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Digital Humanities tools for linking historical maps collections: A case study from the British School at Athens

Keywords: digital humanities, map, linked open data

Summary: The British School at Athens (BSA) holds a collection of over 1500 maps from the 18th century to the present day. The collection is predominantly based on army reconnaissance starting with the Austrian Staff Maps from the 19th century, followed by the British Army maps of Greece from the 1st and 2nd World Wars, culminating in the recent Greek Army maps. The collection includes the British Admiralty Charts form the 19th century and subject specific maps such as geology. Currently, a set of tools and methodologies from the digital humanities community are being explored in order to support the linking of the digital cartographic material with other digital resources of the School and the web publishing of data. This paper presents the first results of this attempt that has as ultimate goal to highlight the value of linked open data in enhancing the search capabilities of a digital collection and in promoting it to the wider public in an alternative more flexible manner.

The historical maps collection of the BSA

The British School at Athens has a map collection that consists of over 1500 sheets dating from the 18th to the late 20th century. The older and rarer maps were collected by the Scottish philhellene George Finlay (1799-1875), whose collection of books, maps and pamphlets was left to the BSA in 1899 forming the core of the library. Other old maps came from former BSA director Humfry Payne (1902-1936) and various School members.

Although the BSA Map Collection includes several commercial maps, it is predominantly based on army reconnaissance starting with the French and Austrian Staff Maps from the 19th century, followed by the British Army maps of the 20th century and culminating in recent Greek Army maps. The collection also includes British Admiralty Charts form the 19th century, commercial maps and map series, thematic maps, historical atlases and miscellaneous cartographic related material. Most of this material came from individual donations and some more recent Greek Army maps were purchased by the BSA to offer a complete coverage of the Greek grounds.

Geographically the maps cover mostly Greece and Asia Minor, although the collection also includes maps from the broader Mediterranean Region, the Balkans and Northern Europe including an 1858 map of Switzerland from Finlay's collection.

Maps have always been important to archaeologists, as they allow them to locate sites. Archaeology was central to the BSA research since the School's foundation in 1886 and therefore the maps must have played an important role in facilitating excavations and field work. Before the availability of detailed Greek Army maps and the introduction of GPS systems, British WWII staff maps were the primary cartographic resource to facilitate archaeological work.

The first documented attempt to organize the map collection goes back to 1952-53, when the BSA Assistant Director and Librarian, John Boardman separated the maps into sections beginning with

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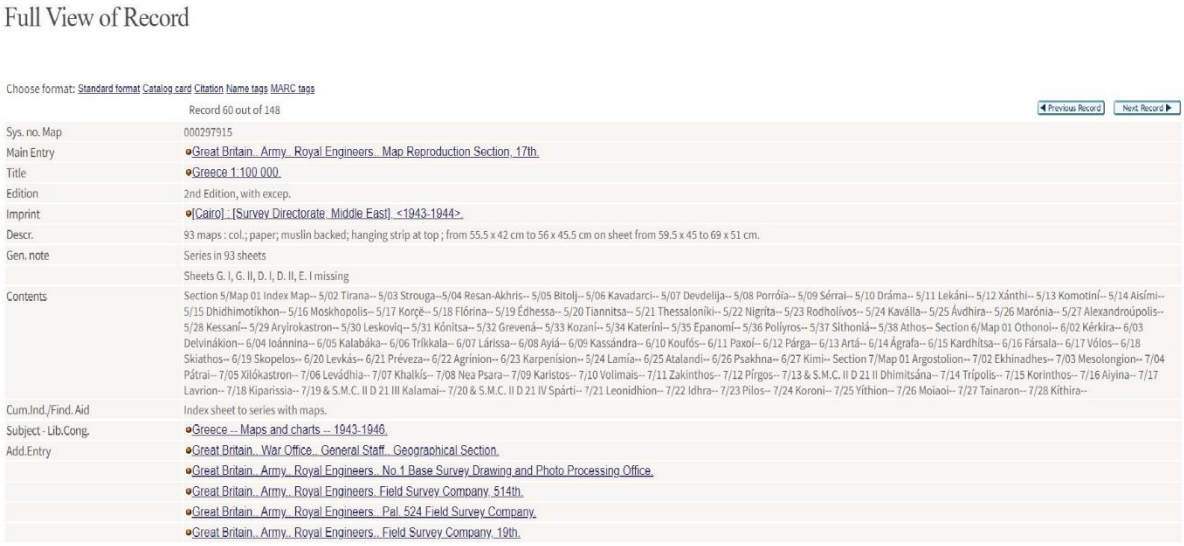
the British staff maps, British Admiralty charts and the British Intelligence maps of Turkey, which formed the three main sections. He organized the rest of the maps by geographical location and special themes (e.g., geological maps). The older maps consist a separate category marked as "rare maps" and follow the old library classification. Maps that were accessed after Broadman's time, such as an extra set of admiralty charts presented by P. de Jong in 1954 and the Hellenic Army maps of 1969-1977 followed the same classification scheme.

A basic classification accompanied with a typewritten catalog worked for several years, but it eventually became clear that there was a need for a more efficient system that would offer better search facilities. Therefore, in 2017 the entire map collection was catalogued in the library automation system ALEPH500 using MARC21 coding and AACR2 (Figure 1). The maps are visible on the Union Catalogue AMBROSIA[1], which is shared between the BSA library and the American School of Classical Studies in Athens library catalogs (Gennadius and Blegen) (Figure 2). The maps were not catalogued one by one, instead they were catalogued by sets of maps. This allows searching, but one has to know they have to consult the contents field and the holdings to locate the map they are interested in.



