Physical Climate Risks at the Intersection of Global and Regional Perspectives

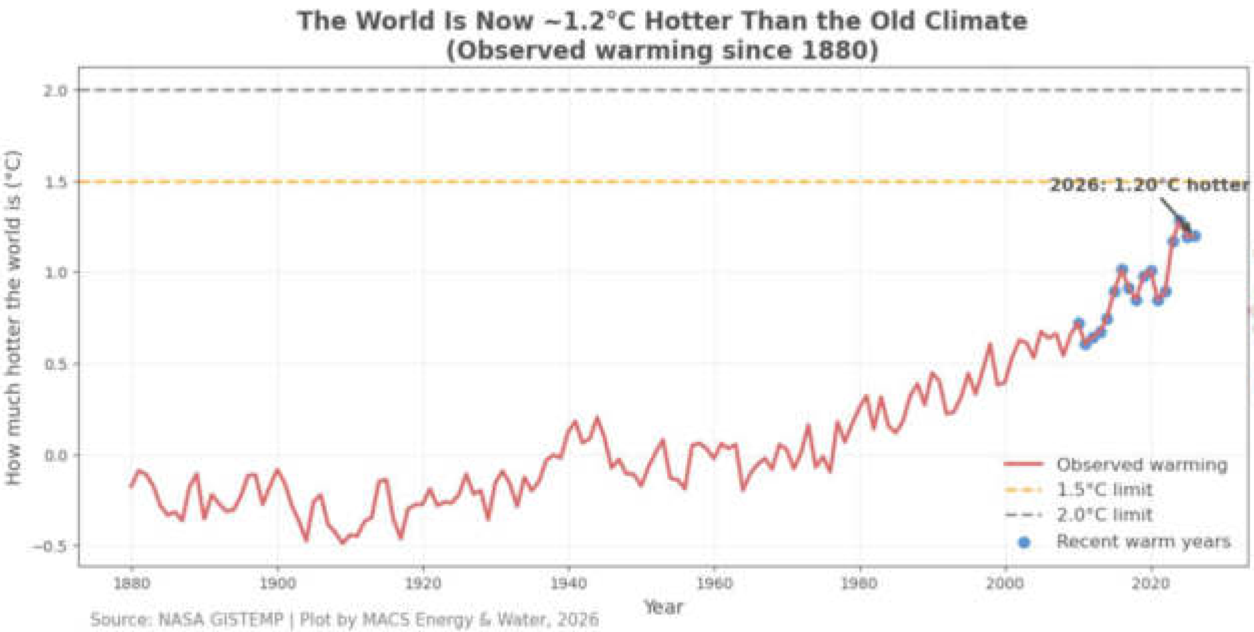
Translating Global & Regional Signals into Asset-Level Decisions

