

# Time-Layered Cultural Map of Australia

Paul Longley Arthur<sup>1</sup>, Erik Champion<sup>2</sup>, Hugh Craig<sup>3</sup>, Ning Gu<sup>4</sup>, Mark Harvey<sup>3</sup>,  
Victoria Haskins<sup>3</sup>, Andrew May<sup>5</sup>, Bill Pascoe<sup>3</sup>, Alana Piper<sup>6</sup>, Lyndall Ryan<sup>3</sup>, Rosalind  
Smith<sup>3</sup>, and Deb Verhoeven<sup>7</sup>

<sup>1</sup> Edith Cowan University, Western Australia

<sup>2</sup> Curtin University, Western Australia

<sup>3</sup> University of Newcastle, New South Wales, Australia

<sup>4</sup> University of South Australia

<sup>5</sup> The University of Melbourne, Victoria, Australia

<sup>6</sup> University of Technology Sydney, New South Wales, Australia

<sup>7</sup> University of Alberta, Edmonton, Canada

paul.arthur@ecu.edu.au

**Abstract.** This paper reports on an Australian project that is developing an online system to deliver researcher-driven national-scale infrastructure for the humanities, focused on mapping, time series, and data integration. Australian scholars and scholars of Australia worldwide are well served with digital resources and tools to deepen the understanding of Australia and its historical and cultural heritage. There are, however, significant barriers to use. The Time Layered Cultural Map of Australia (TLCMap) will provide an umbrella infrastructure related to time and space, helping to activate and draw together existing high-quality resources. TLCMap expands the use of Australian cultural and historical data for research through sharply defined and powerful discovery mechanisms. See <https://tlcmap.newcastle.edu.au/>.

**Keywords:** Deep Mapping, Distributed Network, Spatiotemporal Data, Statistical Analysis, Indigenous History.

## 1 Digital Infrastructure for the Humanities

### 1.1 Background

The Time-layered Cultural Map of Australia (TLCMap) is an online research platform funded by the Australian Research Council Linkage Infrastructure, Equipment and Facilities (LIEF) grant scheme in 2019 and currently under development. When completed, it will deliver researcher-driven national-scale infrastructure for the humanities, focused on mapping, time series, and data integration, and will expand the use of Australian cultural and historical data for research through sharply defined and powerful discovery mechanisms. The project website has recently been launched at <https://tlcmap.newcastle.edu.au/>. TLCMap will enable researchers to visualise hidden geographic and historical patterns and trends, and to build online resources which present to a wider public the rich layers of cultural data in Australian locations. TLCMap

is not a singular project or software application with a defined research outcome, but rather infrastructure “which creates the conditions of possibility for certain kinds of activities” (Brown et al.).

The main function of TLCMap is to generate web-based digital time-maps from spatiotemporal data for humanities’ needs, including time, layering, data, text, media, and virtual reality applications. Linking geo-spatial maps of Australian cultural and historical information, adapted to time series, represents a significant contribution to humanities research in Australia. For researchers, including those without extensive technical backgrounds, it has the potential to transform access to data and to visualisation tools and open new perspectives on Australian culture and history. For the public, it will enable increased accessibility to historical and cultural data through visualisations created by researchers and made available online and in print.

We are at a critical juncture where it is clear that interdisciplinary research underpinned by digital methods and standards is opening valuable new avenues for the humanities and social sciences. The increasing availability of humanities data at scale offers fresh opportunities for discovery through visualisation in maps and timelines, revealing hitherto invisible patterns of association. Ensuring maximum data sharing and interoperability of digital collections and tools is a technical priority for research infrastructure development internationally. Advanced technologies are allowing for the sharing, re-use, analysis and manipulation of data in new ways in digital contexts, and for individuals and groups to work together to solve shared research challenges.

