9TH IMF Statistical Forum

MEASURING CLIMATE CHANGE
THE ECONOMIC AND FINANCIAL DIMENSIONS

EUROPEAN CENTRAL BANK

Indicators on Granular Exposures to Climate-Related Physical Risks

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Overview

1. Introduction
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A new dimension for central banks and statisticians

- "The ECB will develop new ***experimental indicators***, covering relevant green financial instruments and the carbon footprint of financial institutions, as well as their **exposures to climate-related physical risks**."

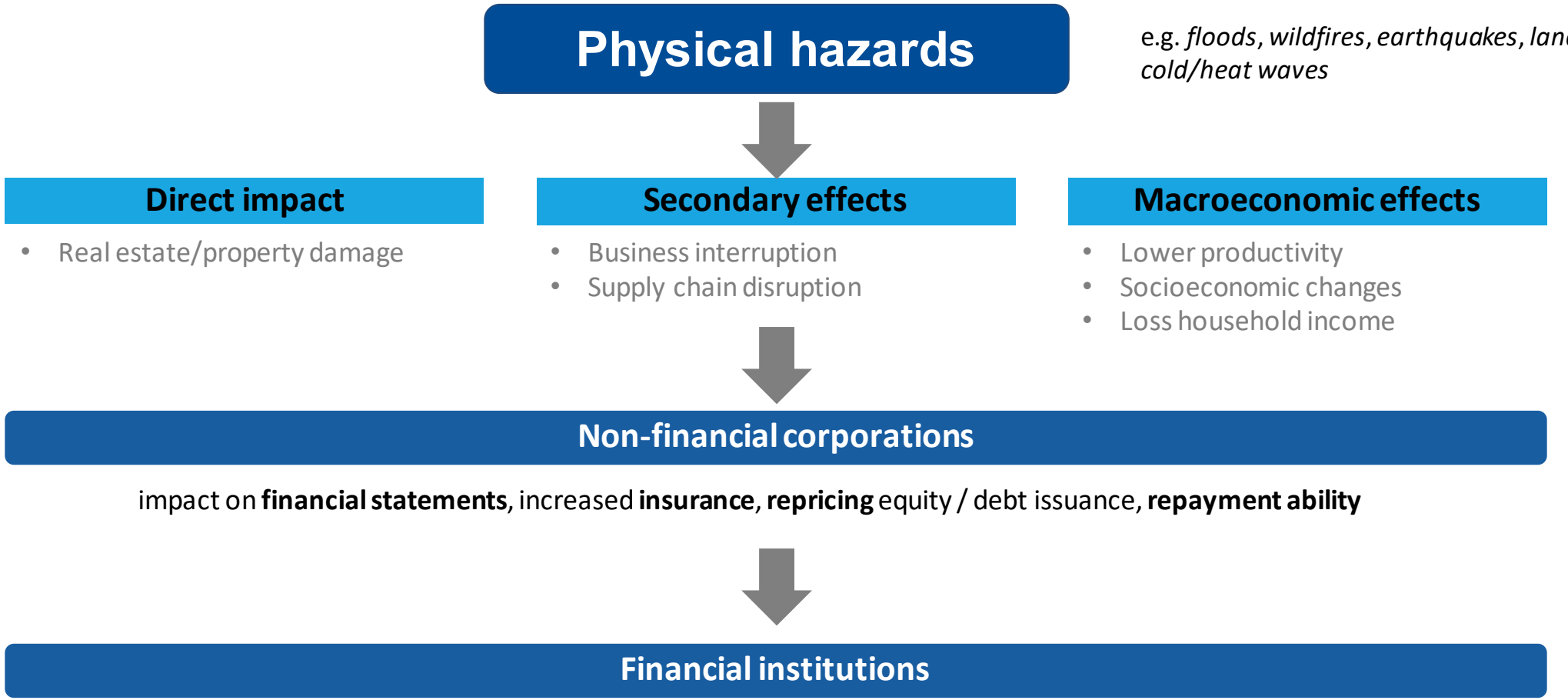
ECB Governing Council, 08/07/2021

- Physical risks are related to the exposure of the society and the economic systems to **extreme climate events** due to **gradual global warming**, as well as to **natural disasters.**

NGFS definition

- The final aim of central bankers and supervisors is to assess the propagation of the physical risk into the financial system.

