FloodRisk-7000

Calculating flood risk with 7000 years of flood frequency data and highly damage relevant cyclone tracks under current & future climatic conditions

F. Prettenthaler, H. Albrecher, M. Hofstätter, D. Kortschak, J. Köberl, A. Lexer, T. Swierczynski

ACRP 8th Call, March 2016 - March 2018

Climate Day, 22-24.05.2017, Vienna

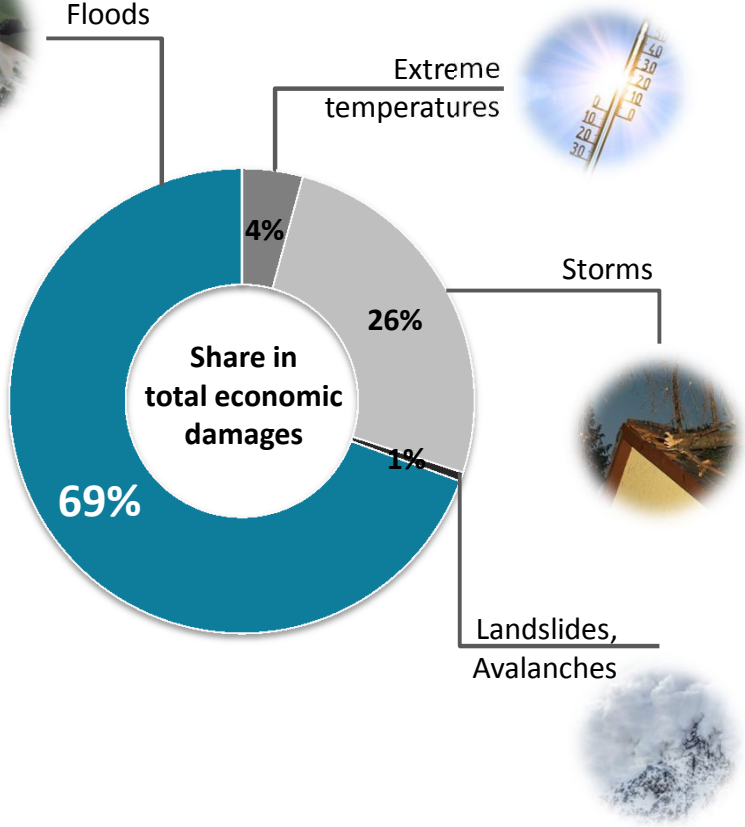
Motivation

- **Floods** are the leading cause of economic damages from natural disasters in Austria

- Estimations on current and future damage potential are of **high importance**

BUT

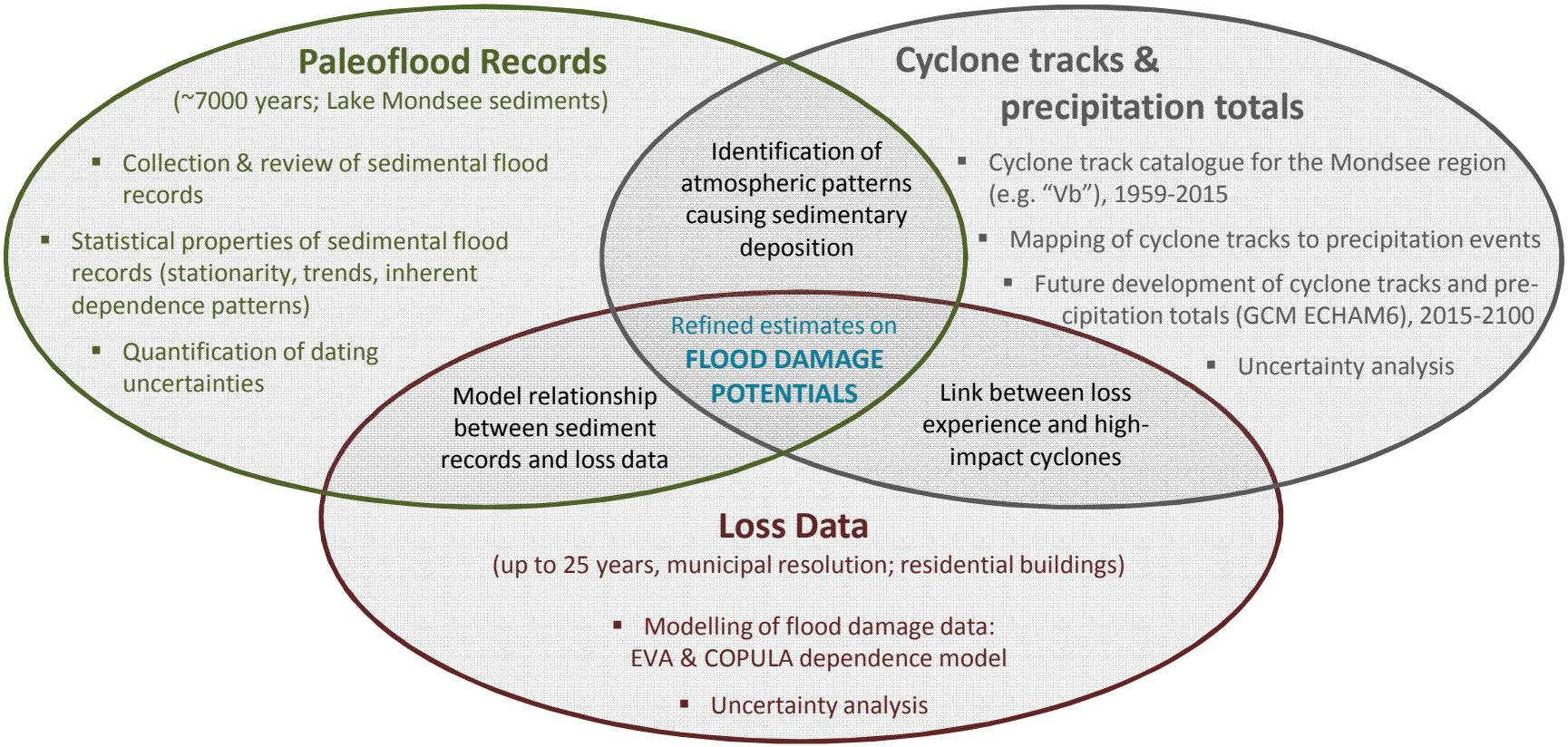
- Uncertainty is high – amongst others due to **short time series** on damage experience



