Christian Rohr: The Historical Climate Database Euro-Climhist - Ways to Weather Hindcasting

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# The Historical Climate Database Euro-Climhist – Ways to Weather Hindcasting

## www.euroclimhist.unibe.ch

## Christian Rohr
## University of Bern

Workshop
"Every Breeze Has a Mood – Storms and Storminess. Climate Extremities and Their Social Effects on the Example of Estonia"

Tallinn, 9 December 2020

# Content

- Historical climatological research in Bern
  - Institute of History, Section of Economic, Social and Environmental History (WSU)
  - Oeschger Centre for Climate Change Research (OCCR)
  - International cooperation projects
- Euro-Climhist – Ways to Weather Hindcasting
  - From punched cards to open access – 40 years of history
  - Challenges in developing the database and interdisciplinary research cooperation
  - Data evaluation
  - Potentials and problems
  - Working with Euro-Climhist

# The section of WSU

- **Chair of Economic, Social and Environmental History (WSU) established 1998 at the Institute of History (Christian Pfister)**
  - Upgrade of a former research unit
  - Christian Pfister as one of the pioneers of historical climatology worldwide
- **Further enlargement to establish a Full Professorship of Environmental and Climate History 2010**
  - Supported by the Oeschger Centre for Climate Change Research (OCCR)
- **Research focuses (amongst others)**
  - Historical climatology based on documentary and instrumental evidence
  - Historical hydrology and avalanche research (societal impacts)
  - Socio-economic impact of climate change in history
  - History of science of climatology

# The Oeschger Centre for Climate Change Research (OCCR)

- Based on a "National Centre of Competence in Research" (NCCR) on "Climate"
    - Today one of the most important and most visible strategic research centres of the University of Bern
- Structure
    - Numerous research groups working together in interdisciplinary cooperation projects
    - Several early career programmes for Master, PhD and Postdoc researchers
- Interdisciplinary projects with participation of WSU researchers
    - Avalanches in the winter of 1916/1917
    - The flood of 1868
    - CHIMES: Early Instrumental Weather Measurements in Switzerland
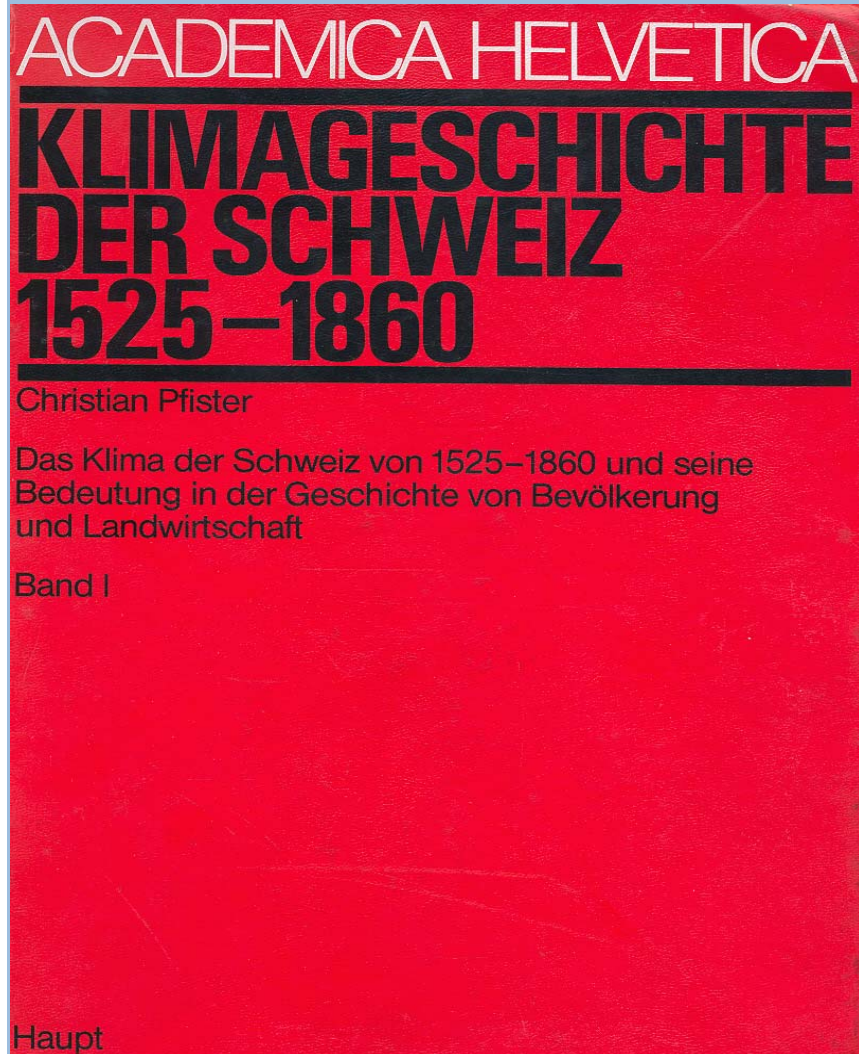
# National und international cooperation