Climate & Finance Round Table

Frankfurt, June 19

Dr. Prosper Evadzi

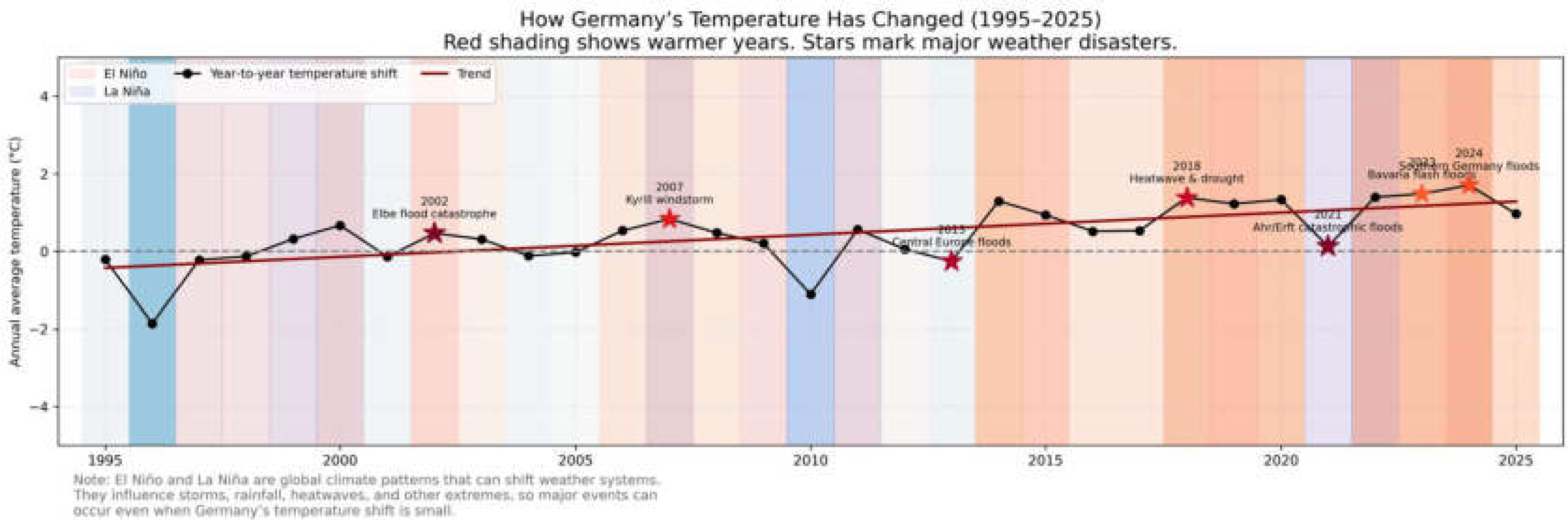
01 Global Drivers vs Regional Patterns



Do global warming trends show up in Germany?

- Global warming is now +1.2°C - the highest in human history
- Germany shows a similar warming pattern, but with strong regional and local variations in temperature and climate extremes

02 Germany's Major Climate-Related Events: What Has Actually Happened?



Year	Month	Severity	Description	ENSO Phase
1990	Feb	3.5	Vivian & Wiebke windstorms	Neutral
2002	Aug	5.0	Elbe flood catastrophe	El Niño
2007	Jan	3.8	Kyrill windstorm	La Niña
2013	Jun	4.5	Central Europe floods	Neutral
2018	Jul	4.2	Heatwave & drought	Neutral
2021	Jul	5.0	Ahr/Erft catastrophic floods	La Niña
2023	Aug	3.0	Bavaria flash floods	Neutral
2024	Jun	3.2	Southern Germany floods	Neutral

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- **Germany has experienced repeated high-impact events** across floods, storms, heatwaves, and droughts
- **Several events align with global climate variability (ENSO)**, but their **magnitude** **is shaped by regional and local factors**
- **Local hazards do not scale linearly with global and regional warming ,** they depend on circulation, soil moisture, topography, and exposure

❑ **Only climate models, regional downscaling, and exposure analysis can quantify how these events impact financial losses, insurance volatility, and infrastructure resilience.**

03 The Scale Mismatch: Why We Need a Translation Framework

Global climate signals ≠ local hazard intensity ≠ asset-level losses

- **Global warming tells us the direction of change**, but not where or how hazards intensify Different hazards respond differently to warming:
- **Regional climate variability shapes local hazard intensity** (floods, storms, heatwaves, droughts)
- **Assets experience risk only through hyper-local conditions** (soil, elevation, drainage, exposure, vulnerability
- **Climate risk must be translated across scales** from **global models → regional downscaling → local hazard → asset exposure → asset risk scoring /climate-credit-risk**

