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A Look at the Risk Industry

Uni Padova – Rovigo - 20th of March 2026

Agenda

Goal

Provide a broad overview of the risk industry

1

Risk is traded
Fundamentals

2

Catastrophe Models
What they are and how they are used

3

Reinsurance Structures
Very brief overview

4

Summary
Questions and employment possibility

Risk Industry

Risk is traded

Fundamentals

The **insured** pays a premium
to the **insurer**

IF the **insured** incurs
damages the **insurer** pays an
agreed amount

Point #1

The risk is traded

There is no IF in the first statement

The risk is ceded for a premium

Point #2

It is a financial service

It increases resilience

For catastrophe it's about survival

Peace of mind

Any risk can be insured: credit, health,
cyber, casualty

Point #3

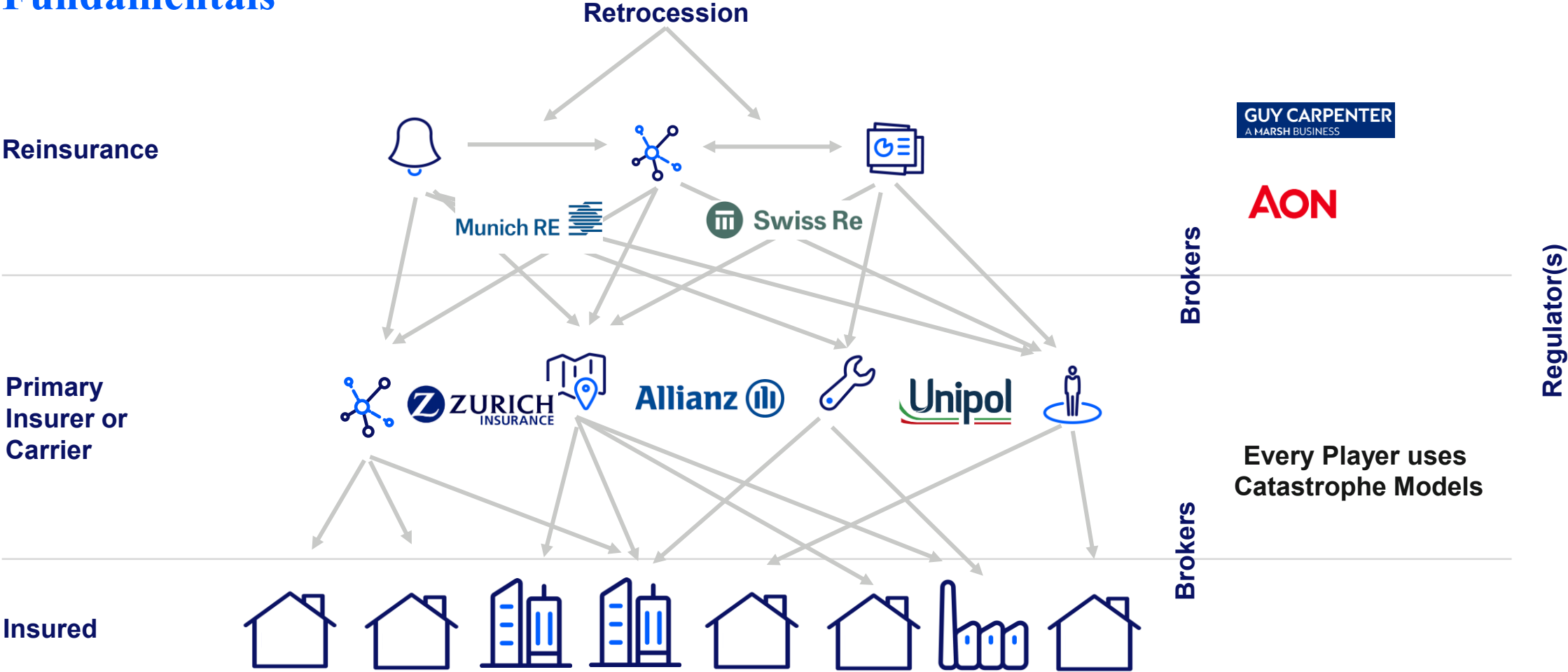
Catastrophe models estimate the risk

To be trade risk needs to be estimated

Originally only about natural catastrophes

Risk is traded

Fundamentals



Risk is traded

Fundamentals

Fondamental Points

- Diversification: by geography and peril
 - Reserves are less than potential damage
 - Premium from one peril region or risk type pays for other risk types or peril region
 - Premium needs to pay:
 - Cost of the company
 - Dividends
 - Investments
 - **Damages**
 - **Reserves**
- Insurance risk differentiates the risk industry from other financial services

Other more sophisticated forms of risk trading

Parametric: a trigger causes an “automatic” payment, no claims needed

Industry Loss Warranty, Insurance Linked Securites / Cat Bonds

In the “Supply and demand” framework:

- the capital of investors and (re)insurance company is the “supply”

