8th International Conference on BIG DATA & Data Science for Official Statistics
BILBAO 2024

Informing Climate Change and Sustainable Development Policies with Integrated Data

BILBAO. SPAIN | 10-14 JUNE 2024 | #UNBigData2024

Methodological Framework for Forward-Looking Physical and Transition Risk Assessment

Fozan Fareed, Economist, IMF

Andinet Woldemichael, Senior Economist, IMF

CLIMATE HAZARDS AND CLIMATE POLICIES HAVE ECONOMIC AND FINANCIAL IMPACT

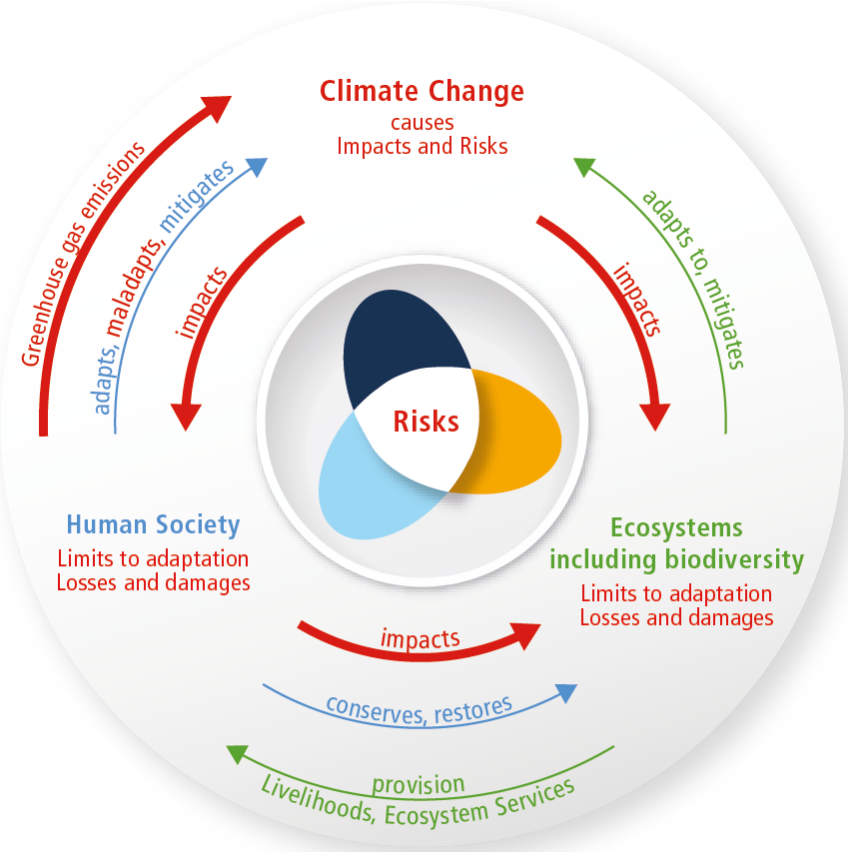
HOW WILL THE FUTURE LOOK LIKE?

Taking the Green Road

Fossil Fueled Development

G20 Data Gaps Initiative: Recommendation 5
Methodological Framework

- G20 initiative ***on Forward looking Physical and Transition Risk Indicators***
- A **concept note** was prepared and presented to G20 countries, and the **definitions and methodological framework** were provided.
- The risk assessment framework integrates **hazard × exposure × vulnerability** with **climate scenarios**.
    - **Climate related event:** The potential occurrence of a physical event (flood, extreme weather etc.) or transition related event (e.g., policy measures).
    - **Exposure:** The presence in places/ settings that could be adversely affected. E.g. exposure to population, built-up area, crops, public structure etc.
    - **Vulnerability:** The propensity or predisposition to be adversely affected. Information on mitigation factors, including social, cultural and natural.



Source: IPCC

Methodological Framework and Stocktaking Survey

Coverage

1. Physical Events

- Extreme Temperature
- Precipitation
- Drought
- Floods
- Wildfires
- Tropical Cyclones
- Sea Level Rise
- Others

2. Transition Events

- Shifts in Economic Policy (carbon taxation, subsidy regime shifts)
- Technological advancements
- Changes in Consumer and Market Sentiment
- Changes to Legal Frameworks

Measuring Risk

Hazard/ Event + Exposure + Vulnerability

Risks to:
Population, GDP, built- up areas (properties, public infrastructure etc.), firms, financial sector

Definitions

G20
DATA GAPS INITIATIVE 3

Concept Note: Data Gaps Initiative (DGI 3) Recommendation 5

Forward-looking Physical and Transition Risk Indicators

(Preliminary Draft)

I. INTRODUCTION

1. The new Data Gaps Initiative – DGI 3 – endorsed by the G20 Finance Ministers and Central Bank Governors in November 2022 highlighted the need for robust, comprehensive, and comparable data for the most urgent policy needs. The IMF staff, in close cooperation with the Financial Stability Board (FSB) Secretariat and the Inter-Agency Group on Economic and Financial Statistics (IAG), and in consultation with participating economies, have developed a workplan calling for better data to understand climate change, together with indicators that cover income and wealth, financial innovation and inclusion, access to private and administrative data, and data sharing.

Global Datasets and Geospatial Tool

Climate Risk Indicators

Work is in progress to develop a tool that integrates different layers on hazards and exposure to identify the hot spots for risk using global data sets

The Artificial Intelligence for Environment and Sustainability (ARIES) presents a promising platform for integrating data on hazards, exposure and vulnerability

Working with many institutions to develop this information

- World Bank; European Space Agency; Basque Center for Climate Change; UN World Meteorological Organization; others

Support countries to develop its own estimates building on global data sets.

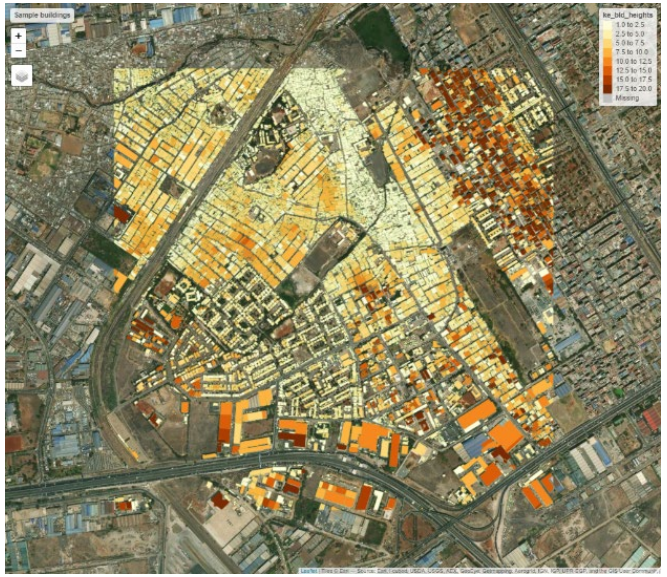
Census of Structures: Residential Properties

