



# Spatial risk analysis and modeling of insurance portfolios

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## Goal and data basis

### Goal

- ▶ Risk analysis and modeling of insurance portfolios with methods from image analysis, stochastic geometry and spatial statistics
- ▶ Risk mapping of insurance portfolios
- ▶ Assessment of the spatial risk situation
- ▶ Regionalized premium rating

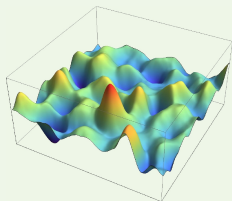
### Data basis

- ▶ Geographically referenced risk locations (e. g. x- and y-coordinates of risk addresses)
- ▶ At each risk location:
  - ▶ Quantities to model: Claim size, claim frequency, claims expenditure, ...
  - ▶ Covariates: insurance sum, construction material of the house, ...

## Tools

### Models

- ▶ Regression with spatial residuals which are modeled by random fields



Realization of a random field

- ▶ Modeling of extremes: max-stable random fields
- ▶ Partition models

## Tools

### Risk mapping

Geographic mapping and analysis of claim sizes, claim frequencies, claims expenditures, net premiums, gross premiums and detection of dangerous risk zones with

- ▶ Randomly colored mosaics
- ▶ Kriging
- ▶ Radial methods
- ▶ Partition models
- ▶ Whittaker smoothing

### Premium rating

- ▶ Regionalized premium rating for each risk address based on Monte-Carlo simulation:
  - ▶ Calculation of the regionalized net premium
  - ▶ Calculation of the safety loading based on ruin theory

## Examples

### Examples of applications in projects

- ▶ Simulation of storms:  
Simulation of storm tracks (in reinsurance) and of claim sizes, frequencies and expenditures in storm insurance (direct insurance)
- ▶ Simulation of flooding (in house insurance)
- ▶ Surrender analysis (in car insurance)