



FIELD RESEARCH DATA SCIENCE PROGRAM: FAIMS PROJECT, AUSTRALIA

Course ID: ARCH 395B

July 2 – July 27, 2018

FIELD SCHOOL DIRECTORS:

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INTRODUCTION

Macquarie University's Field Acquired Information Management Systems (FAIMS) Project provides eResearch and data science support to a range of fieldwork-based research projects in archaeology, epigraphy, history, geoscience, and ecology. We build open-source mobile and web applications to support field research, as well as providing data consulting services in this domain.

The FAIMS project launched in June 2012, funded by a National eResearch Collaboration Tools and Resources (NeCTAR) eResearch Tools award, and has continued since with Australian Research Council and New South Wales state funding. Over that time, we have developed a mobile, offline, multi-user collection platform for structured, free-text, geospatial, and multimedia data. The project also supported enhancements to Australian and US-based online infrastructure for archaeological data management. Using this experience, in 2016 we began helping researchers sort out problems with legacy datasets. Since 2014 we have supported field data collection or legacy data reconciliation at over 25 projects.

FAIMS software and data serves aim not only to make fieldwork more efficient, but also to improve the quality of field-generated data and other ‘digital research objects’ like code used for statistical or geospatial analyses. We promote international best practice with regard to data and code, which advocate that all digital objects associated with research should be FAIR: findable, accessible, interoperable, and reusable (bounded by ethical considerations related to sensitive data). These approaches facilitate large-scale, comparative research by producing compatible data that can be combined to address ‘grand challenges’ in archaeological research. They also make research more transparent – others can better evaluate or reproduce results, improving the reliability of research outcomes and contributing to the advance of knowledge.

DISCLAIMER – READ CAREFULLY

This field school will take place on campus at Macquarie University. Students should expect similar dorm to typical such facilities at US based universities.

If you have any medical concerns, please consult your doctor. For all other concerns, please consult with the project director – as appropriate.

COURSE OBJECTIVES

During this Database Program, students will assist in the digitization, processing, analysis, and visualization of data generated by major field research projects based at Macquarie and elsewhere. This Database Program will involve:

- Digitization of data like audio recordings, scanned text and forms, and maps, using automated tools wherever possible.
- Processing of digital data from forms, spreadsheets, and databases into a single, unified dataset for each project.
- Cleaning and other preparation of these datasets for submission to archives, repositories, or publication platforms.
- Statistical, geospatial, and other analyses of the resulting datasets, including visualizations.

In all cases, emerging best practices in data management and computational analysis in support of transparency will be taught and implemented, including:

- FAIR Data Principles.
- Transparency and Openness Promotion (TOP) Guidelines.
- Code-based reproducible analytical practices.
- Metadata standards (e.g., those provided by the Archaeological Data Service).
- Research data lifecycle management practices (e.g., those provided by the Australian National Data Service).

We will cultivate a ‘ground-up’ approach to data and code reusability and research transparency, in which participants establish working environments, create metadata, and organize data so as to avoid ‘technical debt’ - the need to invest more time later in the process to correct ‘shortcuts’.

To accomplish these goals, students will utilize a variety of techniques, including:

- Establishment of working environments that take advantage of open-source software (Ubuntu, Docker, git, OpenRefine, R, R Studio, markdown, etc.).
- Use of online platforms (e.g., GitHub, Open Science Framework, data repositories, etc.).

- Use of semi-automated tools for data digitization (e.g., OCR, speech-to-text).
- Provision of all metadata necessary for outsiders to understand and use the dataset.
- Use of tools like OpenRefine to ensure data consistency.
- Data modelling to determine optimal structures for dataset.
- Transformation of data to conform with these structures.
- Robust linking of different types of data (structured multimedia, geospatial, etc.).
- Creation of reusable code for data transformation, analysis, and visualization rather than GUI-based software.

The overriding goal of this Database Program is to empower participants by cultivating the ability to ‘learn how to learn’ digital tools and approaches. Emphasis will thus be placed on the determining requirements, assessing possible approaches, finding appropriate tools, using available resources (software documentation, YouTube, Stack Exchange, etc.) to learn those tools, basic project management, and effective communication between domain specialists and technologists.

To accomplish these goals, the Database Program will involve formal training (including Software Carpentry, an internationally recognized approach to practical coding for the novice), readings, lectures, and structured activities, combined with team-based processing of real data from fieldwork projects. At the end of the Database Program, students will have a working knowledge of modern, good-practice approaches to data management and analysis for research, and will have contributed to the production of useful research datasets.