Data source: EM-DAT; 1990-2016

Project Objective & Methodology

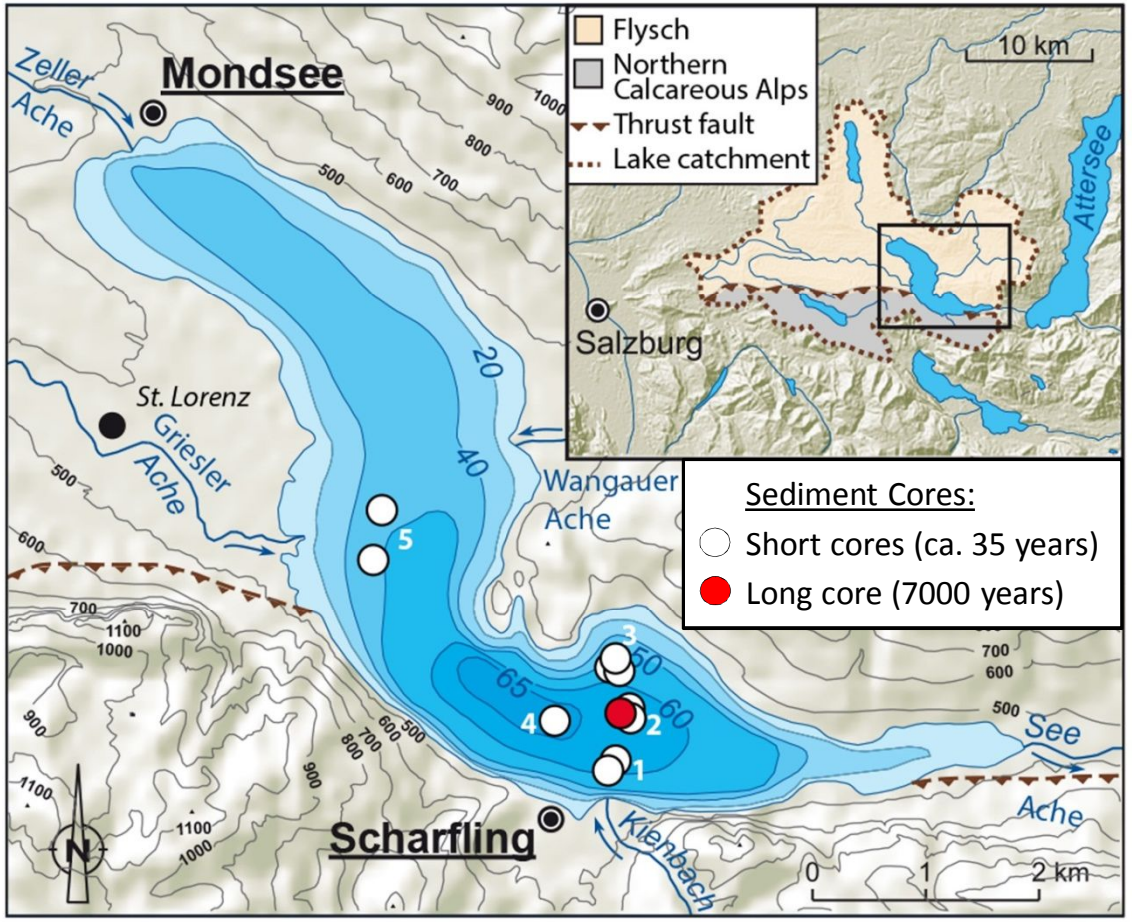
Improve estimations on past, current and future flood damage potentials by making use of and merging different kinds of data sets (Focus: Northern Austria)



Expected Outcomes

- Link between paleoflood records (7000 years) and triggering meteorological events
- Link between damage experience and most likely causes of high-impact cyclones
- Calculated long-term insurance premiums for the current building stock, incorporating paleo-flood information (e.g. regarding temporal variation in flood risks)
- Calculated maximal flood damage potential on the basis of future climate and socio-economic scenarios
- Quantification of the uncertainty reduction due to this novel approach

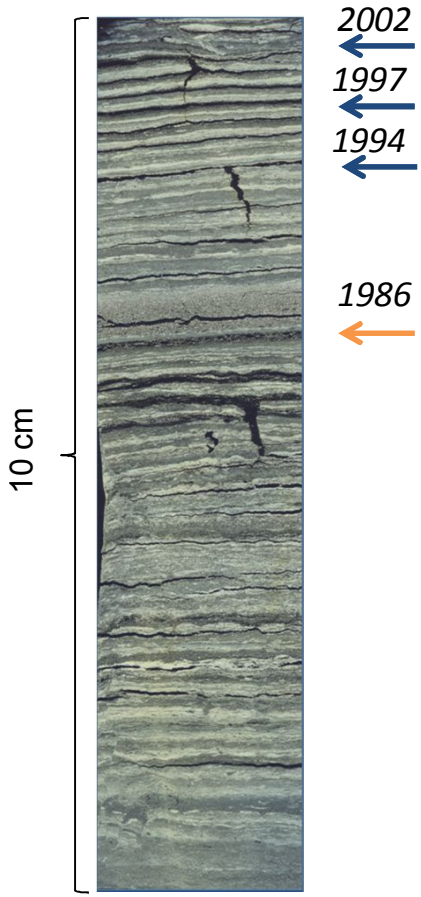
Project study: Mondsee (Upper Austria)



