COPERNICUS THEMATIC WORKSHOP

Physical risk assessment - banking practices

Joseph Moorhouse, BNP Paribas
Nicola Wagner-Rundell, ING

#EUSpace

Copernicus
Europe's eyes on Earth

Agenda

1. **Bank use cases**: How does a bank manage ESG risks? (NWR)
2. **Physical risk modelling** in a bank (JM)
3. **Outlook:** expanding earth observation data use in financial risk management (joint)

Agenda

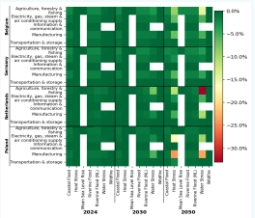
1. **Bank use cases**: How does a bank manage ESG risks?
2. **Physical risk modelling** in a bank
3. **Outlook:** expanding earth observation data use in financial risk management

How we integrate ESG risks in our risk management cycle

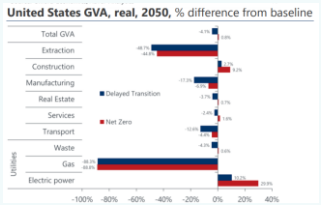
1) Materiality Assessment

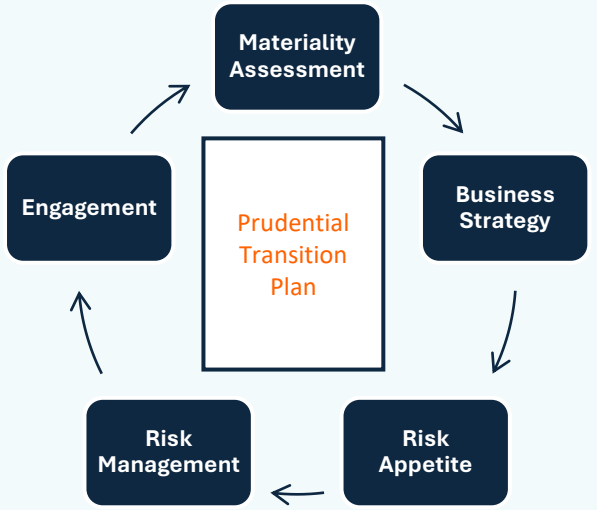
Data based assessment of materiality of all ESG related drivers using physical risk models & transition risk economic models including stress testing

Physical Risk Models



Economic Scenarios





2) Business Strategy & RAS

Support setting sector-based strategies to reshape risk profile in line with risk appetite and more resilient assets, regions, sectors. Supported by climate RAS.

Climate RAS

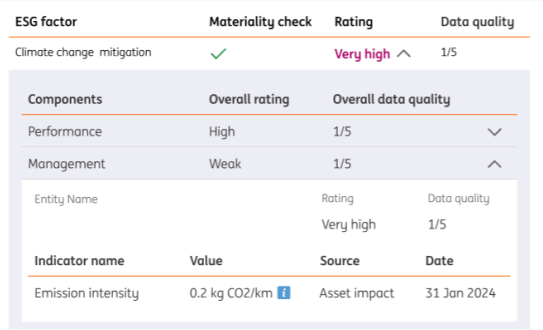
Physical risk portfolio concentration limit

Biodiversity portfolio concentration limit

Transition risk limits

3) Risk Assessment

Identify exposures with highest physical risks for consideration in the credit assessment process



4) Risk Management

Sector Guidance & lending procedures

- Providing ESG risk mitigants and adaptation guidance per sector
- Setting lending criteria and mitigation hierarchies based on identified risks
- Supplying stressed financials from damage functions for sensitivity analysis, LTV adjustments & collateral valuation

