DELIVERABLE

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D3.5 Report on Europeana GIS services and archaeology/architecture site data

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Statement of originality:

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

Contents

List of abbreviations

AA	Archaeological / architectural sites
ADS	Archaeology Data Service
API	Aplication Programming Interphace
EDM	Europeana Data Model
EPSG	European Petroleum Survey Group (now OGP Geomatics Committee)
ESE	Europeana Semantic Elements
ETRS89	European Terrestrial Reference System 1989
INSPIRE	Infrastructure for Spatial Information in the European Community
IPCHS	Institute for the Protection of Cultural Heritage of Slovenia
GIS	Geographic Information System
KML	Keyhole Markup Language
MIDAS	Midas Heritage Standard
SKOS	Simple Knowledge Organization System
WMS	Web Map Service
WFS	Web Feature Service
WGS84	World Geodetic System 1984

1 Executive summary

The deliverable *Report on Europeana GIS services and archaeology/architecture site data* introduces the Europeana GIS services to the archaeology/architecture site data sector.

The **added value of the inclusion of geographic location data in Europeana** is in the:

- browsing of Europeana efficiently through space and time,
- searching for content in a more user friendly way, without need to type geographical names,
- making it possible to discover overlapping cultural content at the same location but originating from different sources and at different times,
- mapping and visualization of the content,
- performing GIS calculations and simulations.

The **objectives of this deliverable** are:

- to inform content providers, aggregators, cultural institutions and others with geographic information services especially Europeana GIS services,
- to present the results of the initial testing Europeana GIS services,
- to give recommendations on a few topics such as co-ordinate systems and the INSPIRE directive when providing geographical data to aggregators,
- to investigate the potential for enriching the place-name services on the basis of geographical information contained in archeological and architectural inventories.

The first part of the deliverable presents the description and evaluation of the geo-parsing tool, gazetteer tool, map annotation tool, web mapping tool. Each tool is described as follows**:**

- definitions,
- general features,
- description of Europeana related tool,
- review and recommendations,
- other tools,
- links and sources.

The second part of the deliverable deals with archaeology/architecture site data in cases where geographic co-ordinates are included describing items in physical space. The recommendations for harmonisation of the the coordinate systems and connection with activities on INSPIRE directive follows. The focus of this part is the discussion and evaluation of the potentials for enriching the place-name services in Europeana through monument inventory. The enriched service could be used especially when:

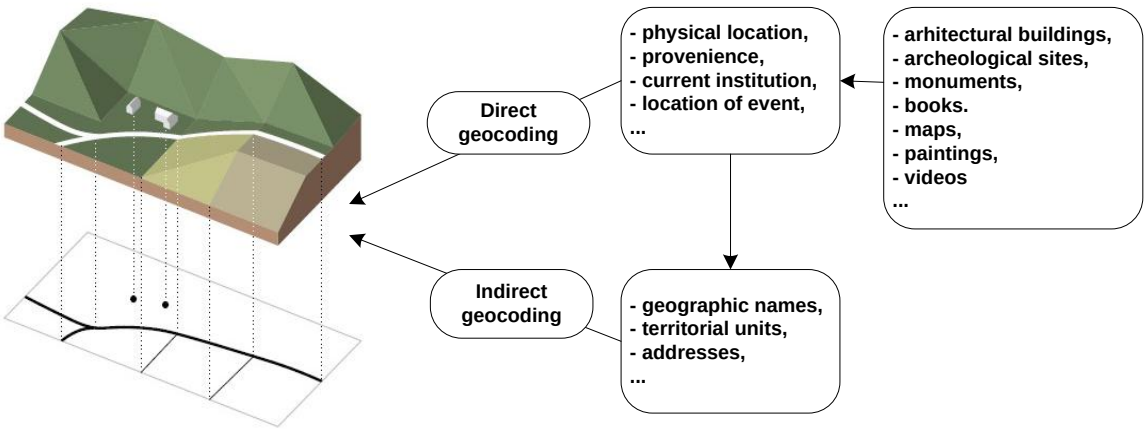
- there are no geographic co-ordinates, to assign them to the movable Europeana objects as are museum objects, books, audiovisual object and so on,
- there are geographic co-ordinates, but a tool for verification of the correctness is needed.

The appendices to this deliverable detail the testing of Europeana geoparsing service, Europeana gazetteer, EuropeanaConnect media annotation tool and the OpenLayers API. Further appendices give basic information on coordinate systems, INSPIRE specifications, cultural spot features in geonames and CARARE inventories.

2 Introduction

Geographic location is one of the most important aspects of information which pertains to cultural heritage items. Examples include provenance, current institution, and location of events. A formalized location attribute (e.g. geo-code or geographical co-ordinates) will significantly enhance the power of searching and the visualization of the content in Europeana and other cultural portals as well. At the time of writing, Europeana is measured in the tens of millions of objects but it is expected there will be several hundreds of millions. As a result, an efficient search engine cannot be imagined without consideration of the spatial and time dimension of objects, together with their historical and cultural context.

Figure 1: Geographic location in digital cultural content



This report is the result of Task 4: Geographic information and heritage site data of CARARE work package 3 and constitutes:

- a review of GIS services being made available in EuropeanaLabs through the EuropeanaConnect project or other projects,
- an evaluation of the potential for enriching the place-name services in Europeana through monument inventory data from the domain,
- an evaluation of the potential for the gazetteer and geoparser services available from Europeana to enrich heritage content.

The first part of the report presents the Europeana GIS services together with initial testing results.

Table 1: List of Europeana GIS services and the focus of the review

Type	Name	Comment
1. Geoparsing tool	Europeana Geoparsing Service v1.0 beta	• Current version is published as a prototype; • It has sufficient functionalities for initial testing; • The testing has the main purpose of discovering practical ways of use.
2. Gazetteer tool	Europeana Gazetteer	• Current version is published as a prototype; • It has sufficient functionalities for initial testing; • The testing has the main purpose of discovering practical ways of use.
3. Map annotation tool	Europeana **Connect** Media Annotation Prototype	• Current version is published as a prototype; • It is useful user interface for annotation capture. However, export facilities cannot be found in the published version.
4. Web mapping tool	Open Layers	• API for web-based mapping is yet not available from Europeana; • Testing performed in the report consisted of initial testing of the few samples of geographic co-ordinates from the CARARE project; • The OpenLayers library is used for this purpose, it is also one of the candidates for building the Europeana API. • The first review of new Europeana prototypes are added.

The second part of the report deals with geographic information in archaeology/architecture site data and gives first recommendations on:

- converting geographic co-ordinates of the content to a common World co-ordinate system,
- making synergy with activities on INSPIRE directive, and
- the potential for enriching the place-name services in Europeana through monument inventory data.

3 Geo-parsing tool

3.1 Definition

The term geoparser denotes a software application or web service that performs the process of Geoparsing. Geoparsing means processing of text or other records of information in order to assign them with geographic identifiers and write them into a geospatial database. The first step of this process automatically extracts and identifies place names in text and then through geo-tagging makes an association between the name and its proper location.

3.2 General features

- A user can input single attribute of geographic name (e.g. country, river, town) or free text including one or more places;
- It performs recognition of word or words describing a geographic name using syntax and semantics rules,
- It finds the most probable geographic location in certain database of geographic names with corresponding geographic co-ordinates if possible,
- It can interface with internet tools such as are portals, web services, API …

3.3 Description of the Europeana Geoparsing Service

The Geoparser is a web service that uses information extraction techniques to automatically identify names of places and time periods mentioned in unstructured text. It works together with the Europeana Gazetteer to assign co-ordinates and dates with the mentioned places and periods.

The target users of the Geoparser are Europeana and Europeana's aggregators and data providers who need to enrich object descriptions by analyzing geographic or temporal references in existing metadata records.

The Geoparser Service was developed within Europeana Connect project on the basis of DigMap geoparser. The Geoparser is a web application capable of place name extraction from textual resources and metadata records. The Service can be used by other applications either by integration within the application (https://europeanalabs.eu/svn/contrib/geoparser) or via the REST web service interface (https://europeanalabs.eu/svn/contrib/geoparserService).[1] The REST interface makes available requests for geoparsing free text and another for geoparsing Europeana metadata records.

[1] From Freire, N.: M5.5.5 The Europeana Geoparser – Second Prototype, version 0.1, Europeanna*Connect*, 24.6.2010

The geographic features are extracted from unstructured text into documents in either XML or HTML format. The tool works in connection with the Europeana*Connect* Gazetteer.

Results outputs are in different output schemes:

- ADL Content schema (adlcs),
- ADL General Protocol (adlgp),
- Geo-names ontology (Geo-names),
- Geo RSS (Really Simple Syndication) (georss),
- GeoNet (gn),
- Keyhole Markup Language (kml),
- metadata Authority Description Data (mads),
- OGC Web Gazetter Service (wfsg).

Status

The current Europeana Geoparsing Service is version 1.0 beta and was published as a prototype in the middle of 2010.

Features

- developed as web service in J2EE environment,
- user interface in REST environment,
- automatic extraction of structured information about places from text,
- automatic extraction of structured information about historical periods from text,
- automatic extraction of metadata records,
- Geoparsing results in XML or HTML format ,
- works in connection with the EuropeanaConnect Gazetteer.

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Link

http://europeana-geo.isti.cnr.it/geoparser/geoparsing

3.3.1 Review and recommendations

1. The Europeana Geoparsing service is a very effective tool for assigning geographic co-ordinates automatically in the cases where there is no available co-ordinates for the cultural object.

2. The Europeana Geoparser input can be structured or unstructured attribute data describing a cultural object. It performs data-mining of the textual descriptions of the cultural objects effectively.

3. The Europeana Geoparser is relatively simple to use; it can be used directly by the end user for testing.

4. Simple testing of the Europeana Geoparser was performed on 1000 items from the Register of cultural heritage of Slovenia. The tool was able to recognise geographic location and co-ordinates of 336 objects from free text input; most of them with adequate precision. In our opinion the test results confirm the usefulness of the tool. See details for main testing results in Appendix: 1.Testing of Europeana Geoparsing Service.

5. The intention of CARARE testing was to make some initial tests in order to:
   - avoid each content provider having to spend a lot of time on testing,
   - formulate advice on methodological issues,
   - ensure content providers and managers of cultural collections use this tool as soon as possible and with reliable results.

   CARARE metadata is ideal for Geoparser testing because it already includes the right co-ordinates.

6. Regarding the results, it should be emphasized that the endings of words in some languages depend on their relationships in a sentence (i.e. conjugation, declension). For example, the city of Ljubljana is referred to differently in sentences "Ljubljana je glavno mesto" and "Rodil se je v Ljubljani.". The geoparser is not able to perform a stem search.

7. Testing revealed that there is ambiguity regarding case sensitive place names. For example the city name "Novo mesto" is not found by the Geoparser although "Novo Mesto" is found - the former is the proper name.

8. The use of more geo-ontology reasoning is recommended for more effective context processing. This means establishing a hierarchy of territorial units (e.g. state – county – town). For example, it could be useful if the Geoparser could exploit the country element of ESE (element name "country") as this could help in better recognition of place names context.

9. The Europeana Geoparsing service could also provide a useful tool for the validation of geographical co-ordinates. It performs validity checks if proper geographical co-ordinates are assigned to certain cultural heritage objects after all projections transformations. Where the co-ordinates are not valid, the service informs the content provider.

10. The output of Europeana Geoparsing service is not very useful for spatial navigation because the spatial accuracy is limited (not in the range up to 5 or 10 meters). It is recommended that the accuracy is enhanced and this could be done by adding local databases of geographic names (archaeological and architectural sites, addresses).

3.4 Other tools

Yahoo! Placemaker
Yahoo! Placemaker[2] is a free geoparsing web service. It identify places in unstructured content like web pages, news, feeds and returns geographic metadata for geographic indexing and markup in order to make applications location aware. The web service returns unique identifiers (WOEID). The output also provides information about the frequency of the place name in the text and its position. The identifiers received (WOEID) can be sent to Yahoo!'s GeoPlanet™ API to be further geographically enriched and used.

However we must note that Placemaker is not a geocoder and is not able to perform street level recognition. It is designed as a geo-extraction and indexing tool to determine where a document or atomic unit of text is geographically located. It serves the geographic developer community as a way to mark-up and index their content in a manner that is globally aware, relevant locally and language neutral. The API can be accessed only via HTTP POST.

- Property rights: copyright, free of charge,
- Link: http://developer.yahoo.com/geo/placemaker/

3.5 Links and sources

- Freire N. et al.: D5.5.1 – The Europeana Geoparser and Gazetteer: Documentation and final prototype, Europeana*Connect*, 1.9.2011
- http://europeana-geo.isti.cnr.it/geoparser/geoparsing
- http://www.digmap.eu/doku.php
- http://developer.yahoo.com/geo/placemaker/
- Bittner T. et al. (2009). A spatio-temporal ontology for geographic information integration, International Journal of Geographical Information Science, vol. 23, no. 6
- Bogorny, V., Kuijpers, B. A., Otavio L. (2009). ST-DMQL: A Semantic Trajectory Data Mining Query Language, International Journal of Geographical Information Science, vol. 23, no. 10

[2] From: http://developer.yahoo.com/geo/placemaker/

4 Gazetteer tool

4.1 Definition

A geographic thesaurus is a structured vocabulary of geographical names or a catalogue of toponyms (place names) assigned with geographic references. A gazetteer service retrieves the geometries for one or more features, given their associated well-known feature identifiers (text strings).

Gazetteers are more than basic place name directories containing names and locations for named geographic places. The gazetteer can be seen as a database of geographical features (e.g. countries, cities, rivers, etc.), with descriptive information about their names, locations, temporal coverage and associations. In addition, the gazetteer also includes historical periods, with descriptive information about their names, time-spans and relations to the geographical concepts. Gazetteers can benefit from an ontological approach to typing schemes, providing a formalization that will better support gazetteer applications, maintenance, interoperability and semi-automatic feature annotation.

4.2 General features

- Spatial and non-spatial attributes of database,
- Coverage of database,
- Database updating,
- Geo-ontology and/or SKOS related services,
- Multilingual services,
- Management of property rights of database,
- User interfaces.

4.3 Description of the Europeana Gazetteer

Status
Prototype.

Features
- data resource including over 9 million geographic names, co-ordinates, and boundaries,
- no legal constraints to use and re-use the information.

Link
http://europeana-geo.isti.cnr.it/gazetteer/homepage.action

4.3.1 Review and recommendations

1. The Europeana Gazetteer is a great tool. It consists of more than 8 million geographic names in one place, in one structure, with geographic co-ordinates, and is free of use.

2. The Europeana Gazetteer is a useful thesaurus of geographical names with the addition of geographical co-ordinates. The thesaurus can be used in two ways. The first is sub-sequential assignment of geographical co-ordinates to objects for which the geographical name is known (e.g. a town). The second is assignment of geographical co-ordinates supported by a controlled vocabulary at the point of metadata description ingestion for some object.

3. Items were compared from the Register of Slovenian settlements with Europeana Gazetteer names. The matching of geographical names was successful in 2651 cases, mostly with adequate precision. See details for the main results of testing in Appendix: 2. Testing of the Europeana Gazetteer.

