



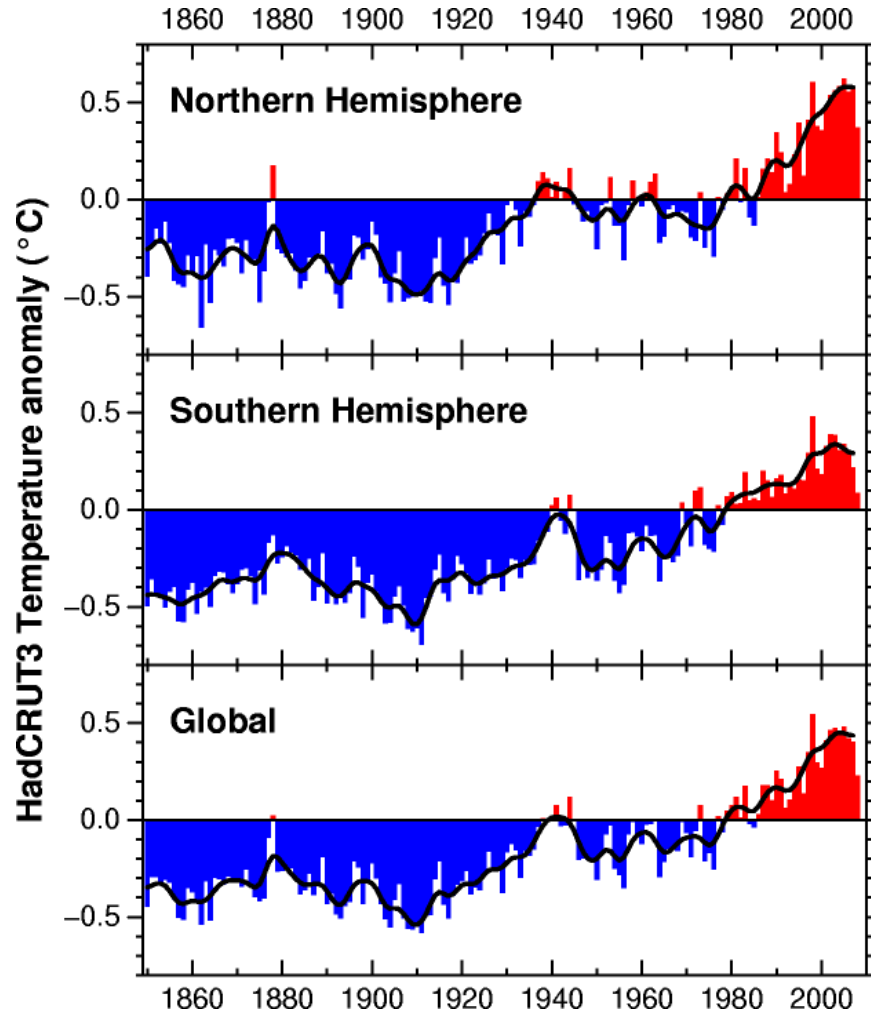
# ***TERENO CT Palaeoclimate Extending the Time Concept***

