Astrolabe
laiton, v. 1550-1555
Londres, The National Maritime Museum

[in] K Lippincott, *The story of time*, Larousse, 2000, s. 116

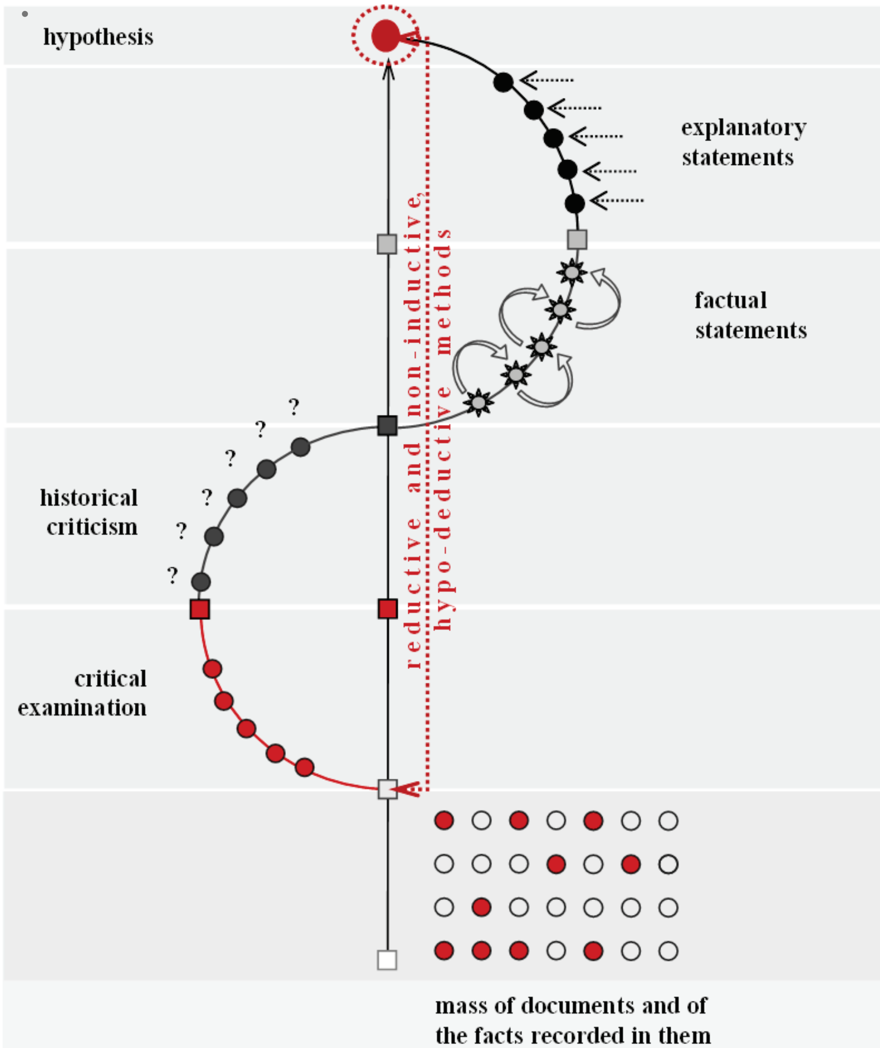
Visualising time with multiple granularities: a generic framework

Iwona DUDEK, Jean-Yves BLAISE
CNRS, France
UMR CNRS/MCC 3495 MAP

We know how to measure time, but it doesn't guarantee that we are able to understand its nature.

U. Eco, *Time*, s. 13 [in] *The story of time*, K. Lippincott, Larousse, 2000

Human Sciences > traces of human activity > historical sciences



results of data sets analyses

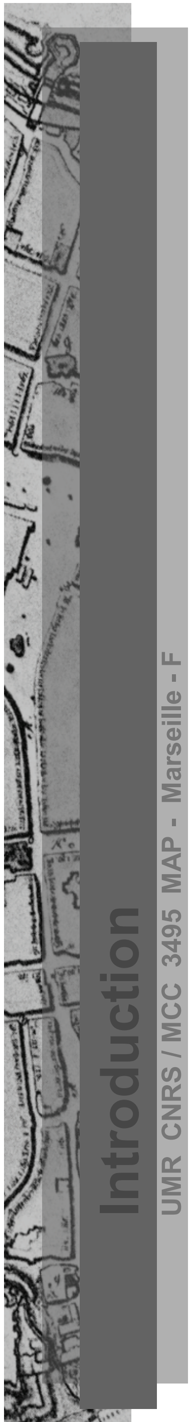
historical explanations
(teleological, causal, ...)

comparison of information
New statements obtained from the interpretation of data set compared with the statements whose place in the discipline has previously been established.

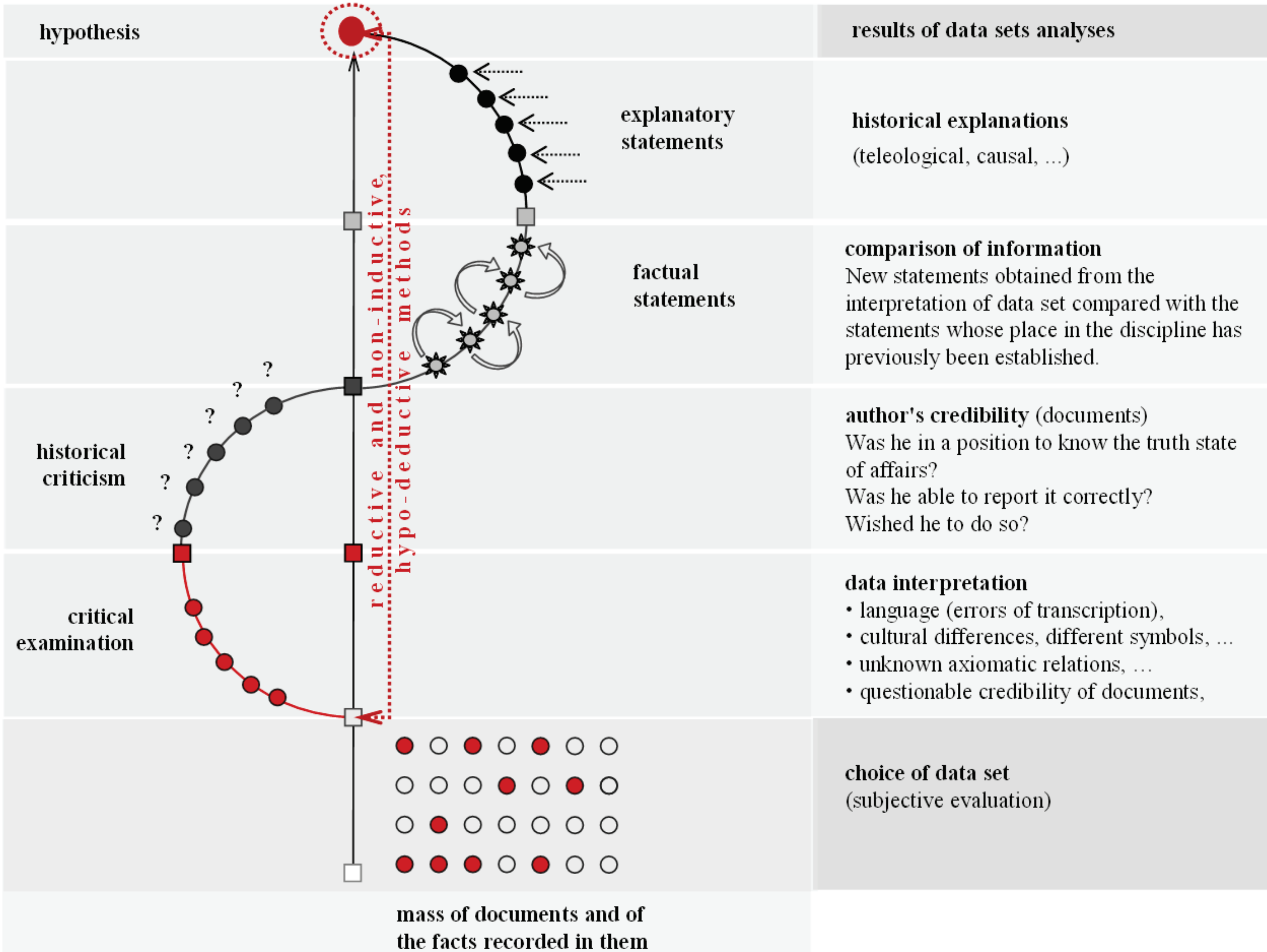
author's credibility (documents)
Was he in a position to know the truth state of affairs?
Was he able to report it correctly?
Wished he to do so?

data interpretation
- language (errors of transcription),
- cultural differences, different symbols, ...
- unknown axiomatic relations, ...
- questionable credibility of documents,

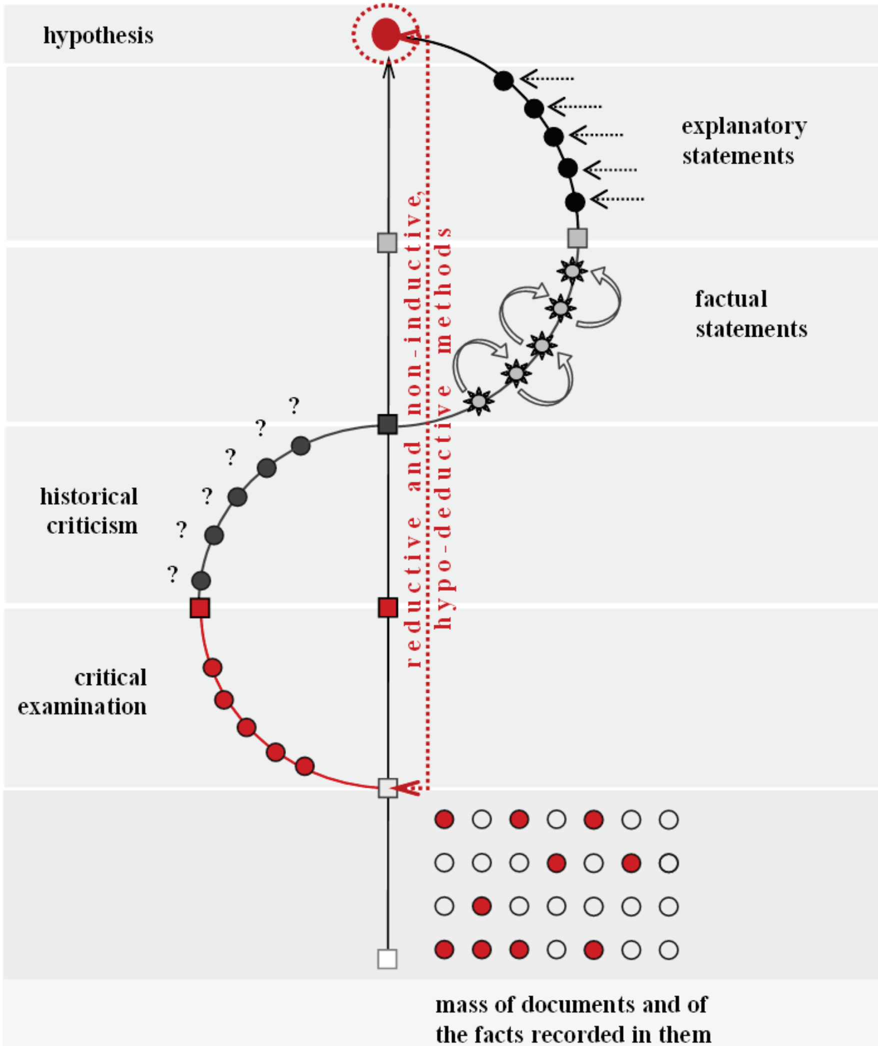
choice of data set
(subjective evaluation)



We can not verify our ideas by an experiment.



One cannot edict general rules



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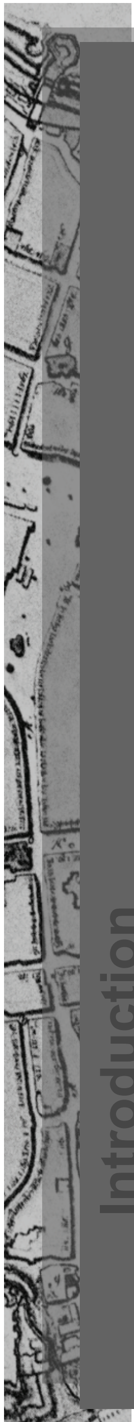
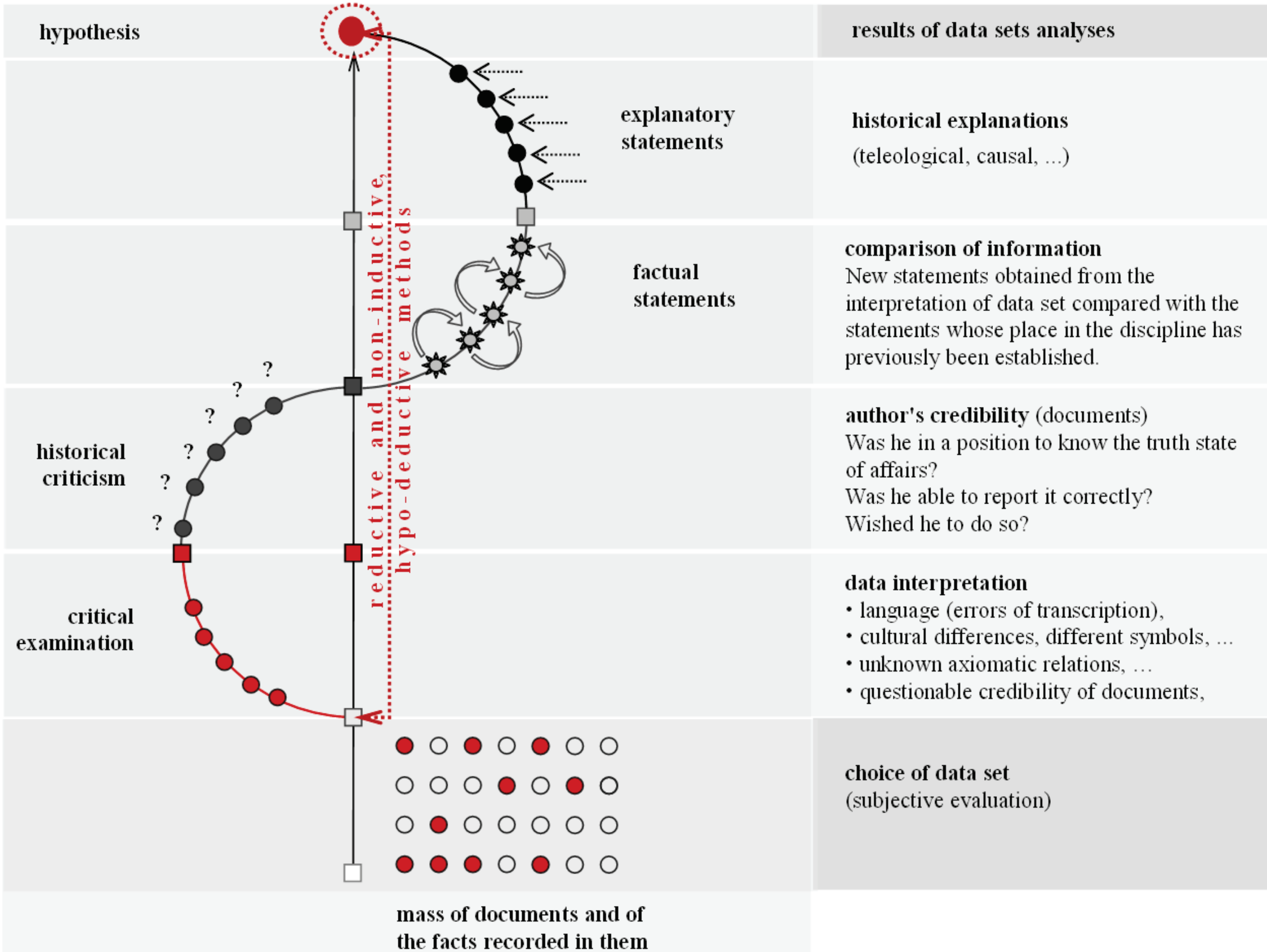


