Journal of open archaeology data

The BORDERSCAPE Project WebGIS: State Formation and Settlement Patterns near the Ancient Egyptian Southern Border

DATA PAPER

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ubiquity press

ABSTRACT

The BORDERSCAPE Project WebGIS database and web app provide an overview of changes in the settlement pattern of the ancient Egyptian southern border during the long process of state formation and border-making. The dataset is set up in Excel and CSV formats and includes 163 archaeological sites from the First Cataract Region in southern Egypt, dating from c. 3800 to 2300 BCE. Eighty-two sites were discovered by the Aswan-Kom Ombo Archaeological Project and are mostly unpublished. The rest of the data was retrieved from originally published material. The dataset is enriched by two inundation models created for the Nile Valley north of the cataract. The WebGIS is an opportunity for data sharing and sets the base for potential data exchange.

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KEYWORDS:
Archaeological sites; Egypt; Settlement patterns; Border; State formation; Border-making

TO CITE THIS ARTICLE:
Siegel O, Bogdani J, Urcia A, Nicolini S, Gatto MC 2024 The BORDERSCAPE Project WebGIS: State Formation and Settlement Patterns near the Ancient Egyptian Southern Border. *Journal of Open Archaeology Data*, 12: 7, pp. 1–10. DOI: https://doi.org/10.5334/joad.125

(1) OVERVIEW

CONTEXT

The BORDERSCAPE WebGIS database and web app are outcomes of *The BORDERSCAPE Project – Egyptian State Formation and the Changing Socio-Spatial Landscape of the First Nile Cataract Region in the 4th and 3rd millennia BCE* (https://www.borderscapeproject.org/). The project investigates the impact of state formation and border-making on the ancient Egyptian southern border in the periods before, during, and immediately after the rise of the Pharaonic state in the 4th to 3rd millennia BCE. The project focuses on detecting the timing and nature of changes in settlement pattern, land use and community structure in the Nile's First Cataract Region. It seeks to identify what power performances were set in place by the bordering process and, more broadly, explore how the process of state formation affected Nubia, Egypt's southern neighbour.

The archaeological dataset used to address these research questions combines evidence from almost 20 years of fieldwork of the Aswan-Kom Ombo Archaeological Project – AKAP (https://www.akapegypt.org/) with published data from other surveys and excavations from the region. Our findings emphasize changes throughout the almost two millennia analysed by the project: from a distributed presence (for the first time in the region) of small villages along the river at the beginning of the 4th millennium BCE to a clusterization of population into larger centers north of the cataract at the time of the state formation, to a contemporary depopulation of the area south of the cataract that will be resettled only later into the 3rd millennium BCE. The extensive efforts that the Pharaonic state made to establish a political and ideological border at the First Cataract ultimately resulted in diverging social practices and material cultures in Upper Egypt and Lower Nubia. These research foci are elaborated upon at greater length in forthcoming publications.[1, 2]

The sites, dated between 3800 and 2300 BCE, are located in the segment of the Nile Valley between the Kom Ombo Plain and the Bab el-Kalabsha. The study area also comprises the nearby desert areas of Kurkur Oasis, Wadi Kubbaniya, Wadi el-Lawi/Wadi Rasras, Wadi Abu Subeira, and Wadi el-Hudi (Figure 1). The dataset includes 163 sites, half of which, 82 in total, were discovered by the Aswan-Kom Ombo Archaeological Project (AKAP). AKAP has conducted surveys and excavations in the First Cataract Region since 2005. Much of this material has already been published in preliminary reports or analyses [2, 4–21], but a great deal of information remained unpublished within the AKAP archives. In addition, numerous other scholars and research teams have been publishing information about the ancient settlements, rock art, and inscriptions of the First Cataract Region since the late 19th century (including [22–34, 36, 38–40]), and the BORDERSCAPE Project has attempted to collect published information about the location, function, periods of occupation, and relative size of these many sites. Given that this is among the most archaeologically well-known regions in the world, following the UNESCO Salvage Campaign of the 1960s, as well as decades of extensive survey and intensive excavation both before and after this crucial period, there are undoubtedly examples that we have missed—and our hope is that scholars and the interested public might consult this database both to aid in their own research and to provide additional information by contacting us directly.