TLCMap provides core features for combining newly created data sets with existing ones; for geocoding free text, as single samples and in large corpora; for discovery through spatial and temporal visualisation; and for disseminating research outcomes, by providing visualisations for conventional and new digital scholarly outlets, and for online platforms and established media outlets with a general audience. With TLCMap, Australian researchers will have an effective new tool for participation in the digital and spatial humanities. ‘Deep mapping’ has become an established technique in the last decade (Bodenhamer et al, 2010, 2015; Roberts, 2016), and there have been significant developments in geospatial research for cultural heritage (Nishanbaev et al, 2019). Multiple layers of many kinds of information can now be overlaid on places, with the associations made among these layers providing insights and understanding, deepening the meaning of a place. Such layering is one of the key aims of TLCMap, which not only provides tools for ‘distant reading’ of humanities material, but over time will deepen the cultural and historical record of Australia by facilitating the integration of new and existing datasets.

Project investigator Lydnall Ryan’s online *Colonial Frontier Massacres in Australia 1788–1872* map (<https://c21ch.newcastle.edu.au/colonialmassacres/map.php>), launched in mid-2017, shows the power of time-layered digital mapping in organising and disseminating information. It reveals hitherto hidden patterns of incidence in massacres, most obviously through the ‘time-slider’ which animates the map with a time dimension. Each massacre is linked to a detailed historical account in a database. There have been hundreds of responses on the website’s comments page, many from Aboriginal communities, and large numbers of page views reaching wide audiences (peaking on 27 July 2018 when there were 15,597 users in one day). Teachers, artists and film

makers have sought permission to use the *Map* in their work. The *New Yorker* magazine devoted a full article to the Map (6 December 2017). A Wikipedia article refers to the site as ‘perhaps the most significant work ever undertaken on the frontier wars’ death toll of black Australians’. The online interactive map is critical to the massacres project both for discovery and for social impact. TLCMap will make this functionality available for any new humanities project in Australia.

## 1.2 Project Aims

Australian scholars and scholars of Australia worldwide are well served with digital resources and tools to enhance the understanding of our country and its historical and cultural heritage (Arthur, 2019). There are, however, significant barriers to use. It is difficult to find accurate and comprehensive information about existing systems and data. Bespoke development is expensive and often focuses on specific project outcomes rather than re-use. Combining data from separate sources is difficult, integrating data and maps and timelines for new projects is slow and expensive, and automatically detecting place and time references in newly available digital texts of newspaper articles and printed books is still in its infancy. The imperative now is to capitalise on the prodigious effort and substantial investment in digital humanities data, by developing infrastructure which dramatically lowers the barriers to use.

The TLCMap infrastructure provides resources for end users to carry out time-sensitive humanities mapping for research and dissemination. It also provides infrastructural services (including user interfaces, visualisations, widgets and the ability to embed content, as well as APIs and web services) for other systems.

The aims of the project are to:

- Provide an online site where location and time data from available cultural and historical datasets can be retrieved and assembled;
- Provide an online facility for producing sophisticated data-rich maps combined with time series which can be exported;
- Provide an online facility to detect Australian and other place names and time references in free text and link these to places in a gazetteer and to a chronology of events significant to Australians; and
- Provide data integration, mapping, time-series and place and time models for incorporation in existing systems such as the Humanities Networked Infrastructure (HuNI) and the Heurist research-driven data management system.

## 1.3 Benefits and Impact

TLCMap will transform access to data and to visualisation tools for researchers in the humanities, including those without extensive technical backgrounds – revealing hidden geographic and historical patterns and trends, and helping them build online resources which present to a wider public the rich layers of culture in Australian locations. TLCMap aims to provide an online facility to create maps and timelines and combine new Australian cultural and historical datasets with existing ones. The project will

provide new tools for humanities researchers to be able to utilise resources already created, and in turn to enrich those sources with tagging and cross-referencing. By enabling more efficient spatial humanities research this project supports existing research strengths and develops research infrastructure for the broader humanities research community. The visualisations in time and space provided by TLCMap can assist researchers to communicate their findings in the public sphere. Outcomes will include the discovery of hitherto hidden patterns in Australian cultural and historical life and a deeper engagement by the wider public in this heritage.