A. Brauer, I. Heinrich, K. Kaiser

Sektion *Klimadynamik und Landschaftsentwicklung*, GFZ Potsdam



## Long-term Monitoring.....for improving predictions



Temperature changes  
in the period of  
instrumental measurements

*Brohan et al., 2006*



# Predictions Depend on the Time when they are made



1949



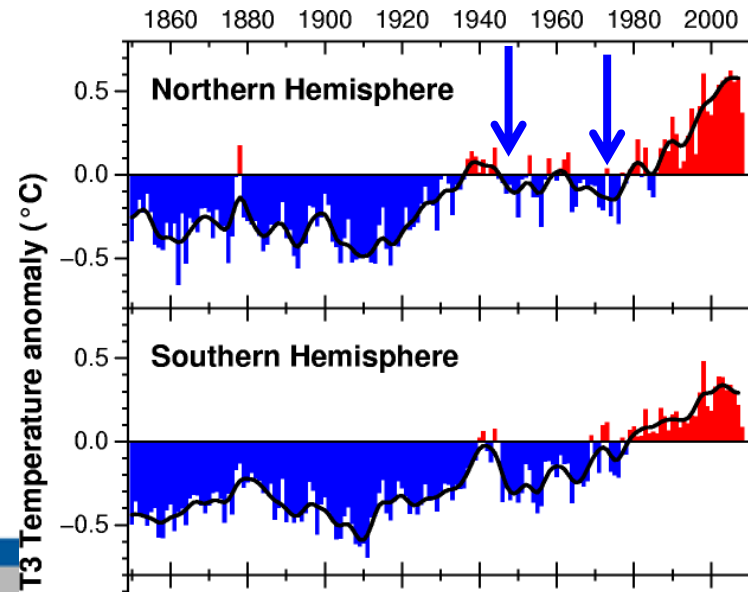
1977



2001

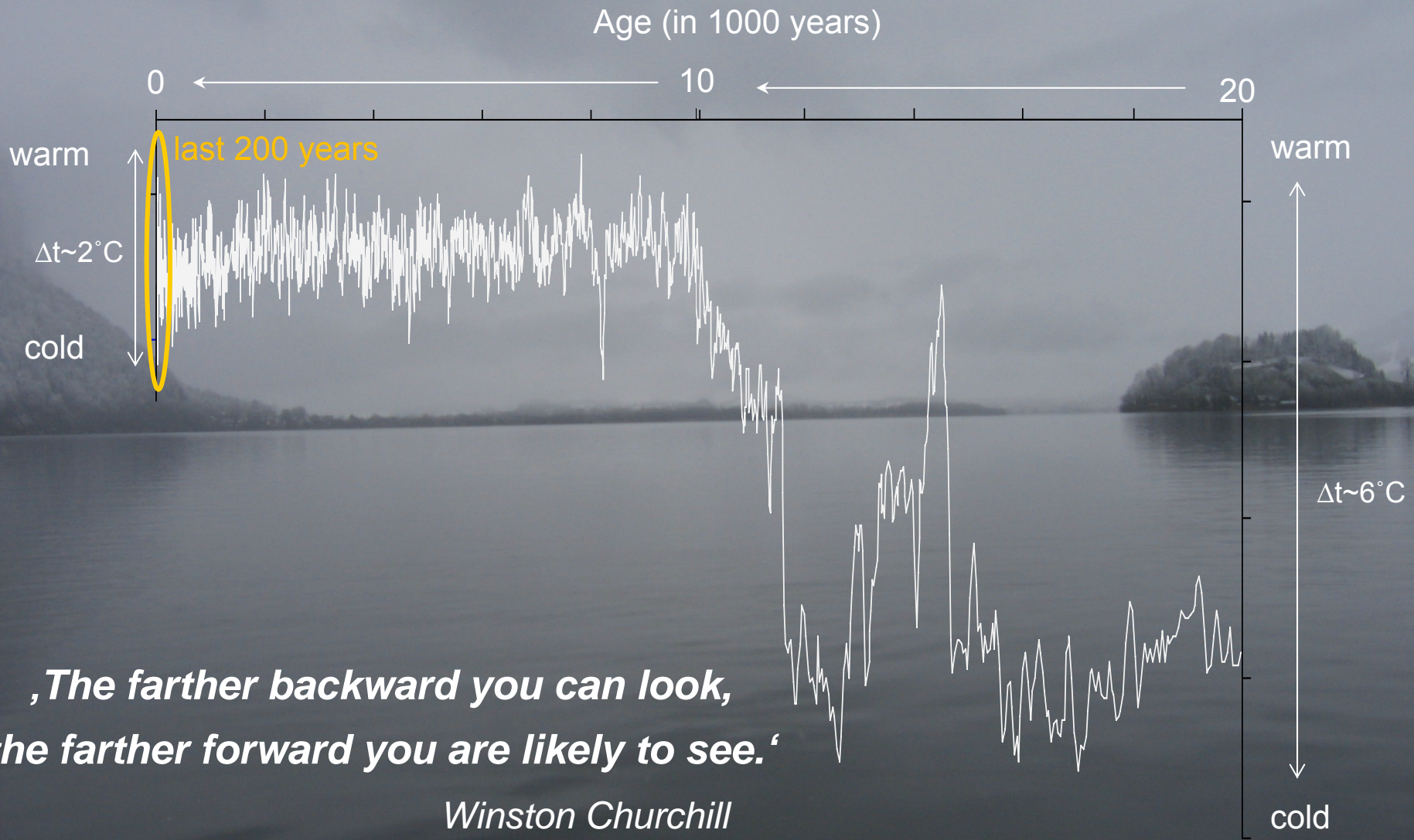


2003



2007

# Geological Proxy Time Series: Greenland Ice Cores

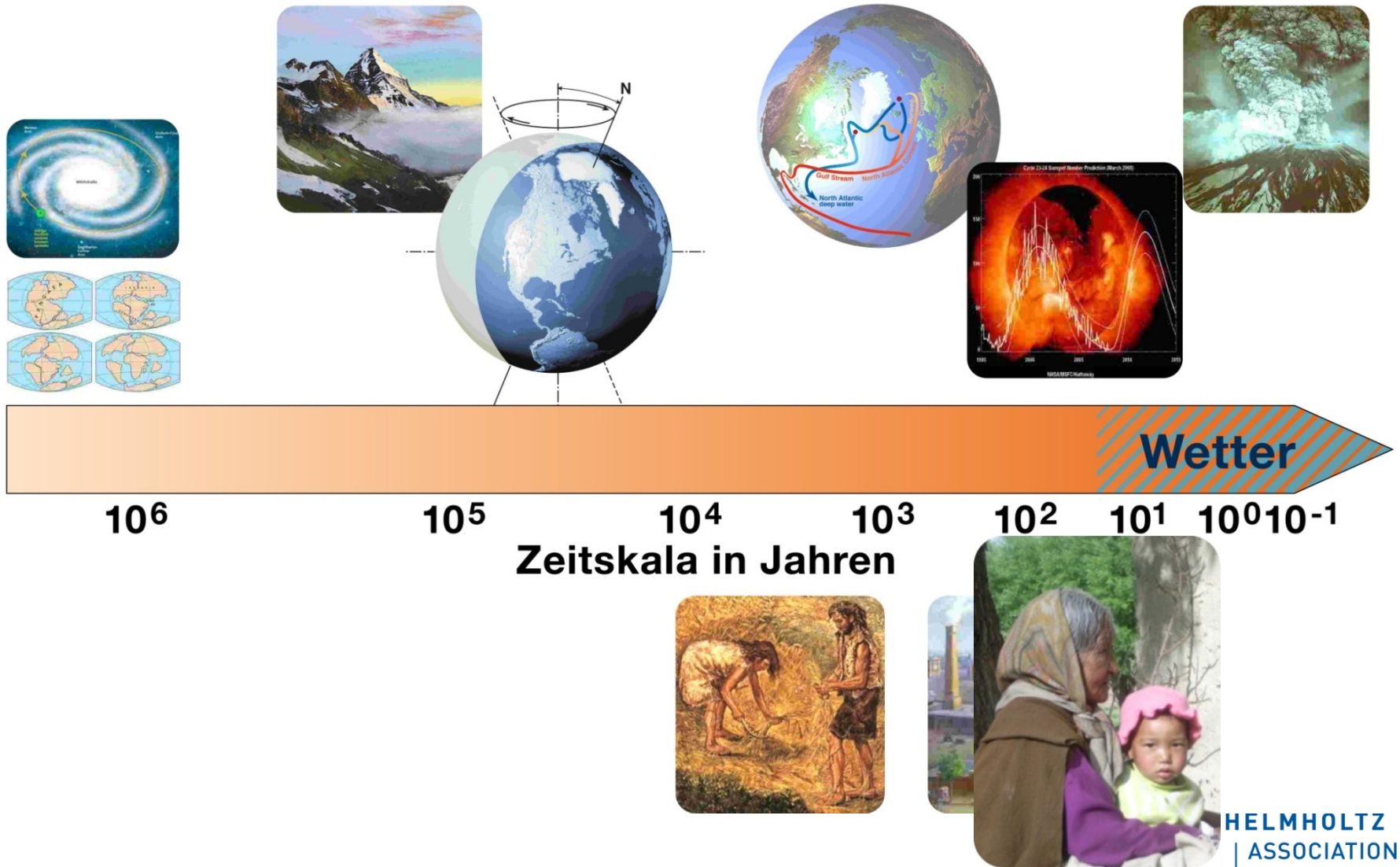


*„The farther backward you can look,  
the farther forward you are likely to see.“*

*Winston Churchill*

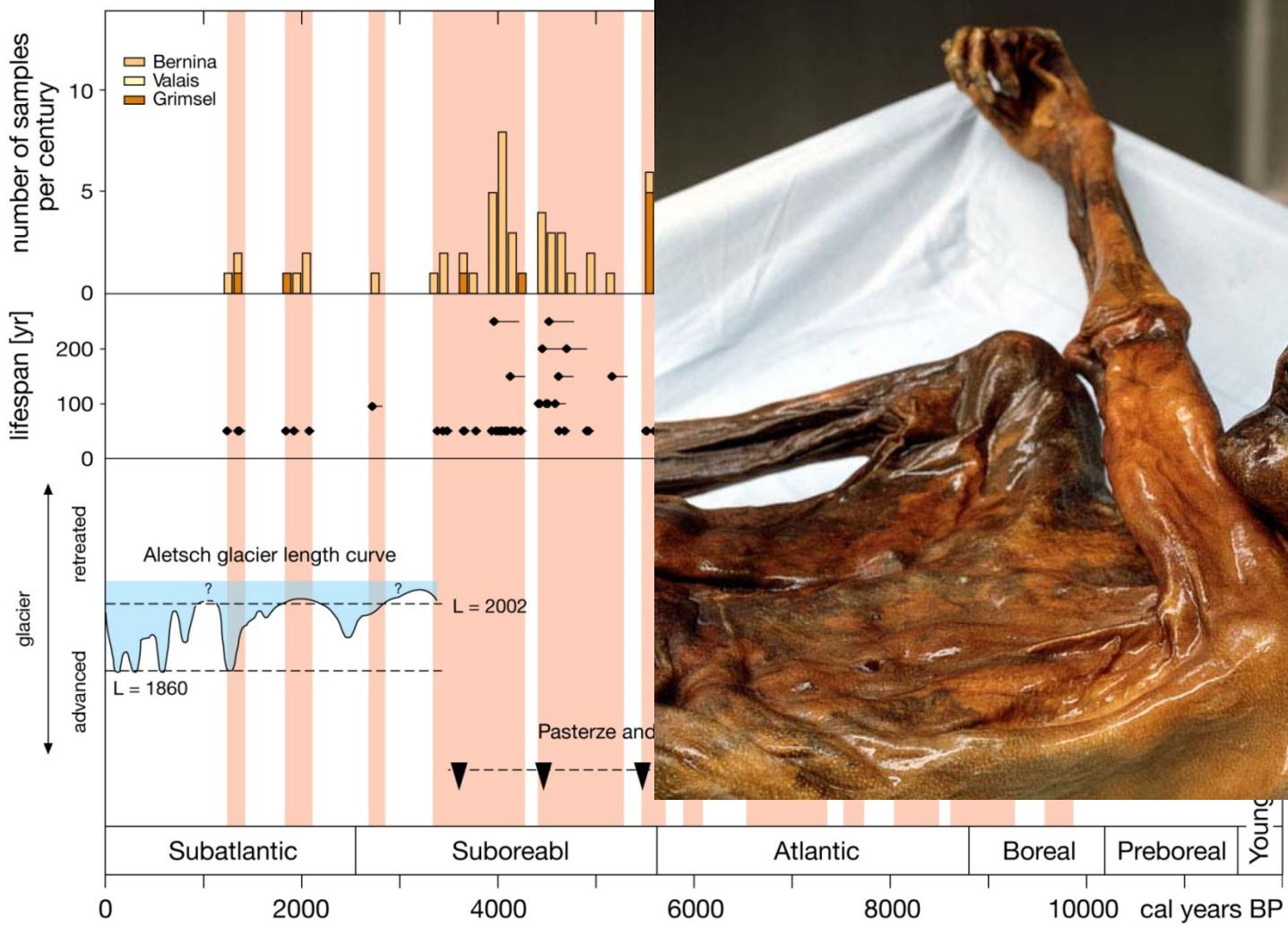


# Climate Driving Mechanisms on Various Time Scales





# Interactions of Mechanisms and Consequences





# Interactions of mechanisms and Consequences

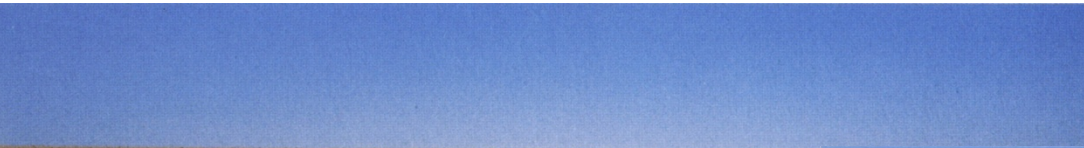


Foto: KRÖPELIN



Foto: KRÖPELIN



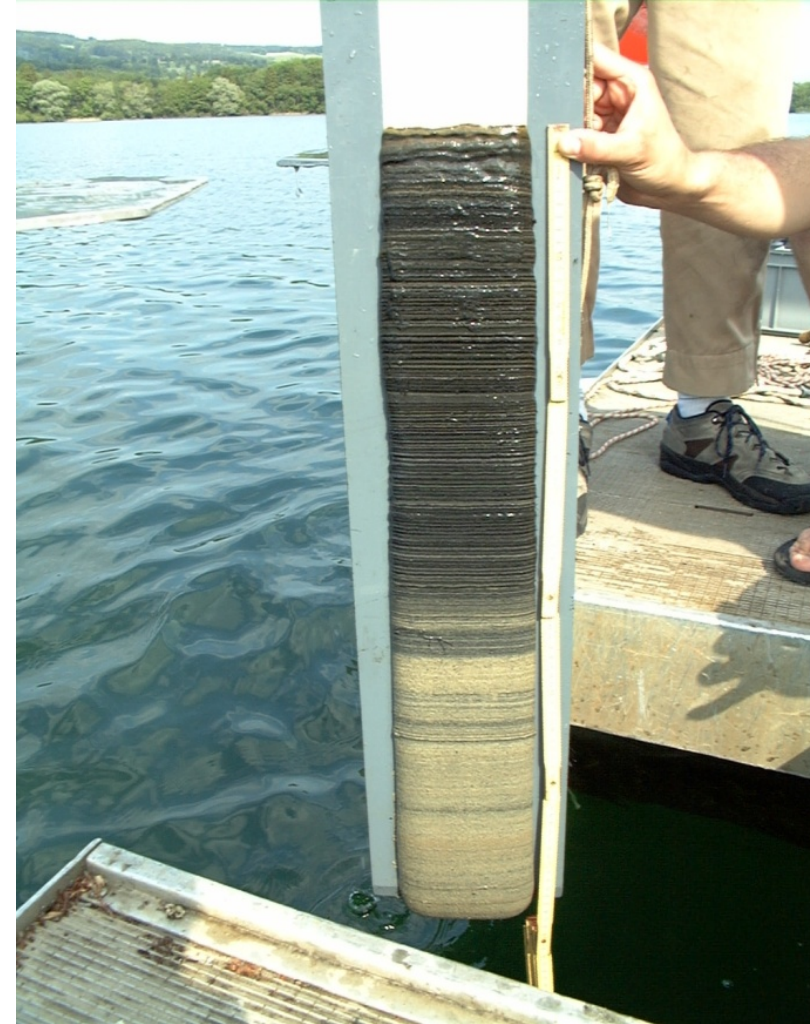
## Information lies on and in the ground







