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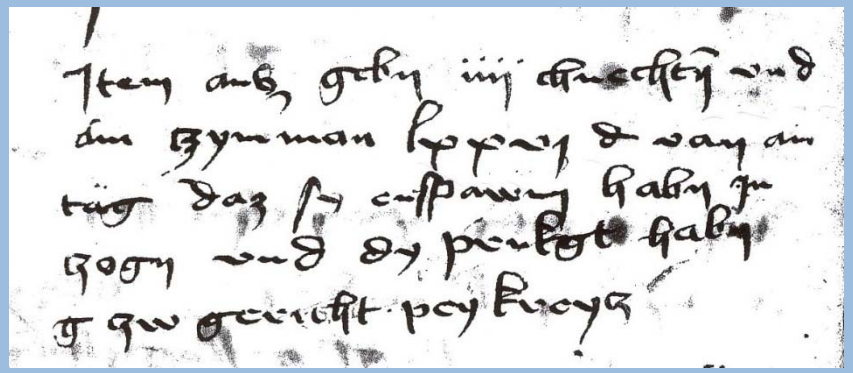
Anthropogenic Historical Sources and Their Use for an Interdisciplinary Environmental and Climate History



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Outline

- General considerations on interdisciplinary cooperation
- Anthropogenic sources for historical climatology and hydrology
  - Typology
  - Source criticism
  - Indices as a means to compare different types of sources
- Examples
  - Series of floods reconstructed from historical account books
  - Climate history and art history: a new perspective on impressionistic paintings
  - Documentary evidence vs. tree-ring evidence: the case of the mega-drought of 1540
- Conclusions

Interdisciplinarity between humanities and natural sciences

- Different scientific cultures
  - Which type of publication preferable?
  - Single authorship or teamwork?
  - Numeric or descriptive analysis?
- Environmental and climate studies
  - Bridging function between humanities and natural sciences
  - Oeschger Centre at the University of Bern provides a perfect framework
- Historians as part of the climatological scientific community
  - First generation of historical climatologists (E. LeRoy Ladurie, H. Lamb, C. Pfister) shows potential of documentary evidence
  - Unique resolution of anthropogenic data for the last 700 years
  - Recent IPCC Reports acknowledge anthropogenic sources (documentary, instrumental) as highly important

Typology of documentary sources

- Documentary sources
  - Made by humans on or without purpose
  - Documentary vs. instrumental sources
- Two main groups of written documentary sources
  - Sources by individuals
  - Sources by institutions (serial entries)
- Written – epigraphical – pictorial sources

Narrative individual sources (1)

- Types
  - Annals (yearbooks) and chronicles
  - Treatises on single natural disasters
  - Literary texts (poems etc.)
  - Charters, petitions
  - Travel reports
  - Private weather and other diaries
  - Newspapers
- Narrative sources contain information about weather events as well as about economic development

Narrative individual sources (2)

- Advantages of narrative sources
  - Contain everything of importance to the author
  - Contain sometimes very detailed descriptions
  - Cover all four seasons
- Disadvantages of narrative sources
  - Subjective
  - Author is not always eye-witness of an event
  - Exaggerations
  - Quality of the different sources varies
  - Dating is very difficult in non contemporary sources
  - Sources contain only information, which is interesting to the author

Written institutional sources

- Manorial accounts (e.g. by landlords, hospitals)
  - Tithes
- Municipal accounts
  - Taxes
  - Grain and wine prices
  - Repairs for bridges, dykes, roofs
- Administrative sources may contain prices and phenological data
- Advantages of administrative sources
  - Less subjective
  - Less problems with dating
  - Long series (up to several centuries)
- Disadvantages of administrative sources
  - Often only a single signal
  - Information is linked to cost and revenue

Epigraphical and pictorial sources

- Flood marks
  - Elaborate inscriptions
  - Lines with date of the year
- Drawings/paintings/photographs of natural disasters and extreme weather
  - Floods and storm surges
  - Earthquakes, landslides, tsunamis
- Maps
  - Comparison shows change of river beds etc.

Flood marks

- Historical flood marks are useful only up to a point for hydrological research
  - Natural dynamic processes in the watercourse
  - Anthropogenic impact
  - Flood marks sometimes freshly painted or displaced
- Flood marks as signs of memory within “cultures of flood management”
  - Installed mainly since “millennium floods” (e.g. 1342, 1501)
  - *Memento naturae*
  - Affixed, engraved or painted on churches, town gates, private houses

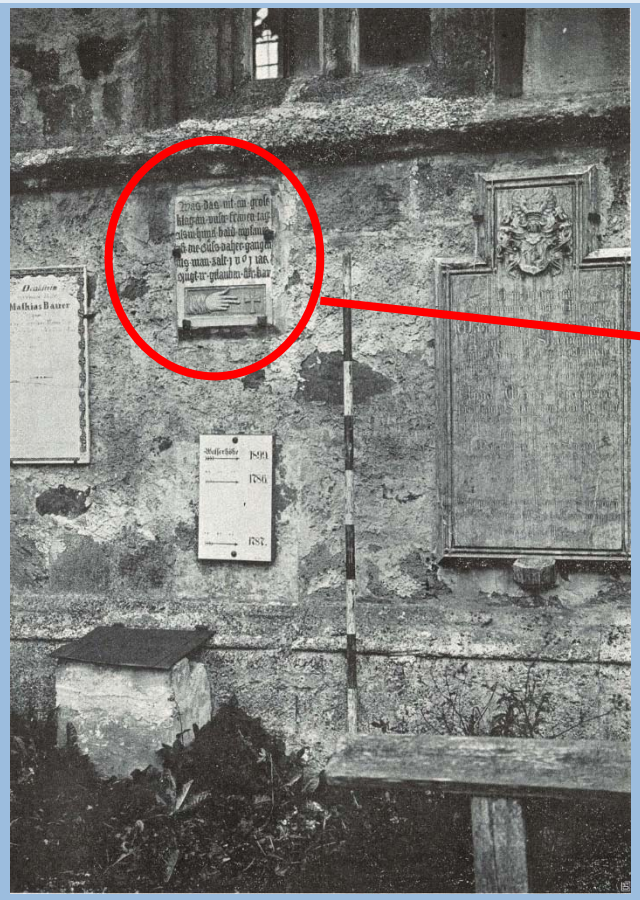
→ Disaster memory is evident for anyone living in this place