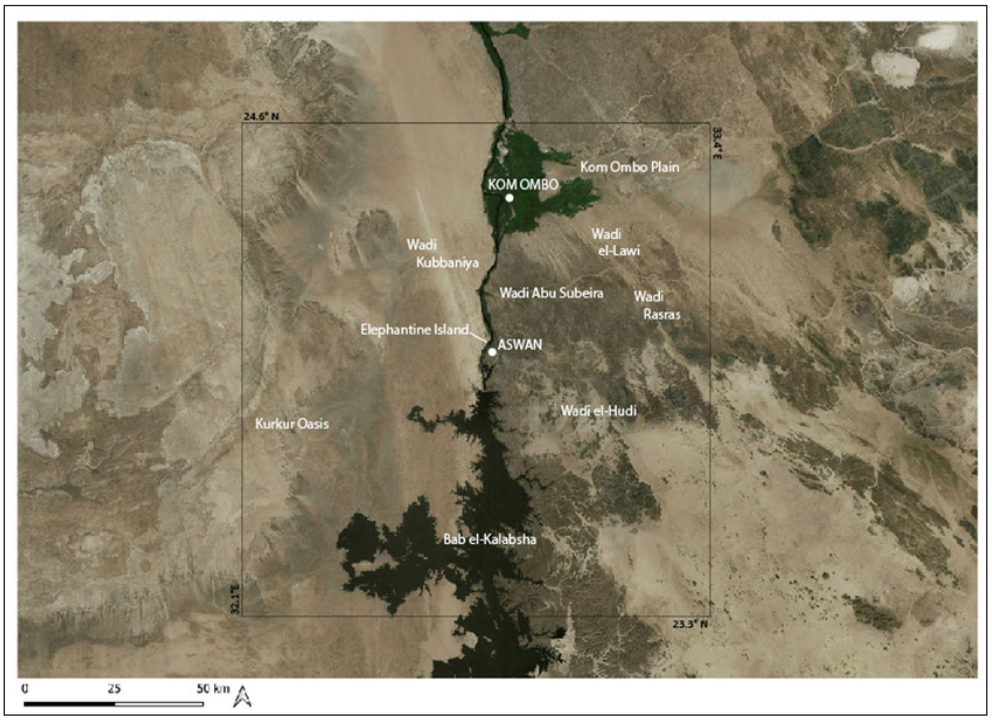

Figure 1 Map of The BORDERSCAPE Project study area.

This paper aims to make publicly available much of the data the BORDERSCAPE Project used to reconstruct the settlement patterns in the First Cataract Region and showcase the WebGIS modules we have built to visualize this data. Within the WebGIS modules, our goals were to show the various archaeological sites in the region organized according to site type (Figure 2) and chronological phases (Figure 3). Beyond visually showing the spatial distribution of archaeological sites together with their macro-typology, viewers may click on each site to learn additional information about each site's sub-type, phasing, and bibliography. To create a long-lasting and sustainable data management platform, we opted for a fully open-source software architecture to reduce costs and facilitate further intervention if and when needed. To offer easy access to any users, the WebGIS has been included in a website-like interface that will work also on portable devices.

SPATIAL COVERAGE

The region interested by the research is that of the First Nile Cataract in southern Egypt, and covers both river valley and desert hinterland (approximately 16092 km^2):

Northern Boundary: +24.6° N
Southern Boundary: +23.3° N
Eastern Boundary: +33.4° E
Western Boundary: +32.1° E

TEMPORAL COVERAGE

The chronological span considered goes from 3800 to 2300 BCE. It was divided into six phases, with three covering the period prior to the formation of a unified Pharaonic state (established by radiocarbon dating and Bayesian modelling at c. 3085 BCE [3]) and three following this decisive event.

(2) METHODS

STEPS

The BORDERSCAPE dataset was created by a combination of data retrieved from the AKAP archives, from fieldwork in collaboration with AKAP, and from published legacy material. Information for each archaeological site from AKAP was entered into a database using Microsoft Access, drawing on over fifteen years of survey and excavation data, photographs, and published reports. Additional sites from other archaeological projects were subsequently added to this database and translated into the project's GIS, together with the AKAP sites (for main bibliographical references, see above). The information entered into the BORDERSCAPE Project database formed the basis for the attribute table that was to be included within the WebGIS application (contained in "borderscape_sites.csv" and "borderscape_archaeological_sites.xlsx" in the repository folder). A series of shapefiles were created using QGIS,