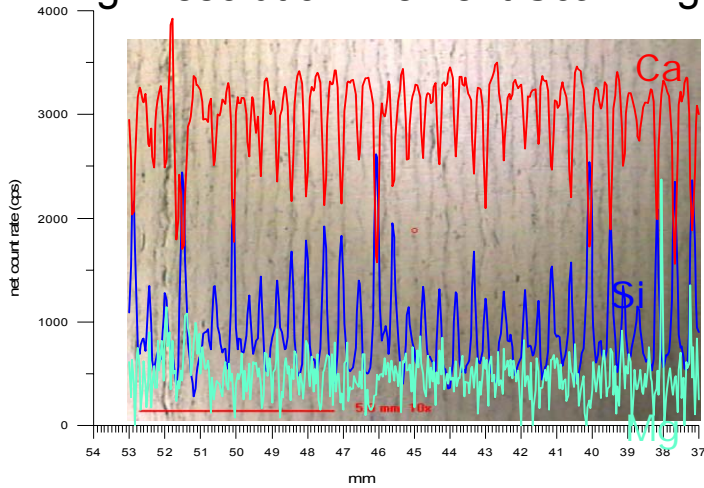
## Take the Information out of the Ground



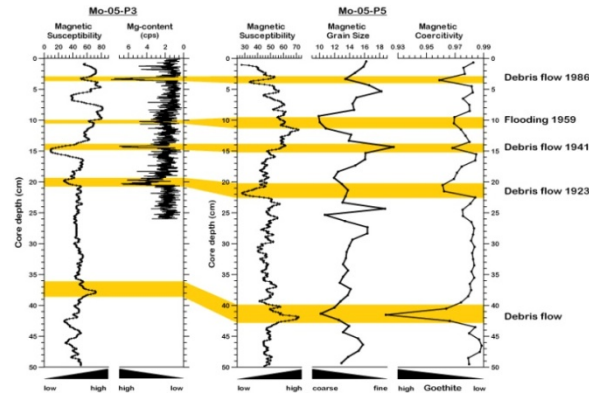


# Challenge: Reading the Information

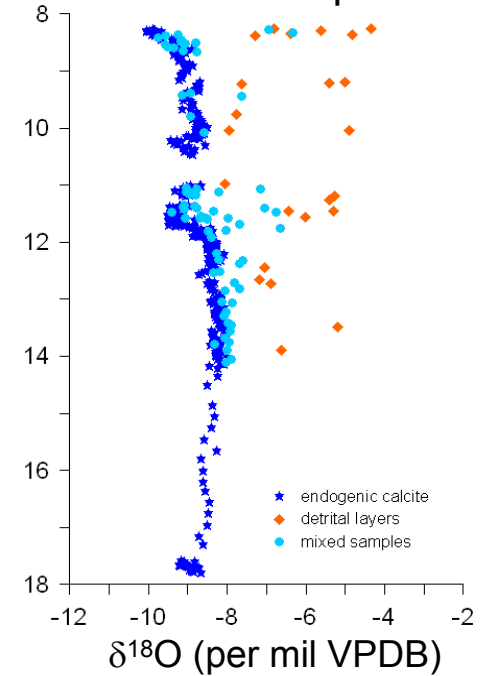
## High-resolution Element Scanning



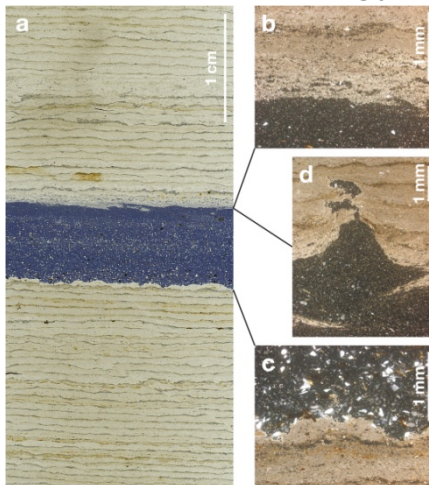
## Rock magnetic Analyses



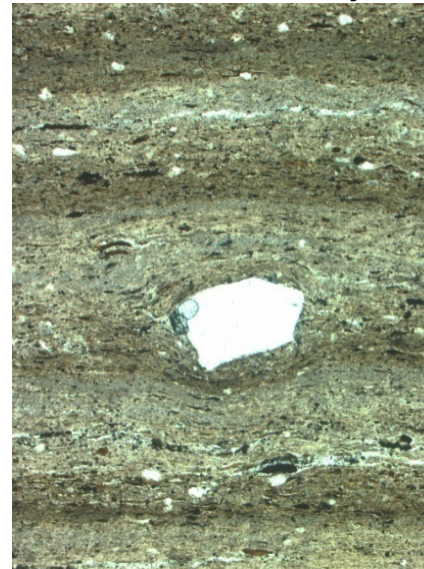
## Stable Isotopes



## Tephrochronology



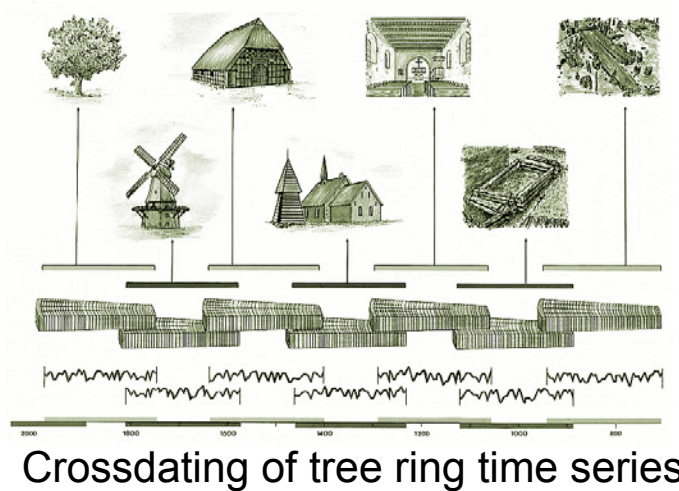
## Micro-facies Analyses





## Challenge: Reading the Information

Old living trees



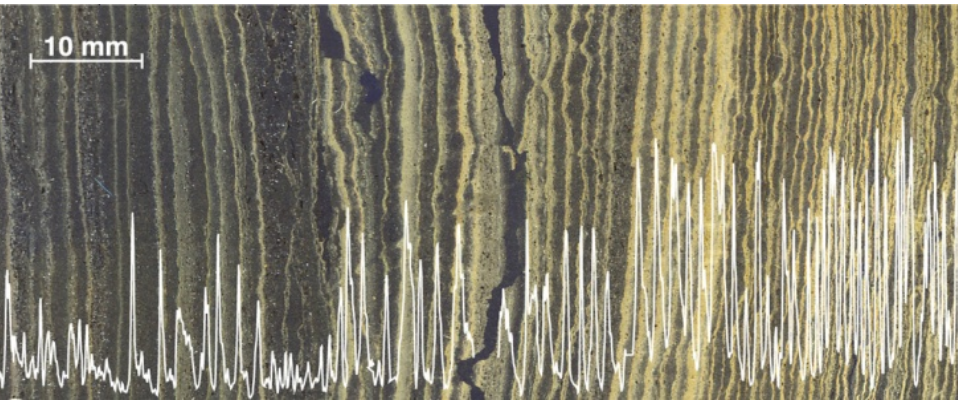
Historical Buildings



Long and well-dated tree ring chronologies from archaeological sources available for the last 1000 years from our cooperation partner DAI (German Archaeological Institute)