Full View of Record

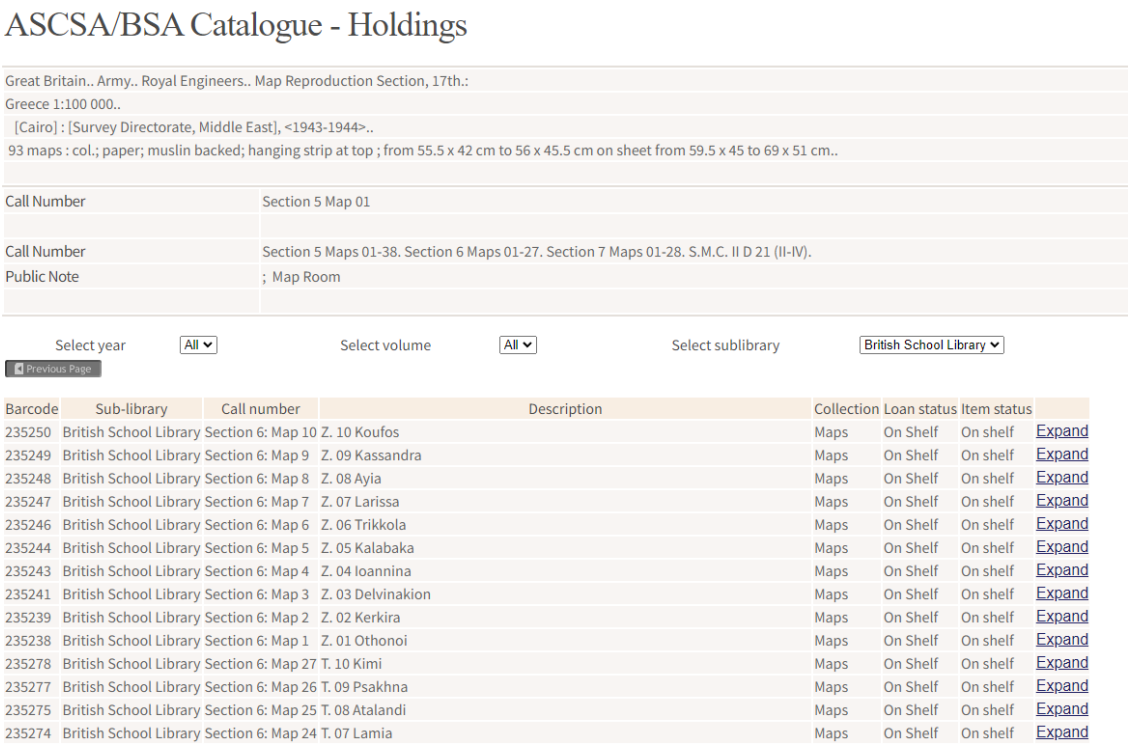
Choose format: Standard format Catalog card Citation Name tags MARC tags

Record 60 out of 148 ◀ Previous Record Next Record ▶

Sys. no. Map	000297915
Main Entry	Great Britain. Army. Royal Engineers. Map Reproduction Section, 17th.
Title	Greece 1:100 000.
Edition	2nd Edition, with excep.
Imprint	[Cairo] : [Survey Directorate, Middle East], <1943-1944>.
Descr.	93 maps : col.; paper; muslin backed; hanging strip at top ; from 55.5 x 42 cm to 56 x 45.5 cm on sheet from 59.5 x 45 to 69 x 51 cm.
Gen. note	Series in 93 sheets
	Sheets G. I, G. II, D. I, D. II, E. I missing
Contents	Section 5/Map 01 Index Map-- 5/02 Tirana-- 5/03 Strouga--5/04 Resan-Akhris-- 5/05 Bitolj-- 5/06 Kavadarci-- 5/07 Devdelija-- 5/08 Porróia-- 5/09 Sérrai-- 5/10 Dráma-- 5/11 Lekáni-- 5/12 Xánthi-- 5/13 Komotiní-- 5/14 Aisími-- 5/15 Dhidhimotikhon-- 5/16 Moskhopolis-- 5/17 Korçë-- 5/18 Flórina-- 5/19 Édhessa-- 5/20 Tiannitsa-- 5/21 Thessaloníki-- 5/22 Nigríta-- 5/23 Rodholívos-- 5/24 Kaválla-- 5/25 Ávdhira-- 5/26 Maróneia-- 5/27 Alexandroúpolis-- 5/28 Kessaní-- 5/29 Aryirokastron-- 5/30 Leskoviq-- 5/31 Kónitsa-- 5/32 Grevená-- 5/33 Kozaní-- 5/34 Kateríni-- 5/35 Epanomí-- 5/36 Políyros-- 5/37 Sithoniá-- 5/38 Athos-- Section 6/Map 01 Othonoi-- 6/02 Kérkira-- 6/03 Delvinákion-- 6/04 Ioánnina-- 6/05 Kalabáka-- 6/06 Tríkkala-- 6/07 Lárissa-- 6/08 Ayiá-- 6/09 Kassándra-- 6/10 Koufós-- 6/11 Paxoí-- 6/12 Párga-- 6/13 Artá-- 6/14 Ágrafa-- 6/15 Kardhítsa-- 6/16 Fársala-- 6/17 Vólos-- 6/18 Skiathos-- 6/19 Skopelos-- 6/20 Levkás-- 6/21 Préveza-- 6/22 Agrínion-- 6/23 Karpenísion-- 5/24 Lamía-- 6/25 Atalandi-- 6/26 Psakhna-- 6/27 Kimi-- Section 7/Map 01 Argostolion-- 7/02 Ekhinadhes-- 7/03 Mesolongion-- 7/04 Pátrai-- 7/05 Xilókastron-- 7/06 Levádhia-- 7/07 Khalkís-- 7/08 Nea Psara-- 7/09 Karístos-- 7/10 Volímais-- 7/11 Zakínthos-- 7/12 Pírgos-- 7/13 & S.M.C. II D 21 II Dhimitsána-- 7/14 Trípolis-- 7/15 Korínthos-- 7/16 Aíyina-- 7/17 Lavrion-- 7/18 Kiparissia-- 7/19 & S.M.C. II D 21 III Kalamai-- 7/20 & S.M.C. II D 21 IV Spárti-- 7/21 Leonidhion-- 7/22 Idhra-- 7/23 Pílos-- 7/24 Koróni-- 7/25 Yíthion-- 7/26 Moíaoi-- 7/27 Tainaron-- 7/28 Kíthira--
Cum.Ind./Find. Aid	Index sheet to series with maps.
Subject - Lib.Cong.	Greece -- Maps and charts -- 1943-1946.
Add.Entry	Great Britain. War Office. General Staff. Geographical Section.
	Great Britain. Army. Royal Engineers. No.1 Base Survey Drawing and Photo Processing Office.
	Great Britain. Army. Royal Engineers. Field Survey Company, 514th.
	Great Britain. Army. Royal Engineers. Pal. 524 Field Survey Company.
	Great Britain. Army. Royal Engineers. Field Survey Company, 19th.