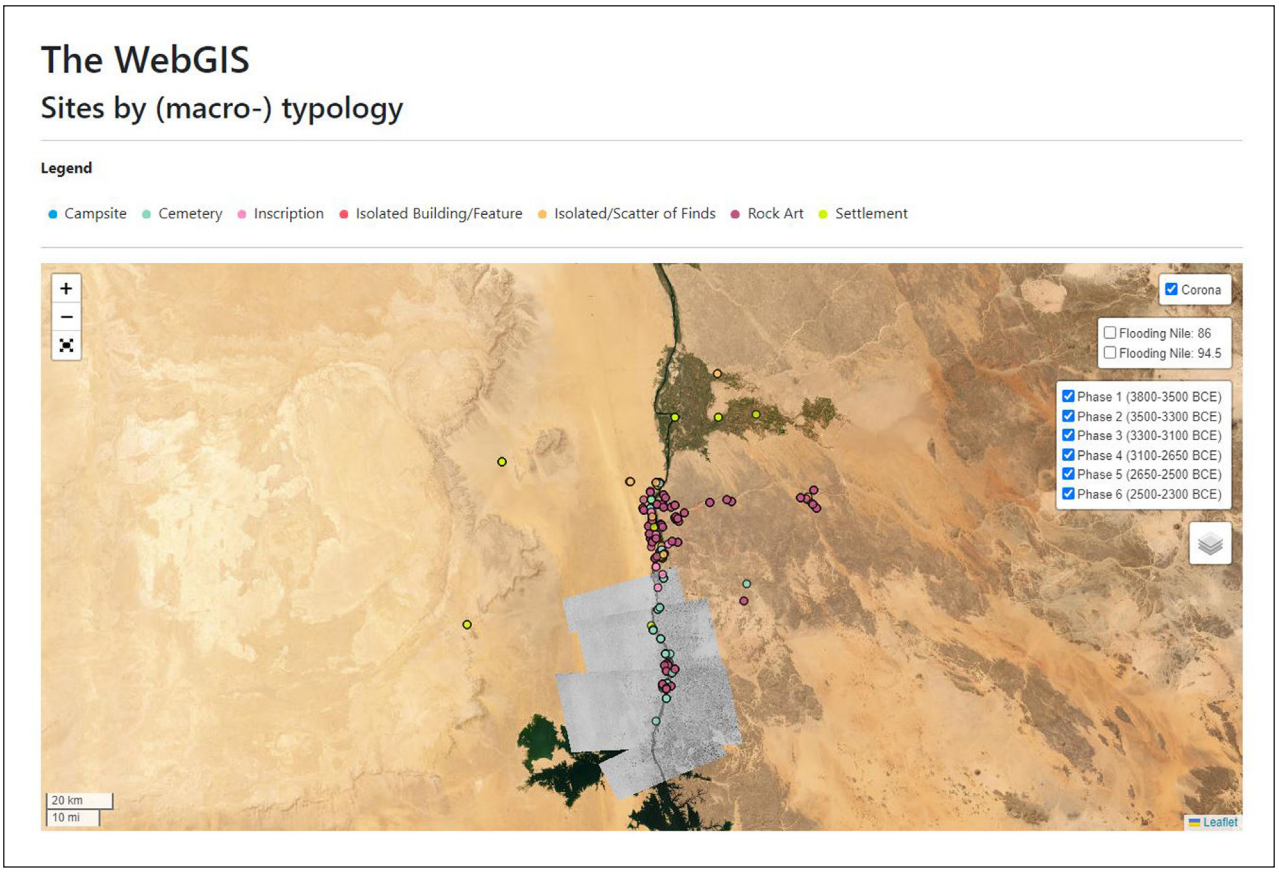

Figure 2 Screenshot of the BORDERSCAPE WebGIS, where all archaeological sites are displayed according to site macro-typology and chronological phases: https://webgis.borderscapeproject.org/webgis/.

