Spatial Technologies in Anthropology
ASM 568 - 97186
Fall 2023 - Michael Barton

Course Objectives, Organization, and Grading

Students should gain a basic understanding of the concepts underlying the operation of geographic information systems, the analysis of digital images, and the acquisition and use of geophysical data and remotely sensed (i.e., spaceborne and airborne platforms) imagery. Students also will learn how to apply these concepts to real-world data by using GIS, image analysis, and multispectral image analysis software. Finally, students will explore how these software tools can be applied to spatial anthropological data.

Class sessions will generally be divided between a **seminar** discussion section, to review GIS and remote sensing concepts and critically evaluate articles that exemplify GIS and remote sensing methodologies in anthropology, and a "**lab practicum**" section where we will work hands on to try GIS or image analysis techniques in a setting where students can work together and ask questions. In the discussion section, I may start by illustrating some concepts and/or examples.

Readings for each class session include:

- General methodology and application from the Wheatley & Gillings and/or Conolly & Lake texts. These are references for methods and their applications. We won't plan to discuss these explicitly, but can talk about them in class when there are questions.
- Articles that exemplify GIS use in anthropological research which we will discuss in class. These will be the basis for the seminar-like discussion, which class members will lead in rotation. You will need to read the assigned articles so as to not feel embarrassed in front of your peers who DID read them.
- I've indicated readings that will be helpful in the lab practicum section and for working on projects. Avoid reading these at your own risk.

Course grades will be based on the following:

1. three short projects that will focus on the application of GIS and image analysis techniques to small, test data sets (45%);
2. the completion and presentation of a conference-quality poster presenting the results of anthropological research employing GIS and/or remote sensing methods (35%); and
3. active participation in class discussion and lab practica (20%).

Course Resources

Texts for Methods and Applications

Conolly, J., & Lake, M. (2006). *Geographical information systems in archaeology*. Cambridge: Cambridge University Press. **[CL]**

Wheatley, D., & Gillings, M. (2002). *Spatial Technology and Archaeology: the Archaeological Applications of GIS*. New York: Taylor & Francis. **[WG]**

Updated 2013: Neteler, M., & Mitasova, H. (2008). *Open Source GIS: a GRASS GIS Approach, 3rd Edition*. New York: Springer. [**NM**] Available as an ebook at: http://link.springer.com.ezproxy1.lib.asu.edu/book/10.1007/978-0-387-68574-8

Other useful books

Gillings, M., Hacıgüzeller, P., Lock, G. (Eds.), 2020. *Archaeological Spatial Analysis: A Methodological Guide*, 1st ed. Routledge. https://doi.org/10.4324/9781351243858 Available as an ebook at: https://www-taylorfrancis-com.ezproxy1.lib.asu.edu/books/edit/10.4324/9781351243858/archaeological-spatial-analysis-mark-gillings-piraye-hacıgüzeller-gary-lock

Smith, M. J. D., Goodchild, M. F., & Longley, P. (2015). *Geospatial Analysis: A Comprehensive Guide to Principles, Techniques and Software Tools* (5th ed.). Troubador Publishing Ltd. Free online plus additional resources at: http://www.spatialanalysisonline.com

Bodenhamer, D. J., Corrigan, J., & Harris, T. M. (2010). *The spatial humanities : GIS and the future of humanities scholarship*. Bloomington: Indiana University Press

Lillesand, T. M., Kiefer, R. W., & Chipman, J. W. (2007). *Remote sensing and image interpretation* (6th ed.). New York: Wiley.

Wiseman, J., & El-Baz, F. (2007). *Remote Sensing in Archaeology*. Available as an ebook at: http://www.springerlink.com/content/978-0-387-44453-6/#section=343768&page=1

Parcak, S. H. (2009). *Satellite Remote Sensing for Archaeology* (1st ed.). Routledge.

Westcott, K. L., & Brandon, R. J. (Eds.). (2000). *Practical Applications of GIS for Archaeologist: a Predictive Modeling Kit*. New York: Taylor & Francis.