ACADEMIC CREDIT UNITS & TRANSCRIPTS

Credit Units: Attending students will be awarded 8 semester credit units (equivalent to 12 quarter credit units) through our academic partner, Connecticut College. Connecticut College is a private, highly ranked liberal arts institution with a deep commitment to undergraduate education. Students will receive a letter grade for attending this field school (see grading assessment and matrix). This field school provides a minimum of 160 direct instructional hours. Students are encouraged to discuss the transferability of credit units with faculty and registrars at their home institutions prior to attending this field school.

Transcripts: An official copy of transcripts will be mailed to the permanent address listed by students on their online application. One additional transcript may be sent to the student's home institution at no additional cost. Additional transcripts may be ordered at any time through the National Student Clearinghouse: <http://bit.ly/2hvurkl>.

PREREQUISITES

This Database program has no formal prerequisites, and assumes no background knowledge. Participants, however, should be comfortable with computers and energized rather than intimidated by the idea of learning sophisticated tools, including coding. Many of our former students found that knowing how to code - by becoming a digital content creator, rather than merely a consumer - was liberating and empowering (cf. Rushkoff 2010 and [this study guide](#)).

LEARNING OUTCOMES

- Evaluate and apply digital approaches and tools to research data.
- Understand and apply data modelling and manipulation techniques.
- Demonstrate the ability to ‘learn how to learn’ new digital tools and approaches.

- Cultivate the ability to translate between domain specialists and technologists.
- Understand and apply the principles of reproducible science/transparent research practices to academic activities.
- Create and implement digital research environments, data analysis and visualization code, and other digital research objects.

GRADING MATRIX

- Exercises from "Software Carpentry Inspired" instruction (10% upon submission of git repositories with completed exercises; marked pass/fail)
- Online Quizzes covering reading and lecture materials (5% per quiz x 4 quizzes = 20%)
 - End Week 1
 - End Week 2
 - End Week 3
 - End Week 4
- Activity Journal (1% per entry submitted to git repo x 20 entries = 20%)
 - +0.33 point for Articulating Intention and Expected results per action
 - +0.33 point for recording specific steps and actions taken
 - +0.33 point for recording and discussing results of actions
- Performance of assigned research data tasks (total 30%)
 - +10 Complete the routine digitization tasks
 - +10 Produce clean data to specification provided
 - +5 Produce a software visualization or analysis of data
 - +5 Implement appropriate environment and tools
- Final project PICO presentation (20%)
 - +2 Performance of final presentation
 - +3 Satisfactory Discussion of results
 - +3 Satisfactory Discussion of method
 - +3 Satisfactory Discussion of research question
 - +3 Satisfactory Preparation of PICO presentation
 - +3 PICO presentation is well formed (2 slides for 2 minute madness, thorough discussion of semester long research project)
 - +3 Long-form PICO presentation has sufficient documentation to stand alone

TRAVEL & MEETING POINT

Students should plan to arrive at Macquarie University by 2:00pm on Monday 02 July 2018. You will then check into your lodgings and gather for an afternoon / evening welcome and kick-off. We recommend that you arrive to Sydney a few days early to overcome jet lag (and see the sights). Lodging with the project will not be available before 02 July, however.

Students must use either a Macquarie Airport Pickup or Sydney Mass Transit to journey to Macquarie University. Macquarie provides [comprehensive instructions](#) for incoming international students covering travel preparation and the journey itself. We recommend following all instructions provided; you may want to save or print a copy (especially the 'On Your Arrival' section).

You can make a [free 'Airport Pickup Request'](#) from Macquarie University if you book it **at least two weeks in advance**.

Otherwise, you will need to travel to Macquarie University by using public transit. To take public transit, buy an OPAL card at the Sydney Airport International Station, take a train to Central on the T2 line (Platform 1) then go to the Macquarie University station via the T1 line to Hornsby (Platform 16) **Make sure that you see Macquarie University displayed on the train before boarding** since multiple routes are labelled 'T1', and only (approximately) every other train runs to the university. We recommend loading the app called "TripView" on your phones before departing, as it can find the best public transport routes for you (and the paid version remembers your planned trips).

Robert Menzies College, where you will be staying (see below), is an easy 100 m walk from the train station.

If you missed your connection or your flight is delayed, please call, text, or email one of the project directors immediately. A local emergency cell phone number will be provided to all enrolled students.