4. The tool efficiency could be significantly enhanced by the gradual inclusion of national registries of settlements and other territorial units. A possible way forward is through connection to the INSPIRE directive implementation in the domain of Geographical names, Territorial units and Addresses.

5. The Europeana Gazetteer also appears to be a useful tool for validation of geographical co-ordinates. It performs a validity check if the proper geographical name is referred to by co-ordinates and informs the user.

4.4 Other tools

The Getty Thesaurus of Geographic Names (TGN)®
Status: Prototype
TGN begun in 1987 and today it contains over one million names. The database consists of place names that are linked with geographic co-ordinates, notes, sources for the data, and place types, which are terms describing the role of the place (e.g. inhabited place and state capital). TGN provides hierarchical information pertaining to regions which encompass the location. It covers the world and places from prehistory to the present. A web interface enables place name search, spatial restriction by nation and continent and temporal restriction.

- Property rights: copyright, free of charge for non-regular and non-extensive use,
- Link: http://www.getty.edu/research/conducting_research/vocabularies/tgn/

Alexandria Digital Library (ADL) gazetteer
Status: Prototype
University of California, Santa Barbara started to develop the Alexandria Digital Library Gazetteer in 1999. ADL associates place and feature names with geographic locations and other descriptive information. A gazetteer can be used to find the geographic location of a named place, and conversely can be used to find all named places within a geographic area. It covers the world and its principal data sources are US Geological Survey's GNIS database and the National Imagery and Mapping Agency's GNS database. The gazetteer is maintained to stay up-to-date. A web interface enables place name searches and restrictions by nation or by continent, and results are displayed on a map.

- Property rights: copyright, free of charge
- Link: http://www.alexandria.ucsb.edu/gazetteer

Global Gazetteer
The Global Gazetteer is a worldwide directory of cities and towns. It contains approximately three million of the world's cities and towns. Place names are categorized by country and linked with location maps, latitude, longitude, altitude, weather, links, and other information for each town.

- Property rights: copyright, free of charge
- Link: http://www.fallingrain.com/world/index.html

The Fuzzy Gazetteer
The Fuzzy Gazetteer searches place names. It queries among over 7 million place names and returns a list of similar names that are hyperlinked to the JRC Digital Map Archive of the European Commission.

- Property rights: copyright, free of charge
- Link: http://isodp.fh-hof.de/fuzzyg/query/

Maplandia
Maplandia is a Google product and enables searching on Google Maps of their online satellite imagery. Gazetteer covers places worldwide and divides them into geographical categories according to continents, countries and administrative regions. It covers Africa, Asia, Australia, Europe, North and South America.

- Property rights: copyright, free to browse on the internet
- Link: http://www.maplandia.com/

Place Name Authority
Place Name Authority is a web service gazetteer. It enables searching the geographical objects such as addresses, place names, the co-ordinates and geographical names. Initially the Gazetteer service was used only for digital directories with point co-ordinates, but over the years it expanded to cover mapped objects with linear or planar geometries.

- Property rights: copyright, free of charge
- Link: http://isk.geobasis-bb.de/index.php/dienste/gazetteer

4.5 Links and sources

- http://www.getty.edu/research/conducting_research/vocabularies/tgn/
- http://www.alexandria.ucsb.edu/gazetteer
- http://www.geo-names.org/
- http://www.fallingrain.com/world/index.html
- http://isodp.fh-hof.de/fuzzyg/query/
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- http://isk.geobasis-bb.de/index.php/dienste/gazetteer
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- Mostern, R., Johnson, I.(2008). From named place to naming event: creating gazetteers for history. International Journal of Geographical Information Science, vol. 22, no. 10
- Janowicz, K. and Keßler, C. (2008). The role of ontology in improving gazetteer interaction, International Journal of Geographical Information Science, vol. 22, no. 10

5 Map annotation tool

5.1 Definition

Map annotation is an annotation stored in the map document. It is a text fragment that explains or names a whole map, part of a map or a map feature. In closed annotation systems users can add, modify or remove information from a Web resource without modifying the resource itself. The annotations can be thought of as a layer on top of the existing resource, and this annotation layer is usually visible to other users who share the same annotation system. Map annotation tool usually provides basic GIS tools to let users draw a polygon, point or line in order to mark locations on the map.

5.2 General features

- annotate a map or its fragments with points, lines or polygons,
- editing existing annotations,
- sharing existing annotations with the public.

5.3 Description of EuropeanaConnect Media Annotation Prototype

The Media Annotation tool is an online media annotation suite developed in the EuropeanaConnect project under the leadership of the AIT Austrian Institute of Technology in co-operation with University of Vienna and the Austrian National Library. The tool is developed to annotate video, images, audio and maps.

Status
Prototype

Features
- Semantic tagging,
- Linked Data interface: annotations exposed as RDF resources,
- Supports images, audio and video content,
- Special support for high-resolution map images (tile-based rendering for faster delivery, geo-referencing, semantic tag suggestions based on geographic location, place search functionality, overlay of present-day country borders, coast outlines, etc.),
- Shape drawing tools on images, maps and video ,
- Runs in internet browsers.

Link
http://dme.ait.ac.at/annotation/

5.3.1 Review and recommendations

1. Europeana Connect Media Annotation tool is an excellent tool for map referencing and annotating.

2. Annotation of historical maps contributes additional information and value to the map and enhances the search capabilities.

3. Appendix: 3. Testing of EuropeanaConnect media annotation tool contains details about testing and describes necessary steps for map annotation.

4. Barrier: export facilities for the annotation data were not found during testing.

5.4 Other tools

Weaving History
Weaving history has been created by the Open Knowledge Foundation. Weaving history enables users to make new threads which are based on factlets that is some historical theme content. Threads can then be visualized on time scale or map in context with other threads. Threads can be also edited.

- Property rights: available under open licenses, specifically all code is licensed under the MIT License and all general content and data is available under a CC Attribution-ShareAlike License. Individual factlets and threads are licensed under their individually specified licenses, free of charge,
- Link: http://weavinghistory.org/

flickr
Flickr supports geo-tagging by adding location information to a photograph. It can be assigned to a single photo or by using Organizr to a group of photos. The photo can then be displayed on the map. Flickr also support exploration of photos on the same location or at range nearby.

- Property rights: copyright, free of charge
- Link: http://www.flickr.com/map/

5.5 Links and sources

- Korb J.: Report on the EuropeanaConnect Workshop on place, digital cultural heritage and the internet, 4-5. November 2010, AIT National Institute of Technology,
- Simon, R. (2010). Explorative User Interfaces for Browsing Historical Maps on the Web. In: 5th International Workshop on Digital Approaches in Cartographic Heritage. Vienna, Austria, 22–24 February 2010. Accessed online at http://userver.ftw.at/~simon/files/cartoheritage-paper29.pdf,

- Simon, R.: End-User Media Annotation with YUMA, presentation at EuropeanaTech Conference, Vienna, Austria, October 5, 2011,
- Goodchild, M. F. and Hill, L. L.(2008). Introduction to digital gazetteer research, International Journal of Geographical Information Science, vol. 22, no. 10.

6 Web mapping tool

6.1 Definitions

Web mapping tools support map generation and map publishing on the internet. Functionality is often limited to displaying maps. In comparison to Web GIS these tools cannot perform sophisticated geo-processing and analysis. Web mapping tools usually do not require client software installation as they run in internet browsers.

6.2 General features

- Display of map and attribute data,
- Showing on/off of map layers,
- Map zoom in/out, pan, identify,
- Searching by attributes,
- Display of background cartographic layers.

6.3 Description of Open Layers

Status
Web mapping service application is free and released under a BSD License (permissive free software licenses)

Features
- Open Source map viewing library,
- Provides a JavaScript API to incorporate maps from a variety of sources into the webpage or application,
- Support for OGC WMS layers, navigation, icons, markers, and layer selection,
- ImplementS the OpenGIS Consortium's Web Mapping Service (WMS) and Web Feature Service (WFS) protocols.

Link
- http://openlayers.org/

6.3.1 Review and recommendations

1. An API for web based mapping is not yet available from Europeana. OpenLayers API is one of the candidates for building the Europeana API. The OpenLayers API has been used to present some issues from samples of CARARE content. There was no intention however to test the functionality or graphic tools of the API. See details in Appendix: 4: Testing of OpenLayers API.

2. The vision of Europeana spatial search and mapping should be implemented as soon as possible (Danube release) and with wide geographic coverage.

3. It is recommended Europeana includes only simple spatial features as points at the beginning.

4. The projections from national or local co-ordinate systems could be transformed to common WGS84 coordinate system in short term in cooperation with content providers. It must be stressed that this is the case especially when the geographic metadata are not documented or reliable enough.

5. Introduction of accuracy attribute is recommended. It is also a part of the W3C Geolocation API Specification. Three ranges of accuracy would suffice for start:
   - less than 10 (or 5) meters, appropriate for navigation tools,
   - between 10 and 1000 meters, appropriate for orientation,
   - more than 1000 meters,
   - unknown.

6. At least a few examples from each content provider are to be included in demonstration of geographical data (http://carare.eculturelab.eu).

7. Recently two Europeana compliant GIS portal prototypes were developed. Europeana 4D displays Europeana data in space and time (http://tinyurl.com/e4d-project). See further description in the Appendix 4: Testing of OpenLayers API

8. The second prototype is Culture Globe. It enables the spatial-temporal browsing through the Europeana metadata with 3D globe visualization in a web browser (https://cultureglobe.github.com). The main component is WebGL Earth. Further information - see the Appendix 4: Testing of OpenLayers API.

6.4 Other tools

Google *Maps*
Google map enables to create personalized, annotated, customized creating place marks, lines and shapes. User can add rich text or html text on a map, embeds photos or video in a map, share the map and collaborate, import KML or Geo RSS to the map or view the map in Google Earth.

- property rights: copyright, free of charge
- links: http://maps.google.com/

Bing Maps
Bing Maps (previously *Live Search Maps*, *Windows Live Maps* and *Windows Live Local*) is a web mapping service provided as a part of Microsoft's Bing suite of search engines and powered by the Bing Maps. Users can browse and search topographically-shaded street maps (Road View, Aerial View, Bird's Eye View, StreetSide View, and 3D View), getting directions between two or more locations and transit directions. Functionality is available from third party applications such as parking, traffic information and sharing maps. Other features to mention are searching for and locating places, businesses and landmarks, and people may view and add "user contributed" entries to the map. Some other functionalities are only enabled with Silverlight installed.

6.5 Links and sources

- Definitions of the Europeana data model elements, Europeana v1.0, version 5.2, 30.7.2010,
- Dekkers M., Gradmann S., Molendijk J.: D3.3 Initial technical & logical architecture and future work recommendations, ECP 2008 DILI 558001, Europeana v1.0, final version 30.7.2010,
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- http://www.w3.org/2008/geolocation/.

7 Geographic information in/and archaeology/architecture site data

7.1 Co-ordinate systems

1. The AA (archaeological / architectural) sector has a more than 30 years long tradition of using geographic information systems when capturing AA data, managing the AA repositories, and processing and displaying AA data on the maps.

2. Data are usually originally geo-coded using local co-ordinate system and national projections and, in many cases, with insufficient documentation of co-ordinate system and bad or no documentation of the digitisation procedures.

3. Geographic co-ordinates of AA data must be transformed (by batch or on the fly) into global co-ordinate systems such as WGS84 or ETRS89 in order to display AA data on common maps at European / World level. ETRS89 is going to be adopted in the European territory as a common European co-ordinate system in the coming years (Appendix 6: Examples of INSPIRE specifications).

4. There is no time set when all co-operating countries in the CARARE project have to transpose all AA data in ETRS89 to be compliant with the INSPIRE directive. Therefore, the following recommendations are made to CARARE content providers.

7.1.1 Recommendations to CARARE content providers

1. Content providers are recommended to provide spatial data in WGS84. For basic information on geographic coordinate systems see Appendix 5.
2. When transforming data to WGS84:
   - Use propretiary or open source software e.g. http://proj4js.org/,
   - Find out precisely what coordinate system your data uses,
   - Test the spatial accuracy of your data before transformation,
   - Make data quality control on the map when performing co-ordinate transformations,
   - And, again, test spatial accuracy of the transformed data on the map.
3. The GIS working group established within CARARE will advise and provide help to content providers when transforming their spatial data to WGS84. Just send an e-mail with sample of metadata to the CARARE forum.
4. If content providers are not very familiar with spatial data, they should ask for help from the GIS working group to transform their spatial data to WGS84 in the CARARE repository.
5. It is suggested that in CARARE meta data the ESPG number is used, for example <car:spatialReferenceSystem>EPSG:4326</car:spatialReferenceSystem>.

7.2 INSPIRE Directive

1. The INSPIRE Directive aims to establish **spatial** information infrastructure in Europe in order "to support European Community environmental policies, and policies or activities which may have an impact on the environment".[3] It came into force on 15 May 2007 and its implementation will follow various stages until full implementation in 2019.

2. The INSPIRE Directive ensures compatibility and usability of the spatial data infrastructures of the Member States in European Union. To achieve this, the Directive requires that common Implementing Rules are adopted in a number of specific areas: metadata, data specifications, network services, data and service sharing and monitoring and reporting.

3. These Implementing Rules are adopted as Commission Decisions or Regulations, and are binding in their entirety. The Directive is addressing 34 spatial data themes organized in three annexes. See Appendix 6: Examples of INSPIRE Specifications.

4. INSPIRE spatial infrastructure provides a great opportunity to be used also in the digital cultural heritage field. Firstly the implementation rules as they are set for co-ordinate reference systems, geographical names and administrative units can be used as a methodological background and as technical standards. On the other side the INSPIRE spatial data as orthoimagery and geographical names could be directly used when representing digital cultural content on web maps.

5. The table below provides the overview of first priority themes most relevant for digital cultural content.

Table 2: First priority themes most relevant for digital cultural content

Coordinate reference systems	Systems for uniquely referencing spatial information in space as a set of co-ordinates (x,y,z) and/or latitude and longitude and height, based on a geodetic horizontal and vertical datum.
Geographical grid systems	Harmonized multi-resolution grid with a common point of origin and standardized location and size of grid cells.
Geographical names	Names of areas, regions, localities, cities, suburbs, towns or settlements, or any geographical or topographical feature of public or historical interest.
Administrative and statistical units	Territorial units of administration for local, regional and national governance, separated by administrative boundaries. It also consists of the statistical units for dissemination or use of statistical information.
Addresses and buildings	Locations based on address identifiers, usually by road name, house number, postal code. It also consists of the geographical location of buildings.

[3] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community(INSPIRE), . See: http://inspire.jrc.ec.europa.eu

Protected sites	Formally by law protected areas such as archaeological sites and architectural buildings.
Orthoimagery	Geo-referenced image data of the Earth's surface, from either satellite or airborne sensors.
Metadata	Metadata description consisting of: identification, classification of spatial data and services, keywords, geographic location, temporal reference, quality and validity, conformity, constraints related to access and use, organizations responsible for the establishment, management, maintenance and distribution of spatial data sets and services, metadata on metadata.