Epigraphical and pictorial sources

Flood mark with inscription from Mittich (Lower Bavaria), 1501

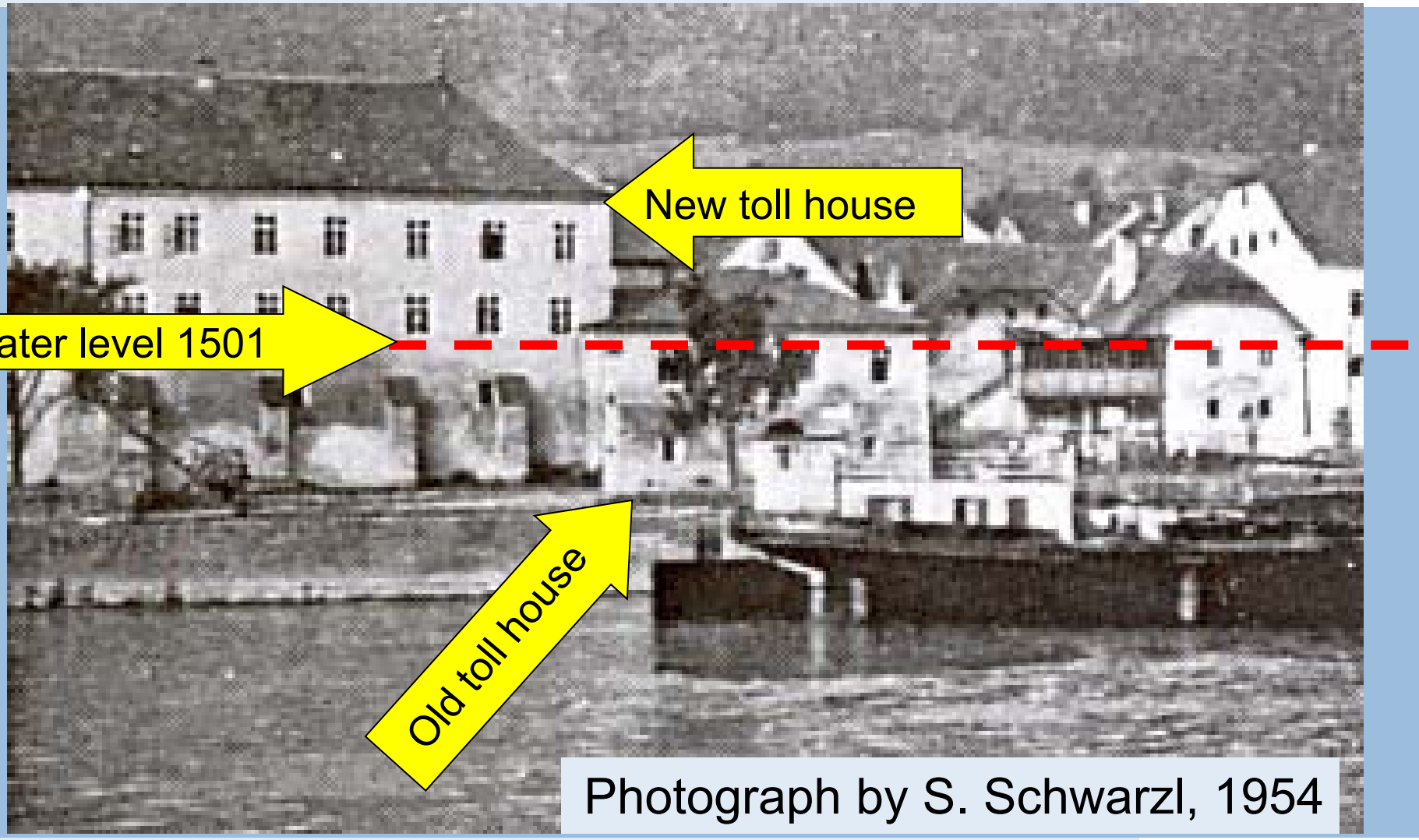
Flood marks

1908



Flood mark with inscription from Mittich (Lower Bavaria), 1501

The toll houses of Engelhartszell (Upper Austria)



Photograph by S. Schwarzl, 1954

Source criticism

- Reliability of documentary sources may vary
  - Is the author an eye-witness?
  - Is the source written near the event (time, space)?
  - Do we have to consider biblical and other patterns, literary topoi etc.?
- Are the records precise?
  - “The winter was very cold”
  - “Lake X was frozen from mid December to mid February”
- Historical chronology
  - Several systems throughout the times and cultures to measure time
  - Advanced knowledge important for historical climatology
    - to avoid doubled events
    - to harmonize between different systems of dating

Classification of documentary evidence
Weather Indices (Pfister-Indices)

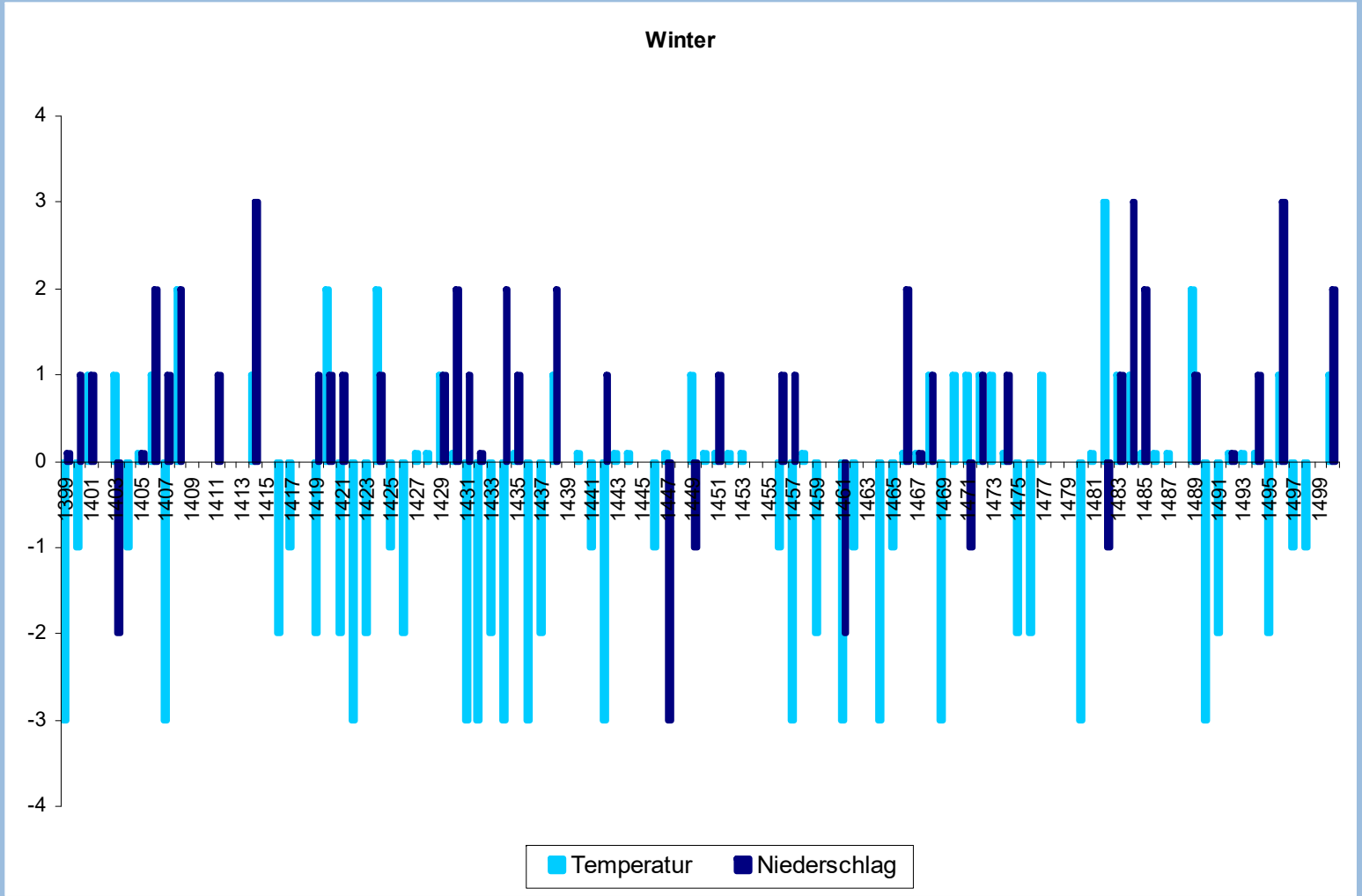
- Temperature indices, precipitation indices
- Seasonal reconstruction
- Scale:

-3	-2	-1	0	1	2	3
extremely cold/dry	very cold/dry	cold/dry	normal	warm/ wet	very warm/ wet	extremely warm/ wet

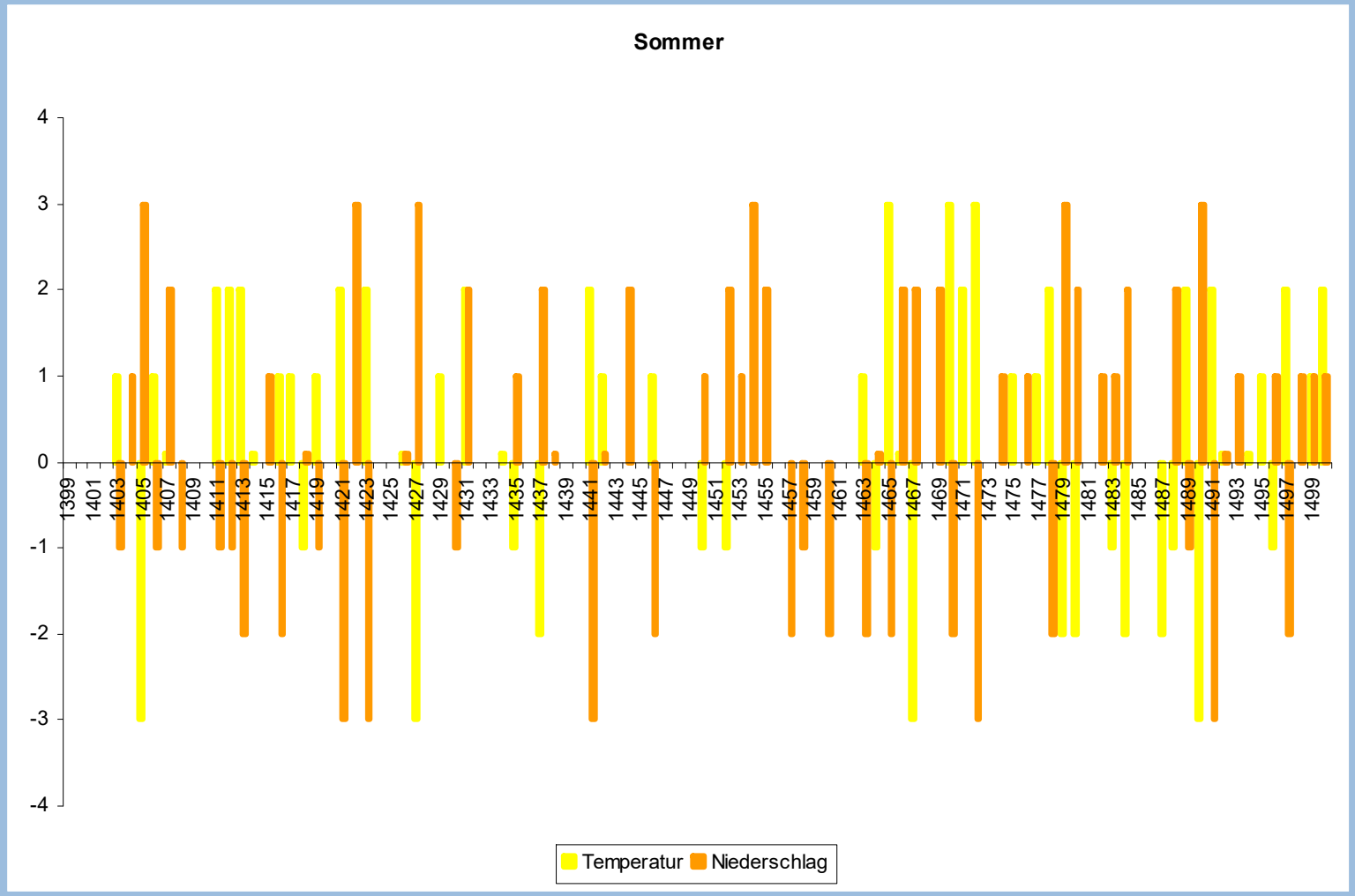
Classification of winter temperatures
Pfister-Indices

3	extremely warm	- no frost or extremely few frost periods mentioned - considerable phenological anomalies - winter described as extremely mild
2	very warm	- almost no frost periods mentioned - remarkable phenological anomalies - winter described as mild
1	warm	- rather rain than snow - little frost mentioned
0	normal	- few frost - sporadic days with drifting ice
-1	cold	- repeated periods with drifting ice - repeated frost periods
-2	very cold	- small rivers or brooks frozen - frost mentioned over a period of about one month - plants damaged by frost
-3	extremely cold	- large rivers and lakes frozen and passable - frost mentioned over a period of about two month - rye or trees damaged by frost

Winter temperature/precipitation 1400-1500
Burgundian Low Countries (Camenisch 2015)



