



# Europeana4D – Visualizing And Exploring Geospatial-Temporal Data

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SUB

NIEDERSÄCHSISCHE STAATS- UND UNIVERSITÄTSBIBLIOTHEK GÖTTINGEN

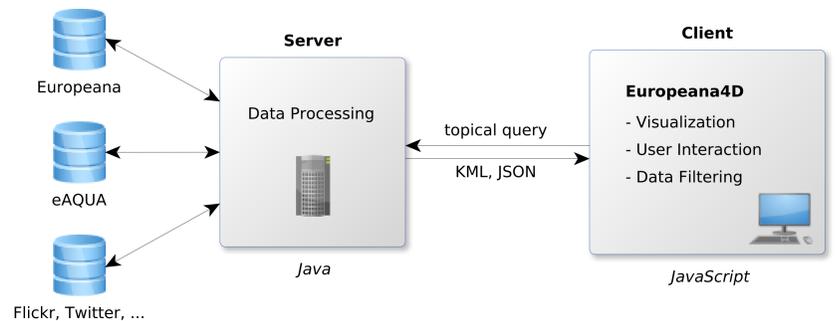
## Introduction

Europeana4D is a web application which displays results of up to 4 topical queries in several linked widgets. Any kind of data with **geospatial and temporal metadata** can be visualized. Europeana4D is an implementation of the comparative design for geospatial-temporal data, which is described in detail in [1].

The **interactive design** allows the user to explore data and highlight, select and filter data divisions dynamically. Further goals of the application are:

- comparison of **trends** and **geospatial distributions**
- finding **co-occurrences** of items for different result sets
- comparison of **migrations** among different topics
- detection of **causality** between different topics

## System Overview



## Map Widget

The *Map Widget* shows the geospatial distribution of results. According to Harris [2], it is a geographical map which is overlaid with bubble glyphs (circles) of different size. We force the circles not to overlap each other in order to improve:

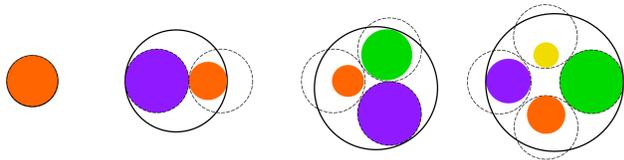
- **readability**: remove clutter, highlight geospatial peaks
- **performance**: reduce the number of circles to render

### Aggregation Algorithm

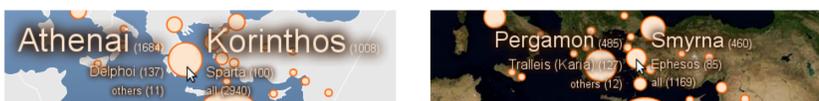
We apply a **hierarchical agglomerative clustering** approach and compute a set of non-overlapping circles for each zoom level. We iteratively merge 2 circles  $c_i$  and  $c_j$ , if:

$$\frac{d_{ij}}{r_i + r_j + \epsilon_{gap}} < 1.$$

The resultant size of a circle reflects the number of items which are assigned to it. For multiple datasets we modified the Circle Packing Algorithm of Kravitz [3].



**Features** are **placename tag clouds** for circles, **historic maps** for 23 epochs and the **selection of one or multiple circles** (polygon, circle area, political border).

