# SOLVENCY II:

## How Geosciences become crucial for the Insurance Business.

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# INSURANCE IS SOCIAL

**Insurance mitigates Risk**

If your house burns down due to lightning the community pays.

**Insurance reduces Risk**

If you want building a house in a flood plane you won't find an insurer.

# INSURANCE IS SOCIAL

**Why do they build buildings like this?**

a) To impress.
b) To demonstrate that they have enough money to pay in case your house burns down.

# HOW MUCH CASH SHOULD INSURANCE HAVE?

Sum of premiums $P$ ≥ average Losses $L$
Plus some extra money $S$ for 'bad' years.

The Ruin problem:

$$S_{t+1} = S_t + P_{\Delta t} - L_{\Delta t}$$

$$\begin{aligned} S_{t+1} &= \text{Solvency at the end of a year} \\ S_t &= \text{Solvency at beginning of a year} \\ P_{\Delta t} &= \text{Premiums during the year} \\ L_{\Delta t} &= \text{Losses during the year} \end{aligned}$$

If $S_{t+1} < 0$ → bankruptcy.

# HOW TO AVOID BANKRUPTCY?

$$S_t > L - P$$

Total annual loss $L$

- is a random variable,
- is insurer specific
  since it depends on the portfolio
  - what is insured
  - where
  - against what

# SOLVENCY II OF THE EU

## Solvency Capital Requirement SCR

EU wants all insurers who write contracts in Europe to stay solvent even in case of a one-in-two-hundred year annual loss.

Why?

- To reduce the risk that an insurer would be unable to meet claims;
- To reduce the losses suffered by policyholders in the event that a firm is unable to meet all claims fully;
- To provide early warning to supervisors so that they can intervene promptly if capital falls below the required level; and
- To promote confidence in the financial stability of the insurance sector.

But how save is this?

SOLVENCY II

# Encounter probability

Probability that an event with return period $\tau$ happens to occur within $N$ years.

$$P_N(\tau) = 1 - \left(1 - \frac{1}{\tau}\right)^N$$

$P_{40}(\tau = 200) \approx 18\%$

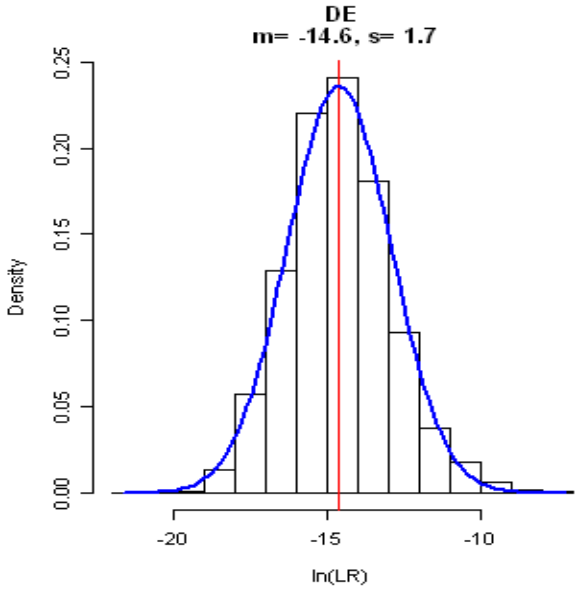
And how to estimate the 200-yr loss?