VISA REQUIREMENTS

You must apply for an [Electronic Travel Authority \(subclass 601\)](#) visa before boarding a plane to Australia. Average processing time for the visa is a few days (but you must apply two weeks before you travel) and the fee is AUD\$20. Go to: <https://www.border.gov.au/Trav/Visa-1/601-#tab-content-1> and follow the instructions under "how to apply":

● You must be outside Australia when you apply and when your ETA is decided.
● You should apply for your ETA at least two weeks before you travel. You will not receive a stamp or label in your passport. You will be provided with a confirmation for your records.
● You can apply for this ETA online at Electronic Travel Authority if you hold a citizen passport from:
○ Brunei
○ Canada
○ Hong Kong (SAR of China)
○ Japan
○ Malaysia
○ Singapore
○ South Korea
○ United States.
● When you lodge your application, they will give you a Transaction Reference Number (TRN). Keep a record of this so you can follow the progress of your application.
● You will need your passport, an email address and a credit card to pay the service charge when you apply.
● Otherwise follow instructions on the website for how to apply.

ACCOMMODATIONS

Students attending this field school will be housed at the [Robert Menzies College](#), which offers a private room (but shared single gender bathrooms). Three meals per day are provided on weekdays; one meal per day (brunch) on weekends. All student rooms at RMC are single rooms, allowing you to create your own space by bringing a little bit of home with you. Every room has: Bed, Wardrobe, Desk, Chair, Bookcase, Pinboard, Fan, Heater, Phone, and Internet connection. There is also a nearby (200m) mall with an extensive food court.

Check in is after 2:00pm on the day of arrival. Check out is before 10:00am on the day of departure. Let us know as soon as possible if you have any dietary requirements.

COURSE SCHEDULE

Typically, we will work five days a week. Your weekends will be free. Locations below are Robert Menzies College (RMC); Museum of Ancient Cultures (MAC); Australian Hearing Hub (AHH). All are within about a 10 minute walk of one another.

Note that 'Software Carpentry' days (the first two days of the will follow a slightly different schedule, but with the same breakfast / lunch / dinner times.

Daily schedule

Time	Location	Activity
7:00/7:45-8:30am	RMC	Breakfast (served from 7am Mon/Fri; from 7.45am Tue/Wed/Thu).
8:30-8:45am	MAC/AHH	Morning welcome / coffee
8:45-10:45am	MAC/AHH	Lecture / discussion / troubleshooting
10:45-11:00am	MAC/AHH	Break
11:00am-12:30pm	MAC/AHH	Data work
12:30-1:30pm	RMC	Lunch
1:30-3:00pm	MAC/AHH	Data work
3:00-3:15pm	MAC/AHH	Break
3:15-4:45pm	MAC/AHH	Data work
4:45-5:00pm	MAC/AHH	Break
5:00-6:30pm	MAC/AHH	Data work
6:30-7:30pm	RMC	Dinner

Week 1 (02-06 July)

	Lecture / discussion	Activities	Readings
Monday	Welcome and orientation, meet between 2:00-3:00pm at RMC		
Tuesday	Software Carpentry		
Wednesday	Software Carpentry		

Thursday	What does a modern research data environment and workflow look like?	Presentation of datasets Choice of dataset	Stewart Lowndes et al 2017.
Friday	Reproducibility and the reproducibility crisis	Gathering requirements	Buck 2015. Munafó 2015.

Week 2 (09-13 July)

	Lecture / discussion	Activities	Readings
Monday	Is there a 'reproducibility crisis' in fieldwork-based disciplines?	Project planning Scoping	McNutt et al 2016. Snow et al 2006.
Tuesday	Data longevity	Elaboration of approach	Vines et al 2014.
Wednesday	Data sharing	Environment setup Scoping completed	Borgman 2012.
Thursday	Big data, small data, and field research	Elaboration	Kansa and Bissell 2010.
Friday	Code and computational reproducibility	Elaboration Presentation of approach Mid-program evaluation	Marwick 2017.

Week 3 (16-20 July)

	Lecture / discussion	Activities	Readings
Monday	Data compliance	'Mini-sprint' kickoff Data work	OECD 2007. NSF 2010.
Tuesday	Good practice Troubleshooting	Data work	Wilkinson et al 2016.
Wednesday	Good practice Troubleshooting	Data work Presentation of proof-of-concept / mid-course correction	Nosek et al 2015.

