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MODELOWANIE RYZYKA POWODZI

Wnioski z powodzi z 2024 roku

9 czerwca 2025

Paweł Franków, Head of Emerging Markets Analytics

1.2024 Flood

2.Change in Flood Risk

3.Quantification of Flood Risk

Agenda

2024 Flood

1

Improved risk quantification can enable effective mitigation

Case Study: September 2024 Central and Eastern Europe Flooding

Rainfall exceeded 100-year return period due to persistent rainfall over several days during 14th-20th September 2024, analogous to 1997 flood in Poland

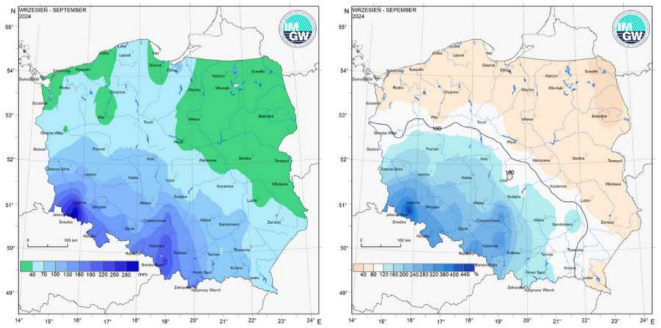
Human-induced climate change has contributed to roughly a **doubling in likelihood and a 7% increase in intensity**

In General: Flood defence improvements, reservoir management (e.g. Racibórz Dolny reservoirs) and **better warning systems** since 1997 and 2010 floods reduced damage

Number of fatalities only around 10%-20% of the 1997 and 2002 European floods

Total Europe industry loss of €2bn, estimated **25-65 year return period** for Poland, Czech Republic and Austria

Rainfall accumulation September 2024
Source: IMGW



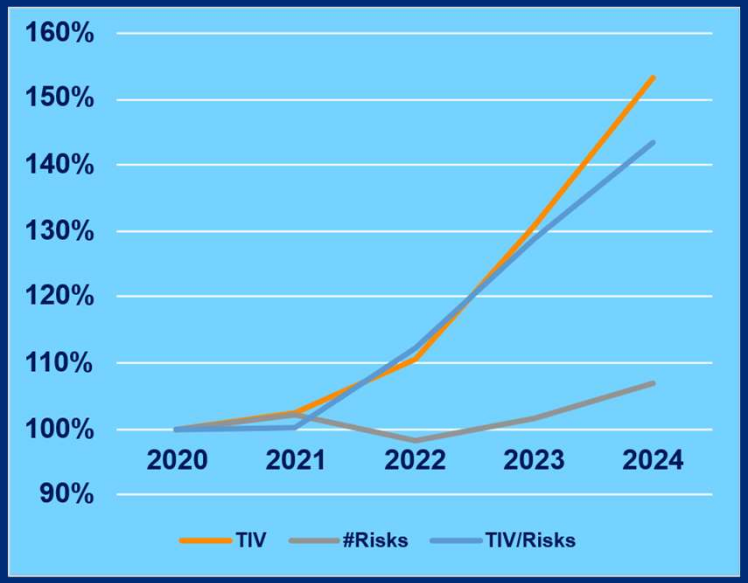
Sources: IMGW, PERILS as of 19th December 2024, Guy Carpenter Report dated 24th September 2024, Climate change and high exposure increased costs and disruption to lives and livelihoods from flooding associated with exceptionally heavy rainfall in Central Europe – World Weather Attribution

Change in Flood Risk

2

Changes in Risk Landscape

Flood risk drivers are subject to change



Average across anonymized portfolios in Poland

+7% no of risks

+53% TIV

Significant portfolio growth and inflation

Risk Selection matters

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Changes in Risk Landscape

Flood risk drivers are subject to change

Exposure / Portfolio

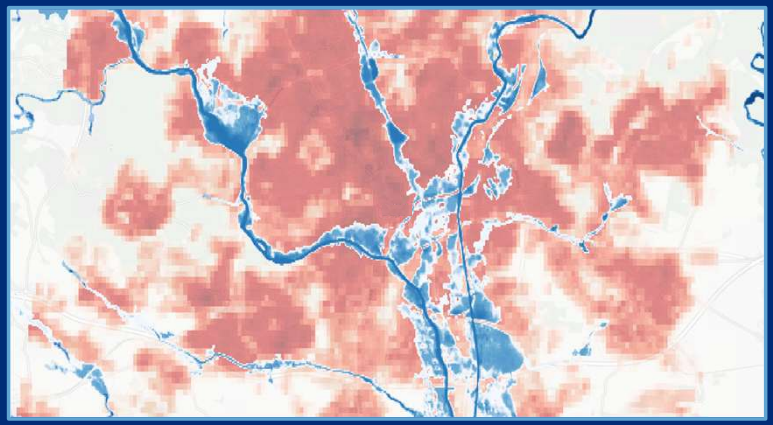
Risk metrics to flood loss are changing constantly:

- Risk Count
- Sums Insured
- Inflation
- Growth strategies
- Locations detail

Socio Economic Factors

Building guidelines allow / prohibit population to build within flood zones

- Based on report by Polish Economic Institute
- As population changes new structure locations develop



