Developing the Cyberinfrastructure for a National Archaeological Site Database

FINAL PROJECT REPORT

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ACCOMPLISHMENTS

What are the major goals of the project?

The Digital Index of North American Archaeology (DINAA) currently has information on >492,000 archaeological sites from 15 states on file, and links it with information across a range of data repositories, using site number as a common identifier (DINAA 2016). Efforts to collect and compile archaeological data have a long history, and information about archaeological sites and collections is maintained by every state and territory. Only rarely, however, have these data been compiled and examined at large geographic scales, especially those crosscutting state lines, and never to the extent underway as the goal of this project. The DINAA team works with the archaeological site file databases held by State Historic Preservation offices and allied federal and tribal agencies in Eastern North America, developing protocols for their linkage for research and management purposes. Site files contain data and metadata about the chronology, location, and function of sites, among other information used by government officials and the research community alike, and can include diagnostic artifact descriptions, radiocarbon data, and bibliographic citations.

DINAA aggregates the data elements about scientific and cultural attributes of sites from agencies' site file records, and prepares these data for Web publication through editorial processes of standards alignment and data cleaning. The only sensitive data that DINAA solicits from agencies are the coordinate locations of sites, information transferred using secure protocols similar to those used for transmitting sensitive data on human-subjects. DINAA does not, however, publish or store coordinates online, instead, these files are maintained in encrypted files in offline machines, where software is used to allocates them to a 400 square kilometer grid for online visualization. Sensitive locational, ownership, and other information from state site file repositories is redacted before being linked into a series of datasets available to all users via the Open Context archaeological publication Web service. The primary goal of the 2012 NSF award was to integrate and link data from ca. 15 states (ca. half a million sites). At present, we have data on hand from 492,062 sites from 15 states, which meets the project goals (Figures 1 and 2). DINAA uses an informatics framework that promotes extensions and reuse by

government personnel in state and federal agencies, and domestic and international researchers. The integration of site file data at continental scales in a new and unique informational infrastructure allows, for the first time, the exploration of the North American archaeological record across multiple temporal periods and geographic regions.

The availability of DINAA output online in the form of maps and data tables (at significantly reduced spatial resolution, to protect sensitive locations) is enhancing researcher and public awareness, education, and appreciation for scientific research in general and archaeology in particular. DINAA has already attracted widespread attention among the digital data community as the utility of this approach is increasingly recognized (e.g., Alessa et al. 2015; Azmi et al. 2015; CARD 2015; IOSA 2015; Raviele 2015; Sheehan 2015:197, 205-207; J. Smith 2015; M. Smith 2015; Ullah 2015:332; Wilcke 2015:8-9). DINAA, with its initial 15 state sample, has demonstrated that vast amounts of primary archaeological data can be integrated and used to address fundamental questions about changes in human land use over time, the nature of the archaeological record collected over the past century, and how changes in climate will affect site preservation and heritage management. Interest in DINAA is stimulating and feeding into similar efforts worldwide. Rather than dictating data management procedures or requiring systems centralization, DINAA fosters archaeological cooperation, independent development and experimentation, through integration of distributed systems managed by a host of institutions. This approach enables community wide participation and intellectual investment in archaeological informatics, making our cyberinfrastructure shared and useful for all.

Major activities

Activities during the fourth and final year of the project under this award included expanding the technical and organizational framework developed in Years 1 and 2 to coordinate among the researchers and state site file managers who provide and create new source data for the DINAA project. As detailed below, by the end of Year 3 we had site file managers and other agency personnel from 15 different states as well as scholars from several institutions working directly with the DINAA team. During Year 4, we initiated contacts with site file managers in the remaining United States, and several more states joined the effort. We have integrated data from 15 states so far, which has permitted researchers the opportunity to test the capabilities of the DINAA database and refine the workflow for the project. We are, in fact, now able to add new state data into DINAA fairly quickly, meaning the feasibility of the project as proposed has been demonstrated, and its potential for growth is open ended.

Major activities during the fourth year of the project included preparation for online publication and indexing of massive data sets--the site file information--from four more states (we had ten completed by the end of the first year, 11 by the end of the second year, and had four more completed but not yet posted by the end of the third year). Workshops, two in the second year and one each in the third and fourth years of the project, facilitated extensive communication between project participants, data contributors, and researchers, and helped successfully demonstrate DINAA's capabilities for cleaning, integrating, and using real data. Project documentation, products, software, and datasets are maintained and disseminated through Open Context (DINAA 2016), which includes the publication of ontologies needed for semantic data integration of site file datasets and new map-based browsing and visualization interfaces and Web services.

The fourth DINAA workshop took place in Washington D.C. in June 2016 with DINAA core team members and National Park Service archaeologists and archaeological data managers. Project principals E. Kansa and J. Wells, and DINAA employee K. Myers, presented DINAA's current implementation, data cleaning, and security practices with personnel in charge of the NPS Archaeological Sites Management Information System, the NPS Cultural Resources GIS, and the NPS office for National Native American Graves Protection and Repatriation Act (NAGPRA) policy. This workshop was a critical first step toward recognizing intersections between DINAA and NPS data management strategies for development of methods to include NPS information in DINAA as well as to facilitate NPS use of DINAA as an information resource. NPS National NAGPRA staff also helped the DINAA team recognize online, machine-readable NAGPRA notices in the Federal Register which can add further information facets to DINAA (recognition of NAGPRA processes for sites in queries) as well as broader impacts (potential use of DINAA in NAGPRA outreach, education, and consultation).

The 2016 workshop complemented three previous highly productive workshops held in in 2014 and 2015. The first of the three, in March 2014, was held at the University of Tennessee and involved 31 participants, including data providers from nine states. A second workshop, held in August 2014 at the University of Indiana, South Bend, aimed at incorporating data from states already a part of the DINAA project, as well as from one new state, Mississippi. The second workshop also included several days dedicated to streamlining technical developments, planning the dissemination of research outcomes resulting from integrated DINAA data, and discussing long-term plans for the DINAA project. The third workshop, held in June 2015 in Laramie, Wyoming, involved interaction with site file managers from the western US, as well as archaeologists associated with the Canadian Archaeological Radiocarbon Database project, which is expanding to include US information that can be linked to DINAA (CARD 2016). Site file data from Wyoming was offered to the DINAA project, with an agreement to be worked out in the final project year.

The DINAA team has thus processed information on ca. 500,000 sites in 15 states, and communicated with every State- and Tribal Historic Preservation Office (SHPO, THPO) in Eastern North America. As of December 2015, during the fourth year, the DINAA team has contacted all 49 site file managers in the continental US, and will continue to expand our contact with THPOs to encompass all of those from federally recognized tribes in North America.

To date our team members have published three papers (Kansa 2016; Wells et al. 2014, 2015) with another several in press, review, or preparation, and made over three dozen blog, poster, and oral conference presentations on the DINAA project (e.g., Anderson 2015a, 2015b, n.d; Anderson et al. 2014, 2015a, 2015b, 2015c, 2015d, 2015e, 2016a, 2016b, 2016c, n.d.; DeMuth et al. 2014a, 2014b; 2015, 2016; Dull et al. 2014; E. Kansa et al. 2013, 2014a, 2014b; 2015a, 2015b; S. Kansa et al. 2015; Myers et al. 2014, 2015; Wells et al. 2013a, 2013b, 2013c, 2014a, 2014b, 2014c, 2014d, 2015, 2016a, 2016b; Yerka et al. 2014, 2015).

Specific Objectives

Our progress during the fourth twelve months of the project toward specific objectives has included:

1. Data Collection: The majority of the first four years of the project has involved the collection and description/organization of site file data structures and primary information, in collaboration with SHPO, THPO, and federal agency managers. The first step is a formal request for site file data, which during Year 4 was made to every SHPO in continental North America, following up on requests made to site file managers in Eastern North America during the first three years. Following discussion and preparation of agreements related to data access and use, these agencies entrust DINAA with their archaeological database, either in its entirety or with some information redacted (as detailed in the agreements). RPA-certified personnel on the DINAA team, working in offline secured environments, redact coordinates and other sensitive information from the records before their use in DINAA. Project principals analyze each dataset to determine variations in ontological structures of key archaeological terms and concepts, forms of quantitative data representation, expression of geolocational coordinates, and purposes and forms of ancillary data (site quality, previous investigations, ownership, etc.). During Year 3 we reached our goal of producing a data set spanning 15 contiguous states in eastern North America. By the end of Year 3, 11 datasets were published online, with site file data from an additional four states (Ohio, Pennsylvania, Maryland, and North Carolina) awaiting publication. In Year 4 data integration continued, with another several new states joining the effort.

2. Data Integration: During Year 3, building on earlier work, we completed development of an integrated database structure by implementing (1) an ontological bridge for qualitative concepts, and (2) a combined site file dataset with cleaned and standardized quantitative data and original qualitative data. This database structure enables search and visualization for the 383,910 sites from the 11 data sets currently published in DINAA. In year 4 the remaining five states were added, for a total just under half a million sites (n=492,062), and contacts were made with personnel in several more states about joining the effort (DINAA 2016).

3. Solicitation of Testers: During Year 4 of the project, prototype DINAA structures that had been posted the previous year were available for examination, and were used to conduct exploratory research (e.g., Anderson et al. 2015c, 2016, n.d.; DeMuth et al. 2015, 2016; Meyers et al. 2015; Wells et al. 2015, 2016b). These included as distribution maps, site lists, and associated metadata related to the Paleoindian, Archaic, Woodland, Late Prehistoric and Historic periods across the total site sample, with finer subdivisions of each period also provided (Figure 3). We have been directing researchers to this information and asked for their feedback. In addition, the project principals, because of their particular research histories, have also been conducting tests with the DINAA datasets, with results presented in a number of conference papers and posters. The data as presented in DINAA appears quite sound, both at showing where archaeological survey and other fieldwork has occurred (i.e., large concentrations of sites are commonly found on federal installations), and where people were living in the past (i.e., large numbers of sites are found near major watercourses).