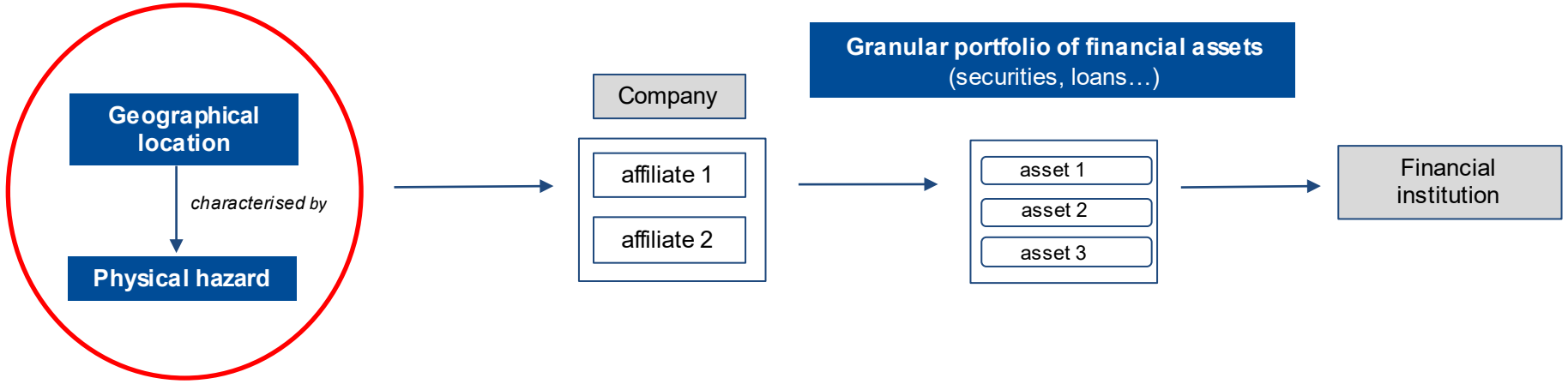
Spillovers from physical hazard to financial system



Sources: Adapted from (NGFS, September 2020) and (ECB/ ESRB, July 2021)

Toward the development of experimental indicators

- Construction of indicators on the exposure of financial institutions to physical risks requires the **integration of different types of information**.



- **Physical hazard** information is the **starting point** for assessing the impact of climate related physical risks on financial institutions and their portfolio, which can be further linked to other data sources.

Data layers for physical risk analysis

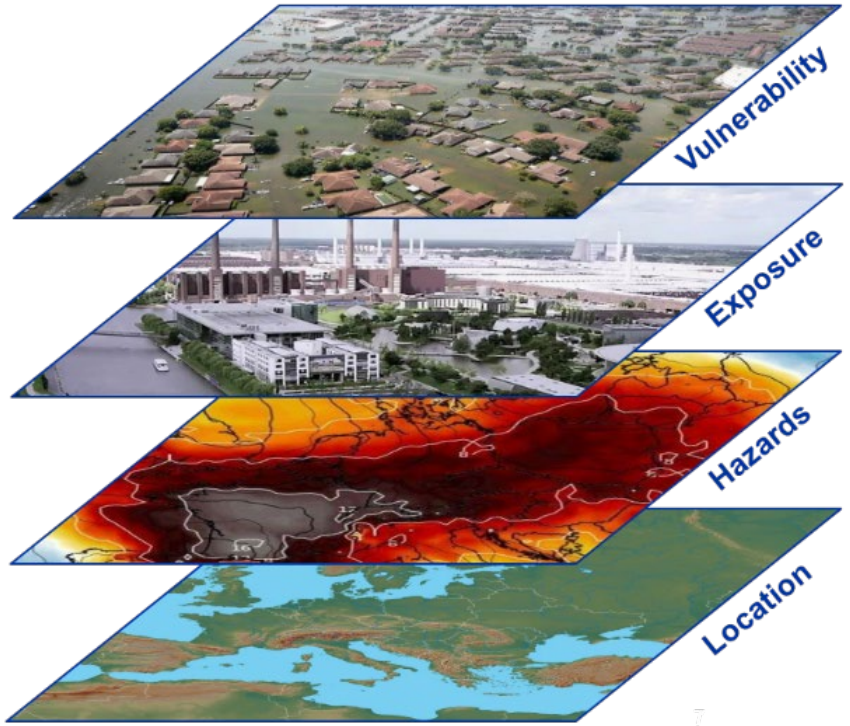
Physical risk assessment – data layers

- Information was classified in **analytical layers** reflecting the dimensions required for the physical risks analysis:
  - **Hazard**: location, frequency and severity
  - **Exposure**: total value of assets / socioeconomic elements
  - **Vulnerability**: degree of damage expected at different intensities of a hazard

  .. combined over the **spatial dimension**.