Thursday	Good practice Troubleshooting	Data work	Archaeology Data Service 2017.
Friday	Troubleshooting	Data work	Borgman 2012

Week 4 (23-27 July)

	Lecture / discussion	Activities	Readings
Monday	Troubleshooting	Data work Documentation	
Tuesday	Troubleshooting	Data work Documentation Presentation prep	
Wednesday	Handover Planning for the future Troubleshooting	Data work Documentation Presentation prep	
Thursday	Presentations		
Friday	Departure		

EQUIPMENT LIST

Computers and accessories

- Our working environment is Ubuntu. To facilitate installation, please bring a modern laptop with (preferably) Ubuntu 16.04 or newer installed. Baring that, Windows 10 Anniversary Update (as per requirements [here](#)), or Mac OS X Sierra or newer (to facilitate Ubuntu virtual machine setup). If your laptop doesn't meet these specifications, bring what you have and we will see what we can do. A limited number of machines will also be available for students to borrow.
- A power cord (or adapter) that fits [Australian outlets](#) (adapters should be available for purchase in the nearby mall, but it's better if you arrive prepared).
- Optional: A modern phone or tablet running Android 6 or newer for an introduction to field data recording applications.

Clothing and other gear

Pack for a three-week stay in a major metropolitan area, living in a typical dormitory (perhaps not as upscale as many American dorms are these days). One of Sydney's largest malls is a few hundred meters from your lodging, so getting anything you forgot should be easy. Prices are comparable to a large US city.

July is mid-winter, but Sydney is subtropical. Typical weather would be sunny, highs of about 20C, lows of about 5C - but check long-range forecasts before departure, it could rain. Be prepared to dress in layers for moderately cool to moderately warm temperatures. Australia is very relaxed, so you won't need dressy clothes for any planned activities.

MANDATORY READINGS

Software Carpentry exercises

Before attending, complete all readings and exercises associated with the following Software Carpentry tutorials:

- <http://swcarpentry.github.io/shell-novice>
- <http://swcarpentry.github.io/git-novice>
- <http://swcarpentry.github.io/r-novice-inflammation>

Reproducibility in fieldwork-based research

All readings will be available via a shared Zotero bibliography well ahead of the Database Program.

- Borgman, Christine L. “The Conundrum of Sharing Research Data.” *J. Am. Soc. Inf. Sci. Technol.* 63, no. 6 (2012): 1059–1078.
- Buck, Stuart. “Solving Reproducibility.” *Science* 348, no. 6242 (2015): 1403.
- Kansa, Eric C, and Ahrash Bissell. “Web Syndication Approaches for Sharing Primary Data in ‘Small Science’ Domains.” *Data Science Journal* 9 (2010): 42–53.
- Marwick, Ben. “Computational Reproducibility in Archaeological Research: Basic Principles and a Case Study of Their Implementation.” *J Archaeol Method Theory* 24, no. 2 (2017): 424–450.
- McNutt, Marcia, Kerstin Lehnert, Brooks Hanson, Brian A Nosek, Aaron M Ellison, and John Leslie King. “Liberating Field Science Samples and Data.” *Science* 351, no. 6277 (2016): 1024–1026.
- Munafò, Marcus R, Brian A Nosek, Dorothy V M Bishop, Katherine S Button, Christopher D Chambers, Nathalie Percie du Sert, Uri Simonsohn, Eric-Jan Wagenmakers, Jennifer J Ware, and John P A Ioannidis. “A Manifesto for Reproducible Science.” *Nature Human Behaviour* 1, no. 1 (2017): 1-9.
- Nosek, B. A., G. Alter, G. C. Banks, D. Borsboom, S. D. Bowman, S. J. Breckler, S. Buck, et al. “Promoting an Open Research Culture.” *Science* 348, no. 6242 (June 25, 2015): 1422.
- NSF. “Data Management for SBE Directorate Proposals and Awards | NSF.” National Science Foundation SBE Directorate, 2010.
- OECD. “OECD Principles and Guidelines for Access to Research Data from Public Funding.” Guidelines. Organization for Economic Co-operation and Development, 2007.
- Snow, Dean R, Mark Gahegan, C Lee Giles, Kenneth G Hirth, George R Milner, Prasenjit Mitra, James Z Wang, and Others. “Cybertools and Archaeology.” *Science* 311, no. 5763 (2006): 958-959.
- Stewart Lowndes, Julia S, Benjamin D Best, Courtney Scarborough, Jamie C Afflerbach, Melanie R Frazier, Casey C O’Hara, Ning Jiang, and Benjamin S Halpern. “Our Path to Better Science in Less Time Using Open Data Science Tools.” *Nature Ecology & Evolution* 1, no. 6 (2017): 1-7.
- Vines, Timothy H, Arianne Y K Albert, Rose L Andrew, Florence Débarre, Dan G Bock, Michelle T Franklin, Kimberly J Gilbert, Jean-Sébastien Moore, Sébastien Renaut, and Diana J Rennison. “The Availability of Research Data Declines Rapidly with Article Age.” *Curr. Biol.* 24, no. 1 (2014): 94–97.
- Wilkinson, Mark D, Michel Dumontier, Ijsbrand Jan Aalbersberg, Gabrielle Appleton, Myles Axton, Arie Baak, Niklas Blomberg, et al. “The FAIR Guiding Principles for Scientific Data Management and Stewardship.” *Scientific Data* 3 (2016): 1-9.