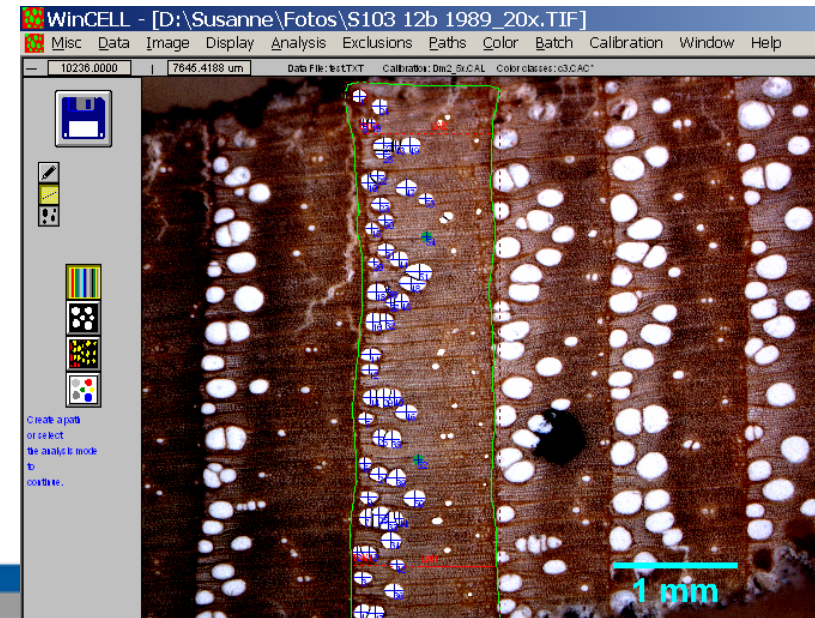
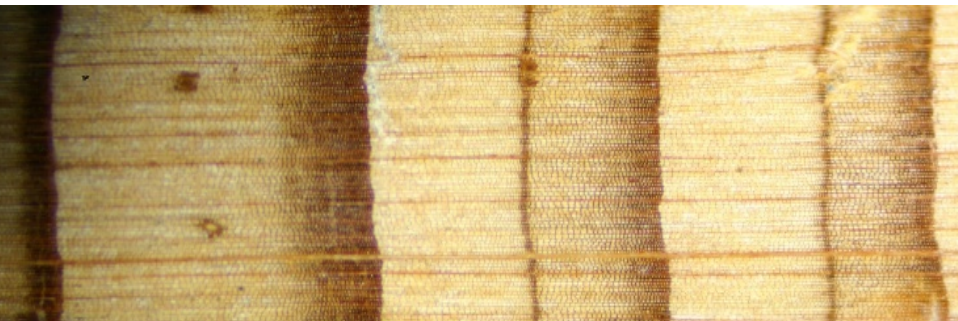


## Challenge: Merging Instrumental and Geological Times



**Novel Concept:  
Reducing Time Resolution in  
Geoarchives:  
Seasonal Resolution in Varved  
Lake Sediments and Tree Rings**

Cell Sizes as Hydrological Proxy



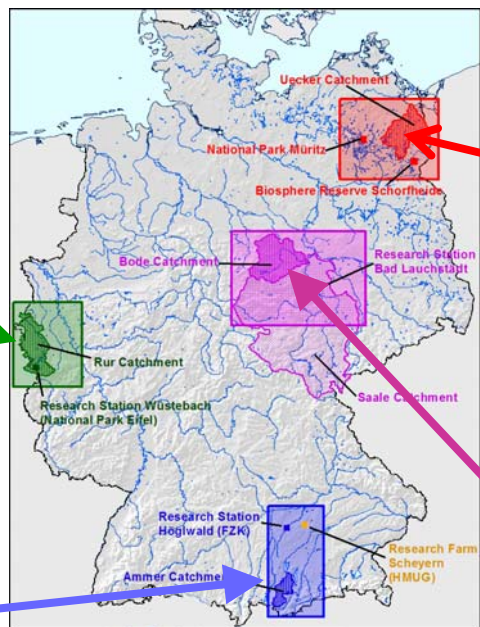
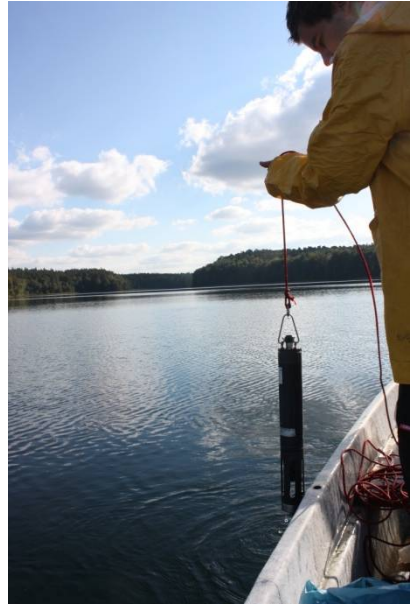