Lock, G. R. (2000). *Beyond the map : archaeology and spatial technologies*. NATO science series. Series A, Life sciences v. 321. Amsterdam ; Washington, DC Tokyo: IOS Press ; Ohmsha [distributor].

Free and Open Source Software (FOSS) used in class

GRASS GIS: (Geographic Resource Analysis Support System) GRASS includes raster and vector GIS, temporal GIS, spatial analysis and modeling, single-band and multispectral image analysis, and digitizing modules. GRASS is open source software and available free of charge. This software can be downloaded in versions for Windows, Mac OS X, and Linux from the International GRASS Development Center at http://grass.osgeo.org. There are also manuals, tutorials, and other information at the site. Additional info can be found on the GRASS-Wiki: https://grasswiki.osgeo.org/wiki/GRASS-Wiki I recommend using the most up to date version 8.3. I also recommend that you download the North Carolina demo data sets to help you get started with GRASS (https://grass.osgeo.org/download/data/).

FIJI/ImageJ: General purpose image processing software: including enhancement, image math, filtering, and analysis. Many plugins available that add features. ImageJ is available for download at: https://imagej.net/Welcome. FIJI is a version of ImageJ that comes packaged with a lot of useful plugins already installed. You can download it at: http://fiji.sc/wiki/index.php/Fiji.

MultiSpec: Image analysis software, specifically designed for working with multispectral remote images. Includes enhancement, rectification, image math, and supervised/unsupervised classification. Download at https://engineering.purdue.edu/~biehl/MultiSpec/

Other Free and Open Source Software

QGIS: Another open source GIS package available free of charge, QGIS is available in versions for Windows, Mac OS X, Linux, and Unix from http://qgis.org/. It is primarily an easy to use and sophisticated vector GIS, including thematic mapping. It can display raster layers under the vectors. It has limited raster analytical capabilities by itself. But with the GRASS plug-in installed, it has access to many of the analytical and raster processing functions of GRASS. A tablet version of QGIS, *QField*, is also available for Android and iOS.

R + RStudio, with packages like ***sp, sf, tmap, terra, raster, and rasterVis.*** R is generally thought of as a statistics package, and it is a very good one. But it goes far beyond statistics and is a general-purpose quantitative analysis, visualization, data management, and programming environment. It has very powerful spatial analysis tools and versatile, publication quality cartography. It's main drawback is a lack of interactive visualization. Rstudio is a program that makes R much easier to use. R can be downloaded at: https://cran.r-project.org and RStudio is available at: https://www.rstudio.com/products/RStudio/

There are R packages to connect with GRASS, QGIS, and ArcGIS. Here are a few sites and a book with more info about using R for spatial analysis and visualization. **Important note when looking at these sites:** Older spatial packages that were widely used and are now retired include rgdal, rgeos, and maptools; their functionality is now available in the newer sp and terra packages:

- https://github.com/Robinlovelace/Creating-maps-in-R;
- http://pakillo.github.io/R-GIS-tutorial/;
- https://cran.r-project.org/web/views/Spatial.html;
- https://us.sagepub.com/en-us/nam/an-introduction-to-r-for-spatial-analysis-and-mapping/book241031
- http://www.r-bloggers.com/r-an-integrated-statistical-programming-environment-and-gis/
- https://www.gislounge.com/r-packages-for-spatial-analysis/

GeoDa: (Geospatial Data Analysis) Software designed for interactive spatial data analysis using visual and statistical tools. Using vector GIS data, it combines analytical maps with spatial statistics. Developed originally here at ASU. It is available at: http://geodacenter.github.io/index.html.

Other packages on Canvas

LibreOffice: An office suite (like Microsoft Office) for Windows, Mac, and Linux. It's database and spreadsheet modules are excellent tools for creating data that can be used in a GIS. It also has a very good drawing module for dressing up maps, along with a good wordproccessor and presentation package (like powepoint). It can be downloaded at http://www.libreoffice.org/. A tablet version for Android and iOS is also available as *Collabora*.