Altitude: 481 m asl, **Lake surface** 13.8 km², **Depth (max):** 68 m, **Catchment:** 247 km²

Floods in Mondsee: June 2013

7000-year flood series from Mondsee sediments



Laminated Mondsee sediments (varves):

- Spring/Summer calcite layer, diatoms (algaes)
- Autumn/Winter clastic debris
- Abundant event layers
  - → Flood layers
  - → debris flows layers

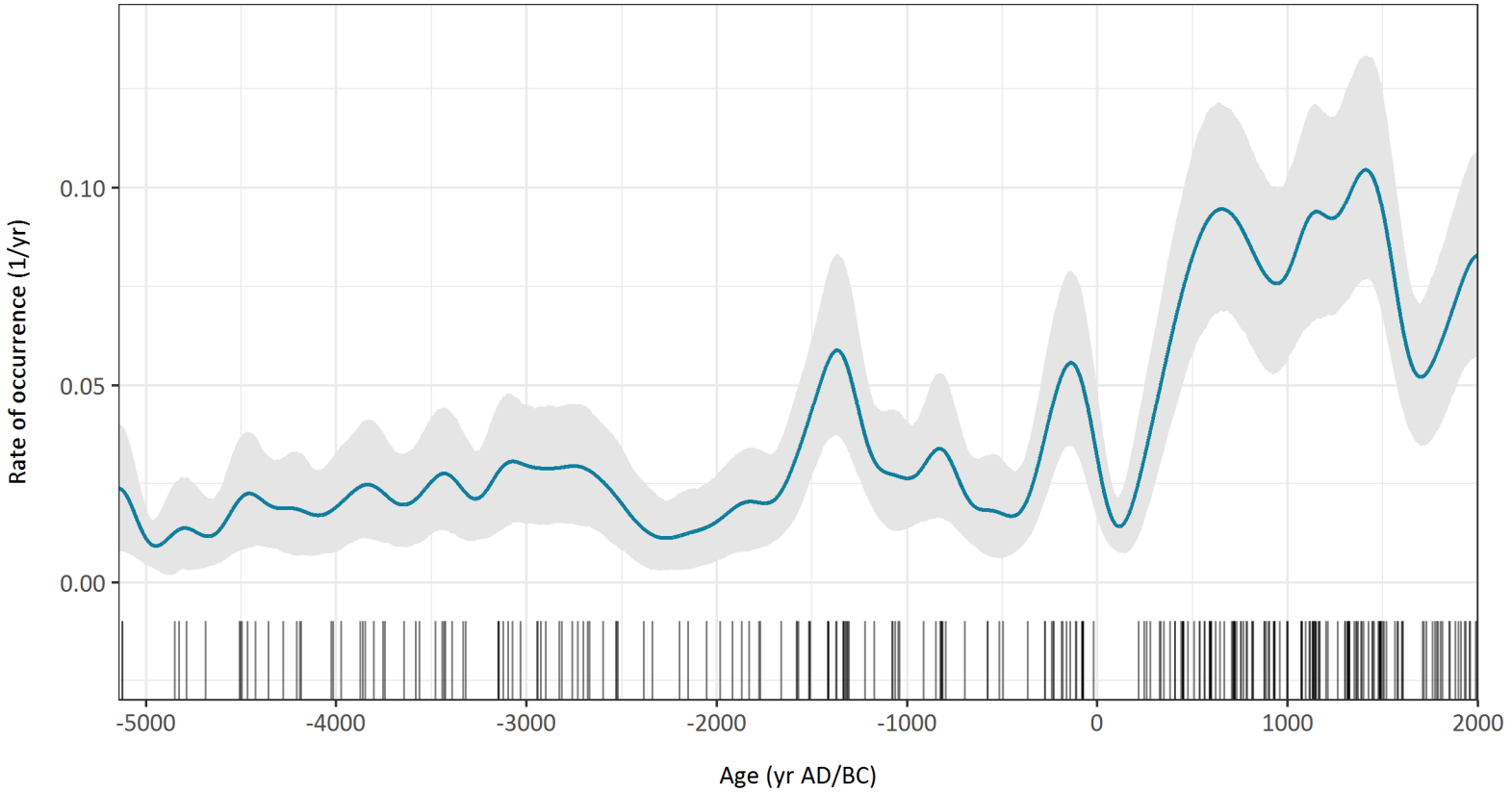
Event layer reconstruction:

Extreme precipitation in summer causes floods and debris flows that lead to detectable sediment input into the lake