- MeteoSwiss and Global Climate Observing Service (GCOS) Switzerland
  - Most important sponsor of the Euro-Climhist project
- Regional research groups for cooperation in historical climate projects
  - University of Brno (Czech Republic)
  - University of Tallinn (Estonia)
  - Several individual researchers in France (Paris, Metz, Dijon, Aix-en-Provence)
  - University of Barcelona (Spain)
  - Further partnerships for cooperation in state of establishment
- Complementary cooperation with other historical climate database projects
  - E.g. TAMBORA (tambora.org, University of Freiburg im Breisgau)

# Euro-Climhist

- Documentary and instrumental evidence to reconstruct historical weather and climate since the Middle Ages
- Development since the late 1970s (Christian Pfister)
- Professionalization of the database since 2010
    - Co-financing since 2010 by GCOS Switzerland
- 2012/2015: Going Public
- Challenges and perspectives for the future
    - Documentary evidence for the Middle Ages at a Europe-wide scale
    - Datasets to be inserted from cooperation projects from different European regions
    - Complete relaunch of the back-end and front-end sections to improve international cooperation (starting 2020/2021)
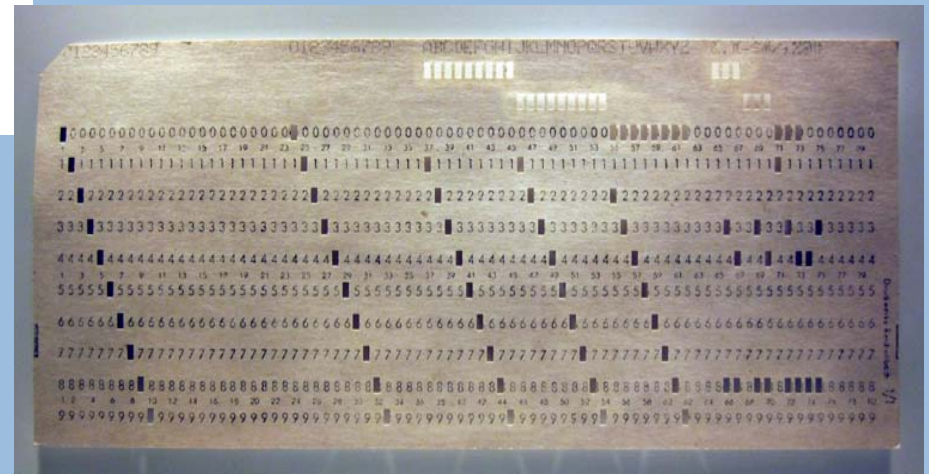
# Starting with CLIMHIST-CH in the 1980s

ACADEMICA HELVETICA

KLIMAGESCHICHTE
DER SCHWEIZ
1525–1860

Christian Pfister

Das Klima der Schweiz von 1525–1860 und seine
Bedeutung in der Geschichte von Bevölkerung
und Landwirtschaft

Band I

Haupt

- Christian Pfister: A climate history of Switzerland, 1525-1860 (1984)
  - Based on 34'000 records

# The PL-1 based programme SRTCLIM (1985)



Programme based on 986 punched cards with 72 signs maximum each

# CLIMHIST-CH: Documentation of records
## A 1251-pages catalogue with endnotes



**Date**

**Code**

**Source reference**

**Evaluation**

# CLIMHIST-CH: Documentation of records
## Endnotes for the drought of 1540

CLIMHIST   Anmerkungen   16. Jahrhundert                    Seite     238

25. 1540: 10./20. Mai auff den Abend ist ein regen kommen, schier die gantze nacht aus geregnet, ist sehr nodtwenig gswin. (GAST,168)