Commercial software

***ArcGIS GIS*:** This software is available on the academic network at ASU, in the Anthropology Department computer laboratory. ASU students can purchase annual licenses for desktop ArcGIS (Windows only) for a steep discount from the commercial price (well over $10k). You will need at least three modules for a reasonably complete spatial analysis platform (primary ArcView module, Spatial Analyst, and Image Analyst) that includes raster and vector GIS, spatial analysis and modeling, image analysis, and digitizing modules.

TerrSet/ Idrisi GIS: This software can be purchased from Clark Labs, Clark University (https://clarklabs.org). The program is available for Windows only. Students can purchase the software for a substantial discount over the commercial price. Idrisi includes raster and vector GIS, spatial analysis and modeling, and single-band and multispectral image analysis. The base price includes all modules except digitizing, which is in the separate CartaLinx module. Idrisi can import data from a wide variety of other sources.

Additional Resources:

Website for Neteler and Mitasova book . Short courses, demo data link, examples, and errata.http://www.grassbook.org/data_menu3rd.php

Demo datasets for GRASS: GRASS demo dataset from North Carolina and Spearfish, ND will be used for examples and some assignments. Available for download from the GRASS GIS downloads site (see above). Also available from the Neteler and Mitasova book web site.

See Canvas for geospatial data sources

Syllabus and Reading List

8/17 Introduction to GIS and Spatial Technologies

[WG] chapt. 1 (Archaeology, Space, and GIS).

[CL] chapt. 1, 3

For discussion:
Anemone, R. l., Conroy, G. C., & Emerson, C. W. (2011). GIS and paleoanthropology: Incorporating new approaches from the geospatial sciences in the analysis of primate and human evolution. *American Journal of Physical Anthropology*, 146(S53), 19–46. doi:10.1002/ajpa.21609

Harris, T. M., Corrigan, J., & Bodenhamer, D. J. (2010). Challenges for the spatial humanities: toward a research agenda. In D. J. Bodenhamer, J. Corrigan, & T. M. Harris (Eds.), *The spatial humanities : GIS and the future of humanities scholarship* (pp. 167–176). Bloomington: Indiana University Press.

McCoy, M. D., & Ladefoged, T. N. (2009). New Developments in the Use of Spatial Technology in Archaeology. *Journal of Archaeological Research*, *17*(3), 263–295. doi:10.1007/s10814-009-9030-1

For reference: introduction to GRASS
Neteler, M., Bowman, M. H., Landa, M., & Metz, M. (2012). GRASS GIS: A multi-purpose open source GIS. *Environmental Modelling & Software*, 31, 124–130. http://doi.org/10.1016/j.envsoft.2011.11.014

8/22 Spatial data: rasters, vectors, and attributes

[WG] chapt. 2 (The Spatial Database)

[CL] chapt. 2

For discussion:
Hill, J. B. (2000). Decision making at the margins: settlement trends, temporal scale, and ecology in the Wadi al Hasa, west-central Jordan. *Journal of Anthropological Archaeology*, *19*, 221–241.

Klehm, C., 2023. The Use and Challenges of Spatial Data in Archaeology. Advances in Archaeological Practice 11, 104–110. https://doi.org/10.1017/aap.2022.38

Lock, G., Pouncett, J., 2017. Spatial thinking in archaeology: Is GIS the answer? Journal of Archaeological Science, Archaeological GIS Today: Persistent Challenges, Pushing Old Boundaries, and Exploring New Horizons 84, 129–135. https://doi.org/10.1016/j.jas.2017.06.002

8/24 *Lab practicum:* exploring spatial data (topology, attributes, and reports)

[NM] chapt. 1-4

8/29 Building a GIS: overlays, projections, and georegistration

PASS OUT PROJECT 1

[WG] chapt. 3 (Acquiring and Integrating Data).