7.2.1 Recommendations

1. CARARE encourages the synergy of CARARE spatial data and the INSPIRE directive as a whole and especially the annex regarding the topics on heritage protected sites. The synergy is encouraged in the first place to foresee the sustainability of both the CARARE content and project.
2. During the CARARE project the requirements of CARARE and INSPIRE are advised to be met on content provider or national level. Some of the members of CARARE GIS working group are experienced with INSPIRE implementation rules and also monitor some national implementations; therefore they could advise individual CARARE content providers in certain situations.
3. When planning the business model of sustainability in the period after CARARE project, it is suggested to investigate the possibilities of more tied connection between CARARE and INSPIRE -protected area on the CARARE level. It could be the value added.
4. When planning the co-operation with INSPIRE take into account Table 3: A quick comparison of CARARE spatial data / INSPIRE directive – heritage protected sites and Figure 2: Variants of CARARE AA-ingestion: variant A- direct AA-ingestion; variant B- indirect via INSPIRE AA-ingestion.

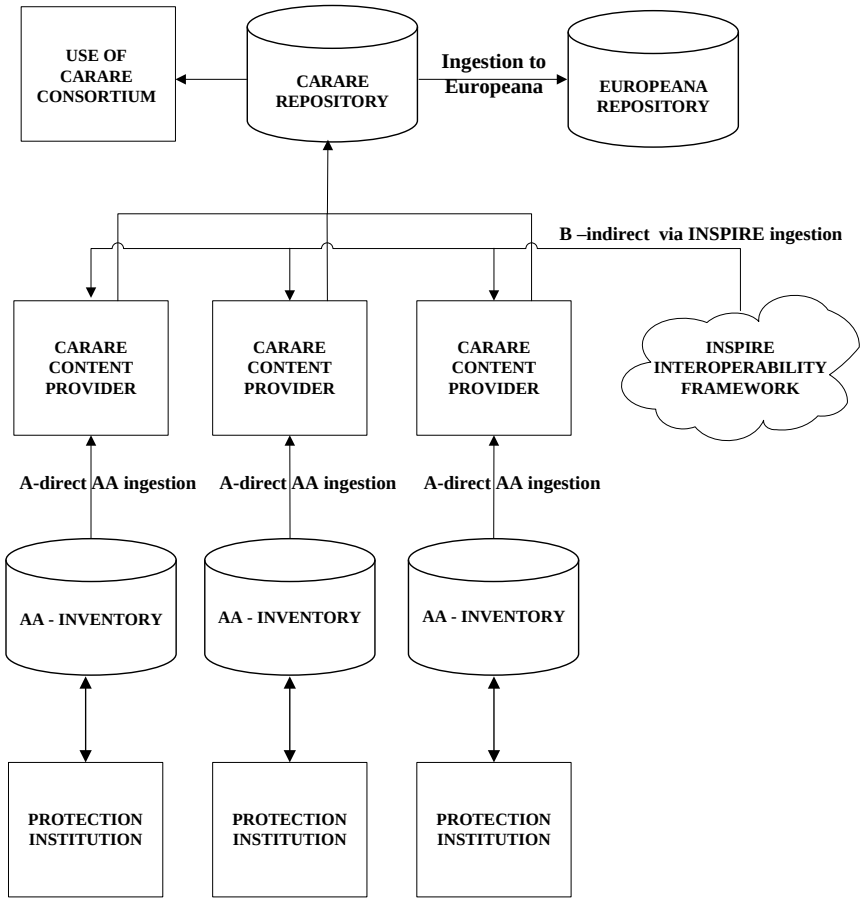
5. Quick thoughts:
   - Use specifications on co-ordinate systems, meta data, data structures,
   - Focus on suggested standards, recommendations guidelines, and good practice documents,
   - Use the data and services /e.g. geographic names, addresses, administrative units, transformation services),
   - Use the orthoimagery,
   - Making CARARE data more interoperable,
   - Reuse of CARARE data for other networks,
   - Consider the sustainabilty of CARARE results.

Table 3: Quick comparison CARARE spatial data / INSPIRE directive – heritage protected sites

	CARARE spatial data	**INSPIRE directive – heritage protected sites**
Main purpose	General public, cultural sector	Environmental protection, land use
Topics	Collections of immovable and movable heritage, described in Dow	Proteced archeological sites and protected buildings, depends on national and local legislation
Value	Informative	Legal value
Main protocols	OAI-PMH, data are harvested as text data to repository	WFS, WMS protocols, spatial features are accessed directly accross interoperable frameworks
Geographic feature	Mainly points, in first phase of Europeana mapping	Mainly polygons
Accuracy	Several macro, mezzo, micro geocoding levels	Only detail: parcel level
Attribute data	Historical description of the real and digital object	Legally binding description
Geographic reference system	WGS84[4]	ETRS89
Responsibility	CARARE content providers	Members States

[4] WGS84 is specified by Europeana as the Geographic Reference System to be used by data providers

Figure 2. Variants of CARARE AA-ingestion: variant A- direct AA-ingestion; variant B-indirect via INSPIRE AA-ingestion



7.3 Potential for enriching the place-name services

1. The Europeana Geoparsing tool is based on Geo-names Gazetteer. The tool itself is recognized as a useful tool for assigning the geo-codes at macro and mezzo level (spatial accuracy more than 10m). The lack of detail accuracy means that the output of Europeana Geoparsing tool is less appropriate for use in micro location navigation.

2. The reason for insufficient accuracy lies in the Geo-names Gazetteer content. The Geo-names Gazetteer does not contain many geographical names related to cultural sites; we estimate only about 0.05%. For details see Appendix 7: Cultural spot features in Geo-names.

3. AA inventories, on the other hand, contain structured geographic information such as address, cadastral, cartographic reference, etc. and also quite accurate geographic co-ordinates. In most cases the minimal standards are Core Data Index to Historic Buildings and Monuments of the Architectural Heritage and International Core Data Standard for Archaeological Sites and Monuments are taken into account. They could be an ideal source for text mining of geographical names assuming any IPR issues can be cleared.

Table 4: Core Data Index to Historic Buildings and Monuments of the Architectural Heritage and International Core Data Standard for Archaeological Sites and Monuments

Core Data Index to Historic Buildings and Monuments of the Architectural Heritage[5]		**International Core Data Standard for Archaeological Sites and Monuments**[6]	
2.0	**Location**	**2.2**	**Location**
2.1	**Administrative Location**	**2.2.1**	**Administrative Location**
2.1.1	State	2.2.1.1	Country or Nation
2.1.2	Geo-political Unit	2.2.1.2	Geo-political Unit
2.1.3	State Administrative Division(s)	2.2.1.3	Administrative Sub-division
2.1.4	Administrative Sub-division	**2.2.2**	**Site Location**
2.2	**Address**	2.2.2.1	Description of Location
2.2.1	Postal name	**2.2.3**	**Address**
2.2.2	Number in the Street/Road	2.2.3.1	Name for Address
2.2.3	Name of Street/Road	2.2.3.2	Number in the Street or Road
2.2.4	Locality	2.2.3.3	Name of Street or Road
2.2.5	Town/City	2.2.3.4	Locality
2.2.6	Postal Code	2.2.3.5	Town or City

[5] 1995, (http://archives.icom.museum/object-id/heritage/core.html)
[6] 1999, (http://archives.icom.museum/object-id/heritage/int.html)

2.3	**Cartographic Reference**	2.2.3.6	Postal or Other Similar National Address Code
2.3.1	X Co-ordinates	**2.2.4**	**Cadastral Reference/Land Unit**
2.3.2	Y Co-ordinates	2.2.4.1	Cadastral Reference
2.3.3	Spatial Referencing System	**2.2.5**	**Cartographic Reference**
2.4	**Cadastral Reference/Land Unit**	2.2.5.1	Cartographic Identifier
		2.2.5.2	Spatial Referencing System
		2.2.5.3	Topology
		2.2.5.4	Qualifier
		2.2.5.5	Sequence Number
		2.2.5.6	Z Coordinate
		2.2.5.7	X Coordinate
		2.2.5.8	Y Coordinate

4. The CARARE project includes great amount of AA-content. See the draft list of CARARE AA-inventories in Appendix 8: CARARE inventories.

Table 5: Scope: Archaeological Sites, Architectural buildings, Monuments, Archaeological excavations, etc.

Type	**Collections**	**Items**	**Countries**
Point	20	4.702.294	
Line	13	25.900	
Polygon	23	1.042.354	
Image/Grid	13	4.165.023	
Total Spatial »Yes«	33		14
Total Spatial »No«	47		

Source: CARARE WP2 content survey

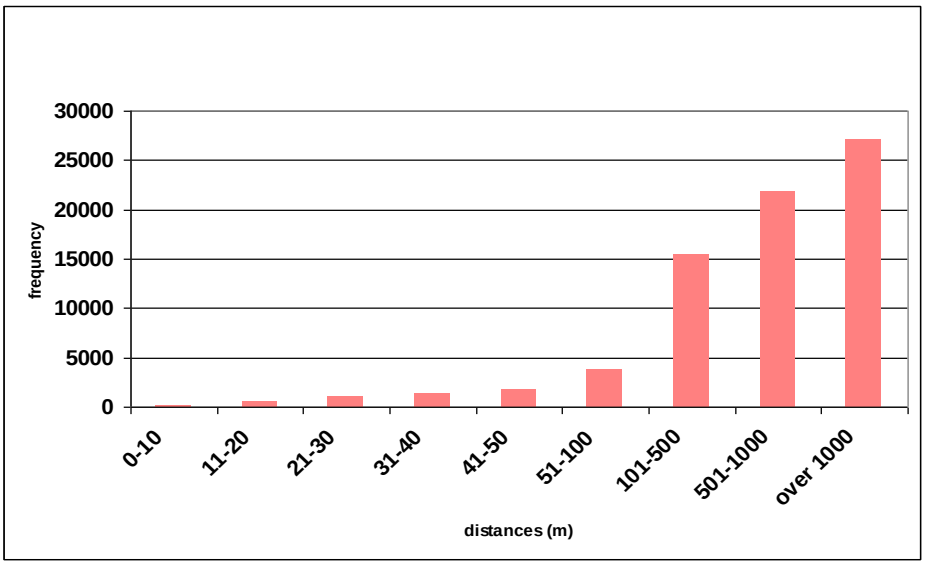
5. It is presumed that there is a high correlation between AA sites and other cultural objects. For example, archaeological objects displayed in museums have been excavated from archaeological sites, or the author of a novel was born in a building recognized as architectural heritage.

6. Two diagrams below show the analysis of Slovenian AA-inventory (Register of Cultural Heritage of Slovenia). All AA sites (approximately 27,000) have exact geographic co-ordinates (estimated accuracy less than 5 metres).

7. In the first diagram instead of the exact co-ordinates from AA-inventory, assigned co-ordinates of the closest settlement are used. So it could be a "proof":
   - However we improved settlement data; the output data are not accurate enough for navigation,

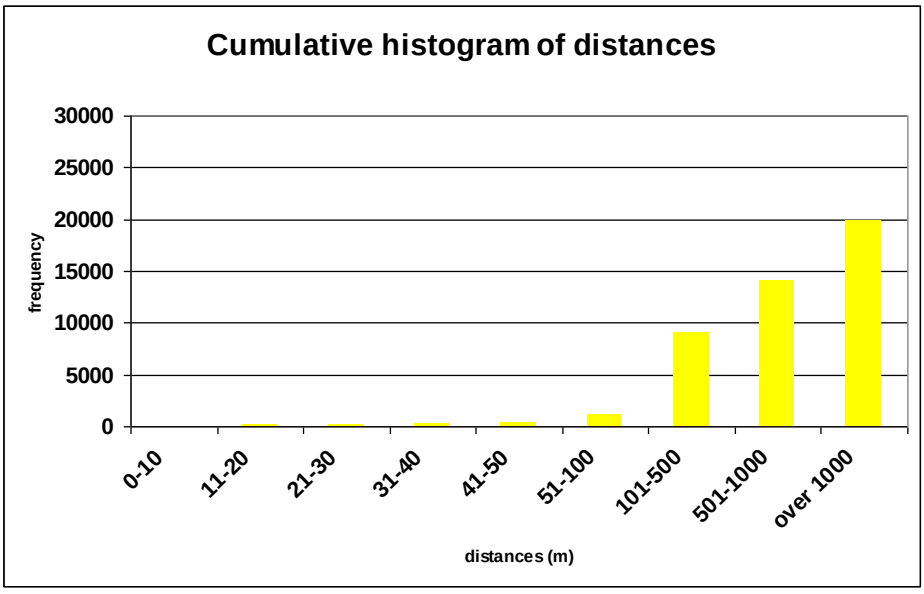
- Therefore, if the AA sites are combined with the Geoparsing database, a significant shift in spatial accuracy is expected (the bold rectangle labels in the diagram show the estimated theoretical shift of spatial accuracy when using AA sites geographical information).

Figure 3: The analysis of Slovenian AA-inventory using National Register of Settlements



8. The second diagram presents the same analysis with Geo-names gazetteer The results are not significantly worse having in mind navigation use.

Figure 4: The analysis of Slovenian AA-inventory using Geo-names



7.3.1 Recommendations

1. AA-Inventories present a great potential for enriching place-name services because of the following reasons:

- The large number of the AA-items,
- Good quality geographic description,
- Well structured information,
- Similar structure of description,
- Accurate geographic co-ordinates usable for navigation,
- Regularly updated,
- Close relationship to movable and intangible cultural heritage.

2. CARARE includes a great amount of AA-data.

- It could make a first step enriching place-name services and,
- The project has been reviewing IPR issues relating AA-data including geographic co-ordinates.

3. CARARE enrichment of the place-name services could be performed with two approaches:

- Adding the AA- places to the Europeana gazetteer, or better still,
- Using the similiarity measures methods (see for example Janowicz, K.: Towards a similarity-based identity assumption service for historical places).

8 Conclusion

The Europeana Geoparser, Europeana Gazetteer and Europeana annotation tool are very effective and useable tools for Europeana geographic information support.

The only drawback of these tools is that the automatically assigned geographic information is less useful for mobile navigation as the consequence of its spatial accuracy.

The architectural and archaeological sites data with known co-ordinates can significantly improve place name services with better output spatial accuracy.

The CARARE project is bringing digital information for immovable cultural heritage to Europeana. The geographic location is a core part of the data for these collections. There are a few million architectural buildings and archaeological sites with known geographic co-ordinates in Europe. The work of the CARARE project could provide Europeana with a critical mass of geographically located cultural heritage objects.

The next step of for the CARARE GIS work package is to test the Europeana API.