# TERENO Network of 'Palaeo-stations'

**Eifel Maar Lakes**



**NE German Lakes**



**Ammersee**

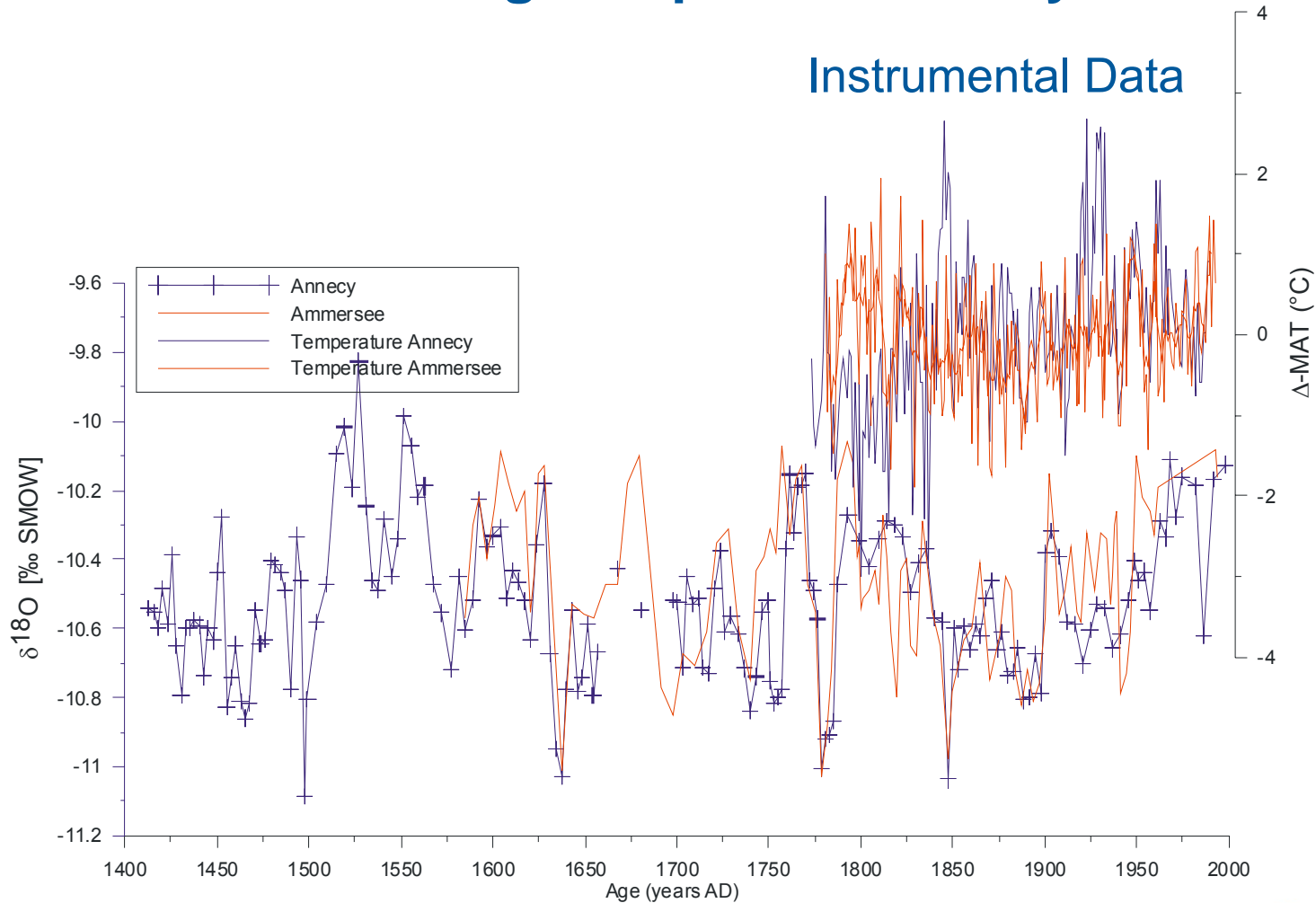


**Jues-See, Harz**



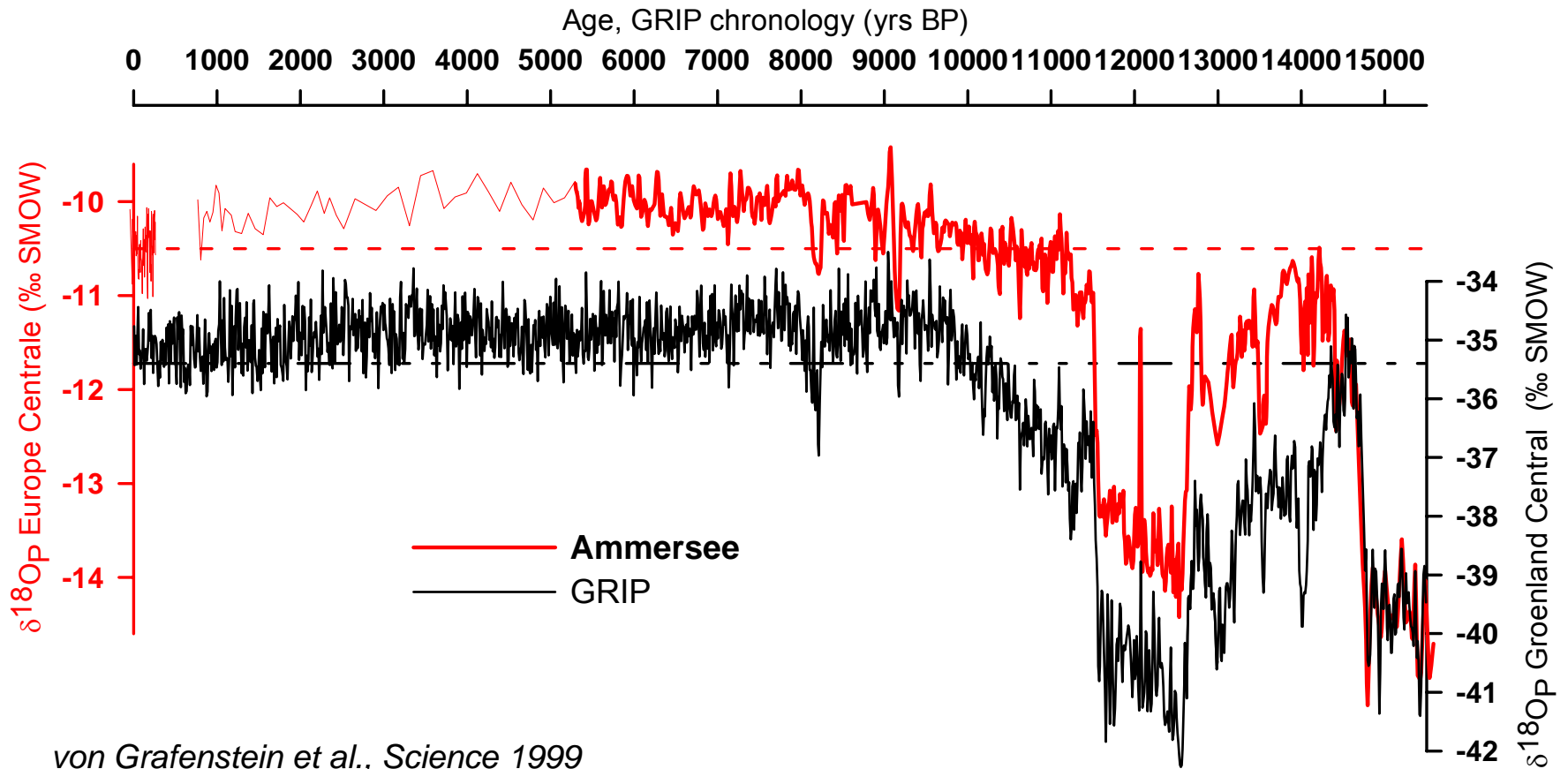


# Ammersee: Calibrating Temperature Proxydata





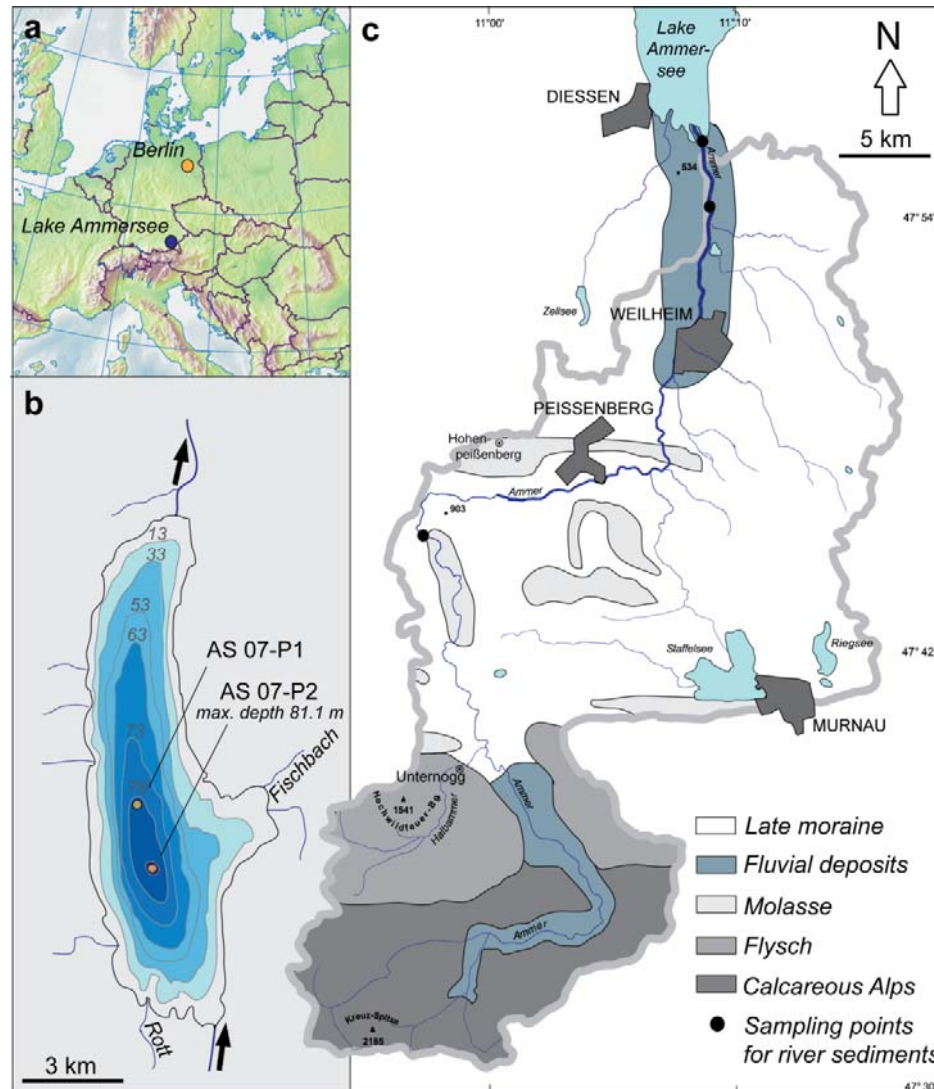
# The Ammersee Palaeotemperature Record



*von Grafenstein et al., Science 1999*



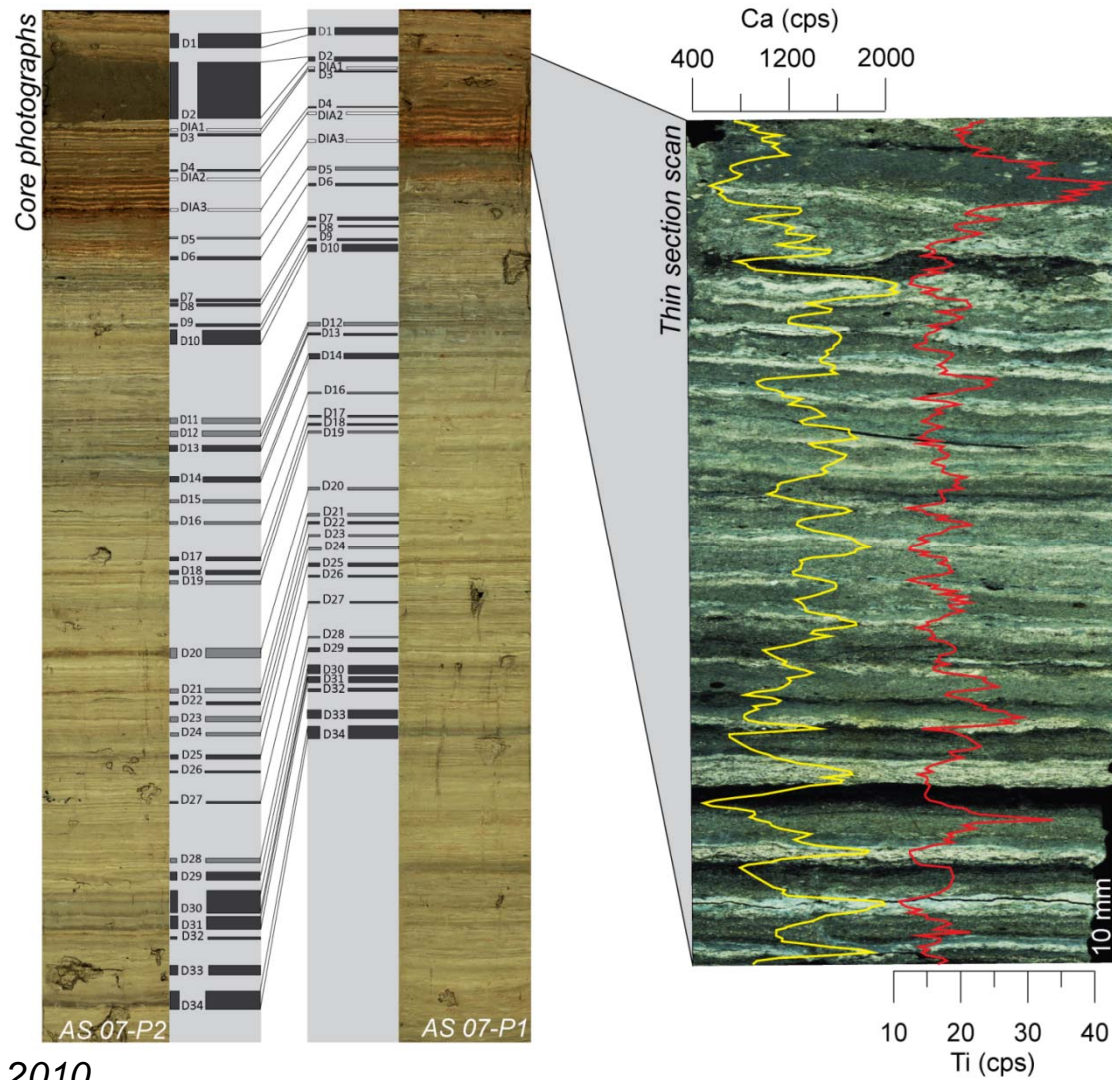
# The Ammersee: An Excellent Palaeoflood Archive