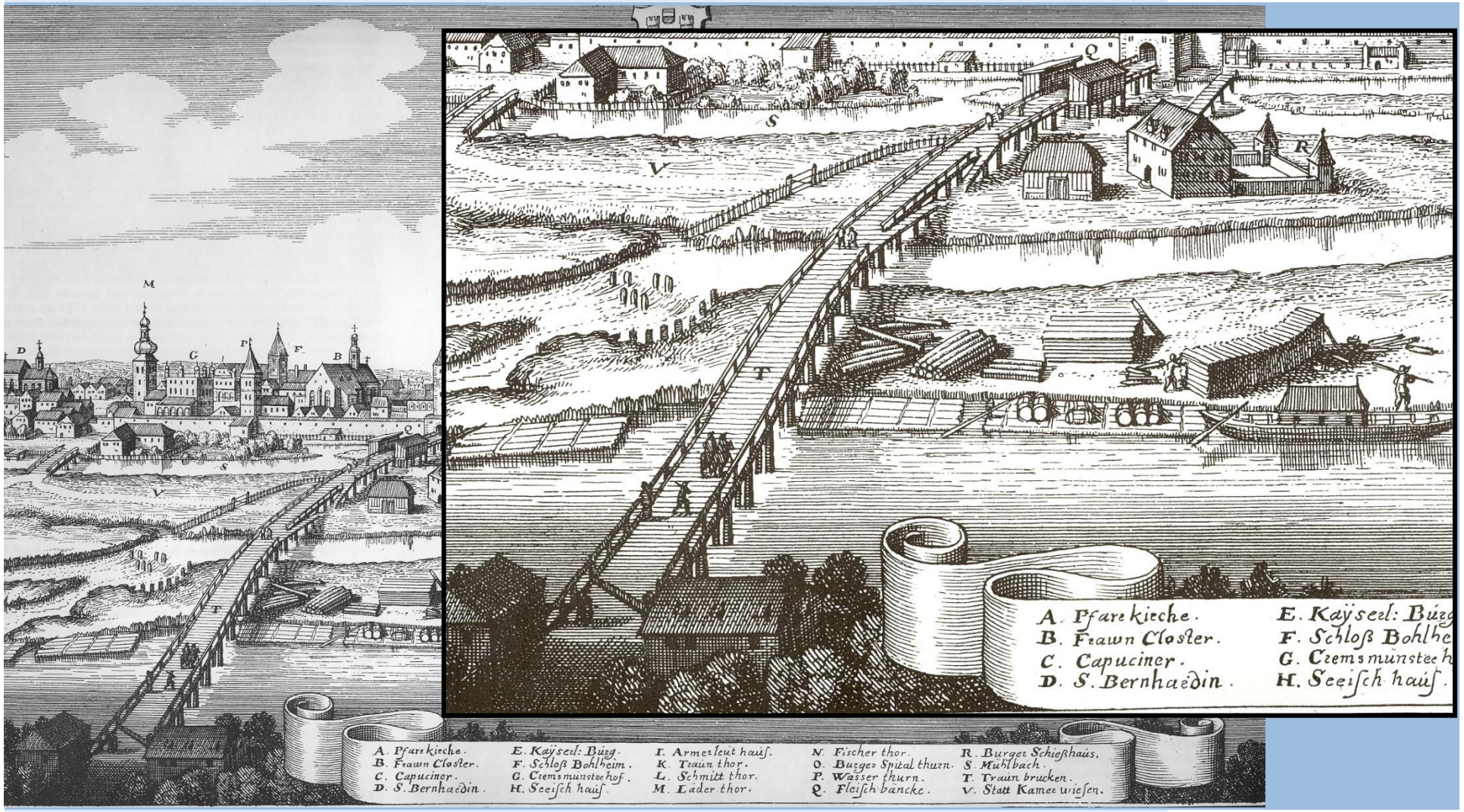
Summer temperature/precipitation 1400-1500
Burgundian Low Countries (Camenisch 2015)



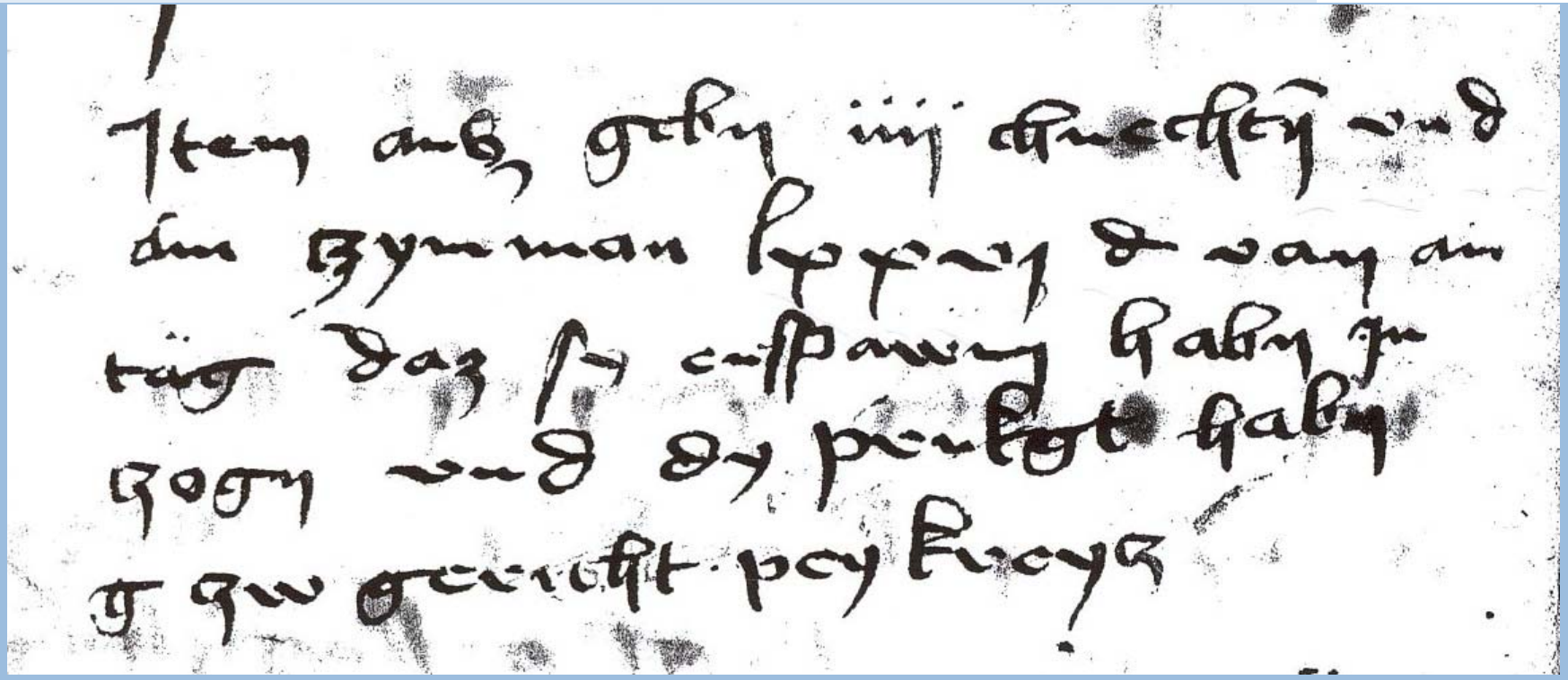
Example 1: The bridge master's accounts of Wels

- Office of the bridge master since the 13th c. to maintain the wooden bridge (about 600 meters long)
- Incoming and outgoing accounts for every year since 1350, since 1441 without major lacunae
- Accounts from 1441 to 1599 examined (Rohr 2007)
- Weekly entries
  - Purchase of timber
  - Salaries for carpenters and their servants
- Classification of the damages by floods and ice
  - 4 scale-system
  - Length of repairs, number of craftsmen working

The city of Wels and the Traun River
(Copperplate print by Matthäus Merian, 1649)



The bridge master's accounts of Wels (1443)