Population Density

Flood Zone

Over 20% of Poland's population living in the areas at risk of flooding

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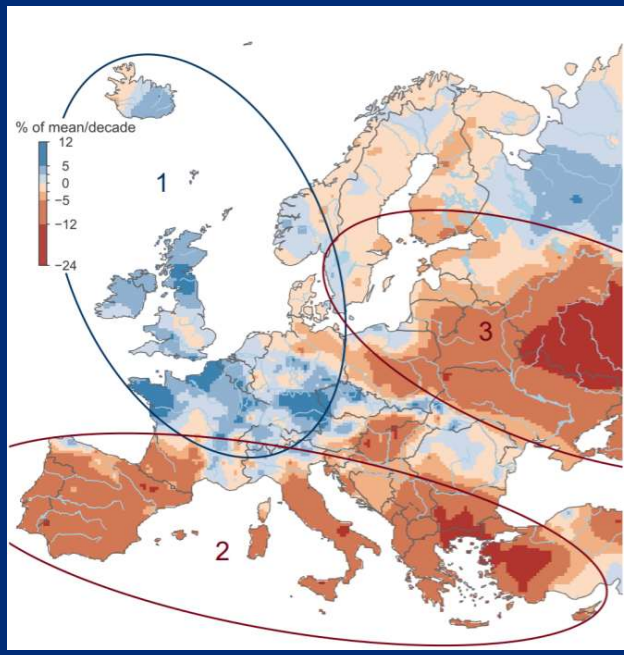
Climate Change Impact

Quantification of climate change impact allows adaption

- Different °C scenarios
- Highly uncertain
- Does not include mitigation measures that will come with increased food risk



Uncertainty

as to long term tribute to climate change in Poland

Adaptation

Defense measures will counterbalance climate change effects. Otherwise much higher values could apply.

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Flood Management

Flood Management has improved significantly.

- Dam updates (some outstanding)
- Mobile Defenses
- Reservoirs
- Warning Systems

Some initiatives not progressing

Investments paid off in 2024 and saved losses and lives

Quantification of Flood Risk

3

GCAT Flood Risk Assessment

Probabilistic Models and Zonation Approaches

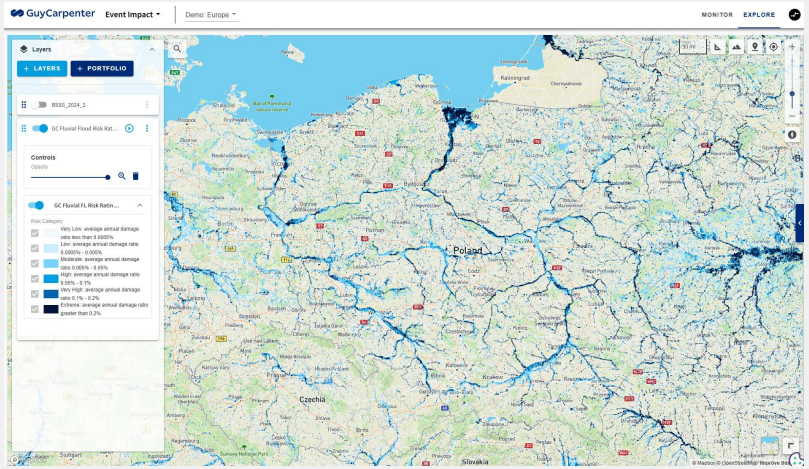
1 - GCAT Risk Rating Layers

Helps with: **Technical underwriting, Identification of loss drivers, Monitoring of UW guidelines and portfolio performance, …**

Release: **2024**

Perils available: **Fluvial flood, pluvial flood** (wildfire, earthquake, tropical cyclone, severe convective storm)

Risk metric: **Occupancy specific annual damage ratios**

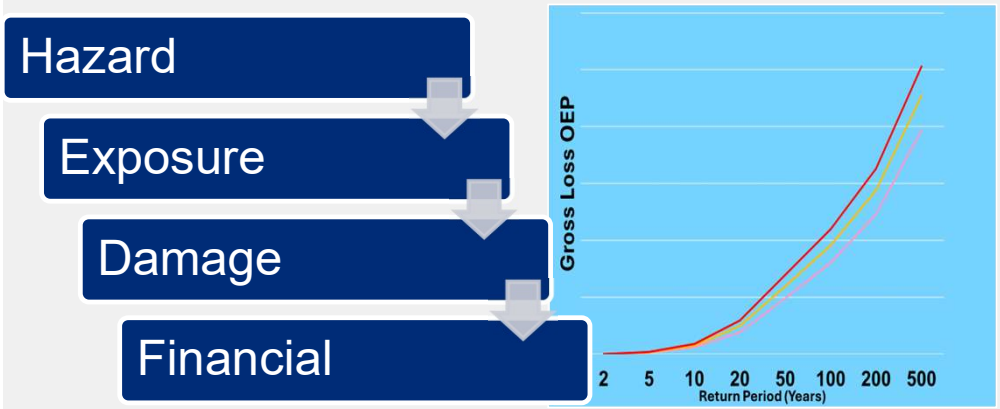


2 - GCAT Probabilistic Model

Helps with: **Identification of tail risk and annual damage. RI structuring and pricing**