4. Uses of DINAA data: With the published data sets, project principals continued several specific research projects to demonstrate the potential of large-scale, integrated data sets. As noted, DINAA permits detailed quantitative and qualitative analyses at unprecedented scale between cultural resource and environmental datasets. Projects initiated in Year 3 and continued in Year 4 include an investigation of the impact of sea level changes on North American archaeological sites, by the DINAA team members and coordinated by David Anderson, Stephen Yerka, and Thad Bissett and the DINAA team. DINAA examined how sea-level rise will impact

cultural resources across the Gulf and Atlantic coasts of the southeastern United States (Anderson n.d.; Anderson et al. 2014, 2015b, 2015c, n.d.) (Figure 4, Table 1). Tens of thousands of historic and prehistoric archaeological sites, and thousands of properties on the National Register of Historic Places, which include archaeological sites, structures, and other cultural property types, will be submerged in the next century alone, given conservative sea-level rise projections, and population and infrastructural shifts inland (i.e., Dasgupta et al. 2009; Donoghue 2011). A paper by Josh Wells and DINAA workshop participants (Wells et al. 2014) examined uses of DINAA in resource management and collaboration. In another example, Andrew White (2014), a researcher investigating household structures for Woodland period sites in the Midwest and South incorporated DINAA identifiers in his online database, the Eastern Woodlands Household Archaeology Database Project (EWHADP). White's project provides a key demonstration of "Linked Data", since his online data and DINAA cross-reference each other. In doing so, his datasets are precisely related to DINAA data, and the DINAA search interface can be used to discover data about ancient households compiled and curated by White. This demonstration shows how different online systems can work together in a complementary manner to enhance research on ancient North America. DINAA's Linked Open Data thus cross-references distributed collections on the Web, enabling users to find and access relevant data in other online datasets, using site numbers as the common identifier. Such linkages have been initiated with a number of other online datasets (see below).

Significant results

DINAA has developed, for the first time, protocols to integrate archaeological site file data from large areas of North America into a unified database structure, and make these capabilities readily available to a wide variety of user communities. Results from the fourth year of the project include:

1. Communication and partnerships: Project principals spent a significant amount of time during Years 1 and 2 in communicating project procedures and objectives, and establishing the trust and understanding essential to good working relationships with the participants in the 15 states comprising our initial sample. Developing procedures for clear communication and trust-building was the single greatest challenge we had to overcome, but once established proved to be an essential foundation for the project, and led to successfully obtaining and integrating data from participating states in Year 2, as well as the collection of data from an additional five sites whose integration occupied Years 3 and 4 efforts. The first workshop in March 2014 was a critical milestone for the project because it helped in establishing a working, face-to-face dialogue between project principals and state representatives, as well as building ties between the state representatives themselves. It was so successful that a second, smaller workshop was held in August 2014, a third in June of 2015, and a fourth in May of 2016.

2. Data import and integration: In Years 3 and 4 we completed the process of importing and integrating site files held by 15 State Historic Preservation Offices (SHPOs) and allied federal and tribal agencies, and initiated contacts with comparable personnel in the remaining parts of the country. These files contain unique site identification numbers, cultural affiliations, descriptions of condition and use, and location and management information, as well as ancillary information about site integrity and quality, diagnostic artifacts, associated collections and reports, and investigative methods. Our target for the project was 15 states. In Year 4, having reached this goal, we initiated contacts with SHPOs in all the remaining United States in

continental North America, with the objective of preparing for subsequent efforts. So far an additional six states have agreed to participate, bringing the total to 21 so far, and discussions are ongoing with many more (Figure 1).

3. Development of ontologies: We completed the development of an ontology for semantic integration of the site file data in Year 2, and continued to refine its use in Years 3 and 4. This ontology permits information from separate states to be combined for use in analysis and report/map generation. We use GitHub as a version control and collaboration tool to facilitate ontology development and promote transparency in our efforts. All revisions, changes, and discussion related to the ontology are publicly tracked and available for inspection and comment by the wider community. The ontology is publicly accessible (DINAA OWL 2016) online at https://github.com/ekansa/oc-ontologies/blob/master/vocabularies/dinaa.owl. The ontology is expressed in OWL (the Web Ontology Language), an open-standard widely supported in semantic Web applications. Because OWL is also supported by tDAR, our efforts with DINAA complement other information systems serving the archaeological community.

4. Web-Scale Data Integration: DINAA's Linked Open Data cross-references distributed collections on the Web, enabling users to find and access relevant data in systems like Archaeology Southwest, the Paleoindian Database of the Americas (PIDBA), the Eastern Woodlands Household Archaeology Database Project (EWHADP), the Canadian Archaeological Radiocarbon Database (CARD), the Digital Archaeological Archive of Comparative Slavery (DAACS), the Chaco Research Archive (CRA), and The Digital Archaeological Record (tDAR) (Figure 5). DINAA already indexes cross-references to many of these systems, and letters of commitment demonstrate how the other systems will incorporate DINAA. Aggregators, such as Pelagios (a collaborator with DINAA), can then "harvest" cross-references between different systems to present users with services, maps, and visualization tools to discover related data and other media that relate to DINAA curated site files. DINAA can serve as a key node in connecting North American archaeological data, especially radiocarbon databases and paleoenvironmental databases. In providing stable Web identifiers for sites, a key conceptual point of reference, multiple datasets can be related together through DINAA identifiers.

5. Other software development and testing: DINAA dataset has an important geospatial component, even though specific site location coordinates are not provided, for legal and ethical reasons (Figure 6). To enable map-based browsing and visualization of geospatial data, we made significant progress on new features for Open Context (http://opencontext.org). To meet the geospatial data needs of DINAA, Open Context has been undergoing significant revision and improvements. The new version of Open Context makes use of several Linked Data standards to promote interoperability, most notably using GeoJSON expressed as JSON-LD. This approach enables "backward" compatibility with widely used software that supports the GeoJSON standard, but also greater semantic precision needed for research applications as expressed with JSON-LD. A demonstration prototype of the GeoJSON service currently powers an alternative visualization/interface of DINAA data. In addition, the next version of Open Context supports enhanced data table export features (CSV format) to make it easier for Excel users to work with "dumps" of raw data published by Open Context. This new export feature is completed and is used to support the project team's study exploring the impact of sea-level rise on archaeological site management. The new source code for Open Context (open-sourced under a GPL Version 3 license) is at: https://github.com/ekansa/open-context-py

Key Outcomes or Other Achievements

1. DINAA data sets
While the goal of the DINAA project is ultimately to integrate data from all 49 states on the North American continental mainland and eventually states and territories beyond, as well as from other countries, we set a goal of 15-20 states for the project period. To date we have 15 partners who have transferred data and several others who have agreed to do so (Figures 1 and 2). DINAA has data for the following states:

Alabama (27,581 sites)
Florida (33,038 sites)
Georgia (53,190 sites)
Illinois (59,512 sites)
Indiana (41,463 sites)
Iowa (26,834 sites)
Kentucky (18,789 sites)
Louisiana (19,091 sites)
Maryland (13,342 sites)
Missouri (32,566 sites)
North Carolina (11,157 sites)
Ohio (49,344 sites)
Pennsylvania (21,824 sites)
South Carolina (28,261 sites)
Virginia (42,479 sites)

The DINAA team has initiated discussion with site file managers and the National Association of State Archaeologists (NASA) about how to incorporate the remaining 34 states in North America, including Alaska; six have already committed (Figure 1). These include: Colorado, Connecticut, Kansas, Maine, Mississippi, and New Hampshire.

2. DINAA Workshops: DINAA has held four workshops involving site file managers and government agency personnel to date, two in 2014, one 2015, and one in 2016, allowing managers to learn from each other and improve overall practice while growing DINAA. Earlier efforts involving site file managers led to the recognition that important information on settlement and land use was present in the combined and mapped data, although these efforts were comparatively small in scale (i.e., a few states) and difficult to implement and illustrate (e.g., Anderson 1996; Anderson and Horak 1995; Wells 2011). DINAA has made these tasks simpler while incorporating much wider arrays of information.

Workshop 1 (March 2014): A two-day workshop of project partners was held in Knoxville in March 2014, bringing together site file managers and researchers, to highlight what had been accomplished in DINAA, the state of site file management in the region, and how to proceed in the future (Figure 7). In time for the workshop, the DINAA team successfully integrated and published archaeological data from 8 states east of the Mississippi. The data include rich chronological, legal, and environmental metadata used by government officials and the research community alike. A total of 31 people attended the March workshop, 29 in person and two

participating remotely by Skype. These included representatives from 9 state agencies providing site file data (AL, FL, IA, IL, KY, LA, MO, PA, and VA) and one observer from a state as of yet uncommitted (TN), as well as personnel from museums, libraries and federal agencies, The participants spent two days discussing the challenges of working with archaeological site files, tools they'd like to develop to make their work more streamlined, and what they would like to see from the DINAA project. A shared goal was making the information they controlled more accessible to public, research, and management communities. For most participants, this was the first time they had met their peer site file managers from other states and had the opportunity to discuss data management. The participants were enthusiastic (indeed, 'thrilled' would be a more accurate word) about the opportunity to learn how their peers work and to exchange ideas on ways to improve their data documentation, presentation, and management. One of the key outcomes of the DINAA workshop was this cross-pollination of site management expertise across state lines. In addition, workshop participants explored a variety of methods and tools popular in open science and digital humanities applications. These ranged from linked data methods, ontologies, web mapping and GeoJSON, and most popular of all, OpenRefine's data clean-up tools. Most site file managers present found the tools used by the DINAA team to facilitate the standardization and integration of data to be directly relevant to their own work.

Workshop 2 (August 2014): Because Workshop 1 produced so much helpful feedback and face-to-face time to focus on technical developments, and after consultation and approval from NSF, we decided to use residual funds for a second, smaller workshop, which took place in South Bend in August 2014 (Figure 8). The aim of DINAA Workshop 2 was to continue training about DINAA, as well as solicit additional feedback on ways that the DINAA project can expand in size and utility. The two-day workshop included a demonstration of the DINAA data browser, and discussion of methods of database construction and secure data handling practices. The workshop was attended by nine people, including two independent researchers who will serve as data testers and partners, and one site file manager who did not attend the initial workshop.