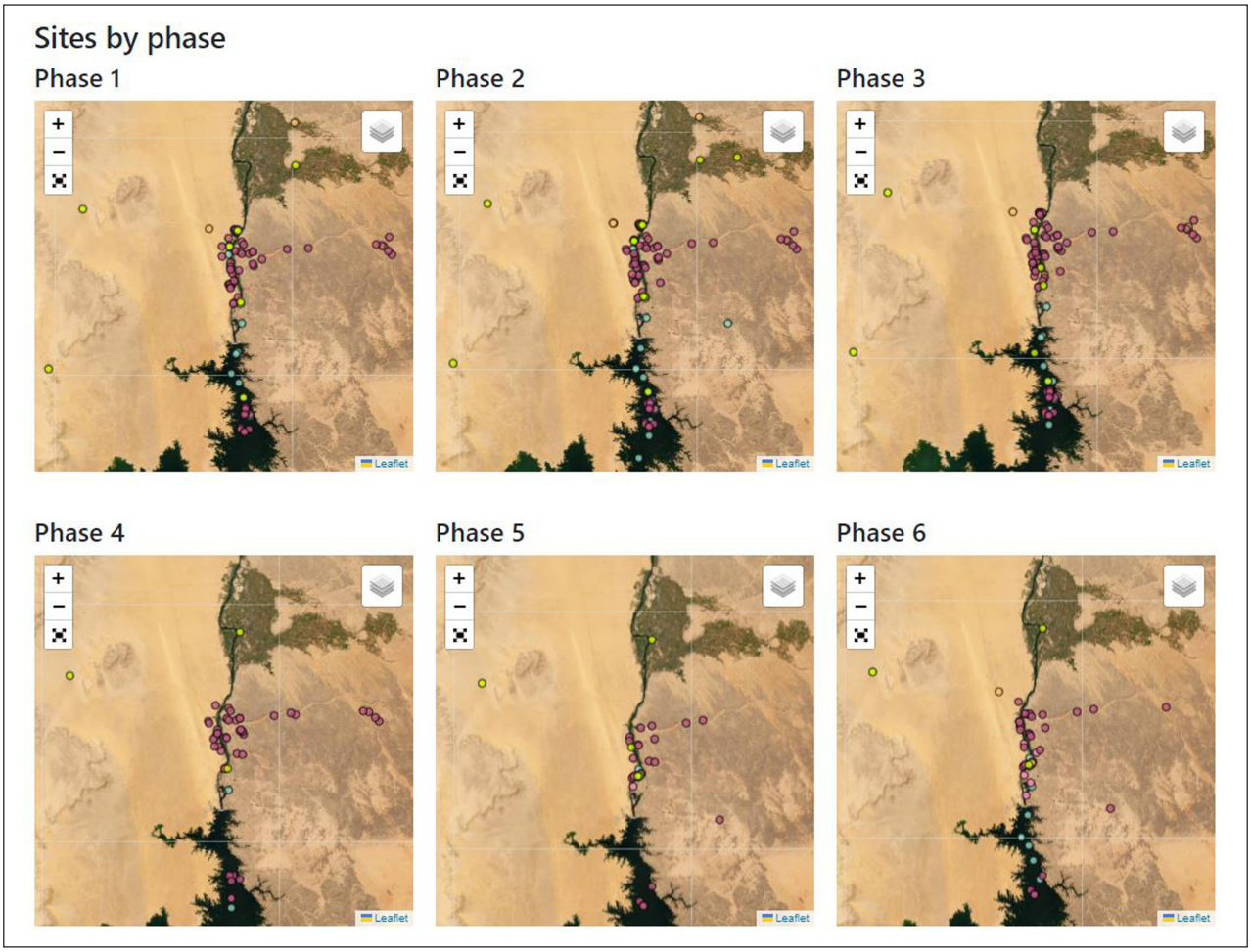

Figure 3 Screenshot of all phase maps with site data displayed by macro-typology within a given temporal phase. This second visual display is very convenient for showing and comparing changes in settlement pattern across phases.

including those for each temporal phase adopted by the project (contained in the folder "borderscape_data.zip"). Contour lines of two inundation models, developed from archaeological and historical sources, were added to show the relation between site location and the flooding water. Details of the flood levels of the Nile at elevation derive from TerraSAR-X/TanDEM-X and LandSAT SRTM data. Georeferenced CORONA imagery ("merged_coronas_freegr.tif") showing the Lower Nubian landscape prior to the construction of the Aswan High Dam was added to overcome the loss of geospatial information south of the cataract where the landscape close to the river is now submerged by Lake Nasser.

SAMPLING STRATEGY

The BORDERSCAPE Project attempted to include all AKAP sites together with as many published sites as possible (including [2, 4–21, 22–34, 36, 38–40]) from within the study region and the project's chronological timeframe. A thorough bibliographical search was undertaken to collect the published data. AKAP sites were discovered and documented through a combination of targeted, extensive ground surveys, consultation with previously published records of excavations in the area (particularly [1, 23–34, 39–40]), remote sensing, and salvage excavations.

QUALITY CONTROL

We used a controlled vocabulary managed via drop-down menus to standardise an otherwise inconsistent dataset. Furthermore, each entry in the database was reviewed and assessed with an accuracy score indicating our confidence in the data's reliability. This score was derived from our evaluation of the reliability of previously published material. At times, we relied on the extensive field experience of the BORDERSCAPE PI in the region to reevaluate certain aspects of the chronological phasing suggested in earlier publications like Reisner's *Archaeological Survey of Nubia* [39].

CONSTRAINTS

Many of the oldest surveys and publications are imprecise, lack quality plans or maps, and sometimes treat key data about archaeological features only in passing. Early excavators occasionally used outmoded terminology or techniques to determine the archaeological cultures or chronology but did not publish the site sufficiently well for us to reassess it confidently. The loss of the southern portion of the Nile Valley under Lake Nasser following the construction of the two Aswan Dams and the impossibility of getting new data for that portion of the study area has greatly constrained our research.