History: **2009** **2012** **2021**

Flood Types: **Fluvial and Pluvial**



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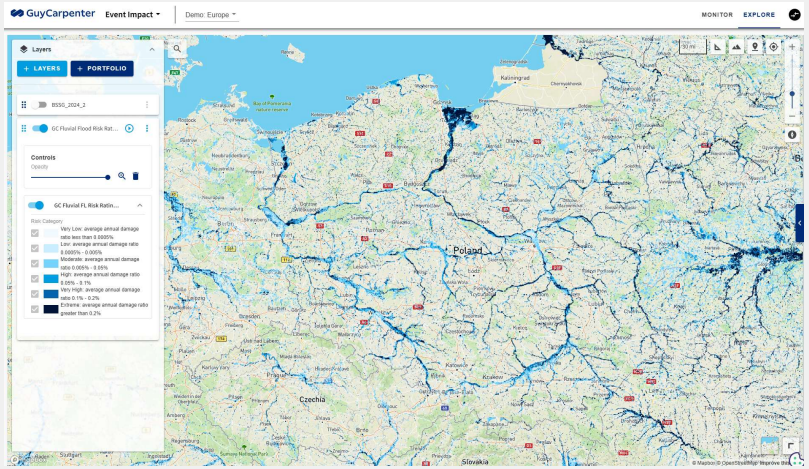

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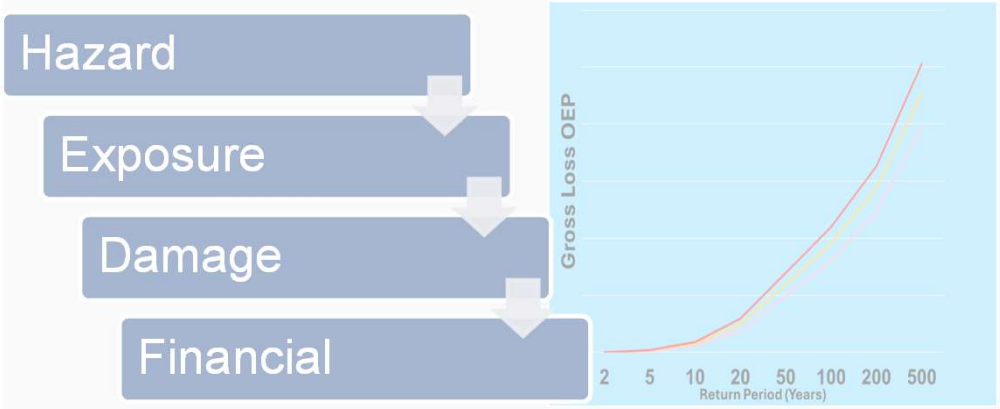
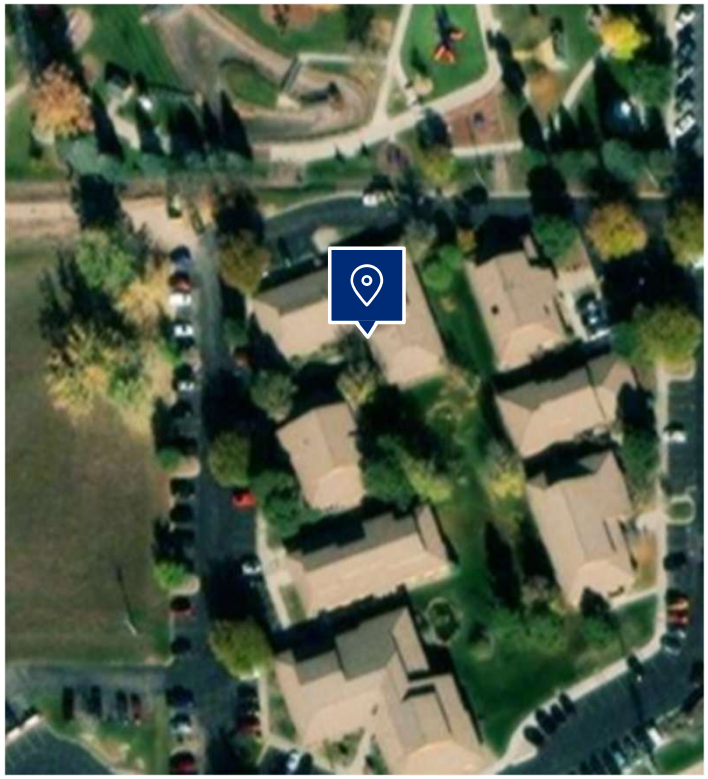


GCAT Risk Rating – Use Case Technical Underwriting

Location-Level Risk Rating

The risk rating products can be used for any locations in the world. They provide the corresponding level of risk by category or the underlying damage ratio for more quantitative underwriting.