04 MACS Conceptual Framework for Climate-Credit Risk

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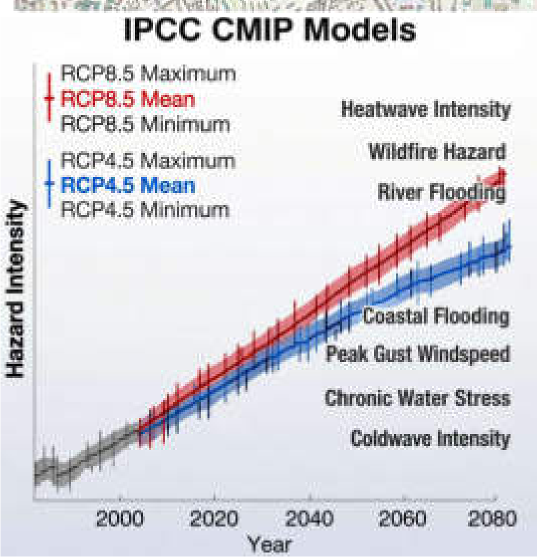
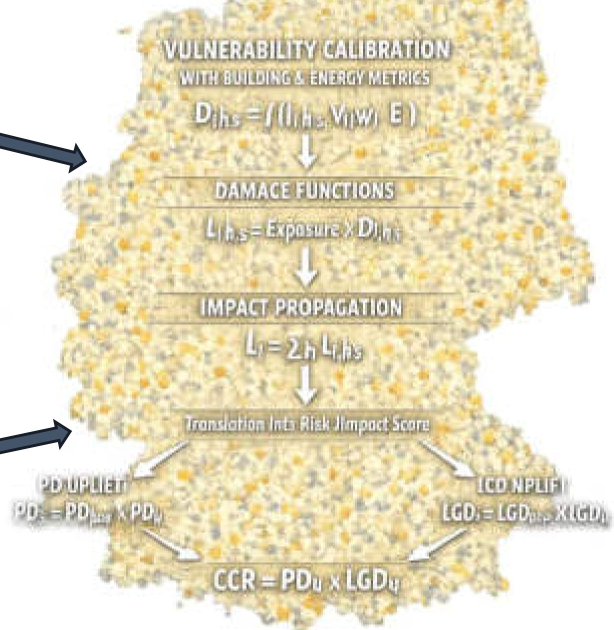
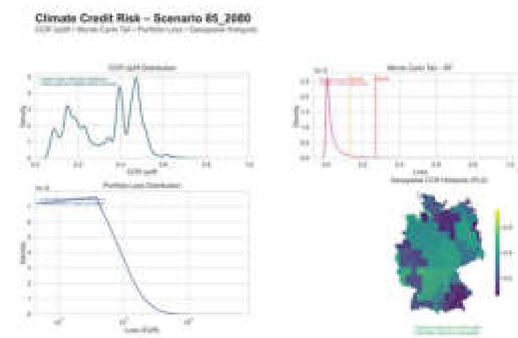


CORE MODELLING ENGINE



SECONDARY LAYER -TAIL-RISK & SCENARIO DIAGNOSTICS



- This framework aligns with **ECB**, **EBA**, **ESRB** and **NGFS** expectations by using IPCC-based climate scenarios, asset-level vulnerability data, and forward-looking loss estimation to assess physical climate risk in a transparent and science-based manner

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- UNEP FI and ECB / European Systemic Risk Board guidance underpin the methodological structure, ensuring transparency, scenario consistency, and supervisory alignment.
- IPCC future climate scenarios are represented through a middle-emission-risk path (RCP4.5) and a high-emission-risk path (RCP8.5), reflecting diverging climate trajectories.
- Open-source, state-of-the-art climate model data (e.g., Copernicus, CMIP6) provide multi-hazard projections for Germany across heat, wildfire, flooding, wind, water stress, and cold extremes.
- Forward-looking climate scenarios are translated into hazard-specific risk levels, forming a consistent scientific basis for physical-risk quantification.
- Building-level vulnerability metrics (e.g., typology, height class, energy system, structural characteristics) are integrated to calibrate hazard-to-damage relationships, in line with ECB expectations for asset-level granularity and UNEP FI guidance on physical-risk modelling.
- These hazard and vulnerability layers feed into the MACS Physical Climate Risk Score, enabling transparent, reproducible, and science-based assessment of climate-related physical risk across assets and portfolios.