Statistical properties of sediment records

- Rate of flood occurrence

  assuming a non-homogeneous Poisson process



Statistical properties of sediment records

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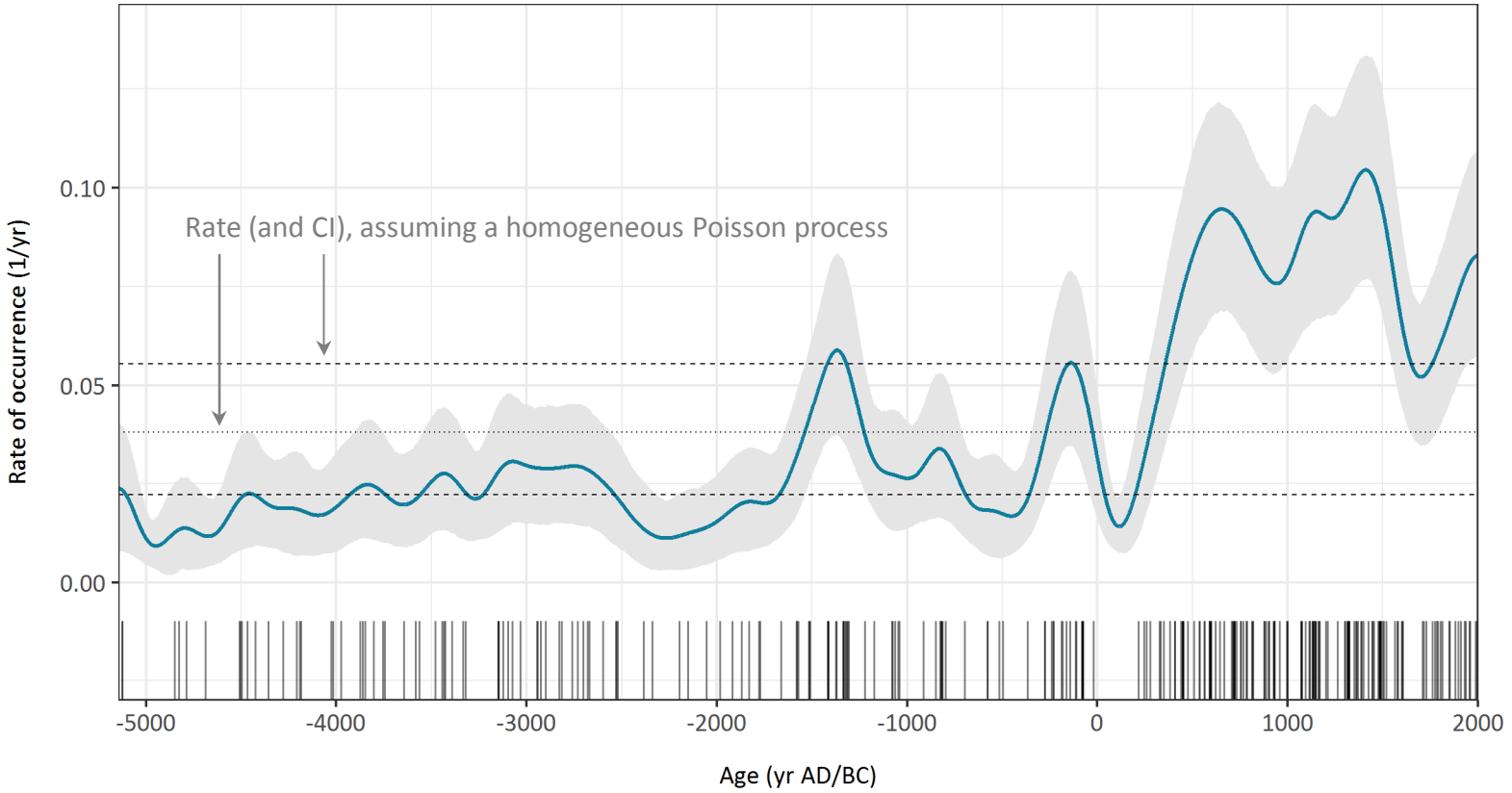
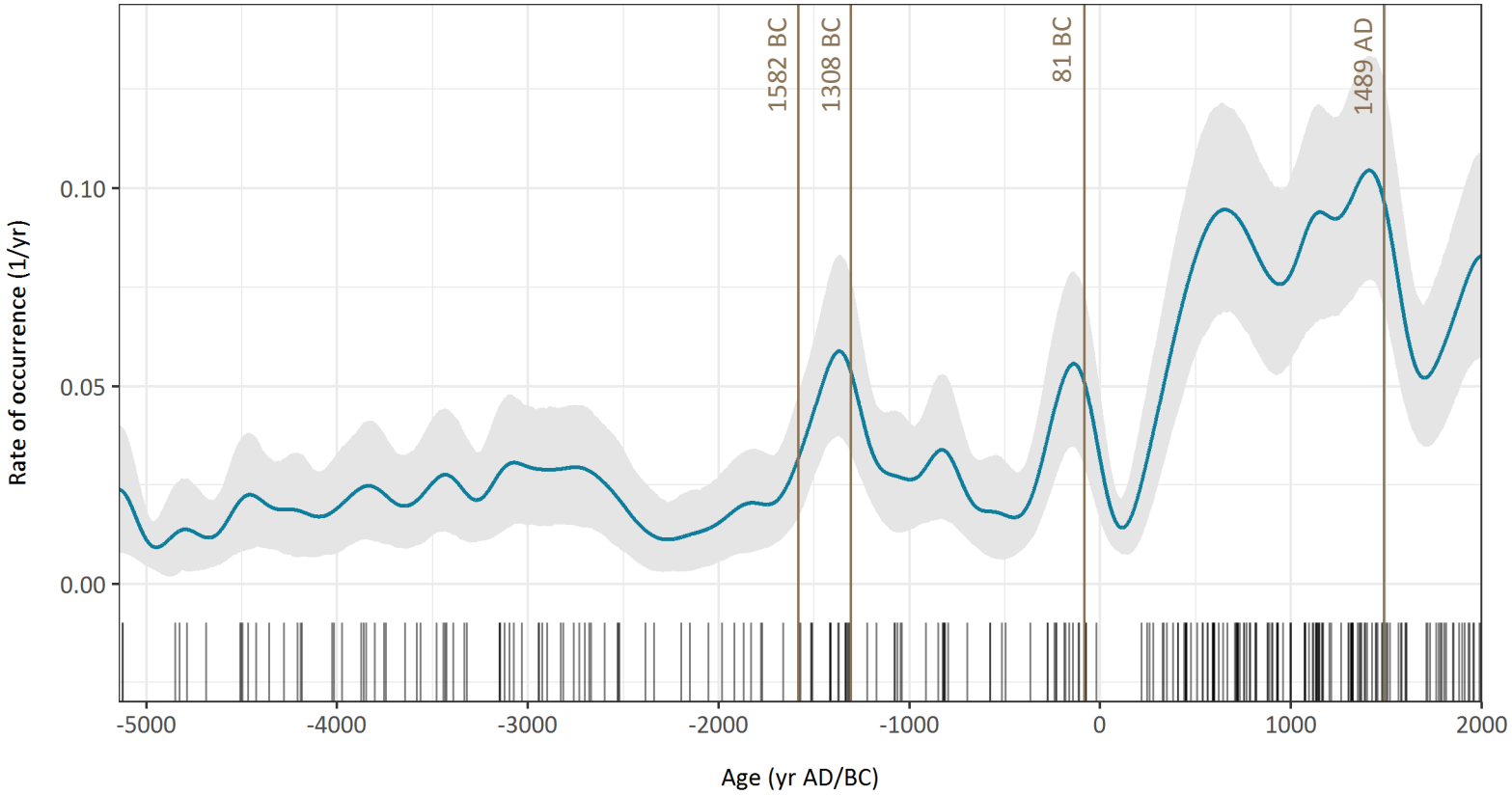