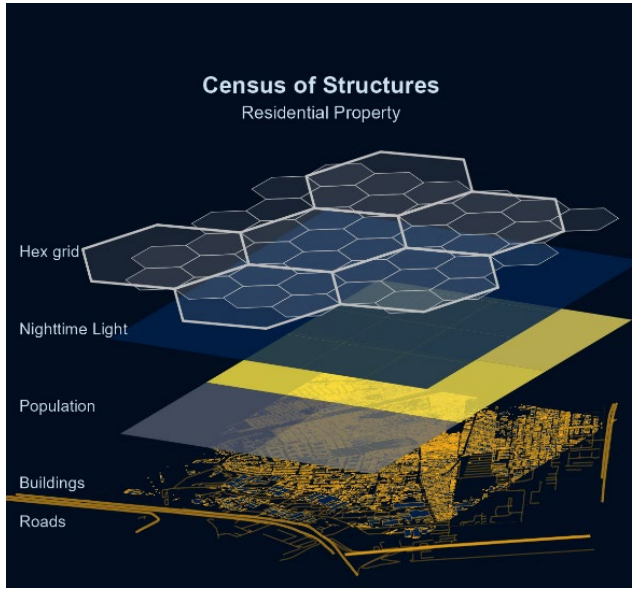
About the Project

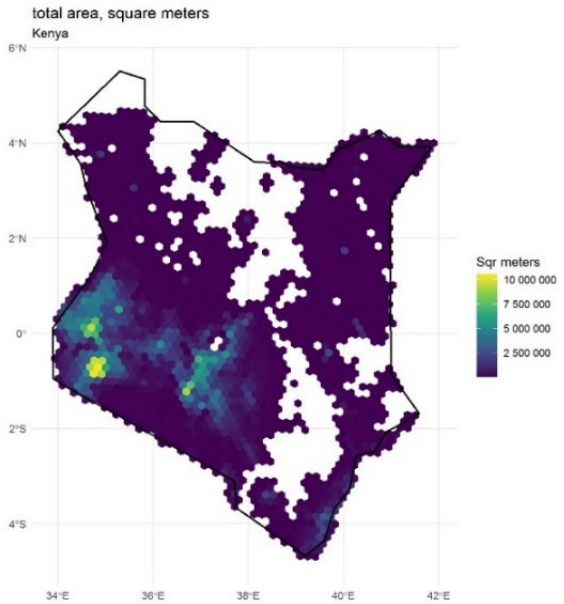
- **Objectives**:
  - Develop a method to construct a global census of residential buildings (geospatial layer)
    - Information on total area of the building (including height) and $$ value
- **Relevance:** Financial sector, insurance industry.
- **Open-source geospatial data:**
  - Building footprints
  - OpenStreetMap
  - Global Human Settlement Layer
  - Gridded population; Nighttime light

Case Study: Residential Properties in Kenya

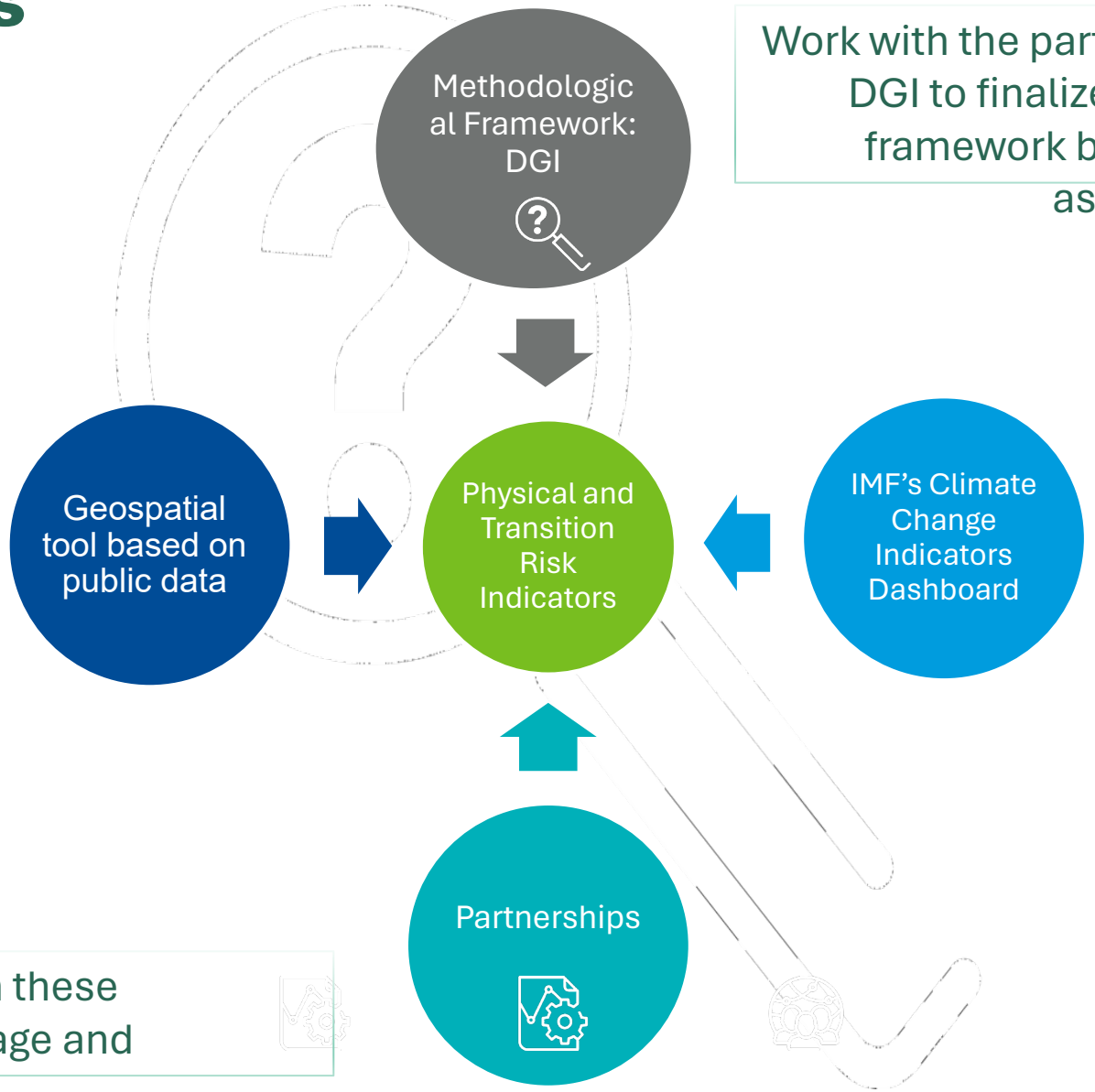
- Census of residential properties = Building footprint + Gridded population + Nighttime light
  - Location of residential properties
  - Area in square meters
  - Value of property







Next Steps

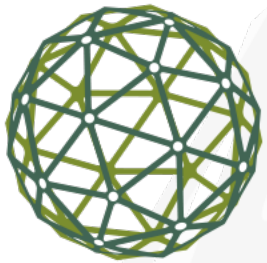


Work with the participating countries of the DGI to finalize the methodological framework based on their needs assessment

IMF | CLIMATE CHANGE DASHBOARD

Build partnerships and build on these indicators. Improve their coverage and usefulness.