5) Engagement

Client Engagement and Client Transition Plans

- Provide advice to front office on client engagement

Sustainable Finance

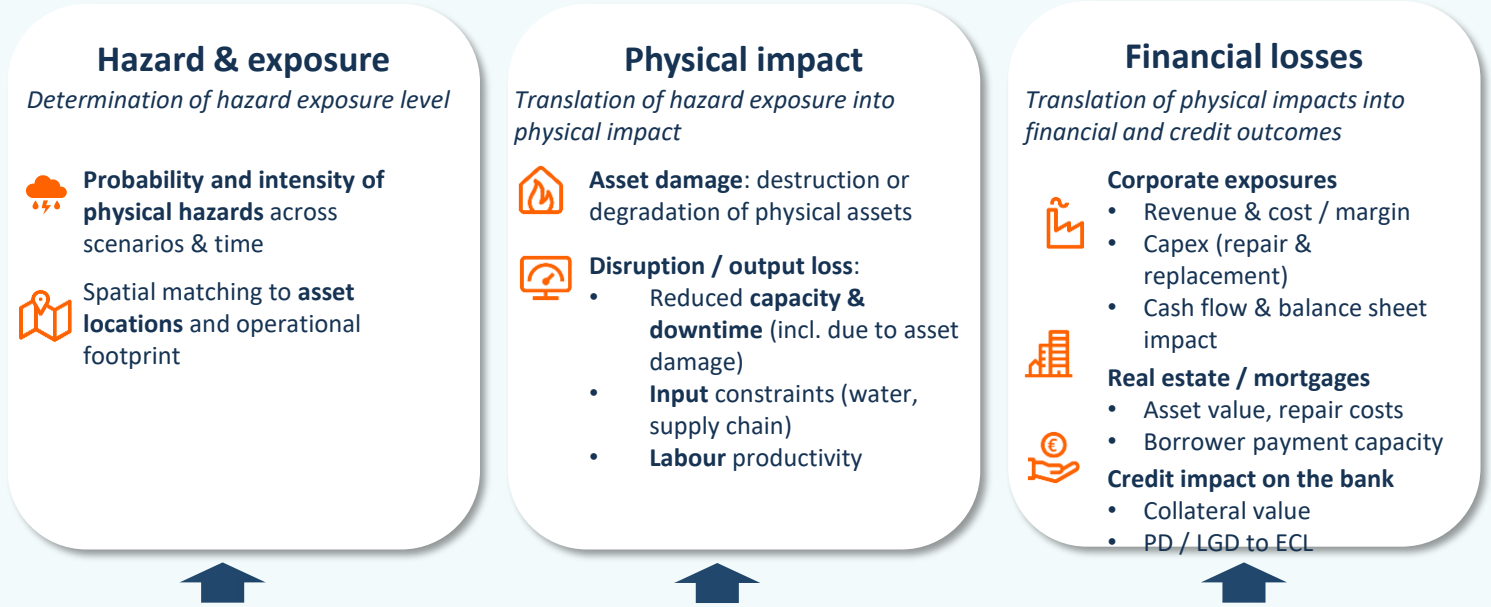
- Supporting taxonomies for adaptation finance

Disclosure

- CSRD, P3

From location-specific hazard exposure to financial and credit impact

Translating hazard exposure into physical impacts, financial losses and credit risk to inform risk appetite, lending and portfolio management



Use Cases

Risk Appetite Setting (RAS)

- Assess portfolio exposure to location-specific hazards and associated financial impacts
- Inform limits, concentration management, and mitigation requirements

Lending decisions

- Assess physical risk at asset, site, or firm level for new and existing exposures
- Identify material risks and required mitigants (e.g. adaptation, insurance)

Stress-testing and scenario analysis

- Evaluate potential impacts under adverse climate scenarios
- Quantify sensitivity to hazard intensification and disruption risks

Credit risk and capital impact

- Translate physical impacts into borrower financials and credit risk
- Inform probability of default (PD), loss given default (LGD) and expected credit loss (ECL)

Agenda

1. **Bank use cases: How does a bank manage ESG risks?**
2. **Physical risk modelling in a bank**
3. **Outlook:** expanding earth observation data use in financial risk management

Quantitative ‘bottom-up’ building blocks

Hazard indicators are combined with vulnerability functions to quantify physical risk