Statistical properties of sediment records

- **Change Points**

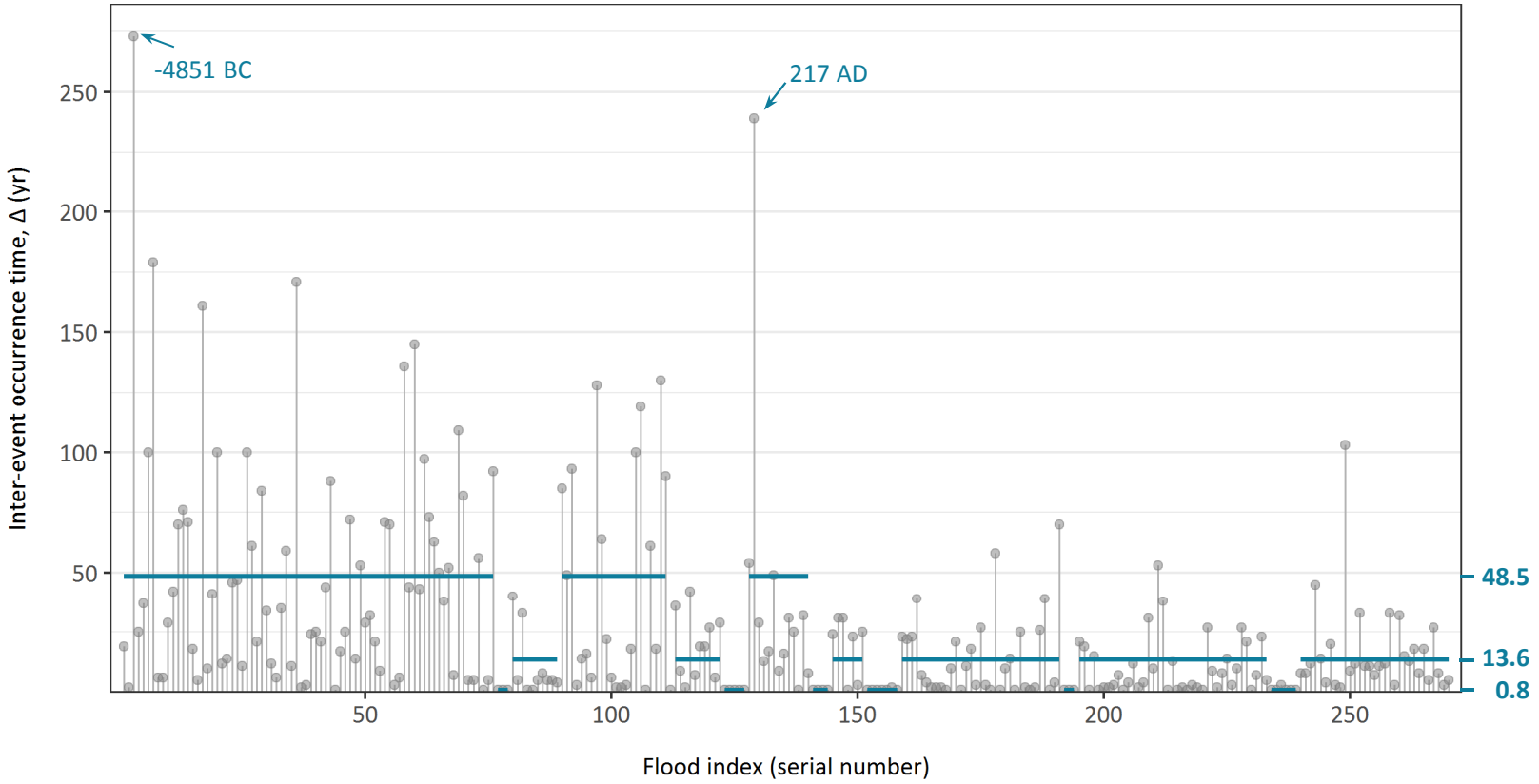
  indicated by a Change Point Analysis on inter-event occurrence time