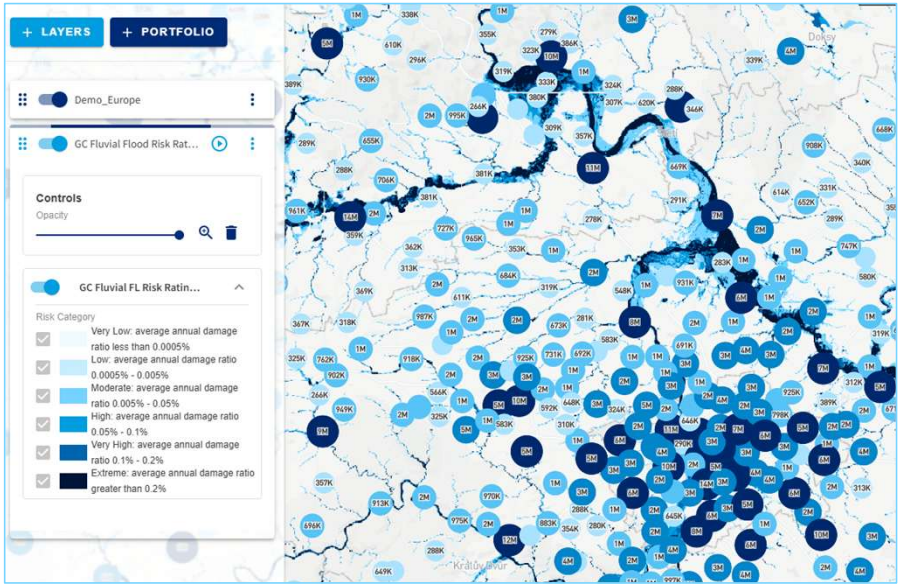


GC Fluvial FL Risk Rating RES v3.0 (Global) Extreme: average annual damage ratio greater than 0.2%	**Extreme**	ⓘ ☐
GC Hail Risk Rating Residential v1.0 (Global) Moderate 6: annual average damage ratio 0.0275% - 0.032%	**Moderate**	ⓘ ☐
GC Straight-Line Wind Risk Rating RES v1.0 (Global) Moderate 1: annual average damage ratio 0.005% - 0.0095%	**Moderate**	ⓘ ☐
GC Wildfire Risk Rating Residential v1.0 (Global) Low 1: annual average damage ratio 0.0005% - 0.00095%	**Low**	ⓘ ☐
GC Tornado Risk Rating RES v1.0 (Global) Low 5: annual average damage ratio 0.0023% - 0.00275%	**Low**	ⓘ ☐
GC Pluvial FL Risk Rating RES v1.0 (Global) Low 10: annual average damage ratio 0.00455% - 0.005%	**Low**	ⓘ ☐
GC EQ Risk Rating RES v1.0 (Global) Very Low: average annual damage ratio less than 0.0005%	**Very Low**	ⓘ ☐

GCAT Risk Rating – Use Case Accumulation Monitoring

Exposure at Risk

Compute the portfolio accumulations within flood risk bins (or any other peril). Monitor portfolio performance over time to measure impact of UW guidelines.



Risk Category	TIV	Risk Count
Very low: average annual damage ratio < 0.0005%	€786.68M	1.89K
Low: average annual damage ratio 0.0005% – 0.005%	€1.83B	4.44K
Moderate: average annual damage ratio 0.005% – 0.05%	€1.55B	3.72K
High: average annual damage ratio 0.05% – 0.1%	€301.56M	908
Very High: average annual damage ratio 0.1% – 0.2%	€193.63M	473
Extreme: average annual damage ratio greater than 0.2%	€151.25M	463

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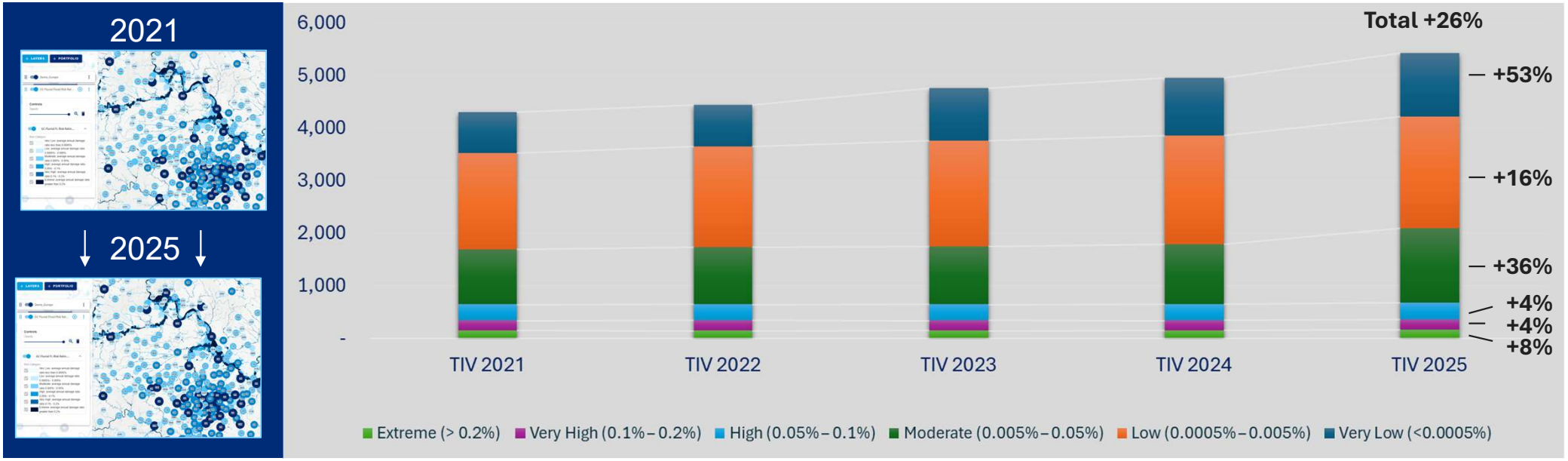

GCAT Risk Rating – Use Case Climate Change Impact

Future Projections for Current Portfolios

Climate change impact to flood policies?

Risk rating maps for future climate scenarios can be used to understand the impact of climate change on an existing portfolio. This is possible by comparing the portfolio aggregation using current and future risk rating.