9 References

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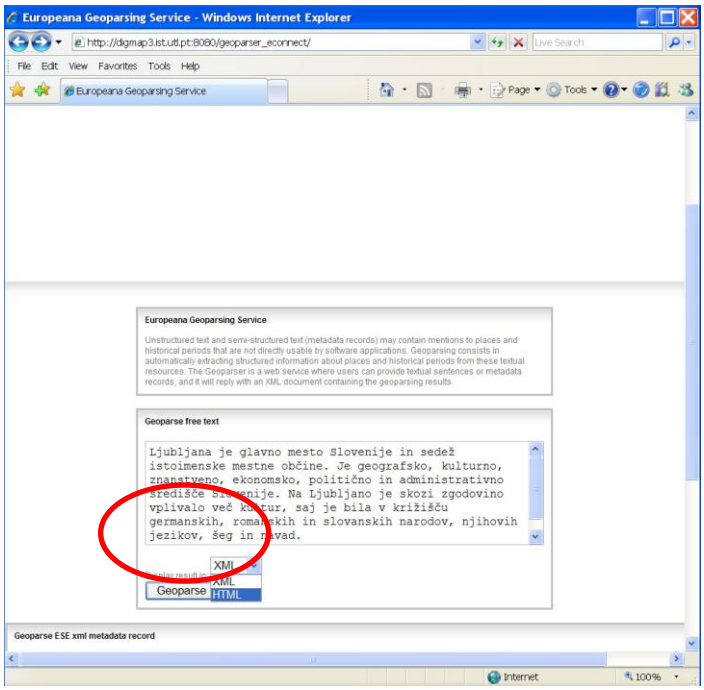
10 Appendices

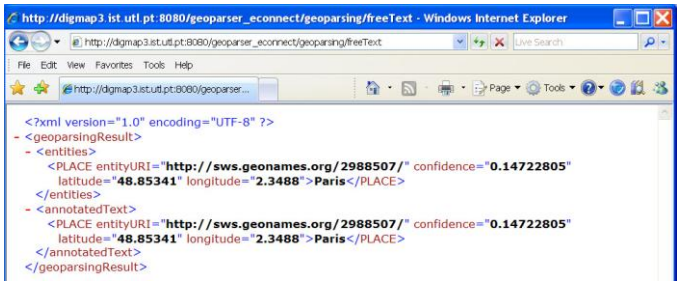
Appendix 1: **TESTING OF EUROPEANA GEO-PARSING SERVICE**

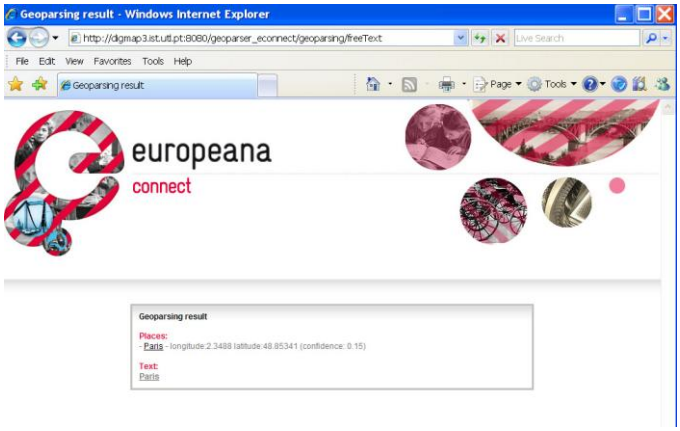
1. The Europeana Geoparsing Service is located at http://europeana-geo.isti.cnr.it/geoparser/geoparsing. Authors tested its functionality on this site – free text and metadata record. The Europeana Geoparser has been tested in November 2010.

2. Geoparsing results of the free text and metadata record can be in xml or html format.

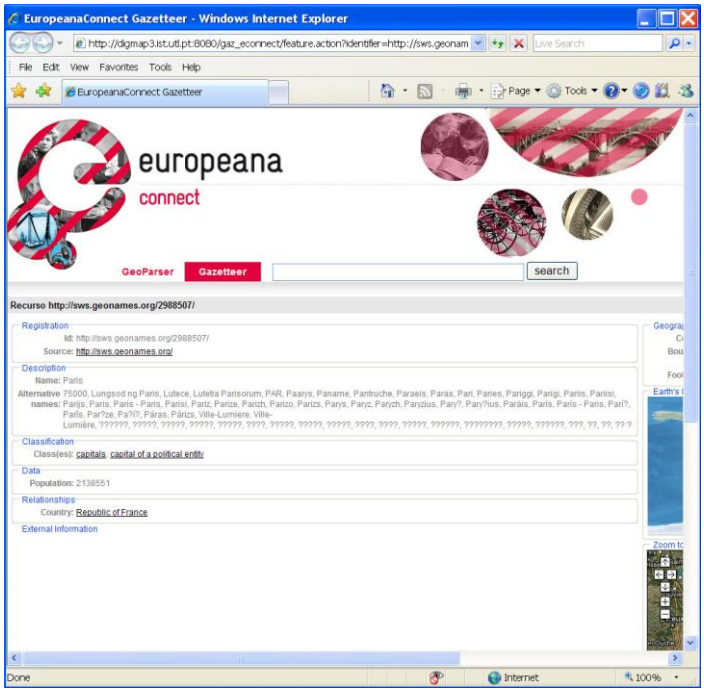


3. The Geoparsing results display in a new browser window.





4. Geoparsing results are connected with the Europeana Gazetteer.

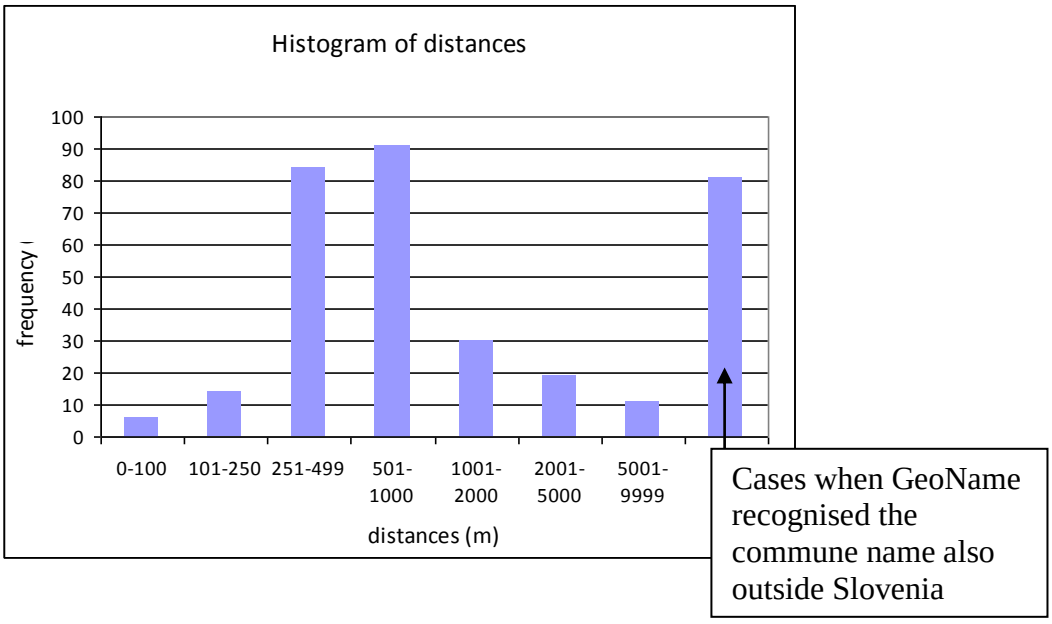


5. The purpose of the analytical testing of Europeana Geoparsing Service was to find out:
   - How many places were recognized by the text search facilitym,
   - How many of recognized places were referenced to a proper place.

6. Testing proceeded through following steps:
   - Random selection of 1000 heritage sites from Slovenian Register of cultural heritage with actually known geographic co-ordinates,
   - Using of the Geoparsing service by REST method,
   - Parsing the results in order to find out geographic co-ordinates,
   - Transformation of local data to WGS84 co-ordinates,
   - Calculation of the distances between original and Geoparser co-ordinates.

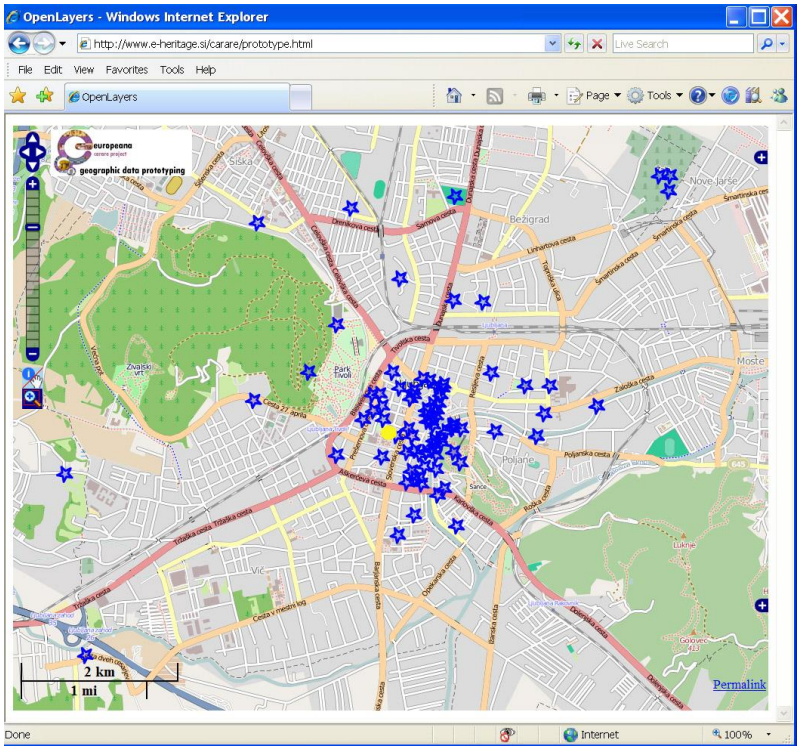
7. The graph below illustrates the distances between original and Geoparser co-ordinates (in metres).

Figure 1.Histogram of distances between original and Geoparser co-ordinates



8. The Geoparser found co-ordinates for 336 heritage sites. We should emphasize at this point that lots of heritages sites are actually small and unknown on conventional maps. We consider that these results are good for such straightforward testing and that Europeana Geoparsing service is useful tool for automatic retrieval of co-ordinates at this level of accuracy. If more information is passed to the Geoparser the results could be further improved. We can assess that Europeana Geoparsing Service is the right tool to assign large quantity of geographic co-ordinates to cultural heritage objects.

9. We reproduce print screen below from the CARARE prototype data in order to illustrate Ljubljana city found by Geoparser (yellow point) and cultural heritage sites in the city (blue stars).



10. Comparison of geoparsing tools[7]

Table 1: Summary of selected online geocoding services

Service name	**Company**	**Limitation of non-commercial Service**	**Service interface**	**Coverage**
Geocoder.us[8]	Locative Technologies	No limitation has been explicitly regulated in the license agreement	SOAP; XML-RPC; REST-CSY, RDF	USA
Google Maps geocoding service[9]	Google	15,000 requests per IP per day	IavaScript API; REST-CSY, ISON,orXML	Global

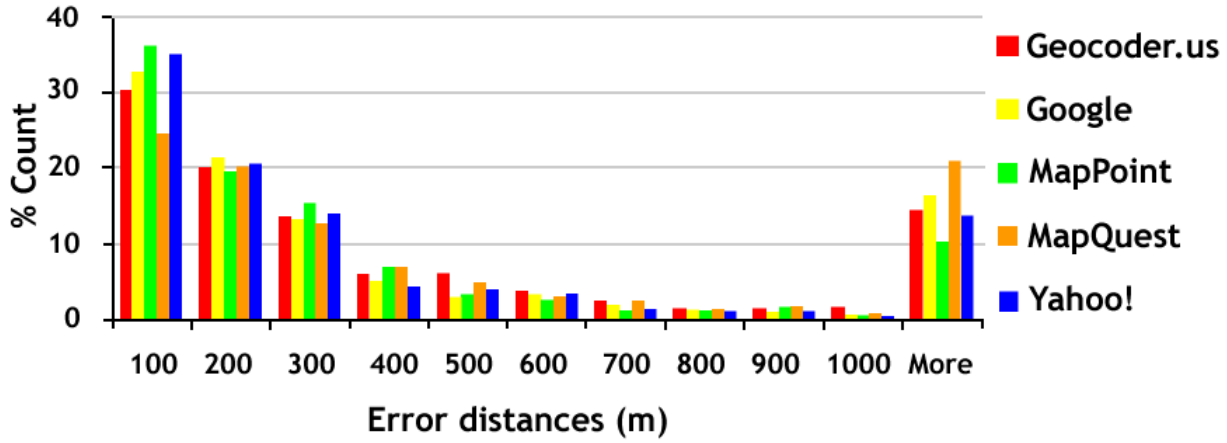
[7] Roongpiboonsopit D., Kmimi H.A. (2010). Comparative evaluation and analysis of online geocoding services. In: International Journal of Geographical Information Science, Vol. 24, No. 7-8, July-August 2010, p.1081-ll00

[8] http://geocoder.us/

MapPoint Web Services' FindAddress[10]	Microsoft	1000 transactions per day	SOAP	Global
MapQuest's geocoding serviced[11]	America Online, Inc. (AOL)	No limitation has been explicitly regulated in the license agreement	IavaScript API; REST-XML	Global
Yahoo! Maps' services - geocoding API[12]	Yahoo! Inc.	5000 queries per IP per day	RESTcXML	Global

Source: Roongpiboonsopit D., Kmimi H.A. (2010). Comparative evaluation and analysis of online geocoding services. In: International Journal of Geographical Information Science, Vol. 24, No. 7-8, July-August 2010, p.1081-ll00

Figure 1. The distribution of error distances computed between each geocoded point and its corresponding baseline for each service.



Source: Roongpiboonsopit D., Kmimi H.A. (2010). Comparative evaluation and analysis of online geocoding services. In: International Journal of Geographical Information Science, Vol. 24, No. 7-8, July-August 2010, p.1081-ll00

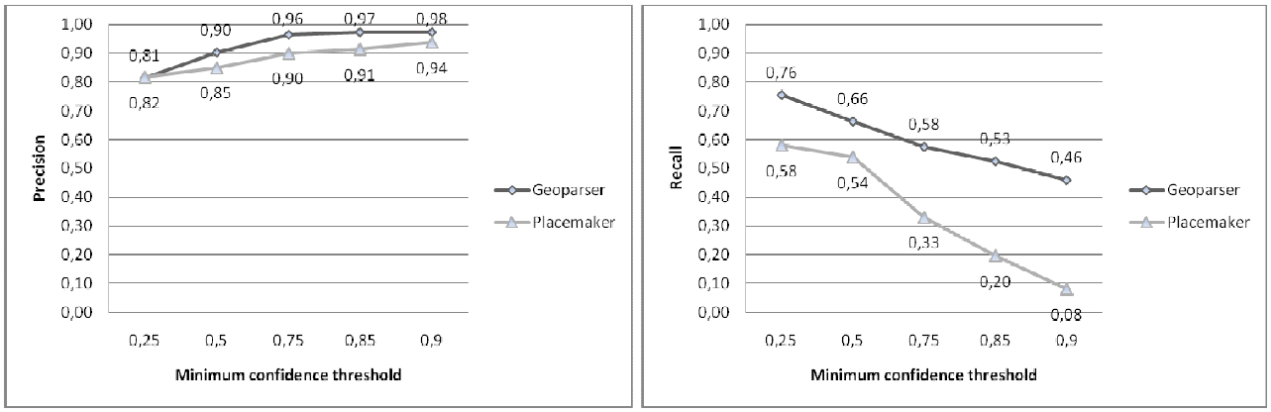
[9] http://code.google.com/apis/maps/documentation/services.html#Geocoding
[10] http://www.microsoft.com/mappoint/products/webservice/defauIt.mspx
[11] http://developer.mapquest.com/home
[12] http://developer.yahoo.com/maps/restN 1/geocode.htmI

11. Comparison of Europeana geoparser with Yahoo Placemaker[13]

We compared the results of the Geoparser against alternative solution Yahoo! Placemaker geoparser. For this comparison, the evaluation collection was geoparsed by both systems and the results compared against those off the manual annotations. The evaluation collection contains 2823 annotated place names. Also in this evaluation, the values of precision, recall, F1-measure and F0,5-measure where calculated. Analysis of the results shows that the Geoparser generally performed better on any confidence level than Placemaker.