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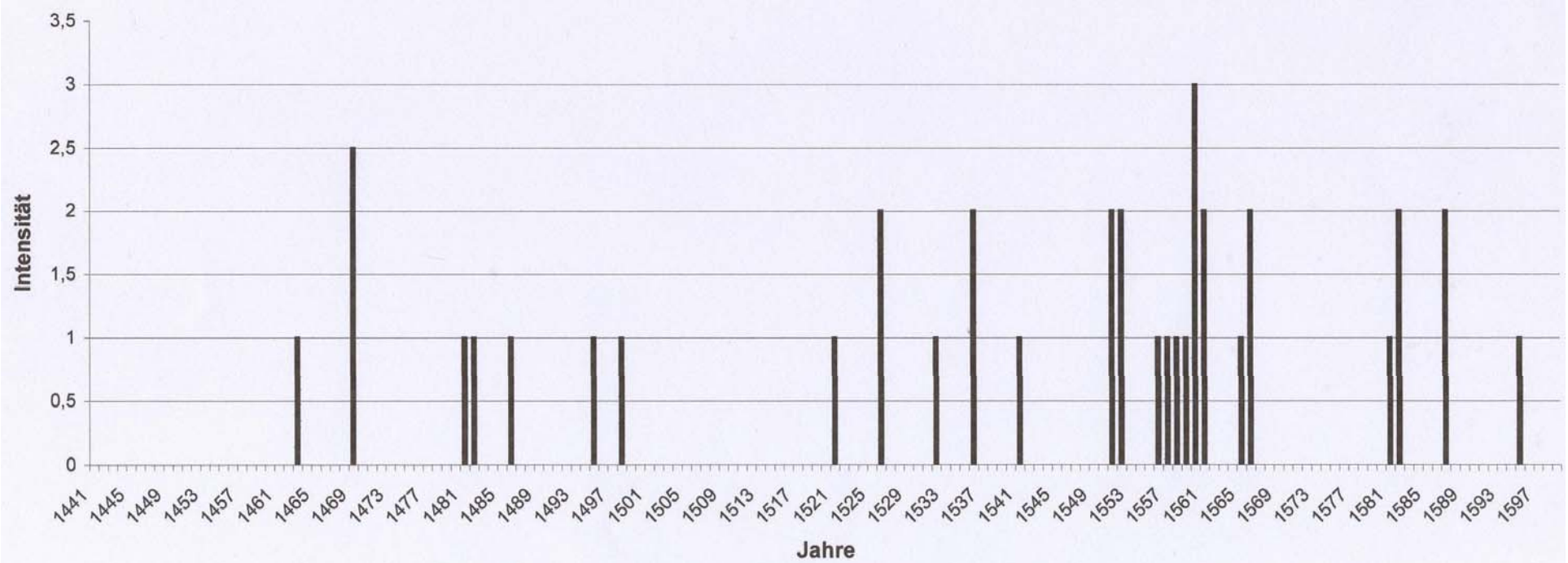
Floods of the Traun River, 1497-1510

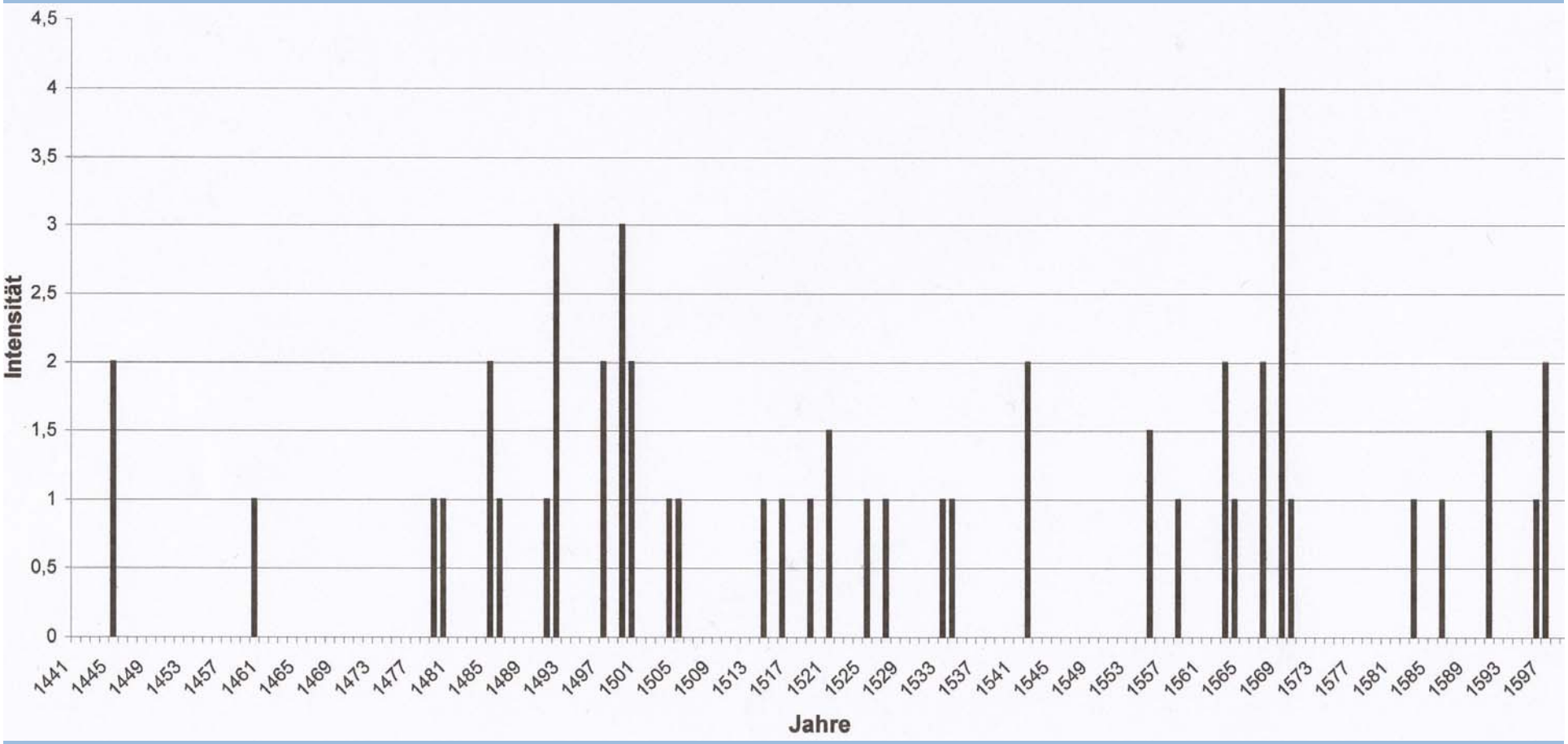
Year	Month	Flood	Intensity
1497	May/early June	flood with destruction	strong (2)
1498	March, August?	two floods	moderate (1/1)
1499	**end of May/June**	**flood with severe destruction**	**very strong (3)**
1500	April, May	two? flood with destruction	moderate/strong (2)
1501	**July?, August**	**disastrous flood**	**extremely strong (4)**
1502		no flood	
1503	**September**	**flood with severe destruction**	**very strong (3)**
1504	May	flood	moderate (1)
1505	May/June, August	two floods	moderate (1/1)
1506	July	flood?	little (1)
1507	August?	flood?	moderate (1)
1508	**July, August**	**two floods with destruction**	**very strong (3)**
1509	fall?	flood?	little (1)
1510		no accounts	

Floods of the Traun River
January-March (1441-1599)