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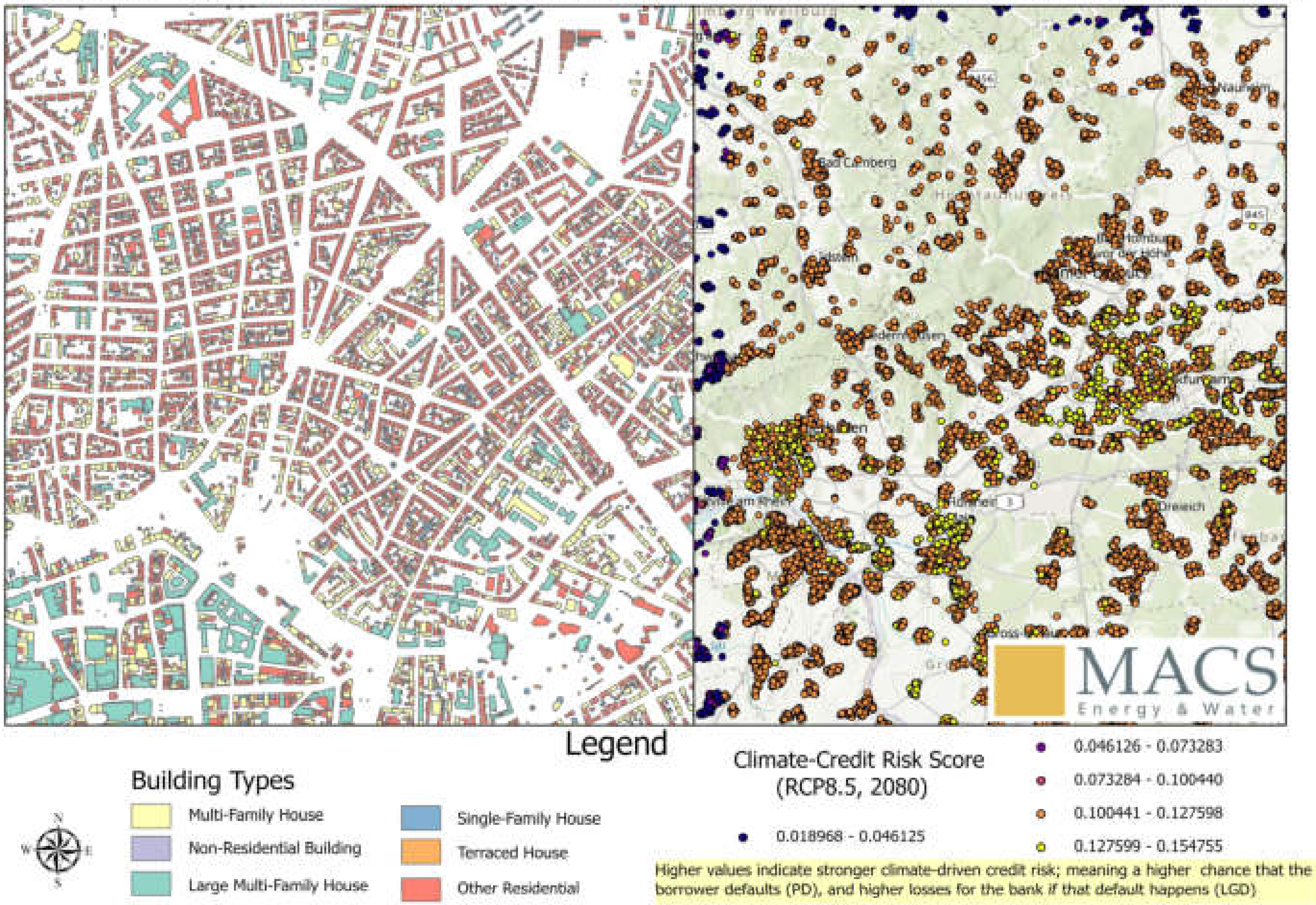
Physical Climate Risks Translated into Climate-Credit Risk for Individual Buildings (Frankfurt Region, RCP8.5, 2080)



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- **Climate-Credit-Risks (CCR)** based on individual building-metrics & Physical climate scenarios
- **Physical hazards** (heat, flood, wind, drought) are translated into **credit-risk drivers** (PD & LGD)
- **Risk scores** reveal spatial clusters where climate impacts materially affect borrower resilience.
- The framework enables **portfolio-wide repricing**, **risk-based lending**, and **forward-looking supervision**.