Thank You!



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ARIES – A solution for risk assessment - A demo

Ferdinando Villa, Basque Center for Climate Change

Andinet Woldemichael, Senior Economist, IMF

United Nations BigData

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GOBIERNO DE ESPAÑA MINISTERIO DE ASUNTOS EXTERIORES, UNIÓN EUROPEA Y COOPERACIÓN

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Developing a digital twin for physical climate-related risks

Sjoerd van der Zwaag
Senior Sustainable Finance Officer, De Nederlandsche Bank (DNB)

Origins of the pilot

Problem

Challenge to **dynamically estimate physical climate-related risks**

1. How to measure physical risks when they occur?
2. How to reflect new circumstances in forward-looking risk estimates?

Potential innovative solutions

Digital twin: a digital replica of a real-world entity or system that enables monitoring and simulation based on live data

Project

Creating an **experimental** digital twin that links external environmental data to financial data

The approach

Learn by doing: combine theory with efforts to build a proof minimum viable product (MVP)

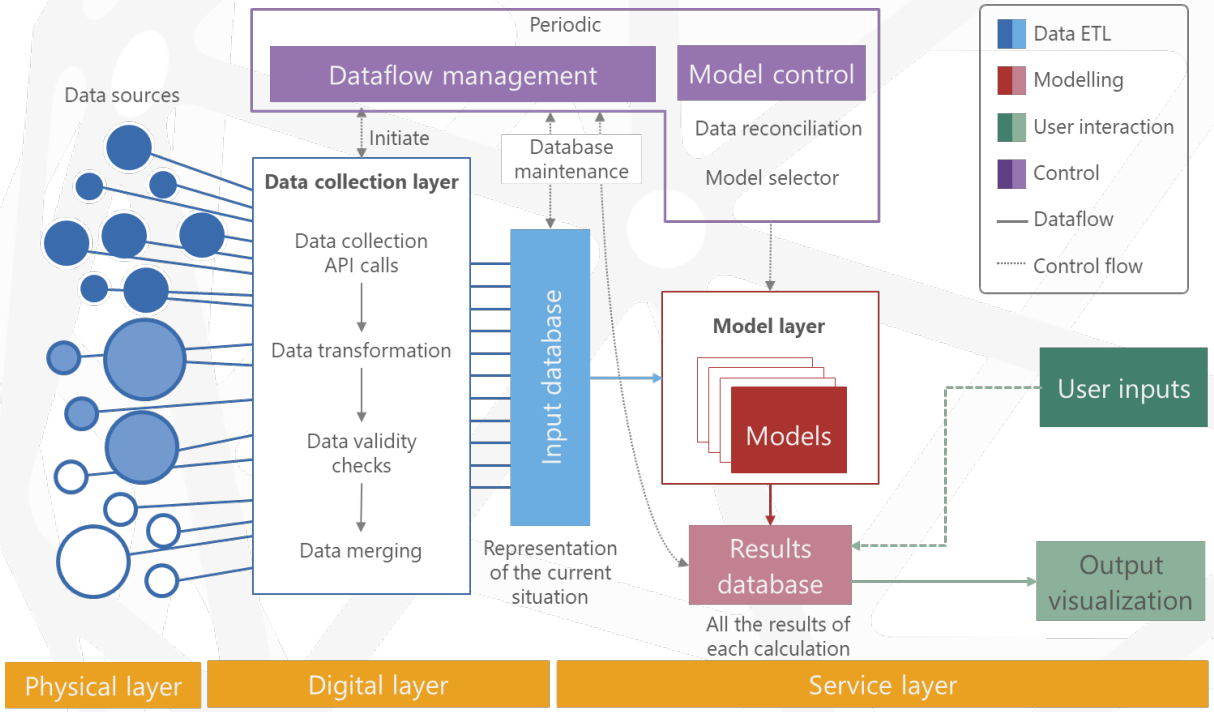
Start small: initially focus on a limit set of physical risks and strive for near real time

Collaborate: Explore how an open-source structure can contribute to the creation of public goods

A common theoretical framework

Hazard	Exposure	Vulnerability	Financial
Models the frequency and intensity of hazards	Collects the geographical and physical property characteristics	Calculates the damage to the properties based on hazard and exposure	Translates the damage from the vulnerability module into financial metrics
Requires			
Public hazard data (intensity data and climate modelling results	**Various sources** - does not have to be based on regulatory reporting	**Public damage functions**	**Institution-specific information**, often from regulatory reporting

Building the MVP



Design criteria: modular set-up, accessible, user friendly, open source

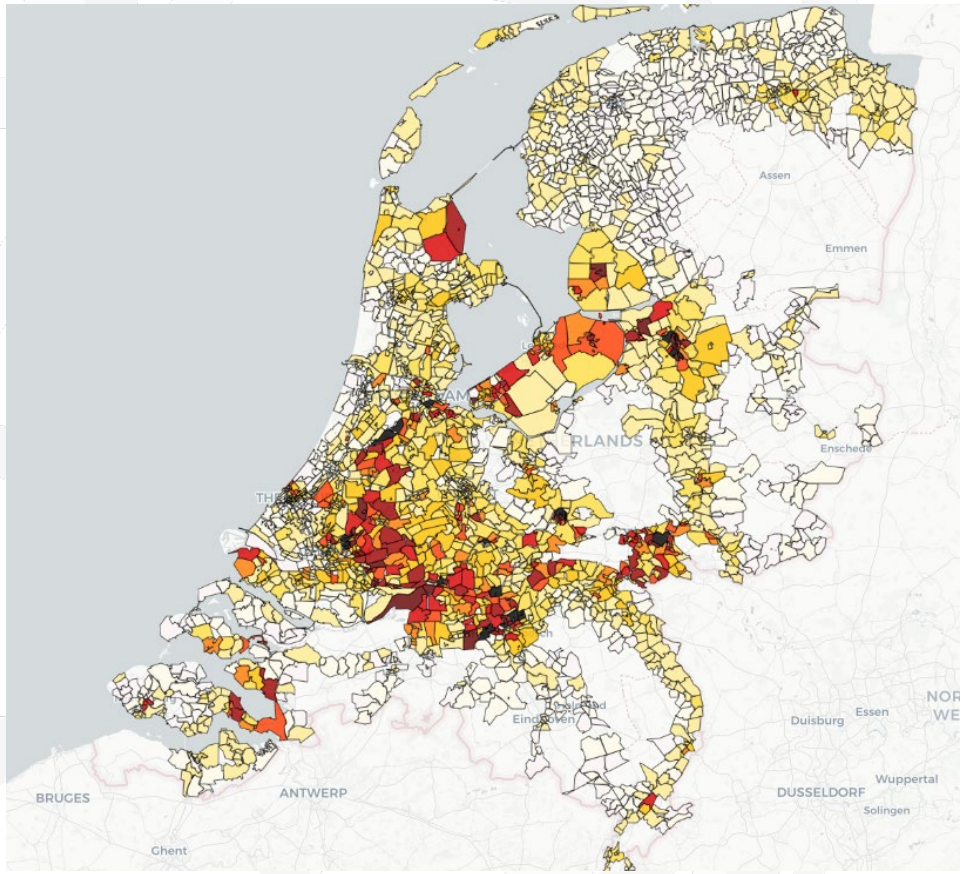
Three experimental use-cases:

- Flood risk in the Netherlands
- Flood risk in France
- Tropical cyclone risk in Hong Kong

Benefits of a modular set-up: for the three use cases, 80-90% of code was generic (i.e., could be re-used)

Use case: flood risk in the Netherlands

- Used to assess **flood risk scenarios** affecting real estate
- Integrates **methodology in two working papers** published by DNB on flood risk*
- Includes first attempts to incorporate **satellite data** to create near real time insights



Source: Illustrative screenshot from digital twin tool applied to flood risk in the Netherlands

** Caloia, F., & Jansen, D. J. (2021). Flood risk and financial stability: Evidence from a stress test for the Netherlands; Caloia, F., van Ginkel, K., & Jansen, D. J. (2023). Floods and financial stability: Scenario-based evidence from below sea level*

First insights

Challenges

1. Availability of near real time data in a usable format
2. Lack of granular supervisory data
3. Public availability of damage curves and hazard projections

Opportunities

1. Much can be achieved by starting small
2. Collaboration opens the door to public goods
3. Experimentation makes challenges more concrete

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Developing a digital twin for physical climate-related risks: The French use case.

Lisa Kerdelhué
Research economist, Banque de France

The French use-case :

Combining information on floods risks, exposures and financial vulnerability

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Combining information on floods risks, exposures and vulnerability

Contributions:

- Connecting together very granular data on hazard, exposure, vulnerability and finance.
- Using accurate definitions of physical assets: **property** and **transferable.**
- Fine-level description of the transmission mechanisms from flood hazards to credit risks.

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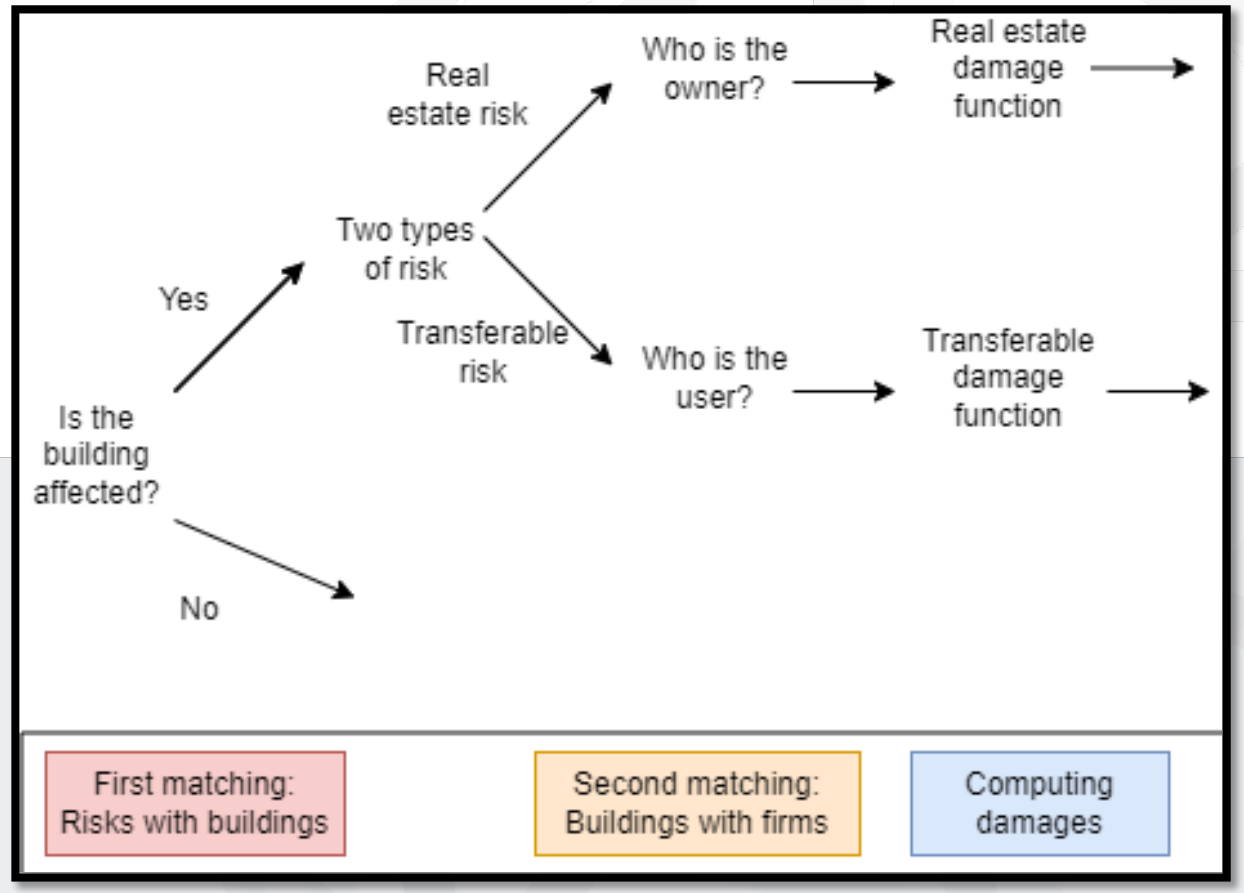
Exposures to floods hazards



The damage functions are calibrated for France and are asset type- and sector-specific.

$$D_{a,s,i} = f(A_a, S_s, I_i)$$

- $D_{a,s,i}$ the damage in €
- A_a the type of asset (property or transferable)
- S_s the sector of the firm
- I_i the intensity of the flood.