26.   1540:  Der Brachmonath gieng ganzt truckhen ein, aber gegen dem End da regnete es alle Tage etliche  Mal, aber nit vil und gab vil Heu. Der Julius fieng an gantz duerr und heiss zu werden, und  war eine grausame Hitz, die waehrete bis zu Eingang des Augusts; es war ein erschroeckliche Wassertheure,  dass  die  Leuth grossen Hunger leiden muessten, des Mahlens halben, und das Obs, Aepfel,  Birn  und Nuss verbrennten an vil Orthen an den Baeumen fielen herab, wie auch der Wein an  den  Reben. Vil Vieh crepierte auch an etlichen Orthen, sonderlich auf der Hart, des Wassers halben;  es  giengen auch die Waelder von allzugrosser Hitz an, und verbrannten von Thann bis in Lothringen  vil  hundert  Juchert  Waeldt,  die  in  vilen  Jahren  nimmer  werden nach wachsen. (THANN,275)

27.   1540 Sommer: Es war eine soche bestaendige duerre, dass das Erdrich dermassen aufgespalten, dass  man  an  etlichen Orthen darauf sitzen und die Fuess in den Spalt henken kont... bey diser grossen  Sommerhitz  fielend  des  Nachts  grosse  und  gute  Taeuwer,  welche  allerley fruecht erquicktend.
Es  wurde  zum  Andenken zu Zuerich von dem Kernan, so diss Jahr gewachsen, aufbehalten, von dem ich (der Schreiber diess) im Jahr 1751 in Haenden gehabt. (GOLDSCHMID,82)

28.  1540:  Um  Magdalenaa  (22.Juli) ging ich (Hans Salat) nach Solothurn, ich schreibe dies an ihrem  Jahrestag,  da  war es unbillig heiss, alle Welt klagte ueber Wassermangel; die Sonne und der  Mond  waren  bei Auf- und Niedergang blutrot schienen auch ganz bleich, dann der Himmel war von  Hitznebel  getruebt.  An  vielen Orten entzuendeten sich die Waelder, man sah viele brennen rings  herum. Den 22.Juli wurde auch in Kriens Sturm galaeutet, da der Herrgottswald brannte. Am Morgen  war es jeweilen in der Weite vor Rauch und Hitze nicht anders, als im Herbst beim Nebel,

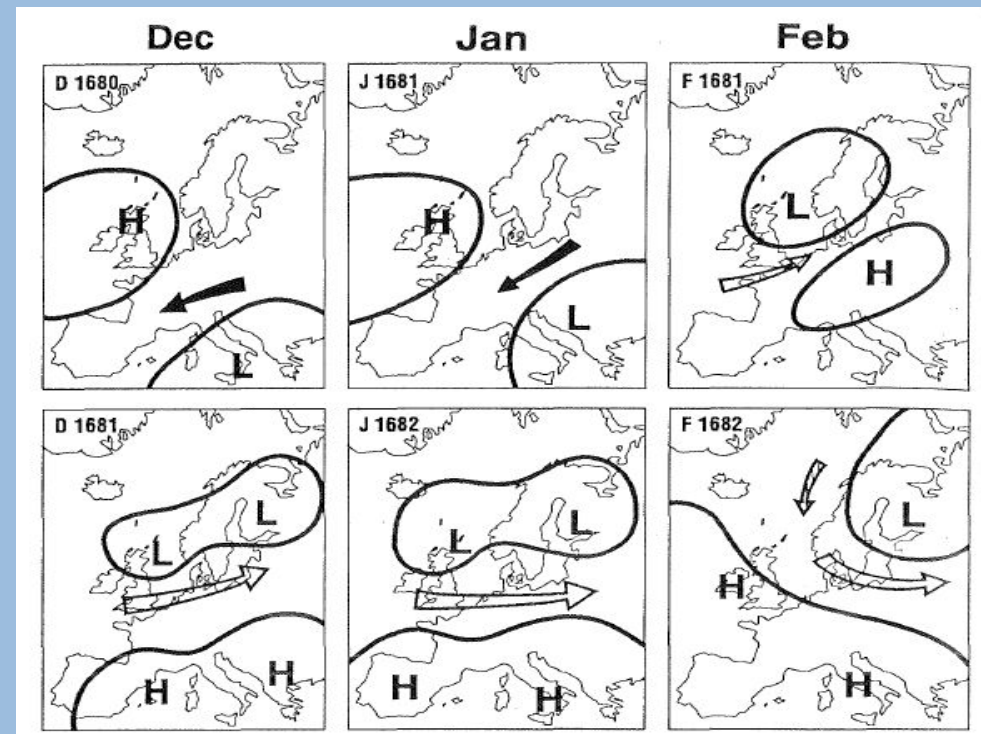# ESF project "European Paleoclimate and Man"
## Monthly historical weather charts for the Late Maunder Minimum (1675-1715)