(3) DATASET DESCRIPTION

OBJECT NAME

Data are stored in the repository Zenodo in a folder named **borderscape_webgis_data_v6.0.zip**.

The attribute table has been submitted to the repository as a vector shapefile and exported in a CSV file "borderscape_sites.csv" and Excel file "borderscape_archaeological_sites.xlsx".

Each archaeological site is described according to the following entries:

Codex: A unique record identifier applied to each site, a progressive number from 001 to 163.
Name: The site name or code given by the archaeological project that documented the site (e.g. WT6, Cemetery 7, etc.). When a specific name/code was not available, the name of the locality was used (e.g. el-Raghayim, Sehel Island).
Locality: The modern name of the district or village where the site is located. The spelling used is that of the original source.
Macro-type: The first level of classification consisting of broad definitions according to function. The terminology used for sub-classifications follows the traditional practice in Egyptology/Nubiology: see, for example, the use of the term 'cemetery' for funerary sites already in Reisner 1910 [39] and the discussions of settlement hierarchy by Nadine Moeller [35] or Gregory Mumford [37]. Though it was created specifically for our dataset, archaeologists should not have difficulty interpreting these classifications.
Site type: This is a second, more detailed classification level defined in a hierarchical sequence. The terms used are meant to provide information on the function and size of each site. These are typically qualitative assessments of the sites in question rather than based on absolute numbers of features. Given that many of these sites were only partially excavated, looted, or, in some cases, have been eclipsed by modern development, it is difficult to determine the size of these sites with certainty. We infer the site's potential hierarchical stand by evaluating the architectural remains and material culture found case by case.

Macro-Types and Site Types combined work as follows:

1. Isolated/Scatter of Finds: Single occurrence or a group of artifacts.
1.1 Isolated Find
1.2 Scatter of artifacts
1.3 Scatter of artifacts in shelter
1.4 Scatter of artifacts, possible cemetery
1.5 Scatter of artifacts, possible quarry
1.6 Scatter of artifacts, possible village
2. Isolated Building/Feature: Isolated building or structure of unknown function.
2.1 Pyramid
2.2 Fortress
2.3 Harbor Installation
3. Settlement: Domestic contexts of all sizes and functions.
3.1 Campsite
3.2 Medium-size long-term campsite
3.3 Concentration of campsites
3.4 Domestic quarter
3.5 Domestic quarter, production area
3.6 Village
3.7 Storage Area
3.8 Proto Urban Centre
3.9 Urban Centre
4. Cemetery: Funerary contexts of all sizes, including isolated graves.
4.1 Isolated Tomb
4.2 Cluster of Tombs (2–10 occurrences)
4.3 Small-size Cemetery (11–50 occurrences)
4.4 Medium-size Cemetery (51–100 occurrences)
4.5 Large-size Cemetery (+100 occurrences spatially concentrated)
4.6 Extensive Cemetery(+100 occurrences spatially distributed)
4.7 Monumental Cemetery
4.8 Funerary Monument
5. Inscription: Rock carved inscriptions.
5.1 Isolated Rock Inscription
5.2 Isolated Rock Inscription, location uncertain
5.3 Cluster of Rock Inscriptions (2–50 occurrences)
5.4 Concentration of Rock Inscriptions (+50 occurrences)
6. Rock Art: Rock art ranges from isolated drawings to clusters of various sizes and densities. The term concentration is intended to define a group of panels that exceed in number and density that is defined as a cluster. Again, within the range of concentrations, the definitions are intended in a progressive manner, from distributed to densely concentrated.
6.1 Isolated Rock Art
6.2 Cluster of Rock Art(2–50 occurrences)
6.3 Dispersed Concentration of Rock Art (51–100 occurrences)
6.4 Clustered Concentration of Rock Art (101–200 occurrences)
6.5 Dense Concentration of Rock Art (+200 occurrences)

Chronological Phases: These phases are defined based on absolute chronology [3], followed by Egyptian

relative chronology. The phases are listed below, with a rough estimate of absolute dates accompanied by their correlates within Egyptian relative chronology. Generally, the phasing and analyses of recent projects were accepted and placed within the BORDERSCAPE Project's phases. Early 20th-century archaeologists' chronological identifications were instead revised before being included.

Phase 1: 3800–3500 BCE, Naqada IC-IIB
Phase 2: 3500–3300 BCE, Naqada IICD
Phase 3: 3300–3100 BCE, Naqada III/Dyn. 0
Phase 4: 3100–2650 BCE, Dyn. 1–2
Phase 5: 2650–2500 BCE, Dyn. 3–4
Phase 6: 2500–2300 BCE, Dyn. 5–6

C14: Radiometric dates available for each site.