Baseline

€4.29B
TIV

11.9K
Risk Count

Risk Category	TIV	Risk Count
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3°C Warming Scenario

€4.82B
TIV

13.4K
Risk Count

Risk Category	TIV	Risk Count
Very low: average annual damage ratio less than 0.0005%	€911.68B	2.52K
Low: average annual damage ratio 0.0005% – 0.005%	€1.62B	4.43K
Moderate: average annual damage ratio 0.005% – 0.05%	€1.41B	3.92K
High: average annual damage ratio 0.05% – 0.1%	€364.55M	1K
Very High: average annual damage ratio 0.1% – 0.2%	€238.43M	671
Extreme: average annual damage ratio greater than 0.2%	€280.03M	810

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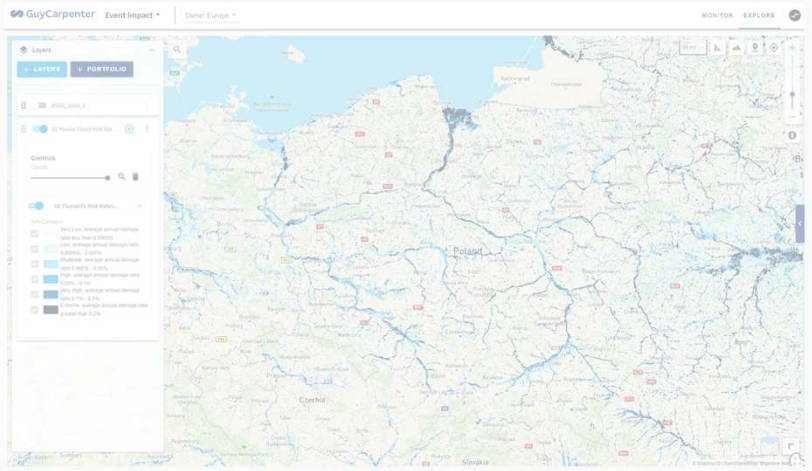

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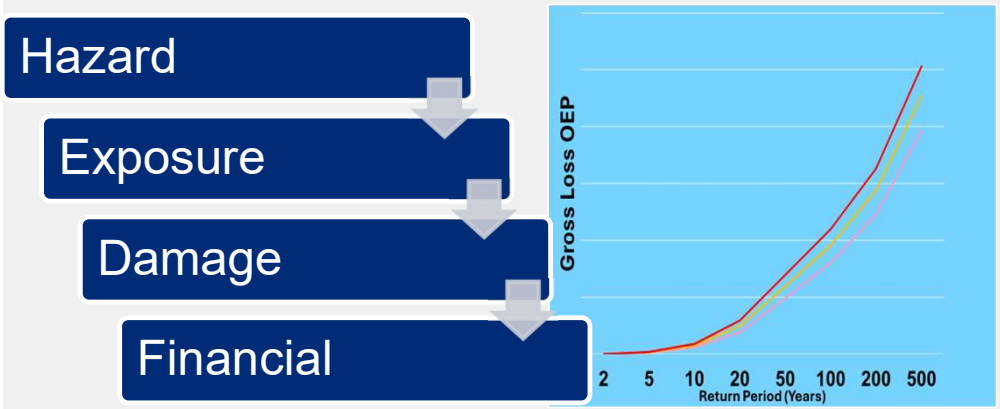


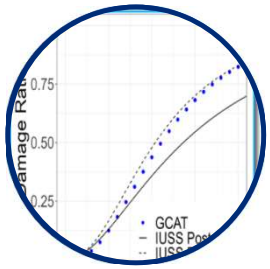
Principles of a Cat Model

EXPOSURE/BUILT ENVIRONMENT

- Portfolio data complete ?
- Exact locations / Aggregation ?
- Construction codes ?