Hazard

Exposure

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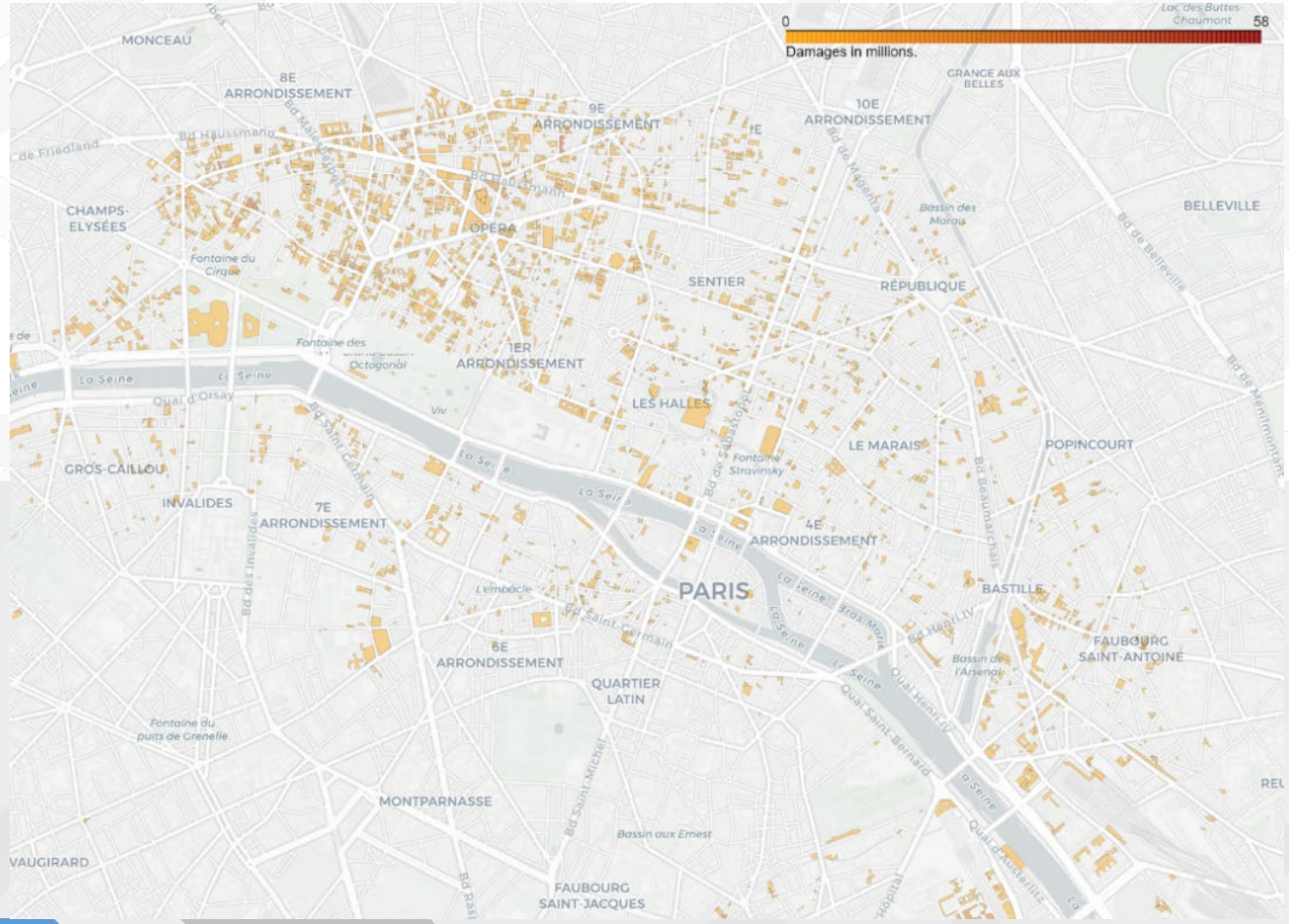
Exposures to floods hazards : Paris



Hazard

Exposure

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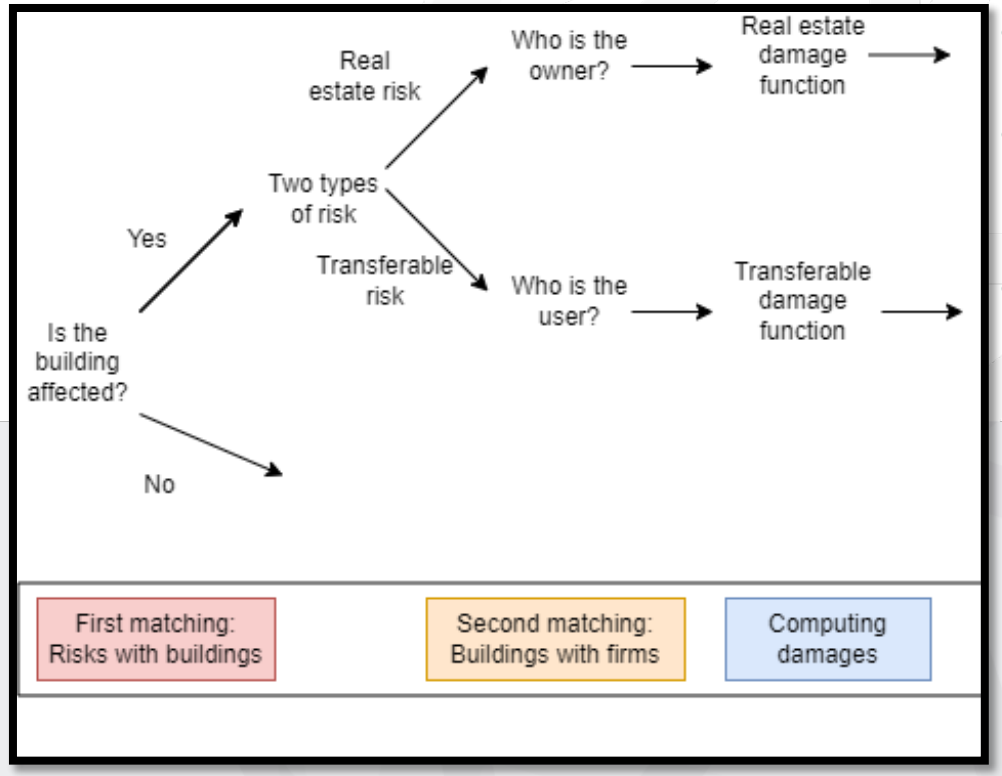
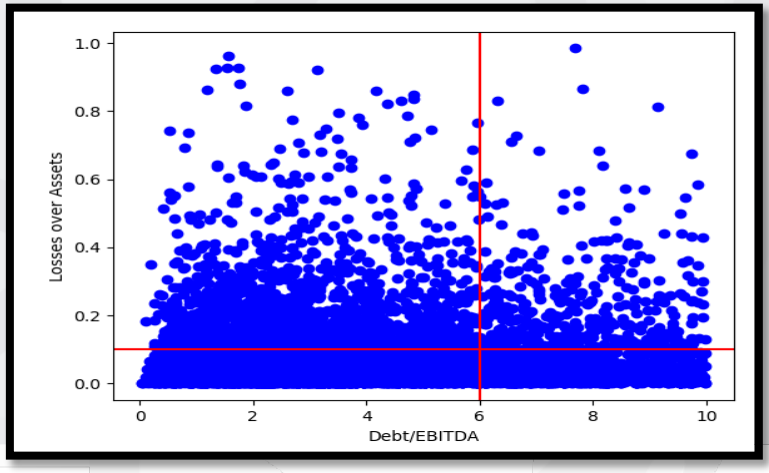
Vulnerability to floods



- **Small firms (PME)** are likely to suffer the most.
- Some sectors are relatively more affected: **Manufacturing, Accomodation and Food Services.**
- A significant number of highly vulnerable firms (**both very affected and highly indebted**) representing a risk for banks.