Synoptic (comparative) interpretation of historical weather charts
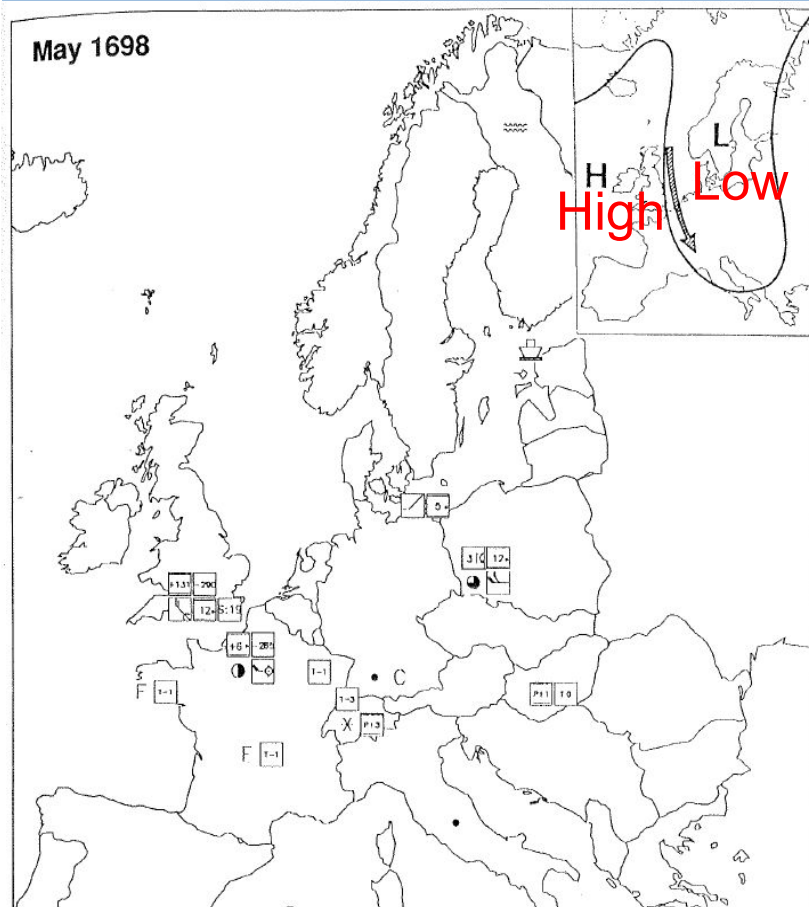
Historical weather chart for May 1698

412 monthly air pressure areas

# Creation of an online database sponsored by GCOS Switzerland since 2010

- 1995-2009: Euro-Climhist in the long slumber (hardly any funding)
- 2009: Decision by the Swiss Federal Council (Bundesrat) to provide a sustainable development of climate related databases
  - Since 2010: yearly support via MeteoSwiss/GCOS Switzerland
- Professionalization of database management
  - Development of a specific methodology to classify and harmonize the observations
  - Development of a specific software
- National and international cooperation projects to enlarge the available datasets
  - Currently approximately 350'000 records available
  - 13th century to present

# Classification of weather-related records
## Numerical Code (CAT) of Euro-Climhist (detail)

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| 1: | descriptive data | Deskriptive Daten |
|---|---|---|
| 1:1: | weather | Witterung |
| 1:1:1: | cover of the sky | Himmelsbedeckung |
| 1:1:1:1: | sunny | vorwiegend sonnig |
| 1:1:1:2: | clouds-partly | wechselnd bewölkt |
| 1:1:1:3: | clouds-overcast | bedeckt |
| 1:1:1:4: | fog | Nebel |
| 1:1:1:5: | fog | Hochnebel |
| 1:1:1:6: | aerosol | Höhenrauch |
| 1:1:1:7: | fog | Nebel mit Auflösung |
| 1:1:1:8: | | Inversion |
| 1:1:2: | precipitation | Niederschlag |
| 1:1:2:1: | rain | Regen |
| 1:1:2:2: | rain showers | Regenschauer |
| 1:1:2:3: | rain-abundant | ergiebiger Niederschlag |
| 1:1:2:4: | rain-varying | veränderlich |
| 1:1:2:5: | snowfall | Schneefall |
| 1:1:2:6: | hail | Graupeln |
| 1:1:2:7: | hail | Hagel |
| 1:1:2:8: | thunderstorm | Gewitter |
| 1:1:2:9: | dew | Tau |
| 1:1:2:10: | rain-red | Wüstenstaub (roter Regen) |
| 1:1:2:11: | rain-small | wenig Niederschlag |
| 1:1:2:12: | rain-no | kein Niederschlag |
| 1:1:2:13: | snowfall-no | kein Schneefall |
| 1:1:2:14: | snowfall-little | wenig Schneefall |