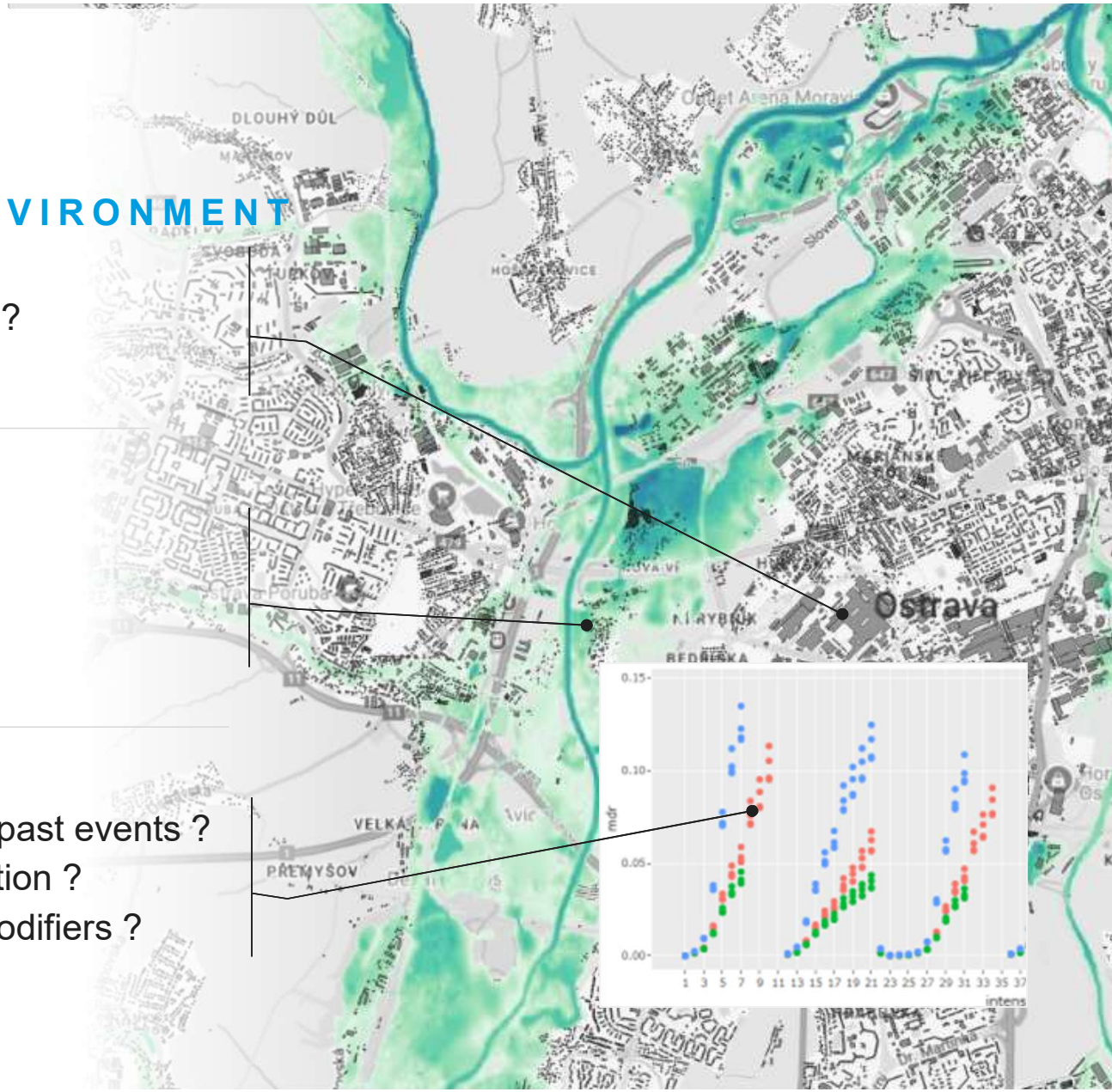
HAZARD

- Historical records complete?
- Intensities vs. Frequency ?
- Defenses ?



VULNERABILITY

- Any claims experience from past events ?
- Inflation / post loss amplification ?
- Risk types and secondary modifiers ?



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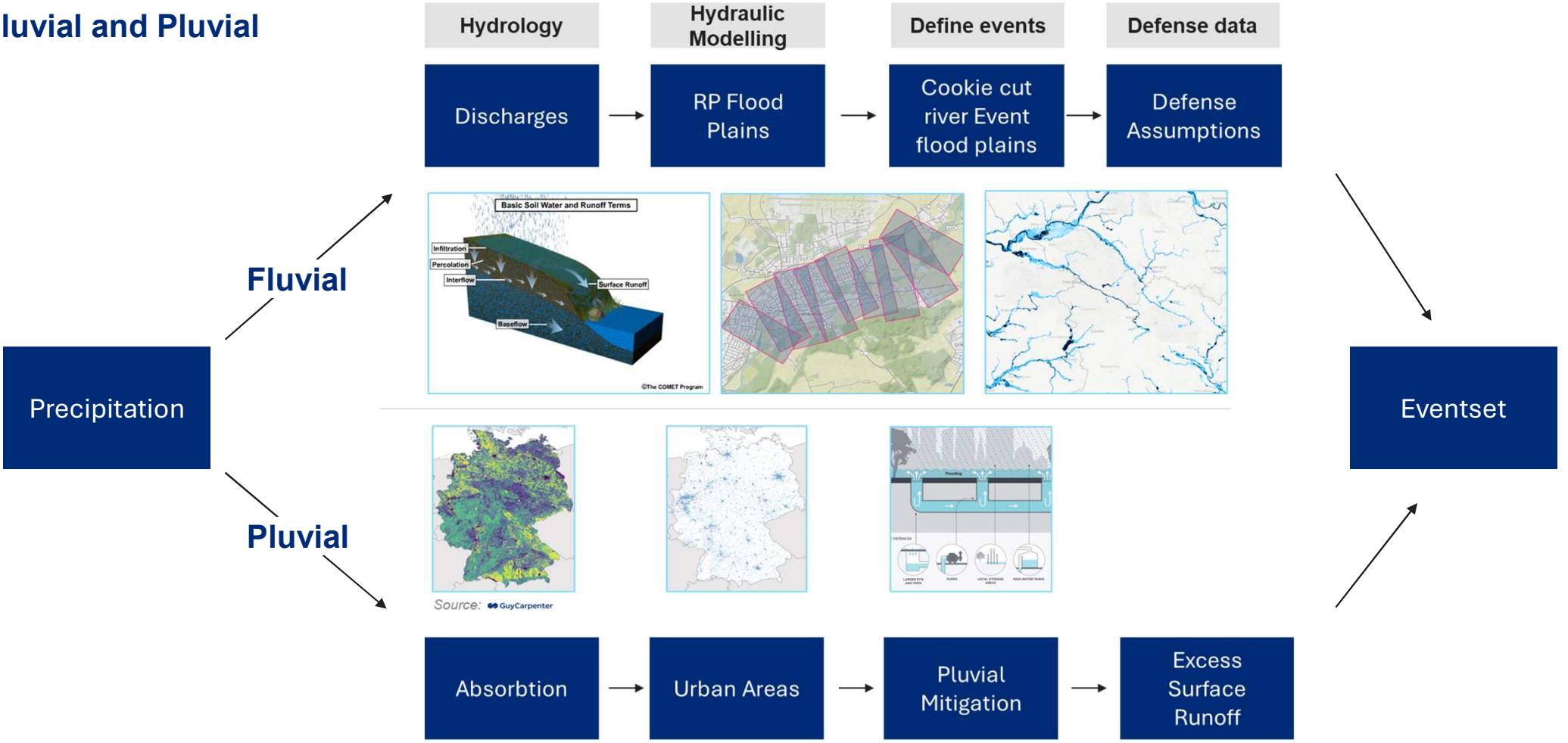
Eventset Generation