Potential LoA by sector vs Debt/Ebitda



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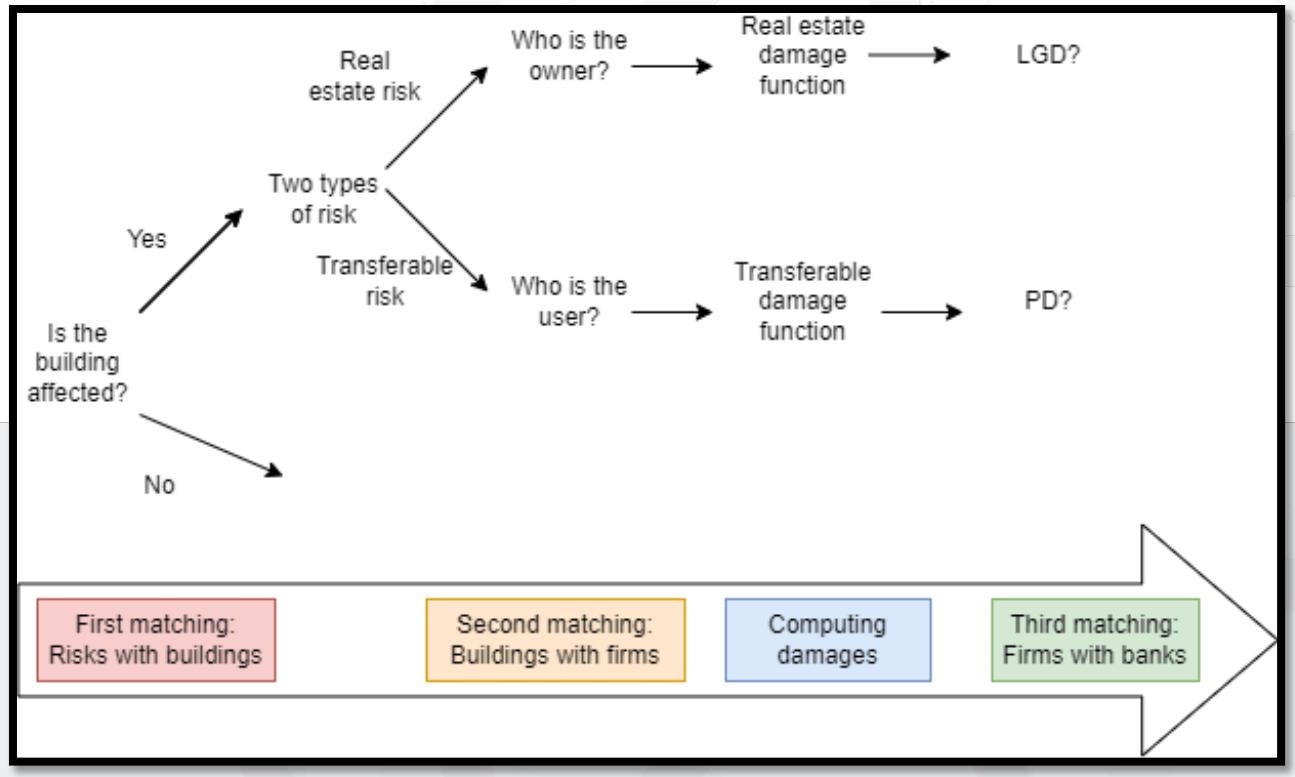
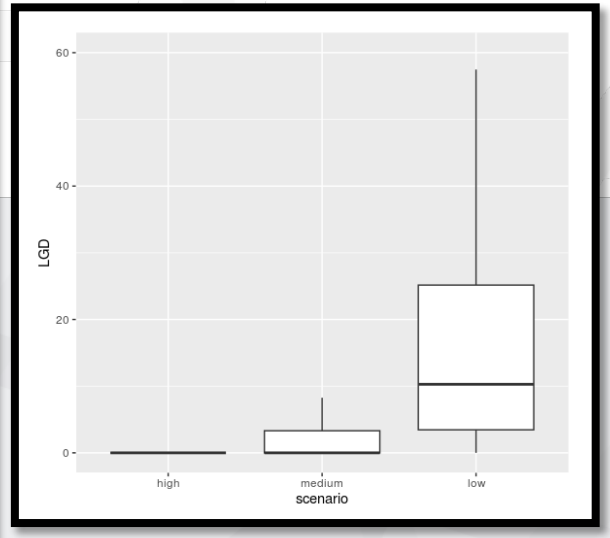
Hazard → Exposure → Vulnerability

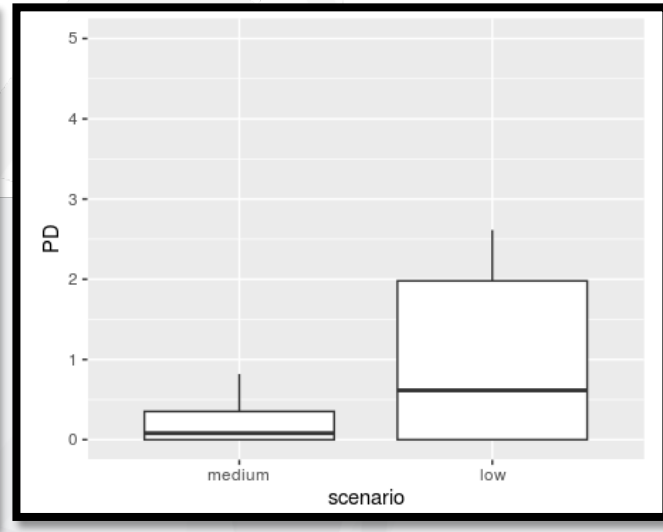
Potential effects on the banking system



LGD increase by scenario (basis points)



PD increase by scenario (basis points)



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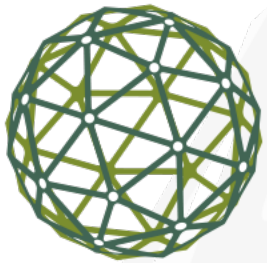
Hazard → Exposure → Vulnerability → Financial System