teleological explanations (goal of phenomenon is given)
causal explanations (cause of phenomenon is given)



Nature of historical data sets

heterogeneity,
uncertainty,
missing data,
uneven distribution in time,
etc.

time points and intervals are often inconsistent in terms of granularity.

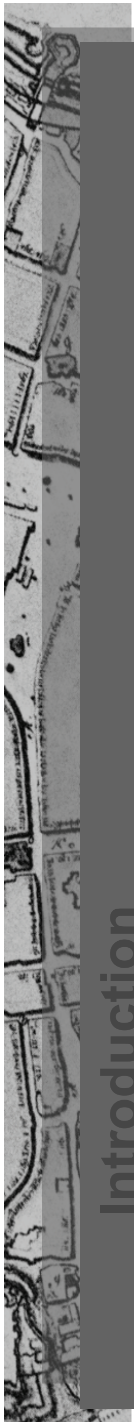
choice of a given temporal granularity

the reality of a conceptual model we use

Visualisation

Nocturnal
buis, 1693
Londres, The National Maritime Museum

[in] K Lippincott, *L'histoire du Temps*, Larousse, 2000, s. 102



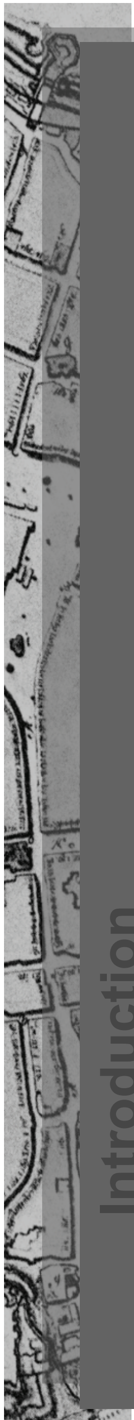
Example :

summer 1543	A fire of a tower took place in summer 1543.
15th July	A modification of the tower started on 15th July 1543.
July	A big quantity of bricks have been bought in July 1543.

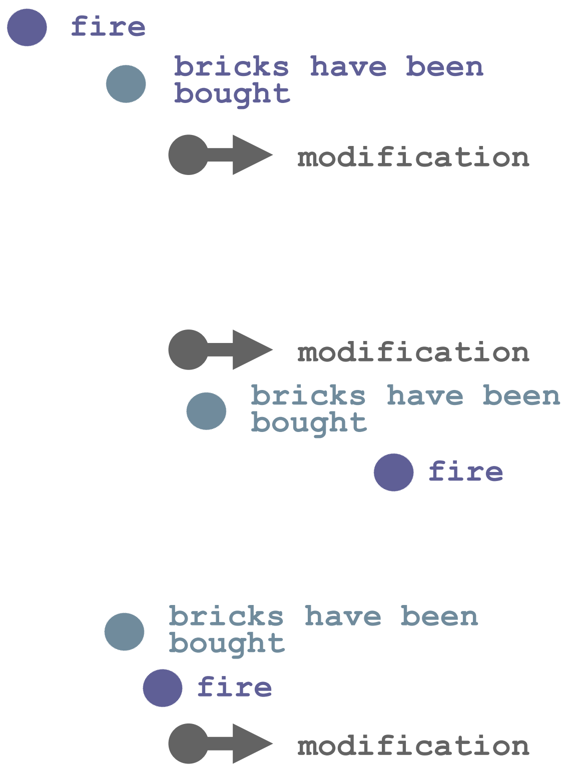
Problems :

- **credibility of data** – ex. author's credibility
- **incertitude of dating** – ex. *probably 1345*

Visualisation



Example :



A fire of a tower took place in summer 1543.

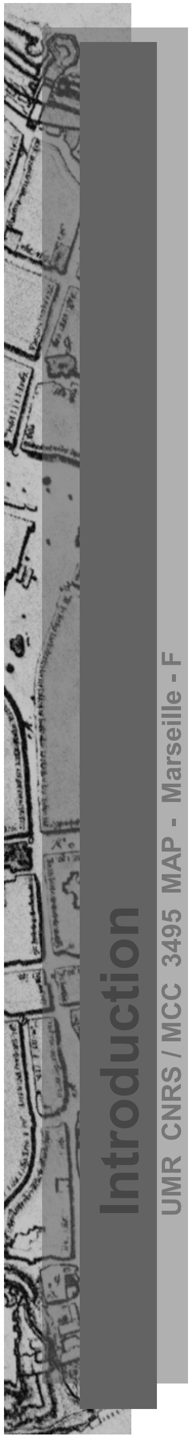
A modification of a tower started on 15th July 1543.

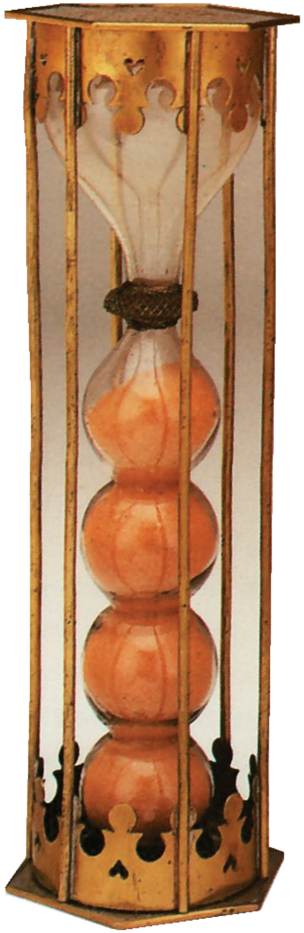
A big quantity of bricks have been bought in July 1543.

Problems :

- credibility of data – ex. authors credibility
- incertitude of dating – ex. probably 1345
- possibility of various scenarios – that imply different cause and effect relations
- <u>data precision (temporal granularity)</u>

Visualisation





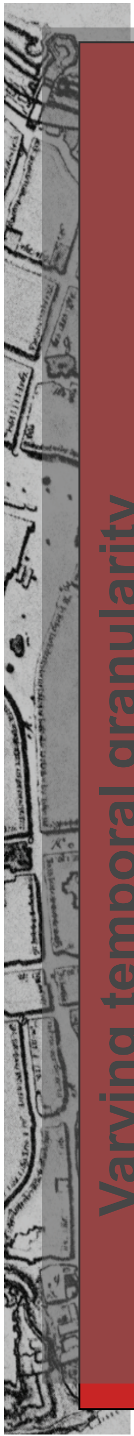
Structure of presentation :

Visualisation of data sets characterised by varying temporal granularity

Comparison of 25 historical calendars

Generic framework of a method of visualising time with multiple granularities (two case studies)

Conclusions



Varying temporal granularity

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Visualisation of datasets characterised by varying temporal granularity

~~summer~~ 1543

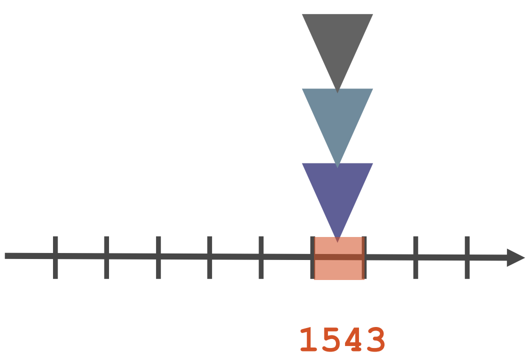
Different temporal granularity

~~15th July~~ 1543

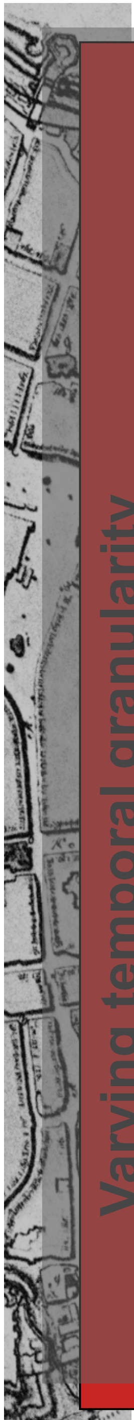
If a *chronon* (the smallest temporal unit)

~~July~~ 1543

one civil year (format YYYY)



Other hints about temporal relations between these events will disappear



Visualisation of datasets characterised by varying temporal granularity

cyclic events/processes
with inconsistent granularities

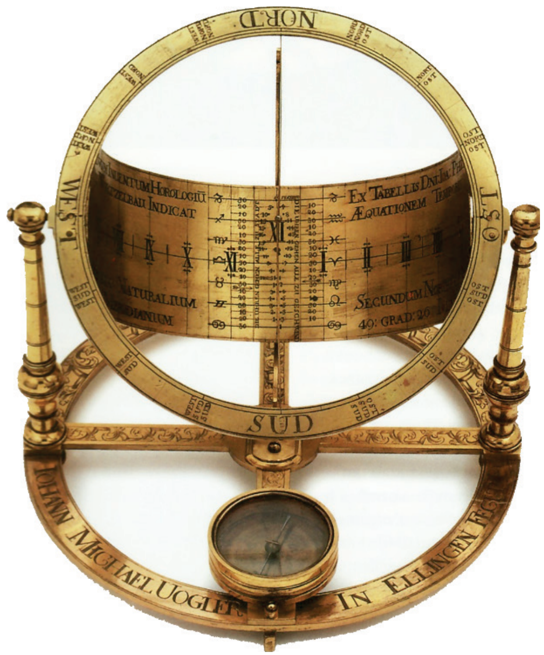
the chapel is
inaccessible
due to snow for
a certain
number of weeks
during the year

- fuzzy cyclic behaviour

a pilgrimage is
organised on
the saint's day
every year

- well-defined cyclic behaviour

How to describe and visualise time with multiple granularities ?



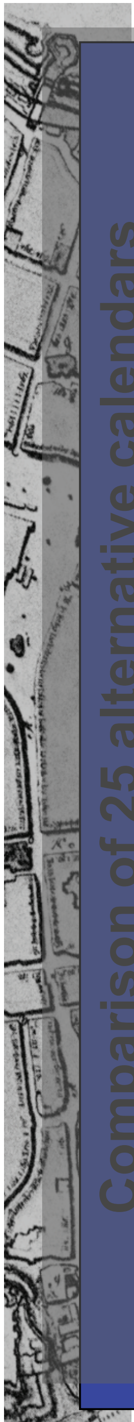
Johann Michael Vogler
Cadran analemmatique
laiton doré, début XVIIIe s.
Londres, The National Maritime Museum

[in] K Lippincott, *L'histoire du Temps*, Larousse, 2000, s. 106

to combine in a single visualisation multiple aspects of the parameter "*time*"

adequate tool/method to visualise and reason about the data sets we use

the idea:
start from how time is handled in general (through calendars)
rather than from historical data sets and tools



Comparison of 25 alternative calendars

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Japanese calendar (*Taiintaiyoreki*)

Tibetan calendar

Babylonian calendar

Burmese calendar

Chinese calendar

Hebrew calendar

Pre-Islamic calendar (*Dżahilijja*)

Symmetry454 calendar

Incas calendar (solar)

French republican calendar

Egyptian calendar

Soviet calendar

Coptic calendar

Julian calendar

Gregorian calendar

Byzantine calendar

Roman calendar (republican)

Inuit calendar

Continental Celtic Calendar (*Gaulish Coligny calendar*)

Muslim calendar (*Hijri*)

Attic state calendar

Maya and Aztec calendars (*Xiuhpohualli, Tonalpohualli*)

Badí' calendar

Incas calendar (lunar)

Balinese Pawukon calendar

Comparison of 25 alternative calendars

covering a wide range of historic periods and cultures or civilisations

eleven key aspects of calendars:

Comparison of 25 alternative calendars

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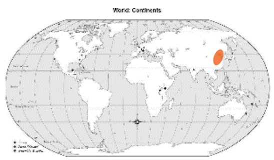
lunar solar lunisolar agricultural



Comparison of 25 alternative calendars

covering a wide range of historic periods and cultures or civilisations

eleven key aspects of calendars:

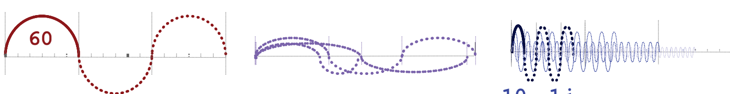
type

period and zone of usage

presence and type of cycles

year discretisation …

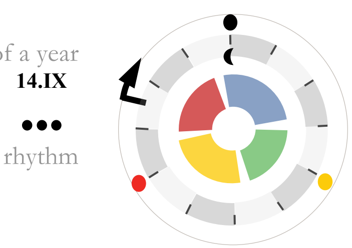
in years cycles of nature in days



number of seasons

beginning of a year
14.IX

intercalation rhythm



5 days 1 day

number of days in a week

number of days in a common year

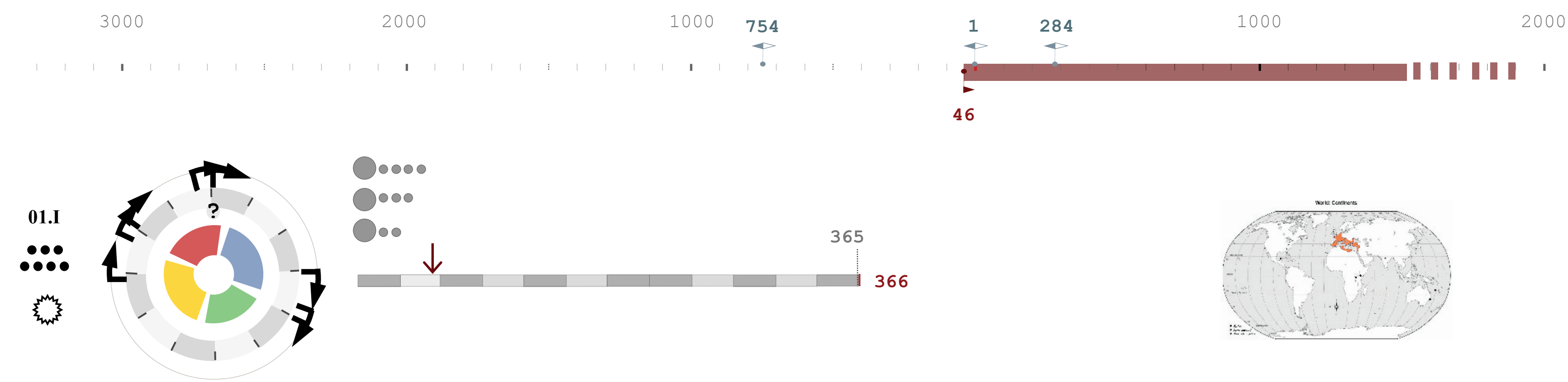
354

387 number of days in a leap year

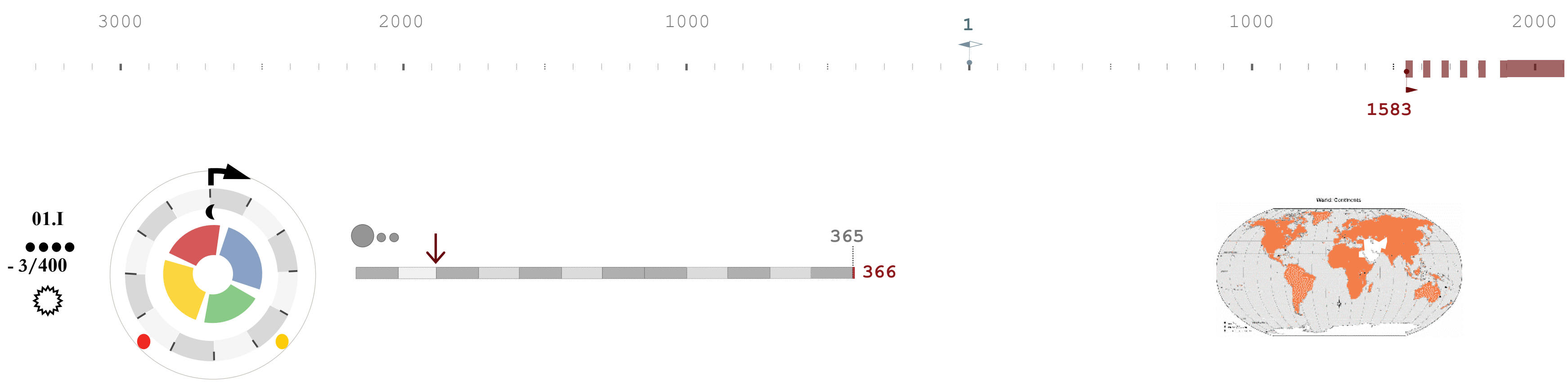
number of months in a common an a leap year
types of a month (duration)

beginning of a day midday midnight 23h sunset sunrise ? no data

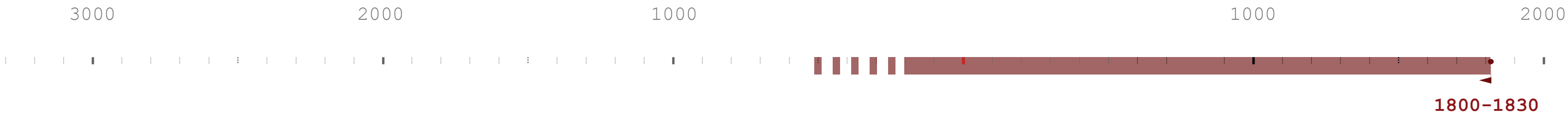
Julian calendar



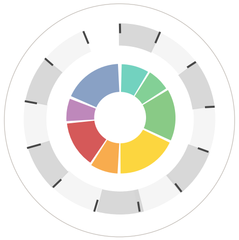
Gregorian calendar

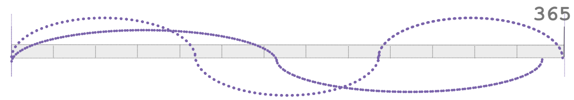


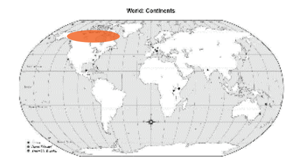
Inuit calendar



midnight sun

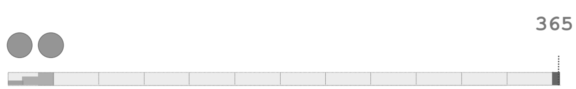


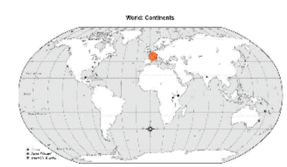




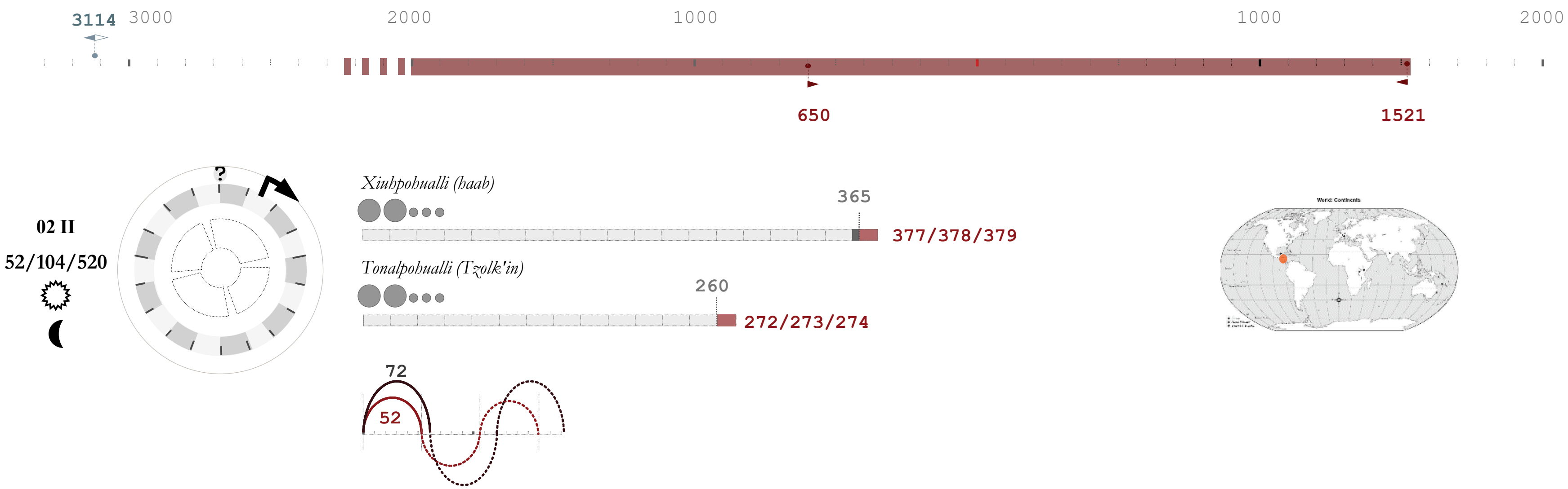
French republican calendar

22-23.IX

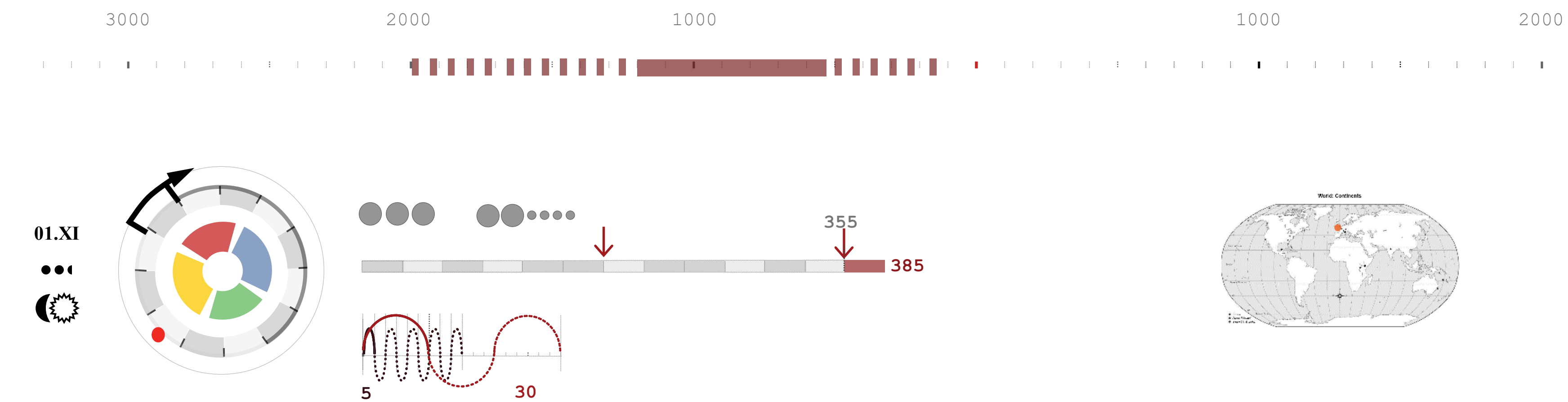




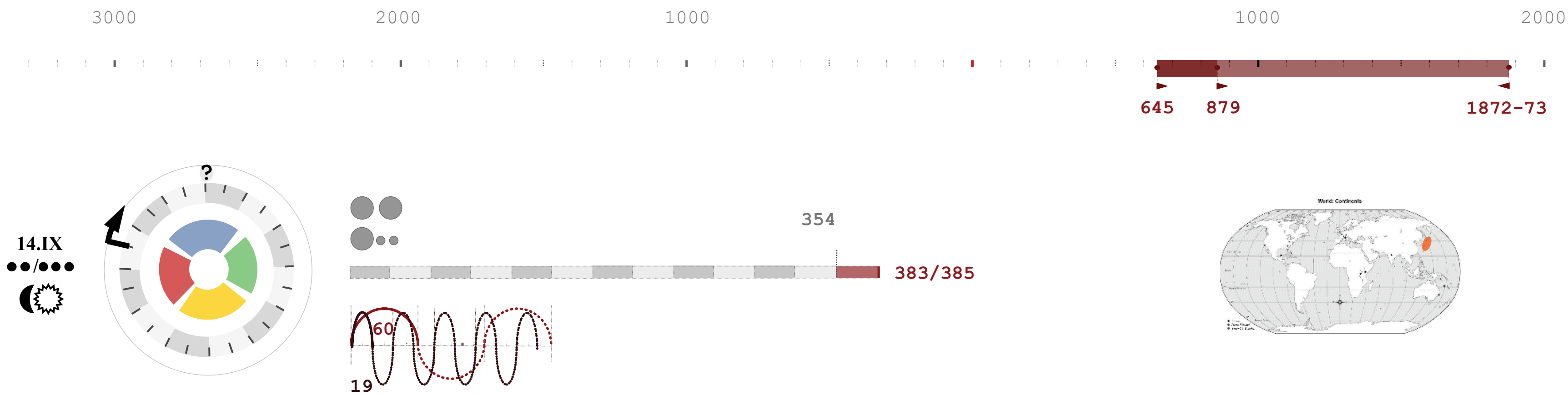
Maya and Aztec calendars



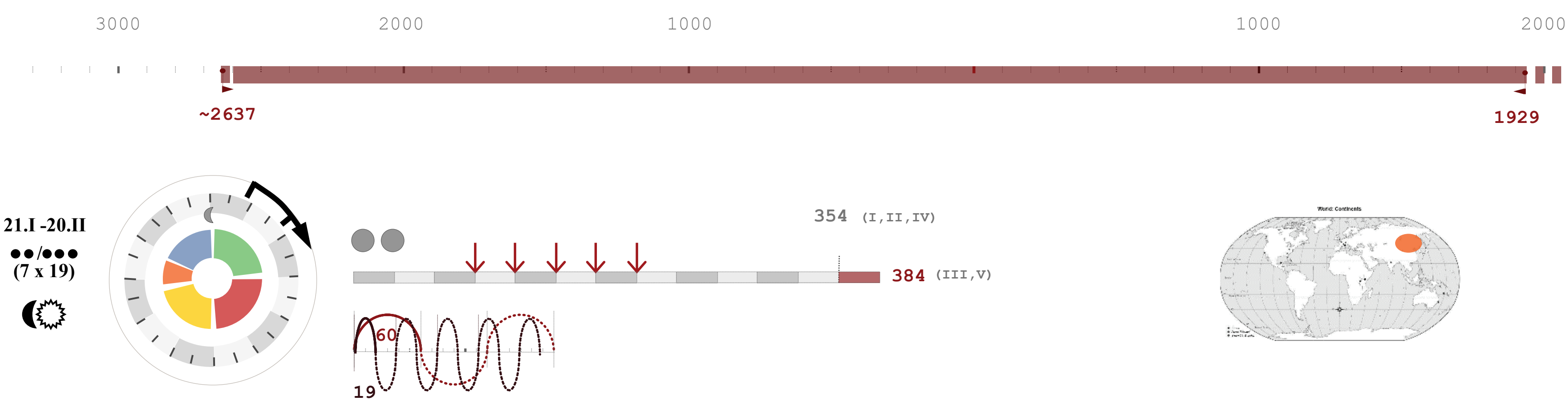
Continental Celtic Calendar (Gaulish Coligny calendar)