[CL] chapt 4-5

For discussion:
Bevan A, Conolly J (2004) GIS, Archaeological Survey, and Landscape Archaeology on the Island of Kythera, Greece. Journal of Field Archaeology 29:123–138. doi: 10.1179/jfa.2004.29.1-2.123

Moncla L, Gaio M, Joliveau T, et al. (2019) Mapping urban fingerprints of odonyms automatically extracted from French novels. International Journal of Geographical Information Science 33:2477–2497. doi: 10.1080/13658816.2019.1584804

Morehart CT (2012) Mapping ancient chinampa landscapes in the Basin of Mexico: a remote sensing and GIS approach. Journal of Archaeological Science 39:2541–2551. doi: 10.1016/j.jas.2012.03.001

8/31 *Lab practicum:* downloading data, specifying projections, and creating a GIS

9/5 Thematic maps: visualizing quantitative information

[WG] chapt. 4

[CL] chapt 7.1-7.2, 12

For discussion:
Flachs A, Stone GD, Shaffer C (2017) Mapping Knowledge: GIS as a Tool for Spatial Modeling of Patterns of Warangal Cotton Seed Popularity and Farmer Decision-Making. Hum Ecol 45:143–159. doi: 10.1007/s10745-016-9885-y

Gallotti, R. (2011). GIS and Intra-Site Spatial Analyses: An Integrated Approach for Recording and Analyzing the Fossil Deposits at Casablanca Prehistoric Sites (Morocco). *Journal of Geographic Information System*, *03*(04), 373–381. doi:10.4236/jgis.2011.34036

Zieliński, M., Dopieralska, J., Królikowska-Ciągło, S., Walczak, A., Belka, Z., 2021. Mapping of spatial variations in Sr isotope signatures (87Sr/86Sr) in Poland — Implications of anthropogenic Sr contamination for archaeological provenance and migration research. Science of The Total Environment 775, 145792. https://doi.org/10.1016/j.scitotenv.2021.145792

9/7 *Lab practicum:* thematic maps and spatial analysis

[NM] chapt. 6.0-6.7

9/12 Spatial relationships and queries

***** PROJECT 1 DUE *****

[WG] chapt. 4, chapt. 7 (pp. 147-148).

For discussion:
Bethke B (2017) The archaeology of pastoralist landscapes in the northwestern plains. American Antiquity 82:798–815. doi: 10.1017/aaq.2017.44

Marean, C. W., Y. Abe, et al. (2001). Estimating the minimum number of skeletal elements (MNE) in zooarchaeology: a review and a new image-analysis GIS approach. *American Antiquity* 66(2): 333-348.

Shaffer, C. A. (2013). Gis analysis of patch use and group cohesiveness of bearded sakis (chiropotes sagulatus) in the upper essequibo conservation concession, guyana. American Journal of Physical Anthropology, 150(2), 235–246. http://doi.org/10.1002/ajpa.22197

9/14 *Lab practicum:* overlays and buffers

[NM] chapts 5.1, 5.4, 6.5 (and others of your choosing in chapts. 5 and 6)

9/19 DEMs and terrain analysis

PASS OUT PROJECT 2

[WG] chapt. 5

[CL] chapt 9

For discussion:
Berthaume MA, Lazzari V, Guy F (2020) The landscape of tooth shape: Over 20 years of dental topography in primates. Evolutionary Anthropology: Issues, News, and Reviews 29:245–262. doi: https://doi.org/10.1002/evan.21856

Benito-Calvo, A., Carvalho, S., Arroyo, A., Matsuzawa, T., Torre, I. de la, 2015. First GIS Analysis of Modern Stone Tools Used by Wild Chimpanzees (Pan troglodytes verus) in Bossou, Guinea, West Africa. PLOS ONE 10, e0121613. https://doi.org/10.1371/journal.pone.0121613

Chase A, Weishampel J (2016) Using Lidar and GIS to Investigate Water and Soil Management in the Agricultural Terracing at Caracol, Belize. Advances in Archaeological Practice 4:357–370. doi: 10.7183/2326-3768.4.3.357

Mitasova, H., Harmon, R. S., Weaver, K. J., Lyons, N. J., & Overton, M. F. (2012). Scientific visualization of landscapes and landforms. *Geomorphology*, *137*(1), 122–137. doi:10.1016/j.geomorph.2010.09.033