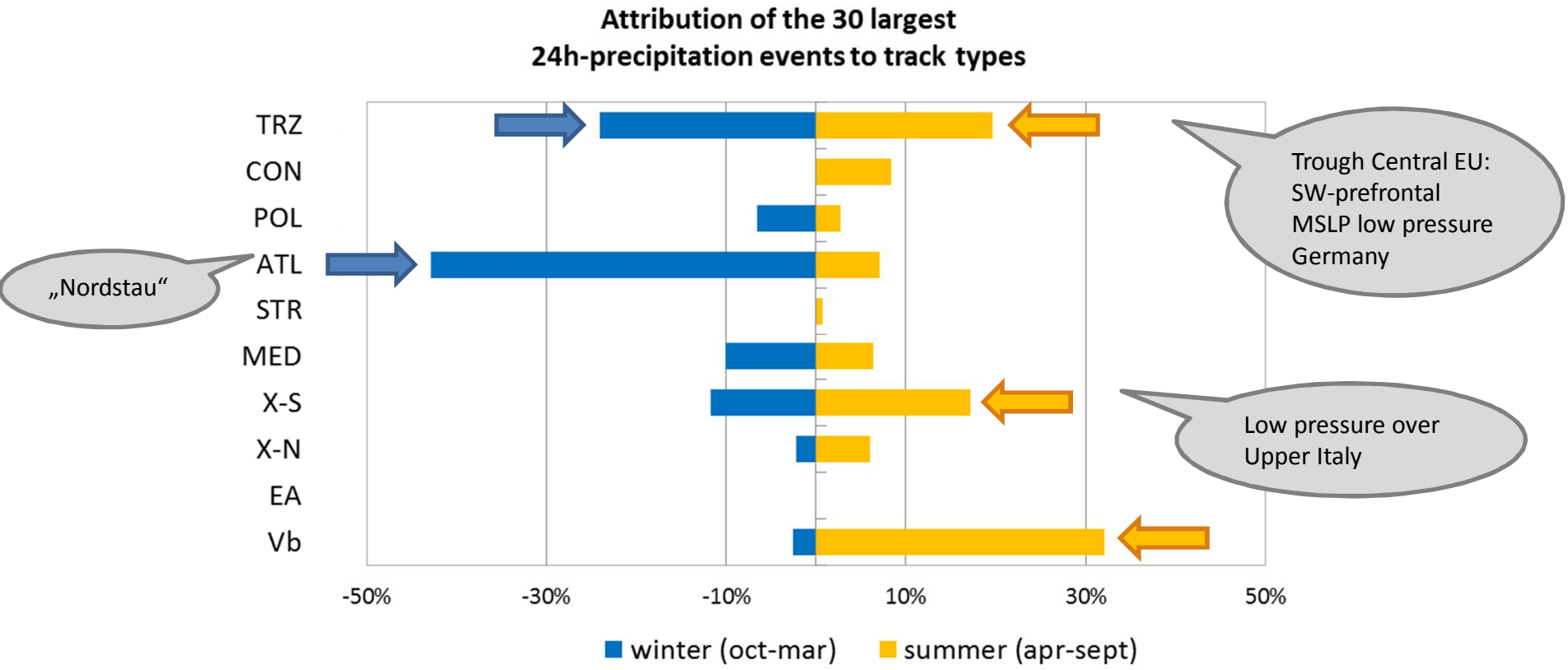
Statistical properties of sediment records