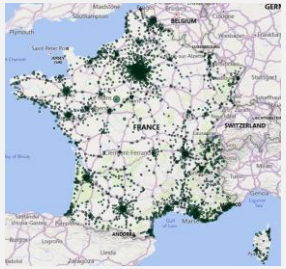
1. Hazards

Climate-related hazards for different scenarios and time horizons

Floods · Drought · Fire · Heat · …

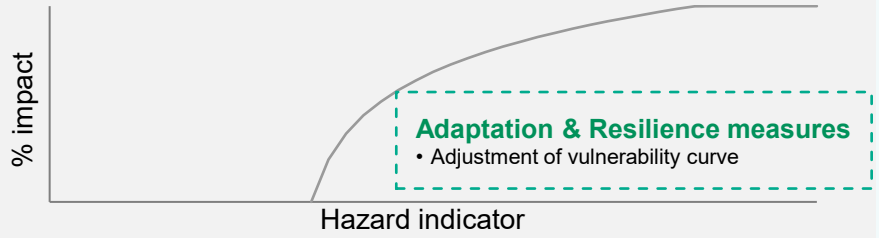
2. Exposures

Exposure based on location of financed assets / collateral



3. Gross damage (vulnerability) functions

Taking into account adaptation & resilience measures



4. Mitigation

Insurance Coverage

State Support

5. Financial quantification

of direct impacts

Capex

Asset damage

- Asset repairs & reconstruction

Revenue Opex

Operations disruption

- Revenue loss pending asset restoration
- Revenue loss due to productivity impact
- Recurring costs increase (chronic)
- Exceptional operating costs (acute)

6. Risk measures

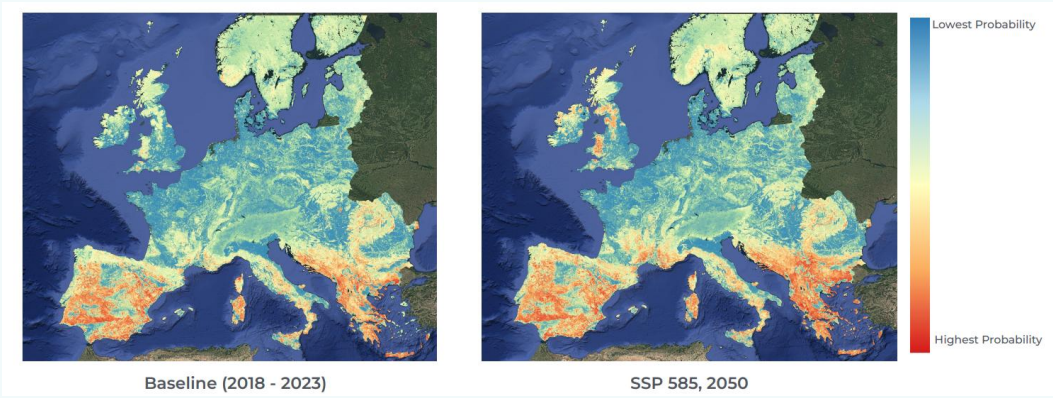
1) **Scores (1-4)**, for embedding into operational processes
2) **Quantitative impacts** e.g., impacts on LGD, PD in scenario analysis (ICAAP) context

Building blocks: hazard indicators

Some banks complement public-domain data with commercial; gap is 1) ability to quantify (e.g. fire) 2) granularity (e.g. inundation)

Hazard	License [1]	Indicator(s)	Resolution	Coverage
Drought (excl. shrink-swell)	P	Days per year with SPEI 3m/12m < X	25 km	Global
Fire	BC	Probability of occurrence	50 m	Global
Flood: coastal	C + P	Flood depths for return periods (10, 20, …, 1500 years)	5 m /1 km	Global
Flood: pluvial	C	Flood depths for return periods (10, 20, …, 1500 years)	5 m	Global
Flood: riverine	C	Flood depths for return periods (10, 20, …, 1500 years)	5 m [100 m / 1 km]	Global
Hail	P	Days per year of 'large hail'	25 km	Global
Heat	P	Various, e.g. days per year with WBGT > X °C	25 km	Global
Precipitation	P	Max. daily water-equivalent precipitation	25 km	Global
Shrink-swell subsidence	BC	Probability of occurrence	100 m	Europe
Water stress	P	Various (Aqueduct, WRI)	Catchment	Global
Water temperature	P	Days per year with temperature > X °C	10 km	Global
Wind – extratropical cyclone	P	Max. sustained wind speed for return periods (10, 20, …, 1500 years)	10 km	Europe
Wind – tropical cyclone	P	Max. sustained wind speed for return periods (10, 20, …, 1500 years)	10 km	Global

Illustration : Days with wet bulb globe temperature above 20 °C (chronic productivity models); internally developed from CMIP6 data