# Content of the database

- Accompanying website with introductory texts, e.g.:
  - Historical climatology and the methods used
  - Sources for climate history
- Data on weather and climatic development for the last 700 years
- Types of datasets
  - Daily and partly even sub-daily weather observation and instrumental measurement (temperature, air pressure, precipitation, wind, cloudiness)
  - "Proxy data", i.e. phenological observations (plants, snow), but also some tree-ring data etc.
  - 92 series, e.g. long series on temperature and precipitation, but also on ice-breakups, grain prices as and indicator of conjunctures, etc.
  - Information about damage caused by weather and climate including the impact on humans, animals and infrastructure
  - Natural hazards and their consequences

# Evaluating documentary evidence on the history of weather and climate
## The use of historical auxiliary sciences

- Chronology
  - Homogenisation of historical dating systems (e.g. according to saints' feasts)
  - Homogenisation between the Julian calendar and the Gregorian calendar
    - Introduced 1582, but in the beginning only in the Catholic territories
    - Important for long-time series of phenological data
- Source criticism / transmission of information
  - Differentiation between primary (in a temporary and spatial sense) and secondary transmission
  - Individual evidence
    - Subjective sample of observations
  - Administrative/institutional evidence
    - Documentation mostly for economical reasons
- Classification of weather observations (so-called Pfister indices)

# Winter temperatures 1434/35 (Pfister indices)
## Source: Camenisch 2015

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

| -3 | |
|---|---|
| Criteria | Example |
| ▪ Large rivers and lakes frozen and passable<br>▪ Frost mentioned over a period of about two month<br>▪ Rye or trees damaged by frost | „*Item in deme jaire uns heren 1400 ind 35 vur kirsmissen vroeire it hart bis darna also dat it stoint 13 wechen […]. ind der Rin bestoint des sundais vur sent Briden dach vur Colne […]. ind stoint also 3 wechen ind einen dach, dat man darover reit uns voire mit wairen karssen gelden mit houlcze ind mit hirrinch in mit wine ind vort groisse eichen doimer die man darover sleifde. ind dat dede man wale 2 ½ weche lank.*" (Cölner Jahrbücher des 14. und 15. Jahrhunderts, p. 124) |

# Working with the Euro-Climhist database



- **Access as a standard user or scientific user**
- **Search engine available in four languages**
  - English
  - French
  - German
  - Italian
- **Search for single records or series**
  - Spatial limitation
  - Specific timespan
  - Area request