The global investment market participates in the risk industry

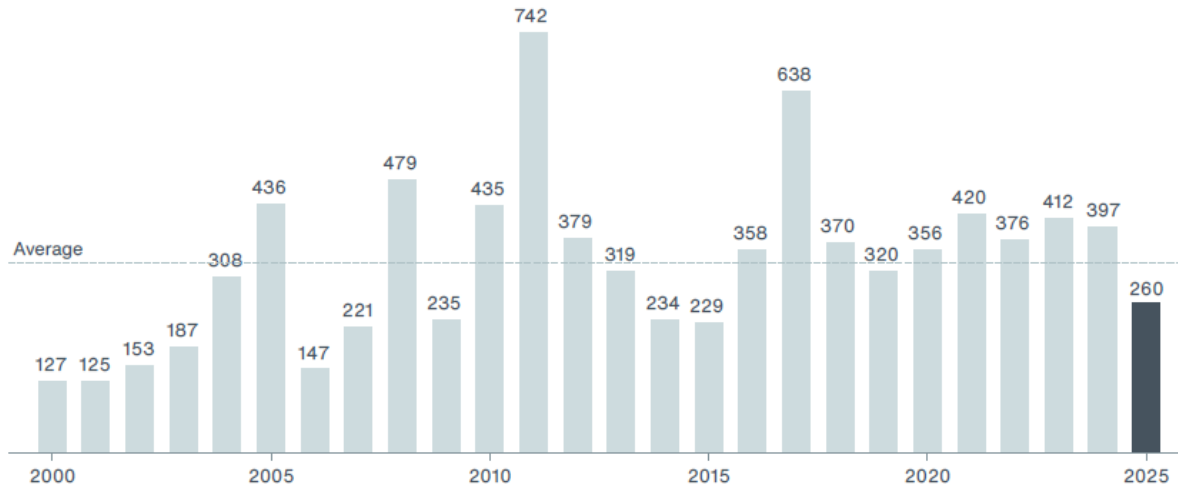
Independent risk estimates are necessary

Cat Models are the currency of the trade

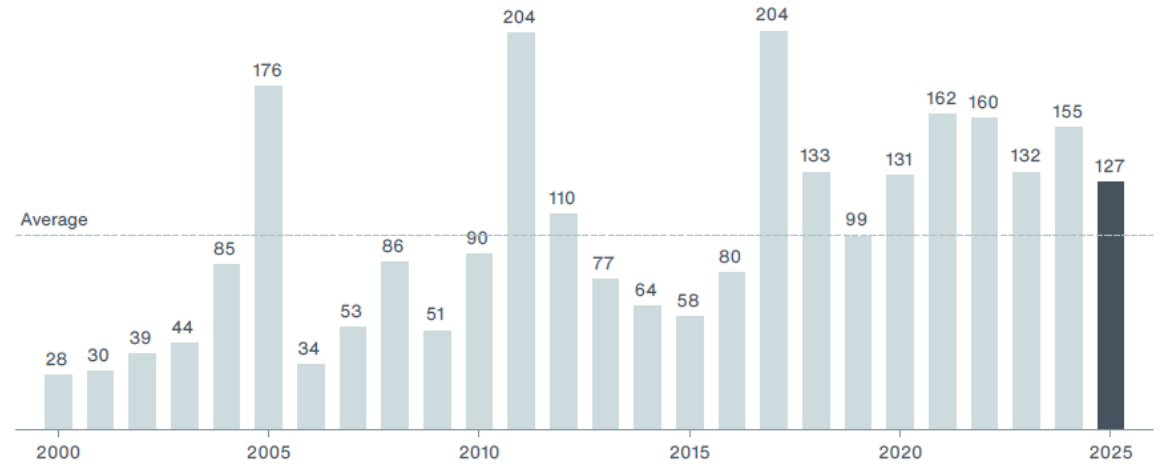
Natural Catastrophe Losses

2025 \$B

Global Economic Losses from Natural Disasters



Global Losses from Natural Insured Disasters



- The risk is real
- Average insured to economic ratio ~35% (21st century average)
- Year on Year variability depending on year-specific peril/region dominance and relative insured take-up ratio

Catastrophe Models

The main perils we need to model

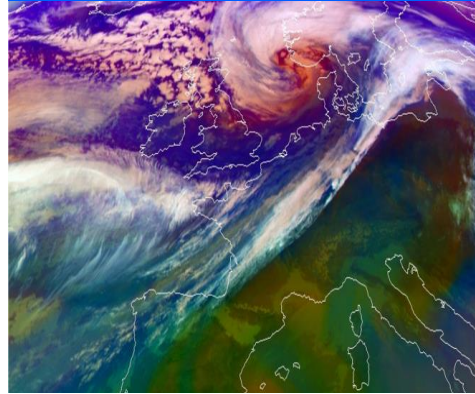
Earthquake



Tropical Cyclone



Extratropical Cyclone



Terrorism



Cyber/Casualty



Flood



Winter Storm



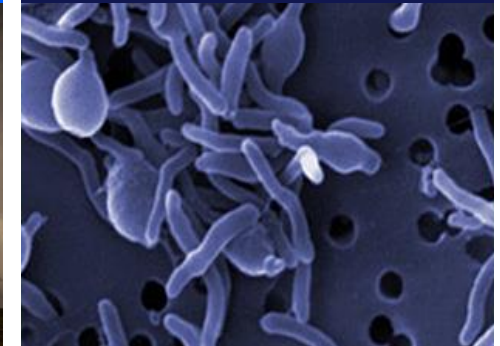
Wildfire



Severe Convective Storm



Pandemic & Longevity



Catastrophe Models

What they are/do

Hazards

- Windstorm (ETC and TC)
- Quake
- Flood
- Thunderstorm (hail)
- Cyber
- Casualty