Figure 1. Screenshot of a map record in AMBROSIA. The title is the name of the country (Greece) and the scale. The actual maps can be seen at the contents note.

[1] http://83.212.248.218:8991/F.



ASCSA/BSA Catalogue - Holdings

Great Britain.. Army.. Royal Engineers.. Map Reproduction Section, 17th.:
Greece 1:100 000..
[Cairo] : [Survey Directorate, Middle East], <1943-1944>..
93 maps : col.; paper; muslin backed; hanging strip at top ; from 55.5 x 42 cm to 56 x 45.5 cm on sheet from 59.5 x 45 to 69 x 51 cm..

Call Number	Section 5 Map 01
Call Number	Section 5 Maps 01-38. Section 6 Maps 01-27. Section 7 Maps 01-28. S.M.C. II D 21 (II-IV).
Public Note	; Map Room

Select year All Select volume All Select sublibrary British School Library
Previous Page

Barcode	Sub-library	Call number	Description	Collection	Loan status	Item status	
235250	British School Library	Section 6: Map 10	Z. 10 Koufos	Maps	On Shelf	On shelf	Expand
235249	British School Library	Section 6: Map 9	Z. 09 Kassandra	Maps	On Shelf	On shelf	Expand
235248	British School Library	Section 6: Map 8	Z. 08 Ayia	Maps	On Shelf	On shelf	Expand
235247	British School Library	Section 6: Map 7	Z. 07 Larissa	Maps	On Shelf	On shelf	Expand
235246	British School Library	Section 6: Map 6	Z. 06 Trikkola	Maps	On Shelf	On shelf	Expand
235244	British School Library	Section 6: Map 5	Z. 05 Kalabaka	Maps	On Shelf	On shelf	Expand
235243	British School Library	Section 6: Map 4	Z. 04 Ioannina	Maps	On Shelf	On shelf	Expand
235241	British School Library	Section 6: Map 3	Z. 03 Delvinakion	Maps	On Shelf	On shelf	Expand
235239	British School Library	Section 6: Map 2	Z. 02 Kerkira	Maps	On Shelf	On shelf	Expand
235238	British School Library	Section 6: Map 1	Z. 01 Othonoi	Maps	On Shelf	On shelf	Expand
235278	British School Library	Section 6: Map 27	T. 10 Kimi	Maps	On Shelf	On shelf	Expand
235277	British School Library	Section 6: Map 26	T. 09 Psakhna	Maps	On Shelf	On shelf	Expand
235275	British School Library	Section 6: Map 25	T. 08 Atalandi	Maps	On Shelf	On shelf	Expand
235274	British School Library	Section 6: Map 24	T. 07 Lamia	Maps	On Shelf	On shelf	Expand

Figure 2. Screenshot of the same record. The individual maps can be seen as holdings.

MARC cataloguing increased the visibility of the map collection and facilitated searching, but still there was a need for a more efficient tool and for individual cataloguing of every single map sheet. Also, as most maps were old and out of copyright the possibility of digitizing the collection or part of it was discussed. In 2021 the map collection became incorporated in the BSA digital collections[2].

The digital catalogue of the collection

Building catalogue records in EMU system

For the management of the BSA collections, EMU Axiell is used. EMU is a commercial Collections Management System that supports cataloguing based on international bibliographic standards as well as the publishing of the information on the web based mainly on custom code. EMU has a centric database which uses "modules" to store information about all cultural heritage management processes. For the historical maps collection more specifically, the modules mainly used are (Figure 3):

Catalogue, that records information (metadata fields) about each object in the collection

Parties, that records details about all people and organisations involved in the object's or collection's life cycle.

Locations, that records details about display and storage locations within BSA for the objects recorded in the Catalogue.

Sites, that records the physical details about a site which is related to an object (e.g., location details, coordinates etc.).

[2] https://digital.bsa.ac.uk

Multimedia, that stores all multimedia resources attached to a historical map (e.g., the scanned image of a map sheet or a map case) in compliance with the Dublin Core metadata standard.