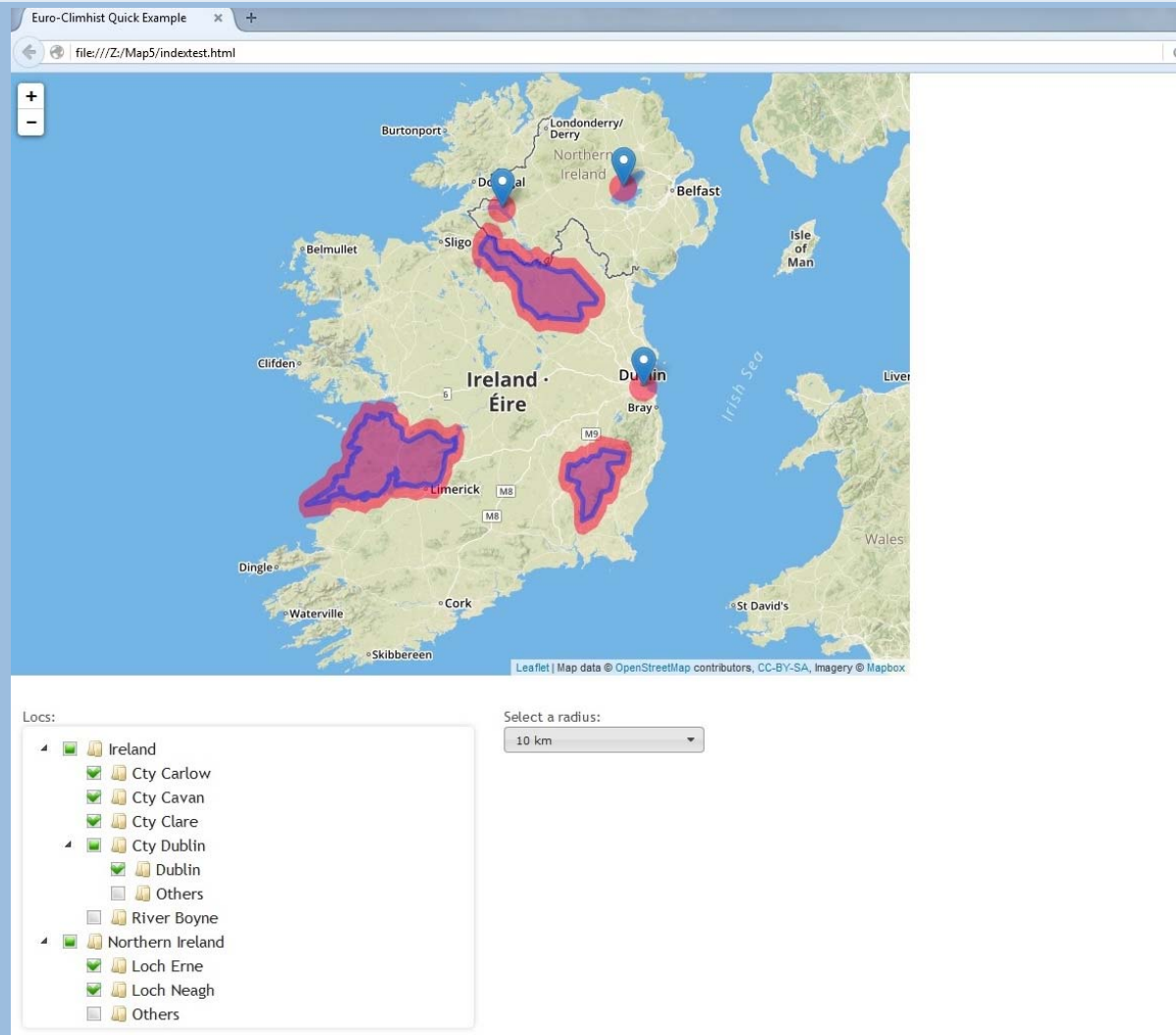# Spatial visualisation of requests and results
## Area request
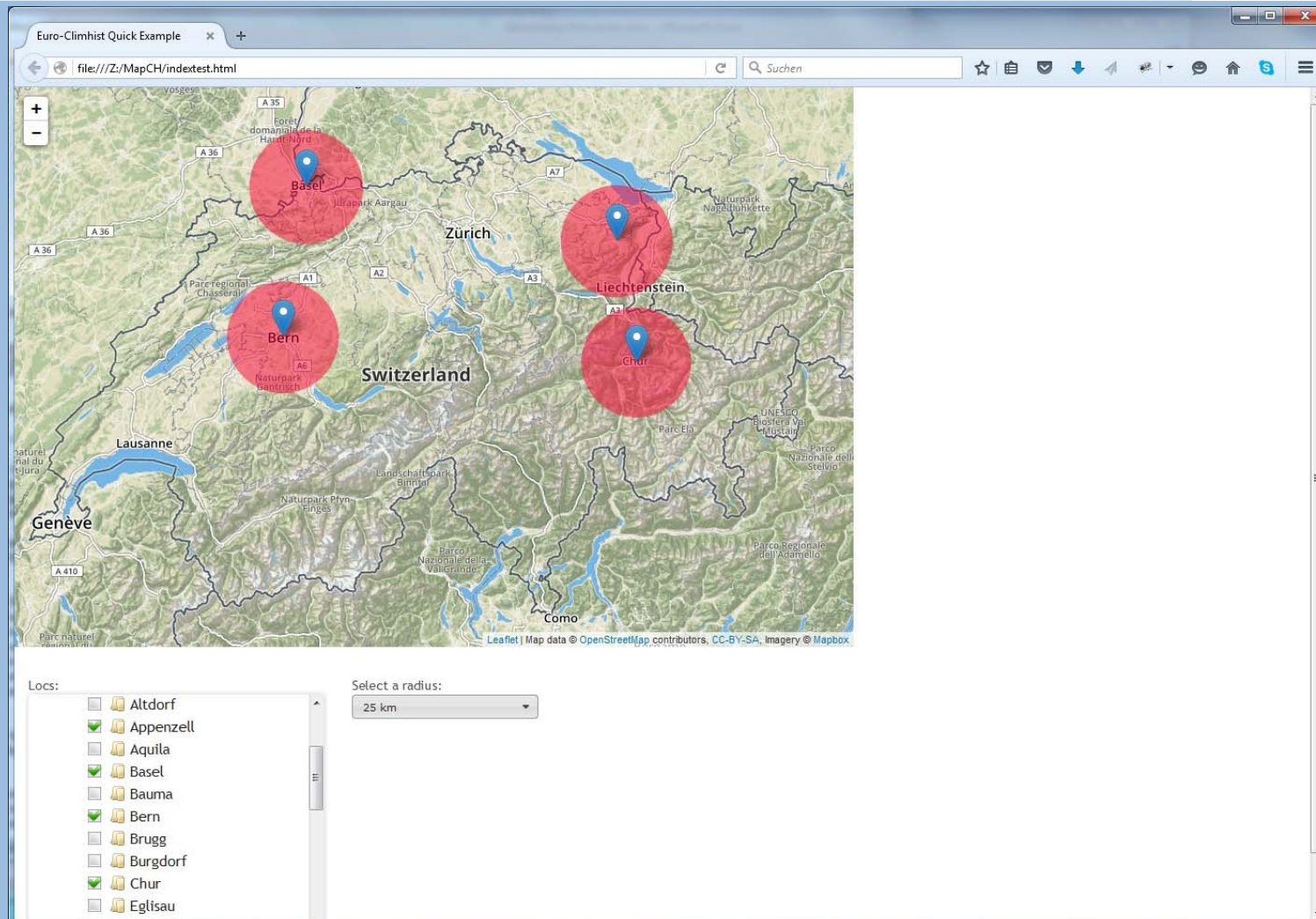
# Spatial visualisation of requests and results
## Request according to political units and lakes