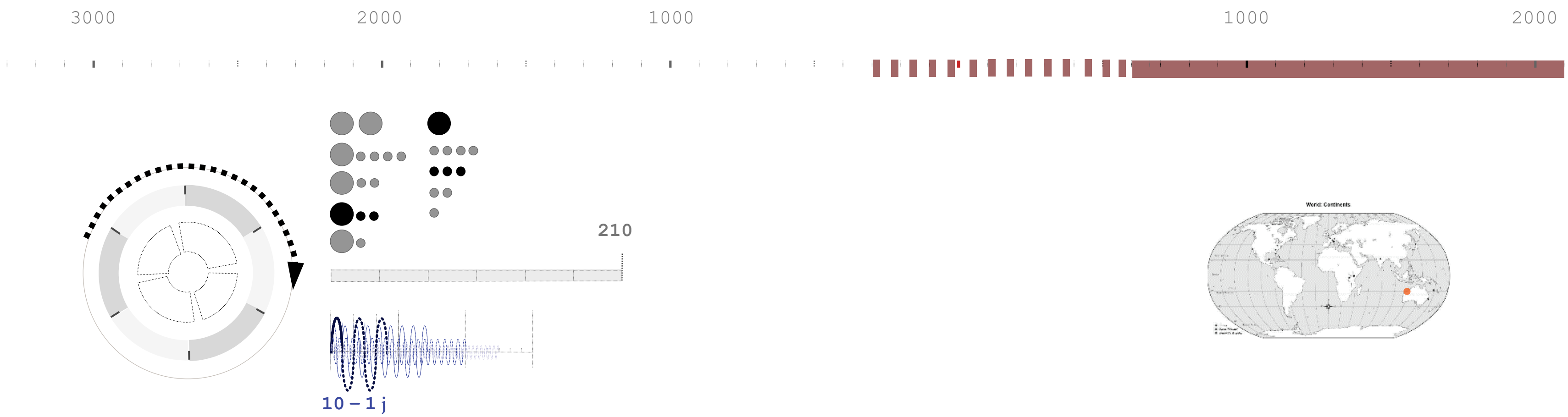
Japanese calendar (Taiintaiyoreki)



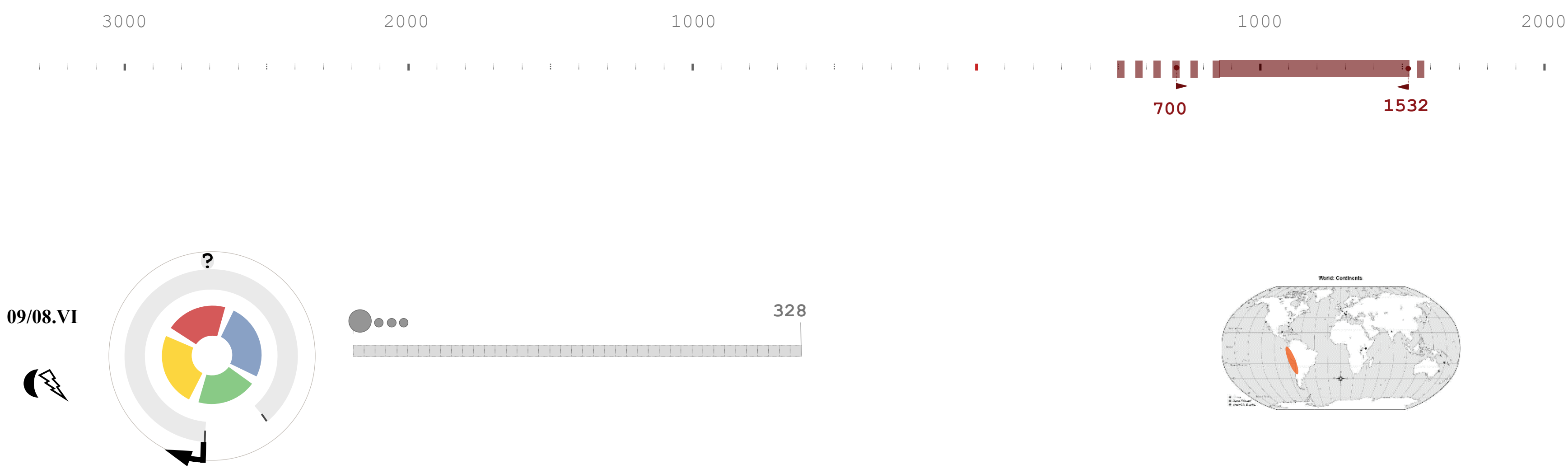
Chinese calendar (Taichu)

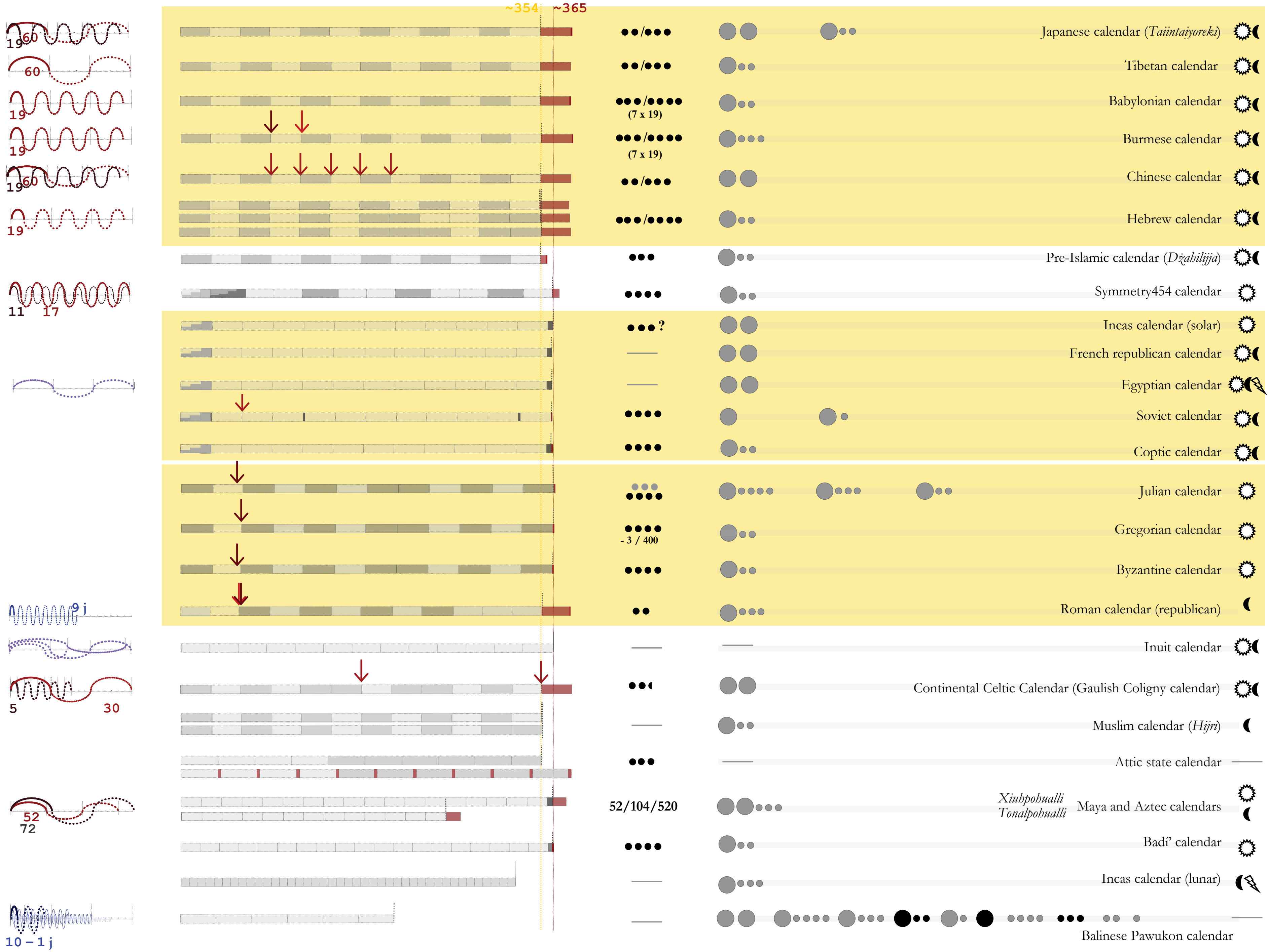


Balinese Pawukon calendar



Incas agricultural calendar




~354
~365
19
60
Japanese calendar (Taiintaiyoreki)
Tibetan calendar
Babylonian calendar
(7 x 19)
Burmese calendar
(7 x 19)
Chinese calendar
Hebrew calendar
Pre-Islamic calendar (Džahilijja)
11
17
Symmetry454 calendar
Incas calendar (solar)
French republican calendar
Egyptian calendar
Soviet calendar
Coptic calendar
Julian calendar
Gregorian calendar
- 3 / 400
Byzantine calendar
9 j
Roman calendar (republican)
Inuit calendar
5
30
Continental Celtic Calendar (Gaulish Coligny calendar)
Muslim calendar (Hijri)
Attic state calendar
52
72
52/104/520
Xiuhpohualli
Tonalpohualli
Maya and Aztec calendars
Badí' calendar
Incas calendar (lunar)
10 – 1 j
Balinese Pawukon calendar


~354
~365
19
60
Japanese calendar (*Taiintaiyoreki*)
60
Tibetan calendar
19
Babylonian calendar
(7 x 19)
19
Burmese calendar
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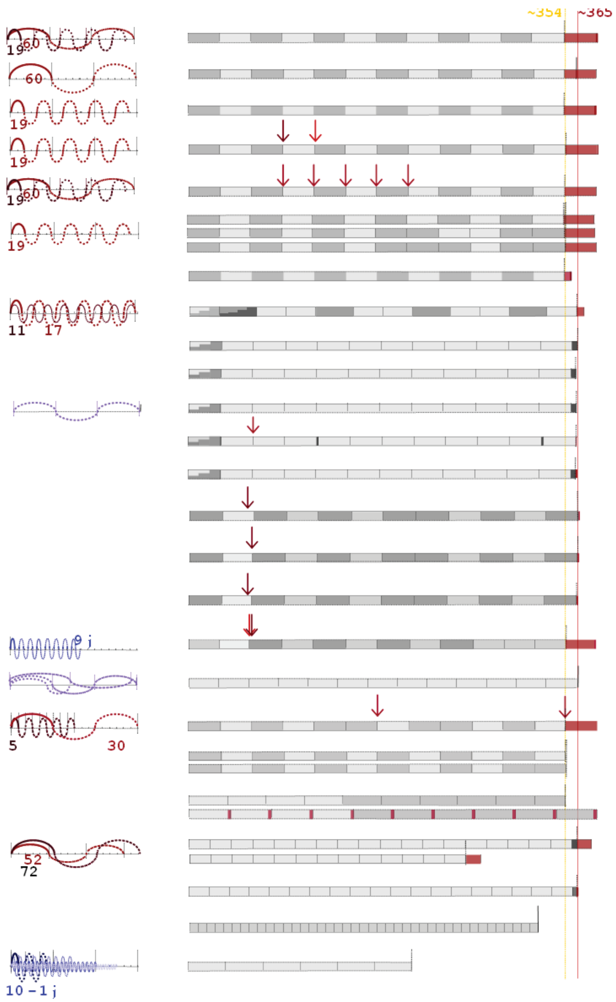

Comparison of 25 alternative calendars

What we noticed :

- similar mechanisms of time discretisation
  year, month, week, day …
- different quantification
  different number of days in month, week, year
- importance of cultural aspect and way of life
- presence of cycles - natural or calendar based
- independence of cycles of nature

- recurrent phenomenon – discontinuity of time in calendars due to human manipulation

Example:

80 additional days in year 46 BC,
11 days less in 1582 AD (in Rome not in Southampton)