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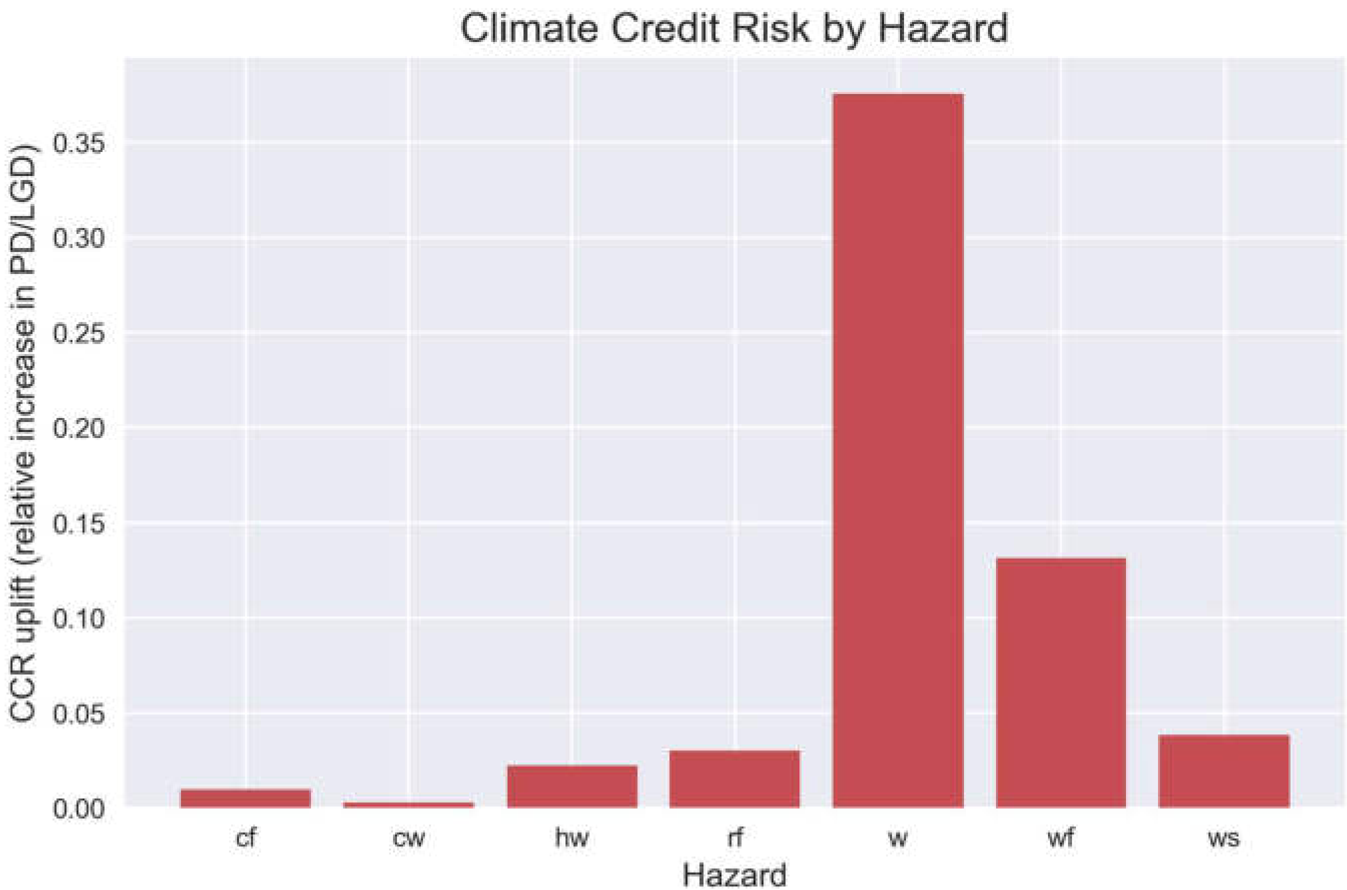