Workshop 3 (June 2015): A third DINAA workshop was held in June 2015 in Laramie, Wyoming (Figure 9). It included contact and interaction with site file managers from the western US, as well as archaeologists associated with the Canadian Archaeological Radiocarbon Database project, which is expanding to include US information that can be linked to DINAA (CARD 2015). Training in what DINAA was and how it operates was covered, as well as how to integrate data from differing cultural areas. Incorporating site file data from Wyoming was explored, with an agreement to be worked out in the final project year.

Workshop 4 (June 2016): The fourth DINAA workshop was held in Washington D.C. in June 2016 with DINAA core team members and National Park Service (NPS) archaeologists and archaeological data managers, as described under major activities. This workshop was a critical first step toward recognizing intersections between DINAA and NPS data management strategies for development of methods to include NPS information in DINAA as well as to facilitate NPS use of DINAA as an information resource. NPS National NAGPRA staff also helped the DINAA team recognize online, machine-readable NAGPRA notices in the Federal Register which can add further information facets to DINAA (recognition of NAGPRA processes for sites in queries) as well as broader impacts (potential use of DINAA in NAGPRA outreach, education, and consultation).

What opportunities for training and professional development has the project provided?
DINAA has funded graduate students, and assisted their training in critical information management skills for the 21st century. At the University of Tennessee one graduate PhD student, Thaddeus G. Bissett, M.A., R.P.A., worked on the project throughout the second year, and assisted in analyses with DINAA data during the third year. He graduated with his PhD in 2014, and continued to work on a voluntary basis (he had taken a job elsewhere) developing research applications, specifically with Stephen J. Yerka on how DINAA data can be used to track site loss due to sea-level rise.

At Indiana University, two graduate students on the Bloomington campus are directed in activities by Dr. Wells from the South Bend campus. Ms. Kelsey Noack Myers, M.A., R.P.A., and Mr. R. Carl DeMuth, have been employed as part-time hourly members of the DINAA staff. As a registered professional archaeologist, Ms. Noack Myers is capable of dealing with sensitive site location data if necessary. These two employees have undergone professional development with a variety of digital resources, including secure data transfer standards using the Indiana University Slashtmp system, MS-Access database standards and other database systems, Protégé ontology editor and OWL web ontology language, and the software development web-hosting service GitHub. These two employees have created individual and comparative prospectuses for state archaeological data structures based on data transfers to DINAA, metadata transfers to DINAA, and online guidebooks and other public metadata made available by individual state offices. The work of these students has been integral to the assessment of various state standards in data management for project planning purposes, to the development of "pick lists" of data types communicated to state partners, to the inspection of data shared with DINAA, and to the production of numerous DINAA conference presentations (see below), for which these employees were listed as co-authors. Ms Kelsey Noack Myers, MA, RPA, has since been appointed Tribal Archaeologist for the Chippewa Cree, and is currently serving as a liaison about DINAA with tribal educators.

Opportunities for professional development and training also presented themselves in unexpected ways through planned DINAA events and interactions. The workshops, poster events, paper presentations, and social media initiated by the DINAA research team have opened dialogue and communication channels with professionals with many years of experience working with site file data and processes. Learning experiences and training opportunities although not structured specifically (and most often impromptu) have become a vital component in information sharing in the project. Stephen Yerka has found particularly valuable the opportunity to connect and speak with professionals and passionate scholars about themes in the field, changes to protocol and the most important aspect: learning the schema and structure (i.e. real vs ideal) how the archaeological community produces, organizes, transfers and consumes these data. As DINAA moves into the next phase it must do so as a community of scholars engaged in a collective dialogue.

How have the results been disseminated to communities of interest?
Since DINAA's inception, the project team has communicated in a variety of ways with active and potential project participants, as well as with any others interested in following the project's developments, through conference presentations, blog posts, and direct email communications.

Our communications during the third year of the project included an increased number of public communications, mostly conference papers and posters, in order to broadly disseminate the results of the DINAA project. DINAA aggregates archaeological data documenting human activities from multiple agency sources and is already the most comprehensive and detailed database documenting human settlement in North America. Open Context, an open access data dissemination service for archaeology, hosts DINAA on the Web (DINAA 2016). The public can download maps, citation records, and other information from the combined site records (no coordinates or other sensitive data are present online) free of charge, and free of intellectual property restrictions. In recognition of their contributions to advance "Open Science", the White House recognized Open Context's Program Director, E. Kansa, as a Champion of Change in June 2013. The German Archaeological Institute (DAI), the national heritage body for Germany, now mirrors Open Context, including all DINAA data, and provides some financial support for continued Open Context development.

1.Publications

To date our team members have published two papers (Wells et al. 2014, 2015) with another several in press, review, or preparation, and made over three dozen blog, poster, and oral conference presentations on the DINAA project (e.g., Anderson 2015a, 2015b, n.d; Anderson et al. 2014, 2015a, 2015b, 2015c, 2015d, 2015e, 2016a, 2016b, 2016c, n.d.; DeMuth et al. 2014a, 2014b; 2015, 2016; Dull et al. 2014; E. Kansa et al. 2013, 2014a, 2014b; 2015a, 2015b; S. Kansa et al. 2015; Myers et al. 2014, 2015; Wells et al. 2013a, 2013b, 2013c, 2014a, 2014b, 2014c, 2014d, 2015, 2016a, 2016b; Yerka et al. 2014, 2015).

2. Paper and poster presentations at major conferences

Midwest Archaeological Conference (Columbus, OH, October 2013)

Poster by Joshua J. Wells: *Building the Big Picture on Eastern North American Prehistory: Initial Findings from the Digital Index of North American Archaeology*. (with co-authors Eric C. Kansa, Sarah Whitcher Kansa, Stephen J. Yerka, R. Carl DeMuth, Kelsey Noack Myers, Thaddeus G. Bissett, and David G. Anderson). Demonstrated what DINAA is and how it works.

Society for American Archaeology (Austin, TX, April 2014), where DINAA principals presented two oral papers and four posters:

Presentation by D.G. Anderson: *Using CRM Data for 'Big Picture' Research,* detailing the importance of CRM research in the development of American archaeology over the last forty years. Giving credit to the hundreds of thousands of technical reports, site file records, and collections and other forms of archaeological data stemming from ever-increasing amounts of CRM research, Anderson argued that compiling and integrating this data is the basis on which big picture research can now be accomplished. As technology and storage have caught up with the massive scale of new archaeological questions, digital repositories like DINAA can be utilized as highly effective tools.

Presentation by J.J. Wells: *Public Data for Public Archaeology: Developing Linked Open Data, Open-Source GIS, and Sensitive Data Standards for the Digital Index of North American Archaeology* (with co-authors (E. Kansa, S. Kansa, Yerka, Noack Myers, DeMuth and Bissett), discussing the relationships between archaeological linked open data and the very same "Big Data" discussed by Anderson. Intersecting with law, research, education, and ethics, the perspectives of anthropology, informatics and cybernetics accommodate a unique look at the

broad scope of implications of this type of research and work to prevent disuse, misuse and abuse as we navigate new human vs. technological problems.
Poster by E. Kansa: *Navigating and Visualizing Archaeological Data on Vastly Different Scales* (co-authored with S. Yerka, S. Kansa, D.G. Anderson, R.C. DeMuth and J.J. Wells), addressed how archaeological research can focus closely on individual objects, or cover a broad span of time over multiple millennia and continents. Data indexing managed by Open Context for DINAA facilitates these types of multiscalar research, hierarchically nesting both temporal and geographic data with a simplified interface and spectacular visualization.
Poster by K.N. Myers: *The Anthropology of Archaeological Data Collection and Management* (with co-authors DeMuth, Wells, Yerka, Bissett, Anderson, S. Kansa, and E. Kansa), detailed the process of defining cultural terms based on published archaeological literature and delineating the ways in which archaeological data are organized based on the aspects that are held to be most pertinent. By demonstrating the differences in metadata terminology choices, the use and associations of words can be made more explicit.
Poster by R. Carl DeMuth: *Examining DINAA's Potential To Reframe Our Archaeological Vocabulary* (with co-authors Noack Myers, Bissett, Anderson, Wells, S. Kansa, E. Kansa and Yerka) asked viewers to consider the terms used by State Historic Preservation Offices (SHPOs) and the effects discordant vocabularies may have on the interoperability of database research between states, while highlighting DINAA's translation abilities as a tool for approaching multi-state analyses.
Poster by Bryan Dull: *Archaeology and Open Source Learning: Uses of DINAA for University Courses in Culture Areas, GIS, Heritage Management, and Outreach* (with co-authors Wells, Yerka, E. Kansa, Anderson, S. Kansa, Noack Myers, DeMuth, and Bissett), provided a look at the DINAA online tool available to the public, this poster demonstrated several examples of the applicability of DINAA to hands-on learning projects in several areas of learning that focus on real archaeological datasets.

Public lecture by Eric Kansa April 2014 featuring DINAA at the University of Pennsylvania's Digital Humanities Forum: *Research on a Global Scale: The Radical Potential* (http://humanities.sas.upenn.edu/13-14/dhf_opendata.shtml)

Public lecture by Eric Kansa Sept. 2014 featuring DINAA at Washington University in St. Louis (http://dss-kansa.doattend.com/)

Midwestern Archaeological Conference (Champaign, Illinois, October 2014)
Poster by J.J. Wells, A.A.White, and project principals on *From the Household to the Changing Landscape: Linked Open Data Perspectives on Eastern North American Cultural Heritage with the Digital Index of North American Archaeology*

Ethnohistory Conference (Indianapolis, Indiana, October 2014)
Invited Panelist J.J. Wells discussed *Approaching Ethnohistory through the Digital Index of North American Archaeology (DINAA)* on digital innovations in ethnohistory.

