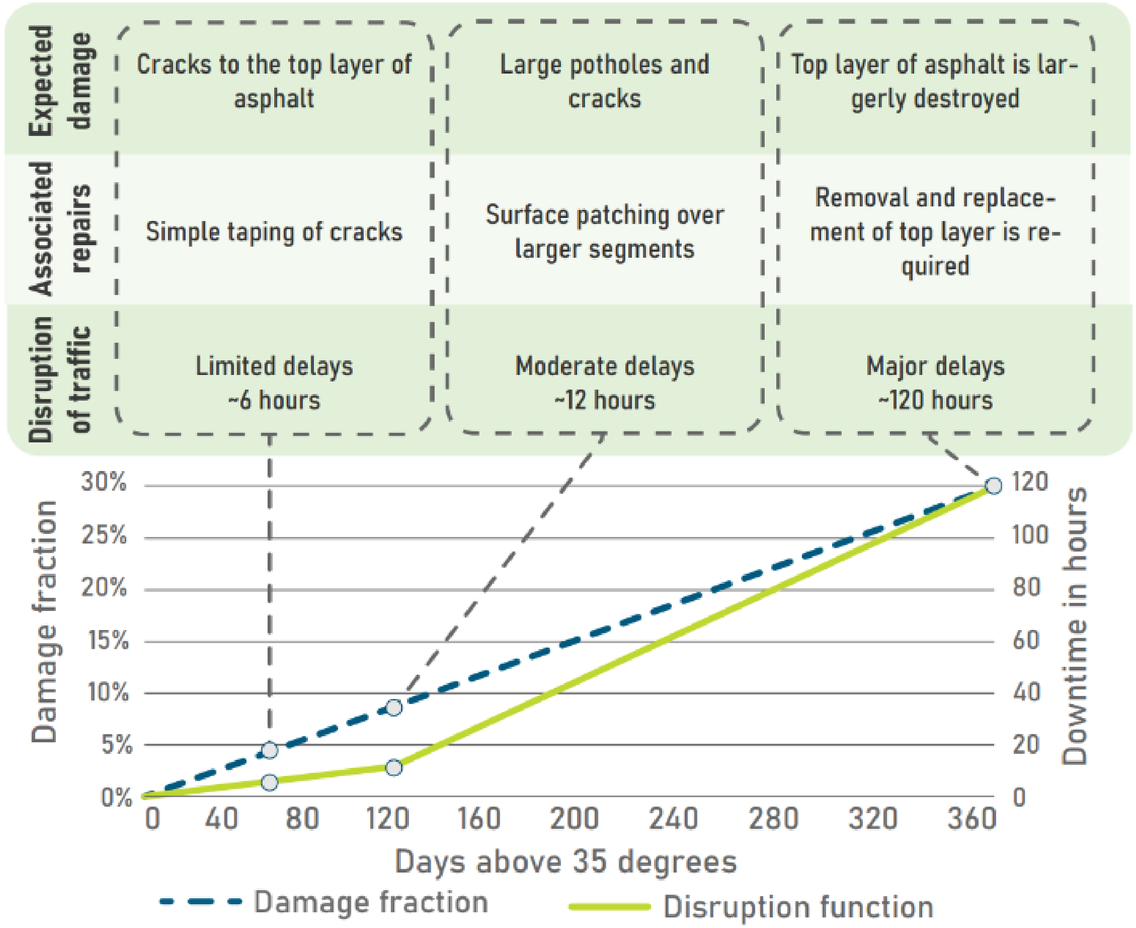


Indirect damage due to road closures

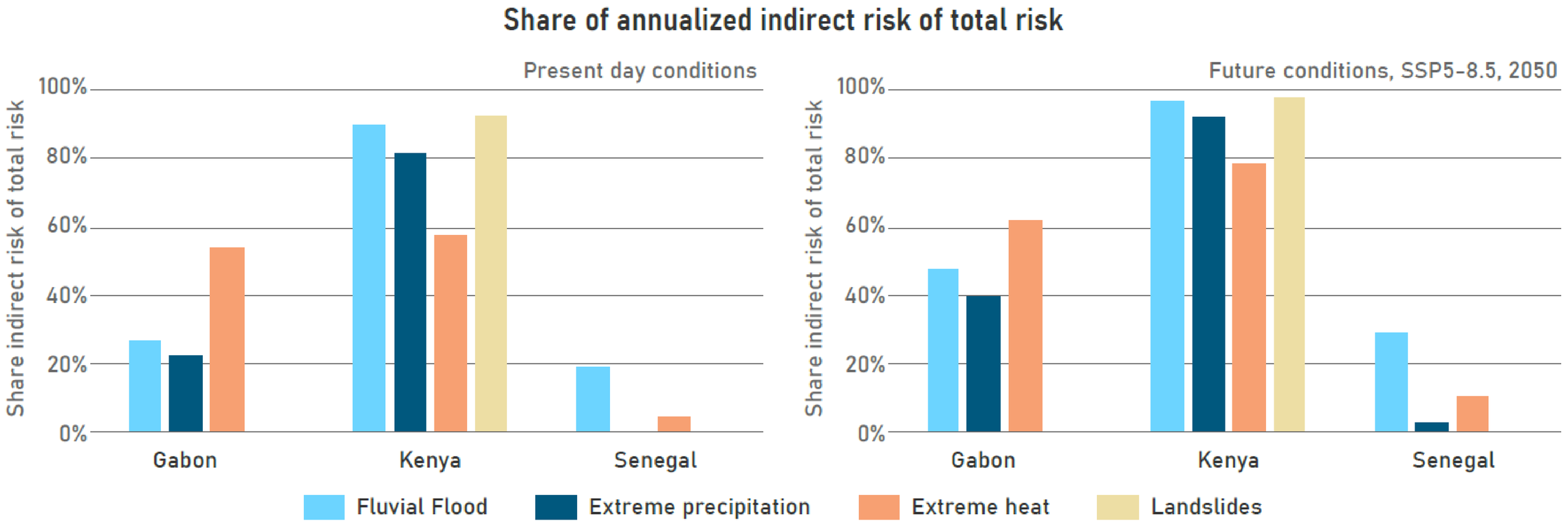
- Hazard-Exposure-Vulnerability framework for **direct damage**
- Extended for **indirect, disruptive losses** using derived disruption curves for each asset
- Multiple natural hazards: floods, heat, landslides etc.
- **Maximum duration of closure** per segment is utilized to calculate indirect damage