Estimate

- Probability of Catastrophe occurrence
- Damage
- Insured loss



Probability of insured loss

What they are used for

Insurance

Risk Trading

Banks

- Credit Risk
- Investments

This is recent

Public Sector, NGOs

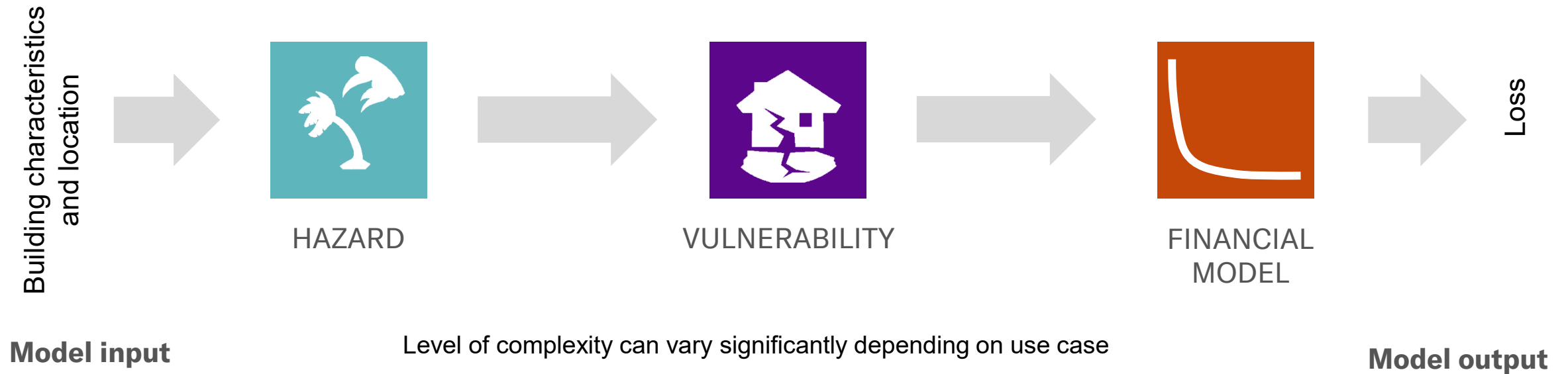
- Emergency planning
- Regional planning
 - Build where the risk is lower

Not used or very rarely

Cat Models are complex, but because of probability of loss/damage the user *understands risk, can take decisions and consciously accept trade offs*

The basic catastrophe modeling framework

Focus on one event: What is the insured loss for this event?



The basic catastrophe modeling framework

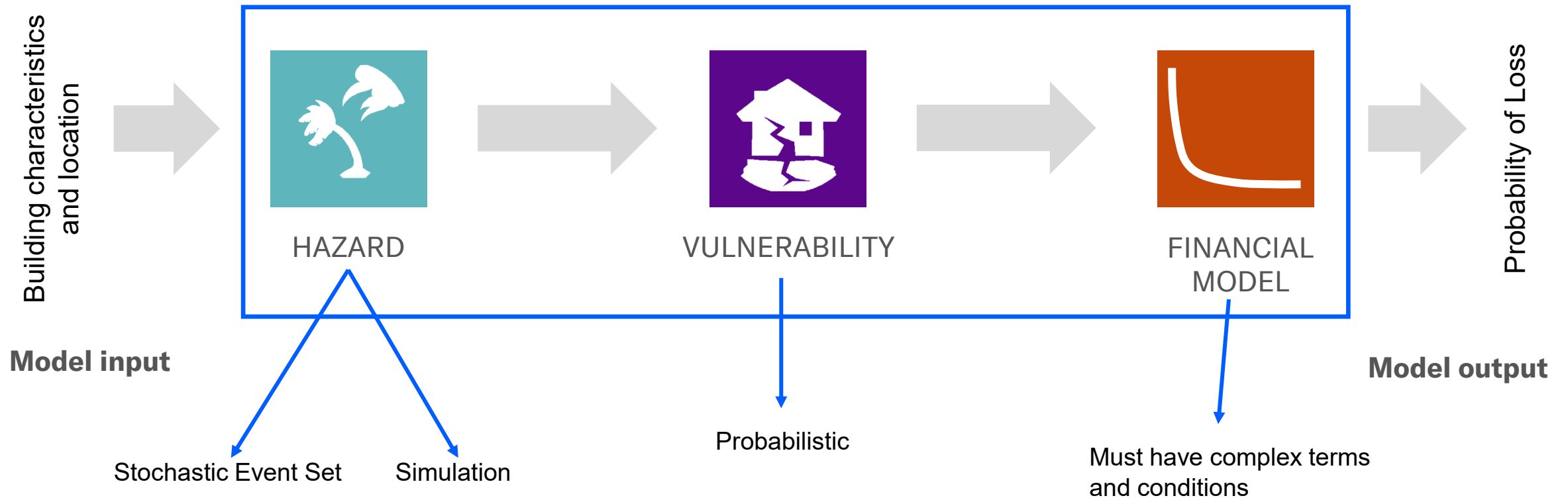
Probabilistic model: What is the probability of insured loss?