Currently, humanities researchers aiming to map data in relation to space and time for their projects can utilise existing services and resources such as AURIN – the Australian Urban Research Infrastructure Network (<https://aurin.org.au/>), Austage – The Australian Live Performance Database (<https://www.ausstage.edu.au/pages/browse/>), AustLit (<https://www.austlit.edu.au/>), The Cultural Atlas Of Australia (<http://australian-cultural-atlas.info/CAA/index.php>), FAIMS – the Field Acquired Information Management Systems Project (<https://www.fedarch.org/>), GIS products such as Google and ArcGIS, Heurist, HuNI (<https://huni.net.au/#/search>), National Map (<https://nationalmap.gov.au/>), Omeka (<https://omeka.org/>), and Trove (<https://trove.nla.gov.au/>). However, this diversity and richness also present challenges, in particular:

- GIS and STEM-oriented mapping systems do not include time series functionality and the ability to process place and time information as perceived rather than as externally referenced;
- Systems such as Google Maps and Omeka offer basic functionality which would be ideal for small projects but which do not fulfil the needs of larger humanities research projects;
- Many of the systems are in need of improvement in user experience: Heurist, for example, has an extraordinary range of advanced features but is overwhelming for a new, uninitiated user; and
- There remains a wide gap between the individual humanities researcher and the ideal of feasible larger-scale and collaborative disciplinary outcomes utilising digital mapping for the humanities. This gap is in skills, discoverability, usability, integration, information workflow and compatibility.

Each separate system referred to above has valuable functions, and although many offer ways to share and embed or use web services, the individual interface stands alone and has limited functionality, incomplete in itself as support for a humanities mapping project. Users need ways to work across these systems. A researcher might wish to select datasets (as in National Map), find all things within a bounding box (as in AURIN or the Australian National Placenames Survey gazetteer), scrutinise them, and build a filtered collection from them (HuNI) – they might then wish to conduct a text search of Trove based on the results from the Gazetteer, and add that layer to their map, then augment and add data to it (Heurist). It is possible to provide relatively simple user interfaces for these functions which might take only a few minutes, or a workshop, to understand, rather than a six-month funded project employing developers. In this way

the infrastructure will increase the return on investment of any functionality in existing systems and data sources, by increasing use and through re-use and re-purposing.

The TLCMap user can import data in two ways – by uploading their own data from their computer, through a conventional find file or drag and drop web interface, or by selecting and importing data from pre-established sources, such as Trove, which will then be processed on the network without the user needing to download it. The user experience makes it simple to get a result in a few steps, for example by uploading a spreadsheet of tabular data, ticking a box to select an online dataset, and viewing them both on a map.

TLCMap includes a Text Map Text (TMT) system which will detect place names in unstructured text, create a digital map from them, and link map points back to mentions in the text. The TMT functionality already exists in an excellent published online example like Emily Lethbridge's *Icelandic Saga Map*, but to produce a similar web map project for another corpus, a humanities researcher would need to recreate it with funding for software developers and research assistance. Automated place name detection for Australian material was also available in the Queensland Cyber Infrastructure Foundation *Paper Miner* project. *Paper Miner* identified the place names in 400Gb of text from Trove. Yet this was a once-off operation, did not allow users to upload their own texts, and is no longer available in any case.

A prototype TMT has been developed at Newcastle to prepare for the TLCMap project. It allows a user to upload a corpus and produce a map which links back to the text in seconds. Comparison with hand-coded places in a test sample shows that it recognises and accurately maps 40% of the place names in the texts. TLCMap will build on this prototype and improve accuracy, add scalability and allow interactive place-name editing of corpora, to correct false positives and faulty locations, and add the place-names in the text not identified in the first pass. The prototype uses a default world gazetteer; TLCMap will incorporate the Australian National Placenames Survey gazetteer of current and historical Australian place names, after some data cleaning to allow automated harvesting of geocoding.