- Several **data sources** were identified for each layer:
  - **Hazard**: floods, wildfires, earthquakes, cold / heat waves
  - **Exposure**: loan / collateral information, holding / issuance of securities, financial statements information, land cover
  - **Vulnerability**: insurance and mitigation data, damage function

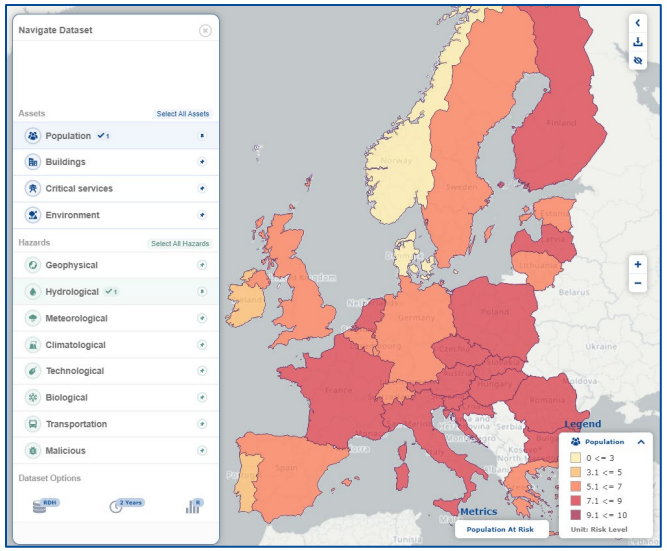
Analytical layers required for physical risk analysis

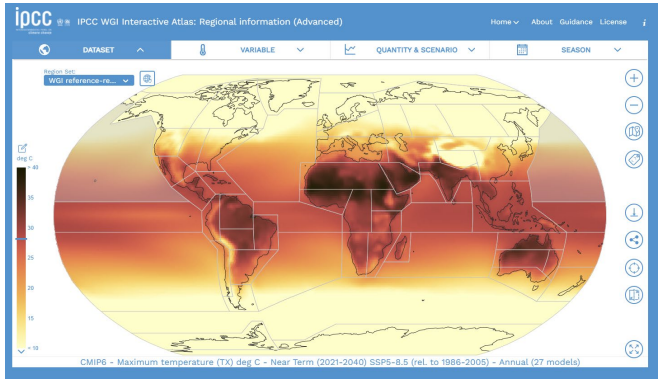


Physical risk = hazards x exposure x vulnerability

Experimental indicators for physical hazard

Physical hazards indicators: a deeper dive





Physical risk has been analysed in several studies*; however, less attention is dedicated to the measures of the underlying **physical hazards**.

We explore and compare **public and commercial sources**:

- *Four Twenty Seven*
- *Joint Research Centre Risk Data Hub (JRC RDH)*
- *Intergovernmental Panel on Climate Change (IPCC) - Interactive Atlas*

Flexible application of **geospatial tools**:

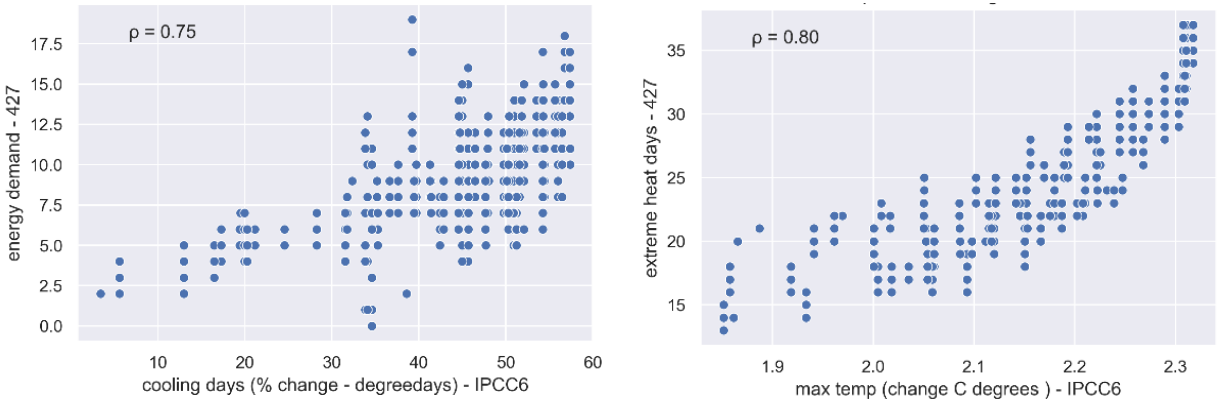
- Hazard data were processed in their original Geographic Information System (GIS) formats
- Extraction of hazard values at the specific location level versus regional aggregations
- Illustration: 90 thousand firm level data with addresses in Germany