RECOMMENDED READINGS

Software Carpentry exercises

Before attending we recommend that you complete at least one of these tutorials:

- <http://swcarpentry.github.io/python-novice-inflammation>
- <http://swcarpentry.github.io/sql-novice-survey>

Reproducibility in fieldwork-based research

- Arbuckle, Benjamin S, Sarah Witcher Kansa, Eric Kansa, David Orton, Canan Çakırlar, Lionel Gourichon, Levent Atici, et al. “Data Sharing Reveals Complexity in the Westward Spread of Domestic Animals across Neolithic Turkey.” *PLoS One* 9, no. 6 (2014): e99845.
- Atici, Levent, Sarah Witcher Kansa, Justin Lev-Tov, and Eric C Kansa. “Other People’s Data: A Demonstration of the Imperative of Publishing Primary Data.” *J Archaeol Method Theory* 20, no. 4 (2012): 663–681.
- Averett, Erin Walcek, Derek B Counts, and Jody Michael Gordon. *Mobilizing the Past for a Digital Future: The Potential of Digital Archaeology*. Digital Press at The University of North Dakota, 2016.
- *Archaeology Data Service: Advice*. <http://archaeologydataservice.ac.uk/advice/DepositingData> (accessed 16 September 2017).
- Beagrie, Neil, and John Houghton. “The Value and Impact of the Archaeology Data Service: A Study and Methods for Enhancing Sustainability.” Charles Beagrie Ltd, September 2013.
- Beck, Anthony, and Cameron Neylon. “A Vision for Open Archaeology.” *World Archaeol.* 44, no. 4 (2012): 479–497.
- Bevan, Andrew. “The Data Deluge.” *Antiquity* 89, no. 348 (December 2015): 1473–1484.
- Borgman, Christine L. *Big Data, Little Data, No Data: Scholarship in the Networked World*. MIT press, 2015.
- Caraher, William. “Slow Archaeology: Technology, Efficiency, and Archaeological Work.” In *Mobilizing the Past for a Digital Future: The Future of Digital Archaeology*, edited by Erin Walcek Averett, Jody Michael Gordon, and Derek B Counts, 421–441. Grand Forks, ND: The Digital Press at the University of North Dakota, 2016.
- Carver, Geo, and Matthias Lang. “Reflections on the Rocky Road to E-Archaeology.” *Computer Applications and Quantitative Methods in Archaeology (CAA), Southampton, March 26-29, 2012*, 224–236.
- Costa, S, A Beck, A H Bevan, and J Ogden. “Archaeology in the Digital Era.” In *Defining and Advocating Open Data in Archaeology*, 449–456. Amsterdam, Netherlands: University of Southampton, 2013.
- Ellis, Steven J R. “Are We Ready for New (Digital) Ways to Record Archaeological Fieldwork? A Case Study from Pompeii.” In *Mobilizing the Past for a Digital Future: The Potential of Digital Archaeology*, edited by Erin Walcek Averett, Jody Michael Gordon, and Derek B Counts, 51–75. Grand Forks, ND: The Digital Press at the University of North Dakota, 2016.
- Frank, Rebecca D, Elizabeth Yakel, and Ixchel M Faniel. “Destruction/Reconstruction: Preservation of Archaeological and Zoological Research Data.” *Arch. Sci.* 15, no. 2 (2015): 141–167.
- Kansa, Eric. “Openness and Archaeology’s Information Ecosystem.” *World Archaeol.* 44, no. 4 (2012): 498–520.