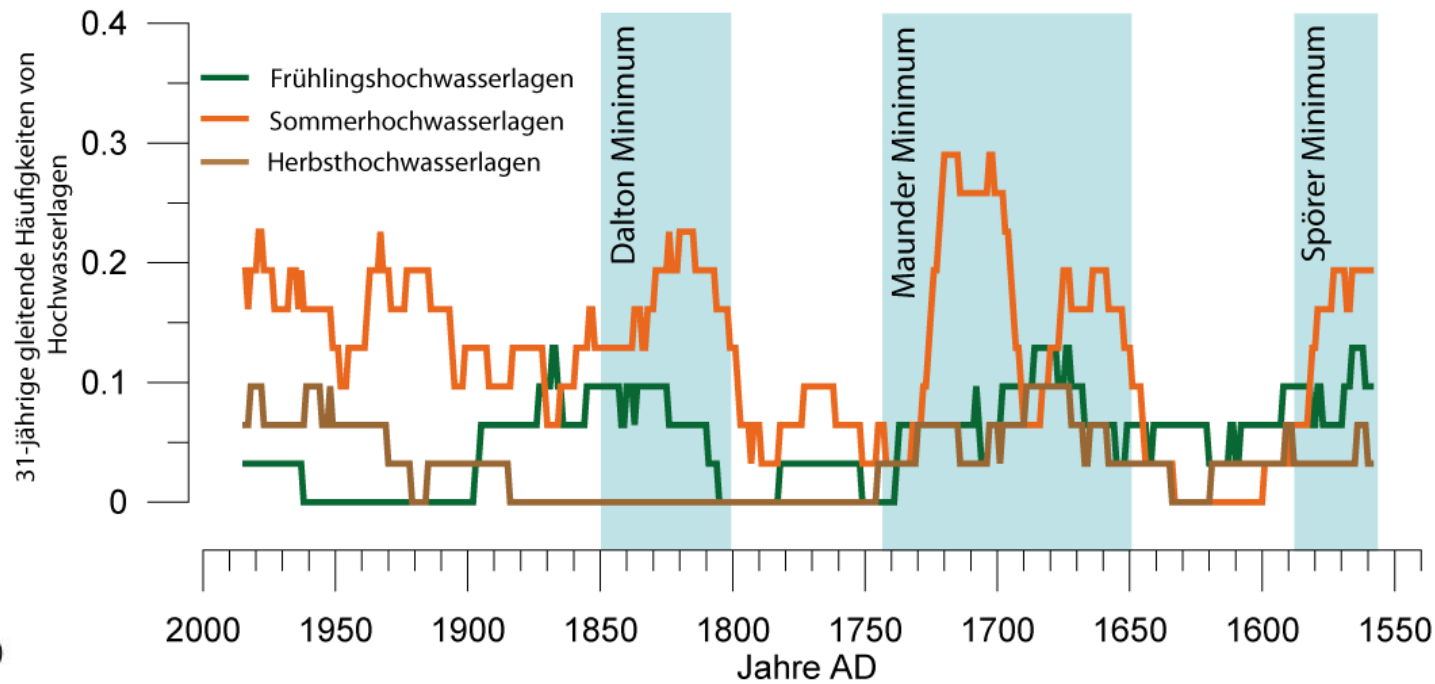
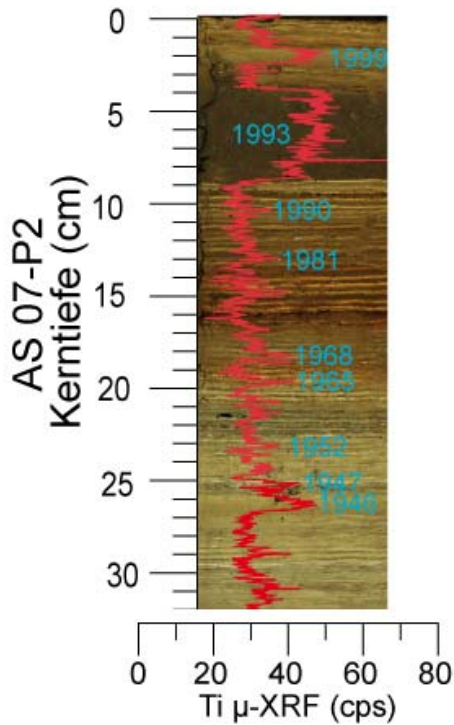
# The Ammersee as Palaeoflood Archive



Czymzik et al., WRR 2010



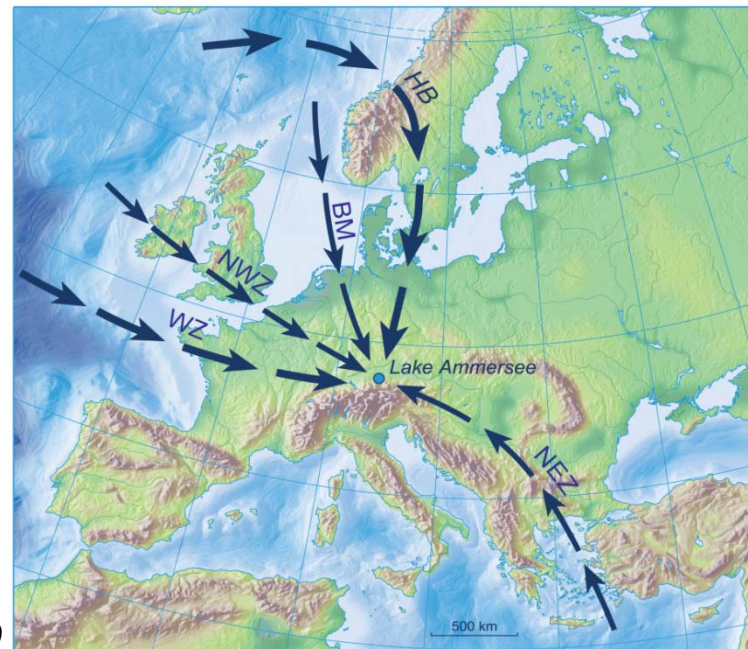
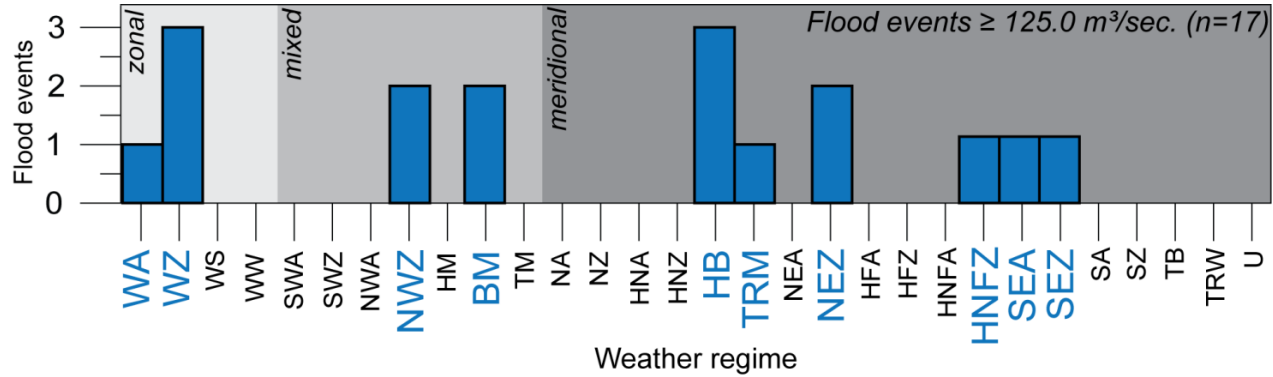
# The Ammersee: An Excellent Palaeoflood Archive