Comparison of 25 alternative calendars

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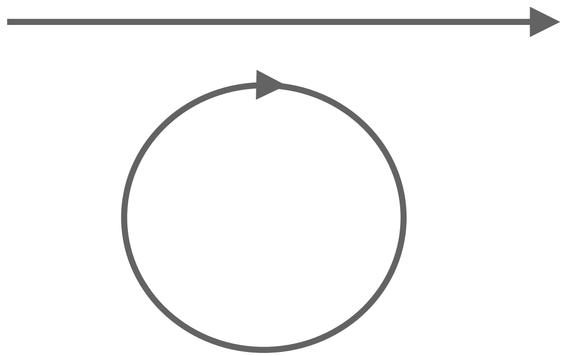
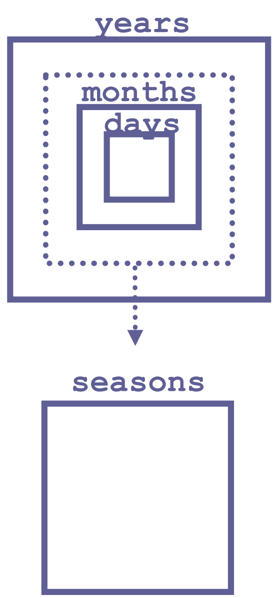
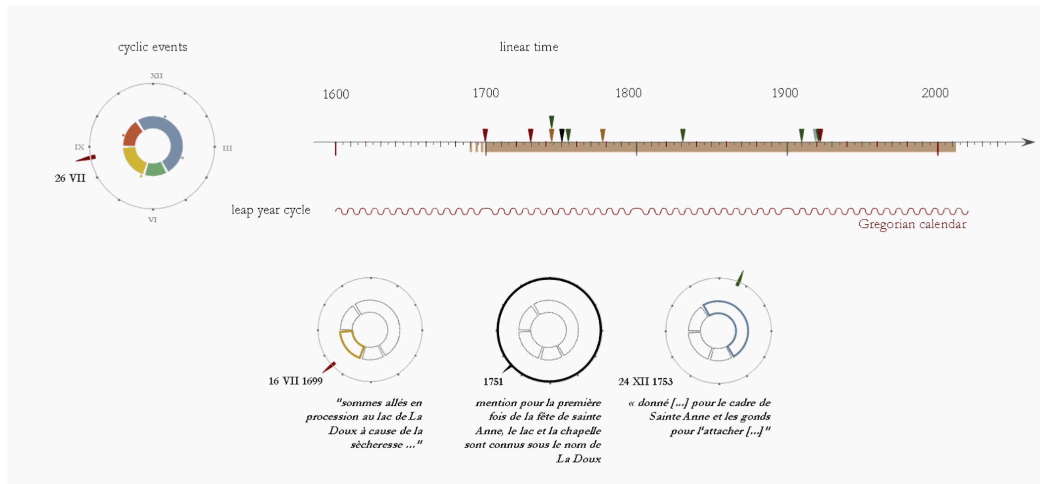


Comparison of 25 alternative calendars

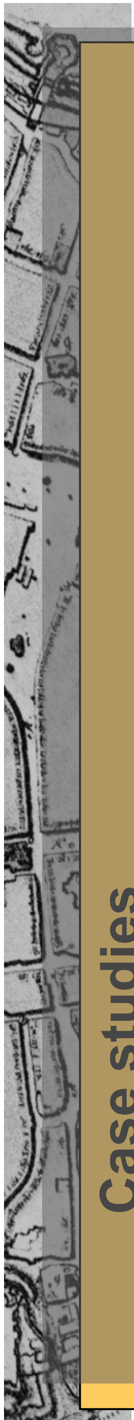
- completed linear time with cyclic time
- pulled out the seasons from a *Russian doll - like time structure*
- allowed independent description of dates





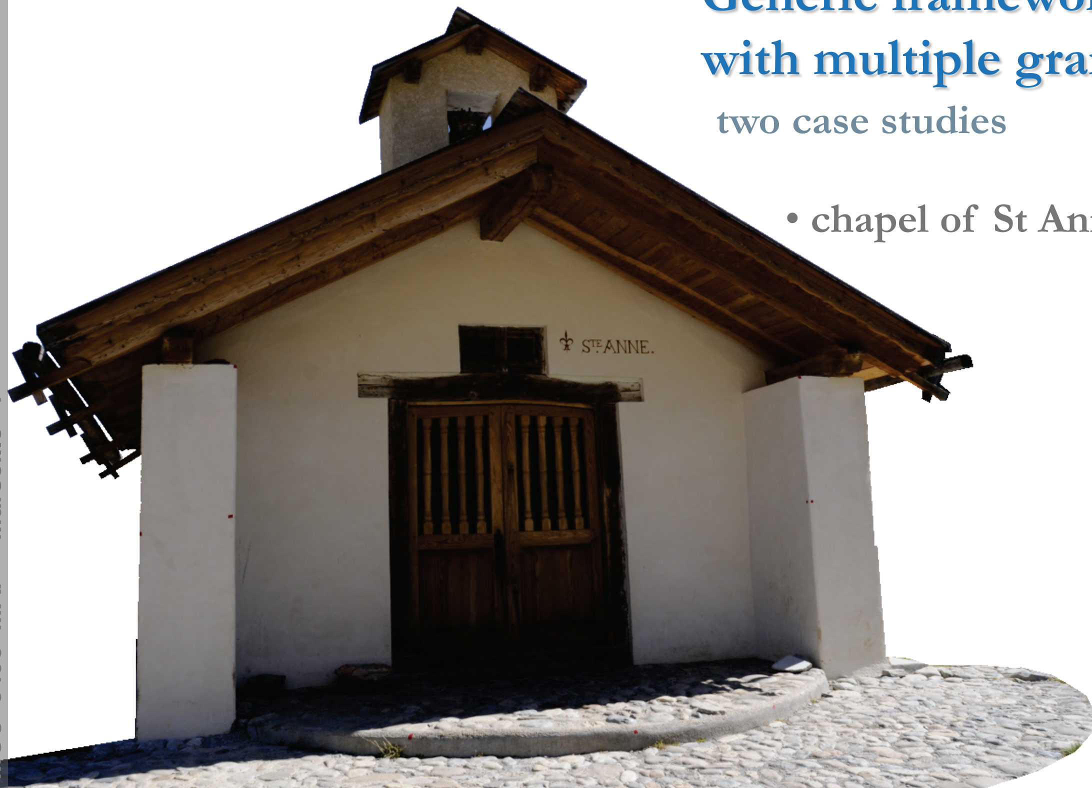
Case studies

UMR CNRS/MCC 3495 MAP - Marseille - F



Generic framework for visualising time with multiple granularities

two case studies



- chapel of St Anne in Southern Alps (2400 m AMSL) France

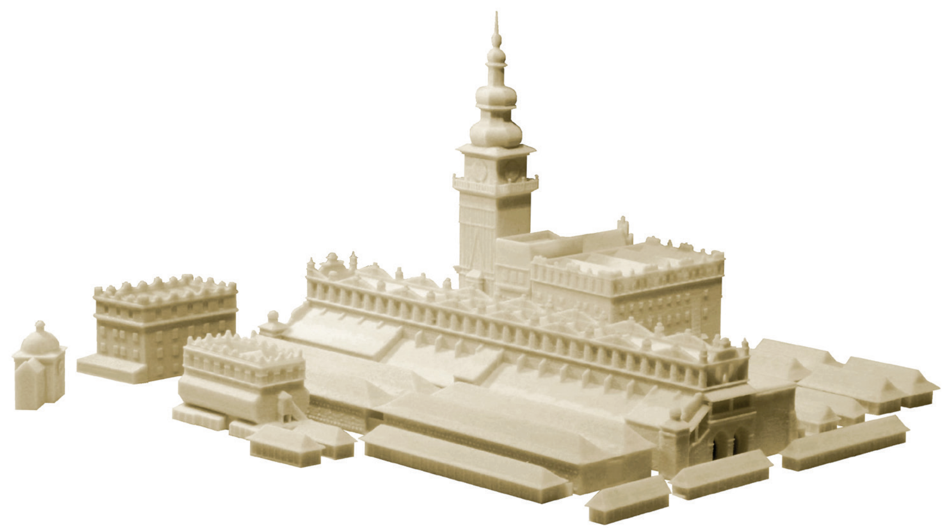
Case studies

UMR CNRS / MCC 3495 MAP - Marseille - F

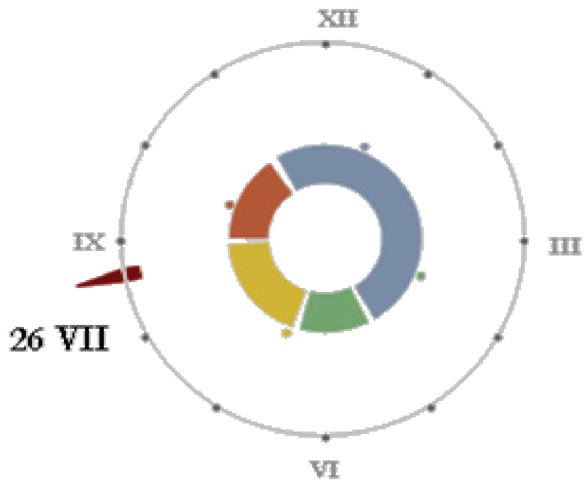
Generic framework for visualising time with multiple granularities

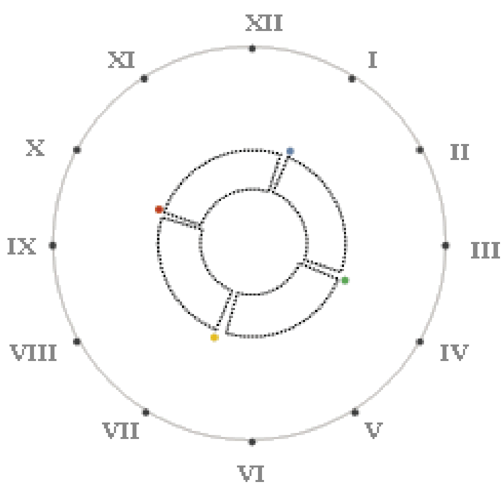
two case studies

- chapel of St Anne in Southern Alps (2400 m) France
- tower of an ancient town hall in Kraków, Poland



chapel of St Anne in Southern Alps





- cyclic events are represented in a clock–like manner
- meteorological seasons do not coincide with astronomical seasons - winter is the longest season (average season length - fuzzy cyclic behaviour)
- annual pilgrimage to the chapel

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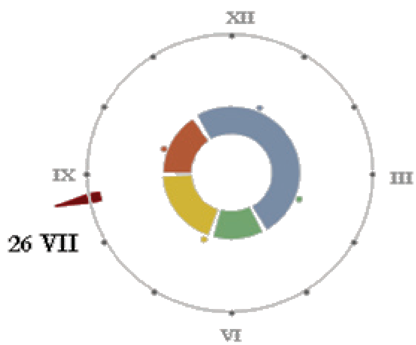
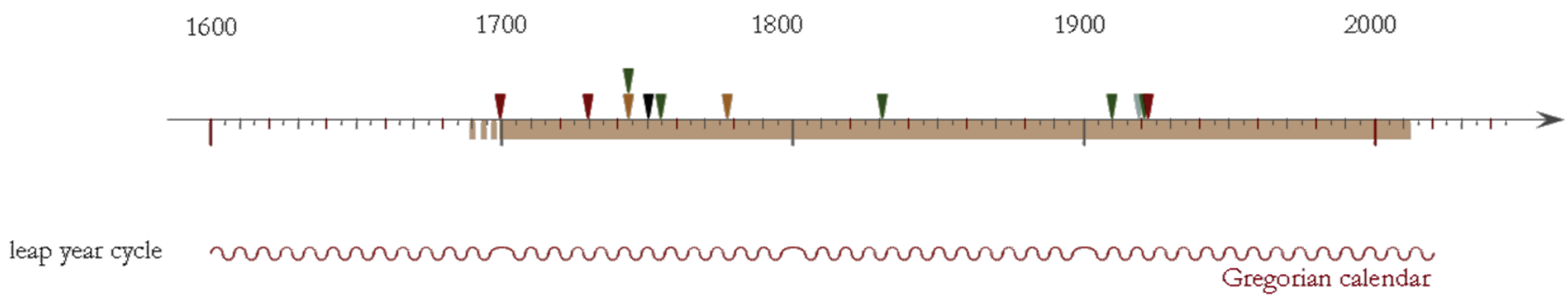


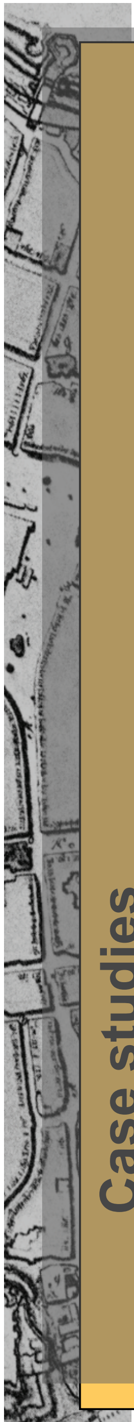
chapel of St Anne in Southern Alps

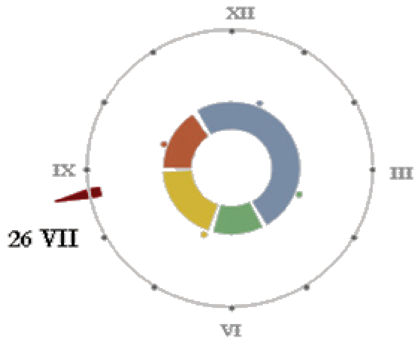


- timeline visualisation
- colours - types of events/processes
- overall lifetime of the chapel
- Gregorian calendar period

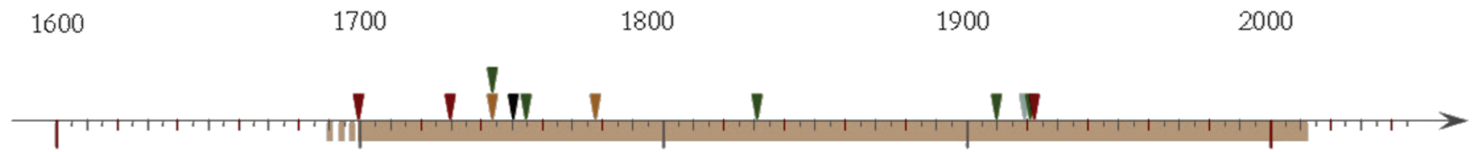
Case studies

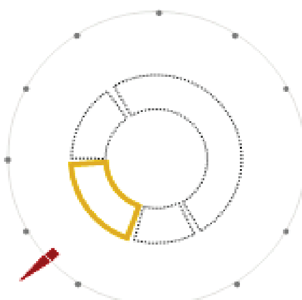
UMR CNRS / MCC 3495 MAP - Marseille - F





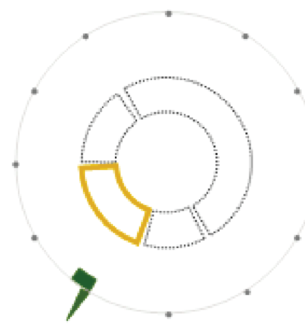
chapel of St Anne in Southern Alps





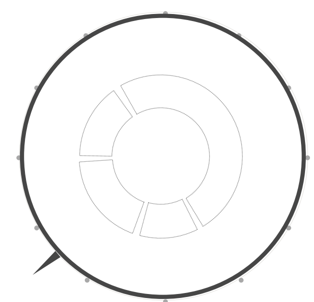
16 VII 1699

"sommes allés en procession au lac de La Doux à cause de la sècheresse ..."