Remarks:
- Precision is the percentage of correctly identified entities in all entities found.
- Recall is the percentage of entities found compared to all existing entities

Figure 2: Calculated values of precision and recall



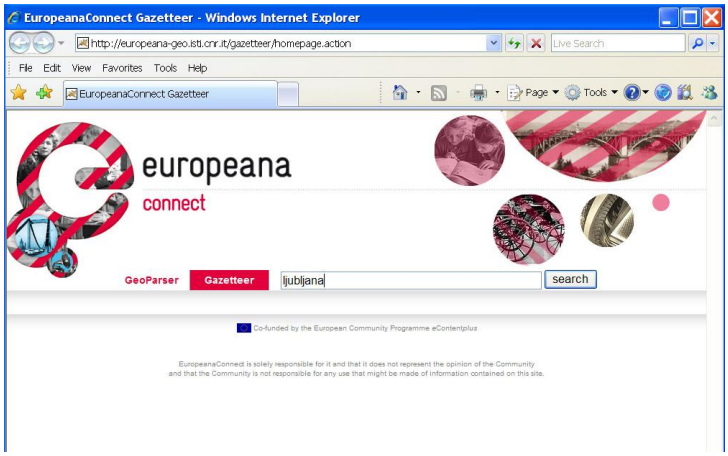
Source: Freire N., Soares A.: D5.5.1 – The Europeana Geoparser and Gazetteer: Documentation and final prototype, EuropeanaConnect, 1.9.2011

Links:
The Europeana Gazetteer Prototype: http://europeana-geo.isti.cnr.it/gazetteer/homepage.action
The EuropeanaConnect Geoparser Prototype: http://europeana-geo.isti.cnr.it/geoparser/Geoparsing

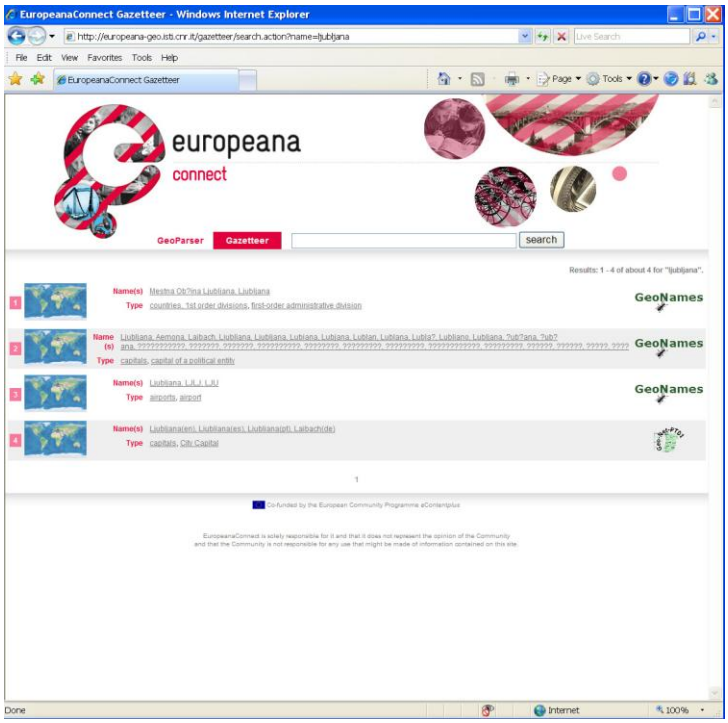
[13] Freire N., Soares A.: D5.5.1 – The Europeana Geoparser and Gazetteer: Documentation and final prototype, EuropeanaConnect, 1.9.2011

Appendix 2: **Testing of the Europeana Gazetteer**

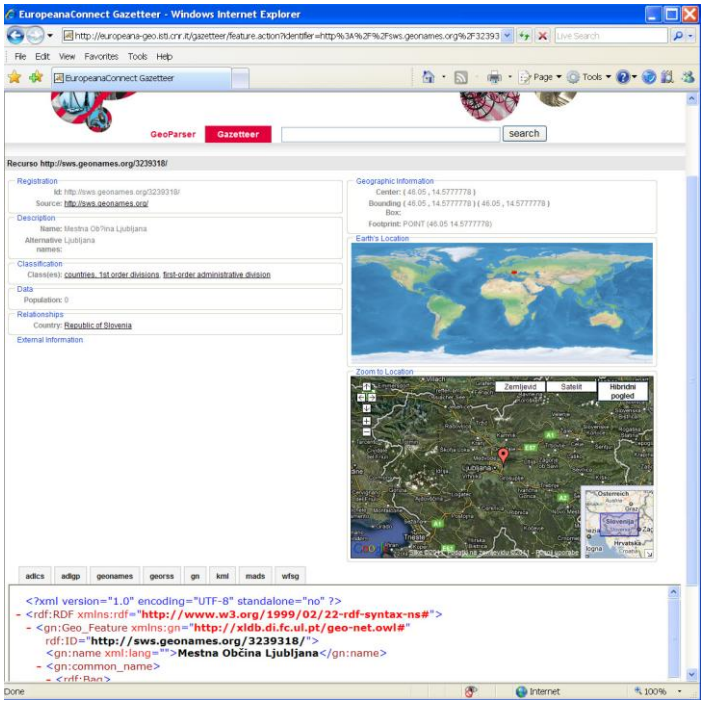
1. Geo-names was tested in December 2010. A simple user interface enables searches of the extensive database.



2. The search results displays as a list.



3. Besides the listing of search results, these can be displayed on the map (powered by Google map). Different output schemes are displayed for the keyword: adlcs: ADL Content schema, adlgp: ADL General Protocol, geo-names: Geo-names ontology, georss: Geo RSS (Really Simple Syndication), gn: GeoNet, kml: Keyhole Markup Language, mads: Metadata Authority Description Data, wfsg: OGC Web Gazetteer Service.



4. The data is accessible for download in tab-delimited text in UTF8 encoding.

5. The purpose of the analytical testing of Europeana gazetteer is to perform:
   - Some exercises in projection transformations from local coordinate systems WGS84,
   - Comparison of centroids of settlements from local source with ones in Europeana gazetteer.

6. Testing proceeded through following steps:
   - Import of Slovene Register of Settlements (6029 items),
   - Transformation of local data to WGS84 co-ordinates,
   - Matching local data with gazetteer by names,
   - Calculation of the distances between original and gazetteer co-ordinates.

7. The graphs below illustrate the distances between original and gazetteer co-ordinates (in metres).

Figure 3: Histogram of distances between original and gazetteer co-ordinates

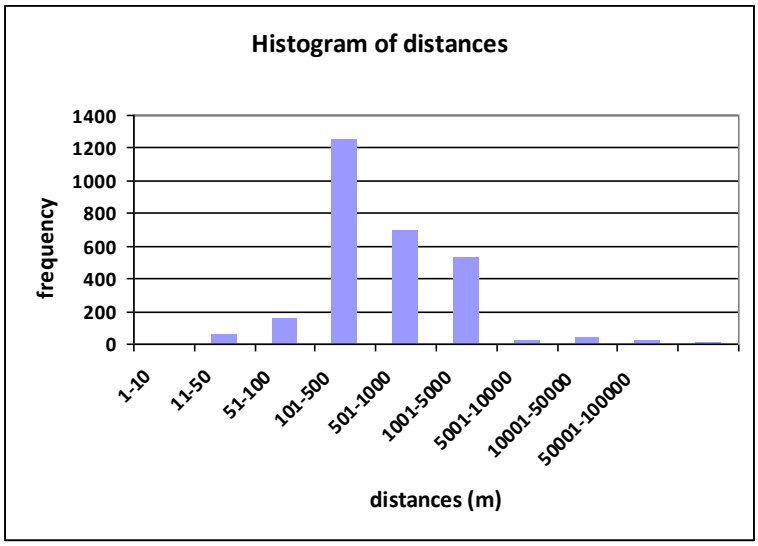
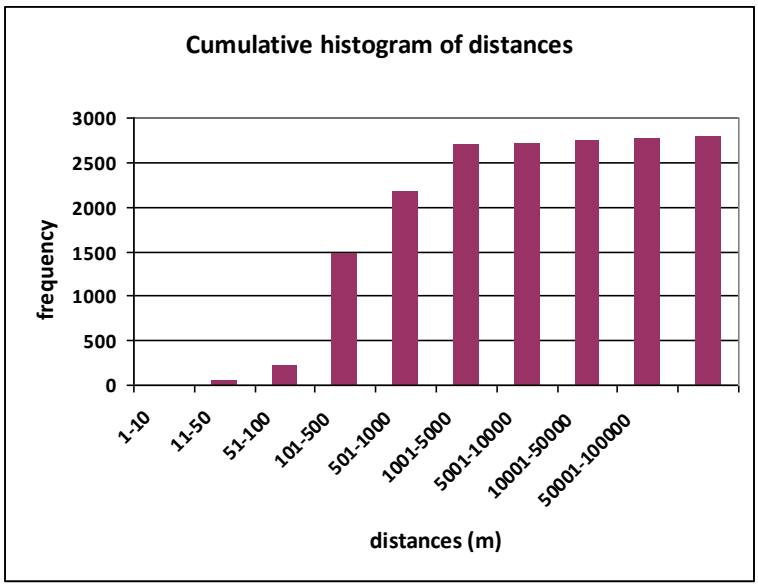


Figure 4: Histogram of cumulative distances between original and gazetteer co-ordinates

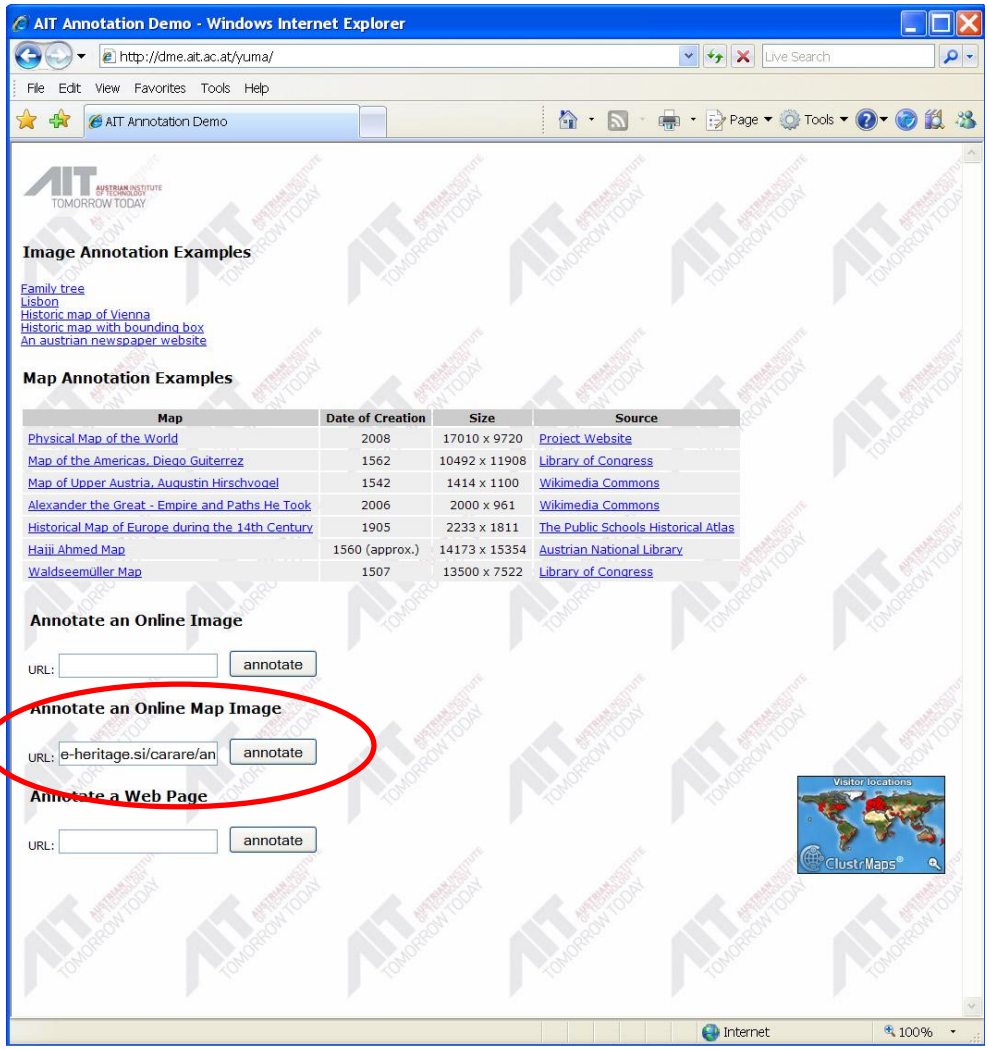


8. There are 2651 settlements matched in local register and Europeana Gazetteer. It is not surprising that not all settlements could be matched because there are a lot of small and also deserted settlements in Slovenia. We can asses that these results are actually good for such straightforward use and that Europeana gazetteer is useful database for finding out co-ordinates on this level of accuracy. This is the right tool to assign large quantity of geographic co-ordinates to geographic names of countries, counties, towns and other territorial units. The use of Europeana gazetteer is especially useful if a national register is not easily available.