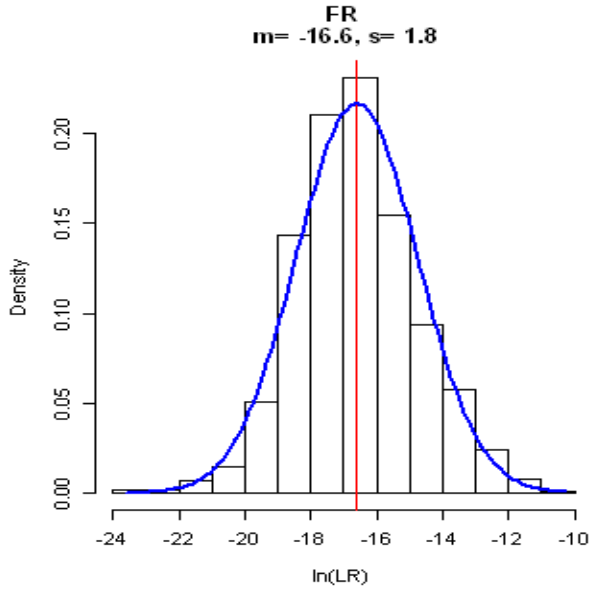
# THE CLASSICAL ACTUARIAL APPROACH

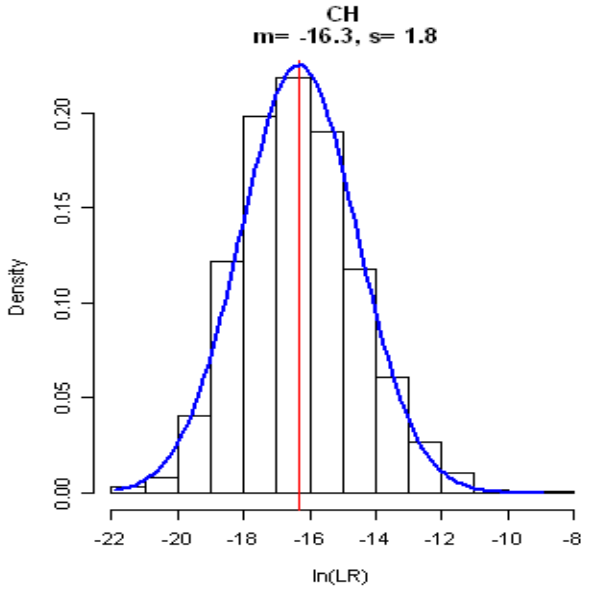
Example:
Distribution of claims due to convective events (hail and wind).

→ Estimate return periods of high losses.

Problem: Extrapolation from short observations periods.



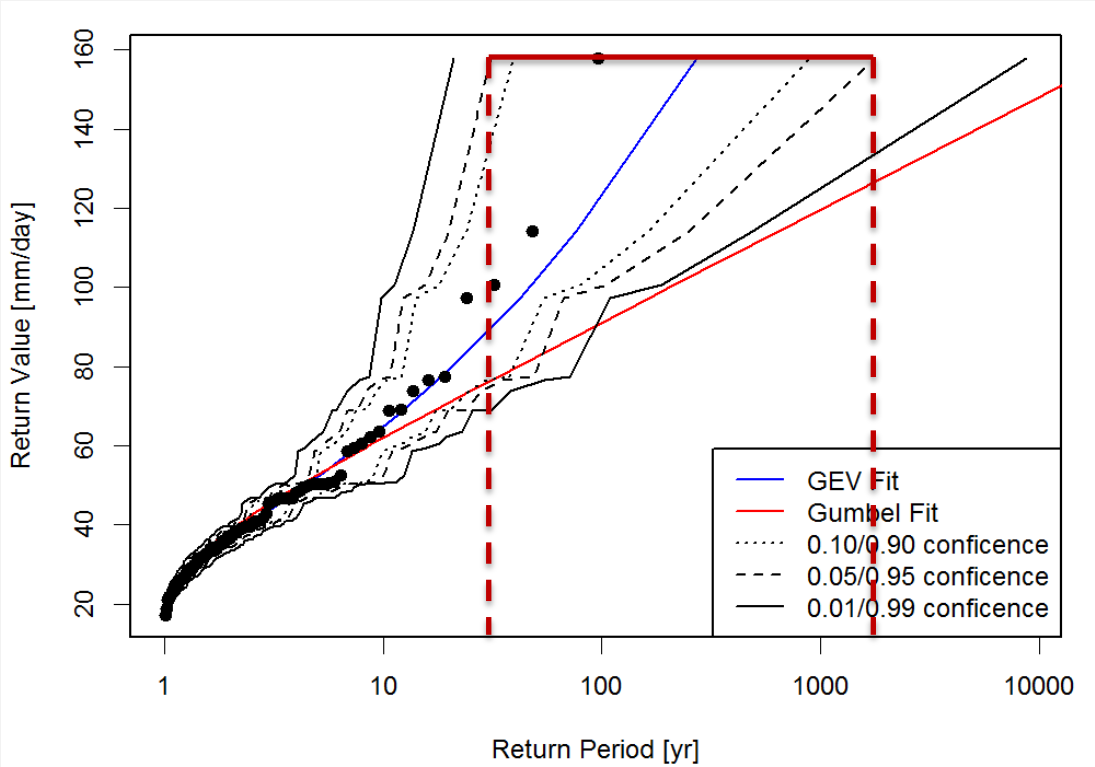



# IS STATISTICAL EXTRAPOLATION ANY GOOD?

- A simple example:
  What is the return period of the rain event causing the Elbe 2002 flood?
- Look at the observed daily rain in Dresden from 1917 to 2011.
- And do extreme value statistics.