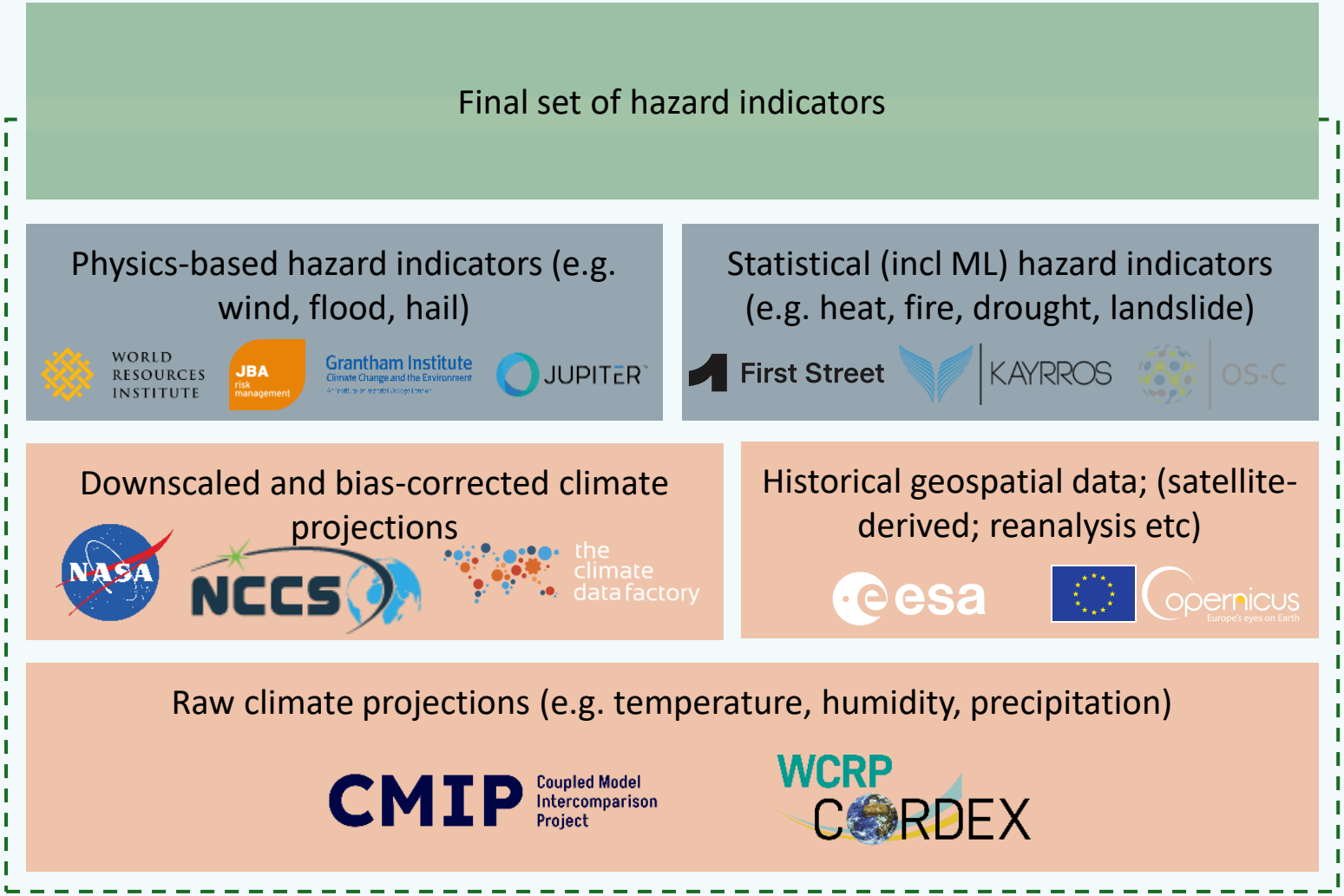


Wildifire data: probability of occurrence trained on GlobFire data (colourbar obfuscated as commercial data).

[1] P = public, C = commercial, BC = bespoke commercial

Hazard indicators: physical climate risk view

For climate risk, inferring indicators from CMIP/CORDEX data is common



- Major aim is to **reduce model risk** (risk that decisions based on models may be wrong through e.g. limited understanding of uncertainties).
- Role for public domain or commercial. For the most complex physics-based indicators, the **necessary expertise** may be beyond institutions' in-house capabilities.
- Possible to leverage research bodies' post-processed data who put directly-usable projections into the public domain.
- All those datasets (even commercial) are ultimately derived from data products in public domain developed through International climate modelling collaborations.