At present, the humanities researcher embarking on a project to harness available historical and cultural data about a region of Australia on a given topic, and to project this in time and space, needs to:

- Search for appropriate systems and determine their capabilities in relation to the project;
- Search for, select, filter, combine, augment and format data of varying volumes from various sources;
- Employ a cartographer and IT specialist to implement and customise or make a bespoke map or time series;
- Find ways to handle 'fuzzy' data in source material (eg: 'end of winter', '1 day north east of the island', etc);
- Add disused historical place names to a gazetteer; and
- Test and correct the final result and write up interpretive guides and user documentation.

This process requires substantial funding and a timeframe of at least six months in most cases. Generally, this means that the study is not even attempted. TLCMap can cater specifically for these needs and the full workflow above and reduce the time frame to days for some activities, with no funding requirement, and aims to encourage ambitious funded projects with vastly reduced timeframes.

## 2 Approach and Methodology

TLCMap focuses on mapping and linking data to maps, providing ready access and new interpretive tools for humanities researchers to take advantage of resources already created, and in turn to enrich those sources with tagging and cross-referencing. The approach involves having single national map and timeline infrastructure to avoid duplication in effort by creating a national platform open to continuing further development. It brings new perspectives to the various repositories of national geospatial resources, assisting in the evaluation of their strengths and weaknesses. By enabling more efficient spatial humanities research this project supports areas of existing research strengths and develops research infrastructure for the broader humanities research community.

The core methodology of the work involves rapid prototyping and the development of the TLCMap infrastructure is following an agile approach. The project has already moved quickly toward a minimum viable product which can be user-tested, refined and built on, and this is work-in-progress that will be reported on. The project is utilising existing systems where possible and focuses on interoperability. Research needs and available resources change rapidly so outcomes need to be delivered quickly in an adaptable way. Delivering results in a year is achievable and is the best way to equip Australian researchers with relevant, up to date infrastructure for world class research. The first prototype, currently under development, will be a searchable web database of descriptive and functional metadata for mappable Australian cultural datasets. The clearinghouse will provide:

- A tool for registering various types of spatial datasets (shapefiles, CSV, KML, GeoRSS, georeferenced and tiled images, and custom formats for specific Australian cultural collections) and entering metadata;
- Visual (map-timeline), thematic (faceted) and textual search of the metadata to identify appropriate datasets;
- An interactive, layered, time-filtered web map and timeline built from the selected datasets;
- Functionality to allow the user to interact closely with data and outputs and complete processes manually where the automated systems produce incomplete or inaccurate results; and
- Generation of RIF-CS metadata for ingest to the ANDS registry to avoid double-up of metadata entry.

The governance and administrative structure of TLCMap capitalises on this rapid-prototyping approach. Partner Universities are closely involved in design and implementation. A user consultation process is being led by a User Engagement and Experience Design consultant to determine priorities, and feed back recommendations to the software designers, and test prototypes. The Advisory Board is providing overall insight and champion the adoption of TLCMap across the humanities in Australia.

The project is interdisciplinary as it combines data from various fields and enable searching simply by spatial location and temporal assignment. Users of the infrastructure will be able to scan across various datasets in a way which may target a particular discipline, but may not, and its design will encourage serendipitous discovery across disciplines.

### 3 Management of Data

TLCMap champions sustainable storage of data, and the linking of data, following the FAIR (Findable, Accessible, Interoperable, and Re-usable) principles (Wilkinson et al, 2016) but will not itself hold data. Data will be preserved in enduring formats by the researchers and their home institutions. However, collating and mapping data brings cross-cultural and ethical challenges which TLCMap is currently addressing. The project investigators are familiar with these challenges. The planned multi-level registration system will operate where considerations of privacy or cultural sensitivity do not allow open access. Owners of existing platforms and datasets will be able to specify the access permitted for the material they introduce, from entirely open availability to access only for the participant.