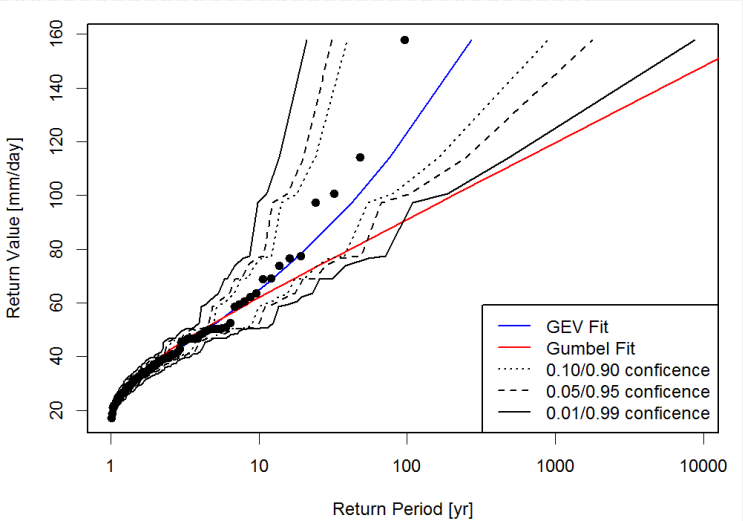
→ Pure statistical approach is very uncertain.



# CAN WE DO BETTER?

Yes,

the really extreme rain is linked to certain weather conditions.



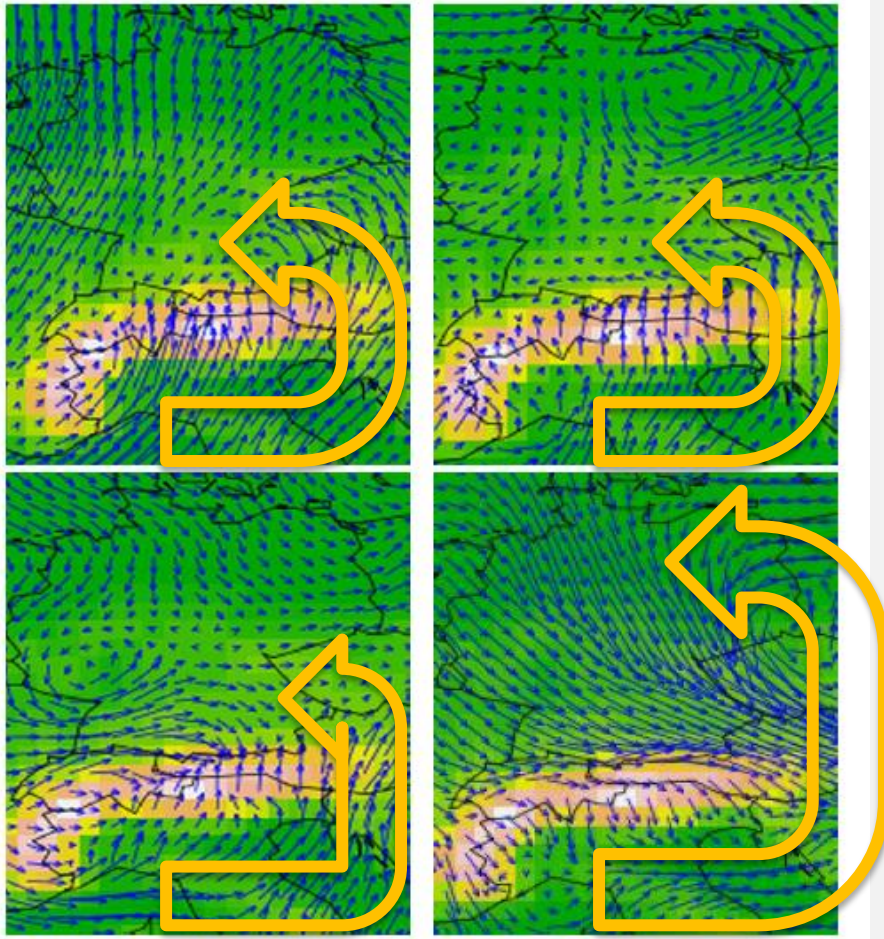



Figure 7.1: 850hPa reanalysis wind field from CFSR for 12 noon of the $18^{th}$ July 1987 (upper left image), the $2^{nd}$ August 1998 (upper right image), the $6^{th}$ July 1999 (lower left image), and the$8^{th}$ August 2002 (lower right image).

# HOW TO AVOID BANKRUPTCY?

$$S_t > L - P$$

## The Standard Formula of Solvency II:

Mean loss = premiums.

Deviation from mean loss is Gaussian → $L = \mu_L + k\,\sigma_L$

Individual losses are correlated → $\rho_{ij} > 0$

The annual ruin probability should be $p_b = 1/200$.