Southeastern Archaeological Conference (Greenville, South Carolina, Nov. 2014)
Poster by D.G. Anderson and project principals: *Linking Archaeological Data at a Large Scale: The Digital Index of North American Archaeology (DINAA)*

Society for American Archaeology (San Francisco, California April 2015)
DINAA principals gave an oral presentation and hosted a poster session entitled "The Acid Test: Exploring the Utility of the Digital Index of North American Archaeology (DINAA) for Use in Applied Research" that was organized by Stephen Yerka and Kelsey Noack Myers. The presentations included:
Poster by Anderson, D.G., S.J. Yerka, E.C. Kansa, S.W. Kansa, J.J. Wells, T.G. Bissett, R.C. DeMuth, and K.N. Myers. 2015a. *Big Data & Big Picture Research: DINAA (The Digital Index of North American Archaeology) and the Things Half a Million Archaeological Sites Can Tell Us.*
Poster by DeMuth, R.C., K.N. Myers, S.J. Yerka, D.G. Anderson, J.J. Wells, E.C. Kansa, and S.W. Kansa. 2015. *The Modern United States of Historical Archaeology Site Reporting: A Multi-state Analysis of Reported Historical Archaeological Sites Archived in the Digital Index of North American Archaeology.*
Poster by Kansa, S.W., E.C. Kansa, A. White, D. G. Anderson, S.J. Yerka, K. Noack Myers, R. C.DeMuth, T.G. Bissett, and J.J. Wells. 2015. *DINAA and Bootstrapping Archaeology's Information Ecosystem*. A poster presented in the session "The Afterlife of Archaeological Information: Use and Reuse of Digital Archaeological Data" organized by Leigh Anne Ellison.
Poster by Myers, K.N., S.J. Yerka, D.G. Anderson, J.J. Wells, S.W. Kansa, E.C. Kansa, and R.C. DeMuth. 2015. *Ouiatenon and its Informational Analogs Making Connections in Colonial Archaeology Less Hard to Handle with Digital Index of North American Archaeology (DINAA).*
Poster, by Yerka, S.J., K.N. Myers, R.C. DeMuth, D.G. Anderson, S.W. Kansa, J.J. Wells, and E.C. Kansa. 2015. *Built to Last: The Paleoindian Database of the Americas (PIDBA) and Openly-shared Primary Data Meet the Digital Index of North American Archaeology (DINAA).*
Discussant by D.G. Anderson for the forum *Building Archaeological Research Communities with Cyberinfrastructure* organized by M. Scott Thompson, 17 April 2015,.

Public lecture by D.G. Anderson on *Big Picture Research in North American Archaeology*. Banquet speaker, Annual Meeting of the Louisiana Archaeological Society, Leesville, Louisiana, 21 February 2015

Disasters, Displacement, and Human Rights Conference (Knoxville, TN., 26 September 2015)
Presentation by Anderson, D.G., S.J. Yerka, J.J. Wells, E.C. Kansa, and S.W. Kansa. *Climate Change and the Destruction of History: Documenting Sea Level Change and Site Loss Using DINAA (Digital Index of North American Archaeology).*

First Floridians Conference (Monticello, Florida, 2 October 2015)
Presentation by Anderson, D.G., T.G. Bissett, D. Echeverry, D.S. Miller, A.M. Smallwood, and S.J. Yerka. *PIDBA (Paleoindian Database of the Americas), Sea-level Change, and Paleoindian Settlement in the Southeastern United States*.

Southeastern Archaeological Conference (Nashville, Tennessee, 19 November 2015)
Poster presented by Anderson, D.G., S.J. Yerka, E.C. Kansa, S.W. Kansa, J.J. Wells, R.C. DeMuth, K.NN. Myers, and T.G. Bissett. *DINAA (The Digital Index of North American Archaeology) and the Future of Big Picture Research in Southeastern Archaeology*.

Society for Historical Archaeology (Washington, D.C., January 2016)

Presentation by DeMuth, R. Carl, Kelsey Noack Myers, Joshua J. Wells, Stephen J. Yerka, David G. Anderson, Eric C. Kansa, and Sarah Whitcher Kansa. 2016. *Building a New Ontology for Historical Archaeology Using the Digital Index of North American Archaeology.*
Presentation by Wells, Joshua, R. Carl DeMuth, Kelsey Noack Myers, Stephen J Yerka, David G. Anderson, Eric C. Kansa, and Sarah Whitcher Kansa. 2016b. *The Big Data History of Archaeology: How Site Definitions and Linked Open Data Practices are Transforming our Understanding of the Historical Past.*

GeoSym 2016 (Knoxville, Tennessee, February 2016)
Presentation by: Anderson, David G., Thaddeus G. Bissett, Stephen J. Yerka, Joshua J. Wells, Eric C. Kansa, Sarah W. Kansa, Carl C. DeMuth, and Kelsey Noack Myers. 2016b. Climate Change and Archaeological Site Destruction in the Southeastern United States: The Role of DINAA (Digital Index of North American Archaeology) in Big Picture Research. A paper presented in the GeoSym 2016 Symposium "Mapping Outside the Lines: Geography as a Nexus for Interdisciplinary and Collaborative Research" Knoxville, Tennessee 6 February 2016.

Society for American Archaeology (Orlando, Florida, April 2016)
Presentation by Anderson, David G., Thaddeus Bissett and Martin Walker. 2016. *Climate Change and Cultural Response in Southeastern North America*. Paper presented in the Symposium Understanding the Nature and Timing of Human Responses to Environmental Change, organized by Jon Lohse and Myles Miller.
Presentation by Wells, J.J., E. Kansa, S.W. Kansa, D.G. Anderson and S.J. Yerka. 2016a. *DINAA Means "Everybody Can Be a Digital Curator": Community-Powered Disciplinary Curational Behaviors with the Digital Index of North American Archaeology (DINAA).* Paper presented in the Symposium What do we mean by "Digital Curation?", organized by Francis McManamon and Julian Richards.

3. Other Public Outlets
Project website: Updates and general communications are shared on the project website: http://ux.opencontext.org/blog/archaeology-site-data/ and include the following material:

1. Data transfer instructions
2. An overview of initial data presentation and navigation features:
3. Information about the March 2014 DINAA workshop in Knoxville

Outreach activities: DINAA principals and staff provided outreach communication about the project and its activities to interested professionals and the general public through several venues.
1. **Invited public lec**ture at the Iowa Office of the State Archaeologist, at the University of Iowa by Wells in December 2013.
2. **Invited presentation** to the European Union policy group, Recommendations for Open Access to Research Data in Europe (RECODE) by Joshua Wells (March 2014), "DINAA: Archaeological Data Sharing and Management in a Federated System." (No NSF funds were spent on this trip, all expenses were sponsored by RECODE).
3. **Blog post** for the Day of Archaeology Project: Wells, Joshua. 2014. "A Day in the Digital Index of North American Archaeology." *Day of Archaeology*.
http://www.dayofarchaeology.com/tag/open-science

4. **Blog post** for the OpenSource.com series of articles celebrating Open Science Week: Myers, Kelsey Noack. 2014. “Public Archaeology with Open Data and Open Source GIS. *OpenSource.com*. http://opensource.com/government/14/6/Digital-Index-of-North-American-Archaeology
5. DINAA Twitter account (@dinaa_proj) Public updates on current developments
6. **Blog Post** by the DINAA core team for Tennessee Archaeology Awareness Month “Tennessee Archaeology in Continental Perspective: Using DINAA to Examine Site Distributions by Time Period Across Eastern North America” (Anderson et al. 2016c). https://tennesseearchaeologycouncil.wordpress.com/tag/dinaa/

What do you plan to do during the next reporting period to accomplish the goals?
With this report the first phase of the DINAA project is complete. With award of second round of funding in 2016, we are continuing to expand DINAA across the United States. Of critical importance is demonstrating the value of integration and, even more importantly, establishing tools, workflows, and training modules so the work can continue well into the future. We are developing means whereby all states participating in DINAA will establish schedules for sharing and archiving data, thus creating a robust public resource for North American archaeology. Ideally, this model would be adapted by other countries and/or regions with similar data access and integration challenges. For DINAA, this would ultimately mean extending beyond the geographical boundaries of the US to include Canada and Mexico. While such expansion has been considered, for the present DINAA effort will be directed to spanning the 49 states in the continental United States.

A primary aim of the DINAA project is long-term accessibility and usefulness. DINAA establishes workflows and simple tools to allow managers of site file data to easily share and integrate their data with other states. All datasets are archived by the California Digital Library through Open Context’s archiving agreement. Thus, decades from now, the DINAA data will be accessible at their permanent DOIs. This modular approach to sustainability and longevity ensures that, even if one element in the system is no longer available, the entire system does not break and the data are still accessible. Other next steps include:

1. **Improve data modeling** (in process now with revisions to Open Context). While DINAA data currently published by Open Context can be queried through ontology associations, researchers will need additional search options. Calendar dates associated with periods defined at a continental scale (as is the case with the DINAA ontology) can vary across regions. For example, the beginning of the Woodland period in one state may differ from the beginning of the Woodland period in a state in another region. Thus, researchers will need to query datasets according to calendar dates as well as DINAA ontology associations. However, Open Context currently only indexes single time spans for each archaeological site file record. Gaps and hiatuses in occupation are also of research interest, and need to be expressed in the data model. The new version of Open Context will have a more refined data model, more fully aligned with emerging standards (GeoJSON-LD and the CIDOC-CRM) to better meet these research needs.
2. **Text-mining literature.** A powerful future application of DINAA will come from text-mining and entity identification of large corpora of archaeological reports and publications. By automatically scanning archaeological reports and publications for Smithsonian “trinomial” identifiers, we should be able to associate references to archaeological sites to DINAA's records. This will enable powerful search and discovery

tools for finding relevant archaeological literature. It will also offer a powerful tool to extract data and discover patterns in archaeological publications, helping to identify gaps in the publication record, changing patterns in chronological and spatial coverage, and other questions.

PRODUCTS What has the project produced?

1. Publications:

Kansa, Eric. C. 2016. Click here to Save the Past. In *Mobilizing the Past for a Digital Future The Potential of Digital Archaeology*, edited by Erin W. Averett, Jody M. Gordon, and Derek B. Counts, pp. 443-472. The Digital Press @The University of North Dakota, Grand Forks.