Avenues: deepening and extending the project

Hackathon in June in BIS Innovation Hub :

- Testing alternative data inputs (open-sources satellite data)
- Extension to other types of physical risks (wildfires)



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A National Statistical Organisation perspective on physical risks

Climate Change-related measuring and understanding of physical and transition risks

Peter Nooteboom (Statistics Netherlands)

United Nations BigData

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GOBIERNO DE ESPAÑA MINISTERIO DE ASUNTOS EXTERIORES, UNIÓN EUROPEA Y COOPERACIÓN

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Developments

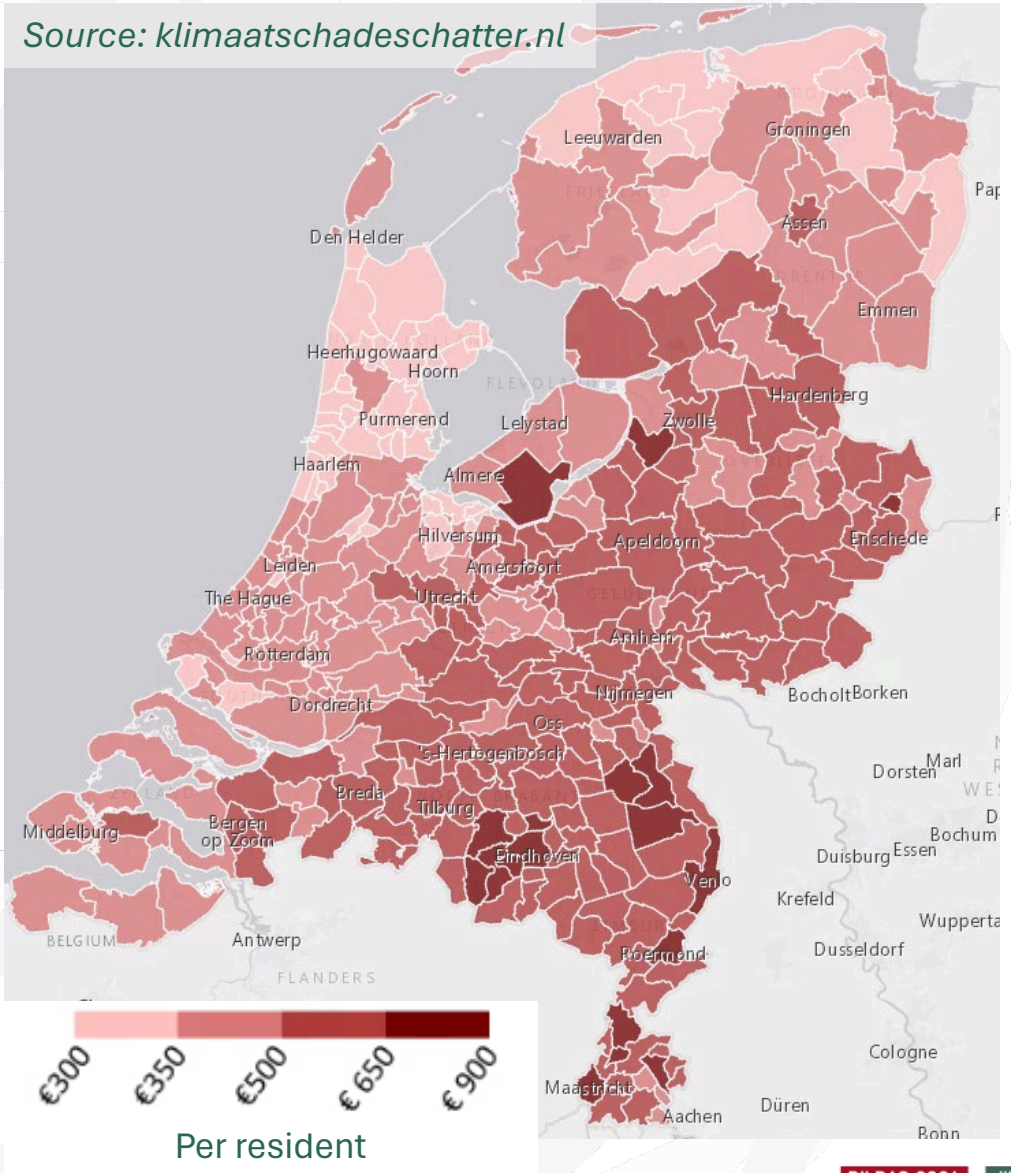
- Climate risk assessments
  - European Environment Agency (EEA)
  - Dutch Environmental Assessment Agency (PBL)

Source: IPCC AR6, WG2

Heat damage 2018-2050

Developments

- Climate risk assessments
  - European Environment Agency (EEA)
  - Dutch Environmental Assessment Agency (PBL)
- Information services
  - Climate effect atlas
  - Climate damage estimator
  - Climate damage monitor
  - Work DNB
  - My waterrisk profile
  - Fundermaps