*Czymzik et al., WRR 2010*



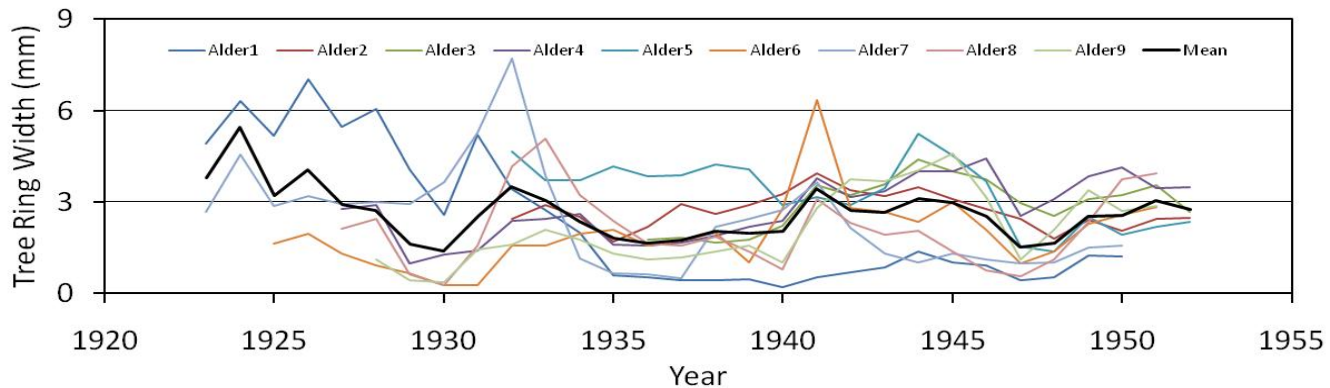
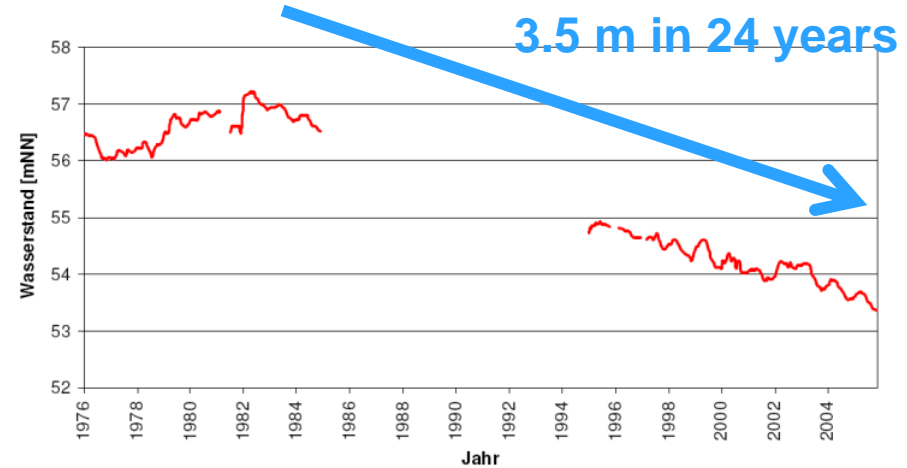
# The Ammersee as Palaeoflood Archive



Czymzik et al., WRR 2010



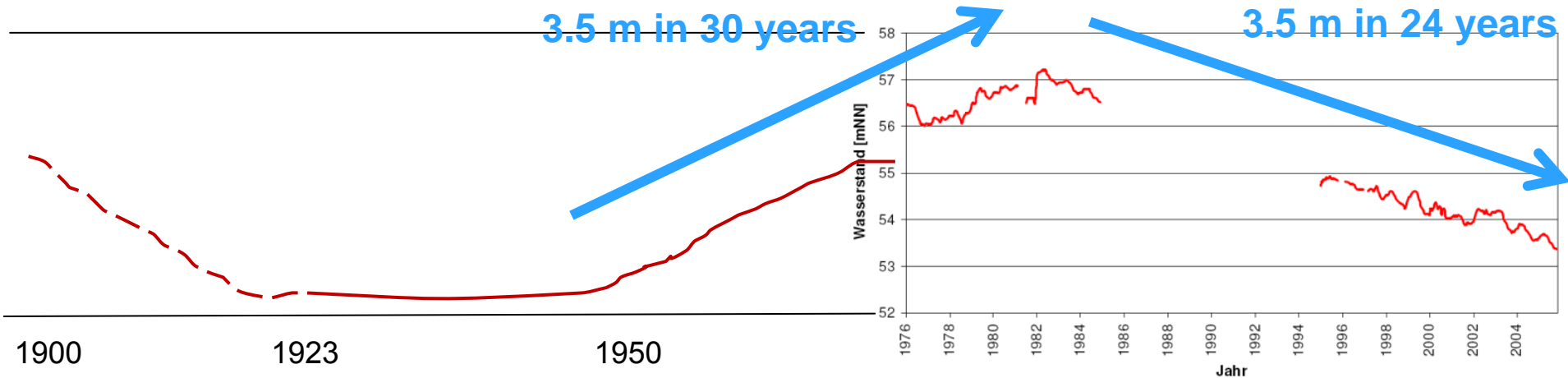
# Redernswalder See: Surprising Lake Level Changes



Tree ring analyses: Growth period (= life time) 1923 – 1952



## Redernswalder See: Surprising Lake Level Changes



- Highly dynamic hydrological system: 3.5 m sea level rise and fall in 60 years!
- Mechanisms and trigger not understood
- Simple explanations are misleading



## Fürstenseer See: Surprising Lake Level Changes



*Summer 1985 (H. Dinkel)*

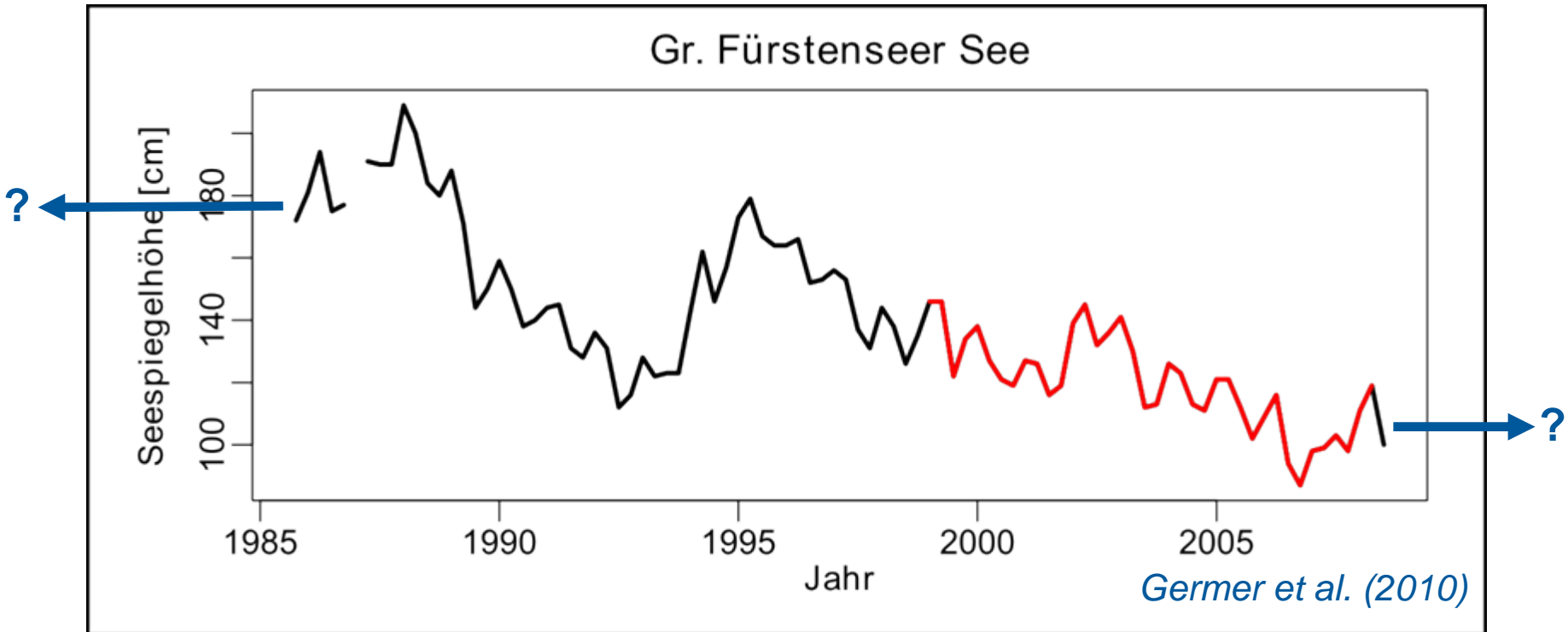


*August 2009 (I. Heinrich)*





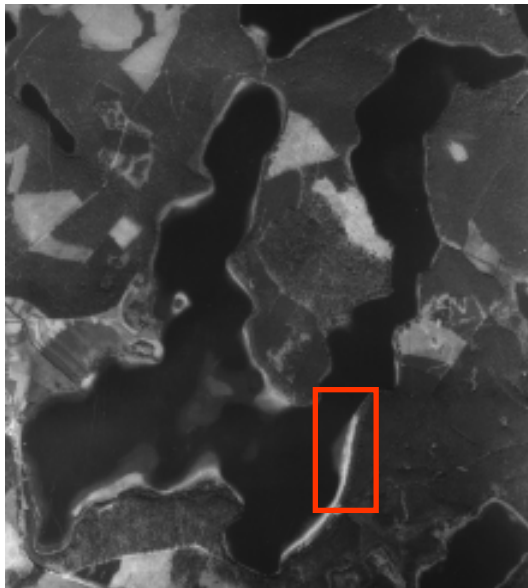
## Fürstenseer See: Surprising Lake Level Changes



In order to **reliably** predict future developments, we have to understand the variability of the system and ultimately its driving mechanisms