Wells, Joshua J., Eric C. Kansa, Sarah W. Kansa, Stephen J. Yerka, David G. Anderson, Thaddeus G. Bissett, Kelsey Noack Myers, and R. Carl DeMuth. 2014. Web-based discovery and integration of archaeological historic properties inventory data: The Digital Index of North American Archaeology (DINAA). *Lit Linguist Computing* 29(3). doi:10.1093/llc/fqu028

Wells, J.J., S.J. Yerka, and C.J. Parr. 2015. Archaeological Experiences with Free and Open Source Geographic Information Systems and Geospatial Freeware: Implementation and Usage Examples in the Compliance, Education, and Research Sectors. In Wilson, Andrew and Ben Edwards eds. *Open Source Archaeology–Ethics and Practice*, pp. 130-146. Warsaw, Poland: DeGruyter Open Press. Available online at http://www.degruyter.com/viewbooktoc/product/460080

2. Meeting Papers and Posters

Nearly three dozen meeting papers and posters on DINAA were presented from 2014 to 2016. (e.g., Anderson 2015a, 2015b, n.d; Anderson et al. 2014, 2015a, 2015b, 2015c, 2015d, 2015e, 2016a, 2016b, 2016c, n.d.; DeMuth et al. 2014a, 2014b; 2015, 2016; Dull et al. 2014; E. Kansa et al. 2013, 2014a, 2014b; 2015a, 2015b; S. Kansa et al. 2015; Myers et al. 2014, 2015; Wells et al. 2013a, 2013b, 2013c, 2014a, 2014b, 2014c, 2014d, 2015, 2016a, 2016b; Yerka et al. 2014, 2015).
See References Cited pdf file in Supplementary Materials.

3. Technologies:

See points 2-4 in the **Significant Results** section

4. Websites:

The project website: http://ux.opencontext.org/blog/archaeology-site-data/

5. Supporting Files

DINAA 2016 Final Report Figures and Tables.pdf

DINAA 2016 Final Report References Cited.pdf

Participants & Other Collaborating Organizations - Who has been involved?
David Anderson: 1 month in 2015/2016
Assisted in the collection and integration of state archaeological site files with the other project PIs. Assisted in the planning of the June 2016 workshop.
Funding Support: University of Tennessee
No foreign travel on international collaborations on this project.

Joshua Wells: 1 month in 2015/2016
Funding Support: University of Indiana, South Bend
Assisted in the planning of the June 2016 workshop.
No foreign travel on international collaborations on this project..

Stephen Yerka: 1 month in 2015/2016
Contribution to the Project: Assisted in the collection and integration of state archaeological site files with the other project PIs. Geospatial management and quality control of project data.
Funding Support: NSF
No foreign travel on international collaborations on this project.

Eric Kansa: 0.5 month in 2015/2016
Contribution to the Project: Assisted in the collection and integration of state archaeological site files with the other project PIs. Developed project website and linkages with Open Context for hosting DINAA products.
Funding Support: NSF
No foreign travel on international collaborations on this project.

Sarah W. Kansa: 0.5 months in 2015/2016
Contribution to the Project: Assisted in the collection and integration of state archaeological site files with the other project PIs. Maintained project website and linkages with Open Context for hosting DINAA products. Assisted in the planning of the June 2016 workshop.
Funding Support: NSF
No foreign travel on international collaborations on this project.

Thaddeus G. Bissett: 0 months in 2015/2016
Kelsey Noack Myers: 1 month in 2015/2016 Assisted in the planning of the June 2016 workshop.
R. Carl DeMuth: 1 month in 2015/2016

What other collaborators or contacts have been involved?

Impact - What is the impact of the project? How has it contributed?
What is the impact on the development of the principal discipline(s) of the project? Impact in archaeology
The DINAA project serves as a public demonstration of best practices for cyberinfrastructure. It also fosters novel networking and data integration among multiple partners across disciplinary and geographic boundaries. Upon its conclusion, the project will share lessons about the capabilities of the data and best practices in a set of public documents. The purpose of these

documents will be (1) to describe the methods and results employed by all participants to investigate research questions, (2) to encourage continued research though exemplary instructions about use the integrated database structure and technical instructions to facilitate regular updates with new data, and (3) to serve as a base for continued growth in professional development of comprehensive archaeological data management standards throughout the cultural resource management sector. Longstanding questions in American archaeology center on the cumulative effect of research sampling strategies and heritage management activities. DINAA helps identify these distribution patterns at varying scales, and permit reproducible analyses on how sampling and reporting activities shape the extant archaeological record as related to institutional goals, economic development, theoretical trends, and other factors.

DINAA will stand as the definitive gazetteer of archaeological sites in the United States, and can become the cornerstone for innovative Linked Data / Semantic Web applications that can bring together artifact analyses, paleoecological data, geological data, collections information, library holdings, and other datasets. While DINAA can play a key role in linking these diverse data, we fully acknowledge the challenges inherent in understanding data aggregated from so many sources. Sampling biases, different definitions of "sites", as well as variable data quality, collection and classification methods, will all complicate research analyses. Nevertheless, archaeology as a whole must regularly grapple with similar challenges. The methods of reproducible research (with open source code, open data, Web interoperability, and public version control) embraced by this project will put future research applications using these data on a stronger foundation of collaboration and transparency. Archaeological data integrated in the manner described here will continue to grow in scale and utility, and in the process transform the practice of our profession.

Impact on other disciplines

The DINAA project will foster novel networking and data integration among multiple partners, as well as research and educational activities across multiple disciplines and geopolitical boundaries. DINAA provides a regularized framework for large scale study of human activities and settlement, which can be more easily combined with geospatial paleoenvironmental data. DINAA can provide a nationwide structure, usable immediately for researchers and heritage management professionals to respond to the challenges of climate change, or (since DINAA is free and open source) it may be retooled for new applications. As DINAA grows, future work could build cross-disciplinary data sharing ties with systems such as: the World Data Center for Paleoclimatology — Data Sets Listing (NOAA 2008); the Neotoma Paleoecology Database (2015); the North American Plant Macrofossil Database (NOAA 2015a); the International Multiproxy Paleofire Database (NOAA 2015b); the Global Charcoal Database (Power et al. 2010); the International Tree-Ring Data Bank (ITRDB 2015); and VERTNET (2015) and FAUNMAP/Neotoma (2015) for faunal distributions. The integration of primary archaeological data with paleoenvironmental data at a continental scale is currently unprecedented, but DINAA has demonstrated its feasibility, and promises to enrich that potential with Linked Open Data strategies. The DINAA project protocols and technical products are available online and shared with the public and the scientific community, offering a platform for emulation, growth, and use, promoting the best practices of open science.

Impact on the development of human resources

The project has facilitated communication between site file managers across eastern North America, and helped them become aware of operations in states other than their own. Opportunities for communication and collaboration are expanding as research projects are developed using combined site file data. The resulting technical papers resulting from this project and its workshops, furthermore, will provide a baseline summary of the current state of archaeological data management across much of the eastern United States, and offer guidance about how to proceed in the future, both within the archaeological profession, and in other disciplines where massive datasets are maintained in multiple repositories.

Training and Capacity Building: We are witnessing burgeoning interest among archaeologists in creating, curating, and using online data. Participating in informatics centered research requires cultivation of new skills and expertise. DINAA team member Eric Kansa participated as faculty in a recent National Endowment for the Humanities (NEH) funded professional development "institute" hosted by Michigan State University (PIs Ethan Watrall and Lynne Goldstein). At this venue, Kansa demonstrated how to use software "entity reconciliation" techniques to relate data to the DINAA database to achieve outcomes like those demonstrated by Andrew White with his EWHADP dataset. A room full of 30 archaeologists, with no prior Web data experience, then each successfully related a sample dataset to DINAA in a matter a matter of minutes. In doing so, they improved the quality and usability of their sample data by linking their data to metadata curated by DINAA. This training not only opens doors for using DINAA specifically, but it also demonstrates how archaeologists can implement Linked Open Data more widely and with other systems and datasets. Thus, DINAA can help provide a general model for expanding archaeology's capacity to develop and use information systems. We provided detailed, step-by-step instructions here: http://opencontext.org/about/recipes.

Impact on physical resources that form infrastructure
The DINAA, upon completion of this project, will be web-based and, thus, will be global, accessible to researchers across multiple disciplines and institutions. As such the project should be able to grow and develop independently, past this initial effort. As noted, our ultimate objective is to have the DINAA, or something like it, eventually operate at multiple levels, from the local level (i.e., at the state or portion thereof in scale), regional (multiple states), to continental or even global in scope. Ideally, we envision the same kind of project we are attempting here linking data between states to be adopted in the years to come to link information from national datasets, to provide analytical potential at a truly global scale. While this will take time and resources to develop, the procedures by which it could be done are being developed as part of the DINAA project.

Impact on institutional resources that form infrastructure
The DINAA provides mechanisms to link information from state and national datasets, to provide analytical potential at local, regional, and national scales.

Impact on informational resources that form infrastructure
The project has developed significant data resources in a manner that greatly facilitates application and reuse by the wider community. T

Impact on technology transfer

DINAA data and services can lay the foundation for compelling public outreach efforts (including mobile apps) that can enable the public to engage with the rich cultural and historical depth that lies all around them.

Impact on society beyond science and technology
The DINAA project is demonstrating how opening up data can benefit research. This is something that has yet to be successfully demonstrated in archaeology at such a large geographic scale. Many resources exist, and many new ones are being created, but the potential and feasibility of linking those resources is not well understood. A major goal of the DINAA project is to demonstrate the feasibility of linking numerous disparate data sources and their potential to address large-scale research questions.

The vast majority of the general public supports historical and archaeological research, and understands and appreciates that we can learn from the lives and accomplishments of our forebears. The DINAA project helps make the vast quantities of data created by historical and archaeological research more accessible to the scholars, land managers, and the public. DINAA will publish nonsensitive heritage data open access and free of charge, preserve these data in digital libraries, and by using a suite of technical standards, promote "remixing," "mashups," and innovative reuses. In doing so, DINAA will help ensure long term access to America's settlement history, and help people gain a much greater appreciation for American history and culture while at the same time cultivate the information management skills and expertise required of the 21st century workplace.