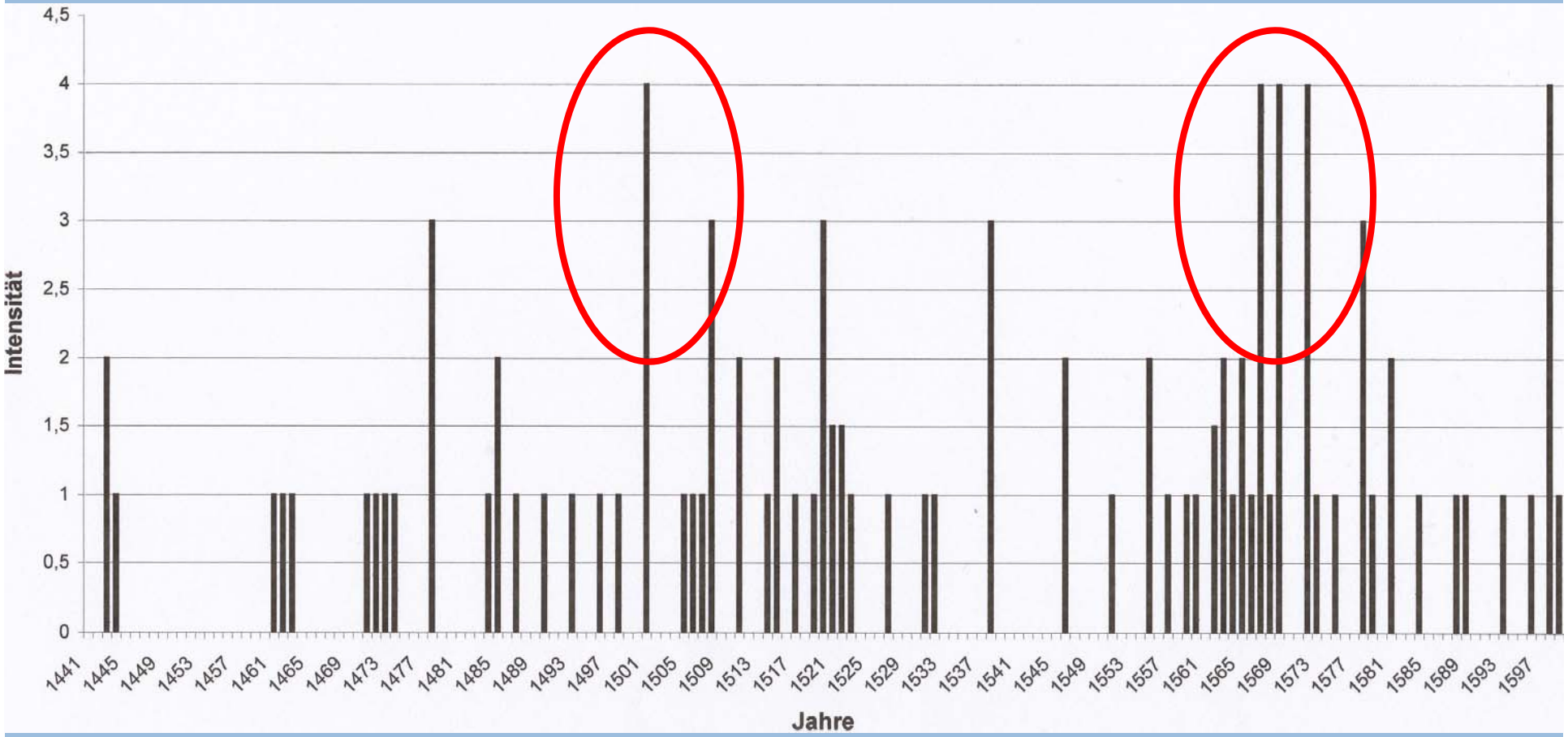
Source: Rohr 2007: 209.

Floods of the Traun River
March-May (1441-1599)



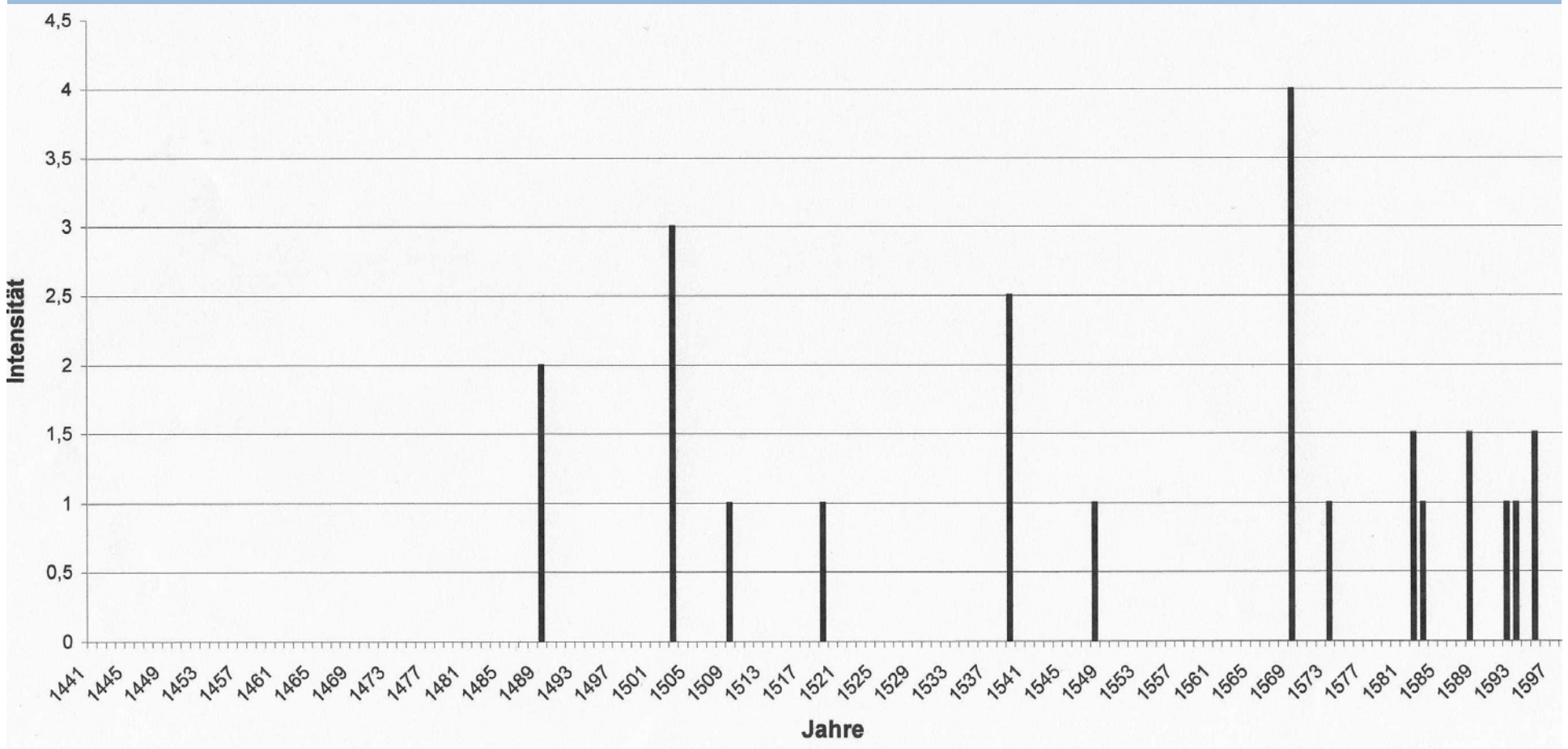
Source: Rohr 2007: 211.