- 5% sample of residential buildings in Germany analyzed: **Wind peaks** emerge as the dominant **Climate Credit Risk** drivers
- Wind-related hazards generate the largest PD/LGD uplifts, consistent with their structural-damage potential and non-linear damage scaling
- Other hazards (coastal flood, river flood, heat wave, cold wave, water stress) show only marginal overall CCR impact but can have localized impact esp. river flood

cf = Coastal Flooding || **cw** = Cold Wave || **hw** = Heat Wave || **rf** = River Flood || **w** = Wind || **wf** = Wildfire || **ws** = Water Stress

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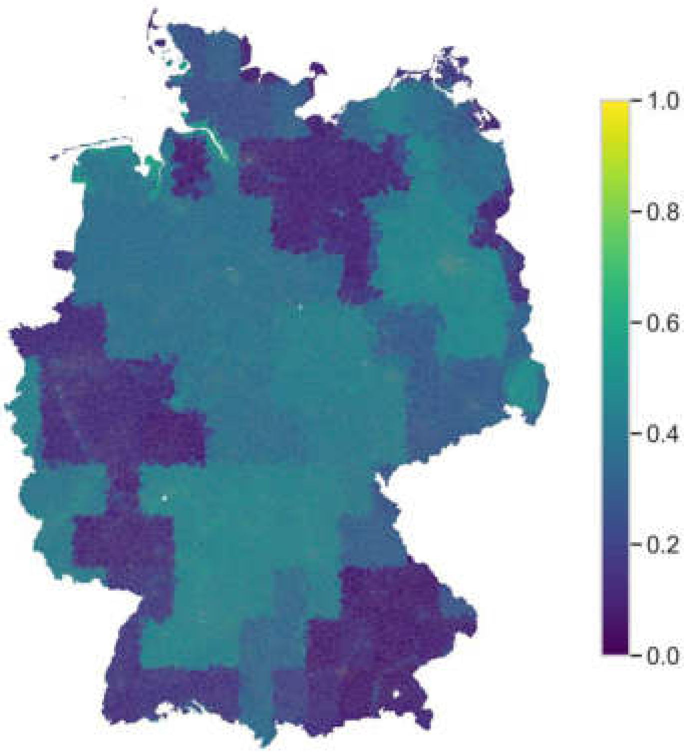
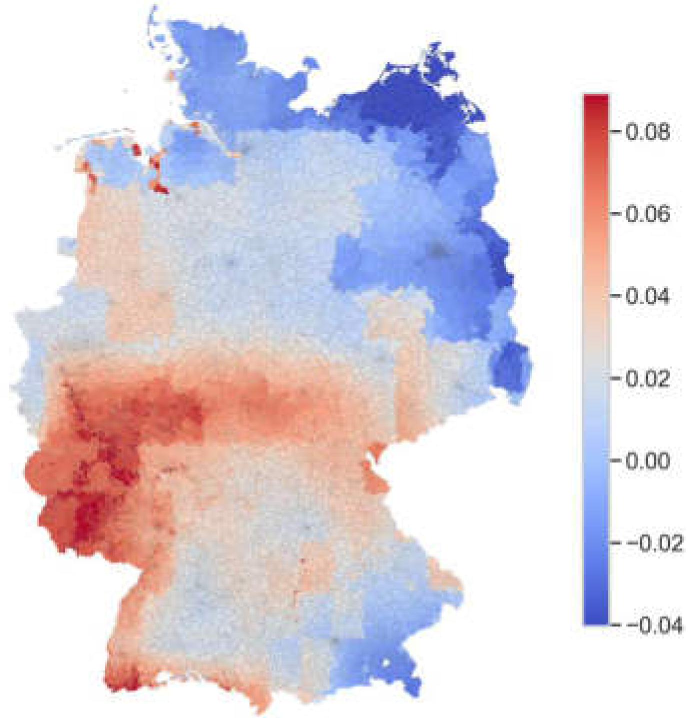
PLZ – CCR (Climate Credit Risk Index) – 85_2050



- PLZ –level CCR index under scenario stress
- Higher CCR= stronger PD/LGD amplification
- Useful for spatial scenario benchmarking.