9/21 *Lab practicum:* analyzing terrain with DEMs

[NM] chapt. 5.0-5.4.2

9/26 From points to surfaces: interpolation and KDE

[WG], chapt. 6, 9

[CL] chapt 6

For discussion:
Costa, J. A., Lima da Costa, M., & Kern, D. C. (2013). Analysis of the spatial distribution of geochemical signatures for the identification of prehistoric settlement patterns in ADE and TMA sites in the lower Amazon Basin. Journal of Archaeological Science, 40(6), 2771–2782. http://doi.org/10.1016/j.jas.2012.12.027

Trepal, D., Lafreniere, D., 2019. Understanding Cumulative Hazards in a Rustbelt City: Integrating GIS, Archaeology, and Spatial History. Urban Science 3, 83. https://doi.org/10.3390/urbansci3030083

Walton, B.J., Findlay, L.J., Hill, R.A., 2021. Insights into short and long term crop foraging strategies in a chacma baboon (*Papio ursinus*) from GPS and accelerometer data. Ecol. Evol. 11, 990–1001. https://doi.org/10.1002/ece3.7114

9/28 *Lab practicum*: interpolation and KDE

[NM] chapt. 6.8-6.10.3

10/3 Catchments, territories and movement

***** PROJECT 2 DUE *****

[WG] chapt. 7, and [CL] chapt 10.1-10.3.1

For discussion:
Milheira RG, De Souza JG, Iriarte J (2019) Water, movement and landscape ordering: A GIS-based analysis for understanding the mobility system of late Holocene mound-builders in southern Brazil. Journal of Archaeological Science 111:105014. doi: 10.1016/j.jas.2019.105014

Pažout, A., Eisenberg, M., 2021. The territory of Hippos: Its settlement dynamics and development from the Hellenistic to the Late Roman period as seen through spatial analytical methods. Journal of Archaeological Science: Reports 38, 103066. https://doi.org/10.1016/j.jasrep.2021.103066

Vaissié, E., 2021. Mobility of Paleolithic Populations: Biomechanical Considerations and Spatiotemporal Modelling. PaleoAnthropology. https://doi.org/10.48738/2021.iss1.73

10/5 *Lab practicum:* cost surfaces and least cost paths

[NM] chapt. 5.4.3

Verhagen P, Nuninger L, Groenhuijzen MR (2019) Modelling of Pathways and Movement Networks in Archaeology: An Overview of Current Approaches. In: Verhagen P, Joyce J, Groenhuijzen MR (eds) Finding the Limits of the Limes: Modelling Demography, Economy and Transport on the Edge of the Roman Empire. Springer International Publishing, Cham, pp 217–249. Also accessible at: https://link.springer.com/chapter/10.1007/978-3-030-04576-0_11

10/10 Visibility and perception

[WG] chapt. 10

[CL] chapt 10.3.2-10.4

For discussion:
Bongers J, Arkush E, Harrower M (2012) Landscapes of death: GIS-based analyses of chullpas in the western Lake Titicaca basin. Journal of Archaeological Science 39:1687–1693. doi: 10.1016/j.jas.2011.11.018

Gillings M (2015) Mapping invisibility: GIS approaches to the analysis of hiding and seclusion. Journal of Archaeological Science 62:1–14. doi: 10.1016/j.jas.2015.06.015

Wernke SA, Kohut LE, Traslaviña A (2017) A GIS of affordances: Movement and visibility at a planned colonial town in highland Peru. Journal of Archaeological Science 84:22–39. doi: 10.1016/j.jas.2017.06.004

10/12 *Lab practicum:* line of sight and viewsheds

[NM] chapt. 5.4.4

10/17 Locational modeling and settlement analysis

PASS OUT PROJECT 3

[WG] chapt. 8

[CL] chapt 8

For discussion:
Bevan, A., Wilson, A., 2013. Models of settlement hierarchy based on partial evidence. Journal of Archaeological Science 40, 2415–2427. https://doi.org/10.1016/j.jas.2012.12.025