- Kansa, Eric C, and Sarah Witcher Kansa. "We All Know That a 14 Is a Sheep: Data Publication and Professionalism in Archaeological Communication." *Journal of Eastern Mediterranean Archaeology and Heritage Studies* 1, no. 1 (2013): 88–97.
- Kansa, S W, F P McManamon, Keith Kintigh, A Brin, and others. "Digital Antiquity and the Digital Archaeological Record (TDAR): Broadening Access and Ensuring Long-Term Preservation for Digital Archaeological Data," 2013.
- Kintigh, Keith, Jeffrey H Altschul, Mary C Beaudry, Robert D Drennan, Ann P Kinzig, Timothy A Kohler, W Fredrick Limp, et al. "Grand Challenges for Archaeology." *Proc Natl Acad Sci.* 111, no. 3 (2014): 879–880.
- Nelson, Bryn. "Data Sharing: Empty Archives." *Nature* 461, no. 7261 (2009): 160–163.
- Peebles, G M. "Sharing Data, Swapping Knowledge, and Building Community: Moving Archaeology from Deep Storage into the Public Eye through the Internet." In *Proceedings of the 37th International Computer Applications and Quantitative Methods in Archaeology Conference*, edited by B Frischer, J W Crawford, and D Koller, 298–307. BAR International Series. Oxford: Archaeopress, 2010.
- "Reality Check on Reproducibility." *Nature* 533, no. 7604 (2016): 437.
- RCUK. "Guidance on Best Practice in the Management of Research Data | RCUK," 2015.
- Roosevelt, Christopher H, Peter Cobb, Emanuel Moss, Brandon R Olson, and Sinan Ünlüsoy. "Excavation Is Destruction Digitization: Advances in Archaeological Practice." *J Field Archaeol.* 40, no. 3 (2015): 325–346.

Hacker culture

- Kelly, Kevin. *Better than Free*, 2008. <http://kk.org/thetechnium/better-than-free/> (accessed 16 September 2017).
- Raymond, Eric. "Homesteading the Noosphere, the Cathedral, and the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary." *O'Reilly & Associates*, 1999.
- Runyon, Joel. *An Unexpected Ass Kicking / IMPOSSIBLE*, 2012. <https://impossiblehq.com/an-unexpected-ass-kicking/> (accessed 16 September 2017).
- Rushkoff, Douglas. *Program Or Be Programmed: Ten Commands for a Digital Age*. OR Books, 2010.
- Stephenson, Neal. "In the Beginning... Was the Command Line, William Morrow & Co." *Inc.*, New York, NY, 1999.

FAIMS Project publications

- Ballsun-Stanton, Brian and Georgia Burnett. Open Data and the Danger of Sympathetic Magic <https://osf.io/preprints/socarxiv/4da7m>.
- Ross, Shawn, Brian Ballsun-Stanton, Adela Sobotkova, and Penny Crook. "Building the Bazaar: Enhancing Archaeological Field Recording Through an Open Source Approach." In *Open Source Archaeology: Ethics and Practice*, edited by Andrew T Wilson and Ben Edwards, 111–29. Warsaw, Poland: De Gruyter Open, 2015.
- Ross, Shawn, Adela Sobotkova, Brian Ballsun-Stanton, and Penny Crook. "Creating Eresearch Tools For Archaeologists: The Federated Archaeological Information Management Systems Project." *Australian Archaeology* 77, no. 1 (2013): 107–119.
- Sobotkova, Adela, Brian Ballsun-Stanton, Shawn Ross, and Penny Crook. "Arbitrary Offline Data Capture on All of Your Androids: The FAIMS Mobile Platform." In *Across Space and Time: Papers*

from the 41st Conference on Computer Applications and Quantitative Methods in Archaeology, Perth, edited by Arianna Traviglia, 25–28, 2015.

- Sobotkova, Adela, Shawn A Ross, Brian Ballsun-Stanton, Andrew Fairbairn, Jessica Thompson, and Parker VanValkenburgh. “Measure Twice, Cut Once: Cooperative Deployment of a Generalized, Archaeology-Specific Field Data Collection System.” In *Mobilizing the Past for a Digital Future: The Potential of Digital Archaeology*, edited by Erin Walcek Averett, Jody Michael Gordon, and Derek B Counts, 337–372. The Digital Press @ University of North Dakota, 2016.