Indirect impacts calculated for:

- Passenger transport due to journey delay – journey time costs and cancelled trips
- Cargo due to journey delay – inventory costs and deterioration costs



Case studies for gabon, kenya and senegal

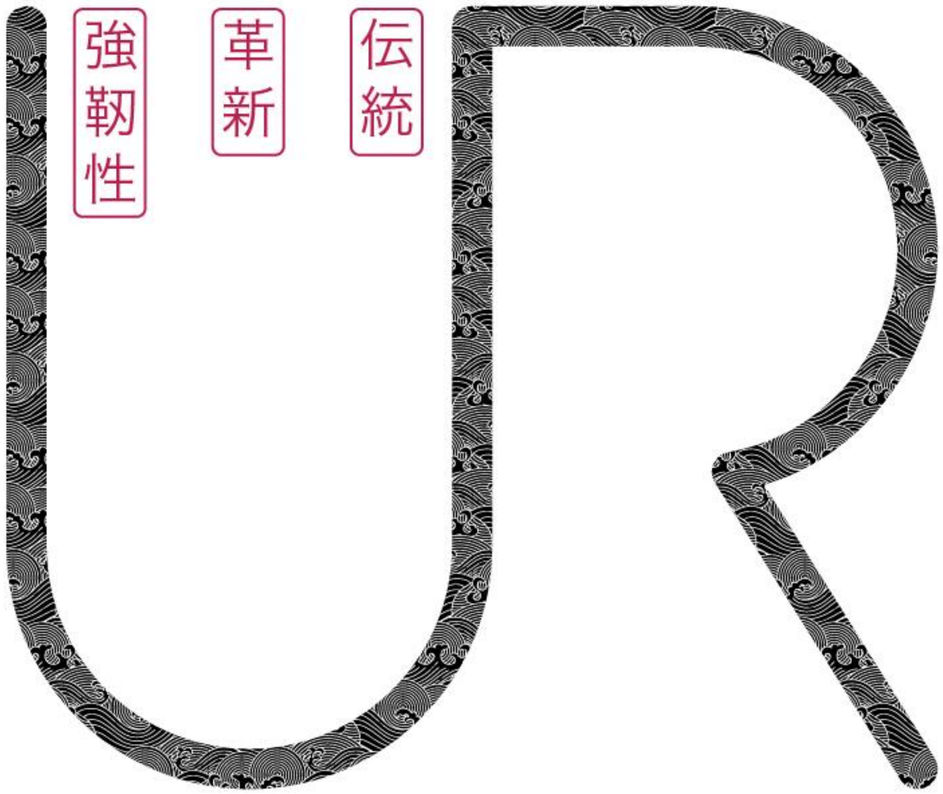


Key take away

Indirect damage…

- has an increasing share over time
- impact can vary largely for roads depending on alternative roads → 5% of total risk for sections with many alternatives, up to over 90% for remote sections of road.
- can differ substantially per country and infrastructure segment.

A more accurate indirect damage assessment allows for better tailoring climate adaptation measures to the physical and social context.



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Reflections

City Resilience Program

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Scenario Role-Play

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Scenario

In the city of Riskopolis, a poor, low-lying neighborhood surrounded on three sides by the river floods every year. Despite the effects the flooding has on residents' health, assets, and livelihoods, the population is growing due to rural-urban migration. Meanwhile, each year the flooding is getting more intense and lasting longer. The government would like to create a river embankment and develop the neighborhood's drainage system; but its budget is fixed and cannot currently fund the required investment. Community leaders have been asking the local council for help for years; but are resisting the infrastructure plans the government commissioned. With high risk, uncertain budgets, and unclear revenue potential, private banks and insurance companies are reluctant to get involved,

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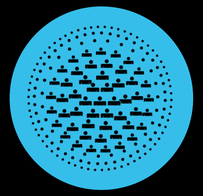
with your neighbors, get in groups of three, choose one of the following roles, and discuss:

Local government

What can you do to help the community become comfortable with the upgrades? What kinds of help do you need to entice private sector actors to fund or finance your goals?



Local community

How do you want the government to help? What is your role in engaging the private sector? What information do you need from other stakeholders?

Private actors

What assurances or information do you need to become comfortable working here? What are your entry points? How can you partner with the local community and council?

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Thank you !