Nicholson, C.M., 2017. Eemian paleoclimate zones and Neanderthal landscape-use: A GIS model of settlement patterning during the last interglacial. Quaternary International 438, 144–157. https://doi.org/10.1016/j.quaint.2017.04.023

Snitker G, Castillo AD, Barton CM, et al. (2018) Patch-based survey methods for studying prehistoric human land-use in agriculturally modified landscapes: A case study from the Canal de Navarrés, eastern Spain. Quaternary International 483:5–22. doi: 10.1016/j.quaint.2018.01.034

Yaworsky, P.M., Vernon, K.B., Spangler, J.D., Brewer, S.C., Codding, B.F., 2020. Advancing predictive modeling in archaeology: An evaluation of regression and machine learning methods on the Grand Staircase-Escalante National Monument. PLOS ONE 15, e0239424. https://doi.org/10.1371/journal.pone.0239424

10/19 *Lab practicum:* modeling with map algebra

[NM] chapt. 5.4.3-5.5.3

10/24 Remote sensing of landscapes

For discussion:
Kempf M (2019) The application of GIS and satellite imagery in archaeological land-use reconstruction: A predictive model? Journal of Archaeological Science: Reports 25:116–128. doi: 10.1016/j.jasrep.2019.03.035

Lasaponara, R., & Masini, N. (2012). Investigating Satellite Landsat TM and ASTER Multitemporal Data Set to Discover Ancient Canals and Acqueduct Systems. In B. Murgante, O. Gervasi, S. Misra, N. Nedjah, A. M. A. C. Rocha, D. Taniar, & B. O. Apduhan (Eds.), *Computational Science and Its Applications – ICCSA 2012* (pp. 497–511). Springer Berlin Heidelberg. Retrieved from http://link.springer.com.ezproxy1.lib.asu.edu/chapter/10.1007/978-3-642-31137-6_38

Lindsay, I., Mkrtchyan, A., 2023. Free and Low-Cost Aerial Remote Sensing in Archaeology: An Overview of Data Sources and Recent Applications in the South Caucasus. Advances in Archaeological Practice 11, 164–183. https://doi.org/10.1017/aap.2023.3

Noviello, M., Ciminale, M., & De Pasquale, V. (2013). Combined application of pansharpening and enhancement methods to improve archaeological cropmark visibility and identification in QuickBird imagery: two case studies from Apulia, Southern Italy. *Journal of Archaeological Science*, *40*(10), 3604–3613. http://doi.org/10.1016/j.jas.2013.04.013

10/26 *Lab practicum:* image enhancement and data fusion

[NM] chapt. 8

Parcak SH (2017) GIS, Remote Sensing, and Landscape Archaeology. Oxford Handbooks Online. doi: 10.1093/oxfordhb/9780199935413.013.11

Canada Centre for Remote Sensing, "Remote Sensing Tutorials" at http://www.nrcan.gc.ca/earth-sciences/geomatics/satellite-imagery-air-photos/satellite-imagery-products/educational-resources/9309

10/31 Remote sensing of locales with geophysical survey

For discussion:
Rego, J. P., & Cegielski, W. H. (2014). Gradiometry survey and magnetic anomaly testing of Castros de Neixón, Galicia, Spain. Journal of Archaeological Science, 46, 417–427. http://doi.org/10.1016/j.jas.2014.01.023

Opitz, R., Herrmann, J., 2018. Recent Trends and Long-standing Problems in Archaeological Remote Sensing. Journal of Computer Applications in Archaeology 1, 19–41. https://doi.org/10.5334/jcaa.11

Scudero S, Martorana R, Capizzi P, et al. (2018) Integrated Geophysical Investigations at the Greek Kamarina Site (Southern Sicily, Italy). Surv Geophys 39:1181–1200. doi: 10.1007/s10712-018-9483-1