- **Three distinct regimes**

  when modelling inter-event occurrence times as Hidden Markov Process

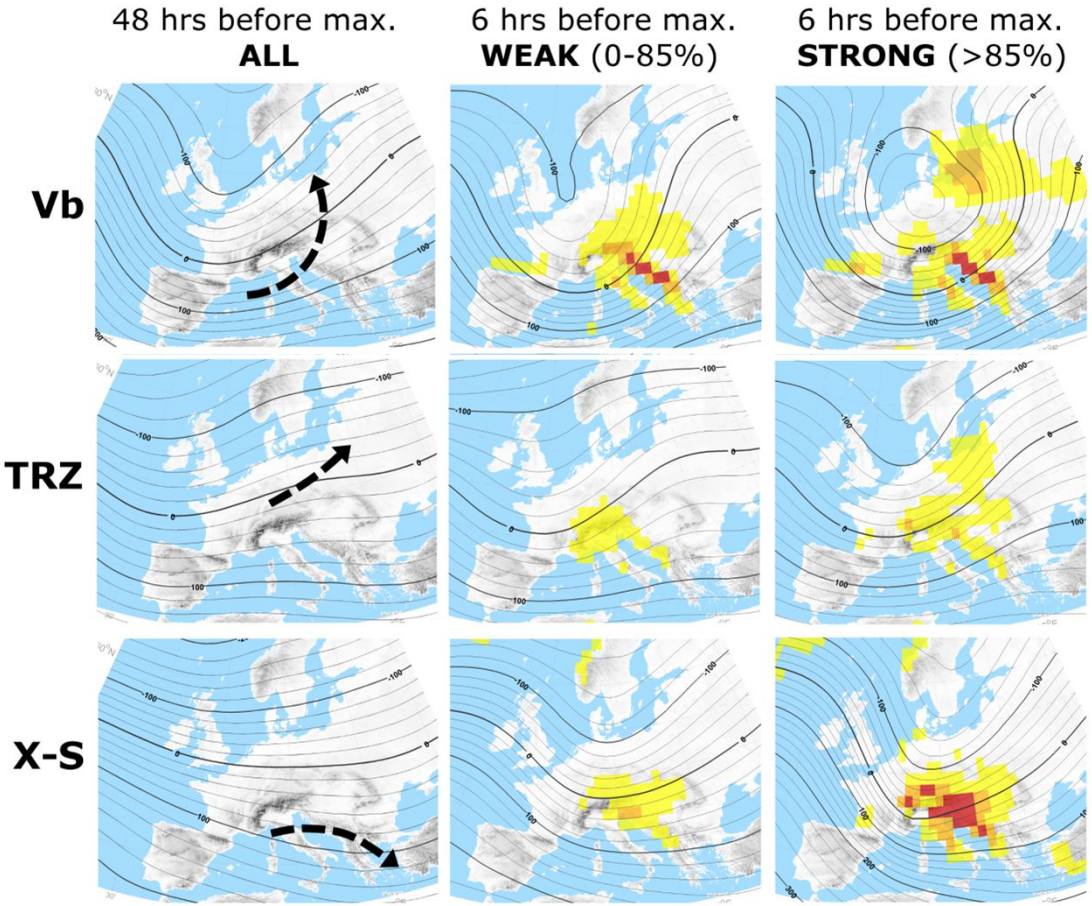


Top30 precipitation events: attribution to track types



Track types according to: Hofstätter, M., Chimani, B., Lexer, A. and Blöschl, G. (2016). *A new classification scheme of European cyclone tracks with relevance to precipitation*, Water Resour. Res., 52, doi:10.1002/2016WR019146

Atmospheric patterns and cyclone track types

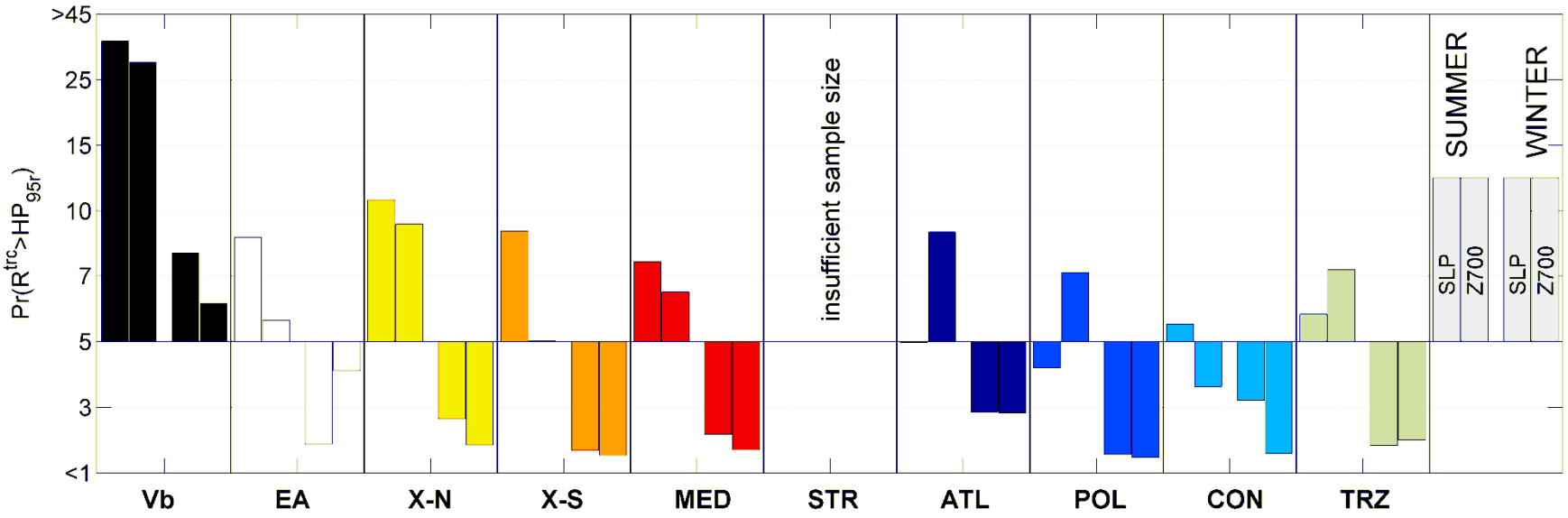


Heavy precipitation inducing circulation patterns for Mondsee (Salzburg/Upper Austria „Stau“), composite from cyclone tracks types

Hofstätter, M., Lexer, A., Homan, M. and G. Blöschl (2017). *Heavy precipitation over Central Europe and the role of cyclone track types*, Int. J. Climat., in review 2017.

Heavy precipitation and cyclone track types

Vb, EA, X-N, X-S show a high probability for an RR^{95}-heavy-precipitation-event in the region Nordstau (includes the Mondsee's catchment area) within the summer half-year