Project Changes
Changes in approach and reasons for change
The original project proposed having a single workshop bringing together site file managers to discuss using DINAA to facilitate data integration across state borders. We found we were able to bring large numbers of people together for far less cost than we originally estimated, allowing us to hold three additional workshops, aimed primarily at exploring the new research and educational opportunities DINAA offers by linking up with an ever-increasing number of open archaeological data systems available on the Web. Because collecting data from individual states took longer than expected, and because feedback from the project workshops resulted in new data and research collaboration, two one year no-cost extension for project completion were requested and received, in 2014 and 2015. A final workshop directed to lessons learned from the project was conducted in June 2016, with a final completion report delivered in the Fall of 2016.

Actual or anticipated problems or delays and actions or plans to resolve them
Because collecting data from individual states took longer than expected, and because feedback from the project workshops resulted in new data and research collaboration, two one year no-cost extension for project completion were requested and received, in 2014 and 2015. The additional time allowed us to complete the collection and integration of data from approximately half a million archaeological sites from 15 states, which we have been making available online since 2014.

Changes that have significant impact on expenditures
None.

Supporting Files
DINAA 2016 Final Report FIGURES FINAL.pdf
DINAA 2016 Final Report References Cited.pdf

LIST OF FIGURES AND TABLES

Figure 1. DINAA partnerships as of December 2016 with dot density plot showing distribution of cultural resources at low resolution within states whose data has been received thus far. Dots do not refer to exact site locations, but to groups of five sites whose position has been randomly distributed within 20x20km grid cells.

Figure 2. DINAA area of effect as of December 2016 with dot density plot showing distribution of cultural resources at low resolution within states whose data has been received thus far, or is being delivered (n=21). Dots do not refer to exact site locations, but to groups of five sites whose position has been randomly distributed within 20x20km grid cells. Ohio data is at county-level resolution.

Figure 3. Open Context map showing how DINAA site file records are displayed online. The display employs shaded 20x20km grid cells to protect site locational information.

Figure 4. Map showing site density as it relates to potential loss from sea-level rise, and grouped by elevation in meters above present mean sea level, illustrating all sites within a buffer of 200 km from the present coastline in gray (Anderson et al. 2015a, 2015b).

Figure 5. DINAA permits links to information in a wide range of online data repositories, using site numbers as the common denominator. DINAA directs users to these outlets, but access and content control remains on their systems. (Black arrows indicate existing linkages, white arrows indicate linkages under development).

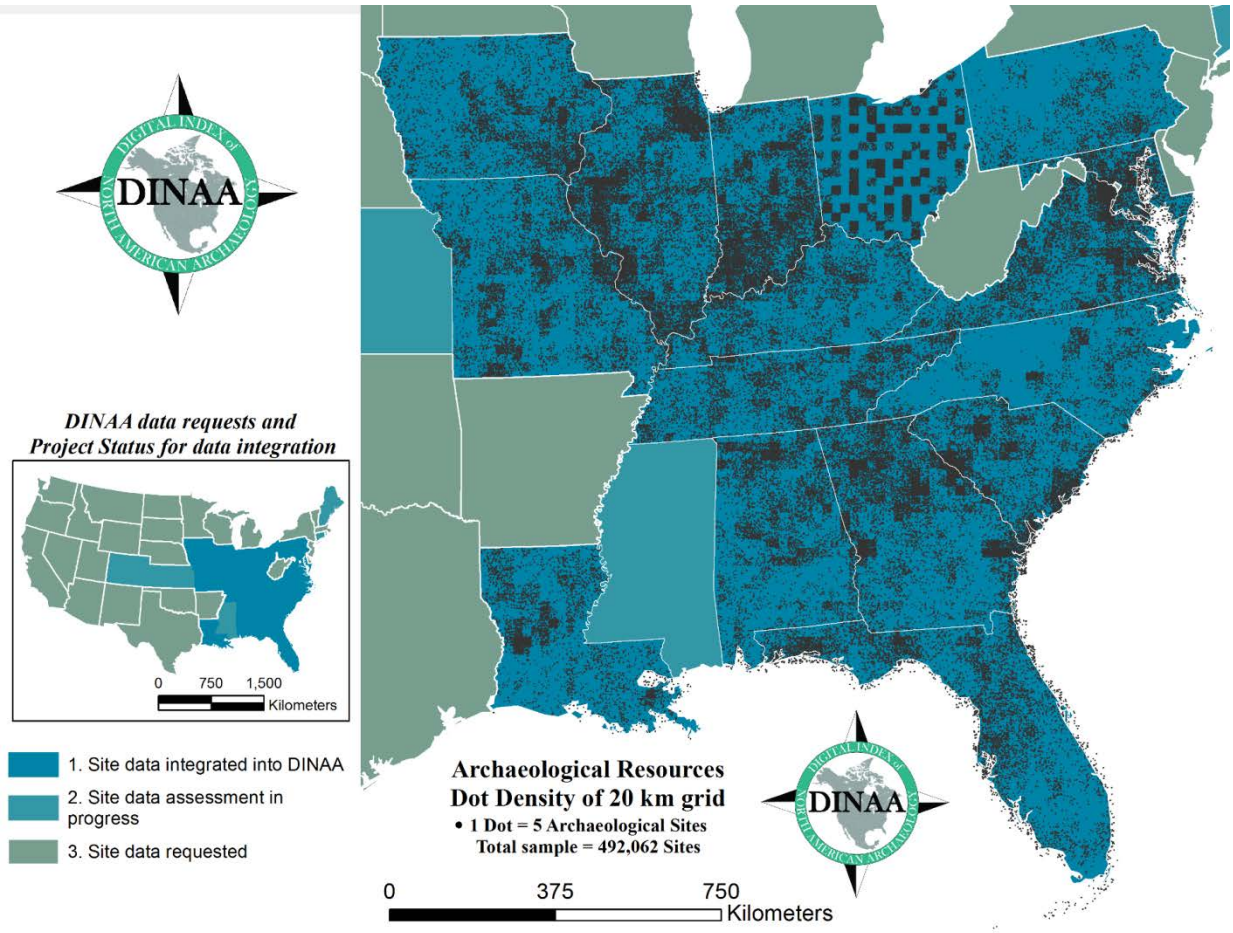
Figure 6. Open Context heat map of Early Archaic sites.

Figure 7. DINAA Workshop 1 participants, UT Office of Research and Engagement, Knoxville, Tennessee, 19-20 March 2014.

Figure 8. DINAA Workshop 2 participants, Indiana University South Bend, 5-6 December 2014.

Figure 9. Some of the DINAA Workshop 3 participants, University of Wyoming, Laramie, June 2015.

Table 1. Archaeological site and National Register of Historic Places eligible property loss in the southeastern United States, given sea-level rise in 1-meter increments.



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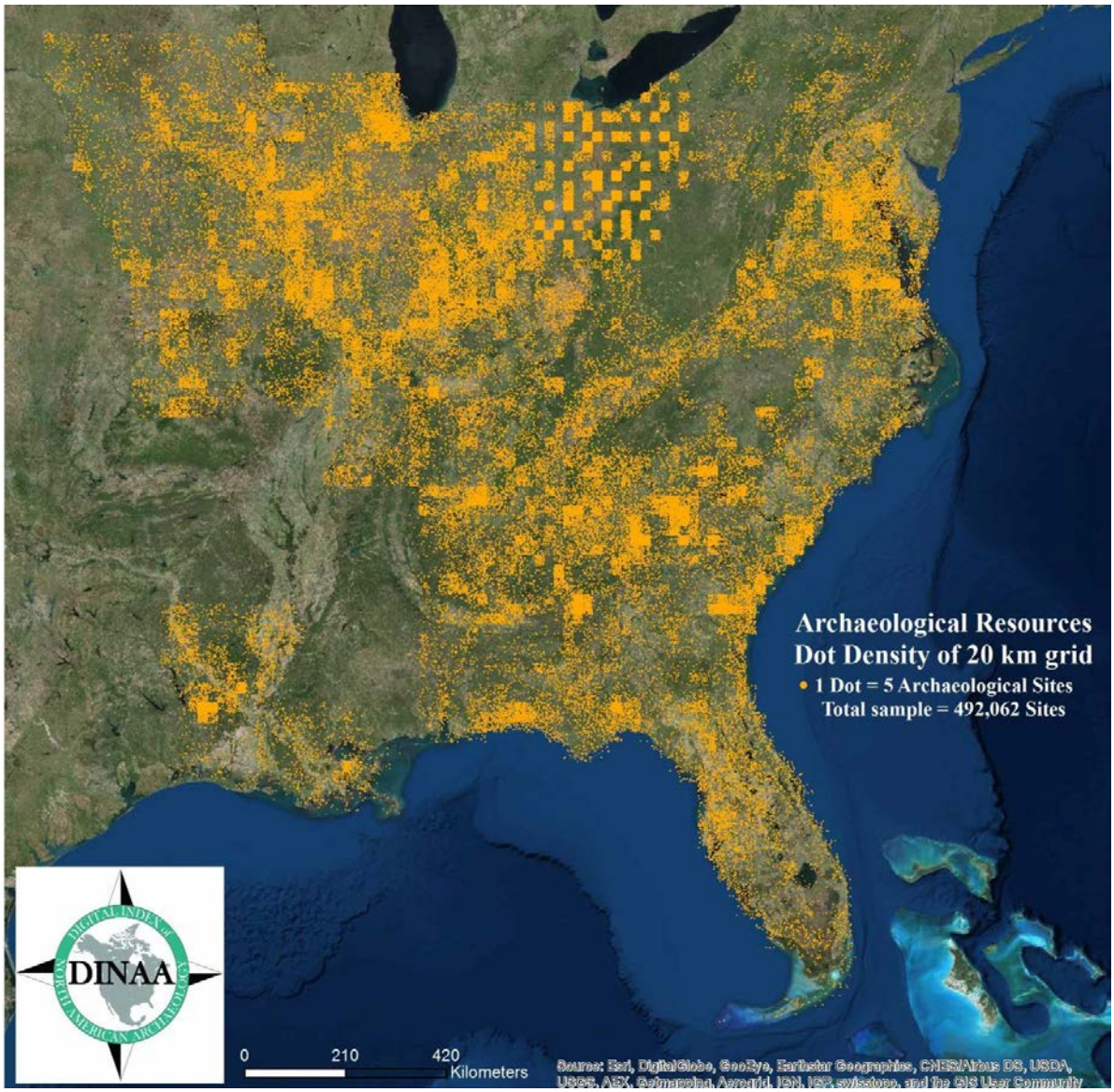