# HOW TO AVOID BANKRUPTCY?

$$S_t > L - P$$

## The Standard Formula of Solvency II:

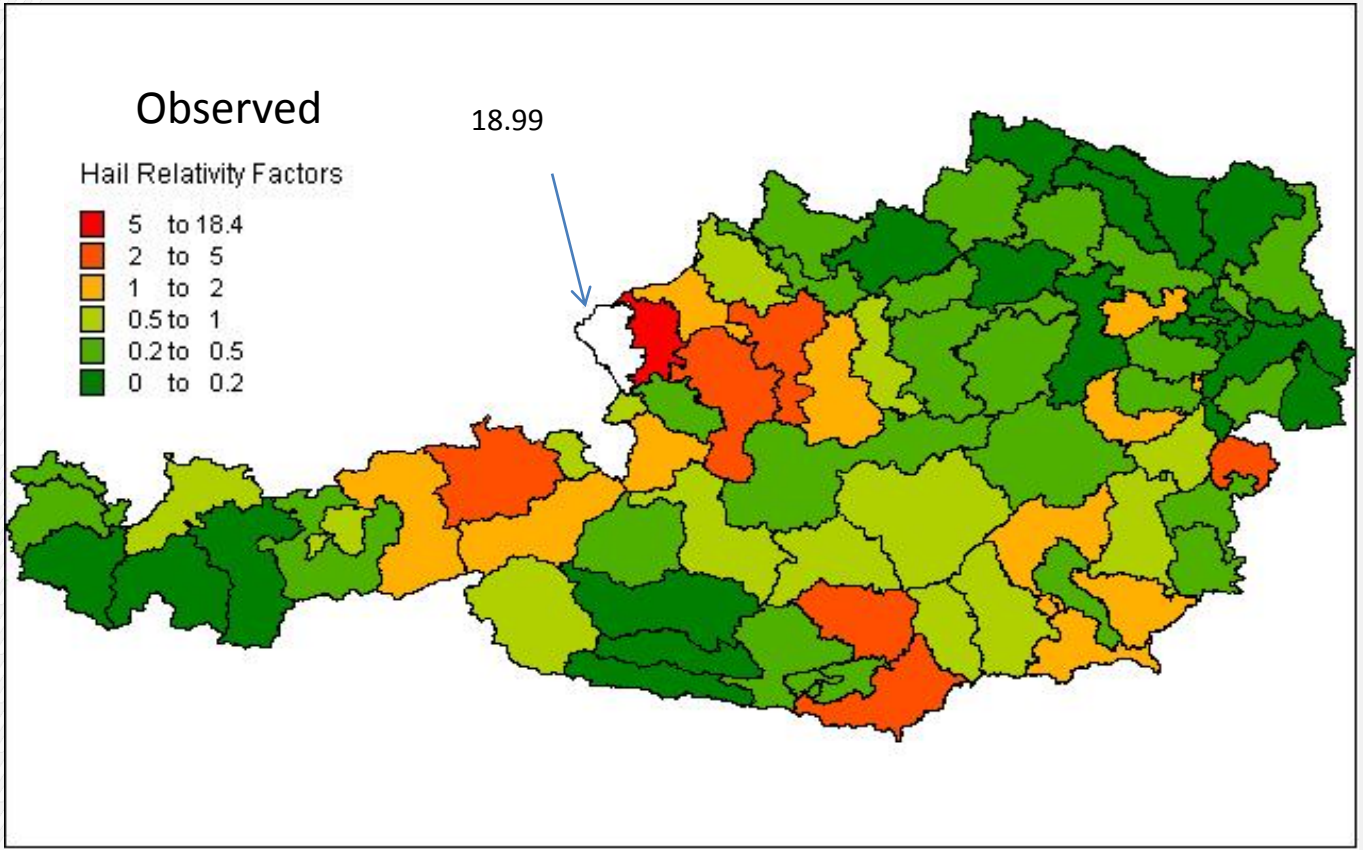
$$SCR = \bar{\lambda} \sqrt{\sum_{i,j} \rho_{i,j} \frac{\lambda_i}{\bar{\lambda}} TIV_i \frac{\lambda_i}{\bar{\lambda}} TIV_j}$$

| | | | | |
|---|---|---|---|---|
| $SCR$ | = | Solvency at beginning of a year | = | Solvency Capital Requirement |
| $\rho_{ij}$ | = | Correlation between different regions/perils | = | Aggregation Matrix |
| $TIV_i$ | = | Total insured value in region $i$ | | |
| $\bar{\lambda}$ | = | Expected aggregated mean loss ratio | = | Market Factor |
| $\frac{\lambda_i}{\bar{\lambda}}$ | = | Local to aggregated loss ratio | = | Relativity Factor |

# RELATIVITY FACTORS

## Local Loss Ratio to Countrywide Loss Ratio

According to this observation one CRESTA cell determines the majority of the loss.
→Don't trust observed loss statistics.
→ Use Risk Models.



# SO WHAT?

## Insurers have the choice

a) Use the standard formula
b) Use an in-house model → developed by geoscientists
c) Use a vendor model → developed by geoscientists.

Summary:
The EU forces insurers to estimate their risk.
Insurers need the work of geoscientists.

→ There is a lot of work waiting to be done by geoscientists.

*Thanks for your attention*