beginning of VII 1909

au commencement de juillet des réparations

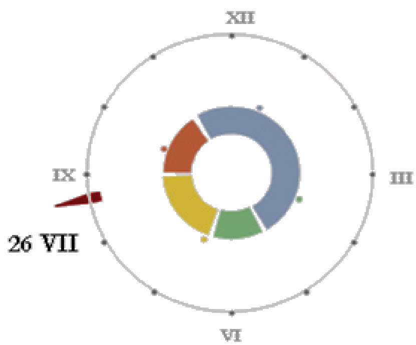


1751

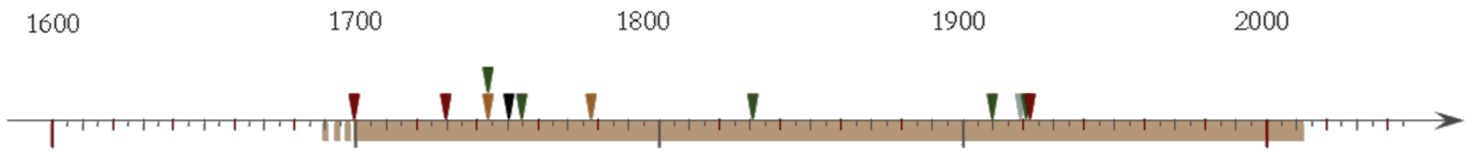
mention pour la première fois de la fête de sainte Anne, le lac et la chapelle sont connus sous le nom de La Doux

Case studies

UMR CNRS / MCC 3495 MAP - Marseille - F



chapel of St Anne in Southern Alps



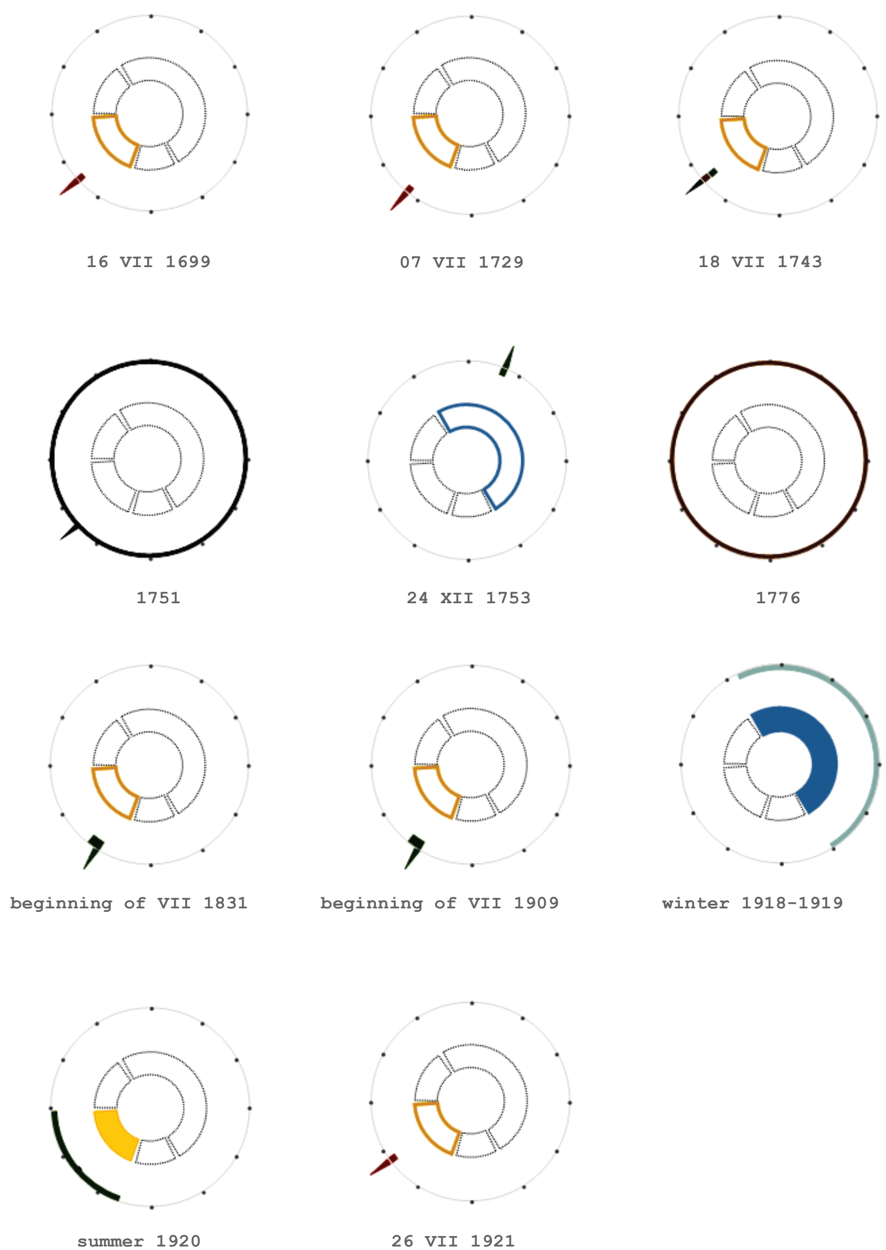
A *chronon* (the smallest temporal unit)

one civil year (format YYYY)

$\not\parallel$

inherent time granularity of the data we handle

DD/MM/YYY
MM/YYY
season YYYY
YYYY



chapel of St Anne in Southern Alps

16 VII 1699

07 VII 1729

18 VII 1743

1751

24 XII 1753

1776

beginning of VII 1831

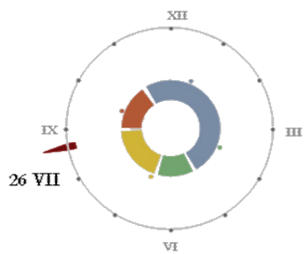
beginning of VII 1909

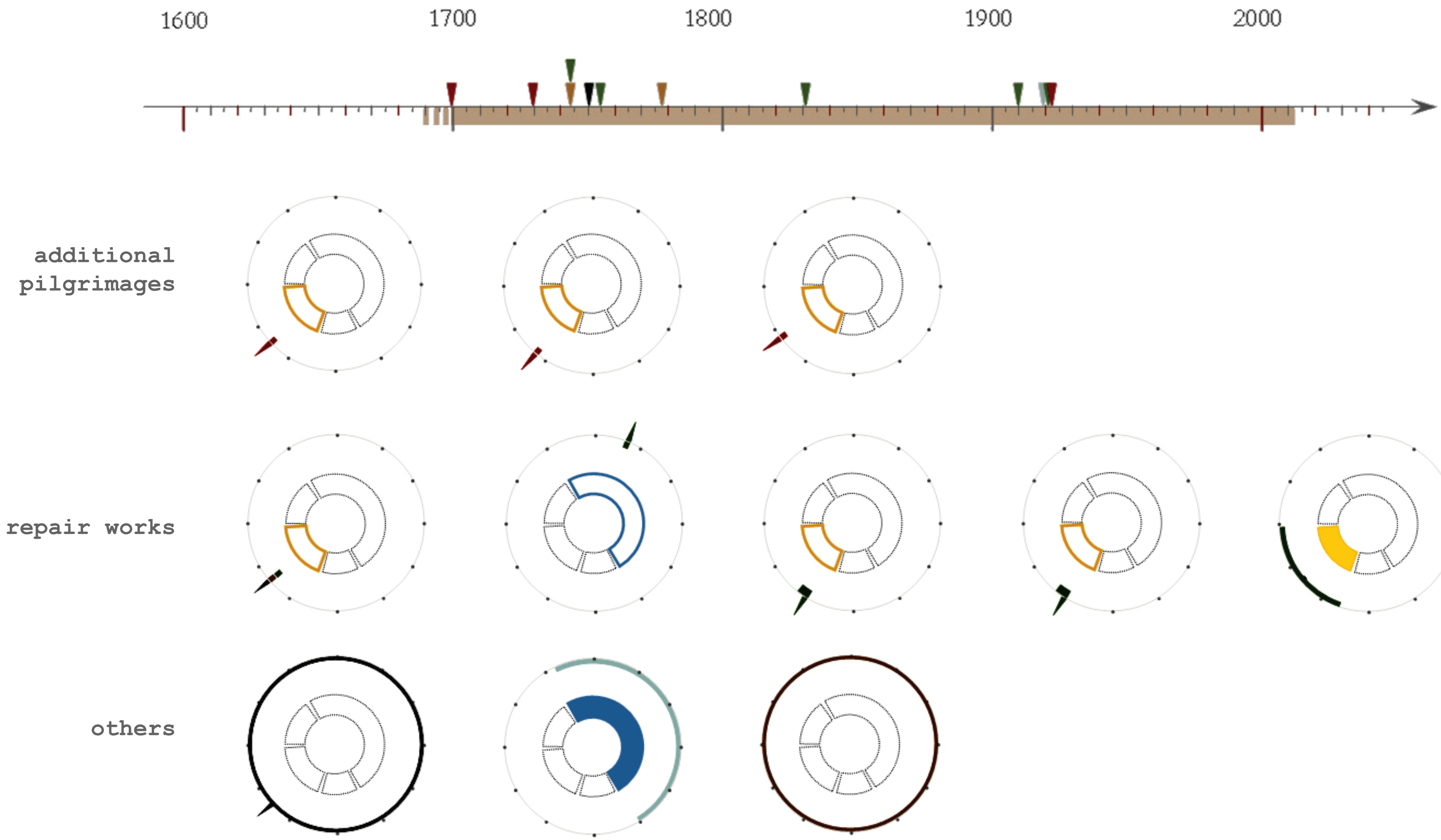
winter 1918-1919

summer 1920

26 VII 1921

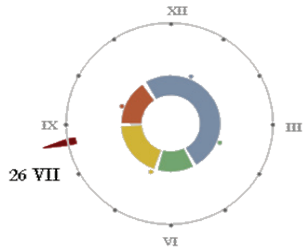
chapel of St Anne in Southern Alps



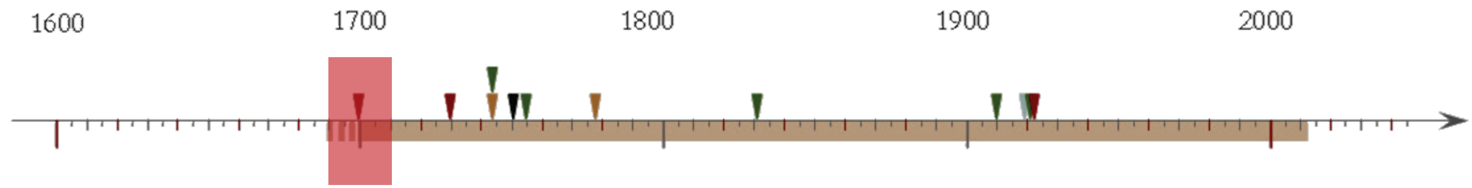


Case studies

UMR CNRS / MCC 3495 MAP - Marseille - F

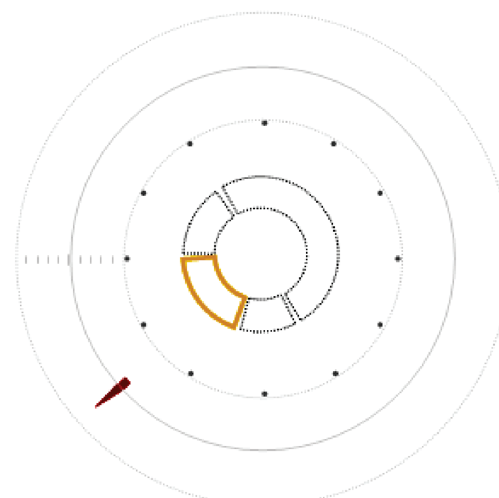


chapel of St Anne in Southern Alps



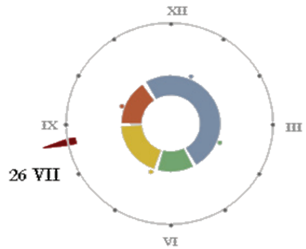
time intervals 1690-1710

(two decades)