The basic catastrophe modeling framework

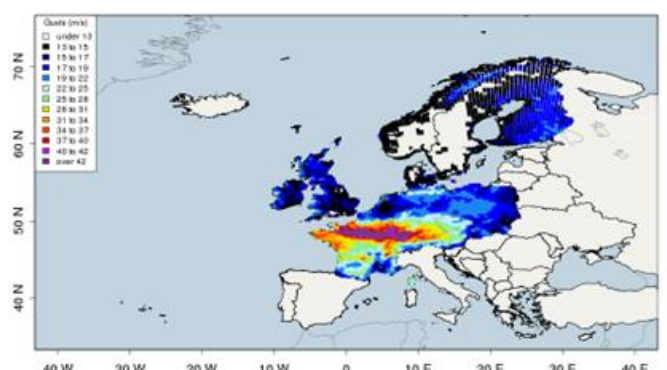
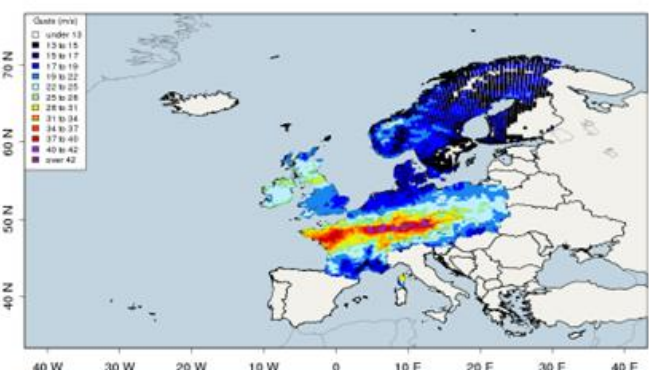
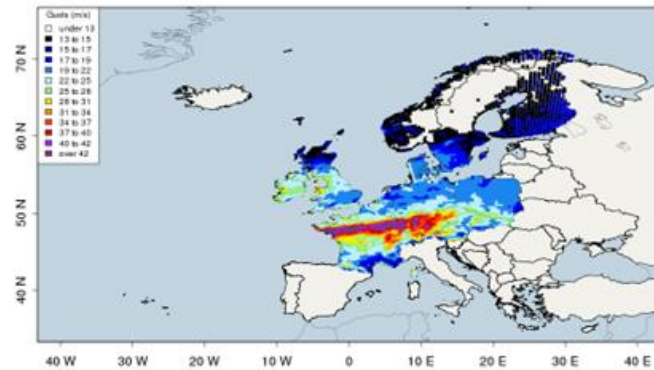
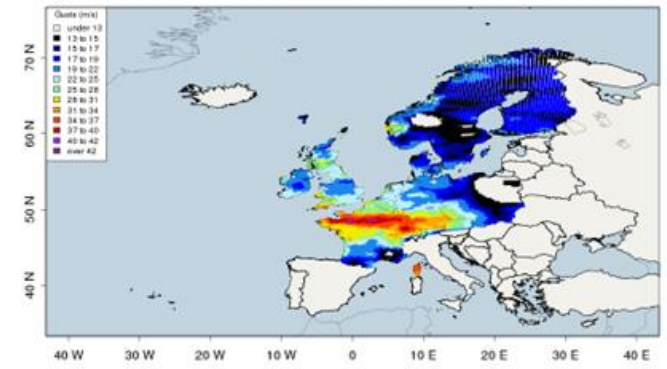
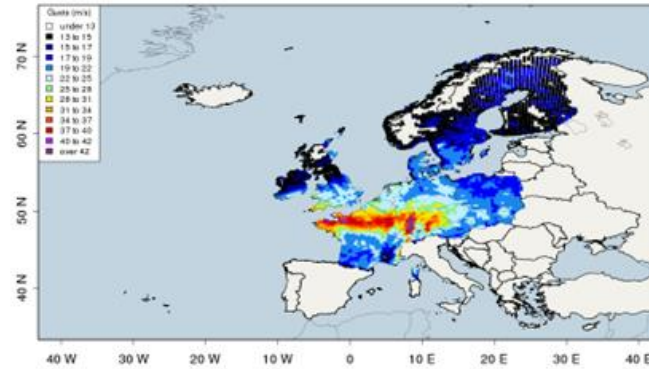
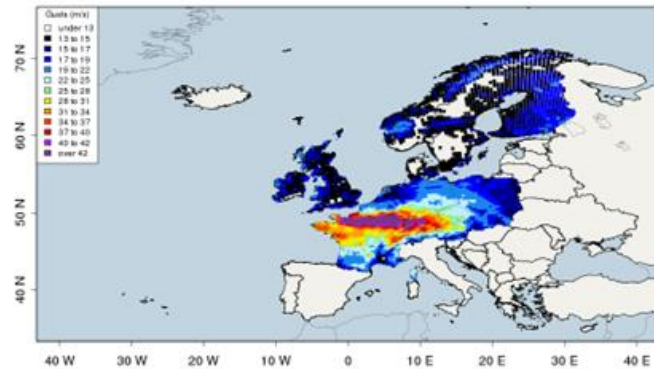
Probabilistic model: What is the probability of insured loss?