Floods of the Traun River
June-August (1441-1599)



Source: Rohr 2007: 212.

Floods of the Traun River
September-December (1441-1599)



Source: Rohr 2007: 213.

Hydrological results

- Major floods occur one to three times every decade
  - Most of them cannot be reconstructed from other written sources
- Frequent occurrence of floods around 1500 and 1570
- Seasonality of floods becomes evident
  - Most of the floods in summer (June to August)
  - Typical for the Alpine and pre-Alpine regions
- Destruction caused by ice increase from the 1520s onwards
- Series taken for cross-dating of a lake sediment series of Lake Mondsee (Swierczynski et al. 2012)

Example 2: Climate history and the dating of impressionistic paintings

- Snowy winters as a popular subject in impressionistic painting
  - Paris, Normandy, Provence
- Exhibition in Remagen (Germany) to test a cooperation between climate historians and art historians (2013)
- Remarkable correlation of paintings, newspaper articles and instrumental measurements
  - Exact dating of single painting possible only by considering results from climate history

December 1879: an extremely cold and snowy winter in Paris

Camille Pissarro: Les boulevards extérieurs. Effet de neiges, 1879, Paris, Musée Marmottan Monet

December 1879: an extremely cold and snowy winter in Paris

- 10 December, 1879: -23.9 °C in Paris
- More than 1 meter of snow in the city centre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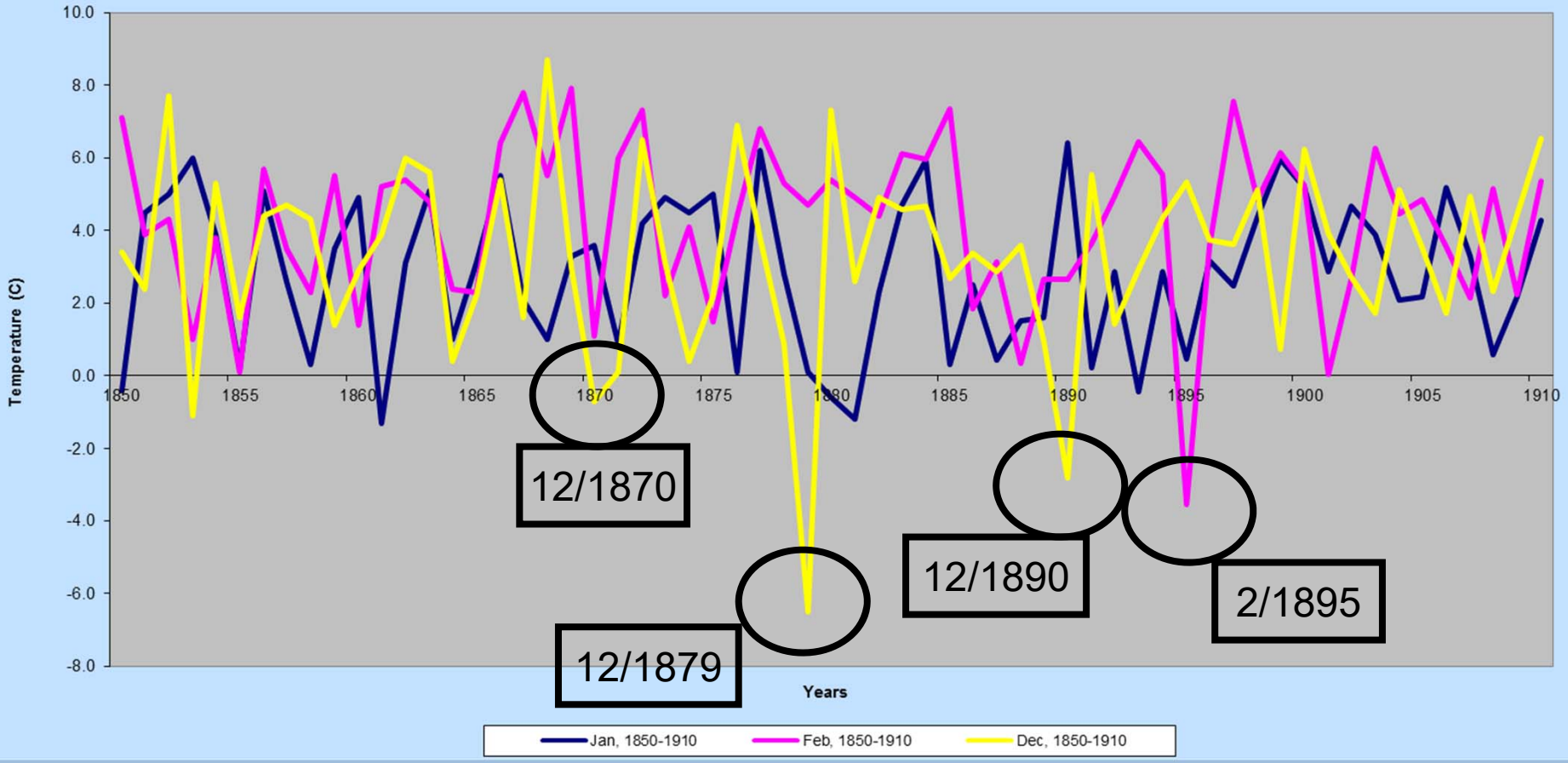
Monthly mean temperatures in Paris, 1850-1910