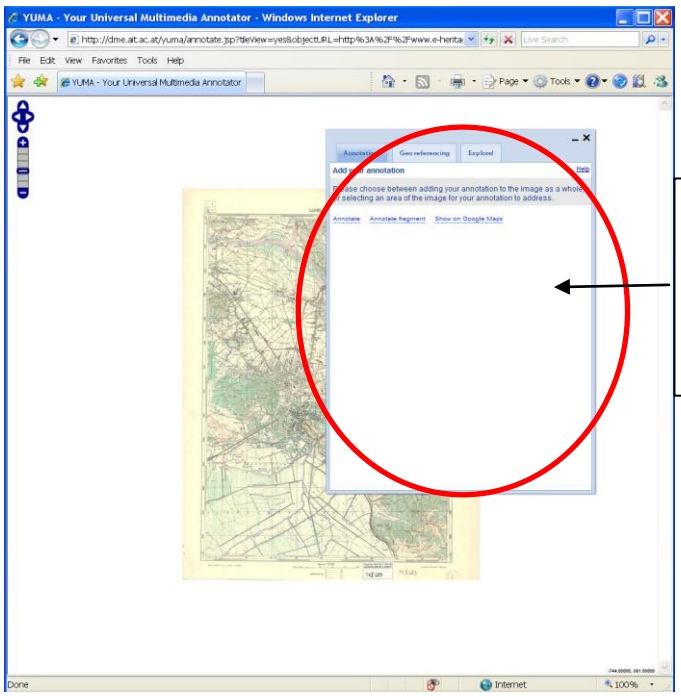
Appendix 3: **TESTING OF EUROPEANA*CONNECT* MEDIA ANNOTATION TOOL**

1. The Map Annotation tool was tested in January 2011. The tool enables to annotate video, images, audio and maps. For purpose of this report we have tested map annotation tool from the test portal available at http://dme.ait.ac.at/yuma. Ljubljana map *Ljubljana, 1951* has been selected for testing for CARARE Report.

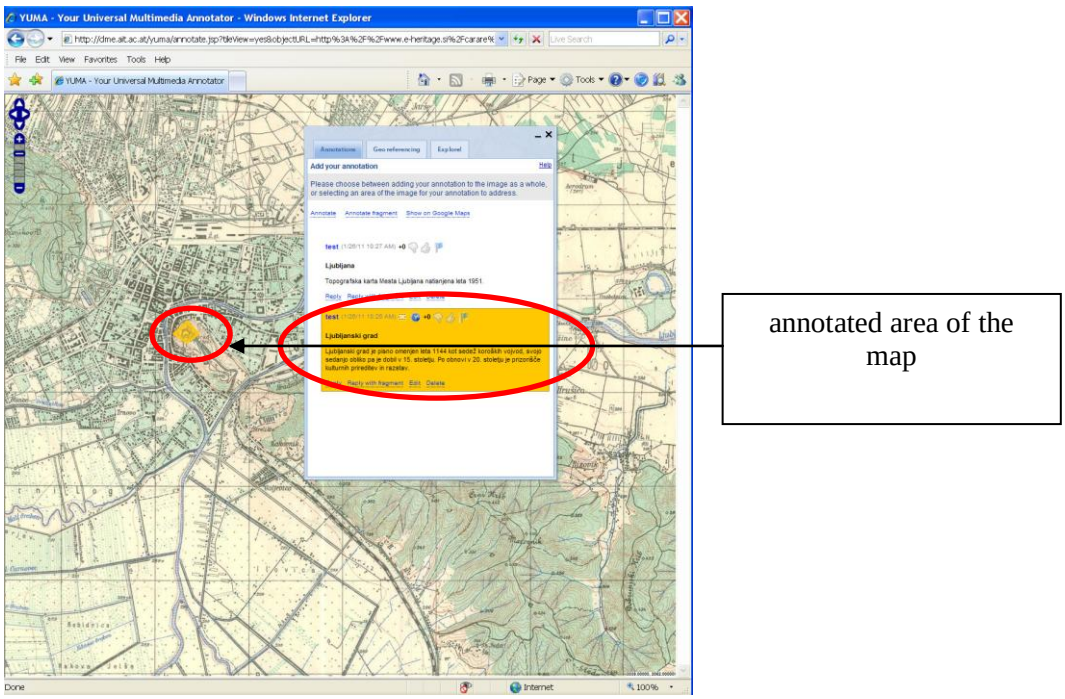
2. The map has been uploaded in the testing portal. The online user interface tool enables to upload the hyperlink where online image, map image or web page is located.



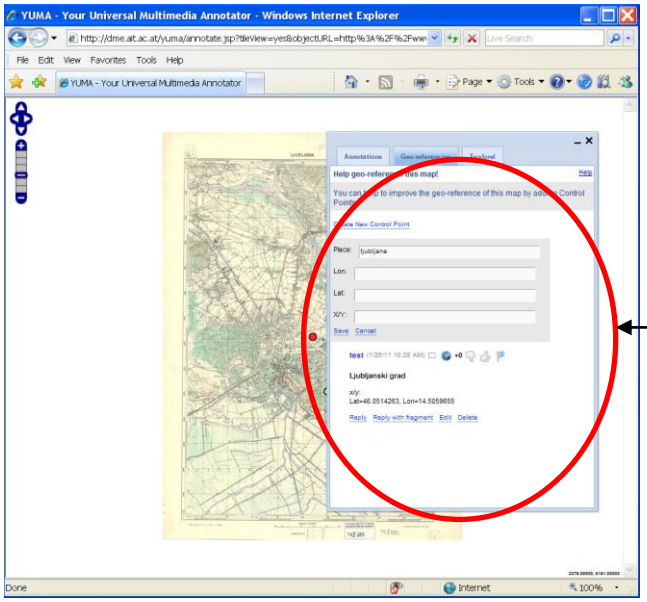
3. After uploading the information about the internet location of a map it opens with a pop – up annotation menu to add annotation and geo-reference the map.



4. We have annotated the Ljubljana Castle and the whole map of Ljubljana for testing purposes. The OpenLayers navigation menu enables users to zoom in, zoom out, and pan the online map. A polygon has to be drawn to annotate selected area. If not, the whole map is annotated instead. The annotations can be edited or deleted. Users can choose whether they are publicly available or not.



5. The annotation tool enables users to geo-reference the online map. It is connected with the geoparser. Users defines the control points, in our case Ljubljanski grad and Ljubljana and the tool retrieves the longitude and latitude of the location.



georeferencing menu of the annotation tool: creating a control point by write place name, longitude and latitude of the annotated location.

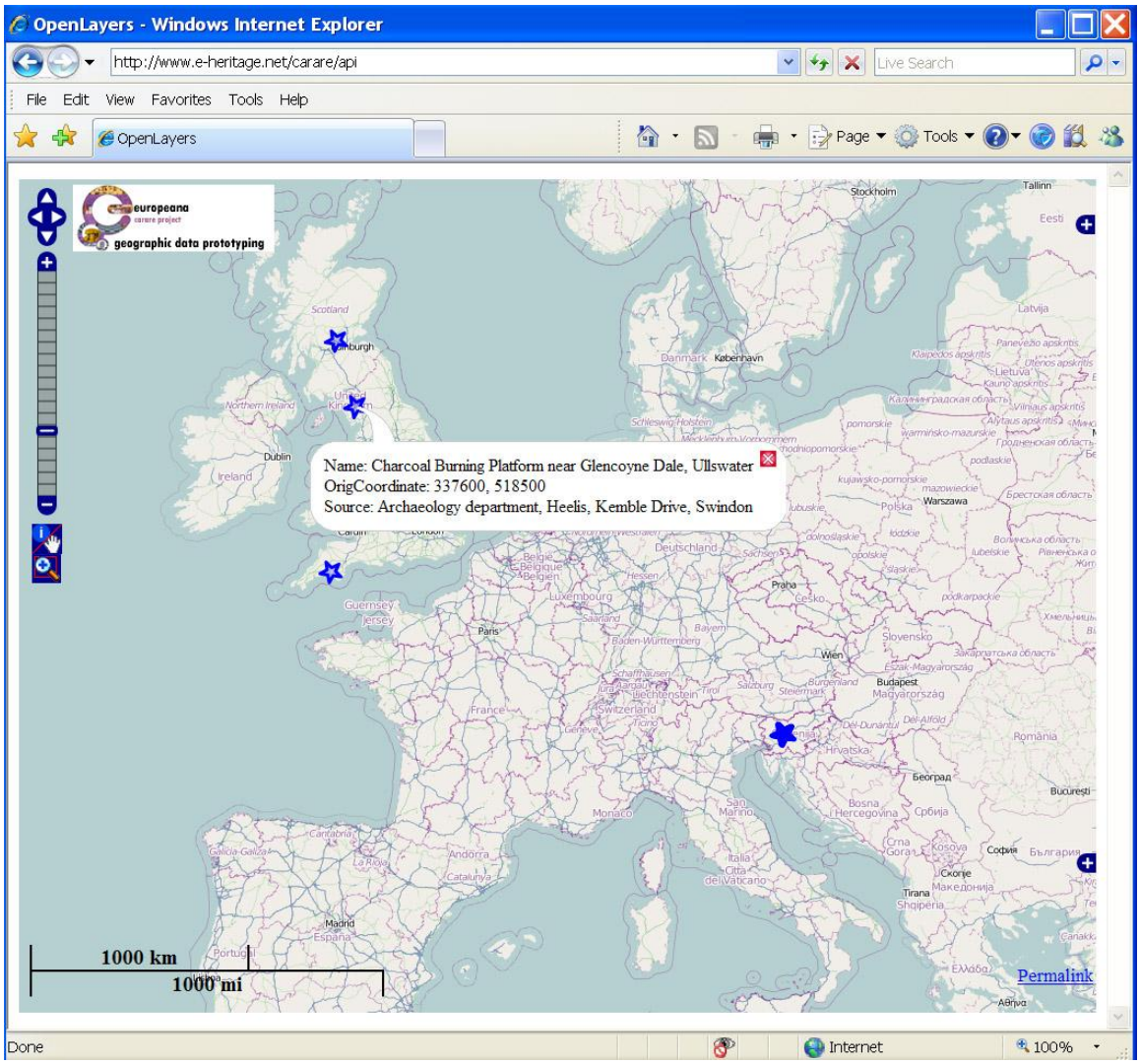
6. Annotations and georeferenced information are stored on the testing server. We upload the hyperlink of online map and we are able then to retrieve the map with annotations and georeference information.

Appendix 4: **TESTING OF OpenLayers API**

1. The main issue of testing the OpenLayers API is to test some samples of CARARE content in order to estimate the reliability of EPSG transformations and support next actions in related issues. We have employed this API for described purpose only. There was no intention to test the functionalities and graphic tools of the API.

2. We installed the Open Layers API on the server of IPCHS and made some relatively simple customisation of application. This was done in order to demonstrate some objects from CARARE prototype data.

   OpenLayers API with CARARE testing data



The above OpenLayers API with CARARE testing data is available online:
http://carare.eculturelab.eu

3. The basic intention of demonstration was to sample check:
   - Transformations with support of avahttp://carare.eculturelab.euilable EPSG parameters,
   - Object display on the OpenStreet base map.

4. Map projections used

Table 1: Map projections used when testing OF OpenLayers API

Use	EPSG	Comment	Link
Prototype data of Slovenia	EPSG:3787	Wrong parameters, corrected	www.spatialreferences.org
Prototype data of Great Britain	EPSG:27700	Proper parameters	http://www.spatialreferences.org/ref/epsg/27700/
Prototype data of Iceland	EPSG:3057	Proper parameters	http://www.spatialreferences.org/ref/epsg/3057/
	EPSG:900913	World Google projection: uses a close variant of the Mercator projection, it cannot show areas around the poles	
	EPSG:4326	World WGS84 projection	

The service /api/proj4js.js (http://proj4js.org/) performs transformation of co-ordinates for additional projections.

5. It is possible in theory that one feature in a projection can be transformed statically or on the fly, for example to ETRS89, with relevant accuracy. That is assumed only under condition that the projection is very well defined with all and precise parameters. However, this is not always the case in practice. Accurate transformation depends on the quality of projection parameters, basic maps used for digitalisation, documentation and official character of projections and transformations.

6. We would like to recommend cautious use of transformations. It is necessary to sample check if the transformed locations are correct.

   For example supposedly the "declared" projection for Slovenia is:

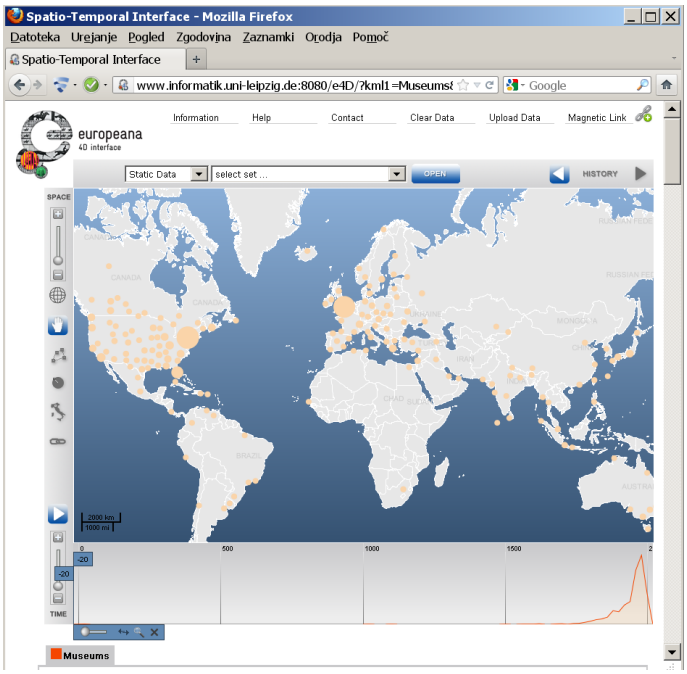
EPSG 3787
proj=tmerc +lat_0=0 +lon_0=15 +k=0.9999 +x_0=500000 +y_0=-5000000 +ellps=bessel +towgs84=577.326,90.129,463.919,5.137,1.474,5.297,2.4232 +units=m +no_defs

however the correct projection is:

EPSG 3787 corrected
Proj4js.defs["EPSG:3787"] = "+proj=tmerc +lat_0=0 +lon_0=15 +k=0.9999 +x_0=500000 +y_0=-5000000 +ellps=bessel +towgs84=426.620,142.62,460.09,4.98,4.49,-12.42,-17.1 +units=m +no_defs";

7. We suggest including in the demonstration referred to above as many prototype data from the CARARE project as possible.

8. **Europeana 4D**[14] is newly developed prototype of geo portal for displaying Europeana data in space and time. It has been presented at the EuropeanaTech Conference in Vienna, Austria, October 4-5 2011. 4D interface enables comparative visualization of multiple queries and supports data annotated with time span data. The prototype application is based on client-server architecture. The tool also supports multiple historical maps. Users can also use their own datasets with the Europeana 4D interface.



[14] Stockmann et al.: Europeana 4D Exploring data in space and time, EuropeanaTech conference, 4-5 Oct 2011, Austrian National Library, Vienna

The following software components have been used:

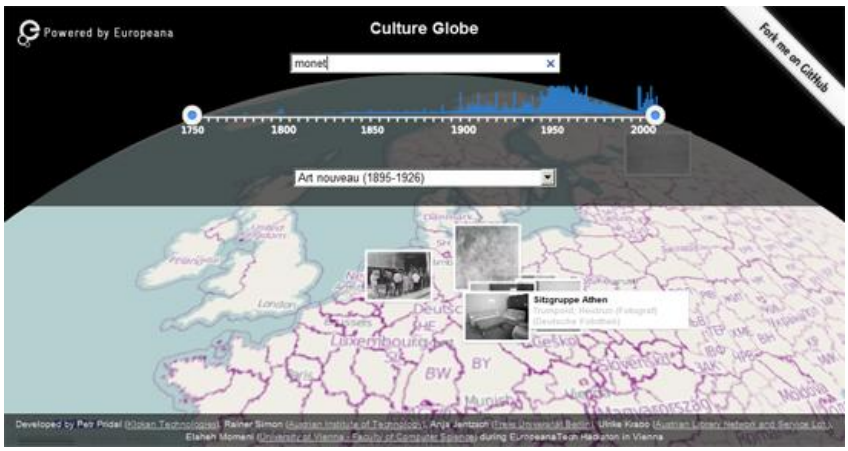
- OpenLayers
- Simile Timeline/Timeplot
- Geo-names (Geoparser...)
- Explorer Canvas (Google)
- GeoServer (OpenStreetmap, Google Maps)
- Google Web Toolkit (GWT)
- KML (XML).