# Weather reports and climate data
## The example of Switzerland, 1522-1523

**Search results**

1522 All year impact of floods and high water / Eulach / S:Bosshart, Chronik — **Disasters**

1522 All year tree-ring width (mm): 0.72 mm: very small / Lötschental / S:Büntgen,Tree_Width_Lötschental

1522 All year tree-ring maximum density (g/cm3): 0.85 g/cm3: slight / Lötschental / S:Büntgen,Tree_MXD_Lötschental

1522 Jan 16 - 26 frost impact / Schaffhausen(SH)(403m) / S:Stockar, Chronik

1522 Apr very cold / Schaffhausen(SH)(403m) / S:Stockar, Chronik

1522 May very cold / Schaffhausen(SH)(403m) / S:Stockar, Chronik — **Weather**

1522 Jun very cold / Schaffhausen(SH)(403m) / S:Stockar, Chronik

1522 Summer hay production abundant / Schaffhausen(SH)(403m) / S:Stockar, Chronik

1522 Jun 25 - 30 fog, variable weather / Schaffhausen(SH)(403m) / S:Stockar, Chronik — **Phenology**

1522 Jul 28 grain harvest begins (d-of-Yr): 209 Day-of-Year: rye late / Swiss Plateau / S:Wetter_Pfister, Grain_harvest

1522 Oct 21 grape harvest begins (d-of-Yr): 294 Day-of-Year: late / Swiss Plateau / S:Wetter-Pfister, Grape_harvest

1523 All year tree-ring width (mm): 0.83 mm: small / Lötschental / S:Büntgen,Tree_Width_Lötschental

1523 All year tree-ring maximum density (g/cm3): 0.84 g/cm3: slight / Lötschental / S:Büntgen,Tree_MXD_Lötschental

**Climate**

*Uff den abereilen und miagen und brachett regnett es vast und was kalt, das ich aim halben dag zu pfingsten ain belzrock must ainlegen das ich wott erfrorn sin von keltin, und warm mian die stuben, ettlich lütt. Was vast kalt."*
(Hans Stockars Jerusalemfahrt 1519 und Chronik 1520-1529, ed. Karl Schib. Basel 1949: 36)

# Series
## Combining temperature and number of days of rain in Basel, May 1765-1766

The function "period" allows a limitation of the search to a specific month or season