## Fürstenseer See: Surprising Lake Level Changes

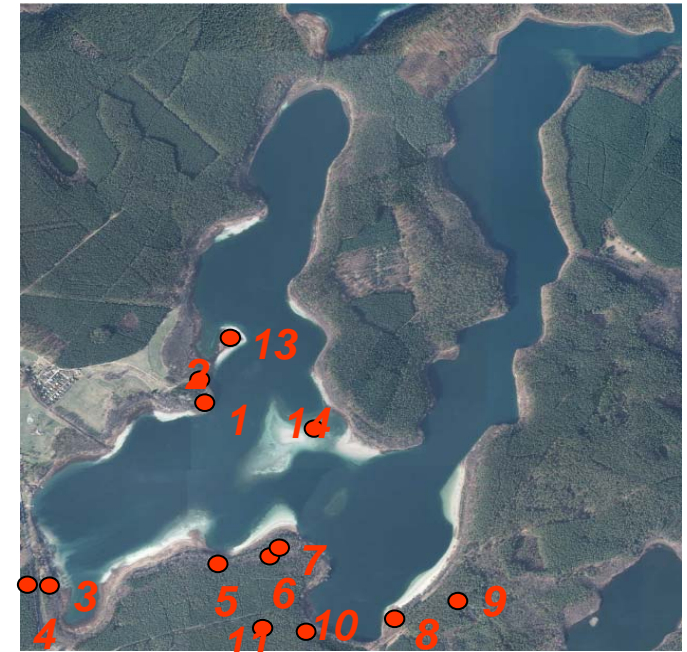


ca1950



today

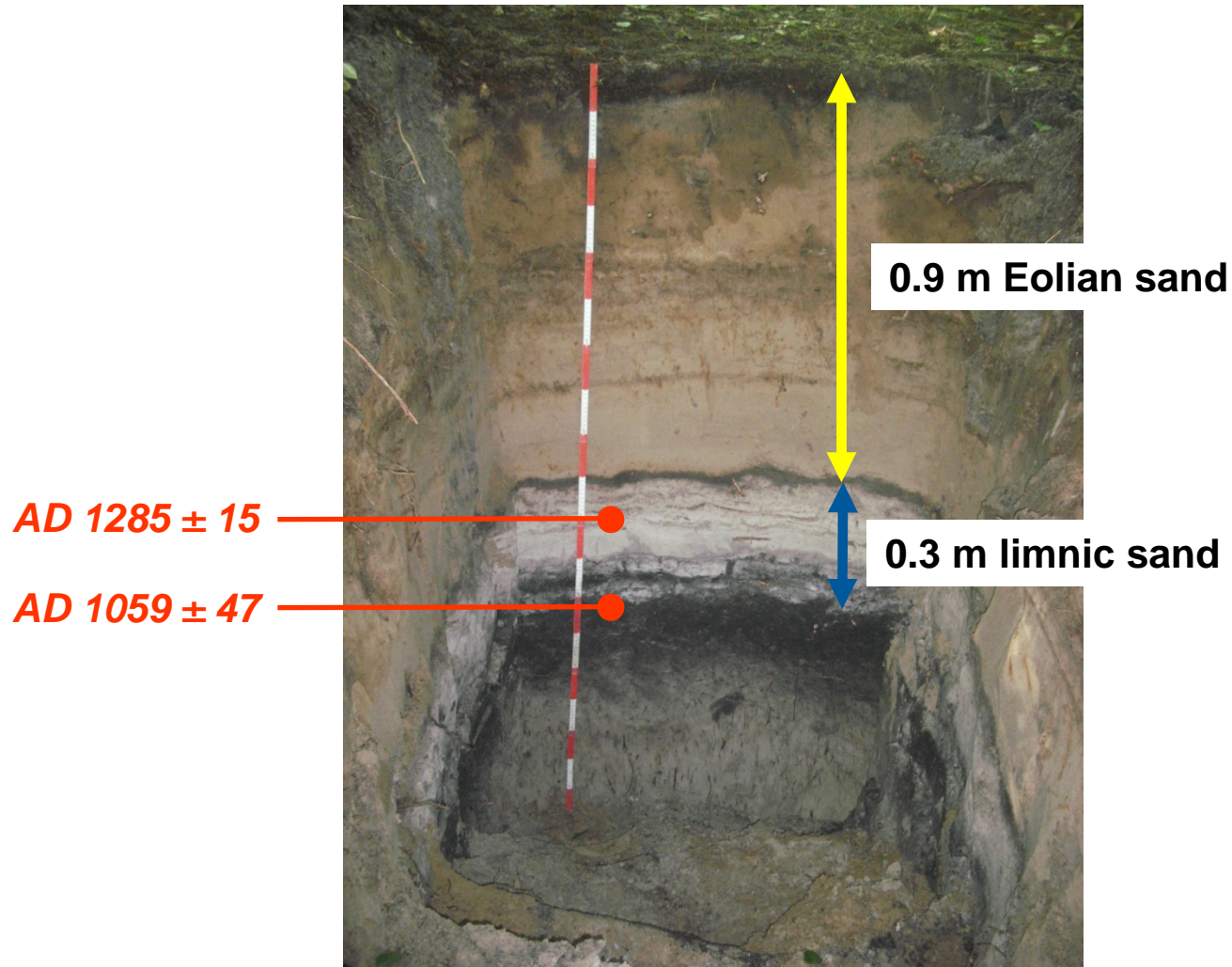
**Multi-Archive Approach:**  
**Lake Sediments + Tree Rings + Soils**  
Including monitoring hydrology, lakes, trees





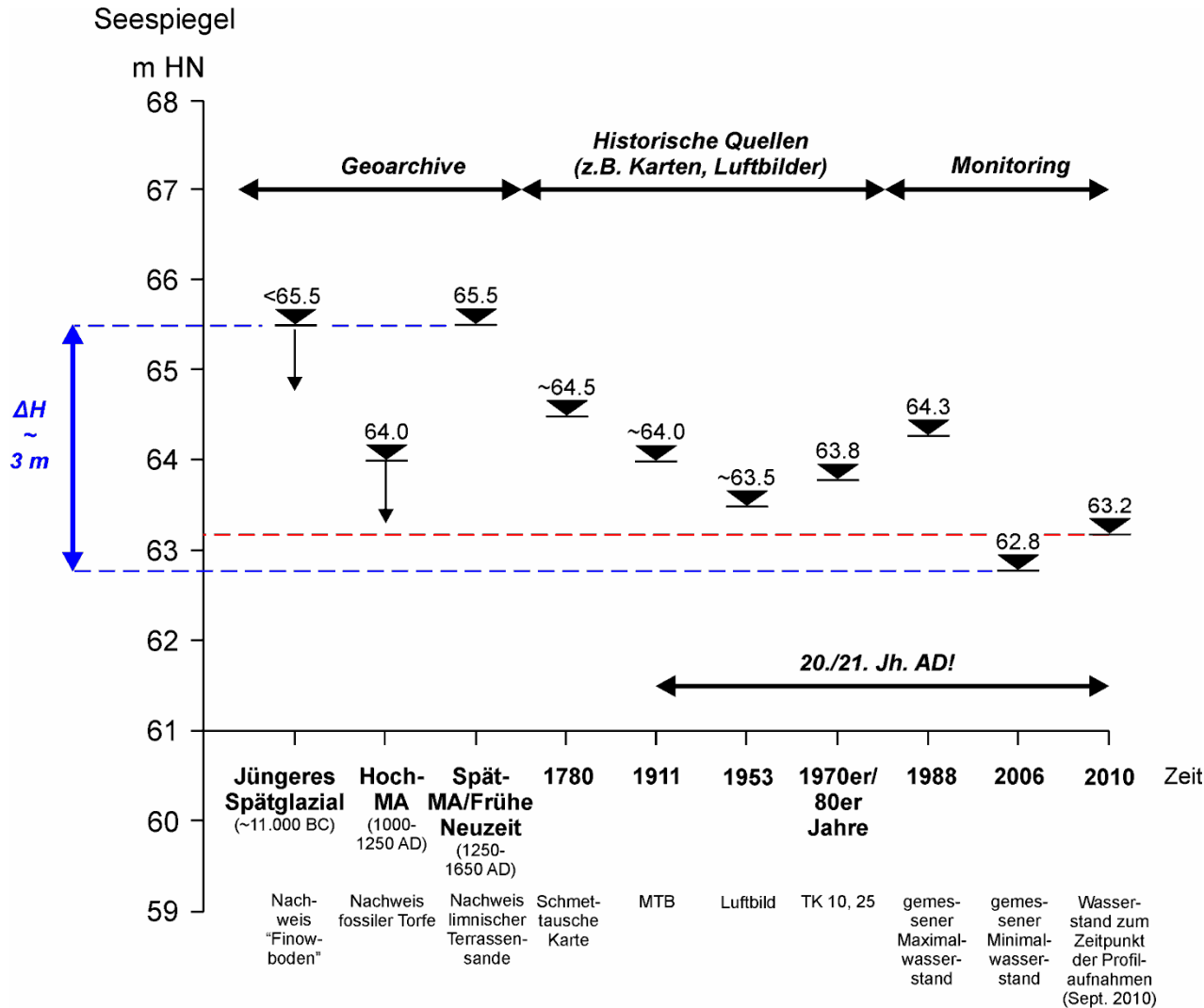


## Fürstenseer See: Surprising Lake Level Changes





# Fürstenseer See: Surprising Lake Level Changes





# Main Goal of the CT Palaeoclimate: *Evaluating Climate Change on a Comprehensive Time Scale*