Links:

- e4D info website: http://tinyurl.com/e4d-project
- Europeana thoughtLab: http://www.europeana.eu/portal/thoughtlab.html
- YouTube channel: http://www.youtube.com/user/europeana4D

9. **Culture Globe** allows for the spatio-temporal browsing through the Europeana metadata with a 3D globe visualization in a web browser. Cultutre Globe is open source and builds on open data. The main component is WebGL Earth.

   Culture Globe was developed by Petr Pridal (Klokan Technologies), Rainer Simon (Austrian Institute of Technology), Anja Jentzsch (Freie Universität Berlin), Ulrike Krabo (Austrian Library Network and Service Ldt.), Elaheh Momeni (University of Vienna - Faculty of Computer Science). Culture Globe won the EuropeanaTech2011 Hackathon competition.



Links:

- Culture globe demo: https://cultureglobe.github.com/
- Authors and description: http://www.wiwiss.fu-berlin.de/en/institute/pwo/bizer/news/EuropeanaTech2011Hackathon.html
- Presentation at EuropeanaTech 2011: http://www.youtube.com/watch?v=PdRG6HtLo0M
- Github repository: https://github.com/cultureglobe/

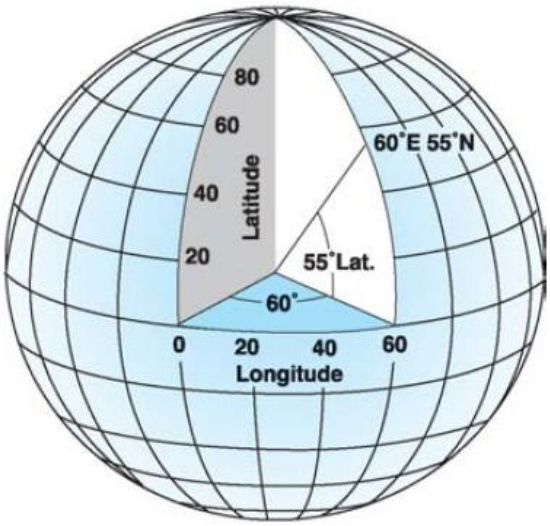
Appendix 5: **Introduction to Co-ordinate Systems**

1. Geographic Co-ordinate Systems[15]

A geographic co-ordinate system (GCS) uses a three-dimensional spherical surface to define locations on the earth. A GCS is often incorrectly called a datum, but a datum is only one part of a GCS. A GCS includes an angular unit of measure, a prime meridian, and a datum (based on a spheroid).

A point is referenced by its longitude and latitude values. Longitude and latitude are angles measured from the earth's centre to a point on the earth's surface. The angles often are measured in degrees (or in grads). The following illustration shows the world as a globe with longitude and latitude values.

Figure 1: Globe with longitude and latitude values



Source: Understanding map projections, GIS by ESRI, ESRI: Redlands, 2004

[15] Source: Understanding map projections, GIS by ESRI, ESRI: Redlands, 2004

2. Projected Co-ordinate Systems[16]

A projected co-ordinate system is defined on a flat, two-dimensional surface. Unlike a geographic co-ordinate system, a projected co-ordinate system has constant lengths, angles, and areas across the two dimensions. A projected co-ordinate system is always based on a geographic co-ordinate system that is based on a sphere or spheroid.

In a projected co-ordinate system, locations are identified by x, y co-ordinates on a grid, with the origin at the centre of the grid. Each position has two values that reference it to that central location. One specifies its horizontal position and the other its vertical position. The two values are called the x co-ordinate and the y co-ordinate. Using this notation, the co-ordinates at the origin are x = 0 and y = 0.

A map projection by itself is not enough to define a projected co-ordinate system. You can state that a dataset is in Transverse Mercator, but does not provide enough information. Where is the centre of the projection? Was a scale factor used? Without knowing the exact values for the projection parameters, the dataset can't be re-projected.

3. Geographic Transformation[17]

A geographic transformation is a mathematical operation that takes the co-ordinates of a point in one geographic co-ordinate system and returns the co-ordinates of the same point in another geographic co-ordinate system. There is also an inverse transformation to allow co-ordinates to be put back to the first co-ordinate system from the second. There are many different types of mathematical operations used to achieve this task.

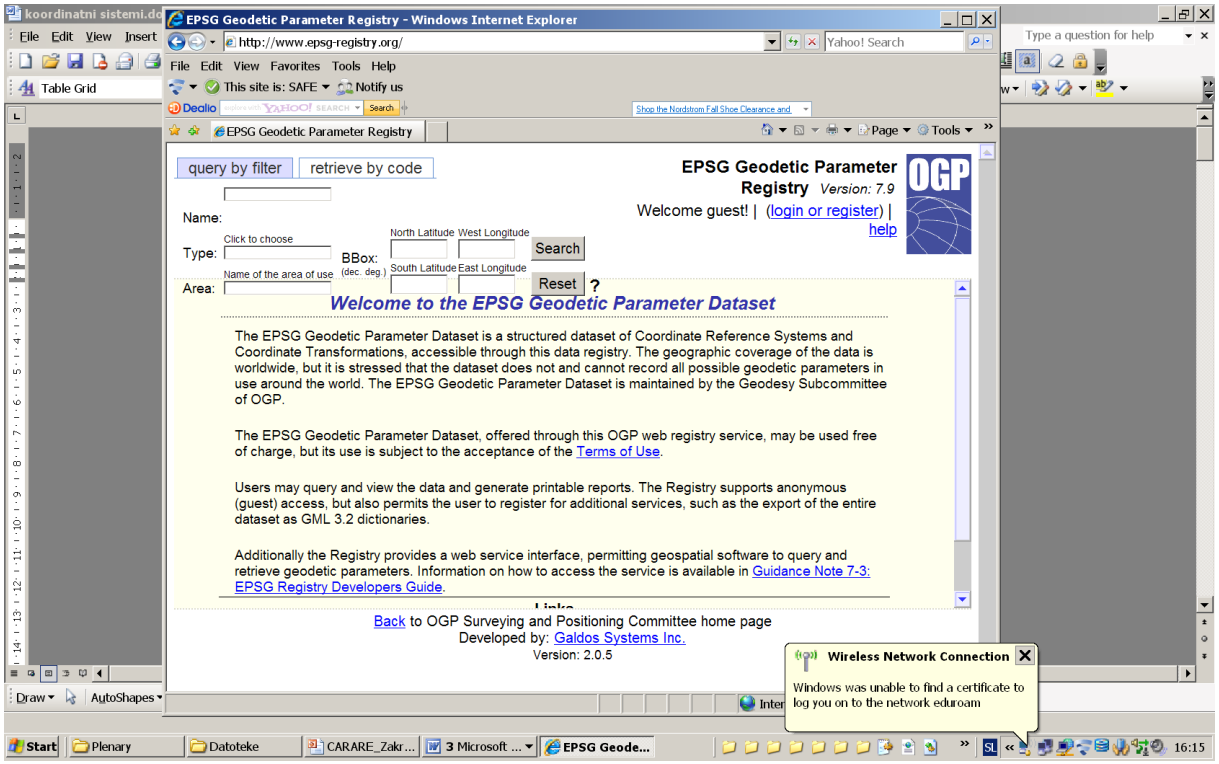
A geotransformation includes a name, two geographic co-ordinate systems (from and to), a method or type, and any parameters required for the method.

- AbridgedMolodenskyTransformation
- Co-ordinateFrameTransformation
- GeocentricTranslation
- HARNTransformation
- LongitudeRotationTransformation
- MolodenskyBadekasTransformation
- MolodenskyTransformation
- NADCONTransformation
- NTv2Transformation
- PositionVectorTransformation

[16] Ibidem
[17] Ibidem

4. European Petroleum Survey Group (EPSG)

The spatial reference identification system is defined by the European Petroleum Survey Group (EPSG) standard, which is a set of standards developed for cartography, surveying, and geodetic data storage. The EPSG Geodetic Parameter Dataset, or EPSG dataset, is maintained by the Geodesy Subcommittee of the Geomatics Committee of the International Association of Oil & Gas Producers (OGP). Version 7.9 of the EPSG Geodetic Parameter Dataset comprises of data corrections and updates to the v7.8 release of June 2011.[18]



[18] Source: http://www.epsg.org/

5. Examples of Co-ordinate Systems[19]

Name: WGS84
Dscription: WGS 84 is the reference co-ordinate system used by the Global Positioning System The co-ordinate origin of WGS 84 is meant to be located at the Earth's centre of mass; the error is believed to be less than 2 cm. In WGS 84, the meridian of zero longitude is the IERS Reference Meridian. It lies 5.31 arc seconds east of the Greenwich Prime Meridian, which corresponds to 102.5 metres (336.3 feet) at the latitude of the Royal Observatory. As of the latest revision, the WGS 84 datum surface is defined as an oblate spheroid (ellipsoid), with major (transverse) radius a = 6,378,137 m at the equator and flattening f = 1/298.257223563. The polar semi-minor (conjugate) radius b can be derived by b = a (1 - f) ≈ 6356752.3142 m. (This is a flattening of 21.384 685 755 km, or ≈ 0.335% in relative terms).
EPSGs: EPSG:4326", "EPSG:900913
Sources: http://en.wikipedia.org/wiki/World_Geodetic_System) http://en.wikipedia.org/wiki/Global_Positioning_System>.

[19] Source: http://spatialreference.org/

Name: ETRS89
Description: European Terrestrial Reference System 1989 (ETRS89) is used as the standard precise GPS co-ordinate system throughout Europe. ETRS89 is based on ITRS (the precise version of WGS84), except that it is tied to the European continent, and hence it is steadily moving away from the WGS84 co-ordinate system. In 2000, the difference between the ITRS (precise WGS84) co-ordinates of a point and the ETRS89 co-ordinates is about 25cm, and increasing by about 2.5 cm per year. ETRS89 is the EU-recommended frame of reference for geodata for Europe. It is the only geodetic datum to be used for mapping and surveying purposes in Europe. ETRS89, as well as WGS-84 and NAD-83, is based on the GRS80 ellipsoid.
EPSGs: EPSG:3346, EPSG:2176
Sources: http://www.ordnancesurvey.co.uk/oswebsite/gps/information/co-ordinatesystemsinfo/co-ordinatesystems.html http://en.wikipedia.org/wiki/European_Terrestrial_Reference_System_1989

Name: Transverse Mercator projection (Gauss–Krüger coordinate system)
Description: The transverse version is widely used in national and international mapping systems around the world, including the UTM. When paired with a suitable geodetic datum, the transverse Mercator delivers high accuracy in zones less than a few degrees in east-west extent. Since the central meridian of the transverse Mercator can be chosen at will, it may be used to construct highly accurate maps (of narrow width) anywhere on the globe. The secant, ellipsoidal form of the transverse Mercator is the most widely applied of all projections for accurate large scale maps. The ellipsoidal form of the transverse Mercator projection was developed by Carl Friedrich Gauss in 1825 and further analysed by Johann Heinrich Louis Krüger in 1912. The projection is known by several names: Gauss Conformal or Gauss-Krüger in Europe; the transverse Mercator in the US; or Gauss-Krüger transverse Mercator generally. The projection is conformal with a constant scale on the central meridian. (There are other conformal generalisations of the transverse Mercator from the sphere to the ellipsoid but only Gauss-Krüger has a constant scale on the central meridian.) Throughout the twentieth century the Gauss-Krüger transverse Mercator was adopted, in one form or another, by many nations (and international bodies); in addition it provides the basis for the Universal Transverse Mercator series of projections. The Gauss-Krüger projection is now the most widely used projection in accurate large scale mapping.
EPSGs: EPSG:2175, EPSG:2311
Sources: http://en.wikipedia.org/wiki/Transverse_Mercator http://en.wikipedia.org/wiki/Transverse_Mercator

Name: Spherical Mercator
Description: Spherical Mercator is a de facto term used inside the OpenLayers community – and also the other existing Open Source GIS community – to describe the projection used by Google Maps, Microsoft Virtual Earth, Yahoo Maps, and other commercial API providers. This term is used to refer to the fact that these providers use a Mercator projection which treats the earth as a sphere, rather than a projection which treats the earth as an ellipsoid. General features of the spherical transverse Mercator in constructing a map on any projection, a sphere is normally chosen to model the earth when the extent of the mapped region exceeds a few hundred kilometers in length in both dimensions. For maps of smaller regions, an ellipsoidal model must be chosen if greater accuracy is required; see next section. The spherical form of the transverse Mercator projection was one of the seven 'new' projections presented, in 1772, by Johann Heinrich Lambert.
EPSGs: EPSG:900913, EPSG:3857, EPSG:102113
Sources: http://docs.openlayers.org/library/spherical_mercator.html http://en.wikipedia.org/wiki/Transverse_Mercator_projection#General_features_of_the_spherical_transverse_Mercator

EXAMPLES OF EPSG PROJECTIONS

```
// EPSG:3787 MGI / Slovene National Grid, Area: Slovenia
    // Example: var point = new OpenLayers.Geometry.Point(461959,101120).transform(new
OpenLayers.Projection("EPSG:3787"), new OpenLayers.Projection("EPSG:900913"));
                    Proj4js.defs["EPSG:3787"] = "+proj=tmerc +lat_0=0 +lon_0=15 +k=0.9999 +x_0=500000
+y_0=-5000000 +ellps=bessel +towgs84=426.620,142.62,460.09,4.98,4.49,-12.42,-17.1 +units=m +no_defs";
```

```
// EPSG:27700 OSGB 1936 / British National Grid, Area: UK - Great Britain onshore; Isle of Man
        Proj4js.defs["EPSG:27700"] = "+proj=tmerc +lat_0=49 +lon_0=-2 +k=0.9996012717 +x_0=400000
+y_0=-100000 +ellps=airy +datum=OSGB36 +units=m +no_defs";
```

```
// EPSG:3057 ISN93 / Lambert 1993, Area: Iceland
        Proj4js.defs["EPSG:3057"] = "+proj=lcc +lat_1=64.25 +lat_2=65.75 +lat_0=65 +lon_0=-19
+x_0=500000 +y_0=500000 +ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs";
```

```
// EPSG:32633 WGS 84 / UTM zone 33N, Area: World - N hemisphere - 12°E to 18°E - by country
        Proj4js.defs["EPSG:32633"] = "+proj=utm +zone=33 +ellps=WGS84 +datum=WGS84 +units=m
+no_defs";
```

```
// EPSG:4326 WGS 84, Area: World
```

```
// EPSG:900913 Spherical Mercator projection (also EPSG:3857)
```