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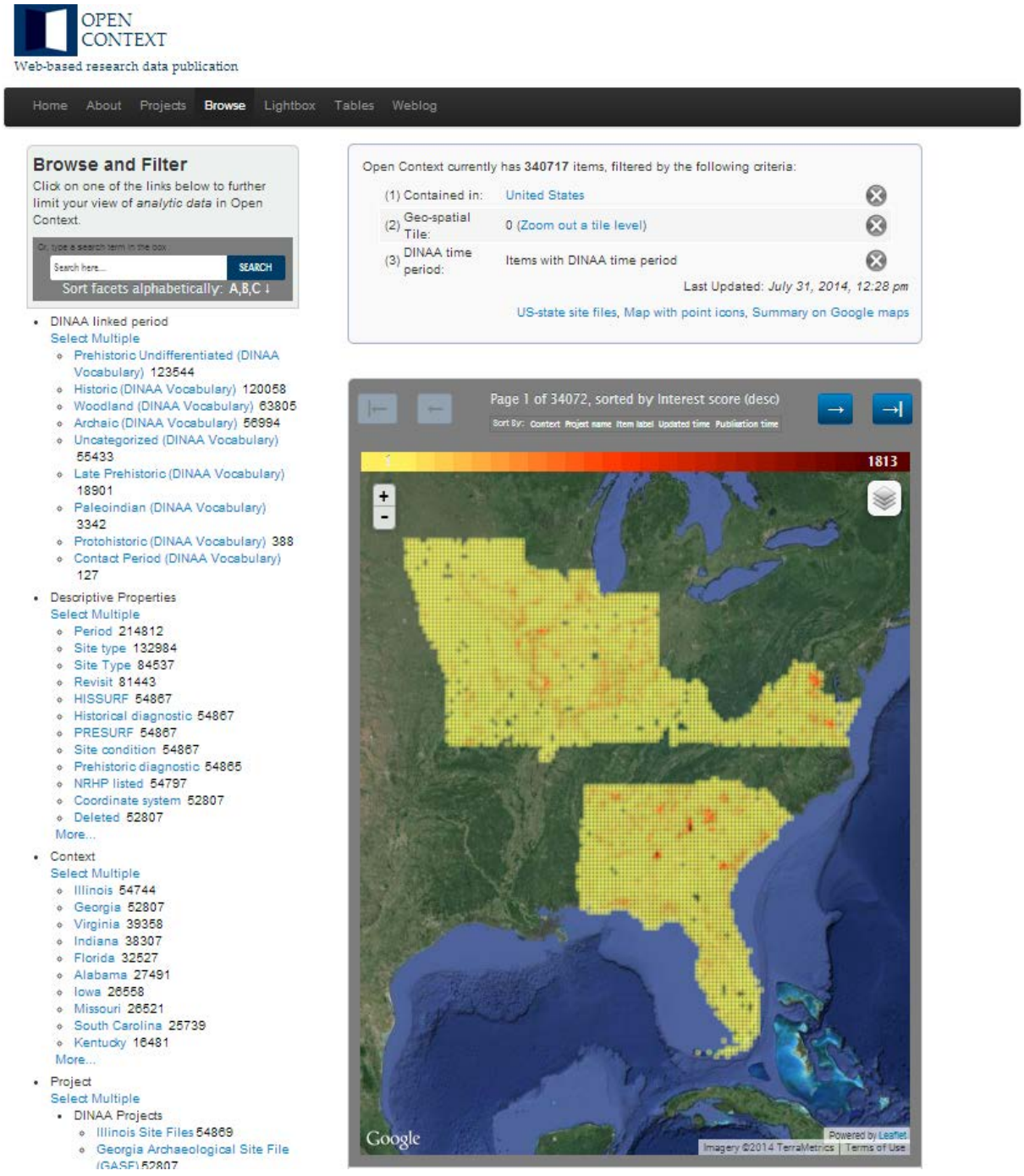

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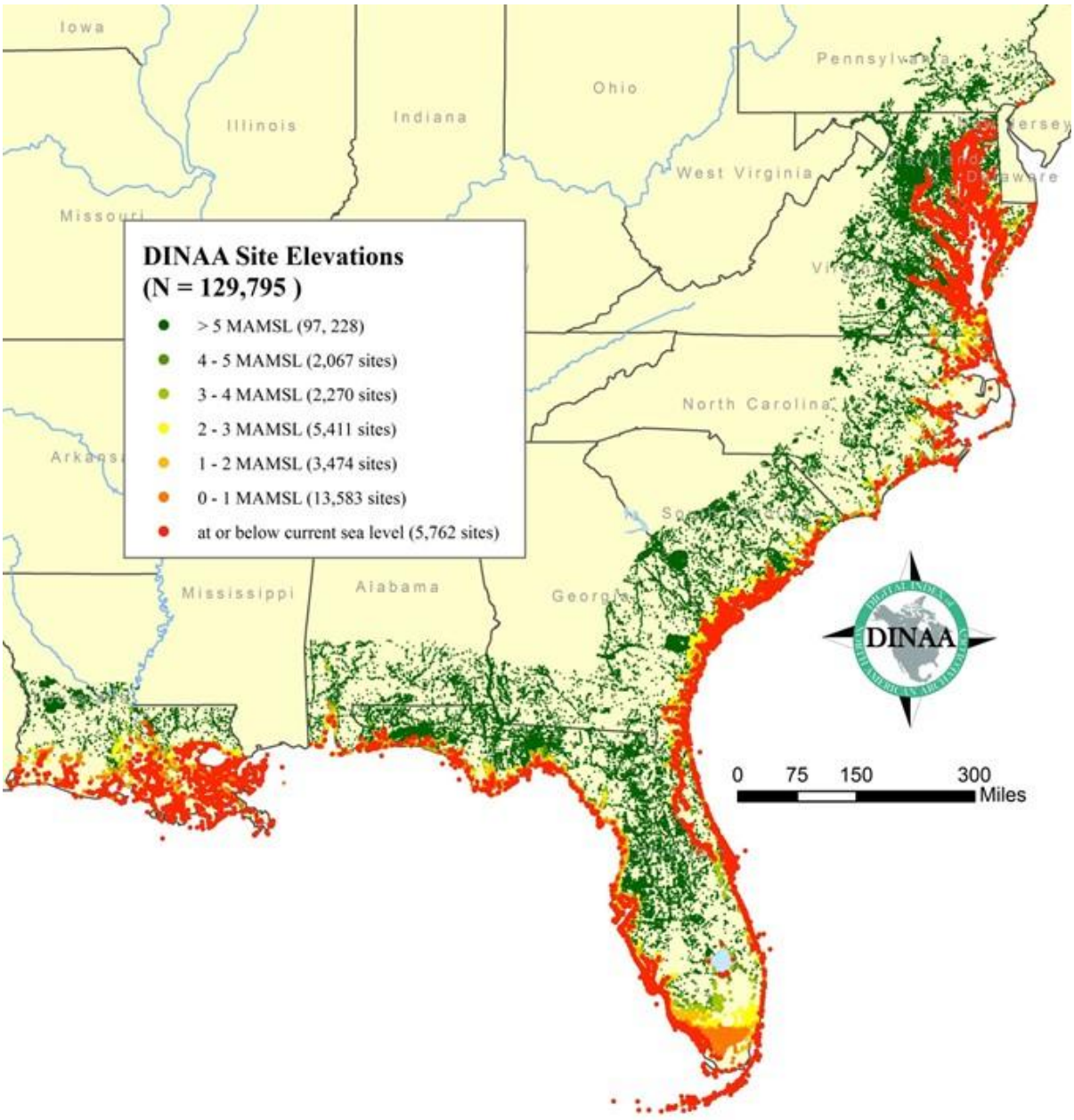