Montecarlo (like) Simulation



Examples of Historical and Stochastic Events

The Stochastic events haven't happened *yet* and need be realistic



Catastrophe modelling Output

The very very basic

Cumulative distribution

$$F_X(x) = P(X \leq x)$$

- Time frame is 1 year
- X can be total Annual Loss or maximum Annual Loss

Exceedance probability

Probability of at least 1 event for variable X exceeding x

$$1 - F_X(x)$$

Return period

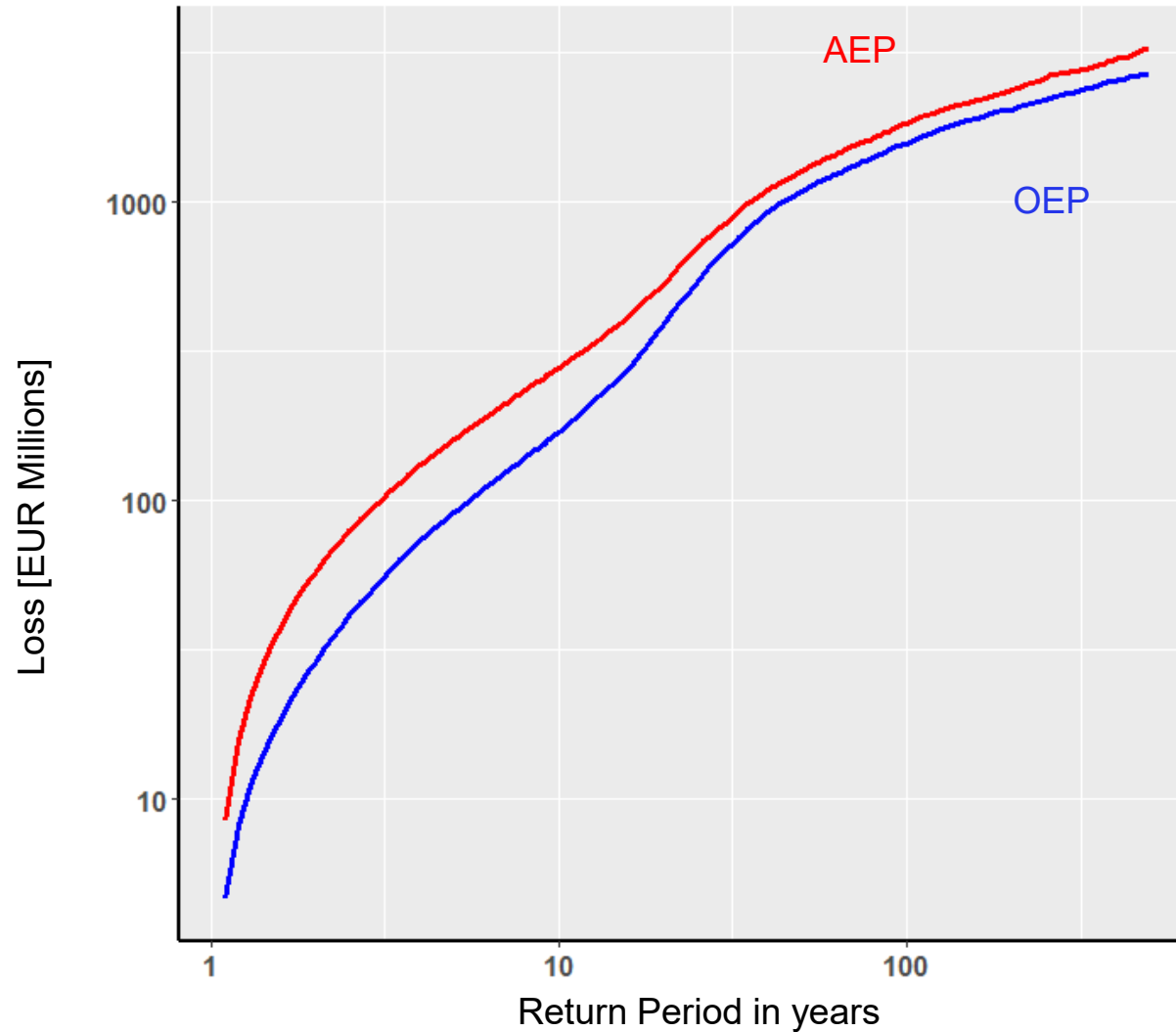
- Take a frequentist approach
- Define **Return Period** as 1/prob
- Return period is a misnomer
- RP = 100 yr means 1% probability of occurrence in 1 year

Main Output Variables

- Annual Average Loss
- Aggregated Exceedance Probability
 - Exceedance Probability of **total** Annual Loss
- Occurrence Exceedance Probability
 - Exceedance Probability of **maximum** Annual Loss

Aggregated EP / Occurrence EP

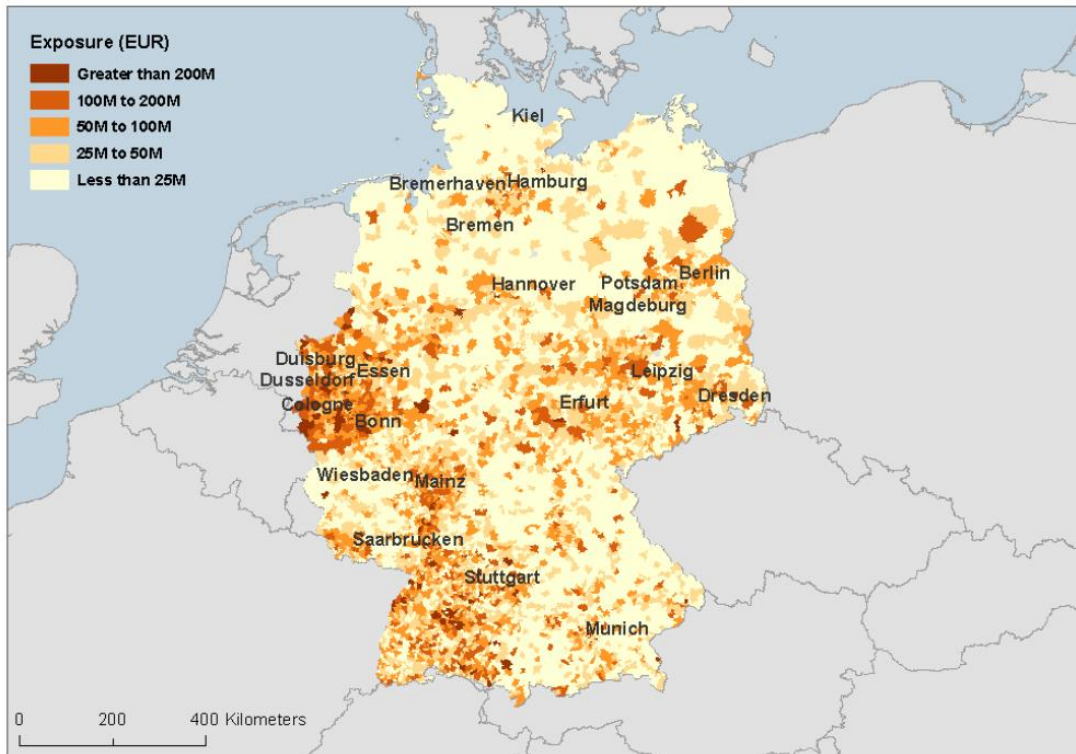
An example



This can be done at any spatial, administrative or business aggregation

PORTFOLIO MANAGEMENT

Insurer Alfa insures 1 million buildings in Germany



Alfa needs to know two main numbers:

1. What is my Average Annual Loss?
2. What is my loss at e.g. 1-in-100yr?

To answer these questions, Alfa needs a NatCat model

Overview of use cases

AAL

- AAL is the minimum price
 - Company costs
 - reserves
 - profit
 - company strategy
 - client dependent

Reinsurance

- How much reinsurance does a primary need to buy?
- What should a primary be charged for reinsurance?
- How much retrocession is needed?