Note: companies/institutions listed are purely examples not recommendations

Pre-event hazard maps (/synthetic event sets)

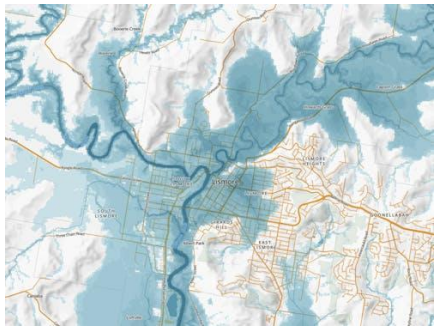
Flood as an example: flood depths for different

- **Acute risks** are particularly impactful for credit risk.
- Impacts are modelled as probability distributions => quantitative calculations for capital adequacy and use of summary statistics such as **Annual Average Loss (AAL)** .
- Starting point is typically flood depth for different return periods.
- AAL, calculated before insurance mitigation, is an important indicator for insurance affordability, e.g. in residential real estate context, properties with AAL >~ 1% are those at highest risk of future impact on asset value => increase of loan-to-value.

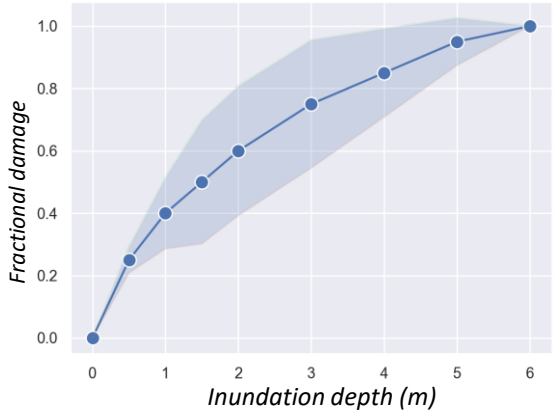
Data sources for vulnerability modelling :

- **Scientific literature e.g. (acute)** EC JRC 2017 *Global flood depth-damage functions*; Eberenz et al. 2021 *Regional Tropical cyclone impact functions for globally consistent risk assessments,* **(chronic)** Luo et al. 2023. *A framework to assess multi-hazard physical climate risk for power generation projects from publicly-accessible sources.*
- **(Public domain) catastrophe modelling tools:** FEMA Hazus (collates sources such as USACE).
- **Own/partner-research:** reanalysis of CCR data for shrink-swell subsidence; reanalysis of CAL FIRE data for wildfire vulnerability.
- **Commercial sources** are avoided in favour of public but considered for domain-specific use (e.g. Multi-Coloured Manual, 2025. Middlesex University for economic appraisal of flood and coastal erosion risk.

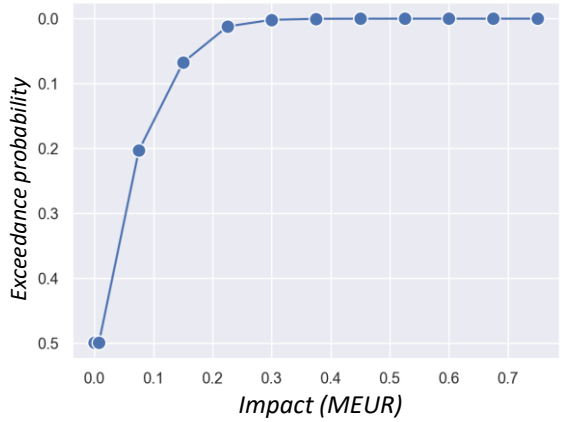
Primary uncertainty
(from asset location)



Secondary uncertainty
(from asset characteristics)



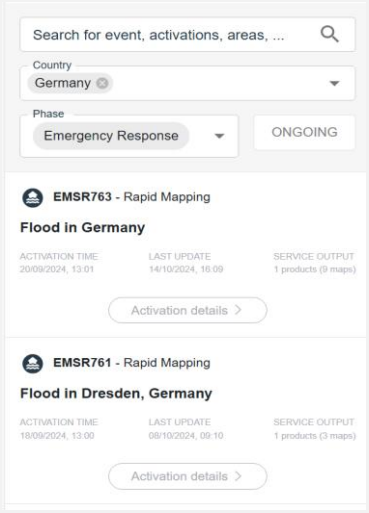
=> Impact (for given year, scenario)