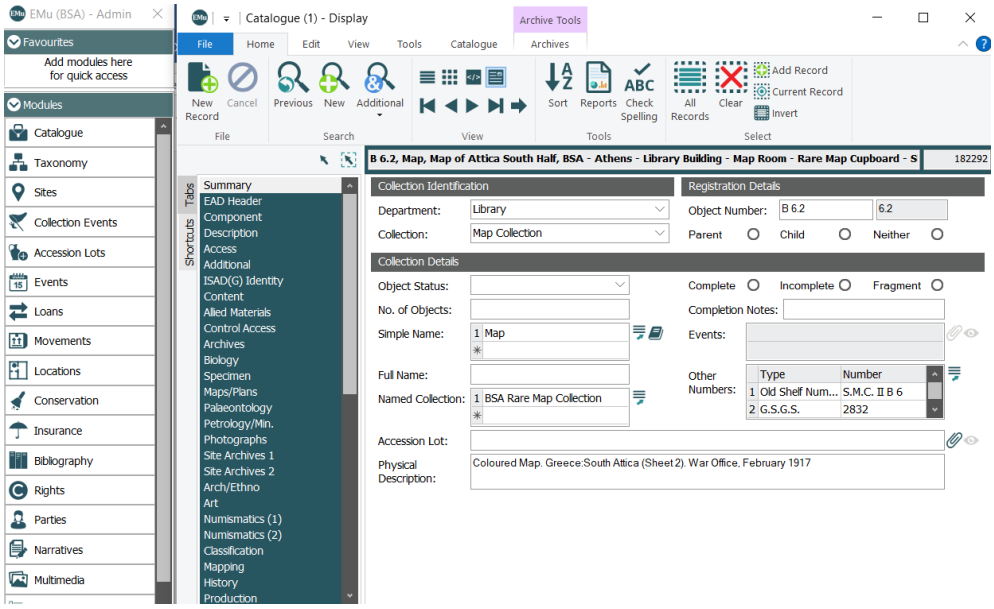


Figure 3: Screenshot of the Catalogue module of EMU – BSA.

The metadata fields mostly used for describing a map are the following:
Department: the responsible department for preserving the historical maps collection (the BSA Library)
Collection: the name of the historical maps collection
Named Collection: this field is used to indicate the object's belonging to a named collection within a certain collection (e.g., nautical charts).
Simple Name: this is a thesaurus-controlled (based on the British Museum thesaurus of object types) value field for describing the object according to the type of object it is (e.g., atlas).
Object Number: the unique identification number of the map within the collection
Other Number: any other number associated with the object (e.g., the number of an older indexing system)
Physical Description: a longer or shorter narrative description of the object.
Map Title: the title of the map
Map Scale: the scale of the map
Authors/Contributors: any person or organization involved in the map's life cycle (e.g., creation or publication)
Author Role: this field defines the role of the author/contributor (e.g., cartographer) (link with the Parties module)
Publication Date: date of publication
Publication city: Place where the map was published
Map Series Title: the title of the series a map belongs to
Locality: any place associated with a map (e.g., a city depicted in the map, or an area referred in the map's title) (link with the Sites module)
Centroid: coordinates of the centroid of the map (Latitude, Longitude in WGS '84).
Mapping: the bounding box of the cartographic area

Bibliography: any bibliographic reference associated with the map (link with the Bibliography module)
Current location: where the map is stored within BSA (link with the Location module)
Notes: any notes of the curator

Web publishing of the digital collection

The publishing of the maps on the web as a digital collection is implemented in EMu's module called "Narratives" and custom code. This module allows to author narrative material and associate it with different components of a collection (objects, sites, people, multimedia resources etc.) and to create dedicated web pages[3]. Users can navigate in the collection based on predefined search criteria (Figure 4) and maps can be displayed either in a grid or list form or located on a map (Figure 5). A public map's catalogue record is illustrated in Figure 6.

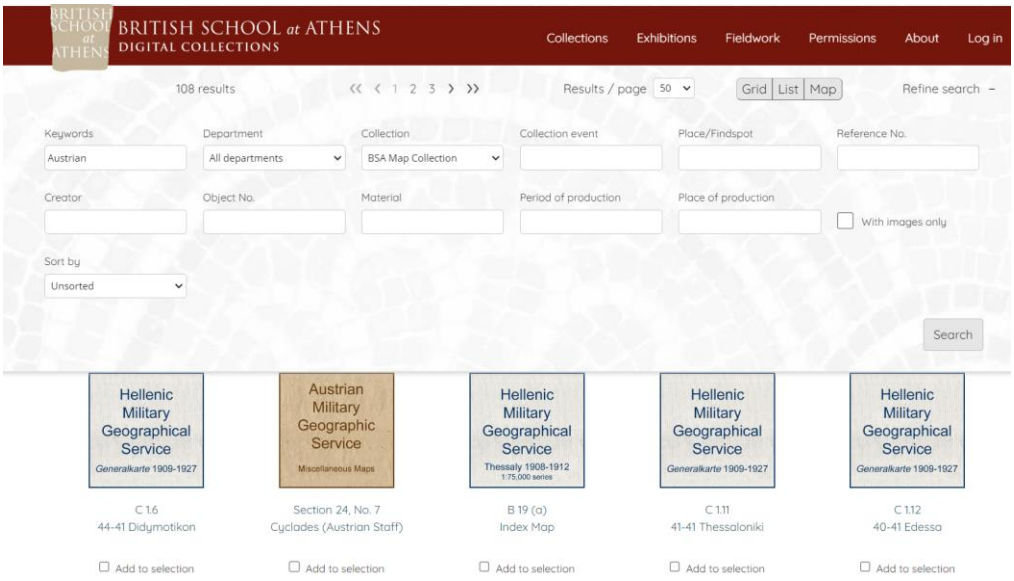


Figure 4: Screenshot of the Refine search tool of the BSA digital collections.