Accuracy: A qualitative assessment of the reliability of available data.

1: Very low. Extremely limited information is available. Location and chronology are undefined. Data is only from a survey. Plans, photos, and drawings are unreliable. There is no chance to verify the data.
2: Low. Little information is available. The location and/or chronology are known, but the details are uncertain. Data from surveys and/or excavations are available but with biases. It is possible to verify some data only.
3: Medium. More substantial information, including location and chronology, is available, but still with biases. Survey and/or excavation data, with relatively detailed reports, are available. Plans, photos, or drawings are also available.
4: Medium high. Substantial information is available, including location and chronology. Data from survey and/or excavation are up to modern standards. Maps, photos, and drawings of good standards.
5: High. Excellent information, including location and chronology. Data from survey and excavation up to modern standards. Detailed maps, photos, and drawings are available. Scientific analyses are occasionally available.

Bibliography: A list of major bibliographical references for each site in abbreviated format (Harvard Style). AKAP's publications pertaining to sites here considered are entered in the reference list accompanying the database.

Project: list of archaeological projects that have worked at each site in abbreviated format. In a few instances, no project could be linked to a site investigation.

AKAP: Aswan-Kom Ombo Archaeological Project
ASN: Archaeological Survey of Nubia
Bonn: Bonner Rheinischen Frieriech-Wilhelms-Universität
DAIK: Deutsches Archäologisches Institut Kairo
IFAO: Institut Français d'Archéologie Orientale
IMET: Missione Italiana del Museo Egizio di Torino
Jaén: Universidad de Jaén
ÖAW: Österreichische Akademie der Wissenschaften
Quarryscapes: QuarryScapes Project
SCA: Supreme Council of Antiquities
SIA: Schweizerische Institut für Ägyptische Bauforschung und Altertumskunde Kairo
Yale: Yale Toshka Desert Survey
YUPEN: Yale University Prehistoric Expedition to Nubia
WASRAP: Wadi Abu Subeira Rock Art Project
WHE: Wadi el-Hudi Expedition

Coordinates: geographical coordinates in WGS84/UTM Zone 36 N (EPSG: 32636). Accuracy varies considerably. For the sites south of the cataract, coordinates were retrieved from historical sources by georeferencing and positioning The Topographical Survey of Egypt maps published by Reisner 1910 [39] and Curto et al. 1967 [22] on the project's GIS.

A "borderscape_bibliography.bib" file accompanies the dataset files in the repository.

Other files submitted to the repository are:

"README.md": a document describing the contents of the repository.
"sites.geojson": a GeoJSON file with information on each archaeological site included in the WebGIS.
"flooding_nile.geojson": a GeoJSON with information on Nile flood levels at 86 m and 94.5 m ASL.
"merged_coronas_freegr.tif": a GEOtiff of the georeferenced CORONA imagery showing the Lower Nubian landscape prior to the construction of the Aswan High Dam.
A folder named "borderscape_data.zip" contains ZIP archives with the shapefiles data: "borderscape_archaeological_sites.zip": a zip archive of a shapefile showing all the archaeological sites and their attributes used in the WebGIS.
"sites_phase_1.zip": a zip archive of a shapefile showing archaeological sites used in the WebGIS from Phase 1.
"sites_phase_2.zip": a zip archive of a shapefile showing archaeological sites used in the WebGIS from Phase 2.
"sites_phase_3.zip": a zip archive of a shapefile showing archaeological sites used in the WebGIS from Phase 3.
"sites_phase_4.zip": a zip archive of a shapefile showing archaeological sites used in the WebGIS from Phase 4.

"sites_phase_5.zip": a zip archive of a shapefile showing archaeological sites used in the WebGIS from Phase 5.
"sites_phase_6.zip": a zip archive of a shapefile showing archaeological sites used in the WebGIS from Phase 6.
"86 m _flooding_contour.zip": a zip archive of a shapefile showing flooded areas at 86 m ASL.
"94.5 m_flooding_contour.zip": a zip archive of a shapefile showing flooded areas at 94.5 m ASL.

DATA TYPE
Primary, Secondary and Processed Data

FORMAT NAMES AND VERSIONS
CSV, SHP, TIF, XLSX, GEOJSON, TXT

CREATION DATES
The database and WebGIS were created between 2021–06–01. and 2024–02–29 as part of the BORDERSCAPE Project.

DATASET CREATORS
MCG: WebGIS data collection, field data collection, chronological and cultural assessment, confidence assessment, contributed to draft and revision of article.

OS: WebGIS data collection/production, field data collection, led draft and revision of article.

SN: WebGIS data collection/production, field data collection, bibliography, contributed to draft and revision of article.