Post-event loss-tagging for residential mortgages

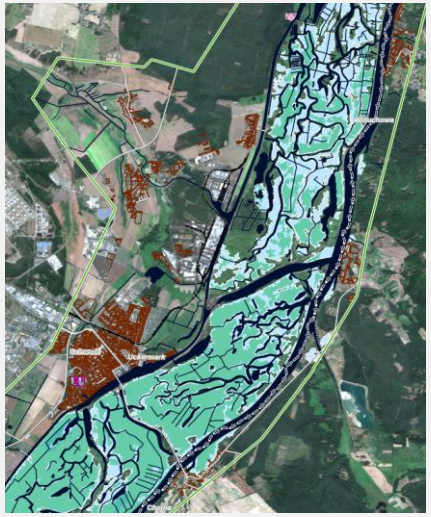
Event Identification

Copernicus satellites recognize extreme weather events like **Flood, Wildfire, Earthquake, Storm & Volcanic eruptions** and activates an event



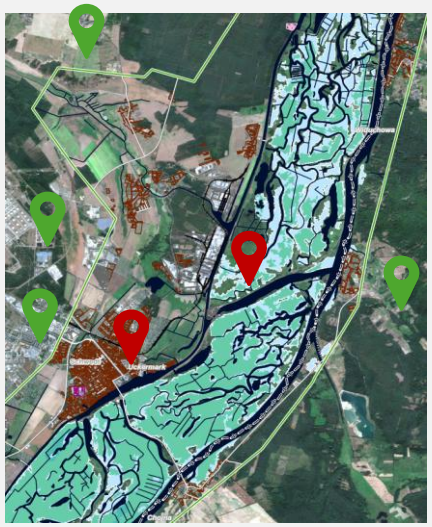
Event evaluation

After the event Copernicus provides the area of interest and maps out which type of areas were affected – **if residential areas were affected, we proceed**



Address mapping

If residential build ups were affected, we **check whether the houses which back our mortgages are within the area of interest** on two accuracy levels rooftop or postal code



Engagement

For those houses where we know the **exact location (geocoordinates)** we can determine whether they are in the area of interest

For those where we don't have the exact location due to data issues, we can use **postal codes as a proxy**

Results are then sent to the taskforce for further processing and tagging

Agenda

1. Bank use cases: How does a bank manage ESG risks?
2. Physical risk modelling in a bank
3. **Outlook: expanding earth observation data use in financial risk management**

Outlook for additional datasets to improve physical climate & nature risk management

Asset exposure What are clients doing where?	• Key as the starting point for **any location-specific** physical risk modelling and pin-pointing **transmission channels**. Data is often missing or unreliable	• **Asset location, type and ownership** (e.g. manufacturing vs office) • **Activities, inputs, outputs** (e.g., food manufacturing, water consumption, effluents)
Hazard intensity indicators What is exposure to physical climate & nature hazards?	• Quantities that can be combined with models of vulnerability to **quantify** risks • **Ready-to-use** (e.g. fire *occurrence probability*); building blocks also (FWI, biomass indices, sea-level change)	• Key challenges: flood, wildfire, landslide, pole-rot; expansion to pollution and ecosystem service loss (soil quality, pests etc) • For acute, need **probability / return period** • Facilitation of CMIP(7) data
Event monitoring What hazards materialize where?	• Event monitoring for post-event assessment • Useful for **scenario realism**	• Near real-time data • Loss tagging • Multi-hazard event sets for scenario construction
Vulnerability & adaptation What protections are in place?	• Location-specific vulnerability and adaptation measures strongly affect whether there is a financial impact	• Environmental / public realm measures • Client-specific measures • Observed recurrence / protection
Ecosystem intactness Nature loss and hazard amplification	• **Ecosystem intactness / land degradation** causes loss of ecosystem services and amplifies “climate” hazards such as flooding, water stress. Currently often not considered, underestimating risks.	• **Ecosystem intactness indices** • Specific ecosystems (e.g., mangroves) or impact drivers (e.g., deforestation) • Data on **hazard amplification** (e.g. deforestation ->flooding)

Thank you!

Joseph Moorhouse and Nicola Wagner-Rundell

BNP Paribas & ING

#EUSpace