11/2 *Lab practicum:* analyzing geophysical survey data

11/7 Combining methods for analyzing geospatial data

***** PROJECT 3 DUE *****

For discussion:
Abson, D. J., Dougill, A. J., & Stringer, L. C. (2012). Using Principal Component Analysis for information-rich socio-ecological vulnerability mapping in Southern Africa. *Applied Geography*, *35*(1-2), 515–524. http://doi.org/10.1016/j.apgeog.2012.08.004

Alexakis D, Sarris A, Astaras T, Albanakis K (2011) Integrated GIS, remote sensing and geomorphologic approaches for the reconstruction of the landscape habitation of Thessaly during the neolithic period. Journal of Archaeological Science 38:89–100. doi: 10.1016/j.jas.2010.08.013

Ullah, I. I., Duffy, P. R., & Banning, E. B. (2014). Modernizing Spatial Micro-Refuse Analysis: New Methods for Collecting, Analyzing, and Interpreting the Spatial Patterning of Micro-Refuse from House-Floor Contexts. Journal of Archaeological Method and Theory. http://doi.org/10.1007/s10816-014-9223-x

11/9 *Lab practicum:* unsupervised and supervised classification

Multispec: Tutorial example in "An Introduction to MultiSpec", available for download at https://engineering.purdue.edu/~biehl/MultiSpec/tutorials.html

11/14 Analyzing geospatial data across time

For discussion:

Gauthier, N., 2016. The spatial pattern of climate change during the spread of farming into the Aegean. Journal of Archaeological Science 75, 1–9. https://doi.org/10.1016/j.jas.2016.09.004

Klassen, S., Carter, A.K., Evans, D.H., Ortman, S., Stark, M.T., Loyless, A.A., Polkinghorne, M., Heng, P., Hill, M., Wijker, P., Niles-Weed, J., Marriner, G.P., Pottier, C., Fletcher, R.J., 2021. Diachronic modeling of the population within the medieval Greater Angkor Region settlement complex. Science Advances 7, eabf8441. https://doi.org/10.1126/sciadv.abf8441

Popescu, G.M., Covătaru, C., Opriș, I., Bălășescu, A., Carozza, L., Radu, V., Haită, C., Sava, T., Barton, C.M., Lazăr, C., 2023. Sine qua non: inferring Kodjadermen-Gumelnița-Karanovo VI population dynamics from aggregated probability distributions of radiocarbon dates. Radiocarbon 1–22. https://doi.org/10.1017/RDC.2023.6

Stephens, L., et al, 2019. Archaeological assessment reveals Earth's early transformation through land use. *Science* 365, 897–902. https://doi.org/10.1126/science.aax1192 and Gauthier, N., 2019. ArchaeoGLOBE animations. https://doi.org/10.7910/DVN/SFGZBS

11/16 *Lab practicum:* concepts and methods for space-time GIS

Gebbert, S., Pebesma, E., 2017. The GRASS GIS temporal framework. International Journal of Geographical Information Science 31, 1273–1292. https://doi.org/10.1080/13658816.2017.1306862

Gebbert, S., Leppelt, T., Pebesma, E., 2019. A Topology Based Spatio-Temporal Map Algebra for Big Data Analysis. Data 4, 86. https://doi.org/10.3390/data4020086

Goodchild, M. F. (2013). Prospects for a Space–Time GIS. Annals of the Association of American Geographers, 103(5), 1072–1077. http://doi.org/10.1080/00045608.2013.792175

11/21 Beyond GIS: modeling landscapes and land-use dynamics

[WG] chapt. 12

For discussion:

Bernabeu Aubán, J., Barton, C.M., Pardo Gordó, S., Bergin, S.M., 2015. Modeling initial Neolithic dispersal. The first agricultural groups in West Mediterranean. Ecological Modelling 307, 22–31. https://doi.org/10.1016/j.ecolmodel.2015.03.015

Crawford, K.A., 2019. Visualising Ostia's Processional Landscape Through a Multi-Layered Computational Approach: Case Study of the Cult of the Magna Mater. Open Archaeology 5, 444–467. https://doi.org/10.1515/opar-2019-0028