* *Climate-related risk and financial stability, ECB / ESRB report, July 2021*
ECB economy-wide climate stress, ECB Occasional Paper Series, September 2021

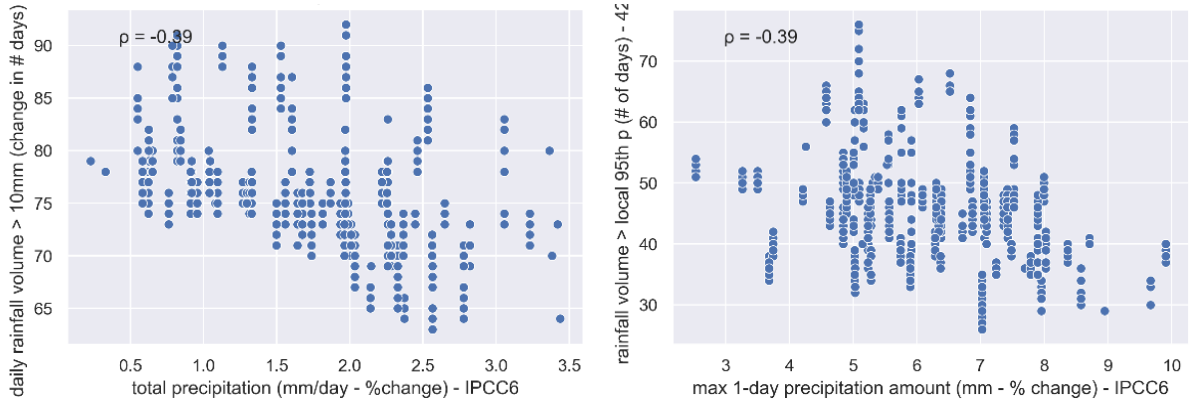
Four Twenty Seven vs IPCC

- Several hazard types available: floods, landslides, earthquakes, heat stress, precipitation
- Indicators which seemed **best aligned** selected for comparison across datasets

Heat stress



Precipitation



Sources: Four Twenty Seven, IPCC, ECB calculations.

High consistency on **heat stress**:

- Similar underlying sources data sources
- Similar measures
- Advances in temperature projections

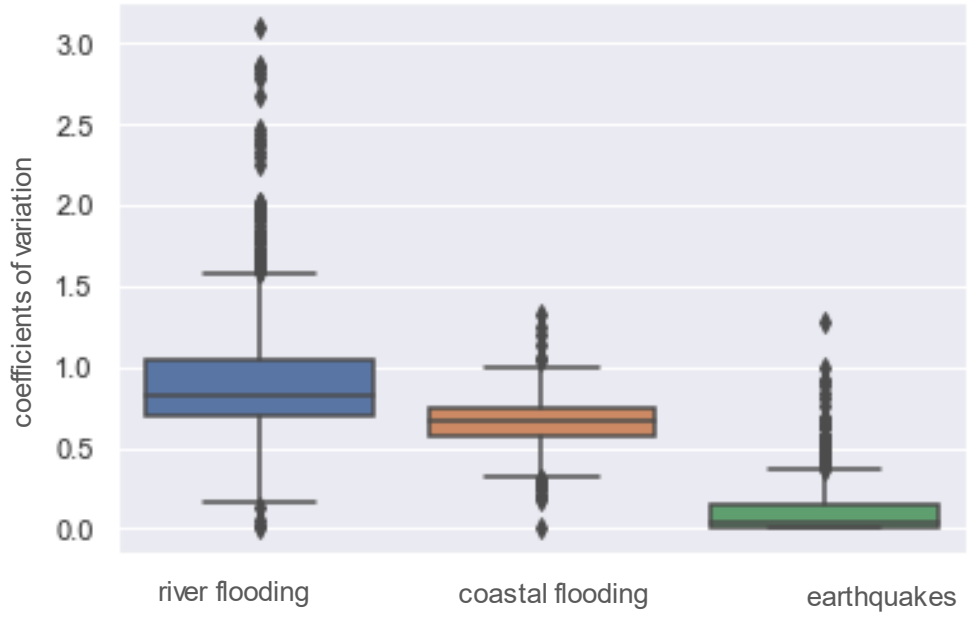
Discrepancy on **precipitation** indicators:

- Different underlying data sources used for modelling
- Type of indicators (truncated versus continuous measures)
- Challenges in modelling of precipitation

Exact location vs regional aggregates

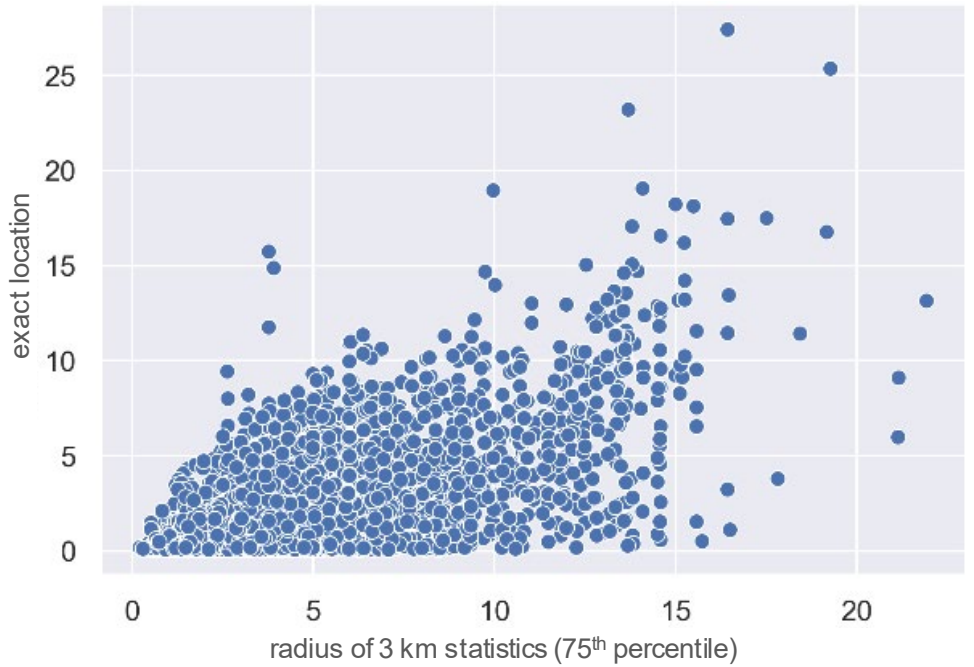
- Investigation of **variability** of hazard values:
- Can values at exact location be approximated by spatial aggregates (area around point of interest, regions)?

Coefficients of variation within NUTS3 in Europe



Sources: JRC RDH, ECB calculations. Notes: Coefficients of variation for river flooding (100 years return period), coastal flooding (100 years return period), and earthquakes (250 years return period).

Exact vs buffer for river flooding in Germany



Sources: JRC RDH, ECB calculations. Notes: physical hazard indicators on river flooding (100 years return period). Buffer statistics are aggregated within radius of 3 km around company location.

Conclusions

Conclusions and future work

Impact **analysis** of **physical hazard** on individual businesses and its subsequent conversion into economic losses is still at **early stage**.

- Challenges in climate modelling (models resolution, accounting for “tipping points”)
- Data gaps in climate related information
- Building further knowledge in cooperation with climate scientists is needed

With respect to **future work**, development in several areas are envisaged:

- Improve coverage and reporting of **location information**
- Exploration of other data sources and inclusion of further **types of hazards** (as well multi-hazard information)
- Extension of the analysis to **other sub-components of physical risk** (exposures, vulnerability)
- Enhancements for **firm level analysis** (e.g. facilities location, supply chain)

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