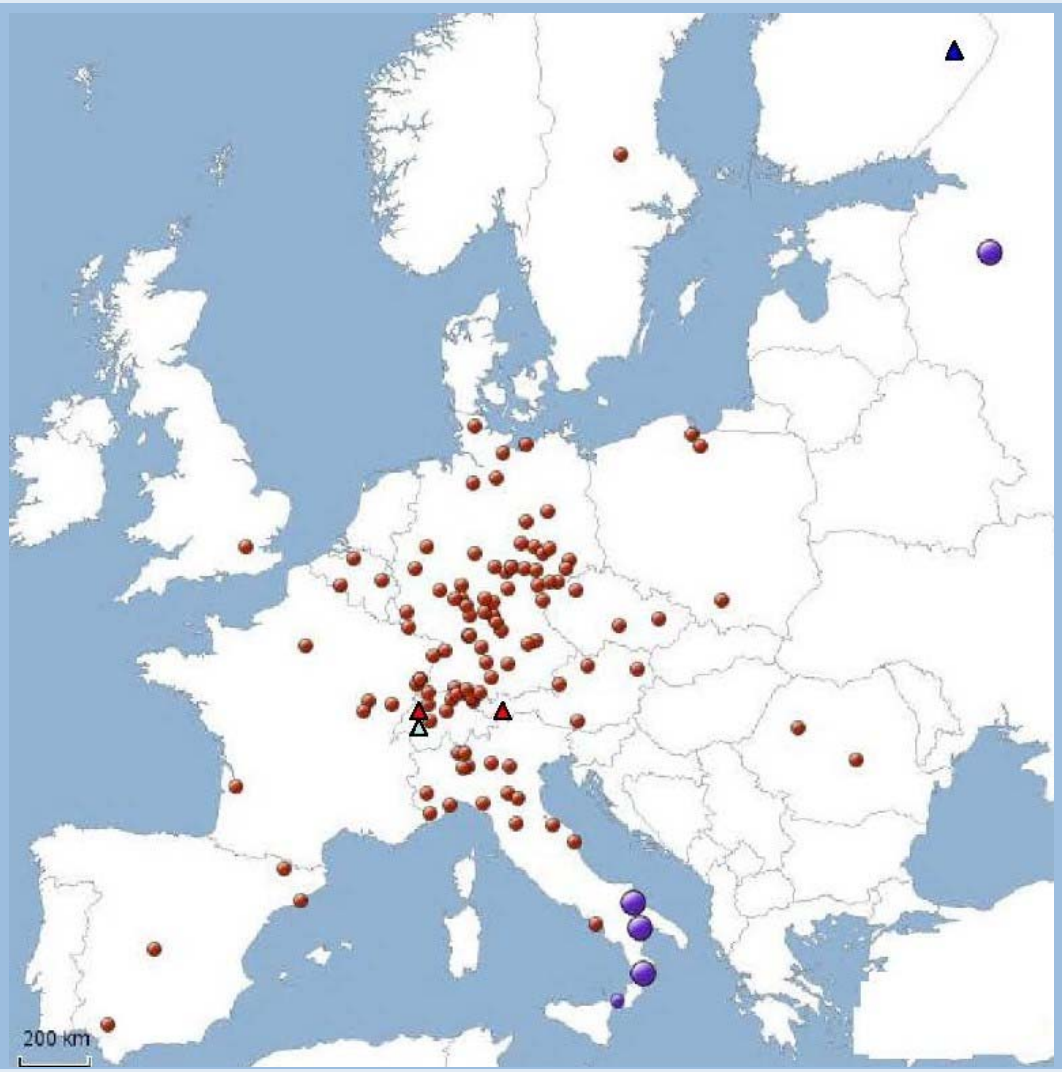


Source: Rohr 2012

Example 3: Documentary evidence vs. tree-ring evidence? The mega-drought of 1540

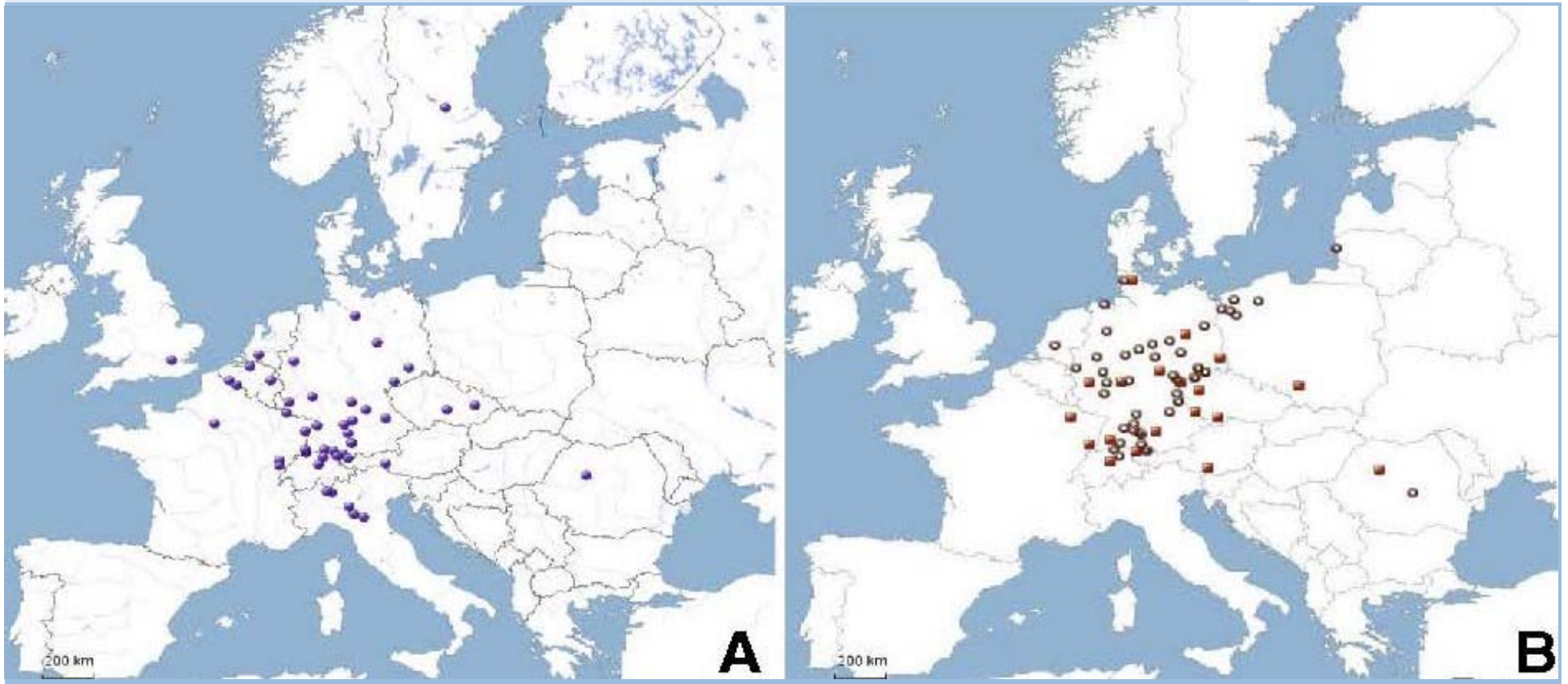
- Mega-drought of 1540 documented by more than 300 first-hand documentary records (Wetter et al. 2014)
  - Meteorological drought (hardly any rain from February to November)
  - Hydrological drought (extremely low water level)
  - Agricultural drought (soil moisture deficit, impact on cattle breeding)
  - Socio-economic drought (mills do not work, etc.)
- Some trees do not show a strong drought signal in their tree-rings (Büntgen et al. 2015)
- "Systematic comparison of tree-ring extremes with documentary and instrumental extremes … needed to get a detailed understanding of the response of tree species to extreme heat and drought." (Pfister et al. 2015: 197).

Documentary evidence vs. tree-ring evidence? The mega-drought of 1540



Spatial distribution of 1540 documentary data related to the occurrence of drought. Source: Wetter et al. 2014: 353.

Documentary evidence vs. tree-ring evidence? The mega-drought of 1540



Documentary evidence on low levels of rivers and lakes (A) and wild, forest and settlement fires (B) during the drought and heat wave in 1540. Source: Wetter et al. 2014: 358.

Conclusions

- Integration of documentary evidence into historical climatology requires skills of historians
  - Source criticism
  - Auxiliary sciences in history (palaeography, chronology, etc.)
- Outstanding resolution of anthropogenic historical data
- Interdisciplinary cooperation enables
  - Cross-dating
  - Complementary information
  - To question the own disciplinary methods related to contradictive results from human and natural archives

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Thank you for your attention!

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