Franklin J, Potts AJ, Fisher EC, et al. (2015) Paleodistribution modeling in archaeology and paleoanthropology. Quaternary Science Reviews 110:1–14. doi: 10.1016/j.quascirev.2014.12.015

11/28 *Lab practicum*: agent based modeling and GIS

Davies, B., Romanowska, I., Harris, K., Crabtree, S.A., 2019. Combining Geographic Information Systems and Agent-Based Models in Archaeology: Part 2 of 3. Advances in Archaeological Practice 7, 185–193. https://doi.org/10.1017/aap.2019.5

11/30 POSTER PRESENTATIONS

Finals week FINAL POSTERS DUE

Student Standards and ASU Policies

Student Standards

Students are required to read and act in accordance with university and Arizona Board of Regents policies, including:

- The Academic Integrity Policy: https://provost.asu.edu/index.php?q=academicintegrity
- The Student Code of Conduct: Arizona Board of Regents Policies 5-301 through 5-308: https://students.asu.edu/srr/code
- The Computer, Internet and Electronic Communications Policy: http://www.asu.edu/aad/manuals/acd/acd125.html

If you fail to meet the standards of academic integrity in any of the criteria listed on the university policy website, sanctions will be imposed by the instructor, school, and/or dean. Academic dishonesty includes borrowing ideas without proper citation, copying others' work (including information posted on the internet), and failing to turn in your own work for group projects. If you follow an argument closely or quote a source directly, you *must* provide a citation to the publication, including the author, date and page number. If you directly quote a source, even in an assignment, you must use quotation marks and a page number citation for each quoted sentence or phrase.

You may work with other students on assignments, however, all work that you do and writing that you turn in must be done independently. If you have any doubt about whether the form of cooperation you contemplate is acceptable, ask the instructor ***in advance of turning in an assignment.***

Disability Resources

Students who feel they will need disability accommodations in this class but have not registered with the Disability Resource Center (DRC) should contact DRC immediately. The DRC Tempe office is located on the first floor of the Matthews Center Building. DRC staff can also be reached at: (480) 965-1234 (V) or (480) 965-9000 (TTY). For additional information, visit: www.asu.edu/studentaffairs/ed/drc.

Expected Classroom Behavior - Campus Courses

Arrive on time for class. Excessive tardiness will be subject to sanctions. Under no circumstances should you allow your cell phone to ring during class. Any disruptive behavior, which includes ringing cell phones, listening to your mp3/iPod player, text messaging, constant talking, eating food noisily, reading a newspaper will not be tolerated. The use of laptops (unless for note taking), cell phones, MP3, IPOD, etc. are strictly prohibited during class.

Policy Against Threatening Behavior

All incidents and allegations of violent or threatening conduct by an ASU student (whether on-or off campus) must be reported to the ASU Police Department (ASU PD) and the Office of the Dean of Students. If either office determines that the behavior poses or has posed a serious threat to personal safety or to the welfare of the campus, the student will not be permitted to return to campus or reside in any ASU residence hall until an appropriate threat assessment has been completed and, if necessary, conditions for return are imposed. ASU PD, the Office of the Dean of Students, and other appropriate offices will coordinate the assessment in light of the relevant circumstances. For more information please visit https://eoss.asu.edu/dos/srr/PoliciesAndProcedures and https://eoss.asu.edu/dos/safety/ThreateningBehavior.

Reporting Title IX Violations

Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at https://sexualviolenceprevention.asu.edu/faqs.

Policy on Sexual Discrimination

Arizona State University is committed to providing an environment free of discrimination, harassment, or retaliation for the entire university community, including all students, faculty members, staff employees, and guests. ASU expressly prohibits discrimination, harassment, and retaliation by employees, students, contractors, or agents of the university based on any protected status: race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, and genetic information.

As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, https://eoss.asu.edu/counseling, is available if you wish discuss any concerns confidentially and privately.

Copyrighted Materials

Students must refrain from uploading to any course shell, discussion board, or website used by the course instructor or other course forum, material that is not the student's original work, unless the students first comply with all applicable copyright laws; faculty members reserve the right to delete materials on the grounds of suspected copyright infringement.