Internal Risk Management

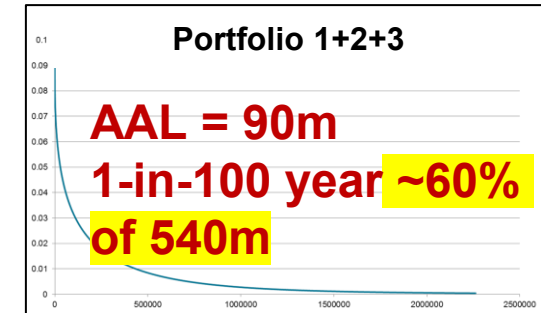
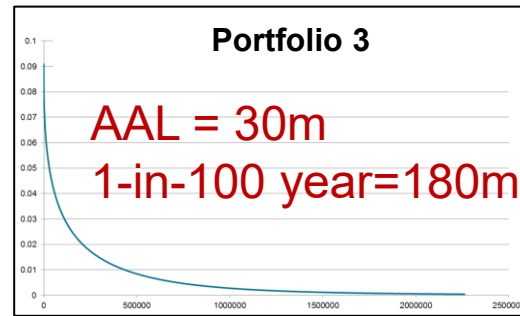
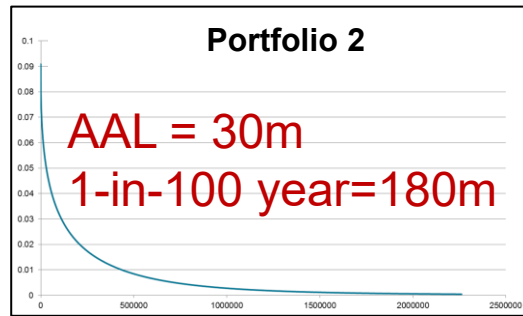
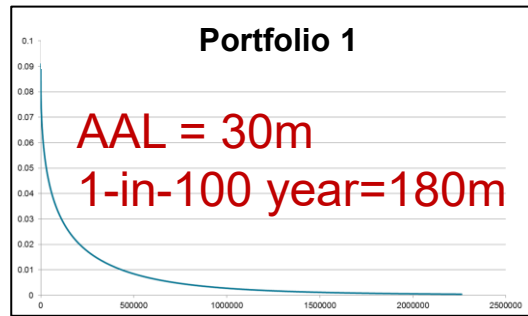
- What is the risk of the company being insolvent?
- How big should reserves be?
- How much should we invest?

Underwriting and Portfolio Management

- The portfolio can be adjusted
 - Policies not renewed or adjusted
 - New business can help differentiation
 - Tail risk increases capital requirements (WS&EQ)
 - Short rp increase burning costs and “earning risk” (CS&FL)

Regulation (SII) – Company Strategy

Diversification by peril and/or region



- Diversification helps to increase efficiency of capital
- Key role of global (re)insurers



(Re)insurance structures

(Re)insurance Structures

Insurance

Basic: limits and deductibles

- Coinsurance: different insurers participate in the same policy
 - Large industrial risk
- Insurance pools:
 - Multiple insurers share a common very large risk, e.g. Nuclear plants
 - Not so common
- State Schemes
 - Nat Cat Scheme in France
 - Consorcio de Seguros in Spain

Proportional Reinsurance

- Includes risk underwritten within the year
 - Cedant pays x% of charged premium to reinsurer
 - Reinsurer pay x% of yearly losses
 - Includes risk underwritten within the year
 - Based on AEP
- Not so common anymore
 - Primary works for reinsurer
 - Useful for small companies