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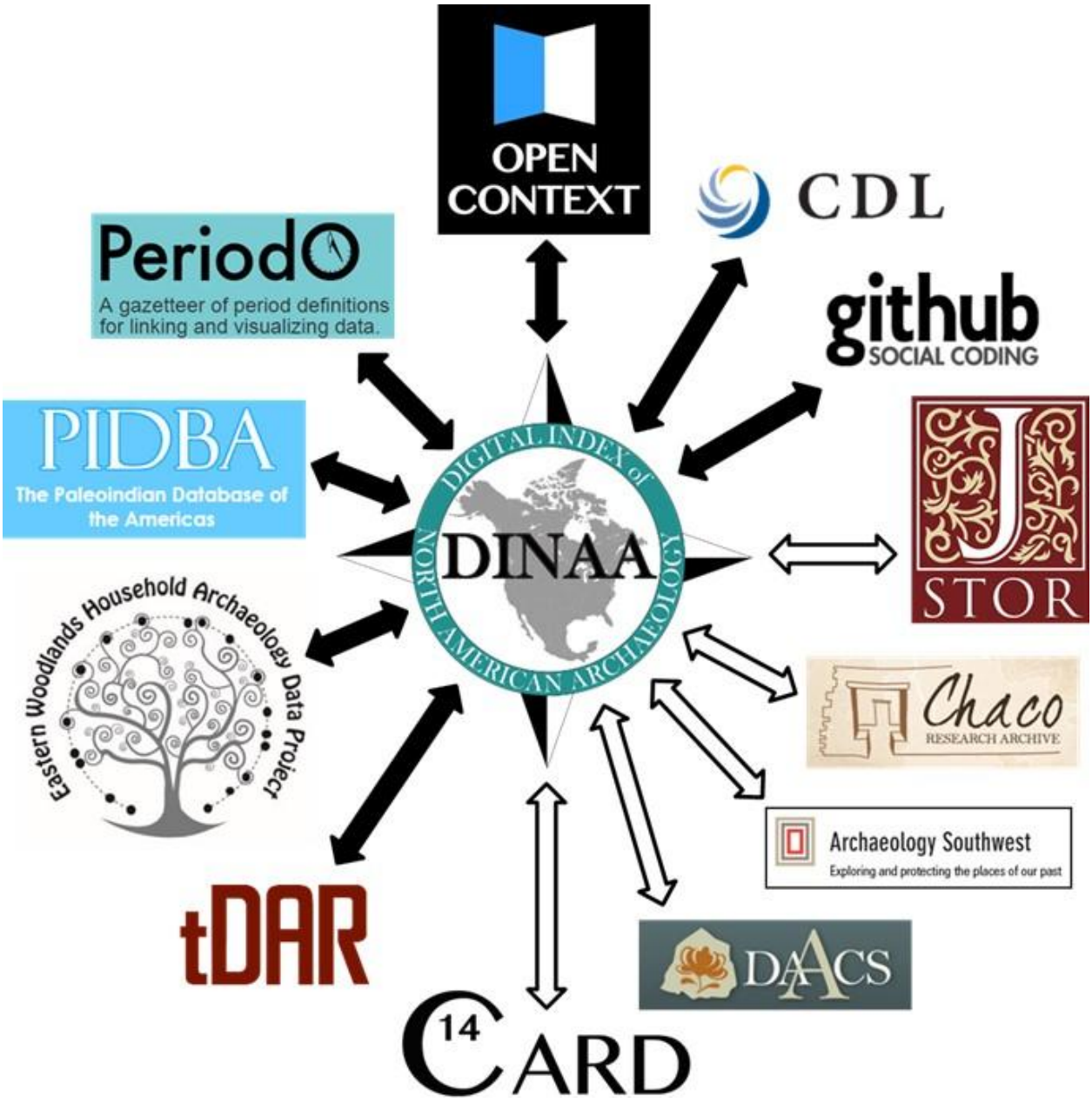

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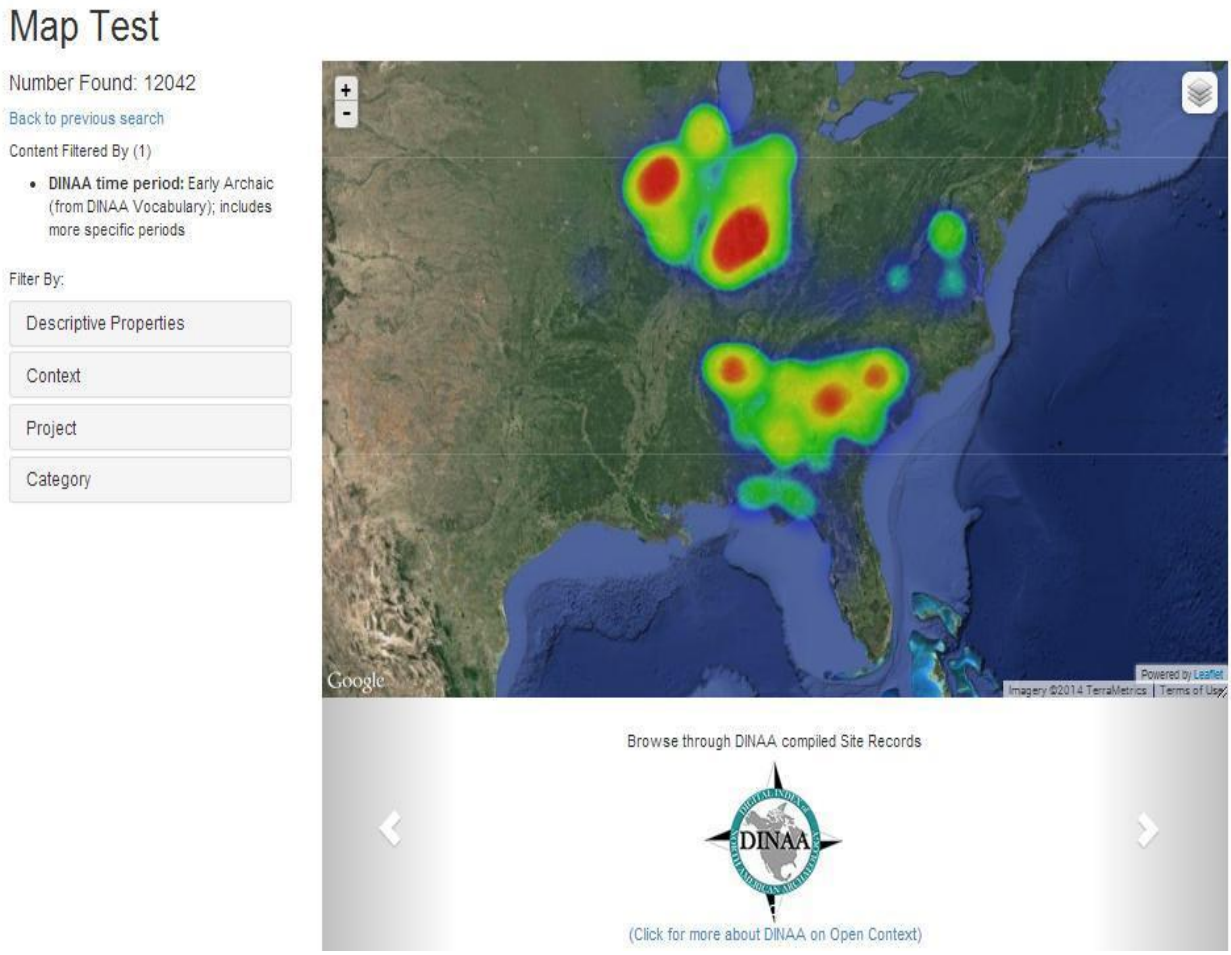

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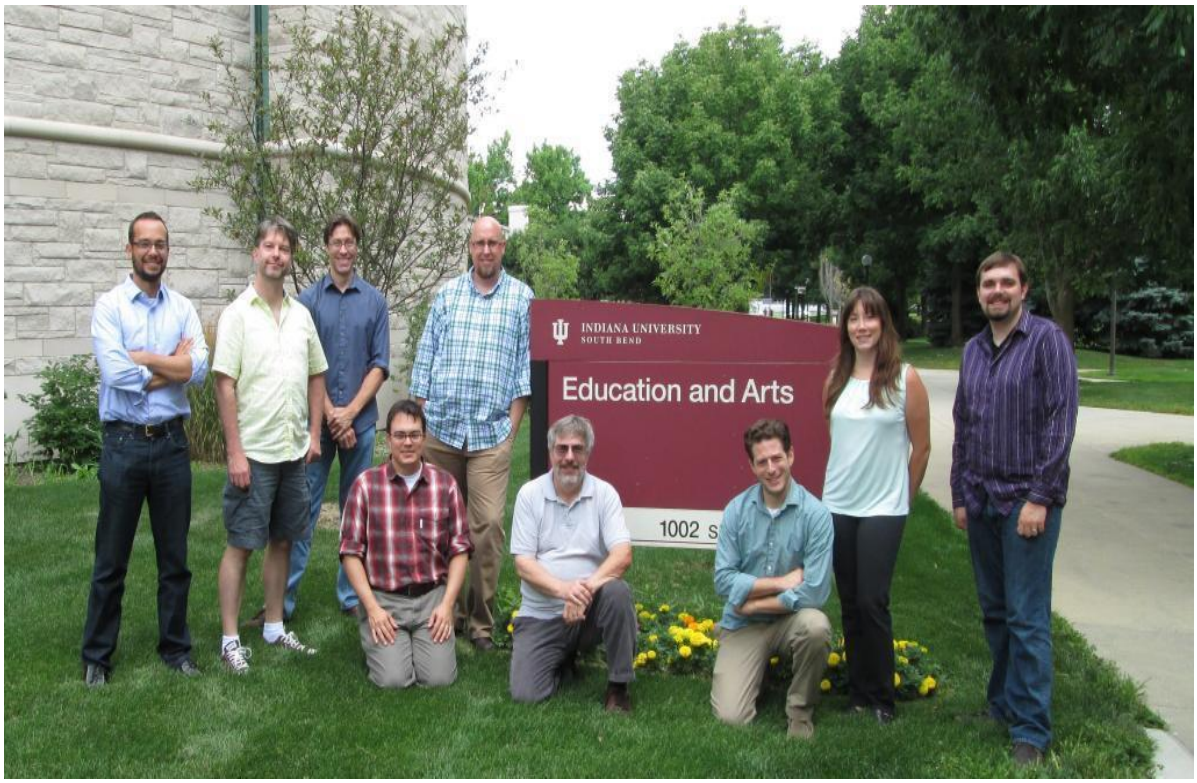

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	No El Data	<0	0 to 1 m	>1 to 2 m	>2 to 3 m	>3 to 4 m	>4 to 5m	Totals
SITE TOTALS	331	5762	13583	3474	5411	2270	2067	32898
Cummulatve Site Totals	331	6093	19676	23150	28561	30831	32898	
NRHP PROPERTY TOTALS	0	283	1035	393	440	187	134	2472
Cummulatve NRHP Property Totals	0	283	1318	1711	2151	2338	2472	

Table 1. Archaeological site and National Register of Historic Places eligible property loss in the southeastern United States, given sea-level rise in 1-meter increments.

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Alessa, L., A. Kliskey, M. Altaweel, M. Barton, S. Bankes, E. Brondizio, and D. Brown, 2015. *Best Practices for Integrating Social Sciences into Social Ecological Systems Science: Future Directions for Building a More Resilient America*. University of Idaho Center for Resilient Communities 2015.

Anderson, D.G. 2015a. Discussant, Forum Building Archaeological Research Communities with Cyberinfrastructure organized by M. Scott Thompson at the 80th Annual Meeting of the Society for American Archaeology 17 April 2015, San Francisco, California.

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