Pfister indices; compared to the climatic normal of 1901-1960

# Potentials and problems

- **Potentials**
  - Increased visibility of historical climate studies for an interdisciplinary and general audience
  - Enhancement of anthropogenic documentary data (cf. IPCC reports)
  - Entanglement of different European research initiatives
  - Data repository for publications in historical climatology

- **Problems**
  - Long-time genesis of the project
  - Quality of data collection varies over time (evaluation necessary)
  - Data collected in the 1980s-2000s partly only available as a computer print or on CD (large box with hundreds of unlabelled and undated CDs in our archive)
  - Spatial visualisation of non-precise data (e.g. "flood on the Rhine")
  - Collection of data follows specific publications (e.g. flood data for 1834 collected for the canton of Valais only)

# Source criticism: the reliability of information
## Severe winter storms in Switzerland, 1626-1645

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1629 Feb storm impact: buildings / Lake Zurich Region / S:Escher, Zürich-See*

1629 Feb 1 - 10 storm impact: buildings / Fischingen(TG)(613m) / S:Brunschwiler, Diarium

1629 Feb 1 - 10 storm impact: buildings / Bern(BE)(540m) / S:Kuepfer, Tagebuch

1629 Feb 1 - 10 storm impact: buildings / Stein am Rhein(ZH)(402m) / S:Vetter, Chronik*

1629 Feb 1 - 10 storm impact: buildings / Winterthur(ZH)(439m) / S:Graf, Chronik

1629 Feb storm impact: buildings / Zurich(ZH)(408m) / S:Müller, Waser_Chronik*

1629 Feb storm impact: buildings / Zurich(ZH)(408m) / S:Steiner, Chronik

1633 Jan 1 - 10 storm impact: buildings / Fischingen(TG)(613m) / S:Brunschwiler, Diarium

1633 Jan 11 - 20 storm impact: forest / Zurich(ZH)(408m) / S:Steiner, Chronik

1633 Jan 21 - 31 storm impact: buildings / Winterthur(ZH)(439m) / S:Graf, Chronik

1645 Jan 21 - 31 storm impact: buildings / Lake Zurich Region / S:Escher, Zürich-See*

1645 Jan 21 - 31 storm impact: buildings / St. Gallen(SG)(670m) / S:Kessler, Begebenheiten*

1645 Jan 21 - 31 storm impact: buildings / Solothurn(SO)(432m) / S:Haffner, Schaw-Platz

1645 Jan 21 - 31 storm impact: buildings / Zurich(ZH)(408m) / S:Steiner, Chronik

1645 Jan 29 storm impact: windows / Geneva(GE)(383m) / S:Roset, Chroniques_Geneve*

1645 Feb 1 - 10 storm impact / Stein am Rhein(ZH)(402m) / S:Vetter, Chronik*

*Non contemporary information subject to errors

Euro-Climhist clearly distinguishes between contemporary, first-quality sources and non-contemporary sources

The centennial storm "Gerd" on 29 January 1645

Contemporary source, only the edition is from 1894!

# The centennial storm "Gerd", 29 January 1645
## Two full-text sources from Euro-Climhist

*Entstuhnde urplötzlich allhie zu Solothurn und anderstwo ein solch ungewohnlicher Sturmwind/ dass er vil hundert Bäum auss der Erden gerissen/ und auff den Tächern vil tausent Ziegel abgeworffen.*

[In the city of Solothurn and on other places an unusually strong storm arose suddenly, uprooting hundreds of trees and smashing down thousands of roof tiles.]   Source: Haffner, Franciscus: Der klein Solothurner allgemeine Schaw-Platz etc. Solothurn 1666: 300.

*Le 19 [29] janvier, [vent] si violent à 8h du matin que le peuple sortit du temple, dont les vitres furent brisées. Le vent fit rebrousser le Rhône, les moulins tournèrent à rebours.*

[On 19 [29] January, at 8 o'clock in the morning, the wind was blowing so violently that the people came out of the church, because its windows were smashed. The storm made the Rhone River turn back, and the mills turned backwards.]   Source: Roset, Michel: Chroniques de Genève, Continuation. In: Fazi, Henri (ed.): Les chroniques de Genève. Genève 1894.

# Spatial visualisation of information
## Floods in Switzerland, summer 1834



Data request in December 2015

"Fake information" on floods of the Reuss River

Floods in the Canton of Grisons still not inserted

**Thank you for your attention!**

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