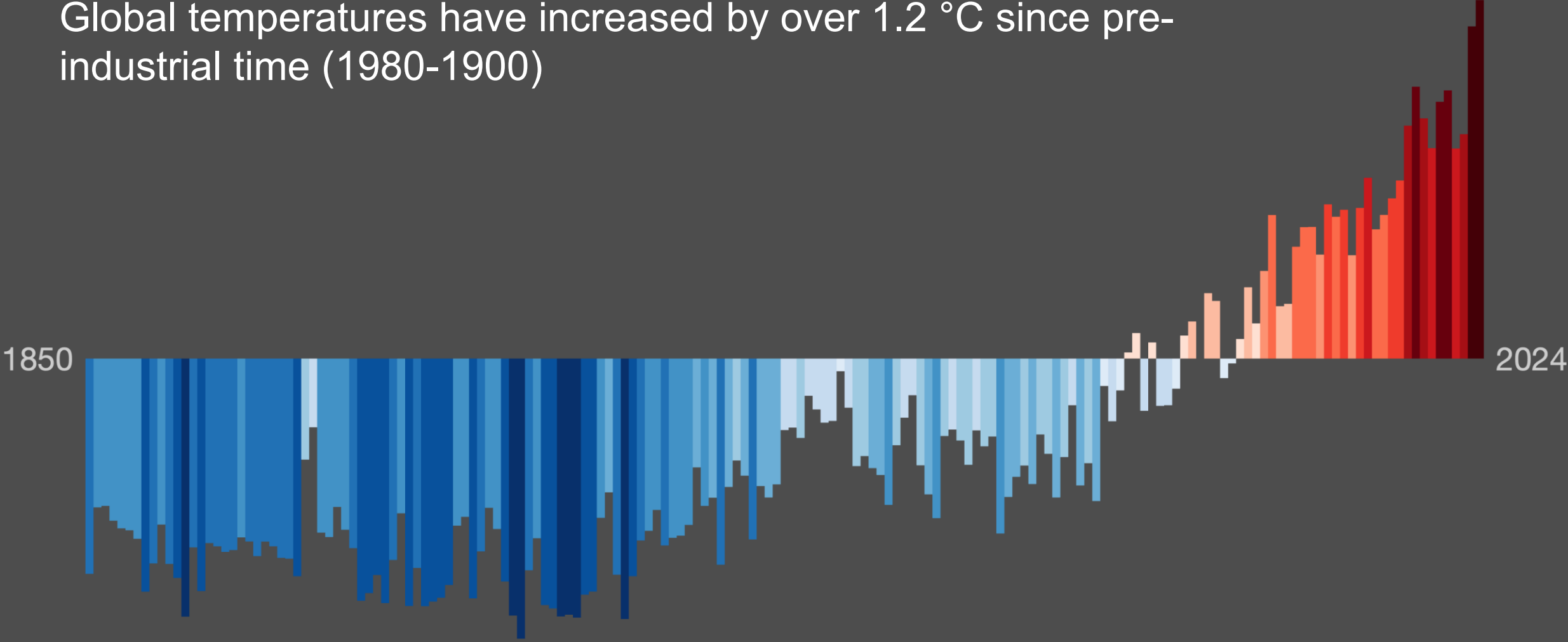
Non Proportional

- Facultative
 - Very high risk
 - Reinsurer can refuse cover
- Per Risk
 - For specific high risk or block of risks
 - Often part of larger program
 - Can have occurrence cover
- Excess of loss
 - Per event
 - Attachment and limit
 - Reinstated
 - Aggregate cover
- Based on OEP (mostly)



Climate Change

Global temperatures have increased by over 1.2 °C since pre-industrial time (1980-1900)



1850-2024 global temperature anomalies

Graphics and lead scientist: [Ed Hawkins](#), National Centre for Atmospheric Science, University of Reading. Source: <https://showyourstripes.info/>

Climate Change

Physical Risk

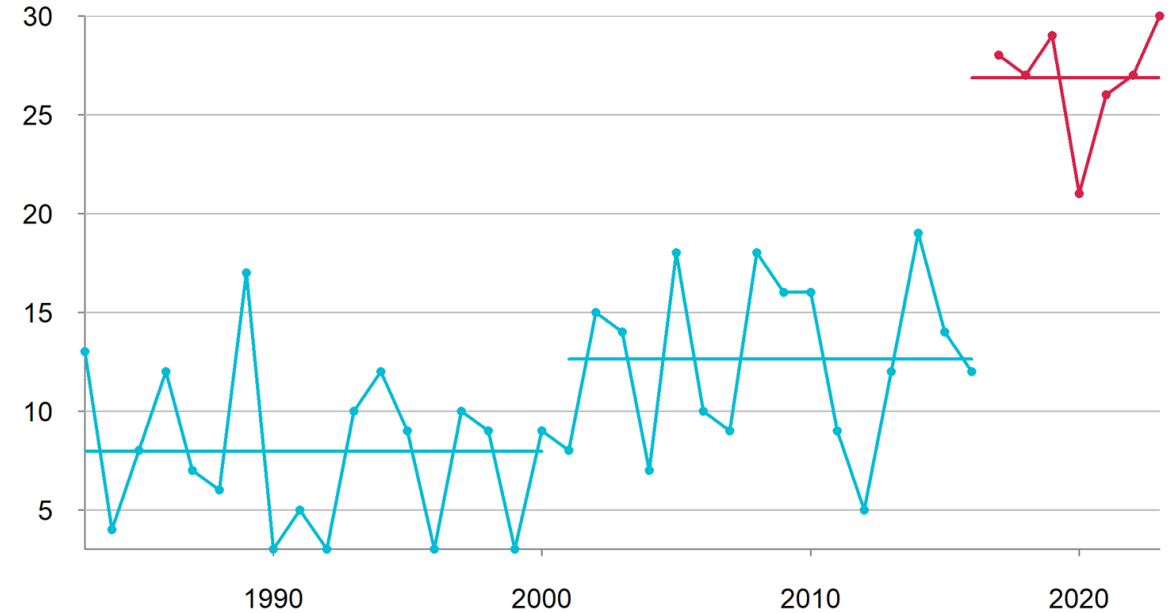
All thermodynamics effect are clear:

- Sea level rise
- Glacier melt
- ...

Dynamical impacts are significantly more uncertain:

- Hurricane: almost a consensus
- European Windstorms and Severe Convective Storms particularly so

Number of Days with Craven parameter exceeding $10,000 \text{ m}^3/\text{s}^3$ for the Summer Months (i.e., June, July, August) in the Po Valley

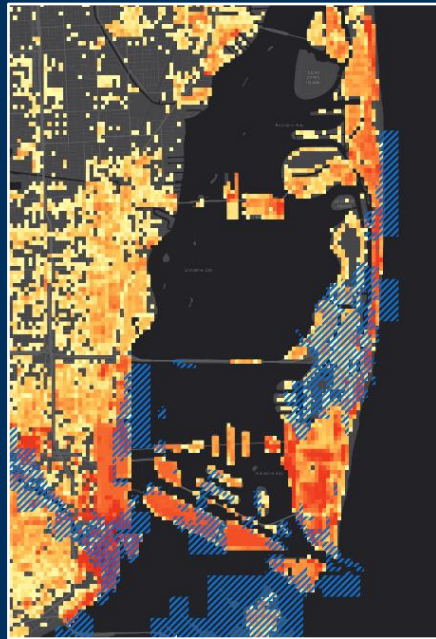


Human behaviour: Italy 2023 5.2b EUR Loss, super bonus, solar panels → 750mil PLA