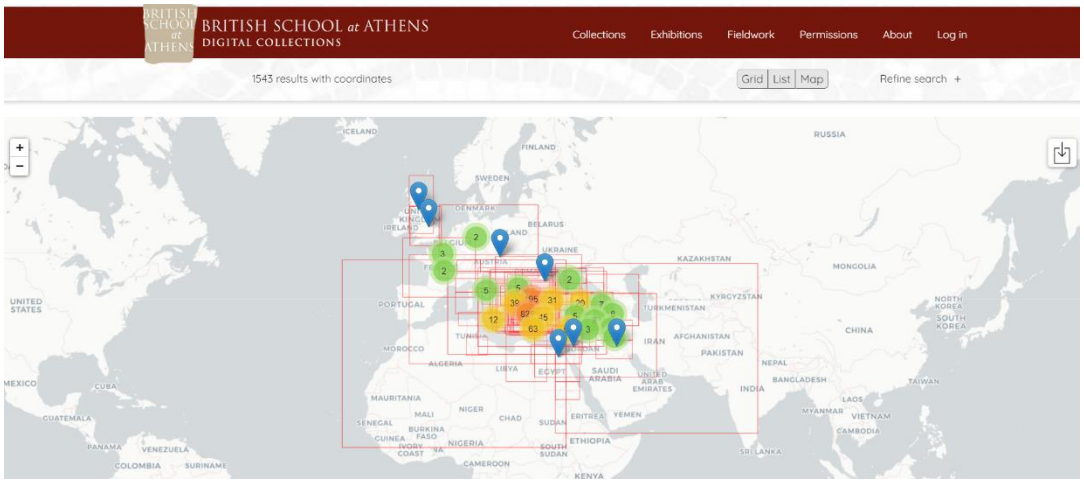


Figure 5: Screenshot of the map display of the BSA maps collection.

[3] The historical maps collection of BSA is available here: https://digital.bsa.ac.uk/collections.php?collection=2805 while all the digital collections of BSA are available here: https://digital.bsa.ac.uk/collections.php.

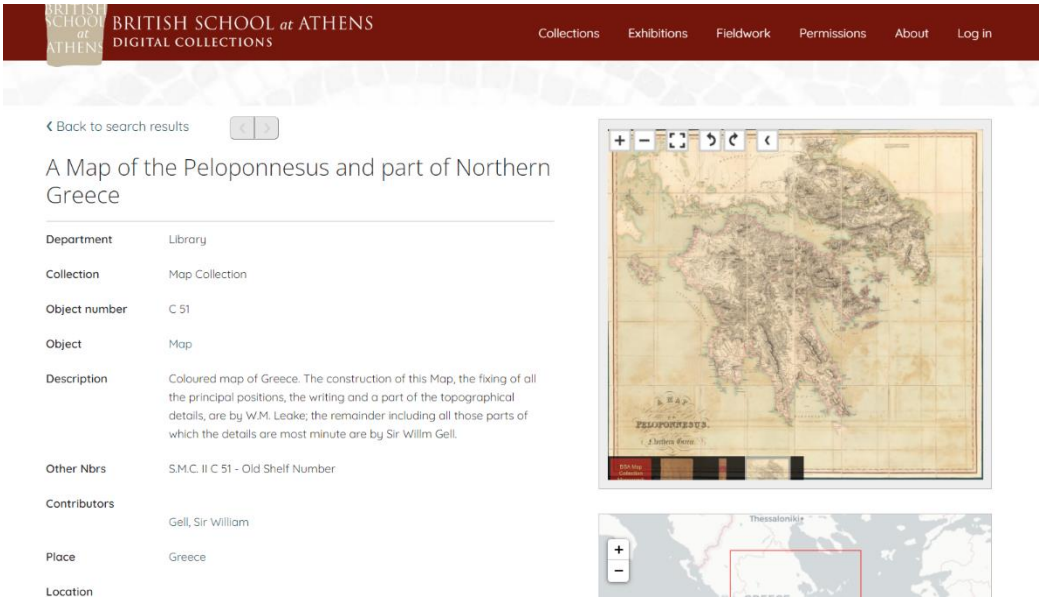


Figure 6: Screenshot of a map's catalogue record.

Searching across all BSA digital collections is supported by EMU and can be based on certain criteria (e.g., search for all material related to William Gell or material that has Cyclades as place reference– Figure 7).

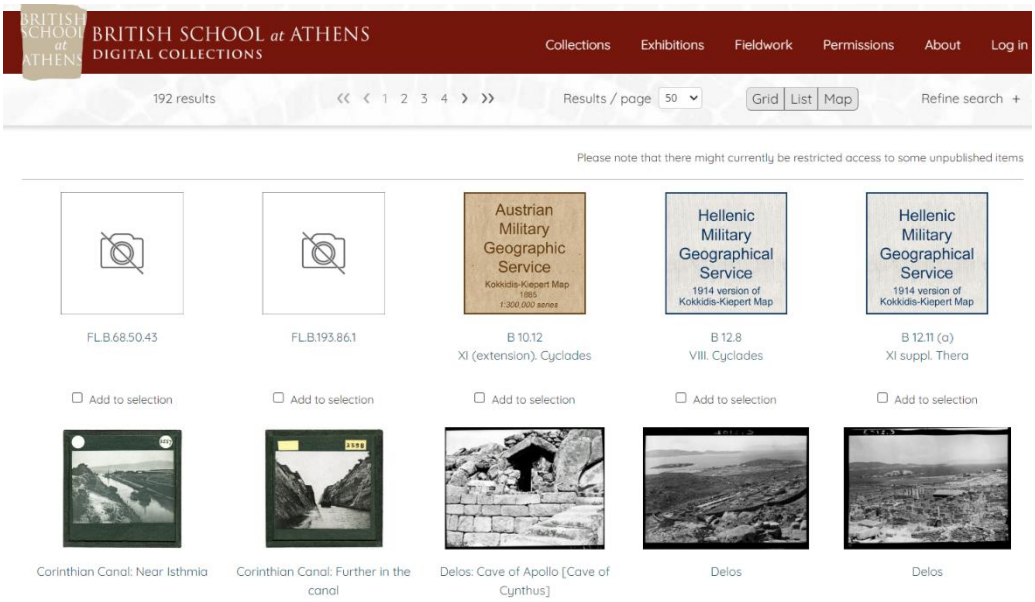


Figure 7: Screenshot of the results retrieved from EMU system related to Cyclades region.