PLZ – Δ CCR (85_2080 – 85_2050)



- Change in CCR uplift between 2050 and 2080
- Positive values = higher CCR in 2080
- Highlights long-term climate stress intensification

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Normalized Monetary Loss(Euro) Potential by 2080 under RCP 8.5

(aggregated at community level)

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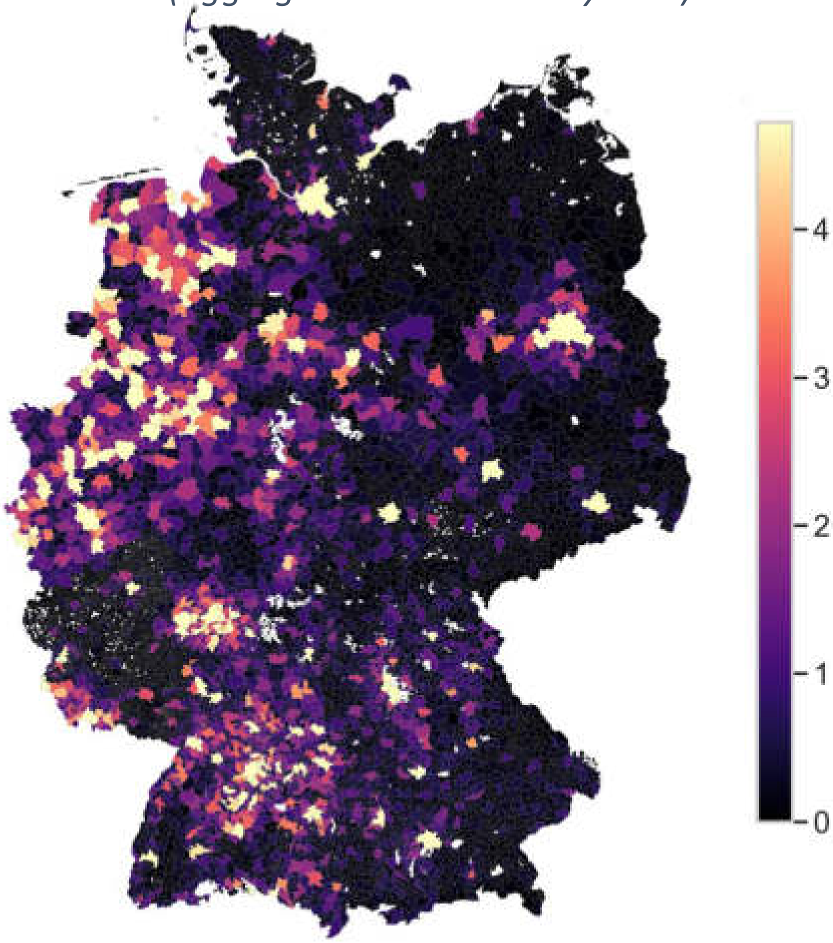

- Aggregated losses represent climate-driven monetary damage scaled per community, allowing direct comparison across regions regardless of population or asset density
- Based on our sampled locations **High-value clusters** in western and southern Germany indicate areas where hazard severity and economic value combine to drive elevated loss potential.
- Spatial patterns highlight regions with elevated exposure to climate hazards, especially areas where hazard intensity and asset concentration coincide
- **Low-value regions** appear in darker tones, reflecting either lower hazard intensity, lower asset exposure, or both

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- Assets experience risk only through hyper-local conditions
- MACS Framework is aligned with ECB, EBA, NGFS, and CSRD expectations: it is strong, forward-looking, scenario-based, asset-level, and hazard-specific
- Model transparency and traceability ensure the approach is defensible to internal model risk, auditors, and supervisors
- The model estimates borrower-level default risk and captures how climate-related losses translate into elevated PD/LGD and portfolio-level risk for financial institutions
- Spatial loss patterns reveal concentrated long-term monetary loss potential under RCP 8.5, highlighting regional hotspots relevant for underwriting and portfolio steering
- Spatial patterns highlight regions with elevated exposure to climate hazards, especially areas where hazard intensity and asset concentration coincide

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