JB: Designed WebGIS, contributed to the draft and revision of the article.

AU: Contributed to WebGIS, contributed to draft and revision of article.

LANGUAGE
English

LICENSE
CC-BY 4.0

REPOSITORY LOCATION
https://zenodo.org/records/11099773
https://doi.org/10.5281/zenodo.11099773

PUBLICATION DATE
01/05/2024

(4) REUSE POTENTIAL

To our knowledge, this is the first attempt to comprehensively plot and gather information about archaeological sites from across the Nile's First Cataract Region. The obtained dataset, available via the WebGIS and in CSV and XLSX formats, should prove a valuable resource for scholars looking for both quantitative and qualitative data about archaeological sites from the Bab el-Kalabsha to Kom Ombo and the desert hinterland during the periods before, during, and after Pharaonic state formation. More specifically, this data makes a wealth of previously unpublished data from AKAP available to any interested researchers. Beyond providing rough site locations and coordinates for use in other GIS based projects, we hope that this format will allow other researchers working in different regions of Egypt and Nubia to both use and compare their own datasets with the material furnished by AKAP and The BORDERSCAPE Project. This material may also prove useful as a comparative study to archaeologists working at the regional scale elsewhere in the Mediterranean world, Africa and beyond. It is also hoped that the rock art sites discussed within our dataset and database may prove useful in refining understandings of the chronological development of this medium in the Upper Egyptian/Lower Nubian context. We encourage colleagues who would like to share data from recent excavations or who can provide insight into any incorrect or missing information within the dataset to email us directly at borderscape@iksio.pan.pl or borderscapeproject@gmail.com.

To keep the BORDERSCAPE WebGIS lightweight, secure, and data-oriented, we have selected a combination of several recognised and widely used coding solutions starting from the Gatsby framework (https://www.gatsbyjs.com/), an open-source static site generator based on the well-known React.js library (https://react.dev/). Particularly, the website was built using a Gatsby starter called s:CMS, created and maintained by LAD (Laboratorio di Archeologia Digitale alla Sapienza, https://purl.org/lad). This customized starter (https://github.com/lab-archeologia-digitale/sCMS/) includes a set of components specifically designed to facilitate the online publishing of easy complex research data, such as geospatial data, or structured databases. The data used to feed the system can be sourced by RESTFul APIs, online, databases or self-hosted static files, as in the case of the BORDERSCAPE Project. The source code of the BORDERSCAPE WebGIS is maintained on GitHub (https://github.com/lab-archeologia-digitale/borderscape), and the free GitHub Pages service (https://pages.github.com/) is used as hosting. The only external dependency of the data publishing platform is the raster layer, which contains the CORONA satellite imagery, previously georeferenced by the project. These maps were converted into a Tiled Web Map service (precisely in the XYZ format) and hosted on the LAD servers provided by the GARR Consortium (https://www.garr.it/), a public Italian IT services provider for public institutions. Since research data are provided to the publishing system as open format files (GeoJSON, RFC7946, https://datatracker.ietf.org/doc/html/rfc7946 for geographical data and CSV for tabular ones), the risk