Limitations and theoretical considerations

Even though EMU is a powerful system for managing cultural heritage objects, there are some limitations:

- It is a commercial product and a significant amount for the license renewal is required annually.
- It has fixed number of licenses

- Any change in the data model (e.g. adding a field) must be paid extra
- Once data are in, it is difficult to manipulate them
- Spatial databases are not supported
- Semantics and Linked Open Data are not supported

The adoption of semantics in the cultural heritage domain information systems has been acknowledged as a critical step for creating linked open data and for making cultural resources available online considering the high interdisciplinary of the cultural heritage information (Doerr, 2009). Bruseker et al. (2017) proposes CIDOC-CRM as the most robust solution for information integration in the cultural heritage domain. CIDOC-CRM (established as ISO 21127:2014) is the most widely used semantic model for describing, linking, and sharing cultural heritage information and for documenting museums' collections. It is an ontology that permits the explicit definition of relationships between heterogeneous cultural objects and therefore making queries based on thematic, spatial, and temporal criteria as well as more advanced visualization and re-usability of data (Crofts et al., 2011). Previous work of Gkadolou and Prastacos (2021) proposed an application profile based on this model to describe historical maps collections and their spatial content in a cultural heritage context. According to this, a historical map can be modelled as an E73 Information Object, a class that refers to identifiable immaterial items such as stories, algorithms, and mathematical processes or formulas that have a recognizable structure and are documented as single units (Crofts et al., 2011). In this meaning, a map is the carrier of the mathematical process and results ("Information Object") for representing space under a certain scale. Having established a historical map within CIDOC model not (only) as a cultural but also as an information object allows the maps to be used as the spatial basis on which other resources of the same chronological period of that of the maps to be linked and to re-use their spatial content. One step forward, the combination of digital cartographic material and other digital archive items under standardized vocabularies and ontologies can lead to digital narrative cartography projects that can provide dynamic interactive experiences to users (Leah, 2013).

In order to address the above issues, an effort has begun in BSA to explore and apply new methodologies for its cultural resources starting from the historical maps collection. The focus lies on Semantics and Linked Open data that have a fundamental role in addressing most of the challenges in creating and sharing open digital collections.

Producing Linked Open Data for the historical maps collection

CIDOC-CRM classes and properties

Based on the work of Gkadolou and Prastacos (2021), the EMU catalogue records were mapped to the classes and properties of the suggested semantic model (Table 1).

EMU field	CIDOC class	CIDOC property
Historical Map	E73 Information Object	
Department	E39 Actor	P147_curated
Collection	E78 Curated Holding	P10_falls_within
Named Collection	E35 Title	P102_has_title
Simple Name	E41 Appellation	P2_has_type

Object Number	E42 Identifier	P48_has_preferred_identifier
Other Number	E42 Identifier	P1_is_identified_by
Physical Description	E62 String	P3_has_note
Map Title	E35 Title	P102_has_title
Map Scale	E62 String	P138i_has_representation
Authors/Contributors	E39 Actor	P135i_was_created_by
Author Role	E55 Type	P2_has_type
Publication Date	E52 Time Span	P182i_starts_after_or_with_the_end_of
Publication city	E53 Place	P7_took_place_at
Map Series Title	E35 Title	P10_falls_within
Locality	E53 Place	P62_depicts
Centroid	E94 Space Primitive	P161_has_spatial_projection
Mapping	E94 Space Primitive	P161_has_spatial_projection
Bibliography	E31 Document	P70_documents
Current location	E53 Place	P55_has_current_location
Former location	E53 Place	P53_has_former_or_current_location
Notes	E62 String	P3_has_note
Map Sheets	E73 Information Object	P57_has_number_of_parts
Digital Image	E31 Document	P70_documents

Table 1. CIDOC classes and properties

For creating data according to this model, an Omeka-S prototype was developed and the data pipeline with EMU system was established. Omeka-S[4] is a web publishing platform for connecting digital cultural heritage collections with other resources online, semantically oriented. It supports data construction as RDF metadata classes and properties for describing a resource of a particular type, based on ontologies (CIDOC-CRM, Dublin Core, FOAF, etc.). Omeka-S is a conventional Linux Apache Mysql PHP application and its functionality can be extended by adding modules that fulfill specific needs (e.g. mapping of data, annotation etc.). It supports protocols for sharing data with multiple repositories (e.g., OAI-PMH) and different data and resources formats (e.g., IIIF) and the creation of web pages (for some indicative case studies see Hilburger et al., 2020; Hardesty, 2014; Kucsma et al., 2010).

The next step was to create a resource template (a set of pre-defined properties, that are used to create and describe an item within Omeka) according to the CIDOC ontology and including the concepts presented in Table 1 (Figure 8).