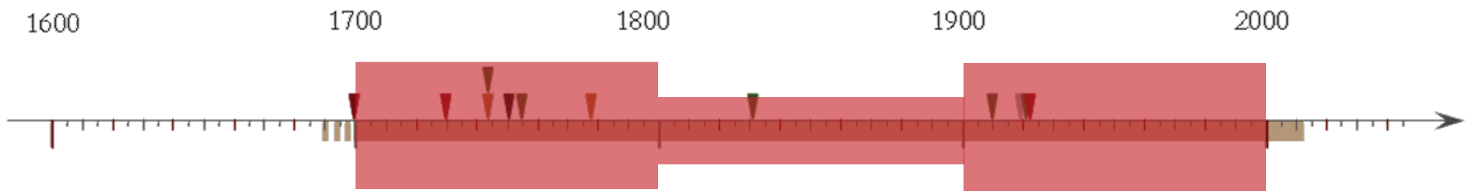


Case studies

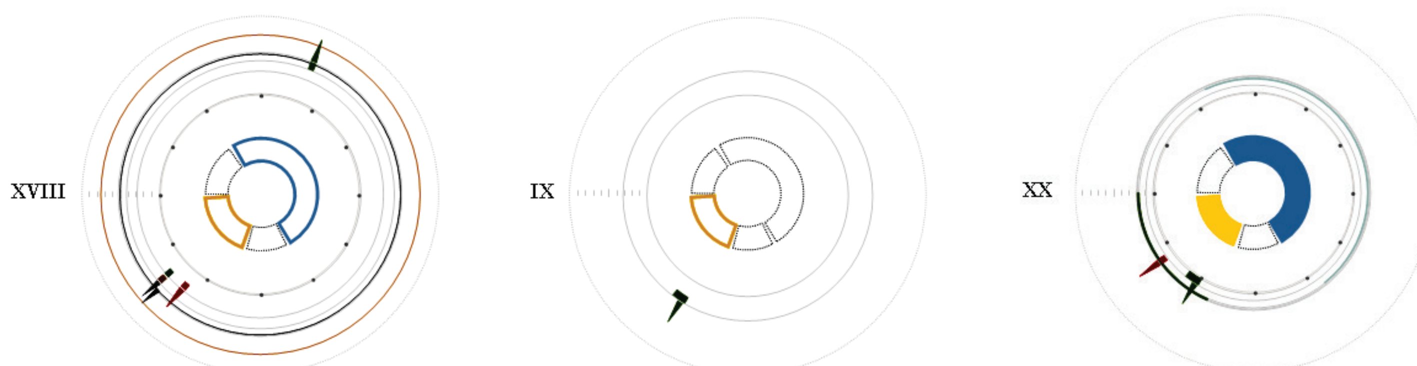
UMR CNRS / MCC 3495 MAP - Marseille - F



chapel of St Anne in Southern Alps

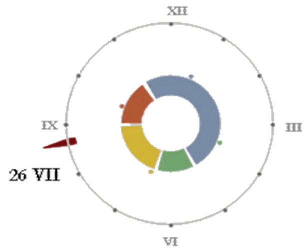


time
intervals
(one century)

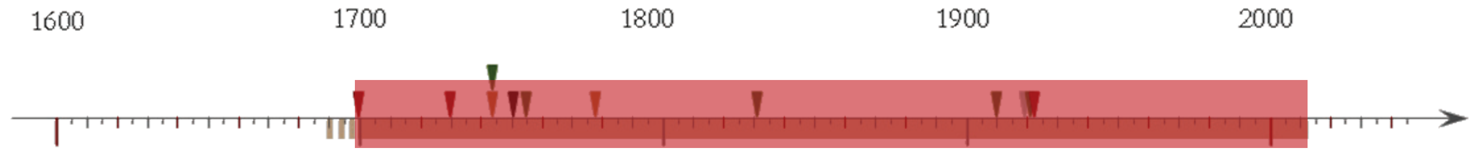


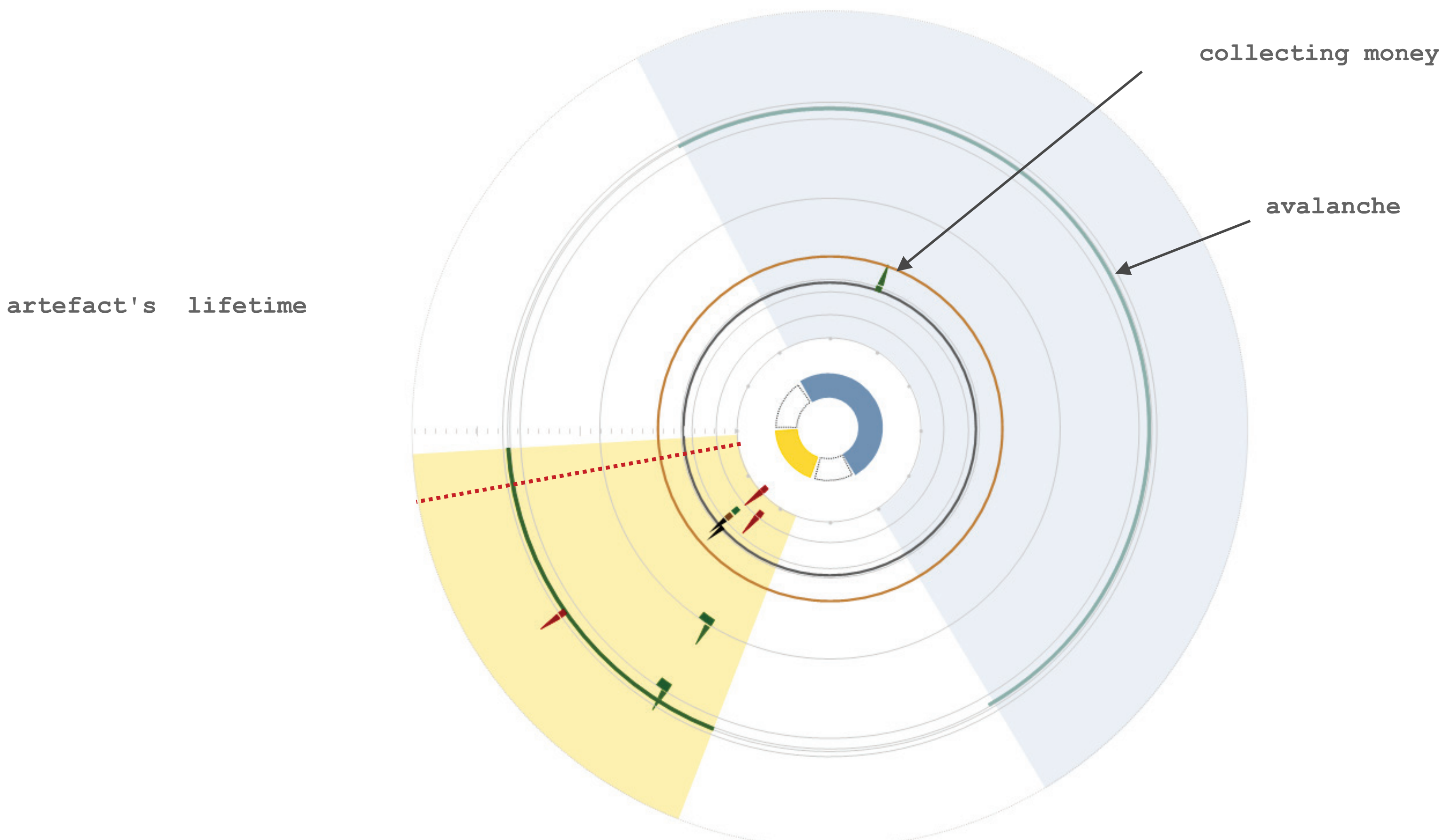
Case studies

UMR CNRS / MCC 3495 MAP - Marseille - F



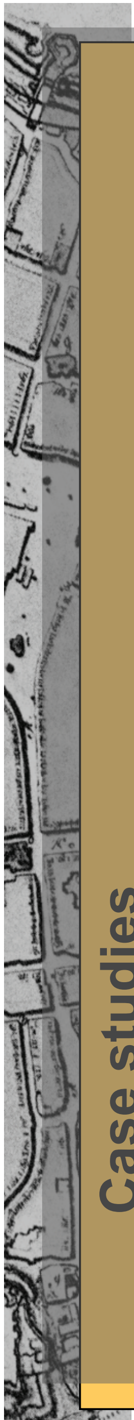
chapel of St Anne in Southern Alps





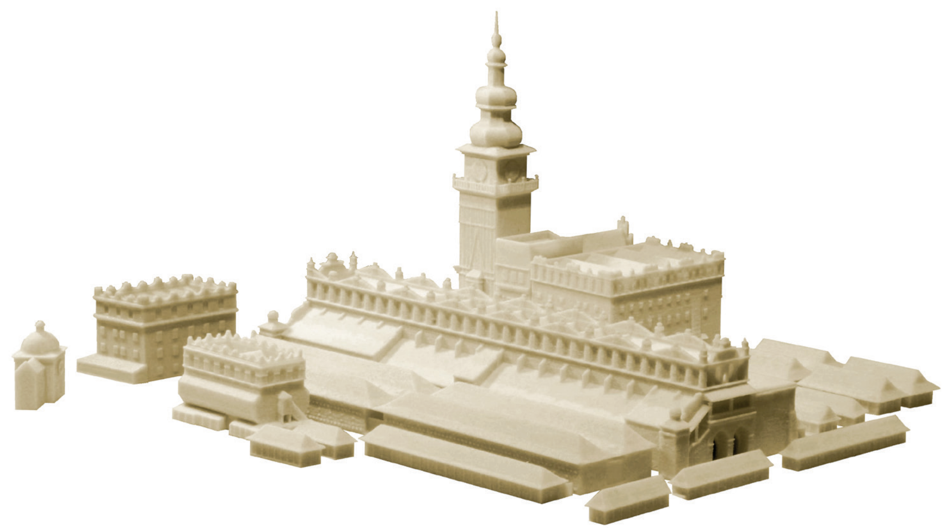
Case studies

UMR CNRS / MCC 3495 MAP - Marseille - F



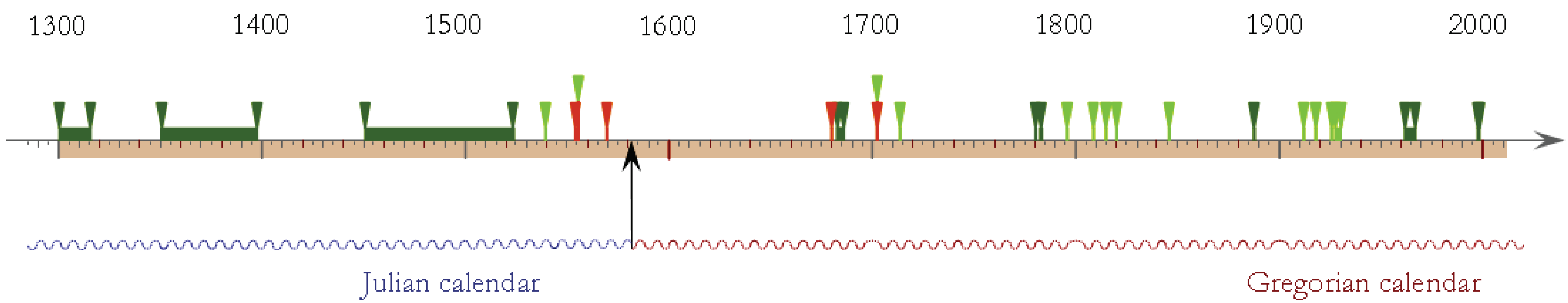
tower of an ancient town hall in Kraków

- fires of Cracow's town hall tower



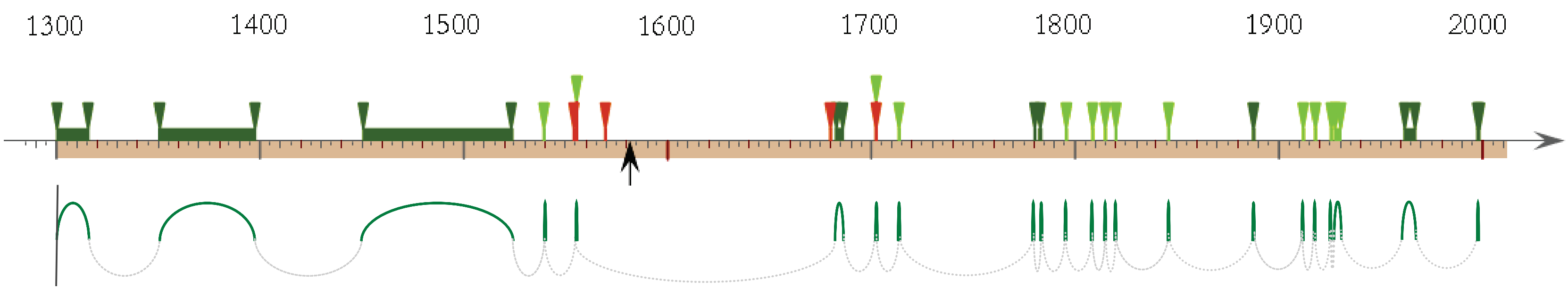
UMR CNRS / MCC 3495 MAP - Marseille - F

tower of an ancient town hall in Kraków



- any annual cyclic event for this artefact
- lifetime of this artefact traverses two calendars
- seasons moving (a rough approximation)
- meteorological seasons do not coincide with the astronomical seasons

tower of an ancient town hall in Kraków



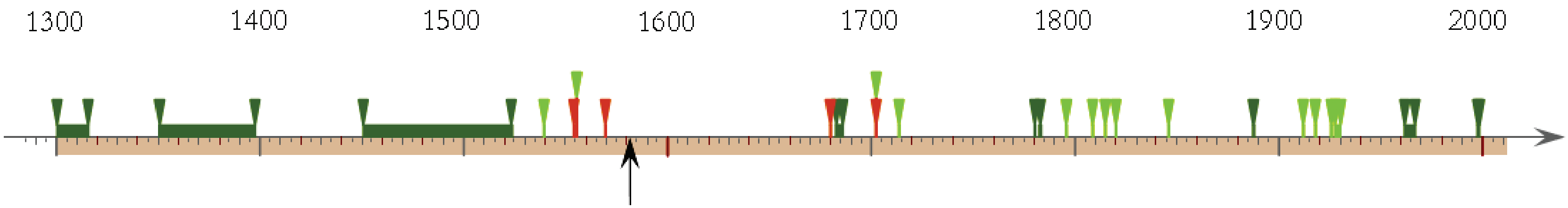
- any cyclic event for this artefact
- rhythm of transformations/reparations