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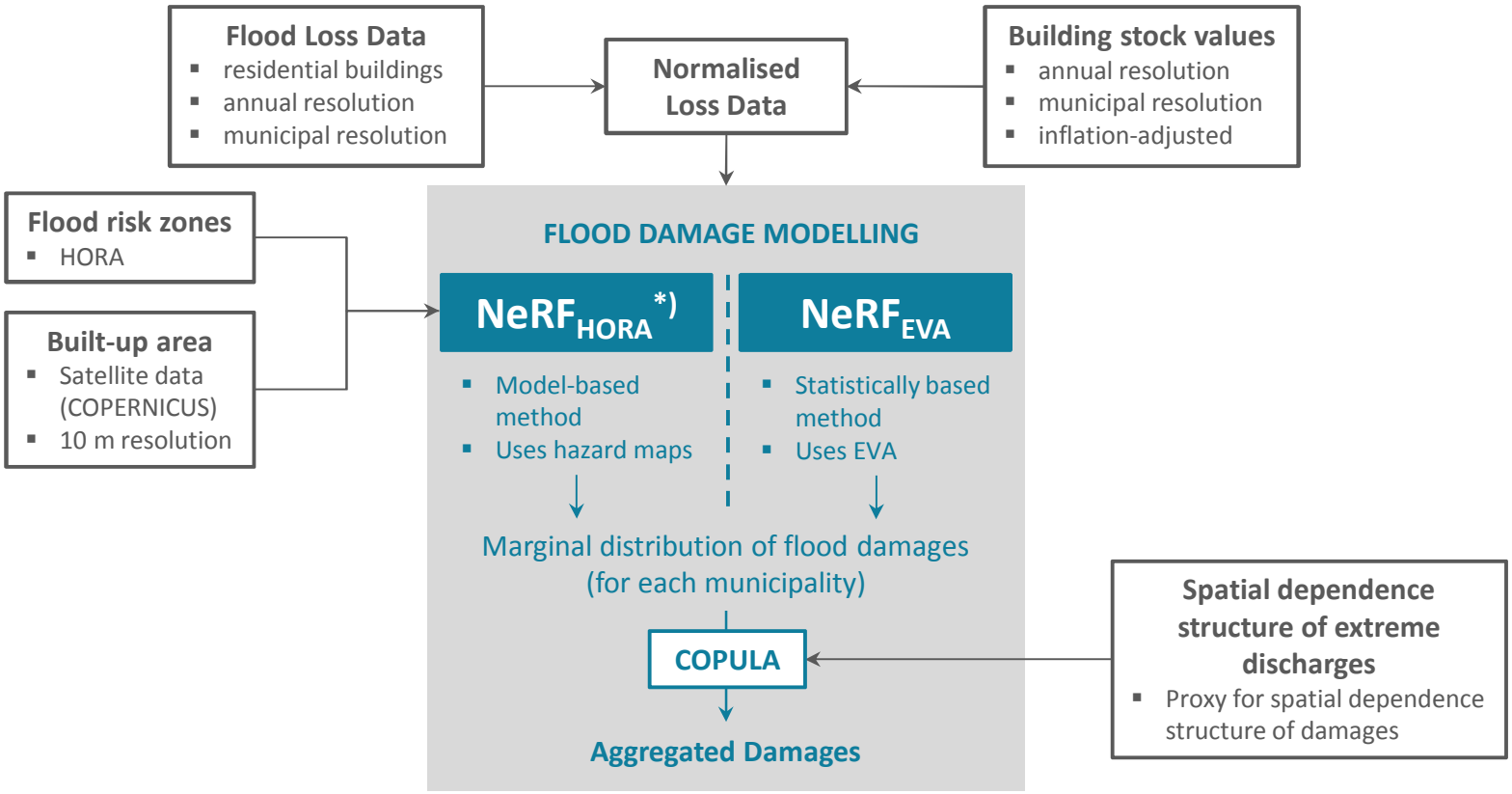
Flood damage modelling

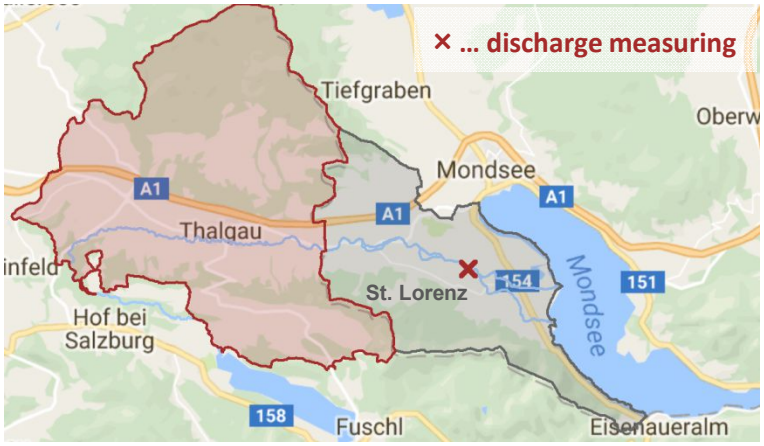


NeRF: Neighborhood
Relationship **F**lood risk model

*) based on Prettenthaler, F., Kortschak, D., et al. (2015): *Catastrophe Management: Riverine Flooding*, in Steininger, K. et al. (ed.) Economic Evaluation of Climate Change Impacts: Development of a Cross-Sectoral Framework and Results for Austria, Springer.

Method for relating sediment records to loss data

Probabilistic procedure



Map data ©2017 GeoBasis-DE/BKG (©2009), Google

1. **Probability of "high" discharge**
   Griesler Ache (station St. Lorenz):
   yearly max. peak discharge > 80 m³/s

2. **Damage threshold for municipality Thalgau**
   Use $NeRF_{EVA}$ & $NeRF_{HORA}$ to calculate Value at Risk, based on probability of "high" discharge (1)

3. **Conditional probability distribution of damages …**
   … for municipalities in the Mondsee area, given that the damage in Thalgau is above or below the damage threshold of (2)

4. **Probability that "high" discharge coincides with flood record in sediment data**

Review & Outlook

- Progress „highlights“
  - Track type catalogue & related precipitation totals
  - Good relation between extreme precipitation events and flood event deposition in sediments
  - Statistical analyses on paleo-flood records
  - Calibration of flood damage models
  - Method for stochastically linking sediment records and stochastic damage models
- Next (big) steps
  - Relationship: flood frequency variability (sediment records) & climate
  - Modelling future flood damage potentials
  - Uncertainty analyses throughout the modelling chain

Project Team

JOANNEUM RESEARCH Forschungsgesellschaft mbH
Franz Prettenthaler, Dominik Kortschak, Judith Köberl, Clemens Habsburg-Lothringen

Contractor: Hansjörg Albrecher (Université de Lausanne)

Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research (AWI)
Tina Swierczynski

The Central Institution for Meteorology and Geodynamics (ZAMG)
Michael Hofstätter, Annemarie Lexer

Danke für die Aufmerksamkeit