[4] https://omeka.org/

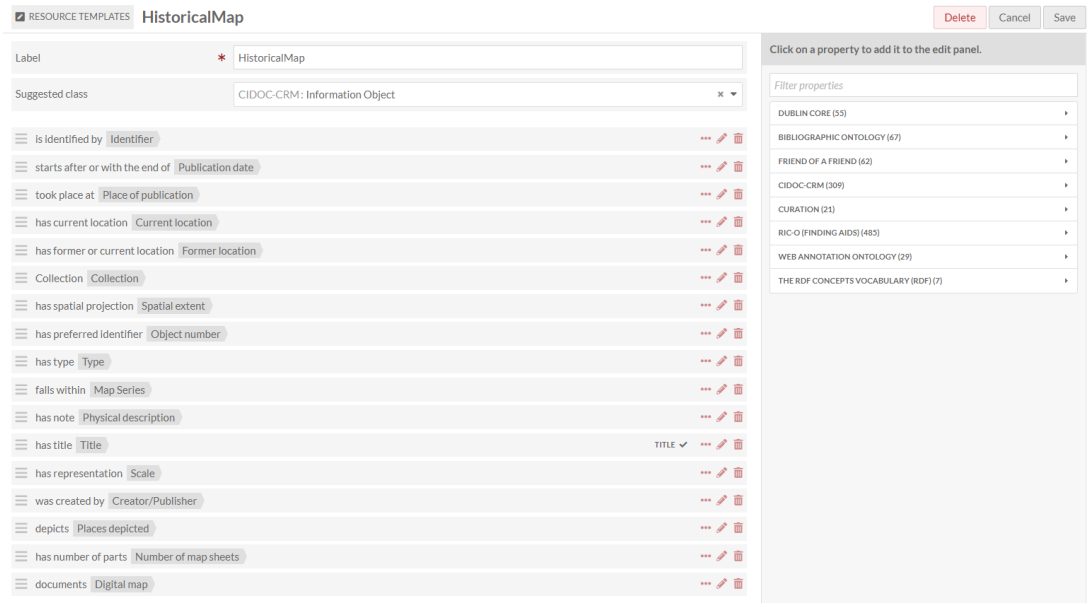


Figure 8. The recourse template for the Historical map class in OMEKA-S.

The resource templates in Omeka-S can be extended to include more concepts (and from alternative ontologies), can be exported in json format, and can be handled as a specialized vocabulary in any other system linked open data oriented. Based on this template, the database was populated with data (called “resource items” in Omeka) for a set of historical maps (Figure 9).

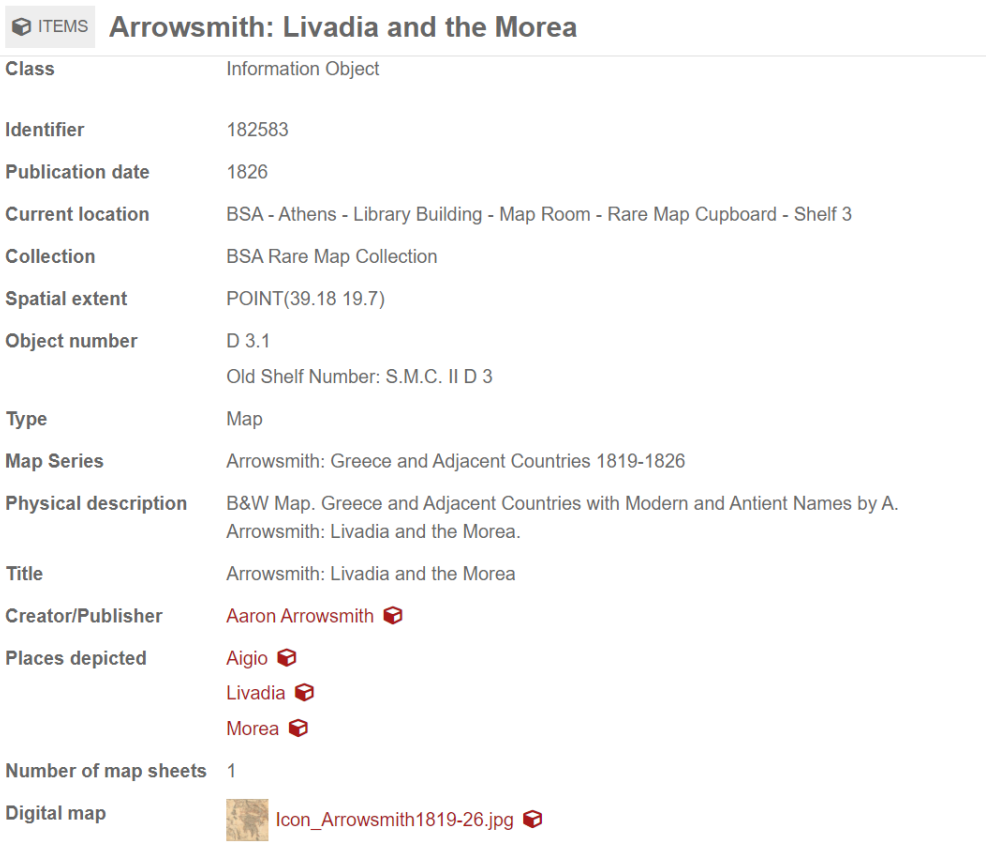


Figure 9. The resource item for the map “Livadia and the Morea” of Arrowsmith.

Link to other resources and web publishing

The link of the historical maps to other digital resources of the BSA archives is established through the concepts of the "Actor" (e.g. map creator, publisher etc.) and "Place". For the "Actor", a resource template taking properties from CIDOC and also Dublin Core was created and for the "Place" the resource template was created by mapping to CIDOC, the minimum fields required for creating a gazetteer based on the Linked Places format suggested by the World Historical Gazetteer initiative[5]. BSA holds a large dataset of place references related to its collections (e.g., place of publication, centroid and spatial extent of aerial photographs, place of production of artefacts, place of recovery, place of raw material origins, cultural sites etc.). These place references – of different levels of detail and accuracy - initially stored in EMU without a hierarchy - have now been formed as a gazetteer within Omeka. Ultimate goal is this gazetteer to serve as the glue for linking the BSA different collections based on the common place reference.
Furthermore, within Omeka-S prototype, geolocating of resources is enabled as well as the W3C Web Annotation Ontology[6]. The latter allows users annotate, tag, comment, rate, highlight, draw, etc. any resource in a normalized way. Specifically, for the historical maps collection, the functionality of annotating the scanned images of the maps and locating data on standard WMS maps with the annotation data model is also enabled (Figure 10).