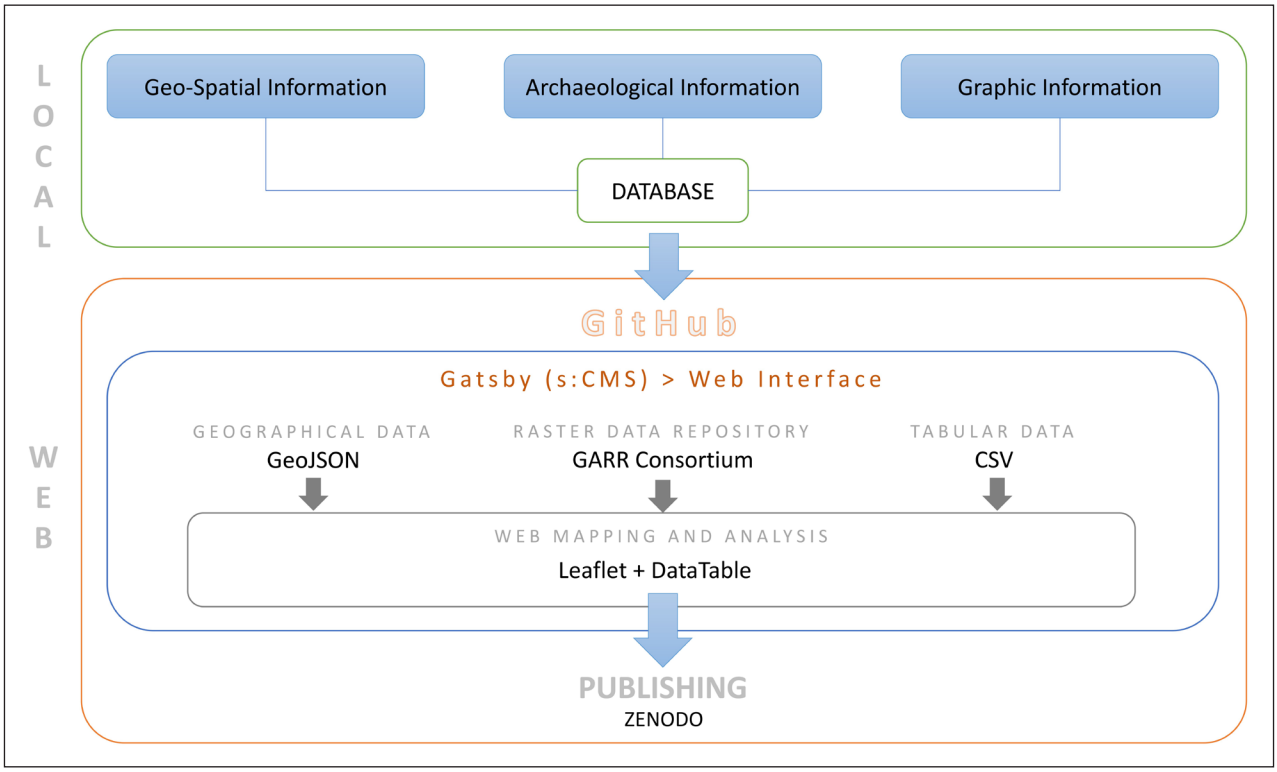

Figure 4 Workflow chart summarizing the steps implemented in constructing The BORDERSCAPE Project WebGIS.

of data-silos effect has been averted, the presentation layer becoming a thin, yet informative, and easy to replace technologic tool. The specific components for the data presentation have all been built with open-source libraries, such as Leaflet (https://leafletjs.com/, https://react-leaflet.js.org/) library for web mapping and DataTables (https://datatables.net/, https://react-data-table-component.netlify.app/) for structured data visualisation and analysis.

Further enhancements, such as data visualisation widgets using graphs and charts, might be developed and implemented into the current project in the future (Figure 4).

NOTES

[1] Gatto, M.C. forthcoming. BORDERSCAPE – Egyptian State Formation and the Changing Socio-Spatial Landscape of the Nile First Cataract Region in the 4th and 3rd millennia BCE. Travaux de l'Institut des Cultures Méditerranéennes et Orientales de l'Académie Polonaise des Sciences. Warsaw/Wiesbaden: IKŚiO PAN/HARRASSOWITZ VERLAG.

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ACKNOWLEDGEMENTS

We would like to thank the German Aerospace Agency for providing us with TerraSAR-X/TanDEM-X data covering our study region (© DLR 2022). We thank the Laboratorio di Archeologia Digitale of Sapienza University of Rome, directed by Julian Bogdani, for the logistic and technical support. Special thanks go to Antonio Curci, co-director with Maria Carmela Gatto of the Aswan-Kom Ombo Archaeological Project – AKAP and the many team members for their invaluable help in collecting data in the field and from AKAP's archives. We also thank the Center for Ancient and Middle Eastern Landscapes of the University of Chicago. Our appreciation goes to Kate Liszka and Brian Kraemer, Louise Rayne, Mohamed Osman, Rebecca Döhl, Linda Borrmann-Dücker, Ana Oliveira, Jade Bajeot and Dorian Vanhulle who in various capacities have provided information. We acknowledge the Egyptian Ministry of Tourism and Antiquities for permission to work granted to the Aswan-Kom Ombo Archaeological Project.

FUNDING INFORMATION

The research leading to these results has received funding from the Norwegian Financial Mechanism 2014–2021 through the Norway Grants and the National Science Centre of Poland (Grant no. POLS 2020/37/K/HS3/04097, PI Maria Carmela Gatto, Institute of Mediterranean and Oriental Cultures, Polish Academy of Sciences).

COMPETING INTERESTS

The authors have no competing interests to declare.

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TO CITE THIS ARTICLE:
Siegel O, Bogdani J, Urcia A, Nicolini S, Gatto MC 2024 The BORDERSCAPE Project WebGIS: State Formation and Settlement Patterns near the Ancient Egyptian Southern Border. *Journal of Open Archaeology Data,* 12: 7, pp. 1–10. DOI: https://doi.org/10.5334/joad.125

Submitted: 08 March 2024 **Accepted:** 05 May 2024 **Published:** 15 May 2024