Fluvial and Pluvial



GCAT Flood Risk Assessment

GCAT model resolving uncertainty in flood risk

Flood Hazard

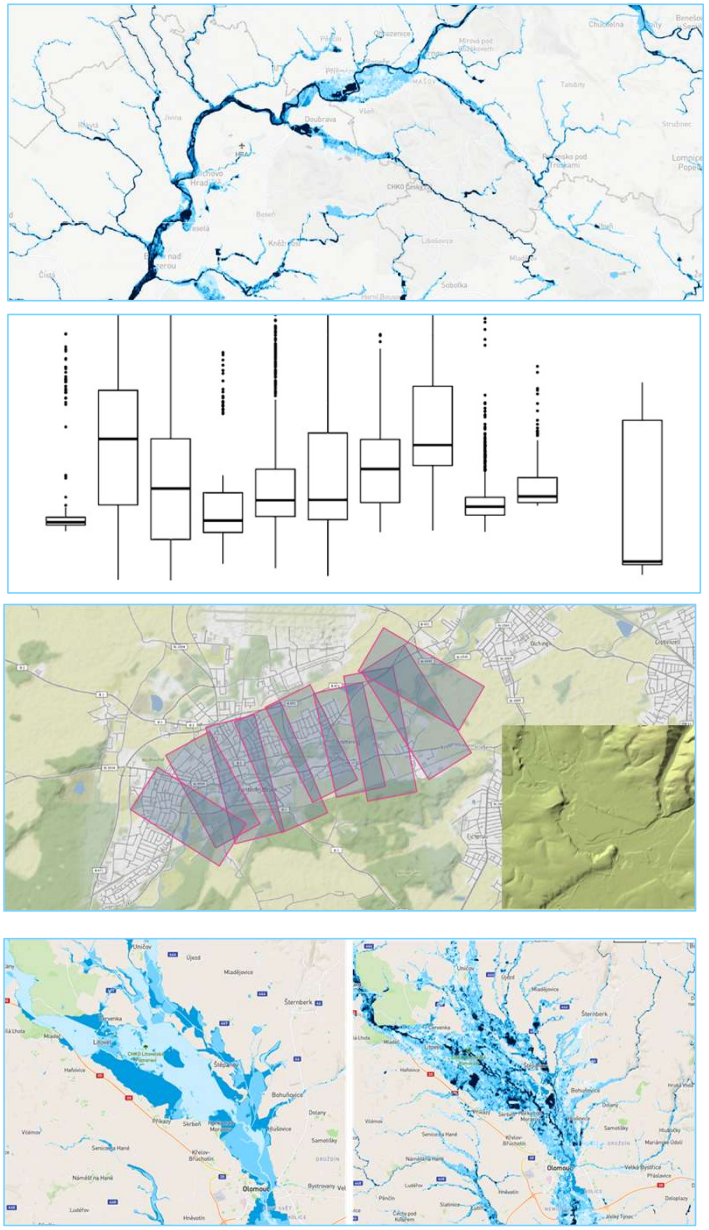
- Flood types covered: Fluvial and Pluvial
- Includes extreme (whilst unlikely) precipitation events and discharges
- Hydraulic simulations based on high resolution DTM (5m!)
- Comprehensive river network covers small size rivers and creeks
- Latest defense assumptions

Goals for simulated synthetic eventset:

→ Reproduces historic flood event losses with realistic return periods

→ Annual average losses reflect loss experience within uncertainty bands

→ Credible tail event losses



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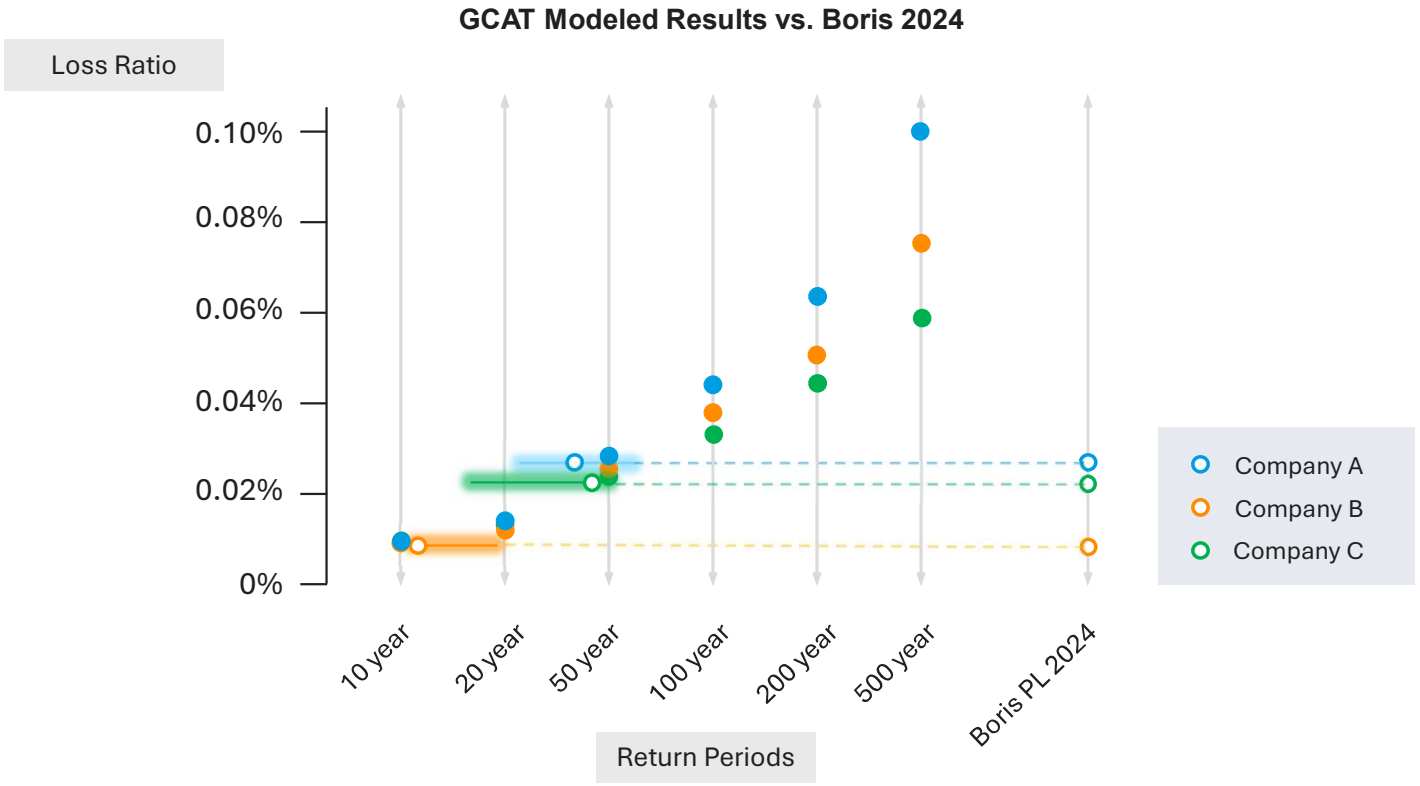
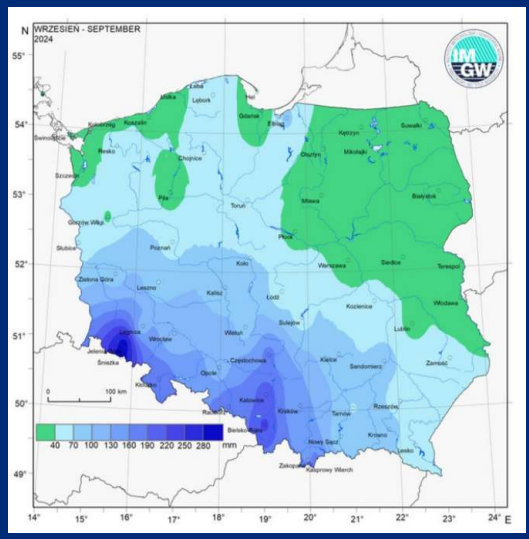
GCAT Model Results and Boris 2024

EP-Curve Samples for 3 Companies



Portfolio specific return period range from 10 years to 50 years – Europewide 25-65 years



Portfolio dependent Boris return periods for different return periods

A LR 0.025% (44RP)

B LR 0.007% (11RP)

C LR 0.023% (48RP)

Source: 2023 report prepared by NMG Consulting

GCAT Flood – Probabilistic Modules

Summary of a Comprehensive Flood Risk Assessment Framework

History PL Flood GCAT releases 2009 2012 2021

All Inland Flood Types Modelled

Two-dimensional Fluvial hydraulic model approach starting with precipitation.

GC-developed methodology for Pluvial

Comprehensive Stochastic Event Catalogue

10,000 simulation years

Reserved correlation across all European countries

Underlying Flood Modelling Layers

JBA: 5m NextMap® DTM

Covered River Network: All rivers with a catchment area of 3 km2 and above

Built Environment for Disaggregation

Risk Type distribution supporting aggregated exposure.

Derived from local sources, GEM 1 ,exposure database, GHSL 2

Vulnerability Module

Numerous flood depth dependent vulnerability distributions for all property lines and Motor

Damage distributions calibrated with detailed claims data and loss adjusters' experience

Up-to-date Multi-sourced Flood Defence Data

2021 DIBAVOD

2021 Collected from local authorities, e.g. Ministry of Agriculture and River Board Authorities

2021 JBA

2021 FLOPROS database

Financial Module in Oasis LMF 4

Validated number samples for convergence

Support complex reinsurance and financial conditions

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Thank you

A business of Marsh McLennan