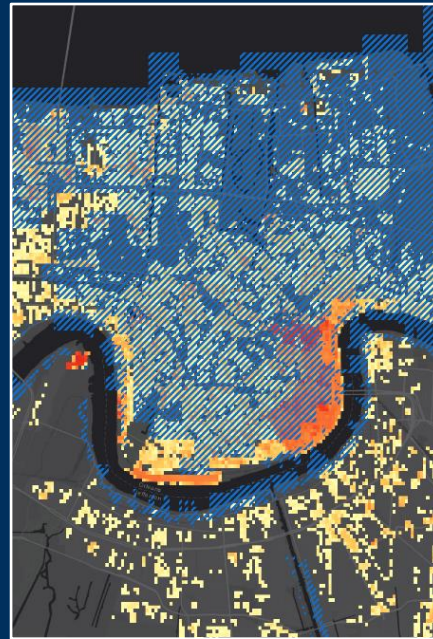
Sea Level Rise + Exposure Growth

Repeat of Hurricanes Andrew, Katrina, Sandy

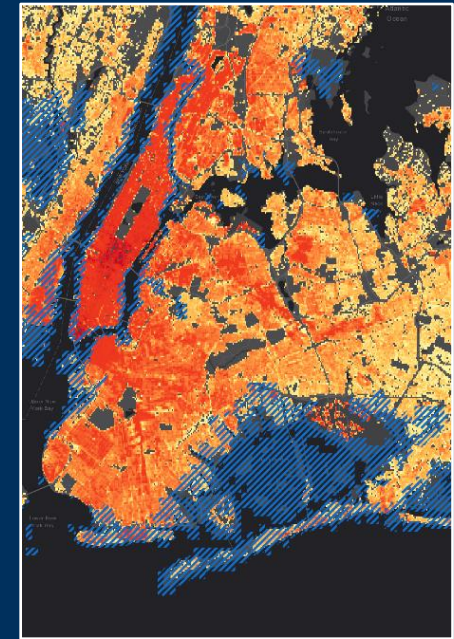
Losses in 2020



Hurricane Andrew | Miami, FL
\$100 Billion



Hurricane Katrina | New Orleans, LA
\$45 Billion Defended
\$73 Billion Undefended

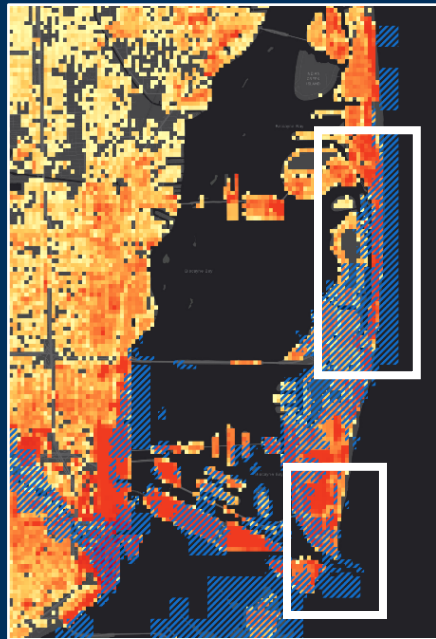


Hurricane Sandy | New York, NY
\$62 Billion

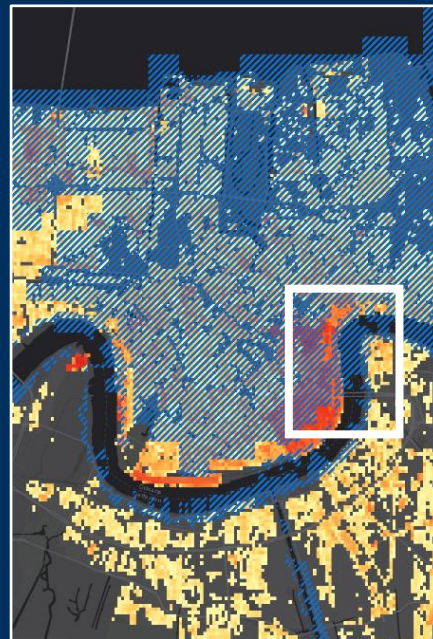
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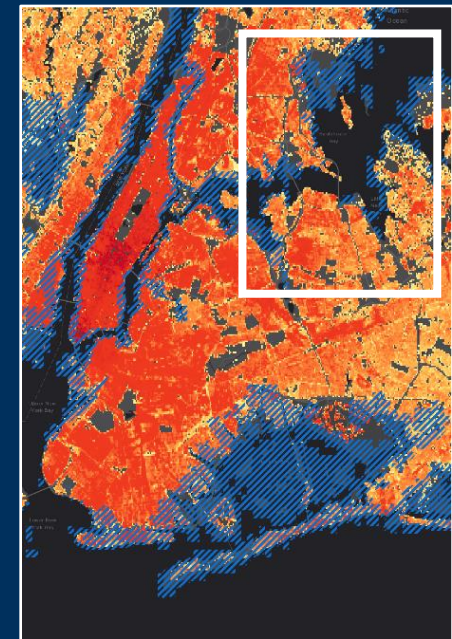
Projected Losses in 2050



Hurricane Andrew | Miami, FL
\$160 Billion



Hurricane Katrina | New Orleans, LA
\$73 Billion Defended
\$136 Billion undefended



Hurricane Sandy | New York, NY
\$148 Billion

Climate Change

How the risk industry is reacting



Regulator

- Assessing exposure of insurance company to climate change
- Requiring Assessment of own risk and solvency
- Integrate climate change into business practices



Climate Change To date

- Capture last 20+ years
- Washed out or implicit?
- Provide “what if” scenarios



Sustainable Pricing

- Use near term (<10yr) view to adjust prices
- Identify unaffordable risk
- Avoid shocks
- Test metrics for future



Sustainable Business planning

- Use near term view to identify impact on portfolio
- Tail goes up faster?
- Capital requirements in 2030?

Summary



Summary

And a few employment tips

The Risk Industry

Is characterized by a diverse mix of applied science and business

- Business and finance drive it
 - You're surrounded by non scientists
- Applied science related to probability theory
 - Internal risk management
 - Actuarial positions
- Natural science is applied to catastrophe modeling
- Expert judgement is necessary and recognized
- Short deadlines, clear applications, impact of work is dealt with **before** it's finished

Cat Modeling

Is a necessary tool for most industry players

Beyond natural catastrophes: cyber, terrorism, casualty

Analytical background is necessary, natural science background strongly wished

Catastrophe models need to be develop and validated

Uncertainties leave room for bespoke applications and tool development

Climate change applications are growing

Many exciting roles at the science/industry interface

Thank you Any questions?

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