### References

1. Arthur, P L.: Tracing the Development of Digital Humanities in Australia. In: R Wong, H L., Chou M (eds.) *Digital Humanities and Scholarly Research Trends in the Asia-Pacific*, pp. 1–18. Information Science Reference (IGI Global), Hershey, PA (2019).
2. AURIN. Melbourne: The University of Melbourne (2011–2016). <https://aurin.org.au>.
3. AusStage. AusStage and contributors, (2003–2017). <https://www.auststage.edu.au>.
4. Austlit. St Lucia: University of Queensland (2002–2017). <https://www.austlit.edu.au>.
5. Australian National Placenames Survey. Placenames Australia (Inc), Sydney (2017). <https://anps.org.au>
6. Bodenhamer, D. J. et al. (eds.): *The Spatial Humanities: GIS and the Future of Humanities Scholarship*. Indiana UP, Bloomington (2010).

7. Bodenhamer, D. J., et al. (eds.): *Deep Maps and Spatial Narratives*. Indiana UP, Bloomington (2015).
8. Brown, S., Clement, T., Mandell, L., Verhoeven, D., Wernimont, J.: *Creating Feminist Infrastructure in the Digital Humanities*. In: *Digital Humanities 2016: Conference Abstracts*. Jagiellonian University University, Kraków. <http://dh2016.adho.org/static/data-copy/532.html>
9. Commonwealth of Australia. *Draft 2016 National Research Infrastructure Roadmap*. Dept. of Education & Training, Canberra (2016).
10. *Cultural Atlas of Australia* St. Lucia, University of Queensland (2011–2017). <http://australian-cultural-atlas.info>.
11. FAIMS. *Field Acquired Information Management Systems Project*. Macquarie University (2014–2017), Sydney. <https://fedarch.org>
12. *FloraCultures*. Edith Cowan University, Perth (2016). <http://floracultures.org.au>
13. *Heurist*. University of Sydney (2013–2017), Sydney. <http://heuristnetwork.org>
14. *HuNI. Humanities Networked Infrastructure*. Deakin University, Melbourne. <https://huni.net.au>
15. Lethbridge, E.: *Icelandic Saga Map*. 2018. <http://sagamap.hi.is/is>
16. *NationalMap*. Department of the Prime Minister and Cabinet (2014–2015), Canberra. <http://nationalmap.gov.au>
17. Nishanbaev, I., Champion, E., McMeekin, D.: *A Survey of Geospatial Semantic Web for Cultural Heritage*. In: *Heritage* 2(2), pp. 1471–1498 (2019). <https://doi.org/10.3390/heritage2020093>, Open Access. <https://www.mdpi.com/2571-9408/2/2/93>
18. *Omeka*. Roy Rosenzweig Center for History and New Media, Fairfax (2007–2017). <https://omeka.org>
19. *Paper Miner*. QCIF, St. Lucia. <https://www.qcif.edu.au/index.php/projects/124-paper-miner-big-questions-in-history>
20. Powers, J. R., Dobson, A., Berry, H. L., Graves, A. M., Hanigan, I. C., Loxton, D. Roberts, Les (eds.): *Deep Mapping*. Special issue, *Humanities* 5.1, (2016).
21. Ryan, L.: *Colonial Frontier Massacres in Eastern Australia 1788–1872*. Newcastle (2017). <https://c21ch.newcastle.edu.au/colonialmassacres>
22. *Trove*. National Library of Australia, Canberra. <https://trove.nla.gov.au>
23. Wilkinson, Mark D., et al.: *The FAIR Guiding Principles for Scientific Data Management and Stewardship*. *Scientific Data* 3, 160018 (2016).
24. Wikipedia contributors. 'List of massacres of Indigenous Australians.' Wikipedia, The Free Encyclopedia, Web (13 Mar. 2018).