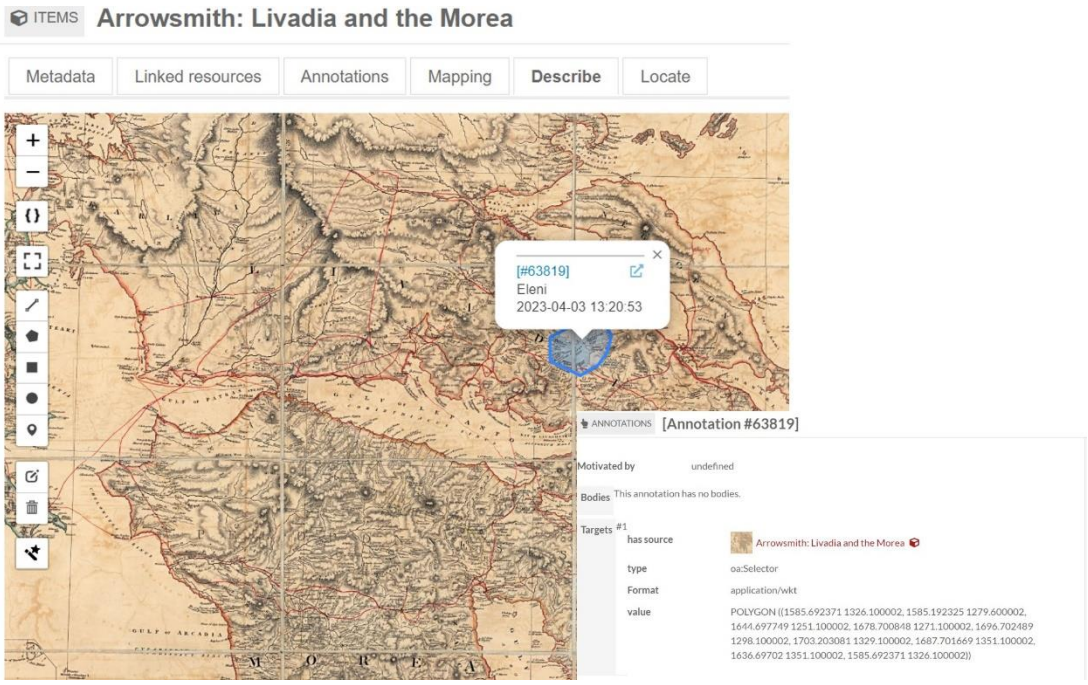


Figure 10. The annotation of a map within Omeka-S.

The publishing of the content created in Omeka-S on the web is implemented by creating web sites of one or more pages combining multiple resource items across collections adding simple or advanced search functionality. A simple example can be seen in Figure 11.

[5] https://whgazetteer.org/.
[6] https://www.w3.org/ns/oa.

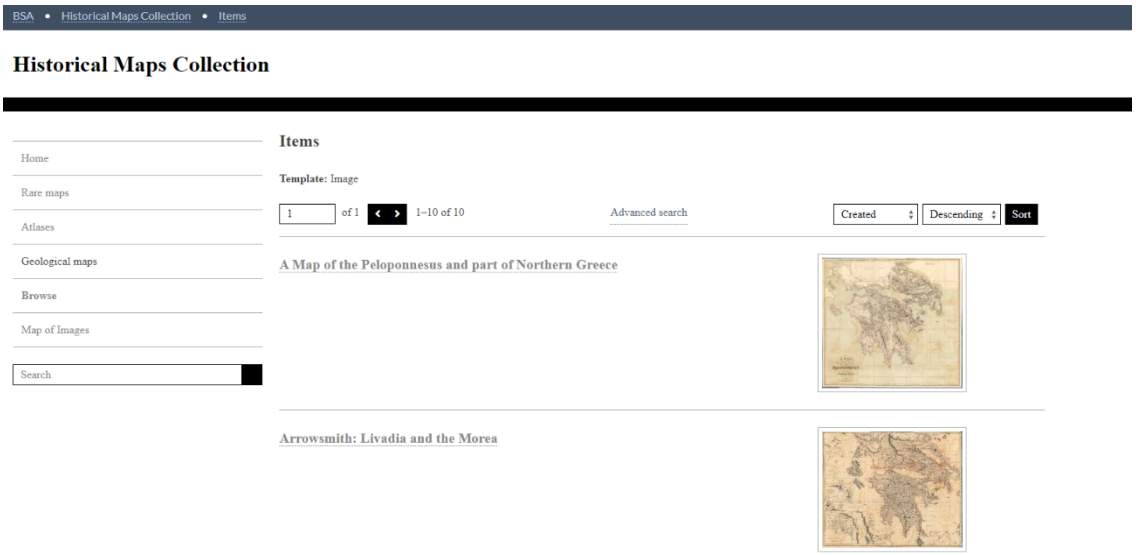


Figure 11. An example of the web page created for a set of historical maps in Omeka-S.

Conclusion

The work presented here is currently ongoing and has as goal to provide an alternative way – semantically oriented – for creating digital collections and publishing them on the web. Data developed within the Omeka-S prototype are according to the Linked Open Data framework: concepts and properties are explicitly defined based on CIDOC, each historical map has obtained a unique URL, data are created in a structure format reusable in other similar methodologically applications. Very importantly, it supports the easy creation of multiple web pages for the digital exhibition of the resources even with minimum technical expertise required from cultural heritage institutions. The next steps of this work are the following:

- Add more collections to the system and produce new thematic digital collections of different digital resources.
- Since, high quality images of the scanned maps are available, create IIIF images[7] and emphasize the use of image annotation as a tool for enriching the descriptive data of the maps.
- Use the interactive annotations to navigate in the maps and build stories on them as a different way to learn more about maps.

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[7] IIIF (International Image Interoperability Framework) is a standard for describing and delivering images over the web that also allows the interactive annotation of images.

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