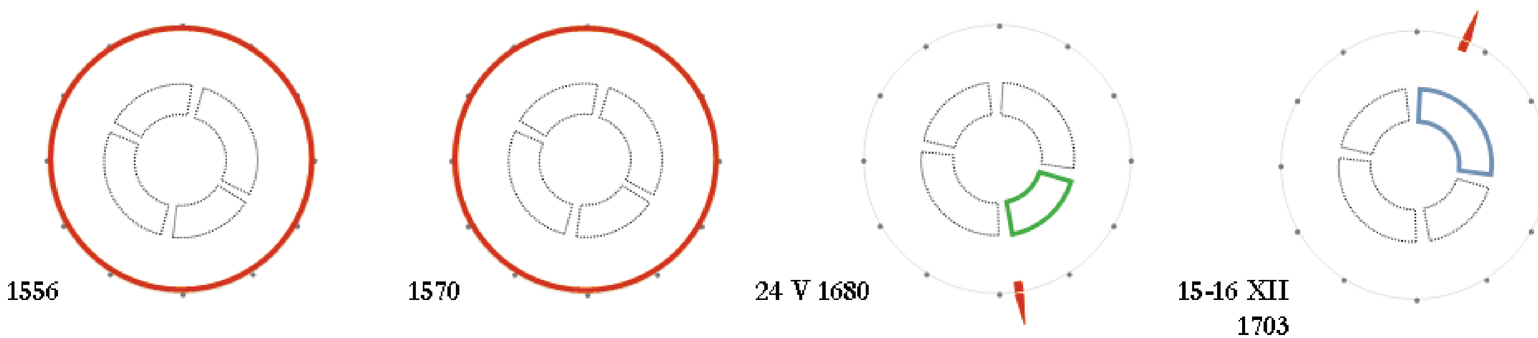
Case studies

Case studies

UMR CNRS / MCC 3495 MAP - Marseille - F

tower of an ancient town hall in Kraków





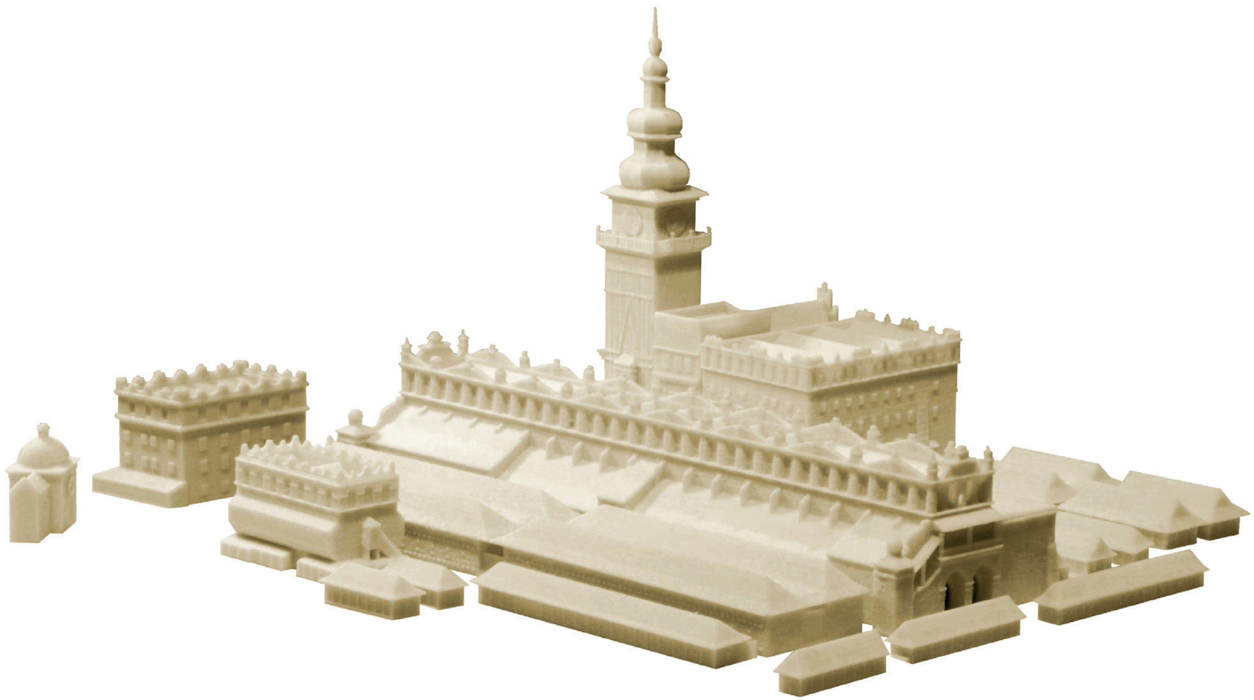
a fire of an artefact is generally short event (in a scale of year)

?

oldest historical sources are less precise in terms of temporal granularity

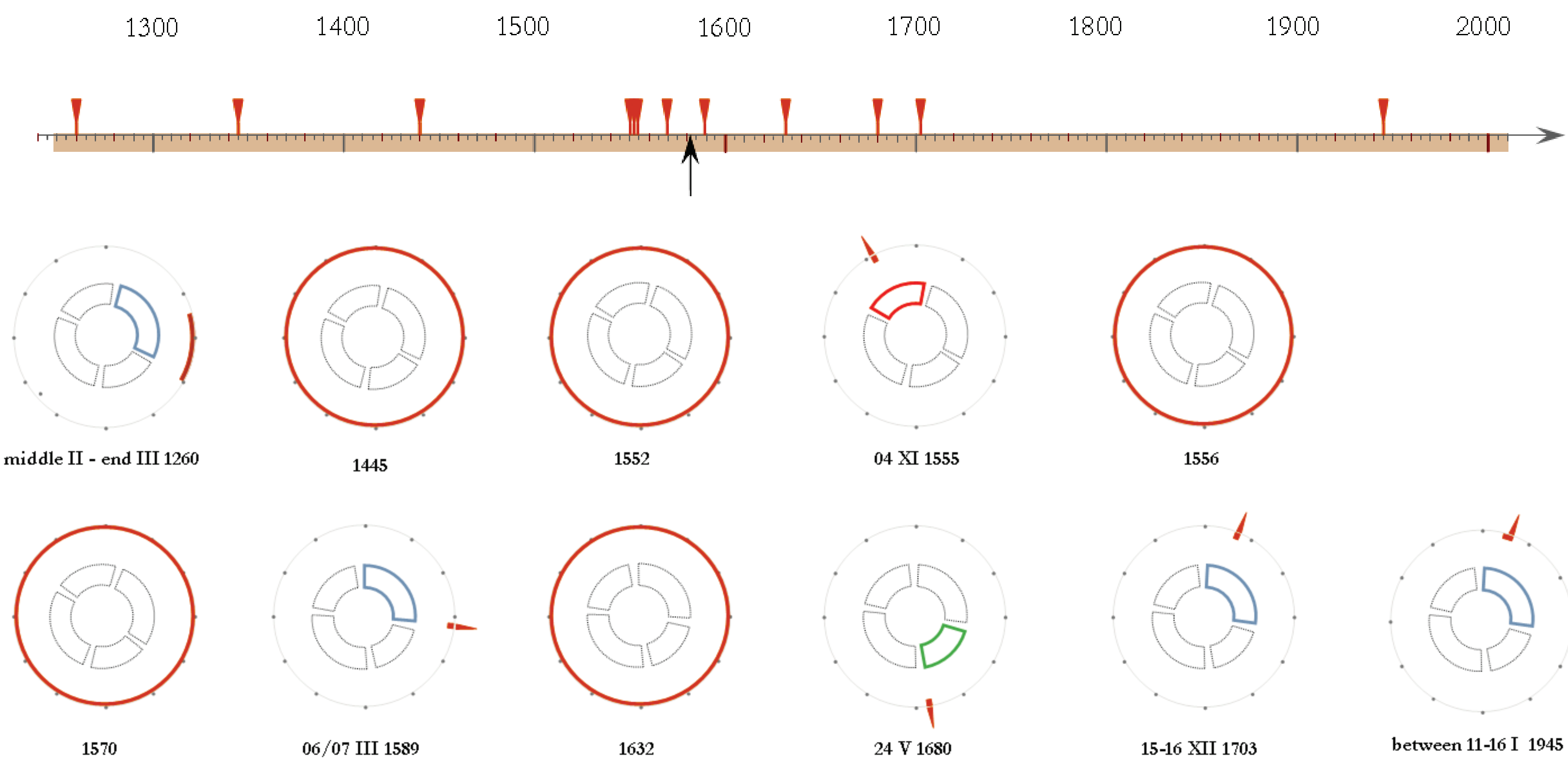
buildings that furnished the Main Market Square in Cracow

- fires at the Market Square

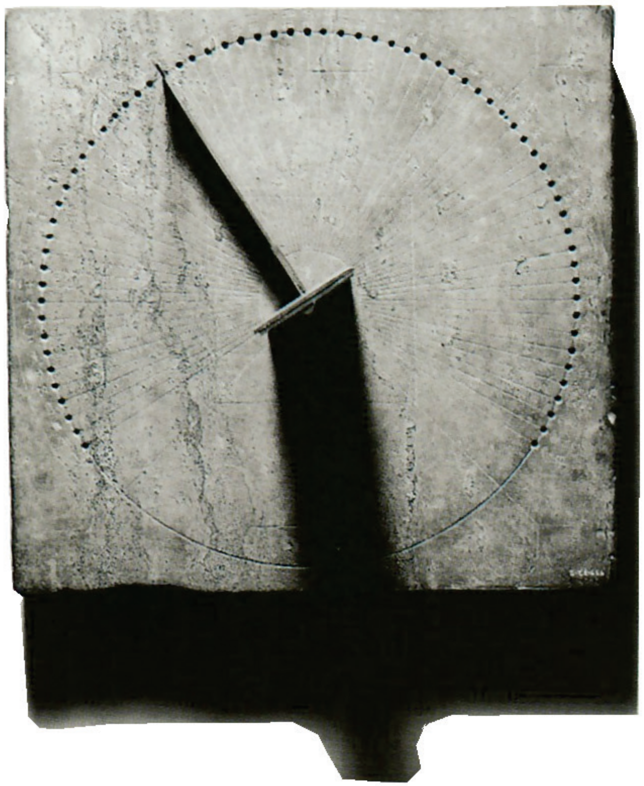


? *oldest historical sources are less precise terms of temporal granularity*

buildings that furnished the Main Market Square in Cracow



oldest historical sources are less precise terms of temporal granularity

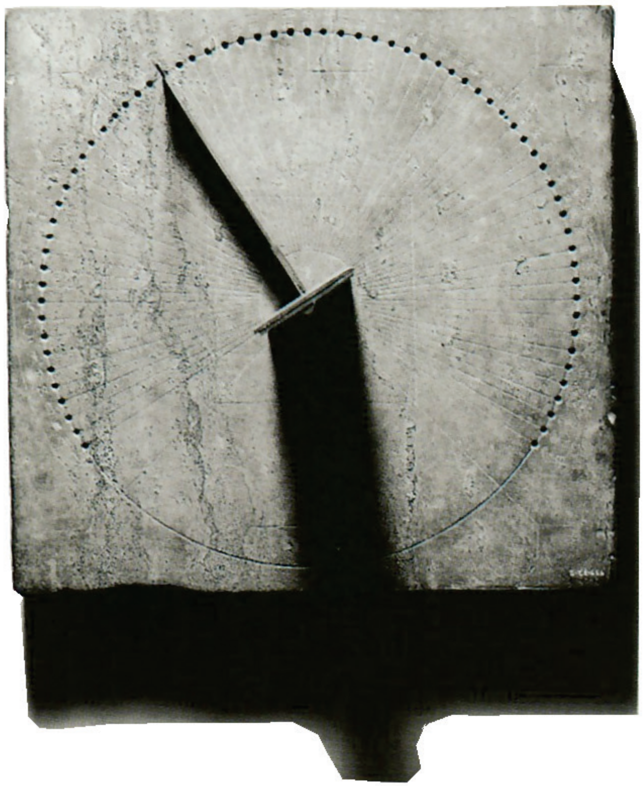


Chine, chronomètre
à gnomon
(gnomon reconstitué),
II^{e} – I^{er} s. av. J.-C.

[dans] K Lippincott, *L'histoire du Temps*, Larousse, 2000

Conclusions

- conceptual framework of a method that aims at facilitating visual thinking
- visual analysis of a set of historical calendars (InfoViz)
    - importance of a cyclic behaviour
    - temporal particularity of geographic zones
    - independence of astronomical and meteorological seasons
- point out how this approach could be transferred to understanding and analysis of individual artefacts



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[dans] K Lippincott, *L'histoire du Temps*, Larousse, 2000

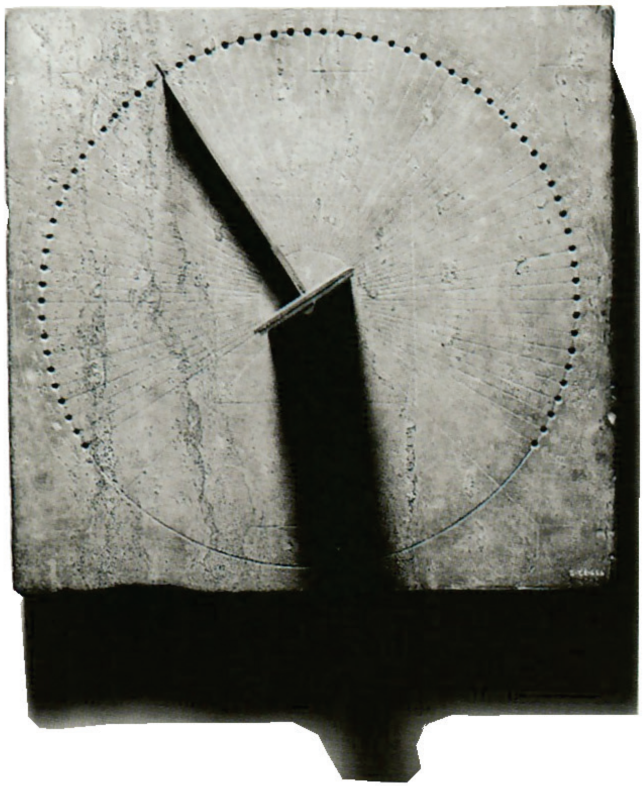
Conclusions

Proposed approach helps in:

- reasoning about a cyclic behaviour
- handling of multiple granularities
- visual comparisons
- 'tailoring' to the local conditions

Now

- go beyond the thirst achievements (ex. implementation)
- further investigate potential benefits and drawbacks of this approach



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[dans] K Lippincott, *L'histoire du Temps*, Larousse, 2000

If we deal with the notion of the time in our research

it is worth to take some time to think about "*time*".