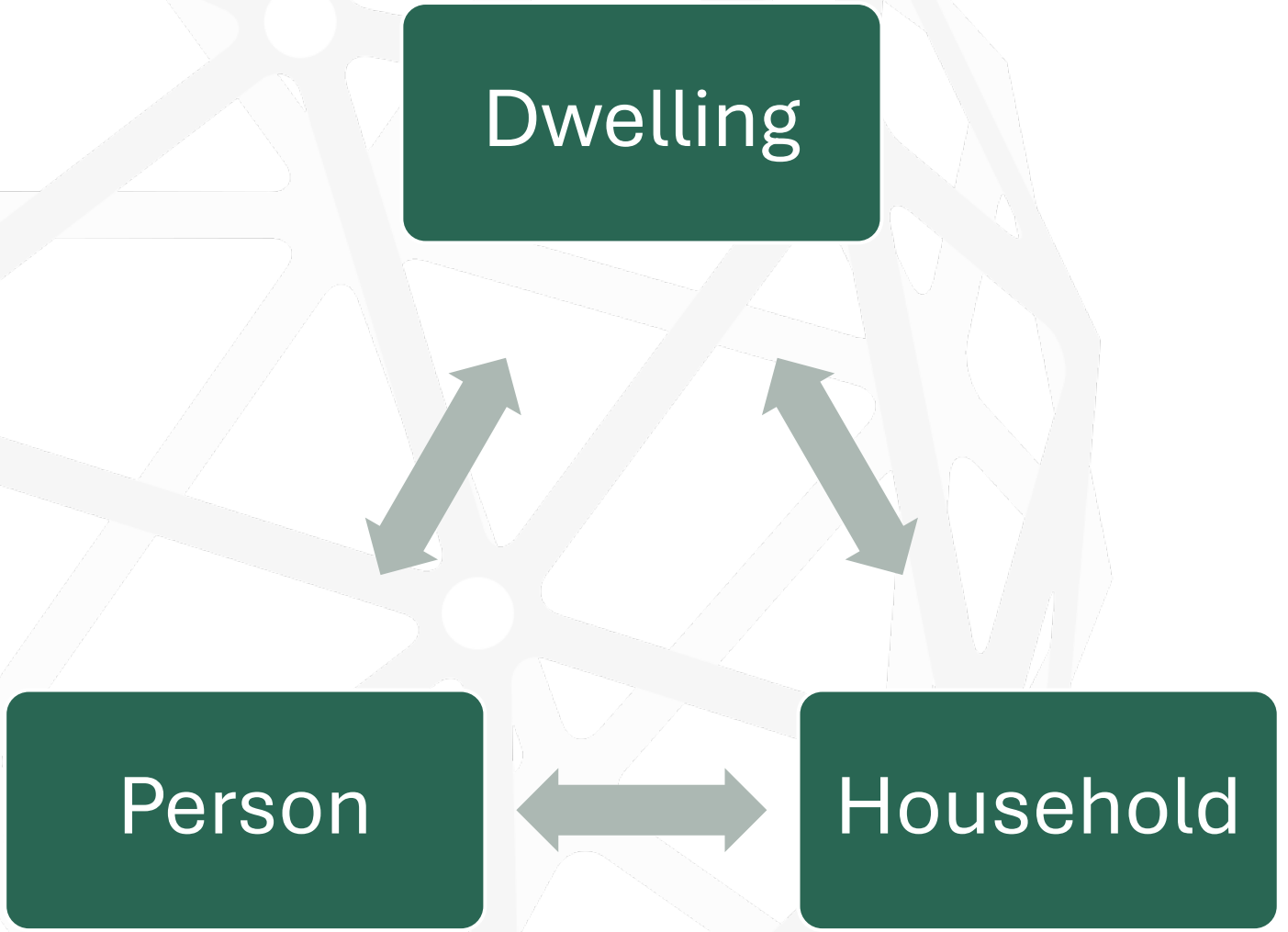


Developments

- Banks: Introduce climate labels at building level (February, 2024).
  - Floods
  - Foundation damage
  - Heat stress

Availability of microdata

- Woonbase, e.g.:
  - Mortgage,
  - Housing costs,
  - Income,
  - Assets,
  - Energy use,
  - Rent,
  - Energy label,
  - Age

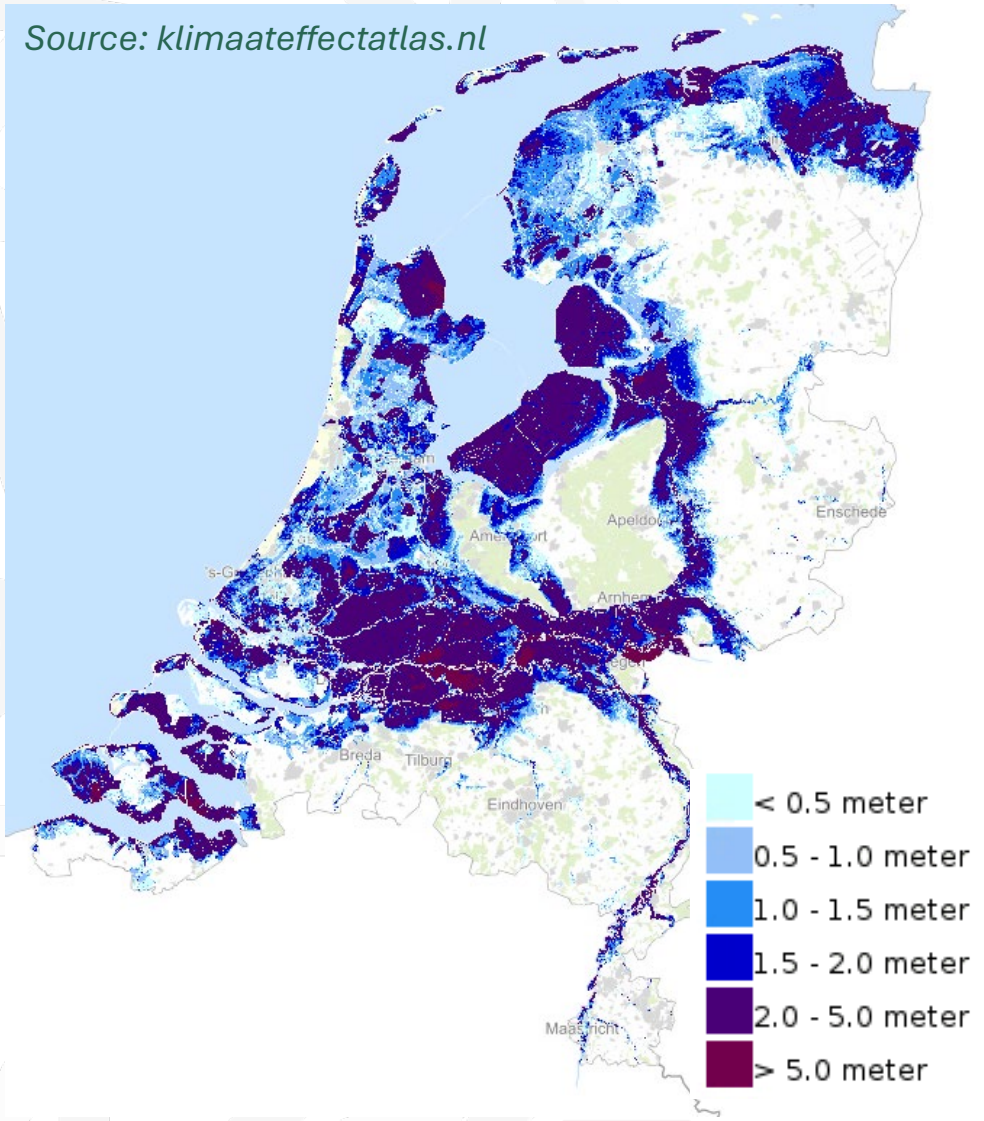


Climate impact on the economy: floods

- Investigate potential exposure:
  - Labor productivity,
  - Production
  - Production compared to GDP,
  - Dwelling capital,
  - Population.

Flood depth

(extremely low probability)



Climate impact on the economy: agriculture

- Focus on agriculture,
- Expand explanatory variables,
- Regionalise,
- Include impactful events

Source: CBS

Aggregate in 2013 Q1	Original (mln)	Weather contribution (mln)
Total GDP	162.340	39
Minerals	4.624	416
Industry	17.207	-129
Energy	2.071	69
Construction	5.952	-267
Catering	2.378	-50

The role of National Statistical Organisations

- Coordinate with other organisations.
- Filling Data Gaps:
  - DGI3, recommendations #5, #7.
  - Network for Greening the Financial System (NGFS).
- Collect data and improve availability at the micro level.

Source: IPCC AR6, WG2