Appendix 6: **Examples of INSPIRE Specifications**[20]

1. INSPIRE Scope

Table 1: INSPIRE scope

Annex I	**Annex II**	**Annex III**
• Coordinate reference systems • Geographical grid systems • Geographical names • Administrative units • Addresses • Cadastral parcels • Transport networks • Hydrography • Protected sites	• Protected sites • Elevation • Land cover • Orthoimagery • Geology	• Geology • Statistical units • Buildings • Soil • Land use • Human health and safety • Utility and governmental services • Production and industrial facilities • Agricultural and aquaculture facilities • Population distribution — demography • Area management/restriction/regulation zones and reporting units • Natural risk zones • Atmospheric conditions • Meteorological geographical features • Oceanographic geographical features • Sea regions • Bio-geographical regions • Habitats and biotopes • Species distribution • Energy resources • Mineral resources

[20] INSPIRE WEB portal http://inspire.jrc.ec.europa.eu/, INSPIRE geoportal http://inspire-geoportal.ec.europa.eu/

2. INSPIRE Implementation Rules

To ensure that the spatial data infrastructures of the Member States are compatible and usable in a Community and trans-boundary context, the Directive requires that common Implementation Rules (IR) are adopted in a number of specific areas:

- Metadata
- Data Specifications
- Network Services
- Data and Service Sharing
- Monitoring and Reporting

3. INSPIRE Specification on Co-ordinate Reference Systems

Table 2: Selected INSPIRE requirements

Requirement 1 For the three-dimensional and two-dimensional (horizontal component), the European Terrestrial Reference System 1989 (ETRS89) shall be used for the areas within the geographical scope of ETRS89.
Requirement 2 The International Terrestrial Reference System (ITRS) or other geodetic coordinate reference systems compliant with ITRS shall be used in areas that are outside the geographical scope of ETRS89.
Requirement 3 For the computation of latitude, longitude and ellipsoidal height, and for the computation of plane co-ordinates using a suitable mapping projection, the parameters of the GRS80 ellipsoid shall be used.
Requirement 4 For representation with plane co-ordinates one of the Lambert Azimuthal Equal Area (ETRS89-LAEA), the Lambert Conformal Conic (ETRS89-LCC) or the Transverse Mercator (ETRS89-TMzn) projection shall be used.

4. INSPIRE Implementation Rules for Metadata

The following section describes the INSPIRE metadata elements briefly as specified by the INSPIRE Implementation Rules for Metadata. The elements are ordered in broader categories:

- Identification
- Classification of spatial data and services
- Keyword
- Geographic location
- Temporal reference
- Quality and validity
- Conformity
- Constraints related to access and use
- Organizations responsible for the establishment, management, maintenance and distribution of spatial data sets and services.
- Metadata on metadata

5. INSPIRE Data Specification on Addresses

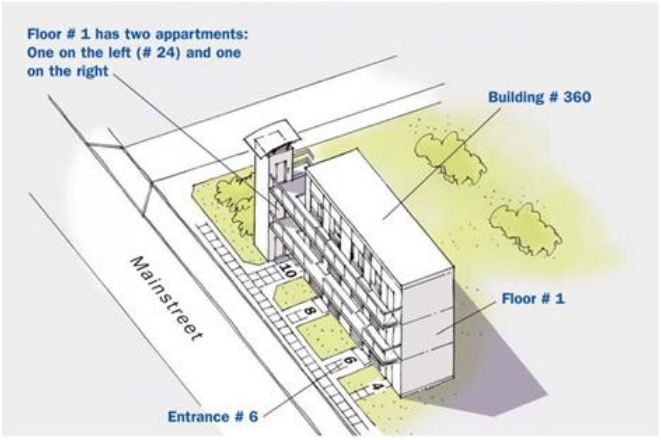


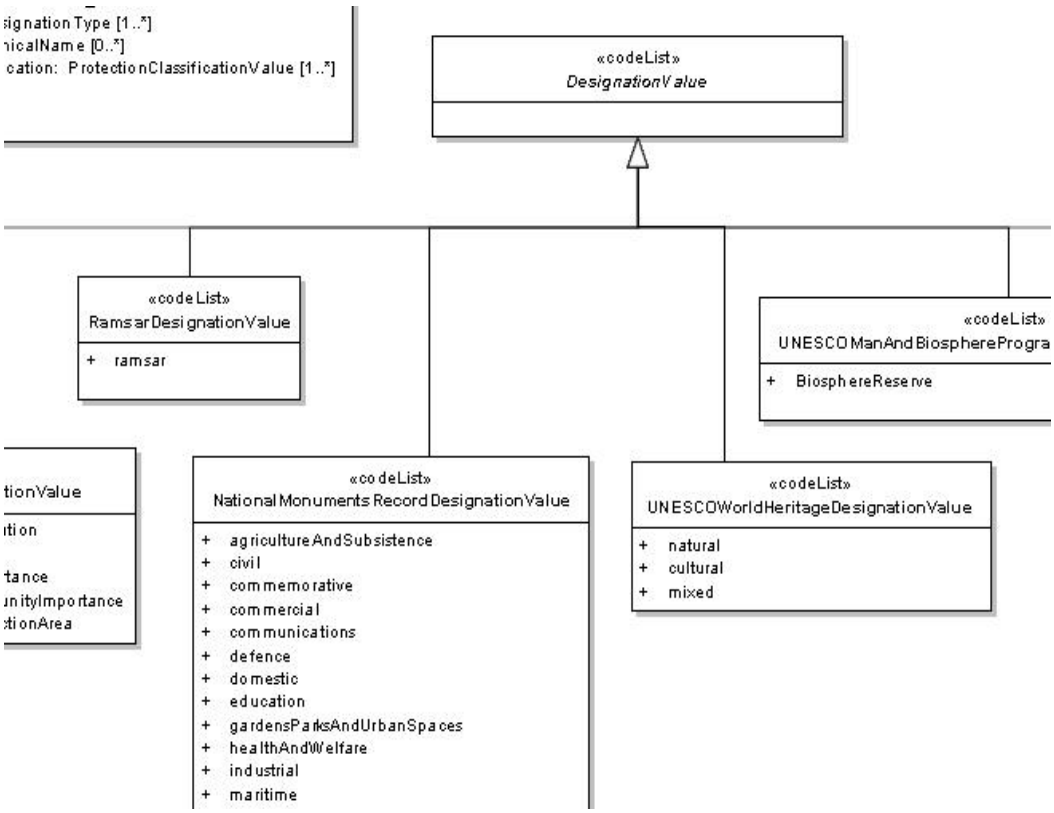
Figure 2. Data specification on address

Sweden	**Denmark**	**United Kingdom**
Mainstreet 6 1101 12345 Farsta	Mainstreet 6 1 TV 2400 København NV	Flat 1A 6, Mainstreet Fairfield Wandsworth London SW18 1ED
The Netherlands	**Belgium (Flanders)**	**Germany**
Mainstreet 24 2500 AA Den Haag	Mainstreet 6 bus 3 2140 Antwerpen	Mainstreet 6 67 433 Kelkheim
Spain	**Czech Republic**	
Mainstreet 6 left 1 1 Cortijo del Marqués 41037, Écija (Sevilla)	Mainstreet 360/6 Chodov 149 00 Prague 41	

6. INSPIRE Data Specification on Protected Sites

	Examples of Protected Site exclusions and inclusions	
	In this theme	**Not in this theme**
	• protected archaeological sites; • protected buildings; • salmonid and cyprinid waters (Fresh Water Fish Directive); • shellfish growing waters (Shellfish Growing Waters Directive).	• restricted areas around drinking water sources (Water Framework Directive); • nitrate-vulnerable zones (Nitrates Directive); • dumping sites; • noise reduction zones;
		• planning and land use controls; • prospecting and mining permit areas; • river basin districts;
		• coastal zone management areas; • bathing waters (Bathing Waters Directive);
Application schemas	The INSPIRE data specification on *Protected sites* includes three application schemas:	

Figure 3. Data Specification on Protected Sites



Source: INSPIRE Data Specification on Protected sites – Guideline, INSPIRE Thematic Working Group Protected sites, 2009

```
<sld:NamedLayer>
   <se:Name>PS.ProtectedSites</se:Name>
   <sld:UserStyle>
    <se:Name>PS.ProtectedSite.Default</se:Name>
    <sld:IsDefault>1</sld:IsDefault>
    <se:FeatureTypeStyle version="1.1.0" xmlns:PS="urn:x-
inspire:specification:ProtectedSites:3.1">
      <se:Description>
       <se:Title>Protected Sites Default Style</se:Title>
       <se:Abstract>Point geometries are rendered as a square with a size of 6 pixels, with a 50%
grey (#808080) fill and a black outline. Line geometries are rendered as a solid black line with a
stroke width of 1 pixel. Polygon geometries are rendered using a 50% grey (#808080) fill and a
solid black outline with a stroke width of 1 pixel.</se:Abstract>
      </se:Description>
      <se:FeatureTypeName>PS:ProtectedSite</se:FeatureTypeName>
      <se:Rule>
       <se:PolygonSymbolizer>
        <se:Geometry>
         <ogc:PropertyName>PS:geometry</ogc:PropertyName>
        </se:Geometry>
       </se:PolygonSymbolizer>
       <se:LineSymbolizer>
        <se:Geometry>
         <ogc:PropertyName>PS:geometry</ogc:PropertyName>
        </se:Geometry>
       </se:LineSymbolizer>
       <se:PointSymbolizer>
        <se:Geometry>
         <ogc:PropertyName>PS:geometry</ogc:PropertyName>
        </se:Geometry>
       </se:PointSymbolizer>
      </se:Rule>
    </se:FeatureTypeStyle>
   </sld:UserStyle>
```

Source: INSPIRE Data Specification on Addresses – Guidelines, INSPIRE Thematic Working Group Addresses, 2009

Appendix 7: **CULTURAL SPOT FEATURES IN GEO-NAMES**

Table 1: Spot features in World

Spot Features (spot, building, farm, …) in World			
226.525	S.CH	church	a building for public Christian worship
224.211	S.SCH	school	building(s) where instruction in one or more branches of knowledge takes place
163.893	S.FRM	farm	a tract of land with associated buildings devoted to agriculture
133.714	S.CMTY	cemetery	a burial place or ground
93.517	S.BLDG	building(s)	a structure built for permanent use, as a house, factory, etc.
83.878	S.null		
82.868	S.HTL	hotel	a building providing lodging and/or meals for the public
60.814	S.DAM	dam	a barrier constructed across a stream to impound water
50.653	S.RSTN	railroad station	a facility comprising ticket office, platforms, etc. for loading and unloading train passengers and freight
38.414	S.MN	mine(s)	a site where mineral ores are extracted from the ground by excavating surface pits and subterranean passages
31.244	S.PO	post office	a public building in which mail is received, sorted and distributed
30.715	S.FRMT	farmstead	the buildings and adjacent service areas of a farm
23.548	S.CMP	camp(s)	a site occupied by tents, huts, or other shelters for temporary use
. . . .			
1.587.983	**Total spot features of about 8.000.000 all features in Geo-names**		

Source: processed by authors from www.geo-names.org

Table 2: Spot Features in World strongly connected to cultural heritage

Spot Features in World strongly connected to cultural heritage			
2.249	S.ANS	ancient site	a place where archaeological remains, old structures, or cultural artefacts are located
1.005	S.HSTS	historical site	a place of historical importance
539	S.MNMT	monument	a commemorative structure or statue
20	S.PYR	pyramid	an ancient massive structure of square ground plan with four triangular faces meeting at a point and used for enclosing tombs
6	S.WALLA	ancient wall	the remains of a linear defensive stone structure
3	S.PYRS	pyramids	ancient massive structures of square ground plan with four triangular faces meeting at a point and used for enclosing tombs
3.822	**Total - cultural heritage of all 1.587.983 spots features**		

Source: processed by authors from www.geo-names.org

Table 3: Spot Features in France strongly connected to cultural heritage

Spot Features in France strongly connected to cultural heritage			
18	S.MNMT	monument	a commemorative structure or statue
14	S.HSTS	historical site	a place of historical importance
4	S.ANS	ancient site	a place where archaeological remains, old structures, or cultural artefacts are located
36	**Total - cultural heritage**		

Source: processed by authors from www.geo-names.org

Appendix 8: **CARARE INVENTORIES**

Provider Name	Country	Collection Name	Collection Size
Direction des Monuments et des Sites, Ministère de la Région de Bruxelles-Capitale	Belgium	Inventory of Archaeological Sites	5000
Direction des Monuments et des Sites, Ministère de la Région de Bruxelles-Capitale	Belgium	Register of Protected Monuments and Sites	4558 digital objects
Direction des Monuments et des Sites, Ministère de la Région de Bruxelles-Capitale	Belgium	Inventory of the build heritage in the Brussels Capital Region	55170 objects
Narodni pamatkovy ustav	Czech	Metainformační systém (MIS)	110000
Heritage Agency of Denmark	Denmark	Fund og Fortidsminder (Site and Monuments Record)	182.000 sites
Heritage Agency of Denmark	Denmark	Fredede og Bevaringsværdige Bygninger (Danish Buildings)	Approx. 4 millions buildings, of which approx. 7000 are listed. Approx. 84,000
Ministry of Culture, Estonia	Estonia	Register of Monuments: archaeological, architectural monuments	13158
Archaeological Heritage Agency,	Iceland	Excavations in Iceland	200 records
Archaeological Heritage Agency, Iceland	Iceland	Listed houses in Iceland	406 records 300 images
Heritage Malta	Malta	Prehistoric Collection	8800 objects
Cultural Heritage Agency, The Netherlands	Netherlands	Dataset of State Monuments	61000
Cultural Heritage Agency, The Netherlands	Netherlands	Archeologische Monumenten Kaart (AMK)	13000
Cultural Heritage Agency, The Netherlands	Netherlands	MACHU: Mapping Cultural Heritage Underwater	> 1000
Erfgoed nederland	Netherlands	Top archives Netherlands Architecture Institute	30.000 objects
Data Archiving and Networked Services	Netherlands	e-archive for Dutch Archaeology (EDNA)	12.000 datasets
National Heritage Board of Poland	Poland	Archaeological sites	427
National Heritage Board of Poland	Poland	Historic Monuments in Poland/Treasures of National Heritage	487 related to 37 monuments
National Heritage Board of Poland	Poland	Castles	100
Institutul de Memorie Culturala	Romania	National Archaeological Record (Repertoriul Arheologic Național -	10000

		RAN)	
Ministry of culture, Slovenia	Slovenia	Cultural monuments of Slovenia	7000
Swedish Open Cultural Heritage / Riksantikvarieambetet	Sweden	Ancient monuments and historical buildings in Sweden	1000000
University of York (ADS)	United Kingdom	The Urban Landscapes of Ancient Merv, Turkmenistan	2163
University of York (ADS)	United Kingdom	ADS Excavation Archives	250000

Source: CARARE Survey WP2