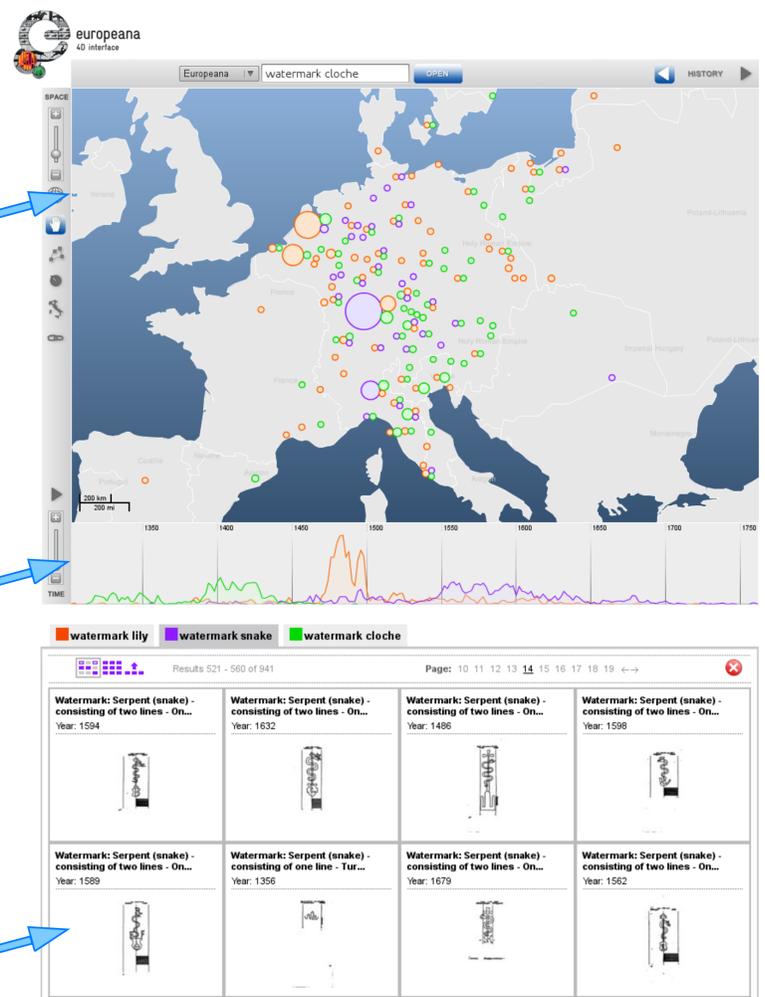


## Europeana Use Case

<http://www.europeana.eu/portal/>

Distribution of **watermarks** of different types, shown on the historic map of 1492.

- **Lily**: geospatial peaks in northern Europe – second half of the 15th century
  - **Cloche**: geospatially well distributed – 14th and 15th century
  - **Snake**: geospatial peaks in northern Italy and central Germany – ~1450-1700
- Domain experts attribute this to the popularity of the Snake watermark as the heraldic device of the Milan dynasty of the Visconti, and later on as Swabian papermakers' hallmark of excellence.



## Time Widget

The *Time Widget* shows the temporal distribution of results. According to Harris [2], it consists of a 2-dimensional segmented area graph with the following axis setting:

- X  $\hat{=}$  time unit (e.g., years, decades, centuries)
- Y  $\hat{=}$  #items per time unit

In case of multiple result sets we draw individual segmented area graphs. We overlay these graphs with the usage of **opacity** to emphasize temporal differences.

**Features** are the **selection of time ranges** and a **time animation** control.

## Detail Widget

The *Detail Widget* is a table which displays information for each individual result item. Possible contents are:

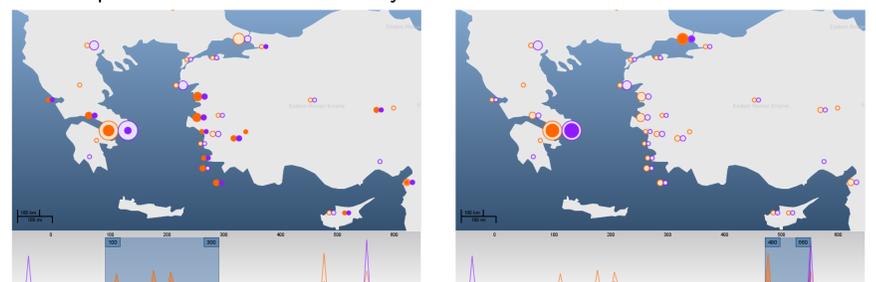
- textual information
- image thumbnails

**Features** are **intra dataset comparison** and the option to modify geospatial or temporal selections by **adding or dropping individual items**.

## eAQUA Use Case

<http://eaqua.e-humanities.net/>

Occurrences of the words **Plato** and **Aristotle** in ancient Greek texts, shown on the historic maps of the 4th and 8th century.



- **Middle Platonism (1st–3rd century)**: widely spread distributions of both topics
  - **Neoplatonism (4th–6/7th century)**: peaks in Athens and Constantinople
- This indicates a correlated movement of both topics from rural regions to metropolises.

## References

- [1] S. Jänicke, C. Heine, R. Stockmann and G. Scheuermann (2012). Comparative visualization of geospatial-temporal data. In *Proceedings of the 3rd International Conference on Information Visualization Theory and Applications, IVAPP 2012*, pages 613–625, Rome, Italy.
- [2] R. L. Harris (1999). *Information Graphics: A Comprehensive Illustrated Reference*. Oxford University Press.
- [3] S. Kravitz (1967). Packing Cylinders into Cylindrical Containers. *Mathematics Magazine*, 40(2):65-71.